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Marine Robuchon

Le 10 mars 2014

**Etude spatio-temporelle de la biodiversité des forêts de laminaires des
côtes bretonnes par une approche intégrée de génétique des
populations et d'écologie des communautés**

TOME 2 : ARTICLES & ANNEXES

Sous la direction de : M^{me} Line Le Gall et M^{me} Myriam Valero

JURY :

M ^{me} Sophie Arnaud-Haond	Chargée de Recherche, IFREMER, Sète	Rapporteuse
M ^{me} Inka Bartsch	Senior Research Scientist, Alfred-Wegener-Institute, Bremerhaven, Germany	Rapporteuse
M. Eric Feunteun	Professeur, Muséum national d'Histoire naturelle, Dinard	Examineur
M. Nicolas Mouquet	Directeur de Recherche, CNRS, Montpellier	Examineur
M ^{me} Line Le Gall	Maître de Conférences, Muséum national d'Histoire naturelle, Paris	Directrice de Thèse
M ^{me} Myriam Valero	Directrice de Recherche, CNRS, Roscoff	Directrice de Thèse

LISTE DES ARTICLES

Article 1: Observed and predicted distributional shifts of subtidal red seaweeds along a biogeographical transition zone in the context of global change

Régis K. Gallon[‡], Marine Robuchon[‡], Boris Leroy, Line Le Gall, Myriam Valero et Eric Feunteun

[‡] contributions égales

Article en révision pour la revue *Journal of Biogeography*

Contributions: EF, LLG, MR, MV et RG ont conçu le projet, EF, LLG, MR et RG ont participé à l'échantillonnage, BL, MR et RG ont réalisé les analyses, MR et RG ont écrit le premier brouillon ; tous les auteurs ont contribué à améliorer le manuscrit.

Article 2 : A survey of the algal community understory in the kelp forest of *Laminaria hyperborea* revealed the presence of a new species of *Kallymenia* (Kallymeniaceae, Rhodophyta): *Kallymenia crouanii* sp. nov.

Marine Robuchon, Line Le Gall, Delphine Gey, Myriam Valero et Alba Vergés

Article en préparation pour la revue *European Journal of Phycology*

Contributions : AV, LLG et MR ont récolté les spécimens et découvert l'espèce. DG et MR ont acquis les séquences. MR et LLG ont réalisé les analyses phylogénétiques. AV a réalisé les descriptions morpho-anatomiques. AV et LLG ont écrit le premier brouillon ; tous les auteurs ont contribué à améliorer le manuscrit.

Article 3: Examining the bank of microscopic stages in kelps using culturing and barcoding

Marine Robuchon, Lucía Couceiro, Akira F. Peters, Christophe Destombe et Myriam Valero

Article sous presse dans la revue *European Journal of Phycology*

Contributions : LC et MR ont conçu le projet, tous les auteurs ont participé à l'échantillonnage, AFP, LC et MR ont suivi les cultures, LC a réalisé les analyses moléculaires, MR a réalisé les analyses statistiques et écrit le premier brouillon ; tous les auteurs ont participé à l'amélioration du manuscrit.

Article 4: Sisters but not twins: contrasting genetic diversity patterns in two closely-related kelp species co-distributed along the Brittany coastline

Marine Robuchon, Line Le Gall, Stéphane Mauger et Myriam Valero

Article soumis à la revue *Molecular Ecology*

Contributions: LLG, MR et MV ont conçu le projet et participé à l'échantillonnage. MR a génotypé les échantillons de *Laminaria digitata* et SM ceux de *Laminaria hyperborea*. MR, MV et SM ont réalisé et synthétisé les analyses. MR a écrit le manuscrit avec les contributions de tous les auteurs.

Article 5: Alteration of sexual reproduction and genetic diversity in the kelp species *Laminaria digitata* at the southern limit of its range

Valeria L. Oppliger, Peter Von Dassow, Sarah Bouchemousse, Marine Robuchon, Myriam Valero, Juan A. Correa, Stéphane Mauger et Christophe Destombe

Article soumis à la revue *PLoS ONE*

Contributions: LVO, MV, JCA et CD ont conçu le projet ; LVO, SB, MB, MV, SM, CD ont participé à échantillonnage et récolte des données de température ; LVO, MB, SM ont participé aux analyses moléculaires ; LVO, PvD, SB ont participé aux analyses de cytométrie de flux ; LVO, CD ont participé à l'obtention de croisement et culture des gamétophytes ; LVO, PvD, MR, MV, CD ont participé à l'analyse des données ; LVO, PvD et CD ont écrit le manuscrit avec contribution de tous les auteurs.

Article 6: Management and conservation of the kelp species *Laminaria digitata*: using genetic tools to explore the potential exporting role of the MPA “Parc naturel marin d’Iroise”

Lucía Couceiro, Marine Robuchon, Christophe Destombe et Myriam Valero

Article paru dans la revue *Aquatic Living Resources* (2013, volume 26, issue 2, p. 197-205)

Contributions: MV a conçu le projet, CD et MV ont participé à l’échantillonnage, LC et MR ont réalisé les analyses et écrit le premier brouillon ; tous les auteurs ont participé à l’amélioration du manuscrit.

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Article 1

Gallon RK, **Robuchon M**, Leroy B, Le Gall L, Valero M, Feunteun E (in revision for *Journal of Biogeography*) Observed and predicted distributional shifts of subtidal red seaweeds along a biogeographical transition zone in the context of global change.

**Observed and predicted distributional shifts of subtidal red seaweeds along a
biogeographical transition zone in the context of global change**

Régis K. Gallon^{1 †*}, Marine Robuchon^{2, 3 †}, Boris Leroy⁴, Line Le Gall², Myriam Valero³ and Eric Feunteun¹

¹UMR 7208 Biologie des Organismes et Ecosystèmes Aquatiques (MNHN-CNRS-UPMC-IRD), Muséum National d'Histoire Naturelle, Centre de Recherche et d'Enseignement sur les Systèmes Côtiers, 38 rue du Port Blanc, 35800 Dinard, France

²UMR 7138 Systématique, Adaptation et Evolution (MNHN-CNRS-UPMC-IRD), Muséum National d'Histoire Naturelle, case postale N° 39, 57 rue Cuvier, 75231 Cedex 05 Paris, France

³UMR 7144 Adaptation et Diversité en Milieu Marin (CNRS-UPMC), Station Biologique de Roscoff, CS 90074, 29688 Roscoff, France

⁴URU 420, Université de Rennes I-Service du Patrimoine Naturel, Muséum National d'Histoire Naturelle, 263 Avenue du Général Leclerc, 35042 Rennes Cedex, France

[†]Equal contribution

*Corresponding author: Email: reg.gallon@gmail.com; Tel: +33 2 23 18 58 85

Running head Global change responses of red seaweeds in Brittany

ABSTRACT

Aim To assess the environmental changes within a marine biogeographical transition zone and how these changes have affected seaweed assemblages and distributions over the past two decades.

Location Brittany (Western France) is a biogeographical transition zone between the cold-temperate and warm-temperate regions.

Methods We assessed spatio-temporal variations of three environmental parameters (sea surface temperature [SST], suspended inorganic matter [SPIM], and chlorophyll-*a*) over the past 20 years in five adjoining regions by using generalised linear models (GLMs). Then, we used two complementary approaches to investigate changes in the assemblages and distributional patterns of red seaweeds based on sampling surveys conducted during two separate periods (1992–1998 and 2010–2012) over the past 20 years, namely, multivariate data analysis and species distribution models (SDMs) with a set of modelling procedures.

Results The coastal water temperature in Brittany has increased by 0.7 °C on average over the past two decades. At a finer scale, changes in SST showed that Brittany constitutes a mosaic of contrasting conditions, with the West and North-Western Brittany regions being colder and affected lesser by climate change compared to the other three regions. Increasing SST primarily caused a significant change in subtidal red seaweed assemblages over the 20-year period, whereas SST amplitude acted as the main driver of species distribution. Between the two periods, SDMs predicted significant species shifts for seven out of 10 representative species and reductions in the distribution ranges of most species.

Main conclusions Our study confirmed important differences across the different regions of the studied biogeographical transition zone. Changes in abiotic parameters and red seaweed assemblages are expected to occur at varying extremes across these regions, with the west and north-western Brittany representing the most stable zones that might constitute a potential refuge for certain species when responding to global changes.

Keywords

Assemblages/Biogeographical transition zone/Brittany/Global change/North Atlantic/Sea surface temperature/Species distribution modelling/Subtidal red seaweeds

INTRODUCTION

The fourth report of the Intergovernmental Panel on Climate Change (IPCC) indicated that global sea surface temperature (SST) has increased by an average of 0.13 °C per decade over the last 50 years (Pachauri, 2007). These rapid shifts in temperature are expected to alter the survival of organisms, by affecting their physiology and phenology (for reviews, see Hughes *et al.*, 2000; Bellard *et al.*, 2012), leading to three non-exclusive responses: (i) acclimatisation (at short timescales) or adaptation (at long timescales), (ii) migration towards places exhibiting suitable temperature ranges, and (iii) extinction. Shifts in species geographical ranges towards polar latitudes, higher altitudes, or deeper waters are the most documented responses for various species in almost all natural systems worldwide (for review, see Parmesan, 2006).

Within this context of shifting species ranges, biogeographical transition regions constitute an important focus area. In these regions, the response of species located at either the southern or northern range limits of a given species may be compared. Lima *et al.* (2007) investigated this by evaluating the direction and intensity of distribution changes of intertidal macroalgae located along the Portuguese coastline (North-East Atlantic). The temperature in the North-Eastern Atlantic region represents the main abiotic factor limiting seaweed growth and reproduction; thus, temperature directly controls the geographic boundaries of this group of organisms (reviewed by Eggert, 2012). In contrast to the expected general poleward shift, Lima *et al.* (2007) reported marked differences in the responses of cold-water and warm-water species. For instance, while the range of warm-water seaweeds has extended northwards, no significant change was observed for cold-water species. They demonstrated that single-species responses may be highly variable and that generalisations about poleward shifts, due to increasing temperature, should be made with caution.

There is increasing empirical evidence supporting northward shifts and/or changes in seaweed assemblages along European coasts. For instance, the brown seaweeds *Bifurcaria bifurcata* and *Cystoseira tamariscifolia* are extending northwards along the British and Irish coasts (Hiscock *et al.*, 2004; Mieszkowska *et al.*, 2005). Diez *et al.* (2012) detected substantial changes in the seaweed communities of the Cantabrian Sea (i.e. the Bay of Biscay, extending along the west coast of France to the Spanish border) during 1991–2008. These observed changes were confirmed by recent insights obtained from species distribution models (SDMs), which, with the development and the accessibility of recent and future environmental data, have been widely used to evaluate the potential impact of climate change on biodiversity and species distribution (e.g. Thuiller, 2004; Bellard *et al.*, 2012). To the best

of our knowledge, studies involving SDMs have used single models, such as generalised additive models or maximum entropy (MaxEnt) models to date. SDMs have been applied to seaweeds, particularly the polar and cold-temperate communities of the North-Eastern Atlantic (Müller *et al.*, 2009), intertidal brown seaweeds (Martinez *et al.*, 2012; Jueterbock *et al.*, 2013) and kelps (Bekkby & Moy, 2011; Raybaud *et al.*, 2013). These studies have generally predicted changes in species composition and abundance in response to temperature increases.

SDMs of seaweeds have traditionally used mean, minimum, or maximum seawater temperature as predictors; however, various non-climatic factors might also act as the limiting factor in seaweed distribution, especially at local scales. For example, nutrient concentration and water turbidity may alter seaweed metabolism and hence affect their performance and survival. Recently, seaweed SDMs that combine temperature variables with other environmental factors and focus on intertidal brown seaweeds have been developed (Martinez *et al.*, 2012; Jueterbock *et al.*, 2013; Raybaud *et al.*, 2013). These studies confirmed the predominant role of temperature in driving species distributions for some species, especially extreme temperature values, rather than mean values. However, these studies also showed that, for some other species, non-climatic variables served as better predictors of distribution, thus highlighting the difficulty of making general predictions about seaweed distributions based on temperature parameters alone. While this difficulty in obtaining reliable predictions has been clarified for intertidal habitats exposed to extreme environmental conditions, it might not hold true for subtidal habitats, where the amplitude of abiotic variables is less drastic (Helmuth *et al.*, 2002). However, information about subtidal communities inhabiting hard substrata remains scarce (Juanes *et al.*, 2008). Moreover, subtidal seaweed assemblages are mainly composed of red seaweeds, which have a higher species richness than brown seaweeds (Guiry & Guiry, 2013), offering the possibility of assessing a large range of species-specific responses.

This study aimed to assess the environmental changes within a marine biogeographical transition zone (Brittany, France), and their impact on subtidal red seaweed assemblages and distributions over the last two decades. Brittany is a hotspot for seaweed species biodiversity (Kerswell, 2006; Santelices *et al.*, 2009) and a biogeographical transition zone between the Celtic Sea and the South European Atlantic Shelf” ecoregions and also between the Northern European Seas and Lusitanian provinces within the realm “temperate Northern Atlantic” (Spalding *et al.*, 2007). Furthermore, the coastline of Brittany is heterogeneous, both in terms of environmental conditions and marine species communities (Dauvin, 1997), and it serves as

a refuge zone for numerous species (reviewed by Provan, 2013). Therefore, Brittany represents a highly relevant zone for studying the species range shifts of seaweeds. Here, we first assessed the environmental changes (SST, concentration of suspended inorganic matter [SPIM], and chlorophyll-*a*) that occurred over the last two decades. Second, we compared red seaweed assemblages that occur within kelp forests between two survey periods (1992–1998 and 2010–2012) along the Brittany coastline, to detect potential changes in assemblage composition in relation to changing environmental conditions at global and regional scales. We implemented species distribution models based on a combination of approaches, including both climatic and non-climatic predictors, to elucidate how red seaweed species have responded to environmental changes over the last two decades. By using both multivariate data analysis of actual data and the most up-to-date SDMs, we sought to better explain the observed and predicted changes in red seaweeds, induced by global change in the Brittany transition zone.

MATERIALS AND METHODS

Study area

The study area encompassed Brittany and a portion of Normandy (France, North-Eastern Atlantic; Fig. 1a). The sampled area extended from 49°N to 47°N and encompassed approximately 600 km of coastline. Within this study area, we delineated five regions *a priori*: Normandy, North Eastern Brittany, North Western Brittany, West Brittany, and South Brittany (Fig. 1a). All these sites are located in the upper subtidal zone and are characterised by rocky substratum, which, at these depths, host (i) kelp assemblages dominated by the two kelp species *Laminaria digitata* (Hudson) J.V. Lamouroux and *Laminaria hyperborea* (Gunnerus) Foslie and (ii) red seaweed assemblages located beneath the kelp canopy.

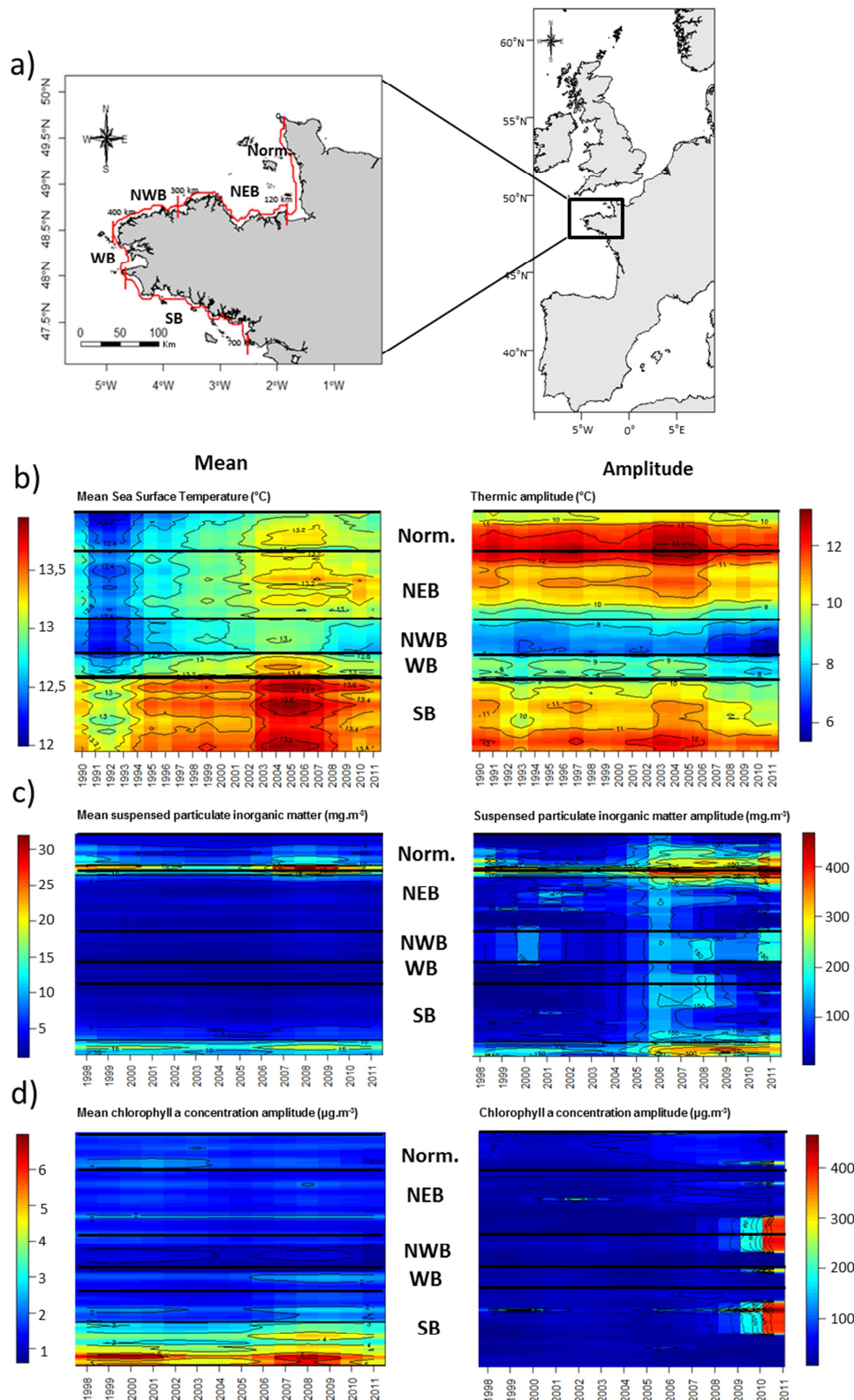


Fig. 1 Localisation of the study area (a) and temporal evolution along the Brittany coastline for (b) Sea Surface Temperature (SST), (c) concentration of Suspended Particulate Inorganic matter (SPIM), and (d) concentration of Chlorophyll a (CHL a). ‘Average’ corresponds to the annual means, while annual ‘amplitude’ corresponds to the difference between the average annual minima and maxima. Time range: 1990–2012 for SST and 1998–2012 for SPIM and CHL a. (Regions: Norm., Normandy; NEB, North Eastern Brittany; NWB, North Western Brittany; WB, West Brittany; and SB, South Brittany).

Environmental data

Six environmental parameters were used to assess and model the distribution of red seaweeds assemblages, including the mean and amplitude of SST, SPIM and chlorophyll-*a*. SST and SPIM and chlorophyll-*a* raw data were extracted from the CERSAT database (Appendix S1). SST and SPIM and chlorophyll-*a* concentrations were measured at 12.00 h. SST data were extracted from datasets collected between 1992 and 2012; however, data for chlorophyll *a* and SPIM were not available before 1998 and were only extracted from 1998 to 2012. Annual means and monthly averaged annual minima and maxima were calculated for each variable. We calculated ‘amplitude’ as the difference between monthly averaged annual minima and maxima.

Red seaweed data

Sampling surveys

Data about red seaweeds were collected during three distinct diving surveys in the five previously defined regions. The first survey was conducted by divers from the ‘Association pour la Découverte du Monde Sous-marin’ (ADMS), who explored the entire Brittany coast during 1992–1998 (Castric-Fey, 2001). During this first survey, 163 sites were explored. The second survey targeted 39 sites, which were sampled during August 2010–September 2011 and were also spread along the entire Brittany coastline. At each site, seaweeds were collected from three to six 1/10 m² plots. Furthermore, additional samples were collected from 22 sites during a 10-min visual census, according to Gallon *et al.* (2013). Each specimen was identified using morphological criteria. Most specimens were identified to the species level, while the remaining were identified to the lowest taxonomic level possible (genus or family level). The third survey was performed within the framework of the CARTHAM project of the French Marine Protected Areas Agency. Twenty sites were sampled along the Brittany and Normandy coasts during July 2011–August 2012.

In all three surveys, the dives did not exceed a depth of 40 m. Only the first two surveys (from south Brittany to North Eastern Brittany) were used for multivariate data analyses, while all three surveys (from south Brittany to Normandy) were used for SDMs. To improve the performance of the models, we included species records from the OBIS database (<http://www.iobis.org/>).

Red seaweed classification

To link changing patterns with species ecological characteristics, we classified the species according to their affinity to cold or warm waters. We defined cold-water species as species that have a northern latitudinal limit strictly over 60° and warm-water species as species that have a northern latitudinal limit equal to or below 60°.

Data analyses

Evolution of abiotic variables

To map variations in SST, SPIM concentration, and chlorophyll-*a* concentration along the Brittany coastline, values were extracted for each cell located at 10 km from the coastline. Among the five defined regions, generalised linear models were computed to visualise trends between 1992 and 2012 for SST and between 1998 and 2012 for SPIM concentration and chlorophyll-*a* concentration.

Pre-treatment of databases

Some modifications were made to the original data to synchronise datasets. The substratum type at each site was checked, and sites that were not on rocky substratum were removed from the analyses. Specimens were identified to the species level, except for some genera where such identification was problematic (Appendix S2). The identification level varied between the first two surveys; therefore, some specimens were pooled into a single group named after the genera (Appendix S1). As the sampling techniques used were not appropriate for collecting the encrusting algae, the group was removed from all datasets. Singleton species (i.e. species only recorded once) were eliminated from the databases.

Evolution of biological data

We studied variation in red seaweed assemblages in relation to time and space using several methods. Firstly, we verified that there was no sampler effect between 2010 and 2012 by a permutational multivariate analysis of variance (PERMANOVA, $df = 1$, pseudo $F = 1.152$, p -value = 0.076). Then, we tested three hypotheses with a PERMANOVA: (i) assemblages differed from one sampling period to the other, (ii) assemblages differed from one region to another, and (iii) assemblages differed from one pair 'sampling period/region' to another. Secondly, when differences were observed, we identified the species contributing to most of these differences by using the Similarity Percentage Analysis (SIMPER) routine. Thirdly, we performed constrained canonical analysis (CCA) to highlight relationships between changes

in red seaweed assemblages and changes in the mean and amplitude of SST and SPIM and chlorophyll-*a* concentrations. All analyses were based on a Bray–Curtis dissimilarity matrix, with presence/absence data being calculated using the *vegan* package (Oksanen *et al.*, 2013) in R-software (R-team, 2013).

Species distribution modelling

Environmental predictor variables

The predictors used for SDMs were derived from the raw data of SST, SPIM and chlorophyll-*a* (Appendix S1). The annual mean, the amplitude, and the monthly averaged annual minimum and maximum for the two periods, 1992–1998 and 2010–2011, were extracted. We also calculated mean, minimum, maximum, and amplitude for these three parameters during the period of seaweed growth (March–September), obtaining 24 predictors. The distribution model was based on hard substratum only.

Modelled species

We modelled the distributions of selected species based on two criteria: (i) species must be present during the two survey periods and (ii) at least 30 records per species are necessary for model training and evaluation (Wisz *et al.*, 2008). Ten species were selected: *Ahnfeltiopsis devoniensis* (n = 111), *Calliblepharis ciliata* (n = 630), *Calliblepharis jubata* (n = 261), *Ceramium* spp. (n = 1480), *Drachiella spectabilis* (n = 218), *Gastroclonium ovatum* (n = 384), *Kallymenia reniformis* (n = 540), *Phyllophora pseudoceranooides* (n = 507), *Plocamium* spp. (n = 1770), and *Sphaerococcus coronopifolius* (n = 115).

Modelling process

Species records were aggregated into 0.02° cells, which corresponded to the lower resolution of the abiotic variables. We selected a set of variables that were not intercorrelated (Pearson's $\rho < 0.70$) and best predicted the distribution for all 10 species (for detailed protocol, see the Supplementary Information in Leroy *et al.*, 2013). We modelled the distribution of the 10 selected species by an ensemble modelling approach (Araújo & New, 2007; Thuiller *et al.*, 2009) using seven niche-based modelling techniques: (1) Generalised Linear Models (GLMs), (2) Generalised Additive Models (GAMs), (3) Generalised Boosted Models (GBMs), (4) Classification Tree Analysis (CTA), (5) Multivariate Adaptive Regression Splines (MARSs), (6) Random Forests (RFs), and (7) MaxEnt. As the chosen models required data for both species presence and the available environmental conditions, we generated five sets of 1000

randomly selected pseudo-absences with equal weighting for presence and absence (Barbet-Massin *et al.*, 2012). We calibrated the models for 1992–1998 and 2010–2012 to integrate the entire range of environmental conditions available for the selected species. Models were calibrated with 70% of data selected at random and then the predictive performance of each model was evaluated based on the remaining 30% (Guisan & Thuiller, 2005) by using the True Skill Statistic criterion (TSS; Allouche, 2006). This process was repeated five times to obtain an average value of model performances, and the final models were calibrated using all data. TSS scores were interpreted using the same classification as Landis & Koch (1997). Models with TSS evaluations below 0.6 were removed. We computed response curves for each model based on the ‘evaluation strip’ method described by Elith *et al.* (2005). Background variables were fixed at the average value for the presence points of the species. Consensus distributions were obtained using the weighted average consensus (WAC) method (Thuiller *et al.*, 2009), which involves averaging model distributions with weights proportional to their TSS score. The final maps were obtained by averaging a composite model from the 10 pseudo-absence runs.

RESULTS

Spatiotemporal changes in abiotic conditions

Abiotic variables (means and amplitudes) have significantly changed over the last 20 years (Table 1a); however, different patterns were observed among the five study regions (Figs. 1b–d, Table 1b).

The mean SST has globally risen by 0.7 °C; however, while this rise averaged 0.040 °C·y⁻¹ for Normandy and North Eastern Brittany, it averaged 0.025 °C·y⁻¹ for North Western, West, and South Brittany (Table 1b). SST amplitude has risen for Normandy and South Brittany, but remained stable for North Eastern, North Western, and West Brittany. Rather than a latitudinal gradient, changes in SST mean and amplitude revealed a mosaic of contrasting conditions, with a cold, resilient water body in North-Western and West Brittany.

SPIM concentration was generally low and remained relatively stable along the entire coastline, except for two areas, the boundary of Normandy with North-Eastern Brittany and in the southern part of South Brittany, where a significant increase in SPIM concentration has been documented since 2006 (Fig. 1c). Average annual amplitude has increased in all regions; specifically, mean values have increased in Normandy, North Eastern Brittany, and North Western Brittany, whereas the mean values have remained stable in West and South Brittany (Fig. 1c; Table 2b).

Over the two decades, higher chlorophyll-*a* concentrations were recorded in South Brittany (~3–6 $\mu\text{g}\cdot\text{m}^{-3}$, with peaks in 1998–2001 and 2006–2009; Fig. 1d) compared to the other four regions (~1–3 $\mu\text{g}\cdot\text{m}^{-3}$). Over the two decades, chlorophyll-*a* concentrations increased in West Brittany and South Brittany, but slightly decreased in the other three regions (Fig. 1d; Table 2b).

Overall, West Brittany was the least impacted region by changes in all the measured abiotic variables over the last 20 years.

Table 1 Results of the generalised linear model testing the factor ‘region’ for the different abiotic parameters averaged over the study period (1992–2012 for sea surface temperature [SST] and 1998–2012 for suspended particulate inorganic matter [SPIM] and chlorophyll a [CHLa] concentrations) (a) and the average annual evolution of the different abiotic parameters within each region studied (b). Regions: Norm., Normandy; NEB, North Eastern Brittany; NWB, North Western Brittany; WB, West Brittany; and SB, South Brittany.

(a)	Degree(s) of freedom	F-model	p-value
Mean			
– SST	4	705.5	< 0.001
– SPIM	4	217.45	< 0.001
– CHLa	4	401.24	< 0.001
Amplitude			
– SST	4	17.214	< 0.001
– SPIM	4	39.47	< 0.001
– CHLa	4	4.624	< 0.001

(b)	Norm.	NEB	NWB	WB	SB
Mean					
– SST	0.043	0.041	0.024	0.026	0.024
– SPIM	0.046	0.028	0.027	-0.009	0.005
– CHLa	-0.022	-0.012	-0.014	0.035	0.036
Amplitude					
– SST	0.229	-0.002	-0.039	-0.051	0.262
– SPIM	11.936	6.171	7.721	5.869	9.328
– CHLa	5.775	3.011	7.716	0.624	1.339

Spatiotemporal changes in red algal assemblages along the Brittany coastline

The PERMANOVA results highlighted significant differences between the two study periods and the five study regions (Table 2a); however, the part of the variance explained by the factor ‘period’ (23.1%) was more than two times higher than the part of the variance explained by the factor ‘region’ (8.6%). The interaction between period and region was also significant; hence, we analysed the differences within each region. Differences between sampling periods appeared significant in all the Brittany regions (Table 2b). However, the magnitude of differences varied among regions. The magnitude was minimal for West Brittany, intermediate for both North Eastern and North Western Brittany, and maximal for South Brittany. The species that contributed the most towards discriminating between the two periods, as detected by SIMPER procedures, are presented in Appendix S2. A summary of changes in the occurrence frequencies of species between the two periods is presented in Table 3.

Table 2 Summary of the PERMANOVA results testing the factors ‘period’ and ‘region’. The factor ‘period’ corresponds to two periods of the survey (T1: 1992–1998 and T2: 2010–2012). The factor ‘region’ corresponds to the different regions that were surveyed (see Fig. 1). Both the global test (a) and the pairwise tests of the factor ‘period’ within each level of the factor ‘region’ (b) are presented. Regions: NEB, North Eastern Brittany; NWB, North Western Brittany; WB, West Brittany; and SB, South Brittany.

	Degree(s) of freedom	F-model	Part of variance explained	p-value
(a)				
<i>Period</i>	1	71.1	0.231	<0.001
<i>Region</i>	3	8.8	0.086	<0.001
<i>Period*Region</i>	3	5.3	0.051	<0.001
<i>Residuals</i>	194		0.631	
(b)				
Region NEB				
- <i>Period</i>	1	28.1	0.342	< 0.001
- <i>Residuals</i>	54		0.658	
Region NWB				
- <i>Period</i>	1	12.2	0.367	< 0.001
- <i>Residuals</i>	21		0.633	
Region WB				
- <i>Period</i>	1	13.2	0.159	< 0.001
- <i>Residuals</i>	70		0.841	
Region SB				
- <i>Period</i>	1	36.0	0.424	< 0.001
- <i>Residuals</i>	49		0.576	

Table 3 Reported distribution ranges and summary of changes in the occurrence frequencies between the two study periods, both globally and within each region, for species contributing to more than 1% of global dissimilarity between the two periods according to the SIMPER procedure. Regions: NEB, North Eastern Brittany; NWB, North Western Brittany; WB, West Brittany; and SB, South Brittany.

Species	Distribution	Changes in the occurrence frequencies between 1992–1998 and 2010–2012				
		Globally	NEB	NWB	WB	SB
<i>Gracilaria gracilis</i>	60/30 (30) + MS	↓	↓	↓	↓	↓
<i>Cryptopleura ramosa</i>	60/30 (30) + MS	↑	↑	↑	↑	↑
<i>Phyllophora crispa</i>	70/35 (35) + MS	↑	↑	↑	↑	↑
<i>Ceramium</i> spp.	N/A	↓	↓	↓	↓	↓
<i>Corallina</i> spp.	N/A	↑	↑	↑	↑	↑
<i>Gastroclonium ovatum</i>	60/30 (30) + MS	↓	↓	↓	↓	↓
<i>Heterosiphonia japonica</i>	60/40 (20) Introduced	↓	↓	↓	↓	↓
<i>Plocamium</i> spp.	N/A	↑	↑	↑	↑	×
<i>Heterosiphonia plumosa</i>	60/30 (30)	↑	↑	↑	↑	↑
<i>Dilsea carnosa</i>	80/35 (45) + NWA	↑	↑	↑	↑	↑
<i>Callophyllis laciniata</i>	65/35 (30)	↑	↑	↑	↑	↑
<i>Seirospora seirosperma</i>	60/30 (30)	↓	↓	↓	↓	↓
<i>Kallymenia reniformis</i>	60/30 (30)	↑	↓	↑	↑	↑
<i>Kallymenia requienii</i>	35/30 (5) + MS	↓	↓	↓	↓	↓
<i>Phyllophora sicula</i>	55/35 (20) + MS	↓	↓	↓	×	×

<i>Calliblepharis ciliata</i>	60/30 (30)	≈	↑	↑	×	×
<i>Gelidium corneum</i>	55/30 (25)	↓	↓	↓	↑	↓
<i>Callithamnion tetragonum</i>	65/30 (35) + NWA	↓	↓	↑	↑	↓
<i>Phyllophora pseudoceranooides</i>	70/40 (30) + NWA	↓	↑	↓	↑	↓
<i>Phycodrys rubens</i>	80/35 (45) + NWA	↑	↑	×	×	↑
<i>Meredithia microphylla</i>	60/30 (30) + MS	↑	↑	×	×	×
<i>Cystoclonium purpureum</i>	70/40 (30) + NWA	↓	↓	×	↓	↓
<i>Delesseria sanguinea</i>	70/40 (30)	↑	×	↑	↑	≈
<i>Palmaria palmata</i>	70/30 (30) + NWA	↑	↑	↑	×	×
<i>Chondrus crispus</i>	70/35 (35) + NWA	↑	×	↑	↑	×
<i>Lomentaria articulata</i>	65/30 (35) + MS + NWA	↑	×	↑	↑	↓
<i>Sphaerococcus coronopifolius</i>	60/30 (30) + MS	↑	↑	↑	×	↓
<i>Polyneura bonnemaisonii</i>	55/40 (5)	↑	↑	×	↑	×
<i>Aglaothamnion hookeri</i>	70/30 (40) + NWA	↓	×	×	↓	↓
<i>Halurus equisetifolius</i>	55/30 (25) + MS	↑	×	≈	↑	↑
<i>Rhodomenia holmesii</i>	55/30 (25)	↑	↑	↑	×	×
<i>Calliblepharis jubata</i>	55/35 (20) + MS	↓	↓	↑	×	×
<i>Porphyra</i> spp.	N/A	≈	×	×	×	×

Distribution is provided in degrees as the highest latitude/lowest latitude (latitude range); MS means that the species is also present in the Mediterranean Sea; NWA means that the species is also present in the North Western Atlantic.

Globally, different patterns emerged among the species that contributed the most to the differences between the two periods. Firstly, the frequency of some species homogeneously decreased across the four Brittany regions between 1992–1998 and 2010–2012 (e.g. *Ceramium* spp., *Gastroclonium ovatum*, and *Heterosiphonia japonica*). Secondly, some species present in the 1992–1998 period were absent in the 2010–2012 period (e.g. *Gracilaria gracilis*, *Seirospora seirosperma*, and *Kallymenia requienii*). Thirdly, the frequency of several species (e.g. *Cryptopleura ramosa*, *Phyllophora crispa*, *Corallina* spp., *Plocamium* spp., and *Heterosiphonia plumosa*) homogeneously increased across regions between the two periods. Fourthly, one species was absent during the first sampling period and appeared in the four regions during the second sampling period (*Dilsea carnosa*). We observed a marked increase in cold-water species compared to warm-water species and a greater decrease in warm-water species compared to cold-water species (Table 4), indicating that assemblages gained cold-water species and lost warm-water species.

Table 4 Observed and predicted changes in relation to the ecological characteristics of the species. The species that were considered contributed to more than 1% of the global dissimilarity between the assemblages of 1992–1998 and 2010–2012.

	Observed rise in occurrence frequency	Observed reduction in occurrence frequency	Predicted northward shift	Predicted range contraction
Warm-water species (N_{observed} = 17 and N_{predicted} = 5)	47 %	47 %	80 %	80 %
Cold-water species (N_{observed} = 12 and N_{predicted} = 3)	67 %	33 %	67 %	100 %

N is the number of species in each category.

Warm-water species: species with a Northern latitudinal limit equal or less than 60°

Cold-water species: species with a Northern latitudinal limit strictly over 60°

Relationship between abiotic and biotic changes

The CCA presented in Figure 2 displays both the spatiotemporal variations of red seaweed assemblages and the evolution of abiotic parameters between 1992–1998 and 2010–2012. The CCA results were consistent with the PERMANOVA results, as they highlighted clear differences in biotic assemblages between the two study periods. Moreover, it appeared that

between the two study periods, the evolution of red seaweed assemblages was mainly driven by the increase in mean SST. Across regions, assemblages appeared to be distributed along a north–south gradient in 1992–1998, but not in 2010–2012, where the assemblages of North Eastern Brittany appeared to have become isolated from the other regions.

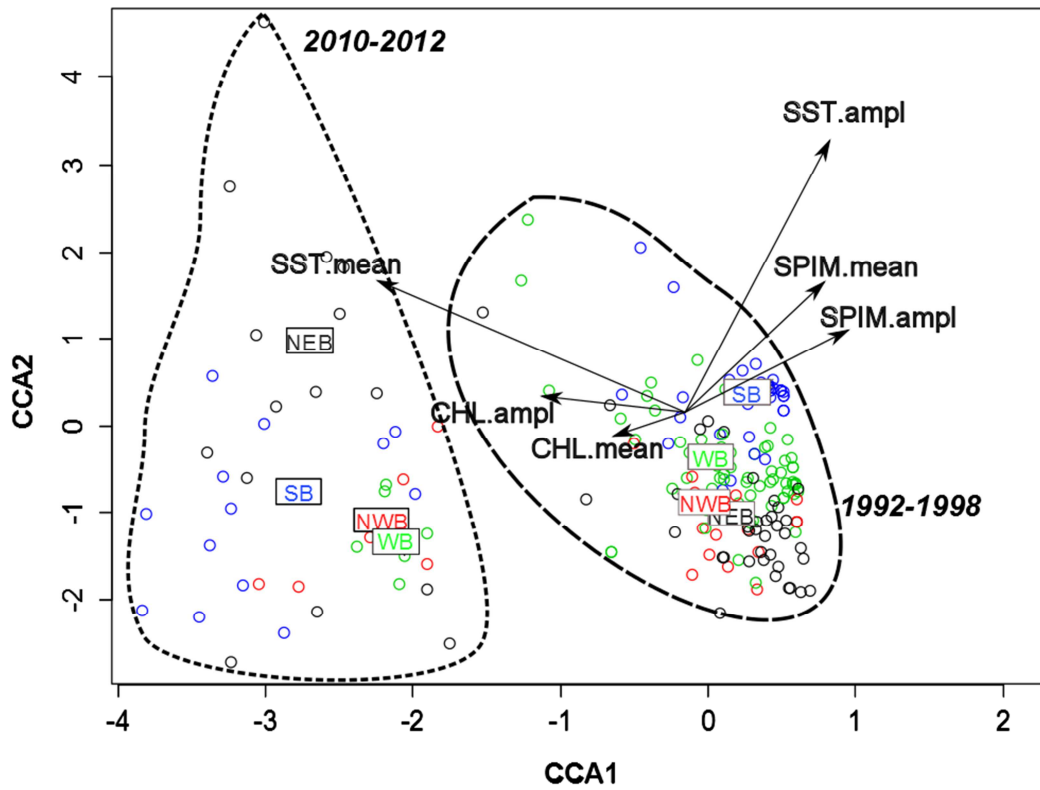


Fig. 2 Canonical correspondence analysis of red seaweed assemblages that were sampled during the periods 1992–1998 and 2010–2012 constrained by mean SST (SST.mean), SST amplitude (SST.ampl), mean chlorophyll a concentration (CHL.mean), amplitude of chlorophyll a concentration (CHL.ampl), mean SPIM (SPIM.mean), and SPIM amplitude (SPIM.ampl). The six environmental parameters contributed significantly towards explaining the observed pattern. Regions: NEB, North Eastern Brittany; NWB, North Western Brittany; WB, West Brittany; and SB, South Brittany.

Species distribution modelling

Model performance

All calibrated models exhibited good prediction performances, with average TSS scores ranging from 0.695 for the GLM to 0.972 for the RF analyses, with an overall average value of 0.847 (see Appendix S3).

Species responses

A specific combination of variables was chosen to model the distribution of each seaweed species (Table 5). Although the number and order of variables significantly explaining the distribution varied among species, the amplitude of SST (either globally or during the growth period) appeared to be the best predictor for the 10 modelled species.

The 10 modelled species expressed similar response patterns to SST variables (Figs. 3a, b). All the species exhibited a peak in their probability of presence for an SST amplitude of around 1 °C, with these probabilities collapsing to a minimum of 0–0.25 when the SST amplitude reached 2 °C (Fig. 3a). The values for all species remained low for their probability of presence beyond an SST amplitude of 2 °C, except for *Calliblepharis ciliata*, which exhibited a probability of presence beyond 0.50 at an SST amplitude of 6 °C. During the growth period (Fig. 3b), the effect of an increase in SST amplitude was also negative for all species, but was less important.

The probability of species presence consistently varied for species sensitive to annual average concentrations of chlorophyll-*a* and decreased until chlorophyll-*a* concentration reached 2.5 µg·m⁻³ and remained constant beyond this value (Fig. 3c). Conversely, responses to chlorophyll-*a* concentrations during the growth period were highly variable among species (Fig. 3d).

The modelled species were more sensitive to high SPIM concentrations during the growth period than during the entire year (Figs. 3e, f). Increasing SPIM concentrations greatly reduced the probability of presence for all modelled species (Fig. 3f).

Table 5 Environmental variables selected for the species distribution modelling of each species. Numbers correspond to the order of importance in the consensus model.

	SST								SPIM					Chlorophyll a						
	Ampl	Ampl G	Max	Max G	Mean	Mean G	Min	Min G	Ampl	Ampl G	Max G	Min	Min G	Ampl	Ampl G	Max	Mean	Mean G	Min	Min G
<i>Ahnfeltiopsis devoniensis</i>		1			2			9	8	6					3	5	4	7		
<i>Calliblepharis ciliata</i>	1	2			3			9	10	7				4		8	5	6		
<i>Calliblepharis jubata</i>	2	1					3	8	6	5						9	4	7		
<i>Ceramium</i> spp.	1	2					3	8	10	9				5	4		6	7		
<i>Drachiella spectabilis</i>	1	2				7	5		8	3						9	4	6		
<i>Gastroclonium ovatum</i>	1	2					3	9	10	7				5		4	6	8		
<i>Jania rubens</i>	2	1					3	9	10	5					4	7	6	8		
<i>Kallymenia reniformis</i>	2	1	3					8	10	5				6	4			9	7	
<i>Phyllophora pseudoceranoides</i>	1	2					3	9	10	7				5	4		6	8		
<i>Plocamium</i> spp.	2	1	3	4							5	9		8		10		6	7	
<i>Sphaerococcus coronopifolius</i>	1	2	4					7				10	8	5		3	6			9

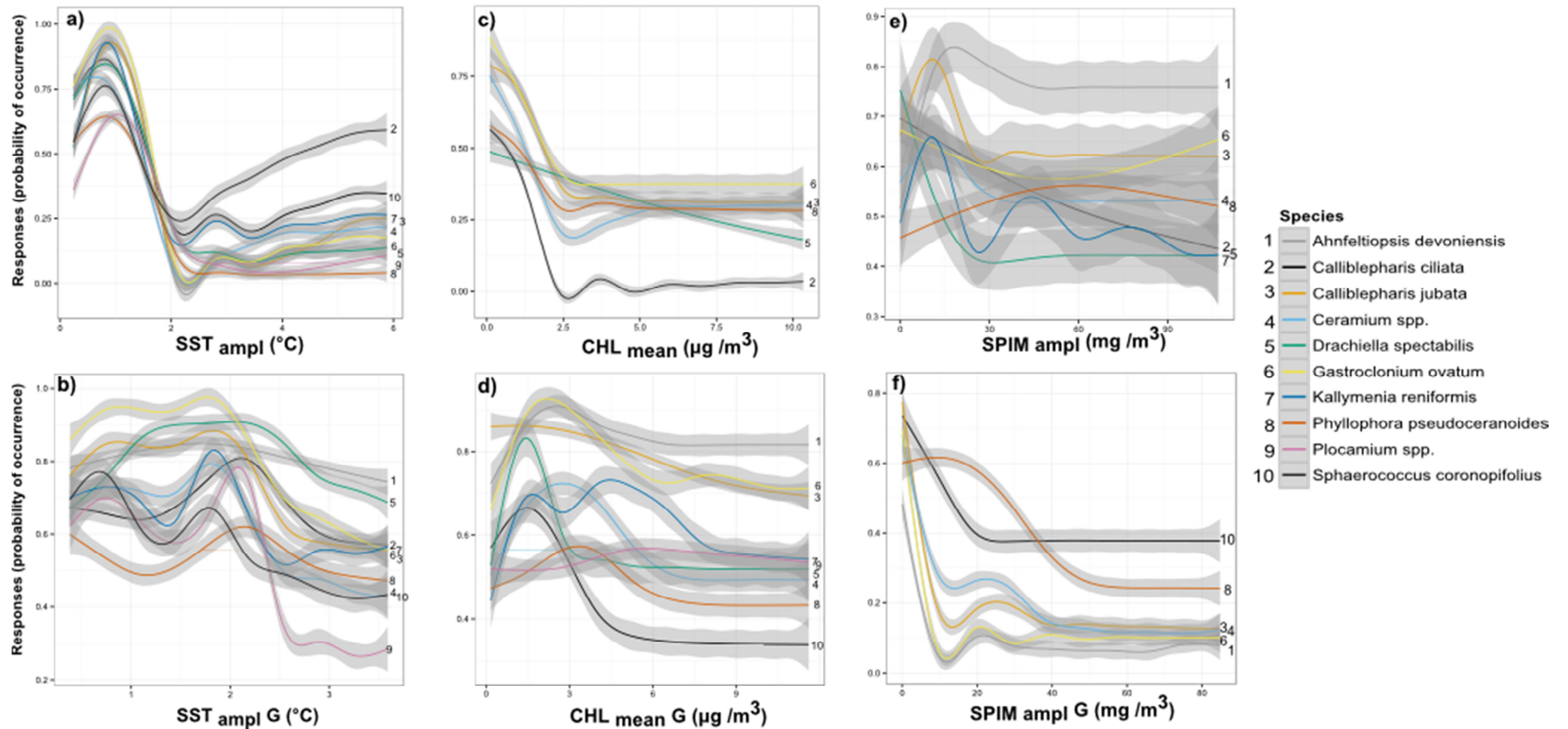


Fig. 3 Response curves of all species that were modelled. Plain line: average predicted values for all models; grey bands: 95% confidence intervals. Only the important variables are shown: (a) Annual amplitude SST; (b) Growth SST amplitude; (c) Annual CHL_{a,mean}; (d) Growth CHL_{a,mean}; (e) SPIM amplitude; and (f) Growth SPIM amplitude. SST: Sea Surface Temperature; CHL_a: concentration in Chlorophyll a; and SPIM: concentration in suspended particulate inorganic matter.

Latitudinal and coastline distributions

The models predicted a northward latitudinal shift for most species, with the notable exception of *Kallymenia reniformis*, *Phyllophora pseudoceranoides*, and *Plocamium* spp. (Fig. 4a; Appendix S3). Furthermore, they predicted a considerable range contraction for most species, except *Plocamium* spp., the range of which was predicted to remain stable, and *Sphaerococcus coronopifolius*, the range of which was predicted to increase in size. The 2010–2012 coastline distribution projections were characterised by (i) reduction in the potential distribution area for most species, especially *Ahnfeltiopsis devoniensis*, *Drachiella spectabilis*, and *Calliblepharis ciliata*, and (ii) a shift towards North-Eastern Brittany for seven of 10 species (Fig. 4b; Appendix S3). The predicted shifts and range contractions were not related to the ecological characteristics of the species (Appendix S3).

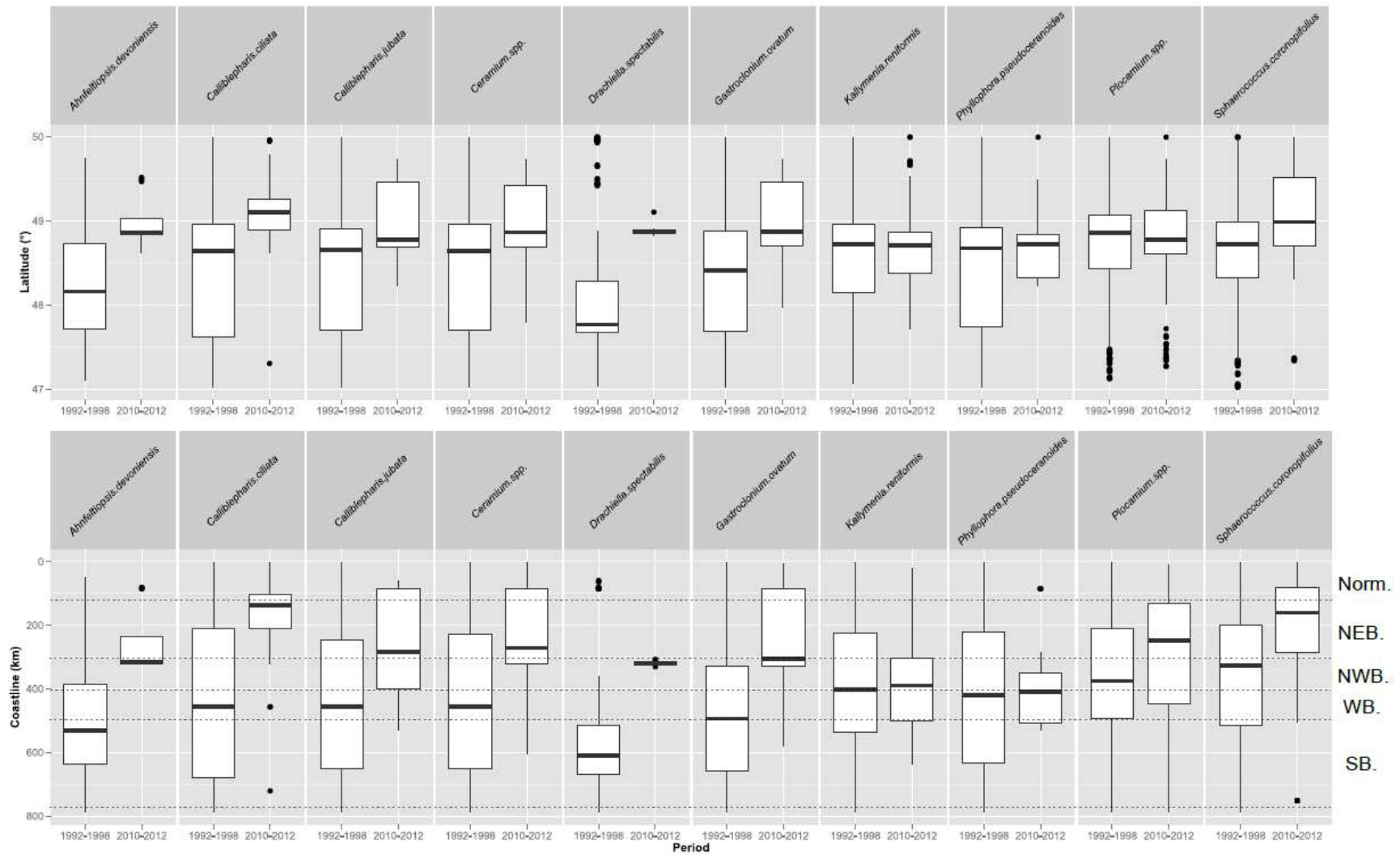


Fig. 4 Latitudinal distribution (a) and distribution along the coastline (b) for the 10 species that were modelled between the two study periods (1992–1998 and 2010–2012). Values were extracted from the two projections (1992–1998 and 2010–2012).

DISCUSSION

SST has globally increased by 0.7 °C along the Brittany coastline of France over the last two decades, whereas SPIM concentrations have remained relatively stable and chlorophyll-*a* concentrations have slightly increased during this period. Nevertheless, this global trend has concealed more complex environmental patterns, with the evolution of various abiotic parameters being highly varied at a local scale. Assuming that these rapid environmental changes have affected the ecology of red seaweeds, we investigated changes in assemblages using multivariate analyses and changes in potential species distributions using SDMs over the past 20 years. Our results revealed strong changes in the distributions of both species and assemblages of red seaweeds during 1992–1998 and 2010–2012. Red seaweeds appear to be strongly dependent on SST, specifically, mean temperature, when considering assemblages, and temperature amplitude, when regarding singles species responses. Therefore, we assumed that temperature has been the main driver of the observed changes, supporting the findings of previous studies (Bartsch *et al.*, 2012, and references therein).

Recorded changes in abiotic conditions

The SST warming rate calculated in this study for Brittany (0.7 °C over the last two decades, i.e. 0.35 °C per decade) was slightly higher than but generally consistent with values estimated by Lima & Wethey in 2011 for the Eastern Atlantic coast (0.27 ± 0.13 °C per decade). At a finer scale, within Brittany, the average SST and the amplitude of SST together indicated that, over the last 20 years, North Western and West Brittany represent the regions least impacted by SST variations, whereas North Eastern and South Brittany represent the regions most impacted by increasing SST and SST amplitude, respectively.

Changes in the other abiotic parameters were detected at a further local scale. SPIM amplitude has increased in two areas since 2006; specifically, at the boundary of Normandy with North-Eastern Brittany and in the southern part of South Brittany. These two areas are known to carry a large amount of terrigenous material from drainage basins. The amplitude of chlorophyll-*a* concentration has increased in two areas, specifically at the boundary between North-Eastern and North-Western Brittany and in South Brittany. These local increases correspond to zones where green tides (i.e. algal blooms) have been observed. Variations in SST and SPIM and chlorophyll-*a* concentrations in Brittany were the least altered in West Brittany over the past 20 years, which corroborates current knowledge about the hydrodynamic features of this region (Le Boyer *et al.*, 2009).

Observed changes in red seaweed assemblages

Our findings showed varying patterns to the changes in red seaweed assemblages across the four Brittany regions over the last two decades. The observed changes were strongly correlated to changes in environmental conditions, particularly mean temperature. The strongest changes in assemblages occurred in the region most impacted by temperature rise (South Brittany). Conversely, the smallest changes in assemblages occurred in West Brittany, the least impacted region.

Specifically, we documented increases in the occurrence of several species (*Corallina* spp., *Cryptopleura ramosa*, *Dilsea carnosa*, *Heterosiphonia plumosa*, *Plocamium* spp., and *Phyllophora crispa*). Interestingly, some studies about recent changes in European seaweed communities obtained similar results for most of these species. For instance, Diez *et al.* (2012) did not find *P. crispa* in their 1991 survey, but found some specimens in their 2008 survey, with an increase in the frequencies of *C. ramosa*, *Corallina* spp., and *Plocamium* spp. between the two surveys. In contrast, Husa *et al.* (2008) described an increase in the frequency of *P. crispa* between their 1994 and 2008 surveys. These findings might indicate that these four species have benefitted from recent environmental changes. These observations seem to be in accordance with previous studies for *Corallina* spp., which have shown that an increase in temperature could be beneficial for the calcification and growth of coralline seaweeds (e.g. Jian-Zhang *et al.*, 2010).

We also recorded strong decreases in the frequency of *Ceramium* spp., *Gastroclonium ovatum*, and *Heterosiphonia japonica* during 1992–1998 and 2010–2012. *Heterosiphonia japonica* is an invasive species from the Western Pacific, with other studies reporting an increase in its frequency during 1991–2008 on the Basque coast (Spain, Diez *et al.*, 2012), 1994–2003 in Norway (Husa *et al.*, 2008) and 1998–2011 in Brittany (Derrien-Courtel *et al.*, 2013). *Heterosiphonia japonica* has been frequently observed in Brittany (pers. obs.); hence, the observed decrease in its occurrence frequency in the present work was probably related to it primarily occurring epiphytically, rather than epilithically, while our sampling effort only focused on the latter habitat type.

We observed the disappearance of several species during 1992–1998 and 2010–2012. *Gracilaria gracilis* was not recorded in the 2010–2012 survey, whereas it was present at every site in the 1992–1998 survey. Similar to *H. japonica*, *G. gracilis* has been observed throughout Brittany, but not in our sampling sites (which were limited to epilithic species), indicating that these species no longer occur under the kelp canopy. *Kallymenia requienii* and *Seirospora seirosperma* were also not recorded in the 2010–2012 survey. The former is a

warm-water species that has not been previously recorded in Brittany. To our knowledge, the latter species has not been observed in Brittany in recent years (Guiry & Guiry, 2013), but was observed in Norway in 2003 (Husa *et al.*, 2008) and was observed at low frequencies in Spain during 2008 (Diez *et al.*, 2012).

Modelled changes in red seaweed distributions

For the 10 modelled species, the best predictor of distribution was SST amplitude, either for the whole year or just during the growth period, re-affirming the crucial role of temperature in shaping the patterns of seaweed distribution, as highlighted by previous studies (Jueterbock *et al.*, 2013; Raybaud *et al.*, 2013). The current results indicate that the distribution of red seaweeds seems to be limited by the temperature range they can cope with, rather than the mean annual temperature.

The models developed here predicted both a northward shift and a contraction of the predicted suitable range for most species over the last two decades, based on the major observed increase in SST. Our models predicted a northward shift in the distribution ranges of seven of 10 species, with the distributions of the remaining three species either contracting or remaining stable. The lack of predicted northward range expansion might indicate that new environmental conditions further north of Brittany are not adequate for these species. Indeed, North-Eastern Brittany is warmer and has been warming at a faster rate than the other Brittany regions over the last two decades, which might have resulted in North-Western and West Brittany becoming isolated, where changes in temperature conditions have been less drastic. This isolated status might be considered to serve as a refuge for many species.

Synthesis

We observed a correlation between the changes in environmental conditions over the last two decades and the documented changes in red seaweed communities. Similarly, when using the same environmental variables, strong changes were predicted from the species distribution models of a restricted species set. Three of the modelled species were among the most discriminant species between the 1992–1998 and 2010–2012 surveys. *Plocamium* spp. was the only taxon that was not predicted to be subjected to range contraction. This prediction may be corroborated by the observed increase in the occurrence frequency of this species between the 1992–1998 and 2010–2012 surveys. *Ceramium* spp. and *Gastroclonium ovatum* were predicted to be subjected to strong range contraction. These predictions were corroborated by the observed decrease in their occurrence frequency between the two survey

periods. Therefore, our predictions that environmental changes have had a strong impact on red seaweeds were strengthened on combining the two different approaches. We initially used multivariate analysis based on real but discrete data, which enabled detection of changes in whole species assemblages. These results were then combined with SDMs, which enabled prediction of the entire distribution for a reduced number of modelled species.

However, we did not observe the expected increase in warm-water species, and shifts were not predicted for all species. Therefore, we hypothesised that this complex pattern of responses to environmental changes might have two origins. Firstly, species might track changes in environmental conditions, but not fast enough, resulting in a time lag between abiotic changes and the resulting changes in biotic assemblages. This pattern type has already been observed for several taxa in the terrestrial realm (Devictor *et al.*, 2012). Secondly, environmental changes occur heterogeneously at very small spatial scales, resulting in complex global variations when species track these changes. These types of local changes are highly likely, given the mosaic of different environments recorded along the Brittany coastline in the current study. Similar outcomes have been documented for recent trends in the range shifts of marine taxa in North America; it has been suggested that marine species shift at different rates and in different directions because they closely track the complex mosaic of local climate velocities (Pinsky *et al.*, 2013).

Study limitations

Here, we compared red seaweed assemblages that were sampled at an interval of 20 years. While important changes in red seaweed assemblages were revealed over this timeframe, several disadvantages were noted. Firstly, the sampling scheme was not identical between the two periods; hence, we had to remove the details of or simplify the results of the most recent study to allow comparison with the sampling data of the first study.

Secondly, the presence of some taxa (i.e. *Ceramium* spp., *Corallina* spp., and *Plocamium* spp.) was evaluated at the generic level; hence, our results for these genera might not reflect the responses of individual species, as responses to climatic stress might differ within a genus (Harley, 2006). Furthermore, the data used in this study are based on morphological identification, whereas global taxonomic knowledge has evolved since the 1990s, highlighting many cases of cryptic diversity, such as in the genera *Corallina* (Walker *et al.*, 2009; Hind & Saunders, 2013) and *Plocamium* (Saunders *et al.*, 2005). Hence, the use of molecular systematics, such as DNA-barcoding, for red seaweed identification (e.g. Saunders & McDevit, 2012) could be used to unravel genuine species distributions and

enhance our understanding of species-specific responses to environmental changes in the future.

Thirdly, if marine species track highly local environmental changes, as suggested by Pinsky *et al.* (2013), they might migrate not only along a latitudinal gradient but also along a depth gradient. In the present study, we did not have access to information about the depth at which the samples were collected; therefore, we could not test this hypothesis. Collecting pertinent local information about abiotic conditions, including the depth, to cover the entire ecological range of a species would contribute towards further accurately predicting species responses to global changes (Owen *et al.*, 2013).

Concluding remarks

The impact of environmental changes on red seaweeds in Brittany over the last two decades was determined using a combination of two different approaches. Changes in both biotic and abiotic conditions in this biogeographical transition zone were contrasted across adjoining regions. Changes in temperature conditions did not follow a latitudinal gradient. These changes were much milder in North-Western and Western Brittany, which potentially represent a refuge zone for red seaweeds. In contrast, further drastic temperature changes were recorded in North-Eastern Brittany, which potentially represents a thermal barrier to the northward migration of red seaweeds. In conclusion, we recommend both (i) extending the scope of observations to other parts of the European coastline and (ii) collecting data at a very fine scale, to better understand how red seaweeds track environmental changes, and therefore, improve our understanding of the dynamics of marine biogeographical transition zones within the context of global change.

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BIOSKETCHES

R.G. and M.R. are PhD students working on the functional diversity of Rhodophyta and the biodiversity of kelp forests, respectively; they participated in the data collection/ideas conception, carried out the analysis and wrote the first draft. B.L. improved the SDMs section. L.L.G and E.F. participated in the data collection and ideas conception. M.V. participated in the ideas conception. All authors substantially improved the manuscript.

SUPPORTING INFORMATION**Appendix S1** Information about abiotic and biotic data used in the study**(a)** Description of the six environmental variables

Variable	Description	Resolution in models	URL link	Period
<i>Depth</i>	Height of the water column (m)	2.2km x 2.2km	emodnet-hydrography.eu	
<i>Seafloor substrate</i>	Only hard substrate are kept		IFREMER-JNCC	
<i>Sea surface temperature</i>	Measure of sea surface temperature in °C	2.2km x 2.2km	/ifremer/cersat/products/gridded/sst-l4hr-AVHRR-fnd/V2/cdf	1990-2012
<i>Suspended inorganic matter</i>	Measure of suspended inorganic matter concentration (10^{-2} g m ⁻³)	2.2km x 2.2km	/ifremer/cersat/products/gridded/ocean-color/atlantic/EUR-L4-SPIM-ATL-v01	1998-2012
<i>Chlorophyll a</i>	Measure of chlorophyll a concentration (10^{-2} mg m ⁻³)	2.2km x 2.2km	/ifremer/cersat/products/gridded/ocean-color/atlantic/EUR-L4-CHL-ATL-v01	1998-2012

(b) List of species detected in Brittany during the sampling period of 1992-1998 and the one of 2010-2012. A cross indicates the presence of the species.

Species name	1992-1998	2010-2012
<i>Acrochaetium bonnemaisoniae</i>	X	
<i>Aglaothamnion bipinnatum</i>	X	
<i>Aglaothamnion diaphanum</i>	X	
<i>Aglaothamnion feldmanniae</i>	X	
<i>Aglaothamnion gallicum</i>	X	
<i>Aglaothamnion hookeri</i>	X	
<i>Aglaothamnion pseudobyssoides</i>	X	
<i>Aglaothamnion tenuissimum</i>	X	
<i>Aglaothamnion tripinnatum</i>	X	
<i>Ahnfeltia plicata</i>	X	X
<i>Ahnfeltiopsis devoniensis</i>	X	
<i>Ahnfeltiopsis</i> sp.		X
<i>Anotrichium furcellatum</i>	X	
<i>Antithamnion cruciatum</i>	X	
<i>Antithamnion densum</i>	X	
<i>Antithamnion sarniense</i>	X	
<i>Antithamnionella spirographidis</i>	X	
<i>Antithamnionella ternifolia</i>	X	
<i>Apoglossum ruscifolium</i>	X	X
<i>Asparagopsis armata</i>	X	X
<i>Bonnemaisonia asparagoides</i>	X	X
<i>Bonnemaisonia clavata</i>	X	
<i>Bornetia secundiflora</i>	X	X
<i>Brongniartella byssoides</i>	X	
<i>Calliblepharis ciliata</i>	X	X
<i>Calliblepharis jubata</i>	X	X
<i>Callithamnion granulatum</i>	X	
<i>Callithamnion tetragonum</i>	X	X
<i>Callithamnion tetricum</i>	X	
<i>Callophyllis laciniata</i>	X	X
<i>Ceramium</i> spp.	X	X
<i>Champia parvula</i>	X	
<i>Chondracanthus teedei</i>	X	
<i>Chondria coerulescens</i>	X	
<i>Chondria dasyphylla</i>	X	
<i>Chondria scintillans</i>	X	
<i>Chondrus crispus</i>	X	X
<i>Chylocladia verticillata</i>	X	X
<i>Compsothamnion decompositum</i>	X	
<i>Compsothamnion gracillimum</i>	X	
<i>Compsothamnion thuyoides</i>	X	
<i>Corallina</i> spp.	X	X
<i>Cordylecladia erecta</i>	X	
<i>Cruoria pellita</i>	X	
<i>Cryptopleura ramosa</i>	X	X
<i>Cystoclonium purpureum</i>	X	X

<i>Dasya arbuscula</i>	X	
<i>Dasya ocellata</i>	X	
<i>Delesseria sanguinea</i>	X	X
<i>Dilsea carnosa</i>		X
<i>Drachiella heterocarpa</i>	X	
<i>Drachiella spectabilis</i>	X	
<i>Dudresnaya verticillata</i>	X	
<i>Erythroglossum laciniatum</i>	X	X
<i>Furcellaria lumbricalis</i>	X	X
<i>Gastroclonium ovatum</i>	X	X
<i>Gelidium corneum</i>	X	X
<i>Gelidium spinosum</i>	X	X
<i>Gelidium spp.</i>	X	X
<i>Gigartina pistillata</i>	X	X
<i>Gonimophyllum buffhamii</i>	X	
<i>Goniotrichum elegans</i>	X	
<i>Gracilaria compressa</i>	X	
<i>Gracilaria gracilis</i>	X	
<i>Gracilaria multipartita</i>	X	
<i>Gracilaria sp.</i>		X
<i>Gracilariopsis longissima</i>	X	
<i>Griffithsia corallinoides</i>	X	X
<i>Gymnogongrus crenulatus</i>	X	X
<i>Gymnogongrus griffithsiae</i>	X	
<i>Halarachnion ligulatum</i>	X	
<i>Halopithys incurva</i>	X	X
<i>Halurus equisetifolius</i>	X	X
<i>Halymenia latifolia</i>	X	
<i>Haraldiophyllum bonnemaisonii</i>	X	
<i>Heterosiphonia japonica</i>	X	X
<i>Heterosiphonia plumosa</i>	X	X
<i>Heterosiphonia sp.</i>		X
<i>Hypnea musciformis</i>	X	
<i>Hypoglossum hypoglossoides</i>		X
<i>Jania rubens</i>	X	
<i>Kallymenia reniformis</i>	X	X
<i>Kallymenia requienii</i>	X	
<i>Liagora viscida</i>	X	
<i>Lomentaria articulata</i>	X	X
<i>Lomentaria clavellosa</i>	X	X
<i>Lomentaria orcadensis</i>	X	
<i>Mastocarpus stellatus</i>	X	X
<i>Membranoptera alata</i>	X	X
<i>Meredithia microphylla</i>	X	X
<i>Microcladia glandulosa</i>	X	
<i>Monosporus pedicellatus</i>	X	
<i>Myriogramme minuta</i>	X	
<i>Myriogramme sp.</i>		X
<i>Naccaria wiggii</i>	X	
<i>Nemalion helminthoides</i>	X	

<i>Neosiphonia harveyi</i>	X	
<i>Nitophyllum punctatum</i>	X	X
<i>Osmundea pinnatifida</i>	X	X
<i>Palmaria palmata</i>	X	X
<i>Petalonia fascia</i>		X
<i>Phycodrys rubens</i>	X	X
<i>Phyllophora crispa</i>	X	X
<i>Phyllophora pseudoceranooides</i>	X	X
<i>Phyllophora sicula</i>	X	X
<i>Phyllophora</i> spp.		X
<i>Plocamium</i> spp.	X	X
<i>Plumaria plumosa</i>	X	X
<i>Polyides rotundus</i>		X
<i>Polyneura bonnemaisonii</i>	X	X
<i>Polyneura</i> spp.		X
<i>Polysiphonia elongata</i>	X	X
<i>Polysiphonia</i> spp.	X	X
<i>Porphyra</i> spp.	X	X
<i>Pterosiphonia</i> spp.	X	X
<i>Pterothamnion crispum</i>	X	
<i>Pterothamnion plumula</i>	X	
<i>Ptilothamnion pluma</i>	X	
<i>Radicilingua thysanorhizans</i>	X	
<i>Rhodomela confervoides</i>	X	
<i>Rhodophyllis divaricata</i>	X	
<i>Rhodymenia coespitosella</i>	X	
<i>Rhodymenia deliticolata</i>		X
<i>Rhodymenia holmesii</i>	X	X
<i>Rhodymenia pseudopalmata</i>		X
<i>Rhodymenia</i> sp.		X
<i>Schizymenia dubyi</i>	X	
<i>Schottera nicaeensis</i>	X	X
<i>Scinaia furcellata</i>	X	
<i>Scinaia turgida</i>	X	
<i>Seirospora seirosperma</i>	X	
<i>Solieria chordalis</i>	X	X
<i>Spermothamnion mesocarpum</i>	X	
<i>Spermothamnion repens</i>	X	
<i>Spermothamnion strictum</i>	X	
<i>Sphaerococcus coronopifolius</i>	X	X
<i>Stenogramma interrupta</i>	X	
<i>Stypocaulon scoparium</i>		X

Appendix S2: Occurrence frequencies of the species in 1992-1998 and 2010-2012 and contribution of each species to overall dissimilarity between the two surveys according to the SIMPER routine. The taxa listed have a contribution of over 1% of the total dissimilarity. The results are presented globally (a) and for the four Brittany regions (b-e).

(a) Globally	Occurrence frequency in 1992-1998	Occurrence frequency in 2010-2012	Contribution to overall dissimilarity	Cumulative contribution to overall dissimilarity
<i>Gracilaria gracilis</i>	1.000	0.000	0.037	0.037
<i>Cryptopleura ramosa</i>	0.012	0.795	0.028	0.064
<i>Phyllophora crispa</i>	0.049	0.795	0.026	0.090
<i>Ceramium</i> spp.	0.945	0.308	0.026	0.116
<i>Corallina</i> spp.	0.049	0.744	0.025	0.141
<i>Gastroclonium ovatum</i>	0.779	0.179	0.024	0.165
<i>Heterosiphonia japonica</i>	0.755	0.179	0.022	0.187
<i>Plocamium</i> spp.	0.209	0.744	0.022	0.209
<i>Heterosiphonia plumosa</i>	0.061	0.641	0.021	0.230
<i>Dilsea carnosa</i>	0.000	0.564	0.021	0.251
<i>Callophyllis laciniata</i>	0.018	0.615	0.020	0.271
<i>Seirospora seirosperma</i>	0.656	0.000	0.020	0.291
<i>Kallymenia reniformis</i>	0.325	0.513	0.018	0.310
<i>Kallymenia requienii</i>	0.613	0.000	0.018	0.328
<i>Phyllophora sicula</i>	0.479	0.077	0.016	0.344
<i>Calliblepharis ciliata</i>	0.344	0.385	0.016	0.361
<i>Gelidium corneum</i>	0.485	0.231	0.016	0.377
<i>Callithamnion tetragonum</i>	0.509	0.256	0.016	0.393
<i>Phyllophora pseudoceranooides</i>	0.442	0.385	0.016	0.409
<i>Phycodryis rubens</i>	0.025	0.410	0.015	0.424
<i>Meredithia microphylla</i>	0.055	0.410	0.014	0.438
<i>Cystoclonium purpureum</i>	0.466	0.026	0.014	0.452
<i>Delesseria sanguinea</i>	0.160	0.385	0.014	0.466
<i>Palmaria palmata</i>	0.018	0.385	0.013	0.479
<i>Chondrus crispus</i>	0.172	0.410	0.013	0.492

<i>Lomentaria articulata</i>	0.160	0.385	0.012	0.504
<i>Sphaerococcus coronopifolius</i>	0.184	0.256	0.012	0.516
<i>Polyneura bonnemaisonii</i>	0.080	0.333	0.012	0.528
<i>Aglaothamnion hookeri</i>	0.399	0.000	0.011	0.539
<i>Halurus equisetifolius</i>	0.123	0.282	0.011	0.549
<i>Rhodymenia holmesii</i>	0.012	0.333	0.010	0.559
<i>Calliblepharis jubata</i>	0.239	0.179	0.010	0.569
<i>Porphyra</i> spp.	0.166	0.179	0.010	0.579

(b) North-Eastern Brittany	Occurrence frequency in 1992-1998	Occurrence frequency in 2010-2012	Contribution to overall dissimilarity	Cumulative contribution to overall dissimilarity
<i>Gracilaria gracilis</i>	1.000	0.000	0.040	0.040
<i>Phyllophora crispa</i>	0.071	1.000	0.038	0.079
<i>Plocamium</i> spp.	0.167	0.929	0.033	0.112
<i>Corallina</i> spp.	0.071	0.786	0.032	0.144
<i>Ceramium</i> spp.	0.952	0.214	0.031	0.175
<i>Phyllophora sicula</i>	0.857	0.143	0.028	0.204
<i>Gastroclonium ovatum</i>	0.738	0.000	0.027	0.231
<i>Meredithia microphylla</i>	0.048	0.714	0.026	0.257
<i>Cryptopleura ramosa</i>	0.000	0.643	0.024	0.281
<i>Gelidium corneum</i>	0.595	0.000	0.022	0.303
<i>Phyllophora pseudoceranooides</i>	0.357	0.643	0.021	0.324
<i>Kallymenia requienii</i>	0.595	0.000	0.021	0.345
<i>Heterosiphonia japonica</i>	0.810	0.500	0.021	0.366
<i>Calliblepharis ciliata</i>	0.167	0.571	0.021	0.386
<i>Kallymenia reniformis</i>	0.571	0.286	0.020	0.407
<i>Callophyllis laciniata</i>	0.048	0.429	0.019	0.426
<i>Seirospora seirosperma</i>	0.524	0.000	0.017	0.443
<i>Polyneura bonnemaisonii</i>	0.095	0.357	0.017	0.460
<i>Dilsea carnosa</i>	0.000	0.429	0.016	0.476
<i>Sphaerococcus coronopifolius</i>	0.167	0.357	0.015	0.491
<i>Callithamnion tetragonum</i>	0.429	0.000	0.014	0.506
<i>Palmaria palmata</i>	0.024	0.357	0.014	0.520
<i>Rhodomenia holmesii</i>	0.000	0.429	0.014	0.533
<i>Calliblepharis jubata</i>	0.357	0.143	0.013	0.547
<i>Heterosiphonia plumosa</i>	0.024	0.357	0.013	0.560
<i>Phycodrys rubens</i>	0.000	0.357	0.012	0.572
<i>Antithamnion sarniense</i>	0.333	0.000	0.011	0.583
<i>Bornetia secundiflora</i>	0.143	0.214	0.010	0.593
<i>Cystoclonium purpureum</i>	0.310	0.000	0.010	0.603

(c) North-Western Brittany	Occurrence frequency in 1992-1998	Occurrence frequency in 2010-2012	Contribution to overall dissimilarity	Cumulative contribution to overall dissimilarity
<i>Callophyllis laciniata</i>	0.000	1.000	0.030	0.030
<i>Gracilaria gracilis</i>	1.000	0.000	0.030	0.061
<i>Chondrus crispus</i>	0.059	1.000	0.029	0.090
<i>Heterosiphonia plumosa</i>	0.059	1.000	0.029	0.119
<i>Corallina</i> spp.	0.118	1.000	0.028	0.147
<i>Cryptopleura ramosa</i>	0.118	1.000	0.027	0.174
<i>Lomentaria articulata</i>	0.000	0.833	0.026	0.200
<i>Heterosiphonia japonica</i>	0.824	0.000	0.022	0.222
<i>Phyllophora crispa</i>	0.176	0.833	0.021	0.243
<i>Calliblepharis jubata</i>	0.235	0.833	0.021	0.265
<i>Dilsea carnosa</i>	0.000	0.667	0.021	0.286
<i>Seirospora seirosperma</i>	0.765	0.000	0.021	0.307
<i>Rhodymenia holmesii</i>	0.000	0.667	0.020	0.327
<i>Ahnfeltiopsis devoniensis</i>	0.765	0.000	0.020	0.347
<i>Mastocarpus stellatus</i>	0.059	0.667	0.020	0.367
<i>Kallymenia reniformis</i>	0.412	1.000	0.020	0.387
<i>Plocamium</i> spp.	0.412	1.000	0.020	0.407
<i>Osmundea pinnatifida</i>	0.118	0.667	0.019	0.426
<i>Ceramium</i> spp.	0.882	0.333	0.018	0.444
<i>Callithamnion tetragonum</i>	0.353	0.667	0.018	0.462
<i>Delesseria sanguinea</i>	0.000	0.500	0.015	0.477
<i>Palmaria palmata</i>	0.000	0.500	0.015	0.493
<i>Gelidium corneum</i>	0.765	0.500	0.015	0.508
<i>Gastroclonium ovatum</i>	0.824	0.500	0.015	0.523
<i>Halurus equisetifolius</i>	0.412	0.500	0.015	0.538
<i>Sphaerococcus coronopifolius</i>	0.118	0.500	0.015	0.553
<i>Phyllophora sicula</i>	0.529	0.000	0.014	0.567
<i>Kallymenia requienii</i>	0.471	0.000	0.012	0.580
<i>Phyllophora pseudoceranooides</i>	0.412	0.167	0.012	0.592

<i>Apoglossum ruscifolium</i>	0.059	0.333	0.011	0.603
<i>Calliblepharis ciliata</i>	0.176	0.333	0.011	0.613
<i>Gigartina pistillata</i>	0.118	0.333	0.010	0.624
<i>Hypoglossum hypoglossoides</i>	0.000	0.333	0.010	0.634
<i>Gymnogongrus crenulatus</i>	0.118	0.333	0.010	0.644

(d) West Brittany	Occurrence frequency in 1992-1998	Occurrence frequency in 2010-2012	Contribution to overall dissimilarity	Cumulative contribution to overall dissimilarity
<i>Cryptopleura ramosa</i>	0.000	1.000	0.032	0.032
<i>Gracilaria gracilis</i>	1.000	0.000	0.032	0.064
<i>Rhodymenia pseudopalmata</i>	0.000	1.000	0.032	0.097
<i>Callophyllis laciniata</i>	0.015	1.000	0.032	0.129
<i>Corallina</i> spp.	0.015	1.000	0.032	0.161
<i>Lomentaria articulata</i>	0.000	0.833	0.027	0.188
<i>Phyllophora crispa</i>	0.015	0.833	0.027	0.215
<i>Chondrus crispus</i>	0.212	1.000	0.027	0.241
<i>Membranoptera alata</i>	0.045	0.833	0.026	0.267
<i>Plocamium</i> spp.	0.303	1.000	0.023	0.290
<i>Halurus equisetifolius</i>	0.076	0.667	0.021	0.311
<i>Kallymenia reniformis</i>	0.227	0.667	0.021	0.331
<i>Gymnogongrus crenulatus</i>	0.015	0.667	0.020	0.351
<i>Heterosiphonia plumosa</i>	0.106	0.667	0.019	0.371
<i>Gastroclonium ovatum</i>	0.742	0.333	0.019	0.389
<i>Heterosiphonia japonica</i>	0.606	0.000	0.017	0.407
<i>Dilsea carnosa</i>	0.000	0.500	0.017	0.423
<i>Callithamnion tetragonum</i>	0.485	0.667	0.017	0.440
<i>Gelidium corneum</i>	0.303	0.500	0.016	0.456
<i>Seirospora seirosperma</i>	0.561	0.000	0.016	0.473
<i>Phyllophora pseudoceranooides</i>	0.288	0.500	0.016	0.489
<i>Apoglossum ruscifolium</i>	0.030	0.500	0.015	0.504
<i>Chylocladia verticillata</i>	0.000	0.500	0.015	0.519
<i>Polyneura bonnemaisonii</i>	0.076	0.500	0.015	0.534
<i>Osmundea pinnatifida</i>	0.000	0.500	0.014	0.548
<i>Kallymenia requienii</i>	0.515	0.000	0.014	0.562
<i>Ceramium</i> spp.	0.924	0.667	0.013	0.575
<i>Cystoclonium purpureum</i>	0.394	0.000	0.012	0.587
<i>Aglaothamnion hookeri</i>	0.409	0.000	0.012	0.598
<i>Hypoglossum hypoglossoides</i>	0.000	0.333	0.011	0.610

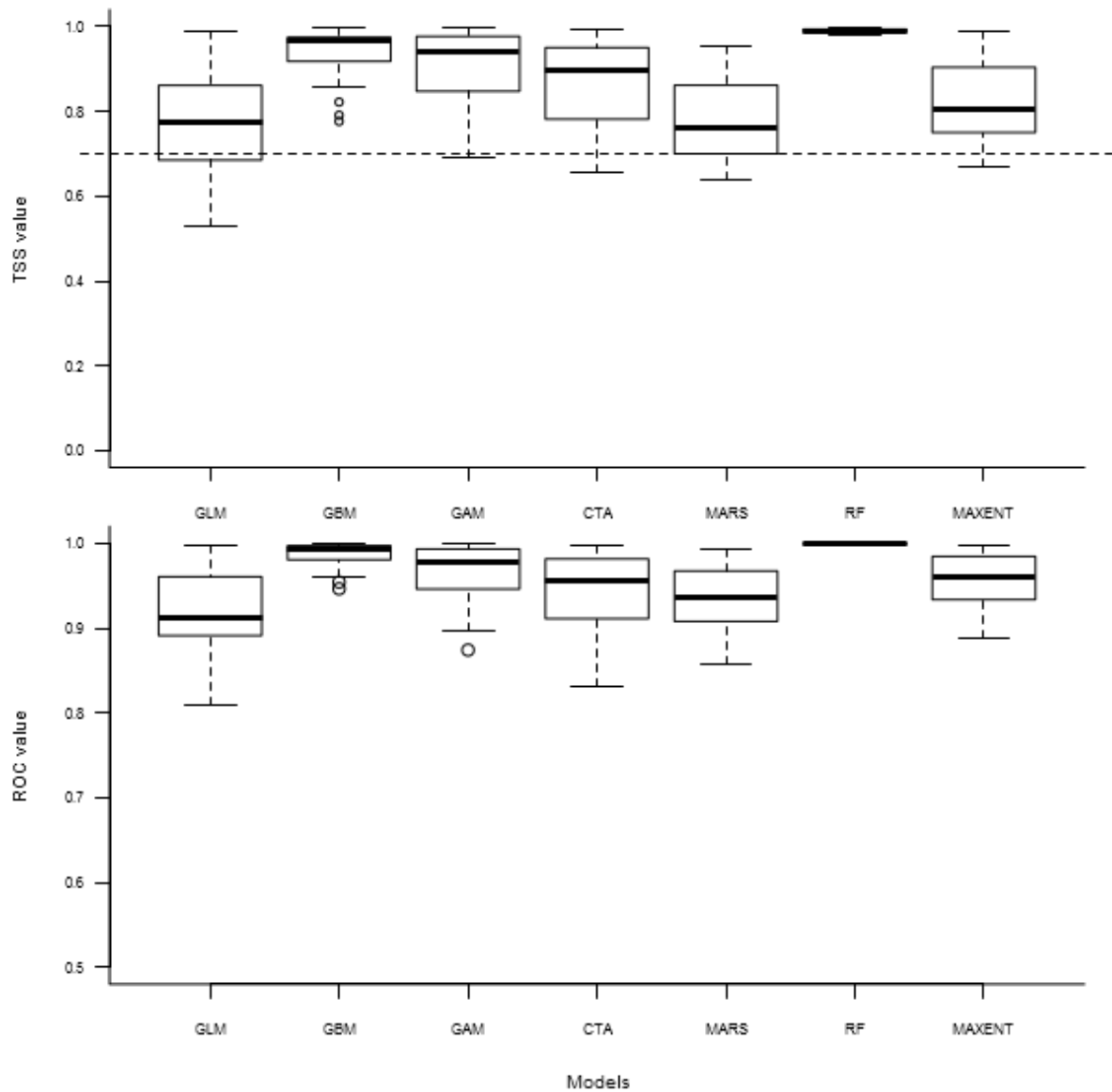
<i>Delesseria sanguinea</i>	0.076	0.333	0.011	0.621
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(e) South Brittany	Occurrence frequency in 1992-1998	Occurrence frequency in 2010-2012	Contribution to overall dissimilarity	Cumulative contribution to overall dissimilarity
<i>Gracilaria gracilis</i>	1.000	0.000	0.027	0.027
<i>Heterosiphonia japonica</i>	0.921	0.000	0.025	0.052
<i>Seirospora seirosperma</i>	0.921	0.000	0.023	0.075
<i>Ceramium</i> spp.	1.000	0.231	0.022	0.097
<i>Kallymenia requienii</i>	0.868	0.000	0.021	0.118
<i>Cryptopleura ramosa</i>	0.000	0.769	0.021	0.139
<i>Gastroclonium ovatum</i>	0.868	0.154	0.020	0.159
<i>Heterosiphonia plumosa</i>	0.026	0.769	0.020	0.178
<i>Cystoclonium purpureum</i>	0.842	0.077	0.019	0.198
<i>Lomentaria clavellosa</i>	0.789	0.000	0.019	0.217
<i>Dilsea carnosa</i>	0.000	0.692	0.019	0.235
<i>Phycodrys rubens</i>	0.000	0.692	0.018	0.254
<i>Phyllophora pseudoceranooides</i>	0.816	0.154	0.018	0.272
<i>Liagora viscida</i>	0.763	0.000	0.018	0.289
<i>Jania rubens</i>	0.684	0.000	0.017	0.306
<i>Microcladia glandulosa</i>	0.737	0.000	0.017	0.323
<i>Spermothamnion repens</i>	0.737	0.000	0.017	0.340
<i>Aglaothamnion hookeri</i>	0.737	0.000	0.017	0.357
<i>Gracilaria compressa</i>	0.711	0.000	0.017	0.373
<i>Callithamnion tetragonum</i>	0.711	0.154	0.016	0.389
<i>Aglaothamnion tenuissimum</i>	0.711	0.000	0.016	0.405
<i>Pterosiphonia</i> spp.	0.711	0.000	0.016	0.421
<i>Stenogramma interrupta</i>	0.684	0.000	0.016	0.437
<i>Bonnemaisonia clavata</i>	0.684	0.000	0.016	0.453
<i>Drachiella spectabilis</i>	0.684	0.000	0.016	0.469
<i>Gelidium spinosum</i>	0.684	0.000	0.016	0.484
<i>Goniotrichum elegans</i>	0.684	0.000	0.016	0.500
<i>Gracilariopsis longissima</i>	0.684	0.000	0.016	0.515
<i>Spermothamnion mesocarpum</i>	0.684	0.000	0.016	0.531
<i>Gelidium corneum</i>	0.553	0.231	0.015	0.546

<i>Scinaia furcellata</i>	0.632	0.000	0.015	0.561
<i>Gelidium</i> spp.	0.684	0.154	0.015	0.576
<i>Lomentaria articulata</i>	0.684	0.154	0.015	0.591
<i>Calliblepharis ciliata</i>	0.711	0.385	0.014	0.605
<i>Delesseria sanguinea</i>	0.500	0.538	0.013	0.619
<i>Kallymenia reniformis</i>	0.184	0.462	0.013	0.632
<i>Sphaerococcus coronopifolius</i>	0.395	0.154	0.013	0.645
<i>Phyllophora crispera</i>	0.026	0.538	0.013	0.658
<i>Porphyra</i> spp.	0.184	0.462	0.012	0.670
<i>Corallina</i> spp.	0.053	0.462	0.012	0.682
<i>Callophyllis laciniata</i>	0.000	0.462	0.011	0.692
<i>Radicilingua thysanorhizans</i>	0.500	0.000	0.010	0.703
<i>Ahnfeltia plicata</i>	0.500	0.000	0.010	0.713

Appendix S3 Detailed information about results of species distribution modeling

(a) TSS and ROC evaluations of the seven models used for the ensemble forecasting



(b) Results of the Student-test assessing the differences between the periods 1992–1998 and 2010–2012 regarding the latitudinal distributions (b1) and the distributions along the coastline (b2). Latitudinal values are expressed as decimal degrees.

(b1)	T-test	df	p-value
<i>Ahnfeltiopsis devoniensis</i>	-9.43	19.64	< 0.01
<i>Calliblepharis ciliata</i>	-18.91	305.61	< 0.01
<i>Calliblepharis jubata</i>	-9.37	84.53	< 0.01
<i>Ceramium</i> spp.	-14.97	531.39	< 0.01
<i>Drachiella spectabilis</i>	-26.11	154.12	< 0.01
<i>Gastroclonium ovatum</i>	-16.21	525.22	< 0.01
<i>Kallymenia reniformis</i>	-2.10	393.69	0.04
<i>Phyllophora pseudoceranoides</i>	-2.91	26.20	0.01
<i>Plocamium</i> spp.	1.51	403.31	0.13
<i>Sphaerococcus coronopifolius</i>	-11.06	609.93	< 0.01

(b2)	T-test	df	p-value
<i>Ahnfeltiopsis devoniensis</i>	-9.75	17.81	< 0.01
<i>Calliblepharis ciliata</i>	-26.33	372.68	< 0.01
<i>Calliblepharis jubata</i>	-8.55	75.80	< 0.01
<i>Ceramium</i> spp.	-18.23	470.92	< 0.01
<i>Drachiella spectabilis</i>	-43.20	507.54	< 0.01
<i>Gastroclonium ovatum</i>	-18.22	403.37	< 0.01
<i>Kallymenia reniformis</i>	-2.19	350.28	0.03
<i>Phyllophora pseudoceranoides</i>	-1.56	26.03	0.13
<i>Plocamium</i> spp.	-3.59	351.96	< 0.01
<i>Sphaerococcus coronopifolius</i>	-12.17	640.36	< 0.01

Article 2

Robuchon M, Le Gall L, Gey D, Valero M, Vergés A (in preparation for *European Journal of Phycology*) A survey of the algal community understory in the kelp forest of *Laminaria hyperborea* revealed the presence of a new species of *Kallymenia* (Kallymeniaceae, Rhodophyta): *Kallymenia crouanii* sp. nov.

A survey of the algal community understory in the kelp forest of *Laminaria hyperborea* revealed the presence of a new species of *Kallymenia* (Kallymeniaceae, Rhodophyta): *Kallymenia crouanii* sp. nov.

NB : This manuscript present a new taxon ; however the International Code of Botanical Nomenclature recognised PhD thesis as valid publications, we therefore removed the diagnosis from this manuscript to avoid the PhD thesis to be recognized as the valid publication of the taxon (priority rule).

MARINE ROBUCHON^{1,2,µ}, LINE LE GALL^{1*}, DELPHINE GEY³, MYRIAM VALERO^{2,µ}
AND ALBA VERGÉS⁴,

¹ UMR7205, Institut Systématique, Evolution, Biodiversité, CNRS-EPHE-MNHN-UPMC, Muséum National d'Histoire Naturelle, case postale N° 39, 57 rue Cuvier, 75231 Cedex 05 Paris, France

² Sorbonne Universités, UPMC Univ Paris 06, UMR 7144 Adaptation et Diversité en Milieu Marin, Equipe BEDIM, Station Biologique de Roscoff, CS 90074, 29688 Roscoff, France

^µ Current address: UMI 3604 Evolutionary Biology and Ecology of Algae, CNRS, UPMC, Station Biologique de Roscoff, CS 90074, 29688 Roscoff, France

³ CNRS - UMS 2700 Service de Systématique moléculaire, Muséum National d'Histoire Naturelle, 75231 cedex 05 Paris, France

⁴ Universitat de Girona, Department of Environmental Science,s Faculty of Sciences, 17071 Girona, Spain

* Corresponding author: legall@mnhn.fr

Fax 00 33 1 40 79 31 97

Running title: *Kallymenia crouanii*

Abstract

In this paper we described *Kallymenia crouanii* sp. nov. (Kallymeniaceae), a new marine red algae from the North-eastern coast of the Atlantic Ocean. This species, which was misidentified in the field as *Kallymenia reniformis*, displayed unique *rbcL* and LSU sequences divergent from other species of *Kallymenia* from at least 7.49% and 5.2% respectively. This species could be distinguished from the other species of the genus *Kallymenia* by a set of vegetative and reproductive characteristics, including a deeply lacerate frond, a shortly stipitate thallus, a dentate margin, largest cortical cells up to 110 μm in diameter, highly refractive stellate medullary cells with arms up to 1000 μm in length, and a monocarpogonial branch system. Molecular phylogenies inferred from *rbcL* and LSU data revealed this new species, albeit with weak support, as the sister taxa of a lineage encompassing the generitype *K. reniformis*, as well as most of the species of *Kallymenia* included in the phylogenetic analysis. A comparison of the main morphological characters to delineate monocarpogonial species of *Kallymenia* is presented. Moreover, after the revision of the literature and several Herbarium (BM, CA, GALW, L, PC) we found in the Weber-van Bosse Herbarium a specimen collected at Roscoff in August 1894 with the anatomical characters of the species described herein which confirms that this new species has been overlooked and is not a recent introduction from allochthonous flora.

Key words: Gigartinales, *Kallymenia reniformis*, *Kallymenia crouanii*, Kallymeniaceae, reproduction, North-eastern Atlantic, Rhodophyta, taxonomy.

Introduction

The macro algal flora of the North-eastern Atlantic has been extensively studied since the end of the 18th century and has long been considered as one of the best characterized flora in the world (see introduction in Dixon & Irvine, 1977). Nonetheless, the advent of molecular systematics have highlighted that the vegetative and reproductive characters traditionally used for species delimitation were not always consistent with molecular phylogenetic approaches in raison of convergence leading to cryptic diversity or phenotypic plasticity causing versatile variations of morphological characters (e.g. Saunders, 2005; Le Gall & Saunders, 2010; De Clerck *et al.*, 2013). Reliable identification of seaweeds is therefore a challenging task on the sole basis of morphological characters. Moreover, in the North-eastern Atlantic where tide amplitude is important, subtidal communities have received little attention compare to intertidal communities. In this context we have undertaken a survey along North-eastern Atlantic coast of France of the understory algal flora in the kelp forest of *Laminaria hyperborea* (Gunnerus) Foslie, which is an emblematic subtidal species of the European coast from Norway to Portugal. In the course of this survey, identification of seaweeds was initially carried out on the base of gross morphology in the field and in the base of DNA sequences of the mitochondrial gene CO1 and/or the nuclear gene LSU. *Kallymenia reniformis* (Turner) J. Agardh is a conspicuous species abundant in the kelp forest of *Laminaria hyperborea* (Bunker *et al.*, 2010), nevertheless it is known to perform several forms depending on its age and probably local conditions. Notwithstanding, *K. reniformis* is the only species of the genus *Kallymenia* currently recorded in the English Channel and in the British Islands (Guiry & Guiry, 2014; <http://www.algaebase.org>; searched on 25 January 2014).

During dives in Iroise Sea, Roscoff and North-western Cotentin we found some plants resembling *Kallymenia reniformis* but which appeared cartilaginous when touching with striations near the base whereas most *K. reniformis* felt smooth and supple. Despite we had suspicions that these specimens were likely not the genuine *K. reniformis* on the base of its anatomy, it took a long time to get the confirmation on a molecular ground because all attempts to obtain CO1 sequences failed and it was only when we tried alternative markers (LSU and then *rbcL*) that we had the certainty to have uncovered an additional species of *Kallymenia* for the North-eastern Atlantic flora and had to assess whether this species had formerly been described.

The genus *Kallymenia* J. Agardh 1842 (Kallymeniaceae, Rhodophyta) currently includes about 40 species (Guiry & Guiry, 2014; <http://www.algaebase.org>; searched on 21st January 2014) widely distributed in both hemispheres. These species are identified on the basis of a variety of morphological features including: (a) the shape of the frond, (b) the presence or absence of a stipe, (c) the shape, size and disposition of cortical cells, (d) the shape and size of the medullary stellate cells and the length of the arms of these cells, (e) the presence of mono- or polycarpogonial branch systems, (f) the presence of uni or multinucleate supporting and subsidiary cells (g) the gonimoblast initial formation, and (h) the diameter of the gonimoblast (J. Agardh, 1842; Norris, 1957, 1964; Abbott, 1968; Codomier 1971; Womersley & Norris, 1971; Womersley, 1994; Vergés & Rodríguez-Prieto, 2006a, 2006b).

In the present manuscript, we describe the morphology and anatomy of both vegetative and reproductive features of the entity uncovered in the algal flora understory the canopy-forming kelp *Laminaria hyperborea*. We inferred its phylogenetic affinities using LSU and *rbcL* sequence data. We assessed whether this taxa had been previously described and we seek its presence in Herbarium of the XIX century to rule out the hypothesis that the presence of this taxa in North-eastern Atlantic results from a recent introduction. In light of the previous analyses, we concluded that we uncovered a new species and proposed to name it *Kallymenia crouanii* Vergés & Le Gall.

Material and methods

Sample collection and herbarium material examined

Nine specimens of *Kallymenia* were collected by SCUBA between 2 and 15 m depth at different sites along the French coast of Brittany and Normandy between 2008 and 2011 (Table 1). In the course of a survey about the flora understory the canopy formed by the kelp *Laminaria hyperborea*, samples were cleaned, frozen at -20°C and then lyophilized for molecular analyses. Additional samples were collected in the framework of a revision of the French flora and were dried as herbarium specimens housed at the Herbarium of the Natural History Museum of Paris (PC). For molecular analyses, samples were cleaned, dried and preserved in silica gel.

In addition to our collections, all the specimens referred to *Kallymenia* spp. housed at BM, CA, GALW and L were examined with the aim of detecting misidentifications of this species in the NE Atlantic. Moreover, some specimens from the personal Herbarium of A.

Vergés (SVP) collected in Oviedo, Spain, were also examined. Herbarium abbreviations follow Thiers (2014).

Anatomy and morphology

Anatomical and reproductive features were observed in squash preparations, using HCl 10 % mixed with acidified 1% aniline-blue, and by sections made with a razor blade and subsequently stained in an acidified 1% aniline-blue/distilled water solution. Habit views were reproduced with a HP Officejet 6500A scanner (Hewlett-Packard, Palo Alto, CA, USA); photomicrographs were taken with a MRc5 (Zeiss, Berlin, Germany) attached to an Axio Imager A2 microscope (Zeiss, Berlin, Germany).

Molecular sequencing and analysis

Material for which we obtained sequences in the present study is listed in Table 1, along with details of collection data, vouchers and their GenBank accession numbers for *rbcl* and LSU sequences. Total DNA was extracted using a DNeasy Plant Mini Kit (QIAGEN, Hilden, Germany), according to the manufacturer's instructions except for the extraction buffer which was prepared in the lab as follow: 1M tris-base, 1M tris-HCl, 0.05M Na₂EDTA, 0.2 M NaCl, 2.5M Potassium Acetate, 10% Tween 20, and 0.2mg/ml Pro K. All attempts to amplify COI from those samples failed with the following combination of primers: GazF1 (Saunders, 2005) and GWSFn (Le Gall & Saunders, 2010) variously combined with the reverse primers GazR1 (Saunders, 2005), GWSRx (Saunders, 2009), Cox1R1 (5'-GTATACATATGATGHGCTCAA-3'). The 5' end of the LSU was successfully amplified in all nine samples with the primer set T01N (Harper & Saunders, 2001)/T20 (Le Gall & Saunders, 2010) and sequenced with the primers T16N (Harper & Saunders, 2001) and T24 (Harper & Saunders, 2001).

Table 1. Collection data of *Kallymenia crouanii* specimens examined. * indicates the holotype designed here.

<i>Taxa</i>	<i>Voucher</i>	<i>Herbarium um</i>		<i>Locality</i>	<i>Region</i>	<i>Date</i>	<i>Leg.</i>
<i>Kallymenia crouanii</i> *	LLG3004	PC0171066	-1m	Lampaul île Ségal	Brittany	12 Aug. 2009	Le Gall, L., Utge, J., Turpin, Y.
<i>Kallymenia crouanii</i>	LLG1209	PC0152307	-6m	Dielette	Normandy	26 May 2008	Le Gall, L.
<i>Kallymenia crouanii</i>	LLG3022	PC0171085	-2m	Les Belvenious	Brittany	10 Aug. 2009	Gladu, Y., Besnier, A., Le Gall, L.
<i>Kallymenia crouanii</i>	LLG3023	PC0171086	-2m	Les Belvenious	Brittany	10 Aug. 2009	Gladu, Y., Besnier, A., Le Gall, L.
<i>Kallymenia crouanii</i>	MAR1318	no voucher	-4m	St Mathieu	Brittany	10 March 2011	Le Gall, L., Turpin, Y.
<i>Kallymenia crouanii</i>	MAR0049	PC0xxxxx	-4m	Santec	Brittany	25 March 2011	Fontana, Y.
<i>Kallymenia crouanii</i>	MAR1133	no voucher	-3m	Rospects	Brittany	14 March 2011	Le Gall, L., Turpin, Y.
<i>Kallymenia crouanii</i>	MAR2234	no voucher	-4m	Santec	Brittany	28 Feb.2012	Robuchon, M.,
<i>Kallymenia crouanii</i>	MAR3375	no voucher	-11m	Linious	Brittany	16 March 2011	Le Gall, L., Turpin, Y.
Herbarium BM							
<i>Kallymenia crouanii</i> as <i>K. reniformis</i> (isotype of <i>Callophyllis</i> <i>flabellata</i>		BM 000805059		Scilly I	British I.	20 Sept. 1899	E. George
Herbarium GAL							
<i>Kallymenia crouanii</i> (as <i>Kallymenia</i> sp)		GALW 1488		Scilly I.	British I.	07 July1983	C. Maggs
<i>Kallymenia crouanii</i>		GALW 1489		Scilly I.	British I.	04 July 1983	C. Maggs

(as *Kallymenia* sp)

Kallymenia crouanii GALW 1493 Scilly I. British I. 04 July 1983 C. Maggs

(as *Kallymenia* sp)

Herbarium L

Kallymenia crouanii L 0653294 N/A Roscoff France 21 Aug. 1894 A. Weber-Van Bosse

(as *K. reniformis*)

Kallymenia crouanii L 0653265 -3m Ría de Arosa Spain 01 July 1963 M. Donze

(as *K. reniformis*)

Kallymenia crouanii L 0653266 N/A Ría de Arosa Spain 05 July 1965 U. W. Oosterhoff

(as *K. reniformis*)

SVP Personal

herbarium A.

Vergés

Kallymenia crouanii SVP OV0542 -15m Artedo Spain 11 July 1997 N/A

Kallymenia crouanii SVP OV0544 -15m Artedo Spain 11 July 1997 N/A

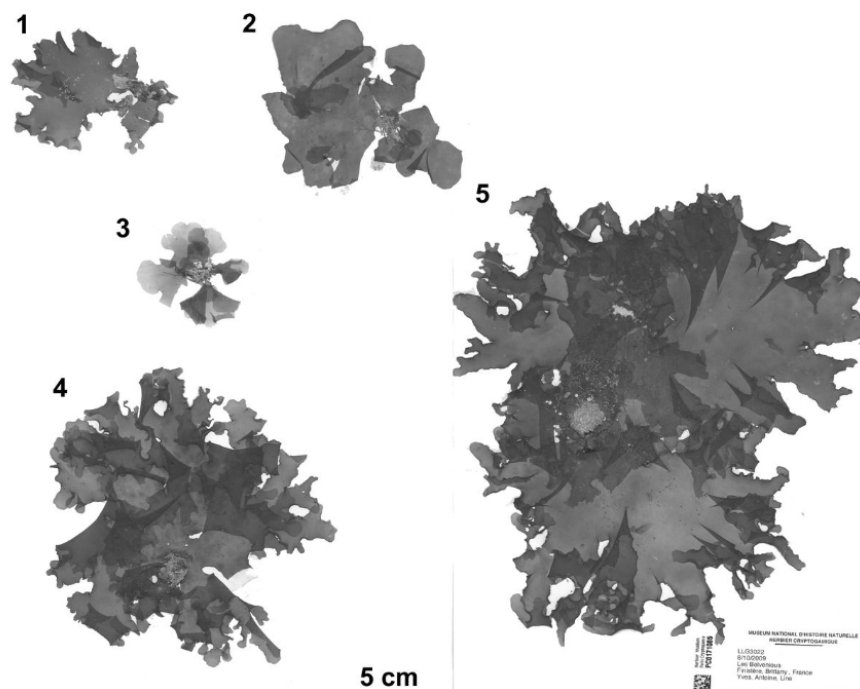
Kallymenia crouanii SVP SANT820 -4m Isla de Moro, Santander Spain 16 Aug. 2009 N. Sánchez & C. Peteiro

Both *rbcL* coding region including the *rbcL-rbcS* spacer and LSU (28S) were amplified for two selected specimens included in this study. *RbcL* was amplified in three fragments covering a total of 1647 bp using the following combinations of primers: F-*rbcL*start / R-753, F-577 / R1381, and F-993 / R-*rbcS* start (Freshwater & Rueness, 1994). LSU (28S) was amplified as three overlapping fragments using primers T01N/T20, T04/T08 and T05/T15, and using the PCR primers and the internal primers T10, T16N, T19N, T22, T24, T25, T30, T33, following protocols of Harper & Saunders (2001) and Le Gall & Saunders (2010). Purification and sequencing reactions were performed by *Genoscope* (www.genoscope.fr, Evry, France). Forward and reverse electropherograms were edited and assembled with the software Codoncode (Dedham, MA). GenBank was searched on January 6th 2014 for “Kallymeniaceae” and all sequences were downloaded before sorting *rbcL* and LSU sequences. For LSU, only sequences longer than 2200bp were selected for phylogenetic analysis using the perl script *fasta_get_seq_length.pl* and *Fastabox*. Multiple sequence alignments were constructed for both markers using *Seaview* version 4 (Gouy *et al.*, 2010). Genetic distances were computed using the neighbor-joining algorithm in *Seaview*. Identical haplotypes were removed prior analysis leading to an LSU alignment including 80 taxa and an *rbcL* one including 67 taxa. Phylogenetic analyses were conducted on *rbcL* and LSU alignments by Bayesian inference using *MrBayes* version 3.2.1 (Ronquist *et al.*, 2012), ML and distance bootstrap values were also calculated using *RAxML* version 8.0.0 (Stamatakis *et al.*, 2008) and *Seaview*, respectively.

Analyses were run with four heated Monte-Carlo Markov Chains for 2,000,000 generations. Output trees and data were sampled every 100 generations. Appropriate burn-in for each run was determined by plotting the overall likelihood against generations prior to estimating the posterior probability distribution. In all analysis, likelihood values were stable after the 200,000 first generations. Final results were based on the pooled samples from the stationary phase of the two independent runs.

Results and discussion

GROSS MORPHOLOGY: Plants erect, up to 22 cm long, 21 cm broad and 110-320 μm thick, shortly stipitate, fixed to the substratum by a small discoid holdfast. Near the base some rings are present, very striking underwater. Young fronds entire or slightly lobed (Figs 1-3), pink to red-brown in colour and membranous; old plants deeply lobed, lacerate (Figs 4-5), cartilaginous and reddish, becoming brownish on fertile female specimens where the gonimoblasts are grouped.

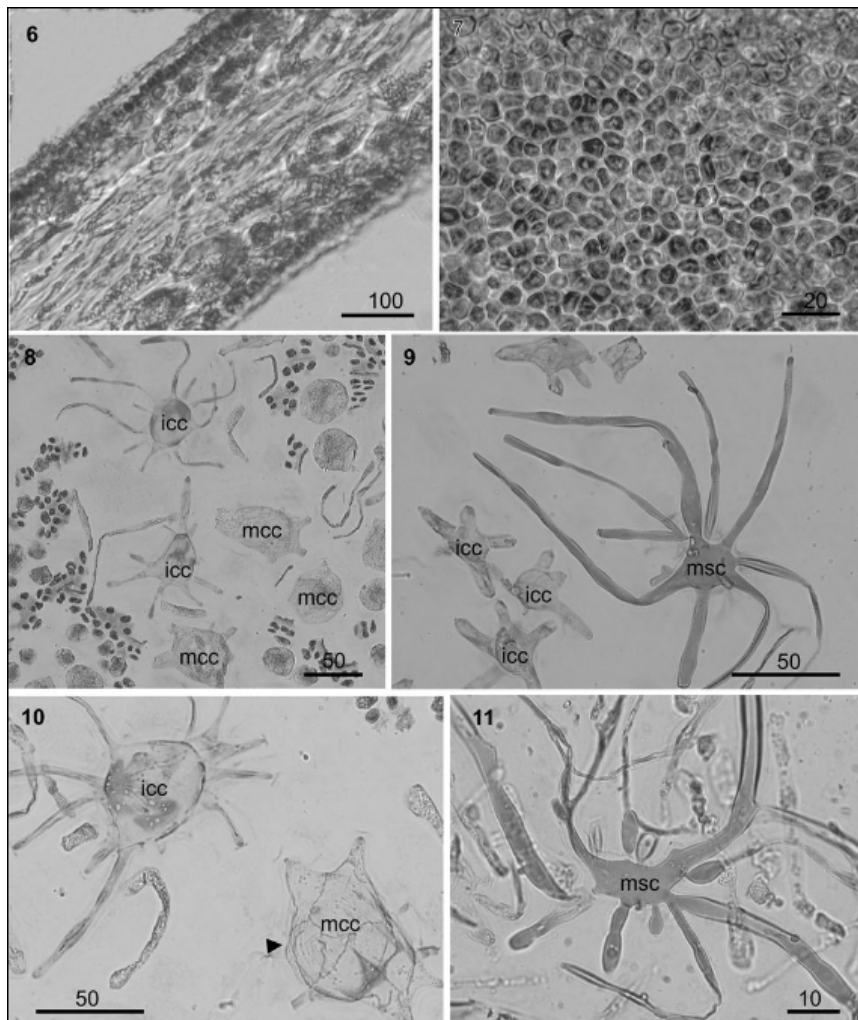


Figs 1-5. *Kallymenia crouanii* sp. nov.: habit morphology. Scale bar = 5 cm. Fig. 1. Holotype (PC 0171066). Figs 2-3. Sterile specimens (PC 0152307, MAR 0049). Figs 4-5. Tetrasporophytes (PC 0171086, PC 0171085).

Underwater, the gross morphology of the taxon studied here was distinct from any other Rhodophyta from the northern Atlantic and despite its resemblance with *Kallymenia reniformis*, its frond fan shaped with conspicuous ridges at its base as well as the cartilaginous texture of the frond lead us to suspect its conspecificity with the latter species.

VEGETATIVE MORPHOLOGY: Thallus structure multi-axial, with a compact cortex composed of several layers of cells (up to 5) diminishing in size outwards and a lax medulla of slender filaments intermixed with a network of stellate cells (Fig. 6). Cortical cells are joined forming

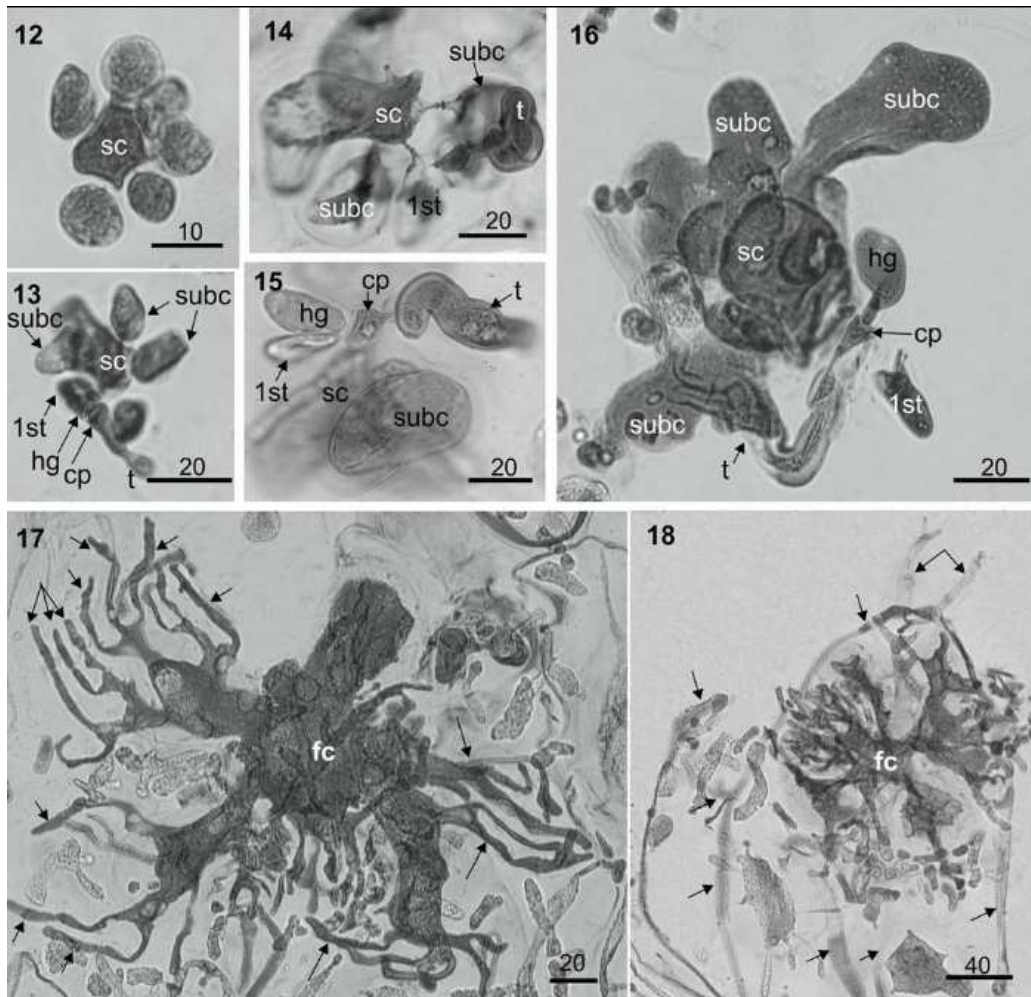
networks parallel to the frond surface; inner cortical cells are also connected to medullary cells and medullary filaments. Internal cortical cells are stellate, hyaline, with a body cell up to 110 μm in diameter; medium cortical layers are composed of cells which are slightly stellate, irregular in shape or ovoid, hyaline or brownish when containing floridean starch, and with a body cell up to 100 μm in diameter those located near the center of the blade and 25-50 μm far from the center ; outer cortical cells polyhedral or irregular in shape, rose to red in colour, 6-10 μm in diameter, and compactly arranged (Fig. 7). Medulla formed by very conspicuous stellate cells, highly refractive (Figs 8-11), with a body cell of 30 (<60) μm in diameter, and arms extending to 800 (<1000) μm long connected to the medullary filaments or to the inner stellate cortical cells. Numerous medullary filaments, composed of one to several cells, simple or branched, hyaline or brownish, and 2-10 μm in diameter.



Figs 6-11. *Kallymenia crouanii* sp. nov.: vegetative anatomy. Scale bar = 100 μm (Fig. 6), 20 μm (Fig. 7), 50 μm (Figs 8-10), 10 μm (Fig. 11). **Fig. 6.** Cross-section of a mature thallus . **Fig. 7.** Cortex in surface view (PC 0171085). **Fig. 8-11.** Different types of stellate cells present in the inner cortex and in the medulla. Medium cortical cells (mcc) without or with short arms and big volume, inner cortical cell (icc) with arms developing in all directions and giant medullary stellate cells (msc) in a squash preparation (PC 0171066).

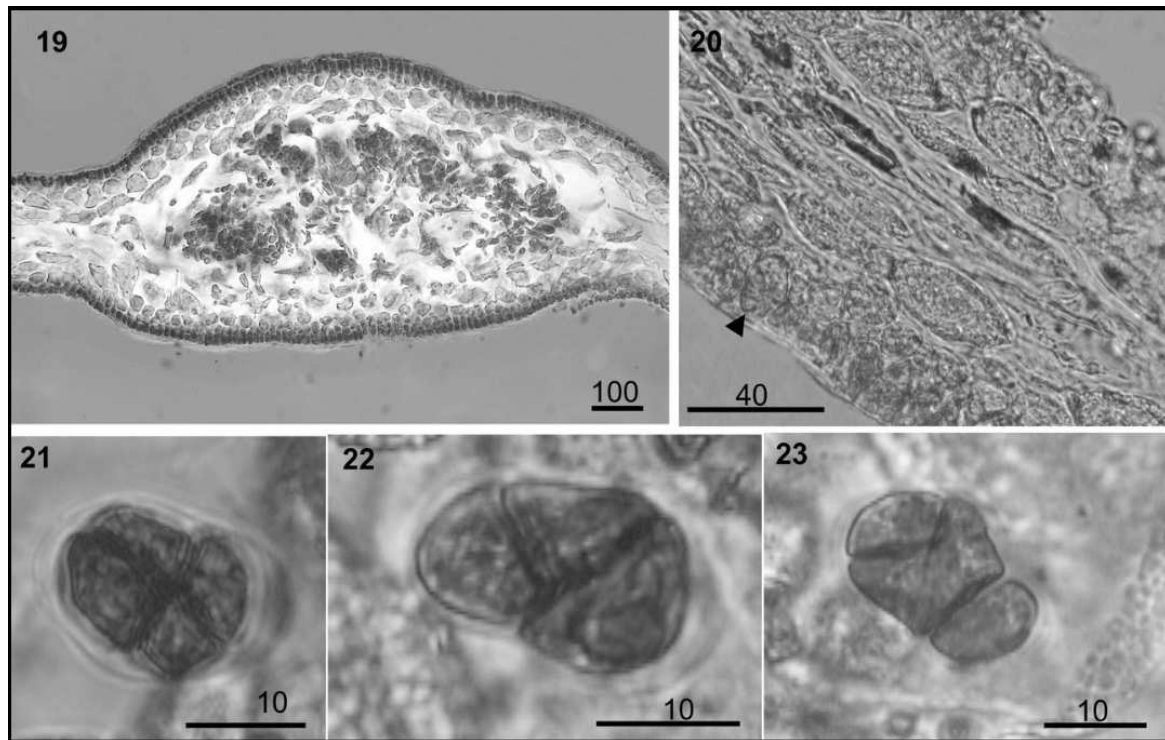
In the taxon here studied, we observed a set of vegetative characters: a foliose frond, a cortex of some layers of cells, with the outer cells smallest, a filamentous medulla with stellate cells remaining; which confirmed that this species likely belong to the genus *Kallymenia* as foreseen on the basis of its gross morphology. However, the size and shape of the stellate medullary cells constitute a conspicuous anatomical character to distinguish this taxon from *Kallymenia reniformis* (arm's length of stellate medullary cells < 400 μm in *K. reniformis* and < 1000 μm in the species here study). Moreover, these two taxa can be differentiated by the length of inner cortical cells (< 60 μm in *K. reniformis* and < 110 μm in the species here study).

REPRODUCTIVE MORPHOLOGY: Plants non-procarpic. Carpogonial branch systems monocarpogonial, arising on inner cortical cells and developing through the cortex. They consist of a supporting cell, rounded or ovoid when young (Fig. 12) but lobed when mature (Figs 13-16), that supports up to 6 subsidiary cells which are rounded first (Figs 6-7) but become enlarged and lobed (Figs 8-9), and a three celled carpogonial branch (Figs 13-16). First cell of the carpogonial branch, the hypogynous cell are ovoid, this one sometimes develops a tail which is connected with the carpogonium (Fig. 16), which is prolonged by a basally twisted trichogyne (Figs 14-16). After fertilization, the supporting cell fuses with subsidiary cells forming a stellate fusion cell (Figs 17-18), up to 180 μm in diameter, that develops digitate protuberances which become connecting filaments. Connecting filaments are hyaline, and can be divided near the fusion cell (Fig 18), and septate at the beginning, measure up to 2 mm in length and 2 μm in width, with a swollen part at the end. Auxiliary cell branch systems are similar in shape to young carpogonial branches, measure up to 40 μm in diameter, and have a rounded supporting cell acting as the auxiliary cell, which support up to six rounded subsidiary cells (Fig. 12). The connecting filament attaches to the supporting cell of the auxiliary cell branch system and cuts off all together with vegetative cells the gonimoblast filaments. Cystocarps protruding, grouped in the medium and upper part of the frond, growing in the direction of the medulla, 760-2000 μm in diameter (Fig. 19), and non-ostiolate, since the carpospores are liberated through a pore. Carpospores 10-16 μm in diameter. Spermatangia unknown. Tetrasporangia scattered in the outer cortex, cruciately or irregularly divided, 18-24 μm in diameter (Figs 20-23).



Figs 12- 18. *Kallymenia crouanii* sp. nov.: Reproductive structures. Scale bar = 10 µm (Fig. 12), 20 µm (Figs 13-17), 40 µm (Fig. 18). **Fig. 12.** Young carpo-gonial cell system or auxiliary cell system (sc: supporting cell, sub: subsidiary cell) (PC 0171066). **Figs 13-16.** Monocarpogonial cell systems (1st: first carpo-gonial cell branch, cp: carpo-gonium, hg: hypogynous cell, sc: supporting cell, subc: subsidiary cell, t: tricogyne) (15-16, 19: PC 0171066; 17-18: SVP OV0542). **Figs. 17-18.** Fusion cells developing connecting filament (arrows) (20: SVP OV0544, 21: SVP OV0542).

The reproductive morphology of the genus *Kallymenia* consists of a carpo-gonial cell system composed of a supporting cell that gives rise to several subsidiary cells, with one or more 3-celled carpo-gonial branches arising on the supporting cell, a fusion cell formed after fertilization, involving the supporting cell and the subsidiary cells, connecting filaments arising from the fusion cell, a gonimoblast consisting of numerous carposporangia intermixed with filaments within the medulla, and tetrasporangia lying within the outer cortex, scattered, cruciate, zonate or irregularly divided (Norris, 1957; Hommersand & Ott 1970; Womersley, 1994; Vergés, 2001; Vergés & Rodríguez-Prieto, 2006a, 2006b). All these features have been clearly observed in the taxon here studied.



Figs 19-23. *Kallymenia crouanii* sp. nov.: Reproductive structures. Scale bar = 100 µm (Fig. 22), 40 µm (Fig. 23), 10 µm (Figs 24-26). **Fig. 19.** Cross section of a carposporophyte (SVP OV0542). **Fig. 20.** Cross section with tetrasporangia (arrow head) immersed in the outer cortex (PC 0171085). **Figs 21-23.** Different patterns of tetrasporangium division (PC 0171085).

The presence of either a monocarpogonial or polycarpogonial cell system is one of the main taxonomic features for differentiating the species of the genus and in this case, it allows us to differentiate the species here studied which is monocarpogonial from the type species *K. reniformis* that is polycarpogonial (Norris, 1957; Hommersand & Ott, 1970; Vergés, 2001).

PHYLOGENETIC AFFINITIES: Despite repeated attempt, we failed to amplify the barcode marker most universally used, i.e the mitochondrial gene coding the cytochrome oxidase 1, for the species here studied. Therefore, phylogenetic affinities of this species was inferred from both LSU and *rbcL* data, two markers for which a comprehensive dataset is available in GenBank. Both phylogenies (Figs. 24 - 25) resolved, albeit with weak support, the species here studied as the sister taxa of the lineage containing most of the species of the genus *Kallymenia* and most importantly the generitype *Kallymenia reniformis*. In light of these results, we claim that the taxon here studied is not closely related to *Kallymenia reniformis*. Furthermore, the level of divergence of this taxon from the other species of *Kallymenia* suggests that this taxon should perhaps be recognized at the generic level. However, some species currently assigned

to the genus *Kallymenia* (i.e. *K. tasmanica* for the LSU phylogeny, *K. cribrosa* for the *rbcL* phylogeny and *K. lacerata*, and *K. requienii* for both phylogenies) are not resolved in the lineage containing the generitype. The delineation of the generic limit of the genus *Kallymenia* is therefore needed but is beyond the scope of the present study and we therefore decided to tentatively assign the species here studied to the genus *Kallymenia*. Interestingly, this is the second new species of *Kallymenia* together with *K. ercegovicii* that has been recently described in European waters (Vergés *et al.* submitted).



Fig. 24. Phylogenetic tree inferred from Bayesian analysis of the LSU data set. Nodes strongly supported (Bayesian posterior probability = 1 and ML & distance bootstrap > 94) were indicated in bold. Otherwise, only Bayesian posterior probabilities > 0.75 were indicated.

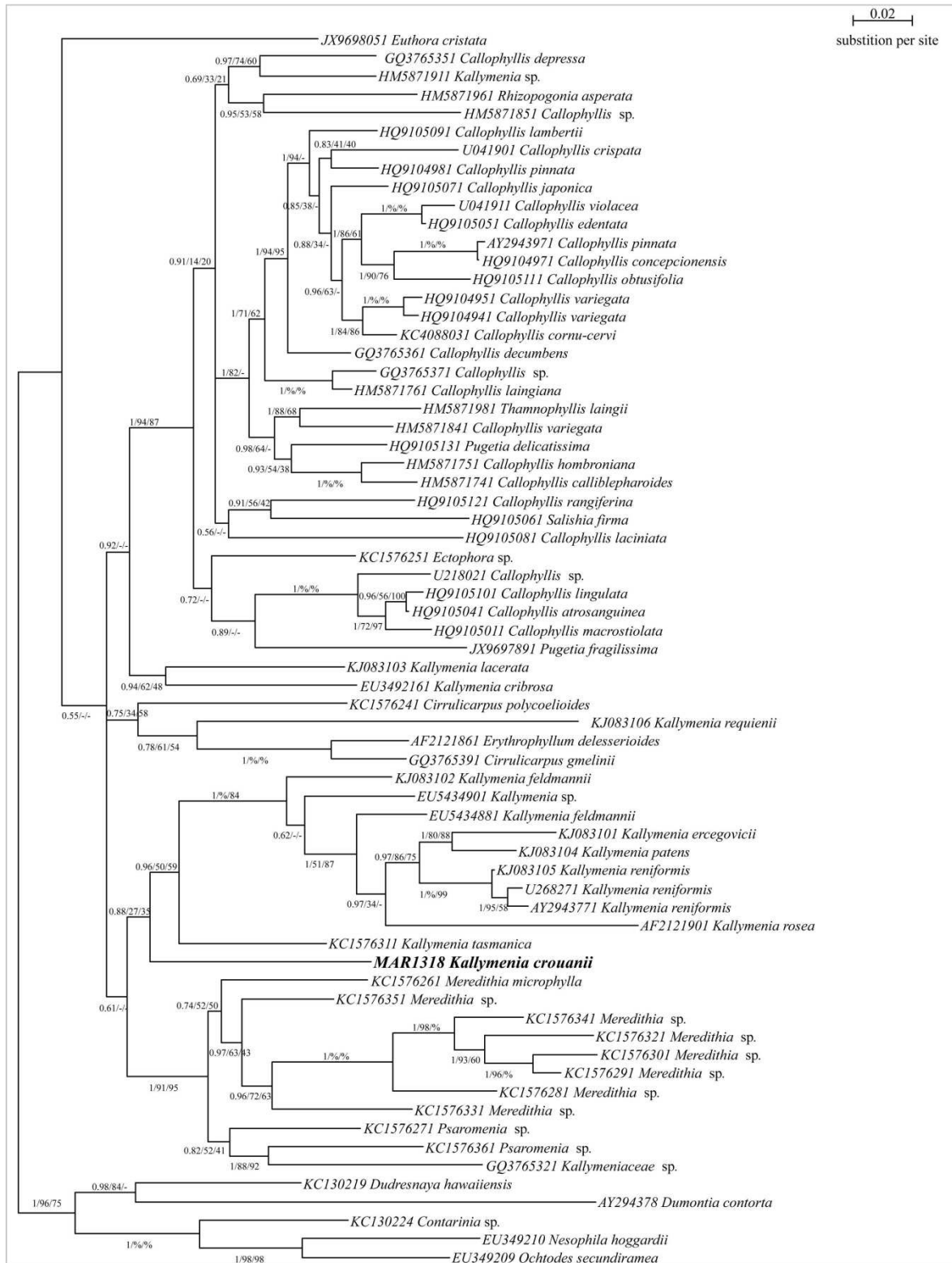
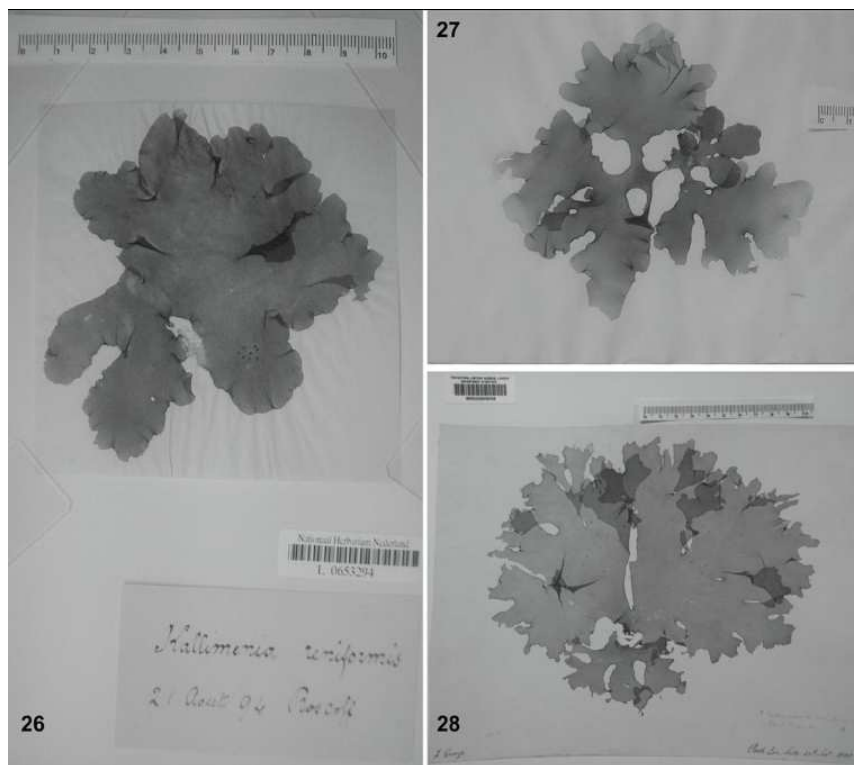


Fig. 25. Phylogenetic tree inferred from Bayesian analysis of the *rbcL* data set. Support at nodes indicates Bayesian posterior probabilities, ML and distance bootstrap, respectively. % indicates bootstrap of 100.

TAXONOMIC DISCUSSION: *Kallymenia reniformis* is the only species of *Kallymenia* inhabiting the British Islands and the English Channel (Feldmann, 1954; Hardy & Guiry, 2003). To assess whether the species here studied was previously described, under a name that would have become synonymous, or misidentified with any other species of the genus *Kallymenia*, we reviewed an important quantity of *Kallymenia* vouchers from the European Herbaria (BM, , GALW, L and PC) which are repositories of a broad and ancient sampling of macroalgae from the North-eastern Atlantic. Given that we found several specimens of the taxon here studied in Finistère (Brittany), we thoroughly examined the *Kallymenia* specimens in the brothers Crouan's Herbarium (CA, but currently in Paris (PC) for its digitalization). We uncovered, within two folders labelled as *Kallymenia reniformis* (Turn.) J. Ag., several specimens with annotation "nob.": *Dumontia pseudo-reniformis*, *Halymenia pseudo-reniformis*, *Halymenia ulvoidea*. All the specimens were carefully examined and their anatomy matched *Kallymenia reniformis* one rather than the one of the taxon here described. However, in the other revised Herbaria (BM, GALW, L), we could identify conspecific specimens to the taxon here studied. These specimens were misidentified with *Kallymenia reniformis* (BM 00805059, L0653265, L0653266 , L0653294; Figs 26, 28), or were left as unidentified species of *Kallymenia* (GALW 1488, GALW 1489, GALW 1493).



Figs 26-28. *Kallymenia crouanii* sp. nov.: specimens found in L and BM herbaria misidentified as *K. reniformis*. **Fig 26.** Fertile female gametophyte collected in 1894 in Roscoff, France (L0653294). **Fig 27.** Sterile individual collected in Galicia, Spain (L653265). **Fig 28.** Tetrasporophyte collected in 1899 in Porth Loo, Scilly I. (BM00805059).

The specimen (L0653294) located in Anna Antoinette Weber-van Bosse Herbarium, housed in Leiden, doubtlessly corresponded to the species here studied. The specimen is a fertile female gametophyte collected in 1894 in Roscoff, France, which was likely collected by Anna Antoinette Weber-van Bosse, herself, as she visited France that year (Woelkerling & Lamy, 1995). The presence of the new species in the Brittany flora at the end of the XIX century proves that this entity has been overlooked (probably confused with *Kallymenia reniformis*) for more than a century. Furthermore, this suggests that this species is autochthonous of North-eastern Atlantic as most of the introductions from other part of the worlds are recent (Maggs & Stegenga, 1999; Pérez-Cirera *et al.*, 1997; Nieto Vázquez, 2001).

A common Mediterranean member of the genus *Kallymenia*, *Kallymenia requienii*, is the most similar species with the taxon studied here. Our phylogenetic analysis (Figs 24-25) clearly separate these two species and reveal that they are genetically distant; despite their morphological similarities, there is no doubt that they belong to two different taxa. After examining numerous samples of both species (Vergés, 2001), some significant differences were observed among them (Table 2). Firstly, *K. requienii* is sessile, and has a small (5 x 8 cm) and lobed frond that clearly differentiates from the stipitate, much bigger (22 x 21 cm) and deeply lobed and lacerate blade of the taxa here studied; the cross-section and inner cortical cells are smaller in *K. requienii* (< 240 µm, < 55 µm, respectively) (< 320 µm, < 110 µm, respectively); than in the taxon here studied), although stellate medullary cells have the same shape, size, colour and appearance. Furthermore, both taxa are monocarpogonial; however, the female reproductive structures and the carposporophyte of *K. requienii* are smaller than the ones of the Atlantic taxon, as the diameter of a mature carpogonial cell system (85 µm in *K. requienii* and <140 µm in the taxon here studied) and the diameter of the carposporophyte (< 480 µm in *K. requienii* and < 2000 µm in the taxon here studied) (Codomier, 1971; Vergés, 2001; Vergés & Rodríguez-Prieto, 2006a). It is noteworthy that the presence of *K. requienii* in the northeastern Atlantic has been reported as a member of the Galician flora (Bárbara *et al.*, 2005), but the review of the Galicia specimens located in the Herbarium of Leiden (L0653265, L0653266) indicate that the specimens reported in Galicia were probably misidentified with the species presented here. Furthermore, the “Association pour la découverte du monde sous-marin” (Castric-Fey *et al.*, 2001) also recorded *K. requienii* in Brittany which, in light of our results, likely prove to be the species presented here.

Finally, to ascertain that the new entity has not been described outside of European waters, we reviewed the characters of the species of *Kallymenia* with a monocarpogonial cell

system (Table 2, include species list and authority) and unknown female reproductive structures (Table 3, include species list and authority). Some significant differences on morphology and anatomy of both vegetative and reproductive structures distinguish the species here studied. Although frond morphology in the genus *Kallymenia* is subject to plasticity, it has often been used for species delineation and in particular, the presence or absence of a stipe, presence of particular lobes, perforations, spines or excrescences are considered distinctive characters at the species level. Therefore, the taxon studied here differs from *K. requienii* and *K. perforata* because the latter species are always sessile; from *K. berggrenii* J. Agardh because it proliferates from spatulate lobes; from *K. cribosa* Harvey, *K. perforata* J. Agardh, *K. sessilis* , and *K. thompsonii* , as they are perforated; and from *K. rubra* and *K. spinosa* because they have excrescences in the frond. The taxon presented here can be differentiated from the rest of the monocarpogonial species of *Kallymenia* by the following vegetative or reproductive characters: i) *K. crassiuscula* and *K. perforata*, have always a thicker cross-section; ii) *K. cribosa*, *K. perforata*, *K. rubra*, *K. sessilis*, *K. spinosa*, *K. tasmanica* and *K. thompsonii* possess a fewer number of cortical cell layers; iii) *K. crassiuscula*, *K. cribosa*, *K. requienii* and *K. rubra* have medullary stellate cells with smaller cell body or arms; iv) *K. sessilis* and *K. thompsonii* have no stellate cells in the medulla (as cells are linear or have not been observed, respectively); v) *K. tasmanica* have an auxiliary cell system very similar in morphology to mature carpogonial cell systems; and viii) *K. berggrenii*, *K. cribosa*, *K. requienii*, *K. sessilis*, *K. tasmanica* and *K. thompsonii* have much smaller carposporophyte (in diameter).

Table 2 Comparison of the main taxonomical characteristics of the monocarpogonial species of *Kallymenia*.* from the illustrations by the authors. n.d. = no available data.

	Lamina	Stipe	Thallus size	Cross section	N° of cortex layers	Inner cortical cells	Medullary stellate cells	Number of subsidiary cells in the auxiliary cell branch system	Gonimoblast	Carposporangia	Tetrasporangia	Distribution	References
<i>K. crassiuscula</i> Okamura	Round, ovate or oblong, mostly without lobes but often splitted. Margin entire	Present	10-25 x 10-25 cm	390-550 µm	5-6	Rounded	Ganglionic, arms 80-130 µm long	7	n.d.	n.d.	n.d.	Japan, Arabian Sea	Okamura 1934; Wynne 2000
<i>K. cribrosa</i> Harvey	Simple, perforated. Margin smooth	Occasionally present	30 x 30 cm	200-500 (-1000) µm	3-4	Ovoid to polygonal or spherical	Light staining, (40-) 90-160 µm; arms rarely longer than cell body	3-5	400-600 µm	(10-) 14-20 µm	20-28 x 17-19 µm	W and S Australia	Womersley and R.E. Norris 1971; Womersley 1994
<i>K. perforata</i> J. Agardh	Undulato-plaited, somewhat umbilicated, waved, perforated and lobed. Margin entire	Absent	30-60 x 30-60 cm	1140 µm	1-2	Rounded	n.d.	6-11	n.d.	n.d.	n.d.	Japan, Ceylon, Tropics	Abbott and McDermid 2002
<i>K. requienii</i> (J. Agardh) J. Agardh	Entire or irregularly lobed	Absent	1-5 x 2-8 cm	110-240 µm	4-5	Stellate, < 55 µm	Darkly staining, body cell < 50 µm in diameter, arms < 1000 µm long	4	320-480 µm	12-16 µm	20-26 x 15-18 µm	Mediterranean Sea	Codomier 1971; Vergés 2001
<i>K. rubra</i> Womersley & R.E. Norris	Irregularly lobed or dissected, with some small excrescences. Margin erose-undulated	Present	4-12 cm high	150-400 µm	3-4	Ovoid or trapezoidal*	Moderately staining, refractive, arms < 200 µm *	3-4	n.d.	n.d.	n.d.	S Australia	Womersley and R.E. Norris 1971; Womersley 1994
<i>K. sessilis</i> Okamura	Frond lobed and undulated with entire margin and a broadly heart-shaped base	Absent	>30 cm high	130-160 µm	3	Stellate	Absent	n.d.	150-200 µm	10 x 10 µm	18 x 20 µm	Japan, Hawaiian Islands	Okamura 1934;
<i>K. spinosa</i> Womersley & R.E. Norris	Gradually to broadly cuneate and covered with branched spines. Upper margin	Present	3-7 x 3-6 cm	200-350 µm	3-4	Ovoid or trapezoidal*	Staining	3	n.d.	n.d.	30-38 x 20-26 µm	S Australia	Womersley and R.E. Norris 1971; Womersley 1994

Article 2: M. Robuchon *et al.*, in preparation for *European Journal of Phycology*

irregularly lobed													
<i>K. tasmanica</i> Harvey	With marginal and overlapped lobes	Present	5-30 cm	250-500 µm	3-4	Irregular*	Darkly staining refractive cells	n.d.	500-1000 µm	12 x 18 µm	18-35 x 11-16 µm	S Australia	Womersley and R.E. Norris 1971; Womersley 1994
<i>K. thompsonii</i> Abbott & McDermid	In rosettes of 2-3 blades. Margin perforated and undulated	Absent	< 10 cm broad	140-250 µm	2	Trapezoidal, 15-39 x 30-80 µm	Non observed	n.d.	160-200 µm	13 x 20 µm	13 x 20 µm	Hawaiian Islands	Abbott and McDermid 2002
<i>K. crouanii</i> sp. nov.	Entire or slightly lobed when young, lacerate when adult. Margin dentate.	Present	22 x 21 cm	110-320 µm	5	Stellate, < 110 µm	Hightly refractive cells, body cell < 60 µm, arms < 1000 µm long	< 6	750-2000 µm	10-16 µm	18-24 µm	N-E Atlantic	Vergés 2001 as <i>K. requienii</i> subsp. <i>Atlantica</i> ; This study

Table 3. Comparison between *K. crouanii* and the *Kallymenia* with the carpogonial branch system unknown.* from the illustrations by the authors. n.d. = no data.

	Lamina	Stipe	Thallus size (cm)	Cross section (μm)	N° of cortex layers	Stellate cells (μm)	Gonimoblast diameter (μm)	Tetrasporangia (μm)	Distribution	References
<i>K. baldwinii</i> E.Y. Dawson	Palmately lacerate, with vein-like thickenings in lacerate segments	Present	13-24 x 28 cm	200-270 μm	n.d.	40-50 μm	500 μm	n.d.	Gulf of California	Dawson 1966
<i>K. berggrenii</i> J.Agardh	Entire, lobed, lacinate, or lacinate-lobate, often proliferating in spatulate to lanceolate lobes	Occasionally present	30 cm broad	n.d.	n.d.	n.d.	1000 μm	n.d.	New Zealand	J. Agardh 1876; Chapman and Parkinson 1974
<i>K. bleckii</i> E.Y. Dawson	Auriculate, irregularly lacerately lobed, with few scattered proliferations. Near the base with forked veins	Present	13-24 x 28 cm	n.d.	n.d.	15-25 (40) μm	600 μm	n.d.	Gulf of California	Dawson 1966
<i>K. brachycystidea</i> J.Agardh	Irregular margin with a few lobes	Present	23 x 15 cm	60-80 μm	3	25-30 μm	n.d.	n.d.	New South Wales, Australia	Womersley and R.E. Norris 1971
<i>K. callopylloides</i> Okamura & Segawa	Linear, soon divided into many main branches irregularly divided into subpalmato-dichotomous segments	Present	4-5 x 5-7 cm	n.d.	3-4	n.d.	n.d.	n.d.	Japan	Okamura 1935
<i>K. chilensis</i> Levring	With a cuneate base deeply divided into segments	Absent	17 cm	125-175 μm	1-2	n.d.	120-150 μm	n.d.	Chile	Levring 1960
<i>K. guaymasensis</i> E.Y. Dawson	Flabellate, deeply divided into many broad, rounded segments	Present	5-7 cm high	60-70 (130) μm	n.d.	n.d.	n.d.	n.d.	Gulf of California	Dawson 1944
<i>K. laciniifolia</i> Levring	Lacinate, with lacerate margins		10 cm high	200-300 μm	2-3	n.d.	n.d.	n.d.	Antarctica	Levring 1944
<i>K. limminghei</i> Montagne	Pseudopeltate or fan. Margins smooth	Present	1x2 cm	130 μm	2-3	n.d.	n.d.	n.d.	Western Caribbean	Littler and Littler 2000
<i>K. morelii</i> (Montagne & Millardet) Børgesen	Lobed with numerous proliferations from the edge	Present	n.d.	n.d.	3-4	n.d.	n.d.	n.d.	I. Mauricius and I. Réunion	Børgesen 1951
<i>K. norrisii</i> Hollenberg & I.A. Abbott	Spatulate to auriculated when young and with ruffled lobes when mature	Occasionally present	> 30 cm high	n.d.	n.d.	Giant, 4000-5000 μm	< 3000 μm	15 x 20-25	California	Abbot 1968
<i>K. oligonema</i> Yamada	Fan-shaped, slightly perforated*. Margin lobed, slightly undulate.	Present	4 x 6 cm	125 μm	n.d.	n.d.	1000 μm	n.d.	Japan	Yamada 1941
<i>K. pacifica</i> Kylin	Simple, circular when young, and dissected by lobes when mature	Present		240-300 μm	4-5	Highly refractive	3000-4000 μm		California, Philippines	Abbot 1968; Silva <i>et al.</i> 1996

Article 2: M. Robuchon *et al.*, in preparation for *European Journal of Phycology*

<i>K. sagamiana</i> Yamada	Irregularly lobed or deeply split into segments splitted or undulate. Margin provided with spine protuberances	Absent	20 cm broad	1200-1400 µm	5-8	n.d.	n.d.	Irregularly shaped and divided	Japan	Yamada 1938
<i>K. schmitzi</i> De Toni	Flabellate, with rounded lobes	n.d.	16 cm	160-190 µm	n.d.	n.d.	n.d.	n.d.	Arctic	DeToni 1897
<i>K. stipitata</i> Okamura	Oblong, gradually expanding in roundish, obovate or transversely expanded membrane, sometimes lobed.	Present	30x20-30 cm	80-140 µm	2-3	n.d.	n.d.	n.d.	Japan	Okamura 1934
<i>K. spathulata</i> (J.Agardh) Codomier ex P.G. Parkinson	Elliptical, with numerous spathulated proliferations around all the thallus	Absent	30x12 cm	150-300 µm	5	Ganglionic, yellow staining, 25 µm	n.d.	n.d.	Mediterranean Sea	Codomier 1971; Vergés 2001
<i>K. veleroae</i> E.Y. Dawson	Entire when young but becoming split and developing lacerated segments	Absent	< 4 cm high	80-90 µm	n.d.	n.d.	n.d.	n.d.	Gulf of California	Dawson 1944
<i>K. crouanii</i> sp. nov.	Entire or slightly lobed when young, lacerate with dentate margin when adult	Present	22 x 21 cm	110-320 µm	5	Hightly refractive cells, body cell < 60 µm, arms < 1000 µm long	750-2000 µm	Cruciate, 18-24	NE Atlantic	This study

The species here studied also differ from the other species of the genus *Kallymenia* for which the carpogonial cell system is unknown (Table 3): i) *K. baldwinii* and *K. bleckii* have veins in the blade, *K. oligonema* has perforated frond, *K. sagamiana* has spine protuberances; *K. callophyloides*, *K. guaymasensis*, *K. lacinifolia* have highly divided talli; and finally, *K. limminghii* has pseudopeltate frond and are very small (< 1 cm); ii) *K. sagamiana*, *K. spathulata* and *K. veleroae* are sessile; iii) *K. brachycistidea*, *K. guaymasensis*, *K. limminghii*, *K. oligonema*, *K. schmitzii*, *K. stipitata* and *K. veleroae* have a much smaller cross-section and *K. sagamiana* has a much wider cross-section; iv) *K. brachycistidea*, *K. callophyloides*, *K. lacinifolia*, *K. limminghii*, *K. morellii* and *K. stipitata* have fewer number of cell cortical layers; v) *K. brachycistidea* and *K. spathulata* have smaller and inconspicuous stellate medullary cells, and *K. norrisii* and *K. pacifica* have giant stellate medullary cells; vi) *K. baldwinii* and *K. bleckii* have a smaller carposporophyte (in diameter) and *K. norrisii* and *K. pacifica* have a greater one.

Taxonomic conclusions

In conclusion, after rejecting all the possibilities to assign the taxa here studied to a previous described species of the genus *Kallymenia*, we consider that the species here studied differs from other *Kallymenia* mainly in the frond shape, the diameter of the inner cortical cells, the conspicuous and refractive stellate medullary cells with very long arms, a monocarpogonial cell system and the carposporophyte size. In light of those features, along with the phylogenies which place the taxa here studied as sister to the lineage containing most of the species of *Kallymenia* including the generitype, we concluded that this taxon is a new species of *Kallymenia* which inhabit the North-eastern Atlantic, cohabiting with the type species of the genus, *K. reniformis*. We proposed to name it *Kallymenia crouanii* in honour of the brothers Crouan because looking at their herbarium, there are clues that they suspected the presence of more than one entity in the genus *Kallymenia* in Brittany.

***Kallymenia crouanii* Verges & Le Gall sp. nov. (Figs. 1-23)**

DIAGNOSIS: the diagnosis has been removed on purpose from this manuscript to avoid the PhD thesis to be recognized as the valid publication of the taxon (priority rule).

HOLOTYPE: PC0171066 (Fig. 1). Female gametophyte.

TYPE LOCALITY: Collected in Lampaul, île Ségale, France, at 2 m depth; 12th August 2009 by L. Le Gall, J. Utgé and Y. Turpin.

ETYMOLOGY: Named in honour of the brothers Crouan for their outstanding contribution to the knowledge of the NE Atlantic macroalgae flora and because of their interest in the genus *Kallymenia*.

Acknowledgements

We thank the curators of the National University of Ireland (GALW), the Nationaal Herbarium Nederland (L) for their assistance loaning voucher specimens. We thank Dr. Joanna Wilbraham and Prof. Juliet Brodie for their assistance during the visit of Alba Vergés to the Herbarium of the Natural History Museum of London (BM) in the framework of the Synthesys Grant she received in 2009 to revise the *Kallymenia* specimens housed at BM. Line Le Gall is grateful to all the people who contributed to the temporally move of the Crouan collection housed at the Marinarium of Concarneau to the National Herbarium of Paris in the aim of its digitalisation prior its return to Concarneau. This study was supported by the projects “Bibliothèque du vivant”(INRA-MNHN-INEE-CNRS) and the Parc Naturel Marin d’Iroise (convention CNRS-UPMC-PNMI N°LS64816). We are extremely grateful to “Service Mer et Observation” of the Station Biologique de Roscoff and the team of SMEL (Synergie, Mer et Littoral) as well as divers of the Parc Naturel Marin d’Iroise and, Yves Gladu, Jose Utge, for contributing to the collections of the specimens. Finally, we warmly thank Bruno Dennetière for his insights regarding historical collections and the International Code of Botanical Nomenclature.

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Article 3

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Examining the bank of microscopic stages in kelps using culturing and barcoding

MARINE ROBUCHON^{1,2,3*}, LUCÍA COUCEIRO^{2,3*}, AKIRA F. PETERS^{4,5}, CHRISTOPHE DESTOMBE^{2,3*} AND MYRIAM VALERO^{2,3*}

¹ *Muséum national d'Histoire naturelle, MNHN, UMR 7138, Systématique, adaptation, évolution, Case postale N° 39, 57 rue Cuvier, 75231 cedex 05 Paris, France*

² *Université Pierre et Marie Curie, UPMC, UMR 7144, Adaptation et Diversité en Milieu Marin, Equipe ‘‘BEDIM’’, Station Biologique de Roscoff, CS 90074, 29688 Roscoff, France*

³ *Centre National de la Recherche Scientifique, CNRS, UMR 7144, Adaptation et Diversité en Milieu Marin, Equipe ‘‘BEDIM’’, Station Biologique de Roscoff, CS 90074, 29688 Roscoff, France*

⁴ *CNRS-UPMC, FR2424, Station Biologique de Roscoff, CS 90074, 29688 Roscoff, France*

⁵ *BEZHIN ROSKO, 29250 Santec, France*

**Current address: UMI 3604, Evolutionary Biology and Ecology of Algae, CNRS, UPMC, PUCCh,UACH, Station Biologique de Roscoff, CS 90074, 29688 Roscoff, France*

Running title: Bank of microscopic stages in kelps

Correspondence to Marine Robuchon. E-mail: robuchon@mnhn.fr

Abstract

This paper describes a method to study the diversity of young kelp sporophytes that are recruited from the bank of microscopic stages. Small samples of rocky substratum (0.5 cm²) were collected from the low intertidal zone, which was dominated by the kelp *Laminaria digitata*. Samples were cultivated in the laboratory under - conditions permitting gametogenesis. Sporophyte recruits in the cultures were isolated and identified at the species-level using the barcoding mitochondrial marker *rpl31-rns*. Sixty percent of the collected samples had at least one to a maximum of 30 kelp recruits, belonging to five different species (*L. digitata*, *L. hyperborea*, *L. ochroleuca*, *Saccharina latissima* and *Sacchorhiza polyschides*). As the examination of freshly-collected rocky samples under a stereo microscope did not reveal any kelp sporophytes, the recruitment in these samples after culture likely occurred from the bank of microscopic forms present on the substratum. Despite the dominance of *L. digitata* in the field, the young sporophytes obtained after culturing were mainly *S. polyschides*. This study illustrates the suitability of culturing in combination with molecular identification of young sporophytes to address several key aspects of kelp ecology related to the existence of a bank of microscopic stages in the field.

Keywords: barcode, bank of microscopic stages, diversity, kelp, Phaeophyceae, recruitment, seaweeds, substratum culturing

Introduction

In the last decade, DNA barcoding has provided rapid and accurate species identification of unidentified and/or microscopic organisms (Pawlowski *et al.*, 2012). On the other hand, culturing natural substrata is a longstanding technique used to study the resting stages of organisms. The seedling emergence method is one of the best known examples of this, where the soil seed bank is estimated through the germination of soil samples (Roberts, 1981). This technique has mainly been employed in terrestrial environments, whereas there are far fewer studies that have investigated seed-bank dynamics in aquatic habitats or wetlands (reviewed by McFarland & Shafer, 2011).

In the marine environment, the existence of a seed bank analogue formed by microscopic life-stages has been described for a variety of seaweeds (e.g. Chapman, 1986; Hoffmann & Santelices, 1991). Potentially, therefore, methods of rocky substratum culturing could be employed to study the ecological role of seed bank analogues in seaweeds, just as has been done in land-plant ecology. However, surprisingly few studies have used this methodology to investigate the biodiversity of microscopic stages of seaweeds on rocky shores (e.g. Müller & Ramírez, 1994; Santelices *et al.*, 1995). One reason may be the inherent difficulty of identifying early-settlement stages based on morphological criteria. However, molecular systematics can provide efficient tools for identification of small specimens of seaweeds (e.g. Clayden & Saunders, 2010; Manghisi *et al.*, 2010), including microscopic stages of kelps (Lane & Saunders, 2005; Fox & Swanson, 2007). Nevertheless, to our knowledge, none of these studies has combined rocky substratum culturing with a subsequent molecular identification of recruits.

The lack of seaweed studies using a combination of rocky substratum culturing and barcoding might be due to several factors. First, the establishment of optimal culture conditions for successful germination of heterogeneous macroalgal recruits is challenging. Moreover, early post-settlement stages of macroalgae are sensitive to a variety of grazers and competitors (see Vadas *et al.*, 1992 and references therein). It is therefore essential to sample pieces of rocky substratum small enough to prevent their negative impact. Finally, culturing natural substrata might seem outdated when compared to the fast emerging field of DNA metabarcoding using the next-generation sequencing technologies (Taberlet *et al.*, 2012). However, the design of metabarcode markers suitable for DNA amplification from environmental samples remains problematic (Taberlet *et al.*, 2012), whereas classical barcode markers for a variety of seaweeds, as well as a comprehensive library of sequences, are

actually available and efficient in species identification (e.g. Engel *et al.*, 2008; Saunders & McDevit, 2012). In addition, substratum culturing and, to a lesser extent, Sanger-based barcoding, are economically accessible for the majority of laboratories.

In this study, we developed methods for combining substratum culturing with molecular identification in order to investigate the diversity of the kelp bank of microscopic stages (gametophytes or embryonic sporophytes). Toward this goal, we sampled natural rocky substrata from plots located in the low intertidal zone dominated by the kelp *Laminaria digitata*. We subsequently cultured these sampled substrata in the laboratory and determined the identity of each young sporophyte that recruits from the bank of microscopic forms to the species-level using a barcoding approach.

Materials and methods

The study was conducted in the low intertidal zone of the Perharidy peninsula (48.73058° N, 4.00366° W) to the west of Roscoff, on the northwest coast of Brittany, France. The study area covered approximately 1200 m² (46 m long by 26 m wide) and was dominated by *Laminaria digitata* (about 30 sporophytes m⁻²) even though a visual survey revealed the presence of three other kelp species at low density (less than one sporophyte m⁻²): *L. hyperborea*, *Saccorhiza polyschides* and *Saccharina latissima*. In order to identify the kelps constituting the bank of microscopic stages present, we haphazardly sampled one piece of substratum (about 0.5 cm²) from each of 30 plots regularly placed 4.5 m apart from each other, using a hammer and chisel. Sampled substrata were placed in separate plastic bags with seawater and brought back to the laboratory, where we observed them under the stereo microscope for the presence of small kelp sporophytes. The substrata were cultivated separately in 30 ml Petri dishes in half-strength Provasoli-enriched autoclaved sea water (Starr & Zeikus, 1993) at 10–15°C and natural daylight (north-facing roof window). The medium was not changed during incubation.

After 50 days of culture, substratum samples were checked carefully under the stereo microscope and the number of kelp recruits per dish was recorded. With the help of dissecting forceps, each recruit was detached from its original substratum and transferred to a Petri dish with new culture medium. When they reached appropriate size for DNA extraction (1–20 mm length), all the recruits were harvested and preserved (–20°C) for molecular analysis.

Total DNA was extracted using ChelexTM 100 resin (Biorad, Hercules, California, USA) according to the method described by Goff & Moon (1993). In order to determine the

taxonomic identity of kelp recruits, we amplified c. 300 bp of the mitochondrial intergenic spacer *rpl31-rns* using the primers described by Engel *et al.* (2008). PCR reactions were performed in a total volume of 20 μ l containing 0.5 μ M of each primer, 150 μ M of each dNTP, 2 mM of MgCl₂, 1 \times GoTaq® Flexibuffer (Promega, Madison, WI, USA), 0.35 units of GoTaq® FlexiDNA polymerase (Promega, Madison, WI, USA), and 4 μ l of 1 : 50 diluted template DNA. The PCR reaction was carried out in a PTC-100 thermocycler (Bio-Rad Laboratories, Hercules, CA, USA). Cycling conditions consisted of an initial denaturing step of 5 min at 95°C, followed by 5 cycles of a touchdown PCR (95°C for 30 s, 60°C for 45 s and 72°C for 45 s; 1°C decrease of the annealing temperature every cycle), 30 additional cycles (95°C for 30 s, 55°C for 45 s, and 72°C for 45 s) and a final elongation step of 10 min at 72°C. The presence of PCR-amplified products was checked using agarose gels. PCR products were purified and sequenced with both forward and reverse primers at Genoscope facilities (Evry, France). Chromatograms were edited using ChromasPro (www.technelysium.com.au) and only traces with high quality values and no ambiguities were used. To identify species, sequences were compared with those deposited in Genbank using the basic local alignment search tool (BLAST) from NCBI (Altschul *et al.*, 1990).

Results

There were no kelp sporophytes or gametophytes visible on the 30 substratum samples immediately after their collection. However, after 50 days of culture, there were 108 thalli resembling kelp recruits in 20 of the 30 samples. These were isolated, grown further and identified with molecular tools, resulting in a total of 86 kelp recruits distributed among 18 substratum samples. The remaining 22 putative kelp recruits were either kelp species for which DNA extraction or PCR did not work or were not kelps.

The number of recruits per sample was highly variable, ranging from zero to 30 young kelps grouped on the same 0.5 cm² size bedrock sample (mean \pm SE: 2.87 \pm 1.07). While eight out of the 18 samples containing kelp recruits had a single individual, four showed a number of recruits varying from two to five, and five had a number of recruits between six and nine. One sample had 30 recruits (Fig. 1).

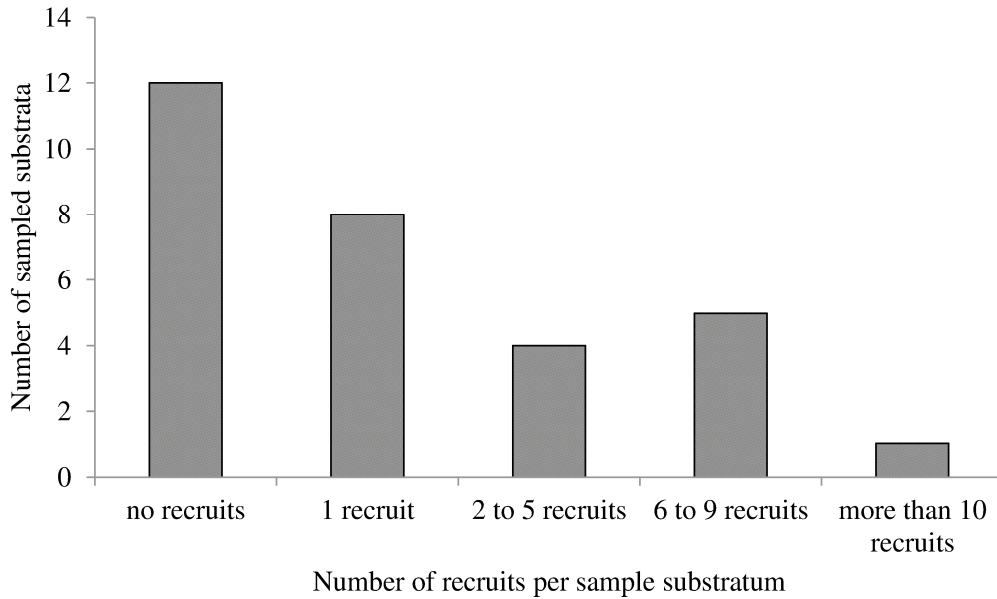


Fig. 1. Distribution of the numbers of recruits observed on samples of natural rock substrata ($N = 30$).

The kelp recruits belonged to five different species: *Saccorhiza polyschides*, *Saccharina latissima*, *Laminaria digitata*, *L. hyperborea* and *L. ochroleuca* (Fig. 2). They corresponded to eight distinct haplotypes (Table 1). *Saccorhiza polyschides* was the dominant species in our samples (67 individuals, 77.9%) and exhibited three haplotypes, while *L. digitata* represented only 9.3% of the recruits (8 individuals) and had a single haplotype. Five *S. latissima* and five *L. hyperborea* recruits (5.8%) were identified. A single haplotype was found for *L. hyperborea*, whereas two were found for *S. latissima*. One recruit was identified as *L. ochroleuca* despite the fact we did not detect this species in the close surrounding intertidal area. In the 10 samples exhibiting more than one recruit, six contained a single species while the remaining four displayed at least two different species. Five exhibited one haplotype while the other five had several haplotypes for at least one species (Table 1).

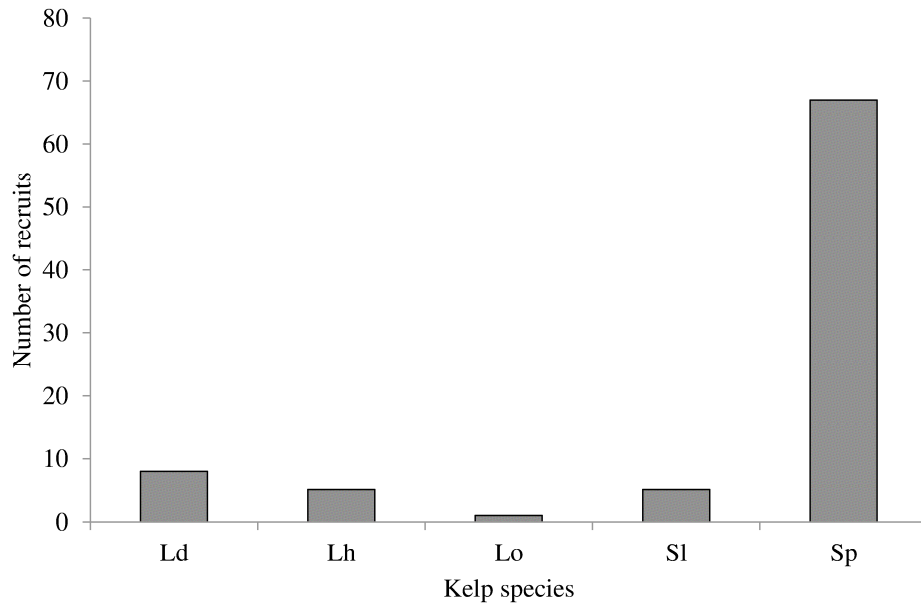


Fig. 2. Species composition of the 86 kelp recruits observed over the 30 sampled substrata; Ld is *Laminaria digitata*, Lh is *Laminaria hyperborea*, Lo is *Laminaria ochroleuca*, Sl is *Saccharina latissima* and Sp is *Saccorhiza polyschides*.

Table 1. Number and haplotype identity for the 18 samples (out of 30) exhibiting recruits. Samples are numbered S1 to S30. Genbank accession numbers are KC337288 for HSp1, KC337289 for HSp2, KC337290 for HSp3, KC337283 for HLd1, KC337286 for HSI1, KC337287 for HSI2, KC337284 for HLh1 and KC337285 for HLo1.

	<i>Laminaria digitata</i>	<i>Laminaria hyperborea</i>	<i>Laminaria ochroleuca</i>	<i>Saccharina latissima</i>	<i>Saccorhiza polyschides</i>
S1	4 HLd1	–	–	–	2 HSp1
S2	–	–	–	–	1 HSp2
S4	–	–	–	1 HSI2	–
S6	–	–	–	–	6 HSp1 + 3 HSp2
S7	–	–	–	1 HSI1	–
S8	1 HLd1	–	–	–	–
S11	–	–	–	–	1 HSp1
S12	–	–	–	–	7 HSp1 + 1 HSp2
S13	–	–	–	–	1 HSp1
S15	1 HLd1	–	–	–	–
S17	–	–	–	1 HSI1	6 HSp1
S18	–	–	–	–	2 HSp1
S19	–	1 HLh1	1 HLo1	–	5 HSp1 + 2 HSp2
S21	–	–	–	–	2 HSp1 + 1 HSp2
S23	–	–	–	1 HSI1	–
S25	–	2 HLh1	–	–	–
S26	2 HLd1	–	–	1 HSI1	22 HSp1 + 2 HSp2 + 3 HSp3
S27	–	2 HLh1	–	–	–

Discussion

In this study, we successfully cultured and identified kelp recruits from natural substratum samples of very small size (0.5 cm²). Our method combining substratum culturing and molecular identification of recruits revealed that some of these samples exhibited both different kelp species and different haplotypes within species, illustrating the fact that 0.5 cm² substratum samples can harbour a considerable diversity at both intra- and interspecific levels. As the examination of freshly-collected rocky samples under a stereo microscope did not reveal any kelp sporophytes, the recruitment in these samples after 50 days of culture might have occurred from microscopic forms of the kelp (i.e. from gametophytes or embryonic sporophytes) and thus corresponds mainly to the bank of microscopic forms which was present on the substratum. These findings are consistent with the growing number of field studies suggesting that kelp microscopic stages are able to resist harsh conditions and may play a crucial role in the recovery of kelp beds (Ladah *et al.*, 1999; Barradas *et al.*, 2011; Engelen *et al.*, 2011; Pereira *et al.*, 2011). Recruitment from such stages was particularly obvious in the study of Ladah *et al.* (1999), who described that after the ENSO events of 1997/1998, macroscopic sporophytes of the giant kelp *Macrocystis pyrifera* completely disappeared from an area located near the southern distributional limit of the species and remained absent for at least seven months. Nevertheless, macroscopic sporophytes appeared *de novo* less than one year after their disappearance, though the nearest spore source was more than 100 km away. Ladah *et al.* (1999) suggested that microscopic stages survived the stressful conditions of ENSO and were the source of the recruitment, supporting the idea that a bank of microscopic forms can survive stressful conditions. However, in all these studies as in ours, the life stages of the microscopic forms (i.e. gametophytes or embryonic sporophytes) remain uncertain.

The microscopic forms we cultured did reflect the complement of kelp species present in the study site but not their relative abundance. Indeed, although *L. digitata* was by far the most abundant kelp species in the field, the young sporophytes we obtained after culturing were mainly individuals of *S. polyschides*. Two different hypotheses might explain this result. First, the bank of microscopic forms might consist mainly of germinations from recently emitted spores, thus inducing a bias in this case towards species reproducing in spring: March is the peak reproductive season for *S. polyschides* (Norton & Burrows, 1969), whereas it is at the end of the reproductive period for *S. latissima* (Parke, 1948) and *L. hyperborea* (Birkett *et al.*, 1998) and prior to reproduction in *L. digitata* (Birkett *et al.*, 1998). Thus, according to this

first hypothesis, the dominance of *S. polyschides* in the bank of microscopic stages present in March is due to a more intense rain of propagules. Alternatively, the dominance of *S. polyschides* in the recruits might result from differences in competitive abilities among the different kelp species present in the bank of microscopic forms. Indeed, *S. polyschides* is an annual species and exhibits a high competitive ability (Pereira *et al.*, 2011; Engelen *et al.*, 2011), whereas *L. digitata* is perennial. Thus, even though the bank of microscopic forms sampled in the field was composed mainly of *L. digitata* individuals, *S. polyschides* might have outcompeted the other kelp species present during germination and/or growth in culture. The culture of substratum revealed the presence of one young sporophyte of *L. ochroleuca* whereas we did not observe any adult sporophyte in the study site. This suggests that, despite the apparent absence of adult sporophytes, *L. ochroleuca* has not completely disappeared from the area but instead survives as microscopic forms in a seed-bank analogue. This bank was subsequently able to participate in sporophyte recruitment in culture conditions and this phenomenon might also happen in the field, producing new macroscopic stages under favourable conditions. This finding is consistent with the fact that the proportions of young sporophytes of *L. hyperborea* and *S. latissima* in culture (relative to *L. digitata*) are more than fifteen times higher than the proportion of adult sporophytes observed in the study site, suggesting that the sporophytes of these species are not all able to survive at this intertidal level and hydrodynamic conditions. These results indicate that microscopic stages may be more tolerant of unfavourable conditions (light, temperature, nutrient and hydrodynamics) than macroscopic stages.

Gametophytes have usually been considered as the resistant phase in kelps. To our knowledge there has been no study investigating the longevity of these stages in the field, although it has been suggested they may only survive for weeks to months (Deysner & Dean, 1984). However, in laboratory cultures, gametophytes can survive for decades. For instance, the oldest gametophyte strains of *L. digitata* available in the Culture Collection of Algae and Protozoa (www.ccap.ac.uk) were isolated in 1974. Furthermore, a laboratory study has shown that kelp gametophytes can survive 16 months in darkness and subsequently regenerate within one to two months of post-culture (tom Dieck, 1993). These findings suggest that kelp gametophytes have the capacity to survive stressful conditions in the field and to regenerate when conditions improve. Thus, in our experiment, the bank of microscopic stages might consist of gametophytes.

Even though we checked substratum samples immediately after collection, we did not observe any gametophytes or sporophytes. There are several possible explanations. First, gametophytes and/or sporophytes were present but too small to be detected by observations under a stereo microscope. Second, gametophytes were present on the substratum but gametogenesis occurred quickly after sampling, triggering their disappearance (Destombe & Oppliger, 2011). Finally, gametophytes were not attached directly to the substratum but hidden as endophytes within microscopic fragments of red algae. Endophytic kelp gametophytes have been reported within various red algae in several studies (Kain, 1979; Garbary *et al.*, 1999; Hubbard *et al.*, 2004). As kelp gametophytes are sensitive to grazing and sedimentation (Vadas *et al.*, 1992), it has been suggested that endophytism could provide physical protection (Garbary *et al.*, 1999). Further investigations, in particular involving direct detection of gametophytes in the field as has been done for other brown macroalgal species (e.g. *Desmarestia ligulata*: Edwards, 2000), are necessary to discriminate among these hypotheses.

Another feature that emerged from this experiment was considerable disparity in the number of recruits per sample, some pieces of substratum (20 or the 30 samples) yielding zero or one recruits while others produced several to many individuals from an equivalent small area (0.5 cm²). This could be because, although the areas we cultivated were very small, we may have randomly sampled different microhabitats resulting in a highly variable density of microscopic stages. For instance, sampling substrata exhibiting microscale roughness might result in higher numbers of recruits because of spores sedimenting into crevices and being trapped by them. Moreover, such microscopic crevices could protect microscopic gametophytes from grazing. Alternatively, the variation in recruits per sample may have been because of aggregated settlement of kelp spores. Aggregation of individuals is a pattern commonly observed in marine invertebrates (Toonen & Pawlik, 2001) and has been reported in all seaweed lineages (Dayton *et al.*, 1984; Callow *et al.*, 1997; Santelices *et al.*, 2008). Because it ensures proximity of reproductive adults, and subsequently of dioecious gametophytes, gregariousness has been described as enhancing reproductive success (Maggs & Callow, 2003). In addition, it has been shown to help retain moisture and reduce heat stress during low tides among organisms living in the group (Scrosati & DeWreede, 1998). In the particular case of kelps, Reed *et al.* (1991) showed that a minimum spore density was necessary for sporophyte production in *Pterygophora californica* and *Macrocystis pyrifera*, and more recently, Muth (2012) demonstrated that sporophyte production significantly

increased as spores became more aggregated in the species *M. pyrifer*. However, our study was not designed to discriminate between these two hypotheses; thus, it would be interesting to carry out a separate study to specifically address spore settlement.

In conclusion, this paper describes an efficient method to study the species composition of the bank of microscopic forms of kelps and consequently to infer the first steps of recruitment in the field. Other methods have been developed to study the factors influencing algal recruitment by placing artificial substrata in the field and subsequently removing them again for microscopical observations (e.g. Neushul *et al.*, 1976; Kennelly, 1983). Although these approaches allow the *in situ* establishment of macroalgal communities to be followed, our method has the advantage of using natural substrata. Furthermore, the method permits substratum-linked factors influencing recruitment to be considered, while also allowing an assessment of the role of microscopic resting stages in recruitment in a climax community. Finally, as an alternative to our approach, DNA metabarcoding of bulk rocky substrata could have been used, without culture and isolation of individual specimens (Taberlet *et al.*, 2012). However, these techniques are both more expensive (currently) and more sensitive to contamination (reviewed by Yoccoz, 2012) than the method we present here. Thus, our work demonstrates that, at a time where next generation sequencing is becoming widespread in modern ecology (Tautz *et al.*, 2010), there are still fundamental questions that can be addressed by simple means.

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Article 4

Robuchon M, Le Gall L, Mauger S, Valero M (submitted to *Molecular Ecology*) Sisters but not twins: contrasting genetic diversity patterns in two closely-related kelp species along Brittany coastline.

Sisters but not twins: contrasting genetic diversity patterns in two closely-related kelp species co-distributed along the Brittany coastline

Marine Robuchon ^{1 2 3 *}, Line Le Gall ¹, Stéphane Mauger ^{2 3 μ} and Myriam Valero ^{2 3 μ *}

¹ ISYEB Institut, UMR 7205 CNRS-EPHE-MNHN-UPMC, Equipe Exploration, Espèces et Evolution, Muséum National d'Histoire Naturelle, case postale N° 39, 57 rue Cuvier, 75231 Cedex 05 Paris, France

² CNRS, UMR 7144 Adaptation et Diversité en Milieu Marin, Equipe BEDIM, Station Biologique de Roscoff, CS 90074, 29688 Roscoff, France

³ Sorbonne Universités, UPMC Univ Paris 06, UMR 7144 Adaptation et Diversité en Milieu Marin, Equipe BEDIM, Station Biologique de Roscoff, CS 90074, 29688 Roscoff, France

^{μ} Current address: UMI 3604 Evolutionary Biology and Ecology of Algae, CNRS, UPMC, Station Biologique de Roscoff, CS 90074, 29688 Roscoff, France

* Corresponding authors: marine.robuchon@gmail.com, +33 6 77 40 54 60 and myriam.valero@sb-roscoff.fr, +33 2 98 29 23 28

Running title: Genetic diversity in two sister kelp species

Abstract

In this paper, we investigated patterns of genetic structure between two sister species of kelp to explore how range dimensions, depth, latitudinal distribution and historical factors can lead to contrasting patterns of genetic diversity. We implemented a hierarchical sampling scheme to compare the patterns of genetic diversity and structure in these two kelp species co-distributed along the coasts of Brittany (France) using microsatellites. Populations of *Laminaria hyperborea* were genetically more diverse and more connected than those of *Laminaria digitata*, in accordance with its distribution in a wider fringe along the coast and at a lower depth. In addition, marginal populations showed reduced genetic diversity and connectivity, which erased isolation-by-distance patterns in both species. As *L. digitata* encounters its southern range limit in Southern Brittany while *L. hyperborea* extends down to mid-Portugal, it was possible to distinguish the effect of limit of habitat continuity from the effect of edge of distributional range. We found that *L. digitata* did not harbour high regional diversity in its southern edge, as expected in a typical rear edge, suggesting that refuges from the last glacial maximum for *L. digitata* were probably not located in Southern Brittany, but most likely further north. For both species, the highest levels of genetic diversity were found in the Iroise Sea and Morlaix Bay, the two regions in which they are being harvested. Preserving genetic diversity of these two foundation species in these areas should thus be a priority for the management of this resource in Brittany.

Keywords: *depth, genetic structure, marginal populations, spatial distribution, range edge, seaweeds*

Introduction

The effect of spatial structure on genetic diversity and the consequences of small population size have been widely investigated (e.g. Charlesworth *et al.* 2003), particularly the field of conservation genetics, because of their potential effect on the survival of populations and species (Frankel & Soulé 1981). In his pioneering article describing the phenomenon of isolation by distance (IBD) in continuously distributed populations, Wright (1943) predicted that a species whose range is essentially linear should show more genetic structure than a species whose range is two-dimensional. This difference in structure results in increased variability in gene frequencies among generations in linearly arranged populations compared to a two-dimensional arrangement. Furthermore, more recent theoretical approaches (Rousset 1997; Barton *et al.* 2013), have confirmed Wright's prediction that species distributed along a linear range should show more differentiation than those spreading in two dimensions.

In addition to the intuitive result that genetic divergence increases with distance, the model of Wilkins and Wakeley (2002) regarding genealogies in a finite continuous habitat predicts that genetic diversity will be at its greatest near the centre of distribution. However, species are not always continuously distributed and may have fragmented populations at different locations along their distribution range, particularly in peripheral populations located at range edges. Thus, population genetic structure is predicted to vary along the geographical range of a species' distribution (Vucetich & Waite 2003; Bridle & Vines 2007). The 'abundant-centre' or 'central-marginal' model of species distributions predicts that peripheral populations exhibit lower genetic diversity and greater genetic differentiation relative to central populations (Eckert *et al.* 2008). Nevertheless, historical factors have been shown to interact with central-marginal trends and shape latitudinal patterns of genetic diversity across species ranges (Guo 2012). In particular, populations occurring along rear edges (*i.e.* low latitude edges) are often located in areas that were refuge zones during the last glacial maximum and are therefore expected to retain high and unique genetic diversity compared to high latitude ranges (Hewitt 1996; Ibrahim *et al.* 1996). Together with central-marginal trends, these predictions indicate that rear-edge populations should exhibit high differentiation, low within-population diversity but high and unique regional diversity (Hampe & Petit 2005). Despite the large number of empirical studies testing range-wide genetic diversity patterns, the effect of range dimensions on genetic structure remains surprisingly little investigated.

The linear nature of coastal habitat shapes the distribution of individuals in one dimension; however, the width of the fringe they occupy may differ between intertidal and subtidal species. For example, intertidal species are often distributed in narrow fringes while subtidal species, particularly in areas where the slope of the continental shelf is weak, may occupy wider fringes (e.g. seagrass meadows and kelp forests). Nevertheless, in addition to the influence of range dimensions, patterns of genetic differentiation in intertidal *versus* subtidal organisms may also result from the combination of other factors. Among the studies comparing levels of genetic differentiation in coastal organisms at several depths (Engel *et al.* 2004; Marko 2004; Kelly & Palumbi 2010; Valero *et al.* 2011; Krueger-Hadfield *et al.* 2013), most have actually revealed decreasing differentiation with increasing depth and have explained this pattern either by differences in immersion time among organisms located at different depths or differences in selective pressure along the depth gradient. However, to our knowledge, the hypothesis regarding the influence of range dimensions has never been suggested as a putative explanation of the contrasted connectivity patterns observed across different depths.

The geography of Brittany results from the erosion of metamorphic and magmatic rocks of the Armorican Massif and therefore most of its shoreline is rocky. This area harbours a high diversity of seaweed species (Kerswell 2006), including two emblematic kelp species: *Laminaria digitata* (Hudson) J.V. Lamouroux and *Laminaria hyperborea* (Gunnerus) Foslie. These foundation species form large underwater forests that play an essential ecological role by providing habitat, protection and food to numerous organisms (Lobban & Harrison 1994; Steneck *et al.* 2002). However, along the North East Atlantic coastline, kelp-dominated habitats have been understudied these last decades in comparison with other regions such as Australasia and North America (reviewed by Smale *et al.* 2013). *Laminaria digitata* (*Ld*) and *L. hyperborea* (*Lh*) are two sister species (McDevit & Saunders 2010) that have similar overall gross morphology with a more (*Lh*) or less (*Ld*) flexible stipe topped by a blade and an identical life cycle in which a macroscopic sporophyte (diploid) alternates with a microscopic gametophyte (haploid). These two species are currently harvested in Brittany for their alginic content. The main differences between *Ld* and *Lh* lie in their zonation and latitudinal distribution. Populations of *Ld* are usually distributed in a narrow fringe along the coast spanning the lower intertidal and the higher subtidal whereas populations of *Lh* are distributed in a wider fringe, sometimes even forming vast stands in the subtidal zone (reviewed by Birkett *et al.* 1998). Along the European coastline, both species overlap for most of their

geographical range distributions; however, the northern most species *Ld* encounters its southern range limit in Southern Brittany while *Lh* extends down to mid-Portugal (Kain 1971; Lüning 1990).

In light of similarities and contrasting characteristics between *Ld* and *Lh*, two hypotheses can be formulated regarding the differences expected in their genetic patterns. First, because populations of *Lh* are distributed in a wider fringe than those of *Ld* and located at a lower depth than those of *Ld*, they should be more connected with higher levels of genetic diversity. Second, with Southern Brittany being the rear edge of *Ld*, populations of this species in that area should harbour higher differentiation, reduced local diversity and high and unique regional diversity compared to other zones of the study area whereas characteristics of *Lh* populations in Southern Brittany should not differ from its other populations.

In this study, we implemented an extensive hierarchical sampling design to characterize the patterns of genetic diversity and structure in *Ld* and *Lh* using microsatellites and test the aforementioned hypotheses.

Materials and methods

Sampling design and study area

To investigate the patterns of genetic diversity and structure occurring among populations of the kelps *Laminaria digitata* and *L. hyperborea* (which characteristics are summarized in Table 1), a hierarchical sampling design was implemented. Three spatial levels were considered: (1) regions separated by 60-180 km, (2) localities separated by 10-15 km and (3) sites separated by 300-1000 m (Fig. 1a). Four regions were included in the study: St Malo Bay (SMB), Morlaix Bay (MoB), Iroise Sea (IrS) and SBr (SBr), all located in Brittany (north-western France, Fig. 1b). In MoB and IrS, which make up the centre of the rocky continuum along the Brittany coastline, four localities, each consisting of one or two sites, were sampled. St Malo Bay is separated from this central rocky continuum by a long sandy beach; therefore, populations of both species in SMB can be considered as marginal/peripheral regarding habitat continuity. SBr represents the southern edge of the distributional range for *Ld*; therefore, in this region, populations of *Ld* can be considered as marginal regarding distributional range, but not those of *Lh* (Table 1). Within SMB and SBr, three localities, each one consisting of one or two sites, were sampled. In total, 21 sites were sampled; all GPS coordinates are given in Table 2.

Tissue collection and DNA extraction

The objective was to collect a minimum of 30 sporophytes by site and by species. However, in three sites (Guimereux, Nerput and St Mathieu) the density of *Ld* sporophytes was too low to reach that number. In total, we collected tissue samples consisting of a small disc of tissue at the base of the blade (a non-lethal procedure) from 829 *Ld* and 1057 *Lh* sporophytes, mostly by scuba diving. At each site, both species were sampled except in Ile Téviec where wave conditions were too dangerous to collect *Ld*. Tissue samples were preserved in individual plastic bags containing silica gel and stored at room temperature. DNA extraction was performed on 5-10 mg of dried tissue using the NucleoSpin® 96 Plant II kit (Macherey-Nagel, GmbH & Co. KG, Düren, Germany) and following the manufacturer's instructions, except for the lysis step during which samples were left at room temperature for 1 h rather than heating to 65 °C for 30 min and the elution step which was performed in 100 µL rather than 200 µL elution buffer.

Microsatellite amplification, scoring and correction

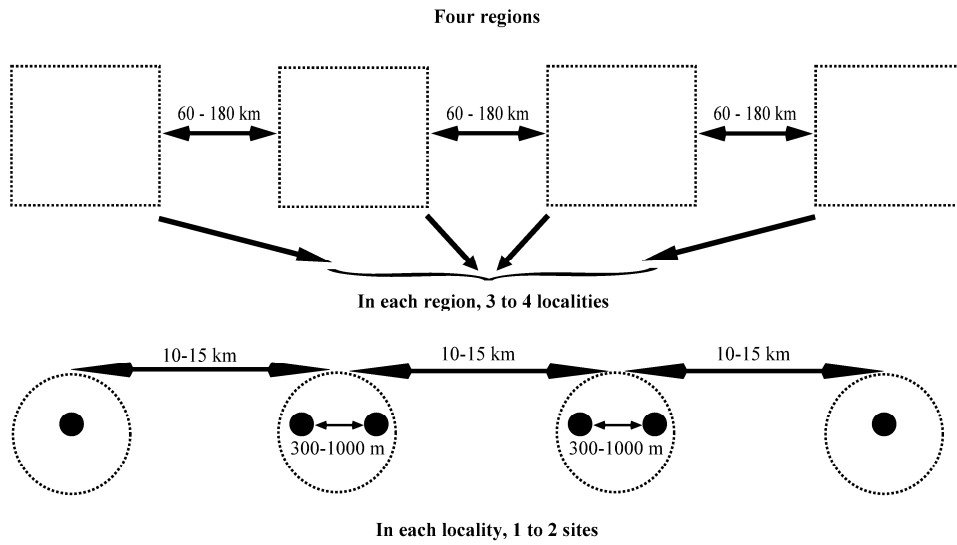
Six microsatellites previously developed for *Ld* (Ld148, Ld158, Ld167, Ld371, Ld531 and Ld704) (Billot *et al.* 1998) and seven additional ones developed for *Laminaria ochroleuca* (Lo4-24, Lo454-15, Lo454-17, Lo454-23, Lo454-24, Lo454-27 and Lo454-28) (Coelho *et al.* com. pers.) were used. For *Ld*, 12 microsatellites were amplified by PCR in four different multiplex mixes MM1 (Ld148, Ld158, Ld167, Ld371, Ld531 and Ld704), MM2 (Lo454-23, Lo454-24 and Lo454-27), MM3 (Lo454-17 and Lo454-28) and MM4 (Lo4-24). For *Lh*, 11 microsatellites were amplified in three different mixes: MM1 (Ld148, Ld158, Ld167, Ld371, Ld531 and Ld704), MM5 (Lo454-15, Lo454-17, and Lo454-28) and MM6 (Lo454-23 and Lo454-24). Multiplex PCRs were performed, amplifying several loci simultaneously, using a PT-200 thermocycler (MJ Research, Waltham, MA, USA) in 10 µL final volume containing 1X GoTaq® Flexi colourless reaction buffer (Promega Corp., Madison, WI, USA), 2 mM MgCl₂, 150 µM dNTPs, 0.35 U GoTaq® DNA polymerase (Promega Corp.) and 2 µL of template DNA (diluted to 1:100). Identity and concentration of primers as well as amplification conditions varied across multiplex mixes. For MM1, primers concentrations were 100 nM for Ld148, Ld167 and Ld371, 150 nM for Ld158 and 200 nM for Ld531 and Ld704. For MM2 to MM6, all primer concentrations were 200 nM.

Table 1 Characteristics of the two sister kelp species studied

Species	Distribution along the European coastline	Zonation	Sporophyte life span	Mechanical harvesting in Brittany
<i>Laminaria digitata</i>	From the western shores of Novaya Zemlya (Russia) and the Svalbard Archipelago (Norway) to southern Brittany (France) ^{1, 2}	Narrow fringe (from 5 to 50 m large) in the low intertidal zone (from +1 to -1 m) ^{2, 3}	4 to 6 years ⁴	Since 1971, with a hydraulic hook (<i>scoubidou</i>) ^{2, 6}
<i>Laminaria hyperborea</i>	From the Bay of Murmansk (Russia) to mid-Portugal ^{1, 2}	Large stands (from 100 m ² to several km ²) in the subtidal zone (from -1 to -30 m) ^{2, 3}	5 to 18 years ^{4, 5}	Tests since 1995 ^{2, 6} , routinely since 2006 ⁷ , with the Norwegian comb

¹Lüning 1990; ²Birkett *et al.* 1998; ³ obs. pers.; ⁴Bartsch *et al.* 2008; ⁵Kain 1971; ⁶Arzel 1998; ⁷Leclerc 2013

(a)



(b)

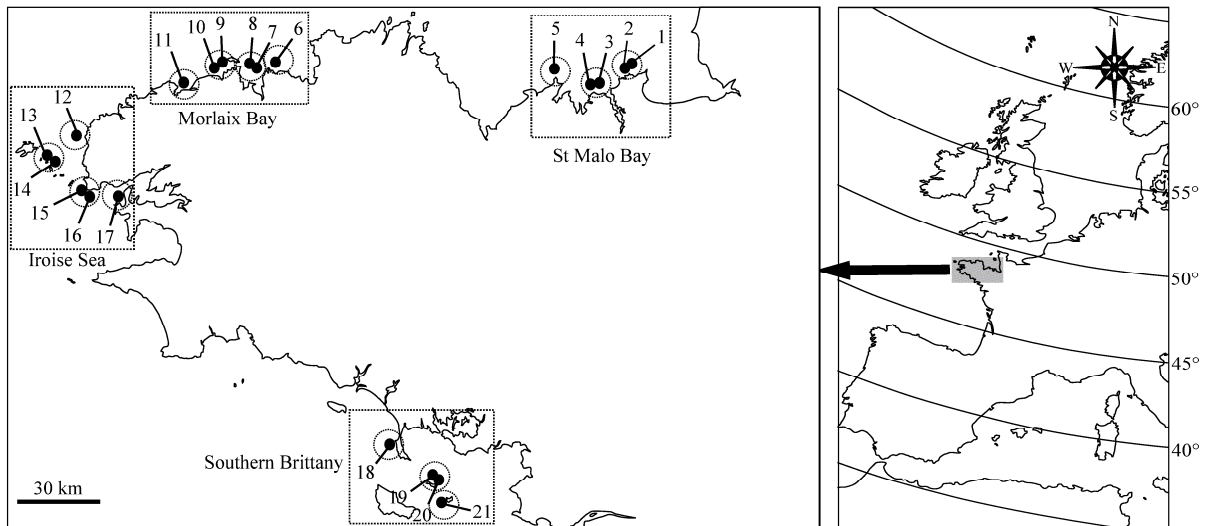


Fig. 1 (a) Diagram of the hierarchical sampling design and (b) map of kelp specimen collection sites in Brittany, France. Sites are: Guimereux (1), La Bigne (2), Nerput (3), Le Moulin (4), Les Amas du Cap (5), Primel (6), Duons Est (7), Duons Ouest (8), Santec 2 (9), Santec 1 (10), Les Amiettes (11), Les Linious (12), Men Vriant (13), Klosenn Malaga (14), Les Rospects (15), St Mathieu (16), Pointe du Grand Gouin (17), Ile Téviec (18), Houat 2 (19), Houat 1 (20) and Hoedic (21). For site coordinates, see Table 2.

For MM1, the PCR programme included an initial denaturation at 94 °C for 5 min, 5 cycles of a touchdown PCR (denaturation at 94 °C for 45 s, annealing at 60 °C for 1 min and extension at 72 °C for 45 s; 1 °C decrease of the annealing temperature every cycle), followed by 30 cycles of denaturation at 94 °C for 45 s, annealing at 55 °C for 45 s and extension at 72 °C for 1 min and a final extension at 72°C for 30 min. For MM2, MM3, MM5 and MM6, the PCR program included an initial denaturation at 94 °C for 5 min, 35 cycles of denaturation at 94 °C

for 30 s, annealing at 60 °C for 30 s and extension at 72 °C for 45 s and a final extension at 72 °C for 20 min. These latter conditions were similar for MM4 except the annealing temperature which was 50 °C. Forward primers were fluorescently labelled with 6-FAM (Ld531, Lo454-15 and Lo454-24), NED (Ld158, Ld371, Lo454-23 and Lo454-28), PET (Ld148, Ld704, Lo4-24 and Lo454-27) or VIC (Ld167 and Lo454-17) dye (Applied Biosystems, Foster City, CA, USA). The loading mix for sizing was prepared by adding 2 µL of each PCR product to 10 µL of loading buffer containing 0.5 µL of the SM594 size standard (Mauger *et al.* 2012) plus 9.5 µL of Hi-Di formamide (Applied Biosystems). This loading mix was denatured at 94 °C for 5 min and run in an ABI 3130 xl capillary sequencer (Applied Biosystems) equipped with 50 cm capillaries.

Alleles were scored manually using the software GeneMapper® version 4.0 (Applied Biosystems). After two re-amplifications, individuals for which more than one locus did not amplify correctly were removed from the dataset. Loci were tested for null alleles and scoring errors were detected using MICRO-CHECKER software version 2.2.3 (van Oosterhout *et al.* 2004). Linkage disequilibrium between pairs of loci was computed with FSTAT (Goudet 2001). The number of repeated multilocus genotypes at each site was calculated using GENALEX 6 (Peakall & Smouse 2005) and the genotype diversity R was computed as the number of distinct genotypes (G) /number of individuals and corrected for sample size ($R=G-1/N-1$, Dorken & Eckert 2001).

Genetic diversity

Standard measures of genetic diversity (mean number of alleles per locus (N_a), unbiased expected heterozygosity (H_e ; Nei 1987), allelic richness (AR) rarefied to 19 individuals) were calculated at each site using FSTAT (Goudet 2001). Allelic richness by site was not calculated for the sites Guimereux, Nerput and St Mathieu because the Ld sample size was too small. Additionally, these three estimates of genetic diversity were calculated for each region by pooling sites within a region, and AR was rarefied to 132 individuals. The number of private alleles (P_a) per site and per region was calculated using GENALEX 6 (Peakall & Smouse 2005). Permutational analyses of variance (PERMANOVA) were performed to test for effects of space ('region' or 'site'), species and their interaction on genetic diversity (AR and H_e) using each couple site/locus as a repetition, on the basis of a Bray-Curtis distance matrix and with 9999 unrestricted permutations of raw data as our data did not fit the assumptions of normality and homogeneity of variance. Homogeneity of multivariate

dispersion was also tested by inferring deviations from a centroid using a distance-based test. These analyses were carried out on a dataset restricted to the eight loci common to both species and the 17 sites where both species presented a number of individuals with complete genotypes ≥ 19 , using PRIMER 6 version 16.1.13 and PERMANOVA+ version 1.0.3. (Clarke & Gorley 2006; Anderson *et al.* 2008). Finally, in each site, departure from random mating (inbreeding coefficient: F_{IS}) was tested using FSTAT (Goudet 2001) by permuting alleles among individuals within populations.

Genetic structure

Pairwise F_{ST} (as defined by Weir & Cockerham 1984) were calculated for all site pairs within each species and significance of differentiation at the level of 5% was tested by permuting genotypes among sites using FSTAT (Goudet 2001). Overall genetic structure for both species was analysed using two complementary approaches. First, principal components analysis (PCA) based on allele frequencies were implemented in PCAGEN (Goudet 1999). Second, analyses of molecular variance (AMOVA) were carried out in Arlequin (Excoffier *et al.* 2005) with sites grouped into regions. Additionally, regional AMOVAs for each region were implemented with sites grouped into localities. Significance of the genetic structure was tested using 9999 permutations.

To perform tests of IBD, geographic distances between each pair of sites were calculated using the shortest path by the sea. IBD was tested for L_d and for L_h , both over all populations and within each region, by implementing Mantel tests between a matrix of genetic distances ($F_{ST}/(1-F_{ST})$) and a matrix of geographic distances (in kilometres), using 1000 resamples. Since L_d and L_h have linear ranges, we used the untransformed geographic distances for both species, in accordance with Rousset (1997). Calculations of geographic distances and Mantel tests were performed in the free software R (R Development Core Team 2005), using the packages *gdistance* (van Etten 2012) and *ncf* (Bjørnstad 2009), respectively.

Results

Microsatellite amplification

Allelic size profiles were unambiguous, and scoring was straightforward. All loci were polymorphic across all sites except Lo454-27 for L_d and Ld531 for L_h ; they were therefore removed from subsequent analyses. We did not detect any null alleles in L_d populations; however, Ld371 and Ld704 showed evidence of null alleles in L_h populations; these two loci

were therefore eliminated from subsequent analyses. The final datasets consisted of 764 individuals genotyped on 10 to 11 loci for *Ld* (Table S1) and 1031 individuals genotyped on 8 to 9 loci for *Lh* (Table S2). No linkage disequilibrium between pairs of loci was detected in either species. For *Ld*, only one site (Primel) showed significant departure from random mating ($F_{IS} = 0.145$, Table 2a), and none for *Lh* (Table 2b). The efficiency of the microsatellite loci to discriminate among individuals was very high because more than 80% of the sites had samples that consisted only of unique multilocus genotypes ($R = 1$) for both species (16/20 sites for *Ld* and 17/21 sites for *Lh*, Tables 2a and b, respectively). The lowest value of genotypic diversity was observed in Santec ($R = 0.90$) for *Ld* with four pairs of individuals sharing the same genotype and in Guimereux ($R = 0.95$) for *Lh* with two pairs of individuals sharing the same genotype.

Patterns of genetic diversity along the Brittany coastline

Multilocus genetic diversity estimates are shown in Table 2a for *Ld* and in Table 2b for *Lh* (details locus by locus are given in Tables S3 and S4, respectively). For *Ld*, the number of alleles (N_a) ranged from 2.5 (SMB region) to 7.3 (IrS region). Rarefied allelic richness (AR) varied from 2.9 (SMB region) to 6.1 (IrS region). Expected heterozygosity varied between 0.349 (SMB region) and 0.624 (IrS region). Therefore, the sites with the lowest genetic diversity estimates were in SMB and those with the highest genetic diversity estimates in IrS. For *Lh*, N_a ranged from 3.1 (SMB region) to 6.6 (SBr region). AR varied from 2.9 (SMB region) to 5.2 (IrS region). H_e varied between 0.429 (SMB region) and 0.622 (IrS region). Therefore, as for *Ld*, both AR and H_e showed their lowest values in SMB and their highest in IrS.

At the regional level, *i.e.* when individuals from all the sites within a region were pooled, the lowest AR and H_e values for *Ld* were observed in SMB and the highest in IrS. In contrast, for *Lh*, while both AR and H_e were also at their lowest in SMB, the highest AR value was detected in SBr whereas H_e was highest in IrS. The lowest P_a value for *Ld* was found in SBr but in SMB for *Lh* and both species held their maximum P_a value in IrS.

Table 2 Geographic locations, size, multilocus genetic and genotypic diversity estimates for samples (a) of *Laminaria digitata* on 11 microsatellite loci and (b) of *Laminaria hyperborea* on 9 microsatellite loci; to see which sites belong to the same locality, see Fig. 1**(a) *L. digitata***

Site (number)	GPS coordinates		Harvesting [#]	N	N_a	AR [§]	H_e	P_a	R	F_{IS}
Guimereux (1)	48.69658	-1.96063	No	7	2.5 ± 0.3	×	0.412 ± 0.069	0	1.00	0.150
La Bigne (2)	48.69452	-1.98453	No	46	4.1 ± 0.6	3.3 ± 0.4	0.390 ± 0.065	6	0.96	-0.054
Nerput (3)	48.65248	-2.14033	No	12	2.7 ± 0.4	×	0.356 ± 0.073	0	1.00	-0.065
Le Moulin (4)	48.65113	-2.11750	No	40	3.3 ± 0.6	2.9 ± 0.5	0.415 ± 0.069	0	0.97	-0.054
Les Amas du Cap (5)	48.68785	-2.32502	No	59	4.0 ± 0.8	3.2 ± 0.6	0.349 ± 0.082	1	1.00	0.058
St Malo Bay (SMB)				164	5.7 ± 0.8	5.4 ± 0.8	0.394 ± 0.069	8		
Primel (6)	48.72933	-3.78566	No	55	5.1 ± 0.8	4.2 ± 0.6	0.496 ± 0.077	1	1.00	0.145 *
Duons Est (7)	48.72490	-3.91978	Yes (light)	48	6.2 ± 1.0	5.1 ± 0.8	0.527 ± 0.078	3	1.00	0.057
Duons Ouest (8)	48.72765	-3.92643	Yes	39	6.1 ± 1.1	5.1 ± 0.9	0.504 ± 0.089	2	1.00	0.019
Santec 2 (9)	48.72603	-4.02358	Yes	41	6.5 ± 1.3	5.4 ± 1.1	0.542 ± 0.075	3	0.90	-0.021
Santec 1 (10)	48.72207	-4.04282	Yes	27	6.3 ± 1.1	5.5 ± 0.9	0.555 ± 0.068	3	1.00	0.078
Les Amiettes (11)	48.70239	-4.13978	No	35	6.1 ± 1.0	5.3 ± 0.9	0.559 ± 0.067	0	1.00	0.061
Morlaix Bay (MoB)				245	8.7 ± 1.4	7.9 ± 1.3	0.534 ± 0.074	13		
Les Linious (12)	48.49265	-4.80418	No	47	6.0 ± 1.0	5.0 ± 0.7	0.565 ± 0.066	1	1.00	0.034
Men Vriant (13)	48.38640	-4.93168	Yes	42	7.3 ± 1.2	5.8 ± 0.9	0.619 ± 0.057	2	1.00	0.043
Klosenn Malaga (14)	48.38153	-4.91928	Yes	42	6.8 ± 0.9	5.9 ± 0.8	0.601 ± 0.057	1	1.00	0.079
Les Rospects (15)	48.32560	-4.76412	No	34	7.1 ± 0.9	6.1 ± 0.8	0.618 ± 0.058	2	1.00	0.087
St Mathieu (16)	48.32770	-4.75218	No	19	5.3 ± 0.8	×	0.593 ± 0.063	1	1.00	0.135

Pointe du Grand Gouin (17)	48.28812	-4.60160	No	37	6.2 ± 1.1	5.5 ± 1.0	0.624 ± 0.070	1	1.00	0.121
Iroise Sea (IrS)				221	9.1 ± 1.1	8.5 ± 1.1	0.612 ± 0.061	13		
Houat 2 (19)	47.39488	-2.96202	No	33	3.8 ± 0.4	3.5 ± 0.3	0.521 ± 0.052	0	1.00	0.062
Houat 1 (20)	47.39452	-2.95820	No	70	3.7 ± 0.4	3.2 ± 0.3	0.489 ± 0.059	0	0.94	0.048
Hoedic (21)	47.33872	-2.89227	No	31	4.1 ± 0.4	3.8 ± 0.4	0.551 ± 0.057	0	1.00	-0.012
Southern Brittany (SBr)				134	4.8 ± 0.5	4.8 ± 0.5	0.521 ± 0.054	0		

(b) *L. hyperborea*

Site (number)	GPS coordinates		Harvesting [#]	N	N_a	AR [§]	H_e	P_a	R	F_{IS}
Guimereux (1)	48.69658	-1.96063	No	42	3.4 ± 0.3	3.0 ± 0.3	0.446 ± 0.068	2	0.95	0.116
La Bigne (2)	48.69452	-1.98453	No	56	4.0 ± 0.6	3.3 ± 0.4	0.490 ± 0.071	0	0.98	0.115
Nerput (3)	48.65248	-2.14033	No	31	3.1 ± 0.5	2.9 ± 0.4	0.429 ± 0.068	0	1.00	0.173
Le Moulin (4)	48.65113	-2.11750	No	56	3.3 ± 0.5	2.9 ± 0.4	0.446 ± 0.071	0	1.00	0.076
Les Amas du Cap (5)	48.68785	-2.33037	No	63	4.1 ± 0.5	3.3 ± 0.4	0.456 ± 0.077	0	1.00	-0.009
St Malo Bay (SMB)				248	5.4 ± 0.6	4.8 ± 0.5	0.461 ± 0.071	2		
Primel (6)	48.72933	-3.78566	No	38	5.6 ± 0.6	4.8 ± 0.5	0.566 ± 0.089	0	1.00	0.066
Duons Est (7)	48.72595	-3.91408	No	50	5.8 ± 0.8	4.9 ± 0.6	0.591 ± 0.090	4	1.00	-0.016
Duons Ouest (8)	48.72765	-3.92643	No	81	5.8 ± 0.6	4.7 ± 0.6	0.584 ± 0.088	0	1.00	0.027
Santec 2 (9)	48.72603	-4.02358	Yes	39	5.4 ± 0.7	4.9 ± 0.7	0.611 ± 0.093	1	1.00	0.061
Santec 1 (10)	48.72207	-4.04282	Yes	45	5.0 ± 0.7	4.5 ± 0.6	0.582 ± 0.097	0	1.00	0.025
Les Amiettes (11)	48.70239	-4.13978	No	44	5.4 ± 0.6	4.9 ± 0.5	0.613 ± 0.084	2	1.00	0.068
Morlaix Bay (MoB)				297	7.4 ± 0.9	6.4 ± 0.7	0.591 ± 0.089	8		

Les Linious (12)	48.49265	-4.80418	No	50	5.2 ± 0.6	4.8 ± 0.5	0.597 ± 0.086	1	1.00	0.051
Men Vriant (13)	48.38640	-4.93168	No	34	5.0 ± 0.6	4.6 ± 0.6	0.590 ± 0.084	1	0.97	0.042
Klosenn Malaga (14)	48.38153	-4.91928	No	46	5.3 ± 0.6	4.8 ± 0.5	0.622 ± 0.081	0	0.98	0.017
Les Rospects (15)	48.32560	-4.76412	No	40	5.8 ± 0.7	5.0 ± 0.6	0.588 ± 0.090	2	1.00	0.023
St Mathieu (16)	48.32770	-4.75218	No	59	6.4 ± 0.8	5.2 ± 0.6	0.590 ± 0.087	8	1.00	0.071
Pointe du Grand Gouin (17)	48.28812	-4.60160	No	42	4.8 ± 0.5	4.5 ± 0.5	0.593 ± 0.075	0	1.00	- 0.027
Iroise Sea (IrS)				271	7.9 ± 1.0	6.7 ± 0.8	0.601 ± 0.082	12		
Ile Tévéc (18)	47.55238	-3.16525	No	62	6.0 ± 0.8	5.0 ± 0.7	0.565 ± 0.097	1	1.00	0.015
Houat 2 (19)	47.39488	-2.96202	No	45	5.4 ± 0.6	4.7 ± 0.5	0.576 ± 0.087	0	1.00	0.095
Houat 1 (20)	47.39452	-2.95820	No	58	6.2 ± 0.8	5.1 ± 0.6	0.604 ± 0.083	2	1.00	0.040
Hoedic (21)	47.33872	-2.89227	No	51	6.6 ± 0.7	5.1 ± 0.5	0.597 ± 0.078	3	1.00	0.046
Southern Brittany (SBr)				215	7.6 ± 0.9	7.0 ± 0.8	0.588 ± 0.086	9		

Sampling was carried out at the same sites for both species except Ile Tévéc where *L. digitata* was not sampled and Duons Est and Les Amas du Cap where species' sites were separated by a few hundred meters. N is the number of individuals per sample; N_a , number of alleles; AR, rarefied allelic richness; H_e , expected heterozygosity as defined by Nei (1987); P_a , the number of private alleles; R , genotypic diversity ($G-I/N-I$, where G is the number of distinct genotypes Dorken & Eckert 2001); F_{IS} , inbreeding coefficient as defined by Weir & Cockerham (1984) calculated overall loci. For N_a , AR and H_e , values are mean and standard errors over loci. Significant values of F_{IS} ($P < 0.05$) are indicated with an asterisk (*). Regional (pooled site samples) sample size and genetic diversity estimates are shown in bold. § For both species, AR values for each site were calculated with a rarefaction size of 19 diploid individuals and AR values for each region were calculated with a rarefaction size of 132 diploid individuals. # pers. comm., M. Laurans.

The pattern of allelic richness varied significantly between species and across regions, and the interaction was significant (Table 3a, Figure 2a). Allelic richness was globally higher in *Lh* (mean AR \pm standard error over sites = 4.6 ± 0.1) than in *Ld* (4.2 ± 0.2). For both species, AR was significantly lower in the SMB region and higher in the two central regions of MoB and IrS, whereas in SBr, the pattern differed according to species, with AR being much higher in *Lh* than in *Ld* (Fig. 2a, pairwise tests not shown). The same pattern was observed at the site level except that only the factor ‘site’ was significant (Fig. 2b, Table 3b).

The pattern of gene diversity also varied significantly between species and across regions but the interaction between these factors was not significant (Table 3c). H_e was always higher in *Lh* (mean $H_e \pm$ standard error over sites = 0.570 ± 0.013) than in *Ld* (0.488 ± 0.019). For both species, H_e followed the same pattern across regions with lower values in SMB and higher values in the three other regions (Fig. 2c). At the site level, only the factor ‘species’ remained significant (Table 3d) with *Lh* showing higher H_e values than *Ld* at all sites (Fig. 2d).

Table 3 Results of the PERMANOVA (permutational analysis of variance) testing the effects of the factors (a) ‘species’ and ‘region’ on allelic richness (AR), (b) ‘species’ and ‘site’ on the AR, (c) ‘species’ and ‘region’ on the expected heterozygosity (H_e) and (d) ‘species’ and ‘site’ on the H_e ; df, degrees of freedom; SS, sum of squares; Pseudo-F, the Pseudo-F statistic; and $P(\text{perm})$, the probability calculated by permutations.

(a) Effects of the factors ‘species’ and ‘region’ on AR

Source of variation	df	SS	Pseudo-F	$P(\text{perm})$
Species	1	1870	4.8	0.021
Region	3	16024	13.6	< 0.001
Species*Region	3	3609	3.1	0.017
Residuals	264	1.032×10^5		
Total	271	1.239×10^5		

(b) Effects of the factors ‘species’ and ‘site’ on AR

Source of variation	df	SS	Pseudo-F	$P(\text{perm})$
Species	1	1025	2.4	0.107
Site	16	17723	2.6	< 0.001
Species*Site	16	4793	0.7	0.820
Residuals	238	1.032×10^5		
Total	271	1.239×10^5		

(c) Effects of the factors 'species' and 'region' on H_e

Source of variation	df	SS	Pseudo-F	$P(\text{perm})$
Species	1	451	6.4	0.011
Region	3	1116	5.3	0.002
Species*Region	3	97	0.5	0.713
Residuals	264	18517		
Total	271	20181		

(d) Effects of the factors 'species' and 'site' on H_e

Source of variation	df	SS	Pseudo-F	$P(\text{perm})$
Species	1	451	5.8	0.016
Site	16	1172	0.9	0.518
Species*Site	16	181	0.1	1
Residuals	238	18377		
Total	271	20181		

Patterns of genetic structure along the Brittany coastline

Global analyses of genetic structure revealed significant genetic differentiation between most sites for *Ld* (153 out of 190 pairwise F_{ST} values, *i.e.* 81%, Table S5), even at very small scales: the minimum distance for which significant differentiation was observed was less than 1 km, *i.e.* within SMB, between Nerput and Le Moulin. In contrast, fewer pairs of sites were significantly differentiated in *Lh* (138 out of 210 pairwise F_{ST} values, *i.e.* 66%, Table S6) and the minimum distance for which a significant differentiation was observed was between 10 and 15 km. Moreover, mean pairwise F_{ST} was lower in *Lh* (mean \pm standard error 0.085 ± 0.006) than in *Ld* (0.094 ± 0.005).

This difference between species regarding global genetic structure was confirmed by results of principal components analyses (PCA, Fig. 3). The first two axes explained 71.3 % (resp. 86.2 %) of the total variance for *Ld* (resp. *Lh*), the first axis explaining more than 50 % in both species (53.5 % for *Ld* and 67.1 % for *Lh*). For both species, sites of SMB were separated from sites of SBr along the first axis and sites of MoB were close to the ones of IrS. However, for *Ld* sites of MoB were separated from the ones of IrS along the second axis (Fig. 3a) while these regions were inseparable for *Lh* (Fig. 3b).

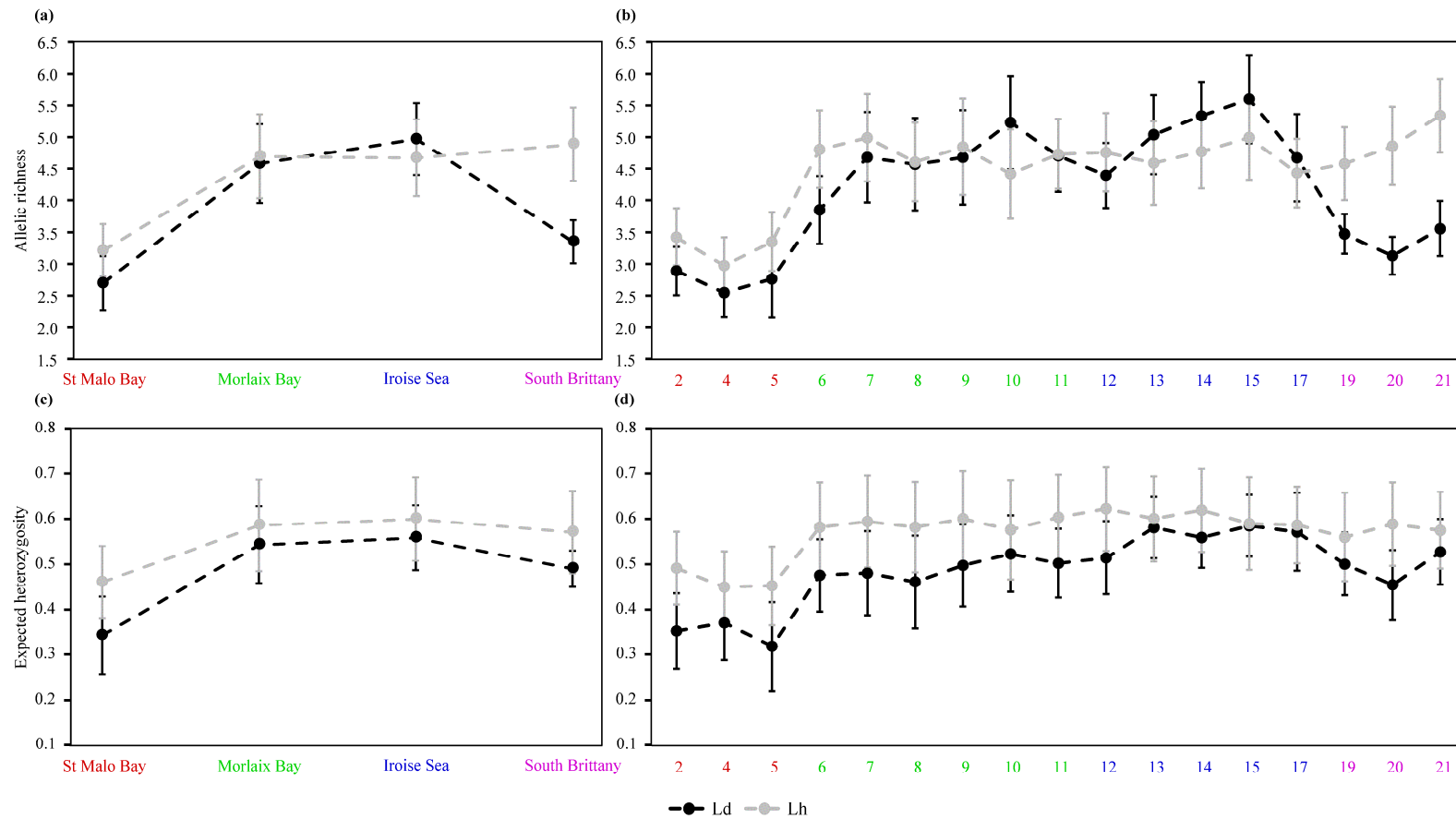


Fig. 2 Comparison of genetic diversity estimates between *Laminaria digitata* (Ld) and *Laminaria hyperborea* (Lh) across space. (a) Allelic richness (AR) by region, (b) AR by site, (c) Expected heterozygosity (H_e) by region and (d) H_e by site. Dots are mean values, bars are standard errors and dashed lines link dots to highlight putative interactions between species and space. Means and errors were calculated over loci for (b) and (d), over loci and sites for (a) and (c). For site names, see Fig.1 and Table 2. Sites 1, 3 and 16 were not included because they had fewer than 19 individuals for at least one species; site 18 was not considered because *L. digitata* was not sampled there

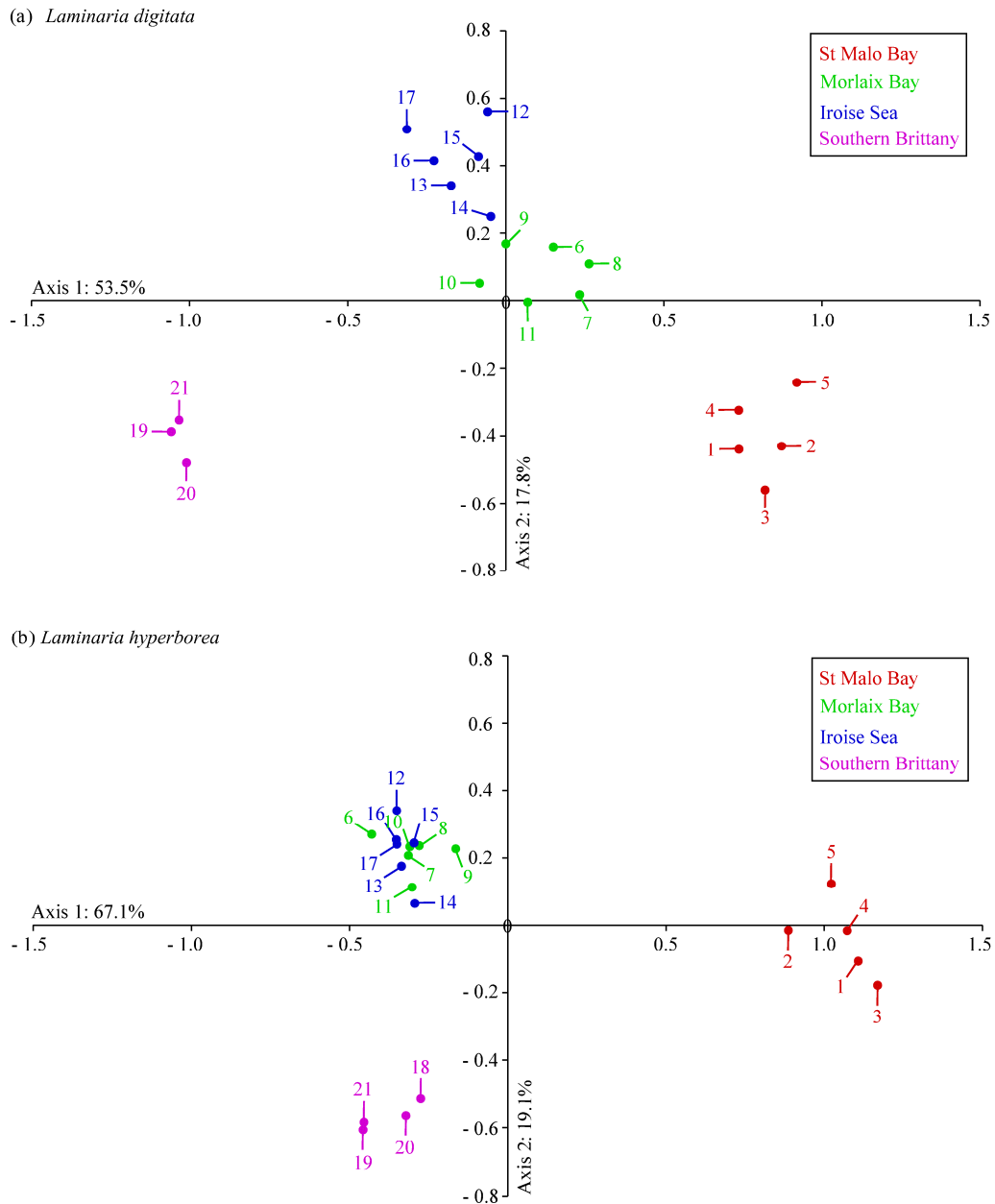


Fig. 3 Principal components analysis (PCA) based on allele frequencies of (a) *Laminaria digitata* populations (cumulative inertia for the first two axes = 71.2%) and (b) *Laminaria hyperborea* populations (cumulative inertia for the first two axes = 86.2%). Inertia percentages are indicated along each axis. For site names, see Fig. 1 and Table 2.

Hierarchical analyses of molecular variance revealed significant partitioning of genetic variation among regions and among localities within regions for *Ld* (Table 4a) and *Lh* (Table 4b). Although the amount of variation associated with the regional level was similar for both species (~ 10% of total variance), the variation associated with the partitioning among localities within regions was almost three times higher in *Ld* than in *Lh*. Analyses of molecular variance within each region revealed contrasting patterns between species (Table

5). In MoB and IrS, patterns were similar for both species with a significant partitioning at the level of localities and a non-significant partitioning at the site level. This pattern was also observed for *Lh* in the two other regions; hence, partitioning did not differ among regions for this species (Table 5b). In contrast, for *Ld*, partitioning at the level of localities was non-significant in SMB but significant at the site level and, in SBr, partitioning was significant at the locality and site levels (Table 5a).

Table 4 Results of the analysis of molecular variance (AMOVA) averaged over loci for localities grouped by region for (a) *Laminaria digitata* and (b) *Laminaria hyperborea*

(a) *L. digitata*

Source of variation	Sum of squares	Variance components	% variation	F-statistic	P
Among regions	378.8	0.303	9.4	$F_{CT} = 0.094$	< 0.001
Among localities within regions	99.2	0.075	2.3	$F_{SC} = 0.026$	< 0.001
Within localities	4278.4	2.836	88.3		
Total	4756.5	3.213			

Global F_{ST} among localities without hierarchy is 0.117, $P < 0.001$

(b) *L. hyperborea*

Source of variation	Sum of squares	Variance components	% variation	F-statistic	P
Among regions	455.7	0.284	10.1	$F_{CT} = 0.101$	< 0.001
Among localities within regions	56.6	0.023	0.8	$F_{SC} = 0.009$	< 0.001
Within localities	5131.5	2.511	89.1		
Total	5643.4	2.818			

Global F_{ST} among localities without hierarchy is 0.109, $P < 0.001$

Table 5 Analysis of molecular variance (AMOVA) of sites grouped by locality for each region of (a) *Laminaria digitata* and (b) *Laminaria hyperborea*

(a) *L. digitata*

Source of variation	Sum of squares	Variance components	% variation	F-statistic	P
<u>Within St Malo Bay</u> (Global F_{ST} among sites without hierarchy is 0.050, $P < 0.001$)					
- Among localities	23.2	- 0.006	- 0.3	$F_{CT} = - 0.003$	0.648
- Among sites within localities	11.2	0.116	5.3	$F_{SC} = 0.052$	< 0.001
- Within sites	672.7	2.089	95.0		
- Total	707.1	2.199			
<u>Within Morlaix Bay</u> (Global F_{ST} among sites without hierarchy is 0.020, $P < 0.001$)					
- Among localities	29.3	0.052	1.8	$F_{CT} = 0.018$	< 0.001
- Among sites within localities	6.9	0.008	0.3	$F_{SC} = 0.003$	0.201
- Within sites	1393.8	2.895	98.0		
- Total	1430.0	2.955			
<u>Within Iroise Sea</u> (Global F_{ST} among sites without hierarchy is 0.022, $P < 0.001$)					
- Among localities	32.8	0.066	1.9	$F_{CT} = 0.019$	< 0.001
- Among sites within localities	7.7	0.008	0.2	$F_{SC} = 0.003$	0.330
- Within sites	1436.6	3.310	97.8		
- Total	1477.2	3.384			
<u>Within Southern Brittany</u> (Global F_{ST} among sites without hierarchy is 0.042, $P < 0.001$)					
- Among localities	13.9	0.090	3.1	$F_{CT} = 0.031$	0.007
- Among sites within localities	5.9	0.034	1.2	$F_{SC} = 0.012$	0.009
- Within sites	743.6	2.811	95.8		
- Total	763.3	2.935			

(b) *L. hyperborea*

Source of variation	Sum of squares	Variance components	% variation	F-statistic	P
<u>Within St Malo Bay</u> (Global F_{ST} among sites without hierarchy is 0.016, $P < 0.001$)					
- Among localities	14.0	0.026	1.2	$F_{CT} = 0.012$	0.018
- Among sites within localities	5.4	0.007	0.4	$F_{SC} = 0.004$	0.239
- Within sites	1005.4	2.052	98.4		
- Total	1024.8	2.085			
<u>Within Morlaix Bay</u> (Global F_{ST} among sites without hierarchy is 0.001, $P = 0.362$)					
- Among localities	10.3	0.010	0.4	$F_{CT} = 0.004$	0.035
- Among sites within localities	4.0	- 0.006	- 0.2	$F_{SC} = - 0.002$	0.928
- Within sites	1556.6	2.655	99.9		
- Total	1570.9	2.659			
<u>Within Iroise Sea</u> (Global F_{ST} among sites without hierarchy is 0.010, $P < 0.001$)					
- Among localities	17.9	0.023	0.9	$F_{CT} = 0.009$	0.007
- Among sites within localities	5.9	0.003	0.1	$F_{SC} = 0.001$	0.369
- Within sites	1437.0	2.684	99.0		
- Total	1460.7				
<u>Within Southern Brittany</u> (Global F_{ST} among sites without hierarchy is 0.013, $P < 0.001$)					
- Among localities	14.5	0.032	1.2	$F_{CT} = 0.012$	0.016
- Among sites within localities	2.8	0.002	0.1	$F_{SC} = 0.001$	0.449
- Within sites	1123.5	2.632	98.7		
- Total	1140.9	2.666			

There was a pattern of IBD in both species when examining all sites together (Fig. 4a, b); however, in *Ld*, most genetic distances were proportional to geographic distance (Fig. 4a), in *Lh*, for a given geographic distance, a large range of genetic distances was observed (Fig. 4b). This variability was mainly due to the fact that sites of SMB were highly differentiated from sites of other regions, whatever their distance. Patterns of IBD within each of the four regions were consistent between species although they varied among regions (Fig. 4c, d): for

both species, there was a significant IBD pattern in MoB and IrS but not in SMB or SBr. However, in SBr, there were fewer comparisons (three and six comparisons for *Ld* and *Lh*, respectively) than in the other regions, which probably affect the power of the statistical test.

Discussion

As hypothesized, *Ld* and *Lh* display distinct patterns of genetic diversity and structure, with populations of *Lh* being more diverse and more connected than those of *Ld* (Table 2, Figs. 2 & 3). The comparison of the genetic diversity patterns between these two sister species can be used to discuss how range dimensions, depth, latitudinal distribution and historical factors can lead to contrasting patterns of genetic diversity.

Differences in minimum dispersal scale

Laminaria digitata and *L. hyperborea* show a pattern of short distance dispersal in the range of what has been reported for most macroalgal species (Santelices 1990; Kinlan *et al.* 2005). The significant partitioning of molecular variance among and within regions revealed that gene flow is reduced and populations are differentiated (Tables 4 & 5) at the scale of 10-15 km in both kelp species (and even at a scale of less than 1 km in *Ld*). The minimum dispersal scale estimated in this study is similar to the values reported in a review of seven kelp species (including *Ld*, Valero *et al.* 2011).

The linear costal habitat favours isolation by distance in Brittany for both kelp species

Our study provided evidence of IBD along the Brittany coast (500 km) for both kelp species (Figure 4) in spite of recent studies that suggest that Euclidian distances may not be appropriate for modelling gene flow in the marine environment. Natural selection, historical factors or models of oceanographic currents appear to better explain patterns of genetic structure in many marine species (for review, see Hedgecock *et al.* 2007; and more recent studies in whelks, White *et al.* 2010; in fucoids, Coleman & Kelaher 2009 and in kelps, Alberto *et al.* 2010). In these species, genetic differentiation patterns reflect past disturbances rather than contemporary processes because the establishment of IBD patterns requires sufficient time and equilibriums are generally not reached. However, Kimura and Weiss (1964) have demonstrated that equilibrium should be reached faster along a linear stretch than in a two-dimensional area.

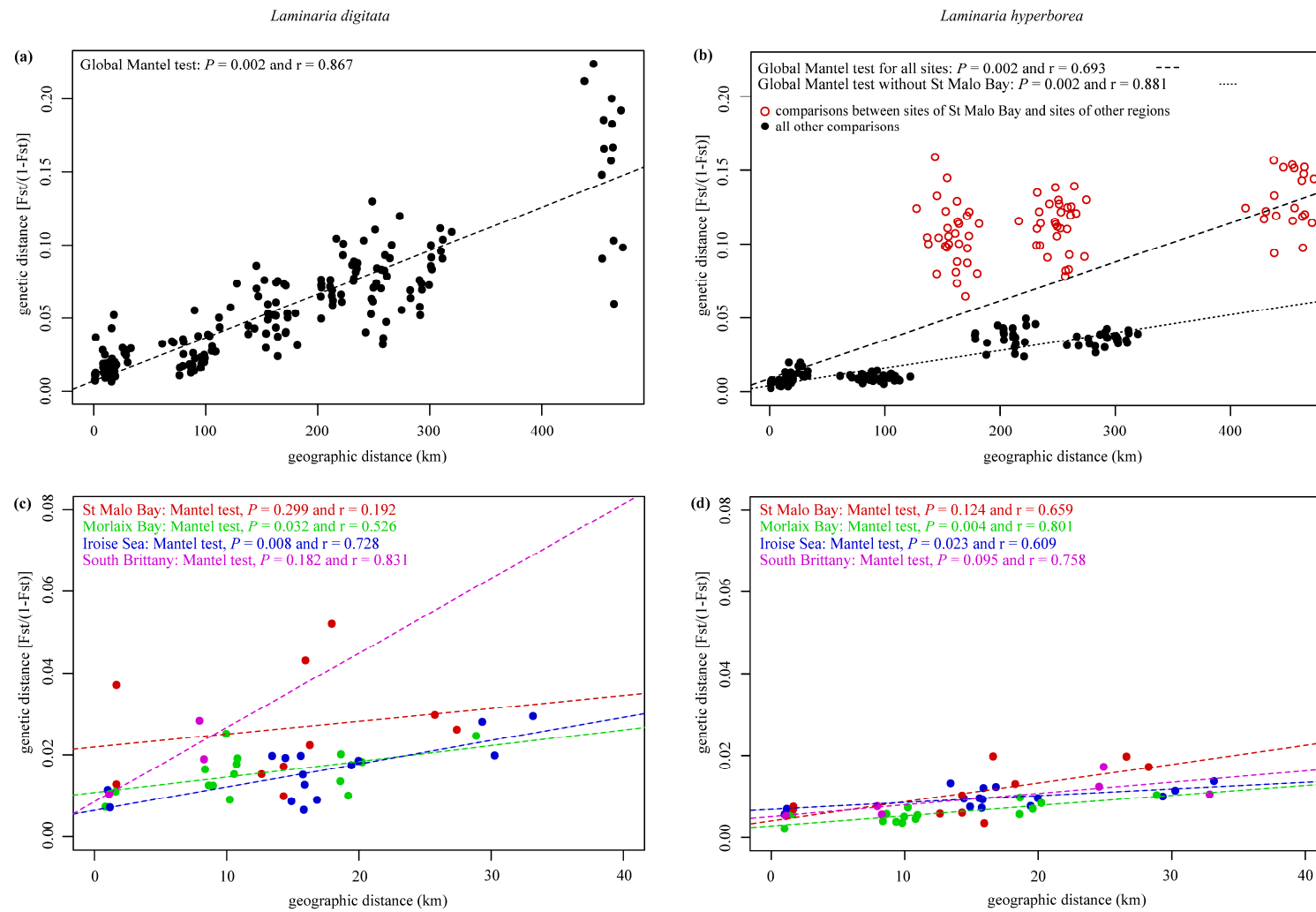


Fig. 4 Isolation by distance of (a) all pairs of *Laminaria digitata* populations, (b) all pairs of *Laminaria hyperborea* populations, (c) pairs of populations within regions for *L. digitata* and (d) pairs of populations within regions for *L. hyperborea*. Estimates of pairwise genetic differentiation [$F_{ST}/(1-F_{ST})$] is plotted against pairwise site distance in kilometres. Mantel non-parametric tests based on 1000 permutations between pairwise genetic differentiation and pairwise site distance are given.

In the present study, the relatively short distance dispersal and almost continuous distribution of two kelps species along the rocky shoreline of Brittany likely explain the fact that our data better fit an IBD pattern than populations of non-linearly distributed and fragmented marine organisms that are connected by larval dispersal for which non-visible oceanic barriers may occur. This hypothesis is supported by a recent review showing clear evidence of IBD across a multitude of macroalgal species (Durrant *et al. in press*).

Differences in genetic structure between the two kelp species: life history traits versus spatial arrangement of populations

For both *Ld* and *Lh*, female gametes are retained on the female gametophyte and male gametes probably do not disperse on more than a few centimeters, dispersal being mainly ensured by planktonic bi-flagellate meiospores which live up to 72 hours (Billot *et al.* 2003). Meiospores are produced on the blade, the distal portion of the plant, and are therefore released 1 to 3 m above the substratum at high tide, which can facilitate their transport in the water column. When released, spores are probably dispersed away from their parent sporophyte and related sibs; accordingly, no significant departure from random mating was observed within most sites for either species (Table 2). Kelp blades within the kelp forest may thus act as paddles increasing water movement and consequently enhancing meiospores' dispersal. In addition, rare events of long distance dispersal are possible by drifting fertile blades that continue to produce and release meiospores as it was shown in the giant kelp *Macrocystis* spp. (Macaya *et al.* 2005). It is noteworthy that *Lh* regenerates its blade once a year, losing its old one, an occurrence that may render long distance dispersal more frequent in this species compared to *Ld*. Furthermore, although both species are perennial, *Lh* lives three times longer than *Ld* (Table 1). Several comparative studies (Hamrick & Godt 1996; Nybom 2004) have reported that longer-lived species retain most of their genetic variability within populations while those with a shorter life span allocate most of their genetic variability among populations like the pattern observed in the present study. However, such effect of longer longevity on higher genetic diversity is not easy to explain and Duminil *et al.* (2007) have revealed that these previous comparative analyses on plants have suffered from several biases.

The differences in spatial structure between the two sister species revealed in our study can rather be attributed to other factors such as differences in the spatial arrangement of their populations: *Ld* occupy a narrow fringe in the low-intertidal zone while populations of *Lh*

form a large fringe in the high to mid-subtidal zone. Our results show that even for two species that are linearly distributed along the coast, the width of the fringe might have an effect on the spatial genetic structure: populations of *Lh* were more connected (*i.e.* less structured) than populations of *Ld* (Fig. 3). This pattern may also result from the influence of depth: several studies have reported a decrease in genetic structure with increasing depth (see for example the reviews based 50 nearshore marine invertebrate species in Kelly and Palumbi (2010) and on 17 kelp species in Valero *et al.* (2011)). There are two arguments that can explain this pattern. The first argument is that intertidal organisms spend less time immersed than subtidal ones and thus have less opportunity to disperse in the water column. The second argument is that intertidal species undergo a greater variety of environmental stresses than subtidal ones (Helmuth & Hofmann 2001). In this stressful environment, selection may favour restricted dispersal (either via differential larval behaviour of fishes, Kelly & Palumbi 2010; or selfing in seaweeds, Billard *et al.* 2010) to maintain local adaptation, and therefore indirectly affect genetic structure.

Marginality of populations: limit of habitat continuity versus edge of distributional range

Although *Lh* generally exhibited more genetic diversity and connectivity than its sister species (Figs. 2 & 3), patterns of genetic diversity and structure varied greatly among the regions studied (Table 3). Core populations located in the regions of MoB and IrS, inhabiting the centre of the continuous rocky habitat of the Brittany coast, harboured a typical pattern of large interconnected populations for both species (highest level of genetic diversity, lowest level of population structure and significant IBD). Moreover, north of SMB, Brittany is flanked by a large sandy stretch of coast (more than 20 km of sandy beach of the famous Mont Saint Michel Bay) unsuitable for settlement of either kelp species. In addition, the region of SBr corresponds to the southern edge of *Ld*'s distributional range, whereas *Lh*'s range extends down to Portugal. For both species, the typical pattern of fragmented marginal populations was found in the region of SMB (lower genetic diversity, increased genetic differentiation and no significant IBD). The fact that neither species showed significant IBD patterns in these marginal populations and only in core continuous populations (Fig. 4) suggests that these marginal populations are not at demographic equilibrium probably because they undergo regular and/or recent perturbations. These results confirm previous studies on *Ld* showing that marginal populations of SMB exhibit low genetic diversity as a result of habitat discontinuity in comparison to populations of MoB and IrS located within the continuum of rocky substratum (Billot *et al.* 2003; Valero *et al.* 2011; Couceiro *et al.* 2013). Examination of

genetic samples collected over time in this species detected genetic changes only for the populations located in the region of SMB (Valero *et al.* 2011), confirming that these marginal populations are subject to recent demographic effects. Here, we demonstrated that, despite showing higher genetic diversity than its sister species, *Lh* is also affected by habitat discontinuity, hence reinforcing the importance of this factor in shaping kelp genetic patterns. This effect of habitat discontinuity leading to chaotic patterns of population genetic structure with weak relationships to inter-population distances has been demonstrated in several rocky shore species such as fishes (Riginos & Nachman 2001; Watts & Johnson 2004; Johansson *et al.* 2008), red macroalgae (Faugeron *et al.* 2001; Faugeron *et al.* 2004) and, in particular, kelps (Alberto *et al.* 2010; Fraser *et al.* 2010 and references therein).

Regarding the populations of the SBr region, genetic diversity remained high for *Lh* and comparable to core populations. In contrast, at the southern edge of its distributional range, *Ld* exhibited reduced within population genetic diversity. The reduced genetic diversity observed in *Ld* probably reflects the small size of populations due to their occurrence in suboptimal habitats. A recent study showed that higher temperatures affect sporulation in *Ld* (Bartsch *et al.* 2013), which may contribute to the dysfunctional meiosis and the supposed occurrence of asexual reproduction observed in some populations of SBr, located slightly south to the populations of the present study (Oppliger 2010; Oppliger *et al.* com. pers.). We did not detect any patterns of asexual reproduction in our study: genotype richness was not systematically lower in SBr. In addition, our study revealed that the pool of *Ld* populations in SBr exhibited neither high nor unique regional genetic diversity as expected according to the rear-edge hypothesis (Hampe & Petit 2005). This hypothesis is based on the historical effect of the last glacial maximum and therefore it predicts that rear edges, because they often correspond to refuges from the last glacial maximum, should harbour high and unique regional diversity (Hewitt 1996; Ibrahim *et al.* 1996). In contrast to our findings and in accordance with the rear-edge hypothesis, field studies have highlighted that some species display high regional genetic diversity towards their rear edge. In the particular case of the photosynthetic marine organisms, several papers have been published recently showing this pattern of low levels of intra-population genetic diversity but high regional genetic diversity of pooled populations typical of rear edges along the European Atlantic coast (in the seagrass *Zostera marina*, Diekmann & Serrão 2012; in the red alga *Chondrus crispus*, Provan & Maggs 2012; and in the kelp *Saccorhiza polyschides*, Assis *et al.* 2013). In the case of *Ld*, we contend that the populations in SBr do not constitute a long-term storage of genetic diversity as in

classical rear edges. Refuges from the last glacial maximum for *Ld* were probably not located in SBr, but most likely further north in the western part of the Channel (e.g. Hurd Deep) as reported for several macroalgae (Provan *et al.* 2005; Maggs *et al.* 2008). Moreover, for both *Ld* and *Lh*, the highest levels of regional genetic diversity and unique diversity were found in the IrS and MoB, i.e., closer to the Hurd Deep, suggesting that this area sheltered refuges during the last glacial maximum.

Recommendations for the harvest and management of natural stocks

In Brittany, *Ld* and *Lh* are both harvested to extract alginates and most of the crop comes from MoB and the IrS, the two regions that store high and unique genetic diversity. On the one hand, the high genetic diversity of these two kelp species in MoB and the IrS ensure a high evolutionary potential for recovery despite harvesting. On the other hand, these populations harbour rare and unique genetic diversity, which is fragile: if lost, it is lost forever. In addition, MoB and the IrS have been described as potential refuges from recent climate change for several species of red seaweeds living under the kelp canopy (Gallon *et al.* submitted). To avoid the loss of rare genetic diversity and its potential negative effects at the community level (reviewed by Hughes *et al.* 2008), harvesting practices in Brittany should avoid fragmenting the kelp populations. Currently, *Lh* is harvested using the Norwegian comb, a dragging device which scrape the substratum leading to substantial breakage and crushing of its surface (obs. pers.). This substratum damage likely causes negative side-effects that have received little attention (Leclerc 2013) because most monitoring efforts are devoted to quotas. Although we do not have enough hindsight yet to assess the impact of the Norwegian comb on the connectivity of *Lh* populations, it would be judicious to design a more efficient device to harvest *Lh* with less impact on the rocky substratum.

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Data accessibility

- Microsatellites sequences: Genbank accessions AJ003161 – AJ003162 – Y17350 – Y17351 – Y17346 – Y17348 – KF767485 – KF767490 – KF767492 – KF767494 – KF767495 – KF767497 – KF767498
- Microsatellites genotypes uploaded as online supplemental material

Author contributions

M.R., L.L. and M.V. conceived and designed the experiments. M.R., L.L. and M.V. collected samples. M.R. genotyped *Ld* samples and S.M. *L. hyperborea* samples. M.R., M.V. and S.M.

participated in data analysis and synthesis. M.R. wrote the manuscript with contributions from all authors.

Supporting information

Table S1 Microsatellite genotypes of *Laminaria digitata* individuals in GeneAlex format

Article 4: M. Robuchon *et al.*, submitted to *Molecular Ecology*

		011	764	020	007	046	012	040	059	055	048	039	41	027	035	47	42	42	34	19	37	33	70	31
				Guimereux	La Bigne	Nerput	Le Moulin	Les Amas	Primel	Duons Est	Duons Ouest	Santec 2	Santec 1	Les Amiettes	Les Linioues	Men Vriant	Klosenn Mala	Les Respects	St Mathieu	Pointe du gra	Houat 2	Houat 1	Hoedic	
Individus	pops	Ld148	Ld158			Ld167			Ld371		Ld531		Ld704		Lo454-23	Lo454-24		Lo454-17		Lo454-28			Lo4-24	
LD-gui12	Guimereux	198	198	242	242	170	176	144	144	144	233	242	288	292	307	316	316	180	180	206	206	224	224	224
LD-gui16	Guimereux	198	198	238	240	176	176	144	144	144	242	242	292	292	307	307	313	316	180	180	206	206	224	224
LD-gui19	Guimereux	189	198	240	242	170	176	144	144	144	242	242	288	292	304	307	316	316	180	180	206	206	224	228
LD-gui2	Guimereux	189	195	240	242	170	170	144	144	144	242	242	288	288	301	307	313	316	180	180	206	206	224	224
LD-gui22	Guimereux	189	198	240	240	176	176	141	144	144	233	242	292	292	307	310	313	316	180	180	206	206	224	224
LD-gui3	Guimereux	195	195	240	240	170	176	135	144	144	233	233	288	292	307	307	316	316	180	180	206	206	224	224
LD-gui7	Guimereux	189	195	240	240	170	170	123	147	144	233	233	288	288	307	307	316	316	180	180	198	206	224	224
LD-big1	La Bigne	195	198	240	240	170	176	144	144	144	233	242	288	288	304	307	313	313	180	180	206	206	224	224
LD-big10	La Bigne	195	195	240	240	176	176	129	144	144	242	242	288	288	307	316	313	316	180	180	198	206	224	224
LD-big11	La Bigne	189	198	240	240	176	176	141	144	144	233	233	288	292	307	307	316	316	180	180	206	206	224	224
LD-big12	La Bigne	189	198	240	242	152	170	144	144	144	233	236	288	288	307	316	316	316	180	180	198	198	224	224
LD-big16	La Bigne	198	198	240	240	176	176	144	144	144	233	242	288	292	307	307	313	316	180	180	206	206	224	224
LD-big17	La Bigne	195	198	240	240	176	176	144	144	144	233	233	288	292	307	307	313	316	180	180	206	206	224	224
LD-big18	La Bigne	195	198	240	240	173	176	144	147	144	242	242	288	288	304	307	313	316	180	180	206	206	224	224
LD-big19	La Bigne	189	198	240	240	176	176	123	144	144	233	233	288	288	307	310	313	316	180	180	206	206	224	224
LD-big2	La Bigne	195	198	240	240	173	176	141	144	144	233	242	286	288	307	307	313	316	180	180	206	206	224	224
LD-big20	La Bigne	189	198	240	240	176	176	135	144	144	233	242	288	288	307	307	313	313	180	180	206	206	224	224
LD-big21	La Bigne	189	195	240	240	170	176	144	147	144	236	242	288	292	307	316	313	316	180	180	206	206	224	224
LD-big22	La Bigne	189	195	240	240	170	176	144	144	144	233	242	288	288	307	316	316	316	180	180	198	206	224	224
LD-big23	La Bigne	195	198	240	240	170	176	144	147	144	233	233	288	292	307	316	316	316	180	180	206	206	224	224
LD-big25	La Bigne	189	189	240	240	170	176	123	144	144	233	233	288	288	307	316	313	316	180	180	206	206	224	224
LD-big26	La Bigne	189	195	240	242	173	176	132	144	144	233	233	288	288	304	307	313	316	180	180	206	218	224	224
LD-big27	La Bigne	189	198	240	240	170	170	144	144	144	242	242	288	288	304	307	313	316	180	180	198	206	224	224
LD-big28	La Bigne	189	195	240	240	170	176	123	144	144	233	242	292	292	307	307	316	316	180	180	206	206	224	224
LD-big29	La Bigne	189	198	240	240	170	176	144	144	144	233	242	288	292	307	316	316	316	180	180	206	206	224	224
LD-big3	La Bigne	189	198	240	242	176	176	144	144	144	242	242	288	288	307	310	310	313	180	180	198	206	224	224
LD-big30	La Bigne	189	195	240	240	170	176	141	144	144	233	242	288	288	307	307	313	316	180	180	206	206	224	224
LD-big31	La Bigne	198	198	240	242	152	176	144	144	144	233	233	288	288	307	307	313	316	180	180	198	198	224	224
LD-big32	La Bigne	189	198	240	242	176	176	123	144	144	233	233	288	288	307	307	316	316	180	180	206	206	224	224
LD-big33	La Bigne	189	198	240	240	170	176	141	144	144	236	242	288	288	307	307	313	316	180	180	198	206	224	224
LD-big34	La Bigne	195	198	240	242	176	176	144	144	144	242	242	288	288	307	307	316	316	180	180	206	206	224	224
LD-big35	La Bigne	195	198	240	242	176	176	144	147	144	242	242	288	292	307	307	316	316	180	180	198	206	224	224
LD-big36	La Bigne	195	198	242	246	170	176	144	147	144	242	242	292	292	307	307	313	316	180	180	206	206	224	224
LD-big37	La Bigne	195	198	240	240	176	176	123	144	144	233	242	288	288	307	307	310	316	180	183	206	206	224	224
LD-big38	La Bigne	198	198	240	240	176	176	123	144	144	233	233	288	288	307	307	313	316	180	180	206	206	224	224
LD-big39	La Bigne	189	198	240	240	170	176	123	144	144	233	242	288	288	307	316	316	316	180	180	206	206	224	224
LD-big4	La Bigne	189	198	240	240	170	176	144	144	144	233	242	288	288	307	307	313	313	180	180	206	206	224	224
LD-big40	La Bigne	189	198	240	240	176	176	135	144	144	233	242	288	288	307	313	316	316	180	180	206	206	224	224
LD-big41	La Bigne	189	198	240	240	164	176	123	144	144	233	233	288	292	304	307	313	316	180	180	198	206	224	224
LD-big42	La Bigne	189	198	240	240	170	176	123	141	144	233	242	288	288	307	307	313	319	180	180	206	206	224	224
LD-big43	La Bigne	189	198	240	242	170	176	132	144	144	233	242	288	288	307	307	313	316	180	180	206	206	224	224
LD-big44	La Bigne	189	195	240	242	170	176	123	144	144	242	242	288	288	307	316	316	316	180	180	198	206	224	224
LD-big45	La Bigne	189	189	240	240	170	170	144	144	144	236	242	288	288	307	307	313	316	180	180	198	206	224	224
LD-big46	La Bigne	189	195	240	240	164	176	120	144	144	233	242	288	292	307	316	313	316	180	180	206	206	224	224
LD-big47	La Bigne	198	198	242	242	176	176	132	144	144	242	242	288	288	304	307	316	316	180	180	206	206	224	224
LD-big48	La Bigne	195	195	240	240	170	176	120	144	144	233	242	288	288	307	310	313	316	180	183	206	206	224	224
LD-big49	La Bigne	189	195	240	242	173	176	132	144	144	233	233	288	288	304	307	313	316	180	180	206	218	224	224
LD-big50	La Bigne	195	195	238	240	170	170	141	144	144	233	242	288	288	304	307	316	316	180	180	198	206	224	224
LD-big51	La Bigne	198	198	240	240	170	176	120	144	144	233	242	288	288	307	307	313	316	180	180	206	206	224	224
LD-big6	La Bigne	195	198	240	240	170	176	144	147	144	233	242	288	288	310	316	313	313	180	180	206	206	224	224
LD-big7	La Bigne	198	198	238	240	170	170	120	144	144	304	316	233	242	316	316	304	316	180	180	206	206	224	224
LD-big8	La Bigne	189	189	238	240	176	176	144	144	144	242	242	288	292	307	316	313	316	180	180	206	206	224	224
LD-big9	La Bigne	198	198	240	240	176	176	144	144	144	233	242	288	292	307	307	313	316	180	180	206	206	224	224
LD-ner11	Nerput	195	198	240	240	176	176	120	123	144	233	242	288	288	307	316	316	316	180	180	206	222	224	224
LD-ner12	Nerput	189	195	240	240	170	176	123	144	144	233	242	288	288	304	307	316	316	180	180	206	206	224	224
LD-ner15	Nerput	189	195	240	240	170	176	144	156	144	242	242	288	292	307	307	313	313	180	180	206	206	224	224
LD-ner1																								

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LD-mou10	Le Moulin	189	195	240	242	176	176	144	144	242	242	288	288	307	307	313	316	180	180	206	206	224	224
LD-mou11	Le Moulin	195	198	240	242	170	176	144	144	233	242	288	288	307	307	313	316	180	180	206	206	224	224
LD-mou13	Le Moulin	189	195	240	242	170	170	144	147	233	242	288	292	307	310	313	313	180	180	206	206	224	224
LD-mou14	Le Moulin	198	198	240	242	170	173	141	144	233	242	288	292	307	316	313	313	180	180	206	206	224	224
LD-mou15	Le Moulin	189	195	240	242	176	176	144	147	242	242	288	292	307	307	313	316	180	180	198	206	224	224
LD-mou17	Le Moulin	195	195	240	242	176	176	144	144	233	233	288	292	307	307	313	316	180	180	206	206	224	224
LD-mou18	Le Moulin	198	198	240	242	176	176	120	147	233	233	288	288	307	307	313	316	180	180	206	206	224	224
LD-mou2	Le Moulin	195	198	240	240	170	176	144	144	233	233	288	292	307	316	298	313	180	180	206	206	224	224
LD-mou21	Le Moulin	195	195	240	242	170	176	147	147	233	242	288	292	307	310	316	316	180	180	198	198	224	224
LD-mou22	Le Moulin	198	198	240	240	176	176	147	153	233	242	288	292	307	310	313	316	180	180	206	206	224	224
LD-mou23	Le Moulin	189	198	240	242	170	176	120	129	233	242	288	288	307	316	313	316	180	180	206	206	224	224
LD-mou24	Le Moulin	189	198	240	242	173	176	144	144	242	242	288	292	307	310	316	316	180	180	206	206	224	224
LD-mou25	Le Moulin	189	198	242	242	173	176	144	147	242	242	288	288	304	310	313	316	180	180	206	206	224	224
LD-mou26	Le Moulin	195	198	240	240	176	176	144	147	242	242	288	292	307	307	316	316	180	180	206	206	224	224
LD-mou27	Le Moulin	198	198	240	242	170	176	144	147	233	242	292	292	304	316	316	316	180	180	206	206	224	224
LD-mou28	Le Moulin	189	198	240	242	170	176	123	144	233	242	288	288	307	307	313	316	180	180	206	206	224	224
LD-mou3	Le Moulin	189	198	240	240	170	176	120	144	242	242	288	292	304	307	313	313	180	180	206	206	224	224
LD-mou31	Le Moulin	189	195	240	242	176	176	120	123	242	242	288	288	307	307	313	316	180	180	198	206	224	224
LD-mou32	Le Moulin	198	198	240	242	170	176	144	147	242	242	288	292	307	316	313	316	180	180	206	206	224	224
LD-mou33	Le Moulin	195	198	240	240	170	176	126	144	242	242	288	292	307	307	313	316	180	180	198	206	224	224
LD-mou34	Le Moulin	189	198	240	242	176	176	144	144	233	236	288	288	307	307	313	316	180	180	206	206	224	224
LD-mou35	Le Moulin	189	198	240	240	170	176	123	144	233	233	292	292	307	307	313	316	180	180	206	206	224	224
LD-mou38	Le Moulin	195	198	240	240	170	176	144	144	242	242	288	288	307	316	316	316	180	180	198	206	224	224
LD-mou39	Le Moulin	195	195	240	240	170	176	123	129	233	242	288	288	307	310	313	316	180	180	206	206	224	228
LD-mou41	Le Moulin	189	195	240	242	176	176	120	123	242	242	288	288	307	307	313	313	180	180	206	206	224	224
LD-mou42	Le Moulin	186	198	240	240	170	170	144	144	242	242	288	288	307	307	313	316	180	180	206	206	224	224
LD-mou43	Le Moulin	198	198	240	242	170	173	141	144	233	242	288	292	307	316	313	313	180	180	206	206	224	224
LD-mou45	Le Moulin	198	198	240	242	170	170	144	147	233	242	288	292	307	310	313	316	180	180	206	206	224	224
LD-mou47	Le Moulin	195	198	221	242	170	170	126	144	242	242	292	292	307	316	313	313	180	180	198	206	224	224
LD-mou48	Le Moulin	198	198	240	240	170	170	141	144	242	242	288	288	307	313	313	316	180	180	206	206	224	224
LD-mou49	Le Moulin	189	198	242	242	170	176	141	147	233	242	288	292	307	310	316	316	180	180	206	206	224	224
LD-mou5	Le Moulin	189	198	240	242	176	176	123	144	242	242	288	292	307	307	313	316	180	180	206	206	224	224
LD-mou50	Le Moulin	195	198	240	242	170	176	144	144	233	242	288	292	304	307	313	313	180	180	198	206	224	224
LD-mou51	Le Moulin	189	195	240	242	176	176	144	147	242	242	288	292	307	310	313	313	180	180	206	206	224	224
LD-mou52	Le Moulin	195	198	240	240	170	173	144	144	242	242	288	288	307	307	316	316	180	180	206	206	224	224
LD-mou6	Le Moulin	189	195	240	242	176	176	141	144	233	242	288	292	307	307	313	316	180	180	206	206	224	224
LD-mou7	Le Moulin	189	198	240	242	170	176	144	144	233	233	292	292	304	307	0	0	180	180	206	206	224	224
LD-mou8	Le Moulin	189	195	240	240	170	176	144	147	233	233	288	292	307	316	316	316	180	180	198	206	224	224
LD-mou9	Le Moulin	195	198	240	240	176	176	144	144	242	242	288	288	307	316	316	316	180	180	206	206	224	224
LD-ama1	Les Amas	189	198	240	240	176	176	120	144	233	242	288	288	307	310	316	316	180	180	206	206	224	224
LD-ama10	Les Amas	195	198	240	242	170	176	123	129	242	242	288	288	310	316	316	316	180	180	206	206	224	224
LD-ama11	Les Amas	195	198	240	242	170	176	144	144	242	242	288	288	307	322	313	316	180	180	206	206	224	224
LD-ama12	Les Amas	189	195	240	240	176	176	144	144	242	242	288	288	304	304	316	316	180	180	198	206	224	224
LD-ama13	Les Amas	189	198	240	242	170	176	144	147	233	236	288	288	307	316	316	316	180	180	206	206	224	224
LD-ama14	Les Amas	195	195	240	240	176	176	144	147	242	242	288	288	304	304	316	316	180	180	206	206	224	224
LD-ama15	Les Amas	189	195	240	242	173	176	144	144	233	242	288	288	307	316	316	316	180	180	206	206	224	224
LD-ama16	Les Amas	189	195	240	242	170	176	144	144	236	236	288	288	307	310	316	316	180	180	198	198	224	224
LD-ama17	Les Amas	189	198	240	240	176	176	144	144	242	242	288	288	304	316	316	316	180	180	198	206	224	224
LD-ama18	Les Amas	189	198	240	240	176	176	144	147	233	242	288	292	310	310	316	316	180	180	198	206	224	224
LD-ama19	Les Amas	189	198	240	242	176	176	120	150	233	242	288	288	307	307	316	316	180	180	206	206	224	224
LD-ama2	Les Amas	189	195	240	240	176	176	144	144	242	242	288	288	304	310	313	316	180	180	206	206	224	224
LD-ama21	Les Amas	189	195	240	242	176	176	144	144	242	242	288	288	307	316	316	316	180	180	198	206	224	224
LD-ama22	Les Amas	195	198	240	240	170	176	144	144	236	242	288	288	307	307	316	316	180	180	206	206	224	224
LD-ama23	Les Amas	189	198	240	240	170	176	144	144	233	242	288	288	307	307	316	316	180	180	206	206	224	224
LD-ama24	Les Amas	189	195	240	240	170	176	120	144	233	242	288	288	316	316	316	316	180	180	206	206	224	224
LD-ama25	Les Amas	195	195	238	240	176	176	144	144	233	233	288	288	304	307	316	316	180	180	206	206	224	224
LD-ama26	Les Amas	189	195	240	240	170	176	144	147	233	242	288	288	307	307	316	316	180	180	198	206	224	224
LD-ama27	Les Amas	189	189	240	240	170	176	144	150	242	242	288	288	307	313	313	316	180	180	198	206	224	224
LD-ama28	Les Amas	186	189	240	240	170	176	120	120	233	242	288	288	304	307	316	316	180	180	206	206	224	224
LD-ama29	Les Amas	0	0	240	240	170	176	141	141	233	236	288	288	307	316	316	316	180	180	206	206	224	224
LD-ama3	Les Amas	189	195	240	242	170	176	144	147	233	242	288	288	307	316	316	316	180	180	198	198	224	224
LD-ama30	Les Amas	189	198	240	240	170	176	144	147	242	242	288	288	313	316	316	316	180	180</				

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LD-ama38	Les Amas	189	189	240	240	176	176	123	144	233	242	288	288	310	310	316	316	180	180	206	206	224	224
LD-ama39	Les Amas	189	189	240	240	170	176	144	144	236	242	286	286	307	307	316	316	180	180	206	206	224	224
LD-ama4	Les Amas	189	189	240	240	170	176	144	144	236	242	288	288	307	307	313	316	180	180	206	206	224	224
LD-ama40	Les Amas	189	198	240	240	176	176	144	144	242	242	288	288	304	307	316	316	180	180	206	206	224	224
LD-ama41	Les Amas	195	198	240	240	176	176	144	144	233	242	288	288	304	310	316	316	180	180	206	206	224	224
LD-ama42	Les Amas	189	189	240	242	170	176	120	144	239	242	288	288	304	316	316	316	180	180	206	206	224	224
LD-ama43	Les Amas	189	198	238	238	170	176	144	147	242	242	288	288	316	316	316	316	180	180	206	206	224	224
LD-ama44	Les Amas	195	198	240	240	176	176	120	144	233	242	288	288	307	316	313	316	180	180	198	206	224	224
LD-ama45	Les Amas	195	198	240	240	176	176	126	144	233	242	288	288	316	316	313	316	180	180	198	206	224	224
LD-ama46	Les Amas	189	198	240	240	170	176	144	144	233	242	288	288	304	310	313	316	180	180	206	206	224	224
LD-ama47	Les Amas	189	198	240	240	176	176	123	144	233	242	288	288	292	304	0	0	180	180	206	206	224	224
LD-ama48	Les Amas	189	195	218	240	176	176	120	123	242	242	288	288	310	316	313	316	180	180	206	206	224	224
LD-ama49	Les Amas	198	198	240	240	176	176	144	144	233	236	288	288	307	307	316	316	180	180	206	206	224	224
LD-ama5	Les Amas	189	195	240	240	176	176	144	144	233	242	288	288	304	304	316	316	180	180	206	206	224	224
LD-ama50	Les Amas	195	198	240	240	170	170	123	144	236	242	288	288	307	310	316	316	180	180	206	206	224	224
LD-ama51	Les Amas	189	198	221	240	170	170	129	144	233	236	288	292	307	307	316	316	180	180	206	206	224	224
LD-ama52	Les Amas	198	198	240	240	176	176	120	129	236	242	0	0	307	307	316	316	180	180	206	206	224	224
LD-ama53	Les Amas	189	198	240	240	170	173	144	144	233	242	288	288	304	307	316	316	180	180	206	206	224	224
LD-ama54	Les Amas	189	195	240	242	176	176	129	144	233	242	288	288	307	310	313	316	180	180	206	206	224	224
LD-ama55	Les Amas	189	195	240	240	170	170	144	147	236	236	288	288	316	316	313	316	180	180	206	206	224	224
LD-ama56	Les Amas	195	195	240	240	176	176	144	144	233	242	288	288	313	316	316	316	180	180	206	206	224	224
LD-ama57	Les Amas	189	195	240	240	176	176	120	144	242	242	288	288	310	316	313	316	180	180	206	206	224	224
LD-ama58	Les Amas	195	198	240	240	176	176	120	120	233	242	288	288	310	316	313	316	180	180	198	206	224	224
LD-ama59	Les Amas	195	198	240	240	176	176	123	150	233	242	288	288	307	307	313	316	180	180	206	206	224	224
LD-ama60	Les Amas	189	195	240	240	176	182	141	144	242	242	288	288	304	310	316	316	180	180	206	206	224	224
LD-ama61	Les Amas	189	189	240	240	176	176	129	144	242	242	288	288	316	316	313	316	180	180	206	206	224	224
LD-ama62	Les Amas	189	198	240	240	176	176	144	144	233	233	288	288	307	316	316	316	180	180	198	206	224	224
LD-ama8	Les Amas	189	198	240	240	176	176	120	144	242	242	286	292	304	313	316	316	180	180	206	206	224	224
LD-ama9	Les Amas	189	195	240	240	176	176	144	147	233	233	288	288	307	307	316	316	180	180	198	206	224	224
LD-pri1	Primel	195	195	238	238	173	173	123	132	236	242	288	288	310	310	316	316	180	180	206	206	224	224
LD-pri10	Primel	189	198	240	240	170	176	123	147	236	236	288	288	313	316	310	316	180	180	206	206	224	224
LD-pri11	Primel	195	195	238	240	173	176	126	132	236	239	288	288	307	307	316	316	180	180	186	206	224	224
LD-pri12	Primel	189	189	240	240	173	173	120	144	233	236	288	288	316	316	310	316	180	180	198	206	224	224
LD-pri13	Primel	186	195	240	240	173	173	126	147	236	242	288	288	307	307	310	316	180	180	206	206	224	224
LD-pri14	Primel	186	198	238	240	173	173	141	144	242	242	288	288	304	307	310	316	180	180	206	206	222	224
LD-pri15	Primel	186	189	240	240	173	173	129	141	236	242	288	288	310	310	313	316	180	180	198	206	224	224
LD-pri16	Primel	195	195	240	240	173	173	132	147	236	239	288	292	289	307	316	316	180	180	189	206	224	224
LD-pri17	Primel	195	195	240	240	173	176	132	132	236	242	288	288	307	307	313	316	180	180	189	206	224	224
LD-pri18	Primel	195	198	240	240	173	173	120	138	239	242	288	288	301	304	313	316	180	180	189	206	224	224
LD-pri19	Primel	195	198	238	240	173	173	126	144	233	236	288	288	292	313	316	316	180	180	198	206	224	224
LD-pri2	Primel	195	195	238	238	173	176	120	144	242	242	288	288	307	316	316	316	180	180	206	206	224	224
LD-pri20	Primel	189	195	238	240	173	173	120	141	236	242	288	292	310	313	316	316	180	180	206	206	224	224
LD-pri21	Primel	195	195	238	240	173	173	120	126	236	236	288	288	307	307	316	316	180	180	206	206	222	224
LD-pri22	Primel	186	189	240	240	173	176	138	141	236	236	288	288	307	313	301	313	180	180	206	206	224	224
LD-pri23	Primel	183	195	240	240	176	176	141	141	236	242	288	288	307	307	316	316	180	180	206	206	224	224
LD-pri24	Primel	189	189	238	238	173	176	141	144	233	242	288	288	307	307	313	316	180	180	206	206	224	224
LD-pri25	Primel	183	186	238	238	173	176	120	132	236	242	288	288	307	307	316	316	180	180	198	198	224	224
LD-pri26	Primel	183	198	238	238	173	176	141	147	242	242	288	290	307	307	316	316	180	180	189	206	224	224
LD-pri27	Primel	189	198	240	240	173	173	120	123	233	236	288	292	310	316	313	316	180	180	189	206	222	224
LD-pri28	Primel	189	195	240	240	173	176	123	135	236	236	288	288	307	307	316	316	180	180	186	198	206	224
LD-pri29	Primel	186	186	240	240	170	170	141	144	242	242	288	288	307	307	316	316	180	180	206	206	224	224
LD-pri3	Primel	195	195	240	240	176	176	126	144	236	242	288	288	307	313	316	316	180	180	186	206	224	224
LD-pri30	Primel	189	189	238	240	173	173	141	144	236	236	288	292	301	307	316	316	180	180	206	206	224	224
LD-pri31	Primel	168	189	238	240	173	176	141	147	236	236	288	288	292	313	316	316	180	180	189	190	206	222
LD-pri32	Primel	186	195	236	240	176	176	138	141	236	242	288	288	310	316	313	316	180	180	206	206	224	224
LD-pri33	Primel	183	189	238	240	170	170	117	120	236	239	288	288	307	307	310	313	180	180	198	198	224	224
LD-pri34	Primel	198	198	240	240	173	176	123	141	233	236	288	290	304	307	316	316	180	180	198	198	224	224
LD-pri35	Primel	183	198	240	240	152	176	123	132	233	242	288	288	307	316	316	316	186	189	198	198	224	224
LD-pri37	Primel	183	195	238	240	170	170	123	123	236	242	288	288	307	307	316	316	180	180	186	206	224	224
LD-pri38	Primel	189	198	238	240	170	176	117	147	233	236	288	292	307	316	316	316	180	180	198	198	224	224
LD-pri39	Primel	183	195	240	240	170	173	123	141	236	239	288	288	307	307	316	319	180	180	206	206	224	224
LD-pri4	Primel	195	198	238	238	173	176	123	126	236	236	288	288	307	310	313	316	180	180	206	206	224	22

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LD-pri47	Primel	195	198	240	240	173	176	144	147	233	242	288	288	301	301	316	316	180	180	198	198	224	224
LD-pri48	Primel	186	189	240	240	173	176	141	144	236	242	288	288	307	316	316	316	180	180	206	206	224	224
LD-pri49	Primel	186	186	238	240	173	176	144	147	236	242	288	288	310	313	313	316	180	180	206	206	224	224
LD-pri5	Primel	198	198	240	240	170	173	123	132	236	236	288	288	307	316	313	313	180	180	206	206	222	224
LD-pri50	Primel	186	189	236	242	173	173	120	147	233	236	288	288	301	301	313	316	180	180	194	206	224	224
LD-pri51	Primel	186	198	240	240	176	176	123	141	236	239	288	288	307	316	310	316	180	180	198	198	224	224
LD-pri52	Primel	186	195	238	238	176	176	123	147	236	236	288	288	307	307	316	316	180	180	206	206	224	224
LD-pri53	Primel	186	198	238	240	176	176	132	147	233	239	288	288	313	313	316	316	180	180	206	206	224	224
LD-pri54	Primel	195	198	238	238	170	170	120	144	236	242	288	288	307	310	0	0	180	186	186	206	224	224
LD-pri55	Primel	183	198	238	238	176	176	123	132	236	236	288	288	310	310	316	316	180	180	198	198	224	224
LD-pri56	Primel	189	195	240	240	173	176	120	120	236	242	288	288	310	316	313	316	180	186	198	206	224	224
LD-pri6	Primel	195	198	238	240	173	176	123	141	236	236	288	288	307	310	313	313	180	189	206	206	224	224
LD-pri7	Primel	195	198	238	238	173	182	144	147	233	242	288	288	307	313	316	316	180	180	206	206	224	224
LD-pri8	Primel	195	195	240	240	176	176	120	123	236	242	288	288	307	307	313	316	180	180	206	206	224	224
LD-pri9	Primel	189	195	240	240	173	173	123	126	242	242	288	288	304	316	316	316	180	180	206	206	224	224
LD-due1	Duons Est	186	198	238	242	158	173	120	132	236	236	288	288	307	316	313	316	180	180	198	206	224	224
LD-due10	Duons Est	189	198	240	240	170	170	129	132	236	242	288	292	292	310	313	316	180	180	206	206	224	224
LD-due11	Duons Est	183	195	238	240	182	182	117	135	236	242	288	292	307	310	316	316	180	180	198	206	224	228
LD-due12	Duons Est	189	198	240	240	170	176	144	150	239	242	288	288	304	304	316	316	180	180	206	206	224	224
LD-due13	Duons Est	195	198	240	240	176	176	141	162	233	239	288	288	307	307	298	316	180	186	206	206	224	224
LD-due14	Duons Est	186	195	240	240	170	173	129	144	233	236	288	292	307	316	313	316	180	180	206	206	224	224
LD-due15	Duons Est	189	198	240	240	170	176	144	144	236	236	288	292	307	307	238	310	189	189	206	206	224	224
LD-due16	Duons Est	189	195	240	240	176	176	144	144	236	242	288	288	310	310	316	316	180	180	206	206	224	224
LD-due17	Duons Est	195	198	240	240	170	173	123	132	233	242	288	288	292	310	316	316	180	189	198	206	224	224
LD-due18	Duons Est	177	189	240	240	173	176	123	126	233	233	288	290	301	316	313	316	180	186	206	206	224	224
LD-due19	Duons Est	186	186	238	240	173	173	144	150	236	242	288	292	307	307	238	316	180	186	206	206	224	224
LD-due2	Duons Est	177	195	238	240	170	170	147	147	239	242	288	292	292	310	316	322	180	180	190	206	224	224
LD-due20	Duons Est	198	198	240	242	173	176	123	144	242	242	288	292	304	307	316	316	180	180	206	206	220	224
LD-due21	Duons Est	195	198	240	240	173	176	144	144	242	242	288	288	307	307	316	316	141	180	198	206	224	224
LD-due22	Duons Est	186	195	240	240	173	173	132	144	236	242	288	292	301	316	316	316	180	189	206	214	224	224
LD-due23	Duons Est	174	198	240	240	173	176	144	153	236	242	288	288	313	313	316	316	180	186	206	206	224	224
LD-due24	Duons Est	189	195	240	240	170	176	132	132	236	242	288	290	307	313	316	316	180	180	206	206	224	224
LD-due25	Duons Est	189	195	240	240	158	182	135	153	236	242	288	288	307	310	316	316	180	189	206	206	224	224
LD-due26	Duons Est	186	198	238	240	176	176	144	144	233	236	288	288	307	313	313	316	180	180	206	206	224	224
LD-due27	Duons Est	186	189	236	240	173	173	138	141	233	242	288	292	307	310	298	313	180	186	198	224	224	224
LD-due28	Duons Est	198	198	240	242	173	135	138	138	233	233	288	288	307	316	316	316	180	189	206	206	224	224
LD-due29	Duons Est	189	192	240	240	170	173	132	138	236	242	292	292	316	316	316	316	180	189	206	206	224	224
LD-due3	Duons Est	189	189	240	240	173	176	144	144	242	242	288	288	310	310	316	316	180	186	206	206	224	224
LD-due30	Duons Est	177	189	236	240	170	176	132	144	233	236	288	288	286	292	313	313	180	189	206	206	224	224
LD-due31	Duons Est	189	195	240	240	170	176	129	144	233	236	288	288	289	307	316	316	180	180	190	206	224	224
LD-due32	Duons Est	189	198	240	240	170	176	123	129	239	239	288	288	307	310	313	316	180	180	198	206	224	224
LD-due33	Duons Est	198	198	240	240	170	173	123	141	242	242	288	288	310	310	316	316	180	189	198	206	224	224
LD-due35	Duons Est	195	198	240	240	173	173	123	147	236	239	288	292	307	310	0	0	180	180	206	206	224	224
LD-due36	Duons Est	189	189	240	240	170	176	144	147	242	242	288	288	307	313	316	316	180	180	198	206	224	224
LD-due37	Duons Est	189	195	240	240	176	176	129	132	236	242	288	288	310	313	316	316	180	180	198	206	224	224
LD-due38	Duons Est	195	198	238	240	173	176	126	126	239	242	286	292	307	310	313	316	180	180	206	206	224	224
LD-due39	Duons Est	189	198	240	240	176	176	138	144	242	242	288	288	307	307	316	316	180	189	206	206	224	224
LD-due4	Duons Est	189	198	240	240	176	176	132	144	242	242	288	288	292	316	316	316	180	180	206	206	224	224
LD-due40	Duons Est	168	198	238	242	173	176	123	144	236	242	288	292	301	310	313	319	180	180	206	206	224	224
LD-due41	Duons Est	186	198	240	240	170	176	123	132	233	242	288	288	310	316	316	316	180	189	206	206	224	224
LD-due42	Duons Est	168	189	238	240	170	173	138	162	236	242	288	288	307	313	310	316	180	180	202	206	224	224
LD-due43	Duons Est	189	198	240	240	173	173	123	147	242	242	288	288	307	313	316	316	180	180	206	206	224	224
LD-due44	Duons Est	198	198	240	240	176	176	141	144	242	242	288	292	286	307	316	316	180	180	206	206	224	224
LD-due45	Duons Est	189	198	240	240	176	176	132	144	236	239	292	292	301	310	313	316	141	180	198	198	224	224
LD-due46	Duons Est	189	195	236	240	173	176	123	135	242	242	288	288	292	316	313	316	180	180	206	206	224	224
LD-due47	Duons Est	177	195	238	240	173	173	120	144	233	239	288	288	292	316	313	316	180	180	206	206	224	224
LD-due48	Duons Est	195	195	240	240	173	176	120	144	233	242	288	288	307	316	298	310	180	180	206	206	224	224
LD-due49	Duons Est	186	198	238	240	170	170	144	144	236	242	288	292	307	307	316	316	180	180	206	206	224	224
LD-due5	Duons Est	177	198	240	240	173	176	120	129	233	236	288	288	310	313	316	316	180	180	198	206	224	224
LD-due50	Duons Est	183	186	238	240	170	176	147	147	236	239	286	288	310	313	316	319	180	180	206	206	224	224
LD-due6	Duons Est	195	198	240	242	170	176	123	135	236	242	288	288	304	310	316	316	180	180	206	206	224	224
LD-due8	Duons Est	198	198	238	240	173	176	132	132	236	236	288	292	307	313	316	316	180	186				

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Duons Q1-68:Duons Ouest	189	195	240	240	176	176	120	150	233	236	288	288	292	316	316	316	180	180	206	206	224	228	
Duons Q1-70:Duons Ouest	198	198	240	240	173	173	120	123	233	242	288	288	310	313	310	319	180	180	206	206	224	224	
Duons Q1-70:Duons Ouest	195	198	240	240	173	173	120	132	242	242	288	292	307	310	313	316	180	180	206	206	224	224	
Duons Q1-77:Duons Ouest	189	195	242	240	170	173	123	150	233	242	288	288	307	307	313	316	180	180	206	206	224	224	
Duons Q1-77:Duons Ouest	177	195	236	238	158	172	123	141	236	239	288	292	307	313	316	316	180	180	206	206	224	224	
Duons Q2-38:Duons Ouest	198	198	240	240	170	173	129	132	242	242	288	288	307	307	313	316	180	180	198	206	0	0	
Duons Q2-66:Duons Ouest	189	195	240	240	170	176	126	147	233	242	288	292	310	310	310	316	180	180	206	206	224	224	
Duons Q2-66:Duons Ouest	198	198	240	240	152	173	126	141	236	242	288	288	307	313	310	319	180	180	206	206	224	224	
Duons Q2-69:Duons Ouest	189	195	238	242	176	176	126	144	233	242	288	292	304	304	316	316	180	180	206	206	224	224	
Duons Q2-73:Duons Ouest	189	195	236	238	161	173	123	153	239	242	288	288	292	307	310	313	180	180	206	206	224	224	
Duons Q2-74:Duons Ouest	198	198	240	240	173	173	120	141	233	233	288	288	307	310	310	316	180	186	206	206	224	224	
Duons Q2-78:Duons Ouest	189	195	240	240	152	173	135	135	242	242	288	288	313	313	313	319	180	180	206	206	224	224	
Duons Q2-81:Duons Ouest	177	189	238	240	170	176	123	132	239	242	286	288	307	316	316	316	180	180	206	206	224	224	
Duons Q2-81:Duons Ouest	189	192	240	240	170	176	132	147	239	242	288	288	310	313	310	313	180	180	198	206	224	224	
Duons Q2-81:Duons Ouest	189	198	240	240	167	176	123	141	236	242	288	288	307	310	316	319	180	180	206	206	224	224	
Duons Q2-83:Duons Ouest	189	189	238	240	170	176	123	132	236	236	284	288	307	313	316	316	180	180	206	206	224	224	
Duons Q2-84:Duons Ouest	189	195	240	240	158	176	123	135	236	242	288	290	301	307	316	316	180	180	206	206	224	224	
Duons Q2-85:Duons Ouest	168	189	240	240	173	176	132	135	239	242	288	288	307	307	313	316	180	180	198	206	224	224	
Duons Q2-86:Duons Ouest	183	198	240	240	170	173	123	126	233	239	288	288	307	316	316	316	180	180	206	206	224	224	
Duons Q3-55:Duons Ouest	183	189	238	240	173	173	120	132	236	239	288	288	307	310	316	316	180	180	206	206	224	224	
Duons Q3-55:Duons Ouest	198	198	240	240	173	176	120	135	242	242	288	288	307	316	313	316	180	189	206	206	224	224	
Duons Q3-55:Duons Ouest	195	195	238	240	170	170	129	147	236	242	288	288	313	316	316	316	180	180	206	206	224	224	
Duons Q3-57:Duons Ouest	189	189	240	240	176	176	117	123	239	242	288	288	310	310	316	316	180	180	206	206	224	224	
Duons Q3-66:Duons Ouest	189	195	240	240	176	176	120	144	236	236	288	288	307	310	310	316	180	180	198	206	222	224	
Duons Q3-66:Duons Ouest	186	189	240	240	173	176	120	123	236	242	288	288	316	319	316	316	180	180	206	206	224	224	
Duons Q3-67:Duons Ouest	186	198	240	242	152	176	132	135	239	242	288	288	304	316	310	316	186	189	206	206	224	224	
Duons Q3-68:Duons Ouest	189	198	240	240	173	176	126	132	236	236	288	292	304	310	298	319	180	180	206	206	224	224	
Duons Q3-68:Duons Ouest	189	189	240	240	173	176	144	144	239	242	288	288	307	307	313	316	180	180	206	206	224	224	
Duons Q3-73:Duons Ouest	189	198	240	240	176	176	120	126	236	239	288	288	307	313	313	316	180	180	206	206	224	224	
Duons Q3-73:Duons Ouest	189	195	238	240	170	173	123	138	236	242	288	288	289	310	310	316	180	180	206	206	224	224	
Duons Q3-77:Duons Ouest	189	198	238	240	176	176	132	138	236	242	288	288	292	307	313	316	189	189	198	206	224	224	
Duons Q3-78:Duons Ouest	189	198	240	240	173	173	126	144	239	242	288	288	313	316	316	316	180	180	206	206	224	224	
Duons Q3-78:Duons Ouest	186	189	240	240	158	173	117	144	236	242	288	288	307	310	316	316	180	189	198	206	224	224	
LD-sa210	Santec 2	198	198	238	240	152	176	132	135	236	236	288	288	310	316	313	316	180	189	206	206	224	224
LD-sa211	Santec 2	186	198	240	240	164	176	135	162	236	242	288	292	301	313	313	313	189	189	206	206	224	224
LD-sa212	Santec 2	177	186	236	240	173	173	123	147	236	236	288	288	292	307	316	319	180	186	198	206	224	224
LD-sa213	Santec 2	168	189	240	242	176	176	126	138	233	242	288	292	307	307	301	316	180	180	206	206	224	224
LD-sa214	Santec 2	189	189	238	240	164	173	150	156	236	242	288	292	307	310	313	316	189	189	198	206	224	224
LD-sa215	Santec 2	198	198	240	240	173	176	123	132	236	236	288	288	301	307	301	316	180	180	206	206	224	224
LD-sa216	Santec 2	168	168	240	240	173	176	135	144	236	242	288	288	307	310	316	316	180	186	206	206	224	224
LD-sa217	Santec 2	189	198	240	240	170	176	123	153	236	236	288	288	307	307	313	316	180	189	198	206	224	224
LD-sa218	Santec 2	183	198	240	240	170	173	120	141	239	242	288	292	301	301	316	319	180	189	206	206	224	224
LD-sa219	Santec 2	189	195	240	240	152	173	120	153	236	242	288	292	310	310	316	316	180	180	206	206	224	224
LD-sa220	Santec 2	189	195	238	240	173	173	138	153	236	236	288	292	292	307	316	316	180	180	202	206	222	224
LD-sa221	Santec 2	189	189	240	240	173	176	123	150	236	242	288	288	301	304	313	316	180	186	198	206	224	224
LD-sa222	Santec 2	189	195	240	240	155	176	123	159	236	242	288	292	307	313	316	316	183	189	206	206	224	224
LD-sa223	Santec 2	186	198	240	240	173	173	123	123	236	242	288	288	313	316	313	316	180	180	206	206	224	224
LD-sa224	Santec 2	168	189	240	240	173	182	141	141	236	242	288	292	307	307	316	316	180	180	206	206	224	224
LD-sa225	Santec 2	186	198	240	240	173	176	150	165	236	239	288	292	307	316	313	316	180	180	198	206	224	224
LD-sa226	Santec 2	198	198	240	240	164	194	120	147	236	236	288	288	292	310	316	316	180	180	206	206	224	224
LD-sa227	Santec 2	183	198	240	240	164	170	117	147	236	242	288	292	310	313	313	316	180	189	206	206	224	224
LD-sa228	Santec 2	186	189	240	240	173	176	120	129	236	236	288	292	304	310	316	316	180	180	198	206	224	224
LD-sa229	Santec 2	168	183	238	240	176	176	132	150	236	242	288	288	307	316	313	316	180	180	198	198	224	224
LD-sa23	Santec 2	189	189	240	240	173	176	123	144	239	242	288	292	304	307	313	316	180	180	198	206	224	224
LD-sa230	Santec 2	186	198	240	242	176	176	123	147	233	236	288	288	307	310	298	316	180	180	198	206	224	224
LD-sa233	Santec 2	186	198	240	240	173	176	150	165	236	239	288	292	307	316	313	316	180	180	198	206	224	224
LD-sa234	Santec 2	195	198	238	240	176	188	150	150	236	242	288	292	292	310	316	316	180	180	206	206	224	224
LD-sa235	Santec 2	183	198	240	240	164	170	117	147	236	242	288	292	310	313	313	316	180	189	206	206	224	224
LD-sa236	Santec 2	186	189	240	240	173	176	120	129	236	236	288	292	304	310	316	316	180	180	198	206	224	224
LD-sa237	Santec 2	195	198	240	240	173	176	165	168	242	242	288	292	307	316	310	313	180	180	198	198	224	224
LD-sa238	Santec 2	186	198	240	242	176	176	123	147	233	236	288	288	307	310	298	316	180	180	198	206	224	224
LD-sa239	Santec 2	189	198	240	242	173	176	123	138	233	236	288	288	307	307	316	316						

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LD-sa247	Santec 2	189	189	238	240	173	176	126	135	236	239	292	292	304	307	310	316	180	180	206	206	224	226
LD-sa25	Santec 2	189	189	0	0	164	176	120	123	242	242	288	288	313	313	280	316	180	180	198	206	224	224
LD-sa27	Santec 2	189	195	240	240	176	176	141	156	236	242	288	292	304	310	313	316	180	186	206	206	224	224
LD-sa28	Santec 2	195	195	238	240	173	176	123	141	236	242	288	288	304	310	313	316	180	180	198	206	224	224
LD-sa29	Santec 2	189	195	238	240	170	176	123	147	236	242	288	288	307	310	316	316	180	189	206	206	224	224
LD-sa11	Santec 1	186	198	240	242	173	173	123	141	236	236	288	292	307	313	313	316	180	189	202	206	224	224
LD-sa110	Santec 1	189	195	236	242	173	176	132	138	236	239	288	288	310	310	316	316	180	180	198	206	224	224
LD-sa112	Santec 1	189	189	240	242	173	176	120	123	233	242	288	292	313	313	313	316	180	189	202	206	224	224
LD-sa113	Santec 1	168	189	238	238	155	176	141	144	236	242	288	292	307	313	316	316	180	180	206	206	224	226
LD-sa114	Santec 1	198	198	238	240	176	176	144	147	233	236	288	288	292	307	298	313	180	189	206	206	224	224
LD-sa115	Santec 1	186	198	240	240	173	173	132	132	236	242	288	292	307	307	0	0	180	186	206	206	224	224
LD-sa116	Santec 1	186	195	240	242	176	176	120	159	236	236	288	288	292	307	316	316	189	189	198	206	224	224
LD-sa117	Santec 1	189	198	236	240	173	176	144	144	236	242	286	288	307	307	0	0	180	180	206	206	224	224
LD-sa118	Santec 1	189	198	236	242	167	176	123	123	233	242	292	292	307	307	316	316	180	180	206	206	224	224
LD-sa119	Santec 1	195	198	240	240	173	173	120	123	236	242	288	292	316	316	316	316	189	189	206	206	224	224
LD-sa12	Santec 1	186	198	240	240	176	176	123	150	233	242	288	288	307	310	316	316	180	180	206	206	224	224
LD-sa120	Santec 1	186	186	236	240	173	176	120	165	236	242	288	292	307	307	316	316	180	186	206	206	224	224
LD-sa121	Santec 1	186	198	240	240	176	188	123	123	233	236	288	288	307	307	0	0	189	189	198	206	224	224
LD-sa123	Santec 1	189	189	240	242	176	182	120	156	233	236	288	288	307	313	298	316	174	180	206	206	224	224
LD-sa124	Santec 1	183	189	238	242	176	182	123	135	236	236	288	292	313	319	313	316	180	189	206	206	222	224
LD-sa125	Santec 1	186	198	240	240	170	176	120	123	236	236	288	288	307	310	316	316	180	180	206	206	224	224
LD-sa126	Santec 1	198	198	240	240	176	182	120	135	236	236	288	292	310	316	0	0	180	180	198	206	224	224
LD-sa127	Santec 1	189	195	240	242	176	176	123	123	236	242	292	292	307	310	316	316	177	180	206	206	224	224
LD-sa128	Santec 1	186	186	238	242	173	176	129	138	236	242	288	288	316	316	316	316	180	180	198	206	224	224
LD-sa129	Santec 1	189	198	240	240	170	173	120	153	236	242	288	288	301	304	316	316	180	189	198	206	224	224
LD-sa13	Santec 1	168	186	240	240	146	173	123	144	242	242	288	288	307	316	313	316	180	189	206	206	224	224
LD-sa130	Santec 1	186	198	240	240	176	176	144	156	236	242	288	288	307	310	0	0	180	189	190	206	224	224
LD-sa14	Santec 1	198	198	240	240	173	173	123	144	236	242	288	292	307	307	316	316	180	186	206	206	224	224
LD-sa15	Santec 1	189	198	240	240	173	173	120	120	236	242	288	292	310	310	0	0	180	189	206	206	224	224
LD-sa16	Santec 1	168	189	218	240	164	173	120	120	236	242	288	292	304	304	0	0	180	180	194	198	224	224
LD-sa17	Santec 1	186	195	238	238	158	173	120	123	233	242	288	288	307	316	0	0	180	180	198	198	224	224
LD-sa19	Santec 1	189	195	240	240	152	152	123	126	233	236	288	288	307	307	310	316	180	180	206	206	224	224
LD-ami1	Les Amiettes	195	198	240	240	173	176	126	138	236	242	288	288	307	310	313	316	180	186	206	206	224	224
LD-ami11	Les Amiettes	186	189	238	240	173	176	120	147	239	242	292	292	307	310	310	316	180	180	206	206	224	224
LD-ami12	Les Amiettes	189	189	240	242	173	176	120	123	233	233	288	292	307	307	316	316	180	180	206	206	224	224
LD-ami13	Les Amiettes	189	198	240	240	176	176	123	144	236	242	286	292	307	313	316	316	180	189	198	206	224	224
LD-ami14	Les Amiettes	198	198	240	240	173	176	126	141	239	242	288	290	307	313	316	316	180	180	206	210	222	224
LD-ami15	Les Amiettes	186	186	240	240	176	182	138	147	239	242	288	288	292	310	313	316	180	189	206	206	224	224
LD-ami16	Les Amiettes	189	195	240	242	176	188	132	144	233	236	288	292	304	307	316	316	180	180	206	206	224	224
LD-ami17	Les Amiettes	186	195	236	240	173	176	120	162	236	242	288	292	307	316	310	316	180	183	198	206	222	224
LD-ami18	Les Amiettes	189	189	240	242	176	176	120	129	242	242	288	292	304	316	316	316	180	180	194	206	224	224
LD-ami19	Les Amiettes	186	198	240	240	152	164	114	132	236	239	288	288	307	307	313	316	189	189	198	206	224	224
LD-ami2	Les Amiettes	189	192	240	240	173	176	123	123	233	236	288	292	304	307	313	313	180	180	206	206	224	224
LD-ami20	Les Amiettes	168	198	240	240	173	176	123	126	236	236	288	288	292	316	310	316	180	180	206	206	224	224
LD-ami21	Les Amiettes	189	195	240	240	173	176	120	120	233	233	288	292	307	307	310	310	180	189	198	206	222	226
LD-ami22	Les Amiettes	183	186	240	240	173	176	129	129	233	236	288	292	307	307	316	316	180	180	206	206	224	224
LD-ami23	Les Amiettes	189	189	238	242	170	173	138	147	233	242	288	292	310	310	316	316	180	189	198	206	224	224
LD-ami24	Les Amiettes	186	186	240	240	176	176	123	126	236	242	288	288	310	310	316	319	180	180	206	206	222	226
LD-ami25	Les Amiettes	189	195	240	240	170	170	120	123	242	242	292	292	307	313	316	316	180	180	206	206	224	224
LD-ami26	Les Amiettes	168	168	240	240	173	176	144	147	236	242	288	292	307	307	316	316	180	189	206	206	224	224
LD-ami27	Les Amiettes	186	198	240	240	170	176	120	162	239	242	288	292	307	310	316	316	180	189	206	206	224	224
LD-ami29	Les Amiettes	189	189	240	242	173	176	117	162	233	236	288	292	316	316	313	316	180	180	206	206	224	224
LD-ami3	Les Amiettes	168	168	240	240	170	173	132	147	233	242	288	292	307	310	316	316	180	180	206	206	224	224
LD-ami30	Les Amiettes	189	198	240	240	170	176	120	153	242	242	288	288	307	313	0	0	180	189	206	210	224	224
LD-ami31	Les Amiettes	168	195	240	240	173	176	126	144	236	236	292	292	304	310	0	0	180	180	206	206	224	224
LD-ami32	Les Amiettes	186	198	240	242	170	176	144	144	236	242	288	292	292	307	0	0	180	180	198	206	224	224
LD-ami33	Les Amiettes	198	198	240	242	173	176	114	123	242	242	288	288	307	307	298	316	180	180	198	206	224	224
LD-ami34	Les Amiettes	168	189	238	240	167	173	126	129	236	242	288	288	310	310	298	316	189	189	206	206	224	226
LD-ami35	Les Amiettes	189	198	240	240	176	176	120	141	242	242	288	288	301	310	304	316	180	180	206	206	224	226
LD-ami36	Les Amiettes	186	189	240	240	176	182	129	144	242	242	292	292	307	307	313	316	180	180	198	206	224	224
LD-ami37	Les Amiettes	168	177	240	240	170	170	120	147	239	242	288	288	307	307	313	313	189	189	206	206	224	224
LD-ami39	Les Amiettes	183	195	240	240	170	176	123	153	236	236	288	29										

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LD-lin11	Les Linious	198	198	238	242	173	176	117	126	236	242	288	292	292	292	316	316	180	180	190	206	224	224	
LD-lin12	Les Linious	186	189	238	242	173	176	117	123	239	242	288	292	292	292	316	316	180	180	198	206	224	224	
LD-lin13	Les Linious	198	198	236	240	173	173	120	138	242	242	288	292	310	310	316	316	180	180	206	206	224	224	
LD-lin14	Les Linious	186	198	236	236	173	176	132	138	236	242	284	292	292	304	298	316	180	180	206	206	224	224	
LD-lin15	Les Linious	186	198	236	242	173	176	132	144	242	242	288	292	307	310	313	316	180	180	198	206	224	224	
LD-lin16	Les Linious	189	198	236	242	173	176	120	132	242	242	288	292	307	310	310	316	180	180	206	206	222	226	
LD-lin17	Les Linious	189	198	240	240	173	176	120	135	236	242	292	292	310	310	316	316	180	180	206	206	224	224	
LD-lin18	Les Linious	189	198	236	240	173	176	132	162	236	242	288	288	310	316	316	316	180	180	206	206	222	224	
LD-lin19	Les Linious	189	198	240	242	173	176	117	117	242	242	288	292	307	310	298	313	180	189	206	206	224	224	
LD-lin20	Les Linious	198	198	238	238	173	173	123	126	236	239	288	288	292	301	310	313	180	180	206	206	224	224	
LD-lin21	Les Linious	189	198	236	240	173	176	120	135	242	242	292	292	292	292	316	316	180	180	206	206	224	226	
LD-lin22	Les Linious	168	198	236	238	173	176	120	141	239	242	288	292	310	310	313	316	180	180	194	206	224	224	
LD-lin23	Les Linious	198	198	236	240	173	176	120	132	242	242	284	288	292	298	313	313	180	186	206	206	224	224	
LD-lin24	Les Linious	186	189	238	240	173	176	114	132	236	242	288	292	307	316	316	316	180	180	194	206	224	224	
LD-lin25	Les Linious	186	198	236	240	170	176	120	135	242	245	284	288	301	307	313	313	180	189	206	206	224	224	
LD-lin26	Les Linious	186	198	238	242	176	176	132	138	242	242	288	288	310	310	316	316	180	180	206	206	222	224	
LD-lin27	Les Linious	186	198	240	242	164	173	117	120	233	236	288	288	304	313	298	316	180	180	194	206	224	224	
LD-lin28	Les Linious	198	198	238	238	173	176	120	132	242	242	288	288	310	310	316	316	180	180	206	206	224	224	
LD-lin29	Les Linious	186	198	236	238	170	176	120	132	239	242	288	288	292	292	298	316	180	180	194	206	222	224	
LD-lin30	Les Linious	180	189	236	240	167	173	120	132	236	242	288	288	304	310	316	322	180	180	206	206	224	224	
LD-lin31	Les Linious	198	198	238	240	167	173	120	132	236	242	284	284	304	310	316	319	180	189	194	206	224	224	
LD-lin32	Les Linious	189	189	240	242	173	176	120	138	236	239	288	288	307	307	298	298	180	180	206	206	224	224	
LD-lin33	Les Linious	186	198	238	240	167	173	126	144	236	242	284	292	304	316	316	316	180	180	190	206	224	224	
LD-lin34	Les Linious	189	198	238	238	164	176	117	120	236	236	288	292	310	310	316	316	180	180	206	210	224	224	
LD-lin35	Les Linious	189	198	238	238	167	176	120	123	242	242	288	292	307	316	313	319	180	186	206	206	224	224	
LD-lin36	Les Linious	198	198	236	238	173	173	120	132	239	242	288	292	316	316	316	316	180	189	206	206	224	224	
LD-lin37	Les Linious	189	198	240	240	173	173	138	147	236	242	284	292	310	310	298	316	180	180	206	206	224	224	
LD-lin38	Les Linious	189	198	240	240	170	173	135	135	242	242	288	288	298	310	316	316	180	180	206	206	224	224	
LD-lin39	Les Linious	198	198	240	242	173	173	123	132	239	242	288	292	316	316	313	316	180	189	206	206	222	224	
LD-lin40	Les Linious	189	198	238	240	173	176	120	144	236	242	288	292	292	298	316	316	180	180	206	206	224	224	
LD-lin41	Les Linious	186	198	236	236	176	176	132	138	242	242	292	292	292	301	316	319	180	180	206	206	224	224	
LD-lin42	Les Linious	168	198	238	240	173	176	123	123	239	239	286	292	310	313	313	313	180	189	206	206	224	224	
LD-lin43	Les Linious	186	198	238	240	173	176	129	135	236	236	286	288	307	310	313	313	180	189	206	206	224	224	
LD-lin44	Les Linious	189	198	240	240	173	176	120	135	236	242	288	292	307	307	298	316	180	189	0	0	224	224	
LD-lin45	Les Linious	168	189	238	240	173	173	123	144	236	242	292	292	294	292	292	313	316	180	180	194	206	224	224
LD-lin46	Les Linious	189	198	238	240	176	176	120	123	236	236	288	292	304	310	316	316	180	189	206	206	224	224	
LD-lin47	Les Linious	198	198	240	242	170	176	147	153	242	242	288	290	292	292	316	316	180	180	206	206	224	224	
LD-lin48	Les Linious	189	189	236	240	170	173	147	150	233	242	288	288	313	313	298	310	180	189	0	0	224	224	
LD-lin49	Les Linious	189	198	238	240	173	176	120	138	239	239	286	292	292	310	313	316	180	180	194	206	224	224	
LD-lin50	Les Linious	198	198	238	238	170	176	120	138	239	242	288	288	310	310	310	313	180	186	206	206	224	224	
LD-lin6	Les Linious	189	198	242	242	170	173	120	132	242	242	288	290	304	304	298	316	180	180	206	206	224	224	
LD-lin7	Les Linious	189	189	240	242	173	176	123	126	242	242	288	292	292	310	310	316	180	180	206	206	224	224	
LD-lin8	Les Linious	198	198	240	242	176	176	138	144	242	242	288	292	310	313	313	316	180	189	190	206	222	224	
LD-men1	Men Vriant	186	186	238	240	173	176	129	135	236	236	286	288	307	313	313	313	180	180	198	206	224	224	
LD-men10	Men Vriant	189	198	240	242	173	176	123	135	233	239	284	292	307	310	316	316	180	189	206	206	222	224	
LD-men11	Men Vriant	186	189	240	240	173	173	123	135	236	236	288	292	292	310	298	313	180	180	206	206	224	224	
LD-men12	Men Vriant	189	198	238	240	173	176	120	132	236	242	292	292	304	304	310	316	189	189	206	206	224	224	
LD-men13	Men Vriant	198	198	236	240	173	176	129	156	239	242	288	292	307	307	310	316	180	189	206	206	222	224	
LD-men14	Men Vriant	198	198	238	238	173	182	150	150	236	239	288	288	313	319	310	316	180	180	206	206	224	224	
LD-men15	Men Vriant	192	198	238	240	176	176	126	165	236	239	288	288	307	310	316	316	180	189	198	198	224	224	
LD-men16	Men Vriant	195	198	242	242	170	170	123	132	236	242	288	292	310	310	316	341	180	180	206	206	224	224	
LD-men17	Men Vriant	186	186	238	240	173	173	120	123	242	242	292	292	313	313	316	322	180	180	198	206	224	224	
LD-men18	Men Vriant	186	198	240	240	173	176	120	132	236	239	288	292	310	310	313	316	180	180	206	206	224	224	
LD-men19	Men Vriant	186	198	240	240	173	173	123	126	242	242	288	288	304	304	298	316	180	189	206	206	224	224	
LD-men2	Men Vriant	177	189	236	236	170	176	114	144	242	242	288	288	307	313	310	316	180	189	198	206	224	224	
LD-men20	Men Vriant	189	198	238	240	170	173	138	156	242	242	292	292	310	316	0	0	180	180	206	206	224	224	
LD-men21	Men Vriant	189	189	236	242	173	176	126	150	233	242	288	292	310	310	313	316	180	180	206	206	224	224	
LD-men22	Men Vriant	186	198	242	242	170	170	129	141	236	242	288	292	304	313	313	316	180	180	198	206	224	224	
LD-men23	Men Vriant	192	198	240	242	176	182	123	159	236	236	288	292	307	310	310	316	180	189	206	210	224	224	
LD-men24	Men Vriant	186	198	240	240	173	176	123	132	236	239	288	292	310	313	298	316	180	186	198	198	224	226	
LD-men25	Men Vriant	189	189	240	242	167	176	135	153	242	242	288	288	301	313	298	310	180	180	206	206	224	228	
LD-men26	Men Vriant	186	186	240	240	173	173	123	147	230	236	288	292	307	310	313	316	180						

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LD-men31	Men Vriant	189	192	238	240	173	173	120	123	236	239	288	288	292	307	316	316	180	189	206	210	222	224
LD-men32	Men Vriant	168	183	240	242	176	176	132	150	236	242	288	288	304	307	313	316	180	180	206	206	224	224
LD-men33	Men Vriant	189	192	240	240	167	173	144	147	236	242	288	292	307	310	316	316	180	195	198	206	224	224
LD-men34	Men Vriant	198	198	236	242	164	173	123	150	236	236	288	288	307	310	316	316	180	180	206	206	224	224
LD-men35	Men Vriant	198	198	236	238	173	176	135	144	242	242	288	292	307	310	313	316	180	180	206	206	224	224
LD-men36	Men Vriant	198	198	238	240	173	173	123	144	239	242	288	294	307	307	316	316	180	186	198	206	224	224
LD-men37	Men Vriant	189	198	240	240	170	176	120	153	236	242	288	292	313	313	295	313	180	186	198	206	224	224
LD-men38	Men Vriant	189	198	236	238	170	173	117	147	242	242	290	292	307	313	313	316	180	180	206	206	224	224
LD-men39	Men Vriant	198	198	238	240	167	167	123	123	242	242	288	292	313	313	338	338	180	180	206	206	222	224
LD-men4	Men Vriant	186	189	238	240	173	173	123	144	236	242	292	294	307	313	316	316	180	189	206	206	224	224
LD-men40	Men Vriant	189	189	238	240	176	176	120	129	236	236	288	288	313	313	313	316	180	189	206	206	224	224
LD-men41	Men Vriant	189	198	236	240	176	176	132	141	239	242	288	290	295	313	298	298	180	180	198	206	222	224
LD-men42	Men Vriant	186	186	240	240	173	176	132	150	242	242	288	288	304	307	316	316	180	180	198	206	224	224
LD-men5	Men Vriant	186	189	238	240	176	176	120	123	236	236	288	292	298	298	310	316	180	180	198	206	222	224
LD-men6	Men Vriant	198	198	240	242	170	176	147	153	242	242	288	290	310	310	301	316	180	189	198	206	220	222
LD-men7	Men Vriant	186	189	236	240	170	173	147	150	233	242	288	288	307	316	316	316	180	180	198	206	222	224
LD-men8	Men Vriant	195	198	236	242	173	176	120	120	233	236	292	292	310	310	298	313	180	180	198	206	224	224
LD-men9	Men Vriant	186	189	240	240	173	182	126	141	242	245	288	292	313	313	301	316	180	180	206	206	222	224
LD-klo1	Klosenn Mala	189	189	238	240	170	176	126	150	236	236	288	292	301	307	316	316	180	180	198	206	224	224
LD-klo10	Klosenn Mala	195	198	240	242	173	176	120	147	236	236	288	292	304	307	316	316	180	189	206	206	224	224
LD-klo11	Klosenn Mala	189	195	234	234	152	167	120	126	236	236	292	292	295	313	301	316	180	189	194	206	224	228
LD-klo13	Klosenn Mala	189	198	240	242	170	176	147	153	236	242	288	292	304	307	316	316	180	180	198	206	222	224
LD-klo14	Klosenn Mala	189	189	240	240	173	176	129	150	233	233	288	292	307	316	310	316	180	189	206	206	224	224
LD-klo15	Klosenn Mala	189	198	236	242	170	176	120	123	239	242	288	288	307	313	316	316	180	180	206	206	224	224
LD-klo18	Klosenn Mala	186	189	236	240	176	176	141	156	236	242	288	292	310	310	310	316	180	180	206	206	224	224
LD-klo19	Klosenn Mala	189	198	236	240	173	173	132	132	236	242	284	288	307	313	310	319	180	180	198	206	224	228
LD-klo2	Klosenn Mala	198	198	240	240	158	173	126	135	242	242	288	292	307	310	298	322	180	180	206	206	220	224
LD-klo20	Klosenn Mala	183	189	240	240	173	176	141	141	236	239	288	292	307	310	313	316	180	195	206	210	224	224
LD-klo21	Klosenn Mala	189	198	240	240	170	170	123	141	233	236	288	292	307	307	316	316	180	180	206	206	224	224
LD-klo22	Klosenn Mala	189	189	240	240	170	170	120	129	242	242	288	292	307	307	313	316	180	180	198	206	224	224
LD-klo23	Klosenn Mala	183	186	240	240	173	176	126	153	242	242	288	288	310	313	313	316	180	195	206	210	224	224
LD-klo24	Klosenn Mala	183	198	240	240	155	176	120	153	236	242	288	288	307	310	310	316	180	180	198	206	224	224
LD-klo25	Klosenn Mala	189	189	238	240	173	173	123	138	242	242	288	292	307	310	298	316	180	180	206	206	224	224
LD-klo26	Klosenn Mala	195	198	236	240	170	173	123	144	239	242	288	288	289	289	310	316	189	189	206	206	220	224
LD-klo27	Klosenn Mala	168	198	238	240	173	173	123	132	236	242	288	288	304	307	310	316	180	180	206	206	224	224
LD-klo28	Klosenn Mala	189	189	238	240	164	173	123	144	236	242	288	288	310	313	313	316	180	180	206	206	222	222
LD-klo29	Klosenn Mala	198	198	240	240	176	176	126	138	0	0	292	292	310	310	313	316	180	180	198	206	222	224
LD-klo3	Klosenn Mala	186	186	240	242	164	173	117	120	236	239	288	290	310	310	316	316	180	183	198	206	224	224
LD-klo30	Klosenn Mala	198	198	242	242	167	173	117	126	239	242	288	288	301	313	313	316	180	180	194	206	224	224
LD-klo31	Klosenn Mala	198	198	240	240	173	176	120	135	236	242	292	292	307	310	310	316	180	180	198	206	222	224
LD-klo32	Klosenn Mala	186	189	240	240	164	173	120	141	239	242	288	290	307	310	313	316	180	180	198	206	224	224
LD-klo33	Klosenn Mala	168	189	238	240	164	170	123	153	236	239	288	292	307	307	316	316	180	186	206	210	224	224
LD-klo34	Klosenn Mala	168	189	236	242	173	173	117	126	236	242	290	292	307	307	313	316	180	180	206	206	224	224
LD-klo35	Klosenn Mala	189	198	240	240	164	176	120	126	236	236	284	290	295	310	316	316	180	189	206	206	224	228
LD-klo36	Klosenn Mala	186	189	240	242	164	173	120	144	242	242	288	292	307	307	310	316	180	180	206	206	224	224
LD-klo37	Klosenn Mala	186	189	236	236	170	173	135	153	242	242	288	292	307	313	313	316	180	180	206	206	222	224
LD-klo38	Klosenn Mala	177	189	240	240	170	170	120	144	236	242	288	288	292	313	316	316	180	180	206	206	224	224
LD-klo39	Klosenn Mala	189	198	240	242	173	173	120	126	236	236	288	288	292	307	313	316	180	189	206	206	224	224
LD-klo4	Klosenn Mala	189	198	240	240	176	176	129	132	242	242	286	288	313	313	310	316	180	180	206	206	224	224
LD-klo40	Klosenn Mala	183	192	240	240	173	176	129	150	233	242	288	292	310	316	298	313	180	180	206	206	220	224
LD-klo42	Klosenn Mala	189	198	238	240	182	182	135	156	242	242	288	288	307	310	313	316	180	180	206	206	224	224
LD-klo43	Klosenn Mala	189	198	236	240	176	176	138	150	233	245	288	290	310	310	313	316	186	195	206	206	228	228
LD-klo44	Klosenn Mala	186	198	240	240	176	176	126	126	236	245	288	292	301	310	310	316	183	189	206	206	224	224
LD-klo45	Klosenn Mala	186	198	236	240	170	170	129	147	236	236	288	288	301	301	310	316	180	180	206	206	224	224
LD-klo46	Klosenn Mala	198	198	236	240	173	173	117	120	236	242	288	288	307	307	316	316	180	180	206	206	224	224
LD-klo47	Klosenn Mala	189	198	236	238	170	173	129	129	236	236	292	292	304	316	313	316	180	180	198	206	220	224
LD-klo5	Klosenn Mala	189	198	236	240	170	173	126	138	242	242	288	292	313	313	316	316	180	189	206	206	224	224
LD-klo6	Klosenn Mala	198	198	238	240	173	173	120	132	236	242	288	288	304	310	310	313	180	180	206	206	224	228
LD-klo7	Klosenn Mala	189	189	242	242	176	176	120	147	236	236	284	288	307	307	313	313	180	180	206	206	224	224
LD-klo9	Klosenn Mala	198	198	240	242	176	176	120	126	236	242	288	288	307	313	316	316	180	195	198	198	224	224
LD-ros1	Les Rospects	186	198	236	240	152	173	123	132	236	242	288	288	307	307	316	316	180	180	198	206	224	224
LD-ros10	Les Rospects	186	195	236	240	170	176	123	132	239	242	286	288	301	310	313	316	186	189	206</			

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LD-ros19	Les Rospects	189	189	236	240	173	176	135	150	236	242	288	288	307	310	316	316	180	180	194	206	224	224
LD-ros2	Les Rospects	189	198	238	242	170	176	117	117	233	236	288	288	301	313	316	319	189	192	198	206	224	224
LD-ros20	Les Rospects	189	198	238	240	176	176	120	126	233	236	288	292	298	301	313	316	180	180	206	206	224	224
LD-ros21	Les Rospects	189	198	240	242	173	173	144	147	236	242	288	288	310	313	316	316	180	180	206	206	224	224
LD-ros22	Les Rospects	189	198	240	242	176	176	120	126	233	242	288	288	310	310	310	316	180	180	206	206	220	224
LD-ros23	Les Rospects	189	198	236	240	173	173	123	123	236	239	288	290	307	307	304	316	180	180	194	206	224	224
LD-ros24	Les Rospects	189	198	240	240	176	176	120	120	242	242	288	292	307	313	298	316	180	189	198	206	224	224
LD-ros25	Les Rospects	168	195	240	242	164	176	132	138	233	239	288	288	307	313	316	316	180	180	198	206	222	224
LD-ros26	Les Rospects	183	204	218	242	173	176	144	144	236	236	292	292	310	310	316	316	180	189	206	206	222	224
LD-ros27	Les Rospects	168	195	218	240	173	173	120	123	242	242	288	288	310	313	310	313	180	180	206	206	224	224
LD-ros28	Les Rospects	198	198	240	242	173	173	117	156	236	242	288	288	298	304	316	316	180	189	206	206	224	224
LD-ros29	Les Rospects	198	198	238	240	173	173	129	129	236	242	290	290	289	289	313	316	180	180	206	206	222	224
LD-ros3	Les Rospects	186	195	240	240	176	176	117	120	236	242	288	292	301	316	316	316	180	180	206	206	224	224
LD-ros31	Les Rospects	198	198	238	240	173	176	120	129	233	236	288	292	298	307	313	316	180	180	206	206	224	224
LD-ros32	Les Rospects	186	198	238	238	158	176	132	153	236	239	288	292	310	310	316	319	180	180	206	206	224	224
LD-ros33	Les Rospects	189	189	240	242	170	173	123	165	230	236	288	292	295	310	313	316	180	189	206	206	222	224
LD-ros34	Les Rospects	186	189	236	240	176	176	123	132	236	236	288	292	307	310	313	316	180	189	206	222	224	224
LD-ros35	Les Rospects	198	198	242	242	167	173	147	153	236	242	288	288	307	316	310	316	189	189	206	206	220	224
LD-ros36	Les Rospects	189	198	240	240	158	176	126	129	239	242	290	292	310	310	310	341	180	189	206	206	224	224
LD-ros4	Les Rospects	189	198	236	242	176	182	123	165	236	236	288	292	301	301	304	310	180	180	206	206	218	224
LD-ros5	Les Rospects	198	198	236	238	167	173	120	123	242	242	288	292	307	313	301	313	189	189	206	206	224	226
LD-ros6	Les Rospects	168	186	238	238	176	176	120	144	236	242	288	288	307	310	316	322	180	180	198	206	224	224
LD-ros7	Les Rospects	189	189	240	242	173	173	117	132	239	242	288	292	307	310	298	310	180	180	198	206	224	224
LD-ros8	Les Rospects	189	198	240	240	173	176	132	138	236	242	288	292	304	304	316	316	180	189	198	198	224	224
LD-ros9	Les Rospects	186	198	242	242	173	176	126	126	233	242	288	288	310	310	313	316	180	180	206	206	224	224
LD-mat1	St Mathieu	198	198	240	240	164	170	120	132	236	236	288	292	310	313	316	316	180	189	202	206	224	226
LD-mat10	St Mathieu	198	198	242	242	167	170	117	123	236	242	288	292	313	313	313	316	189	195	206	206	222	224
LD-mat11	St Mathieu	189	198	240	242	167	170	123	141	236	242	290	290	307	310	316	316	180	180	206	206	224	224
LD-mat14	St Mathieu	189	195	238	244	173	176	129	153	236	239	288	288	313	313	316	319	180	180	206	210	222	222
LD-mat15	St Mathieu	189	195	236	240	173	176	129	129	236	239	292	292	310	313	313	316	180	180	206	206	224	224
LD-mat16	St Mathieu	168	198	242	242	173	173	129	159	236	242	0	0	307	313	316	316	180	189	206	206	224	224
LD-mat19	St Mathieu	189	198	238	240	173	173	117	150	236	242	288	288	304	313	316	316	180	180	198	206	224	224
LD-mat20	St Mathieu	186	198	240	240	173	176	123	126	236	242	288	292	307	307	313	316	180	180	206	206	224	224
LD-mat22	St Mathieu	189	189	238	238	164	173	120	135	236	242	288	288	307	310	0	0	186	189	206	206	224	224
LD-mat24	St Mathieu	198	198	238	240	167	167	129	138	236	239	288	292	310	310	313	316	180	189	206	206	224	224
LD-mat26	St Mathieu	186	189	238	238	173	173	120	135	242	242	288	288	292	313	310	313	180	180	206	206	224	224
LD-mat29	St Mathieu	198	198	238	240	173	173	129	153	239	242	288	292	310	310	316	316	180	180	206	206	222	224
LD-mat3	St Mathieu	189	195	242	242	173	173	144	153	242	242	288	288	304	310	313	313	180	189	206	206	224	224
LD-mat32	St Mathieu	168	186	238	238	152	176	120	120	233	236	288	294	307	307	316	316	180	180	206	206	224	224
LD-mat35	St Mathieu	186	198	238	238	152	164	117	132	236	242	288	292	313	313	316	316	180	180	198	198	224	224
LD-mat37	St Mathieu	189	189	240	242	173	176	123	153	239	242	288	288	313	313	310	319	180	180	206	206	224	224
LD-mat4	St Mathieu	186	195	240	240	173	176	123	129	242	242	288	288	307	313	316	316	180	189	206	206	224	224
LD-mat5	St Mathieu	198	198	240	240	167	173	123	138	233	236	288	288	304	310	310	313	180	189	0	0	224	224
LD-mat7	St Mathieu	189	198	240	240	170	173	117	144	236	242	284	288	310	310	313	316	180	189	206	206	224	224
LD-gou1	Pointe du gra	186	198	238	242	158	173	120	132	233	242	288	288	310	310	310	316	180	180	206	206	224	224
LD-gou10	Pointe du gra	186	198	240	240	170	173	129	150	242	242	288	290	310	310	310	316	180	195	206	206	224	228
LD-gou11	Pointe du gra	195	198	236	240	173	173	129	144	233	242	292	292	310	310	313	316	180	180	206	206	224	224
LD-gou12	Pointe du gra	189	195	242	242	173	176	150	156	242	242	292	292	310	313	313	316	141	189	206	206	224	224
LD-gou13	Pointe du gra	186	198	240	240	173	173	120	144	233	236	288	292	301	301	310	316	189	189	206	206	224	224
LD-gou14	Pointe du gra	168	186	238	242	173	176	147	165	242	242	288	290	319	319	316	316	180	180	206	206	224	226
LD-gou15	Pointe du gra	189	195	238	240	164	173	126	132	233	236	288	292	313	313	310	313	180	180	206	206	224	224
LD-gou16	Pointe du gra	189	198	240	240	173	176	132	135	236	242	288	292	292	316	316	316	180	189	206	214	224	226
LD-gou17	Pointe du gra	186	198	238	238	176	176	120	144	242	242	292	292	310	313	310	316	180	189	206	206	224	224
LD-gou18	Pointe du gra	198	198	240	240	173	176	132	132	233	242	288	292	310	316	310	316	189	189	206	206	224	224
LD-gou19	Pointe du gra	189	198	240	240	173	173	132	147	236	236	288	292	307	307	313	316	180	180	206	206	224	224
LD-gou2	Pointe du gra	186	189	236	242	173	173	120	138	236	239	288	292	301	301	310	313	189	189	194	206	224	224
LD-gou20	Pointe du gra	195	198	238	240	173	173	120	153	236	242	288	288	313	313	316	316	180	180	206	206	224	224
LD-gou21	Pointe du gra	186	186	238	242	164	176	129	162	233	233	290	290	313	313	310	313	180	180	206	206	224	224
LD-gou22	Pointe du gra	198	198	238	240	176	176	117	120	236	236	288	288	301	301	310	313	180	180	206	206	224	224
LD-gou23	Pointe du gra	195	198	238	242	164	167	117	132	236	239	288	292	298	316	310	316	180	195	206	206	222	224
LD-gou24	Pointe du gra	183	186	238	242	164	164	153	165	236	236	288	292	298	307	310	310	180	189	206	206	224	224
LD-gou26	Pointe du gra	195	198	220	242	170	176	144	150	239	242	288	292	307	310	310	310	189					

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LD-gou34	Pointe du gra 186	195	238	238	164	173	120	132	233	233	284	288	313	313	313	316	180	189	206	206	224	224	
LD-gou35	Pointe du gra 186	195	240	242	173	176	129	150	233	242	292	292	310	310	310	316	180	180	206	206	224	224	
LD-gou37	Pointe du gra 198	198	238	242	173	176	120	135	236	236	284	288	310	313	313	313	180	189	206	206	222	224	
LD-gou38	Pointe du gra 189	198	236	238	173	173	129	129	233	236	290	292	310	313	313	316	180	189	206	206	224	224	
LD-gou39	Pointe du gra 198	198	236	236	164	164	123	144	233	236	288	290	310	310	310	316	180	189	206	206	224	224	
LD-gou40	Pointe du gra 186	195	238	242	173	176	144	162	0	0	292	292	310	313	316	316	180	180	206	206	224	224	
LD-gou41	Pointe du gra 186	195	238	242	170	173	147	156	242	242	288	292	289	289	310	313	189	189	206	206	224	228	
LD-gou42	Pointe du gra 195	198	236	240	173	176	132	147	236	239	288	292	298	313	316	316	180	180	206	206	224	224	
LD-gou43	Pointe du gra 186	198	242	242	173	176	147	147	236	245	288	290	301	304	310	313	180	189	206	206	224	224	
LD-gou6	Pointe du gra 189	198	236	238	173	176	156	159	236	236	288	292	313	313	0	0	180	189	206	206	224	226	
LD-gou8	Pointe du gra 189	195	240	242	164	176	117	162	236	236	288	288	310	310	310	316	189	189	198	206	224	224	
LD-gou9	Pointe du gra 186	198	240	242	173	176	147	147	0	0	288	290	301	304	310	313	180	189	206	206	224	224	
LD-ho210	Houat 2	186	186	240	242	170	170	123	126	236	242	288	292	313	313	298	316	189	189	206	206	224	226
LD-ho212	Houat 2	183	189	240	240	173	173	123	126	242	242	288	292	307	307	313	316	180	195	194	206	224	224
LD-ho215	Houat 2	186	189	240	240	170	173	120	120	242	242	292	292	307	316	313	313	180	180	206	206	224	224
LD-ho216	Houat 2	183	186	240	240	173	173	123	123	236	236	288	288	307	313	313	316	180	189	194	206	224	224
LD-ho217	Houat 2	183	186	236	236	170	173	123	126	242	242	288	292	313	316	316	316	186	186	194	206	224	224
LD-ho218	Houat 2	186	186	240	240	170	173	123	123	236	242	288	292	313	313	316	316	189	189	194	206	224	224
LD-ho22	Houat 2	183	189	240	240	173	173	123	126	236	236	288	292	307	307	316	316	180	195	206	206	224	224
LD-ho220	Houat 2	198	198	240	240	173	173	120	120	242	242	292	292	301	313	316	316	180	189	194	194	224	224
LD-ho221	Houat 2	186	186	236	240	173	173	123	123	242	242	292	292	313	316	316	316	186	189	194	206	224	224
LD-ho222	Houat 2	189	198	240	240	173	173	123	126	236	242	288	292	307	307	316	316	180	189	206	206	224	224
LD-ho223	Houat 2	189	198	240	240	170	176	123	123	236	245	292	292	307	313	313	316	189	189	194	206	224	224
LD-ho224	Houat 2	186	198	240	242	170	173	123	123	236	242	288	292	307	313	316	316	189	195	206	206	224	224
LD-ho225	Houat 2	186	189	240	240	170	173	126	126	236	242	288	292	307	316	313	316	189	195	194	198	224	224
LD-ho226	Houat 2	183	183	240	240	173	173	123	126	236	236	288	292	307	307	316	316	180	195	194	206	224	224
LD-ho229	Houat 2	186	189	240	240	173	173	123	126	236	242	288	288	307	313	316	316	189	189	206	206	224	224
LD-ho23	Houat 2	186	198	240	242	173	173	123	123	236	242	288	288	313	316	298	316	189	189	194	206	224	224
LD-ho230	Houat 2	189	198	240	240	173	173	120	123	242	242	288	292	313	313	316	316	180	189	194	206	224	226
LD-ho231	Houat 2	186	189	236	240	170	173	123	129	236	239	288	292	307	307	316	316	180	186	198	206	224	224
LD-ho234	Houat 2	177	186	240	240	173	173	120	123	236	236	288	292	310	310	313	316	195	195	194	206	224	224
LD-ho235	Houat 2	189	198	236	240	170	173	120	123	236	236	288	292	313	313	316	316	186	189	194	206	224	224
LD-ho236	Houat 2	189	189	240	240	170	173	120	120	236	236	288	292	307	313	313	316	189	189	206	206	224	224
LD-ho237	Houat 2	183	198	240	240	170	173	120	123	236	242	292	292	307	316	313	316	180	189	194	206	224	224
LD-ho239	Houat 2	186	186	236	236	170	173	126	126	236	236	288	292	313	313	316	316	180	195	194	194	224	224
LD-ho24	Houat 2	183	198	240	242	170	173	123	123	242	242	288	292	307	313	316	316	180	189	206	206	224	224
LD-ho241	Houat 2	186	186	240	242	170	173	123	123	236	242	288	292	313	313	316	316	180	186	194	198	224	224
LD-ho243	Houat 2	189	189	242	242	173	173	120	126	236	239	288	292	313	313	313	316	180	195	194	206	224	224
LD-ho244	Houat 2	183	186	240	240	173	176	123	129	236	242	288	292	307	313	316	316	189	189	190	194	224	226
LD-ho245	Houat 2	186	186	236	236	170	170	117	126	236	242	288	292	313	313	313	316	189	195	194	206	224	226
LD-ho246	Houat 2	186	189	240	240	173	173	120	123	236	242	292	292	313	313	316	316	189	189	194	206	224	224
LD-ho25	Houat 2	186	186	242	242	164	173	114	126	236	242	288	288	307	313	313	316	189	189	206	206	224	224
LD-ho26	Houat 2	183	186	240	240	173	173	123	123	236	245	292	292	307	307	316	316	189	189	0	0	224	224
LD-ho27	Houat 2	183	198	236	240	173	173	120	126	242	242	288	288	310	313	316	316	186	189	194	206	224	224
LD-ho29	Houat 2	183	189	240	240	173	173	123	123	236	242	288	292	307	307	316	316	189	195	194	194	224	224
LD-ho11	Houat 1	177	186	240	240	170	170	120	120	236	242	292	292	307	313	0	0	189	189	194	194	224	224
LD-ho110	Houat 1	189	198	240	240	173	173	120	120	236	242	288	288	307	313	313	316	189	189	194	206	224	224
LD-ho111	Houat 1	189	198	240	242	170	173	123	126	242	242	292	292	313	313	316	316	189	189	206	206	224	224
LD-ho112	Houat 1	186	198	240	240	176	176	120	123	236	242	292	292	307	313	316	316	186	189	194	206	224	224
LD-ho113	Houat 1	186	189	240	240	170	173	123	126	236	236	288	292	313	313	313	316	186	189	206	206	224	224
LD-ho114	Houat 1	189	198	240	240	170	176	120	126	236	239	288	288	307	313	313	316	189	189	206	206	224	224
LD-ho116	Houat 1	183	189	240	240	170	170	126	126	236	242	292	292	316	316	313	313	180	189	194	206	224	224
LD-ho117	Houat 1	186	189	240	240	173	173	126	129	242	242	292	292	307	313	0	0	189	189	194	206	224	226
LD-ho118	Houat 1	183	198	240	242	170	173	120	126	236	242	288	288	307	307	313	316	189	195	194	206	224	224
LD-ho119	Houat 1	183	186	240	240	170	170	123	123	242	242	292	292	316	316	313	313	180	180	206	206	224	224
LD-ho12	Houat 1	186	186	240	240	173	176	117	123	236	242	288	288	310	313	316	316	189	189	194	206	224	226
LD-ho120	Houat 1	186	198	240	240	170	170	117	120	236	242	288	292	307	313	313	316	180	189	194	206	224	224
LD-ho121	Houat 1	177	198	240	240	173	173	120	126	236	242	288	292	313	313	316	316	189	195	194	206	224	224
LD-ho122	Houat 1	189	198	240	240	173	173	126	126	236	242	288	292	307	313	316	316	189	189	194	206	224	226
LD-ho123	Houat 1	186	189	236	240	170	176	123	126	242	242	288	292	307	313	313	316	189	189	206	206	224	224
LD-ho124	Houat 1	186	198	240	240	173	176	123	123	236	236	292	292	307	313	313	313	186	195	194	206	224	224
LD-ho125	Houat 1	183	198	240	240	173	173	123	123	236	236	288	288										

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LD-ho132	Houat 1	186	198	240	240	170	173	120	129	236	242	288	292	307	313	316	316	180	189	206	206	224	224
LD-ho133	Houat 1	198	198	240	240	170	173	120	126	236	242	288	292	313	313	313	316	189	195	194	206	224	224
LD-ho134	Houat 1	198	198	240	240	170	173	123	123	236	242	288	292	307	316	313	316	189	195	194	206	224	224
LD-ho135	Houat 1	186	198	240	240	170	170	117	120	236	242	288	292	307	313	313	316	180	189	194	206	224	224
LD-ho136	Houat 1	198	198	240	240	170	176	120	120	236	236	288	288	307	316	316	316	189	189	206	206	224	224
LD-ho137	Houat 1	183	198	236	240	173	173	123	123	236	236	288	292	313	313	313	316	180	189	194	206	224	224
LD-ho138	Houat 1	183	198	240	240	170	173	123	126	236	236	288	288	307	307	316	316	180	189	206	206	224	224
LD-ho139	Houat 1	198	198	240	240	173	173	123	123	242	242	292	292	313	313	316	316	189	189	194	194	224	224
LD-ho14	Houat 1	183	189	240	240	170	173	120	123	236	239	288	292	307	313	316	316	186	189	206	206	224	224
LD-ho140	Houat 1	189	198	240	240	170	173	120	126	236	242	292	292	307	313	316	316	189	189	194	206	224	224
LD-ho141	Houat 1	183	198	240	240	173	173	123	123	236	242	288	288	307	307	316	316	186	189	206	206	224	224
LD-ho142	Houat 1	183	189	240	240	173	173	123	123	242	242	292	292	313	313	310	313	180	189	194	206	224	224
LD-ho143	Houat 1	186	189	240	240	176	176	123	123	236	242	288	292	307	316	316	316	189	189	206	206	224	224
LD-ho144	Houat 1	198	198	240	240	173	173	120	129	236	242	288	292	307	313	313	316	189	189	198	206	224	224
LD-ho145	Houat 1	186	186	240	240	170	173	126	126	236	242	292	292	313	313	313	313	186	189	206	206	224	224
LD-ho146	Houat 1	189	198	240	240	173	173	126	129	236	239	292	292	307	313	313	313	180	189	194	206	224	224
LD-ho147	Houat 1	186	198	240	242	170	170	114	126	236	242	288	292	313	313	313	316	186	189	206	206	224	224
LD-ho148	Houat 1	183	198	240	240	170	173	123	126	236	242	288	288	313	313	313	316	189	189	194	198	224	224
LD-ho149	Houat 1	198	198	240	240	173	173	120	123	236	242	288	292	313	313	316	316	186	195	194	206	224	224
LD-ho15	Houat 1	183	186	240	240	170	173	120	123	236	242	288	292	307	307	313	316	189	195	206	206	224	224
LD-ho150	Houat 1	183	186	240	240	170	173	123	126	239	242	288	292	313	316	313	316	180	186	194	194	224	224
LD-ho151	Houat 1	198	198	240	240	170	170	123	123	236	242	288	292	307	313	313	316	189	195	206	206	224	224
LD-ho152	Houat 1	183	198	240	240	170	173	123	123	236	239	288	292	307	313	313	316	189	195	194	206	224	224
LD-ho153	Houat 1	186	186	240	240	173	173	123	123	239	242	288	292	313	313	316	316	195	195	194	206	224	224
LD-ho154	Houat 1	183	186	240	242	173	173	123	123	236	236	288	292	313	313	316	316	189	189	198	206	224	224
LD-ho155	Houat 1	183	198	240	240	173	173	123	123	239	242	288	292	313	313	316	316	189	195	194	206	224	224
LD-ho156	Houat 1	183	198	240	240	173	173	120	123	236	242	288	292	313	313	313	313	186	189	206	206	222	224
LD-ho157	Houat 1	186	186	240	240	173	173	123	123	236	242	288	288	310	313	316	316	189	189	206	206	224	226
LD-ho158	Houat 1	183	186	240	242	173	176	120	123	236	239	288	288	313	313	316	316	189	189	198	206	224	224
LD-ho159	Houat 1	186	189	240	242	170	170	120	123	236	242	292	292	307	313	316	316	180	189	198	206	224	224
LD-ho16	Houat 1	189	198	240	240	173	176	120	126	236	242	288	288	313	313	316	316	189	195	206	206	224	224
LD-ho160	Houat 1	189	198	240	240	173	176	120	123	242	242	288	288	307	313	313	316	180	180	194	206	224	224
LD-ho161	Houat 1	186	189	240	242	170	173	120	126	236	242	288	288	313	313	313	316	189	189	206	206	224	224
LD-ho162	Houat 1	198	198	240	240	176	176	120	123	236	242	288	288	313	313	313	316	180	189	206	206	224	224
LD-ho163	Houat 1	183	198	240	240	173	176	123	126	236	236	292	292	313	313	313	316	189	189	206	206	222	224
LD-ho164	Houat 1	186	186	242	242	170	170	114	123	239	239	292	292	313	313	316	316	180	180	206	206	224	224
LD-ho165	Houat 1	186	186	240	240	173	176	120	123	236	236	288	292	307	313	316	316	180	189	206	206	224	224
LD-ho166	Houat 1	186	198	240	240	173	176	123	123	239	242	288	292	307	313	316	316	186	189	206	206	224	224
LD-ho167	Houat 1	186	198	240	240	170	176	123	123	236	242	288	292	313	316	316	316	195	195	194	194	224	224
LD-ho168	Houat 1	198	198	240	240	173	173	123	123	236	242	288	292	313	313	313	313	186	189	194	206	224	224
LD-ho169	Houat 1	186	198	240	240	170	170	123	126	236	242	288	288	313	313	313	316	186	186	206	206	224	224
LD-ho17	Houat 1	198	198	240	240	170	170	123	123	242	242	288	292	313	313	316	316	186	195	194	206	224	224
LD-ho170	Houat 1	186	186	240	242	173	176	123	123	236	242	292	292	313	313	316	316	180	189	194	206	224	224
LD-ho171	Houat 1	186	186	240	240	170	173	117	138	233	236	288	292	310	313	313	313	189	195	206	206	224	224
LD-ho18	Houat 1	186	186	240	240	173	176	120	123	236	242	288	292	307	313	316	316	189	189	194	206	224	224
LD-ho19	Houat 1	186	198	236	240	173	173	120	123	236	242	288	292	313	313	313	316	186	189	206	206	224	224
LD-hoe1	Hoedic	189	198	236	240	170	173	120	120	236	242	288	292	307	316	313	316	186	189	194	206	224	224
LD-hoe10	Hoedic	189	198	240	240	173	173	120	123	242	245	288	292	307	313	313	316	180	189	206	206	224	226
LD-hoe11	Hoedic	189	198	236	236	173	173	120	135	242	245	292	292	307	313	313	313	189	195	206	206	224	224
LD-hoe12	Hoedic	189	198	240	242	170	173	117	123	242	245	288	292	307	313	313	316	189	189	206	206	224	224
LD-hoe13	Hoedic	186	198	240	240	173	173	120	120	230	242	292	292	307	313	316	316	180	189	206	206	224	224
LD-hoe14	Hoedic	189	189	242	242	170	173	117	123	236	242	292	292	313	313	316	316	180	180	194	206	224	224
LD-hoe15	Hoedic	189	189	240	240	173	173	123	123	236	242	288	292	307	307	313	313	180	186	194	198	224	224
LD-hoe16	Hoedic	186	186	240	240	173	173	120	123	242	242	288	292	307	313	316	316	189	195	194	206	224	224
LD-hoe17	Hoedic	189	189	240	240	170	173	120	135	236	239	288	292	313	316	313	313	186	189	194	206	224	224
LD-hoe18	Hoedic	186	189	240	240	170	173	123	123	242	242	292	292	307	313	313	316	189	195	206	206	224	224
LD-hoe19	Hoedic	186	195	236	236	170	173	120	123	242	242	288	292	313	316	316	316	189	195	194	198	224	224
LD-hoe2	Hoedic	186	189	240	240	173	173	117	123	236	236	292	292	307	307	313	316	186	189	198	206	224	224
LD-hoe21	Hoedic	186	198	236	236	170	173	120	123	242	245	292	292	307	313	316	316	189	189	198	206	224	224
LD-hoe22	Hoedic	189	198	236	240	173	173	120	126	236	239	292	292	307	313	316	319	189	195	198	206	224	224
LD-hoe23	Hoedic	186	189	240	240	173	173	117	120	236	242	288	292	307	313	313	316	186	189	194	198	224	224
LD-hoe24	Hoedic	186	198	240	242	170	173																

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LD-hoe32	Hoedic	183	186	236	236	173	173	123	123	242	245	292	292	307	313	313	316	195	195	206	206	224	224
LD-hoe33	Hoedic	186	189	236	240	173	173	120	120	236	236	292	292	307	307	313	316	180	189	194	206	224	224
LD-hoe34	Hoedic	186	189	240	240	170	173	120	129	242	242	288	288	307	313	316	316	180	195	206	206	224	224
LD-hoe4	Hoedic	183	198	236	236	170	173	120	126	242	242	292	292	307	307	313	316	189	189	194	194	224	224
LD-hoe6	Hoedic	186	198	240	240	173	173	117	120	236	242	288	292	310	313	316	316	180	189	194	206	224	224
LD-hoe7	Hoedic	189	198	236	242	170	170	117	123	242	245	292	292	307	313	313	316	189	195	194	198	224	224
LD-hoe8	Hoedic	189	189	240	240	170	173	120	123	242	242	288	292	301	310	316	316	189	195	194	206	224	224
LD-hoe9	Hoedic	186	189	236	240	170	176	123	126	236	242	288	290	313	313	313	316	186	195	194	198	224	224

Table S2 Microsatellite genotypes of *Laminaria hyperborea* individuals in GeneAlex format

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		9	1031	21	42	56	31	56	63	38	50	81	39	45	44	50	34	46	40	59	42	62	45	58	50
				Guimereux	La Bigne	Nerput	Le Moulin	Les Amas	Primel	Duons Est	Duons Ouest	Santec 2	Santec 1	Les Amiettes	Les Linioux	Men Vriant	Joseenn Malag	Les Respects	St Mathieu	ite du grand G	Ile Téviéc	Houat 2	Houat 1	Hoedic	
Individu	pops	Ld148			Ld158		Ld167		Lo454-15		Lo454-17		Lo454-28		Lo4-24		Lo454-23		Lo454-24						
gui1	Guimereux	207	249	222	228	146	146	161	161	161	180	180	234	234	216	216	202	214	214	268	280				
gui1bis	Guimereux	207	249	222	228	152	161	161	161	161	165	180	222	258	216	216	214	214	214	268	268				
gui10	Guimereux	207	207	222	222	155	161	161	161	161	180	180	222	258	216	216	202	214	214	268	280				
gui10bis	Guimereux	207	249	222	222	161	161	161	161	161	180	189	222	234	216	216	214	214	214	268	280				
gui11	Guimereux	207	237	222	222	161	161	161	161	164	165	165	222	234	216	216	214	214	214	280	280				
gui11bis	Guimereux	207	207	222	222	155	155	161	161	164	180	180	222	234	216	216	214	214	214	268	280				
gui12	Guimereux	207	249	222	228	155	161	161	161	161	180	180	222	222	216	216	214	214	214	268	280				
gui13	Guimereux	207	249	222	222	161	161	161	161	161	165	180	234	258	216	216	214	214	214	268	268				
gui13bis	Guimereux	240	249	222	222	158	161	161	161	161	165	180	222	258	216	216	214	214	214	268	268				
gui14	Guimereux	207	240	222	222	155	155	161	164	164	165	165	222	258	216	216	214	214	214	268	280				
gui14bis	Guimereux	207	237	222	222	155	155	164	164	164	165	180	234	258	216	216	214	214	214	280	283				
gui15	Guimereux	207	249	222	222	161	161	161	161	161	165	180	234	258	216	216	214	214	214	268	268				
gui15bis	Guimereux	207	240	222	222	155	161	161	161	161	168	180	222	234	216	216	214	214	214	268	268				
gui16	Guimereux	207	237	222	222	161	161	161	164	164	165	165	222	258	216	216	202	220	268	283					
gui17	Guimereux	207	237	222	222	155	161	161	161	161	165	165	222	262	216	216	202	214	268	268					
gui17bis	Guimereux	207	207	222	222	155	161	161	164	180	180	222	258	216	216	214	214	214	280	280					
gui18	Guimereux	207	237	222	222	161	161	161	161	180	180	222	234	216	216	202	202	268	268						
gui18bis	Guimereux	207	207	222	222	146	155	161	161	180	180	222	258	216	216	214	214	214	268	268					
gui19	Guimereux	207	249	222	228	155	161	161	161	165	180	222	258	216	216	202	214	268	268						
gui2	Guimereux	207	237	222	222	161	164	164	180	180	234	234	216	216	216	202	214	268	280						
gui20	Guimereux	207	249	222	222	161	161	164	164	164	165	165	234	258	216	216	214	214	280	289					
gui20bis	Guimereux	249	249	222	222	155	161	161	161	180	180	258	258	000	000	214	214	280	280						
gui21	Guimereux	207	240	222	228	146	161	161	164	180	180	234	258	216	216	202	214	268	283						
gui21bis	Guimereux	207	249	222	228	155	161	161	161	165	180	234	258	216	216	214	214	268	268						
gui22	Guimereux	207	249	222	222	161	161	161	161	180	180	234	234	216	216	214	214	268	268						
gui23	Guimereux	207	207	222	228	155	161	161	161	180	180	222	234	212	216	214	268	280							
gui24	Guimereux	207	237	222	222	161	161	161	161	180	180	222	222	216	216	202	214	268	283						
gui25	Guimereux	207	207	222	228	155	161	161	164	165	180	222	222	216	216	202	214	268	280						
gui26	Guimereux	207	240	222	222	146	146	161	161	180	180	234	234	216	216	202	214	268	283						
gui27	Guimereux	207	237	222	222	161	161	161	164	165	165	222	234	216	216	214	214	280	280						
gui28	Guimereux	207	207	222	222	155	155	161	161	165	180	222	222	222	202	214	280	283							
gui3	Guimereux	207	240	222	228	155	161	161	180	180	234	234	216	216	202	214	283	283							
gui4	Guimereux	207	240	222	228	155	161	161	161	180	180	222	234	216	216	202	214	268	268						
gui4bis	Guimereux	207	207	222	222	152	161	161	164	165	180	234	234	216	216	202	214	280	280						
gui5	Guimereux	207	237	222	222	152	155	161	164	165	165	222	222	216	216	202	202	280	280						
gui5bis	Guimereux	207	249	222	222	161	161	161	161	165	165	234	234	216	216	214	214	268	268						
gui6	Guimereux	207	237	222	222	146	161	161	164	165	165	222	258	216	216	202	214	268	268						
gui6bis	Guimereux	240	240	222	222	155	161	161	161	165	165	222	258	216	216	202	214	268	268						
gui7	Guimereux	207	240	222	222	155	155	161	164	180	180	222	234	216	216	214	214	280	280						
gui8	Guimereux	207	207	222	222	161	161	161	161	180	180	234	258	216	216	214	214	280	283						
gui9	Guimereux	207	207	222	222	155	155	161	161	180	180	222	258	216	216	202	214	268	280						
gui9bis	Guimereux	207	249	222	222	161	161	161	164	180	180	258	258	216	216	214	214	268	283						
big1	La Bigne	249	249	222	222	155	167	164	164	165	180	234	258	216	216	214	214	268	289						
big10	La Bigne	207	237	222	222	155	161	161	161	180	180	222	258	212	216	214	214	268	280						
big11	La Bigne	207	249	222	228	155	161	164	164	165	165	234	258	216	216	202	214	268	280						
big12	La Bigne	207	237	222	222	155	161	161	164	180	180	234	258	216	216	202	214	268	268						
big13	La Bigne	237	237	222	222	146	161	164	164	168	168	234	234	216	216	202	214	268	283						
big14	La Bigne	219	240	222	228	155	161	161	164	180	180	222	258	216	216	202	214	280	280						
big15	La Bigne	207	249	222	222	146	155	161	164	165	165	234	258	216	216	214	214	280	283						
big16	La Bigne	207	249	222	222	146	146	161	164	180	180	234	234	216	216	202	214	268	283						
big17	La Bigne	207	207	228	228	155	161	161	161	165	165	234	234	212	216	202	214	268	280						
big18	La Bigne	207	207	222	222	146	161	161	164	180	180	234	234	216	216	214	214	268	283						
big19	La Bigne	204	204	222	228	137	146	164	164	165	180	222	222	216	216	214	214	268	268						
big2	La Bigne	207	207	222	222	152	155	164	164	165	165	234	258	216	216	202	214	268	268						
big20	La Bigne	207	207	222	228	146	152	161	164	180	180	234	258	216	216	202	214	268	268						
big21	La Bigne	207	237	222	222	161	161	161	161	180	180	234	258	216	216	202	214	268	280						
big22	La Bigne	207	207	222	222	161	161	161	164	165	165	222	234	216	216	202	214	283	289						
big23	La Bigne	207	207	222	222	155	161	161	164	165	165	234	234	216	216	202	214	268	283						
big24	La Bigne	207	249	222	228	155	161	164	164	165	180	222	234	216	216	214	214	268	268						
big24bis	La Bigne	237	240	222	228	158	161	161	161	180	180	258	258	216	216	214	214	268	289						
big25	La Bigne	207	240	222	222	155	155	161	164	180	180	234													

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big30	La Bigne	207	249	222	222	161	161	161	164	165	180	222	222	216	218	214	214	268	280
big31	La Bigne	207	207	222	222	155	161	161	161	180	180	234	234	216	216	214	214	280	283
big32	La Bigne	207	249	222	222	161	161	161	161	180	180	222	234	216	216	214	214	268	283
big33	La Bigne	207	207	228	228	161	161	161	164	165	165	258	258	216	216	214	214	000	000
big34	La Bigne	207	237	222	222	155	161	161	164	165	165	222	234	216	216	202	214	280	283
big36	La Bigne	207	207	222	222	146	161	161	161	165	165	222	222	216	216	202	214	280	280
big37	La Bigne	237	240	222	222	155	155	161	161	180	180	234	258	216	216	214	214	268	283
big38	La Bigne	207	207	222	222	155	161	161	161	180	180	234	234	216	216	214	214	268	283
big39	La Bigne	240	249	222	222	155	155	164	164	165	165	222	258	216	216	214	214	280	283
big4	La Bigne	207	207	222	222	146	161	161	161	165	180	222	234	216	216	202	202	268	280
big40	La Bigne	207	240	222	222	152	161	161	161	165	180	222	222	216	216	202	214	268	283
big41	La Bigne	249	249	222	222	155	155	161	161	180	180	222	250	214	216	202	214	268	268
big42	La Bigne	207	249	222	222	155	161	161	164	180	180	234	258	216	216	202	214	280	283
big43	La Bigne	207	249	222	222	146	161	161	161	180	180	222	242	216	216	202	214	268	268
big44	La Bigne	237	249	222	222	146	155	161	164	180	180	234	258	216	216	214	214	268	268
big45	La Bigne	237	237	222	228	152	155	164	164	165	165	234	258	216	216	214	214	280	283
big46	La Bigne	207	237	222	228	146	161	161	161	165	180	234	258	216	216	202	202	268	280
big47	La Bigne	207	237	222	222	155	161	161	164	165	180	222	222	216	216	214	214	268	268
big48	La Bigne	207	207	222	222	152	155	161	161	168	168	234	234	216	216	214	214	280	283
big49	La Bigne	207	207	222	222	155	161	161	164	165	180	222	258	216	216	214	214	268	268
big5	La Bigne	207	237	222	222	155	161	161	161	165	165	234	258	216	216	202	214	268	268
big5bis	La Bigne	207	207	222	228	161	161	161	161	165	180	222	234	216	216	214	214	268	280
big50	La Bigne	207	237	222	222	155	161	161	164	165	180	222	258	216	216	202	214	268	283
big51	La Bigne	207	207	222	228	155	155	161	161	165	180	258	262	216	216	202	214	268	268
big52	La Bigne	207	249	222	222	155	161	161	164	180	180	234	258	216	216	202	214	280	283
big53	La Bigne	207	207	222	228	152	161	161	161	180	180	222	258	216	216	214	214	280	280
big54	La Bigne	207	249	222	222	146	161	161	161	165	165	222	222	216	216	202	214	268	280
big55	La Bigne	207	207	222	222	155	161	161	161	165	165	234	234	216	216	214	214	280	289
big6	La Bigne	207	207	222	222	161	161	164	164	180	180	234	258	216	216	202	214	268	283
big7	La Bigne	240	240	222	222	155	161	161	164	165	168	222	258	216	216	202	214	268	280
big8	La Bigne	237	240	222	222	155	161	161	164	165	165	234	258	216	216	202	214	268	280
big9	La Bigne	207	207	222	228	146	161	161	164	165	165	234	250	216	216	214	214	268	268
ner1	Nerput	207	240	222	222	146	161	161	161	180	180	222	258	216	216	214	214	280	283
ner1bis	Nerput	207	237	222	222	161	161	161	164	180	180	234	258	216	216	214	214	268	268
ner10	Nerput	207	249	222	222	146	155	161	161	180	180	222	222	216	216	214	214	268	268
ner11	Nerput	207	207	222	222	152	155	161	161	180	180	222	258	216	216	202	202	268	268
ner12	Nerput	207	249	222	228	161	161	161	164	180	180	234	234	216	216	202	214	268	280
ner13	Nerput	240	240	222	222	161	161	161	161	165	180	234	258	216	216	214	214	268	268
ner14	Nerput	207	207	222	222	161	161	161	164	165	180	222	258	216	216	202	214	280	283
ner14bis	Nerput	207	240	222	222	155	167	161	161	180	180	234	234	216	216	214	214	268	268
ner15	Nerput	207	249	222	228	155	161	161	161	165	165	234	234	216	216	202	214	268	280
ner16	Nerput	207	207	222	222	158	161	161	161	165	180	234	258	216	216	214	214	268	280
ner17	Nerput	207	207	222	222	161	161	164	164	165	180	234	234	216	216	202	202	280	280
ner18	Nerput	207	249	222	222	155	155	161	161	165	165	222	234	212	216	214	214	268	268
ner19	Nerput	207	237	222	222	155	155	161	161	165	180	258	258	216	216	202	214	283	283
ner2	Nerput	207	249	222	228	155	161	161	161	180	180	222	222	216	216	202	202	268	268
ner20	Nerput	237	249	222	222	161	161	161	161	180	180	234	234	216	216	214	214	268	280
ner21	Nerput	207	249	222	222	152	161	161	161	165	180	222	234	216	216	202	214	268	280
ner22	Nerput	207	207	222	222	155	155	161	161	165	165	222	258	216	216	214	214	280	283
ner23	Nerput	207	207	222	222	161	161	161	161	165	165	234	234	216	216	214	214	268	283
ner24	Nerput	207	249	222	222	155	161	161	164	180	180	222	258	216	216	214	214	268	268
ner26	Nerput	207	249	222	222	155	161	161	161	180	180	222	258	216	216	202	214	280	283
ner27	Nerput	207	207	222	222	161	161	161	161	165	180	222	234	216	216	214	214	268	283
ner28	Nerput	207	207	222	222	146	161	161	164	165	165	258	258	216	216	214	214	268	283
ner29	Nerput	207	207	222	222	155	155	161	161	180	180	234	258	212	216	214	214	280	289
ner3	Nerput	240	240	222	222	161	161	161	161	165	180	222	234	216	216	202	214	268	280
ner30	Nerput	207	207	222	228	161	161	161	161	180	180	222	258	216	216	202	202	268	280
ner4	Nerput	207	207	222	228	155	161	161	164	165	165	222	234	216	216	214	214	268	268
ner5	Nerput	207	207	222	222	155	161	161	161	165	165	234	234	216	216	214	214	268	280
ner6	Nerput	207	249	222	222	161	161	164	164	180	180	234	258	216	216	202	202	268	268
ner7	Nerput	207	237	222	228	161	161	161	161	180	180	234	258	216	216	214	214	268	268
ner8	Nerput	237	240	222	222	155	161	161	161	165	180	234	258	216	216	199	202	268	268
ner9	Nerput	207	207	222	228	161	161	161	161	180	180	234	258	216	216	202	214	280	283
mou1	Le Moulin	207	207	222	222	155	155	164	164	180	180	234	258	216	216	214	214	268	268
mou10	Le Moulin	207	249	222	222	155	161	161	164	180	180	222	234	216	216	202	214	268	283
mou11	Le Moulin	207	207	222	228	152	161	161	161	168	168	234	234	216	216	202	214	280	280
mou12	Le Moulin	207	249	222	222	146	161	161	161	180	180	222	234	216	216	214	214	268	268
mou13	Le Moulin	207	207	222	228	146	161	161	164	180	180	234	258	216	216	202	214	268	283
mou14	Le Moulin	207	249	222	228	161	167	161	164	180	180	222	234	216	216	214	214	280	280

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mou15	Le Moulin	207	249	222	222	155	161	161	161	165	165	234	234	216	216	214	214	268	283
mou16	Le Moulin	237	237	222	222	161	161	161	164	168	168	222	234	216	216	214	214	268	283
mou16bis	Le Moulin	207	249	222	222	155	161	161	161	165	180	222	234	216	216	214	214	268	283
mou17	Le Moulin	207	207	222	228	158	161	161	161	165	180	222	222	216	216	214	214	268	268
mou18	Le Moulin	207	249	228	228	155	161	161	164	180	180	234	258	216	216	214	214	280	280
mou19	Le Moulin	207	237	222	228	152	161	161	164	180	180	234	258	216	216	202	214	268	280
mou2	Le Moulin	207	207	222	222	152	161	161	161	180	180	222	222	216	216	202	214	280	283
mou20	Le Moulin	207	249	222	222	155	167	164	182	165	165	234	234	216	216	214	214	268	268
mou20bis	Le Moulin	207	240	222	222	152	161	161	161	165	180	222	234	216	216	202	214	268	283
mou21	Le Moulin	207	240	222	222	155	161	161	164	165	165	222	222	216	216	214	214	268	283
mou22	Le Moulin	207	249	222	228	146	155	161	161	180	195	234	234	216	216	214	214	280	283
mou23	Le Moulin	207	207	222	222	155	155	161	164	165	165	222	234	216	216	202	214	280	289
mou24	Le Moulin	207	243	222	222	155	161	161	164	165	165	234	234	216	216	214	214	268	268
mou25	Le Moulin	207	249	222	228	152	161	161	161	165	180	222	222	216	216	202	214	268	280
mou26	Le Moulin	207	240	222	222	161	161	161	161	180	180	222	234	216	216	202	202	268	268
mou27	Le Moulin	207	240	222	228	146	161	161	164	168	168	222	222	216	216	214	214	268	268
mou28	Le Moulin	207	207	222	222	155	161	161	161	165	165	222	234	216	216	202	214	280	280
mou29	Le Moulin	207	240	222	222	146	155	164	164	165	180	222	234	216	216	202	214	280	280
mou29bis	Le Moulin	207	207	222	222	146	152	161	164	180	180	234	234	216	216	214	214	268	268
mou3	Le Moulin	207	249	222	222	161	161	161	161	180	180	258	258	216	216	202	214	280	280
mou30	Le Moulin	207	237	222	228	155	155	161	161	165	180	234	234	216	216	214	214	280	280
mou30bis	Le Moulin	207	207	222	222	146	161	161	164	165	180	222	234	216	216	214	214	268	283
mou31	Le Moulin	207	207	222	222	155	161	161	161	165	180	222	234	216	216	214	214	268	268
mou32	Le Moulin	207	237	228	228	152	161	161	161	165	165	234	234	216	216	202	214	280	280
mou33	Le Moulin	207	249	222	222	155	155	161	164	180	180	222	234	216	216	214	214	268	268
mou34	Le Moulin	207	237	222	222	155	161	161	161	180	180	222	222	216	216	202	214	280	283
mou35	Le Moulin	207	207	222	228	161	161	161	161	180	180	234	234	216	216	202	214	268	280
mou36	Le Moulin	207	249	222	222	155	161	161	164	165	180	234	258	216	216	202	202	268	280
mou37	Le Moulin	207	207	222	222	146	155	161	164	180	180	222	258	216	216	202	214	268	268
mou38	Le Moulin	207	207	222	222	155	161	161	164	165	180	234	234	216	216	214	214	268	283
mou39	Le Moulin	207	207	222	222	152	161	164	164	180	180	234	258	216	216	214	214	280	283
mou4	Le Moulin	207	237	222	222	146	161	161	161	165	165	234	234	216	216	202	202	268	283
mou40	Le Moulin	207	207	222	222	161	161	161	164	165	165	234	258	216	216	202	214	280	283
mou41	Le Moulin	207	207	222	222	152	155	161	161	180	180	234	234	216	216	214	214	268	283
mou42	Le Moulin	207	249	222	228	155	161	161	161	180	180	222	222	216	216	214	214	268	280
mou43	Le Moulin	207	240	222	222	155	161	161	164	180	180	222	234	216	216	202	214	268	283
mou44	Le Moulin	207	240	222	222	155	155	161	164	180	180	258	258	216	216	214	214	268	268
mou46	Le Moulin	207	207	222	222	155	161	161	161	165	180	222	234	216	216	214	214	268	280
mou47	Le Moulin	207	249	222	222	155	155	161	164	180	180	234	234	216	216	214	214	268	283
mou48	Le Moulin	207	207	222	222	155	161	161	161	165	165	234	258	216	216	202	214	268	280
mou49	Le Moulin	207	240	222	222	155	155	161	161	180	180	234	258	216	216	214	214	268	268
mou5	Le Moulin	207	207	222	222	155	161	161	161	165	165	222	234	216	216	202	214	268	268
mou50	Le Moulin	249	249	222	222	155	155	161	164	165	165	234	234	216	216	214	214	268	280
mou51	Le Moulin	207	249	222	222	152	155	161	161	168	180	234	258	216	216	214	214	268	268
mou52	Le Moulin	207	207	222	228	155	161	161	164	165	180	222	258	216	216	214	214	268	268
mou53	Le Moulin	207	249	222	222	161	161	161	161	180	180	222	258	216	216	202	214	268	268
mou6	Le Moulin	207	207	222	222	152	155	164	164	165	180	234	258	216	216	214	214	280	283
mou7	Le Moulin	207	207	222	228	155	155	161	161	165	180	234	234	216	216	202	202	268	280
mou8	Le Moulin	207	237	222	222	155	161	161	161	180	180	222	258	216	216	202	214	280	283
mou9	Le Moulin	207	207	222	222	155	161	161	161	165	165	234	258	216	216	214	214	268	280
ama1	Les Amas	207	237	222	222	155	155	161	164	165	180	234	234	216	216	202	214	268	268
ama1bis	Les Amas	207	237	222	222	161	167	161	161	180	180	222	222	216	216	214	214	280	283
ama10	Les Amas	207	237	222	228	155	158	161	164	180	180	222	222	216	216	202	214	268	280
ama10bis	Les Amas	207	249	222	228	161	161	161	164	165	180	234	258	212	216	214	214	268	280
ama11	Les Amas	207	207	222	222	161	167	161	161	165	180	222	246	216	216	202	202	268	283
ama12	Les Amas	207	249	222	222	155	167	161	164	180	180	222	234	216	216	202	214	280	283
ama12bis	Les Amas	237	249	222	222	155	161	161	161	165	180	222	234	216	216	202	202	000	000
ama13	Les Amas	207	207	222	222	161	161	161	164	165	165	234	234	216	216	202	214	280	283
ama13bis	Les Amas	219	249	222	222	161	161	161	164	180	180	234	234	000	000	202	214	268	280
ama14	Les Amas	237	237	222	222	158	158	161	164	165	180	222	222	216	216	196	214	268	268
ama14bis	Les Amas	207	237	222	222	155	161	161	161	165	180	234	234	216	216	214	214	280	280
ama15	Les Amas	237	249	222	222	158	161	161	164	180	180	222	222	216	216	214	214	268	280
ama15bis	Les Amas	207	207	222	222	158	167	161	164	180	180	222	234	216	216	199	214	268	280
ama16	Les Amas	207	237	222	222	152	161	161	161	165	180	234	234	216	216	202	214	280	283
ama16bis	Les Amas	207	207	222	222	161	161	161	164	180	180	222	222	216	216	202	202	268	280
ama17	Les Amas	207	207	222	222	161	167	161	161	165	180	222	234	216	216	214	214	268	283
ama17bis	Les Amas	207	237	222	222	155	161	164	164	165	180	222	246	000	000	214	214	268	268
ama18	Les Amas	207	249	222	222	155	161	161	161	180	180	222	234	216	216	214	214	268	280
ama18bis	Les Amas	207	237	222	222	155	167	161	161	180	180	222	234	216	216	214	214	280	286

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ama19	Les Amas	207	249	222	222	155	161	161	164	180	180	222	234	216	216	202	214	268	283
ama19bis	Les Amas	207	249	222	222	155	161	164	164	165	165	234	234	216	216	202	214	000	000
ama2	Les Amas	237	249	222	222	155	161	161	161	180	180	234	234	216	216	199	202	268	280
ama20	Les Amas	207	249	222	222	155	155	161	164	180	180	222	234	216	216	199	214	268	280
ama21	Les Amas	249	249	222	222	158	161	161	164	180	180	222	222	216	216	202	214	283	283
ama21bis	Les Amas	207	249	222	222	161	161	164	164	180	180	222	234	216	216	196	214	268	268
ama22	Les Amas	207	207	222	222	155	155	164	164	165	180	222	234	216	216	202	214	268	280
ama22bis	Les Amas	207	207	222	222	155	161	161	164	165	180	234	262	216	216	214	214	268	283
ama23	Les Amas	207	237	222	222	155	161	161	161	165	165	222	234	216	216	202	214	268	286
ama23bis	Les Amas	207	207	222	222	155	167	161	161	165	180	222	234	216	216	202	202	283	289
ama24	Les Amas	207	207	222	222	155	161	161	164	165	165	222	234	216	216	214	214	280	283
ama24bis	Les Amas	207	249	222	222	155	161	161	164	180	180	222	222	216	216	202	202	268	268
ama25	Les Amas	207	207	222	222	155	161	152	161	168	180	234	234	216	216	202	214	283	283
ama25bis	Les Amas	207	237	222	222	158	161	161	161	180	180	234	234	216	216	214	214	280	283
ama26	Les Amas	207	207	222	228	146	161	161	161	180	180	222	234	216	216	214	214	280	283
ama26bis	Les Amas	207	249	222	222	155	161	161	164	180	180	234	234	216	216	214	214	283	283
ama27	Les Amas	207	249	222	222	155	161	152	164	180	180	222	234	216	216	202	214	283	283
ama27bis	Les Amas	207	249	222	222	155	161	161	161	165	180	222	222	216	216	196	202	268	289
ama28	Les Amas	207	237	222	222	155	167	161	164	165	180	222	234	216	216	214	214	268	283
ama29	Les Amas	207	207	222	228	161	167	161	164	165	180	222	234	216	216	214	214	268	268
ama29bis	Les Amas	207	249	222	222	155	161	161	161	180	180	222	234	216	216	202	214	283	283
ama3	Les Amas	207	237	222	222	155	155	161	161	165	180	222	234	216	216	202	214	268	268
ama3bis	Les Amas	207	207	228	228	155	155	161	161	180	180	222	222	216	216	214	214	268	283
ama30	Les Amas	207	249	222	222	161	161	161	164	180	180	222	234	216	216	199	202	268	283
ama31	Les Amas	207	207	222	222	155	161	161	161	180	180	222	222	216	216	214	214	268	280
ama32	Les Amas	207	246	222	222	155	155	161	164	165	180	222	234	216	216	214	214	283	283
ama33	Les Amas	207	207	222	222	155	161	161	164	165	180	222	234	216	216	202	214	268	280
ama34	Les Amas	219	237	222	228	161	161	164	164	165	180	234	234	216	216	214	214	268	289
ama35	Les Amas	207	237	222	222	161	161	152	161	180	180	222	234	216	216	199	214	283	286
ama36	Les Amas	207	249	222	222	155	161	161	164	180	180	222	234	216	216	202	214	268	268
ama37	Les Amas	207	249	222	222	155	161	161	161	165	180	222	234	216	216	196	208	280	280
ama38	Les Amas	207	237	222	222	155	161	161	161	165	165	234	234	216	216	199	214	268	280
ama4	Les Amas	207	249	222	222	155	161	161	161	180	180	234	234	216	216	214	214	268	280
ama4bis	Les Amas	219	249	222	222	161	161	161	164	180	180	222	234	216	216	199	214	280	283
ama5	Les Amas	207	249	222	222	152	158	161	161	180	180	222	234	216	216	214	214	280	283
ama5bis	Les Amas	207	249	222	222	155	161	161	164	180	180	234	234	216	216	202	202	280	283
ama6	Les Amas	207	207	222	222	155	155	161	161	165	165	222	234	216	216	199	214	268	283
ama6bis	Les Amas	207	249	222	222	155	161	161	161	180	180	234	258	216	216	214	214	268	280
ama7	Les Amas	207	240	222	222	155	161	161	164	165	180	222	234	216	216	196	214	280	283
ama7bis	Les Amas	207	237	222	222	155	155	161	161	180	180	234	234	216	216	202	202	268	280
ama8	Les Amas	207	249	222	228	155	161	161	161	180	180	222	222	216	216	202	214	280	283
ama8bis	Les Amas	207	249	228	228	155	155	161	164	180	180	222	234	216	216	199	214	283	283
ama9	Les Amas	207	249	222	222	152	155	164	164	180	180	234	258	216	216	214	214	283	283
ama9bis	Les Amas	207	207	222	222	155	158	161	164	180	180	234	234	000	000	214	214	280	286
pri1	Primel	207	249	222	222	146	152	164	167	165	180	242	246	216	216	214	223	268	268
pri10	Primel	219	243	222	222	146	152	164	164	180	180	222	258	216	216	202	214	268	289
pri11	Primel	237	240	222	222	155	155	164	164	165	177	222	222	216	216	202	223	283	283
pri12	Primel	237	240	222	222	146	146	164	164	165	180	246	246	216	216	199	223	289	289
pri13	Primel	240	240	222	222	146	146	164	164	168	168	246	258	216	216	223	223	283	289
pri14	Primel	207	237	222	222	152	155	164	164	168	180	234	258	216	216	214	223	268	283
pri15	Primel	219	249	222	222	146	152	152	164	168	177	246	246	216	216	199	202	268	289
pri16	Primel	237	237	222	222	152	161	152	164	168	168	222	222	216	216	214	223	268	289
pri17	Primel	207	237	222	228	146	155	164	170	165	183	222	234	216	216	214	223	268	268
pri18	Primel	240	249	222	228	146	158	164	164	156	165	222	246	216	216	223	223	265	268
pri19	Primel	237	237	222	222	146	155	161	164	165	165	222	234	216	216	196	199	265	283
pri2	Primel	219	237	222	222	152	155	164	170	168	168	222	246	216	216	223	223	280	292
pri20	Primel	219	219	222	222	152	158	161	164	165	180	246	258	216	216	223	223	268	289
pri21	Primel	237	240	222	222	146	146	164	164	168	168	234	246	216	216	214	214	283	283
pri22	Primel	219	240	222	222	146	152	164	167	165	168	234	234	212	216	214	214	283	283
pri23	Primel	219	237	222	222	152	152	164	164	168	168	234	246	216	216	199	223	283	283
pri24	Primel	237	237	222	222	146	152	164	164	165	180	234	258	216	216	214	214	277	283
pri25	Primel	237	237	222	222	146	152	164	164	165	165	234	258	216	216	214	214	283	286
pri26	Primel	219	237	222	222	146	167	164	164	165	180	222	246	216	216	220	223	283	283
pri27	Primel	219	240	222	228	146	161	164	167	165	180	222	258	216	216	199	223	268	289
pri28	Primel	237	240	222	222	155	167	164	164	165	165	222	234	216	216	196	223	289	289
pri29	Primel	237	240	222	228	146	155	161	164	165	168	258	258	216	216	214	223	268	283
pri3	Primel	207	219	222	222	158	167	152	164	168	168	234	246	216	216	214	214	286	289
pri30	Primel	237	237	222	222	152	155	164	167	168	177	222	234	216	216	223	223	268	286
pri31	Primel	219	237	222	222	146	155	164	164	165	165	222	234	216	216	202	202	268	286

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pri32	Primel	219	240	222	228	146	167	164	164	165	180	222	246	216	218	214	214	280	283
pri33	Primel	237	237	222	222	146	158	164	164	168	180	222	242	216	216	214	223	268	289
pri34	Primel	219	237	222	222	152	155	152	167	165	168	222	222	212	216	214	223	268	283
pri35	Primel	207	240	222	222	146	146	164	164	165	165	222	234	216	216	214	223	000	000
pri37	Primel	237	237	222	222	146	167	152	164	168	177	234	266	216	216	214	214	268	268
pri38	Primel	207	237	222	222	152	164	161	164	165	165	234	234	216	216	214	223	283	289
pri39	Primel	240	249	222	228	146	146	164	164	165	168	234	258	216	216	199	214	283	289
pri4	Primel	219	219	222	222	146	155	164	167	165	165	222	234	216	216	199	223	268	268
pri5	Primel	219	219	222	228	152	158	164	164	165	165	234	258	216	216	223	223	268	268
pri6	Primel	207	249	222	228	152	155	161	164	165	180	258	258	216	216	199	223	268	268
pri7	Primel	237	240	222	222	146	167	164	164	165	168	234	238	216	216	223	223	280	289
pri8	Primel	237	237	222	222	158	167	161	164	165	165	234	258	216	216	214	223	283	289
pri9	Primel	219	240	222	222	146	152	164	164	165	165	234	246	216	216	223	223	289	289
due1	Duons Est	219	240	222	222	146	167	152	164	165	168	234	242	216	218	214	223	268	286
due10	Duons Est	207	237	222	222	146	161	152	164	165	168	234	246	216	218	214	223	283	289
due11	Duons Est	237	249	222	222	155	164	164	167	165	165	222	246	216	216	202	223	268	280
due12	Duons Est	219	243	222	222	167	167	161	164	168	180	222	234	216	216	196	199	268	268
due13	Duons Est	219	237	222	222	146	146	164	164	168	177	234	246	216	216	202	223	283	283
due14	Duons Est	237	243	222	222	146	167	152	164	165	180	222	258	216	216	214	223	283	283
due15	Duons Est	219	237	222	222	146	152	164	164	165	177	234	246	216	216	214	214	268	280
due16	Duons Est	240	240	222	222	146	146	164	164	165	165	222	246	216	216	223	223	286	289
due17	Duons Est	237	249	222	222	146	152	164	164	165	165	234	258	216	216	214	214	268	283
due18	Duons Est	207	249	222	222	146	155	164	164	165	180	222	222	216	216	202	214	286	289
due19	Duons Est	240	249	222	222	146	158	161	164	165	165	234	258	216	216	202	214	268	268
due2	Duons Est	240	243	222	222	146	155	152	161	165	168	234	258	216	216	223	223	268	289
due20	Duons Est	207	240	222	222	146	167	161	164	165	186	222	234	216	218	214	223	277	280
due21	Duons Est	237	240	222	222	146	152	164	164	165	168	222	246	216	216	214	223	283	289
due22	Duons Est	219	243	222	222	152	155	152	164	165	168	234	246	216	216	202	223	268	283
due23	Duons Est	237	249	222	222	146	164	152	164	165	180	258	258	216	216	199	223	265	283
due24	Duons Est	219	240	222	222	155	161	152	164	165	168	234	246	216	216	223	223	289	289
due25	Duons Est	219	237	222	222	146	155	161	164	165	168	234	258	216	216	196	202	268	289
due26	Duons Est	219	240	222	222	155	158	164	164	165	165	222	222	216	216	214	223	283	289
due27	Duons Est	219	240	222	228	152	155	161	164	177	180	222	246	216	216	214	223	268	283
due28	Duons Est	207	237	222	222	146	158	152	161	165	165	222	222	216	218	202	214	265	268
due29	Duons Est	237	237	222	222	152	152	164	164	165	165	222	222	216	216	202	202	289	289
due3	Duons Est	237	240	222	222	146	152	164	164	165	180	234	258	216	216	202	214	268	280
due30	Duons Est	237	240	222	222	146	167	164	164	165	168	234	234	216	216	199	223	283	283
due31	Duons Est	237	237	222	228	152	158	152	164	165	168	222	222	216	216	214	223	268	283
due32	Duons Est	219	237	222	222	146	158	161	164	165	177	222	242	216	216	202	214	268	283
due33	Duons Est	207	219	222	222	155	158	161	164	168	168	222	258	216	216	202	223	286	289
due34	Duons Est	237	240	222	222	146	155	152	161	165	165	222	234	216	216	214	223	286	289
duE34bis	Duons Est	207	219	222	222	146	152	152	164	168	180	222	258	216	216	214	223	268	268
due35	Duons Est	237	240	222	228	146	152	164	167	165	165	258	270	216	216	223	223	277	283
due36	Duons Est	207	237	222	222	146	152	164	164	168	168	222	258	216	216	223	223	283	289
due37	Duons Est	240	249	222	222	158	167	164	170	165	165	242	246	216	216	199	223	268	283
due38	Duons Est	237	249	222	222	146	158	161	164	165	165	222	246	216	216	214	214	283	283
due39	Duons Est	207	219	228	228	146	155	164	164	165	180	222	234	216	216	205	214	268	283
due4	Duons Est	207	237	222	222	146	161	164	167	165	180	222	234	216	216	214	223	289	289
due40	Duons Est	219	237	222	222	158	167	161	164	168	168	222	234	216	216	214	214	283	289
due41	Duons Est	219	219	222	228	152	152	164	164	165	168	234	258	216	216	214	223	289	289
due42	Duons Est	240	240	222	228	158	164	167	170	165	168	222	222	216	216	196	214	268	268
due43	Duons Est	237	240	222	222	146	155	152	161	180	183	222	246	216	216	196	214	268	283
due44	Duons Est	219	237	222	222	146	155	161	164	165	165	234	234	216	216	196	214	265	286
due45	Duons Est	219	219	222	222	146	164	164	164	168	168	222	250	216	216	223	223	283	289
due46	Duons Est	207	237	222	222	146	155	164	167	168	168	234	258	216	216	190	214	268	280
due47	Duons Est	225	225	222	228	146	155	164	164	165	180	222	246	216	216	214	223	283	289
due48	Duons Est	207	237	222	228	146	155	164	164	165	165	234	246	216	216	214	223	268	289
due5	Duons Est	237	249	222	228	146	146	164	164	165	165	222	234	216	216	202	202	268	283
due6	Duons Est	207	237	222	222	146	158	167	167	165	168	234	258	216	216	223	226	283	289
due7	Duons Est	219	237	222	222	152	167	164	164	156	180	222	246	216	216	223	223	268	289
duE7bis	Duons Est	243	249	222	222	146	164	164	164	168	180	234	258	216	216	223	223	289	289
due8	Duons Est	237	240	222	222	155	155	161	164	180	180	222	246	216	216	196	214	286	289
due9	Duons Est	237	240	222	228	155	161	164	164	180	180	222	242	216	216	214	223	268	268
duo1	Duons Ouest	237	237	222	222	146	158	161	170	165	165	222	258	216	216	214	223	283	283
duo10	Duons Ouest	207	240	222	222	146	146	152	164	168	168	222	258	216	216	214	223	268	289
duo11	Duons Ouest	240	249	222	222	146	164	164	167	165	165	234	258	216	216	214	223	286	289
duo12	Duons Ouest	240	249	222	222	146	164	164	164	168	168	234	246	216	216	196	223	268	289
duo13	Duons Ouest	237	249	222	222	164	164	152	164	165	165	222	246	216	216	202	214	268	289
duo14	Duons Ouest	219	237	222	222	146	155	164	164	165	165	222	234	212	212	199	214	268	283

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duo15	Duons Ouest 237	240	222	222	146	152	152	161	165	168	234	258	216	218	223	223	268	289	
duo16	Duons Ouest 207	237	222	228	155	164	164	164	165	165	246	258	216	216	223	223	268	283	
duo17	Duons Ouest 207	237	222	228	146	152	161	164	180	180	222	234	216	216	223	223	268	292	
duo18	Duons Ouest 237	249	222	228	146	155	164	164	168	168	234	242	216	216	214	214	268	283	
duo19	Duons Ouest 219	240	222	222	146	167	164	167	165	168	222	234	216	216	202	223	268	283	
duo2	Duons Ouest 219	240	222	222	164	164	164	164	168	168	222	258	214	216	202	223	268	283	
duo20	Duons Ouest 237	249	222	228	146	152	152	164	165	165	222	222	216	216	199	214	268	268	
duo22	Duons Ouest 207	237	222	222	167	167	164	164	168	180	222	258	216	216	196	214	268	283	
duo24	Duons Ouest 240	249	222	222	155	161	164	164	156	168	222	246	216	216	202	214	283	283	
duo25	Duons Ouest 240	240	222	222	146	155	164	164	165	168	234	242	216	216	214	223	268	268	
duo26	Duons Ouest 237	240	222	222	146	152	164	167	165	180	222	222	216	216	214	214	283	286	
duo27	Duons Ouest 207	207	222	222	155	164	161	164	165	180	222	234	216	216	214	223	268	283	
duo28	Duons Ouest 240	246	222	228	146	155	161	167	165	165	234	234	216	216	223	223	268	289	
duo29	Duons Ouest 207	207	222	222	146	146	152	167	165	165	234	234	216	216	196	223	268	268	
duo3	Duons Ouest 237	240	222	222	152	155	164	164	168	168	222	258	216	216	214	223	283	283	
duo30	Duons Ouest 219	249	222	228	146	152	152	167	165	165	234	246	216	216	196	214	268	283	
duo31	Duons Ouest 207	207	222	222	146	152	164	164	165	168	246	246	216	216	196	223	268	283	
duo32	Duons Ouest 237	237	222	222	146	155	164	164	165	165	234	242	216	216	214	223	268	289	
duo33	Duons Ouest 219	219	222	222	155	167	161	167	165	180	222	242	216	216	202	214	283	292	
duo34	Duons Ouest 207	249	222	228	146	161	161	164	165	165	234	234	216	216	214	223	283	289	
duo35	Duons Ouest 240	240	222	222	146	152	164	164	180	180	234	246	216	216	202	214	268	289	
duo36	Duons Ouest 237	243	222	222	152	155	164	167	168	168	234	258	216	216	214	226	277	283	
duo38	Duons Ouest 237	237	222	228	146	155	161	164	165	180	222	258	216	216	214	214	268	283	
duo39	Duons Ouest 219	219	222	228	155	155	170	179	165	165	222	246	216	216	214	214	283	283	
duo4	Duons Ouest 207	207	222	222	146	155	161	164	165	165	234	234	216	216	223	223	268	289	
duo40	Duons Ouest 219	237	222	222	146	146	164	167	165	168	222	234	216	218	202	214	283	289	
duo41	Duons Ouest 237	237	222	222	146	152	164	164	165	168	222	246	216	216	223	223	283	289	
duo42	Duons Ouest 240	249	222	228	146	146	164	167	168	180	222	234	216	216	196	223	268	283	
duo44	Duons Ouest 237	249	222	222	152	161	164	167	165	168	222	246	216	216	202	214	280	289	
duo45	Duons Ouest 207	237	222	222	164	167	164	167	165	168	222	258	216	218	199	223	268	283	
duo46	Duons Ouest 219	243	222	222	155	161	164	164	168	180	234	258	216	216	202	202	283	283	
duo47	Duons Ouest 237	240	222	222	155	155	164	164	165	168	234	246	216	216	214	223	268	283	
duo48	Duons Ouest 237	240	222	228	146	152	152	164	165	165	234	258	216	216	202	214	283	289	
duo49	Duons Ouest 219	237	222	222	158	161	164	167	165	168	258	258	216	216	202	214	268	289	
duo5	Duons Ouest 219	219	222	222	152	155	164	164	165	168	222	246	216	216	196	196	289	289	
duo50	Duons Ouest 207	237	222	222	152	152	152	164	165	168	222	234	216	216	202	223	268	289	
duo51	Duons Ouest 207	240	222	222	146	164	164	164	168	168	222	258	212	216	196	223	268	289	
duo52	Duons Ouest 237	237	222	222	146	158	164	164	165	168	234	246	216	216	223	223	283	283	
duo53	Duons Ouest 237	237	222	222	155	155	164	164	168	180	234	258	216	216	202	202	268	268	
duo54	Duons Ouest 207	219	222	222	146	158	164	170	180	180	234	246	216	216	214	223	283	289	
duo55	Duons Ouest 207	237	222	222	146	146	152	164	165	165	222	258	216	216	202	214	280	286	
duo56	Duons Ouest 207	237	222	222	158	161	164	164	165	165	222	234	216	216	223	223	280	283	
duo57	Duons Ouest 243	249	222	228	152	152	164	164	165	180	246	246	216	216	202	214	268	283	
duo58	Duons Ouest 207	219	222	228	146	146	164	164	165	165	222	234	216	216	196	223	268	286	
duo59	Duons Ouest 207	237	222	222	146	146	152	164	165	165	222	258	216	216	202	202	283	289	
duo6	Duons Ouest 207	240	222	222	155	167	161	164	165	168	246	246	216	216	196	223	286	289	
duo60	Duons Ouest 237	249	222	222	146	155	164	164	165	165	234	234	216	216	196	223	268	268	
duo61	Duons Ouest 219	219	222	222	146	152	161	164	165	165	222	258	216	216	214	223	268	283	
duo62	Duons Ouest 207	237	222	222	146	167	164	170	165	168	222	242	216	216	214	223	283	283	
duo63	Duons Ouest 207	219	222	222	152	155	164	164	165	168	234	246	216	216	214	214	268	289	
duo64	Duons Ouest 207	240	222	222	146	158	167	167	165	168	234	246	216	216	214	214	268	289	
duo65	Duons Ouest 207	219	222	222	158	167	161	164	165	180	222	222	216	216	214	214	283	289	
duo66	Duons Ouest 219	237	222	228	152	158	164	167	168	180	222	258	216	216	202	214	268	289	
duo67	Duons Ouest 219	249	222	222	164	167	152	167	168	168	242	258	216	216	202	223	280	283	
duo68	Duons Ouest 219	237	222	222	146	152	164	170	165	165	222	258	216	216	214	223	283	289	
duo69	Duons Ouest 237	237	222	222	155	155	152	164	165	180	234	250	216	216	202	223	268	283	
duo7	Duons Ouest 237	240	222	222	155	167	164	164	168	168	234	258	216	216	199	223	289	289	
duo70	Duons Ouest 219	219	222	222	146	155	164	170	168	168	234	234	216	216	202	214	283	283	
duo71	Duons Ouest 207	237	222	228	152	158	164	164	165	168	222	234	216	216	202	214	268	268	
duo72	Duons Ouest 219	237	222	222	146	152	161	164	165	165	234	246	216	216	199	202	268	283	
duo73	Duons Ouest 207	240	222	222	146	155	164	164	165	165	177	222	234	216	216	202	214	280	289
duo74	Duons Ouest 240	243	222	222	146	164	167	170	168	168	234	234	216	216	214	214	268	286	
duo75	Duons Ouest 219	240	222	222	146	152	164	167	165	180	234	246	216	216	214	223	268	289	
duo76	Duons Ouest 237	240	222	222	155	155	161	167	165	165	234	234	216	216	202	223	289	292	
duo77	Duons Ouest 219	240	222	222	146	152	164	164	165	165	246	246	216	216	214	223	268	289	
duo78	Duons Ouest 204	237	222	222	146	152	164	167	165	168	222	234	216	216	223	226	268	268	
duo79	Duons Ouest 207	237	222	222	146	155	164	164	165	180	222	258	216	216	202	223	268	268	
duo8	Duons Ouest 237	237	228	228	161	167	152	164	165	165	222	222	216	216	214	223	265	268	
duo80	Duons Ouest 219	237	222	222	146	146	161	164	165	165	246	258	216	216	202	223	268	286	

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duo84	Duons Ouest	237	237	222	222	155	161	161	164	168	168	222	234	216	216	199	223	268	289
duo85	Duons Ouest	207	243	222	222	146	167	152	164	165	165	222	222	216	216	202	223	283	286
duo86	Duons Ouest	207	207	222	222	146	167	161	164	168	168	222	242	216	216	214	223	268	289
duo87	Duons Ouest	240	240	222	222	146	167	152	164	165	168	222	222	216	216	196	223	268	286
duo89	Duons Ouest	207	237	222	222	146	158	164	167	165	168	222	246	216	216	214	214	283	283
duo9	Duons Ouest	237	240	222	222	146	155	161	164	165	177	222	234	216	216	223	223	283	289
sa21	Santec 2	219	240	222	222	143	155	161	161	165	168	222	222	216	216	214	223	289	289
sa210	Santec 2	219	237	222	228	146	161	161	161	165	180	234	234	216	216	202	214	265	289
sa211	Santec 2	219	243	222	222	155	158	167	167	165	180	246	258	216	216	214	223	277	292
sa212	Santec 2	207	219	228	228	146	155	164	164	165	168	234	234	216	216	214	223	289	289
sa213	Santec 2	219	240	222	222	155	158	152	164	165	165	222	222	216	216	223	223	268	289
sa214	Santec 2	207	219	222	228	146	161	164	164	168	183	222	222	216	216	202	202	283	289
sa216	Santec 2	237	237	222	222	155	155	164	164	165	180	222	234	216	216	196	214	268	280
sa217	Santec 2	219	237	222	222	146	164	164	170	165	180	222	222	216	216	214	223	283	289
sa218	Santec 2	237	240	222	222	146	167	152	164	168	180	246	250	216	216	202	214	283	289
sa219	Santec 2	219	240	222	222	158	164	152	164	165	168	222	246	216	216	223	223	268	289
sa22	Santec 2	207	237	222	222	155	155	164	170	165	168	234	234	216	216	196	196	283	283
sa220	Santec 2	207	207	222	228	146	155	164	170	165	180	222	258	216	216	214	214	268	268
sa221	Santec 2	219	249	222	222	152	161	161	164	168	180	222	234	216	216	202	214	277	283
sa222	Santec 2	219	243	222	222	146	164	164	167	168	180	234	246	216	216	202	214	268	289
sa223	Santec 2	207	237	222	222	152	167	164	164	165	165	222	222	216	216	214	223	283	283
sa224	Santec 2	237	249	222	222	155	167	164	167	165	168	222	222	216	216	199	223	268	286
sa225	Santec 2	207	240	222	222	152	155	152	161	168	168	222	234	216	216	214	223	268	283
sa226	Santec 2	207	240	222	222	146	167	152	167	165	168	222	242	216	216	214	223	286	289
sa227	Santec 2	219	240	222	222	158	167	161	170	165	165	222	258	216	216	223	223	268	283
sa228	Santec 2	237	240	222	222	158	158	164	164	165	180	234	246	216	218	223	223	283	283
sa229	Santec 2	237	237	222	222	146	158	152	161	165	165	234	242	216	216	199	214	268	289
sa23	Santec 2	219	237	222	222	152	152	152	167	168	177	234	234	216	216	214	223	268	289
sa230	Santec 2	219	240	222	228	158	164	152	164	165	180	222	234	216	216	214	214	280	283
sa231	Santec 2	237	249	222	222	155	161	164	164	165	180	222	258	216	216	214	223	268	268
sa232	Santec 2	219	237	222	222	146	152	164	164	168	168	246	246	216	216	223	223	265	280
sa233	Santec 2	219	243	222	222	155	155	164	167	168	168	222	234	216	216	202	223	268	283
sa234	Santec 2	240	249	222	222	146	146	167	215	165	180	234	246	216	216	202	214	268	283
sa235	Santec 2	237	249	222	228	155	161	152	164	165	165	258	258	216	216	214	214	283	289
sa236	Santec 2	237	240	222	228	146	152	164	164	180	180	234	258	216	216	199	214	268	283
sa237	Santec 2	237	237	222	228	146	158	161	164	168	180	234	250	216	216	202	202	268	283
sa238	Santec 2	207	237	222	222	155	167	161	161	165	168	234	258	000	000	214	214	283	283
sa239	Santec 2	243	243	222	222	000	000	161	164	165	165	222	234	216	216	196	202	268	289
sa24	Santec 2	207	237	222	228	152	152	164	164	165	180	258	258	216	216	196	214	283	283
sa240bis	Santec 2	240	249	222	222	152	155	164	164	168	180	238	258	216	216	223	223	000	000
sa25	Santec 2	237	240	222	228	146	158	164	164	165	165	222	222	216	216	196	214	289	289
sa26	Santec 2	237	237	222	222	146	167	164	164	165	165	222	258	216	216	196	214	283	289
sa27	Santec 2	207	207	222	222	152	152	164	170	165	168	222	234	216	216	202	214	289	289
sa28	Santec 2	207	219	222	222	146	152	164	170	165	168	222	234	216	216	214	223	268	283
sa29	Santec 2	219	237	222	222	152	155	161	170	180	183	246	258	216	216	214	223	268	292
sa11	Santec 1	240	240	222	222	146	161	164	164	165	165	234	234	216	216	214	223	268	283
sa110	Santec 1	219	240	222	222	146	155	152	164	168	180	222	234	216	216	214	214	268	268
sa111	Santec 1	219	243	222	222	146	152	152	161	165	168	222	246	216	216	202	223	268	283
sa112	Santec 1	207	219	222	222	152	161	164	167	165	180	234	258	216	216	199	214	268	289
sa113	Santec 1	240	249	222	228	152	155	152	167	165	183	222	234	216	216	223	223	268	268
sa114	Santec 1	207	207	222	222	158	167	161	164	168	168	222	222	216	216	202	223	268	289
sa115	Santec 1	219	237	222	222	152	158	164	170	165	180	222	246	216	216	214	223	283	286
sa116	Santec 1	237	243	222	222	152	158	152	164	165	180	234	258	216	216	199	199	268	289
sa117	Santec 1	237	249	222	228	152	152	152	164	165	165	234	242	216	216	214	223	283	283
sa118	Santec 1	219	237	222	222	146	155	167	167	165	165	234	242	216	216	202	223	283	283
sa119	Santec 1	207	219	222	222	155	155	161	164	165	168	222	246	216	216	202	214	268	283
sa12	Santec 1	219	237	222	222	146	158	161	161	165	165	222	234	216	216	202	214	268	283
sa120	Santec 1	219	237	222	228	155	167	164	164	165	180	222	234	216	216	202	223	289	289
sa121	Santec 1	207	237	222	222	152	158	152	152	165	168	234	246	216	216	199	214	268	283
sa122	Santec 1	219	219	222	222	158	161	164	164	168	168	222	246	216	216	214	223	283	289
sa122bis	Santec 1	240	240	222	222	158	158	161	164	168	180	234	234	216	216	199	223	289	289
sa123	Santec 1	219	240	222	222	146	164	164	170	165	165	222	246	216	216	214	223	280	286
sa124	Santec 1	207	240	222	228	146	167	164	164	168	168	222	246	216	216	199	223	268	289
sa125	Santec 1	240	249	222	228	146	155	161	164	165	165	234	246	216	216	223	223	268	283
sa126	Santec 1	219	240	222	222	155	161	164	170	165	168	234	246	216	216	196	214	277	283
sa127	Santec 1	237	237	222	228	146	167	164	167	165	180	222	222	216	216	223	223	265	268
sa128	Santec 1	237	249	222	222	152	158	161	164	165	165	222	222	216	216	202	223	283	283
sa129	Santec 1	207	237	222	222	155	161	164	164	165	168	234	246	216	216	199	214	268	289
sa13	Santec 1	219	240	222	222	152	158	164	164	165	177	222	258	216	216	223	223	268	289

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sa130	Santec 1	219	237	222	228	146	155	164	164	165	165	246	258	216	216	214	223	289	289
sa131	Santec 1	207	249	222	222	167	167	164	167	168	168	234	246	216	216	196	223	268	283
sa132	Santec 1	219	219	222	228	152	164	167	167	168	168	222	222	216	216	202	223	268	283
sa133	Santec 1	240	249	222	222	152	155	164	164	165	180	246	258	216	216	199	223	268	268
sa134	Santec 1	240	243	222	222	152	164	164	167	165	165	222	246	216	216	214	223	000	000
sa135	Santec 1	237	249	222	222	146	152	161	164	165	165	222	234	000	000	214	223	283	283
sa136	Santec 1	240	249	222	222	146	155	161	164	165	165	222	234	216	216	223	226	268	289
sa137	Santec 1	219	237	222	222	146	155	164	167	168	168	222	234	216	216	196	214	283	289
sa138	Santec 1	207	249	222	222	155	158	164	164	165	180	222	222	216	216	223	223	268	283
sa139	Santec 1	207	249	222	222	152	158	161	164	180	180	222	222	216	216	223	223	289	289
sa14	Santec 1	240	240	222	222	155	155	164	167	165	165	246	258	216	216	199	223	268	283
sa140	Santec 1	240	240	222	222	146	152	152	164	165	165	246	246	216	216	223	223	268	268
sa141	Santec 1	207	240	222	222	158	158	152	164	177	180	222	258	216	216	196	223	268	283
sa142	Santec 1	219	219	222	222	152	161	164	167	168	168	222	246	216	216	202	223	268	289
sa143	Santec 1	207	237	222	222	152	158	164	164	165	168	234	258	216	216	199	226	268	268
sa144	Santec 1	240	249	222	222	146	167	161	164	165	165	222	246	216	216	214	223	289	292
sa15	Santec 1	237	237	222	222	146	152	164	164	168	168	222	234	216	216	202	223	268	283
sa16	Santec 1	240	249	222	228	167	167	164	164	168	168	234	258	216	216	214	214	283	289
sa17	Santec 1	207	237	222	222	155	167	164	167	165	180	222	234	216	216	196	223	283	283
sa18	Santec 1	237	249	222	222	152	155	164	164	165	165	222	246	216	216	196	214	268	283
sa19	Santec 1	237	237	222	222	146	155	161	164	165	168	222	234	216	216	214	214	283	289
ami	Les Amiettes	240	240	222	228	152	158	164	170	180	180	234	234	216	216	199	223	265	289
ami10	Les Amiettes	240	249	222	222	146	158	164	167	168	177	234	246	216	216	202	214	283	289
ami11	Les Amiettes	207	240	222	222	152	152	164	167	165	165	234	254	216	216	223	223	268	289
ami12	Les Amiettes	237	240	222	222	146	167	164	173	180	180	222	234	216	216	223	223	289	289
ami13	Les Amiettes	207	249	222	222	155	164	164	164	165	168	222	234	216	216	196	223	283	286
ami14	Les Amiettes	207	249	222	222	155	167	161	164	165	180	222	258	216	218	202	223	268	289
ami15	Les Amiettes	207	240	222	222	152	152	164	164	165	165	234	246	212	216	199	214	268	268
ami16	Les Amiettes	219	240	222	222	146	155	164	164	165	168	246	258	216	216	202	223	268	268
ami17	Les Amiettes	219	237	222	222	146	152	161	164	165	168	222	258	216	216	196	202	277	283
ami18	Les Amiettes	243	249	222	222	158	161	164	164	168	168	222	258	216	216	202	214	268	289
ami19	Les Amiettes	219	219	222	222	146	167	164	179	165	168	234	258	212	218	223	223	283	286
ami2	Les Amiettes	237	240	222	222	146	155	161	164	177	177	222	258	216	216	214	214	268	289
ami20	Les Amiettes	207	240	222	222	152	158	164	164	165	165	222	222	216	216	223	223	000	000
ami21	Les Amiettes	219	243	222	222	152	167	164	167	165	165	234	258	216	216	202	214	289	289
ami22	Les Amiettes	237	249	222	222	146	152	164	164	165	168	234	246	216	216	214	223	268	289
ami23	Les Amiettes	240	249	222	222	146	155	161	164	165	180	222	234	216	216	199	223	268	268
ami24	Les Amiettes	240	243	222	222	152	155	152	164	165	165	234	258	216	216	214	214	268	289
ami25	Les Amiettes	219	240	222	222	146	146	161	164	165	165	222	234	216	216	223	223	268	283
ami26	Les Amiettes	240	249	222	228	146	155	164	170	168	168	246	258	216	216	214	214	268	289
ami27	Les Amiettes	219	237	222	228	152	155	164	167	165	168	242	258	216	216	214	223	268	283
ami28	Les Amiettes	237	237	222	222	146	152	164	164	168	168	222	234	216	218	214	214	268	289
ami29	Les Amiettes	207	237	222	228	155	155	152	170	168	180	222	258	212	214	202	223	265	289
ami3	Les Amiettes	240	249	222	222	146	146	164	164	165	165	222	242	216	216	214	214	268	268
ami30	Les Amiettes	153	240	222	222	146	152	161	167	165	165	222	234	216	216	214	223	277	277
ami31	Les Amiettes	207	240	222	222	155	155	161	164	165	168	222	222	216	216	199	223	283	283
ami32	Les Amiettes	219	249	222	222	152	155	161	167	168	180	234	258	216	216	199	223	265	289
ami33	Les Amiettes	237	243	222	222	155	167	152	161	165	168	222	246	216	216	202	214	283	283
ami34	Les Amiettes	237	240	222	228	152	167	164	167	168	168	222	258	216	216	196	223	268	289
ami35	Les Amiettes	207	219	222	222	152	161	164	170	165	168	222	258	212	216	202	223	265	265
ami36	Les Amiettes	207	207	222	222	155	155	164	164	165	165	222	234	216	216	223	223	268	268
ami37	Les Amiettes	240	243	222	222	152	158	161	164	165	165	222	234	216	216	199	214	283	289
ami38	Les Amiettes	240	240	222	222	146	146	152	167	165	168	222	246	216	216	214	223	283	283
ami38bis	Les Amiettes	240	243	222	222	152	155	164	167	165	168	234	258	216	218	196	199	000	000
ami39	Les Amiettes	207	219	222	222	146	164	161	164	165	168	222	234	216	216	214	223	283	283
ami4	Les Amiettes	240	249	228	228	152	152	161	164	168	168	222	234	216	216	196	214	268	289
ami40	Les Amiettes	207	207	222	228	146	158	164	170	165	168	234	234	216	216	214	223	268	283
ami41	Les Amiettes	237	237	222	222	146	152	161	161	165	180	246	258	216	216	223	223	268	268
ami42	Les Amiettes	237	240	222	222	146	158	164	179	165	180	246	258	216	216	223	223	286	289
ami5	Les Amiettes	207	249	222	222	146	152	167	167	168	168	246	246	216	216	223	223	283	289
ami6	Les Amiettes	207	219	222	222	146	155	164	164	180	180	222	246	216	216	202	202	289	289
ami6bis	Les Amiettes	240	240	222	222	152	155	152	164	165	168	234	258	216	216	202	211	268	268
ami7	Les Amiettes	219	219	222	222	152	155	164	164	165	168	246	246	216	216	214	214	289	289
ami8	Les Amiettes	207	240	222	222	146	158	167	167	168	168	234	234	216	216	214	223	268	283
ami9	Les Amiettes	237	240	222	222	155	158	161	164	168	168	246	258	216	216	202	223	283	283
lin1	Les Linious	240	243	222	222	146	158	164	164	156	165	234	234	216	216	202	223	286	289
lin10	Les Linious	219	219	222	222	146	146	164	164	168	180	222	242	216	216	214	214	268	268
lin11	Les Linious	207	219	222	222	146	158	164	167	168	180	222	242	216	216	196	202	268	268
lin12	Les Linious	237	243	222	228	155	161	164	167	168	168	258	258	216	216	202	223	268	283

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lin13	Les Linious	207	228	222	222	146	146	152	164	165	168	222	258	216	216	214	223	268	289
lin14	Les Linious	219	237	222	222	146	155	164	164	165	165	246	246	216	218	214	223	283	289
lin15	Les Linious	219	240	222	222	146	164	164	170	165	180	222	246	216	216	202	223	283	283
lin16	Les Linious	237	240	222	222	152	164	164	164	168	168	222	234	216	216	214	214	283	286
lin17	Les Linious	207	219	222	228	158	158	164	164	165	168	234	258	216	216	214	223	268	286
lin18	Les Linious	237	243	222	222	152	164	164	170	168	177	222	234	216	216	214	223	289	289
lin19	Les Linious	237	240	222	222	146	146	152	164	165	168	234	234	216	216	202	223	268	268
lin2	Les Linious	237	240	222	222	146	152	164	164	165	168	222	234	216	216	196	214	283	289
lin20	Les Linious	237	249	222	222	146	155	152	164	168	180	222	258	216	216	202	223	268	289
lin21	Les Linious	240	249	222	222	155	161	164	164	165	168	222	258	216	216	196	223	283	289
lin22	Les Linious	237	243	222	222	152	152	164	164	168	168	222	258	216	216	214	226	286	286
lin23	Les Linious	240	240	222	222	146	155	161	164	177	180	234	242	216	216	214	223	268	283
lin24	Les Linious	237	240	222	222	152	155	164	164	165	165	222	246	216	216	202	223	268	289
lin25	Les Linious	219	243	222	222	152	164	164	164	165	165	242	258	216	218	214	223	268	283
lin26	Les Linious	237	240	222	228	146	146	164	170	165	165	234	258	216	216	196	214	268	268
lin27	Les Linious	207	240	222	228	146	155	164	167	168	168	222	234	216	216	202	223	283	289
lin28	Les Linious	219	240	222	222	146	158	164	164	165	165	222	222	216	216	202	202	268	268
lin29	Les Linious	207	243	222	228	146	158	164	164	168	180	222	234	216	216	223	226	268	289
lin3	Les Linious	240	249	222	222	146	146	164	164	180	180	222	222	216	216	202	214	277	277
lin30	Les Linious	207	243	222	222	146	152	164	167	165	168	222	246	216	216	202	214	268	283
lin31	Les Linious	207	219	222	222	146	146	164	170	165	180	234	246	216	216	214	223	268	289
lin32	Les Linious	219	249	222	222	161	161	164	164	165	180	234	234	216	216	214	223	268	286
lin33	Les Linious	207	240	222	222	146	158	164	164	180	180	222	242	216	216	214	223	283	283
lin34	Les Linious	219	237	228	228	155	155	164	164	165	180	234	258	216	216	214	223	289	289
lin35	Les Linious	237	237	222	228	146	155	152	164	168	168	234	234	216	216	214	214	268	289
lin36	Les Linious	240	249	222	222	155	164	152	164	165	168	222	246	216	216	214	214	283	286
lin37	Les Linious	219	237	222	222	155	167	164	164	156	165	222	222	216	216	196	214	268	280
lin38	Les Linious	219	249	222	222	155	161	161	164	156	165	242	258	216	216	223	223	277	283
lin39	Les Linious	240	249	222	228	155	167	164	164	180	180	222	246	216	216	214	214	280	289
lin4	Les Linious	207	237	222	222	146	152	164	164	165	165	246	258	216	216	214	223	289	289
lin40	Les Linious	219	237	222	222	146	158	164	164	156	156	222	234	216	216	199	223	268	268
lin41	Les Linious	207	249	222	222	146	167	167	170	168	180	242	258	216	216	196	223	289	289
lin42	Les Linious	207	237	222	228	146	158	164	164	165	165	222	246	216	216	202	223	268	268
lin43	Les Linious	240	240	228	228	155	158	164	164	168	168	222	234	216	216	223	223	268	283
lin44	Les Linious	237	237	222	222	152	164	152	164	180	180	222	246	216	216	218	223	283	283
lin45	Les Linious	207	240	222	222	146	155	161	164	168	180	222	242	216	216	214	214	268	289
lin46	Les Linious	219	249	222	228	146	158	164	164	165	168	222	234	216	216	214	223	268	283
lin47	Les Linious	219	240	222	228	158	158	164	164	165	165	222	242	216	216	196	196	268	289
lin48	Les Linious	207	219	222	228	152	167	164	164	168	168	242	246	216	216	214	223	283	289
lin49	Les Linious	207	237	222	222	146	161	161	164	165	168	222	222	216	216	202	202	268	283
lin5	Les Linious	240	249	222	228	152	164	152	164	168	168	246	246	216	216	223	223	283	289
lin50	Les Linious	219	237	222	228	155	158	164	170	165	165	222	242	216	218	223	223	289	289
lin51	Les Linious	240	240	222	222	146	164	164	164	168	180	246	258	212	218	202	223	283	286
lin6	Les Linious	219	249	222	228	152	155	164	164	165	165	222	222	216	216	199	214	268	283
lin8	Les Linious	237	240	222	228	146	146	164	164	168	168	242	262	216	216	214	223	283	283
lin9	Les Linious	237	240	222	222	146	167	164	164	168	180	246	258	216	216	199	214	268	289
men1	Men Vriant	219	237	222	222	146	155	164	164	165	168	222	234	216	216	199	223	268	268
men10	Men Vriant	237	243	222	228	146	158	164	164	168	180	222	234	216	216	214	223	283	283
men11	Men Vriant	240	249	222	222	146	161	161	164	165	180	222	246	216	216	223	223	289	289
men13	Men Vriant	207	237	222	228	158	164	161	161	180	180	246	246	216	216	223	223	283	289
men14	Men Vriant	219	219	222	222	158	158	164	164	165	165	234	234	216	216	214	223	268	289
men15	Men Vriant	240	249	222	222	146	146	161	164	165	168	222	222	216	216	214	223	268	268
men17	Men Vriant	219	240	222	228	146	161	164	164	165	168	222	258	216	216	214	223	268	289
men18	Men Vriant	219	240	222	228	146	155	164	164	165	168	246	258	216	216	214	223	265	289
men19	Men Vriant	240	249	222	228	146	161	164	164	165	180	222	258	216	216	196	223	280	283
men2	Men Vriant	207	240	222	228	158	161	152	164	165	165	222	258	216	216	202	214	268	289
men20	Men Vriant	207	249	222	222	161	164	161	164	165	168	234	234	216	216	223	223	289	289
men21	Men Vriant	207	219	222	222	146	158	164	164	165	165	246	258	216	216	214	223	286	286
men23	Men Vriant	219	240	220	222	152	158	164	167	165	180	258	258	216	216	196	223	289	289
men24	Men Vriant	207	240	222	222	146	155	161	164	168	168	246	258	216	216	196	214	268	289
men26	Men Vriant	219	240	222	222	155	167	164	164	168	168	258	262	216	216	199	223	289	289
men28	Men Vriant	207	237	222	222	152	158	152	164	165	165	234	258	216	216	214	223	289	289
men29	Men Vriant	207	237	222	222	146	146	164	164	168	168	234	258	216	216	214	223	283	289
men3	Men Vriant	240	240	222	222	152	152	164	167	165	168	222	234	216	216	214	226	289	289
men30	Men Vriant	219	219	222	222	152	158	152	164	168	168	222	246	216	216	214	214	268	268
men32	Men Vriant	237	240	222	228	152	164	161	161	168	180	222	258	216	216	202	223	283	289
men33	Men Vriant	219	243	222	228	146	155	164	164	165	165	234	258	216	216	214	223	280	283
men34	Men Vriant	219	243	222	228	146	155	164	164	165	165	234	258	216	216	214	223	280	283
men35	Men Vriant	207	237	228	228	155	167	164	167	165	168	234	258	216	216	214	214	268	289

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men36	Men Vriant	207	240	222	222	146	167	164	164	168	168	234	246	216	216	223	223	286	286
men37	Men Vriant	219	240	222	222	146	158	164	164	165	180	222	234	216	216	202	214	268	283
men38	Men Vriant	240	249	222	228	152	155	161	161	165	180	222	234	212	216	202	223	268	283
men4	Men Vriant	240	240	222	228	146	164	161	164	168	168	246	258	216	216	214	223	283	286
men40	Men Vriant	240	243	222	222	152	155	164	164	168	168	222	234	216	216	214	214	283	289
men41	Men Vriant	219	249	222	228	146	158	164	164	165	165	234	234	216	216	214	223	268	268
men43	Men Vriant	207	240	222	222	146	146	164	164	165	168	222	258	216	216	214	223	283	283
men5	Men Vriant	207	207	222	222	155	155	164	170	165	165	258	266	216	216	199	214	283	283
men7	Men Vriant	207	219	222	222	146	155	152	164	165	168	222	258	216	216	214	223	268	292
men8	Men Vriant	207	237	222	222	146	146	152	164	165	165	222	246	212	216	199	223	283	283
men9	Men Vriant	240	249	222	222	152	158	152	164	165	165	222	222	216	216	214	223	283	283
klo1	Klosenn Mala	243	249	222	228	146	155	161	167	165	165	258	258	216	216	223	223	268	268
klo10	Klosenn Mala	243	243	222	222	146	158	164	164	177	180	234	246	216	216	196	223	268	268
klo11	Klosenn Mala	243	243	222	222	155	158	164	164	165	168	222	258	216	216	202	214	289	289
klo12	Klosenn Mala	219	243	222	228	155	155	161	164	168	168	242	258	212	218	199	223	283	289
klo13	Klosenn Mala	219	249	222	222	155	158	161	164	165	168	222	246	216	216	196	223	277	277
klo14	Klosenn Mala	240	243	222	222	146	155	152	170	156	165	234	242	216	216	214	223	268	289
klo15	Klosenn Mala	237	249	222	228	146	155	164	164	165	180	234	238	216	216	214	223	268	280
klo16	Klosenn Mala	240	243	222	228	146	146	164	164	165	180	222	222	216	216	202	223	283	283
klo17	Klosenn Mala	237	237	222	228	146	146	161	170	165	168	222	222	216	216	202	223	280	283
klo18	Klosenn Mala	219	237	222	228	146	158	161	164	165	165	222	234	216	216	202	214	268	268
klo19	Klosenn Mala	240	249	222	222	155	158	164	170	165	168	242	242	216	216	196	223	268	283
klo2	Klosenn Mala	219	240	222	222	152	158	161	161	165	165	222	246	216	216	199	223	289	289
klo20	Klosenn Mala	219	240	222	222	161	161	161	164	168	168	234	258	216	216	214	223	280	283
klo21	Klosenn Mala	207	240	222	222	152	155	152	164	165	180	246	258	216	216	199	223	268	283
klo22	Klosenn Mala	219	237	222	222	146	155	164	164	165	165	222	234	216	216	199	223	268	280
klo23	Klosenn Mala	207	249	222	222	158	167	164	164	165	168	222	222	216	216	199	223	289	289
klo24	Klosenn Mala	207	249	222	222	146	155	161	164	180	180	234	258	216	216	196	223	268	280
klo25	Klosenn Mala	240	243	222	228	146	146	164	164	165	180	222	222	216	216	202	223	283	283
klo26	Klosenn Mala	237	249	222	222	146	155	164	170	165	168	246	246	216	216	196	214	286	289
klo27	Klosenn Mala	219	243	222	222	146	155	164	167	165	165	222	222	216	216	223	223	283	283
klo28	Klosenn Mala	219	249	228	228	155	158	164	170	165	180	234	258	216	216	202	223	283	289
klo29	Klosenn Mala	237	249	222	222	146	158	152	170	165	168	222	234	216	216	202	223	268	268
klo3	Klosenn Mala	237	237	222	228	146	155	152	164	156	165	234	246	216	216	196	214	283	283
klo30	Klosenn Mala	237	237	222	222	146	158	161	164	165	180	234	234	216	216	223	223	268	283
klo31	Klosenn Mala	207	240	222	222	146	167	167	167	168	168	222	258	216	216	199	223	268	283
klo32	Klosenn Mala	219	249	222	222	155	158	164	164	165	168	246	246	212	216	202	223	268	283
klo33	Klosenn Mala	207	240	222	228	158	164	164	164	165	180	222	258	216	216	214	223	268	289
klo34	Klosenn Mala	219	240	228	228	146	155	164	164	156	165	242	258	216	216	214	223	277	289
klo35	Klosenn Mala	243	243	222	222	155	155	164	164	165	165	234	258	216	216	214	223	283	283
klo37	Klosenn Mala	207	207	222	228	158	164	158	167	168	180	222	234	216	216	223	223	289	289
klo38	Klosenn Mala	207	243	222	222	152	158	164	167	165	180	222	246	216	216	196	223	283	289
klo39	Klosenn Mala	207	243	222	222	146	158	161	161	165	165	246	258	216	216	223	226	277	286
klo4	Klosenn Mala	207	240	222	228	152	161	161	164	180	180	234	258	216	218	214	223	283	289
klo40	Klosenn Mala	219	243	222	228	146	161	164	164	165	168	246	258	216	216	223	223	283	289
klo41	Klosenn Mala	219	240	222	228	152	161	161	164	165	165	234	246	216	216	202	223	268	283
klo42	Klosenn Mala	240	249	222	222	152	155	152	164	165	165	234	258	216	216	196	214	283	289
klo43	Klosenn Mala	237	240	222	222	146	155	161	164	180	180	246	258	218	218	214	223	283	286
klo44	Klosenn Mala	249	249	222	222	146	146	161	164	165	168	234	246	216	216	196	214	268	283
klo45	Klosenn Mala	207	240	222	222	155	164	161	164	165	168	234	258	216	216	199	214	268	283
klo46	Klosenn Mala	240	240	222	222	158	161	164	167	165	180	222	258	216	216	214	214	268	283
klo47	Klosenn Mala	219	237	222	222	146	164	152	164	165	168	222	234	216	216	214	214	289	289
klo5	Klosenn Mala	237	243	222	222	155	155	152	164	165	180	222	234	216	216	199	214	283	289
klo6	Klosenn Mala	219	240	222	222	155	158	164	164	168	180	234	258	216	216	214	223	268	289
klo7	Klosenn Mala	237	240	222	222	146	164	164	164	165	165	234	246	216	216	214	220	268	283
klo8	Klosenn Mala	219	240	222	222	146	146	164	170	165	180	222	246	216	216	199	223	268	283
klo9	Klosenn Mala	219	240	222	222	155	164	164	167	156	156	258	258	216	216	214	223	283	289
ros1	Les Rospects	219	219	222	222	146	146	164	164	165	168	222	246	216	216	223	223	268	268
ros10	Les Rospects	249	249	222	222	158	164	152	164	168	168	234	234	216	216	214	223	283	289
ros11	Les Rospects	237	240	222	222	146	161	161	164	180	180	234	246	216	218	214	223	268	283
ros12	Les Rospects	204	246	222	222	137	137	164	164	165	165	234	242	216	218	202	214	283	289
ros13	Les Rospects	207	240	222	222	146	158	161	164	165	168	222	258	216	216	196	202	283	289
ros14	Les Rospects	237	240	222	222	146	155	164	164	168	180	222	222	216	216	214	214	268	283
ros15	Les Rospects	237	243	222	222	146	158	161	164	165	165	222	258	216	216	223	223	268	289
ros16	Les Rospects	237	240	222	222	146	164	164	164	165	168	246	258	216	216	214	214	283	283
ros17	Les Rospects	219	240	222	222	152	158	152	167	168	180	246	246	216	216	214	223	268	280
ros18	Les Rospects	207	240	222	222	146	152	152	164	180	180	234	246	216	216	214	223	268	289
ros19	Les Rospects	207	219	222	222	146	158	161	164	168	168	222	222	216	216	214	223	268	289
ros2	Les Rospects	207	219	222	222	146	155	164	164	165	165	222	246	216	216	223	223	268	283

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ros20	Les Rospects	237	240	222	222	146	152	161	164	165	165	234	258	216	216	223	223	283	283
ros21	Les Rospects	237	249	222	222	146	167	164	164	168	177	234	258	216	216	196	214	283	289
ros22	Les Rospects	237	240	222	228	146	167	161	164	180	180	234	242	216	216	196	214	283	283
ros23	Les Rospects	219	243	222	222	158	158	161	164	165	165	222	246	216	216	196	223	289	289
ros24	Les Rospects	207	207	222	228	152	155	161	164	165	168	222	246	216	216	214	223	268	289
ros25	Les Rospects	237	237	222	222	158	158	164	164	180	180	222	246	216	216	214	214	283	289
ros26	Les Rospects	237	237	222	222	146	164	164	170	168	180	222	234	216	216	223	223	283	283
ros27	Les Rospects	219	240	222	222	146	155	164	170	165	165	222	246	216	216	199	202	283	289
ros28	Les Rospects	219	240	222	222	155	167	164	164	165	168	222	234	216	216	223	223	268	268
ros29	Les Rospects	240	243	222	222	146	164	167	170	168	180	234	246	216	216	214	223	268	280
ros3	Les Rospects	237	237	222	222	146	167	164	164	165	168	234	258	216	216	214	223	268	283
ros30	Les Rospects	207	207	222	222	146	167	164	164	165	174	222	234	216	216	214	223	268	283
ros30bis	Les Rospects	219	240	222	222	146	158	164	167	165	168	234	242	216	216	214	223	283	283
ros31	Les Rospects	219	237	222	222	146	146	164	167	168	180	242	246	216	216	208	223	289	289
ros32	Les Rospects	207	219	222	222	155	158	164	164	168	168	250	258	216	216	223	223	265	283
ros33	Les Rospects	237	249	222	222	146	167	164	164	165	165	222	246	216	216	214	214	286	289
ros34	Les Rospects	000	000	222	222	155	158	152	164	165	180	242	258	216	216	223	223	283	283
ros35	Les Rospects	237	249	222	222	155	158	167	170	165	168	246	258	216	216	214	223	268	268
ros36	Les Rospects	207	219	222	228	155	167	164	164	180	180	234	246	216	216	214	223	283	283
ros37	Les Rospects	240	249	222	222	146	158	161	167	165	168	234	234	216	216	202	223	268	280
ros38	Les Rospects	219	237	222	228	155	164	164	164	165	165	234	258	216	216	214	223	277	283
ros39	Les Rospects	219	219	222	222	146	155	164	170	165	180	234	246	212	216	223	223	283	289
ros4	Les Rospects	219	240	222	222	155	164	164	164	165	165	222	222	212	216	214	223	283	289
ros5	Les Rospects	237	240	222	222	152	158	161	170	165	168	222	234	216	216	214	214	268	289
ros6	Les Rospects	237	240	222	222	158	161	161	170	165	168	222	242	216	218	214	223	268	280
ros7	Les Rospects	237	249	222	228	146	161	164	164	180	180	214	234	214	216	214	214	268	283
ros8	Les Rospects	240	243	222	222	161	167	164	164	168	180	234	234	216	216	199	202	283	289
ros9	Les Rospects	219	237	222	222	146	146	161	164	180	180	222	238	216	216	199	214	268	289
mat1	St Mathieu	237	240	222	228	152	155	164	164	165	165	222	258	216	216	196	223	283	283
mat10	St Mathieu	237	249	222	228	146	158	164	164	165	168	234	234	216	216	214	214	268	283
mat11	St Mathieu	207	237	222	222	146	152	164	164	180	180	246	258	216	216	202	202	268	283
mat12	St Mathieu	207	237	222	222	146	155	152	152	156	165	222	222	216	216	196	223	268	283
mat12bis	St Mathieu	240	240	222	222	155	167	164	164	165	168	246	246	216	216	214	223	268	283
mat13	St Mathieu	237	240	222	222	146	155	164	164	165	168	222	246	216	216	199	202	268	274
mat13bis	St Mathieu	240	240	222	222	146	155	164	164	165	168	246	246	216	216	199	214	283	283
mat14	St Mathieu	207	237	222	222	146	152	161	164	168	168	258	258	216	218	214	226	280	283
mat15	St Mathieu	243	243	222	222	146	158	164	167	165	165	222	234	216	216	214	223	268	292
mat16	St Mathieu	219	219	222	222	146	152	161	170	165	180	222	246	212	216	202	214	268	283
mat17	St Mathieu	219	249	222	228	152	164	161	161	165	168	222	246	216	216	214	223	283	283
mat17bis	St Mathieu	237	243	222	222	146	158	164	164	165	180	222	246	216	216	214	223	268	289
mat18	St Mathieu	207	240	222	222	155	158	161	170	165	180	246	258	212	216	199	223	268	289
mat18bis	St Mathieu	207	240	222	222	146	155	161	164	168	168	234	234	216	216	196	214	277	283
mat19	St Mathieu	240	249	222	222	155	161	161	164	168	177	222	222	212	216	214	226	283	286
mat2	St Mathieu	219	243	222	222	152	161	152	164	165	180	222	258	216	216	214	214	268	268
mat20	St Mathieu	237	237	222	228	146	146	164	164	168	168	242	258	218	218	214	223	268	268
mat21	St Mathieu	219	243	222	222	146	155	161	164	168	168	234	258	216	216	214	214	277	283
mat21bis	St Mathieu	237	240	222	222	146	146	161	164	168	168	242	246	212	216	202	214	283	283
mat22	St Mathieu	237	243	222	222	158	164	164	164	180	180	222	234	216	216	196	223	268	283
mat23	St Mathieu	237	249	222	222	146	146	161	167	165	168	234	258	216	216	214	223	283	289
mat24	St Mathieu	237	240	222	222	146	164	164	164	165	168	234	246	216	216	214	226	268	283
mat25	St Mathieu	240	243	222	222	152	155	164	164	165	180	222	258	212	212	214	214	283	286
mat25bis	St Mathieu	219	249	222	222	152	158	164	167	165	180	222	234	216	216	214	223	280	283
mat26	St Mathieu	153	219	222	222	155	155	164	164	165	168	242	246	216	216	214	223	268	283
mat27	St Mathieu	207	237	222	222	152	164	164	164	156	168	222	258	216	216	223	223	283	286
mat27bis	St Mathieu	237	237	222	222	146	158	152	161	165	180	234	246	216	216	214	214	283	289
mat28	St Mathieu	237	237	222	222	158	167	164	164	165	165	222	246	216	216	223	223	268	283
mat28bis	St Mathieu	237	237	222	222	146	158	164	164	180	180	222	222	216	216	199	214	283	289
mat29	St Mathieu	000	000	222	222	146	158	164	164	168	168	222	234	216	216	214	214	277	283
mat3	St Mathieu	219	240	222	222	146	164	164	164	168	168	246	246	216	216	223	223	289	289
mat30	St Mathieu	237	243	222	222	146	158	164	164	165	180	246	258	216	216	214	214	265	283
mat30bis	St Mathieu	240	243	222	222	146	158	164	164	165	168	238	246	216	216	223	223	283	283
mat31	St Mathieu	207	237	222	222	146	158	161	164	180	180	234	258	216	216	199	214	268	283
mat31bis	St Mathieu	219	243	222	222	152	158	164	167	165	168	246	246	216	216	214	223	277	283
mat32	St Mathieu	207	240	222	222	155	167	164	164	165	165	246	246	216	216	214	223	268	277
mat33	St Mathieu	219	240	222	222	158	158	164	164	165	168	234	246	216	216	214	223	283	289
mat33bis	St Mathieu	186	198	222	222	155	158	314	332	180	180	198	198	224	224	223	223	283	289
mat34	St Mathieu	219	237	222	222	146	158	164	164	168	180	222	258	216	216	202	214	283	283
mat34bis	St Mathieu	207	219	222	222	155	167	164	164	168	180	234	234	216	216	214	223	268	277
mat35	St Mathieu	219	237	222	222	146	155	164	164	168	168	234	246	212	216	214	223	283	283

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mat36	St Mathieu	240	240	222	222	152	155	161	164	165	165	234	234	216	216	202	208	277	283
mat36bis	St Mathieu	237	243	222	222	152	158	164	164	165	165	222	234	216	216	196	202	268	283
mat37	St Mathieu	240	240	222	222	152	152	161	164	165	168	258	258	216	216	214	214	283	289
mat38	St Mathieu	207	240	222	222	155	155	164	164	168	168	222	258	216	216	223	223	268	283
mat38bis	St Mathieu	219	240	222	222	155	158	164	164	168	168	222	238	212	216	223	223	268	283
mat39	St Mathieu	219	219	222	222	152	155	164	164	168	168	222	234	216	216	202	214	283	283
mat4	St Mathieu	207	237	222	222	155	164	164	164	165	168	234	242	216	216	223	223	268	283
mat40	St Mathieu	207	219	222	222	146	146	164	164	165	168	234	234	216	216	223	223	268	283
mat41	St Mathieu	237	237	222	222	152	158	164	167	168	168	234	258	216	216	214	214	268	283
mat42	St Mathieu	240	240	222	222	152	158	164	167	168	168	222	246	216	216	214	223	268	289
mat43	St Mathieu	237	240	222	222	158	164	164	170	168	168	222	242	218	218	199	214	265	289
mat5	St Mathieu	207	243	222	228	146	158	164	164	165	168	222	258	216	218	196	223	277	283
mat6	St Mathieu	207	237	222	222	146	155	164	164	168	180	222	258	216	218	196	223	283	283
mat7	St Mathieu	219	234	222	222	146	146	164	164	165	168	222	234	216	216	214	223	265	289
mat8	St Mathieu	219	237	222	222	155	158	164	164	177	180	234	246	216	216	196	199	283	289
mat8bis	St Mathieu	207	219	222	222	146	146	161	161	165	180	246	258	216	216	223	223	268	268
mat9	St Mathieu	237	240	222	222	146	146	164	164	156	168	242	258	216	218	196	223	268	268
mat9bis	St Mathieu	207	243	222	222	146	164	161	164	156	165	246	258	216	216	199	202	283	289
gou1	Pointe du gra	219	219	222	222	146	152	164	167	165	165	234	258	216	216	202	214	268	283
gou10	Pointe du gra	237	222	222	228	155	155	164	170	165	168	222	234	212	216	199	223	280	289
gou11	Pointe du gra	219	240	222	222	146	155	152	164	165	165	222	222	216	216	223	223	268	283
gou12	Pointe du gra	237	237	222	222	146	164	152	164	165	165	234	234	216	216	202	214	283	286
gou13	Pointe du gra	237	240	222	222	152	155	161	164	165	165	234	246	216	216	223	223	268	283
gou14	Pointe du gra	237	240	222	228	146	158	164	164	165	165	234	234	216	216	199	214	268	289
gou15	Pointe du gra	237	243	222	222	146	158	161	164	165	165	242	246	216	216	199	223	280	283
gou16	Pointe du gra	219	237	222	222	146	155	164	164	165	180	222	258	216	218	223	223	268	289
gou17	Pointe du gra	237	237	222	222	152	158	161	164	168	177	234	234	216	216	199	214	268	289
gou18	Pointe du gra	207	219	222	222	146	155	164	164	165	168	222	258	216	216	214	214	283	289
gou19	Pointe du gra	240	243	222	222	155	158	161	161	165	168	222	234	216	216	223	223	268	283
gou2	Pointe du gra	237	240	222	228	152	158	164	164	165	165	222	222	216	216	223	223	268	289
gou20	Pointe du gra	237	222	222	222	146	167	152	164	165	168	222	242	216	216	223	223	283	289
gou21	Pointe du gra	207	240	222	228	152	164	161	161	165	180	222	258	218	218	214	223	268	268
gou22	Pointe du gra	207	237	222	228	146	164	164	164	165	180	222	222	216	216	223	223	268	283
gou23	Pointe du gra	207	219	222	228	146	161	152	170	165	168	222	222	216	216	223	223	283	283
gou24	Pointe du gra	207	237	222	222	146	167	161	164	165	168	222	234	216	216	199	223	283	283
gou25	Pointe du gra	207	243	222	228	146	155	161	164	165	165	246	258	216	216	199	214	268	283
gou25bis	Pointe du gra	207	237	222	222	152	167	152	164	165	168	222	234	216	216	214	223	268	289
gou26	Pointe du gra	237	222	222	228	146	158	164	164	165	165	222	234	216	216	214	214	268	280
gou27	Pointe du gra	207	237	222	222	158	158	161	161	168	168	222	242	216	216	214	223	268	283
gou28	Pointe du gra	207	237	222	222	146	158	161	167	165	168	222	234	216	216	196	223	268	283
gou29	Pointe du gra	237	222	222	222	146	164	152	161	168	168	234	246	212	216	214	223	268	283
gou3	Pointe du gra	219	237	222	228	146	158	164	164	168	180	234	258	216	216	214	223	268	283
gou30	Pointe du gra	219	249	222	222	146	155	152	164	168	168	222	242	216	216	214	223	283	289
gou31	Pointe du gra	207	219	222	222	152	158	164	167	168	168	234	258	216	218	223	223	283	289
gou32	Pointe du gra	219	240	222	222	158	161	152	164	165	168	222	258	216	216	223	223	283	283
gou33	Pointe du gra	219	219	222	228	146	164	164	164	165	168	222	222	216	216	214	223	286	289
gou34	Pointe du gra	207	219	222	222	152	158	152	164	165	180	222	258	216	216	199	223	286	286
gou35	Pointe du gra	237	240	222	228	158	164	164	170	165	168	222	246	216	216	202	214	283	283
gou36	Pointe du gra	219	237	222	222	146	158	152	164	165	165	222	242	216	216	223	223	268	289
gou36bis	Pointe du gra	237	243	222	222	155	158	164	164	180	180	234	234	216	216	214	223	280	283
gou37	Pointe du gra	237	240	222	222	155	155	152	164	165	165	234	258	216	216	196	223	268	289
gou38	Pointe du gra	207	237	222	228	146	155	164	170	168	168	222	246	216	216	214	223	283	283
gou39	Pointe du gra	237	240	222	222	152	158	161	164	165	168	246	246	216	216	214	223	265	280
gou4	Pointe du gra	237	237	222	228	152	155	161	164	165	168	246	258	216	216	214	214	268	283
gou40	Pointe du gra	219	219	222	222	155	158	152	164	165	168	242	246	216	216	214	223	283	283
gou5	Pointe du gra	207	237	222	222	146	155	161	164	165	168	234	234	216	216	199	214	268	289
gou6	Pointe du gra	219	219	222	222	158	164	164	164	168	180	222	258	216	216	199	223	268	268
gou7	Pointe du gra	207	240	222	228	146	164	164	164	165	165	222	234	216	216	223	223	268	283
gou8	Pointe du gra	240	249	222	228	146	158	152	164	165	177	234	258	216	216	223	223	280	283
gou9	Pointe du gra	237	237	222	228	146	158	164	167	165	177	222	258	216	216	214	214	280	283
tev1	Ile Tévéc	237	243	222	222	146	158	164	173	165	198	238	258	216	216	214	223	286	289
tev10	Ile Tévéc	207	207	222	222	146	152	152	164	165	165	222	246	216	216	214	214	289	289
tev11	Ile Tévéc	207	243	222	222	152	158	161	161	165	165	210	258	216	216	214	223	283	286
tev12	Ile Tévéc	243	243	222	222	146	146	164	164	165	165	234	234	216	216	214	223	277	283
tev13	Ile Tévéc	243	243	222	222	155	161	161	164	165	198	234	258	216	216	214	223	268	289
tev14	Ile Tévéc	237	243	222	222	152	158	161	164	165	180	234	258	216	216	208	214	289	289
tev15	Ile Tévéc	207	237	222	222	146	152	161	173	165	165	222	258	216	216	214	214	277	283
tev16	Ile Tévéc	243	243	222	222	146	155	164	164	165	180	250	258	216	216	214	214	277	283
tev18	Ile Tévéc	207	243	222	222	152	167	164	173	165	198	258	258	216	218	199	208	283	289

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tev19	Ile Téviec	243	243	222	222	146	161	164	164	180	180	238	258	216	216	214	223	277	289
tev2	Ile Téviec	243	243	222	222	152	152	164	164	165	165	246	258	216	216	214	223	268	289
tev20	Ile Téviec	219	243	222	222	152	152	164	164	165	168	222	258	216	216	223	223	286	289
tev21	Ile Téviec	219	243	222	222	152	155	161	164	165	180	238	258	216	216	199	202	283	286
tev22	Ile Téviec	207	207	222	222	152	161	161	164	165	198	258	258	216	216	202	214	268	283
tev23	Ile Téviec	240	243	222	222	146	152	161	161	165	180	234	238	216	216	199	214	283	289
tev24	Ile Téviec	237	243	222	222	146	155	161	164	165	198	222	246	212	216	223	223	283	289
tev25	Ile Téviec	207	240	222	222	152	158	167	173	165	165	234	258	216	216	208	214	283	283
tev26	Ile Téviec	207	243	222	222	146	158	161	164	165	168	246	258	216	216	208	223	265	280
tev27	Ile Téviec	219	243	222	222	146	152	161	164	165	180	234	246	216	216	199	223	277	289
tev28	Ile Téviec	207	243	222	222	146	152	161	161	165	165	258	258	216	216	199	226	268	289
tev29	Ile Téviec	243	243	222	222	152	161	164	164	165	180	234	258	216	216	199	223	268	283
tev3	Ile Téviec	237	243	222	222	158	158	164	164	165	198	234	258	216	216	214	223	289	289
tev30	Ile Téviec	237	243	222	222	146	152	164	170	165	165	222	242	216	216	214	214	283	286
tev31	Ile Téviec	207	240	222	222	152	158	161	161	165	165	222	258	216	216	214	214	283	289
tev32	Ile Téviec	243	243	222	222	146	155	161	161	165	180	238	250	216	216	208	214	268	292
tev33	Ile Téviec	237	243	222	222	152	155	152	164	165	180	222	234	216	216	199	199	283	289
tev34	Ile Téviec	240	243	222	222	146	152	152	161	165	180	222	246	216	216	193	223	283	289
tev35	Ile Téviec	243	243	222	222	146	161	164	164	165	165	246	246	216	216	214	223	268	286
tev36	Ile Téviec	243	243	222	222	146	146	161	164	165	180	258	258	216	216	193	220	283	283
tev37	Ile Téviec	207	243	222	222	152	158	164	164	165	180	246	258	216	216	208	208	289	289
tev38	Ile Téviec	237	243	222	222	146	146	164	173	165	180	222	246	212	216	199	223	265	268
tev39	Ile Téviec	237	240	222	222	146	155	161	164	165	165	222	234	216	216	214	223	283	289
tev4	Ile Téviec	207	240	222	222	155	164	164	164	165	180	258	258	212	216	214	223	283	289
tev40	Ile Téviec	243	243	222	222	146	146	164	167	165	198	234	258	216	216	214	214	268	283
tev41	Ile Téviec	243	243	222	222	155	155	161	164	165	180	238	258	216	216	214	223	268	289
tev42	Ile Téviec	237	240	222	222	146	146	164	167	165	198	222	234	212	216	214	223	277	283
tev43	Ile Téviec	207	243	222	222	146	152	161	164	165	180	210	246	216	216	196	223	286	289
tev44	Ile Téviec	237	243	222	222	152	158	161	164	165	180	246	246	216	216	196	208	289	289
tev45	Ile Téviec	207	243	222	222	152	164	164	164	165	165	000	000	212	216	223	223	268	289
tev46	Ile Téviec	243	243	222	222	158	161	152	161	165	165	234	258	216	216	208	223	289	289
tev47	Ile Téviec	243	243	222	222	152	158	161	164	165	180	222	234	216	216	208	223	268	277
tev48	Ile Téviec	237	237	222	222	146	152	164	164	165	180	258	258	212	216	196	199	268	280
tev49	Ile Téviec	243	243	222	222	146	152	161	164	165	165	234	258	216	216	214	214	283	283
tev5	Ile Téviec	207	237	222	222	152	155	161	173	165	165	258	258	216	216	214	223	268	283
tev50	Ile Téviec	243	243	222	222	146	155	152	161	165	180	258	258	216	216	196	202	277	280
tev51	Ile Téviec	243	243	222	222	152	155	161	167	168	198	222	222	216	216	196	223	268	268
tev52	Ile Téviec	219	243	222	222	146	161	161	167	165	180	222	246	216	216	223	223	265	277
tev53	Ile Téviec	207	207	222	222	152	155	167	173	165	165	222	250	216	216	214	223	268	268
tev54	Ile Téviec	249	249	222	222	146	158	164	164	165	165	250	250	216	216	214	214	283	286
tev55	Ile Téviec	219	243	222	222	146	161	152	164	165	168	246	258	216	216	196	208	268	283
tev56	Ile Téviec	243	243	222	222	146	152	152	161	165	168	222	258	216	216	208	214	283	283
tev57	Ile Téviec	207	249	222	222	152	158	152	164	168	180	222	258	216	216	199	223	277	283
tev58	Ile Téviec	240	243	222	222	146	155	161	164	165	165	258	258	216	216	214	223	277	289
tev59	Ile Téviec	243	243	222	228	152	152	164	167	165	165	222	258	216	218	223	223	268	280
tev6	Ile Téviec	240	240	222	222	152	155	161	164	165	165	258	258	216	216	196	223	286	289
tev60	Ile Téviec	207	237	222	222	152	155	161	164	165	165	222	238	216	216	214	223	277	289
tev61	Ile Téviec	243	243	222	222	146	152	161	164	165	165	222	246	216	216	223	223	268	289
tev62	Ile Téviec	237	237	222	222	143	161	161	161	180	198	222	258	216	216	193	223	283	283
tev63	Ile Téviec	243	243	222	222	152	158	167	167	165	180	238	258	216	216	214	223	283	283
tev7	Ile Téviec	243	243	222	222	146	155	164	164	180	180	222	234	216	216	199	199	000	000
tev8	Ile Téviec	207	243	222	222	146	146	164	164	165	165	222	238	216	216	223	226	286	289
tev9	Ile Téviec	243	243	222	222	146	155	161	164	165	168	246	258	216	218	208	214	283	286
ho21	Houat 2	237	240	222	222	146	158	161	161	168	198	234	258	212	216	214	223	286	289
ho210	Houat 2	240	243	222	222	146	152	161	167	165	198	258	258	212	216	223	223	277	289
ho211	Houat 2	237	240	222	222	155	155	167	173	198	198	222	222	216	216	214	223	268	286
ho212	Houat 2	240	240	222	222	152	158	161	164	168	198	234	246	216	218	223	223	265	289
ho213	Houat 2	207	249	222	222	146	152	161	164	165	168	222	222	216	216	199	223	283	283
ho213bis	Houat 2	240	243	222	222	146	146	164	164	165	165	238	258	216	216	214	223	283	286
ho214	Houat 2	240	240	222	222	146	146	161	161	180	198	234	238	216	216	208	208	283	286
ho215	Houat 2	243	243	222	222	152	161	161	161	165	198	238	238	216	216	223	223	268	286
ho216	Houat 2	243	243	222	222	146	146	164	164	165	165	246	258	216	218	193	208	283	286
ho217	Houat 2	237	240	222	222	146	146	161	170	165	165	234	246	212	216	199	199	268	289
ho218	Houat 2	240	243	222	222	146	158	164	164	165	165	258	258	216	218	199	199	283	289
ho219	Houat 2	207	243	222	222	146	152	161	173	165	165	222	234	216	216	208	223	286	289
ho219bis	Houat 2	237	243	222	222	146	146	164	164	165	168	234	258	216	216	199	208	283	289
ho22	Houat 2	240	243	222	222	146	152	164	182	165	165	258	258	216	216	214	223	268	286
ho220	Houat 2	207	243	222	222	146	146	161	164	165	165	246	246	216	216	208	223	283	286
ho221	Houat 2	240	240	222	222	146	146	161	167	165	198	246	258	216	216	223	223	283	289

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ho222	Houat 2	207	207	222	222	146	146	164	173	165	198	258	258	216	216	214	223	268	289
ho224	Houat 2	240	240	222	222	146	152	164	170	165	168	246	246	216	216	196	223	277	277
ho225	Houat 2	237	243	222	222	152	158	161	164	165	165	222	258	212	216	223	223	268	268
ho226	Houat 2	237	237	222	222	146	152	164	164	165	168	250	258	216	218	199	214	277	289
ho227	Houat 2	240	243	222	222	149	152	161	167	165	165	222	238	216	216	199	223	277	286
ho227bis	Houat 2	237	240	222	222	152	152	161	164	198	198	222	258	216	216	223	223	283	289
ho228	Houat 2	219	243	222	222	152	158	161	161	165	177	238	246	216	216	223	223	283	286
ho228bis	Houat 2	243	243	000	000	146	152	161	173	165	180	222	238	216	216	199	208	283	289
ho229	Houat 2	207	243	222	222	146	146	161	173	165	165	238	238	216	216	208	223	283	286
ho23	Houat 2	243	243	222	222	146	146	161	161	180	180	238	262	216	216	208	223	268	283
ho230	Houat 2	207	207	222	222	146	158	164	164	165	165	258	258	216	216	214	223	268	268
ho231	Houat 2	207	219	222	222	146	155	161	164	165	165	246	258	216	216	214	223	268	289
ho232	Houat 2	240	243	222	222	152	152	161	161	165	165	222	222	212	216	214	223	268	268
ho233	Houat 2	207	243	222	222	146	152	161	167	165	165	222	234	216	216	214	223	283	289
ho233bis	Houat 2	237	243	222	222	152	161	152	167	180	198	246	258	212	216	214	214	268	280
ho234	Houat 2	207	240	222	228	146	152	161	161	165	165	234	246	216	216	223	223	268	283
ho235	Houat 2	207	207	222	222	152	152	152	167	165	165	234	258	216	216	214	223	268	268
ho236	Houat 2	240	243	222	222	152	158	161	164	165	165	238	258	216	216	199	223	268	283
ho237	Houat 2	219	243	222	222	146	152	161	164	165	165	222	258	212	216	208	223	268	286
ho238bis	Houat 2	240	240	222	222	152	155	164	164	180	198	222	258	216	216	193	223	286	289
ho24	Houat 2	219	243	222	222	146	146	152	161	168	198	246	246	216	216	214	223	268	289
ho240bis	Houat 2	243	243	222	222	146	152	161	164	165	180	250	258	212	216	214	223	289	289
ho242bis	Houat 2	207	240	222	222	146	161	164	164	165	168	258	258	216	216	193	223	283	286
ho25	Houat 2	240	240	222	222	146	146	164	164	165	165	246	246	212	212	193	193	283	289
ho26	Houat 2	240	243	222	222	146	152	161	164	165	165	222	246	216	216	199	223	283	289
ho27	Houat 2	240	243	222	222	152	155	164	173	165	165	234	258	216	216	214	223	283	286
ho28	Houat 2	240	243	222	222	152	152	164	164	165	165	258	258	216	216	214	223	283	289
ho28bis	Houat 2	243	243	222	222	146	152	161	164	165	165	222	246	216	216	214	223	286	286
ho29	Houat 2	243	243	222	222	152	155	161	164	165	165	250	250	216	216	223	223	286	289
ho11	Houat 1	237	249	222	222	146	146	161	164	165	198	246	246	216	216	223	223	283	286
ho110	Houat 1	243	243	222	222	146	146	155	164	165	198	222	246	216	216	199	208	289	289
ho111	Houat 1	240	243	222	222	146	146	164	182	165	168	242	246	216	216	223	223	277	289
ho112	Houat 1	237	243	222	222	146	146	164	167	165	198	242	262	216	216	214	223	286	289
ho113	Houat 1	240	243	222	222	146	155	161	161	165	180	234	246	216	218	223	223	286	289
ho114	Houat 1	207	237	222	222	146	146	161	164	165	168	246	258	212	212	202	208	268	268
ho115	Houat 1	207	240	222	222	146	146	161	164	168	180	222	250	216	218	193	223	268	289
ho116	Houat 1	207	207	222	222	146	158	161	167	168	198	246	258	212	212	214	223	286	289
ho117	Houat 1	240	243	222	222	152	158	161	164	165	180	222	238	216	216	208	214	268	283
ho118	Houat 1	243	243	222	222	146	158	161	161	165	168	238	258	212	216	208	214	268	268
ho119	Houat 1	243	243	222	222	152	161	161	164	165	198	258	258	216	216	208	214	268	289
ho12	Houat 1	144	240	222	222	146	146	164	173	165	168	234	258	216	218	208	208	283	283
ho120	Houat 1	240	243	222	222	146	152	161	164	165	168	250	258	216	216	214	223	268	283
ho121	Houat 1	207	243	222	222	161	161	152	161	165	168	238	258	216	216	223	223	268	289
ho122	Houat 1	240	240	222	222	155	155	152	173	165	180	246	258	216	216	214	223	283	283
ho123	Houat 1	240	240	222	222	146	152	161	161	165	180	222	234	216	216	214	223	283	286
ho124	Houat 1	237	240	222	222	146	152	164	164	165	168	234	238	216	216	199	208	283	286
ho125	Houat 1	207	207	222	222	146	155	164	164	165	198	222	238	216	216	193	208	283	283
ho126	Houat 1	240	243	222	222	146	155	161	161	165	198	234	258	216	216	208	208	283	286
ho127	Houat 1	240	249	222	222	146	146	161	179	165	180	222	246	216	216	196	223	268	286
ho128	Houat 1	240	243	222	228	146	152	161	161	165	165	238	246	216	216	214	223	283	283
ho129	Houat 1	207	240	222	222	152	155	161	167	165	165	234	246	216	216	223	223	286	289
ho13	Houat 1	243	243	222	222	155	161	164	167	168	198	258	258	216	216	199	223	283	289
ho130	Houat 1	243	246	222	222	146	146	161	161	165	198	222	258	216	218	223	223	289	289
ho131	Houat 1	207	243	222	222	146	146	161	164	168	168	234	234	216	218	208	214	268	286
ho132	Houat 1	240	243	222	228	152	158	161	161	165	168	234	246	216	216	202	223	268	289
ho133	Houat 1	207	243	222	222	146	146	161	161	165	180	246	258	216	216	214	223	268	289
ho134	Houat 1	237	240	222	222	146	152	164	170	165	165	258	258	212	218	214	223	268	289
ho135	Houat 1	207	207	222	222	146	146	164	170	165	165	234	258	216	216	223	223	268	289
ho136	Houat 1	240	243	222	222	146	152	161	170	168	198	222	234	212	212	202	208	283	289
ho137	Houat 1	240	240	222	222	152	152	164	164	165	168	258	258	216	216	214	214	283	286
ho138	Houat 1	237	240	222	222	155	161	164	167	165	168	222	258	216	218	214	223	268	283
ho139	Houat 1	207	240	222	222	146	146	161	164	165	198	234	258	216	216	199	223	289	289
ho14	Houat 1	225	240	222	222	146	155	161	161	165	165	246	258	216	216	199	214	268	283
ho140	Houat 1	240	243	222	222	146	152	164	182	165	180	234	238	216	218	199	223	268	268
ho141	Houat 1	237	243	222	222	146	161	161	167	165	165	222	222	216	216	199	223	283	286
ho142	Houat 1	240	240	222	222	146	155	161	164	165	198	234	258	216	216	199	223	289	289
ho143	Houat 1	000	000	222	222	146	146	182	182	165	165	222	250	218	218	223	223	289	289
ho144	Houat 1	240	243	222	222	146	155	152	161	165	180	238	258	216	216	214	223	286	289
ho145	Houat 1	243	243	222	222	149	149	161	164	165	165	222	258	216	216	199	208	268	289

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ho146	Houat 1	243	249	222	222	146	161	161	164	165	165	234	246	216	216	196	223	283	286
ho147	Houat 1	237	240	222	222	146	161	161	167	165	198	246	246	216	216	193	223	283	286
ho148	Houat 1	207	225	222	228	146	158	161	170	168	198	234	246	216	216	199	223	286	289
ho149	Houat 1	243	243	222	222	146	152	161	164	195	198	222	246	216	216	208	223	268	268
ho15	Houat 1	219	240	222	222	152	155	167	167	165	180	234	234	216	216	223	223	268	289
ho150	Houat 1	240	243	222	222	155	155	161	173	165	180	222	234	216	216	199	223	268	268
ho151	Houat 1	237	243	222	222	146	161	161	161	165	198	258	258	216	216	214	223	268	289
ho152	Houat 1	237	240	222	222	146	146	167	179	165	165	222	258	212	216	223	223	289	289
ho153	Houat 1	240	243	222	222	152	152	164	164	165	165	258	258	216	216	214	223	283	286
ho154	Houat 1	207	207	222	222	146	152	161	161	165	198	234	234	216	216	199	223	283	289
ho155	Houat 1	207	243	222	222	143	152	161	164	165	198	234	246	216	216	199	214	277	289
ho156	Houat 1	240	243	222	222	146	146	164	164	165	165	222	246	218	218	214	223	283	289
ho157	Houat 1	240	243	222	222	146	152	164	167	165	198	258	258	216	216	214	223	268	277
ho158	Houat 1	240	243	222	222	146	158	161	164	165	165	246	246	212	216	208	223	268	286
ho16	Houat 1	207	207	222	222	146	146	161	182	165	180	222	258	216	216	208	223	268	286
ho17	Houat 1	243	249	222	222	146	161	152	161	165	198	250	258	212	216	214	223	283	286
ho18	Houat 1	243	243	222	222	146	146	164	167	165	198	234	258	216	216	196	214	280	283
ho19	Houat 1	237	240	222	222	146	146	161	161	165	165	222	238	216	216	208	214	268	289
hoe1	Hoedic	219	243	222	222	146	161	152	152	165	165	258	258	216	216	214	223	283	286
hoe10	Hoedic	240	240	222	222	146	158	164	167	165	165	222	234	216	216	223	223	283	289
hoe11	Hoedic	207	243	224	228	146	158	161	164	165	198	258	258	212	216	214	214	268	283
hoe12	Hoedic	237	249	222	224	146	146	161	173	165	165	222	242	212	216	193	223	283	289
hoe13	Hoedic	243	243	222	224	155	155	161	167	165	165	234	246	216	216	208	223	283	283
hoe14	Hoedic	243	243	222	222	146	152	158	164	165	198	234	246	212	216	223	223	283	289
hoe15	Hoedic	240	243	222	222	146	158	161	173	165	198	222	250	216	216	193	223	289	289
hoe16	Hoedic	243	243	222	222	155	158	164	167	165	198	258	258	218	218	223	223	289	289
hoe17	Hoedic	243	243	222	222	146	158	164	167	198	198	250	258	212	216	208	223	268	289
hoe18	Hoedic	240	243	222	228	146	152	161	173	165	165	222	234	216	216	223	223	283	286
hoe19	Hoedic	219	219	222	222	146	146	167	173	165	168	222	258	216	216	208	214	268	283
hoe2	Hoedic	240	243	222	222	152	155	161	170	165	165	246	258	216	216	208	220	283	289
hoe20	Hoedic	207	243	222	222	146	152	164	167	165	180	222	258	216	216	199	223	268	286
hoe21	Hoedic	207	243	222	222	146	161	164	167	165	165	222	222	216	216	223	223	277	286
hoe22	Hoedic	237	240	222	222	152	161	161	167	165	165	258	258	216	216	223	223	289	289
hoe23	Hoedic	243	243	222	222	146	146	161	164	165	168	234	258	216	216	208	223	289	289
hoe24	Hoedic	207	237	222	222	146	161	161	164	165	198	222	246	216	216	208	223	268	283
hoe25	Hoedic	237	243	222	222	146	155	164	164	165	165	246	258	212	216	199	214	268	286
hoe26	Hoedic	207	243	222	222	146	152	152	164	165	165	246	246	216	216	193	223	289	292
hoe27	Hoedic	243	243	222	222	146	152	164	167	165	168	222	246	216	216	193	214	268	289
hoe28	Hoedic	240	240	222	222	146	152	161	164	165	165	246	246	216	216	193	223	277	280
hoe29	Hoedic	240	243	222	222	146	146	164	164	165	180	246	246	216	216	214	223	268	283
hoe3	Hoedic	219	237	222	222	146	161	167	173	165	165	246	258	216	216	223	223	283	286
hoe30	Hoedic	207	243	222	222	146	146	161	164	165	180	250	258	216	216	223	223	268	268
hoe31	Hoedic	237	243	222	228	146	155	167	167	165	165	222	258	218	218	214	223	268	283
hoe32	Hoedic	219	237	222	222	146	152	164	164	180	198	246	258	216	216	214	223	283	292
hoe33	Hoedic	207	243	222	222	146	155	164	167	165	165	234	258	216	216	223	232	283	289
hoe34	Hoedic	240	240	222	222	146	146	167	167	165	165	242	246	216	216	214	223	280	283
hoe35	Hoedic	207	237	222	222	152	158	167	173	165	165	222	258	216	216	196	214	268	289
hoe36	Hoedic	243	243	222	222	152	155	152	173	165	198	246	258	216	216	223	223	289	289
hoe37	Hoedic	240	243	222	222	152	161	164	173	165	198	258	258	216	216	208	223	268	268
hoe38	Hoedic	207	243	222	222	146	152	161	167	165	165	258	258	216	216	196	223	286	286
hoe39	Hoedic	000	000	222	222	146	161	161	164	165	165	242	250	216	216	223	223	268	283
hoe4	Hoedic	243	243	222	222	152	155	161	164	165	165	246	258	216	216	199	223	268	283
hoe40	Hoedic	240	249	222	228	152	152	161	164	165	165	222	258	216	216	223	223	268	286
hoe41	Hoedic	243	249	222	222	146	146	161	164	165	165	222	234	216	216	196	223	283	289
hoe42	Hoedic	243	243	222	222	146	146	164	170	165	198	246	258	216	216	199	223	289	289
hoe43	Hoedic	240	240	222	222	155	155	161	167	198	198	258	258	216	218	199	223	289	289
hoe44	Hoedic	243	249	222	222	146	155	161	161	165	180	246	246	216	216	214	223	277	283
hoe45	Hoedic	225	225	222	222	152	161	161	164	165	165	222	258	216	216	199	223	268	286
hoe46	Hoedic	237	240	222	222	152	158	164	170	180	180	222	234	212	216	199	223	283	283
hoe47	Hoedic	207	243	222	224	146	146	161	164	165	180	222	250	216	216	199	223	268	283
hoe48	Hoedic	207	249	222	222	146	146	164	167	180	198	250	258	216	218	214	223	277	289
hoe49	Hoedic	243	243	222	222	146	152	164	164	165	198	234	258	216	216	214	214	283	289
hoe5	Hoedic	240	243	222	222	146	152	164	173	180	180	246	258	216	216	214	223	286	289
hoe5bis	Hoedic	240	243	222	222	146	146	164	164	165	165	234	258	216	218	214	223	268	289
hoe6	Hoedic	225	237	222	222	152	158	161	161	165	165	258	258	216	216	223	223	283	286
hoe7	Hoedic	207	240	222	222	146	152	161	161	165	180	222	258	216	218	214	223	268	283
hoe8	Hoedic	207	240	222	222	146	152	161	173	165	204	238	246	216	216	208	214	268	289
hoe9	Hoedic	237	243	222	222	146	152	161	164	165	180	258	258	216	216	214	223	286	289

Table S3 *Laminaria digitata* genetic diversity estimates by locus

Site	Locus	Na	AR	H_e	F_{IS}
Guimereux	Ld148	3	×	0.714	0.200
	Ld158	3	×	0.548	0.217
	Ld167	2	×	0.548	0.217
	Ld371	5	×	0.595	0.040
	Ld531	2	×	0.548	0.478
	Ld704	2	×	0.548	0.217
	Lo454-23	4	×	0.393	-0.091
	Lo454-24	2	×	0.357	-0.200
	Lo454-17	1	×	0.000	×
	Lo454-28	2	×	0.143	0.000
Lo4-24	2	×	0.143	0.000	
La Bigne	Ld148	3	3.0	0.659	-0.088
	Ld158	4	3.2	0.318	0.043
	Ld167	5	4.2	0.533	-0.061
	Ld371	8	6.8	0.569	-0.223
	Ld531	5	3.7	0.567	0.042
	Ld704	5	3.2	0.330	0.144
	Lo454-23	4	3.9	0.445	-0.076
	Lo454-24	5	3.5	0.527	-0.196
	Lo454-17	2	1.7	0.043	-0.011
	Lo454-28	3	2.7	0.298	0.123
Lo4-24	1	1.0	0.000	×	
Nerput	Ld148	3	×	0.659	-0.138
	Ld158	2	×	0.083	0.000
	Ld167	2	×	0.523	0.203
	Ld371	6	×	0.720	-0.389
	Ld531	3	×	0.542	0.077
	Ld704	2	×	0.288	-0.158
	Lo454-23	4	×	0.481	-0.213
	Lo454-24	2	×	0.295	0.436
	Lo454-17	2	×	0.159	-0.048
	Lo454-28	3	×	0.163	-0.023
Lo4-24	1	×	0.000	×	
Le Moulin	Ld148	4	3.5	0.660	-0.061
	Ld158	3	2.5	0.482	-0.297
	Ld167	3	3.0	0.546	-0.008
	Ld371	8	6.9	0.658	-0.025
	Ld531	3	2.5	0.478	0.163
	Ld704	2	2.0	0.460	-0.086
	Lo454-23	5	4.5	0.516	-0.163
	Lo454-24	3	2.5	0.519	-0.038
	Lo454-17	1	1.0	0.000	×
	Lo454-28	2	2.0	0.222	0.098
Lo4-24	2	1.5	0.025	0.000	
Les Amas du Cap	Ld148	4	3.6	0.661	-0.122
	Ld158	5	3.3	0.262	0.014
	Ld167	4	2.9	0.395	0.012
	Ld371	9	6.9	0.603	0.073
	Ld531	4	3.3	0.587	0.048
	Ld704	3	2.4	0.101	0.486
	Lo454-23	9	6.3	0.766	0.181
	Lo454-24	2	2.0	0.240	-0.006
	Lo454-17	1	1.0	0.000	×
	Lo454-28	2	2.0	0.224	0.168
Lo4-24	1	1.0	0.000	×	
Primel	Ld148	6	5.3	0.780	0.137
	Ld158	4	3.1	0.488	0.366
	Ld167	5	3.7	0.605	0.279
	Ld371	11	9.1	0.870	-0.066
	Ld531	4	4.0	0.632	-0.006
	Ld704	3	2.6	0.139	-0.050
	Lo454-23	8	6.7	0.719	0.242
	Lo454-24	5	3.7	0.420	0.119
	Lo454-17	3	3.0	0.289	-0.068
	Lo454-28	5	3.4	0.424	0.486
Lo4-24	2	1.9	0.088	-0.038	
Duons Est	Ld148	9	7.0	0.781	-0.040
	Ld158	4	3.7	0.373	-0.062
	Ld167	5	4.5	0.699	0.135
	Ld371	14	11.8	0.868	0.112
	Ld531	4	4.0	0.692	0.067
	Ld704	4	3.3	0.386	0.028
Lo454-23	9	8.0	0.807	0.071	

	Lo454-24	7	5.4	0.456	0.067
	Lo454-17	4	3.6	0.358	-0.048
	Lo454-28	5	3.4	0.336	0.193
	Lo4-24	3	1.8	0.041	-0.005
Duons Ouest	Ld148	8	6.6	0.743	-0.000
	Ld158	4	3.6	0.351	0.050
	Ld167	9	6.7	0.734	0.197
	Ld371	14	11.9	0.902	-0.052
	Ld531	4	4.0	0.699	-0.064
	Ld704	5	3.5	0.254	-0.110
	Lo454-23	9	7.4	0.800	0.006
	Lo454-24	5	4.7	0.602	0.020
	Lo454-17	3	2.9	0.214	0.280
	Lo454-28	3	2.5	0.167	-0.073
	Lo4-24	3	2.3	0.082	-0.019
	Santec 2	Ld148	7	6.4	0.783
Ld158		4	3.5	0.381	-0.116
Ld167		10	7.4	0.704	-0.005
Ld371		18	14.8	0.910	-0.018
Ld531		4	3.9	0.590	-0.117
Ld704		4	2.9	0.471	-0.088
Lo454-23		7	6.9	0.802	0.057
Lo454-24		7	5.6	0.525	-0.162
Lo454-17		4	3.4	0.368	0.139
Lo454-28		3	2.5	0.379	-0.030
Lo4-24		3	1.9	0.048	-0.006
Santec 1		Ld148	6	5.7	0.775
	Ld158	5	4.7	0.589	0.183
	Ld167	11	9.0	0.718	0.175
	Ld371	15	12.6	0.844	0.122
	Ld531	4	3.7	0.625	-0.244
	Ld704	3	2.7	0.435	-0.021
	Lo454-23	8	7.4	0.756	0.266
	Lo454-24	4	4.0	0.365	-0.008
	Lo454-17	5	4.4	0.519	0.073
	Lo454-28	5	4.3	0.402	0.078
	Lo4-24	3	2.4	0.073	-0.010
	Les Amiettes	Ld148	8	7.0	0.806
Ld158		4	3.5	0.347	0.094
Ld167		8	6.1	0.682	-0.132
Ld371		15	13.2	0.914	0.063
Ld531		4	4.0	0.703	0.065
Ld704		4	3.3	0.503	0.035
Lo454-23		7	6.4	0.711	0.197
Lo454-24		6	5.1	0.545	0.052
Lo454-17		4	3.3	0.423	0.121
Lo454-28		4	3.3	0.300	-0.144
Lo4-24		3	2.9	0.213	0.194
Les Linioux		Ld148	5	4.2	0.615
	Ld158	4	4.0	0.727	0.034
	Ld167	5	4.5	0.626	-0.156
	Ld371	15	11.3	0.872	0.000
	Ld531	5	4.1	0.587	0.130
	Ld704	6	4.8	0.627	-0.017
	Lo454-23	8	7.5	0.785	0.268
	Lo454-24	6	5.2	0.610	0.162
	Lo454-17	4	3.2	0.297	-0.147
	Lo454-28	5	4.1	0.305	0.030
	Lo4-24	3	2.6	0.160	0.071
	Men Vriant	Ld148	8	6.5	0.744
Ld158		4	4.0	0.669	0.039
Ld167		6	5.3	0.699	0.115
Ld371		18	14.1	0.919	-0.011
Ld531		6	4.9	0.669	0.075
Ld704		6	4.4	0.564	-0.013
Lo454-23		10	7.7	0.788	0.185
Lo454-24		9	6.8	0.666	0.011
Lo454-17		4	3.3	0.386	-0.111
Lo454-28		4	3.2	0.431	-0.048
Lo4-24		5	3.6	0.276	-0.034
		Ld148	8	6.5	0.711
	Ld158	5	4.7	0.603	0.092
	Ld167	9	6.7	0.752	0.272
	Ld371	14	13.0	0.912	0.008

Klosenn Malaga	Ld531	5	4.7	0.653	0.141
	Ld704	5	4.2	0.559	-0.023
	Lo454-23	9	7.9	0.778	0.174
	Lo454-24	7	5.2	0.603	-0.145
	Lo454-17	5	4.3	0.354	0.125
	Lo454-28	4	3.5	0.346	-0.034
Les Respects	Lo4-24	4	3.9	0.337	0.152
	Ld148	8	6.9	0.740	0.046
	Ld158	5	4.8	0.710	0.089
	Ld167	8	6.6	0.677	0.218
	Ld371	14	12.7	0.910	0.095
	Ld531	6	5.4	0.693	-0.103
	Ld704	5	4.6	0.503	0.123
	Lo454-23	10	8.6	0.798	0.226
	Lo454-24	9	7.1	0.664	-0.019
	Lo454-17	4	3.1	0.410	0.140
	Lo454-28	4	3.5	0.422	0.164
St Mathieu	Lo4-24	5	4.3	0.270	-0.091
	Ld148	5	×	0.744	0.134
	Ld158	5	×	0.669	0.477
	Ld167	6	×	0.699	0.068
	Ld371	13	×	0.919	0.019
	Ld531	4	×	0.669	-0.195
	Ld704	5	×	0.564	0.142
	Lo454-23	5	×	0.788	0.287
	Lo454-24	4	×	0.666	0.126
	Lo454-17	4	×	0.386	-0.055
Pointe du grand Gouin	Lo454-28	4	×	0.431	0.358
	Lo4-24	3	×	0.276	0.349
	Ld148	6	5.3	0.755	-0.074
	Ld158	5	4.5	0.744	0.092
	Ld167	7	5.7	0.684	0.051
	Ld371	16	14.1	0.921	0.120
	Ld531	5	4.6	0.719	0.305
	Ld704	4	3.9	0.643	0.033
	Lo454-23	10	8.8	0.807	0.431
	Lo454-24	3	3.0	0.655	-0.060
Houat 2	Lo454-17	4	3.3	0.532	0.136
	Lo454-28	4	3.2	0.179	0.247
	Lo4-24	4	3.6	0.226	0.045
	Ld148	5	4.6	0.737	0.096
	Ld158	3	3.0	0.461	0.409
	Ld167	4	3.4	0.454	-0.002
	Ld371	6	5.0	0.654	0.166
	Ld531	4	3.6	0.565	0.035
	Ld704	2	2.0	0.504	-0.263
	Lo454-23	5	4.5	0.637	0.239
Houat 1	Lo454-24	3	2.8	0.385	-0.101
	Lo454-17	4	4.0	0.670	0.096
	Lo454-28	4	3.5	0.553	-0.129
	Lo4-24	2	2.0	0.116	-0.049
	Ld148	5	4.6	0.720	0.028
	Ld158	3	2.6	0.173	0.091
	Ld167	3	3.0	0.594	0.230
	Ld371	7	5.2	0.655	0.128
	Ld531	4	3.3	0.581	-0.179
	Ld704	2	2.0	0.504	0.007
Hoedic	Lo454-23	4	3.6	0.537	0.095
	Lo454-24	3	2.3	0.446	0.176
	Lo454-17	4	4.0	0.623	0.013
	Lo454-28	3	2.8	0.465	-0.075
	Lo4-24	3	2.2	0.083	-0.027
	Ld148	6	5.4	0.722	-0.118
	Ld158	3	3.0	0.575	0.383
	Ld167	4	3.5	0.458	-0.128
	Ld371	6	5.8	0.743	0.088
	Ld531	5	4.5	0.638	0.039
Hoedic	Ld704	3	2.9	0.450	-0.004
	Lo454-23	6	5.1	0.611	-0.162
	Lo454-24	3	2.6	0.514	0.059
	Lo454-17	4	4.0	0.686	-0.176
	Lo454-28	3	3.0	0.601	-0.074
	Lo4-24	2	1.9	0.063	-0.017

Table S4 *Laminaria hyperborea* genetic diversity estimates by locus

Site	Locus	Na	AR	H_e	F_{IS}
Guimereux	Ld148	4	4.0	0.605	-0.180
	Ld158	2	2.0	0.212	-0.123
	Ld167	5	4.3	0.602	0.249
	Lo454-15	2	2.0	0.355	0.128
	Lo454-17	4	2.9	0.497	0.426
	Lo454-28	4	3.5	0.676	0.013
	Lo4-24	3	2.2	0.073	0.664
	Lo454-23	3	2.5	0.397	-0.019
	Lo454-24	4	3.5	0.596	0.241
La Bigne	Ld148	6	4.9	0.629	0.233
	Ld158	2	2.0	0.260	0.107
	Ld167	7	4.9	0.674	-0.060
	Lo454-15	2	2.0	0.474	0.171
	Lo454-17	3	3.0	0.578	0.568
	Lo454-28	6	4.5	0.689	0.041
	Lo4-24	4	2.2	0.070	-0.016
	Lo454-23	2	2.0	0.395	-0.175
	Lo454-24	4	3.9	0.645	0.013
Nerput	Ld148	4	4.0	0.548	0.058
	Ld158	2	2.0	0.203	-0.111
	Ld167	6	5.0	0.577	0.273
	Lo454-15	2	2.0	0.276	0.300
	Lo454-17	2	2.0	0.477	0.392
	Lo454-28	3	3.0	0.661	0.024
	Lo4-24	2	1.9	0.063	-0.017
	Lo454-23	3	2.6	0.457	0.365
	Lo454-24	4	3.6	0.599	0.084
Le Moulin	Ld148	5	4.3	0.495	-0.118
	Ld158	2	2.0	0.260	0.107
	Ld167	6	4.9	0.673	-0.088
	Lo454-15	3	2.3	0.417	0.015
	Lo454-17	4	3.3	0.549	0.480
	Lo454-28	3	3.0	0.614	0.069
	Lo4-24	1	1.0	0.000	×
	Lo454-23	2	2.0	0.387	0.032
	Lo454-24	4	3.3	0.623	0.112
Les Amas du Cap	Ld148	6	4.3	0.599	-0.167
	Ld158	2	2.0	0.148	0.355
	Ld167	6	4.9	0.653	-0.069
	Lo454-15	3	2.7	0.474	-0.039
	Lo454-17	3	2.3	0.402	0.131
	Lo454-28	5	3.5	0.545	-0.048
	Lo4-24	2	1.3	0.017	0.000
	Lo454-23	5	4.1	0.557	0.088
	Lo454-24	5	4.5	0.705	0.000
Primel	Ld148	6	5.5	0.747	0.084
	Ld158	2	2.0	0.191	-0.104
	Ld167	7	6.2	0.763	-0.069
	Lo454-15	5	4.7	0.425	-0.115
	Lo454-17	6	4.9	0.674	0.180
	Lo454-28	7	5.8	0.776	0.016
	Lo4-24	3	2.3	0.078	-0.018
	Lo454-23	6	5.2	0.674	0.180
	Lo454-24	8	6.6	0.762	0.184
Duons Est	Ld148	7	6.5	0.800	-0.076
	Ld158	2	2.0	0.198	0.091
	Ld167	7	6.8	0.787	-0.092
	Lo454-15	5	4.6	0.553	-0.048
	Lo454-17	7	5.0	0.659	0.120
	Lo454-28	7	5.6	0.759	-0.081
	Lo4-24	2	1.9	0.078	-0.032
	Lo454-23	8	5.9	0.714	-0.008
	Lo454-24	7	6.3	0.770	0.064

Duons Ouest	Ld148	8	6.2	0.791	0.080
	Ld158	2	2.0	0.189	0.020
	Ld167	7	6.8	0.788	0.013
	Lo454-15	6	5.1	0.589	-0.070
	Lo454-17	5	3.6	0.600	0.218
	Lo454-28	6	5.1	0.755	-0.014
	Lo4-24	4	2.3	0.084	0.269
	Lo454-23	6	5.2	0.727	-0.001
	Lo454-24	8	5.7	0.731	-0.047
Santec 2	Ld148	6	6.0	0.802	-0.023
	Ld158	2	2.0	0.246	0.060
	Ld167	8	7.4	0.839	0.059
	Lo454-15	6	5.5	0.687	0.142
	Lo454-17	5	4.2	0.673	-0.028
	Lo454-28	7	6.0	0.753	0.148
	Lo4-24	2	1.5	0.026	0.000
	Lo454-23	5	4.9	0.716	0.069
	Lo454-24	8	6.9	0.761	0.066
Santec 1	Ld148	6	5.8	0.813	0.071
	Ld158	2	2.0	0.182	-0.100
	Ld167	7	6.8	0.834	-0.013
	Lo454-15	5	4.8	0.620	-0.003
	Lo454-17	5	4.1	0.625	0.289
	Lo454-28	5	4.7	0.728	-0.100
	Lo4-24	1	1.0	0.000	×
	Lo454-23	6	5.6	0.725	-0.042
Les Amiettes	Ld148	7	6.4	0.815	0.024
	Ld158	2	2.0	0.168	0.186
	Ld167	7	6.3	0.787	-0.011
	Lo454-15	7	6.0	0.675	-0.044
	Lo454-17	4	3.8	0.643	0.223
	Lo454-28	6	5.1	0.763	-0.101
	Lo4-24	4	3.2	0.192	0.173
	Lo454-23	6	5.4	0.723	0.120
	Lo454-24	6	5.6	0.749	0.237
Les Linious	Ld148	7	6.3	0.819	-0.074
	Ld158	2	2.0	0.311	0.035
	Ld167	7	6.8	0.797	0.047
	Lo454-15	5	4.7	0.382	-0.098
	Lo454-17	5	4.5	0.703	0.260
	Lo454-28	6	5.4	0.779	0.024
	Lo4-24	3	2.3	0.115	0.131
	Lo454-23	6	5.4	0.721	0.002
Men Vriant	Ld148	6	6.0	0.806	-0.059
	Ld158	3	2.6	0.355	-0.078
	Ld167	7	6.9	0.807	0.016
	Lo454-15	5	4.5	0.494	0.107
	Lo454-17	3	3.0	0.608	0.226
	Lo454-28	6	5.1	0.762	-0.041
	Lo4-24	2	1.8	0.058	-0.015
	Lo454-23	6	5.4	0.658	-0.207
	Lo454-24	7	6.0	0.761	0.343
Klosenn Malaga	Ld148	6	6.0	0.836	0.038
	Ld158	2	2.0	0.305	0.073
	Ld167	7	6.5	0.782	-0.029
	Lo454-15	6	5.4	0.634	0.006
	Lo454-17	5	4.3	0.660	0.045
	Lo454-28	6	5.3	0.784	0.029
	Lo4-24	3	2.5	0.126	0.482
	Lo454-23	7	5.8	0.726	-0.168
	Lo454-24	6	5.6	0.746	0.096
	Ld148	8	6.9	0.816	0.026

Les Respects	Ld158	2	2.0	0.119	-0.054
	Ld167	8	7.6	0.811	-0.049
	Lo454-15	5	4.9	0.562	-0.023
	Lo454-17	5	4.0	0.685	0.233
	Lo454-28	7	5.9	0.788	-0.047
	Lo4-24	4	3.1	0.144	-0.042
	Lo454-23	6	5.2	0.648	0.035
	Lo454-24	7	5.4	0.718	0.025
St Mathieu	Ld148	10	7.2	0.818	0.051
	Ld158	2	1.9	0.082	-0.036
	Ld167	7	6.3	0.790	-0.030
	Lo454-15	7	5.0	0.448	0.206
	Lo454-17	5	4.3	0.678	0.151
	Lo454-28	7	6.0	0.793	0.081
	Lo4-24	4	3.5	0.276	0.385
	Lo454-23	7	5.9	0.716	0.077
	Lo454-24	9	6.5	0.705	-0.083
Pointe du grand Gouin	Ld148	6	5.6	0.749	0.046
	Ld158	2	2.0	0.311	-0.224
	Ld167	7	6.5	0.803	-0.157
	Lo454-15	5	4.8	0.629	-0.060
	Lo454-17	4	3.8	0.599	0.046
	Lo454-28	5	5.0	0.753	0.020
	Lo4-24	3	2.6	0.137	0.305
	Lo454-23	5	4.5	0.624	0.047
Lo454-24	6	5.4	0.728	-0.079	
Ile Téviec	Ld148	6	5.5	0.649	0.180
	Ld158	2	1.3	0.016	0.000
	Ld167	8	6.1	0.769	-0.069
	Lo454-15	6	5.2	0.660	0.022
	Lo454-17	4	3.9	0.530	-0.125
	Lo454-28	8	6.6	0.768	0.018
	Lo4-24	3	2.6	0.138	-0.052
	Lo454-23	9	7.1	0.761	0.046
	Lo454-24	8	6.7	0.793	0.028
Houat 2	Ld148	6	5.3	0.734	0.152
	Ld158	2	1.4	0.023	0.000
	Ld167	6	5.2	0.660	0.057
	Lo454-15	7	5.9	0.692	0.069
	Lo454-17	5	4.4	0.524	0.237
	Lo454-28	7	6.3	0.799	0.221
	Lo4-24	3	2.9	0.276	0.033
	Lo454-23	6	5.4	0.680	0.020
Lo454-24	7	5.8	0.792	-0.039	
Houat 1	Ld148	9	6.4	0.751	0.043
	Ld158	2	1.7	0.051	-0.018
	Ld167	7	5.8	0.657	0.134
	Lo454-15	9	7.0	0.714	0.058
	Lo454-17	5	4.3	0.625	-0.185
	Lo454-28	8	6.7	0.803	0.056
	Lo4-24	3	3.0	0.342	0.394
	Lo454-23	7	6.1	0.727	-0.067
	Lo454-24	6	5.0	0.765	0.053
Hoedic	Ld148	9	6.6	0.765	0.111
	Ld158	3	2.7	0.149	0.080
	Ld167	5	5.0	0.693	-0.048
	Lo454-15	8	6.0	0.766	0.001
	Lo454-17	6	4.1	0.522	0.174
	Lo454-28	8	6.1	0.762	0.074
	Lo4-24	4	2.9	0.283	0.307
	Lo454-23	9	6.4	0.661	-0.098
Lo454-24	7	6.1	0.775	0.013	

Table S5 *Laminaria digitata* pairwise F_{ST} and their probabilities as calculated in FSTAT

Article 4: M. Robuchon *et al.*, submitted to *Molecular Ecology*

Pairwise F_{ST}

	La Bigne	Nerput	Le Moulin	Les Amas	Primel	Duons Est	Duons Ouest	Santec 2	Santec 1	Les Amiettes	Les Linious	Men Vriant	Klosenn Mala,	Les Respects	St Mathieu	Pointe du grai	Houat 2	Houat 1	Hoedic
Guimereux	0.0145	0.0293	0,000000	0.0828	0.1287	0.0592	0.0892	0.1051	0.091	0.0625	0.1177	0.0928	0.0767	0.1038	0.1206	0.1339	0.2318	0.2397	0.2153
La Bigne		0.0259	0.019	0.0466	0.1236	0.0702	0.0841	0.1189	0.1178	0.0866	0.1622	0.1334	0.1137	0.1335	0.1692	0.1864	0.2828	0.2699	0.2761
Nerput			0.0717	0.0495	0.1036	0.0609	0.075	0.1074	0.0989	0.0711	0.1727	0.1324	0.1079	0.1316	0.1607	0.1744	0.2543	0.2502	0.2616
Le Moulin				0.0871	0.14	0.0793	0.0952	0.119	0.1194	0.0845	0.1316	0.1134	0.0983	0.1174	0.1455	0.157	0.2633	0.2566	0.2428
Les Amas					0.1196	0.0632	0.0747	0.1165	0.1206	0.0929	0.165	0.1443	0.1236	0.141	0.1791	0.2056	0.307	0.2936	0.3221
Primel						0.0239	0.026	0.0281	0.0228	0.0377	0.0894	0.0482	0.042	0.0413	0.0492	0.0956	0.1514	0.1667	0.1803
Duons Est								0.0024	0.0129	0.0143	0.0076	0.0525	0.025	0.019	0.0261	0.0343	0.0699	0.1372	0.1398
Duons Ouest									0.0271	0.0109		0.0561	0.0311	0.0163	0.0286	0.0339	0.0777	0.1561	0.1572
Santec 2									0.0018	0.0045	0.051	0.0156	0.0117	0.0128	0.0293	0.0584	0.1178	0.1216	0.1365
Santec 1										0.0038	0.0478	0.0149	0.0144	0.0097	0.0219	0.0521	0.0876	0.101	0.1085
Les Amiettes											0.0494	0.0173	0.0063	0.0171	0.0312	0.0553	0.1096	0.1163	0.1191
Les Linious												0.0175	0.0264	0.0209	0.0235	0.0456	0.149	0.165	0.14
Men Vriant													0.0014	0	0	0.0252	0.0946	0.1081	0.0985
Klosenn Malaga														0.0026	0.0071	0.0402	0.1046	0.1196	0.1063
Les Respects															0.0004	0.0219	0.1127	0.1285	0.1181
St Mathieu																0.0201	0.1029	0.1134	0.1122
Pointe du grand Gouin																		0.1213	0.1308
Houat 2																			0.012
Houat 1																			0.0207

P-values obtained after : 3800 permutations

Indicative adjusted nominal level (5%) for multiple comparisons is : **0.000263**

	La Bigne	Nerput	Le Moulin	Les Amas	Primel	Duons Est	Duons Ouest	Santec 2	Santec 1	Les Amiettes	Les Linious	Men Vriant	Klosenn Mala,	Les Respects	St Mathieu	Pointe du grai	Houat 2	Houat 1	Hoedic
Guimereux	0.36289	0.16158	0.27895	0.00026	0.00026	0.00553	0.00026	0.00026	0.00026	0.00132	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026
La Bigne		0.08132	0.00053	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026
Nerput				0.00026	0.00132	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026
Le Moulin					0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026
Les Amas						0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026
Primel							0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026
Duons Est							0.59184	0.00026	0.00421	0.00263	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026
Duons Ouest								0.00079	0.00105	0.02	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026
Santec 2									0.80316	0.17237	0.00026	0.00026	0.00079	0.00105	0.00079	0.00026	0.00026	0.00026	0.00026
Santec 1										0.39684	0.00026	0.03158	0.00105	0.095	0.00447	0.00026	0.00026	0.00026	0.00026
Les Amiettes											0.00026	0.00842	0.01474	0.01368	0.00158	0.00026	0.00026	0.00026	0.00026
Les Linious												0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026
Men Vriant													0.38474	0.68079	0.35711	0.00026	0.00026	0.00026	0.00026
Klosenn Malaga														0.20553	0.07158	0.00026	0.00026	0.00026	0.00026
Les Respects															0.16974	0.00026	0.00026	0.00026	0.00026
St Mathieu																0.00026	0.00026	0.00026	0.00026
Pointe du grand Gouin																	0.00026	0.00026	0.00026
Houat 2																		0.00237	0.00079
Houat 1																			0.00026

Values in bold are significant at the level of 5%

Table S6 *Laminaria hyperborea* pairwise F_{ST} and their probabilities as calculated in FSTAT

Article 4: M. Robuchon *et al.*, submitted to *Molecular Ecology*

Pairwise F_{ST}

	La Bigne	Nerput	Le Moulin	Les Amas	Primel	Duons Est	Duons Ouest	Santec 2	Santec 1	Les Amiettes	Les Linious	Men Vriant	Klosenn Mala	Les Respectes	St Mathieu	Pointe du graille	Téviéc	Houat 2	Houat 1	Hoedic	
Guimereux	0.0024	0	0.001	0.0248	0.2148	0.1794	0.1745	0.1524	0.1865	0.1757	0.1947	0.1902	0.171	0.183	0.1963	0.1965	0.1904	0.2229	0.1888	0.2178	
La Bigne		0.0077	0.0018	0.0293	0.1599	0.1313	0.125	0.1076	0.1408	0.1306	0.1454	0.1375	0.1272	0.1362	0.1487	0.148	0.1508	0.1843	0.1552	0.1794	
Nerput			0.0022	0.0307	0.2307	0.1949	0.1871	0.166	0.1992	0.1857	0.2111	0.2038	0.1816	0.197	0.2096	0.2102	0.1988	0.2293	0.1931	0.2245	
Le Moulin				0.0173	0.207	0.1741	0.1647	0.145	0.179	0.1679	0.1887	0.1823	0.1669	0.1773	0.1889	0.1895	0.1903	0.2258	0.1925	0.2223	
Les Amas					0.2006	0.167	0.1627	0.1361	0.1687	0.1698	0.1821	0.1859	0.1604	0.164	0.1785	0.183	0.1927	0.2346	0.2023	0.2291	
Primel						0	0.0004	0.0052	0.0037	0.0072	0.0034	0.0059	0.0118	0.0012	0.0097	0.0068	0.0657	0.0646	0.0658	0.0636	
Duons Est							0	0	0	0.0027	0.0007	0.0018	0.0032	0	0.011	0.0039	0.0533	0.0566	0.0528	0.0534	
Duons Ouest								0	0.0018	0.0033	0.0061	0.0077	0.0093	0.0049	0.0138	0.0082	0.0618	0.065	0.0592	0.0614	
Santec 2									0	0.0011	0.0065	0.0047	0.003	0.0005	0.0135	0.0051	0.0515	0.0659	0.0596	0.0604	
Santec 1										0	0.0099	0.0072	0.005	0.0045	0.0164	0.0066	0.0618	0.0625	0.062	0.0604	
Les Amiettes											0.009	0.0023	0.0052	0.0076	0.0137	0.0159	0.0513	0.0461	0.0411	0.0473	
Les Linious												0.0018	0.008	0.0035	0.0091	0.016	0.0746	0.0791	0.0735	0.0753	
Men Vriant													0.0008	0.0042	0.0137	0.0093	0.0566	0.0562	0.0534	0.0542	
Klosenn Malaga														0.0028	0.0138	0.0082	0.0392	0.0452	0.0395	0.036	
Les Respectes															0.0004	0.0065	0.0604	0.0655	0.0574	0.0606	
St Mathieu																0.0162	0.0637	0.0706	0.0662	0.0722	
Pointe du grand Gouin																	0.0668	0.0668	0.0649	0.0636	
Ile Téviéc																		0.0148	0.0252	0.0114	
Houat 2																			0	0	
Houat 1																					0.0058

P-values obtained after : 4200 permutations

Indicative adjusted nominal level (5%) for multiple comparisons is : **0.000238**

	La Bigne	Nerput	Le Moulin	Les Amas	Primel	Duons Est	Duons Ouest	Santec 2	Santec 1	Les Amiettes	Les Linious	Men Vriant	Klosenn Mala	Les Respectes	St Mathieu	Pointe du graille	Téviéc	Houat 2	Houat 1	Hoedic	
Guimereux	0.38286	0.99548	0.35929	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	
La Bigne		0.17262	0.24167	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	
Nerput			0.28238	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	
Le Moulin				0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	
Les Amas					0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	0.00024	
Primel						0.95571	0.40143	0.29333	0.39929	0.16238	0.02643	0.13929	0.00119	0.2281	0.01976	0.06714	0.00024	0.00024	0.00024	0.00024	
Duons Est							0.86214	0.97238	0.53048	0.15071	0.435	0.20881	0.03952	0.54381	0.00262	0.09619	0.00024	0.00024	0.00024	0.00024	
Duons Ouest								0.70429	0.3569	0.05048	0.04762	0.02881	0.00024	0.0681	0.00024	0.00048	0.00024	0.00024	0.00024	0.00024	
Santec 2									0.69976	0.16976	0.04119	0.12762	0.06167	0.53262	0.00119	0.015	0.00024	0.00024	0.00024	0.00024	
Santec 1										0.31429	0.00286	0.07905	0.00548	0.05714	0.00024	0.00119	0.00024	0.00024	0.00024	0.00024	
Les Amiettes											0.00095	0.0769	0.00524	0.01429	0.00262	0.00024	0.00024	0.00024	0.00024	0.00024	
Les Linious												0.0381	0.10857	0.09167	0.00333	0.00048	0.00024	0.00024	0.00024	0.00024	
Men Vriant													0.10024	0.0781	0.00095	0.02024	0.00024	0.00024	0.00024	0.00024	
Klosenn Malaga														0.14857	0.00857	0.00214	0.00024	0.00024	0.00024	0.00024	
Les Rospects															0.24619	0.06071	0.00024	0.00024	0.00024	0.00024	
St Mathieu																0.00024	0.00024	0.00024	0.00024	0.00024	
Pointe du grand Gouin																	0.00024	0.00024	0.00024	0.00024	
Ile Téviéc																		0.0019	0.00024	0.00071	
Houat 2																				0.58357	
Houat 1																					0.10619
																					0.00714

Values in bold are significant at the level of 5%

Article 5

Oppliger VL, Von Dassow P, Bouchemousse S, **Robuchon M**, Valero M, Correa JA, Mauger S, Destombe C (submitted to *PLoS ONE*) Alteration of sexual reproduction and genetic diversity in the kelp species *Laminaria digitata* at the southern limit of its range.

**Alteration of sexual reproduction and genetic diversity in the kelp species
Laminaria digitata at the southern limit of its range**

L. Valeria Oppliger^{1,2,3}, Peter Von Dassow¹, Sarah Bouchemousse^{2,3}, Marine Robuchon^{2,3,4,*},
Myriam Valero^{2,3,*}, Juan A. Correa¹, Stéphane Mauger^{2,3,*} & Christophe Destombe^{2,3,*}

(1) Departamento de Ecología, Facultad de Ciencias Biológicas, Pontificia Universidad Católica de Chile, Post-code 6513677, Santiago, Chile.

(2) Sorbonne Universités, UPMC Univ. Paris 06, UMR 7144, Station Biologique de Roscoff, 29682 Roscoff, France.

(3) CNRS, UMR 7144, Station Biologique de Roscoff, Place Georges Teissier, 29682 Roscoff, France.

(4) MNHN, UMR 7138, Systématique, Adaptation, Evolution, Case postale N° 39, 57 rue Cuvier, 75231 cedex 05 Paris, France.

*Current address: UMI 3604, Evolutionary Biology and Ecology of Algae, CNRS, UPMC, PUCCh, UACH, Station Biologique de Roscoff, CS 90074, 29688 Roscoff, France

SHORT TITLE: Geographical parthenogenesis in *Laminaria digitata*

ABSTRACT

Adaptation to marginal habitats at species range-limits has often been associated with parthenogenetic reproduction in terrestrial animals and plants. Laboratory observations have shown that brown algae exhibit a high propensity for parthenogenesis by various mechanisms. The kelp *Laminaria digitata* is an important component of the ecosystem in Northern European rocky intertidal habitats. We studied four *L. digitata* populations for the effects of marginality on genetic diversity and sexual reproduction. Two populations were marginal: One (Loquirec, in Northern Brittany) was well within the geographic range and temperature tolerance of the species, but was genetically isolated from other populations by large stretches of sandy beaches. Another population was at the range limits of the species in (Quiberon, in Southern Brittany) and was exposed to much higher seasonal temperature changes. Microsatellite analyses confirmed that these populations showed decreased genetic and allelic diversity, consistent with marginality and genetic isolation. Sporophytes from both marginal populations showed greatly diminished spore-production compared to central populations, but only the southern-limit population (Quiberon) showed a high propensity for producing unreduced (2N) spores. Unreduced 2N spores formed phenotypically normal gametophytes with nuclear area consistent with $\geq 2N$ DNA contents, and microsatellite studies suggested these were produced at least in part by automixis. However, despite this being the dominant path of spore production in Quiberon sporophyte individuals, the genetic evidence indicated the population was maintained mostly by sexual reproduction. Thus, although spore production and development showed the expected tendency of geographical parthenogenesis in marginal populations, this appeared to be a consequence of maladaptation, rather than an adaptation to, life in a marginal habitat.

INTRODUCTION

The ubiquity of sex among eukaryotes has long been a paradox due to the high costs associated with mating and recombination (Maynard-Smith 1978, Otto 2009). Sex incurs both significant genetic costs, as parents share only half their genes with their progeny, and energetic costs, as meiosis is slower than mitosis and more prone to failure, and sexual reproduction also requires investment of energy into encountering compatible mates. Theoretically, asexual females transmit twice as many genes to each offspring compared to sexually reproducing females (Maynard-Smith 1978), yet sex is the predominant mode of reproduction in nearly all multicellular taxa. Several theories attempt to explain the evolutionary maintenance of sex through the benefits of genetic reshuffling which accelerates the production of advantageous new genotypes, facilitating adaptation, and limiting the accumulation of deleterious mutations (Bell 1980, Lynch 1984, Kondrashov and Kondrashov 2001, Becks and Agrawal 2012, Roze 2012). Sexual and asexual lineages may co-exist in the long term as a result of a dynamic equilibrium between the origin of new asexual lineages and their extinction (Nunney 1989).

Geographical parthenogenesis refers to the case where closely related sexual and asexual lineages exhibit distinct distributions (Vandel 1928). Asexual forms often tend to be prevalent in populations that occupy the margins of a species range, including high altitudes, deserts, or small islands. Geographical parthenogenesis has been observed in several organisms including both marine and terrestrial arthropods (Beaton and Hebert 1988, Law and Crespi 2002), vertebrates (Moritz *et al.* 1989, Kearney 2003), plants (VanDijk 2003, Hörandl 2006), and both red (West and Zuccarello 1999, Kamiya and West 2008, Fierst *et al.* 2010) and brown macroalgae (Tatarenkov *et al.* 2005). Marginal populations are generally characterised by increased genetic isolation, genetic differentiation, and variability in individual and population performance. Several mechanisms have been proposed to explain these patterns (reviewed in Kawecki 2008), including: 1. Sexuality may be more advantageous in habitats when selection results from biotic interactions, as co-evolutionary arms-race with parasites, predators and competitors favor continued generation of new gene combinations (Hamilton 1980, Lively *et al.* 1990). In contrast, asexuality might be favored in sparsely inhabited regions where abiotic factors dominate and the relative energetic costs of mating are higher (Hamilton *et al.* 1990). 2. Asexuals are superior colonists of new habitats because they do not have the two-fold cost of sex (Cuellar 1974). 3. Asexuality maintains

locally adapted gene combinations (Peck *et al.* 1998). 4. Asexuals avoid the cost of inbreeding depression (Haag and Ebert 2004).

Brown algae (Phaeophyceae) are a closely-related group of multicellular organisms that form essential structural components of near-shore marine ecosystems. These organisms exhibit a complex haplo-diplontic life cycle where both haploid and diploid phases exhibit vegetative growth. Diploid sporophytes produce spores by meiosis, which then undergo mitotic division to form multicellular haploid gametophytes. Fertilization eventually restores the diploid sporophyte state, which again grows vegetatively. Multiple mechanisms to avoid or modify sexuality exist within brown algae. Haploid cells from the gametophyte can undergo endomitosis to restore diploidy without fertilization in *Ectocarpus* sp., *Laminaria japonica*, *Undaria pinnatifida* and *Lessonia nigrescens* (Fang 1984, Oppliger *et al.* 2007, Bothwell *et al.* 2010). Apomeiosis, the replacement of meiosis with a mitotic division to produce diploid spores, has been documented in *Ectocarpus* sp. (Bothwell *et al.* 2010). Finally, almost all brown algae are capable of reproducing by fragmentation of either haploid or diploid multicellular phases, completely skipping the sexual cycle (Tom Dieck 1992, Ar-Gall *et al.* 1996, Lewis 1996).

The kelp *Laminaria digitata* exhibits a broad distribution along the European coast, with the southern limit clearly defined on the Atlantic coast of Southern Brittany (Luning 1990). The present study aims at understanding the reproductive systems of populations at both the center and the edge of distribution of *Laminaria digitata*. We studied four populations for the effects of marginality on genetic diversity and sexual reproduction. Two populations were marginal: one (Loquirec, in Northern Brittany) was well within the geographic range and temperature tolerance of the species, but was genetically isolated from other populations by large stretches of sandy beaches (Billot *et al.*, 2003, Valero *et al.* 2011; Couceiro *et al.* 2013). Another population was at the range limits of the species in (Quiberon, in Southern Brittany) and was exposed to much higher seasonal temperature changes (Robuchon *et al.*, submitted). Two populations were central: Porspoder and Roscoff (both at central Brittany). We tested the occurrence of geographical parthenogenesis through a combination of distinct approaches including: population genetic analyses, analyses of spore production, flow cytometry and microscopic analyses of spore and gametophyte ploidy, and *in vitro* culture and microscopic observations.

MATERIAL AND METHODS

Site characterization

Two or three sites in each of four regions along the Brittany coast (Locquirec, Roscoff, Porspoder, Quiberon) were selected according their contrasted geographical and ecological characteristics (Figure 1, Table 1).



Figure 1. Studied sites of *Laminaria digitata* in Brittany, France.

Sea surface temperature

Sea surface temperature (SST) data were obtained from daily High Resolution Sea Surface Temperature from 1992 to 2003 over the IBIROOS area (Ireland Biscay Iberia Regional Operating Operational System) in 0.044° Geographical Grid" AVHRR (Advanced Very High Resolution Radiometer) from NOAA (Méléder *et al.* 2010). Mean seasonal temperature was estimated for each season: winter (from 15 December to 15 March), spring (from 15 March to 15 June), summer (from 15 June to 15 September), autumn (from 15 September to 15 December) (ECOOP Project: <http://www.ecoop.eu>). The full remote sensing dataset for the entire Brittany coast is described in Gallon *et al.* (submitted). Direct data on temperature in the lower intertidal habitat occupied by *L. digitata* sporophytes was directly recorded using temperature data loggers TidbiT v2 - UTBI-001 Hobo© Onset© fixed to rocks in the Roscoff site 48°42'44"N 3°57'30"W between July 2009-March 2010, and in the Quiberon site 47°28'09"N 3°05'40"W between July 2009-January 2010. Data loggers recorded temperature every 15 minutes.

Table 1. Geographic information and statistic summary of the sampled populations. N is the number of individuals sampled, He is the unbiased genetic diversity (Nei 1987), Na is the number of alleles, AR is the allelic richness based on the smallest sample size (19 diploid individuals), Fis is the departure from random meeting (Weir and Cockerham 1984) and R is the genotypic diversity (number of distinct genotypes/number of individuals, Dorken and Eckert 2001). He, Na, AR and Fis have been calculated using FSTAT (Goudet 2001); values by population are mean \pm standard error over loci and values by region are mean \pm standard error over populations.

Region	Site	GPS position	Population type	N	He	Na	AR	Fis	R
Locquirec	Porz Mellec ¹	48°41'11"N 3°37'06"W	Peripheral	19	0.518 \pm 0.066	3.71 \pm 0.47	3.71 \pm 0.47	-0.019 \pm 0.045	1,00
	Beg Douar	48°41'12"N 3°36'47"W	Peripheral	31	0.519 \pm 0.052	4.14 \pm 0.55	3.82 \pm 0.44	0.033 \pm 0.035	1,00
	<i>Mean \pm SE</i>				<i>0.518 \pm 0.000</i>	<i>3.93 \pm 0.21</i>	<i>3.77 \pm 0.05</i>	<i>0.007 \pm 0.026</i>	<i>1,00</i>
Roscoff	Ar Pourven	48°42'44"N 3°57'30"W	Central	49	0.614 \pm 0.070	6.14 \pm 1.71	5.31 \pm 1.41	0.013 \pm 0.030	1,00
	Sieck ¹	48°42'40"N 4°03'37"W	Central	41	0.629 \pm 0.070	7.14 \pm 1.74	6.03 \pm 1.31	-0.019 \pm 0.029	1,00
	Duons	48°43'41"N 3°55'32"W	Central	45	0.611 \pm 0.076	6.57 \pm 1.38	5.29 \pm 1.02	0.068 \pm 0.041	1,00
	<i>Mean \pm SE</i>				<i>0.618 \pm 0.005</i>	<i>6.62 \pm 0.29</i>	<i>5.54 \pm 0.24</i>	<i>0.021 \pm 0.026</i>	<i>1,00</i>
Porspoder	St Laurent	48°31'11"N 4°46'45"W	Central	27	0.676 \pm 0.046	7.00 \pm 1.20	6.44 \pm 1.03	-0.011 \pm 0.025	1,00
	Le Conquet ²	48°19'48"N 4°46'25"W	Central	27	0.671 \pm 0.061	6.71 \pm 1.80	6.22 \pm 1.57	0.067 \pm 0.048	1,00
	Molène ²	48°23'49"N 4°56'01"W	Central	20	0.695 \pm 0.043	6.43 \pm 1.15	6.35 \pm 1.14	0.085 \pm 0.054	1,00
	<i>Mean \pm SE</i>				<i>0.681 \pm 0.007</i>	<i>6.71 \pm 0.17</i>	<i>6.33 \pm 0.07</i>	<i>0.047 \pm 0.030</i>	<i>1,00</i>
Quiberon	Pointe Conguel South	47°28'09"N 3°05'40"W	Peripheral	41	0.495 \pm 0.072	4.29 \pm 0.94	3.87 \pm 0.77	0.071 \pm 0.047	0,98
	Pointe de Conguel North	47°28'12"N 3°05'29"W	Peripheral	49	0.555 \pm 0.058	5.43 \pm 0.90	4.42 \pm 0.68	0.049 \pm 0.029	1,00
	Belle-Ile	47°19'41"N 3°07'27"W	Peripheral	47	0.474 \pm 0.067	4.29 \pm 0.61	3.72 \pm 0.44	0.027 \pm 0.045	0,98
	<i>Mean \pm SE</i>				<i>0.508 \pm 0.024</i>	<i>4.67 \pm 0.38</i>	<i>4.00 \pm 0.21</i>	<i>0.049 \pm 0.013</i>	<i>0,98</i>

¹ These sites have already been analyzed in Valero *et al.* 2011 (Sieck = NB3, Porspoder = NB1 and PorzMellec = NB4); values might slightly differ because of different sub-sampling in the two analysis.

² These sites have already been analyzed in Couceiro *et al.* 2012 (Le Conquet = MPA2 and Molène = MPA1); values might slightly differ because of different sub-sampling in the two analysis.

Comparison of mean seasonal temperature between sites was tested using a 2-way ANOVA with season (fixed, 4 levels) and location (fixed, 4 levels) as factors. Differences among locations were considered in relation to season. The response variable was the mean temperature. Data was log transformed in order to fit the assumptions of normality and homogeneity of variances. Type III sum of squares were used for tests of significance. All statistical analyses were done with MINITAB v. 13.2 (State College, PA, USA), by performing ANOVA and Tukey's tests for *a posteriori* multiple comparisons of means ($\alpha = 0.05$). Comparisons of median temperature between sites recorded from data loggers were made using Mann-Whitney tests MINITAB v. 13.2 (State College, PA, USA).

Sampling

A total of 135 fertile thalli were sampled along the Brittany coast between Locquirec and Quiberon (Fig. 1) from July to September 2009. Two locations, Porspoder and Roscoff, were chosen for the continuous distribution of *Laminaria digitata* (hereafter referred to as central populations), and two locations, Quiberon and Locquirec, were sampled, one at the southern range limit of the distribution and the other in northern Brittany. These latter locations were considered to be marginal because they represents the southern-most population of *L. digitata* and the other is isolated by sandy beaches. From 23 to 38 mature sporophytic individuals were collected from these four regions. This sampling was done to analyze spores by flow cytometry and to culture them.

In addition, a hierarchical sampling was performed in order to compare genetic diversity within and among the four regions (two sites in Quiberon and 3 sites in Porspoder, Roscoff and Locquirec, Table 1). A total of 396 sporophytes (i.e. 19 to 49 individuals for each sites of the four regions, Table 1) were collected during low spring tides. Tissue samples, consisting of a small disc excised from the basis of the blade, were preserved in individual plastic bags containing silica gel and stored at room temperature.

Sporophyte and gametophyte DNA extraction, PCR and genotyping

For the genetic analyses of the sporophyte individuals, DNA extraction and PCR amplifications of seven microsatellite loci (Ld1-124, Ld2-148, Ld2-158, Ld2-167, Ld2-371, Ld2-531 and Ld2-704) were performed using the same protocols as those

described in Billot *et al.* (1998). In addition, to identify the cytological mechanism that produces diploid spores in *L. digitata*, descendants were genotyped for a total of 8 sporophyte parents and 12-24 gametophytes per parent with the two microsatellite markers Ld2-371 and Ld2-531. Because of the small amount of material, DNA extractions for gametophytes were done with Chelex 100[®] (Bio-Rad Laboratories, Hercules, CA), 5% and proteinase k 10mg/mL according to Wattier *et al.* (1997).

PCR products were electrophoresed on 6% polyacrylamide denaturing gels using an automated DNA sequencer (Li-Cor 4200[™]) along with a DNA sequence of known length to estimate allele sizes to ensure that allele sizes corresponded exactly to those estimated in other studies (Billot *et al.*, 2002; Valero *et al.*, 2011; Couceiro *et al.*, 2012).

Genetic and genotypic diversity analyses

Standard measures of genetic diversity (mean number of alleles per locus (N_a), unbiased expected heterozygosity (H_e ; Nei 1987), allelic richness (AR) rarefied to 19 individuals for each sites were computed with the software FSTAT v2.9.3 (Goudet 2001). To test the hypothesis that central populations were more genetically diverse than marginal populations, differences of H_e and AR among groups were tested with the software FSTAT v2.9.3 (Goudet 2001) using 5000 random permutations of populations among groups. F_{is} estimates of the average deviation from random mating within populations were computed for each locus, and heterozygote deficiencies and excesses were tested using 1000 randomizations of alleles among individuals within each population using FSTAT v2.9.3 (Goudet 2001). The number of diploid individual showing the same genotype (repeated multilocus genotypes) by site was calculated using GENALEX 6.2 (Peakall & Smouse 2006) and the genotype diversity R was computed as the number of distinct genotypes (G) /number of individuals and corrected for sample size ($R = G - 1 / N - 1$, Dorken & Eckert 2001). The number of repeated multipocus genotypes was compared with the estimation of the expected number of individuals with the same multilocus genotype i) assuming Hardy-Weinberg equilibrium and ii) assuming mating among half-sibs with the software GeneAlex 6.2 (Peakall & Smouse, 2006).

Spore release

Fertile fragments of equal size (3,8 cm²) were cut off from each plant, cleaned in running tap water and exposed to air for 30 minutes. Ten fragments per plant were transferred to four 50mL plastic Falcons tubes containing 40μL of filtered seawater at 0.2 μm, set on ice and agitated. Fertile fragments were withdrawn from the tubes after 12h. Each spore suspension was divided in three aliquots. The first aliquot was used to estimate the number of released spores per ml under a binocular microscope with Neubauer chambers, the second one was used to obtain gametophyte cultures, and the third one was fixed with 1% formaldehyde for flow cytometry analyses.

Flow cytometry analyses

Ploidy levels (relative DNA content) of *L. digitata* spores were estimated analysis of fixed spores stained with Sybr Green I (Invitrogen, Carlsbad, CA, USA) on a FACSCanto II flow cytometer (BD Biosciences, San Jose, CA, USA). Exponentially growing cultures of haploid *Emiliana huxleyi* RCC1217, a unicellular eukaryotic phytoplankton, were fixed with the same fixative and added as an internal standard during staining. This species was selected as it could be easily distinguished from *L. digitata* spores based on chlorophyll, forward scatter, and side scatter properties. Early trials on isolated nuclei obtained from live spores using previously established protocols (Marie et al. 2000, Marie et al. 2005) found that ploidy analyses of fixed spores and extracted nuclei yielded similar results. However, isolation of nuclei from live spores requires substantial dilution of spores into a nuclear extraction buffer. Analysis of fixed spores was selected to allow consistent analysis of ploidy even from sporophyte thalli that yielded very low spore numbers. Data were analyzed using the BD FACSDiva and FlowJo software (Treestar, Ashland, OR, USA). Spore ploidy was scored as 1N-dominant if the ratio 1N spores/2N spores was ≥ 3 , 2N-dominant the ratio was $\leq 1/3$, and co-dominant if the ratio was between 1/3 and 3.

Culturing of gametophytes for study of development, sex ratio, ploidy, and meiosis segregation

Five drops of each spore suspension were inoculated in 55 mm x 14 mm plastic Petri dishes with Provasoli enriched seawater and incubated in a culture chamber set at 15°C, 12:12 light:dark, 25-35 μmol photons m⁻²s⁻¹. Culture medium was changed once a week and observations were done monthly for 10 months.

Sex ratio estimations

Sex ratio estimations were done on 9 progenies from Quiberon. Male and female gametophytes were identified according to their morphological characteristics using a Nikon Eclipse TE300 inverted microscope (Nikon Corp., Tokyo, Japan). Female gametophytes are characterized by large cells and filaments with few branches whereas male gametophytes are smaller and display highly branched filaments formed by small cells. These morphological differences make them unambiguously identifiable under the light microscope. The numbers of male and female gametophytes were determined by counting their occurrence in three visual fields per slide using the 10x objective. Sex ratio was expressed as the frequency of males per progeny (i.e. males/(males+females)).

Estimation of gametophyte ploidy by microscopy

Comparative ploidy levels of 10 male and female gametophytes from 2 progenies from Quiberon and 2 gametophytes from 2 progenies from Roscoff were estimated by measuring nuclear area using the fluorescent DNA Hoechst stain (Invitrogen, European Headquarters) and epifluorescence inverted microscope Zeiss Observer Z1 (Carl Zeiss Microimaging, Inc., USA), as described in Bothwell *et al.* (2010). Images of nuclei were analyzed with ImageJ software (National Institutes of Health, available at www.nih.gov).

RESULTS

Sea surface temperature between sites

Coastal sea surface temperature analysis showed that SST depended on season and location factors (ANOVA, $F_{3,191} = 40.37$, $p < 0.0001$, $F_{3,191} = 804.06$, $p < 0.0001$). The season by location interaction was significant (ANOVA $F_{9,191} = 19.84$, $P < 0.0001$) (Fig. 2A). Quiberon site experienced higher spring (mean and standard deviation 13.06 ± 0.32) and summer (17.89 ± 0.66) temperature than Roscoff, Porspoder and Locquirec (in spring 11.46 ± 0.51 , 11.38 ± 0.44 , 11.15 ± 0.49 and in summer 15.20 ± 0.48 , 14.64 ± 0.50 , 16.00 ± 0.39 , respectively). In addition, the mean summer temperature recorded in the Locquirec site was higher than those recorded in Roscoff and Porspoder (Tukey test: $p < 0.05$). In the contrary, the mean winter temperature in Quiberon was lower (8.83 ± 1.03) than in the other sites (10.34 ± 0.528 , 10.71 ± 0.42 , 9.98 ± 0.47 , respectively) (Tukey test: $p < 0.05$). Local data loggers in the lower intertidal confirmed that Quiberon experienced higher summer temperatures and lower winter temperatures than

Roscoff (Mann and Withney test $p < 0.001$) with in august median values of temperature in Quiberon and Roscoff of 17.46 and 16.39 respectively and in january 8.17 and 9.17 respectively) (Fig. 2B).

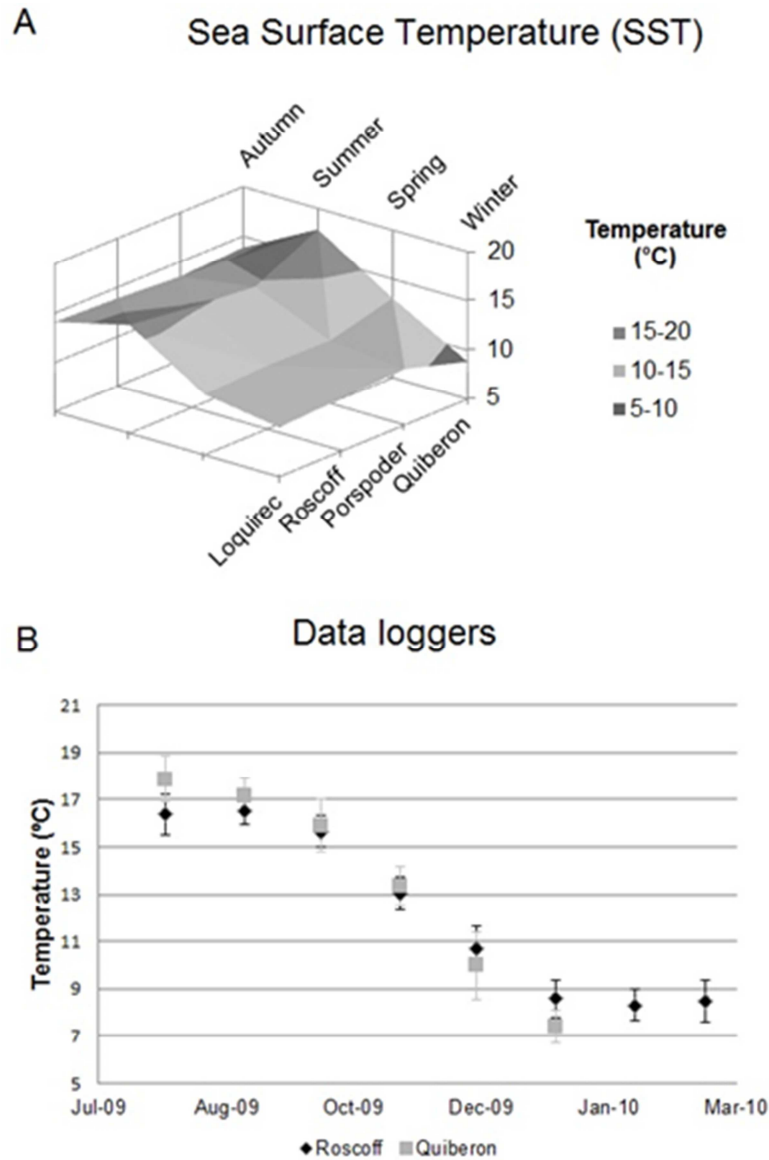


Figure 2. Seasonal temperature variation at Roscoff and Quiberon. A) Seasonal sea surface temperature (SST) determined from satellite (mean seasonal temperature, averaged over all 12 years). B) Direct measurements of data loggers.

Genetic analysis of sporophyte populations

The number of alleles varied from 2 (locus Ld1-124, site Pointe de Conguel, region of Quiberon) to 17 (locus Ld1-371, sites of Sieck and site of Le Conquet, in the two central regions of Roscoff and Porspoder). Microsatellite analysis (Table 1) showed that marginal populations located in the sites in Quiberon and Loquirec showed significantly lower genetic diversity (AR and H_e) than populations located in the central area

(Porspoder and Roscoff) (permutation tests of comparison among central versus marginal populations for H_e , p -value=0.002; for AR, p -value=0.002). The lowest genetic diversity (H_e) was found in the marginal populations located in the area of Quiberon with an average of 0.51 ± 0.04 and in the area of Loquirec (0.52 ± 0.00) whereas central populations located in Roscoff and Porspoder showed higher values (respectively 0.61 ± 0.01 and 0.67 ± 0.02). Similarly, the allelic diversity (N_a) and allelic richness (AR) were in average lower in marginal populations than in central ones.

The fixation index F_{IS} , corresponding to the deficit of heterozygote in a population, was relatively low whatever the populations studied, ranging from -0.019 in Sieck (Roscoff) to 0.085 in Molène (Porspoder). No clear difference was observed between marginal and central populations. Of the 396 individual analyzed, 394 (99.5%) had unique seven-locus genotypes; there were therefore only 2 repeated genotypes in any of the analyzed individuals. These individuals with the same multilocus genotype were observed only in two sites in the marginal region of Quiberon (R not equal to 1, Table 1).

Production of spores and gametophytes

In initial trials we observed that gametophyte cultures were readily established from Roscoff sporophytes, but attempts often failed from sporophytes originating from Quiberon (data not shown). To investigate causes, spore production was examined from over 25 individuals from all four sites. Sporophyte individuals from Quiberon and Loquirec both showed greatly diminished spore release in comparison with individuals from Roscoff and Porspoder. Average spore production was 14-fold higher in Roscoff and 25-fold higher in Porspoder in comparison to Quiberon (Fig. 3).

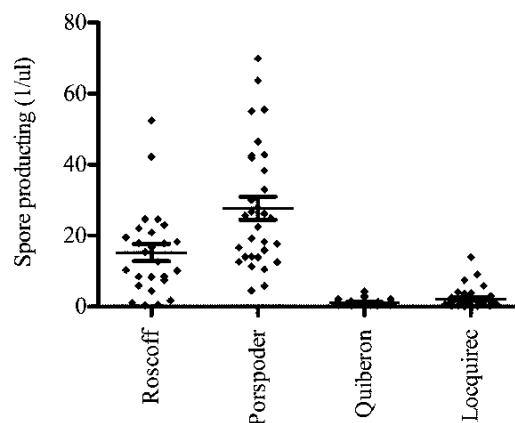


Figure 3. Spore release (number of spores per μL) by sporophytes of the four populations of *L. digitata*.

Spore ploidy

The spores produced by individuals from Roscoff, Porspoder, and Locquirec populations were predominantly haploid, whereas individuals from Quiberon produced high percentages of diploid spores (Table 2, Fig. 4). Microscopic observation of spores showed that diploid spores generally lacked flagella (data not shown).

Table 2. Flow cytometry results in the studied populations. **N**: nb. of progenies displaying haploid profiles of DNA content. **2N**: nb. of progenies displaying diploid profiles of DNA content. **N & 2N**: nb. of progenies displaying haploid and diploid profiles of DNA content.

Population	N	2N	N & 2N	not scorable	Total
Roscoff	31/33	1/33	1/33	3	36
Porspoder	23/23	0/23	0/23	0	23
Quiberon	3/30	10/30	17/30	8	38
Locquirec	14/14	0/14	0/14	24	38

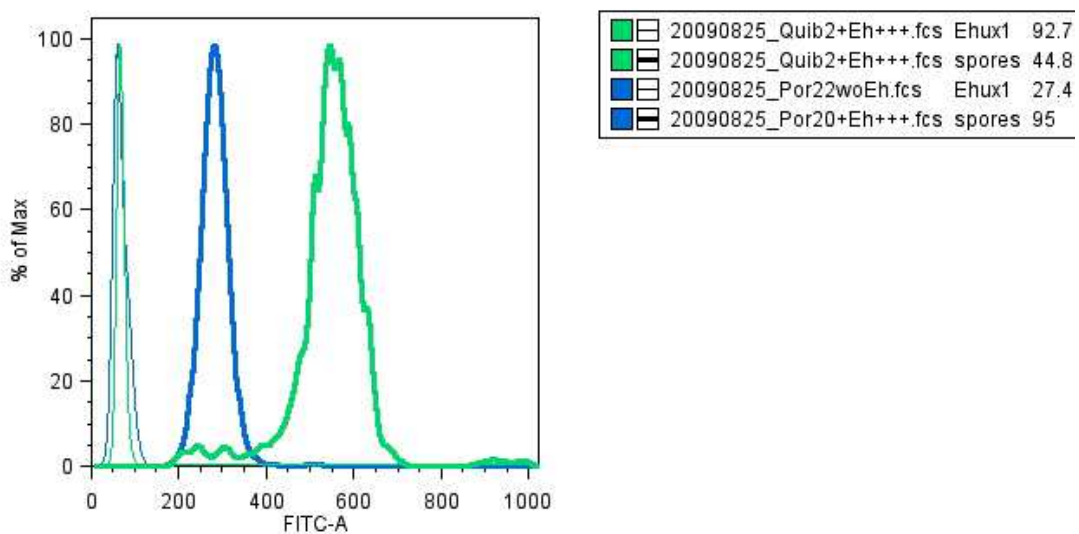


Figure 4. Example flow cytometric analysis of spore ploidy, showing histograms of Sybr Green I fluorescence (DNA content). Green lines show a representative Quiberon sporophyte and blue lines show a representative Porspoder sporophyte. In both cases the thick lines represent spores, and thin lines represent the internal standard (*Emiliana huxleyi* cells) added to the same sample during staining.

Development, sex-ratio, and ploidy of gametophytes

The spores produced by the sporophyte individuals from sites in Quiberon germinated and developed normally into gametophytes. These gametophytes did not differ in color, shape or texture from gametophytes obtained from germination of spores from Roscoff

individuals. In culture, these gametophytes initiated new juvenile sporophytes that for the first steps of development did not differ from those obtained from gametophytes of Roscoff.

Average sex ratios of the gametophytes obtained from spores of Quiberon were balanced (average of 0,461 +/- 0,185). However, three of the nine studied progenies displayed female bias, as judged by comparison to the binomial law (Table 3).

Table 3: Sex ratio in nine progenies of Quiberon. Bold numbers represent deviated sex ratios according to the binomial law.

Progeny	Total gametophytes in the progeny	Sex ratio
1	117	0,56
2	64	0,33
3	15	0,13
4	5	0,80
5	115	0,51
6	29	0,38
7	59	0,56
8	131	0,40
9	40	0,47

The nuclei of filamentous gametophytes were visible under epifluorescence microscopy (Figure 5). The gametophytes obtained from spores of Quiberon displayed a significantly larger nuclear area than gametophytes of Roscoff (Kruskal-Wallis test: $H=104.44$, $df=1$, $p<0.0001$) (Table 4, Figure 6).

Table 4. Nuclear area of gametophytes from Quiberon and Roscoff

N° nuclei	Roscoff		Quiberon									
	Male Area	Female Area	Male Area	Male Area	Female Area	Female Area	Male Area	Male Area	Male Area	Male Area	Male Area	Male Area
1	365	292	476	560	891	772	592	758	996	505	1100	488
2	374	396	487		791	810	735	1454	803	622	698	448
3	302	259	614			709	626		991	575	647	478
4	344	349	434			559	447		695	706	621	552
5	257	228	486				440		1030	652	705	577
6	397	209	460				542			543	975	677
7	310	307	405				512			820	870	402
8	243	244	516				543			949		810
9	377	280	296				571					541
10	282	293					585					674
11	427	273										
12	244	275										
13	303	312										
14	242	302										
15	444	433										
16	327	426										
17	295											
18	268											
19	279											
20	212											
Mean	314,6	304,88	463,8	560	841	712,5	559	1106	903	672	802	565
Sd	65,524	65,903	85,86		70,71	110,49	86,2	492	146	150	183	124

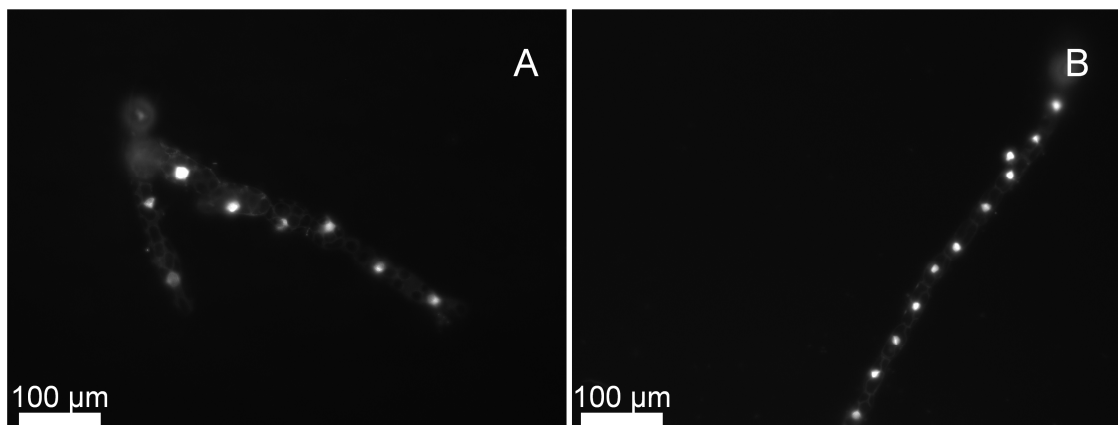


Figure 5. Gametophytes dyed with DNA stain. A) Female gametophyte from Quiberon. B) Female gametophyte from Roscoff.

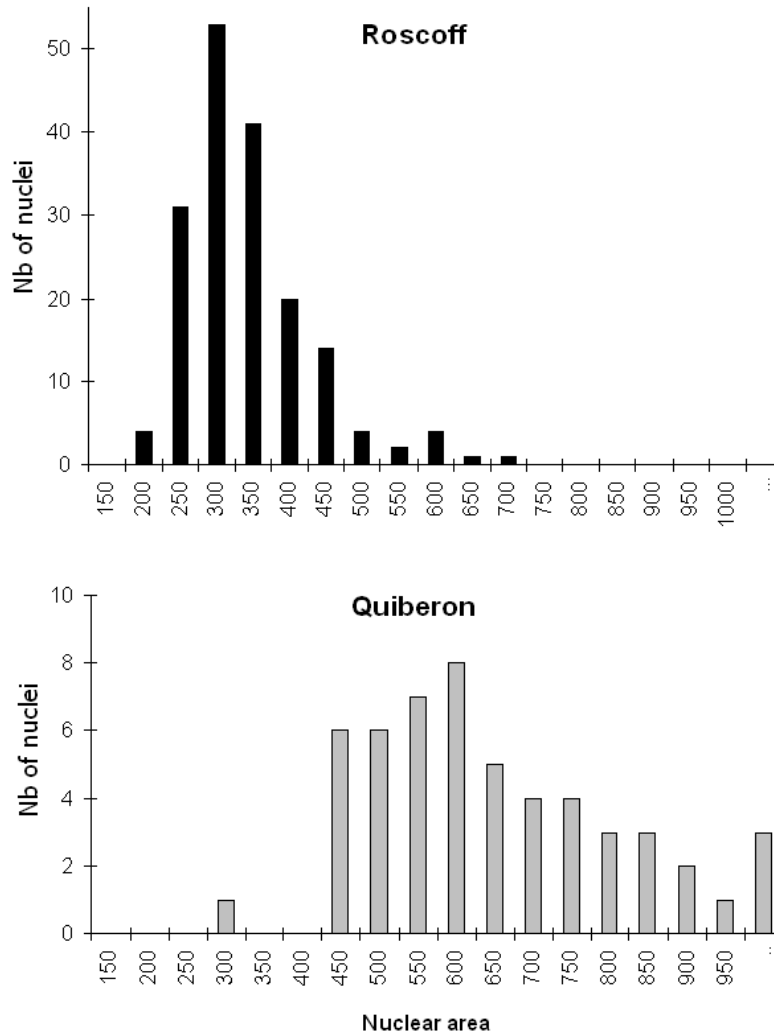


Figure 6. Nuclear area of gametophytes from central and marginal (Quiberon) populations.

The heterozygous sporophyte (Supplementary Table 1) sampled in Roscoff produced gametophyte progeny which all showed only a single allele at each microsatellite locus (Ld371 and Ld531), and segregation was Mendelian. Most of the gametophyte progenies from heterozygous sporophyte individuals from Quiberon also showed only one allele at each locus (consistent with haploidy or homozygosity). However, out of all 121 gametophytes that were successfully genotyped at least at one locus, 9 gametophytes were detected that were heterozygous at least at one locus. Progenies from parents that were double heterozygotes are of particular interest, as they allow distinguishing between distinct types of apomeiosis and meiosis with automixis. Of 43 progeny from four double-heterozygote parents where both alleles successfully amplified, two progenies (4.7%) were single-heterozygote and two (4.7%) were single-heterozygote. The rest (90.7%) showed only one allele at both loci (Table 5 and Supplementary Table 1).

Table 5. Genotyping results for gametophyte progenies of four Quiberon sporophytes double-heterozygous at two microsatellite loci. Here are listed only progeny for which both loci were successfully scored. Full genetic results (including alleles) are indicated in Supplementary Table 1.

Progeny genotype	Number (%)
Haploid or double-homozygote	39 (90.7)
Single heterozygote	2 (4.7)
Double heterozygote	2 (4.7)

DISCUSSION

Of the four populations studied here, two populations could be considered as marginal based on genetic diversity analyses, but only one population was at the range limits defined by physiological tolerance (temperature effects on spore production). The Loquirec population was not near the geographic range limits of the species, yet this population is isolated from other populations by extensive sandy beaches. In contrast, the Quiberon population represents the southern-most limit of the range of the species distribution, and is exposed more pronounced seasonal changes in temperature, with, in particular, a higher summer temperature that is frequently above the favorable temperature conditions in the field to produce meiospores (Bartsch et al. 2008, Bartsch et al. 2013). In the southern distribution boundary of *Saccharina latissima* (as *Laminaria saccharina*), Lee & Brinkhuis, (1986) reported that in August, while ripe sori were present, no meiospores were released. Recently, Bartsch et al. (2013) demonstrated a clear inhibition of reproduction in *L. digitata* when temperature reaches 18°C, whereas reproduction is maximum at 10°C. Both the Quiberon and Loquirec populations showed reduced genetic and allelic diversity consistent with lower immigration and diminished population size (confirming the previous study of Billot et al., 2003; Valero et al., 2011 and Couceiro et al., 2013). Additionally, both the Quiberon and Loquirec marginal populations also showed greatly reduced production of spores, yet only the Quiberon population showed an increase in the proportion of non-reduced spores (2N spores). This is consistent with previous evidence that there are two types of marginality for *Laminaria* species in Brittany: geographical range-limit populations strongly affected by sub-optimal physical conditions versus populations that where fragmentation by distance may be the dominant force (Robuchon et al submitted) (ecological rather than geographical range-limit).

A variety of mechanisms for parthenogenesis or cloning have been demonstrated to be available to Laminiarian algae in laboratory studies (Fang 1983, Fang 1984, Ar-Gall *et al.* 1996, Lewis 1996, Asensi *et al.* 2001, Oppliger *et al.* 2007). Thus, we expected that *L. digitata* populations in Quiberon and/or Loquirec might also be displaying some form of geographical parthenogenesis, and that the parthenogenetic mechanism selected might help to distinguish between alternative hypotheses. For example, the production of spores by apomeiosis would preserve heterozygosity and locally adapted genotypes, while also permitting retention of a heteromorphic life cycle. Genetic data from the Quiberon population in the field indeed detected individuals apparently produced by apomeiosis at a low frequency.

The nuclear area of male and female gametophytes developed from predominantly 2N spores of Quiberon individuals was consistent with gametophytes that are at least diploid. These diploid gametophytes are able to survive and to develop normally *in vitro*. Three mechanisms could allow diploid gametophytes: 1) Apomeiosis, the complete replacement of meiosis with mitotic divisions, would cause the production of gametophytes that were essentially genetically identical to the sporophyte parents, 2) Automixis, where two of the four nuclear products of meiosis fuse, resulting in diploid spores that were genetically different and, 3) Endomitosis, that would involve haploid spores restoring diploidy by chromosome doubling (Simon *et al.* 2003).

Although most of the gametophytes successfully cultured and genotyped from Quiberon *L. digitata* sporophyte parents exhibited only one allele at each locus, heterozygous gametophytes were detected, and two individuals showed a distinct diploid genotype than their parents (heterozygous at only one locus compared to parents that were heterozygous at both loci). As Quiberon parents typically produced some 1N spores (which would be expected to develop into normal haploid gametophytes), this result could be produced by a combination of 1N spores and 2N spores produced by automixis (with equal probability of fusion of all gametophyte products). However, nuclear area measurements suggested that the Quiberon gametophytes were predominantly of diploid DNA content. This would imply that most progeny were homozygous diploids, with recombination causing heterozygosity in a small proportion. That would be consistent with failure specifically of Meiosis II after recombination between homologous chromosomes in Meiosis prophase, or automixis involving re-fusion preferentially of the two nuclear products of Meiosis II (terminal fusion). This mechanism, which has also been proposed in animals (Stenberg *et al.* 2009) and in the

diatom *Thalassiosira angulata* (Mills and Kaczmarek 2006) can result in diploid progeny that are predominantly homozygous but retain heterozygosity at some loci due to meiotic recombination between sister chromosomes (resulting in distinct chromatids attached to the same centromere and therefore co-segregating during Meiosis I).

Surprisingly, despite the apparent propensity for *L. digitata* to engage in parthenogenesis, microsatellite genetic data are not consistent with it being the major reproductive mode in natural populations. While FIS values for Quiberon were two times higher than in Roscoff, the values stayed close to zero and so there was no important heterozygote deficiency. Automixis, especially terminal fusion automixis, would be expected to produce populations that are deficient in heterozygotes. Endomitosis would lead to completely homozygous individuals and can also be ruled out as being important in natural populations. Finally, the repeated multi-locus genotype suggests that parthenogenesis might indeed occur in Quiberon, but rarely, and the occurrence of multi-locus genotypes was not higher than expected by chance with random mating.

Other mechanisms such as polyploidy (or diploidisation) is often associated with asexuality (Vandel 1928, Suomalainen *et al.* 1987) and may give ecological advantages in harsh environments, as is well documented for polyploidy plants (Stebbins 1950), or animals (Kearney 2003). An example is the study done on the ostracod *Eucypris virens* that reported that triploid, but not diploid asexual clones were able to colonize higher latitudes, expanding the range. It was suggested that the wider distribution range of triploids was due to elevated ploidy rather than asexuality (Adolfsson *et al.* 2009). It is still not clear if polyploidy itself or hybridization, which may include the generation of higher ploidies, promotes asexuality and further range expansion (Kearney 2005, 2006, Lundmark 2006). However in our study we did not find evidence of triploid or tetraploid sporophytes existing in natural populations of Quiberon. For each microsatellite locus analyzed, genotypes of the sporophytes were either homozygous or heterozygous, showing only 1 or 2 alleles and not higher numbers. Also, even individuals that produced predominantly diploid spores also typically produced at least a small proportion of spores with the normal haploid DNA content.

Marginality is usually associated with higher abiotic stresses, and the Quiberon habitat exhibits higher and more fluctuating regimes of temperature than central population. As all kelps, *L. digitata* is sensitive to elevated temperature, and the observed change in its reproductive system might be an effect of exposure to higher and more fluctuating

temperatures. The diminished spore production combined with the capacity for non-reduced spores to develop into gametophytes creates a greater proportional capacity for asexuality in marginal populations, similar to the pattern of geographical parthenogenesis frequently observed in terrestrial species. However, population genetics shows no evidence that this parthenogenetic capacity is actually dominant in the maintenance of marginal populations of *L. digitata*. In the case of the Locquirec population, spore production was greatly diminished but the proportion of 2N spores produced was no higher than in individuals from the Roscoff population. The production of high percentages of 2N spores by Quiberon individuals was not reflected in a restoration of total spore production capacity and gametophyte formation.

Of the many hypotheses often invoked to explain the pattern of geographical parthenogenesis seen in terrestrial organisms, a dominant theme is that pathenogenic reproduction might provide particular genetic advantages either in avoiding inbreeding in small populations or in preserving well-adapted genotypes when dominant abiotic stressors are predictable, as opposed to biotic stressors which are highly variable and subject to co-evolution (Kawecki 2008, Kearney 2003, 2005, 2006). Instead of asexuality being an adaptation advantageous in marginal populations, it seems that physiological factors first are specifically repressing sexual reproduction and the low level intrinsic capacity for parthenogenesis (by various mechanisms in *Laminaria* species) does not increase enough to compensate. Such maladaptive response in the southern edge of its distribution, threaten this European kelp species with risk of local extinction as predicted by Ecological Niche Models under global change scenario (Raybaud *et al.* 2013).

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Supplementary Table 1. Genotyping results for 8 progenies of Quiberon with two microsatellite loci. Parents 1-8 are from Quiberon, parent 10 is from Roscoff. In each case the alleles are given for each locus in the parents, and the number of progeny with each combination of parental alleles is given (no progeny included alleles not found in the parent). Gametophytes where only a single allele was detected at each loci that was successfully scored might be haploid or homozygous diploids.

Parent	1	3	5	6	7	8	9	10
Ld2-371 alleles:	123/135	123/129	132/138	117/138	120/123	117/132	123/132	123/144
Ld2-531 alleles:	236/242	242/242	236/245	236/236	220/242	239/245	239/239	233/236
Classification of the progeny	double heterozygote	single heterozygote	double heterozygote	single heterozygote	double heterozygote	double heterozygote	single heterozygote	double heterozygote
Haploid or double homozygote	14	4	8	16	12	5	15	5
Single heterozygote	0	1	1	1	0	1	0	0
Double heterozygote	1	0	1	0	0	0	0	0
1 locus, haploid or homozygote	5	5	7	5	2	2	5	2
1 locus, heterozygote	0	0	1	0	1	1	0	0
both loci failed	3	1	5	1	8	14	3	5

Article 6

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Management and conservation of the kelp species *Laminaria digitata*: using genetic tools to explore the potential exporting role of the MPA “*Parc naturel marin d’Iroise*”

Lucía COUCEIRO^{1,2}, Marine ROBUCHON^{1,2,3}, Christophe DESTOMBE^{1,2} and Myriam VALERO^{1,2,a}

¹ UPMC, UMR 7144, Adaptation et diversité en milieu marin, Équipe BEDIM, Station Biologique de Roscoff, Place Georges Teissier, 29682 Roscoff, France

² CNRS, UMR 7144, Adaptation et diversité en milieu marin, Équipe BEDIM, Station Biologique de Roscoff, Place Georges Teissier, 29682 Roscoff, France

³ MNHN, UMR 7138, Systématique, adaptation, évolution, 57 rue Cuvier, 75231 Paris Cedex 05, France

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Abstract – Marine protected areas (MPAs) have been depicted as a useful tool for improving fishery management and protecting biodiversity. For example, by acting as source populations, MPAs may provide a spillover of adults/propagules, enhancing recruitment to surrounding, non-protected waters. However, such positive effect will depend on how a MPAs design matches population biology and dispersal abilities of the target species. High levels of intraspecific genetic diversity without pronounced structure have been found in many marine organisms over large spatial scales (from hundreds to thousands kilometres) but do not hold for other ecologically and economically important species such as coral reef fishes, seagrasses and kelps. In particular, the limited potential for dispersal of many macroalgae suggests the occurrence of self-sustaining, “closed” populations that contrast with the “open” populations of many fishes and invertebrates. Consequently, the high resilience of fish/invertebrate populations cannot be generalized to the whole marine realm. In the present work, we use genetic tools to explore the role of the MPA *Parc naturel marin d’Iroise* in the management of the emblematic kelp *Laminaria digitata*. While kelps have received much more scientific attention than any other seaweed group, there is still critical baseline knowledge which needs to be addressed for their effective management. Our genetic survey of 12 *L. digitata* populations along the Brittany coast, four of them located within the boundaries of the *Parc naturel marin d’Iroise*, allowed us to assess the conservation value of these kelp populations. In particular, classical genetic metrics as well as more recent clustering approaches were used to identify and characterize Management Units. Moreover, assignment tests were employed to determine contemporary migration events and source/sink populations. Our results show that populations within this MPA have high conservation value. However, we also identify other populations of conservation interest.

Keywords: Population genetic connectivity / Microsatellite markers / Gene flow / Gametophyte bank / Seaweed / *Laminaria digitata* / Marine protected area / Ushant front / Atlantic Ocean / Dispersal / Kelp / Marginal populations / Management units / Genetic diversity / Source/sink

1 Introduction

Marine Protected Areas (MPAs) cover many different types of protection. Some are “no-take zones” while others allow various levels of extractive activities (Kelleher 1999). Their main goal, as seen by the International Union for Conservation of Nature (IUCN), is to preserve biological diversity and to enhance the productivity of the oceans. Accordingly, a single MPA should be either self-sustaining or connected to other MPAs via dispersal (i.e. network of MPAs) to successfully accomplish its purpose and promote population persistence (Clinchy 1997). The effectiveness of a particular MPA

will depend on its specific objectives, but MPAs are generally envisioned to play an ecosystem role on a scale larger than their own boundaries (Agardy 1994). For example, by acting as source populations (Pulliam 1988), MPAs have been shown to provide a spillover of adults/propagules, enhancing recruitment to surrounding, non-protected areas (Teske et al. 2010). Still, such positive effect will depend on how MPA designs match the population biology and dispersal abilities of target species. Connectivity is thus a critical parameter for optimizing the size and spacing of MPAs. However, getting direct measures of propagule dispersal in the sea has proven difficult (but see Almany et al. 2007) and genetic tools are frequently used as an alternative to infer connectivity and scales of population structure (Palumbi 2004). These

^a Corresponding author: valero@sb-roscoff.fr

methods have found widespread applications in the identification and conservation of populations and, in particular, they have helped to guide new approaches to fisheries management (Selkoe et al. 2008). The power of detecting migration through population genetic analyses has considerably improved during this last decade because of concomitant developments of DNA technologies, computational power and new sophisticated statistical methods (Waples et al. 2008). Among these new analytical tools, assignment methods (Paetkau et al. 2004; Manel et al. 2005) allow us to estimate the direction of migration between populations, thus providing important demographic information (e.g. source/sink dynamics) for sitting marine reserves (Crowder et al. 2000; Cowen and Sponaugle 2009).

Marine populations display a high spatio-temporal heterogeneity regarding genetic and demographic factors such as dispersal distances and settlement rates. The “open”, non-structured populations of many exploited fishes (Carr et al. 2003; Kinlan et al. 2005) contrast with the “closed” populations of other ecologically and/or economically important species such as coral reef fishes (Jones et al. 2009), seagrasses (Procaccini et al. 2007) and kelps (Valero et al. 2011). Hence the high resilience of some exploited fish populations to human impacts due to a decoupling of local offspring production from propagule acquisition (Roughgarden et al. 1988) cannot be generalized to the entire marine world. Genetic data are therefore needed to characterize dispersal and population connectivity in these other ecologically and economically important marine resources.

The MPA *Parc naturel marin d'Iroise* (PNMI), located into the Ushant Sea (western Brittany, France), was created in October 2007 to promote a sustainable use of the regional marine resources including the kelp *Laminaria digitata*. In fact, *L. digitata* is one of the most commonly harvested species in Europe as a source of alginates. Indeed, more than 50% of the yield of *L. digitata* in France comes from the area of Molène located in the aforementioned MPA (Arzel 1998; Alban et al. 2011). Compared to other marine organisms, dispersal distances of spores and gametes are reported to be very limited in macroalgae (Santelices 1990), ranging from less than one metre to over 4 km (see Kinlan and Gaines 2003 and references therein). However, although rare, long-distance dispersal events might have essential consequences on population connectivity (Kinlan et al. 2005). In the particular case of kelps, dispersal is mainly ensured by planktonic haploid spores but long-distance dispersal may occur in some species via rafting individuals (Thiel and Gutow 2005). The few studies that have examined patterns of population connectivity of macroalgae also suggest that habitat discontinuity may be the main factor shaping spatial genetic differentiation (in *L. digitata*, Billot et al. 2003; Valero et al. 2011; in *Durvinella antarctica*, Fraser et al. 2010; in *Macrocystis pyrifera*, Alberto et al. 2010; and in *Hormosira banksii* Coleman et al. 2011). Specifically, contrasting levels of genetic diversity have been reported in *L. digitata* between large continuous and small isolated populations along the Brittany coasts. Furthermore, the temporal genetic instability observed in these small populations (Valero et al. 2011) suggests that they are not self-sustaining units and their persistence might rely only on immigration from adjacent sources (sink populations).

In the present work, we use genetic tools to explore the potential exporting role of the PNMI in the conservation of the engineering kelp *L. digitata*. Our sampling scheme, ranging from Southern Brittany to the Gulf of Saint Malo, intended to compare populations within and outside the PNMI, but also populations differing in size (small isolated *versus* large continuous stands). Our main goal is to evaluate the conservation value of these populations based on three criteria inferred from genetic data: amount and distribution of the genetic diversity, level of resilience, and source/sink dynamics.

2 Materials and methods

2.1 Sampling and genotyping

In order to compare *L. digitata* populations within the PNMI with surrounding populations, four localities sampled in 2006 into/nearby this MPA were added to a previous data set (Valero et al. 2011). To facilitate comparisons, the same population codes as those in Valero et al. (2011) were used here. The previously studied samples, collected during 2005/2006, involved eight populations placed either northwards (Northern Brittany: NB2, NB4, NB4, and Saint Malo Gulf: SM1) or southwards (Southern Brittany: SB3, SB2, and SB1) of the boundaries of the PNMI, as well as one population at its northern limit (NB1) (Fig. 1). The new data set included three populations located within the boundaries of the MPA PNMI (MPA1, MPA2, and MPA3) as well as one population placed 15 km southwards (SB4) (Fig. 1).

DNA extraction for the new samples was performed as in Valero et al. (2011). Likewise, the same seven microsatellite loci were amplified in these samples following previous protocols (Billot et al. 1998; Valero et al. 2011). In total, our dataset comprised 330 individuals (20–30 individuals per population) of which 115 were collected inside the aforementioned MPA.

2.2 Summary statistics, Hardy-Weinberg expectations and linkage disequilibrium

Standard measures of genetic diversity for each population were calculated in GENEALLEX version 6.41 (Peakall and Smouse 2006): mean number of alleles per locus (N_a), unbiased expected heterozygosity (H_e), and number of private alleles. Moreover, all pairs of loci across sites were tested for linkage disequilibrium using a Markov chain approximation of an exact test as implemented in GENEPOP web version 4.0.10 (Raymond and Rousset 1995). Conformity to Hardy-Weinberg equilibrium within each sampling site was also assessed using the same software. In both cases, sequential Bonferroni correction was applied in order to account for multiple comparisons (Rice 1989).

2.3 Population structure

Genetic differentiation among populations was first investigated using pairwise F_{ST} estimates based on the approach

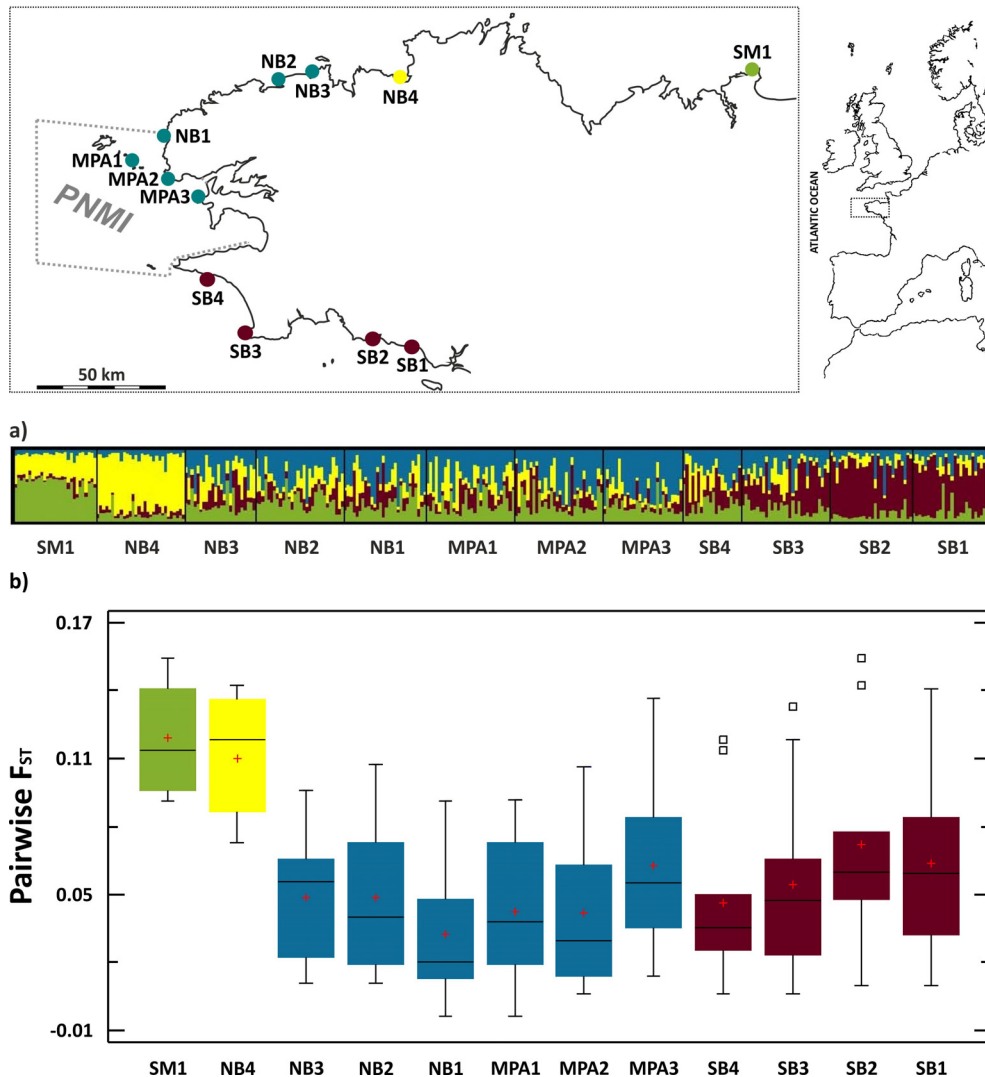


Fig. 1. Map of Brittany showing sampling sites and the perimeter of the Marine Protected Area *Parc naturel marin d'Iroise* (dotted line). (a) STRUCTURE bar plot for $K = 4$ averaged over 20 independent runs; each vertical segment represents one single individual and colours indicate the relative contribution of each one of the 4 identified clusters to its genetic make-up. (b) Box-and-whisker plot of pairwise F_{ST} values for each population (colours indicate genetic clusters as identified by STRUCTURE).

of Weir and Cockerham (1984) and calculated in FSTAT version 2.93 (Goudet 1995). Deviation of obtained values from zero was tested by randomizing genotypes among samples (1320 permutations). For each of the N (12) studied populations, the $N-1$ (11) pairwise F_{ST} values were averaged in order to get an estimate of their mean level of genetic differentiation.

In a separate analysis, the most likely number of genetic clusters was inferred using the STRUCTURE software, version 2.2 (Pritchard et al. 2000). This program was run under the admixture and independent allele frequency model using a Markov chain Monte Carlo length of 300 000 steps after a burn-in of 200 000. The number of clusters (K) was determined by estimating the probability of the data $[\ln \Pr(X|K)]$ for runs with $K = 2-12$, averaged over 20 independent runs. The value of K that most likely captured the major structure in the data was determined as the smallest K at which average $\log \Pr(X|K)$ estimates levelled out. For the selected K ,

results from replicate runs were averaged with CLUMPP version 1.1.2 (Jakobsson and Rosenberg 2007) and displayed graphically using DISTRUCT version 1.1 (Rosenberg 2004). Moreover, the number and identity of the genetic clusters identified by this method was corroborated using the alternative bayesian approach implemented in BAPS version 5.2 (Corander et al. 2008).

2.4 Contemporary migration and source/sink populations

In order to estimate contemporary migration events among the studied populations, first-generation migrant tests were performed in GENECLASS2 (Piry et al. 2004). This approach computes for each individual the probability of belonging to the population where it was sampled (based on its multilocus

Table 1. Genetic diversity estimates for the studied populations (N : sampling size, Na : mean number of alleles per locus \pm SD, Nap : number of private alleles, He : unbiased expected heterozygosity; numbers in brackets denote mean values \pm SD re-estimated for $N = 20$).

Population	N	Na	Nap	He
SM1	28	4.00 \pm 0.76 [3.35 \pm 1.42]	1 [0.09 \pm 0.22]	0.561 \pm 0.06
NB4	30	4.27 \pm 0.68 [3.37 \pm 0.90]	0 [0.00 \pm 0.01]	0.518 \pm 0.04
NB3	24	6.43 \pm 1.54 [4.91 \pm 2.57]	2 [0.15 \pm 0.24]	0.625 \pm 0.06
NB2	30	6.57 \pm 1.72 [4.86 \pm 2.70]	0 [0.18 \pm 0.32]	0.664 \pm 0.06
NB1	28	7.14 \pm 1.32 [5.36 \pm 2.08]	3 [0.17 \pm 0.20]	0.678 \pm 0.05
MPA1	30	7.14 \pm 1.22 [5.40 \pm 2.12]	2 [0.24 \pm 0.33]	0.700 \pm 0.04
MPA2	30	6.14 \pm 1.14 [5.04 \pm 2.90]	2 [0.20 \pm 0.27]	0.673 \pm 0.07
MPA3	27	6.71 \pm 1.80 [4.81 \pm 2.02]	0 [0.04 \pm 0.09]	0.665 \pm 0.06
SB4	20	5.86 \pm 0.99 [4.52 \pm 1.78]	1 [0.27 \pm 0.23]	0.610 \pm 0.07
SB3	30	6.86 \pm 1.32 [4.68 \pm 2.17]	1 [0.14 \pm 0.20]	0.578 \pm 0.08
SB2	28	5.29 \pm 1.09 [3.95 \pm 1.72]	0 [0.02 \pm 0.04]	0.545 \pm 0.09
SB1	25	5.29 \pm 1.23 [4.08 \pm 2.32]	0 [0.05 \pm 0.09]	0.523 \pm 0.11

genotype) and those individuals which fail to pass a given threshold p -value are considered first-generation migrants. Assignment probabilities were here calculated using the partially Bayesian method of Rannala and Mountain (1997) in combination with the Monte Carlo re-sampling algorithm of Paetkau et al. (2004). Moreover, since we did not sample all potential source sites, we used $L = L_{\text{home}}$ as the statistical criterion for the likelihood computation (critical p fixed to 0.05).

Finally, the status of each populations as a source/sink was determined by characterizing its pattern of asymmetric migration (i.e. emigration minus immigration), a measure of the degree to which a population is a donor or a recipient of migrants. Emigration/immigration estimates were derived from GENECLASS2 output since, even though this program does not explicitly provide migration rates, a rough approximation can be obtained by dividing the number of individuals identified as migrants by the sample size (Manel et al. 2005).

3 Results

The seven microsatellite loci amplified from 5 (*Ld158*) to 22 (*Ld371*) alleles each. Levels of genetic diversity were highly variable among sampling sites (Table 1). The mean number of alleles per locus (Na) ranged almost twofold across all localities, from 4.00 (SM1) to 7.14 (NB1 and MPA1). Unbiased expected heterozygosities (He) showed also a considerable range of values (0.518–0.700) and, as for the previous estimate, lowest levels were found in those populations located at both edges of the sampling range (0.518, 0.523, 0.545, and 0.561 for NB4, SB1, SB2, and SM1, respectively). Finally, 12 of the 73 detected alleles (16.4%) were unique to a given population (i.e. private alleles) with frequencies oscillating between 0.017 and 0.033. In particular, the central population NB1 showed 3 private alleles while NB3, MPA1, and MPA2 showed 2, SM1, SB4 and SB3 exhibited only one, and none were found in NB4, NB2, MPA3, SB2, and SB1. In order to discard a potential bias in the observed pattern of genetic diversity due to unequal sampling sizes, allelic diversity estimates were recalculated using a rarefaction approach (Kalinowski 2005). Both allelic richness and private allelic richness corroborated previous results. Allelic richness values oscillated from 3.35 to

5.40 and depicted 3 main groups of populations: SM1, NB4, SB2, and SB1 with values between 3.35 and 4.08; NB3, NB2, MPA3, SB4, and SB3 with intermediate values (4.52–4.91); and NB1, MPA1, and MPA2 showing the highest estimates (>5). Likewise, private allelic richness estimates were lower than 0.10 for SM1, NB4, MPA3, SB2, and SB1, but higher than 0.20 for the central populations MPA1 and SB4.

Tests for linkage disequilibrium revealed significant departures in 19 of 252 comparisons at a critical level of $p < 0.05$. This amount of significant tests is slightly higher than the expected by chance as type I errors (i.e. 13). However, only 4 pairs of loci (*Ld124/Ld148*, *Ld158/Ld167*, *Ld167/Ld371* and *Ld371/Ld704*) showed consistent deviations in two or more localities, while departures in the remaining 10 involved just one population. Moreover, only one test remained significant after sequential Bonferroni correction reflecting that observed results are due to demographic phenomena within populations rather than physical linkage. Likewise, tests for Hardy-Weinberg equilibrium revealed significant departures in 10 of 84 comparisons at a critical level of $p < 0.05$ but no population showed evidence of departure from random mating after Bonferroni correction.

Average values of $[\log \Pr (X|K)]$ from STRUCTURE runs reached a plateau at $K = 4$. Since a higher number of clusters did not change the geographical clustering pattern but increased considerably standard deviations, we chose $K = 4$ as the number of genetic groups best capturing the structure of our data (Fig. 1a). Clustering using BAPS was consistent with this partition (results not shown) and, in both cases, results were highly coherent with the spatial arrangement of the sampled populations. Thus, while two of the identified clusters were each composed by a single, isolated population (SM1 and NB4), the remaining two brought together 6 and 4 adjacent sites (NB3, NB2, NB1, MPA1, MPA2, and MPA3 for one cluster –Northwestern Brittany– and SB4, SB3, SB2, and SB1 for the other –Southern Brittany–). On the other hand, levels of genetic admixture were highly variable among individuals covering almost the whole range of possible values (0.10–0.95). Nevertheless, despite this huge variability, substantial differences among clusters could be observed. Thus, individuals from NB4 cluster showed the lowest

genetic admixture (0.25 ± 0.12) while individuals from SM1 and Southern Brittany clusters exhibited intermediate levels (0.45 ± 0.09 and 0.48 ± 0.27 , respectively) and individuals from Northwestern Brittany cluster presented the highest values (0.60 ± 0.20).

Results of genetic differentiation using average pairwise F_{ST} statistics over each population were consistent with the above described pattern (Fig. 1b). Thus, estimates between the populations identified as two independent clusters by the bayesian approaches (i.e. marginal SM1 and NB4 populations) and all other populations were high and significant corroborating their relative genetic isolation. In particular, pairwise F_{ST} values for SM1 ranged from 0.09 to 0.15 (0.12 ± 0.02) while they oscillated between 0.07 and 0.14 for NB4 (0.11 ± 0.03). In contrast, F_{ST} estimates for those populations that characterize Northwestern Brittany cluster were on average half, ranging from 0.00 to 0.14 (0.05 ± 0.03). Finally, populations of Southern Brittany cluster showed F_{ST} values slightly higher than those from Northwestern Brittany, even though they also showed substantial variability (from 0.01 to 0.15; 0.06 ± 0.04). In fact, five comparisons in this last cluster (namely, SB4-SM1, SB4-NB4, SB3-SM1, SB2-SM1, and SB2-NB4) exhibited values numerically distant from the remaining 32 estimates, indicating increased genetic differentiation among the populations located at both edges of the sampling range.

First-generation migrant tests detected a total of 28 individuals (9%) that could not be assigned to the population in which they were sampled based on the likelihood of their multilocus genotypes (Fig. 2a). As expected, a considerable proportion of these putative migrants occurred among populations belonging to the same genetic cluster (58%, i.e. 15 individuals). In particular, 42% of these within-cluster migration events were observed into the Northwestern cluster while the remaining 15% occurred within the Southern cluster. Moreover, a substantial fraction of these within-cluster events involved adjacent populations (46% and 75% for the Northwestern cluster and the Southern cluster, respectively). Among-cluster migration was mainly due to exchanges between Northwestern and Southern clusters (82%). The remaining putative migrants corresponded to 1 individual sampled in SB3 whose population of origin could not be identified and 3 individuals collected in NB4 but attributed to MPA1, SB3, and again, an unsampled population. Interestingly, the bridge between Northwestern and Southern populations was more frequently established by MPA2/SB4 but not MPA3/SB4. Also, in agreement with population structure results, it was noteworthy that no migration event was detected in SM1.

GENECLASS2 output also provided important insights about the directionality and asymmetry of gene flow. When all populations were taken into account, 58% of the migration events occurred northwards while 42% happened southwards. The same tendency could be observed within each cluster: 56% of the migrants from Northwestern populations moved northwards while this percentage was even higher for those migrants from Southern populations (63%). However, the examination of gene flow directionality on a population basis also revealed some important exceptions to the previous pattern. For example, 4 of the 5 migrants from MPA2 moved

southwards and the same behaviour was observed for 2 of the 3 migrants identified from NB2. The studied populations also showed a very different pattern regarding the asymmetry of their gene flow (Fig. 2b): while the net balance among emigration and immigration rates, was positive for 3 populations (MPA1, MPA2, and MPA3), it remained equal to zero in 4 populations (SM1, NB2, SB4, and SB3) or, was even negative in NB4, NB3, NB1, SB2, and SB1. In particular, the role of MPA1 as source population was prominent (7 emigrants versus 1 immigrant) whereas NB4 and NB1 showed the highest immigration rates.

4 Discussion

4.1 Genetic architecture and connectivity of *L. digitata* populations along Brittany

Large brown algae of the order Laminariales, also known as kelps, characterize intertidal and subtidal rocky shores of temperate regions (Bolton 2010). By forming a major biogenic habitat, these macroalgae sustain important associated biodiversity. However, they are also subject to growing anthropogenic pressures and a worldwide decline has been recently reported (Airoldi and Beck 2007). Ensuring that marine reserves adequately protect these habitats, including their connectivity, is therefore a key issue in conservation of temperate marine regions (Coleman et al. 2011).

In this study, we have characterized the pattern of genetic connectivity, including contemporary gene flow, of Brittany populations of *L. digitata* scattered within and around the MPA PNMI. Our results show that the studied populations, covering approximately 400 km of coastline, belong to 4 genetic groups. As expected, two of these groups were composed of a single population: the marginal populations SM1 and NB4. In agreement with the lack of available substrate, and therefore conspecific populations on the adjacent coastline (Billot et al. 2003; Valero et al. 2011), these two groups exhibited low genetic diversity and strong differentiation. Indeed, the influence of habitat discontinuity on population connectivity has been also evoked for other kelp species (Alberto et al. 2010; Fraser et al. 2010; Coleman et al. 2011). The two remaining groups revealed a clear differentiation between Northwestern and Southern Brittany. The Northwestern group brought together 6 adjacent populations, including the totality of the PNMI populations. Genetic diversity estimates achieved here their highest values and a substantial gene flow within-cluster but also between adjacent clusters was found. The Southern group was composed of the 4 populations located at the southern edge of our sampling range. Both genetic diversity and differentiation estimates showed a wider range of values, reflecting the higher heterogeneity of this cluster. Thus, although levels of genetic diversity were, on average, moderate, estimates for SB1 and SB2 were considerably low and comparable to those of SM1 and NB4; in contrast, SB3 and SB4 showed levels comparable to those of the neighbouring Northwestern cluster. Similarly, SB1 and SB2 exhibited genetic differentiation substantially higher than SB3 and SB4. Taken together, these results suggest the occurrence of a transition zone (SB3 and SB4) between Northwestern and Southern clusters.

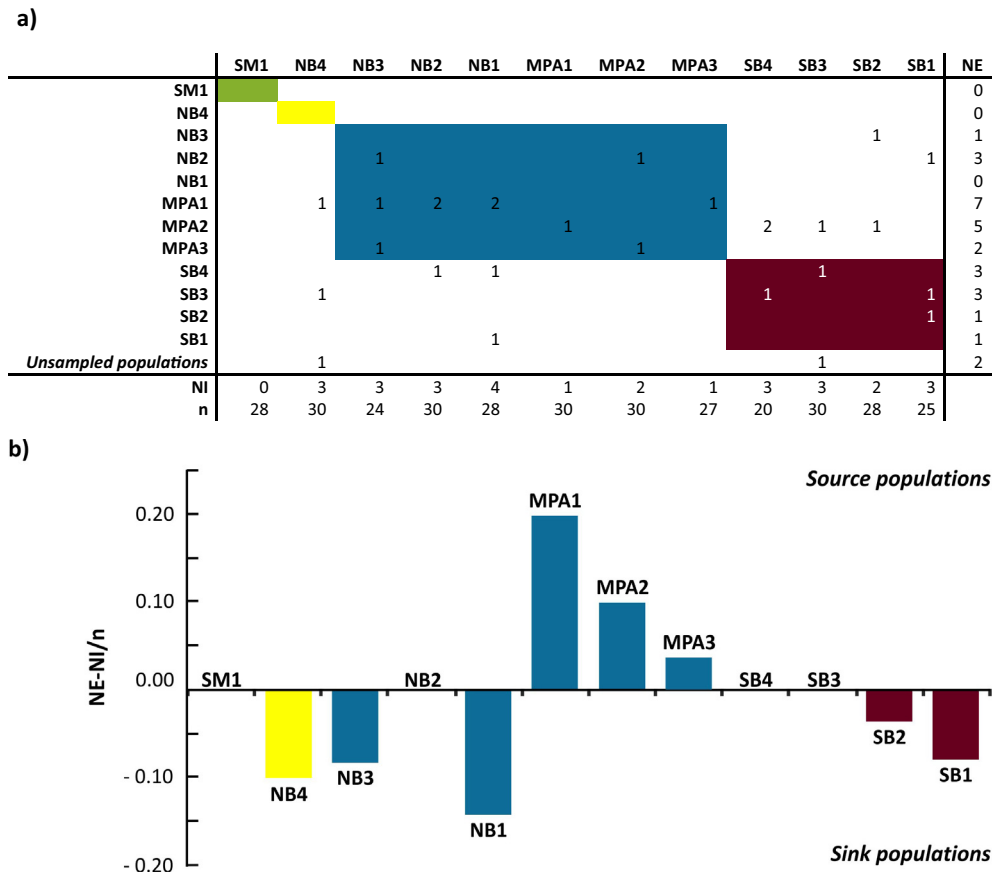


Fig. 2. (a) Results of first-generation migrant tests performed in GENECLASS2; columns assign to rows (NE: number of emigrants, NI: number of immigrants, n : sample size). Colours denote the four genetic clusters identified by STRUCTURE. (b) Emigration-immigration asymmetry; positive values denote that a site is a net donor of migrants (source population) while negative values indicate a net recipient of migrants (sink population). Colours indicate STRUCTURE genetic clusters.

Interestingly, the genetic partition regarding the Northwestern and Southern clusters nearly fits the main hydrological features of the region (Ayata et al. 2010). In contrast with previous findings (Billot et al. 2003), this result suggests that connectivity among Southern and Northern Brittany populations is mainly determined by hydrodynamic features. The existence of an oceanic front joining Southern Brittany to Cornwall has been long described (Pingree 1975; Le Fèvre 1986). This thermal front, known as the Ushant front, appears in spring with the increase of ocean temperature and lasts until the mixing of the water column in autumn, thus preventing dispersal between the Bay of Biscay and the western English Channel. The clustering of our populations in two distinct, but not completely isolated groups fits well with this seasonal barrier. In fact, genetic isolation among populations at both edges of the Ushant front has been reported for other marine species (Jolly et al. 2005; Charrier et al. 2006). Besides, our results regarding contemporary gene flow also agree with the general north-northeastward drift of the North Atlantic Current (Koutsikopoulos and Le Cann 1996). However, even though migration mainly occurred northwards, we also find some exceptions illustrating that regional hydrodynamics are highly complex and include numerous mesoscale features (Ayata et al. 2010).

The division between Northwestern and Southern populations also agrees with the zonation of the marine biogeographical provinces in the Northeast Atlantic. The Iroise Sea is known to be a boundary between the Boreal and the Lusitanian provinces (Dinter 2001). Accordingly, the described genetic partition reflects that Northwestern populations clearly belong to the Boreal province while those from the Southern cluster are influenced by the adjacent Lusitanian province. Furthermore, our results regarding these two clusters also support the central-marginal hypothesis which predicts lower genetic diversity and higher differentiation for the populations at the limits of the species distribution range (Eckert et al. 2008). Like other cold-temperate species, *L. digitata* exhibits its southern limit of distribution in Europe around the 47th north parallel; hence Southern cluster populations are located at the south margin of its distribution range. As expected, genetic diversity was consistently higher in Northwestern than Southern populations whereas genetic differentiation suggested a lower connectivity in this last cluster. Indeed, fragmented populations as well as high ecological/demographical variability have been reported in other kelps near their limits of distribution (Coleman et al. 2011). These findings suggest that latitude is also an important factor structuring kelp populations; therefore, kelp genetic architecture might be as

efficient as species distribution patterns for discriminating biogeographical provinces and defining habitats/areas of conservation concern.

4.2 Implications for *L. digitata* management/conservation

Management units (MUs, i.e. functionally independent populations of conspecific individuals, Moritz 1994) have been recently proposed as a means to efficiently guide monitoring/conservation programs seeing that, populations within a given species may be sufficiently differentiated to require separate management (Frankham 2004). Even though MUs can rely on geography, demography or ecology, genetic data are increasingly being used to delineate them. Our analyses clearly demonstrate that all *L. digitata* populations within the *PNMI* belong to the same MU and should therefore be managed as a whole; this MU (here after referred as Northwestern MU) also includes two other populations located ca. 60 km beyond the *PNMI* northern limit. A second MU encompassing the four populations within the Southern cluster can be also defined (Southern MU). While it seems obvious that both MUs should be protected, the Northwestern MU exhibits certain features suggesting a higher conservation value. First, since Northwestern MU populations show the highest genetic diversity, they should harbour the largest genetic legacy of *L. digitata* within the region. Second, populations identified as sources by our analysis of asymmetric gene flow all belong to the Northwestern MU and, in particular, all are located inside the *PNMI*. Protecting source populations constitutes a widely-accepted guideline in MPA design (Roberts 1997). Since sources are self-sustaining populations but also produce a surplus of individuals (Jones et al. 2007), preserving them can increase recruitment/captures in the adjacent, non-protected populations (Roberts 1997). Finally, it has been argued that populations representing the best MPA candidates have to also exhibit high resilience so they can rescue other depleted populations (Salm et al. 2006). Although demographic data for the studied populations are not available, some insights suggest that Northwestern MU populations display high resilience. A spatio-temporal survey covering 7–9 years and comprising 8 of our 12 populations revealed no significant changes in genetic diversity/differentiation for Northwestern MU populations suggesting that effective population sizes have remained unchanged (Valero et al. 2011). In contrast, a significant change in the population genetic metrics was detected for the isolated populations SM1 and NB4 indicating that they have probably suffered a recent genetic impoverishment.

Even if Northwestern MU populations seem to fulfil the role of highly diverse, source, resilient populations, their protection alone might not ensure the long-term persistence of the species. Firstly, it is important to note that the *PNMI* is not a no-take MPA (even though some *L. digitata* stands around Sein Island have not been harvested for years and harvesting is strictly regulated; Le Niliot, pers. comm.). Indeed, it harbours some of the most exploited kelp populations in France. The management of these populations should therefore be considered with awareness to maintain their conservation potential.

Next, while protecting sources and/or highly-diverse populations is essential, sinks and/or less-diverse populations might also be of conservation concern. Although we have used neutral markers and we ignore whether Northwestern and Southern MUs are also divergent regarding adaptive traits, particular ecological/genetic conditions at the range edge might promote locally adaptive alleles (Bridle and Vines 2006). Finally, evidence indicates that southern Brittany populations of *L. digitata* show high interannual variability regarding population size: (i) theoretically, marginal populations are often small and subject to bottlenecks (Eckert et al. 2008); (ii) southern distribution of *L. digitata* might be constrained by overheating of North Atlantic waters (Arzel 1998); and (iii) field surveys carried out by the authors during the last decade also point to fluctuations in their demographic structure (unpublished data). However, it is important to remind that, while *L. digitata* displays a life-history alternating between two independent generations (a macroscopic diploid sporophyte and a microscopic haploid gametophyte), demographic data often focus on the macroscopic forms (but see Oppliger et al. 2012). Thus, populations might persist and self-sustain even when sporophytes have completely disappeared. The role of macroalgal microscopic stages as resistant forms has been actually largely debated. In a way analogous to terrestrial seed banks, Chapman (1986) coined the term “bank of microscopic forms” to designate the macroalgal microscopic stages able to survive environmental conditions too stressful for the macroscopic thalli thus allowing population persistence. The nature of such “bank of microscopic forms” has been quite investigated later but general conclusions are still lacking (reviewed in Hoffmann and Santelices 1991; Carney and Edwards 2006). Thus, while gametophytes can be affected by different environmental stresses (e.g. Dring et al. 1996), many studies advocate this stage as the resistant phase. In the particular case of kelps, two-week upper survival temperatures for Laminariales show that gametophytes exhibit higher tolerance than sporophytes in most species (Bartsch et al. 2008). Early investigations also demonstrate that *Laminaria* gametophytes can survive in a vegetative state in the absence of blue light and begin gametogenesis when it is present (Lüning 1981). Despite all above, there is no field evidence of delayed development in macroalgae excepting for the giant kelp *Macrocystis pyrifera* (Ladah and Zertuche-González 1999). Further field studies (or laboratory studies investigating interactive effects of multiple stressors) are therefore needed in order to make reliable ecological inferences.

5 Conclusion

In the present study, we illustrate the efficiency of molecular tools in identifying populations of conservation concern in the Brittany kelp *L. digitata*. While estimating connectivity is a key issue in conservation biology, obtaining direct measures of migration rates remains challenging in the marine realm, especially in species with microscopic dispersal phases. Using highly polymorphic microsatellites, patterns of both genetic diversity and structure were inferred using classical population genetic analysis. In addition, up-to-date clustering approaches and assignment tests were employed to identify MUs and

sources/sink populations. Our study shows that *PNMI* populations belong to the same MU and actually exhibit high conservation value. The relevance in protecting other areas of the species range is also discussed.

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**ANNEXE 1. ETUDE DU ROLE INGENIEUR DE *LAMINARIA DIGITATA* SUR LES
COMMUNAUTES DE MACROALGUES VIVANT SOUS SA CANOPEE**

Contexte et objectifs

Les espèces ingénieuses ont été définies par Jones (1994, 1997) comme « des organismes dont la présence ou l'activité altère l'environnement physique ou change le flux des ressources, créant ou modifiant ainsi les habitats et influençant toutes les espèces associées ». Ces espèces ont un grand intérêt en biologie de la conservation puisque protéger une espèce ingénieuse permet de protéger en même temps les espèces et les fonctions de l'écosystème dans lequel elle évolue (Crain & Bertness 2006). En particulier, les espèces ingénieuses ont été décrites comme facilitant le recrutement d'autres espèces, augmentant la diversité spécifique et stabilisant la composition de la communauté associée (Wright & Jones 2006 ; Badano et al. 2006). Comme les phanérogames marines et les coraux, les laminaires ont été décrites comme des espèces ingénieuses puisque les supprimer peut perturber profondément l'écosystème et modifier la structure des communautés (Estes et al. 1989 ; Jones 1997 ; Coleman & Williams 2002) ; cependant, le rôle exact qu'elles jouent sur la communauté associée demeure flou. D'un côté, les laminaires pourraient faciliter le recrutement d'autres espèces d'algues car elles modifient leur environnement immédiat en le rendant plus propice à l'installation d'autres espèces (protection des courants et de la lumière, température plus élevée) ; d'un autre côté, les laminaires pourraient également jouer le rôle de compétiteur (compétition pour l'espace, la lumière et les nutriments) et empêcher physiquement, en balayant la roche de leur lame, l'installation d'autres espèces.

L'objectif de cette étude est d'évaluer le rôle ingénieur de l'espèce *Laminaria digitata* sur la communauté de macroalgues vivant sous sa canopée. A cette fin, une expérience a été mise en place permettant de suivre le recrutement des macroalgues après une perturbation dans des zones où *L. digitata* est présente et des zones où *L. digitata* est absente. Les données issues de cette expérience permettent en particulier de répondre aux trois questions suivantes : i) est-ce que la présence de *L. digitata* facilite le recrutement d'autres espèces de macroalgues? ii) est-ce que la diversité spécifique d'une communauté de macroalgues est plus élevée quand *L. digitata* est présente ? iii) est-ce que la présence de *L. digitata* permet de stabiliser la composition spécifique de la communauté de macroalgues ?

Matériel et méthodes

- Zone d'étude. Zone rocheuse située dans le bas du milieu intertidal accessible à pieds seulement aux marées de vives-eaux et dont les communautés biologiques sont

dominées par *L. digitata*, au pied du rocher dit « Le Loup » (48,73058°; -4,00366°), pointe de Perharidy, Roscoff, Bretagne, France.

- Définition et distribution des traitements. Un plan d'échantillonnage a été établi dans une zone de 25m de large sur 45m de long dans laquelle 60 cadrats d'un quart de m² ont été délimités tous les 5m en plaçant des pitons dans la roche. Quatre traitements ont été définis (Figure 1a) et repartis aléatoirement entre les 60 quadrats (15 quadrats/traitement, Figure 1b). Le premier traitement, « grattés », consiste en une élimination des organismes vivant sur la roche à l'aide d'un couteau à peintre. Le deuxième traitement, « brûlés », consiste en une élimination des organismes vivant sur la roche à l'aide d'un couteau à peintre puis une stérilisation de la roche à l'aide d'un chalumeau. Le troisième traitement, « transplantés », consiste à ajouter aux « brûlés » des transplants de jeunes sporophytes de *L. digitata* récoltés dans la zone, à raison de trois sporophytes par quadrat (ce qui correspond à la densité moyenne observée dans la zone) : les sporophytes sont attachés par leur crampon sur une grille en plastique qui est ensuite fixée sur la roche. Le quatrième traitement, « témoins », correspond à des quadrats qui restent intouchés. La comparaison des quadrats « transplantés » et des « brûlés » permet de répondre aux questions relatives au rôle ingénieur du sporophyte macroscopique de *L. digitata* sur les communautés de macroalgues. La comparaison des quadrats « brûlés » (élimination des organismes macro et microscopiques) et « grattés » (élimination des organismes macroscopiques seulement) permet de répondre à d'autres questions relatives au rôle des phases microscopiques de *L. digitata* dans la résilience des populations (analyses en cours menées par Lucía Couceiro, post-doc dans l'équipe BEDIM à la station biologique de Roscoff, et discutées brièvement dans le chapitre II). Tous les traitements ont été établis pendant les marées d'équinoxe de mars 2011 (t0). La Figure 2 illustre l'apparence des quadrats juste après établissement des traitements.

- Echantillonnage temporel. Pour chaque type de quadrat, le recrutement a été suivi au cours du temps lors des marées de vives-eaux 2 mois après (t1), 6 mois après (t2), 12 mois après (t3), 18 mois après (t4) et 24 mois après (t5) les traitements. A chaque temps, trois quadrats de chaque traitement (soit 12 quadrats) ont été échantillonnés en récoltant toutes les macroalgues à l'aide d'un couteau à peintre et éventuellement d'une pince pour les plus petites.

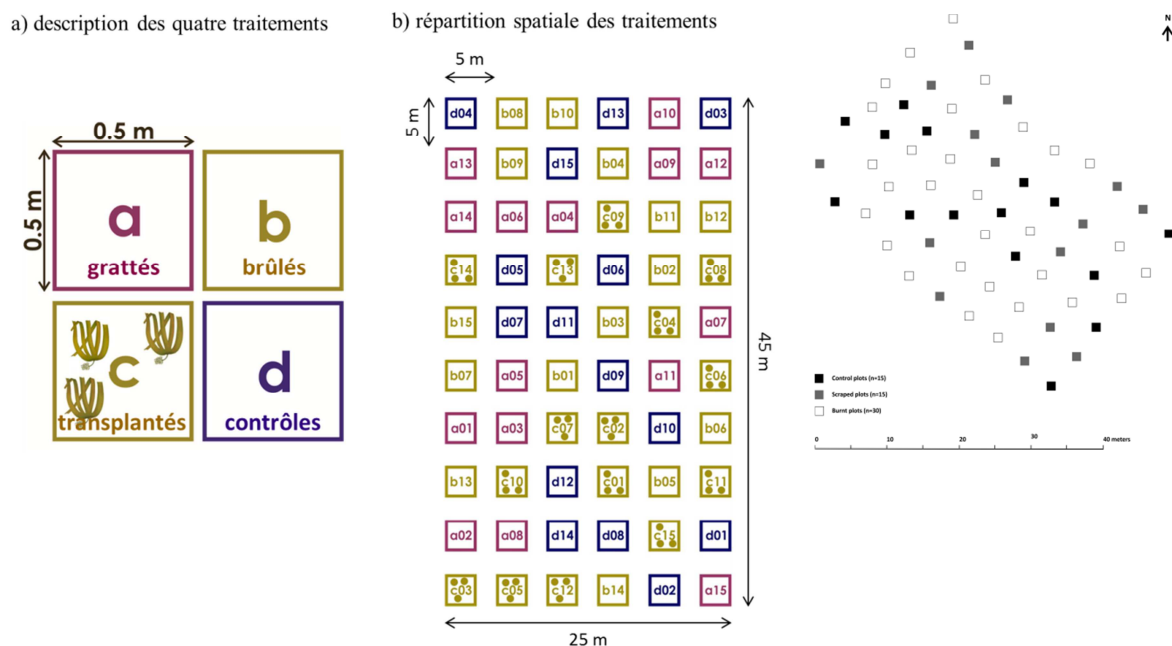


Figure 1. Illustration schématique des quatre types de traitement (a) et répartition des traitements dans l'espace entre les soixante quadrats (b).

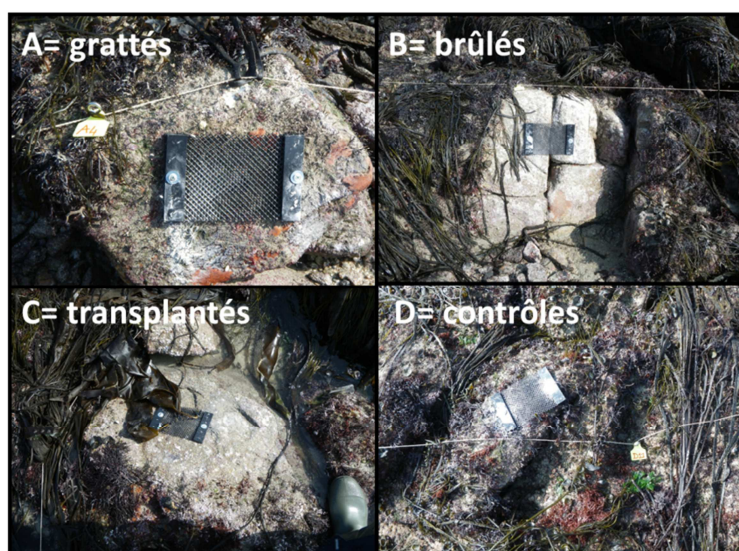


Figure 2. Photos de quatre quadrats illustrant les quatre types de traitement différents, prises immédiatement après l'établissement des traitements.

- Traitement des échantillons. Pour chaque quadrat « brûlé », « gratté » et « témoin », la détermination des espèces a été faite sur la base de critères morphologiques et l'estimation de la biomasse sèche a été obtenue après 48h de séchage à 60 °C pour les cinq espèces de macroalgues les plus abondantes. De plus, pour les quadrats « grattés » uniquement, tous les sporophytes de laminaires ont été isolés, mesurés puis conservés dans du silica gel pour une future détermination spécifique à l'aide d'un marqueur d'ADN mitochondrial et pour une analyse de la diversité génétique à l'aide de marqueurs microsatellites pour les individus de *L. digitata*.
- Jeux de données. Toutes les analyses relatives à l'étude du rôle ingénieur de *L. digitata* ont été menées en parallèle sur des données de présence/absence de toutes les espèces de macroalgues et sur des données de biomasse des cinq espèces les plus abondantes.
- Attendus spécifiques et analyse des données. Si les traitements sont distribués de manière aléatoire à t0 alors les communautés de macroalgues échantillonnées à t0 ne devraient pas être différentes entre les quadrats « brûlés » et « transplantés » (les quadrats « témoins » n'ayant pas été perturbés, nous ne disposons pas de leur composition à t0). Cette vérification a été menée en faisant une analyse de la variance multivariée par permutations (PERMANOVA) pour tester l'effet du facteur « traitement » et en visualisant la différence de composition en espèces entre quadrats par une ordination multidimensionnelle non métrique (nMDS). Si *L. digitata* facilite le recrutement d'autres espèces, alors le recrutement devrait être plus rapide dans les quadrats « transplantés » que dans les « brûlés », et donc, les quadrats « transplantés » devraient revenir plus vite à leur état de référence (défini ici comme « l'état où ils seraient s'ils n'avaient pas subi de perturbation, c'est-à-dire, similaires aux quadrats « témoins ») que les quadrats « brûlés ». Cette hypothèse a été testée en faisant des PERMANOVAS testant l'effet traitement globalement puis pour chaque paire de traitement ainsi que par un calcul de similarité moyenne entre traitements, et ce, à chaque pas de temps. Si *L. digitata* augmente la richesse spécifique alors la richesse spécifique devrait être plus importante dans les quadrats « transplantés » que dans les quadrats « brûlés » ; cette hypothèse a été testée en calculant la richesse spécifique pour chaque quadrat et en comparant les valeurs moyennes par traitement,

globalement et à chaque pas de temps. Si *L. digitata* stabilise la composition de la communauté au cours du temps, alors i) la richesse spécifique et ii) la composition des communautés devraient être moins variables au cours du temps globalement et entre chaque pas de temps dans les quadrats « transplantés » que dans les quadrats « brûlés ». Cette hypothèse a été testée en calculant la variance de la richesse spécifique et en testant la différence entre communautés entre temps au sein de chaque traitement (PERMANOVA et calcul de similarité). Toutes les PERMANOVAs, nMDS et calculs de similarité ont été réalisés avec le logiciel PERMANOVA + (Anderson et al. 2008) sur la base d'une matrice de distance de Bray-Curtis et avec 9999 permutations. Etant donné la faible puissance du jeu de données (3 répétitions seulement pour chaque couple traitement/temps), le seuil de significativité de 10% est considéré.

NB : la détermination des espèces s'est également faite sur des critères moléculaires mais cette seconde détermination n'est disponible que sur les spécimens récoltés aux temps t0, t1, t2 et t3 ; pour les temps t0 à t3, les analyses ont été menées en parallèle entre les déterminations basées sur des critères morphologiques seulement et celles intégrant les critères moléculaires; les résultats sont similaires. C'est pourquoi les résultats présentés dans la suite de cette annexe sont basées sur une détermination des espèces à partir de critères morphologiques seulement mais couvrent les temps t0 à t5. Les données de détermination intégrant les critères moléculaires sur les temps t0 à t3 sont détaillées dans l'annexe 4.

Résultats

- Vérification de la distribution aléatoire des traitements. Il n'y a pas de différence significative entre traitements à t0, que ce soit en considérant les données de présence/absence (p-value = 0.340, Figure 1) ou de biomasse (p-value = 0.120).

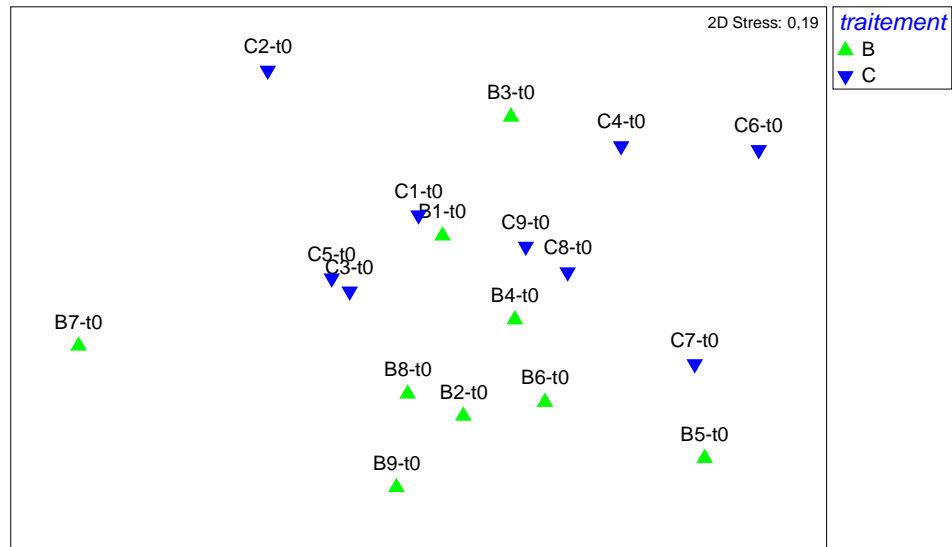


Figure 1. nMDS illustrant la distribution des quadrats à t0 sur la base d'une matrice de présence/absence d'espèces avant établissement des traitements; les quadrats B sont les « brûlés » et les C sont les « transplantés ».

- Question 1 : est-ce que la présence de *L. digitata* facilite le recrutement d'autres espèces de macroalgues ?

Les résultats sur les données de présence/absence et sur les données de biomasse des cinq espèces les plus abondantes montrent qu'il y a des différences entre temps d'échantillonnage et entre traitements (Tableau 1). Les analyses sur les données de présence/absence révèlent que les quadrats « transplantés » ressemblent plus aux « témoins » que les « brûlés » à partir de t3 et jusqu'à t5, comme attendu sous l'hypothèse selon laquelle *L. digitata* faciliterait le recrutement (Tableau 2a). Cependant, les pourcentages de similarité moyenne ne sont pas très différents entre les trois paires de traitements testées et pourraient être le reflet de la variabilité naturelle des communautés plutôt que de l'effet facilitation du recrutement par *L. digitata*. Les résultats sur les données de biomasse des cinq espèces les plus abondantes montrent qu'à chaque temps, les quadrats « transplantés » ressemblent plus aux « témoins » que les « brûlés » (Tableau 2b), comme attendu sous l'hypothèse de facilitation, et que la similarité « transplantés » / « témoins » augmente au cours du temps pendant que la similarité « transplantés » / « brûlés » diminue au cours du temps, ce qui suggère que l'effet « facilitation » augmente tandis que l'effet « perturbation » diminue au cours du temps.

Tableau 1. Résultat des PERMANOVAs testant les effets des facteurs « traitement » et « temps » sur la composition en espèces des quadrats, (a) sur les données de présence/absence des espèces (b) sur les données de biomasse des cinq espèces les plus abondantes. P (perm) est la probabilité critique calculée par permutations et % de variation est la part de la variance expliquée par le facteur. Les valeurs en rouge indiquent des différences significatives au seuil de 5%.

a) Facteur	P (perm)	% de variation
Traitement	0.0001	36.7
Temps	0.0591	2.0
Traitement*Temps	0.0142	8.1

b) Facteur	P (perm)	% de variation
Traitement	0.0030	7.1
Temps	0.0001	15.6
Traitement*Temps	0.0674	7.0

Tableau 2. Résultats des PERMANOVAs testant l'effet du facteur « traitement » et pourcentage de similarité moyenne pour chaque paire de traitements et à chaque pas de temps (a) sur les données de présence/absence des espèces (b) sur les données de biomasse des cinq espèces les plus abondantes. P (perm) est la probabilité critique calculée par permutations et % de similarité est le pourcentage de similarité moyenne entre traitements. Les valeurs en orange en indiquent des différences significatives au seuil de 10%.

a)	<i>t1 (+2 mois)</i>		<i>t2 (+6 mois)</i>		<i>t3 (+12 mois)</i>	
	P (perm)	% similarité	P (perm)	% similarité	P (perm)	% similarité
Brûlés/transplantés	0.0970	59.2	0.9002	70.1	0.4975	67.9
Brûlés/témoins	0.1979	62.9	0.4021	68.7	0.0996	64.2
Transplantés/témoins	0.0999	53.7	0.2970	66.7	0.0969	64.5

Groupes	<i>t4 (+18 mois)</i>		<i>t5 (+24 mois)</i>	
	P (perm)	% similarité	P (perm)	% similarité
Brûlés/transplantés	0.2937	66.2	0.5950	57.8
Brûlés/témoins	1.0000	65.1	0.5094	58.9
Transplantés/témoins	0.6001	66.9	0.0990	66.8

b) Groupes	t1 (+2 mois)		t2 (+6 mois)		t3 (+12 mois)	
	P (perm)	% similarité	P (perm)	% similarité	P (perm)	% similarité
Brûlés/transplantés	0.3074	57.8	0.2985	36.8	0.4033	25.4
Brûlés/témoins	0.0981	3.1	0.1049	3.5	0.0934	3.7
Transplantés/témoins	0.0992	6.3	0.0979	9.3	0.0967	9.0

Groupes	t4 (+18 mois)		t5 (+24 mois)	
	P (perm)	% similarité	P (perm)	% similarité
Brûlés/transplantés	0.0989	14.5	1.0000	14.6
Brûlés/témoins	0.3030	16.5	0.3999	7.3
Transplantés/témoins	0.3995	14.5	0.6057	20.9

- Question 2 : est-ce que la diversité spécifique d'une communauté de macroalgues est plus élevée quand *L. digitata* est présente ?

Contrairement à ce qui est attendu par rapport au rôle ingénieur de *L. digitata*, la richesse spécifique n'est en général pas plus élevée dans les quadrats « transplantés » que dans les quadrats « brûlés », c'est même le contraire à t1 (Tableau 3).

Tableau 3. Richesse spécifique moyenne (\pm erreur standard) par traitement, globalement et à chaque pas de temps.

	globale	t1	t2	t3	t4	t5
Brûlés	22.4 \pm 0.5	23.3 \pm 2.7	23.7 \pm 3.9	23.3 \pm 3.5	22.0 \pm 1.0	19.3 \pm 4.9
Transplantés	21.4 \pm 1.1	14.7 \pm 2.4	26.7 \pm 3.8	22.7 \pm 2.3	20.3 \pm 0.9	22.0 \pm 2.9
Témoins	24.9 \pm 1.1	30.3 \pm 0.3	28.0 \pm 0.0	20.7 \pm 2.0	25.0 \pm 2.3	20.3 \pm 0.3

- Question 3 : est-ce que la présence de *L. digitata* permet de stabiliser la composition spécifique de la communauté de macroalgues ?

La variance de la richesse spécifique est généralement plus élevée dans les quadrats « transplantés » que dans les quadrats « brûlés » (Tableau 4), contrairement à ce qui est attendu par rapport au rôle ingénieur de *L. digitata* sur la stabilisation des communautés. En revanche, les résultats basés sur les données de présence/absence montrent que la similarité moyenne intra-traitement est plus élevée dans les quadrats

« transplantés » que dans les quadrats « brûlés », globalement au cours du temps et entre chaque pas de temps (sauf entre t1 et t2, Tableau 5a), en accord avec l'hypothèse de plus grande stabilité de la composition spécifique en présence de *L. digitata*. Cependant, les résultats basés sur la biomasse des cinq espèces les plus abondantes ne montrent pas le même patron : les quadrats « brûlés » sont plus similaires entre eux que les « transplantés » entre eux dans certains cas (globalement, entre t1 et t2 et entre t3 et t4) mais pas dans d'autres (entre t2 et t3 et entre t4 et t5, Tableau 5b).

Tableau 4. Variance de la richesse spécifique par traitement, globalement et entre chaque pas de temps.

	globale	t1-t2	t2-t3	t3-t4	t4-t5
Brûlés	3.22	0.06	0.06	0.89	3.56
Transplantés	19.02	72.00	2.35	2.72	1.39
Témoins	19.48	2.72	26.89	9.39	10.89

Tableau 5. Similarité moyenne intra-traitement, globalement et entre chaque pas de temps, sur la base des données de présence/absence (a) et des données de biomasse des cinq espèces les plus abondantes (b).

a)	globale	t1-t2	t2-t3	t3-t4	t4-t5
Brûlés	53.12	52.53	60.73	59.83	45.57
Transplantés	56.42	47.63	61.77	62.26	62.63
Témoins	59.74	61.74	62.48	58.92	49.45

b)	globale	t1-t2	t2-t3	t3-t4	t4-t5
Brûlés	24.44	44.52	26.91	17.42	15.14
Transplantés	19.73	40.15	28.94	10.44	19.53
Témoins	20.63	17.43	16.16	26.04	21.99

Interprétations préliminaires

Nos résultats semblent indiquer que le rôle de *L. digitata* dans la résilience des communautés change au cours du temps. En effet, le fait que la richesse spécifique soit beaucoup plus faible dans les quadrats « transplantés » que dans les quadrats « brûlés » (Tableau 3), que les quadrats « transplantés » commencent à plus ressembler aux « témoins » que les « brûlés » à partir de t3 (Tableau 2a) et que la similarité moyenne intra-traitement soit plus élevée dans les quadrats « transplantés » dans tous les cas sauf entre t1 et t2 (Tableau 5a) suggèrent que *L. digitata* agit dans un premier temps comme compétitrice, réduisant le nombre d'espèces pouvant s'installer sous sa canopée, et dans un deuxième temps comme

facilitatrice, offrant aux espèces qui ont réussi à s'installer des conditions de développement propices et stabilisant la communauté.

Cependant, les seuils de significativité ne sont pas très forts et les résultats assez variables, en particulier, ils peuvent différer selon que l'on s'intéresse à la présence/absence des espèces ou à la biomasse des cinq espèces les plus abondantes. Cette incongruence est à replacer dans le contexte de l'étude, faite en milieu naturel : pour chaque traitement, trois quadrats sont échantillonnés à chaque pas de temps, et, bien que ces trois quadrats aient subi le même traitement, il existe sur la zone d'étude beaucoup d'autres facteurs non contrôlés tels que la bathymétrie, le niveau d'infractuosité et d'inclinaison de la roche et la présence de brouteurs. Nous disposons depuis peu des données sur la position bathymétrique de chacun des quadrats et il est prévu de refaire les analyses en intégrant ce facteur, ce qui devrait nous permettre de distinguer la part de variabilité qui est liée à la profondeur de celle qui est liée à la présence de *L. digitata*. D'autre part, les données ont jusqu'ici été analysées en mode multivarié mais d'autres réponses plus simples peuvent être testées comme la biomasse totale ou l'abondance relative d'espèces opportunistes. Ces analyses seront réalisées prochainement.

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**ANNEXE 2. STRUCTURE SPATIALE DES COMMUNAUTES DE MACROALGUES
DES FORETS DE LAMINAIRES DES COTES BRETONNES**

Contexte et objectifs

Comprendre comment s'assemblent les espèces au sein des communautés est un enjeu majeur de la recherche en écologie, qui suscite de nombreux débats. Historiquement, la structure des communautés était principalement considérée comme le résultat de processus déterministes définissant les niches des espèces sur des critères de conditions environnementales et d'interactions biotiques (Hutchinson 1957 ; Grime 1973 ; Tilman 1982). Au début des années 2000, cette vision déterministe est remise en cause par Hubbell (2001) qui propose une théorie dans laquelle toutes les espèces sont équivalentes en termes de niche écologique (pas de sélection) et la structure des communautés est simplement le fruit de processus stochastiques (migration et extinction, dispersion limitée mais équivalente entre espèces). Dans un effort d'intégrer les deux visions, Leibold et al. (2004) ont proposé un cadre conceptuel avec quatre paradigmes, chacun donnant une importance relative différente à la dispersion, à la dérive, aux filtres environnementaux et aux interactions biotiques (voir encadré 3 du tome 1) pour expliquer la structure des métacommunautés. Bien qu'il soit aujourd'hui admis que les communautés sont structurées à la fois par des processus déterministes et stochastiques (Leibold & McPeck 2006), il n'existe pas de consensus sur l'importance relative de ces deux types de processus qui pourraient différer selon les conditions environnementales (Chase 2007 ; Chase & Myers 2011) et/ou l'échelle spatiale considérée (Cottenie 2005 ; Chase & Myers 2011; Logue et al. 2011). Certains travaux suggèrent que dans des milieux peu perturbés, l'assemblage des communautés est principalement régi par des processus stochastiques tandis que dans des milieux perturbés, les processus déterministes dominant (*e.g.* Chase 2007 ; Chase et al. 2009 ; Chase & Myers 2011). La théorie des métacommunautés a été développée pour étudier la coexistence des espèces au sein de communautés connectées entre elles par la dispersion; cependant, à plus large échelle spatiale, les communautés peuvent être déconnectées et pour étudier la coexistence des espèces il faut alors tenir compte des processus historiques / biogéographiques (Cottenie 2005 ; Chase & Myers 2011 ; Logue et al. 2011).

Les objectifs de cette étude sont d'évaluer si l'importance relative des processus purement stochastiques (*i.e.* dispersion limitée non incluse) et déterministes (dispersion limitée incluse) dans l'assemblage des communautés varie selon les conditions environnementales et/ou selon l'échelle spatiale considérée en étudiant la structure des communautés de macroalgues des forêts de laminaires des côtes bretonnes i) au sein et entre quatre régions aux caractéristiques environnementales contrastées et aux histoires

probablement différentes par rapport à l'oscillation des climats passés (voir article 1), ii) entre des communautés situées à des niveaux bathymétriques (et donc des conditions environnementales) différents. A cette fin, nous avons calculé des indices de diversité α et β (définis dans l'encadré 3) et un indice permettant de mesurer à quel point la structure des communautés s'écarte d'un modèle nul où seuls les événements stochastiques interviennent (β_{RC} tel qu'utilisé dans Chase et al. 2011).

Matériel et méthodes

- Echantillonnage. Même plan d'échantillonnage hiérarchique que celui décrit dans l'article 4 de cette thèse ; à chaque site, l'échantillonnage en plongée des macroalgues a été effectué dans trois quadrats de $1/10 \text{ m}^2$ placés aléatoirement entre les pieds de laminaires, au niveau de la ceinture de *Laminaria digitata* (*Ld*, zonation bathymétrique chevauchant la limite inférieure de l'intertidal et la limite supérieure du subtidal, entre -1 et +1 m) et au niveau de la ceinture de *Laminaria hyperborea* (*Lh*, zone subtidale, entre -1 et -30 m). L'évaluation semi quantitative de la densité des laminaires a été faite selon une échelle de densité échelonnée de 1 à 4 (1 : très peu dense et 4 : tellement dense qu'il est difficile de poser les quadrats entre les pieds de laminaires, voir Figure 1).
- Détermination des espèces. Approche intégrée combinant des critères morphologiques et des critères moléculaires (séquençage du gène mitochondrial COI ou du gène nucléaire LSU, selon les recommandations de McDevit & Saunders 2012).
- Analyses des données. Calcul des indices de diversité spécifique (richesse spécifique (SR), diversité de Simpson ($1-\lambda$), de différenciation entre communautés (F_{TSC}), définis dans l'encadré 3) par site ainsi que de l'indice β_{RC} qui est une métrique de diversité β permettant de mesurer si les communautés sont plus similaires ($\beta_{RC} < 0$) ou plus différentes ($\beta_{RC} > 0$) que sous l'hypothèse de complète stochasticité, *i.e.* les communautés résultent d'un tirage aléatoire des espèces dans le pool régional d'espèces ($\beta_{RC} = 0$). Ainsi, $\beta_{RC} = 2[(\sum (SS_{exp} > SS_{obs}) + 0.5 \sum (SS_{exp} = SS_{obs}))/N] - 0.5$ où SS_{exp} correspond au nombre d'espèces partagées entre deux sites attendu sous l'hypothèse de complète stochasticité, SS_{obs} correspond au nombre observé d'espèces partagées entre deux sites et N correspond au nombre de permutations réalisées pour

calculer la distribution des valeurs de SS_{exp} . Des analyses de variance ont été effectuées pour tester l'effet « région », l'effet « communauté » et leur interaction sur les différents indices de diversité. Ces ANOVAs ont été réalisées avec le programme PERMANOVA + (Anderson et al. 2008) avec 9999 permutations. L'isolement par la distance des communautés a été testé sous R (R Development Core Team 2005) par un test de Mantel avec 10000 permutations.

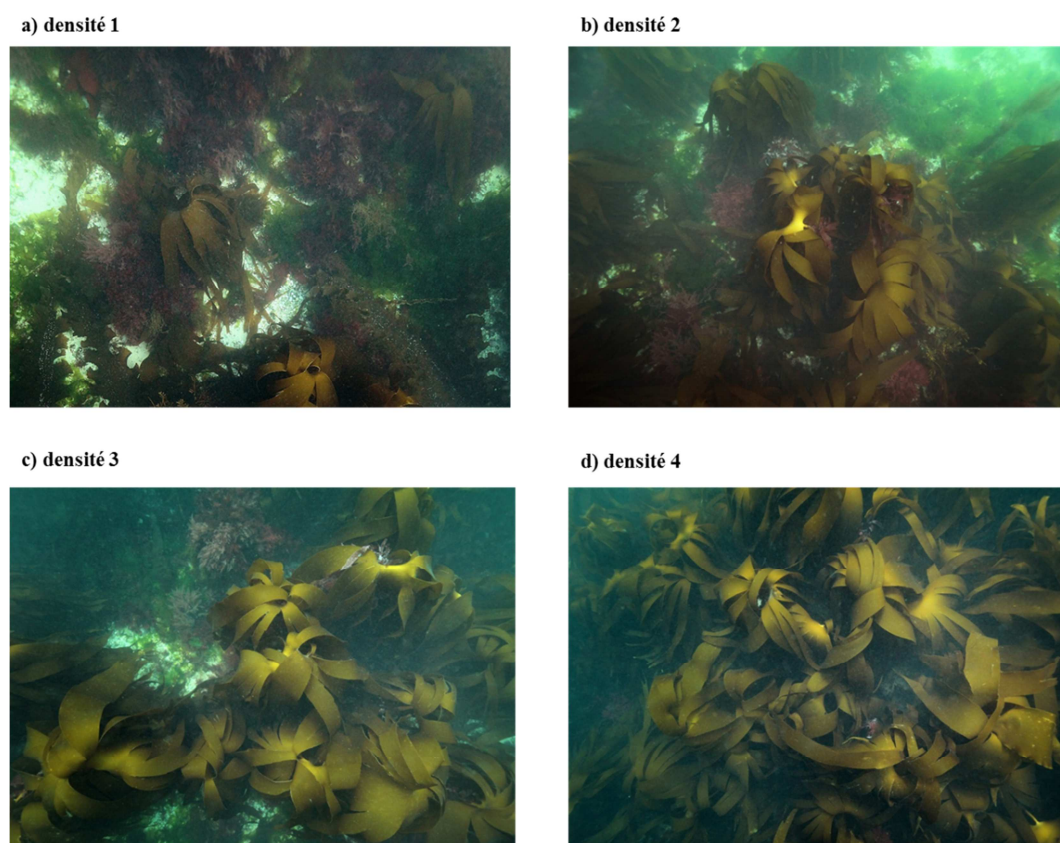


Figure 1. Photos illustrant l'échelle semi-quantitative d'évaluation de la densité en laminaires. Crédit photographique : Wilfried Thomas, Station biologique de Roscoff.

Résultats

Sur les 19 sites pour lesquels l'effort d'échantillonnage a été comparable entre communautés dominée par *L. digitata* ou par *L. hyperborea*, un total de 134 espèces a été récolté (Tableau 1). Les différents indices de diversité des communautés de macroalgues associées à *L. digitata* et à *L. hyperborea* calculés par site sont présentés dans le Tableau 2. A l'échelle du site (Tableau 2) et de la région (Tableau 1) les plus faibles valeurs de diversité (SR ou $1-\lambda$) sont trouvées dans les sites de la région de St Malo et les plus fortes valeurs dans les sites de Bretagne Sud pour les communautés en sous strate de *L. digitata* ou de

L. hyperborea (Tableau 2). Les indices de différenciation par site montrent logiquement une réponse opposés à ceux de diversité : les plus faibles valeurs de différenciation (F_{STC}) sont trouvées dans les sites de Bretagne Sud et les plus fortes valeurs dans les sites de St Malo, et ce à la fois pour les communautés en sous strate de *L. digitata* et celles en sous strate de *L. hyperborea*. Ainsi, les communautés en sous strate de *des deux espèces de laminaires* présentent des réponses similaires entre régions pour ces trois indices. Néanmoins, la variation de ces indices entre sites peut être très forte au sein d'une région (ceci est particulièrement vrai pour SR dans les régions centrales de la baie de Morlaix et de la mer d'Iroise pour les communautés en sous strate de *L. hyperborea*, Tableau 2), et d'autre part, les communautés en sous strate de *L. digitata* et celles en sous strate de *L. hyperborea* présentent des réponses différentes entre régions pour le β_{RC} , avec des fortes valeurs en Bretagne Sud pour les deux communautés et en baie de St Malo pour les communautés en sous strate de *L. hyperborea* seulement. Notons qu'en Bretagne Sud pour *L. digitata* le β_{RC} est égal à 1, ce qui peut correspondre à une des limites de cette méthode expliquée par Chase et al. (2011) : quand deux communautés divergent toutes les deux de l'attendu nul, leur β_{RC} converge vers 1, et ceci est d'autant plus vrai quand les communautés sont riches en espèces, et, dans notre situation, sans doute accentué encore par le faible nombre de sites considérés (2 sites seulement).

La comparaison entre les communautés en sous strate de *L. digitata* et en sous strate de *L. hyperborea* montre que sur l'échantillonnage total, le nombre d'espèces dans la communauté en sous strate de *L. digitata* est plus important que dans la communauté en sous strate de *L. hyperborea* (Tableau 1), alors que c'est la tendance inverse au niveau des sites (Tableau 2). Cette différence peut s'expliquer par une plus forte structuration des communautés en sous strate de *L. digitata* entre sites, ce que montre l'indice de différenciation F_{STC} (Tableau 2). Cette différenciation peut s'expliquer par une plus faible dispersion des espèces et/ou par des filtres déterministes plus stringents dans les communautés en sous strate de *L. digitata*.

Les résultats des PERMANOVAs sont présentés dans le tableau 3 (3a pour SR, 3b pour $1-\lambda$, 2c pour F_{STC} et 2d pour β_{RC}) et confirment la différence significative entre régions pour ces différents indices. Ces analyses confirment également que le même type de réponse est observé pour les deux indices de diversité entre les communautés en sous strate de *L. digitata* et celles en sous strate de *L. hyperborea* (facteur communauté non significatif, Tableau 3a et 3b). En revanche, les indices de différenciations F_{STC} et β_{RC} sont

significativement différents entre ces deux communautés (Tableau 3c et 3b, facteur communauté significatif). Aucune interaction entre les facteurs région et communauté n'est significative.

L'isolement par la distance est marginalement significatif au seuil de 10% pour les communautés en sous strate de *L. digitata*, et significatif au seuil de 5% pour la communauté en sous strate de *L. hyperborea*. Ces résultats montrent que la dispersion se fait de proche en proche pour les espèces composant les deux communautés. Bien que les valeurs soient seulement marginalement significatives pour les espèces associées à *L. digitata* la pente de la droite suggère que la dispersion est plus limitée dans les communautés en sous strate de *L. digitata* que dans celles en sous strate de *L. hyperborea* (Figure 2).

La densité des individus de *L. digitata* et de *L. hyperborea* estimée pour chacun des sites étudiés par une mesure semi-quantitative est donnée dans le Tableau 2. Elle est généralement plus forte pour *L. hyperborea* que pour *L. digitata* et plus faible pour les deux espèces dans les sites de Bretagne Sud. La variation entre sites d'une même région est très élevée quelles que soient les régions et les espèces sauf pour *L. hyperborea* dans la région de St Malo. La figure 3 montre la richesse spécifique tend à diminuer avec la densité de laminaire, cette tendance n'est significative que pour *L. hyperborea*.

Tableau 1. Nombre total d'espèces récoltées sur les 19 sites échantillonnés pour les deux communautés, par communauté (a) et par région (b), en distinguant les espèces spécifiques à chaque communauté et à chaque région. (c) nombre d'espèces par région après une procédure de raréfaction afin de comparer les régions aux efforts d'échantillonnage différents : la raréfaction s'est faite sur deux sites pour *Ld* et trois sites pour *Lh* (moyenne sur l'ensemble des combinaisons de sites possibles au sein d'une région).

a) Nombre d'espèces par communauté

	<i>Ld</i>	<i>Lh</i>	total <i>Ld+Lh</i>
total	107	100	134
spécifiques/communes	34	27	73

b) Nombre d'espèces par région

	Baie de St Malo	Baie de Morlaix	Mer d'Iroise	Bretagne Sud	total Bretagne
total	39	92	80	63	134
spécifiques/communes	5	20	16	9	84

c) Nombre d'espèces par région et par communauté après procédure de raréfaction

	Baie de St Malo	Baie de Morlaix	Mer d'Iroise	Bretagne Sud
<i>Ld</i> (raréfaction sur 2 sites)	20,2	32,2	29,3	48
<i>Lh</i> (raréfaction sur 3 sites)	24,2	42,6	42,5	53

Tableau 2. Indices de diversité des communautés de macroalgues en sous strate de *Laminaria digitata* (*Ld*) et de *Laminaria hyperborea* (*Lh*) par site. Pour la définition des indices, voir encadré 3 du tome 1 de cette thèse. Afin de comparer les sites entre eux, le F_{STC} est calculé avec une procédure de raréfaction telle que dans Evanno et al. (2009). Le β_{RC} est calculé selon Chase et al. (2011), la définition du « pool régional » correspondant au pool d'espèces propre à chaque région. d correspond à l'évaluation semi-quantitative de la densité en laminaires. Les couleurs correspondent à chaque région : en rouge la baie de St Malo, en vert la baie de Morlaix, en bleu la mer d'Iroise et en rose la Bretagne Sud.

Site	<i>Ld</i>					<i>Lh</i>				
	SR	1- λ	F_{STC}	β_{RC}	d	SR	1- λ	F_{STC}	β_{RC}	d
Guimereux	13	0,685	0,258	0,358	1	13	0,768	0,155	-0,098	4
La Bigne	14	0,728	0,170	0,710	2	14	0,749	0,119	0,045	4
Nerput	10	0,722	0,166	0,303	1	11	0,843	0,100	-0,183	4
Le Moulin	12	0,855	0,140	-0,258	2	10	0,791	0,113	0,338	4
Les Amas	12	0,655	0,257	0,703	4	14	0,681	0,178	0,353	3
<i>Moyenne baie de St Malo</i>	12,2	0,729	0,198	0,363	2,0	12,4	0,767	0,145	0,091	3,8
Primel	20	0,873	0,153	0,100	3	16	0,806	0,126	0,058	4
Duons Est	14	0,758	0,196	0,104	2	18	0,900	0,082	-0,212	4
Duons Ouest	19	0,838	0,177	0,280	3	20	0,856	0,121	-0,258	4
Santec 2	23	0,765	0,167	0,350	2	31	0,919	0,080	0,578	3
Santec 1	22	0,875	0,151	0,250	1	26	0,914	0,087	0,608	2
Les Amiettes	20	0,894	0,116	0,408	2	12	0,857	0,090	-0,242	4
<i>Moyenne baie de Morlaix</i>	19,7	0,834	0,160	0,249	2,2	20,5	0,876	0,098	0,089	3,5
Les Linious	13	0,798	0,192	0,098	4	10	0,825	0,121	-0,292	4
Men Vriant	20	0,731	0,202	0,194	2	25	0,821	0,118	0,266	1
Klosenn Malaga	22	0,901	0,141	0,480	2	26	0,906	0,095	0,196	1
Les Rospects	16	0,882	0,134	-0,202	2	22	0,903	0,091	0,426	4
St Mathieu	20	0,897	0,130	0,046	1	20	0,906	0,088	0,472	4
Pointe du grand Gouin	20	0,760	0,188	0,136	4	27	0,901	0,086	0,500	4
<i>Moyenne mer d'Iroise</i>	18,5	0,828	0,165	0,125	2,5	21,7	0,877	0,100	0,261	3,0
Houat 2	31	0,922	0,130	1,000	2	33	0,914	0,078	0,615	1
Houat 1	35	0,924	0,145	1,000	1	32	0,930	0,083	0,720	1
Hoedic	NA	NA	NA	NA	NA	23	0,857	0,097	0,395	3
<i>Moyenne Bretagne Sud</i>	33,0	0,923	0,137	1,000	1,5	29,3	0,900	0,086	0,577	1,7
Moyenne globale	18,7	0,814	0,169	0,319	2,2	20,2	0,852	0,105	0,214	3,2
Ecart-type	6,4	0,086	0,040	0,345	0,9	7,5	0,067	0,026	0,336	1,1
Erreur standard	1,5	0,020	0,009	0,079	0,2	1,7	0,015	0,006	0,075	0,3

Le F_{STC} est calculé sur des échantillons raréfiés à 59 individus pour *Ld* et 80 pour *Lh*. Pour le calcul du β_{RC} , la définition du « pool régional » varie selon chacune des régions et correspond à l'ensemble des espèces détectées dans la région. Le site Hoedic n'est pas renseigné pour *Ld* car un seul quadrat a pu être échantillonné (au lieu de trois pour les autres sites).

Tableau 3. Résultats des PERMANOVAs (permutational analysis of variance) testant les effets “région” et “communauté” (*i.e.* en sous-strate de *Laminaria digitata* ou de *Laminaria hyperborea*) sur (a) SR, (b) $1-\lambda$, (c) F_{STC} et (d) β_{RC} des 39 sites échantillonnés. df, degrés de liberté; SS, somme des carrés; Pseudo-F, la statistique Pseudo-F; et $P(\text{perm})$, la probabilité calculée par permutations (les valeurs significatives au seuil de 5% sont en rouge et au seuil de 10% en orange).

(a) Effets des facteurs “région” et “communauté” sur SR

Source de variation	Df	SS	Pseudo-F	$P(\text{perm})$
Région	3	6721	16.1	< 0.001
Communauté	1	3.913	2.81×10^{-2}	0.953
Région*Communauté	3	179.5	0.430	0.767
Résidus	31	4317		
Total	38	1.123×10^4		

(b) Effets des facteurs “région” et “communauté” sur $1-\lambda$

Source de variation	Df	SS	Pseudo-F	$P(\text{perm})$
Région	3	431.2	11.1	< 0.001
Communauté	1	24.01	1.86	0.186
Région*Communauté	3	17.16	0.442	0.720
Résidus	31	400.8		
Total	38	894.1		

(c) Effets des facteurs “région” et “communauté” sur F_{STC}

Source de variation	Df	SS	Pseudo-F	$P(\text{perm})$
Région	3	1214	4.16	0.009
Communauté	1	4009	41.2	< 0.001
Région*Communauté	3	182.2	0.624	0.649
Résidus	31	3017		
Total	38	9301		

(d) Effets des facteurs “région” et “communauté” sur β_{RC}

Source de variation	Df	SS	Pseudo-F	$P(\text{perm})$
Région	3	1.502	6.16	0.002
Communauté	1	0.2725	3.36	0.078
Région*Communauté	3	0.3688	1.51	0.227
Résidus	31	2.516		
Total	38	4.393		

Annexe 2

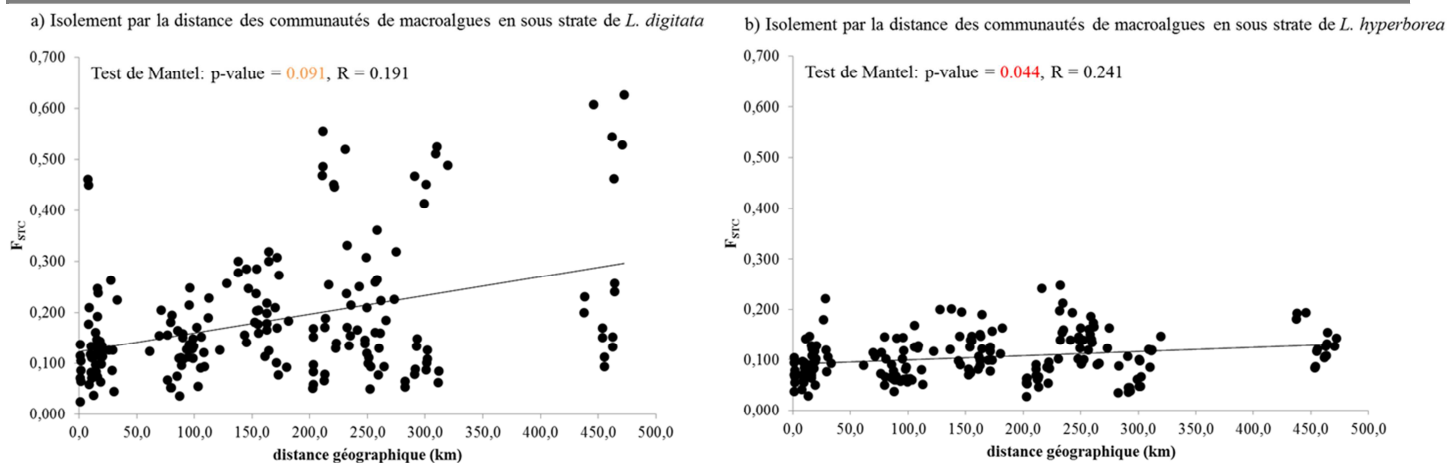


Figure 2. Test de l'isolement par la distance sur les communautés de macroalgues (a) en sous-strate de *Laminaria digitata* et (b) en sous-strate de *Laminaria hyperborea*.

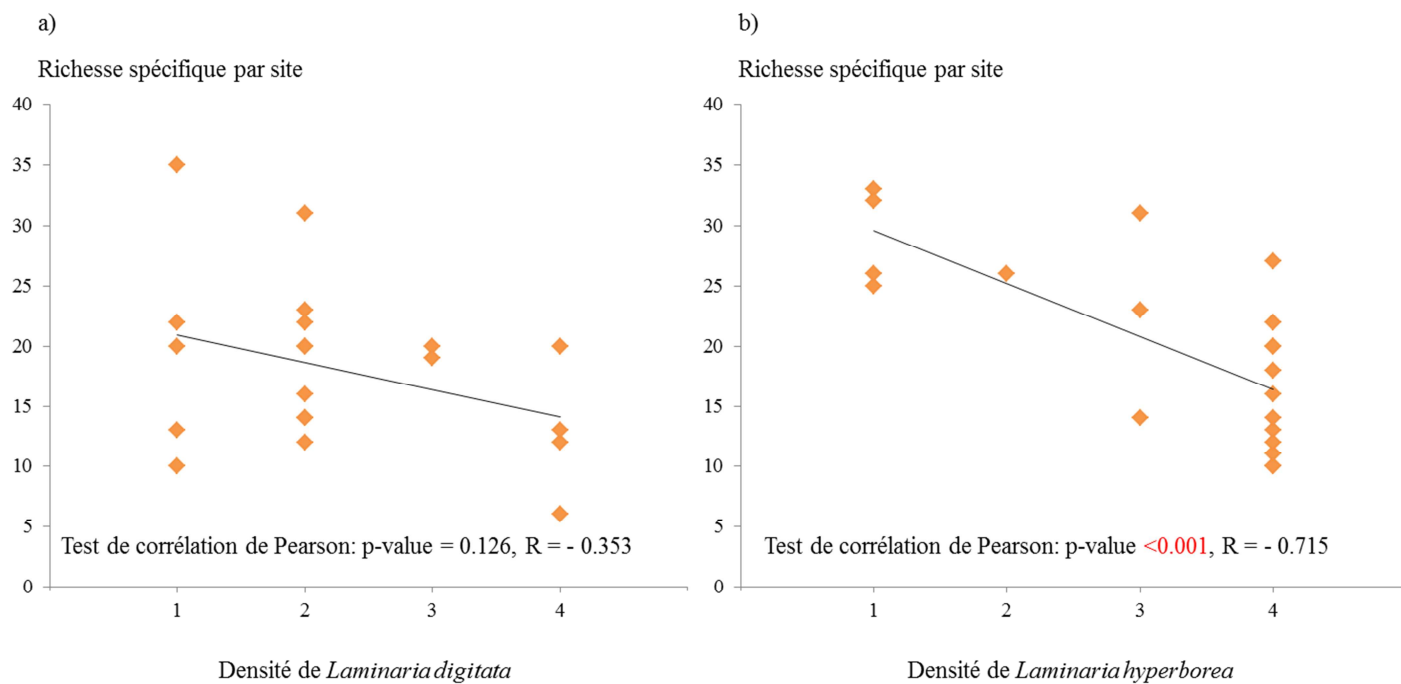


Figure 3. Relation entre la richesse spécifique par site et une mesure semi quantitative de la densité de la laminaire dominante dans les communautés (a) en sous-strate de *Laminaria digitata* et (b) en sous-strate de *Laminaria hyperborea*.

Interprétations préliminaires

- Comparaison entre diversité échantillonnée totale et diversité échantillonnée par site. Alors que l'échantillonnage total montre que le nombre d'espèces est plus important dans les communautés en sous strate de *Ld* que dans les communautés en sous strate de *Lh* (Tableau 1a), l'échantillonnage par site montre la tendance inverse (Tableau 2). Ce patron peut s'expliquer de manière non exclusive par le fait que la dispersion est plus limitée pour les communautés en sous strate de *Ld* que pour celles en sous strate de *Lh* (Figure 2) et que les filtres déterministes sont plus drastiques dans les communautés en sous strate de *Ld* que dans les communautés en sous strate de *Lh*. Kain (1979) suggère que l'action abrasive de la lame de *Ld* pourrait empêcher certaines espèces de s'installer sous sa canopée. D'autre part, alors que l'échantillonnage total montre un plus fort nombre d'espèces en baie de Morlaix par rapport aux autres régions (Tableau 1b), c'est la Bretagne Sud qui montre le plus fort nombre d'espèces par site (Tableau 2). Cette différence de réponse s'efface après une procédure de raréfaction sur l'échantillonnage total. En effet, sur un effort d'échantillonnage de deux sites, la Bretagne Sud devient la région qui présente le plus grand nombre d'espèces (Tableau 1c). Pour toutes les régions, il y a un nombre considérable d'espèces qui apparaissent spécifiques à cette région (Tableau 1b). Ce résultat, si on considère que l'échantillonnage est suffisamment représentatif de la diversité des espèces au sein des régions souligne le fait que toutes les espèces ne peuvent pas visiter toutes les régions et donc, que les processus historiques ayant mené à la diversification des espèces dans chaque région doivent être pris en compte pour expliquer la structure des communautés à l'échelle de la Bretagne.
- Comparaison du niveau site entre régions. Toutes les mesures de diversité mesurées au niveau des sites varient significativement entre régions (Tableaux 2 et 3). La diversité spécifique par site est la plus forte en Bretagne Sud et la moins forte en baie de St Malo. Les communautés sont plus structurées en baie de St Malo que dans les autres régions. Les communautés sont en moyenne plus différentes entre elles que sous l'hypothèse de complète stochasticité mais l'importance relative des processus déterministes dans l'assemblage des communautés est plus élevée en Bretagne Sud (pour les deux communautés) et en baie de St Malo (pour les communautés en sous-strate de *Ld*), régions aux amplitudes thermiques annuelles les plus fortes (voir article 1) que dans les autres régions. Cet éloignement du modèle nul pourrait s'expliquer de

manière non exclusive par une dispersion limitée, une influence des filtres environnementaux ou des interactions biotiques ; nos résultats montrent que la dispersion est effectivement limitée (Figure 2) et la relation négative entre richesse spécifique et densité en laminaires (Figure 3) suggère l'existence d'une compétition entre la laminaire dominante et les macroalgues en sous strate (*e.g.* compétition pour la lumière, action abrasive de la lame).

- Comparaison entre communautés. La diversité spécifique n'est pas significativement différente entre les communautés en sous strate de *Ld* et celles en sous strate de *Lh* (Tableaux 2, 3a, 3b). En revanche, les communautés en sous strate de *Ld* sont significativement plus structurées que celles en sous strate de *Lh* (Tableaux 2 et 3c) et l'importance relative des processus déterministes dans l'assemblage des communautés est également significativement plus élevée dans les communautés en sous strate de *Ld* (*i.e.* dans un milieu en limite de l'intertidal considéré comme plus stressant que le subtidal, Helmuth & Hofmann 2001) que dans celles en sous strate de *Lh* (Tableaux 2 et 3d). La dispersion est limitée pour les deux communautés d'espèces, mais peut-être plus fortement pour celles en sous strate de *Ld* que celles en sous strate de *Lh* (Figure 2). La richesse spécifique par site décroît avec la densité en laminaires pour les deux communautés (Figure 3).
- Conclusions. Nos résultats suggèrent qu'à l'échelle de la Bretagne, toutes les communautés ne sont pas connectées et que l'explication de la coexistence des espèces à cette échelle nécessite de tenir compte des processus historiques ayant mené à la diversification des espèces dans chaque région, intégrant à la fois la dynamique des métacommunautés et celle de la biogéographie, comme cela a été fait par Leibold et al. (2010). Cependant, la comparaison des communautés au sein des régions menée dans notre étude révèle que l'importance relative des processus déterministes dans l'assemblage des communautés varie, comme attendu, selon les conditions environnementales considérées. Nos résultats sont en accord avec l'hypothèse selon laquelle l'importance relative des processus déterministes est plus forte dans les milieux plus perturbés que dans les milieux moins perturbés (Chase 2007 ; Chase et al. 2009), que ce soit en comparant les quatre régions ou les deux communautés. Finalement, nos résultats montrent que la structure est plus forte et la dispersion plus limitée dans les communautés en sous-strate de *Ld* que dans celles en sous-strate de

Lh, de la même manière que la structure génétique est plus forte et la dispersion plus limitée dans les populations de *Ld* que dans les populations de *Lh* (article 4).

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**ANNEXE 3. STRUCTURE SPATIALE DES PATRONS DE SGDC (“SPECIES-
GENETIC DIVERSITY CORRELATION”) : L’EXEMPLE DES FORETS DE
LAMINAIRES DES COTES BRETONNES**

NB : Pour des raisons de clarté de lecture, certaines explications sont dupliquées entre cette annexe et le chapitre III.2.

Contexte et objectifs

La diversité spécifique au sein des communautés et la diversité génétique au sein de populations sont toutes les deux façonnées par un même set de processus : migration, dérive, sélection et spéciation/mutation (revu par Vellend 2010). Si ces processus agissent dans le même sens et aux mêmes échelles de temps et d'espace sur les deux niveaux de diversité, alors cela devrait résulter en des patrons positivement corrélés de diversité spécifique et de diversité génétique. Plusieurs études ont en effet révélé des SGDCs positives (*e.g.* Vellend 2004; Cleary et al. 2006; He et al. 2008; Robinson et al. 2010 ; Lamy et al. 2013) ; cependant, un petit nombre d'études ont montré qu'il existait une corrélation négative entre les deux niveaux de diversité (Johnson 1973; Karlin et al. 1984) ou une absence de corrélation (Taberlet et al. 2012). Cette diversité de réponses suggère que les patrons de SGDC (et les mécanismes qui la sous-tendent) varient dans l'espace (conditions environnementales contrastées, échelle spatiale considérée) et/ou selon le système biologique étudié. Une revue des effets attendus de la dérive, de l'immigration et de la sélection sur les deux niveaux de biodiversité génétique et spécifique (inspirée notamment des travaux de Vellend & Geber (2005), Taberlet et al. (2012) et Lamy et al. (2013) et présentée en détail dans le chapitre III.2) permet en effet de formuler les trois attendus théoriques suivants :

- une SGDC sur un ensemble de communautés a plus des chances d'émerger si les communautés étudiées varient par leur taille et/ou leur degré de connectivité et/ou les caractéristiques environnementales de leur habitat ;
- une SGDC positive a plus de chance d'émerger si les processus neutres de dérive et d'immigration dominant tandis que la sélection (en interaction avec l'immigration et/ou sous la forme d'une compétition pour l'espace et/ou via des filtres environnementaux spécifiques) peut éroder une SGDC voire entraîner une SGDC négative ;
- dans le cas où la sélection agit via des filtres environnementaux, une SGDC positive est attendue si l'espèce pour laquelle la diversité génétique est étudiée (l'espèce cible) répond de la même façon que les autres espèces de la communauté tandis qu'une SGDC négative est attendue si l'espèce cible répond de manière opposée au reste de la

communauté (et pas de SGDC si les espèces de la communauté répondent de manière différentes aux filtres environnementaux).

Ces trois attendus théoriques à eux seuls peuvent permettre d'expliquer la diversité des patrons de SGDC dans le cadre d'une étude de communautés locales connectées au sein d'une région, ce qui constitue la plupart des études empiriques existantes. En effet, parmi ces études, les auteurs expliquent les SGDCs positives observées par une influence parallèle sur les deux niveaux de biodiversité soit de la taille des patches d'habitat (et donc la dérive) et/ou de la connectivité entre les patches d'habitat (et donc de l'immigration ; *e.g.* Vellend 2004 ; Lamy et al. 2013) soit des filtres environnementaux qui agissent de la même façon pour toutes les espèces de la communauté étudiée (*e.g.* He et al. 2008). Les SGDCs négatives sont quant à elles justifiées par une action différentielle de la sélection sur l'espèce cible par rapport aux autres espèces de la communauté (*e.g.* Karlin et al. 1984). Cependant, à plus grande échelle spatiale, les processus historiques tels que l'effet des glaciations sur la structure et la diversité génétique des populations (Hewitt 2000) ou, de manière plus générale, l'effet du climat sur la répartition biogéographique des espèces, se rajoutent aux dynamiques contemporaines et peuvent expliquer une absence de SGDC (Taberlet et al. 2012). Il est difficile d'évaluer à quel point ces situations sont fréquentes en conditions naturelles car, à notre connaissance, peu de travaux ont étudié des patrons de SGDC à plusieurs échelles spatiales simultanément.

Les objectifs de cette étude sont d'évaluer comment les patrons de diversité spécifique et de diversité génétique co-varient selon l'échelle spatiale, les conditions environnementales et le système biologique considérés en étudiant ces patrons dans les communautés de macroalgues des forêts de laminaires des côtes bretonnes i) globalement sur l'ensemble des sites échantillonnés *versus* au sein de chaque région, ii) entre quatre régions aux caractéristiques environnementales contrastées (voir article 3), iii) entre des systèmes biologiques qui diffèrent par leur niveau bathymétrique et l'espèce de laminaire dominante. En particulier, les attendus théoriques précisés dans le paragraphe précédent nous permettent d'émettre les trois hypothèses spécifiques à notre modèle d'étude suivantes :

- hypothèse 1 : on s'attend à observer une SGDC globale positive car on compare des sites localisés dans des régions présentant d'une part des degrés de connectivité entre populations de laminaires et entre communautés de macroalgues différents et d'autre part des conditions abiotiques différentes. Etant donné que la connectivité des communautés de macroalgues (les deux espèces de laminaires cibles incluses) sont

plus connectées (voir article 4 et annexe 2) et les variations de température plus tamponnées dans les régions de la baie de Morlaix et de la mer d'Iroise par rapport à la baie de St Malo (voir article 3), une corrélation positive est donc attendue entre tous les indices de diversité ou différenciation entre les niveaux de diversité intraspécifique et interspécifique sur l'ensemble des sites de la Bretagne. *A contrario*, la présence d'une SGDC intra région est moins probable étant donné que la connectivité et les conditions environnementales varient moins au sein qu'entre les régions.

- hypothèse 2 : le degré de connectivité (entre populations et entre communautés) et les conditions abiotiques étant plus variables au sein de la baie de St Malo qu'en baie de Morlaix et qu'en mer d'Iroise, on s'attend plutôt à observer des patrons de SGDC intra région en baie de St Malo qu'en baie de Morlaix ou qu'en mer d'Iroise où la connectivité est grande et les conditions abiotiques tamponnées.
- hypothèse 3 : le milieu de vie des communautés dominées par *L. digitata* étant plus perturbé que celui des communautés dominées par *L. hyperborea*, et, si l'on suit les hypothèses de Chase et al. (2007 ; 2009 ; 2011), les processus déterministes étant relativement plus importants dans les milieux perturbés par rapport aux milieux non perturbés où les processus stochastiques dominent, l'importance relative des processus déterministes serait plus importante dans les communautés dominées par *L. digitata* que dans les communautés dominées par *L. hyperborea* (annexe 2), et donc les patrons de SGDC devraient émerger plus dans les communautés dominées par *L. hyperborea* que dans celles dominées par *L. digitata*. De plus, en Bretagne Sud et en baie de St Malo, les populations de *L. digitata* sont marginales (en limite d'aire de distribution méridionale en Bretagne Sud / marginales par rapport à la fragmentation du substrat rocheux en baie de St Malo, voir article 4) et sont probablement mal adaptées aux températures plus chaudes de ces régions (*e.g.* qui pourraient limiter leur reproduction, Bartsch et al. 2013 ; article 5), ce qui n'est pas forcément le cas des autres espèces de macroalgues. Dans ces régions, et quand la diversité génétique est mesurée chez *L. digitata*, on se place alors dans la situation où l'espèce cible répond différemment des autres espèces de la communauté, et donc on s'attend à observer soit une SGDC négative, soit pas de SGDC.

Matériel et méthodes

- Echantillonnage. Même plan d'échantillonnage hiérarchique que celui décrit dans l'article 4 de cette thèse ; à chaque site, échantillonnage des communautés de macroalgues pour la diversité spécifique (voir annexe 2) et des individus de la laminaire dominante pour la diversité génétique (voir article 4 de cette thèse) au niveau de la ceinture de *Laminaria digitata* (*Ld*, limite intertidal/subtidal, généralement entre + 1 et - 1 m) et au niveau de la ceinture de *Laminaria hyperborea* (*Lh*, milieu subtidal, généralement entre -1 et - 30 m).
- Détermination de la diversité spécifique. Voir annexe 2.
- Détermination de la diversité génétique. Voir article 4.
- Analyses des données. Des tests de corrélation de Pearson ont été réalisés sous R (R Development Core Team 2005) pour tester les corrélations entre i) indices de richesse spécifique (SR) et génétique (AR) ; ii) entre indices de diversité spécifique ($1 - \lambda$) et génétique (H_e) et iii) indices de différenciation entre communautés (F_{STC}) et entre populations (F_{ST}). *NB : le test de corrélation de Pearson n'est probablement pas le mieux adapté pour tester la corrélation entre F_{STC} et F_{ST} étant donné que ces deux variables dépendent toutes les deux de la distance ; une méthode alternative serait d'utiliser un test de corrélation partielle en utilisant la distance comme co-variable mais les analyses n'ont pas encore été menées (elles le seront prochainement).*

Résultats

- Vérification de l'hypothèse 1. est-ce que les patrons de SGDC sont plus fréquents à l'échelle globale qu'à l'échelle intra région ?

La réponse dépend de la communauté considérée. Pour les communautés dominées par *L. hyperborea*, la corrélation entre diversité génétique et spécifique sur l'ensemble des sites est significative et positive pour tous les indices. En revanche, pour les communautés dominées par *L. digitata*, seule la corrélation entre $1 - \lambda$ et H_e est significative et positive quand on considère tous les sites ; cependant, si on exclut les sites de la Bretagne Sud, la SGDC devient positive et significative pour tous les indices. Cette différence de réponse peut être liée au fait que les populations de *L.*

digitata en Bretagne Sud sont en limite d'aire de distribution et présentent une faible diversité génétique (articles 4, 5 et 6) alors que ce n'est pas forcément le cas des autres algues de la communauté : l'absence de SGDC serait donc dû au fait que l'espèce cible ne répond pas de la même façon que les autres espèces de la communauté (ou qu'il y a des réponses variées des espèces de la communauté) aux filtres environnementaux (voir aussi réponse à l'hypothèse 3).

- Vérification de l'hypothèse 2. Les patrons de SGDCs sont-ils plus présents en baie de St Malo qu'en baie de Morlaix et mer d'Iroise ?

Oui car la seule région présentant une SGDC significative intra région est la baie de St Malo (Tableau 1). Cependant, ce n'est significatif que pour les indices de richesse dans la communauté dominée par *L. hyperborea*. Le fait qu'il n'y ait pas de SGDC en baie de St Malo dans la communauté dominée par *L. digitata* est difficilement interprétable pour l'instant (possiblement lié à l'altération du succès reproducteur de *L. digitata* dans cette région aux fortes amplitudes thermiques, voir article 5). Le fait qu'il n'y ait pas de SGDC en considérant les indices de fréquence dans *L. hyperborea* peut s'expliquer par la relative insensibilité des indices de fréquence aux variations de taille des communautés par rapport aux indices de richesse. C'est le principe de détection des bottlenecks en génétique des populations (Luikart & Cornuet 1998), mais qui peut tout à fait s'appliquer aux communautés : en effet, lors d'une réduction de la taille des populations (respectivement des communautés), les allèles (respectivement les espèces) rares ont plus de chances d'être perdus que les communs, ce qui fait baisser de façon importante la richesse allélique (respectivement spécifique) mais impacte peu l'hétérozygotie attendue (respectivement la diversité de Simpson). Le fait qu'il n'y ait pas de SGDC en considérant les indices de structure dans les communautés dominées par *L. hyperborea*, malgré le fait que les indices de structure soient plus élevés aux deux niveaux génétique et spécifique par rapport à ceux des autres régions pourrait s'expliquer par le fait que le turnover de la diversité spécifique se fait à plus petite échelle spatiale que celui de la diversité génétique (voir chapitre III.1).

- Vérification de l'hypothèse 2 : les patrons de SGDC sont-ils plus fréquents dans les communautés dominées par *L. hyperborea* que dans celles dominées par *L. digitata* ?

Oui car sur les corrélations réalisées globalement sans exclure de sites et en intra région, nous avons mis en évidence 4 SGDC positives et 1 SGDC positive pour les communautés dominées par *L. digitata*. Cependant, nous n'avons pas pu tester le patron de SGDC en Bretagne Sud pour la communauté dominée par *L. digitata*, car seuls deux sites ont été échantillonnés pour les communautés dominées par *L. digitata* dans cette région. Toutefois, la Figure 2 montre qu'en Bretagne Sud, la diversité génétique de *L. digitata* est réduite par rapport aux régions de la baie de Morlaix et de la mer d'Iroise tandis que la diversité spécifique est augmentée par rapport à ces mêmes régions, ce qui conforte notre hypothèse selon laquelle *L. digitata* ne réagit pas aux filtres environnementaux de la même façon que les autres espèces de la communauté. Ce résultat est probablement dû au fait que, contrairement à la plupart des autres espèces de la communauté, *L. digitata* est en limite d'aire de distribution sud en Bretagne Sud, et donc elle n'est pas à son optimum de température, ce qui a notamment des conséquences à la fois directes sur la taille de ses populations et sur ses capacités de reproduction (Bartsch et al. 2013 ; article 5) et par conséquent sur sa diversité génétique.

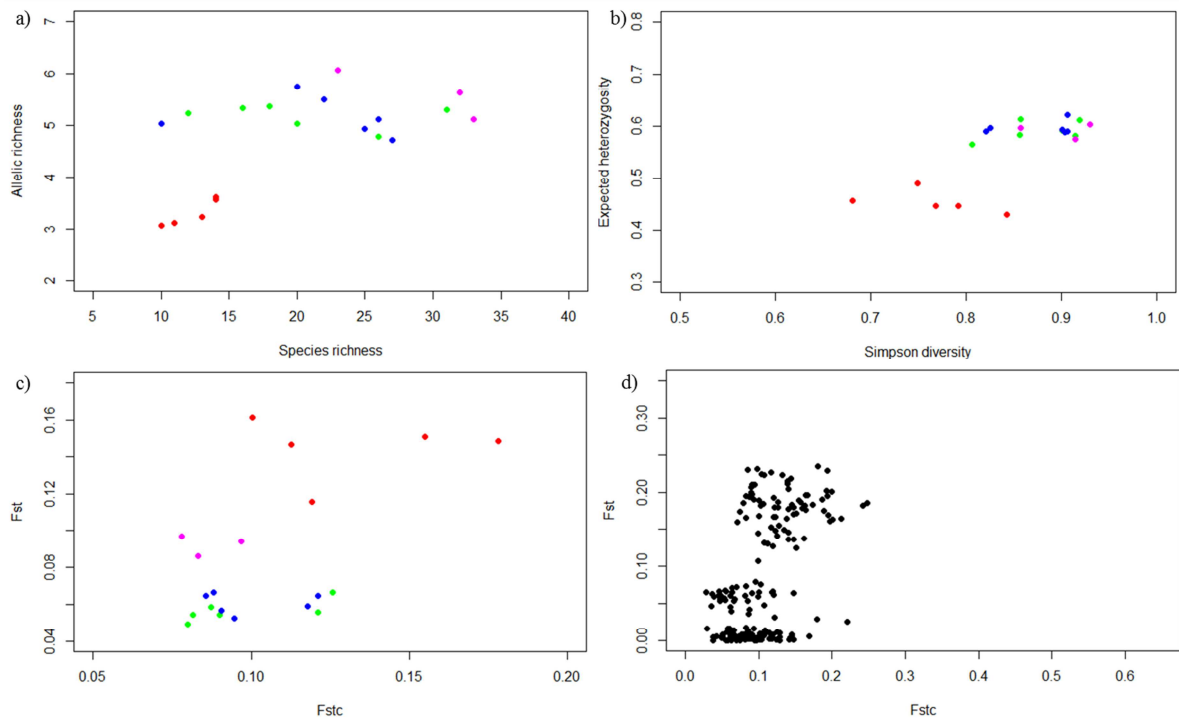


Figure 1. Co-variation de la diversité spécifique des communautés de macroalgues (axe des abscisses) et de la diversité génétique de *Laminaria hyperborea* (axe des ordonnées) dans les communautés dominées par *Laminaria hyperborea*. Les différents indices utilisés sont définis dans l'encadré 3 du tome 1 de cette thèse. (a) Richesse allélique en fonction de la richesse spécifique par site, (b) Hétérozygotie attendue en fonction de la diversité de Simpson par site, (c) Structure génétique en fonction de la structure des communautés (moyennes par site), (d) Structure génétique en fonction de la structure des communautés (valeurs pour chaque couple de sites). Les couleurs représentent les 4 régions : baie de St Malo en rouge, baie de Morlaix en vert, mer d'Iroise en bleu et Bretagne Sud en rose.

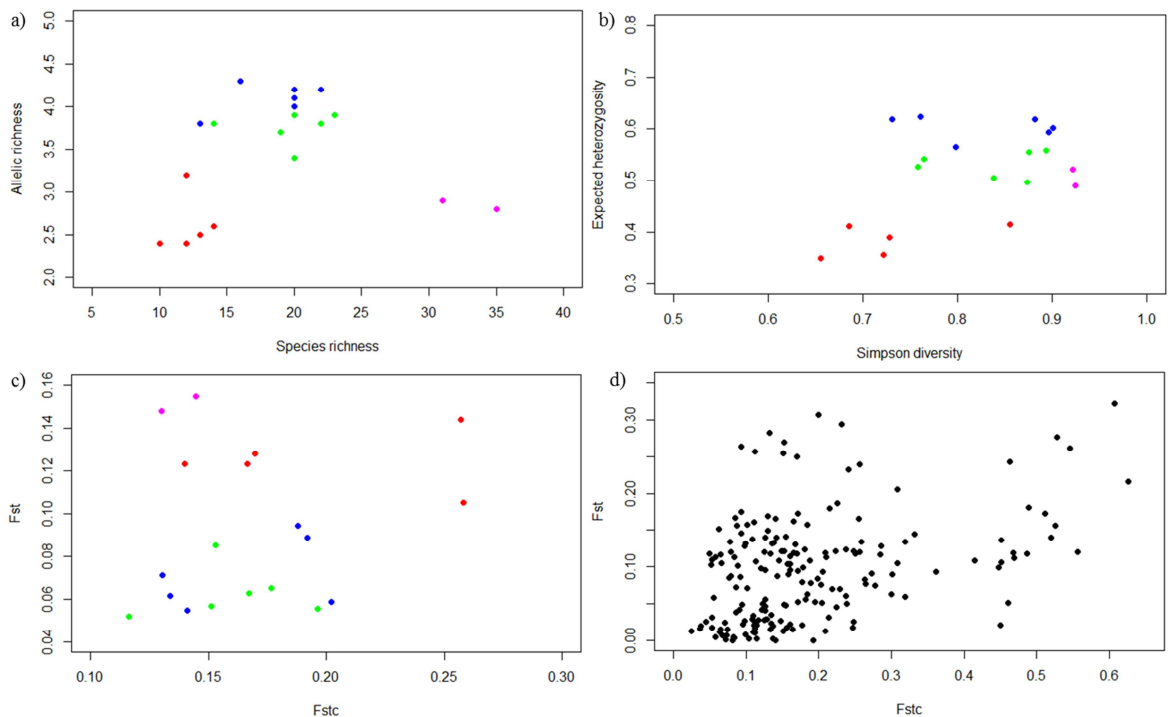


Figure 2. Co-variation de la diversité spécifique des communautés de macroalgues (axe des abscisses) et de la diversité génétique de *Laminaria digitata* (axe des ordonnées) dans les communautés dominées par *Laminaria digitata*. Les différents indices utilisés sont définis dans l'encadré 3 du tome 1 de cette thèse. (a) Richesse allélique en fonction de la richesse spécifique par site, (b) Hétérozygotie attendue en fonction de la diversité de Simpson par site, (c) Structure génétique en fonction de la structure des communautés (moyennes par site), (d) Structure génétique en fonction de la structure des communautés (valeurs pour chaque couple de sites). Les couleurs représentent les 4 régions : baie de St Malo en rouge, baie de Morlaix en vert, mer d'Iroise en bleu et Bretagne Sud en rose.

Tableau 1. Matrice des probabilités critiques (p-value) et coefficients de corrélation (R) associés au test de corrélation de Pearson entre indices équivalents de diversité spécifique (de la communauté de macroalgues) et de diversité génétique (de la laminaire dominante) par site, dans les communautés dominées par *Laminaria digitata* (*Ld*) d'une part et *Laminaria hyperborea* (*Lh*) d'autre part. Pour la définition des indices, voir encadré 3 du tome 1 de cette thèse. Le nombre entre parenthèses correspond au nombre de sites pris en compte pour le test de corrélation. En rouge sont représentées les SGDCs (« species-genetic diversity correlations ») positives significatives au seuil de 5% et en orange au seuil de 10% ; en bleu sont représentées les corrélations négatives significatives au seuil de 5%.

Test de corrélation entre:	SR et AR		1- λ et He		F _{STC} et F _{ST} *	
	p-value	R	p-value	R	p-value	R
Global <i>Lh</i>						
<i>Lh</i> tous sites (20)	0,009	0,571	< 0,001	0,726	0,012	0,549
<i>Lh</i> tous sites excepté ceux de la baie de St Malo (15)	0,917	-0,030	0,284	0,296	0,550	-0,168
Global <i>Ld</i>						
<i>Ld</i> tous sites (19)	0,504	0,163	0,035	0,486	0,467	0,181
<i>Ld</i> tous sites exceptés ceux de la baie de St Malo (14)	0,003	-0,727	0,311	-0,292	0,574	-0,165
<i>Ld</i> tous sites exceptés ceux de la Bretagne Sud (17)	0,001	0,721	0,019	0,560	0,072	0,571
<i>Ld</i> tous sites exceptés ceux de la baie de St Malo et ceux de la Bretagne Sud (12)	0,839	0,066	0,816	-0,075	0,293	0,331
Intra-région <i>Lh</i>						
<i>Lh</i> baie de St Malo (5)	0,047	0,883	0,343	-0,544	0,913	0,068
<i>Lh</i> baie de Morlaix (6)	0,623	-0,257	0,308	0,504	0,107	0,720
<i>Lh</i> mer d'Iroise (6)	0,693	-0,208	0,678	0,218	0,998	0,001
<i>Lh</i> Bretagne Sud (3)	0,275	-0,908	0,955	-0,071	1,000	< - 0,001
Intra-région <i>Ld</i>[#]						
<i>Ld</i> baie de St Malo (5)	0,821	0,141	0,305	0,580	0,993	0,006
<i>Ld</i> baie de Morlaix (6)	0,847	0,102	0,858	0,095	0,880	0,080
<i>Ld</i> mer d'Iroise (6)	0,309	0,503	0,669	-0,225	0,348	0,469

* valeurs moyennes par site ; [#] pas de test intra Bretagne Sud car seulement deux sites

Interprétations préliminaires

Nos résultats corroborent presque toutes les hypothèses émises. Quels que soient les indices retenus, les comparaisons entre sites montrent une SGDC positive et significative pour les communautés dominées par *L. hyperborea* et pour les communautés dominées par *L. digitata* (dans le cas où on exclue les sites de la région particulière de la Bretagne Sud pour *L. digitata*, qui correspond à la limite d'aire de distribution de cette espèce). Ces corrélations positives sont essentiellement dues aux plus faibles valeurs de diversité et plus fortes valeurs de différenciation des communautés et des populations des deux espèces laminaires de la région de St Malo par rapport aux autres régions. En effet, lorsque l'on retire les sites des St Malo de l'analyse, toutes les corrélations ne sont plus significatives. Ceci peut s'expliquer par le fait que le degré de connectivité et les variations de température sont plus contrastées en baie de St Malo que dans les autres régions (en particulier : baie de Morlaix et mer d'Iroise) formant un large continuum rocheux aux températures relativement froides et qui varient peu. De plus, les SGDC positives sont plus fréquentes dans les communautés dominées par *L. hyperborea* que dans celles dominées par *L. digitata*, en accord avec l'hypothèse selon laquelle les processus déterministes, vraisemblablement plus importants dans les

communautés dominées par *L. digitata* (au moins en baie de St Malo et en Bretagne Sud comme en témoigne l'altération de leur reproduction, voir article 5 ; également en accord avec l'hypothèse selon laquelle l'importance relative de processus déterministes est plus grande dans les milieux perturbés, ici le milieu intertidal), érodent les patrons de SGDC. D'autre part, bien que nous n'ayons pas pu tester la présence d'une SGDC au sein de la région Bretagne Sud pour *L. digitata*, nos résultats suggèrent que *L. digitata* ne répond pas de la même façon que les autres espèces de la communauté aux filtres environnementaux. Ceci est en accord avec les résultats obtenus, par ailleurs, sur les anomalies de la reproduction des sporophytes de *L. digitata*, à des températures supérieures à 25°C, qui peuvent être observées en été au moment de la reproduction des sporophytes dans cette région de Bretagne Sud (article 5). Un échantillonnage plus important devrait permettre de tester si l'on observe une SGDC négative (si les autres espèces de la communauté répondent de manière opposée à l'espèce cible aux filtres environnementaux) ou pas de SGDC (si les réponses sont contrastées entre espèces de la communauté) en Bretagne Sud en prenant *L. digitata* comme espèce cible.

Pris dans leur ensemble, nos résultats suggèrent que la présence d'une SGDC positive varie selon le système biologique et/ou l'importance relative des processus stochastiques et déterministes sur les deux niveaux de diversité, le comportement du système biologique et l'importance relative des processus stochastiques et déterministes pouvant eux-mêmes varier avec la latitude et la profondeur. Il est important de rappeler à ce stade que, bien que nos données suggèrent que la structure des communautés se rapproche plus d'une structure attendue sous hypothèse de complète stochasticité (avec dispersion illimitée à partir du pool régional d'espèces) dans les communautés en sous strate de *L. hyperborea* par rapport aux communautés en sous strate de *L. digitata* (annexe 2), nos données ne permettent pas d'attribuer cette différence à un phénomène de dispersion limitée ou à une action de filtres déterministes. En d'autres termes, nos données ne permettent pas de montrer qu'il y a plus de sélection dans les communautés en sous strate de *L. digitata* par rapport aux communautés en sous strate de *L. hyperborea*. Cependant, trois arguments laissent à penser que l'importance relative des processus déterministes serait plus grande dans les communautés dominées par *L. digitata* que dans les communautés dominées par *L. hyperborea*. Tout d'abord, les études de Chase et al. (2007, 2009, 2011) suggèrent que l'importance relative des processus déterministes est plus grande dans les milieux perturbés par rapport aux milieux non perturbés, et le milieu intertidal peut être considéré comme plus perturbé que le milieu subtidal. De plus, nos résultats montrent que la richesse spécifique est localement réduite dans

les communautés en sous strate de *L. digitata* par rapport à la sous strate de *L. hyperborea* en accord avec l'hypothèse de Kain (1979) selon laquelle l'action abrasive de la lame de *L. digitata* sur le substrat rocheux va réduire la possibilité d'installation d'espèces sous sa canopée. Enfin, nos données montrant une faible diversité génétique combinée à l'altération de la reproduction dans les populations de *L. digitata* en Bretagne Sud et en baie de St Malo (article 5) suggèrent que la sélection agit sur les populations *L. digitata* au moins dans ces deux régions. Ces trois arguments constituent un faisceau d'indices qui suggère que l'influence relative des processus déterministes est plus importante dans les communautés dominées par *L. digitata* que dans les communautés dominées par *L. hyperborea*.

Ainsi, dans les systèmes biologiques où les processus stochastiques dominent, il y a de fortes chances d'observer une SGDC, en accord avec l'hypothèse émise par Etienne & Olf (2004) selon laquelle toute corrélation positive entre diversité génétique neutre et diversité spécifique peut être interprétée comme une preuve de la prévalence de processus neutres, et celle de Vellend & Geber (2005) selon laquelle l'action parallèle de processus neutres sur les deux niveaux de diversité génétique et spécifique constitue l'explication la plus parcimonieuse à une corrélation positive entre diversité génétique neutre et diversité spécifique. Cependant, nos résultats montrent également qu'étudier les patrons de SGDC dans une zone qui couvre une latitude suffisante pour observer l'effet du gradient latitudinal sur la diversité génétique des espèces peut expliquer pourquoi diversité génétique et diversité spécifique ne sont pas forcément corrélées. D'autres études empiriques et théoriques sur les patrons de co-variation entre diversité génétique et diversité spécifique à large échelle spatiale sont nécessaires afin de mieux intégrer l'étude de la biodiversité à ses deux niveaux intra et inter spécifiques dans un continuum d'échelles spatiales alliant dynamique des métacommunautés (et des métapopulations) et dynamique biogéographique.

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**ANNEXE 4. COMPILATION DES DONNEES SUR LES ESPECES DE
MACROALGUES RECOLTEES DURANT LA THESE**

Annexe 4

1	A	B	C	D	E	F	G	H	I	J	K	L
spécimen	couleur	famille	espèce morpho	région	échantillonnage	ceinture	quadrat/vue	nb individus/biomasse	espèce COI	espèce LSU	espèce tuFA	
2	MAR1337	rouge	Gigartineae	<i>Chondrus crispus</i>	BDM	Amiettes hiver 2011	Ld	Q1	20		<i>Chondrus crispus</i>	
3	MAR1338	rouge	Cystocloniaceae	<i>Calliblepharis jubata</i>	BDM	Amiettes hiver 2011	Ld	Q1	17		<i>Calliblepharis jubata</i>	
4	MAR1339	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	BDM	Amiettes hiver 2011	Ld	Q1	5			
5	MAR1340	rouge	Wrangeliaceae	<i>Halurus equisetifolius</i>	BDM	Amiettes hiver 2011	Ld	Q1	3			
6	MAR1341	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	BDM	Amiettes hiver 2011	Ld	Q1	8			
7	MAR1342	rouge	Delesseriaceae	<i>Halosiphonia plumosa</i>	BDM	Amiettes hiver 2011	Ld	Q1	4			
8	MAR1343	rouge	Delesseriaceae	<i>Hypoglossum hypoglossoides</i>	BDM	Amiettes hiver 2011	Ld	Q1	4			
9	MAR1344	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDM	Amiettes hiver 2011	Ld	Q1	8		<i>Plocamium1</i>	
10	MAR1345	rouge	Rhodomeleaceae	<i>Osmundea pinnatifida</i>	BDM	Amiettes hiver 2011	Ld	Q1	6			
11	MAR1346	rouge	Corallinaceae	<i>Corallina sp</i>	BDM	Amiettes hiver 2011	Ld	Q1	20			
12	MAR1347	rouge	Callithamnaceae	<i>Callithamnion tetragonum</i>	BDM	Amiettes hiver 2011	Ld	Q1	3		<i>Callithamnion tetragonum</i>	
13	MAR1348	rouge	Gigartineae	<i>Chondrus crispus</i>	BDM	Amiettes hiver 2011	Ld	Q2	20		<i>Chondrus crispus</i>	
14	MAR1349	rouge	Ceramium sp	<i>Ceramium sp</i>	BDM	Amiettes hiver 2011	Ld	Q2	2			
15	MAR1350	rouge	Corallinaceae	<i>Corallina sp</i>	BDM	Amiettes hiver 2011	Ld	Q2	10		<i>Corallina caespitosa</i>	
16	MAR1351	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDM	Amiettes hiver 2011	Ld	Q2	20			
17	MAR1352	rouge	Cystocloniaceae	<i>Calliblepharis jubata</i>	BDM	Amiettes hiver 2011	Ld	Q2	5		<i>Calliblepharis jubata</i>	
18	MAR1353	rouge	Ceramium sp	<i>Ceramium sp</i>	BDM	Amiettes hiver 2011	Ld	Q2	3		<i>Polysiphonia1</i>	
19	MAR1354	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDM	Amiettes hiver 2011	Ld	Q2	1			
20	MAR1355	rouge	Champiaceae	<i>Gastroclonium avatum</i>	BDM	Amiettes hiver 2011	Ld	Q2	5		<i>Lomentaria clavellosa</i>	
21	MAR1356	rouge	Delesseriaceae	<i>Hypoglossum hypoglossoides</i>	BDM	Amiettes hiver 2011	Ld	Q2	4			
22	MAR1357	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	BDM	Amiettes hiver 2011	Ld	Q2	3			
23	MAR1358	rouge	Callithamnaceae	<i>Callithamnion tetragonum</i>	BDM	Amiettes hiver 2011	Ld	Q2	1		<i>Callithamnion tetragonum</i>	
24	MAR1359	rouge	Rhodomeleaceae	<i>Osmundea pinnatifida</i>	BDM	Amiettes hiver 2011	Ld	Q2	1			
25	MAR1360	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	BDM	Amiettes hiver 2011	Ld	Q2	5			
26	MAR1361	rouge	Cystocloniaceae	<i>Calliblepharis jubata</i>	BDM	Amiettes hiver 2011	Ld	Q3	15		<i>Calliblepharis jubata</i>	
27	MAR1362	rouge	Gigartineae	<i>Chondrus crispus</i>	BDM	Amiettes hiver 2011	Ld	Q3	10		<i>Chondrus crispus</i>	
28	MAR1363	rouge	Callithamnaceae	<i>Callithamnion tetragonum</i>	BDM	Amiettes hiver 2011	Ld	Q3	4		<i>Ceramium3</i>	
29	MAR1364	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	BDM	Amiettes hiver 2011	Ld	Q3	6			
30	MAR1365	rouge	Delesseriaceae	<i>Hypoglossum hypoglossoides</i>	BDM	Amiettes hiver 2011	Ld	Q3	3		<i>Hypoglossum hypoglossoides1</i>	
31	MAR1366	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	BDM	Amiettes hiver 2011	Ld	Q3	1			
32	MAR1367	rouge	Corallinaceae	<i>Corallina sp</i>	BDM	Amiettes hiver 2011	Ld	Q3	10		<i>Haliptilon squamatum</i>	
33	MAR1368	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDM	Amiettes hiver 2011	Ld	Q3	2			
34	MAR1369	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDM	Amiettes hiver 2011	Ld	Q3	5			
35	MAR1370	rouge	Rhodomeleaceae	<i>Osmundea pinnatifida</i>	BDM	Amiettes hiver 2011	Ld	Q3	5			
36	MAR1371	rouge	Ceramium sp	<i>Ceramium sp</i>	BDM	Amiettes hiver 2011	Ld	Q3	1		<i>Ceramium5</i>	
37	MAR1372	rouge	Kallymeniaceae	<i>Meredithia microphylla</i>	BDM	Amiettes hiver 2011	Lh	Q1	1			
38	MAR1373	rouge	Dumontiaceae	<i>Dilsea carnos</i>	BDM	Amiettes hiver 2011	Lh	Q1	3		<i>Dilsea carnos</i>	
39	MAR1374	rouge	Kallymeniaceae	<i>Kallymenia reniformis</i>	BDM	Amiettes hiver 2011	Lh	Q1	1			
40	MAR1375	rouge	Dasyaceae	<i>Heterosiphonia plumosa</i>	BDM	Amiettes hiver 2011	Lh	Q1	8			
41	MAR1376	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	BDM	Amiettes hiver 2011	Lh	Q1	2		<i>Callophyllis laciniata2</i>	
42	MAR1377	rouge	Wrangeliaceae	<i>Halurus equisetifolius</i>	BDM	Amiettes hiver 2011	Lh	Q1	2		<i>Halurus equisetifolius</i>	
43	MAR1378	brun	Laminariaceae	<i>Laminaria hyperborea</i>	BDM	Amiettes hiver 2011	Lh	Q1	1		<i>Laminaria hyperborea</i>	
44	MAR1379	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDM	Amiettes hiver 2011	Lh	Q1	1			
45	MAR1380	rouge	Corallinaceae	<i>Corallina sp</i>	BDM	Amiettes hiver 2011	Lh	Q1	1			
46	MAR1381	rouge	Phylloporaceae	<i>Phyllophora crispa</i>	BDM	Amiettes hiver 2011	Lh	Q2	10		<i>Phyllophora crispa</i>	
47	MAR1382	rouge	Dumontiaceae	<i>Dilsea carnos</i>	BDM	Amiettes hiver 2011	Lh	Q2	1		<i>Dilsea carnos</i>	
48	MAR1383	rouge	Corallinaceae	<i>Corallina sp</i>	BDM	Amiettes hiver 2011	Lh	Q2	20			
49	MAR1384	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	BDM	Amiettes hiver 2011	Lh	Q2	1		<i>Callophyllis laciniata2</i>	
50	MAR1385	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDM	Amiettes hiver 2011	Lh	Q2	5			
51	MAR1386	rouge	Corallinaceae	<i>Corallina sp</i>	BDM	Amiettes hiver 2011	Lh	Q3	7		<i>Corallina officinalis2</i>	
52	MAR1387	rouge	Rhodymeniaceae	<i>Rhodymenia holmesii</i>	BDM	Amiettes hiver 2011	Lh	Q3	10		<i>Rhodymenia pseudopalmeta</i>	
53	MAR1388	rouge	Wrangeliaceae	<i>Halurus equisetifolius</i>	BDM	Amiettes hiver 2011	Lh	Q3	1			
54	MAR1389	rouge	Phylloporaceae	<i>Phyllophora crispa</i>	BDM	Amiettes hiver 2011	Lh	Q3	2		<i>Phyllophora crispa</i>	
55	MAR1390	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDM	Amiettes hiver 2011	Lh	Q3	3			
56	MAR1391	rouge	Gelidiales	<i>Gelidium corneum</i>	BDM	Amiettes hiver 2011	Lh	Q3	1		<i>Gelidium sp</i>	
57	MAR1392	rouge	Phylloporaceae	<i>Mastocarpus stellatus</i>	BDM	Duons Est hiver 2011	Ld	Q1	20		<i>Mastocarpus stellatus2</i>	
58	MAR1393	rouge	Gigartineae	<i>Chondrus crispus</i>	BDM	Duons Est hiver 2011	Ld	Q1	20		<i>Chondrus crispus</i>	
59	MAR1394	rouge	Dumontiaceae	<i>Dilsea carnos</i>	BDM	Duons Est hiver 2011	Ld	Q1	2			
60	MAR1395	rouge	Cystocloniaceae	<i>Calliblepharis jubata</i>	BDM	Duons Est hiver 2011	Ld	Q1	1		<i>Calliblepharis jubata</i>	
61	MAR1396	rouge	Delesseriaceae	<i>Apoglossum ruscfolium</i>	BDM	Duons Est hiver 2011	Ld	Q1	1		<i>Apoglossum ruscfolium</i>	
62	MAR1397	rouge	Callithamnaceae	<i>Callithamnion tetragonum</i>	BDM	Duons Est hiver 2011	Ld	Q1	1		<i>Callithamnion tetricum</i>	
63	MAR1398	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	BDM	Duons Est hiver 2011	Ld	Q1	3		<i>Lomentaria articulata</i>	
64	MAR1399	rouge	Corallinaceae	<i>Corallina sp</i>	BDM	Duons Est hiver 2011	Ld	Q2	1		<i>Corallina officinalis2</i>	
65	MAR1400	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDM	Duons Est hiver 2011	Ld	Q2	1		<i>Plocamium cartilagineum</i>	
66	MAR1401	rouge	Palmaria palmata	<i>Palmaria palmata</i>	BDM	Duons Est hiver 2011	Ld	Q2	1		<i>Palmaria palmata</i>	
67	MAR1402	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	BDM	Duons Est hiver 2011	Ld	Q2	1		<i>Polyneura bonnemaisonii</i>	
68	MAR1403	rouge	Gigartineae	<i>Chondrus crispus</i>	BDM	Duons Est hiver 2011	Ld	Q2	4		<i>Ahnfeliopsis devoniensis</i>	
69	MAR1404	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDM	Duons Est hiver 2011	Ld	Q3	1		<i>Plocamium cartilagineum</i>	
70	MAR1405	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDM	Duons Est hiver 2011	Ld	Q3	1			
71	MAR1406	rouge	Corallinaceae	<i>Corallina sp</i>	BDM	Duons Est hiver 2011	Ld	Q3	1		<i>Corallina elongata</i>	
72	MAR1407	rouge	Delesseriaceae	<i>Delesseria sanguinea</i>	BDM	Duons Est hiver 2011	Lh	Q1	1		<i>Delesseria sanguinea</i>	
73	MAR1408	rouge	Dasyaceae	<i>Heterosiphonia plumosa</i>	BDM	Duons Est hiver 2011	Lh	Q1	5			
74	MAR1409	rouge	Phylloporaceae	<i>Phyllophora crispa</i>	BDM	Duons Est hiver 2011	Lh	Q1	8		<i>Phyllophora crispa</i>	
75	MAR1410	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDM	Duons Est hiver 2011	Lh	Q1	1		<i>Callophyllis laciniata</i>	
76	MAR1411	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	BDM	Duons Est hiver 2011	Lh	Q1	2		<i>Callophyllis laciniata2</i>	
77	MAR1412	rouge	Delesseriaceae	<i>Delesseriaceae</i>	BDM	Duons Est hiver 2011	Lh	Q1	4			
78	MAR1413	brun	Styopaulaceae	<i>Halopteris filicina</i>	BDM	Duons Est hiver 2011	Lh	Q1	1		<i>Halopteris filicina1</i>	
79	MAR1414	brun	Dictyota sp	<i>Dictyota sp</i>	BDM	Duons Est hiver 2011	Lh	Q1	8			
80	MAR1415	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	BDM	Duons Est hiver 2011	Lh	Q1	4		<i>Halurus equisetifolius</i>	
81	MAR1416	rouge	Delesseriaceae	<i>Acrosorium uncinatum</i>	BDM	Duons Est hiver 2011	Lh	Q1	1			
82	MAR1417	rouge	Phylloporaceae	<i>Phyllophora crispa</i>	BDM	Duons Est hiver 2011	Lh	Q2	5		<i>Phyllophora crispa</i>	
83	MAR1418	rouge	Rhodymeniaceae	<i>Rhodymenia holmesii</i>	BDM	Duons Est hiver 2011	Lh	Q2	7		<i>Rhodymenia pseudopalmeta</i>	
84	MAR1419	rouge	Rhodymeniaceae	<i>Rhodymenia holmesii</i>	BDM	Duons Est hiver 2011	Lh	Q2	8		<i>Phyllophora sicula</i>	
85	MAR1420	rouge	Dasyaceae	<i>Heterosiphonia plumosa</i>	BDM	Duons Est hiver 2011	Lh	Q2	3			
86	MAR1421	rouge	Kallymeniaceae	<i>Kallymenia reniformis</i>	BDM	Duons Est hiver 2011	Lh	Q2	2			
87	MAR1422	brun	Styopaulaceae	<i>Halopteris filicina</i>	BDM	Duons Est hiver 2011	Lh	Q2	1		<i>Halopteris filicina1</i>	
88	MAR1423	rouge	Dictyota sp	<i>Dictyota sp</i>	BDM	Duons Est hiver 2011	Lh	Q2	1			
89	MAR1424	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	BDM	Duons Est hiver 2011	Lh	Q2	1		<i>Callophyllis laciniata2</i>	
90	MAR1425	rouge	Delesseriaceae	<i>Delesseriaceae</i>	BDM	Duons Est hiver 2011	Lh	Q2	1		<i>Delesseriaceae2</i>	
91	MAR1426	rouge	Delesseriaceae	<i>Delesseriaceae</i>	BDM	Duons Est hiver 2011	Lh	Q2	1		<i>Polyneura</i>	
92	MAR1427	rouge	Delesseriaceae	<i>Delesseriaceae</i>	BDM	Duons Est hiver 2011	Lh	Q2	1		<i>Acrosorium ciliolatum</i>	
93	MAR1428	rouge	Delesseriaceae	<i>Delesseriaceae</i>	BDM	Duons Est hiver 2011	Lh	Q3	5		<i>Delesseria sanguinea</i>	
94	MAR1429	rouge	Dumontiaceae	<i>Dilsea carnos</i>	BDM	Duons Est hiver 2011	Lh	Q3	1		<i>Dilsea carnos</i>	
95	MAR1430	rouge	Dasyaceae	<i>Heterosiphonia plumosa</i>	BDM	Duons Est hiver 2011	Lh	Q3	5			
96	MAR1431	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDM	Duons Est hiver 2011	Lh	Q3	2			
97	MAR1432	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDM	Duons Est hiver 2011	Lh	Q3	4			
98	MAR1433	rouge	Phylloporaceae	<i>Phyllophora crispa</i>	BDM	Duons Est hiver 2011	Lh	Q3	6		<i>Phyllophora crispa</i>	
99	MAR1434	rouge	Delesseriaceae	<i>Delesseriaceae</i>	BDM	Duons Est hiver 2011	Lh	Q3	2		<i>Polyneura</i>	
100	MAR1435	rouge	Delesseriaceae	<i>Delesseriaceae</i>	BDM	Duons Est hiver 2011	Lh	Q3	2			
101	MAR1436	rouge	Delesseriaceae	<i>Delesseriaceae</i>	BDM	Duons Est hiver 2011	Lh	Q3	1		<i>Rhodophyllis3</i>	
102	MAR1437	rouge	Gigartineae	<i>Chondrus crispus</i>	BDM	Duons Ouest hiver 2011	Ld	Q1	10		<i>Chondrus crispus</i>	
103	MAR1438	rouge	Gigartineae	<i>Chondrus crispus</i>	BDM	Duons Ouest hiver 2011	Ld	Q1	na		<i>Chondrus crispus</i>	
104	MAR1439	rouge	Gigartineae	<i>Chondrus crispus</i>	BDM	Duons Ouest hiver 2011	Ld	Q1	na		<i>Chondrus crispus</i>	
105	MAR1440	verte	Ulva sp	<i>Ulva sp</i>	BDM	Duons Ouest hiver 2011	Ld	Q1	1			<i>Ulva sp2</i>
106	MAR1441	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	BDM	Duons Ouest hiver 2011	Ld	Q1	6			
107	MAR1442	rouge	Corallinaceae	<i>Corallina sp</i>	BDM	Duons Ouest hiver 2011	Ld	Q1	3			
108	MAR1443	rouge	Rhodomeleaceae	<i>Osmundea pinnatifida</i>	BDM	Duons Ouest hiver 2011	Ld	Q1	1		<i>Osmundea osmunda</i>	
109	MAR1444	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	BDM	Duons Ouest hiver 2011	Ld	Q1	4			
110	MAR1445	rouge	Callithamnaceae	<i>Callithamnion tetragonum</i>	BDM	Duons Ouest hiver 2011	Ld	Q1	3		<i>Callithamnion tetricum</i>	
111	MAR1446	rouge										

Annexe 4

	A	B	C	D	E	F	G	H	I	J	K	L
130	MAR1465	rouge	Callitrichaceae	<i>Callitrichum tetragonum</i>	BDM	Duons Ouest hiver 2011	Ld	Q3	3			<i>Callitrichum tetragonum</i>
131	MAR1466	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	BDM	Duons Ouest hiver 2011	Ld	Q3	1			
132	MAR1467	rouge	Plocamiales	<i>Plocamium</i> sp	BDM	Duons Ouest hiver 2011	Lh	Q1	5			
133	MAR1468	rouge	Corallinales	<i>Corallina</i> sp	BDM	Duons Ouest hiver 2011	Lh	Q1	20			<i>Haliptilon squamatum</i>
134	MAR1469	rouge	Delesseriaceae	<i>Delesseria</i> sp	BDM	Duons Ouest hiver 2011	Lh	Q1	30			<i>Acrosorium ciliolatum</i>
135	MAR1470	rouge	Phylloporaceae	<i>Phyllopora crispa</i>	BDM	Duons Ouest hiver 2011	Lh	Q1	5			<i>Phyllopora crispa</i>
136	MAR1471	rouge	Rhodomeniaceae	<i>Rhodomenia holmesii</i>	BDM	Duons Ouest hiver 2011	Lh	Q1	5			<i>Rhodomenia pseudopalmeta</i>
137	MAR1472	rouge	Plocamiales	<i>Plocamium</i> sp	BDM	Duons Ouest hiver 2011	Lh	Q1	4			
138	MAR1473	rouge	Delesseriaceae	<i>Acrosorium uncinatum</i>	BDM	Duons Ouest hiver 2011	Lh	Q1	10			<i>Acrosorium</i> sp
139	MAR1474	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	BDM	Duons Ouest hiver 2011	Lh	Q1	2			<i>Callophyllis laciniata2</i>
140	MAR1475	rouge	Gigartinales	<i>Chondrus crispus</i>	BDM	Duons Ouest hiver 2011	Lh	Q1	4			<i>Chondrus crispus</i>
141	MAR1476	rouge	Corallinales	<i>Corallina</i> sp	BDM	Duons Ouest hiver 2011	Lh	Q2	5			<i>Haliptilon squamatum</i>
142	MAR1477	rouge	Corallinales	<i>Corallina</i> sp	BDM	Duons Ouest hiver 2011	Lh	Q2	5			<i>Corallina officinalis1</i>
143	MAR1478	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	BDM	Duons Ouest hiver 2011	Lh	Q2	3			<i>Callophyllis laciniata2</i>
144	MAR1479	rouge	Delesseriaceae	<i>Acrosorium uncinatum</i>	BDM	Duons Ouest hiver 2011	Lh	Q2	1			<i>Acrosorium ciliolatum</i>
145	MAR1480	rouge	Dasyaceae	<i>Heterosiphonia plumosa</i>	BDM	Duons Ouest hiver 2011	Lh	Q2	3			<i>Heterosiphonia plumosa</i>
146	MAR1481	brune	Dictyotaaceae	<i>Dictyota</i> sp	BDM	Duons Ouest hiver 2011	Lh	Q2	2			<i>Saccorhiza polyschides</i>
147	MAR1482	rouge	Delesseriaceae	<i>Delesseriaceae</i>	BDM	Duons Ouest hiver 2011	Lh	Q2	20			<i>Acrosorium</i> sp
148	MAR1483	rouge	Delesseriaceae	<i>Hypoglossum hypoglossoides</i>	BDM	Duons Ouest hiver 2011	Lh	Q2	2			
149	MAR1484	rouge	Phylloporaceae	<i>Phyllopora crispa</i>	BDM	Duons Ouest hiver 2011	Lh	Q2	7			
150	MAR1485	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	BDM	Duons Ouest hiver 2011	Lh	Q2	20			<i>Acrosorium</i> sp
151	MAR1486	rouge	Delesseriaceae	<i>Delesseriaceae</i>	BDM	Duons Ouest hiver 2011	Lh	Q2	5			
152	MAR1487	rouge	Sphaerococcaceae	<i>Sphaerococcus coronopifolius</i>	BDM	Duons Ouest hiver 2011	Lh	Q3	1			<i>Sphaerococcus coronopifolius</i>
153	MAR1488	rouge	Dumontiaceae	<i>Dilsea carnosae</i>	BDM	Duons Ouest hiver 2011	Lh	Q3	1			<i>Dilsea carnosae</i>
154	MAR1489	rouge	Rhodomeniaceae	<i>Rhodomenia holmesii</i>	BDM	Duons Ouest hiver 2011	Lh	Q3	4			
155	MAR1490	rouge	Phylloporaceae	<i>Phyllopora crispa</i>	BDM	Duons Ouest hiver 2011	Lh	Q3	1			<i>Gymnogangangus crenulatus</i>
156	MAR1491	rouge	Kallymeniaceae	<i>Kallymenia reniformis</i>	BDM	Duons Ouest hiver 2011	Lh	Q3	1			
157	MAR1492	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	BDM	Duons Ouest hiver 2011	Lh	Q3	1			<i>Callophyllis laciniata2</i>
158	MAR1493	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	BDM	Duons Ouest hiver 2011	Lh	Q3	5			
159	MAR1494	rouge	Delesseriaceae	<i>Cryptopleura</i> sp	BDM	Duons Ouest hiver 2011	Lh	Q3	1			<i>Polyneura</i>
160	MAR1495	rouge	Plocamiales	<i>Plocamium</i> sp	BDM	Duons Ouest hiver 2011	Lh	Q3	2			
161	MAR1496	rouge	Delesseriaceae	<i>Delesseriaceae</i>	BDM	Duons Ouest hiver 2011	Lh	Q3	3			<i>Polyneura</i>
162	MAR2337	brune	Himantaliaceae	<i>Himantalia elongata</i>	Loup	éradication t0	Ld	B1	26,8			<i>Himantalia elongata</i>
163	MAR2338	rouge	Phylloporaceae	<i>Mastocarpus stellatus</i>	Loup	éradication t0	Ld	B1	24,64			<i>Mastocarpus stellatus</i>
164	MAR2339	rouge	Gigartinales	<i>Chondrus crispus</i>	Loup	éradication t0	Ld	B1	10,78			
165	MAR2340	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	Loup	éradication t0	Ld	B1	2,78			<i>Lomentaria articulata</i>
166	MAR2341	rouge	Rhodomelaceae	<i>Osmundea pinnatifida</i>	Loup	éradication t0	Ld	B1	1,9			
167	MAR2342	rouge	Furcellariaceae	<i>Furcellaria lumbricalis</i>	Loup	éradication t0	Ld	B1	na			<i>Furcellaria lumbricalis</i>
168	MAR2343	rouge	Champiaceae	<i>Gastroclonium ovatum</i>	Loup	éradication t0	Ld	B1	na			<i>Gastroclonium ovatum</i>
169	MAR2344	verte	Ulveae	<i>Ulva</i> sp	Loup	éradication t0	Ld	B1	na			
170	MAR2345	rouge	Gigartinales	<i>Chondracanthus acicularis</i>	Loup	éradication t0	Ld	B1	na			<i>Chondracanthus acicularis</i>
171	MAR2346	rouge	Phylloporaceae	<i>Gymnogangus</i> sp	Loup	éradication t0	Ld	B1	na			<i>Chondrus crispus</i>
172	MAR2347	rouge	Cystocloniaceae	<i>Calliblepharis jubata</i>	Loup	éradication t0	Ld	B1	na			
173	MAR2348	verte	Cladophoraceae	<i>Cladophora</i> sp	Loup	éradication t0	Ld	B1	na			
174	MAR2349	rouge	Palmariales	<i>Palmaria palmata</i>	Loup	éradication t0	Ld	B1	na			<i>Palmaria palmata</i>
175	MAR2350	rouge	Gelidiaceae	<i>Gelidium corneum</i>	Loup	éradication t0	Ld	B1	na			<i>Gelidium</i> sp
176	MAR2351	rouge	Gelidiaceae	<i>Gelidium</i> sp	Loup	éradication t0	Ld	B1	na			<i>Gelidium</i> sp
177	MAR2352	rouge	Corallinales	<i>Corallina</i> sp	Loup	éradication t0	Ld	B1	na			
178	MAR2353	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	Loup	éradication t0	Ld	B1	na			CONTA HOMO SAPIENS
179	MAR2354	rouge	Delesseriaceae	<i>Apoglossum rusciifolium</i>	Loup	éradication t0	Ld	B1	na			
180	MAR2355	rouge	Rhodomeniaceae	<i>Rhodomenia holmesii</i>	Loup	éradication t0	Ld	B1	na			
181	MAR2356	brune	Himantaliaceae	<i>Himantalia elongata</i>	Loup	éradication t0	Ld	B2	212,44			<i>Himantalia elongata</i>
182	MAR2357	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	Loup	éradication t0	Ld	B2	1,15			
183	MAR2358	rouge	Gigartinales	<i>Chondracanthus acicularis</i>	Loup	éradication t0	Ld	B2	3,5			<i>Chondracanthus acicularis</i>
184	MAR2359	rouge	Gigartinales	<i>Chondrus crispus</i>	Loup	éradication t0	Ld	B2	3,83			
185	MAR2360	rouge	Phylloporaceae	<i>Mastocarpus stellatus</i>	Loup	éradication t0	Ld	B2	10,72			
186	MAR2361	verte	Cladophoraceae	<i>Cladophora</i> sp	Loup	éradication t0	Ld	B2	na			
187	MAR2362	verte	Ulveae	<i>Ulva</i> sp	Loup	éradication t0	Ld	B2	na			
188	MAR2363	verte	Ulveae	<i>Ulva</i> sp	Loup	éradication t0	Ld	B2	na			
189	MAR2364	rouge	Rhodomelaceae	<i>Osmundea pinnatifida</i>	Loup	éradication t0	Ld	B2	na			<i>Osmundea osmunda</i>
190	MAR2365	rouge	Corallinales	<i>Corallina</i> sp	Loup	éradication t0	Ld	B2	na			
191	MAR2366	rouge	Palmariales	<i>Palmaria palmata</i>	Loup	éradication t0	Ld	B2	na			<i>Palmaria palmata</i>
192	MAR2367	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	Loup	éradication t0	Ld	B2	na			
193	MAR2368	rouge	Furcellariaceae	<i>Furcellaria lumbricalis</i>	Loup	éradication t0	Ld	B2	na			<i>Furcellaria lumbricalis</i>
194	MAR2369	rouge	Cystocloniaceae	<i>Calliblepharis ciliata</i>	Loup	éradication t0	Ld	B2	na			<i>Calliblepharis jubata</i>
195	MAR2370	rouge	Cystocloniaceae	<i>Calliblepharis</i> sp	Loup	éradication t0	Ld	B2	na			
196	MAR2371	rouge	Champiaceae	<i>Gastroclonium ovatum</i>	Loup	éradication t0	Ld	B2	na			<i>Gastroclonium ovatum</i>
197	MAR2372	brune	Fucaceae	<i>Fucus</i> sp	Loup	éradication t0	Ld	B2	na			<i>Fucus serratus</i>
198	MAR2373	brune	Acinetosporaceae	<i>Pylaeella</i> sp	Loup	éradication t0	Ld	B2	na			
199	MAR2374	brune	Himantaliaceae	<i>Himantalia elongata</i>	Loup	éradication t0	Ld	B3	20,42			
200	MAR2375	rouge	Gigartinales	<i>Chondrus crispus</i>	Loup	éradication t0	Ld	B3	3,85			<i>Chondrus crispus</i>
201	MAR2376	rouge	Phylloporaceae	<i>Mastocarpus stellatus</i>	Loup	éradication t0	Ld	B3	9,26			
202	MAR2377	rouge	Rhodomelaceae	<i>Osmundea pinnatifida</i>	Loup	éradication t0	Ld	B3	2,99			
203	MAR2378	rouge	Champiaceae	<i>Gastroclonium ovatum</i>	Loup	éradication t0	Ld	B3	0,88			<i>Gastroclonium ovatum</i>
204	MAR2379	rouge	Gigartinales	<i>Gigartina pistillata</i>	Loup	éradication t0	Ld	B3	na			<i>Gigartina pistillata</i>
205	MAR2380	rouge	Cystocloniaceae	<i>Calliblepharis jubata</i>	Loup	éradication t0	Ld	B3	na			<i>Calliblepharis jubata</i>
206	MAR2381	rouge	Furcellariaceae	<i>Furcellaria lumbricalis</i>	Loup	éradication t0	Ld	B3	na			
207	MAR2382	rouge	Phylloporaceae	<i>Gymnogangus</i> sp	Loup	éradication t0	Ld	B3	na			<i>Ahnfeltlopsis devoniensis</i>
208	MAR2383	rouge	Gigartinales	<i>Chondracanthus acicularis</i>	Loup	éradication t0	Ld	B3	na			<i>Chondracanthus acicularis</i>
209	MAR2384	brune	Fucaceae	<i>Fucus serratus</i>	Loup	éradication t0	Ld	B3	na			<i>Fucus vesiculosus</i>
210	MAR2385	rouge	Gracilariaceae	<i>Gracilaria</i> sp	Loup	éradication t0	Ld	B3	na			<i>Gracilariopsis longissima</i>
211	MAR2386	rouge	Plocamiales	<i>Plocamium</i> sp	Loup	éradication t0	Ld	B3	na			<i>Plocamium cartilagineum</i>
212	MAR2387	rouge	Champiaceae	<i>Chylocladia verticillata</i>	Loup	éradication t0	Ld	B3	na			<i>Lomentaria articulata</i>
213	MAR2388	rouge	Corallinales	<i>Corallina</i> sp	Loup	éradication t0	Ld	B3	na			
214	MAR2389	verte	Cladophoraceae	<i>Cladophora</i> sp	Loup	éradication t0	Ld	B3	na			
215	MAR2390	verte	Ulveae	<i>Ulva</i> sp	Loup	éradication t0	Ld	B3	na			
216	MAR2391	rouge	Delesseriaceae	<i>Palmyra</i> sp	Loup	éradication t0	Ld	B3	na			
217	MAR2392	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	Loup	éradication t0	Ld	B3	na			
218	MAR2393	rouge	Delesseriaceae	<i>Apoglossum rusciifolium</i>	Loup	éradication t0	Ld	B3	na			
219	MAR2394	rouge	Phylloporaceae	<i>Phyllopora crispa</i>	Loup	éradication t0	Ld	B3	na			
220	MAR2395	rouge	Ceramiales	<i>Ceramium</i> sp	Loup	éradication t0	Ld	B3	na			<i>Brongniartella3</i>
221	MAR2396	rouge	Ceramiales	<i>Ceramium</i> sp	Loup	éradication t0	Ld	B3	na			
222	MAR2397	rouge	Gelidiaceae	<i>Gelidium</i> sp	Loup	éradication t0	Ld	B3	na			<i>Gelidium spinosum</i>
223	MAR2398	rouge	Gelidiaceae	<i>Gelidium corneum</i>	Loup	éradication t0	Ld	B3	na			
224	MAR2399	brune	Himantaliaceae	<i>Himantalia elongata</i>	Loup	éradication t0	Ld	B4	176			
225	MAR2400	rouge	Phylloporaceae	<i>Mastocarpus stellatus</i>	Loup	éradication t0	Ld	B4	10,01			<i>Mastocarpus stellatus</i>
226	MAR2401	rouge	Gigartinales	<i>Chondracanthus acicularis</i>	Loup	éradication t0	Ld	B4	2,06			
227	MAR2402	rouge	Gigartinales	<i>Chondrus crispus</i>	Loup	éradication t0	Ld	B4	18,27			<i>Chondrus crispus</i>
228	MAR2403	brune	Fucaceae	<i>Fucus serratus</i>	Loup	éradication t0	Ld	B4	24,61			
229	MAR2404	rouge	Corallinales	<i>Corallina</i> sp	Loup	éradication t0	Ld	B4	na			
230	MAR2405	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	Loup	éradication t0	Ld	B4	na			
231	MAR2406	verte	Cladophoraceae	<i>Cladophora</i> sp	Loup	éradication t0	Ld	B4	na			
232	MAR2407	rouge	Rhodomelaceae	<i>Osmundea pinnatifida</i>	Loup	éradication t0	Ld	B4	na			
233	MAR2408	rouge	Cystocloniaceae	<i>Calliblepharis jubata</i>	Loup	éradication t0	Ld	B4	na			<i>Calliblepharis jubata</i>
234	MAR2409	verte	Ulveae	<i>Ulva</i> sp	Loup	éradication t0	Ld	B4	na			
235	MAR2410	rouge	Palmariales	<i>Palmaria palmata</i>	Loup	éradication t0	Ld	B4	na			<i>Palmaria palmata</i>
236	MAR2411	rouge	Gigartinales	<i>Gigartina pistillata</i>	Loup	éradication t0	Ld	B4	na			<i>Gigartina pistillata</i>
237	MAR2412	rouge	Furcellariaceae	<i>Furcellaria lumbricalis</i>	Loup	éradication t0	Ld	B4	na			<i>Furcellaria lumbricalis</i>
238	MAR2413	rouge	Ceramiales	<i>Ceramium</i> sp	Loup	éradication t0	Ld	B4	na			
239	MAR2414	brune	Acinetosporaceae	<i>Pylaeella</i> sp	Loup	éradication t0	Ld	B4	na			<i>Ectocarpus fasciculatus</i>
240	MAR2415	rouge	Gracilariaceae	<i>Gracilaria</i> sp	Loup	éradication t0	Ld	B4	na			<i>Gracilaria</i> sp
241	MAR2416	rouge	Phylloporaceae	<i>Phyllopora crispa</i>	Loup	éradication t0	Ld	B4	na			
242	MAR2417	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	Loup	éradication t0	Ld	B4	na			
243	MAR2418</											

Annexe 4

	A	B	C	D	E	F	G	H	I	J	K	L
259	MAR2434	brune	Himanthaliaceae	<i>Himanthalia elongata</i>	Loup	éradication t0	Ld	B5	na			
260	MAR2435	rouge	Cystocloniaceae	<i>Calliblepharis ciliata</i>	Loup	éradication t0	Ld	B6	10,83		<i>Calliblepharis jubata</i>	
261	MAR2436	rouge	Phylloporaceae	<i>Mustocarpus stellatus</i>	Loup	éradication t0	Ld	B6	10,31	<i>Phyllophora crispa</i>		
262	MAR2437	rouge	Champiaceae	<i>Gastroclonium ovatum</i>	Loup	éradication t0	Ld	B6	1,47			
263	MAR2438	rouge	Gigartineae	<i>Chondrus crispus</i>	Loup	éradication t0	Ld	B6	2,53	<i>Chondrus crispus</i>		
264	MAR2439	rouge	Furcellariaceae	<i>Furcellaria lumbricalis</i>	Loup	éradication t0	Ld	B6	1,74		<i>Furcellaria lumbricalis</i>	
265	MAR2440	rouge	Gigartineae	<i>Chondracanthus acicularis</i>	Loup	éradication t0	Ld	B6	na		<i>Chondracanthus acicularis</i>	
266	MAR2441	rouge	Phylloporaceae	<i>Gymnogongrus sp</i>	Loup	éradication t0	Ld	B6	na			
267	MAR2442	rouge	Callithamniaceae	<i>Calliblepharis sp</i>	Loup	éradication t0	Ld	B6	na			
268	MAR2443	rouge	Rhodomeleaceae	<i>Osmundea pinnatifida</i>	Loup	éradication t0	Ld	B6	na	<i>Osmundea osmunda</i>		
269	MAR2444	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	Loup	éradication t0	Ld	B6	na		<i>Lomentaria articulata</i>	
270	MAR2445	rouge	Corallinaceae	<i>Corallina sp</i>	Loup	éradication t0	Ld	B6	na			
271	MAR2446	brune	Himanthaliaceae	<i>Himanthalia elongata</i>	Loup	éradication t0	Ld	B6	na	<i>Himanthalia elongata</i>		
272	MAR2447	verte	Ulveae	<i>Ulva sp</i>	Loup	éradication t0	Ld	B6	na			
273	MAR2448	rouge	Palmariaaceae	<i>Palmaria palmata</i>	Loup	éradication t0	Ld	B6	na			
274	MAR2449	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	Loup	éradication t0	Ld	B6	na			
275	MAR2450	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	Loup	éradication t0	Ld	B6	na			
276	MAR2451	rouge	Phylloporaceae	<i>Mustocarpus stellatus</i>	Loup	éradication t0	Ld	B7	46,54	<i>Mustocarpus stellatus1</i>		
277	MAR2452	rouge	Gigartineae	<i>Chondracanthus acicularis</i>	Loup	éradication t0	Ld	B7	1,77			
278	MAR2453	brune	Himanthaliaceae	<i>Himanthalia elongata</i>	Loup	éradication t0	Ld	B7	0,82			
279	MAR2454	rouge	Rhodomeleaceae	<i>Osmundea pinnatifida</i>	Loup	éradication t0	Ld	B7	0,8			
280	MAR2455	rouge	Gigartineae	<i>Chondrus crispus</i>	Loup	éradication t0	Ld	B7	30,08	<i>Chondrus crispus</i>		
281	MAR2456	rouge	Fucaceae	<i>Fucus sp</i>	Loup	éradication t0	Ld	B7	na	<i>Fucus serratus</i>		
282	MAR2457	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	Loup	éradication t0	Ld	B7	na	<i>Lomentaria articulata</i>		
283	MAR2458	verte	Vaucheriaceae	<i>Vaucheria sp</i>	Loup	éradication t0	Ld	B7	na			
284	MAR2459	rouge	Gelidiaceae	<i>Gelidium corneum</i>	Loup	éradication t0	Ld	B7	na			
285	MAR2460	rouge	Delesseriaceae	<i>Apoglossum ruscfolium</i>	Loup	éradication t0	Ld	B7	na	<i>Apoglossum ruscfolium</i>		
286	MAR2461	brune	Fucaceae	<i>Fucus serratus</i>	Loup	éradication t0	Ld	B8	11,03	<i>Fucus serratus</i>		
287	MAR2462	rouge	Palmariaaceae	<i>Palmaria palmata</i>	Loup	éradication t0	Ld	B8	8,82	<i>Palmaria palmata</i>		
288	MAR2463	brune	Himanthaliaceae	<i>Himanthalia elongata</i>	Loup	éradication t0	Ld	B8	1,04			
289	MAR2464	rouge	Gigartineae	<i>Chondrus crispus</i>	Loup	éradication t0	Ld	B8	37,62	<i>Chondrus crispus</i>		
290	MAR2465	rouge	Phylloporaceae	<i>Mustocarpus stellatus</i>	Loup	éradication t0	Ld	B8	21,71	<i>Mustocarpus stellatus2</i>		
291	MAR2466	rouge	Furcellariaceae	<i>Furcellaria lumbricalis</i>	Loup	éradication t0	Ld	B8	na			
292	MAR2467	verte	Cladophoraceae	<i>Cladophora sp</i>	Loup	éradication t0	Ld	B8	na			
293	MAR2468	rouge	Corallinaceae	<i>Corallina sp</i>	Loup	éradication t0	Ld	B8	na			
294	MAR2469	rouge	Rhodomeleaceae	<i>Osmundea pinnatifida</i>	Loup	éradication t0	Ld	B8	na			
295	MAR2470	verte	Ulveae	<i>Ulva sp</i>	Loup	éradication t0	Ld	B8	na			
296	MAR2471	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	Loup	éradication t0	Ld	B8	na	<i>Lomentaria articulata</i>		
297	MAR2472	rouge	Gigartineae	<i>Chondracanthus acicularis</i>	Loup	éradication t0	Ld	B8	na		<i>Chondracanthus acicularis</i>	
298	MAR2473	brune	Sargassaceae	<i>Halidrys siliquosa</i>	Loup	éradication t0	Ld	B8	na			
299	MAR2474	brune	Acinetosporaceae	<i>Pylaiella sp</i>	Loup	éradication t0	Ld	B8	na			
300	MAR2475	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	Loup	éradication t0	Ld	B8	na			
301	MAR2476	rouge	Ceramieaceae	<i>Ceramium sp</i>	Loup	éradication t0	Ld	B8	na			
302	MAR2477	rouge	Gelidiaceae	<i>Gelidium corneum</i>	Loup	éradication t0	Ld	B8	na		<i>Gelidium sp</i>	
303	MAR2478	brune	Himanthaliaceae	<i>Himanthalia elongata</i>	Loup	éradication t0	Ld	B9	72,63+99,28	<i>Himanthalia elongata</i>		
304	MAR2479	rouge	Phylloporaceae	<i>Mustocarpus stellatus</i>	Loup	éradication t0	Ld	B9	26,09+26,78	<i>Mustocarpus stellatus2</i>		
305	MAR2480	rouge	Gigartineae	<i>Chondrus crispus</i>	Loup	éradication t0	Ld	B9	15,03	<i>Chondrus crispus</i>		
306	MAR2481	rouge	Rhodomeleaceae	<i>Osmundea pinnatifida</i>	Loup	éradication t0	Ld	B9	5,66	<i>Osmundea osmunda</i>		
307	MAR2482	rouge	Gigartineae	<i>Chondracanthus acicularis</i>	Loup	éradication t0	Ld	B9	3,2		<i>Chondracanthus acicularis</i>	
308	MAR2483	brune	Fucaceae	<i>Fucus vesiculosus</i>	Loup	éradication t0	Ld	B9	na	<i>Fucus vesiculosus</i>		
309	MAR2484	brune	Fucaceae	<i>Fucus serratus</i>	Loup	éradication t0	Ld	B9	na			
310	MAR2485	rouge	Champiaceae	<i>Gastroclonium ovatum</i>	Loup	éradication t0	Ld	B9	na			
311	MAR2486	verte	Cladophoraceae	<i>Cladophora sp</i>	Loup	éradication t0	Ld	B9	na			
312	MAR2487	rouge	Corallinaceae	<i>Corallina sp</i>	Loup	éradication t0	Ld	B9	na			
313	MAR2488	rouge	Placodiaceae	<i>Placodium sp</i>	Loup	éradication t0	Ld	B9	na	<i>Placodium cartilagineum</i>		
314	MAR2489	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	Loup	éradication t0	Ld	B9	na		<i>Lomentaria articulata</i>	
315	MAR2490	verte	Ulveae	<i>Ulva sp</i>	Loup	éradication t0	Ld	B9	na			
316	MAR2491	rouge	Palmariaaceae	<i>Palmaria palmata</i>	Loup	éradication t0	Ld	B9	na		<i>Palmaria palmata</i>	
317	MAR2492	rouge	Ceramieaceae	<i>Ceramium sp</i>	Loup	éradication t0	Ld	B9	na		<i>Brongnartella3</i>	
318	MAR2493	brune	Ectocarpaceae	<i>Ectocarpus</i>	Loup	éradication t0	Ld	B9	na	<i>Ectocarpus fasciculatus</i>		
319	MAR2494	rouge	Delesseriaceae	<i>Delesseriaceae</i>	Loup	éradication t0	Ld	B9	na			
320	MAR2495	rouge	Gelidiaceae	<i>Gelidium corneum</i>	Loup	éradication t0	Ld	B9	na			
321	MAR2496	brune	Acinetosporaceae	<i>Pylaiella sp</i>	Loup	éradication t0	Ld	B9	na	<i>Ectocarpus fasciculatus</i>		
322	MAR2497	rouge	Cystocloniaceae	<i>Calliblepharis ciliata</i>	Loup	éradication t0	Ld	B9	na	<i>Calliblepharis jubata</i>		
323	MAR2498	brune	Himanthaliaceae	<i>Himanthalia elongata</i>	Loup	éradication t0	Ld	C1	1,86	<i>Himanthalia elongata</i>		
324	MAR2499	rouge	Furcellariaceae	<i>Furcellaria lumbricalis</i>	Loup	éradication t0	Ld	C1	45,61		<i>Furcellaria lumbricalis</i>	
325	MAR2500	rouge	Gigartineae	<i>Chondrus crispus</i>	Loup	éradication t0	Ld	C1	50	<i>Chondrus crispus</i>		
326	MAR2501	rouge	Phylloporaceae	<i>Mustocarpus stellatus</i>	Loup	éradication t0	Ld	C1	14,81	<i>Chondrus crispus</i>		
327	MAR2502	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	Loup	éradication t0	Ld	C1	2,67		<i>Lomentaria articulata</i>	
328	MAR2503	rouge	Gigartineae	<i>Gigartina pistillata</i>	Loup	éradication t0	Ld	C1	na	<i>Furcellaria lumbricalis</i>		
329	MAR2504	rouge	Phylloporaceae	<i>Gymnogongrus sp</i>	Loup	éradication t0	Ld	C1	na	<i>Gymnogongrus crenulatus</i>		
330	MAR2505	rouge	Cystocloniaceae	<i>Calliblepharis jubata</i>	Loup	éradication t0	Ld	C1	na			
331	MAR2506	brune	Fucaceae	<i>Fucus sp</i>	Loup	éradication t0	Ld	C1	na			
332	MAR2507	rouge	Rhodomeleaceae	<i>Osmundea pinnatifida</i>	Loup	éradication t0	Ld	C1	na			
333	MAR2508	rouge	Gigartineae	<i>Chondracanthus acicularis</i>	Loup	éradication t0	Ld	C1	na		<i>Chondracanthus acicularis</i>	
334	MAR2509	rouge	Champiaceae	<i>Gastroclonium ovatum</i>	Loup	éradication t0	Ld	C1	na			
335	MAR2510	rouge	Corallinaceae	<i>Corallina sp</i>	Loup	éradication t0	Ld	C1	na			
336	MAR2511	verte	Ulveae	<i>Ulva sp</i>	Loup	éradication t0	Ld	C1	na			
337	MAR2512	rouge	Gelidiaceae	<i>Gelidium corneum</i>	Loup	éradication t0	Ld	C1	na			
338	MAR2513	rouge	Palmariaaceae	<i>Palmaria palmata</i>	Loup	éradication t0	Ld	C1	na	<i>Palmaria palmata</i>		
339	MAR2514	rouge	Delesseriaceae	<i>Delesseriaceae</i>	Loup	éradication t0	Ld	C1	na	<i>Gymnogongrus crenulatus</i>		
340	MAR2515	rouge	Indéterminée	<i>non identifiée</i>	Loup	éradication t0	Ld	C1	na	<i>Ahnfeltia plicata</i>		
341	MAR2516	rouge	Delesseriaceae	<i>Apoglossum ruscfolium</i>	Loup	éradication t0	Ld	C1	na			
342	MAR2517	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	Loup	éradication t0	Ld	C1	na	<i>Rhodophyllis2</i>		
343	MAR2518	rouge	Ceramieaceae	<i>Ceramium sp</i>	Loup	éradication t0	Ld	C1	na	<i>Boergeseniella fruticulosa</i>		
344	MAR2519	rouge	Furcellariaceae	<i>Furcellaria lumbricalis</i>	Loup	éradication t0	Ld	C2	0,16			
345	MAR2520	rouge	Rhodomeleaceae	<i>Osmundea pinnatifida</i>	Loup	éradication t0	Ld	C2	0,08	<i>Osmundea osmunda</i>		
346	MAR2521	rouge	Gigartineae	<i>Chondracanthus acicularis</i>	Loup	éradication t0	Ld	C2	0,2		<i>Chondracanthus acicularis</i>	
347	MAR2522	rouge	Gigartineae	<i>Chondrus crispus</i>	Loup	éradication t0	Ld	C2	2,18	<i>Chondrus crispus</i>		
348	MAR2523	rouge	Phylloporaceae	<i>Phyllophora crispa</i>	Loup	éradication t0	Ld	C2	0,07			
349	MAR2524	rouge	Corallinaceae	<i>Corallina sp</i>	Loup	éradication t0	Ld	C2	na			
350	MAR2525	brune	Fucaceae	<i>Fucus sp</i>	Loup	éradication t0	Ld	C2	na	<i>Fucus serratus</i>		
351	MAR2526	rouge	Phylloporaceae	<i>Gymnogongrus sp</i>	Loup	éradication t0	Ld	C2	na	<i>Gymnogongrus crenulatus</i>		
352	MAR2527	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	Loup	éradication t0	Ld	C2	na			
353	MAR2528	rouge	Gelidiaceae	<i>Gelidium corneum</i>	Loup	éradication t0	Ld	C2	na			
354	MAR2529	?	Indéterminée	<i>non identifiée</i>	Loup	éradication t0	Ld	C2	na			
355	MAR2530	rouge	Ceramieaceae	<i>Ceramium sp</i>	Loup	éradication t0	Ld	C2	na	<i>Ceramium secundatum</i>		
356	MAR2531	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	Loup	éradication t0	Ld	C2	na			
357	MAR2532	brune	Himanthaliaceae	<i>Himanthalia elongata</i>	Loup	éradication t0	Ld	C3	4,19			
358	MAR2533	rouge	Palmariaaceae	<i>Palmaria palmata</i>	Loup	éradication t0	Ld	C3	2,92		<i>Palmaria palmata</i>	
359	MAR2534	rouge	Gigartineae	<i>Chondrus crispus</i>	Loup	éradication t0	Ld	C3	3,71	<i>Chondrus crispus</i>		
360	MAR2535	rouge	Gigartineae	<i>Chondracanthus acicularis</i>	Loup	éradication t0	Ld	C3	1,27			
361	MAR2536	rouge	Phylloporaceae	<i>Mustocarpus stellatus</i>	Loup	éradication t0	Ld	C3	6,91	<i>Chondrus crispus</i>		
362	MAR2537	rouge	Cystocloniaceae	<i>Calliblepharis jubata</i>	Loup	éradication t0	Ld	C3	na			
363	MAR2538	rouge	Corallinaceae	<i>Corallina sp</i>	Loup	éradication t0	Ld	C3	na			
364	MAR2539	verte	Cladophoraceae	<i>Cladophora sp</i>	Loup	éradication t0	Ld	C3	na			
365	MAR2540	rouge	Rhodomeleaceae	<i>Osmundea pinnatifida</i>	Loup	éradication t0	Ld	C3	na	<i>Osmundea osmunda</i>		
366	MAR2541	brune	Fucaceae	<i>Fucus sp</i>	Loup	éradication t0	Ld	C3	na			
367	MAR2542	verte	Ulveae	<i>Ulva sp</i>	Loup	éradication t0	Ld	C3	na			
368	MAR2543	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	Loup	éradication t0	Ld	C3	na		<i>Lomentaria articulata</i>	
369	MAR2544	rouge	Phylloporaceae	<i>Gymnogongrus sp</i>	Loup	éradication t0	Ld	C3	na	<i>Ahnfeltiopsis devoniensis</i>		
370	MAR2545	rouge	Gelidiaceae	<i>Gelidium corneum</i>	Loup	éradication t0	Ld	C3	na			
371	MAR2546	rouge	Delesseriaceae	<i>Apoglossum ruscfolium</i>	Loup	éradication t0	Ld	C3	na			
372	MAR2547	rouge	Kallymeniaceae	<i>Collophylis laciniata</i>	Loup	éradication t0	Ld	C3	na			
373	MAR2548	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	Loup	éradication t0	Ld	C3	na			

Annexe 4

	A	B	C	D	E	F	G	H	I	J	K	L
388	MAR2563	brune	Sargassaceae	<i>Bifurcaria bifurcata</i>	Loup	éradication t0	Ld	C4	na			
389	MAR2564	rouge	Callithamiaceae	<i>Calliblepharis sp</i>	Loup	éradication t0	Ld	C4	na	<i>Bifurcaria bifurcata</i>		
390	MAR2565	rouge	Plocamiaceae	<i>Plocamium sp</i>	Loup	éradication t0	Ld	C4	na	<i>Neosiphonia harveyi</i>		
391	MAR2566	verte	Ulveae	<i>Ulvu sp</i>	Loup	éradication t0	Ld	C4	na	<i>Plocamium cartilagineum</i>		
392	MAR2567	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	Loup	éradication t0	Ld	C4	na			
393	MAR2568	rouge	Delesseriaceae	<i>Polyneura bonnemaisoniai</i>	Loup	éradication t0	Ld	C4	na			
394	MAR2569	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	Loup	éradication t0	Ld	C4	na			
395	MAR2570	rouge	Delesseriaceae	<i>Agelossium ruscifolium</i>	Loup	éradication t0	Ld	C4	na			
396	MAR2571	rouge	Phylloporaceae	<i>Gymnogongrus sp</i>	Loup	éradication t0	Ld	C4	na			
397	MAR2572	?	Indéterminée	<i>non identifiée</i>	Loup	éradication t0	Ld	C4	na			
398	MAR2573	rouge	Corallinaceae	<i>Corallina sp</i>	Loup	éradication t0	Ld	C5	0,45			
399	MAR2574	brune	Himanthaliaceae	<i>Himanthalia elongata</i>	Loup	éradication t0	Ld	C5	0,41			
400	MAR2575	brune	Sargassaceae	<i>Bifurcaria bifurcata</i>	Loup	éradication t0	Ld	C5	0,65			
401	MAR2576	rouge	Gigartineae	<i>Chondrus crispus</i>	Loup	éradication t0	Ld	C5	27,08	<i>Chondrus crispus</i>		
402	MAR2577	rouge	Phylloporaceae	<i>Mostocarpus stellatus</i>	Loup	éradication t0	Ld	C5	10,16	<i>Chondrus crispus</i>		
403	MAR2578	verte	Cladophoraceae	<i>Cladophora sp</i>	Loup	éradication t0	Ld	C5	na			
404	MAR2579	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	Loup	éradication t0	Ld	C5	na		<i>Lomentaria articulata</i>	
405	MAR2580	rouge	Rhodomeleaceae	<i>Osmundea pinnatifida</i>	Loup	éradication t0	Ld	C5	na			
406	MAR2581	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	Loup	éradication t0	Ld	C5	na			
407	MAR2582	verte	Ulveae	<i>Ulvu sp</i>	Loup	éradication t0	Ld	C5	na			
408	MAR2583	rouge	Gigartineae	<i>Chondracanthus acicularis</i>	Loup	éradication t0	Ld	C5	na			
409	MAR2584	rouge	Gelidiaceae	<i>Gelidium corneum</i>	Loup	éradication t0	Ld	C5	na		<i>Gelidium sp</i>	
410	MAR2585	rouge	Delesseriaceae	<i>Agelossium ruscifolium</i>	Loup	éradication t0	Ld	C5	na			
411	MAR2586	rouge	Palmariaaceae	<i>Palmaria palmata</i>	Loup	éradication t0	Ld	C5	na		<i>Palmaria palmata</i>	
412	MAR2587	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	Loup	éradication t0	Ld	C5	na			
413	MAR2588	rouge	Phylloporaceae	<i>Phyllophora crispa</i>	Loup	éradication t0	Ld	C5	na			
414	MAR2589	rouge	Ceramieaceae	<i>Ceramium sp</i>	Loup	éradication t0	Ld	C5	na		<i>Rhodomele confervoides</i>	
415	MAR2590	brune	Himanthaliaceae	<i>Himanthalia elongata</i>	Loup	éradication t0	Ld	C6	6,05			
416	MAR2591	rouge	Furcellariaceae	<i>Furcellaria lumbricalis</i>	Loup	éradication t0	Ld	C6	18,77		<i>Furcellaria lumbricalis</i>	
417	MAR2592	rouge	Gracilariaceae	<i>Gracilaria gracilis</i>	Loup	éradication t0	Ld	C6	1,31			
418	MAR2593	rouge	Rhodomeleaceae	<i>Osmundea pinnatifida</i>	Loup	éradication t0	Ld	C6	1,31			
419	MAR2594	brune	Fuaceae	<i>Fucus serratus</i>	Loup	éradication t0	Ld	C6	4,01	<i>Fucus serratus</i>		
420	MAR2595	rouge	Cystocloniaceae	<i>Calliblepharis jubata</i>	Loup	éradication t0	Ld	C6	na	<i>Calliblepharis jubata</i>		
421	MAR2596	verte	Ulveae	<i>Ulvu sp</i>	Loup	éradication t0	Ld	C6	na			
422	MAR2597	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	Loup	éradication t0	Ld	C6	na		<i>Lomentaria articulata</i>	
423	MAR2598	rouge	Corallinaceae	<i>Corallina sp</i>	Loup	éradication t0	Ld	C6	na		<i>Corallina officinalis2</i>	
424	MAR2599	rouge	Champiaceae	<i>Gastroclonium ovatum</i>	Loup	éradication t0	Ld	C6	na			
425	MAR2600	brune	Sargassaceae	<i>Bifurcaria bifurcata</i>	Loup	éradication t0	Ld	C6	na			
426	MAR2601	rouge	Plocamiaceae	<i>Plocamium sp</i>	Loup	éradication t0	Ld	C6	na	<i>Bifurcaria bifurcata</i>		
427	MAR2602	rouge	Phylloporaceae	<i>Gymnogongrus sp</i>	Loup	éradication t0	Ld	C6	na	<i>Plocamium nanum</i>		
428	MAR2603	rouge	Gigartineae	<i>Chondrus crispus</i>	Loup	éradication t0	Ld	C6	na	<i>Gymnogongrus crenulatus</i>		
429	MAR2604	rouge	Indéterminée	<i>non identifiée</i>	Loup	éradication t0	Ld	C6	na	<i>Chondrus crispus</i>		
430	MAR2605	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	Loup	éradication t0	Ld	C6	na	<i>Ahnfeltia plicata</i>		
431	MAR2606	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	Loup	éradication t0	Ld	C6	na			
432	MAR2607	rouge	Callithamiaceae	<i>Calliblepharis sp</i>	Loup	éradication t0	Ld	C6	na			
433	MAR2608	rouge	Dasyaceae	<i>Heterosiphonia plumosa</i>	Loup	éradication t0	Ld	C6	na			
434	MAR2609	rouge	Furcellariaceae	<i>Furcellaria lumbricalis</i>	Loup	éradication t0	Ld	C7	0,34			
435	MAR2610	rouge	Kallymeniaceae	<i>Kallymenia reniformis</i>	Loup	éradication t0	Ld	C7	0,79		<i>Palmaria palmata</i>	
436	MAR2611	rouge	Gigartineae	<i>Gigartina pistillata</i>	Loup	éradication t0	Ld	C7	1,49		<i>Chondrus crispus</i>	
437	MAR2612	rouge	Phylloporaceae	<i>Mostocarpus stellatus</i>	Loup	éradication t0	Ld	C7	4,24	<i>Chondrus crispus</i>		
438	MAR2613	rouge	Gigartineae	<i>Chondrus crispus</i>	Loup	éradication t0	Ld	C7	6,97	<i>Chondrus crispus</i>		
439	MAR2614	rouge	Gelidiaceae	<i>Gelidium corneum</i>	Loup	éradication t0	Ld	C7	na		<i>Gelidium sp</i>	
440	MAR2615	rouge	Champiaceae	<i>Gastroclonium ovatum</i>	Loup	éradication t0	Ld	C7	na			
441	MAR2616	verte	Ulveae	<i>Ulvu sp</i>	Loup	éradication t0	Ld	C7	na			
442	MAR2617	rouge	Corallinaceae	<i>Corallina sp</i>	Loup	éradication t0	Ld	C7	na			
443	MAR2618	brune	Himanthaliaceae	<i>Himanthalia elongata</i>	Loup	éradication t0	Ld	C7	na			
444	MAR2619	rouge	Rhodomeleaceae	<i>Osmundea pinnatifida</i>	Loup	éradication t0	Ld	C7	na	<i>Osmundea osmunda</i>		
445	MAR2620	brune	Fuaceae	<i>Fucus serratus</i>	Loup	éradication t0	Ld	C7	na	<i>Fucus serratus</i>		
446	MAR2621	rouge	Delesseriaceae	<i>Polyneura bonnemaisoniai</i>	Loup	éradication t0	Ld	C7	na			
447	MAR2622	rouge	Gigartineae	<i>Chondracanthus acicularis</i>	Loup	éradication t0	Ld	C7	na		<i>Chondracanthus acicularis</i>	
448	MAR2623	rouge	Gracilariaceae	<i>Gracilaria gracilis</i>	Loup	éradication t0	Ld	C7	na	<i>Gracilariopsis longissima</i>		
449	MAR2624	rouge	Cystocloniaceae	<i>Calliblepharis jubata</i>	Loup	éradication t0	Ld	C7	na	<i>Calliblepharis jubata</i>		
450	MAR2625	rouge	Palmariaaceae	<i>Palmaria palmata</i>	Loup	éradication t0	Ld	C8	2,01			
451	MAR2626	rouge	Corallinaceae	<i>Corallina sp</i>	Loup	éradication t0	Ld	C8	10,71			
452	MAR2627	rouge	Gracilariaceae	<i>Gracilaria sp</i>	Loup	éradication t0	Ld	C8	1,66		<i>Chondria scintillans</i>	
453	MAR2628	rouge	Furcellariaceae	<i>Furcellaria lumbricalis</i>	Loup	éradication t0	Ld	C8	8,19		<i>Polyides rotundus</i>	
454	MAR2629	brune	Himanthaliaceae	<i>Himanthalia elongata</i>	Loup	éradication t0	Ld	C8	2,32			
455	MAR2630	verte	Ulveae	<i>Ulvu sp</i>	Loup	éradication t0	Ld	C8	na			
456	MAR2631	rouge	Gigartineae	<i>Chondracanthus acicularis</i>	Loup	éradication t0	Ld	C8	na			
457	MAR2632	rouge	Cystocloniaceae	<i>Calliblepharis jubata</i>	Loup	éradication t0	Ld	C8	na			
458	MAR2633	rouge	Cladophoraceae	<i>Cladophora sp</i>	Loup	éradication t0	Ld	C8	na			
459	MAR2634	rouge	Gigartineae	<i>Chondrus crispus</i>	Loup	éradication t0	Ld	C8	na		<i>Chondrus crispus</i>	
460	MAR2635	rouge	Acinetosporaceae	<i>Pylaeella sp</i>	Loup	éradication t0	Ld	C8	na			
461	MAR2636	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	Loup	éradication t0	Ld	C8	na			
462	MAR2637	rouge	Champiaceae	<i>Gastroclonium ovatum</i>	Loup	éradication t0	Ld	C8	na	<i>Gastroclonium ovatum</i>		
463	MAR2638	rouge	Rhodomeleaceae	<i>Osmundea pinnatifida</i>	Loup	éradication t0	Ld	C8	na			
464	MAR2639	brune	Sargassaceae	<i>Bifurcaria bifurcata</i>	Loup	éradication t0	Ld	C8	na			
465	MAR2640	rouge	Delesseriaceae	<i>Polyneura bonnemaisoniai</i>	Loup	éradication t0	Ld	C8	na			
466	MAR2641	rouge	Plocamiaceae	<i>Plocamium sp</i>	Loup	éradication t0	Ld	C8	na	<i>Plocamium nanum</i>		
467	MAR2642	rouge	Ceramieaceae	<i>Ceramium sp</i>	Loup	éradication t0	Ld	C8	na			
468	MAR2643	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	Loup	éradication t0	Ld	C8	na			
469	MAR2644	brune	Himanthaliaceae	<i>Himanthalia elongata</i>	Loup	éradication t0	Ld	C9	40,05			
470	MAR2645	brune	Sargassaceae	<i>Bifurcaria bifurcata</i>	Loup	éradication t0	Ld	C9	16,79	<i>Bifurcaria bifurcata</i>		
471	MAR2646	rouge	Gigartineae	<i>Chondrus crispus</i>	Loup	éradication t0	Ld	C9	9,21		<i>Chondrus crispus</i>	
472	MAR2647	rouge	Phylloporaceae	<i>Mostocarpus stellatus</i>	Loup	éradication t0	Ld	C9	17,22	<i>Mostocarpus stellatus2</i>		
473	MAR2648	brune	Laminariaceae	<i>Saccharina latissima</i>	Loup	éradication t0	Ld	C9	4,35			
474	MAR2649	verte	Ulveae	<i>Ulvu sp</i>	Loup	éradication t0	Ld	C9	na			
475	MAR2650	rouge	Gigartineae	<i>Chondracanthus acicularis</i>	Loup	éradication t0	Ld	C9	na		<i>Chondracanthus acicularis</i>	
476	MAR2651	brune	Acinetosporaceae	<i>Pylaeella sp</i>	Loup	éradication t0	Ld	C9	na			
477	MAR2652	verte	Cladophoraceae	<i>Cladophora sp</i>	Loup	éradication t0	Ld	C9	na			
478	MAR2653	rouge	Furcellariaceae	<i>Furcellaria lumbricalis</i>	Loup	éradication t0	Ld	C9	na		<i>Furcellaria lumbricalis</i>	
479	MAR2654	brune	Fuaceae	<i>Fucus serratus</i>	Loup	éradication t0	Ld	C9	na	<i>Fucus serratus</i>		
480	MAR2655	rouge	Cystocloniaceae	<i>Calliblepharis jubata</i>	Loup	éradication t0	Ld	C9	na			
481	MAR2656	rouge	Rhodomeleaceae	<i>Osmundea pinnatifida</i>	Loup	éradication t0	Ld	C9	na			
482	MAR2657	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	Loup	éradication t0	Ld	C9	na		<i>Lomentaria articulata</i>	
483	MAR2658	rouge	Champiaceae	<i>Gastroclonium ovatum</i>	Loup	éradication t0	Ld	C9	na	<i>Gastroclonium ovatum</i>		
484	MAR2659	rouge	Corallinaceae	<i>Corallina sp</i>	Loup	éradication t0	Ld	C9	na			
485	MAR2660	rouge	Gelidiaceae	<i>Gelidium corneum</i>	Loup	éradication t0	Ld	C9	na		<i>Gelidium sp</i>	
486	MAR2661	rouge	Phylloporaceae	<i>Phyllophora crispa</i>	Loup	éradication t0	Ld	C9	na			
487	MAR2662	rouge	Palmariaaceae	<i>Palmaria palmata</i>	Loup	éradication t0	Ld	C9	na		<i>Palmaria palmata</i>	
488	MAR2663	rouge	Plocamiaceae	<i>Plocamium sp</i>	Loup	éradication t0	Ld	C9	na			
489	MAR2664	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	Loup	éradication t0	Ld	C9	na			
490	MAR2665	rouge	Ceramieaceae	<i>Ceramium sp</i>	Loup	éradication t0	Ld	C9	na			
491	MAR2666	rouge	Indéterminée	<i>non identifiée</i>	Loup	éradication t0	Ld	C9	na			
492	MAR2667	verte	Ulveae	<i>Ulvu sp</i>	Loup	éradication t1	Ld	B7	9,81		<i>Collaenoma sp</i>	
493	MAR2668	verte	Ulveae	<i>Ulvu sp</i>	Loup	éradication t1	Ld	B7	4,01			
494	MAR2669	verte	Ulveae	<i>Ulvu sp</i>	Loup	éradication t1	Ld	B7	2,91			
495	MAR2670	verte	Ulveae	<i>Ulvu sp</i>	Loup	éradication t1	Ld	B7	2,99			
496	MAR2671	rouge	Phylloporaceae	<i>Mostocarpus stellatus</i>	Loup	éradication t1	Ld	B7	0,62	<i>Mostocarpus stellatus2</i>		
497	MAR2672	rouge	Gigartineae	<i>Chondrus crispus</i>	Loup	éradication t1	Ld	B7	na		<i>Chondrus crispus</i>	
498	MAR2673	rouge	Bangiaceae	<i>Porphyra sp</i>	Loup	éradication t1	Ld	B7	na	<i>Pyropia sp. collinsii</i>		
499	MAR2674	rouge	Gigartineae	<i>Chondracanthus acicularis</i>	Loup	éradication t1	Ld	B7	na			
500	MAR2675	rouge	Ceramieaceae	<i>Ceramium sp</i>	Loup	éradication t1	Ld	B7	na	<i>Ceramium secundatum</i>		
501	MAR2676	rouge	Palmariaaceae	<i>Palmaria palmata</i>	Loup	éradication t1	Ld	B7	na	<i>Palmaria palmata</i>		
502	MAR2677	rouge	Rhodomeleaceae	<i>Osmundea pinnatifida</i>	Loup	éradication t1	Ld	B7	na	<i>Osmundea osmunda</i>		
503	MAR2678	brune	Acinetosporaceae	<i>Pylaeella sp</i>	Loup	éradication t1	Ld	B7	na			
504</												

Annexe 4

	A	B	C	D	E	F	G	H	I	J	K	L
517	MAR2692	rouge	Gigartineae	<i>Chondracanthus acicularis</i>	Loup	éradication t1	Ld	BB	0,5			
518	MAR2693	rouge	Gigartineae	<i>Chondrus crispus</i>	Loup	éradication t1	Ld	BB	na		<i>Chondrus crispus</i>	
519	MAR2694	rouge	Rhodymeniaceae	<i>Rhodymenia pseudopalmeta</i>	Loup	éradication t1	Ld	BB	na			
520	MAR2695	brune	Acinetosporaceae	<i>Pylaiella sp</i>	Loup	éradication t1	Ld	BB	na	<i>Hincksia granulosa</i>		
521	MAR2696	rouge	Corallineae	<i>Corallina sp</i>	Loup	éradication t1	Ld	BB	na			
522	MAR2697	rouge	Bangiaceae	<i>Porphyra sp</i>	Loup	éradication t1	Ld	BB	na		<i>Pyropia sp. collinsii</i>	
523	MAR2698	rouge	Phylloporaceae	<i>Phylloporia pseudoceranoides</i>	Loup	éradication t1	Ld	BB	na			
524	MAR2699	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	Loup	éradication t1	Ld	BB	na		<i>Palmaria palmata</i>	
525	MAR2700	brune	Sargassaceae	<i>Bifurcaria bifurcata</i>	Loup	éradication t1	Ld	BB	na	<i>Bifurcaria bifurcata</i>		
526	MAR2701	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	Loup	éradication t1	Ld	BB	na			
527	MAR2702	rouge	Furcellariaceae	<i>Furcellaria lumbricalis</i>	Loup	éradication t1	Ld	BB	na			
528	MAR2703	verte	Cladophoraceae	<i>Cladophora sp</i>	Loup	éradication t1	Ld	BB	na			
529	MAR2704	rouge	Delesseriaceae	<i>Delesseria sanguinea</i>	Loup	éradication t1	Ld	BB	na			
530	MAR2705	rouge	Palmarieae	<i>Palmaria palmata</i>	Loup	éradication t1	Ld	BB	na	<i>Palmaria palmata</i>		
531	MAR2706	rouge	Cystocloniaceae	<i>Calliblepharis ciliata</i>	Loup	éradication t1	Ld	BB	na	<i>Calliblepharis jubata</i>		
532	MAR2707	rouge	Champiaceae	<i>Gastroclonium ovatum</i>	Loup	éradication t1	Ld	BB	na	<i>Gastroclonium ovatum</i>		
533	MAR2708	rouge	Ceramieae	<i>Ceramium sp</i>	Loup	éradication t1	Ld	BB	na		<i>Ceramium sp</i>	
534	MAR2709	rouge	Ceramieae	<i>Ceramium sp</i>	Loup	éradication t1	Ld	BB	na			
535	MAR2710	verte	Ulveae	<i>Ulvaria sp</i>	Loup	éradication t1	Ld	BB	na			
536	MAR2711	rouge	Rhodomeleae	<i>Osmundea pinnatifida</i>	Loup	éradication t1	Ld	BB	na	<i>Osmundea osmunda</i>		
537	MAR2712	rouge	Ceramieae	<i>Ceramium sp</i>	Loup	éradication t1	Ld	BB	na		<i>Brongiartella2</i>	
538	MAR2713	brune	Dictyotaee	<i>Dictyota dichotoma</i>	Loup	éradication t1	Ld	BB	na			
539	MAR2714	brune	Desmarestiaceae	<i>Desmarestia sp</i>	Loup	éradication t1	Ld	BB	na			
540	MAR2715	rouge	Fucaceae	<i>Fucus sp</i>	Loup	éradication t1	Ld	BB	na			
541	MAR2716	brune	Sargassaceae	<i>Sargassum muticum</i>	Loup	éradication t1	Ld	BB	na	<i>Sargassum muticum</i>		
542	MAR2717	rouge	Ahnfeltiaceae	<i>Ahnfeltia sp</i>	Loup	éradication t1	Ld	BB	na			
543	MAR2718	verte	Ulveae	<i>Ulva sp</i>	Loup	éradication t1	Ld	B9	40,15			
544	MAR2719	verte	Ulveae	<i>Ulva sp</i>	Loup	éradication t1	Ld	B9	1,13			
545	MAR2720	rouge	Gigartineae	<i>Chondracanthus acicularis</i>	Loup	éradication t1	Ld	B9	0,1			
546	MAR2721	rouge	Rhodomeleae	<i>Osmundea pinnatifida</i>	Loup	éradication t1	Ld	B9	0,07			
547	MAR2722	rouge	Gigartineae	<i>Chondrus crispus</i>	Loup	éradication t1	Ld	B9	0,13	<i>Chondrus crispus</i>		
548	MAR2723	rouge	Cystocloniaceae	<i>Calliblepharis jubata</i>	Loup	éradication t1	Ld	B9	na	<i>Calliblepharis jubata</i>		
549	MAR2724	verte	Ulveae	<i>Ulvaria sp</i>	Loup	éradication t1	Ld	B9	na			
550	MAR2725	rouge	Gracilariaceae	<i>Gracilaria sp</i>	Loup	éradication t1	Ld	B9	na			
551	MAR2726	rouge	Bonnemaisoniaceae	<i>Asparagopsis armata</i>	Loup	éradication t1	Ld	B9	na			
552	MAR2727	rouge	Gelidiaceae	<i>Gelidium corneum</i>	Loup	éradication t1	Ld	B9	na	<i>Gelidium sp</i>		
553	MAR2728	rouge	Gelidiaceae	<i>Gelidium sp</i>	Loup	éradication t1	Ld	B9	na	<i>Gelidium sp</i>		
554	MAR2729	rouge	Corallineae	<i>Corallina sp</i>	Loup	éradication t1	Ld	B9	na			
555	MAR2730	rouge	Kalymeniaceae	<i>Meredithia microphylla</i>	Loup	éradication t1	Ld	B9	na			
556	MAR2731	verte	Cladophoraceae	<i>Cladophora sp</i>	Loup	éradication t1	Ld	B9	na			
557	MAR2732	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	Loup	éradication t1	Ld	B9	na	<i>Cryptopleura ramosa</i>		
558	MAR2733	brune	Acinetosporaceae	<i>Pylaiella sp</i>	Loup	éradication t1	Ld	B9	na			
559	MAR2734	brune	Desmarestiaceae	<i>Desmarestia sp</i>	Loup	éradication t1	Ld	B9	na			
560	MAR2735	rouge	Phylloporaceae	<i>Gymnogangrus sp</i>	Loup	éradication t1	Ld	B9	na	<i>Ahnfeltiopsis devoniensis</i>		
561	MAR2736	rouge	Bangiaceae	<i>Porphyra sp</i>	Loup	éradication t1	Ld	B9	na	<i>Pyropia leucosticta</i>		
562	MAR2737	brune	Himanthaliaceae	<i>Himanthalia elongata</i>	Loup	éradication t1	Ld	B9	na			
563	MAR2738	rouge	Palmarieae	<i>Palmaria palmata</i>	Loup	éradication t1	Ld	B9	na	<i>Palmaria palmata</i>		
564	MAR2739	rouge	Ceramieae	<i>Ceramium sp</i>	Loup	éradication t1	Ld	B9	na			
565	MAR2740	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	Loup	éradication t1	Ld	B9	na	<i>Lomentaria articulata</i>		
566	MAR2741	brune	Fucaceae	<i>Fucus sp</i>	Loup	éradication t1	Ld	B9	na	<i>Fucus serratus</i>		
567	MAR2742	brune	Sargassaceae	<i>Bifurcaria bifurcata</i>	Loup	éradication t1	Ld	B9	na	<i>Bifurcaria bifurcata</i>		
568	MAR2743	rouge	Indéterminée	<i>non identifiée</i>	Loup	éradication t1	Ld	B9	na			
569	MAR2744	verte	Ulveae	<i>Ulva sp</i>	Loup	éradication t1	Ld	C7	19,13			
570	MAR2745	verte	Ulveae	<i>Ulva sp</i>	Loup	éradication t1	Ld	C7	1,41			
571	MAR2746	rouge	Gigartineae	<i>Chondrus crispus</i>	Loup	éradication t1	Ld	C7	4,72	<i>Chondrus crispus</i>		
572	MAR2747	brune	Himanthaliaceae	<i>Himanthalia elongata</i>	Loup	éradication t1	Ld	C7	0,54			
573	MAR2748	rouge	Gigartineae	<i>Chondracanthus acicularis</i>	Loup	éradication t1	Ld	C7	0,41	<i>Chondracanthus acicularis</i>		
574	MAR2749	verte	Cladophoraceae	<i>Cladophora sp</i>	Loup	éradication t1	Ld	C7	na			
575	MAR2750	rouge	Gelidiaceae	<i>Gelidium corneum</i>	Loup	éradication t1	Ld	C7	na	<i>Gelidium sp</i>		
576	MAR2751	brune	Acinetosporaceae	<i>Pylaiella sp</i>	Loup	éradication t1	Ld	C7	na	<i>Ectocarpus fasciculatus</i>		
577	MAR2752	rouge	Phylloporaceae	<i>Mastocarpus stellatus</i>	Loup	éradication t1	Ld	C7	na	<i>Chondrus crispus</i>		
578	MAR2753	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	Loup	éradication t1	Ld	C7	na	<i>Lomentaria articulata</i>		
579	MAR2754	rouge	Ceramieae	<i>Ceramium sp</i>	Loup	éradication t1	Ld	C7	na	<i>Ceramium sp</i>		
580	MAR2755	rouge	Ceramieae	<i>Ceramium sp</i>	Loup	éradication t1	Ld	C7	na			
581	MAR2756	rouge	Rhodomeleae	<i>Osmundea pinnatifida</i>	Loup	éradication t1	Ld	C7	na			
582	MAR2757	brune	Sargassaceae	<i>Halidrys siliquosa</i>	Loup	éradication t1	Ld	C7	na	<i>Cystoseira baccata</i>		
583	MAR2758	rouge	Bangiaceae	<i>Porphyra sp</i>	Loup	éradication t1	Ld	C7	na	<i>Pyropia sp. collinsii</i>		
584	MAR2759	rouge	Palmarieae	<i>Palmaria palmata</i>	Loup	éradication t1	Ld	C7	na	<i>Palmaria palmata</i>		
585	MAR2760	rouge	Corallineae	<i>Corallina sp</i>	Loup	éradication t1	Ld	C7	na			
586	MAR2761	rouge	Cystocloniaceae	<i>Calliblepharis ciliata</i>	Loup	éradication t1	Ld	C7	na	<i>Calliphylis laciniata</i>		
587	MAR2762	verte	Ulveae	<i>Ulva sp</i>	Loup	éradication t1	Ld	C8	3,61			
588	MAR2763	verte	Ulveae	<i>Ulva sp</i>	Loup	éradication t1	Ld	C8	na			
589	MAR2764	brune	Himanthaliaceae	<i>Himanthalia elongata</i>	Loup	éradication t1	Ld	C8	na			
590	MAR2765	brune	Dictyotaee	<i>Dictyota dichotoma</i>	Loup	éradication t1	Ld	C8	na			
591	MAR2766	rouge	Palmarieae	<i>Palmaria palmata</i>	Loup	éradication t1	Ld	C8	na	<i>Palmaria palmata</i>		
592	MAR2767	rouge	Gigartineae	<i>Chondracanthus acicularis</i>	Loup	éradication t1	Ld	C8	na			
593	MAR2768	rouge	Corallineae	<i>Corallina sp</i>	Loup	éradication t1	Ld	C8	na			
594	MAR2769	rouge	Ceramieae	<i>Ceramium sp</i>	Loup	éradication t1	Ld	C8	na	<i>Ceramium sp</i>		
595	MAR2770	rouge	Bangiaceae	<i>Porphyra sp</i>	Loup	éradication t1	Ld	C8	na	<i>Pyropia sp. collinsii</i>		
596	MAR2771	rouge	Cystocloniaceae	<i>Calliblepharis ciliata</i>	Loup	éradication t1	Ld	C8	na	<i>Palmaria palmata</i>		
597	MAR2772	verte	Cladophoraceae	<i>Cladophora sp</i>	Loup	éradication t1	Ld	C8	na			
598	MAR2773	verte	Ulveae	<i>Ulva sp</i>	Loup	éradication t1	Ld	C9	28,2			
599	MAR2774	brune	Acinetosporaceae	<i>Pylaiella sp</i>	Loup	éradication t1	Ld	C9	1			
600	MAR2775	rouge	Palmarieae	<i>Palmaria palmata</i>	Loup	éradication t1	Ld	C9	0,35	<i>Palmaria palmata</i>		
601	MAR2776	rouge	Gigartineae	<i>Chondrus crispus</i>	Loup	éradication t1	Ld	C9	na	<i>Chondrus crispus</i>		
602	MAR2777	brune	Himanthaliaceae	<i>Himanthalia elongata</i>	Loup	éradication t1	Ld	C9	na			
603	MAR2778	rouge	Dictyotaee	<i>Dictyota dichotoma</i>	Loup	éradication t1	Ld	C9	na			
604	MAR2779	rouge	Rhodomeleae	<i>Osmundea pinnatifida</i>	Loup	éradication t1	Ld	C9	na			
605	MAR2780	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	Loup	éradication t1	Ld	C9	na	<i>Lomentaria articulata</i>		
606	MAR2781	rouge	Corallineae	<i>Corallina sp</i>	Loup	éradication t1	Ld	C9	na			
607	MAR2782	rouge	Ceramieae	<i>Ceramium sp</i>	Loup	éradication t1	Ld	C9	na	<i>Brongiartella2</i>		
608	MAR2783	rouge	Ceramieae	<i>Ceramium sp</i>	Loup	éradication t1	Ld	C9	na			
609	MAR2784	rouge	Ceramieae	<i>Ceramium sp</i>	Loup	éradication t1	Ld	C9	na	<i>Ceramium sp</i>		
610	MAR2785	rouge	Gracilariaceae	<i>Gracilaria sp</i>	Loup	éradication t1	Ld	C9	na	<i>Calliblepharis jubata</i>		
611	MAR2786	rouge	Cystocloniaceae	<i>Calliblepharis jubata</i>	Loup	éradication t1	Ld	C9	na	<i>Calliblepharis jubata</i>		
612	MAR2787	rouge	Cystocloniaceae	<i>Calliblepharis ciliata</i>	Loup	éradication t1	Ld	C9	na	<i>Palmaria palmata</i>		
613	MAR2788	rouge	Gelidiaceae	<i>Gelidium sp</i>	Loup	éradication t1	Ld	C9	na	<i>Gelidium sp</i>		
614	MAR2789	brune	Styocaulaceae	<i>Halopteris filicina</i>	Loup	éradication t1	Ld	C9	na			
615	MAR2790	rouge	Bangiaceae	<i>Porphyra sp</i>	Loup	éradication t1	Ld	C9	na			
616	MAR2791	rouge	Gigartineae	<i>Chondracanthus acicularis</i>	Loup	éradication t1	Ld	C9	na			
617	MAR2792	brune	Cladostephaceae	<i>Cladostephus spongiosus</i>	Loup	éradication t1	Ld	C9	na			
618	MAR2793	rouge	Gigartineae	<i>Chondracanthus acicularis</i>	Loup	éradication t1	Ld	D7	13,21	<i>Chondracanthus acicularis</i>		
619	MAR2794	rouge	Gigartineae	<i>Chondrus crispus</i>	Loup	éradication t1	Ld	D7	35,76			
620	MAR2795	rouge	Phylloporaceae	<i>Mastocarpus stellatus</i>	Loup	éradication t1	Ld	D7	5,43			
621	MAR2796	brune	Himanthaliaceae	<i>Himanthalia elongata</i>	Loup	éradication t1	Ld	D7	3,71			
622	MAR2797	verte	Ulveae	<i>Ulva sp</i>	Loup	éradication t1	Ld	D7	2,18			
623	MAR2798	rouge	Phylloporaceae	<i>Gymnogangrus sp</i>	Loup	éradication t1	Ld	D7	na	<i>Gymnogangrus crenulatus</i>		
624	MAR2799	rouge	Rhodomeleae	<i>Osmundea pinnatifida</i>	Loup	éradication t1	Ld	D7	na			
625	MAR2800	rouge	Bangiaceae	<i>Porphyra sp</i>	Loup	éradication t1	Ld	D7	na			
626	MAR2801	brune	Acinetosporaceae	<i>Pylaiella sp</i>	Loup	éradication t1	Ld	D7	na	<i>Pylaiella littoralis</i>		
627	MAR2802	verte	Ulveae	<i>Ulva sp</i>	Loup	éradication t1	Ld	D7	na			
628	MAR2803	brune	Fucaceae	<i>Fucus sp</i>	Loup	éradication t1	Ld	D7	na			
629	MAR2804	verte	Cladophoraceae	<i>Cladophora sp</i>	Loup	éradication t1	Ld	D7	na			
630	MAR2805	rouge	Gracilariaceae	<i>Gracilaria sp</i>	Loup	éradication t1	Ld	D7	na	<i>Gracilariopsis longissima</i>		
631	MAR2806	rouge	Palmarieae	<i>Palmaria palmata</i>	Loup	éradication t1	Ld	D7	na	<i>Palmaria palmata</i>		
632	MAR2807	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	Loup	éradication t1	Ld	D7	na	<i>Lomentaria articulata</i>		
633	MAR2808	rouge	Gelidiaceae	<i>Gelidium latifolium</i>	Loup	éradication t1	Ld	D7	na	<i>Gelidium sp</i>		
634												

Annexe 4

A	B	C	D	E	F	G	H	I	J	K	L
646	MAR2821	brune	Dictyotaceae	<i>Dictyota dichotoma</i>	Loup	éradication t1	Ld	D7	na		
647	MAR2822	rouge	Ahnfeltiaceae	<i>Ahnfeltia sp</i>	Loup	éradication t1	Ld	D7	na		
648	MAR2823	rouge	Delesseriaceae	<i>Apoglossum ruscifolium</i>	Loup	éradication t1	Ld	D7	na		
649	MAR2824	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	Loup	éradication t1	Ld	D7	na		
650	MAR2825	rouge	Gigartineae	<i>Chondrus crispus</i>	Loup	éradication t1	Ld	D8	21,24		
651	MAR2826	rouge	Furcellariaceae	<i>Furcellaria lumbricalis</i>	Loup	éradication t1	Ld	D8	1,03		
652	MAR2827	rouge	Cystocloniaceae	<i>Calliblepharis jubata</i>	Loup	éradication t1	Ld	D8	0,92	Calliblepharis jubata	
653	MAR2828	rouge	Corallinaceae	<i>Corallina sp</i>	Loup	éradication t1	Ld	D8	6,2		
654	MAR2829	rouge	Gigartineae	<i>Chondracanthus acicularis</i>	Loup	éradication t1	Ld	D8	3,73		Chondracanthus acicularis
655	MAR2830	brune	Cladostephaceae	<i>Cladostephus spongiosus</i>	Loup	éradication t1	Ld	D8	na		
656	MAR2831	rouge	Champiaceae	<i>Gastroclonium ovatum</i>	Loup	éradication t1	Ld	D8	na		
657	MAR2832	rouge	Bonnemaisoniaceae	<i>Bonnemaisonia asparagoides</i>	Loup	éradication t1	Ld	D8	na		
658	MAR2833	rouge	Plocamiaceae	<i>Plocamium sp</i>	Loup	éradication t1	Ld	D8	na		
659	MAR2834	rouge	Delesseriaceae	<i>Apoglossum ruscifolium</i>	Loup	éradication t1	Ld	D8	na	Apoglossum ruscifolium	
660	MAR2835	rouge	Wrangeliaceae	<i>Griffithsia corallinoides</i>	Loup	éradication t1	Ld	D8	na		
661	MAR2836	rouge	Ceramieaceae	<i>Ceramium sp</i>	Loup	éradication t1	Ld	D8	na		
662	MAR2837	rouge	Ceramieaceae	<i>Ceramium sp</i>	Loup	éradication t1	Ld	D8	na		Ceramium sp
663	MAR2838	rouge	Ceramieaceae	<i>Ceramium sp</i>	Loup	éradication t1	Ld	D8	na		
664	MAR2839	rouge	Graclariaceae	<i>Graclaria sp</i>	Loup	éradication t1	Ld	D8	na		
665	MAR2840	rouge	Gelidiaceae	<i>Gelidium carneum</i>	Loup	éradication t1	Ld	D8	na		
666	MAR2841	rouge	Bangiaceae	<i>Porphyra sp</i>	Loup	éradication t1	Ld	D8	na	Pyropia sp. collinsii	
667	MAR2842	rouge	Phylloporaceae	<i>Phyllophora pseudoceranoides</i>	Loup	éradication t1	Ld	D8	na		
668	MAR2843	rouge	Rhodymeniaceae	<i>Rhodymenia holmesii</i>	Loup	éradication t1	Ld	D8	na		
669	MAR2844	rouge	Rhodymeniaceae	<i>Rhodymenia pseudopalmeta</i>	Loup	éradication t1	Ld	D8	na		
670	MAR2845	verte	Ulveae	<i>Ulva sp</i>	Loup	éradication t1	Ld	D8	na		
671	MAR2846	verte	Ulveae	<i>Ulva sp</i>	Loup	éradication t1	Ld	D8	na		
672	MAR2847	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	Loup	éradication t1	Ld	D8	na		Cryptopleura ramosa
673	MAR2848	verte	Cladophoraceae	<i>Cladophora sp</i>	Loup	éradication t1	Ld	D8	na		
674	MAR2849	brune	Himanthaliaceae	<i>Himanthalia elongata</i>	Loup	éradication t1	Ld	D8	na		
675	MAR2850	rouge	Kallymeniaceae	<i>Collophylis laciniata</i>	Loup	éradication t1	Ld	D8	na		
676	MAR2851	brune	Acinetosporaceae	<i>Pyloiella sp</i>	Loup	éradication t1	Ld	D8	na	Pyloiella littoralis	
677	MAR2852	rouge	Dumontiaceae	<i>Dilsea carmosa</i>	Loup	éradication t1	Ld	D8	na		Polyneura bonnemaisonii
678	MAR2853	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	Loup	éradication t1	Ld	D8	na		Lomentaria articulata
679	MAR2854	brune	Fuaceae	<i>Fucus sp</i>	Loup	éradication t1	Ld	D8	na		
680	MAR2855	rouge	Phylloporaceae	<i>Gymnogongrus sp</i>	Loup	éradication t1	Ld	D8	na		Gymnogongrus crenulatus
681	MAR2856	rouge	Palmarieae	<i>Palmaria palmata</i>	Loup	éradication t1	Ld	D8	na		
682	MAR2857	rouge	Rhodomelaceae	<i>Osmundea pinnatifida</i>	Loup	éradication t1	Ld	D8	na		
683	MAR2858	rouge	Graclariaceae	<i>Graclaria sp</i>	Loup	éradication t1	Ld	D8	na		Gracilariopsis longissima
684	MAR2859	rouge	Phylloporaceae	<i>Mastocarpus stellatus</i>	Loup	éradication t1	Ld	D9	26,8+32,27	Mastocarpus stellatus1	
685	MAR2860	brune	Himanthaliaceae	<i>Himanthalia elongata</i>	Loup	éradication t1	Ld	D9	13,75		
686	MAR2861	rouge	Rhodomelaceae	<i>Osmundea pinnatifida</i>	Loup	éradication t1	Ld	D9	6,13		
687	MAR2862	rouge	Champiaceae	<i>Chylocladia verticillata</i>	Loup	éradication t1	Ld	D9	3,99		
688	MAR2863	rouge	Gigartineae	<i>Chondrus crispus</i>	Loup	éradication t1	Ld	D9	6,06		
689	MAR2864	brune	Sargassaceae	<i>Bifurcaria bifurcata</i>	Loup	éradication t1	Ld	D9	na	Bifurcaria bifurcata	
690	MAR2865	brune	Fuaceae	<i>Fucus sp</i>	Loup	éradication t1	Ld	D9	na		
691	MAR2866	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	Loup	éradication t1	Ld	D9	na		
692	MAR2867	rouge	Furcellariaceae	<i>Furcellaria lumbricalis</i>	Loup	éradication t1	Ld	D9	na		Furcellaria lumbricalis
693	MAR2868	verte	Ulveae	<i>Ulva sp</i>	Loup	éradication t1	Ld	D9	na		
694	MAR2869	rouge	Gigartineae	<i>Chondracanthus acicularis</i>	Loup	éradication t1	Ld	D9	na		Chondracanthus acicularis
695	MAR2870	rouge	Bangiaceae	<i>Porphyra sp</i>	Loup	éradication t1	Ld	D9	na		Pyropia leucosticta
696	MAR2871	rouge	Ceramieaceae	<i>Ceramium sp</i>	Loup	éradication t1	Ld	D9	na		Pyropia leucosticta
697	MAR2872	rouge	Ceramieaceae	<i>Ceramium sp</i>	Loup	éradication t1	Ld	D9	na		Caulacanthus ustulatus
698	MAR2873	rouge	Corallinaceae	<i>Corallina sp</i>	Loup	éradication t1	Ld	D9	na		
699	MAR2874	rouge	Gelidiaceae	<i>Gelidium sp</i>	Loup	éradication t1	Ld	D9	na		
700	MAR2875	rouge	Gelidiaceae	<i>Gelidium sp</i>	Loup	éradication t1	Ld	D9	na		
701	MAR2876	rouge	Rhodymeniaceae	<i>Rhodymenia holmesii</i>	Loup	éradication t1	Ld	D9	na		
702	MAR2877	brune	Dictyotaceae	<i>Dictyota dichotoma</i>	Loup	éradication t1	Ld	D9	na		
703	MAR2878	brune	Scytosiphonaceae	<i>Calpomenia peregrina</i>	Loup	éradication t1	Ld	D9	na		
704	MAR2879	verte	Cladophoraceae	<i>Cladophora sp</i>	Loup	éradication t1	Ld	D9	na		
705	MAR2880	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	Loup	éradication t1	Ld	D9	na		Acrosorium sp
706	MAR2881	rouge	Sphaerococcaceae	<i>Sphaerococcus coronopifolius</i>	Loup	éradication t1	Ld	D9	na		
707	MAR2882	rouge	Plocamiaceae	<i>Plocamium sp</i>	Loup	éradication t1	Ld	D9	na		
708	MAR2883	rouge	Graclariaceae	<i>Graclaria sp</i>	Loup	éradication t1	Ld	D9	na		Osmundea sp
709	MAR2884	rouge	Graclariaceae	<i>Graclaria sp</i>	Loup	éradication t1	Ld	D9	na		
710	MAR2885	brune	Acinetosporaceae	<i>Pyloiella sp</i>	Loup	éradication t1	Ld	D9	na	Pyloiella littoralis	
711	MAR2886	brune	Cladostephaceae	<i>Cladostephus spongiosus</i>	Loup	éradication t1	Ld	D9	na		
712	MAR2887	rouge	Cystocloniaceae	<i>Calliblepharis jubata</i>	Loup	éradication t1	Ld	D9	na		Calliblepharis jubata
713	MAR2888	rouge	Champiaceae	<i>Gastroclonium ovatum</i>	Loup	éradication t1	Ld	D9	na		Gastroclonium ovatum
714	MAR2889	rouge	Ahnfeltiaceae	<i>Ahnfeltia plicata</i>	Loup	éradication t1	Ld	D9	na		Ahnfeltia plicata
715	MAR2890	rouge	Palmarieae	<i>Palmaria palmata</i>	Loup	éradication t1	Ld	D9	na		
716	MAR2891	verte	Ulveae	<i>Ulva sp</i>	Loup	éradication t2	Ld	B1	5,54		
717	MAR2892	rouge	Gigartineae	<i>Chondrus crispus</i>	Loup	éradication t2	Ld	B1	2,83		Chondrus crispus
718	MAR2893	rouge	Phylloporaceae	<i>Mastocarpus stellatus</i>	Loup	éradication t2	Ld	B1	5,33	Mastocarpus stellatus1	
719	MAR2894	brune	Himanthaliaceae	<i>Himanthalia elongata</i>	Loup	éradication t2	Ld	B1	2,62		
720	MAR2895	rouge	Gigartineae	<i>Chondracanthus acicularis</i>	Loup	éradication t2	Ld	B1	4,41		
721	MAR2896	rouge	Graclariaceae	<i>Graclaria sp</i>	Loup	éradication t2	Ld	B1	na		
722	MAR2897	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	Loup	éradication t2	Ld	B1	na		Cryptopleura ramosa
723	MAR2898	rouge	Phylloporaceae	<i>Gymnogongrus sp</i>	Loup	éradication t2	Ld	B1	na		Gymnogongrus crenulatus
724	MAR2899	brune	Dictyotaceae	<i>Dictyota dichotoma</i>	Loup	éradication t2	Ld	B1	na		
725	MAR2900	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	Loup	éradication t2	Ld	B1	na		Lomentaria articulata
726	MAR2901	rouge	Corallinaceae	<i>Corallina sp</i>	Loup	éradication t2	Ld	B1	na		
727	MAR2902	brune	Cladostephaceae	<i>Cladostephus spongiosus</i>	Loup	éradication t2	Ld	B1	na		
728	MAR2903	rouge	Dasyaceae	<i>Heterosiphonia plumosa</i>	Loup	éradication t2	Ld	B1	na		
729	MAR2904	rouge	Bonnemaisoniaceae	<i>Asparagopsis armata</i>	Loup	éradication t2	Ld	B1	na		
730	MAR2905	verte	Ulveae	<i>Ulva olivascens</i>	Loup	éradication t2	Ld	B1	na		
731	MAR2906	rouge	Champiaceae	<i>Gastroclonium ovatum</i>	Loup	éradication t2	Ld	B1	na		Gastroclonium ovatum
732	MAR2907	verte	Cladophoraceae	<i>Cladophora sp</i>	Loup	éradication t2	Ld	B1	na		
733	MAR2908	rouge	Furcellariaceae	<i>Furcellaria lumbricalis</i>	Loup	éradication t2	Ld	B1	na		Furcellaria lumbricalis
734	MAR2909	rouge	Rhodomelaceae	<i>Osmundea pinnatifida</i>	Loup	éradication t2	Ld	B1	na		
735	MAR2910	rouge	Gelidiaceae	<i>Gelidium sp</i>	Loup	éradication t2	Ld	B1	na		
736	MAR2911	rouge	Ceramieaceae	<i>Ceramium sp</i>	Loup	éradication t2	Ld	B1	na		Brongiartella3
737	MAR2912	rouge	Ceramieaceae	<i>Ceramium sp</i>	Loup	éradication t2	Ld	B1	na		
738	MAR2913	verte	Ulveae	<i>Ulva sp</i>	Loup	éradication t2	Ld	B1	na		
739	MAR2914	brune	Laminariaceae	<i>Saccharina latissima</i>	Loup	éradication t2	Ld	B1	na		Palmaria palmata
740	MAR2915	rouge	Palmarieae	<i>Palmaria palmata</i>	Loup	éradication t2	Ld	B1	na		Palmaria palmata
741	MAR2916	brune	Desmarestiaceae	<i>Desmarestia aciculata</i>	Loup	éradication t2	Ld	B1	na		
742	MAR2917	rouge	Delesseriaceae	<i>Apoglossum ruscifolium</i>	Loup	éradication t2	Ld	B1	na	Apoglossum ruscifolium	
743	MAR2918	rouge	Delesseriaceae	<i>Hypoglossum hypoglossoides</i>	Loup	éradication t2	Ld	B1	na		
744	MAR2919	rouge	Ahnfeltiaceae	<i>Ahnfeltia plicata</i>	Loup	éradication t2	Ld	B1	na		
745	MAR2920	rouge	Cystocloniaceae	<i>Calliblepharis jubata</i>	Loup	éradication t2	Ld	B1	na		Calliblepharis jubata
746	MAR2921	rouge	Plocamiaceae	<i>Plocamium sp</i>	Loup	éradication t2	Ld	B1	na		Plocamium nanum
747	MAR2922	verte	Ulveae	<i>Ulva sp</i>	Loup	éradication t2	Ld	B2	20,08		
748	MAR2923	verte	Ulveae	<i>Ulva sp</i>	Loup	éradication t2	Ld	B2	5,67		
749	MAR2924	brune	Laminariaceae	<i>Saccharina latissima</i>	Loup	éradication t2	Ld	B2	0,48		
750	MAR2925	brune	Phyllariaceae	<i>Saccorhiza polyschides</i>	Loup	éradication t2	Ld	B2	4,56		
751	MAR2926	brune	Himanthaliaceae	<i>Himanthalia elongata</i>	Loup	éradication t2	Ld	B2	1,31		
752	MAR2927	rouge	Ceramieaceae	<i>Ceramium sp</i>	Loup	éradication t2	Ld	B2	na		Ceramium sp
753	MAR2928	rouge	Ceramieaceae	<i>Ceramium sp</i>	Loup	éradication t2	Ld	B2	na		Ceramium sp
7											

Annexe 4

	A	B	C	D	E	F	G	H	I	J	K	L
775	MAR2950	rouge	Palmaria	<i>Palmaria palmata</i>	Loup	éradication t2	Ld	B3	na		<i>Palmaria palmata</i>	
776	MAR2951	rouge	Gelidiaceae	<i>Gelidium sp</i>	Loup	éradication t2	Ld	B3	na			
777	MAR2952	rouge	Gelidiaceae	<i>Gelidium sp</i>	Loup	éradication t2	Ld	B3	na			
778	MAR2953	rouge	Phylloporaceae	<i>Gymnogongrus sp</i>	Loup	éradication t2	Ld	B3	na	<i>Gymnogongrus crenulatus</i>		
779	MAR2954	rouge	Ceramiales	<i>Ceramium sp</i>	Loup	éradication t2	Ld	B3	na			
780	MAR2955	brune	Sargassaceae	<i>Cystoseira sp</i>	Loup	éradication t2	Ld	B3	na			
781	MAR2956	brune	Fucaceae	<i>Fucus sp</i>	Loup	éradication t2	Ld	B3	na			
782	MAR2957	rouge	Champiaceae	<i>Gastroclonium ovatum</i>	Loup	éradication t2	Ld	B3	na			
783	MAR2958	verte	Cladophoraceae	<i>Cladophora sp</i>	Loup	éradication t2	Ld	B3	na			
784	MAR2959	verte	Cladophoraceae	<i>Cladophora sp</i>	Loup	éradication t2	Ld	B3	na			
785	MAR2960	brune	Cladostephaceae	<i>Cladostephus spongiosus</i>	Loup	éradication t2	Ld	B3	na			
786	MAR2961	brune	Desmarestiaceae	<i>Desmarestia oculata</i>	Loup	éradication t2	Ld	B3	na			
787	MAR2962	rouge	Corallinales	<i>Corallina sp</i>	Loup	éradication t2	Ld	B3	na			
788	MAR2963	rouge	Gracilariaceae	<i>Gracilaria sp</i>	Loup	éradication t2	Ld	B3	na	<i>Calliblepharis jubata</i>		
789	MAR2964	brune	Acinetosporaceae	<i>Pylaiella sp</i>	Loup	éradication t2	Ld	B3	na			
790	MAR2965	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	Loup	éradication t2	Ld	B3	na		<i>Cryptopleura ramosa</i>	
791	MAR2966	verte	Ulveae	<i>Ulva olivascens</i>	Loup	éradication t2	Ld	B3	na			
792	MAR2967	brune	Dictyotaceae	<i>Dictyota dichotoma</i>	Loup	éradication t2	Ld	B3	na			
793	MAR2968	rouge	Furcellariaceae	<i>Furcellaria lumbricalis</i>	Loup	éradication t2	Ld	B3	na		<i>Furcellaria lumbricalis</i>	
794	MAR2969	rouge	Rhodomeleaceae	<i>Osmundea pinnatifida</i>	Loup	éradication t2	Ld	B3	na	<i>Osmundea osmunda</i>		
795	MAR2970	brune	Phyllariaceae	<i>Saccorhiza polyschides</i>	Loup	éradication t2	Ld	C1	35,49			
796	MAR2971	verte	Ulveae	<i>Ulva sp</i>	Loup	éradication t2	Ld	C1	9,75			
797	MAR2972	rouge	Ulveae	<i>Ulva sp</i>	Loup	éradication t2	Ld	C1	8,65			
798	MAR2973	rouge	Gigartinaceae	<i>Chondrus crispus</i>	Loup	éradication t2	Ld	C1	5,59		<i>Chondrus crispus</i>	
799	MAR2974	rouge	Gelidiaceae	<i>Gelidium sp</i>	Loup	éradication t2	Ld	C1	1,53		<i>Gelidium sp</i>	
800	MAR2975	brune	Himanthaliaceae	<i>Himanthalia elongata</i>	Loup	éradication t2	Ld	C1	na			
801	MAR2976	rouge	Phylloporaceae	<i>Gymnogongrus sp</i>	Loup	éradication t2	Ld	C1	na	<i>Ahnfeltopsis devoniensis</i>		
802	MAR2977	rouge	Indéterminé	<i>non identifié</i>	Loup	éradication t2	Ld	C1	na	<i>Boergesenella fruticulosa</i>		
803	MAR2978	rouge	Gigartinaceae	<i>Chondracanthus acicularis</i>	Loup	éradication t2	Ld	C1	na		<i>Chondracanthus acicularis</i>	
804	MAR2979	verte	Ulveae	<i>Ulva olivascens</i>	Loup	éradication t2	Ld	C1	na			
805	MAR2980	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	Loup	éradication t2	Ld	C1	na			
806	MAR2981	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	Loup	éradication t2	Ld	C1	na		<i>Callophyllis laciniata</i>	
807	MAR2982	brune	Dictyotaceae	<i>Dictyota dichotoma</i>	Loup	éradication t2	Ld	C1	na			
808	MAR2983	rouge	Delesseriaceae	<i>Apoglossum ruscfolium</i>	Loup	éradication t2	Ld	C1	na			
809	MAR2984	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	Loup	éradication t2	Ld	C1	na			
810	MAR2985	rouge	Corallinales	<i>Corallina sp</i>	Loup	éradication t2	Ld	C1	na			
811	MAR2986	rouge	Cystocloniaceae	<i>Calliblepharis jubata</i>	Loup	éradication t2	Ld	C1	na	<i>Calliblepharis jubata</i>		
812	MAR2987	rouge	Gracilariaceae	<i>Gracilaria sp</i>	Loup	éradication t2	Ld	C1	na			
813	MAR2988	rouge	Rhodomeleaceae	<i>Osmundea pinnatifida</i>	Loup	éradication t2	Ld	C1	na	<i>Osmundea osmunda</i>		
814	MAR2989	rouge	Ceramiales	<i>Ceramium sp</i>	Loup	éradication t2	Ld	C1	na			
815	MAR2990	rouge	Palmaria	<i>Palmaria palmata</i>	Loup	éradication t2	Ld	C1	na		<i>Palmaria palmata</i>	
816	MAR2991	verte	Cladophoraceae	<i>Cladophora sp</i>	Loup	éradication t2	Ld	C1	na			
817	MAR2992	verte	Cladophoraceae	<i>Cladophora sp</i>	Loup	éradication t2	Ld	C1	na			
818	MAR2993	rouge	Kallymeniaceae	<i>Kallymenia reniformis</i>	Loup	éradication t2	Ld	C1	na			
819	MAR2994	brune	Acinetosporaceae	<i>Pylaiella sp</i>	Loup	éradication t2	Ld	C1	na	<i>Pylaiella littoralis</i>		
820	MAR2995	rouge	Phylloporaceae	<i>Mastocarpus stellatus</i>	Loup	éradication t2	Ld	C1	na	<i>Chondrus crispus</i>		
821	MAR2996	rouge	Plocamiaceae	<i>Plocanium sp</i>	Loup	éradication t2	Ld	C1	na	<i>Plocanium lyngbyanum</i>		
822	MAR2997	rouge	Bonnemaisoniaceae	<i>Bonnemaisonia asparagoides</i>	Loup	éradication t2	Ld	C1	na			
823	MAR2998	brune	Laminariaceae	<i>Saccharina latissima</i>	Loup	éradication t2	Ld	C1	na	<i>Saccharina latissima</i>		
824	MAR2999	brune	Phyllariaceae	<i>Saccorhiza polyschides</i>	Loup	éradication t2	Ld	C2	29,3			
825	MAR3000	rouge	Gigartinaceae	<i>Chondrus crispus</i>	Loup	éradication t2	Ld	C2	22,22		<i>Chondrus crispus</i>	
826	MAR3001	brune	Himanthaliaceae	<i>Himanthalia elongata</i>	Loup	éradication t2	Ld	C2	2,44			
827	MAR3002	verte	Ulveae	<i>Ulva sp</i>	Loup	éradication t2	Ld	C2	8,12			
828	MAR3003	verte	Ulveae	<i>Ulva sp</i>	Loup	éradication t2	Ld	C2	6,39			
829	MAR3004	rouge	Champiaceae	<i>Champia parvula</i>	Loup	éradication t2	Ld	C2	na			
830	MAR3005	rouge	Delesseriaceae	<i>Hypoglossum hypoglossoides</i>	Loup	éradication t2	Ld	C2	na			
831	MAR3006	rouge	Ceramiales	<i>Ceramium sp</i>	Loup	éradication t2	Ld	C2	na		<i>Ceramium sp</i>	
832	MAR3007	rouge	Ceramiales	<i>Ceramium sp</i>	Loup	éradication t2	Ld	C2	na			
833	MAR3008	brune	Cladostephaceae	<i>Cladostephus spongiosus</i>	Loup	éradication t2	Ld	C2	na			
834	MAR3009	rouge	Dasyaceae	<i>Heterosiphonia plumosa</i>	Loup	éradication t2	Ld	C2	na			
835	MAR3010	rouge	Palmaria	<i>Palmaria palmata</i>	Loup	éradication t2	Ld	C2	na	<i>Palmaria palmata</i>		
836	MAR3011	rouge	Kallymeniaceae	<i>Kallymenia reniformis</i>	Loup	éradication t2	Ld	C2	na	<i>Palmaria palmata</i>		
837	MAR3012	verte	Cladophoraceae	<i>Cladophora sp</i>	Loup	éradication t2	Ld	C2	na			
838	MAR3013	rouge	Gigartinaceae	<i>Chondracanthus acicularis</i>	Loup	éradication t2	Ld	C2	na			
839	MAR3014	rouge	Ahnfeltiaceae	<i>Ahnfeltia plicata</i>	Loup	éradication t2	Ld	C2	na			
840	MAR3015	brune	Fucaceae	<i>Fucus sp</i>	Loup	éradication t2	Ld	C2	na			
841	MAR3016	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	Loup	éradication t2	Ld	C2	na	<i>Cryptopleura ramosa</i>		
842	MAR3017	rouge	Delesseriaceae	<i>Polynura bonnemaisonii</i>	Loup	éradication t2	Ld	C2	na			
843	MAR3018	verte	Ulveae	<i>Ulva olivascens</i>	Loup	éradication t2	Ld	C2	na			
844	MAR3019	rouge	Cystocloniaceae	<i>Calliblepharis jubata</i>	Loup	éradication t2	Ld	C2	na	<i>Calliblepharis jubata</i>		
845	MAR3020	rouge	Phylloporaceae	<i>Mastocarpus stellatus</i>	Loup	éradication t2	Ld	C2	na	<i>Mastocarpus stellatus2</i>		
846	MAR3021	rouge	Gracilariaceae	<i>Gracilaria sp</i>	Loup	éradication t2	Ld	C2	na	<i>Calliblepharis jubata</i>		
847	MAR3022	rouge	Furcellariaceae	<i>Furcellaria lumbricalis</i>	Loup	éradication t2	Ld	C2	na	<i>Furcellaria lumbricalis</i>		
848	MAR3023	brune	Scytosiphonaceae	<i>Calpomonia peregrina</i>	Loup	éradication t2	Ld	C2	na			
849	MAR3024	brune	Dictyotaceae	<i>Dictyota dichotoma</i>	Loup	éradication t2	Ld	C2	na			
850	MAR3025	rouge	Rhodomeleaceae	<i>Osmundea pinnatifida</i>	Loup	éradication t2	Ld	C2	na			
851	MAR3026	rouge	Corallinales	<i>Corallina sp</i>	Loup	éradication t2	Ld	C2	na			
852	MAR3027	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	Loup	éradication t2	Ld	C2	na		<i>Lomentaria articulata</i>	
853	MAR3028	rouge	Gelidiaceae	<i>Gelidium sp</i>	Loup	éradication t2	Ld	C2	na			
854	MAR3029	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	Loup	éradication t2	Ld	C2	na			
855	MAR3030	rouge	Phylloporaceae	<i>Gymnogongrus sp</i>	Loup	éradication t2	Ld	C2	na			
856	MAR3031	rouge	Ceramiales	<i>Ceramiales</i>	Loup	éradication t2	Ld	C2	na	<i>Polysiphonia2</i>		
857	MAR3032	rouge	Cystocloniaceae	<i>Cystoclonium purpureum</i>	Loup	éradication t2	Ld	C2	na			
858	MAR3033	rouge	Ceramiales	<i>Ceramiales</i>	Loup	éradication t2	Ld	C2	na			
859	MAR3034	rouge	Ceramiales	<i>Ceramiales</i>	Loup	éradication t2	Ld	C2	na			
860	MAR3035	rouge	Gelidiaceae	<i>Gelidium sp</i>	Loup	éradication t2	Ld	C2	na			
861	MAR3036	rouge	Sphaerococcaceae	<i>Sphaerococcus coronopifolius</i>	Loup	éradication t2	Ld	C2	na			
862	MAR3037	brune	Laminariaceae	<i>Saccharina latissima</i>	Loup	éradication t2	Ld	C3	2,94			
863	MAR3038	brune	Phyllariaceae	<i>Saccorhiza polyschides</i>	Loup	éradication t2	Ld	C3	1,07			
864	MAR3039	verte	Ulveae	<i>Ulva sp</i>	Loup	éradication t2	Ld	C3	6,32			
865	MAR3040	verte	Ulveae	<i>Ulva sp</i>	Loup	éradication t2	Ld	C3	15,85			
866	MAR3041	rouge	Palmaria	<i>Palmaria palmata</i>	Loup	éradication t2	Ld	C3	2,32		<i>Palmaria palmata</i>	
867	MAR3042	rouge	Gigartinaceae	<i>Chondrus crispus</i>	Loup	éradication t2	Ld	C3	na			
868	MAR3043	brune	Himanthaliaceae	<i>Himanthalia elongata</i>	Loup	éradication t2	Ld	C3	na			
869	MAR3044	verte	Ulveae	<i>Ulva olivascens</i>	Loup	éradication t2	Ld	C3	na			
870	MAR3045	rouge	Delesseriaceae	<i>Hypoglossum hypoglossoides</i>	Loup	éradication t2	Ld	C3	na			
871	MAR3046	rouge	Champiaceae	<i>Gastroclonium ovatum</i>	Loup	éradication t2	Ld	C3	na			
872	MAR3047	rouge	Gigartinaceae	<i>Chondracanthus acicularis</i>	Loup	éradication t2	Ld	C3	na			
873	MAR3048	rouge	Gracilariaceae	<i>Gracilaria sp</i>	Loup	éradication t2	Ld	C3	na			
874	MAR3049	brune	Sargassaceae	<i>Cystoseira sp</i>	Loup	éradication t2	Ld	C3	na			
875	MAR3050	rouge	Gelidiaceae	<i>Gelidium sp</i>	Loup	éradication t2	Ld	C3	na			
876	MAR3051	brune	Fucaceae	<i>Fucus sp</i>	Loup	éradication t2	Ld	C3	na			
877	MAR3052	rouge	Ceramiales	<i>Ceramium sp</i>	Loup	éradication t2	Ld	C3	na		<i>Ceramium sp</i>	
878	MAR3053	brune	Desmarestiaceae</									

Annexe 4

	A	B	C	D	E	F	G	H	I	J	K	L
904	MAR3079	rouge	Dasyaceae	<i>Heterosiphonia plumosa</i>	Loup	éradication t2	Ld	D1	na			
905	MAR3080	rouge	Cystocloniaceae	<i>Calliblepharis jubata</i>	Loup	éradication t2	Ld	D1	na	<i>Calliblepharis jubata</i>		
906	MAR3081	rouge	Bonnemaisoniaceae	<i>Bonnemaisonia asparagoides</i>	Loup	éradication t2	Ld	D1	na			
907	MAR3082	rouge	Indéterminée	non identifiée	Loup	éradication t2	Ld	D1	na			
908	MAR3083	rouge	Indéterminée	non identifiée	Loup	éradication t2	Ld	D1	na	<i>Neosiphonia flavimarina</i>		
909	MAR3084	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	Loup	éradication t2	Ld	D1	na			<i>Lomentaria articulata</i>
910	MAR3085	verte	Cladophoraceae	<i>Cladophora sp</i>	Loup	éradication t2	Ld	D1	na			
911	MAR3086	rouge	Gracilariaceae	<i>Gracilaria sp</i>	Loup	éradication t2	Ld	D1	na			<i>Chondria scintillans</i>
912	MAR3087	rouge	Corallinaceae	<i>Corallina sp</i>	Loup	éradication t2	Ld	D1	na			
913	MAR3088	rouge	Furcellariaceae	<i>Furcellaria lumbricalis</i>	Loup	éradication t2	Ld	D1	na			<i>Furcellaria lumbricalis</i>
914	MAR3089	rouge	Gigartiniaceae	<i>Chondracanthus acicularis</i>	Loup	éradication t2	Ld	D1	na			<i>Chondracanthus acicularis</i>
915	MAR3090	rouge	Ceramiales	<i>Ceramium sp</i>	Loup	éradication t2	Ld	D1	na			
916	MAR3091	rouge	Ceramiales	<i>Ceramium sp</i>	Loup	éradication t2	Ld	D1	na	<i>Ceramium secundatum</i>		
917	MAR3092	rouge	Indéterminée	non identifiée	Loup	éradication t2	Ld	D1	na	<i>Ceramium secundatum</i>		
918	MAR3093	rouge	Gigartiniaceae	<i>Chondrus crispus</i>	Loup	éradication t2	Ld	D2	60,8			<i>Chondrus crispus</i>
919	MAR3094	brune	Himanthaliaceae	<i>Himanthalia elongata</i>	Loup	éradication t2	Ld	D2	0,38			
920	MAR3095	verte	Ulveae	<i>Ulva sp</i>	Loup	éradication t2	Ld	D2	1,14			
921	MAR3096	rouge	Phylloporaceae	<i>Gymnogongrus sp</i>	Loup	éradication t2	Ld	D2	0,83			
922	MAR3097	brune	Fucales	<i>Fucus serratus</i>	Loup	éradication t2	Ld	D2	0,24	<i>Sargassum muticum</i>		
923	MAR3098	rouge	Gelidiaceae	<i>Gelidium sp</i>	Loup	éradication t2	Ld	D2	na			
924	MAR3099	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	Loup	éradication t2	Ld	D2	na			<i>Cryptopleura ramosa</i>
925	MAR3100	verte	Ulveae	<i>Ulva sp</i>	Loup	éradication t2	Ld	D2	na			
926	MAR3101	verte	Cladophoraceae	<i>Lola sp</i>	Loup	éradication t2	Ld	D2	na			
927	MAR3102	rouge	Cladophoraceae	<i>Cladophora sp</i>	Loup	éradication t2	Ld	D2	na			
928	MAR3103	brune	Sargassaceae	<i>Sargassum muticum</i>	Loup	éradication t2	Ld	D2	na			
929	MAR3104	rouge	Rhodomeleaceae	<i>Osmundea pinnatifida</i>	Loup	éradication t2	Ld	D2	na			
930	MAR3105	brune	Desmarestiaceae	<i>Desmarestia aciculata</i>	Loup	éradication t2	Ld	D2	na			
931	MAR3106	rouge	Corallinaceae	<i>Corallina sp</i>	Loup	éradication t2	Ld	D2	na			
932	MAR3107	brune	Cladostephaceae	<i>Cladostephus spongiosus</i>	Loup	éradication t2	Ld	D2	na			
933	MAR3108	rouge	Ceramiales	<i>Ceramium sp</i>	Loup	éradication t2	Ld	D2	na			
934	MAR3109	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	Loup	éradication t2	Ld	D2	na			
935	MAR3110	rouge	Ceramiales	<i>Ceramium sp</i>	Loup	éradication t2	Ld	D2	na			
936	MAR3111	brune	Acinetosporaceae	<i>Pylaiella sp</i>	Loup	éradication t2	Ld	D2	na	<i>Pylaiella littoralis</i>		
937	MAR3112	rouge	Cystocloniaceae	<i>Calliblepharis jubata</i>	Loup	éradication t2	Ld	D2	na	<i>Calliblepharis jubata</i>		
938	MAR3113	brune	Dictyotaceae	<i>Dictyota dichotoma</i>	Loup	éradication t2	Ld	D2	na			
939	MAR3114	rouge	Gracilariaceae	<i>Gracilaria sp</i>	Loup	éradication t2	Ld	D2	na			
940	MAR3115	rouge	Gigartiniaceae	<i>Chondracanthus acicularis</i>	Loup	éradication t2	Ld	D2	na			
941	MAR3116	rouge	Plocamiaceae	<i>Plocamium sp</i>	Loup	éradication t2	Ld	D2	na			<i>Plocamium cartilagineum</i>
942	MAR3117	rouge	Ahnfeltiaceae	<i>Ahnfeltia plicata</i>	Loup	éradication t2	Ld	D2	na			<i>Ahnfeltia plicata</i>
943	MAR3118	rouge	Delesseriaceae	<i>Hypoglossum hypoglossoides</i>	Loup	éradication t2	Ld	D2	na			
944	MAR3119	rouge	Palmaria	<i>Palmaria palmata</i>	Loup	éradication t2	Ld	D2	na			
945	MAR3120	rouge	Delesseriaceae	<i>Apoglossum ruscfolium</i>	Loup	éradication t2	Ld	D2	na			
946	MAR3121	rouge	Bonnemaisoniaceae	<i>Asparagopsis armata</i>	Loup	éradication t2	Ld	D2	na			
947	MAR3122	rouge	Bonnemaisoniaceae	<i>Bonnemaisonia asparagoides</i>	Loup	éradication t2	Ld	D2	na			
948	MAR3123	rouge	Himanthaliaceae	<i>Himanthalia elongata</i>	Loup	éradication t2	Ld	D3	659,18	<i>Himanthalia elongata</i>		
949	MAR3124	rouge	Gigartiniaceae	<i>Chondrus crispus</i>	Loup	éradication t2	Ld	D3	74,91			<i>Chondrus crispus</i>
950	MAR3125	rouge	Phylloporaceae	<i>Mastocarpus stellatus</i>	Loup	éradication t2	Ld	D3	64	<i>Mastocarpus stellatus2</i>		
951	MAR3126	rouge	Ceramiales	<i>Ceramium sp</i>	Loup	éradication t2	Ld	D3	8,36	<i>Ceramium secundatum</i>		
952	MAR3127	rouge	Gigartiniaceae	<i>Chondracanthus acicularis</i>	Loup	éradication t2	Ld	D3	13,21			<i>Chondracanthus acicularis</i>
953	MAR3128	rouge	Palmaria	<i>Palmaria palmata</i>	Loup	éradication t2	Ld	D3	na	<i>Palmaria palmata</i>		
954	MAR3129	rouge	Corallinaceae	<i>Corallina sp</i>	Loup	éradication t2	Ld	D3	na			
955	MAR3130	brune	Sargassaceae	<i>Sargassum muticum</i>	Loup	éradication t2	Ld	D3	na			
956	MAR3131	verte	Cladophoraceae	<i>Lola sp</i>	Loup	éradication t2	Ld	D3	na			
957	MAR3132	verte	Ulveae	<i>Ulva sp</i>	Loup	éradication t2	Ld	D3	na			
958	MAR3133	verte	Ulveae	<i>Ulva sp</i>	Loup	éradication t2	Ld	D3	na			
959	MAR3134	rouge	Cladophoraceae	<i>Cladophora sp</i>	Loup	éradication t2	Ld	D3	na			
960	MAR3135	brune	Cladostephaceae	<i>Cladostephus spongiosus</i>	Loup	éradication t2	Ld	D3	na			
961	MAR3136	verte	Ulveae	<i>Ulva olivascens</i>	Loup	éradication t2	Ld	D3	na			
962	MAR3137	rouge	Furcellariaceae	<i>Furcellaria lumbricalis</i>	Loup	éradication t2	Ld	D3	na			<i>Furcellaria lumbricalis</i>
963	MAR3138	rouge	Cystocloniaceae	<i>Calliblepharis jubata</i>	Loup	éradication t2	Ld	D3	na	<i>Calliblepharis jubata</i>		
964	MAR3139	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	Loup	éradication t2	Ld	D3	na	<i>Lomentaria articulata</i>		
965	MAR3140	rouge	Indéterminée	non identifiée	Loup	éradication t2	Ld	D3	na	<i>Calliblepharis jubata</i>		
966	MAR3141	rouge	Gelidiaceae	<i>Gelidium sp</i>	Loup	éradication t2	Ld	D3	na			
967	MAR3142	brune	Dictyotaceae	<i>Dictyota dichotoma</i>	Loup	éradication t2	Ld	D3	na			
968	MAR3143	rouge	Gracilariaceae	<i>Gracilaria sp</i>	Loup	éradication t2	Ld	D3	na	<i>Chondria scintillans</i>		
969	MAR3144	rouge	Delesseriaceae	<i>Hypoglossum hypoglossoides</i>	Loup	éradication t2	Ld	D3	na			
970	MAR3145	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	Loup	éradication t2	Ld	D3	na			<i>Cryptopleura ramosa</i>
971	MAR3146	rouge	Bonnemaisoniaceae	<i>Bonnemaisonia asparagoides</i>	Loup	éradication t2	Ld	D3	na	<i>Callithamnion sp</i>		
972	MAR3147	rouge	Phylloporaceae	<i>Gymnogongrus sp</i>	Loup	éradication t2	Ld	D3	na	<i>Gymnogongrus crenulatus</i>		
973	MAR3148	rouge	Ahnfeltiaceae	<i>Ahnfeltia plicata</i>	Loup	éradication t2	Ld	D3	na			
974	MAR3149	brune	Acinetosporaceae	<i>Pylaiella sp</i>	Loup	éradication t2	Ld	D3	na	<i>Ectocarpus fasciculatus</i>		
975	MAR3150	rouge	Indéterminée	non identifiée	Loup	éradication t2	Ld	D3	na			
976	MAR3151	rouge	Wangeliaceae	<i>Plumaria elegans</i>	Loup	éradication t2	Ld	D3	na	<i>Neosiphonia harveyi</i>		
977	MAR3152	rouge	Ceramiales	<i>Ceramium sp</i>	Loup	éradication t2	Ld	D3	na			<i>Ceramium sp</i>
978	MAR3153	rouge	Ceramiales	<i>Ceramiales</i>	Loup	éradication t2	Ld	D3	na			
979	MAR3154	verte	Ulveae	<i>Ulva sp</i>	Loup	éradication t3	Ld	B4	8,95			
980	MAR3155	rouge	Gigartiniaceae	<i>Chondracanthus acicularis</i>	Loup	éradication t3	Ld	B4	0,55			
981	MAR3156	rouge	Gigartiniaceae	<i>Chondrus crispus</i>	Loup	éradication t3	Ld	B4	0,95	<i>Chondrus crispus</i>		
982	MAR3157	brune	Himanthaliaceae	<i>Himanthalia elongata</i>	Loup	éradication t3	Ld	B4	0,40			
983	MAR3158	rouge	Rhodomeleaceae	<i>Osmundea pinnatifida</i>	Loup	éradication t3	Ld	B4	0,05			
984	MAR3159	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	Loup	éradication t3	Ld	B4	na	<i>Lomentaria articulata</i>		
985	MAR3160	rouge	Champiaceae	<i>Gastroclonium ovatum</i>	Loup	éradication t3	Ld	B4	na			
986	MAR3161	rouge	Corallinaceae	<i>Corallina sp</i>	Loup	éradication t3	Ld	B4	na			
987	MAR3162	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	Loup	éradication t3	Ld	B4	na	<i>Cryptopleura ramosa</i>		
988	MAR3163	brune	Acinetosporaceae	<i>Pylaiella sp</i>	Loup	éradication t3	Ld	B4	na			<i>Palmaria palmata</i>
989	MAR3164	rouge	Palmaria	<i>Palmaria palmata</i>	Loup	éradication t3	Ld	B4	na			
990	MAR3165	rouge	Phylloporaceae	<i>Gymnogongrus sp</i>	Loup	éradication t3	Ld	B4	na	<i>Gymnogongrus crenulatus</i>		
991	MAR3166	rouge	Ceramiales	<i>Ceramium sp</i>	Loup	éradication t3	Ld	B4	na	<i>Ceramium secundatum</i>		
992	MAR3167	brune	Fucales	<i>Fucus serratus</i>	Loup	éradication t3	Ld	B4	na	<i>Fucus serratus</i>		
993	MAR3168	rouge	Cystocloniaceae	<i>Calliblepharis jubata</i>	Loup	éradication t3	Ld	B4	na	<i>Calliblepharis jubata</i>		
994	MAR3169	brune	Cladostephaceae	<i>Cladostephus spongiosus</i>	Loup	éradication t3	Ld	B4	na			
995	MAR3170	rouge	Delesseriaceae	<i>Apoglossum ruscfolium</i>	Loup	éradication t3	Ld	B4	na			
996	MAR3171	rouge	Dasyaceae	<i>Heterosiphonia japonica</i>	Loup	éradication t3	Ld	B4	na			
997	MAR3172	brune	Phyllariaceae	<i>Saccorhiza polyschides</i>	Loup	éradication t3	Ld	B5	65,20			
998	MAR3173	brune	Laminariaceae	<i>Saccharina latissima</i>	Loup	éradication t3	Ld	B5	61,65	<i>Saccharina latissima</i>		
999	MAR3174	verte	Ulveae	<i>Ulva sp</i>	Loup	éradication t3	Ld	B5	2,96			
1000	MAR3175	rouge	Cystocloniaceae	<i>Calliblepharis jubata</i>	Loup	éradication t3	Ld	B5	0,54	<i>Calliblepharis jubata</i>		
1001	MAR3176	rouge	Gigartiniaceae	<i>Chondrus crispus</i>	Loup	éradication t3	Ld	B5	1,96			
1002	MAR3177	rouge	Furcellariaceae	<i>Furcellaria lumbricalis</i>	Loup	éradication t3	Ld	B5	na	<i>Furcellaria lumbricalis</i>		
1003	MAR3178	rouge	Gigartiniaceae	<i>Chondracanthus acicularis</i>	Loup	éradication t3	Ld	B5	na	<i>Chondracanthus acicularis</i>		
1004	MAR3179	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	Loup	éradication t3	Ld	B5	na			
1005	MAR3180	rouge	Gracilariaceae	<i>Gracilaria sp</i>	Loup	éradication t3	Ld	B5	na			
1006	MAR3181	rouge	Corallinaceae	<i>Corallina sp</i>	Loup	éradication t3	Ld	B5	na			
1007	MAR3182	rouge	Ceramiales	<i>Ceramium sp</i>	Loup	éradication t3	Ld	B5	na	<i>Polysiphonia elongata</i>		
1008	MAR3183	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	Loup	éradication t3	Ld	B5	na	<i>Palmaria palmata</i>		
1009	MAR3184	brune	Sargassaceae	<i>Sargassum muticum</i>	Loup	éradication t3	Ld	B5	na			
1010	MAR3185	rouge	Champiaceae	<i>Gastroclonium ovatum</i>	Loup	éradication t3	Ld	B5	na	<i>Gastroclonium ovatum</i>		
1011	MAR3186	verte	Cladophoraceae	<i>Cladophora sp</i>	Loup	éradication t3	Ld	B5	na			
1012	MAR3187	brune	Fucales	<i>Fucus serratus</i>	Loup	éradication t3	Ld	B5	na	<i>Fucus serratus</i>		
1013	MAR3188	rouge	Phylloporaceae	<i>Gymnogongrus sp</i>	Loup	éradication t3	Ld	B5	na	<i>Ahnfeltiopsis devoniensis</i>		
1014	MAR3189	brune	Himanthaliaceae	<i>Himanthalia elongata</i>	Loup	éradication t3	Ld	B5	na	<i>Himanthalia elongata</i>		
1015	MAR3190	rouge	Dasyaceae	<i>Heterosiphonia japonica</i>	Loup	éradication t3	Ld	B5	na	<i>Rhodomela confervoides</i>		
1016	MAR3191	rouge	Delesseriaceae	<i>Apoglossum ruscfolium</i>	Loup	éradication t3	Ld	B5	na			<i>Palmaria palmata</i>
1017	MAR3192	rouge	Gelidiaceae	<i>Gelidium sp</i>	Loup	éradication t3	Ld	B5	na			
1018	MAR3193	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	Loup	éradication t3	Ld	B5	na	<i>Callophyllis laciniata</i>		
1019	MAR3194	rouge	Gelidiaceae	<i>Gelidium sp</i>	Loup	éradication t3	Ld	B5	na			
1020	MAR3195	br										

Annexe 4

	A	B	C	D	E	F	G	H	I	J	K	L
1033	MAR3208	rouge	Phylloporaceae	<i>Phyllophora pseudoceranoides</i>	Loup	éradication t3	Ld	B6	na			
1034	MAR3209	rouge	Rhodomeleaceae	<i>Polysiphonia sp</i>	Loup	éradication t3	Ld	B6	na	<i>Collithamnion sp</i>		
1035	MAR3210	rouge	Dasyaceae	<i>Heterosiphonia plumosa</i>	Loup	éradication t3	Ld	B6	na	<i>Heterosiphonia plumosa</i>		
1036	MAR3211	rouge	Champiaceae	<i>Gastroclonium ovatum</i>	Loup	éradication t3	Ld	B6	na			
1037	MAR3212	rouge	Gigartineae	<i>Chondrus crispus</i>	Loup	éradication t3	Ld	B6	na			<i>Chondrus crispus</i>
1038	MAR3213	rouge	Gracilariaceae	<i>Gracilaria sp</i>	Loup	éradication t3	Ld	B6	na			<i>Chondria scintillans</i>
1039	MAR3214	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	Loup	éradication t3	Ld	B6	na			<i>Lomentaria articulata</i>
1040	MAR3215	brune	Cladostephaceae	<i>Cladostephus spongiosus</i>	Loup	éradication t3	Ld	B6	na			
1041	MAR3216	brune	Fucaeae	<i>Fucus serratus</i>	Loup	éradication t3	Ld	B6	na	<i>Fucus serratus</i>		
1042	MAR3217	brune	Stypocaulaceae	<i>Halopteris filicina</i>	Loup	éradication t3	Ld	B6	na			
1043	MAR3218	rouge	Furcellariaceae	<i>Furcellaria lumbricalis</i>	Loup	éradication t3	Ld	B6	na			<i>Furcellaria lumbricalis</i>
1044	MAR3219	rouge	Delesseriaceae	<i>Delesseriaceae</i>	Loup	éradication t3	Ld	B6	na			<i>Cryptopleura ramosa</i>
1045	MAR3220	rouge	Phylloporaceae	<i>Gymnogangrus sp</i>	Loup	éradication t3	Ld	B6	na			
1046	MAR3221	brune	Dictyoteae	<i>Dictyota dichotoma</i>	Loup	éradication t3	Ld	B6	na			
1047	MAR3222	rouge	Delesseriaceae	<i>Apoglossum ruscifolium</i>	Loup	éradication t3	Ld	B6	na			
1048	MAR3223	rouge	Delesseriaceae	<i>Hypoglossum hypoglossoides</i>	Loup	éradication t3	Ld	B6	na			
1049	MAR3224	rouge	Ceramiaceae	<i>Ceramium sp</i>	Loup	éradication t3	Ld	B6	na			
1050	MAR3225	verte	Ulvaeeae	<i>Ulvaria sp</i>	Loup	éradication t3	Ld	B6	na			
1051	MAR3226	verte	Ulvaeeae	<i>Ulva sp</i>	Loup	éradication t3	Ld	C4	1,63			
1052	MAR3227	rouge	Gigartineae	<i>Chondrus crispus</i>	Loup	éradication t3	Ld	C4	2,34			
1053	MAR3228	brune	Himanthaliaceae	<i>Himanthalia elongata</i>	Loup	éradication t3	Ld	C4	2,13	<i>Himanthalia elongata</i>		
1054	MAR3229	rouge	Phyllariaceae	<i>Saccorhiza polyschides</i>	Loup	éradication t3	Ld	C4	1,77			
1055	MAR3230	rouge	Palmariaeeae	<i>Palmaria palmata</i>	Loup	éradication t3	Ld	C4	0,42			<i>Palmaria palmata</i>
1056	MAR3231	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	Loup	éradication t3	Ld	C4	na			
1057	MAR3232	verte	Bryopsidaceae	<i>Bryopsis plumosa</i>	Loup	éradication t3	Ld	C4	na			
1058	MAR3233	rouge	Phylloporaceae	<i>Mastocarpus stellatus</i>	Loup	éradication t3	Ld	C4	na	<i>Chondrus crispus</i>		
1059	MAR3234	rouge	Delesseriaceae	<i>Apoglossum ruscifolium</i>	Loup	éradication t3	Ld	C4	na			<i>Mastocarpus stellatus</i>
1060	MAR3235	brune	Cladostephaceae	<i>Cladostephus spongiosus</i>	Loup	éradication t3	Ld	C4	na			
1061	MAR3236	brune	Fucaeae	<i>Fucus serratus</i>	Loup	éradication t3	Ld	C4	na	<i>Fucus serratus</i>		
1062	MAR3237	verte	Cladophoraceae	<i>Cladophora sp</i>	Loup	éradication t3	Ld	C4	na			
1063	MAR3238	brune	Stypocaulaceae	<i>Halopteris filicina</i>	Loup	éradication t3	Ld	C4	na			
1064	MAR3239	brune	Sargassaceae	<i>Sargassum muticum</i>	Loup	éradication t3	Ld	C4	na			
1065	MAR3240	rouge	Champiaceae	<i>Gastroclonium ovatum</i>	Loup	éradication t3	Ld	C4	na	<i>Gastroclonium ovatum</i>		
1066	MAR3241	verte	Cladophoraceae	<i>Cladophora sp</i>	Loup	éradication t3	Ld	C4	na			
1067	MAR3242	rouge	Cystocloniaceae	<i>Calliblepharis jubata</i>	Loup	éradication t3	Ld	C4	na	<i>Calliblepharis jubata</i>		
1068	MAR3243	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	Loup	éradication t3	Ld	C4	na			
1069	MAR3244	rouge	Plocamiaceae	<i>Plocamium sp</i>	Loup	éradication t3	Ld	C4	na	<i>Plocamium cartilagineum</i>		
1070	MAR3245	rouge	Phylloporaceae	<i>Gymnogangrus sp</i>	Loup	éradication t3	Ld	C4	na	<i>Ahnfeltiopsis devoniensis</i>		
1071	MAR3246	rouge	Ceramiaceae	<i>Ceramium sp</i>	Loup	éradication t3	Ld	C4	na			
1072	MAR3247	rouge	Ceramiaceae	<i>Ceramium sp</i>	Loup	éradication t3	Ld	C4	na			<i>Brongniartella?</i>
1073	MAR3248	rouge	Corallineae	<i>Corallina sp</i>	Loup	éradication t3	Ld	C4	na			
1074	MAR3249	rouge	Delesseriaceae	<i>Delesseriaceae</i>	Loup	éradication t3	Ld	C4	na			
1075	MAR3250	rouge	Rhodomeleaceae	<i>Osmundea pinnatifida</i>	Loup	éradication t3	Ld	C4	na			
1076	MAR3251	rouge	Gelidiaceae	<i>Gelidium sp</i>	Loup	éradication t3	Ld	C4	na			
1077	MAR3252	rouge	Gelidiaceae	<i>Gelidium sp</i>	Loup	éradication t3	Ld	C4	na			
1078	MAR3253	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	Loup	éradication t3	Ld	C4	na			
1079	MAR3254	rouge	Gigartineae	<i>Chondracanthus acicularis</i>	Loup	éradication t3	Ld	C4	na			
1080	MAR3255	rouge	Delesseriaceae	<i>Hypoglossum hypoglossoides</i>	Loup	éradication t3	Ld	C4	na			
1081	MAR3256	brune	Laminariaceae	<i>Saccharina latissima</i>	Loup	éradication t3	Ld	C5	4,60			
1082	MAR3257	verte	Ulvaeeae	<i>Ulva sp</i>	Loup	éradication t3	Ld	C5	6,20			
1083	MAR3258	rouge	Palmariaeeae	<i>Palmaria palmata</i>	Loup	éradication t3	Ld	C5	4,30			<i>Palmaria palmata</i>
1084	MAR3259	rouge	Gigartineae	<i>Chondrus crispus</i>	Loup	éradication t3	Ld	C5	3,30			<i>Chondrus crispus</i>
1085	MAR3260	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	Loup	éradication t3	Ld	C5	0,05			
1086	MAR3261	rouge	Rhodomeleaceae	<i>Osmundea pinnatifida</i>	Loup	éradication t3	Ld	C5	na	<i>Osmundea osmunda</i>		
1087	MAR3262	rouge	Ceramiaceae	<i>Ceramium sp</i>	Loup	éradication t3	Ld	C5	na	<i>Polysiphonia elongata</i>		
1088	MAR3263	rouge	Ceramiaceae	<i>Ceramium sp</i>	Loup	éradication t3	Ld	C5	na			
1089	MAR3264	rouge	Gigartineae	<i>Chondracanthus acicularis</i>	Loup	éradication t3	Ld	C5	na			<i>Chondracanthus acicularis</i>
1090	MAR3265	brune	Himanthaliaceae	<i>Himanthalia elongata</i>	Loup	éradication t3	Ld	C5	na	<i>Himanthalia elongata</i>		
1091	MAR3266	rouge	Corallineae	<i>Corallina sp</i>	Loup	éradication t3	Ld	C5	na			
1092	MAR3267	brune	Fucaeae	<i>Fucus serratus</i>	Loup	éradication t3	Ld	C5	na	<i>Fucus serratus</i>		
1093	MAR3268	rouge	Gelidiaceae	<i>Gelidium sp</i>	Loup	éradication t3	Ld	C5	na			
1094	MAR3269	rouge	Phylloporaceae	<i>Mastocarpus stellatus</i>	Loup	éradication t3	Ld	C5	na	<i>Mastocarpus stellatus?</i>		
1095	MAR3270	rouge	Delesseriaceae	<i>Hypoglossum hypoglossoides</i>	Loup	éradication t3	Ld	C5	na	<i>Palmaria palmata</i>		
1096	MAR3271	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	Loup	éradication t3	Ld	C5	na	<i>Cryptopleura ramosa</i>		
1097	MAR3272	rouge	Cystocloniaceae	<i>Calliblepharis jubata</i>	Loup	éradication t3	Ld	C5	na			
1098	MAR3273	rouge	Phylloporaceae	<i>Gymnogangrus sp</i>	Loup	éradication t3	Ld	C5	na	<i>Ahnfeltiopsis devoniensis</i>		
1099	MAR3274	rouge	Delesseriaceae	<i>Delesseriaceae</i>	Loup	éradication t3	Ld	C5	na	<i>Rhodophyllis?</i>		
1100	MAR3275	verte	Ulvaeeae	<i>Ulva sp</i>	Loup	éradication t3	Ld	C5	na			
1101	MAR3276	rouge	Gracilariaceae	<i>Gracilaria sp</i>	Loup	éradication t3	Ld	C5	na	<i>Palmaria palmata</i>		
1102	MAR3277	verte	Ulvaeeae	<i>Ulva sp</i>	Loup	éradication t3	Ld	C5	11,14			
1103	MAR3278	rouge	Cystocloniaceae	<i>Calliblepharis jubata</i>	Loup	éradication t3	Ld	C6	0,37	<i>Calliblepharis jubata</i>		
1104	MAR3279	rouge	Gigartineae	<i>Chondracanthus acicularis</i>	Loup	éradication t3	Ld	C6	0,61			<i>Chondracanthus acicularis</i>
1105	MAR3280	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	Loup	éradication t3	Ld	C6	0,24			
1106	MAR3281	rouge	Phylloporaceae	<i>Gymnogangrus sp</i>	Loup	éradication t3	Ld	C6	0,32	<i>Ahnfeltiopsis devoniensis</i>		
1107	MAR3282	brune	Himanthaliaceae	<i>Himanthalia elongata</i>	Loup	éradication t3	Ld	C6	na	<i>Himanthalia elongata</i>		
1108	MAR3283	rouge	Palmariaeeae	<i>Palmaria palmata</i>	Loup	éradication t3	Ld	C6	na	<i>Palmaria palmata</i>		
1109	MAR3284	verte	Cladophoraceae	<i>Cladophora sp</i>	Loup	éradication t3	Ld	C6	na			
1110	MAR3285	rouge	Champiaceae	<i>Gastroclonium ovatum</i>	Loup	éradication t3	Ld	C6	na			
1111	MAR3286	rouge	Rhodomeleaceae	<i>Osmundea pinnatifida</i>	Loup	éradication t3	Ld	C6	na			
1112	MAR3287	rouge	Delesseriaceae	<i>Hypoglossum hypoglossoides</i>	Loup	éradication t3	Ld	C6	na			<i>Laminaria hyperborea</i>
1113	MAR3288	rouge	Furcellariaceae	<i>Furcellaria lumbricalis</i>	Loup	éradication t3	Ld	C6	na	<i>Furcellaria lumbricalis</i>		
1114	MAR3289	rouge	Corallineae	<i>Corallina sp</i>	Loup	éradication t3	Ld	C6	na			
1115	MAR3290	rouge	Dasyaceae	<i>Heterosiphonia japonica</i>	Loup	éradication t3	Ld	C6	na	<i>Rhodomele confervoides</i>		
1116	MAR3291	rouge	Ceramiaceae	<i>Ceramium sp</i>	Loup	éradication t3	Ld	C6	na	<i>Ceramium secundatum</i>		
1117	MAR3292	rouge	Ceramiaceae	<i>Ceramium sp</i>	Loup	éradication t3	Ld	C6	na	<i>Polysiphonia elongata</i>		
1118	MAR3293	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	Loup	éradication t3	Ld	C6	na	<i>Lomentaria articulata</i>		
1119	MAR3294	rouge	Plocamiaceae	<i>Plocamium sp</i>	Loup	éradication t3	Ld	C6	na	<i>Plocamium cartilagineum</i>		
1120	MAR3295	rouge	Gracilariaceae	<i>Gracilaria sp</i>	Loup	éradication t3	Ld	C6	na			
1121	MAR3296	brune	Sargassaceae	<i>Sargassum muticum</i>	Loup	éradication t3	Ld	C6	na	<i>Cystoseira baccata</i>		
1122	MAR3297	rouge	Delesseriaceae	<i>Apoglossum ruscifolium</i>	Loup	éradication t3	Ld	C6	na	<i>Apoglossum ruscifolium</i>		
1123	MAR3298	rouge	Delesseriaceae	<i>Delesseria sanguinea</i>	Loup	éradication t3	Ld	C6	na			
1124	MAR3299	rouge	Lomentariaceae	<i>Lomentaria clavellosa</i>	Loup	éradication t3	Ld	C6	na			
1125	MAR3300	brune	Himanthaliaceae	<i>Himanthalia elongata</i>	Loup	éradication t3	Ld	D4	10,60			
1126	MAR3301	rouge	Rhodomeleaceae	<i>Osmundea pinnatifida</i>	Loup	éradication t3	Ld	D4	1,95	<i>Osmundea pinnatifida</i>		
1127	MAR3302	rouge	Gigartineae	<i>Chondrus crispus</i>	Loup	éradication t3	Ld	D4	2,75			<i>Chondrus crispus</i>
1128	MAR3303	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	Loup	éradication t3	Ld	D4	0,55	<i>Lomentaria articulata</i>		
1129	MAR3304	rouge	Gigartineae	<i>Chondracanthus acicularis</i>	Loup	éradication t3	Ld	D4	1,35			<i>Chondracanthus acicularis</i>
1130	MAR3305	rouge	Phylloporaceae	<i>Mastocarpus stellatus</i>	Loup	éradication t3	Ld	D4	na	<i>Mastocarpus stellatus?</i>		
1131	MAR3306	rouge	Palmariaeeae	<i>Palmaria palmata</i>	Loup	éradication t3	Ld	D4	na	<i>Palmaria palmata</i>		
1132	MAR3307	brune	Fucaeae	<i>Fucus serratus</i>	Loup	éradication t3	Ld	D4	na			
1133	MAR3308	rouge	Gelidiaceae	<i>Gelidium sp</i>	Loup	éradication t3	Ld	D4	na			
1134	MAR3309	rouge	Champiaceae	<i>Gastroclonium ovatum</i>	Loup	éradication t3	Ld	D4	na			
1135	MAR3310	rouge	Bonnemaisoniaceae	<i>Bonnemaisonia asparagoides</i>	Loup	éradication t3	Ld	D4	na	<i>Plumaria plumosa</i>		
1136	MAR3311	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	Loup	éradication t3	Ld	D4	na			<i>Cryptopleura ramosa</i>
1137	MAR3312	verte	Ulvaeeae	<i>Ulva sp</i>	Loup	éradication t3	Ld	D4	na			
1138	MAR3313	verte	Cladophoraceae	<i>Cladophora sp</i>	Loup	éradication t3	Ld	D4	na			
1139	MAR3314	rouge	Cystocloniaceae	<i>Calliblepharis jubata</i>	Loup	éradication t3	Ld	D4	na	<i>Calliblepharis jubata</i>		
1140	MAR3315	rouge	Corallineae	<i>Corallina sp</i>	Loup	éradication t3	Ld	D4	na			
1141	MAR3316	brune	Acinetosporaceae	<i>Pylaiella sp</i>	Loup	éradication t3	Ld	D4	na	<i>Pylaiella littoralis</i>		
1142	MAR3317	rouge	Gigartineae	<i>Chondrus crispus</i>	Loup	éradication t3	Ld	D5	75,63			<i>Chondrus crispus</i>
1143	MAR3318	rouge	Phylloporaceae	<i>Mastocarpus stellatus</i>	Loup	éradication t3	Ld	D5	45,08	<i>Mastocarpus stellatus?</i>		
1144	MAR3319	brune	Himanthaliaceae	<i>Himanthalia elongata</i>	Loup	éradication t3	Ld	D5	10,60			
1145	MAR3320	rouge	Gigartineae	<i>Chondracanthus acicularis</i>	Loup	éradication t3	Ld	D5	7,36			<i>Chondracanthus acicularis</i>
1146	MAR3321	verte	Cladophoraceae	<i>Cladophora sp</i>	Loup	éradication t3	Ld	D5	3,12			
1147	MAR332											

Annexe 4

	A	B	C	D	E	F	G	H	I	J	K	L
1162	MAR3337	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	Loup	éradication t3	Ld	D5	na			
1163	MAR3338	rouge	Palmariaaceae	<i>Palmaria palmata</i>	Loup	éradication t3	Ld	D5	na			
1164	MAR3339	brune	Himanthaliaceae	<i>Himanthalia elongata</i>	Loup	éradication t3	Ld	D6	57,29			
1165	MAR3340	rouge	Gigartineae	<i>Chondrus crispus</i>	Loup	éradication t3	Ld	D6	15,84		<i>Chondrus crispus</i>	
1166	MAR3341	rouge	Phylloporaceae	<i>Mastocarpus stellatus</i>	Loup	éradication t3	Ld	D6	8,58		<i>Mastocarpus stellatus</i> 2	
1167	MAR3342	rouge	Gigartineae	<i>Chondracanthus acicularis</i>	Loup	éradication t3	Ld	D6	8,66			
1168	MAR3343	brune	Acinetosporaceae	<i>Pyloella sp</i>	Loup	éradication t3	Ld	D6	8,33			
1169	MAR3344	rouge	Delesseriaceae	<i>Apoglossum rusCIFolium</i>	Loup	éradication t3	Ld	D6	na			
1170	MAR3345	rouge	Gigartineae	<i>Gigartina pistillata</i>	Loup	éradication t3	Ld	D6	na			
1171	MAR3346	brune	Cladostephaceae	<i>Cladostephus spongiosus</i>	Loup	éradication t3	Ld	D6	na			
1172	MAR3347	rouge	Ceramieaceae	<i>Ceramium sp</i>	Loup	éradication t3	Ld	D6	na			
1173	MAR3348	rouge	Champiaceae	<i>Gastroclonium ovatum</i>	Loup	éradication t3	Ld	D6	na			
1174	MAR3349	rouge	Corallineae	<i>Corallina sp</i>	Loup	éradication t3	Ld	D6	na			
1175	MAR3350	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	Loup	éradication t3	Ld	D6	na		<i>Rhodophyllis3</i>	
1176	MAR3351	rouge	Gelidiaceae	<i>Gelidium sp</i>	Loup	éradication t3	Ld	D6	na		<i>Gelidium spinosum</i>	
1177	MAR3352	brune	Desmarestiaceae	<i>Desmarestia sp</i>	Loup	éradication t3	Ld	D6	na			
1178	MAR3353	rouge	Dasyaceae	<i>Heterosiphonia plumosa</i>	Loup	éradication t3	Ld	D6	na			
1179	MAR3354	brune	Sargassaceae	<i>Bifurcaria bifurcata</i>	Loup	éradication t3	Ld	D6	na		<i>Chondrus crispus</i>	
1180	MAR3355	rouge	Furcellariaceae	<i>Furcellaria lumbricalis</i>	Loup	éradication t3	Ld	D6	na		<i>Meredithia microphylla</i>	
1181	MAR3356	rouge	Rhodomeleaceae	<i>Osmundea pinnatifida</i>	Loup	éradication t3	Ld	D6	na		<i>Osmundea pinnatifida</i>	
1182	MAR3357	rouge	Cystocloniaceae	<i>Calliblepharis jubata</i>	Loup	éradication t3	Ld	D6	na			
1183	MAR3358	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	Loup	éradication t3	Ld	D6	na		<i>Lomentaria articulata</i>	
1184	MAR3359	rouge	Gelidiaceae	<i>Gelidium sp</i>	Loup	éradication t3	Ld	D6	na			
1185	MAR3360	rouge	Palmariaaceae	<i>Palmaria palmata</i>	Loup	éradication t3	Ld	D6	na			
1186	MAR3361	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	Loup	éradication t3	Ld	D6	na			
1187	MAR3362	verte	Cladophoraceae	<i>Cladophora sp</i>	Loup	éradication t3	Ld	D6	na			
1188	MAR3363	verte	Ulveaceae	<i>Ulva sp</i>	Loup	éradication t3	Ld	D6	na			
1189	MAR3364	rouge	Ceramieaceae	<i>Ceramium sp</i>	Loup	éradication t3	Ld	D6	na		<i>Griffithsia sp</i>	
1190	MAR3393	verte	Ulveaceae	<i>Ulva sp</i>	Loup	éradication t4	Ld	B10	19,89			
1191	MAR3394	rouge	Gigartineae	<i>Chondrus crispus</i>	Loup	éradication t4	Ld	B10	15,97			
1192	MAR3395	brune	Himanthaliaceae	<i>Himanthalia elongata</i>	Loup	éradication t4	Ld	B10	6,69			
1193	MAR3396	rouge	Phylloporaceae	<i>Mastocarpus stellatus</i>	Loup	éradication t4	Ld	B10	5,66			
1194	MAR3397	rouge	Gigartineae	<i>Chondracanthus acicularis</i>	Loup	éradication t4	Ld	B10	6,09			
1195	MAR3398	rouge	Ceramieaceae	<i>Ceramium sp</i>	Loup	éradication t4	Ld	B10	na			
1196	MAR3399	rouge	Ceramieaceae	<i>Ceramium sp</i>	Loup	éradication t4	Ld	B10	na			
1197	MAR3400	rouge	Ceramieaceae	<i>Ceramium sp</i>	Loup	éradication t4	Ld	B10	na			
1198	MAR3401	rouge	Ceramieaceae	<i>Ceramium sp</i>	Loup	éradication t4	Ld	B10	na			
1199	MAR3402	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	Loup	éradication t4	Ld	B10	na			
1200	MAR3403	brune	Sargassaceae	<i>Bifurcaria bifurcata</i>	Loup	éradication t4	Ld	B10	na			
1201	MAR3404	rouge	Palmariaaceae	<i>Palmaria palmata</i>	Loup	éradication t4	Ld	B10	na			
1202	MAR3405	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	Loup	éradication t4	Ld	B10	na			
1203	MAR3406	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	Loup	éradication t4	Ld	B10	na			
1204	MAR3407	rouge	Gelidiaceae	<i>Gelidium sp</i>	Loup	éradication t4	Ld	B10	na			
1205	MAR3408	rouge	Gelidiaceae	<i>Gelidium sp</i>	Loup	éradication t4	Ld	B10	na			
1206	MAR3409	brune	Acinetosporaceae	<i>Pyloella sp</i>	Loup	éradication t4	Ld	B10	na			
1207	MAR3410	brune	Fucaceae	<i>Fucus serratus</i>	Loup	éradication t4	Ld	B10	na			
1208	MAR3411	verte	Cladophoraceae	<i>Cladophora sp</i>	Loup	éradication t4	Ld	B10	na			
1209	MAR3412	rouge	Rhodomeleaceae	<i>Polysiphonia sp</i>	Loup	éradication t4	Ld	B10	na			
1210	MAR3413	rouge	Rhodymeniaceae	<i>Rhodymenia pseudopalmeta</i>	Loup	éradication t4	Ld	B10	na			
1211	MAR3414	brune	Cladostephaceae	<i>Cladostephus spongiosus</i>	Loup	éradication t4	Ld	B10	na			
1212	MAR3415	rouge	Champiaceae	<i>Gastroclonium ovatum</i>	Loup	éradication t4	Ld	B10	na			
1213	MAR3416	rouge	Cystocloniaceae	<i>Calliblepharis jubata</i>	Loup	éradication t4	Ld	B10	na			
1214	MAR3417	rouge	Phylloporaceae	<i>Gymnogongrus crenulatus</i>	Loup	éradication t4	Ld	B10	na			
1215	MAR3418	rouge	Rhodomeleaceae	<i>Osmundea pinnatifida</i>	Loup	éradication t4	Ld	B10	na			
1216	MAR3419	verte	Cladophoraceae	<i>Lola complexa</i>	Loup	éradication t4	Ld	B10	na			
1217	MAR3420	rouge	Palmariaaceae	<i>Palmaria palmata</i>	Loup	éradication t4	Ld	B12	4,69			
1218	MAR3421	verte	Ulveaceae	<i>Ulva sp</i>	Loup	éradication t4	Ld	B12	4,92			
1219	MAR3422	rouge	Cystocloniaceae	<i>Calliblepharis jubata</i>	Loup	éradication t4	Ld	B12	1,42			
1220	MAR3423	rouge	Gigartineae	<i>Chondracanthus acicularis</i>	Loup	éradication t4	Ld	B12	3,5			
1221	MAR3424	brune	Himanthaliaceae	<i>Himanthalia elongata</i>	Loup	éradication t4	Ld	B12	2,24			
1222	MAR3425	rouge	Dasyaceae	<i>Heterosiphonia japonica</i>	Loup	éradication t4	Ld	B12	na			
1223	MAR3426	rouge	Gigartineae	<i>Chondrus crispus</i>	Loup	éradication t4	Ld	B12	na			
1224	MAR3427	rouge	Plocamiaceae	<i>Plocamium sp</i>	Loup	éradication t4	Ld	B12	na			
1225	MAR3428	rouge	Ceramieaceae	<i>Ceramium sp</i>	Loup	éradication t4	Ld	B12	na			
1226	MAR3429	rouge	Gelidiaceae	<i>Gelidium sp</i>	Loup	éradication t4	Ld	B12	na			
1227	MAR3430	rouge	Phylloporaceae	<i>Gymnogongrus crenulatus</i>	Loup	éradication t4	Ld	B12	na			
1228	MAR3431	rouge	Delesseriaceae	<i>Delesseriaceae</i>	Loup	éradication t4	Ld	B12	na			
1229	MAR3432	rouge	Ahnfeltiaceae	<i>Ahnfeltia plicata</i>	Loup	éradication t4	Ld	B12	na			
1230	MAR3433	rouge	Ceramieaceae	<i>Ceramium sp</i>	Loup	éradication t4	Ld	B12	na			
1231	MAR3434	rouge	Champiaceae	<i>Gastroclonium ovatum</i>	Loup	éradication t4	Ld	B12	na			
1232	MAR3435	verte	Cladophoraceae	<i>Cladophora sp</i>	Loup	éradication t4	Ld	B12	na			
1233	MAR3436	rouge	Corallineae	<i>Corallina sp</i>	Loup	éradication t4	Ld	B12	na			
1234	MAR3437	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	Loup	éradication t4	Ld	B12	na			
1235	MAR3438	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	Loup	éradication t4	Ld	B12	na			
1236	MAR3439	rouge	Rhodomeleaceae	<i>Osmundea pinnatifida</i>	Loup	éradication t4	Ld	B12	na			
1237	MAR3440	rouge	Furcellariaceae	<i>Furcellaria lumbricalis</i>	Loup	éradication t4	Ld	B12	na			
1238	MAR3441	rouge	Dasyaceae	<i>Heterosiphonia plumosa</i>	Loup	éradication t4	Ld	B12	na			
1239	MAR3442	brune	Laminariaceae	<i>Laminaria digitata</i>	Loup	éradication t4	Ld	C10	46,8			
1240	MAR3443	rouge	Gigartineae	<i>Chondrus crispus</i>	Loup	éradication t4	Ld	C10	12,95			
1241	MAR3444	rouge	Palmariaaceae	<i>Palmaria palmata</i>	Loup	éradication t4	Ld	C10	4,29			
1242	MAR3445	rouge	Rhodomeleaceae	<i>Osmundea pinnatifida</i>	Loup	éradication t4	Ld	C10	1,4			
1243	MAR3446	brune	Himanthaliaceae	<i>Himanthalia elongata</i>	Loup	éradication t4	Ld	C10	3,65			
1244	MAR3447	rouge	Gelidiaceae	<i>Gelidium sp</i>	Loup	éradication t4	Ld	C10	na			
1245	MAR3448	rouge	Gelidiaceae	<i>Gelidium sp</i>	Loup	éradication t4	Ld	C10	na			
1246	MAR3449	verte	Ulveaceae	<i>Ulva sp</i>	Loup	éradication t4	Ld	C10	na			
1247	MAR3450	rouge	Champiaceae	<i>Chylocladia verticillata</i>	Loup	éradication t4	Ld	C10	na			
1248	MAR3451	rouge	Furcellariaceae	<i>Furcellaria lumbricalis</i>	Loup	éradication t4	Ld	C10	na			
1249	MAR3452	rouge	Gigartineae	<i>Chondracanthus acicularis</i>	Loup	éradication t4	Ld	C10	na			
1250	MAR3453	rouge	Delesseriaceae	<i>Apoglossum rusCIFolium</i>	Loup	éradication t4	Ld	C10	na			
1251	MAR3454	rouge	Delesseriaceae	<i>Delesseriaceae</i>	Loup	éradication t4	Ld	C10	na			
1252	MAR3455	rouge	Delesseriaceae	<i>Delesseria sanguinea</i>	Loup	éradication t4	Ld	C10	na			
1253	MAR3456	verte	Cladophoraceae	<i>Cladophora sp</i>	Loup	éradication t4	Ld	C10	na			
1254	MAR3457	rouge	Corallineae	<i>Corallina sp</i>	Loup	éradication t4	Ld	C10	na			
1255	MAR3458	rouge	Rhodomeleaceae	<i>Polysiphonia sp</i>	Loup	éradication t4	Ld	C10	na			
1256	MAR3459	rouge	Cystocloniaceae	<i>Calliblepharis jubata</i>	Loup	éradication t4	Ld	C10	na			
1257	MAR3460	rouge	Phylloporaceae	<i>Gymnogongrus crenulatus</i>	Loup	éradication t4	Ld	C10	na			
1258	MAR3461	rouge	Champiaceae	<i>Gastroclonium ovatum</i>	Loup	éradication t4	Ld	C10	na			
1259	MAR3462	brune	Laminariaceae	<i>Saccharina latissima</i>	Loup	éradication t4	Ld	C11	268,75			
1260	MAR3463	brune	Laminariaceae	<i>Laminaria digitata</i>	Loup	éradication t4	Ld	C11	64,15			
1261	MAR3464	verte	Ulveaceae	<i>Ulva sp</i>	Loup	éradication t4	Ld	C11	6,57			
1262	MAR3465	rouge	Gigartineae	<i>Chondrus crispus</i>	Loup	éradication t4	Ld	C11	11,76			
1263	MAR3466	rouge	Cystocloniaceae	<i>Calliblepharis jubata</i>	Loup	éradication t4	Ld	C11	1,96			
1264	MAR3467	rouge	Gelidiaceae	<i>Gelidium sp</i>	Loup	éradication t4	Ld	C11	na			
1265	MAR3468	brune	Himanthaliaceae	<i>Himanthalia elongata</i>	Loup	éradication t4	Ld	C11	na			
1266	MAR3469	rouge	Phylloporaceae	<i>Gymnogongrus crenulatus</i>	Loup	éradication t4	Ld	C11	na			
1267	MAR3470	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	Loup	éradication t4	Ld	C11	na			
1268	MAR3471	verte	Cladophoraceae	<i>Cladophora sp</i>	Loup	éradication t4	Ld	C11	na			
1269	MAR3472	rouge	Plocamiaceae	<i>Plocamium sp</i>	Loup	éradication t4	Ld	C11	na			
1270	MAR3473	brune	Fucaceae	<i>Fucus sp</i>	Loup	éradication t4	Ld	C11	na			
1271	MAR3474	rouge	Ceramieaceae	<i>Ceramium sp</i>	Loup	éradication t4	Ld	C11	na			
1272	MAR3475	rouge	Gigartineae	<i>Chondracanthus acicularis</i>	Loup	éradication t4	Ld	C11	na			
1273	MAR3476	rouge	Rhodomeleaceae	<i>Osmundea pinnatifida</i>	Loup	éradication t4	Ld	C11	na			
1274	MAR3477	rouge	Corallineae	<i>Corallina sp</i>	Loup	éradication t4	Ld	C11	na			
1275	MAR3478	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	Loup	éradication t4	Ld	C11	na			
1276	MAR3479	rouge	Gelidiaceae	<i>Gelidium sp</i>	Loup	éradication t4	Ld	C11	na			
1277	MAR3480	rouge	Delesseriaceae	<i>Apoglossum rusCIFolium</i>	Loup	éradication t4	Ld	C11	na			
1278	MAR3481	rouge	Palmariaaceae	<i>Palmaria palmata</i>	Loup	éradication t4	Ld	C11	na			
1279	MAR3482	rouge	Champiaceae	<i>Gastroclonium ovatum</i>	Loup	éradication t4	Ld	C11	na			
1280	MAR3483	brune	Phyllariaceae	<i>Saccorhiza polyschides</i>								

Annexe 4

	A	B	C	D	E	F	G	H	I	J	K	L
1291	MAR3494	rouge	Rhodomelocaceae	<i>Osmundea pinnatifida</i>	Loup	éradication t4	Ld	C12	na			
1292	MAR3495	rouge	Phylloporaceae	<i>Gymnogongrus crenulatus</i>	Loup	éradication t4	Ld	C12	na			
1293	MAR3496	rouge	Palmariaceae	<i>Palmaria palmata</i>	Loup	éradication t4	Ld	C12	na			
1294	MAR3497	rouge	Gigartiniaceae	<i>Chondracanthus acicularis</i>	Loup	éradication t4	Ld	C12	na			
1295	MAR3498	rouge	Plocamiaceae	<i>Plocamium sp</i>	Loup	éradication t4	Ld	C12	na			
1296	MAR3499	rouge	Phylloporaceae	<i>Mastocarpus stellatus</i>	Loup	éradication t4	Ld	C12	na			
1297	MAR3500	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	Loup	éradication t4	Ld	C12	na			
1298	MAR3501	rouge	Corallinaceae	<i>Corallina sp</i>	Loup	éradication t4	Ld	C12	na			
1299	MAR3502	brune	Himanthaliaceae	<i>Himanthalia elongata</i>	Loup	éradication t4	Ld	C12	na			
1300	MAR3503	rouge	Champiaceae	<i>Gastroclonium ovatum</i>	Loup	éradication t4	Ld	C12	na			
1301	MAR3504	rouge	Delesseriaceae	<i>Apoglossum ruscfolium</i>	Loup	éradication t4	Ld	C12	na			
1302	MAR3505	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	Loup	éradication t4	Ld	C12	na			
1303	MAR3506	rouge	Gigartiniaceae	<i>Chondracanthus acicularis</i>	Loup	éradication t4	Ld	D10	7,96			
1304	MAR3507	rouge	Cystocloniaceae	<i>Calliblepharis jubata</i>	Loup	éradication t4	Ld	D10	3,97			
1305	MAR3508	rouge	Furcellariaceae	<i>Furcellaria lumbricalis</i>	Loup	éradication t4	Ld	D10	5,02			
1306	MAR3509	rouge	Gigartiniaceae	<i>Chondrus crispus</i>	Loup	éradication t4	Ld	D10	5,7			
1307	MAR3510	brune	Phyllariaceae	<i>Saccorhiza polyschides</i>	Loup	éradication t4	Ld	D10	4,52			
1308	MAR3511	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	Loup	éradication t4	Ld	D10	na			
1309	MAR3512	rouge	Ceramiales	<i>Ceramium sp</i>	Loup	éradication t4	Ld	D10	na			
1310	MAR3513	rouge	Plocamiaceae	<i>Plocamium sp</i>	Loup	éradication t4	Ld	D10	na			
1311	MAR3514	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	Loup	éradication t4	Ld	D10	na			
1312	MAR3515	rouge	Corallinaceae	<i>Corallina sp</i>	Loup	éradication t4	Ld	D10	na			
1313	MAR3516	rouge	Phylloporaceae	<i>Gymnogongrus crenulatus</i>	Loup	éradication t4	Ld	D10	na			
1314	MAR3517	rouge	Rhodymeniaceae	<i>Rhodymenia pseudopalmita</i>	Loup	éradication t4	Ld	D10	na			
1315	MAR3518	rouge	Phylloporaceae	<i>Mastocarpus stellatus</i>	Loup	éradication t4	Ld	D10	na			
1316	MAR3519	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	Loup	éradication t4	Ld	D10	na			
1317	MAR3520	rouge	Delesseriaceae	<i>Apoglossum ruscfolium</i>	Loup	éradication t4	Ld	D10	na			
1318	MAR3521	rouge	Rhodomelocaceae	<i>Osmundea pinnatifida</i>	Loup	éradication t4	Ld	D10	na			
1319	MAR3522	brune	Himanthaliaceae	<i>Himanthalia elongata</i>	Loup	éradication t4	Ld	D10	na			
1320	MAR3523	rouge	Kallymeniaceae	<i>Collophylis laciniata</i>	Loup	éradication t4	Ld	D10	na			
1321	MAR3524	verte	Ulveae	<i>Ulva sp</i>	Loup	éradication t4	Ld	D10	na			
1322	MAR3525	verte	Cladophoraceae	<i>Lola complexa</i>	Loup	éradication t4	Ld	D10	na			
1323	MAR3526	brune	Laminariaceae	<i>Laminaria digitata</i>	Loup	éradication t4	Ld	D10	na			
1324	MAR3527	brune	Himanthaliaceae	<i>Himanthalia elongata</i>	Loup	éradication t4	Ld	D10	102,94			
1325	MAR3528	rouge	Gigartiniaceae	<i>Chondrus crispus</i>	Loup	éradication t4	Ld	D11	68,01			
1326	MAR3529	rouge	Phylloporaceae	<i>Mastocarpus stellatus</i>	Loup	éradication t4	Ld	D11	17,45			
1327	MAR3530	rouge	Gigartiniaceae	<i>Chondracanthus acicularis</i>	Loup	éradication t4	Ld	D11	17,84			
1328	MAR3531	rouge	Cystocloniaceae	<i>Calliblepharis jubata</i>	Loup	éradication t4	Ld	D11	2,82			
1329	MAR3532	verte	Cladophoraceae	<i>Lola complexa</i>	Loup	éradication t4	Ld	D11	na			
1330	MAR3533	rouge	Palmariaceae	<i>Palmaria palmata</i>	Loup	éradication t4	Ld	D11	na			
1331	MAR3534	rouge	Indéterminée	<i>non identifiée</i>	Loup	éradication t4	Ld	D11	na			
1332	MAR3535	rouge	Delesseriaceae	<i>Hypoglossum hypoglossoides</i>	Loup	éradication t4	Ld	D11	na			
1333	MAR3536	rouge	Ceramiales	<i>Ceramium sp</i>	Loup	éradication t4	Ld	D11	na			
1334	MAR3537	rouge	Ceramiales	<i>Ceramium sp</i>	Loup	éradication t4	Ld	D11	na			
1335	MAR3538	rouge	Phylloporaceae	<i>Mastocarpus stellatus</i>	Loup	éradication t4	Ld	D11	na			
1336	MAR3539	rouge	Corallinaceae	<i>Corallina sp</i>	Loup	éradication t4	Ld	D11	na			
1337	MAR3540	rouge	Champiaceae	<i>Gastroclonium ovatum</i>	Loup	éradication t4	Ld	D11	na			
1338	MAR3541	rouge	Bonnemaisoniaceae	<i>Asparagopsis armata</i>	Loup	éradication t4	Ld	D11	na			
1339	MAR3542	brune	Cladostephaceae	<i>Cladostephus spongiosus</i>	Loup	éradication t4	Ld	D11	na			
1340	MAR3543	verte	Ulveae	<i>Ulva sp</i>	Loup	éradication t4	Ld	D11	na			
1341	MAR3544	rouge	Kallymeniaceae	<i>Collophylis laciniata</i>	Loup	éradication t4	Ld	D11	na			
1342	MAR3545	brune	Acinetosporaceae	<i>Pylaiella sp</i>	Loup	éradication t4	Ld	D11	na			
1343	MAR3546	brune	Sargassaceae	<i>Sargassum muticum</i>	Loup	éradication t4	Ld	D11	na			
1344	MAR3547	rouge	Rhodomelocaceae	<i>Osmundea pinnatifida</i>	Loup	éradication t4	Ld	D11	na			
1345	MAR3548	rouge	Gelidiales	<i>Gelidium sp</i>	Loup	éradication t4	Ld	D11	na			
1346	MAR3549	rouge	Gelidiales	<i>Gelidium sp</i>	Loup	éradication t4	Ld	D11	na			
1347	MAR3550	rouge	Plocamiaceae	<i>Plocamium sp</i>	Loup	éradication t4	Ld	D11	na			
1348	MAR3551	rouge	Ceramiales	<i>Ceramium sp</i>	Loup	éradication t4	Ld	D11	na			
1349	MAR3552	rouge	Ceramiales	<i>Ceramium sp</i>	Loup	éradication t4	Ld	D11	na			
1350	MAR3553	rouge	Ceramiales	<i>Ceramium sp</i>	Loup	éradication t4	Ld	D11	na			
1351	MAR3554	rouge	Delesseriaceae	<i>Delesseriaceae</i>	Loup	éradication t4	Ld	D11	na			
1352	MAR3555	rouge	Delesseriaceae	<i>Acrosorium uncinatum</i>	Loup	éradication t4	Ld	D11	na			
1353	MAR3556	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	Loup	éradication t4	Ld	D11	na			
1354	MAR3557	brune	Dictyotaceae	<i>Dictyota dichotoma</i>	Loup	éradication t4	Ld	D11	na			
1355	MAR3558	rouge	Champiaceae	<i>Chylocladia verticillata</i>	Loup	éradication t4	Ld	D11	na			
1356	MAR3559	verte	Cladophoraceae	<i>Cladophora sp</i>	Loup	éradication t4	Ld	D11	na			
1357	MAR3560	rouge	Ahnfeltiaceae	<i>Ahnfeltia plicata</i>	Loup	éradication t4	Ld	D11	na			
1358	MAR3561	rouge	Phylloporaceae	<i>Gymnogongrus crenulatus</i>	Loup	éradication t4	Ld	D11	na			
1359	MAR3562	brune	Laminariaceae	<i>Laminaria digitata</i>	Loup	éradication t4	Ld	D12	125,07			
1360	MAR3563	rouge	Gigartiniaceae	<i>Chondrus crispus</i>	Loup	éradication t4	Ld	D12	131,88			
1361	MAR3564	rouge	Palmariaceae	<i>Palmaria palmata</i>	Loup	éradication t4	Ld	D12	2,47			
1362	MAR3565	verte	Ulveae	<i>Ulva sp</i>	Loup	éradication t4	Ld	D12	1,79			
1363	MAR3566	rouge	Cystocloniaceae	<i>Calliblepharis jubata</i>	Loup	éradication t4	Ld	D12	2,58			
1364	MAR3567	brune	Sargassaceae	<i>Bifurcaria bifurcata</i>	Loup	éradication t4	Ld	D12	na			
1365	MAR3568	rouge	Kallymeniaceae	<i>Kallymenia reniformis</i>	Loup	éradication t4	Ld	D12	na			
1366	MAR3569	rouge	Delesseriaceae	<i>Apoglossum ruscfolium</i>	Loup	éradication t4	Ld	D12	na			
1367	MAR3570	brune	Dictyotaceae	<i>Dictyopteris polyodioides</i>	Loup	éradication t4	Ld	D12	na			
1368	MAR3571	rouge	Rhodomelocaceae	<i>Polysiphonia sp</i>	Loup	éradication t4	Ld	D12	na			
1369	MAR3572	verte	Cladophoraceae	<i>Cladophora sp</i>	Loup	éradication t4	Ld	D12	na			
1370	MAR3573	rouge	Furcellariaceae	<i>Furcellaria lumbricalis</i>	Loup	éradication t4	Ld	D12	na			
1371	MAR3574	verte	Ulveae	<i>Ulva sp</i>	Loup	éradication t4	Ld	D12	na			
1372	MAR3575	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	Loup	éradication t4	Ld	D12	na			
1373	MAR3576	rouge	Kallymeniaceae	<i>Collophylis laciniata</i>	Loup	éradication t4	Ld	D12	na			
1374	MAR3577	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	Loup	éradication t4	Ld	D12	na			
1375	MAR3578	brune	Himanthaliaceae	<i>Himanthalia elongata</i>	Loup	éradication t4	Ld	D12	na			
1376	MAR3579	rouge	Rhodomelocaceae	<i>Osmundea pinnatifida</i>	Loup	éradication t4	Ld	D12	na			
1377	MAR3580	rouge	Gelidiales	<i>Gelidium sp</i>	Loup	éradication t4	Ld	D12	na			
1378	MAR3581	rouge	Corallinaceae	<i>Corallina sp</i>	Loup	éradication t4	Ld	D12	na			
1379	MAR3582	rouge	Phylloporaceae	<i>Gymnogongrus crenulatus</i>	Loup	éradication t4	Ld	D12	na			
1380	MAR3583	rouge	Delesseriaceae	<i>Delesseria sanguinea</i>	Loup	éradication t4	Ld	D12	na			
1381	MAR3584	rouge	Ceramiales	<i>Ceramium sp</i>	Loup	éradication t4	Ld	D12	na			
1382	MAR3585	rouge	Ceramiales	<i>Ceramium sp</i>	Loup	éradication t4	Ld	D12	na			
1383	MAR3586	rouge	Ceramiales	<i>Ceramium sp</i>	Loup	éradication t4	Ld	D12	na			
1384	MAR3587	rouge	Indéterminée	<i>non identifiée</i>	Loup	éradication t4	Ld	D12	na			
1385	MAR3588	rouge	Indéterminée	<i>non identifiée</i>	Loup	éradication t4	Ld	D12	na			
1386	MAR3589	rouge	Champiaceae	<i>Chylocladia verticillata</i>	Loup	éradication t4	Ld	D12	na			
1387	MAR3590	rouge	Ceramiales	<i>Ceramium sp</i>	Loup	éradication t4	Ld	D12	na			
1388	MAR3591	rouge	Gigartiniaceae	<i>Chondracanthus acicularis</i>	Loup	éradication t4	Ld	D12	na			
1389	MAR3592	brune	Laminariaceae	<i>Laminaria digitata</i>	Loup	éradication t5	Ld	B13	6,39			
1390	MAR3593	brune	Laminariaceae	<i>Saccharina latissima</i>	Loup	éradication t5	Ld	B13	9,12			
1391	MAR3594	rouge	Gigartiniaceae	<i>Chondrus crispus</i>	Loup	éradication t5	Ld	B13	0,19			
1392	MAR3595	rouge	Corallinaceae	<i>Corallina sp</i>	Loup	éradication t5	Ld	B13	0,65			
1393	MAR3596	rouge	Wirangiellaceae	<i>Plumaria plumosa</i>	Loup	éradication t5	Ld	B13	0,09			
1394	MAR3597	rouge	Palmariaceae	<i>Palmaria palmata</i>	Loup	éradication t5	Ld	B13	na			
1395	MAR3598	verte	Cladophoraceae	<i>Cladophora sp</i>	Loup	éradication t5	Ld	B13	na			
1396	MAR3599	brune	Himanthaliaceae	<i>Himanthalia elongata</i>	Loup	éradication t5	Ld	B13	na			
1397	MAR3600	rouge	Delesseriaceae	<i>Apoglossum ruscfolium</i>	Loup	éradication t5	Ld	B13	na			
1398	MAR3601	rouge	Dumontiaceae	<i>Dilsea cerosa</i>	Loup	éradication t5	Ld	B13	na			
1399	MAR3602	rouge	Ceramiales	<i>Ceramiales</i>	Loup	éradication t5	Ld	B13	na			
1400	MAR3603	brune	Phyllariaceae	<i>Saccorhiza polyschides</i>	Loup	éradication t5	Ld	B14	46,82			
1401	MAR3604	rouge	Cystocloniaceae	<i>Calliblepharis jubata</i>	Loup	éradication t5	Ld	B14	11,12			
1402	MAR3605	verte	Ulveae	<i>Ulva sp</i>	Loup	éradication t5	Ld	B14	4,5			
1403	MAR3606	rouge	Furcellariaceae	<i>Furcellaria lumbricalis</i>	Loup	éradication t5	Ld	B14	8,05			
1404	MAR3607	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	Loup	éradication t5	Ld	B14	1,24			
1405	MAR3608	brune	Himanthaliaceae	<i>Himanthalia elongata</i>	Loup	éradication t5	Ld	B14	na			
1406	MAR3609	rouge	Delesseriaceae	<i>Apoglossum ruscfolium</i>	Loup	éradication t5	Ld	B14	na			
1407	MAR3610	rouge	Rhodomelocaceae	<i>Osmundea sp</i>	Loup	éradication t5	Ld	B14	na			
1408	MAR3611	rouge	Delesseriaceae	<i>Delesseriaceae</i>	Loup	éradication t5	Ld	B14	na			
1409	MAR3612	rouge	Delesseriaceae	<i>Delesseriaceae</i>	Loup	éradication t5	Ld	B14	na			
1												

Annexe 4

	A	B	C	D	E	F	G	H	I	J	K	L
1420	MAR3623	rouge	Dasyaceae	<i>Heterosiphonia japonica</i>	Loup	éradication t5	Ld	B14	na			
1421	MAR3624	brune	Acinetosporaceae	<i>Pylaiella</i> sp	Loup	éradication t5	Ld	B14	na			
1422	MAR3625	brune	Sargassaceae	<i>Sargassum muticum</i>	Loup	éradication t5	Ld	B14	na			
1423	MAR3626	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	Loup	éradication t5	Ld	B14	na			
1424	MAR3627	rouge	Gigartineae	<i>Chondrus crispus</i>	Loup	éradication t5	Ld	B14	na			
1425	MAR3628	rouge	Champlacaeae	<i>Gastroclonium ovatum</i>	Loup	éradication t5	Ld	B14	na			
1426	MAR3629	rouge	Palmariaaceae	<i>Palmaria palmata</i>	Loup	éradication t5	Ld	B14	na			
1427	MAR3630	rouge	Phylloporaceae	<i>Mastocarpus stellatus</i>	Loup	éradication t5	Ld	B14	na			
1428	MAR3631	verte	Cladophoraceae	<i>Cladophora</i> sp	Loup	éradication t5	Ld	B14	na			
1429	MAR3632	rouge	Gracilariaceae	<i>Gracilaria</i> sp	Loup	éradication t5	Ld	B14	na			
1430	MAR3633	rouge	Palmariaaceae	<i>Palmaria palmata</i>	Loup	éradication t5	Ld	B15	5,9			
1431	MAR3634	brune	Himanthaliaceae	<i>Himanthalia elongata</i>	Loup	éradication t5	Ld	B15	7,82			
1432	MAR3635	rouge	Gigartineae	<i>Chondrus crispus</i>	Loup	éradication t5	Ld	B15	8,72			
1433	MAR3636	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	Loup	éradication t5	Ld	B15	2,56			
1434	MAR3637	rouge	Rhodomeleaceae	<i>Osmundea</i> sp	Loup	éradication t5	Ld	B15	1,84			
1435	MAR3638	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	Loup	éradication t5	Ld	B15	na			
1436	MAR3639	rouge	Gigartineae	<i>Chondracanthus acicularis</i>	Loup	éradication t5	Ld	B15	na			
1437	MAR3640	rouge	Phylloporaceae	<i>Gymnogangrus</i> sp	Loup	éradication t5	Ld	B15	na			
1438	MAR3641	brune	Fuaceae	<i>Fucus vesiculosus</i>	Loup	éradication t5	Ld	B15	na			
1439	MAR3642	brune	Fuaceae	<i>Fucus serratus</i>	Loup	éradication t5	Ld	B15	na			
1440	MAR3643	rouge	Phylloporaceae	<i>Mastocarpus stellatus</i>	Loup	éradication t5	Ld	B15	na			
1441	MAR3644	rouge	Cystocloniaceae	<i>Calliblepharis jubata</i>	Loup	éradication t5	Ld	B15	na			
1442	MAR3645	rouge	Corallinaceae	<i>Corallina</i> sp	Loup	éradication t5	Ld	B15	na			
1443	MAR3646	rouge	Champlacaeae	<i>Gastroclonium ovatum</i>	Loup	éradication t5	Ld	B15	na			
1444	MAR3647	rouge	Ceramiales	<i>Ceramiales</i>	Loup	éradication t5	Ld	B15	na			
1445	MAR3648	rouge	Gelidiaceae	<i>Gelidium</i> sp	Loup	éradication t5	Ld	B15	na			
1446	MAR3649	verte	Cladophoraceae	<i>Cladophora</i> sp	Loup	éradication t5	Ld	B15	na			
1447	MAR3650	rouge	Wrangeliaceae	<i>Halurus equisetifolius</i>	Loup	éradication t5	Ld	B15	na			
1448	MAR3651	verte	Ulveae	<i>Ulva</i> sp	Loup	éradication t5	Ld	B15	na			
1449	MAR3652	brune	Laminariaceae	<i>Laminaria digitata</i>	Loup	éradication t5	Ld	C13	8,77			
1450	MAR3653	rouge	Phylloporaceae	<i>Mastocarpus stellatus</i>	Loup	éradication t5	Ld	C13	12,8			
1451	MAR3654	rouge	Gigartineae	<i>Chondrus crispus</i>	Loup	éradication t5	Ld	C13	5,99			
1452	MAR3655	brune	Himanthaliaceae	<i>Himanthalia elongata</i>	Loup	éradication t5	Ld	C13	3,02			
1453	MAR3656	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	Loup	éradication t5	Ld	C13	1,9			
1454	MAR3657	rouge	Gelidiaceae	<i>Gelidium</i> sp	Loup	éradication t5	Ld	C13	na			
1455	MAR3658	rouge	Rhodomeleaceae	<i>Polysiphonia</i> sp	Loup	éradication t5	Ld	C13	na			
1456	MAR3659	verte	Cladophoraceae	<i>Cladophora</i> sp	Loup	éradication t5	Ld	C13	na			
1457	MAR3660	rouge	Cystocloniaceae	<i>Calliblepharis jubata</i>	Loup	éradication t5	Ld	C13	na			
1458	MAR3661	rouge	Corallinaceae	<i>Corallina</i> sp	Loup	éradication t5	Ld	C13	na			
1459	MAR3662	rouge	Rhodomeleaceae	<i>Osmundea</i> sp	Loup	éradication t5	Ld	C13	na			
1460	MAR3663	rouge	Delesseriaceae	<i>Delesseriaceae</i>	Loup	éradication t5	Ld	C13	na			
1461	MAR3664	verte	Ulveae	<i>Ulva</i> sp	Loup	éradication t5	Ld	C13	na			
1462	MAR3665	rouge	Champlacaeae	<i>Gastroclonium ovatum</i>	Loup	éradication t5	Ld	C13	na			
1463	MAR3666	rouge	Gigartineae	<i>Chondracanthus acicularis</i>	Loup	éradication t5	Ld	C13	na			
1464	MAR3667	brune	Fuaceae	<i>Fucus serratus</i>	Loup	éradication t5	Ld	C13	na			
1465	MAR3668	rouge	Palmariaaceae	<i>Palmaria palmata</i>	Loup	éradication t5	Ld	C13	na			
1466	MAR3669	brune	Laminariaceae	<i>Laminaria digitata</i>	Loup	éradication t5	Ld	C14	110,31			
1467	MAR3670	brune	Himanthaliaceae	<i>Himanthalia elongata</i>	Loup	éradication t5	Ld	C14	19,99			
1468	MAR3671	rouge	Gigartineae	<i>Chondrus crispus</i>	Loup	éradication t5	Ld	C14	9,4			
1469	MAR3672	rouge	Palmariaaceae	<i>Palmaria palmata</i>	Loup	éradication t5	Ld	C14	4,21			
1470	MAR3673	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	Loup	éradication t5	Ld	C14	2,29			
1471	MAR3674	rouge	Rhodomeleaceae	<i>Polysiphonia</i> sp	Loup	éradication t5	Ld	C14	na			
1472	MAR3675	rouge	Delesseriaceae	<i>Apoglossum ruscifolium</i>	Loup	éradication t5	Ld	C14	na			
1473	MAR3676	rouge	Gelidiaceae	<i>Gelidium</i> sp	Loup	éradication t5	Ld	C14	na			
1474	MAR3677	rouge	Wrangeliaceae	<i>Plumaria plumosa</i>	Loup	éradication t5	Ld	C14	na			
1475	MAR3678	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	Loup	éradication t5	Ld	C14	na			
1476	MAR3679	rouge	Ceramiales	<i>Ceramium</i> sp	Loup	éradication t5	Ld	C14	na			
1477	MAR3680	rouge	Ceramiales	<i>Ceramium</i> sp	Loup	éradication t5	Ld	C14	na			
1478	MAR3681	rouge	Corallinaceae	<i>Corallina</i> sp	Loup	éradication t5	Ld	C14	na			
1479	MAR3682	verte	Cladophoraceae	<i>Cladophora</i> sp	Loup	éradication t5	Ld	C14	na			
1480	MAR3683	rouge	Furcellariaceae	<i>Furcellaria lumbricalis</i>	Loup	éradication t5	Ld	C14	na			
1481	MAR3684	rouge	Gigartineae	<i>Chondracanthus acicularis</i>	Loup	éradication t5	Ld	C14	na			
1482	MAR3685	rouge	Rhodomeleaceae	<i>Osmundea</i> sp	Loup	éradication t5	Ld	C14	na			
1483	MAR3686	verte	Ulveae	<i>Ulva</i> sp	Loup	éradication t5	Ld	C14	na			
1484	MAR3687	rouge	Champlacaeae	<i>Gastroclonium ovatum</i>	Loup	éradication t5	Ld	C14	na			
1485	MAR3688	rouge	Cystocloniaceae	<i>Calliblepharis jubata</i>	Loup	éradication t5	Ld	C14	na			
1486	MAR3689	rouge	Phylloporaceae	<i>Gymnogangrus</i> sp	Loup	éradication t5	Ld	C14	na			
1487	MAR3690	rouge	Gracilariaceae	<i>Gracilaria</i> sp	Loup	éradication t5	Ld	C14	na			
1488	MAR3691	rouge	Phylloporaceae	<i>Mastocarpus stellatus</i>	Loup	éradication t5	Ld	C14	na			
1489	MAR3692	rouge	Cystocloniaceae	<i>Calliblepharis jubata</i>	Loup	éradication t5	Ld	C15	8,63			
1490	MAR3693	rouge	Gracilariaceae	<i>Gracilaria</i> sp	Loup	éradication t5	Ld	C15	3,31			
1491	MAR3694	rouge	Corallinaceae	<i>Corallina</i> sp	Loup	éradication t5	Ld	C15	6,95			
1492	MAR3695	rouge	Furcellariaceae	<i>Furcellaria lumbricalis</i>	Loup	éradication t5	Ld	C15	0,76			
1493	MAR3696	brune	Himanthaliaceae	<i>Himanthalia elongata</i>	Loup	éradication t5	Ld	C15	1,35			
1494	MAR3697	brune	Fuaceae	<i>Fucus</i> sp	Loup	éradication t5	Ld	C15	na			
1495	MAR3698	rouge	Delesseriaceae	<i>Delesseriaceae</i>	Loup	éradication t5	Ld	C15	na			
1496	MAR3699	verte	Ulveae	<i>Ulva</i> sp	Loup	éradication t5	Ld	C15	na			
1497	MAR3700	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	Loup	éradication t5	Ld	C15	na			
1498	MAR3701	rouge	Phylloporaceae	<i>Phyllophora crispa</i>	Loup	éradication t5	Ld	C15	na			
1499	MAR3702	rouge	Phylloporaceae	<i>Gymnogangrus</i> sp	Loup	éradication t5	Ld	C15	na			
1500	MAR3703	rouge	Phylloporaceae	<i>Gymnogangrus</i> sp	Loup	éradication t5	Ld	C15	na			
1501	MAR3704	rouge	Rhodomeleaceae	<i>Osmundea</i> sp	Loup	éradication t5	Ld	C15	na			
1502	MAR3705	rouge	Rhodomeleaceae	<i>Polysiphonia</i> sp	Loup	éradication t5	Ld	C15	na			
1503	MAR3706	rouge	Ceramiales	<i>Ceramium</i> sp	Loup	éradication t5	Ld	C15	na			
1504	MAR3707	rouge	Palmariaaceae	<i>Palmaria palmata</i>	Loup	éradication t5	Ld	C15	na			
1505	MAR3708	rouge	Champlacaeae	<i>Gastroclonium ovatum</i>	Loup	éradication t5	Ld	C15	na			
1506	MAR3709	rouge	Gelidiaceae	<i>Gelidium</i> sp	Loup	éradication t5	Ld	C15	na			
1507	MAR3710	verte	Cladophoraceae	<i>Cladophora</i> sp	Loup	éradication t5	Ld	C15	na			
1508	MAR3711	rouge	Gigartineae	<i>Chondrus crispus</i>	Loup	éradication t5	Ld	C15	na			
1509	MAR3712	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	Loup	éradication t5	Ld	C15	na			
1510	MAR3713	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	Loup	éradication t5	Ld	C15	na			
1511	MAR3714	rouge	Plocamiaceae	<i>Plocamium</i> sp	Loup	éradication t5	Ld	C15	na			
1512	MAR3715	rouge	Dasyaceae	<i>Heterosiphonia japonica</i>	Loup	éradication t5	Ld	C15	na			
1513	MAR3716	rouge	Gigartineae	<i>Chondracanthus acicularis</i>	Loup	éradication t5	Ld	C15	na			
1514	MAR3717	rouge	Ahnfeltiaceae	<i>Ahnfeltia plicata</i>	Loup	éradication t5	Ld	C15	na			
1515	MAR3718	rouge	Wrangeliaceae	<i>Plumaria plumosa</i>	Loup	éradication t5	Ld	C15	na			
1516	MAR3719	rouge	Indéterminée	<i>non identifiée</i>	Loup	éradication t5	Ld	C15	na			
1517	MAR3720	brune	Laminariaceae	<i>Laminaria digitata</i>	Loup	éradication t5	Ld	D13	232,68			
1518	MAR3721	brune	Himanthaliaceae	<i>Himanthalia elongata</i>	Loup	éradication t5	Ld	D13	15,29			
1519	MAR3722	rouge	Gigartineae	<i>Chondrus crispus</i>	Loup	éradication t5	Ld	D13	13,07			
1520	MAR3723	rouge	Rhodomeleaceae	<i>Osmundea</i> sp	Loup	éradication t5	Ld	D13	3,49			
1521	MAR3724	rouge	Gigartineae	<i>Chondracanthus acicularis</i>	Loup	éradication t5	Ld	D13	8,22			
1522	MAR3725	brune	Fuaceae	<i>Fucus vesiculosus</i>	Loup	éradication t5	Ld	D13	na			
1523	MAR3726	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	Loup	éradication t5	Ld	D13	na			
1524	MAR3727	verte	Cladophoraceae	<i>Cladophora</i> sp	Loup	éradication t5	Ld	D13	na			
1525	MAR3728	verte	Ulveae	<i>Ulva</i> sp	Loup	éradication t5	Ld	D13	na			
1526	MAR3729	brune	Cladostephaceae	<i>Cladostephus spongiosus</i>	Loup	éradication t5	Ld	D13	na			
1527	MAR3730	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	Loup	éradication t5	Ld	D13	na			
1528	MAR3731	rouge	Phylloporaceae	<i>Gymnogangrus</i> sp	Loup	éradication t5	Ld	D13	na			
1529	MAR3732	rouge	Gelidiaceae	<i>Gelidium</i> sp	Loup	éradication t5	Ld	D13	na			
1530	MAR3733	rouge	Delesseriaceae	<i>Apoglossum ruscifolium</i>	Loup	éradication t5	Ld	D13	na			
1531	MAR3734	rouge	Ceramiales	<i>Ceramiales</i>	Loup	éradication t5	Ld	D13	na			
1532	MAR3735	brune	Acinetosporaceae	<i>Pylaiella</i> sp	Loup	éradication t5	Ld	D13	na			
1533	MAR3736	rouge	Cystocloniaceae	<i>Calliblepharis jubata</i>	Loup	éradication t5	Ld	D13	na			
1534	MAR3737	rouge	Wrangeliaceae	<i>Plumaria plumosa</i>	Loup	éradication t5	Ld	D13	na			
1535	MAR3738	rouge	Champlacaeae	<i>Gastroclonium ovatum</i>	Loup	éradication t5	Ld	D13	na			
1536	MAR3739	rouge	Furcellariaceae	<i>Furcellaria lumbricalis</i>	Loup	éradication t5	Ld	D13	na			
1537	MAR3740	rouge	Corallinaceae	<i>Corallina</i> sp	Loup	éradication t5	Ld	D13	na			
1538	MAR3741	brune	Laminariaceae	<i>Laminaria digitata</i>	Loup	éradication t5	Ld	D14	734,64			

Annexe 4

	A	B	C	D	E	F	G	H	I	J	K	L
1549	MAR3752	rouge	Gigartinales	<i>Chondracanthus acicularis</i>	Loup	éradication t5	Ld	D14	na			
1550	MAR3753	rouge	Ahnfeltiaceae	<i>Ahnfeltia plicata</i>	Loup	éradication t5	Ld	D14	na			
1551	MAR3754	rouge	Phylloporaceae	<i>Mastocarpus stellatus</i>	Loup	éradication t5	Ld	D14	na			
1552	MAR3755	verte	Cladophoraceae	<i>Cladophora sp</i>	Loup	éradication t5	Ld	D14	na			
1553	MAR3756	rouge	Furcellariaceae	<i>Furcellaria lumbricalis</i>	Loup	éradication t5	Ld	D14	na			
1554	MAR3757	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	Loup	éradication t5	Ld	D14	na			
1555	MAR3758	verte	Ulveae	<i>Ulva sp</i>	Loup	éradication t5	Ld	D14	na			
1556	MAR3759	brune	Acinetosporaceae	<i>Pyxialia sp</i>	Loup	éradication t5	Ld	D14	na			
1557	MAR3760	rouge	Graclariaceae	<i>Graclaria sp</i>	Loup	éradication t5	Ld	D14	na			
1558	MAR3761	brune	Laminariaceae	<i>Laminaria digitata</i>	Loup	éradication t5	Ld	D15	11,62			
1559	MAR3762	rouge	Palmariaaceae	<i>Palmaria palmata</i>	Loup	éradication t5	Ld	D15	9,55			
1560	MAR3763	rouge	Phylloporaceae	<i>Mastocarpus stellatus</i>	Loup	éradication t5	Ld	D15	24,79			
1561	MAR3764	rouge	Gigartinales	<i>Chondrus crispus</i>	Loup	éradication t5	Ld	D15	42,14			
1562	MAR3765	brune	Himantaliaceae	<i>Himantalia elongata</i>	Loup	éradication t5	Ld	D15	3,9			
1563	MAR3766	rouge	Gelidiaceae	<i>Gelidium sp</i>	Loup	éradication t5	Ld	D15	na			
1564	MAR3767	rouge	Delesseriaceae	<i>Apoglossum ruscifolium</i>	Loup	éradication t5	Ld	D15	na			
1565	MAR3768	verte	Cladophoraceae	<i>Cladophora sp</i>	Loup	éradication t5	Ld	D15	na			
1566	MAR3769	rouge	Wangiellaceae	<i>Plumaria plumosa</i>	Loup	éradication t5	Ld	D15	na			
1567	MAR3770	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	Loup	éradication t5	Ld	D15	na			
1568	MAR3771	verte	Ulveae	<i>Ulva sp</i>	Loup	éradication t5	Ld	D15	na			
1569	MAR3772	rouge	Corallinales	<i>Corallina sp</i>	Loup	éradication t5	Ld	D15	na			
1570	MAR3773	rouge	Bonnemaisoniaceae	<i>Asparagopsis armata</i>	Loup	éradication t5	Ld	D15	na			
1571	MAR3774	rouge	Phylloporaceae	<i>Gymnogongrus sp</i>	Loup	éradication t5	Ld	D15	na			
1572	MAR3775	brune	Fucaceae	<i>Fucus serratus</i>	Loup	éradication t5	Ld	D15	na			
1573	MAR3776	brune	Fucaceae	<i>Fucus vesiculosus</i>	Loup	éradication t5	Ld	D15	na			
1574	MAR3777	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	Loup	éradication t5	Ld	D15	na			
1575	MAR3778	rouge	Gigartinales	<i>Chondracanthus acicularis</i>	Loup	éradication t5	Ld	D15	na			
1576	MAR3779	rouge	Champiaceae	<i>Gastroclonium avatum</i>	Loup	éradication t5	Ld	D15	na			
1577	MAR3780	rouge	Rhodomeleaceae	<i>Osmundea sp</i>	Loup	éradication t5	Ld	D15	na			
1578	MAR1967	rouge	Phylloporaceae	<i>Phyllophora crispa</i>	BDSM	Guimereux hiver 2011	Ld	Q1	6			
1579	MAR1968	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	BDSM	Guimereux hiver 2011	Ld	Q1	21			
1580	MAR1969	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDSM	Guimereux hiver 2011	Ld	Q1	23			
1581	MAR1970	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	BDSM	Guimereux hiver 2011	Ld	Q1	1			
1582	MAR1971	rouge	Delesseriaceae	<i>Delesseria sanguinea</i>	BDSM	Guimereux hiver 2011	Ld	Q1	1	Delesseria sanguinea		
1583	MAR1972	rouge	Phylloporaceae	<i>Gymnogongrus sp</i>	BDSM	Guimereux hiver 2011	Ld	Q2	1			
1584	MAR1973	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	BDSM	Guimereux hiver 2011	Ld	Q2	4			
1585	MAR1974	rouge	Phylloporaceae	<i>Phyllophora crispa</i>	BDSM	Guimereux hiver 2011	Ld	Q2	4			
1586	MAR1975	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDSM	Guimereux hiver 2011	Ld	Q2	30			
1587	MAR1976	rouge	Dumontiaceae	<i>Dilsea carnosa</i>	BDSM	Guimereux hiver 2011	Ld	Q2	6			
1588	MAR1977	rouge	Corallinales	<i>Corallina sp</i>	BDSM	Guimereux hiver 2011	Ld	Q2	1	Corallina officinalis2		
1589	MAR1978	rouge	Delesseriaceae	<i>Delesseria</i>	BDSM	Guimereux hiver 2011	Ld	Q3	1	Kallymenia reniformis		
1590	MAR1979	rouge	Dumontiaceae	<i>Dilsea carnosa</i>	BDSM	Guimereux hiver 2011	Ld	Q3	5	Dilsea carnosa		
1591	MAR1980	rouge	Phylloporaceae	<i>Phyllophora sp</i>	BDSM	Guimereux hiver 2011	Ld	Q3	5			
1592	MAR1981	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDSM	Guimereux hiver 2011	Ld	Q3	23			
1593	MAR1982	rouge	Delesseriaceae	<i>Polyneura sp</i>	BDSM	Guimereux hiver 2011	Ld	Q3	12			
1594	MAR1983	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	BDSM	Guimereux hiver 2011	Ld	Q3	2			
1595	MAR1984	rouge	Delesseriaceae	<i>Delesseria</i>	BDSM	Guimereux hiver 2011	Ld	Q3	1	Cryptopleura ramosa		
1596	MAR1985	rouge	Phylloporaceae	<i>Phyllophora crispa</i>	BDSM	Guimereux hiver 2011	Lh	Q1	3			
1597	MAR1986	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	BDSM	Guimereux hiver 2011	Lh	Q1	10			
1598	MAR1987	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDSM	Guimereux hiver 2011	Lh	Q1	80	Plocamium cartilagineum		
1599	MAR1988	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	BDSM	Guimereux hiver 2011	Lh	Q1	9			
1600	MAR1989	brune	Dictyotaceae	<i>Dictyopteris polyodioides</i>	BDSM	Guimereux hiver 2011	Lh	Q1	2			
1601	MAR1990	rouge	Dasyaceae	<i>Heterosiphonia plumosa</i>	BDSM	Guimereux hiver 2011	Lh	Q2	1			
1602	MAR1991	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDSM	Guimereux hiver 2011	Lh	Q2	>100			
1603	MAR1992	rouge	Phylloporaceae	<i>Phyllophora crispa</i>	BDSM	Guimereux hiver 2011	Lh	Q2	11	Phyllophora crispa		
1604	MAR1993	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	BDSM	Guimereux hiver 2011	Lh	Q2	6	Callophyllis laciniata1		
1605	MAR1994	brune	Dictyotaceae	<i>Dictyopteris polyodioides</i>	BDSM	Guimereux hiver 2011	Lh	Q2	6			
1606	MAR1995	rouge	Corallinales	<i>Corallina sp</i>	BDSM	Guimereux hiver 2011	Lh	Q2	1			
1607	MAR1996	rouge	Phylloporaceae	<i>Phyllophora pseudoceranoides</i>	BDSM	Guimereux hiver 2011	Lh	Q2	3	Rhodymenia pseudopalmeta		
1608	MAR1997	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	BDSM	Guimereux hiver 2011	Lh	Q2	3			Cryptopleura ramosa
1609	MAR1998	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	BDSM	Guimereux hiver 2011	Lh	Q3	2	Callophyllis laciniata2		
1610	MAR1999	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	BDSM	Guimereux hiver 2011	Lh	Q3	2	Polyneura bonnemaisonii		
1611	MAR2000	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDSM	Guimereux hiver 2011	Lh	Q3	80	Polyneura bonnemaisonii		
1612	MAR2001	rouge	Delesseriaceae	<i>Delesseria</i>	BDSM	Guimereux hiver 2011	Lh	Q3	7			
1613	MAR2002	rouge	Phylloporaceae	<i>Phyllophora crispa</i>	BDSM	Guimereux hiver 2011	Lh	Q3	7	Phyllophora crispa		
1614	MAR2003	rouge	Phylloporaceae	<i>Phyllophora pseudoceranoides</i>	BDSM	Guimereux hiver 2011	Lh	Q3	1	Rhodymenia pseudopalmeta		
1615	MAR1699	rouge	Phylloporaceae	<i>Membranoptera alata</i>	BS	Hoedic hiver 2011	Ld	Q3	1	Membranoptera alata		
1616	MAR1700	rouge	Delesseriaceae	<i>Delesseria</i>	BS	Hoedic hiver 2011	Ld	Q3	1			
1617	MAR1701	rouge	Delesseriaceae	<i>Delesseria</i>	BS	Hoedic hiver 2011	Ld	Q3	1			
1618	MAR1702	rouge	Delesseriaceae	<i>Nitophyllum punctatum</i>	BS	Hoedic hiver 2011	Ld	Q3	1			
1619	MAR1703	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	BS	Hoedic hiver 2011	Ld	Q3	5			
1620	MAR1704	rouge	Corallinales	<i>Corallina sp</i>	BS	Hoedic hiver 2011	Ld	Q3	100	Corallina officinalis2		
1621	MAR1705	brune	Dictyotaceae	<i>Dictyopteris polyodioides</i>	BS	Hoedic hiver 2011	Ld	Q3	6			
1622	MAR1706	rouge	Sphaerococcaceae	<i>Sphaerococcus coronopifolius</i>	BS	Hoedic hiver 2011	Lh	Q1	1	Plocamium lyngbyanum		
1623	MAR1707	rouge	Plocamiaceae	<i>Plocamium sp</i>	BS	Hoedic hiver 2011	Lh	Q1	1			
1624	MAR1708	rouge	Dasyaceae	<i>Heterosiphonia plumosa</i>	BS	Hoedic hiver 2011	Lh	Q1	1	Heterosiphonia plumosa		
1625	MAR1709	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	BS	Hoedic hiver 2011	Lh	Q1	13			Callophyllis laciniata
1626	MAR1710	brune	Phyllariaceae	<i>Saccorhiza polyschides</i>	BS	Hoedic hiver 2011	Lh	Q1	1			
1627	MAR1711	brune	Dictyotaceae	<i>Dictyopteris polyodioides</i>	BS	Hoedic hiver 2011	Lh	Q1	4	Fucus serratus		
1628	MAR1712	rouge	Champiaceae	<i>Chylocladia verticillata</i>	BS	Hoedic hiver 2011	Lh	Q1	1			
1629	MAR1713	rouge	Delesseriaceae	<i>Apoglossum ruscifolium</i>	BS	Hoedic hiver 2011	Lh	Q1	1	Apoglossum ruscifolium		
1630	MAR1714	rouge	Phylloporaceae	<i>Phyllophora crispa</i>	BS	Hoedic hiver 2011	Lh	Q1	2	Gymnogongrus crenulatus		
1631	MAR1715	brune	Sargassaceae	<i>Halidrys siliquosa</i>	BS	Hoedic hiver 2011	Lh	Q1	1			
1632	MAR1716	rouge	Corallinales	<i>Corallina sp</i>	BS	Hoedic hiver 2011	Lh	Q1	15	Corallina officinalis2		
1633	MAR1717	rouge	Ceramiales	<i>Ceramium sp</i>	BS	Hoedic hiver 2011	Lh	Q1	1	Ceramium2		
1634	MAR1718	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	BS	Hoedic hiver 2011	Lh	Q1	4			
1635	MAR1719	rouge	Delesseriaceae	<i>Delesseria</i>	BS	Hoedic hiver 2011	Lh	Q2	1			
1636	MAR1720	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	BS	Hoedic hiver 2011	Lh	Q2	33	Polyneura		
1637	MAR1721	rouge	Corallinales	<i>Corallina sp</i>	BS	Hoedic hiver 2011	Lh	Q2	50	Corallina officinalis1		
1638	MAR1722	brune	Dictyotaceae	<i>Dictyota dichotoma</i>	BS	Hoedic hiver 2011	Lh	Q2	5	?		
1639	MAR1723	brune	Phyllariaceae	<i>Saccorhiza polyschides</i>	BS	Hoedic hiver 2011	Lh	Q3	2			
1640	MAR1724	rouge	Phylloporaceae	<i>Phyllophora crispa</i>	BS	Hoedic hiver 2011	Lh	Q3	6	Phyllophora crispa		
1641	MAR1725	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	BS	Hoedic hiver 2011	Lh	Q3	30			
1642	MAR1726	verte	Ulveae	<i>Ulva sp</i>	BS	Hoedic hiver 2011	Lh	Q3	1			Ulva australis
1643	MAR1727	brune	Dictyotaceae	<i>Dictyota dichotoma</i>	BS	Hoedic hiver 2011	Lh	Q3	2			
1644	MAR1728	rouge	Plocamiaceae	<i>Plocamium sp</i>	BS	Hoedic hiver 2011	Lh	Q3	4			
1645	MAR1729	rouge	Corallinales	<i>Corallina sp</i>	BS	Hoedic hiver 2011	Lh	Q3	5	Corallina officinalis1		
1646	MAR1730	rouge	Wangiellaceae	<i>Halurus equisetifolius</i>	BS	Hoedic hiver 2011	Lh	Q3	4			Halurus equisetifolius
1647	MAR1731	rouge	Delesseriaceae	<i>Hypoglossum hypoglossoides</i>	BS	Hoedic hiver 2011	Lh	Q3	9	Hypoglossum hypoglossoides1		
1648	MAR1732	rouge	Gelidiaceae	<i>Gelidium corneum</i>	BS	Hoedic hiver 2011	Lh	Q3	3	Gelidium2		
1649	MAR1733	rouge	Ceramiales	<i>Ceramium sp</i>	BS	Houat 1 hiver 2011	Ld	Q1	3	Ceramium3		
1650	MAR1734	rouge	Ceramiales	<i>Ceramium sp</i>	BS	Houat 1 hiver 2011	Ld	Q1	2	Ceramium3		
1651	MAR1735	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	BS	Houat 1 hiver 2011	Ld	Q1	15			
1652	MAR1736	rouge	Wangiellaceae	<i>Halurus equisetifolius</i>	BS	Houat 1 hiver 2011	Ld	Q1	30	Callithamnion tetragonum		
1653	MAR1737	rouge	Champiaceae	<i>Gastroclonium avatum</i>	BS	Houat 1 hiver 2011	Ld	Q1	5	Gastroclonium avatum		
1654	MAR1738	rouge	Wangiellaceae	<i>Plumaria plumosa</i>	BS	Houat 1 hiver 2011	Ld	Q1	16	Polysiphonia brodiei		
1655	MAR1739	rouge	Delesseriaceae	<i>Polysiphonia sp</i>	BS	Houat 1 hiver 2011	Ld	Q1	20	Polysiphonia stricta		
1656	MAR1740	rouge	Delesseriaceae	<i>Delesseria</i>	BS	Houat 1 hiver 2011	Ld	Q1	1	Rhodophyllis2		
1657	MAR1741	verte	Ulveae	<i>Ulva sp</i>	BS	Houat 1 hiver 2011	Ld	Q1	15			
1658	MAR1742	rouge	Champiaceae	<i>Chylocladia verticillata</i>	BS	Houat 1 hiver 2011	Ld	Q1	15	Lomentaria articulata		
1659	MAR1743	rouge	Delesseriaceae	<i>Hypoglossum hypoglossoides</i>	BS	Houat 1 hiver 2011	Ld	Q1	3	Membranoptera alata		
1660	MAR1744	rouge	Delesseriaceae	<i>Apoglossum ruscifolium</i>	BS	Houat 1 hiver 2011	Ld	Q1	2			
1661	MAR1745	rouge	Gelidiaceae									

Annexe 4

	A	B	C	D	E	F	G	H	I	J	K	L
1678	MAR1762	rouge	Champiaceae	<i>Chylocladia verticillata</i>	BS	Houat 1 hiver 2011	Ld	O2	12			
1679	MAR1763	rouge	Rhodomeleaceae	<i>Osmundea pinnatifida</i>	BS	Houat 1 hiver 2011	Ld	O2	5	<i>Lomentaria articulata</i>		
1680	MAR1764	brune	Fuaceae	<i>Fucus serratus</i>	BS	Houat 1 hiver 2011	Ld	O2	12			
1681	MAR1765	rouge	Gigartineae	<i>Chondrus crispus</i>	BS	Houat 1 hiver 2011	Ld	O2	>100	<i>Chondrus crispus</i>		
1682	MAR1766	rouge	Gelidiaceae	<i>Gelidium corneum</i>	BS	Houat 1 hiver 2011	Ld	O2	1			
1683	MAR1767	rouge	Palmariaaceae	<i>Palmaria palmata</i>	BS	Houat 1 hiver 2011	Ld	O2	2			<i>Palmaria palmata</i>
1684	MAR1768	rouge	Delesseriaceae	<i>Hypoglossum hypoglossoides</i>	BS	Houat 1 hiver 2011	Ld	O2	4			<i>Hypoglossum hypoglossoides2</i>
1685	MAR1769	verte	Ulveaceae	<i>Ulva sp</i>	BS	Houat 1 hiver 2011	Ld	O2	25			
1686	MAR1770	rouge	Phyllophoraceae	<i>Mastocarpus stellatus</i>	BS	Houat 1 hiver 2011	Ld	O2	2	<i>Ahnfeltiopsis devoniensis</i>		
1687	MAR1771	rouge	Phyllophoraceae	<i>Gymnogongrus sp</i>	BS	Houat 1 hiver 2011	Ld	O2	5			
1688	MAR1772	rouge	Dasyaceae	<i>Heterosiphonia plumosa</i>	BS	Houat 1 hiver 2011	Ld	O3	5	<i>Heterosiphonia plumosa</i>		
1689	MAR1773	rouge	Corallinaceae	<i>Corallina sp</i>	BS	Houat 1 hiver 2011	Ld	O3	15	<i>Corallina officinalis1</i>		
1690	MAR1774	rouge	Callithamniaceae	<i>Callithamnion tetragonum</i>	BS	Houat 1 hiver 2011	Ld	O3	15	<i>Callithamnion tetragonum</i>		
1691	MAR1775	rouge	Gelidiaceae	<i>Gelidium corneum</i>	BS	Houat 1 hiver 2011	Ld	O3	10			
1692	MAR1776	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	BS	Houat 1 hiver 2011	Ld	O3	8			
1693	MAR1777	rouge	Champiaceae	<i>Chylocladia verticillata</i>	BS	Houat 1 hiver 2011	Ld	O3	60			
1694	MAR1778	rouge	Gigartineae	<i>Chondrus crispus</i>	BS	Houat 1 hiver 2011	Ld	O3	25	<i>Chondrus crispus</i>		
1695	MAR1779	rouge	Ceramieae	<i>Ceramium sp</i>	BS	Houat 1 hiver 2011	Ld	O3	7	<i>Ceramium secundatum</i>		
1696	MAR1780	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	BS	Houat 1 hiver 2011	Ld	O3	15			
1697	MAR1781	rouge	Delesseriaceae	<i>Nitophyllum punctatum</i>	BS	Houat 1 hiver 2011	Ld	O3	2			
1698	MAR1782	rouge	Phyllophoraceae	<i>Phyllophora crispa</i>	BS	Houat 1 hiver 2011	Ld	O3	20	<i>Gymnogongrus crenulatus</i>		
1699	MAR1783	brune	Dictyotaceae	<i>Dictyota dichotoma</i>	BS	Houat 1 hiver 2011	Ld	O3	2			
1700	MAR1784	brune	Fuaceae	<i>Fucus serratus</i>	BS	Houat 1 hiver 2011	Ld	O3	1			<i>Saccorhiza polyschides</i>
1701	MAR1785	rouge	Plocamieae	<i>Plocamium sp</i>	BS	Houat 1 hiver 2011	Ld	O3	1			
1702	MAR1786	rouge	Phyllophoraceae	<i>Membranoptera alata</i>	BS	Houat 1 hiver 2011	Ld	O3	6			
1703	MAR1787	rouge	Delesseriaceae	<i>Hypoglossum hypoglossoides</i>	BS	Houat 1 hiver 2011	Ld	O3	6			<i>Hypoglossum hypoglossoides2</i>
1704	MAR1788	rouge	Rhodomeleaceae	<i>Osmundea pinnatifida</i>	BS	Houat 1 hiver 2011	Ld	O3	1			
1705	MAR1789	verte	Ulveaceae	<i>Ulva sp</i>	BS	Houat 1 hiver 2011	Ld	O3	5			
1706	MAR1790	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	BS	Houat 1 hiver 2011	Lh	O1	1	<i>Polyneura</i>		
1707	MAR1791	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	BS	Houat 1 hiver 2011	Lh	O1	10			
1708	MAR1792	rouge	Delesseriaceae	<i>Delesseriaceae</i>	BS	Houat 1 hiver 2011	Lh	O1	6			
1709	MAR1793	rouge	Delesseriaceae	<i>Delesseriaceae</i>	BS	Houat 1 hiver 2011	Lh	O1	2			
1710	MAR1794	rouge	Delesseriaceae	<i>Delesseriaceae</i>	BS	Houat 1 hiver 2011	Lh	O1	2			
1711	MAR1795	rouge	Delesseriaceae	<i>Delesseriaceae</i>	BS	Houat 1 hiver 2011	Lh	O1	1			
1712	MAR1796	rouge	Delesseriaceae	<i>Delesseria sanguinea</i>	BS	Houat 1 hiver 2011	Lh	O1	13	<i>Delesseria sanguinea</i>		
1713	MAR1797	brune	Dictyotaceae	<i>Dictyopteris polypodioides</i>	BS	Houat 1 hiver 2011	Lh	O1	20			
1714	MAR1798	rouge	Dictyotaceae	<i>Dictyota dichotoma</i>	BS	Houat 1 hiver 2011	Lh	O1	22	?		
1715	MAR1799	brune	Corallinaceae	<i>Corallina sp</i>	BS	Houat 1 hiver 2011	Lh	O1	50	<i>Corallina officinalis2</i>		
1716	MAR1800	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	BS	Houat 1 hiver 2011	Lh	O1	1			<i>Lomentaria articulata</i>
1717	MAR1801	rouge	Delesseriaceae	<i>Apoglossum rusCIFolium</i>	BS	Houat 1 hiver 2011	Lh	O1	2	<i>Apoglossum rusCIFolium</i>		
1718	MAR1802	rouge	Delesseriaceae	<i>Hypoglossum hypoglossoides</i>	BS	Houat 1 hiver 2011	Lh	O1	2	<i>Hypoglossum hypoglossoides2</i>		
1719	MAR1803	rouge	Dasyaceae	<i>Heterosiphonia plumosa</i>	BS	Houat 1 hiver 2011	Lh	O1	5	<i>Heterosiphonia plumosa</i>		
1720	MAR1804	rouge	Dumontiaceae	<i>Dilsea carnosa</i>	BS	Houat 1 hiver 2011	Lh	O1	2	<i>Dilsea carnosa</i>		
1721	MAR1805	verte	Ulveaceae	<i>Ulva sp</i>	BS	Houat 1 hiver 2011	Lh	O1	2			
1722	MAR1806	rouge	Phyllophoraceae	<i>Phyllophora sp</i>	BS	Houat 1 hiver 2011	Lh	O1	1	<i>Gymnogongrus crenulatus</i>		
1723	MAR1807	rouge	Gelidiaceae	<i>Gelidium sp</i>	BS	Houat 1 hiver 2011	Lh	O1	1			
1724	MAR1808	rouge	Ceramieae	<i>Ceramium sp</i>	BS	Houat 1 hiver 2011	Lh	O1	1	<i>Bonnemaisonia hamifera</i>		
1725	MAR1809	rouge	Phyllophoraceae	<i>Phyllophora pseudoceranoides</i>	BS	Houat 1 hiver 2011	Lh	O2	1	<i>Gymnogongrus crenulatus</i>		
1726	MAR1810	rouge	Phyllophoraceae	<i>Phyllophora crispa</i>	BS	Houat 1 hiver 2011	Lh	O2	4	<i>Phyllophora crispa</i>		
1727	MAR1811	rouge	Gelidiaceae	<i>Gelidium sp</i>	BS	Houat 1 hiver 2011	Lh	O2	1			
1728	MAR1812	rouge	Delesseriaceae	<i>Polysiphonia sp</i>	BS	Houat 1 hiver 2011	Lh	O2	1			
1729	MAR1813	rouge	Delesseriaceae	<i>Nitophyllum punctatum</i>	BS	Houat 1 hiver 2011	Lh	O2	1	<i>Polyneura</i>		
1730	MAR1814	rouge	Delesseriaceae	<i>Delesseria sanguinea</i>	BS	Houat 1 hiver 2011	Lh	O2	2	<i>Delesseria sanguinea</i>		
1731	MAR1815	rouge	Delesseriaceae	<i>Phycodrys rubens</i>	BS	Houat 1 hiver 2011	Lh	O2	13			
1732	MAR1816	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	BS	Houat 1 hiver 2011	Lh	O2	7	<i>Polyneura bonnemaisonii</i>		
1733	MAR1817	rouge	Wrangeliaceae	<i>Plumaria plumosa</i>	BS	Houat 1 hiver 2011	Lh	O2	3	<i>Bonnemaisonia hamifera</i>		
1734	MAR1818	rouge	Dasyaceae	<i>Heterosiphonia plumosa</i>	BS	Houat 1 hiver 2011	Lh	O2	37	<i>Heterosiphonia plumosa</i>		
1735	MAR1819	brune	Dictyotaceae	<i>Dictyopteris polypodioides</i>	BS	Houat 1 hiver 2011	Lh	O2	15	<i>Fucus serratus</i>		
1736	MAR1820	brune	Dictyotaceae	<i>Dictyota dichotoma</i>	BS	Houat 1 hiver 2011	Lh	O2	11			
1737	MAR1821	rouge	Corallinaceae	<i>Corallina sp</i>	BS	Houat 1 hiver 2011	Lh	O2	3	<i>Corallina officinalis1</i>		
1738	MAR1822	brune	Phyllariaceae	<i>Saccorhiza polyschides</i>	BS	Houat 1 hiver 2011	Lh	O2	1	<i>Ectocarpales</i>		
1739	MAR1823	rouge	Delesseriaceae	<i>Hypoglossum hypoglossoides</i>	BS	Houat 1 hiver 2011	Lh	O2	3	<i>Hypoglossum hypoglossoides2</i>		
1740	MAR1824	rouge	Wrangeliaceae	<i>Halurus equisetifolius</i>	BS	Houat 1 hiver 2011	Lh	O2	1	<i>Pterothamnion plumula</i>		
1741	MAR1825	rouge	Phyllophoraceae	<i>Phyllophora pseudoceranoides</i>	BS	Houat 1 hiver 2011	Lh	O3	1	<i>Rhodomenia pseudopalmeta</i>		
1742	MAR1826	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	BS	Houat 1 hiver 2011	Lh	O3	12			
1743	MAR1827	rouge	Dasyaceae	<i>Heterosiphonia plumosa</i>	BS	Houat 1 hiver 2011	Lh	O3	12	<i>Heterosiphonia plumosa</i>		
1744	MAR1828	rouge	Kallymeniaceae	<i>Collophylis laciniata</i>	BS	Houat 1 hiver 2011	Lh	O3	1	<i>Collophylis laciniata2</i>		
1745	MAR1829	rouge	Rhodymeniaceae	<i>Rhodymenia holmesii</i>	BS	Houat 1 hiver 2011	Lh	O3	1	<i>Collophylis laciniata2</i>		
1746	MAR1830	rouge	Wrangeliaceae	<i>Halurus equisetifolius</i>	BS	Houat 1 hiver 2011	Lh	O3	2	<i>Callithamnion tetragonum</i>		
1747	MAR1831	rouge	Delesseriaceae	<i>Polysiphonia sp</i>	BS	Houat 1 hiver 2011	Lh	O3	1			
1748	MAR1832	rouge	Delesseriaceae	<i>Nitophyllum punctatum</i>	BS	Houat 1 hiver 2011	Lh	O3	5			
1749	MAR1833	rouge	Wrangeliaceae	<i>Plumaria plumosa</i>	BS	Houat 1 hiver 2011	Lh	O3	3	<i>Bonnemaisonia hamifera</i>		
1750	MAR1834	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	BS	Houat 1 hiver 2011	Lh	O3	20	<i>Acrosarium</i>		
1751	MAR1835	brune	Styocaulaceae	<i>Halopteris filicina</i>	BS	Houat 1 hiver 2011	Lh	O3	1			
1752	MAR1836	rouge	Corallinaceae	<i>Corallina sp</i>	BS	Houat 1 hiver 2011	Lh	O3	35	<i>Corallina officinalis1</i>		
1753	MAR1837	rouge	Delesseriaceae	<i>Phycodrys rubens</i>	BS	Houat 1 hiver 2011	Lh	O3	10	<i>Delesseria sanguinea</i>		
1754	MAR1838	brune	Dictyotaceae	<i>Dictyopteris polypodioides</i>	BS	Houat 1 hiver 2011	Lh	O3	7			
1755	MAR1839	verte	Ulveaceae	<i>Ulva sp</i>	BS	Houat 1 hiver 2011	Lh	O3	3			
1756	MAR1840	rouge	Phyllophoraceae	<i>Phyllophora crispa</i>	BS	Houat 1 hiver 2011	Lh	O3	5	<i>Phyllophora crispa</i>		
1757	MAR1841	brune	Phyllariaceae	<i>Saccorhiza polyschides</i>	BS	Houat 1 hiver 2011	Lh	O3	1	<i>Ectocarpales</i>		
1758	MAR1842	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	BS	Houat 1 hiver 2011	Lh	O3	1			<i>Lomentaria articulata</i>
1759	MAR1843	rouge	Rhodomeleaceae	<i>Osmundea pinnatifida</i>	BS	Houat 1 hiver 2011	Lh	O3	1			<i>Palmaria palmata</i>
1760	MAR1844	rouge	Delesseriaceae	<i>Hypoglossum hypoglossoides</i>	BS	Houat 1 hiver 2011	Lh	O3	8	<i>Hypoglossum hypoglossoides2</i>		
1761	MAR1845	rouge	Delesseriaceae	<i>Apoglossum rusCIFolium</i>	BS	Houat 1 hiver 2011	Lh	O3	6			
1762	MAR1846	rouge	Gelidiaceae	<i>Gelidium sp</i>	BS	Houat 1 hiver 2011	Lh	O3	3			
1763	MAR1847	brune	Dictyotaceae	<i>Dictyota dichotoma</i>	BS	Houat 1 hiver 2011	Lh	O3	7			
1764	MAR1848	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	BS	Houat 1 hiver 2011	Ld	O1	23			<i>Lomentaria articulata</i>
1765	MAR1849	rouge	Delesseriaceae	<i>Delesseriaceae</i>	BS	Houat 2 hiver 2011	Ld	O1	2	<i>Nitophyllum punctatum</i>		
1766	MAR1850	rouge	Delesseriaceae	<i>Delesseriaceae</i>	BS	Houat 2 hiver 2011	Ld	O1	1			
1767	MAR1851	rouge	Phyllophoraceae	<i>Phyllophora crispa</i>	BS	Houat 2 hiver 2011	Ld	O1	20	<i>Gymnogongrus crenulatus</i>		
1768	MAR1852	rouge	Callithamniaceae	<i>Callithamnion tetragonum</i>	BS	Houat 2 hiver 2011	Ld	O1	25	<i>Callithamnion tetragonum</i>		
1769	MAR1853	rouge	Delesseriaceae	<i>Polysiphonia sp</i>	BS	Houat 2 hiver 2011	Ld	O1	1	<i>Callithamnion tetragonum</i>		
1770	MAR1854	rouge	Delesseriaceae	<i>Polysiphonia sp</i>	BS	Houat 2 hiver 2011	Ld	O1	6	<i>Ceramium secundatum</i>		
1771	MAR1855	rouge	Bangiaceae	<i>Porphyra sp</i>	BS	Houat 2 hiver 2011	Ld	O1	1	<i>Pyropia leucostica</i>		
1772	MAR1856	rouge	Rhodomeleaceae	<i>Osmundea pinnatifida</i>	BS	Houat 2 hiver 2011	Ld	O1	4			

Annexe 4

	A	B	C	D	E	F	G	H	I	J	K	L
1807	MAR1891	rouge	Delesseriaceae	Delesseriaceae	BS	Houat 2 hiver 2011	Ld	Q3	1			
1808	MAR1892	rouge	Delesseriaceae	Hypoglossum hypoglossoides	BS	Houat 2 hiver 2011	Ld	Q3	4			
1809	MAR1893	rouge	Dasyaceae	Heterosiphonia plumosa	BS	Houat 2 hiver 2011	Ld	Q3	12			Heterosiphonia plumosa
1810	MAR1894	rouge	Callithamniaceae	Callithamion tetragonum	BS	Houat 2 hiver 2011	Ld	Q3	20			
1811	MAR1895	rouge	Phylloporaceae	Phyllophora crispa	BS	Houat 2 hiver 2011	Ld	Q3	18			Gymnogangrus crenulatus
1812	MAR1896	rouge	Gigartineae	Chondrus crispus	BS	Houat 2 hiver 2011	Ld	Q3	25			Chondrus crispus
1813	MAR1897	rouge	Ceramiales	Ceramium sp	BS	Houat 2 hiver 2011	Ld	Q3	16			
1814	MAR1898	verte	Ulveae	Ulva sp	BS	Houat 2 hiver 2011	Ld	Q3	8			
1815	MAR1899	rouge	Palmaria	Palmaria palmata	BS	Houat 2 hiver 2011	Ld	Q3	4			
1816	MAR1900	rouge	Champiaceae	Gastroclonium ovatum	BS	Houat 2 hiver 2011	Ld	Q3	1			Lomentaria clavellosa
1817	MAR1901	rouge	Gelidiaceae	Gelidium corneum	BS	Houat 2 hiver 2011	Ld	Q3	3			
1818	MAR1902	rouge	Rhodomeleaceae	Osmundea pinnatifida	BS	Houat 2 hiver 2011	Ld	Q3	12			
1819	MAR1903	rouge	Delesseriaceae	Apoglossum ruscifolium	BS	Houat 2 hiver 2011	Ld	Q3	8			
1820	MAR1904	brune	Laminariaceae	Laminaria hyperborea	BS	Houat 2 hiver 2011	Ld	Q3	1			
1821	MAR1905	rouge	Corallinaceae	Corallina sp	BS	Houat 2 hiver 2011	Ld	Q3	3			
1822	MAR1906	brune	Dictyotaceae	Dictyota dichotoma	BS	Houat 2 hiver 2011	Lh	Q1	9			
1823	MAR1907	rouge	Delesseriaceae	Delesseriaceae	BS	Houat 2 hiver 2011	Lh	Q1	1			
1824	MAR1908	rouge	Delesseriaceae	Delesseriaceae	BS	Houat 2 hiver 2011	Lh	Q1	6			
1825	MAR1909	rouge	Delesseriaceae	Cryptopleura ramosa	BS	Houat 2 hiver 2011	Lh	Q1	12			
1826	MAR1910	rouge	Delesseriaceae	Polysiphonia sp	BS	Houat 2 hiver 2011	Lh	Q1	1			
1827	MAR1911	rouge	Kallymeniaceae	Meredithia microphylla	BS	Houat 2 hiver 2011	Lh	Q1	1			
1828	MAR1912	rouge	Kallymeniaceae	Callophyllis laciniata	BS	Houat 2 hiver 2011	Lh	Q1	1			
1829	MAR1913	rouge	Delesseriaceae	Polyneura bonnemaisonii	BS	Houat 2 hiver 2011	Lh	Q1	10			Polyneura
1830	MAR1914	rouge	Ulveae	Ulva sp	BS	Houat 2 hiver 2011	Lh	Q1	8			
1831	MAR1915	rouge	Corallinaceae	Corallina sp	BS	Houat 2 hiver 2011	Lh	Q1	60			
1832	MAR1916	rouge	Callithamniaceae	Callithamion tetragonum	BS	Houat 2 hiver 2011	Lh	Q1	3			Bonnemaisonia hamifera
1833	MAR1917	rouge	Wrangeliaceae	Halurus equisetifolius	BS	Houat 2 hiver 2011	Lh	Q1	4			
1834	MAR1918	?	Indéterminé	non identifié	BS	Houat 2 hiver 2011	Lh	Q1	1			
1835	MAR1919	rouge	Dasyaceae	Heterosiphonia plumosa	BS	Houat 2 hiver 2011	Lh	Q1	19			Heterosiphonia plumosa
1836	MAR1920	brune	Dictyotaceae	Dictyopteris polyodioides	BS	Houat 2 hiver 2011	Lh	Q1	2			
1837	MAR1921	rouge	Phylloporaceae	Phyllophora crispa	BS	Houat 2 hiver 2011	Lh	Q1	8			Phyllophora crispa
1838	MAR1922	rouge	Bonnemaisoniaceae	Asparagopsis armata	BS	Houat 2 hiver 2011	Lh	Q1	2			
1839	MAR1923	rouge	Gigartineae	Chondrus crispus	BS	Houat 2 hiver 2011	Lh	Q1	35			Chondrus crispus
1840	MAR1924	rouge	Delesseriaceae	Hypoglossum hypoglossoides	BS	Houat 2 hiver 2011	Lh	Q1	12			
1841	MAR1925	rouge	Lomentariaceae	Lomentaria articulata	BS	Houat 2 hiver 2011	Lh	Q1	1			
1842	MAR1926	brune	Phyllariaceae	Saccharia polyschides	BS	Houat 2 hiver 2011	Lh	Q1	3			Ectocarpales
1843	MAR1927	rouge	Ceramiales	Ceramium sp	BS	Houat 2 hiver 2011	Lh	Q1	1			
1844	MAR1928	rouge	Ceramiales	Ceramium sp	BS	Houat 2 hiver 2011	Lh	Q1	1			
1845	MAR1929	rouge	Gelidiaceae	Gelidium sp	BS	Houat 2 hiver 2011	Lh	Q2	1			Polysiphonia elongata
1846	MAR1930	rouge	Delesseriaceae	Polyneura bonnemaisonii	BS	Houat 2 hiver 2011	Lh	Q2	30			Lomentaria clavellosa
1847	MAR1931	brune	Dictyotaceae	Dictyota dichotoma	BS	Houat 2 hiver 2011	Lh	Q2	15			?
1848	MAR1932	rouge	Delesseriaceae	Hypoglossum hypoglossoides	BS	Houat 2 hiver 2011	Lh	Q2	9			
1849	MAR1933	rouge	Dasyaceae	Heterosiphonia plumosa	BS	Houat 2 hiver 2011	Lh	Q2	50			Heterosiphonia plumosa
1850	MAR1934	rouge	Plocamiaceae	Plocamium sp	BS	Houat 2 hiver 2011	Lh	Q2	9			
1851	MAR1935	rouge	Lomentariaceae	Lomentaria articulata	BS	Houat 2 hiver 2011	Lh	Q2	1			
1852	MAR1936	rouge	Callithamniaceae	Callithamion tetragonum	BS	Houat 2 hiver 2011	Lh	Q2	3			Bonnemaisonia hamifera
1853	MAR1937	brune	Dictyotaceae	Dictyopteris polyodioides	BS	Houat 2 hiver 2011	Lh	Q2	7			
1854	MAR1938	verte	Ulveae	Ulva sp	BS	Houat 2 hiver 2011	Lh	Q2	10			
1855	MAR1939	rouge	Gigartineae	Chondrus crispus	BS	Houat 2 hiver 2011	Lh	Q2	10			Chondrus crispus
1856	MAR1940	brune	Fucaceae	Fucus serratus	BS	Houat 2 hiver 2011	Lh	Q2	1			Fucus serratus
1857	MAR1941	rouge	Rhodomeleaceae	Osmundea pinnatifida	BS	Houat 2 hiver 2011	Lh	Q2	4			
1858	MAR1942	rouge	Delesseriaceae	Polysiphonia sp	BS	Houat 2 hiver 2011	Lh	Q2	1			
1859	MAR1943	rouge	Delesseriaceae	Polysiphonia sp	BS	Houat 2 hiver 2011	Lh	Q2	1			Polysiphonia brodiei
1860	MAR1944	rouge	Corallinaceae	Corallina sp	BS	Houat 2 hiver 2011	Lh	Q2	50			Corallina officinalis2
1861	MAR1945	rouge	Phylloporaceae	Phyllophora crispa	BS	Houat 2 hiver 2011	Lh	Q2	15			Phyllophora crispa
1862	MAR1946	rouge	Delesseriaceae	Apoglossum ruscifolium	BS	Houat 2 hiver 2011	Lh	Q2	1			Apoglossum ruscifolium
1863	MAR1947	rouge	Bonnemaisoniaceae	Asparagopsis armata	BS	Houat 2 hiver 2011	Lh	Q3	1			
1864	MAR1948	rouge	Gelidiaceae	Gelidium sp	BS	Houat 2 hiver 2011	Lh	Q3	1			Lomentaria clavellosa
1865	MAR1949	rouge	Delesseriaceae	Apoglossum ruscifolium	BS	Houat 2 hiver 2011	Lh	Q3	1			
1866	MAR1950	rouge	Delesseriaceae	Polysiphonia sp	BS	Houat 2 hiver 2011	Lh	Q3	1			
1867	MAR1951	rouge	Ceramiales	Ceramium sp	BS	Houat 2 hiver 2011	Lh	Q3	2			
1868	MAR1952	rouge	Dasyaceae	Heterosiphonia plumosa	BS	Houat 2 hiver 2011	Lh	Q3	>100			
1869	MAR1953	rouge	Delesseriaceae	Delesseria sanguinea	BS	Houat 2 hiver 2011	Lh	Q3	1			Delesseria sanguinea
1870	MAR1954	rouge	Delesseriaceae	Hypoglossum hypoglossoides	BS	Houat 2 hiver 2011	Lh	Q3	16			
1871	MAR1955	rouge	Corallinaceae	Corallina sp	BS	Houat 2 hiver 2011	Lh	Q3	30			
1872	MAR1956	rouge	Phylloporaceae	Phyllophora crispa	BS	Houat 2 hiver 2011	Lh	Q3	15			
1873	MAR1957	verte	Ulveae	Ulva sp	BS	Houat 2 hiver 2011	Lh	Q3	3			
1874	MAR1958	rouge	Delesseriaceae	Phycodrys rubens	BS	Houat 2 hiver 2011	Lh	Q3	1			
1875	MAR1959	brune	Dictyotaceae	Dictyopteris polyodioides	BS	Houat 2 hiver 2011	Lh	Q3	7			
1876	MAR1960	rouge	Gigartineae	Chondrus crispus	BS	Houat 2 hiver 2011	Lh	Q3	3			Chondrus crispus
1877	MAR1961	rouge	Wrangeliaceae	Halurus equisetifolius	BS	Houat 2 hiver 2011	Lh	Q3	1			
1878	MAR1962	brune	Dictyotaceae	Dictyota dichotoma	BS	Houat 2 hiver 2011	Lh	Q3	8			
1879	MAR1963	rouge	Plocamiaceae	Plocamium sp	BS	Houat 2 hiver 2011	Lh	Q3	1			
1880	MAR1964	rouge	Lomentariaceae	Lomentaria articulata	BS	Houat 2 hiver 2011	Lh	Q3	4			
1881	MAR1965	rouge	Ceramiales	Ceramium sp	BS	Houat 2 hiver 2011	Lh	Q3	1			Bonnemaisonia hamifera
1882	MAR1966	rouge	Delesseriaceae	Polyneura bonnemaisonii	BS	Houat 2 hiver 2011	Lh	Q3	23			
1883	MAR1000	rouge	Gigartineae	Gigartina pistillata	PNMI	Kloenn Malaga hiver 2011	Ld	Q1	23			Chondrus crispus
1884	MAR1001	rouge	Gigartineae	Chondracanthus acicularis	PNMI	Kloenn Malaga hiver 2011	Ld	Q1	8			Chondracanthus acicularis
1885	MAR1002	rouge	Ceramiales	Ceramium sp	PNMI	Kloenn Malaga hiver 2011	Ld	Q1	2			Ceramium secundatum
1886	MAR1003	rouge	Plocamiaceae	Plocamium sp	PNMI	Kloenn Malaga hiver 2011	Ld	Q1	5			
1887	MAR1004	rouge	Gigartineae	Chondrus crispus	PNMI	Kloenn Malaga hiver 2011	Ld	Q1	6			
1888	MAR1005	rouge	Furcellariaceae	Furcellaria lumbricalis	PNMI	Kloenn Malaga hiver 2011	Ld	Q1	44			Furcellaria lumbricalis
1889	MAR1006	brune	Himanthaliaceae	Himanthalia elongata	PNMI	Kloenn Malaga hiver 2011	Ld	Q1	1			
1890	MAR1007	rouge	Dasyaceae	Heterosiphonia plumosa	PNMI	Kloenn Malaga hiver 2011	Ld	Q1	5			
1891	MAR1008	rouge	Gelidiaceae	Gelidium corneum	PNMI	Kloenn Malaga hiver 2011	Ld	Q1	1			
1892	MAR1009	rouge	Lomentariaceae	Lomentaria articulata	PNMI	Kloenn Malaga hiver 2011	Ld	Q1	6			
1893	MAR1010	brune	Dictyotaceae	Dictyota dichotoma	PNMI	Kloenn Malaga hiver 2011	Ld	Q1	25			
1894	MAR1011	rouge	Callithamniaceae	Callithamion tetragonum	PNMI	Kloenn Malaga hiver 2011	Ld	Q1	2			Callithamion tetragonum
1895	MAR1012	rouge	Delesseriaceae	Apoglossum ruscifolium	PNMI	Kloenn Malaga hiver 2011	Ld	Q1	2			
1896	MAR1013	rouge	Delesseriaceae	Cryptopleura ramosa	PNMI	Kloenn Malaga hiver 2011	Ld	Q1	12			
1897	MAR1014	rouge	Corallinaceae	Corallina sp	PNMI	Kloenn Malaga hiver 2011	Ld	Q1	7			Corallina officinalis2
1898	MAR1015	rouge	Kallymeniaceae	Callophyllis laciniata	PNMI	Kloenn Malaga hiver 2011	Ld	Q1	3			Callophyllis laciniata2
1899	MAR1016	rouge	Delesseriaceae	Polyneura bonnemaisonii	PNMI	Kloenn Malaga hiver 2011	Ld	Q1	2			
1900	MAR1017	brune	Cladostephaceae	Cladostephus spongiosus	PNMI	Kloenn Malaga hiver 2011	Ld	Q1	9			Laminaria hyperborea
1901	MAR1018	rouge	Kallymeniaceae	Callophyllis laciniata	PNMI	Kloenn Malaga hiver 2011	Ld	Q2	1			Callophyllis laciniata2
1902	MAR1019	rouge	Delesseriaceae	Cryptopleura ramosa	PNMI	Kloenn Malaga hiver 2011	Ld	Q2	7			
1903	MAR1020	rouge	Corallinaceae	Corallina sp	PNMI	Kloenn Malaga hiver 2011	Ld	Q2	33			
1904	MAR1021	rouge	Dasyaceae	Heterosiphonia plumosa	PNMI	Kloenn Malaga hiver 2011	Ld	Q2	14			Heterosiphonia plumosa
1905	MAR1022	brune	Cladostephaceae	Cladostephus spongiosus	PNMI	Kloenn Malaga hiver 2011	Ld	Q2	10			Laminaria hyperborea
1906	MAR1023	rouge	Gelidiaceae	Gelidium corneum	PNMI	Kloenn Malaga hiver 2011	Ld	Q3	5			
1907	MAR1024	rouge	Delesseriaceae	Cryptopleura ramosa	PNMI	Kloenn Malaga hiver 2011	Ld	Q3	3			
1908	MAR1025	rouge	Phylloporaceae	Membranoptera alata	PNMI	Kloenn Malaga hiver 2011	Ld	Q3	3			
1909	MAR1026	rouge	Rhodomeleaceae	Osmundea pinnatifida	PNMI	Kloenn Malaga hiver 2011	Ld	Q3	1			
1910	MAR1027	rouge	Gigartineae	Chondrus crispus	PNMI	Kloenn Malaga hiver 2011	Ld	Q3	2			
1911	MAR1028	rouge	Ceramiales	Ceramiales	PNMI	Kloenn Malaga hiver 2011	Ld	Q3	2			
1912	MAR1029	rouge	Phylloporaceae	Gymnogangrus sp	PNMI	Kloenn Malaga hiver 2011	Ld	Q3	1			Gymnogangrus crenulatus
1913	MAR1030	rouge	Delesseriaceae	Polyneura bonnemaisonii	PNMI	Kloenn Malaga hiver 2011	Ld	Q3	1			
1914	MAR1031	rouge	Delesseriaceae	Apoglossum ruscifolium	PNMI	Kloenn Malaga hiver 2011	Ld	Q3	1			
1915	MAR1032	rouge	Kallymeniaceae	Callophyllis laciniata	PNMI	Kloenn Malaga hiver 2011	Ld	Q3	1			Callophyllis laciniata2
1916	MAR1033	rouge	Kallymeniaceae	Callophyllis laciniata	PNMI	Kloenn Malaga hiver 2011	Lh	Q1	6			Callophyllis laciniata2
1917	MAR1034	rouge	Champiaceae	Gastroclonium ovatum	PNMI	Kloenn Malaga hiver 2011	Lh	Q1	6			
1918	MAR1035	rouge	Corallinaceae	Corallina sp	PNMI	Kloenn Malaga hiver 2011	Lh	Q1	5			Corallina officinalis1
1919	MAR1036	rouge	Lomentariaceae	Lomentaria articulata	PNMI	Kloenn Malaga hiver 2011	Lh	Q1	1			
1920	MAR1037	rouge	Dasyaceae	Heterosiphonia plumosa	PNMI	Kloenn Malaga hiver 2011	Lh	Q1	1			
1921	MAR1038	brune	Cladostephaceae	Cladostephus spongiosus	PNMI	Kloenn Malaga hiver 2011	Lh	Q1				

Annexe 4

	A	B	C	D	E	F	G	H	I	J	K	L
1936	MAR1053	brune	Laminariaceae	<i>Laminaria digitata</i>	PNMI	Klosenn Malaga hiver 2011	Lh	Q3	1			
1937	MAR1054	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	PNMI	Klosenn Malaga hiver 2011	Lh	Q3	5			<i>Himantalia elongata</i>
1938	MAR1055	rouge	Phylloporaceae	<i>Membranoptera alata</i>	PNMI	Klosenn Malaga hiver 2011	Lh	Q3	1			
1939	MAR1056	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	PNMI	Klosenn Malaga hiver 2011	Lh	Q3	3			<i>Callophyllis laciniata</i>
1940	MAR1057	rouge	Delesseriaceae	<i>Agoglossum rusciifolium</i>	PNMI	Klosenn Malaga hiver 2011	Lh	Q3	6			
1941	MAR1058	rouge	Palmariaaceae	<i>Palmaria palmata</i>	PNMI	Klosenn Malaga hiver 2011	Lh	Q3	1			<i>Palmaria palmata</i>
1942	MAR1059	rouge	Gigartiniaceae	<i>Gigartina psittata</i>	PNMI	Klosenn Malaga hiver 2011	Lh	Q3	5			<i>Chondrus crispus</i>
1943	MAR1060	rouge	Rhodymeniaceae	<i>Rhodymenia pseudopalmeta</i>	PNMI	Klosenn Malaga hiver 2011	Lh	Q3	34			<i>Rhodymenia pseudopalmeta</i>
1944	MAR1061	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	PNMI	Klosenn Malaga hiver 2011	Lh	Q3	3			<i>Cryptopleura ramosa</i>
1945	MAR1062	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	PNMI	Klosenn Malaga hiver 2011	Lh	Q3	1			<i>Lomentaria clavellosa</i>
1946	MAR1063	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	PNMI	Klosenn Malaga hiver 2011	Lh	Q3	1			<i>Lomentaria articulata</i>
1947	MAR1064	brune	Cladostephaceae	<i>Cladostephus spongiosus</i>	PNMI	Klosenn Malaga hiver 2011	Lh	Q3	3			
1948	MAR2004	brune	Dictyotaceae	<i>Dictyopteris polypodioides</i>	BDSM	La Bigne hiver 2011	Ld	Q1	18			
1949	MAR2005	rouge	Phylloporaceae	<i>Phyllopora sicula</i>	BDSM	La Bigne hiver 2011	Ld	Q1	2			
1950	MAR2006	rouge	Phylloporaceae	<i>Phyllopora crispa</i>	BDSM	La Bigne hiver 2011	Ld	Q1	5			<i>Phyllopora crispa</i>
1951	MAR2007	rouge	Phylloporaceae	<i>Phyllopora pseudoceranoides</i>	BDSM	La Bigne hiver 2011	Ld	Q1	2			
1952	MAR2008	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	BDSM	La Bigne hiver 2011	Ld	Q1	3			
1953	MAR2009	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDSM	La Bigne hiver 2011	Ld	Q1	100			
1954	MAR2010	rouge	Delesseriaceae	<i>Delesseriaceae</i>	BDSM	La Bigne hiver 2011	Ld	Q1	1			<i>Stenogramma interruptum</i>
1955	MAR2011	rouge	Callithamiaceae	<i>Callithamion sp</i>	BDSM	La Bigne hiver 2011	Ld	Q1	1			
1956	MAR2012	rouge	Wrangeliaceae	<i>Halurus equisetifolius</i>	BDSM	La Bigne hiver 2011	Ld	Q1	1			
1957	MAR2013	rouge	Phylloporaceae	<i>Phyllopora pseudoceranoides</i>	BDSM	La Bigne hiver 2011	Ld	Q2	2			<i>Rhodymenia pseudopalmeta</i>
1958	MAR2014	rouge	Phylloporaceae	<i>Phyllopora crispa</i>	BDSM	La Bigne hiver 2011	Ld	Q2	14			<i>Phyllopora crispa</i>
1959	MAR2015	rouge	Dumontiaceae	<i>Dilsea carnos</i>	BDSM	La Bigne hiver 2011	Ld	Q2	1			<i>Dilsea carnos</i>
1960	MAR2016	rouge	Delesseriaceae	<i>Delesseriaceae</i>	BDSM	La Bigne hiver 2011	Ld	Q2	1			<i>Gymnogongrus crenulatus</i>
1961	MAR2017	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDSM	La Bigne hiver 2011	Ld	Q2	15			<i>Plocamium 1</i>
1962	MAR2018	rouge	Phylloporaceae	<i>Phyllopora pseudoceranoides</i>	BDSM	La Bigne hiver 2011	Ld	Q3	2			
1963	MAR2019	rouge	Phylloporaceae	<i>Phyllopora sicula</i>	BDSM	La Bigne hiver 2011	Ld	Q3	2			
1964	MAR2020	rouge	Phylloporaceae	<i>Phyllopora crispa</i>	BDSM	La Bigne hiver 2011	Ld	Q3	17			<i>Phyllopora crispa</i>
1965	MAR2021	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	BDSM	La Bigne hiver 2011	Ld	Q3	5			
1966	MAR2022	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDSM	La Bigne hiver 2011	Ld	Q3	30			<i>Plocamium 1</i>
1967	MAR2023	brune	Dictyotaceae	<i>Dictyopteris polypodioides</i>	BDSM	La Bigne hiver 2011	Ld	Q3	1			<i>Dictyopteris polypodioides</i>
1968	MAR2024	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	BDSM	La Bigne hiver 2011	Lh	Q1	8			<i>Callophyllis laciniata2</i>
1969	MAR2025	brune	Dictyotaceae	<i>Dictyopteris polypodioides</i>	BDSM	La Bigne hiver 2011	Lh	Q1	1			
1970	MAR2026	rouge	Phylloporaceae	<i>Phyllopora sicula</i>	BDSM	La Bigne hiver 2011	Lh	Q1	3			
1971	MAR2027	rouge	Phylloporaceae	<i>Phyllopora crispa</i>	BDSM	La Bigne hiver 2011	Lh	Q1	3			<i>Phyllopora crispa</i>
1972	MAR2028	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	BDSM	La Bigne hiver 2011	Lh	Q1	12			
1973	MAR2029	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDSM	La Bigne hiver 2011	Lh	Q1	90			
1974	MAR2030	rouge	Dumontiaceae	<i>Dilsea carnos</i>	BDSM	La Bigne hiver 2011	Lh	Q1	13			<i>Dilsea carnos</i>
1975	MAR2031	rouge	Phylloporaceae	<i>Phyllopora pseudoceranoides</i>	BDSM	La Bigne hiver 2011	Lh	Q2	1			
1976	MAR2032	rouge	Phylloporaceae	<i>Phyllopora crispa</i>	BDSM	La Bigne hiver 2011	Lh	Q2	2			
1977	MAR2033	rouge	Delesseriaceae	<i>Delesseriaceae</i>	BDSM	La Bigne hiver 2011	Lh	Q2	1			
1978	MAR2034	rouge	Delesseriaceae	<i>Delesseriaceae</i>	BDSM	La Bigne hiver 2011	Lh	Q2	2			<i>Cryptopleura ramosa</i>
1979	MAR2035	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	BDSM	La Bigne hiver 2011	Lh	Q2	17			
1980	MAR2036	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDSM	La Bigne hiver 2011	Lh	Q2	22			<i>Plocamium 2</i>
1981	MAR2037	rouge	Dumontiaceae	<i>Dilsea carnos</i>	BDSM	La Bigne hiver 2011	Lh	Q2	9			
1982	MAR2038	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	BDSM	La Bigne hiver 2011	Lh	Q2	3			<i>Callophyllis laciniata2</i>
1983	MAR2039	rouge	Corallinaceae	<i>Corallina sp</i>	BDSM	La Bigne hiver 2011	Lh	Q2	5			
1984	MAR2040	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	BDSM	La Bigne hiver 2011	Lh	Q3	14			<i>Callophyllis laciniata2</i>
1985	MAR2041	rouge	Kallymeniaceae	<i>Kallymenia reniformis</i>	BDSM	La Bigne hiver 2011	Lh	Q3	1			
1986	MAR2042	rouge	Phylloporaceae	<i>Phyllopora crispa</i>	BDSM	La Bigne hiver 2011	Lh	Q3	4			
1987	MAR2043	rouge	Phylloporaceae	<i>Phyllopora sicula</i>	BDSM	La Bigne hiver 2011	Lh	Q3	1			<i>Gymnogongrus crenulatus</i>
1988	MAR2044	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	BDSM	La Bigne hiver 2011	Lh	Q3	30			<i>Polyneura bonnemaisonii</i>
1989	MAR2045	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDSM	La Bigne hiver 2011	Lh	Q3	25			
1990	MAR2046	rouge	Delesseriaceae	<i>Delesseriaceae</i>	BDSM	La Bigne hiver 2011	Lh	Q3	1			
1991	MAR2047	rouge	Delesseriaceae	<i>Delesseriaceae</i>	BDSM	La Bigne hiver 2011	Lh	Q3	1			
1992	MAR2048	rouge	Dumontiaceae	<i>Dilsea carnos</i>	BDSM	La Bigne hiver 2011	Lh	Q3	3			
1993	MAR2049	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	BDSM	Le Moulin hiver 2011	Ld	Q1	3			<i>Callophyllis laciniata2</i>
1994	MAR2050	rouge	Corallinaceae	<i>Corallina sp</i>	BDSM	Le Moulin hiver 2011	Ld	Q1	5			<i>Corallina officinalis1</i>
1995	MAR2051	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDSM	Le Moulin hiver 2011	Ld	Q1	25			
1996	MAR2052	rouge	Phylloporaceae	<i>Phyllopora crispa</i>	BDSM	Le Moulin hiver 2011	Ld	Q1	20			
1997	MAR2053	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	BDSM	Le Moulin hiver 2011	Ld	Q1	19			<i>Polyneura bonnemaisonii</i>
1998	MAR2054	rouge	Delesseriaceae	<i>Delesseriaceae</i>	BDSM	Le Moulin hiver 2011	Ld	Q1	1			<i>Rhodophyllis1</i>
1999	MAR2055	rouge	Delesseriaceae	<i>Delesseriaceae</i>	BDSM	Le Moulin hiver 2011	Ld	Q1	1			<i>Callophyllis laciniata2</i>
2000	MAR2056	rouge	Phylloporaceae	<i>Phyllopora crispa</i>	BDSM	Le Moulin hiver 2011	Ld	Q2	17			<i>Rhodymenia pseudopalmeta</i>
2001	MAR2057	rouge	Kallymeniaceae	<i>Kallymenia reniformis</i>	BDSM	Le Moulin hiver 2011	Ld	Q2	2			<i>Kallymenia reniformis</i>
2002	MAR2058	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	BDSM	Le Moulin hiver 2011	Ld	Q2	19			
2003	MAR2059	rouge	Delesseriaceae	<i>Polyneura sp</i>	BDSM	Le Moulin hiver 2011	Ld	Q2	1			<i>Kallymenia reniformis</i>
2004	MAR2060	rouge	Delesseriaceae	<i>Polyneura sp</i>	BDSM	Le Moulin hiver 2011	Ld	Q2	16			
2005	MAR2061	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDSM	Le Moulin hiver 2011	Ld	Q2	11			
2006	MAR2062	rouge	Dumontiaceae	<i>Dilsea carnos</i>	BDSM	Le Moulin hiver 2011	Ld	Q2	12			
2007	MAR2063	rouge	Corallinaceae	<i>Corallina sp</i>	BDSM	Le Moulin hiver 2011	Ld	Q3	8			<i>Corallina officinalis2</i>
2008	MAR2064	rouge	Phylloporaceae	<i>Phyllopora crispa</i>	BDSM	Le Moulin hiver 2011	Ld	Q3	11			<i>Rhodymenia pseudopalmeta</i>
2009	MAR2065	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDSM	Le Moulin hiver 2011	Ld	Q3	15			
2010	MAR2066	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDSM	Le Moulin hiver 2011	Ld	Q3	>100			
2011	MAR2067	rouge	Phylloporaceae	<i>Phyllopora pseudoceranoides</i>	BDSM	Le Moulin hiver 2011	Lh	Q1	8			
2012	MAR2068	rouge	Phylloporaceae	<i>Phyllopora crispa</i>	BDSM	Le Moulin hiver 2011	Lh	Q1	14			
2013	MAR2069	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	BDSM	Le Moulin hiver 2011	Lh	Q1	5			
2014	MAR2070	rouge	Kallymeniaceae	<i>Meredithia microphylla</i>	BDSM	Le Moulin hiver 2011	Lh	Q1	1			<i>Rhodymenia pseudopalmeta</i>
2015	MAR2071	rouge	Phylloporaceae	<i>Phyllopora sicula</i>	BDSM	Le Moulin hiver 2011	Lh	Q1	1			
2016	MAR2072	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDSM	Le Moulin hiver 2011	Lh	Q2	30			
2017	MAR2073	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	BDSM	Le Moulin hiver 2011	Lh	Q2	11			
2018	MAR2074	rouge	Delesseriaceae	<i>Polyneura sp</i>	BDSM	Le Moulin hiver 2011	Lh	Q2	1			
2019	MAR2075	rouge	Delesseriaceae	<i>Polyneura sp</i>	BDSM	Le Moulin hiver 2011	Lh	Q2	10			<i>Polyneura</i>
2020	MAR2076	rouge	Phylloporaceae	<i>Phyllopora pseudoceranoides</i>	BDSM	Le Moulin hiver 2011	Lh	Q2	3			
2021	MAR2077	rouge	Phylloporaceae	<i>Phyllopora crispa</i>	BDSM	Le Moulin hiver 2011	Lh	Q2	18			<i>Phyllopora crispa</i>
2022	MAR2078	rouge	Corallinaceae	<i>Corallina sp</i>	BDSM	Le Moulin hiver 2011	Lh	Q3	8			<i>Corallina officinalis1</i>
2023	MAR2079	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDSM	Le Moulin hiver 2011	Lh	Q3	>100			
2024	MAR2080	rouge	Phylloporaceae	<i>Phyllopora crispa</i>	BDSM	Le Moulin hiver 2011	Lh	Q3	4			
2025	MAR2081	rouge	Phylloporaceae	<i>Phyllopora sicula</i>	BDSM	Le Moulin hiver 2011	Lh	Q3	2			
2026	MAR2082	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	BDSM	Le Moulin hiver 2011	Lh	Q3	1			<i>Callophyllis laciniata2</i>
2027	MAR2083	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDSM	Les Amas hiver 2011	Ld	Q1	17			
2028	MAR2084	rouge	Dasyaceae	<i>Heterosiphonia plumosa</i>	BDSM	Les Amas hiver 2011	Ld	Q1	1			
2029	MAR2085	rouge	Phylloporaceae	<i>Phyllopora crispa</i>	BDSM	Les Amas hiver 2011	Ld	Q2	48			
2030	MAR2086	rouge	Corallinaceae	<i>Corallina sp</i>	BDSM	Les Amas hiver 2011	Ld	Q2	3			
2031												

Annexe 4

	A	B	C	D	E	F	G	H	I	J	K	L
2065	MAR2121	rouge	Delesseriaceae	<i>Polysiphonia sp</i>	<i>BDSM</i>	Les Amas hiver 2011	Lh	Q3	1			
2066	MAR1065	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	<i>PNMI</i>	Linious hiver 2011	Ld	Q1	1			
2067	MAR1066	rouge	Plocamiaceae	<i>Plocamium sp</i>	<i>PNMI</i>	Linious hiver 2011	Ld	Q1	10			
2068	MAR1067	rouge	Wrangeliaceae	<i>Halurus equisetifolius</i>	<i>PNMI</i>	Linious hiver 2011	Ld	Q1	2		<i>Halurus equisetifolius</i>	
2069	MAR1068	rouge	Corallinaceae	<i>Corallina sp</i>	<i>PNMI</i>	Linious hiver 2011	Ld	Q1	23			
2070	MAR1069	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	<i>PNMI</i>	Linious hiver 2011	Ld	Q1	2		<i>Callophyllis laciniata2</i>	
2071	MAR1070	rouge	Plocamiaceae	<i>Plocamium sp</i>	<i>PNMI</i>	Linious hiver 2011	Ld	Q3	21		<i>Plocamium lyngbyanum</i>	
2072	MAR1071	rouge	Corallinaceae	<i>Corallina sp</i>	<i>PNMI</i>	Linious hiver 2011	Ld	Q2	21		<i>Corallina elongata</i>	
2073	MAR1072	rouge	Dumontiaceae	<i>Dilsea carnos</i>	<i>PNMI</i>	Linious hiver 2011	Ld	Q2	1			
2074	MAR1073	brune	Laminariaceae	<i>Laminaria hyperborea</i>	<i>PNMI</i>	Linious hiver 2011	Ld	Q2	2			
2075	MAR1074	rouge	Gelidiaceae	<i>Gelidium corneum</i>	<i>PNMI</i>	Linious hiver 2011	Ld	Q3	1		<i>Gelidium1</i>	
2076	MAR1075	rouge	Delesseriaceae	<i>Hypoglossum hypoglossoides</i>	<i>PNMI</i>	Linious hiver 2011	Ld	Q3	1			
2077	MAR1076	rouge	Phylloporaceae	<i>Membranoptera alata</i>	<i>PNMI</i>	Linious hiver 2011	Ld	Q3	1		<i>Membranoptera alata</i>	
2078	MAR1077	rouge	Plocamiaceae	<i>Plocamium sp</i>	<i>PNMI</i>	Linious hiver 2011	Ld	Q3	4			
2079	MAR1078	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	<i>PNMI</i>	Linious hiver 2011	Ld	Q3	4		<i>Callophyllis laciniata2</i>	
2080	MAR1079	rouge	Gigartineae	<i>Chondrus crispus</i>	<i>PNMI</i>	Linious hiver 2011	Ld	Q3	4		<i>Chondrus crispus</i>	
2081	MAR1080	rouge	Corallinaceae	<i>Corallina sp</i>	<i>PNMI</i>	Linious hiver 2011	Ld	Q3	17		<i>Corallina elongata</i>	
2082	MAR1081	rouge	Dumontiaceae	<i>Dilsea carnos</i>	<i>PNMI</i>	Linious hiver 2011	Lh	Q1	8			
2083	MAR1082	rouge	Corallinaceae	<i>Corallina sp</i>	<i>PNMI</i>	Linious hiver 2011	Lh	Q1	30		<i>Corallina officinalis2</i>	
2084	MAR1083	rouge	Plocamiaceae	<i>Plocamium sp</i>	<i>PNMI</i>	Linious hiver 2011	Lh	Q1	9			
2085	MAR1084	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	<i>PNMI</i>	Linious hiver 2011	Lh	Q1	1		<i>Callophyllis laciniata</i>	
2086	MAR1085	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	<i>PNMI</i>	Linious hiver 2011	Lh	Q1	1		<i>Lomentaria articulata</i>	
2087	MAR1086	rouge	Phylloporaceae	<i>Phyllophora crispa</i>	<i>PNMI</i>	Linious hiver 2011	Lh	Q2	21		<i>Rhodymenia pseudopalmeta</i>	
2088	MAR1087	rouge	Corallinaceae	<i>Corallina sp</i>	<i>PNMI</i>	Linious hiver 2011	Lh	Q2	5		<i>Corallina officinalis1</i>	
2089	MAR1088	rouge	Delesseriaceae	<i>Delesseriaceae</i>	<i>PNMI</i>	Linious hiver 2011	Lh	Q2	10			
2090	MAR1089	rouge	Delesseriaceae	<i>Delesseriaceae</i>	<i>PNMI</i>	Linious hiver 2011	Lh	Q2	5			
2091	MAR1090	rouge	Rhodymeniaceae	<i>Rhodymenia pseudopalmeta</i>	<i>PNMI</i>	Linious hiver 2011	Lh	Q2	3		<i>Rhodymenia pseudopalmeta</i>	
2092	MAR1091	rouge	Kallymeniaceae	<i>Kallymenia reniformis</i>	<i>PNMI</i>	Linious hiver 2011	Lh	Q2	1			
2093	MAR1092	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	<i>PNMI</i>	Linious hiver 2011	Lh	Q2	1		<i>Rhodymenia pseudopalmeta</i>	
2094	MAR1093	rouge	Corallinaceae	<i>Corallina sp</i>	<i>PNMI</i>	Linious hiver 2011	Lh	Q3	5		<i>Corallina officinalis1</i>	
2095	MAR1094	rouge	Plocamiaceae	<i>Plocamium sp</i>	<i>PNMI</i>	Linious hiver 2011	Lh	Q3	1			
2096	MAR1095	rouge	Delesseriaceae	<i>Cryptoleura ramosa</i>	<i>PNMI</i>	Linious hiver 2011	Lh	Q3	1		<i>Acrosorium sp</i>	
2097	MAR1096	rouge	Kallymeniaceae	<i>Kallymenia reniformis</i>	<i>PNMI</i>	Linious hiver 2011	Lh	Q3	3			
2098	MAR1097	rouge	Dumontiaceae	<i>Dilsea carnos</i>	<i>PNMI</i>	Linious hiver 2011	Lh	Q3	18			
2099	MAR3365	rouge	Delesseriaceae	<i>Delesseria sanguinea</i>	<i>PNMI</i>	Linious hiver 2011	Lh	Q4	na			
2100	MAR3366	rouge	Phylloporaceae	<i>Phyllophora crispa</i>	<i>PNMI</i>	Linious hiver 2011	Lh	Q4	na		<i>Phyllophora crispa</i>	
2101	MAR3367	rouge	Plocamiaceae	<i>Plocamium sp</i>	<i>PNMI</i>	Linious hiver 2011	Lh	Q4	na		<i>Plocamium cartilagineum</i>	
2102	MAR3368	brune	Dictyotaceae	<i>Dictyota dichotoma</i>	<i>PNMI</i>	Linious hiver 2011	Lh	Q4	na			
2103	MAR3369	rouge	Kallymeniaceae	<i>Kallymenia reniformis</i>	<i>PNMI</i>	Linious hiver 2011	Lh	Q4	na			
2104	MAR3370	rouge	Corallinaceae	<i>Corallina sp</i>	<i>PNMI</i>	Linious hiver 2011	Lh	Q4	na		<i>Corallina officinalis2</i>	
2105	MAR3371	rouge	Delesseriaceae	<i>Delesseria sanguinea</i>	<i>PNMI</i>	Linious hiver 2011	Lh	Q5	na		<i>Delesseria sanguinea</i>	
2106	MAR3372	rouge	Delesseriaceae	<i>Phycodrys rubens</i>	<i>PNMI</i>	Linious hiver 2011	Lh	Q5	na		<i>Phycodrys rubens</i>	
2107	MAR3373	rouge	Dumontiaceae	<i>Dilsea carnos</i>	<i>PNMI</i>	Linious hiver 2011	Lh	Q5	na			
2108	MAR3374	rouge	Phylloporaceae	<i>Phyllophora crispa</i>	<i>PNMI</i>	Linious hiver 2011	Lh	Q5	na		<i>Phyllophora crispa</i>	
2109	MAR3375	rouge	Kallymeniaceae	<i>Meredithia microphylla</i>	<i>PNMI</i>	Linious hiver 2011	Lh	Q5	na		<i>Strange Kallymeniaceae</i>	
2110	MAR3376	rouge	Rhodymeniaceae	<i>Rhodymenia pseudopalmeta</i>	<i>PNMI</i>	Linious hiver 2011	Lh	Q5	na			
2111	MAR3377	rouge	Dasyaceae	<i>Heterosiphonia plumosa</i>	<i>PNMI</i>	Linious hiver 2011	Lh	Q5	na			
2112	MAR3378	rouge	Plocamiaceae	<i>Plocamium sp</i>	<i>PNMI</i>	Linious hiver 2011	Lh	Q5	na		<i>Plocamium lyngbyanum</i>	
2113	MAR0035	rouge	Bonnemaisoniaceae	<i>Bonnemaisonia asparagoides</i>	<i>PNMI</i>	Linious hiver 2011	Lh	Vue	na		<i>Bonnemaisonia asparagoides</i>	
2114	MAR0036	rouge	Ceramiales	<i>Ceramiales</i>	<i>PNMI</i>	Linious hiver 2011	Lh	Vue	na		<i>Brongniartella byssoides</i>	
2115	MAR0031	rouge	Kallymeniaceae	<i>Kallymenia reniformis</i>	<i>PNMI</i>	Linious hiver 2011	Lh	Vue	na		<i>Kallymenia reniformis</i>	
2116	MAR0033	rouge	Kallymeniaceae	<i>Kallymenia reniformis</i>	<i>PNMI</i>	Linious hiver 2011	Lh	Vue	na		<i>Kallymenia reniformis</i>	
2117	MAR0034	rouge	Kallymeniaceae	<i>Meredithia microphylla</i>	<i>PNMI</i>	Linious hiver 2011	Lh	Vue	na		<i>Kallymenia reniformis</i>	
2118	MAR0032	rouge	Delesseriaceae	<i>Phycodrys rubens</i>	<i>PNMI</i>	Linious hiver 2011	Lh	Vue	na		<i>Phycodrys rubens</i>	
2119	MAR0070	rouge	Phylloporaceae	<i>Phyllophora crispa</i>	<i>PNMI</i>	Linious hiver 2011	Lh	Vue	na		<i>Phyllophora crispa</i>	
2120	MAR2167	rouge	Delesseriaceae	<i>Apoglossum ruscfolium</i>	<i>PNMI</i>	Linious hiver 2012	Lh	Q1	na			
2121	MAR2168	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	<i>PNMI</i>	Linious hiver 2012	Lh	Q1	na		<i>Callophyllis laciniata2</i>	
2122	MAR2169	rouge	Corallinaceae	<i>Corallina sp</i>	<i>PNMI</i>	Linious hiver 2012	Lh	Q1	na			
2123	MAR2170	rouge	Delesseriaceae	<i>Cryptoleura ramosa</i>	<i>PNMI</i>	Linious hiver 2012	Lh	Q1	na			
2124	MAR2171	rouge	Delesseriaceae	<i>Delesseria sanguinea</i>	<i>PNMI</i>	Linious hiver 2012	Lh	Q1	na		<i>Delesseria sanguinea</i>	
2125	MAR2172	rouge	Delesseriaceae	<i>Delesseria sp</i>	<i>PNMI</i>	Linious hiver 2012	Lh	Q1	na		<i>Acrosorium ciliolatum</i>	
2126	MAR2173	brune	Styocaulaceae	<i>Halopteris filicina</i>	<i>PNMI</i>	Linious hiver 2012	Lh	Q1	na			
2127	MAR2174	rouge	Dasyaceae	<i>Heterosiphonia plumosa</i>	<i>PNMI</i>	Linious hiver 2012	Lh	Q1	na		<i>Halopteris filicina1</i>	
2128	MAR2175	rouge	Kallymeniaceae	<i>Kallymenia reniformis</i>	<i>PNMI</i>	Linious hiver 2012	Lh	Q1	na		<i>Kallymenia reniformis</i>	
2129	MAR2176	rouge	Delesseriaceae	<i>Phycodrys rubens</i>	<i>PNMI</i>	Linious hiver 2012	Lh	Q1	na		<i>Delesseria sanguinea</i>	
2130	MAR2177	rouge	Phylloporaceae	<i>Phyllophora crispa</i>	<i>PNMI</i>	Linious hiver 2012	Lh	Q1	na		<i>Phyllophora crispa</i>	
2131	MAR2178	rouge	Phylloporaceae	<i>Phyllophora sicula</i>	<i>PNMI</i>	Linious hiver 2012	Lh	Q1	na		<i>Phyllophora crispa</i>	
2132	MAR2179	rouge	Plocamiaceae	<i>Plocamium sp</i>	<i>PNMI</i>	Linious hiver 2012	Lh	Q1	na		<i>Plocamium cartilagineum</i>	
2133	MAR2180	rouge	Sphaerococcaceae	<i>Sphaerococcus coronopifolius</i>	<i>PNMI</i>	Linious hiver 2012	Lh	Q1	na			
2134	MAR2181	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	<i>PNMI</i>	Linious hiver 2012	Lh	Q2	na		<i>Callophyllis laciniata2</i>	
2135	MAR2182	rouge	Delesseriaceae	<i>Cryptoleura ramosa</i>	<i>PNMI</i>	Linious hiver 2012	Lh	Q2	na		<i>Cryptoleura ramosa</i>	
2136	MAR2183	rouge	Delesseriaceae	<i>Delesseria sanguinea</i>	<i>PNMI</i>	Linious hiver 2012	Lh	Q2	na		<i>Delesseria sanguinea</i>	
2137	MAR2184	brune	Styocaulaceae	<i>Halopteris filicina</i>	<i>PNMI</i>	Linious hiver 2012	Lh	Q2	na			
2138	MAR2185	rouge	Delesseriaceae	<i>Phycodrys rubens</i>	<i>PNMI</i>	Linious hiver 2012	Lh	Q2	na		<i>Delesseria sanguinea</i>	
2139	MAR2186	rouge	Phylloporaceae	<i>Phyllophora crispa</i>	<i>PNMI</i>	Linious hiver 2012	Lh	Q2	na		<i>Phyllophora crispa</i>	
2140	MAR2187	rouge	Phylloporaceae	<i>Phyllophora sicula</i>	<i>PNMI</i>	Linious hiver 2012	Lh	Q2	na		<i>Phyllophora crispa</i>	
2141	MAR2188	rouge	Gigartineae	<i>Chondrus crispus</i>	<i>PNMI</i>	Linious hiver 2012	Lh	Q2	na		<i>Rhodymenia pseudopalmeta</i>	
2142	MAR2189	rouge	Delesseriaceae	<i>Apoglossum ruscfolium</i>	<i>PNMI</i>	Linious hiver 2012	Lh	Q3	na		<i>Apoglossum ruscfolium</i>	
2143	MAR2190	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	<i>PNMI</i>	Linious hiver 2012	Lh	Q3	na		<i>Callophyllis laciniata2</i>	
2144	MAR2191	rouge	Delesseriaceae	<i>Cryptoleura ramosa</i>	<i>PNMI</i>	Linious hiver 2012	Lh	Q3	na		<i>Cryptoleura ramosa</i>	
2145	MAR2192	rouge	Delesseriaceae	<i>Delesseria sanguinea</i>	<i>PNMI</i>	Linious hiver 2012	Lh	Q3	na		<i>Delesseria sanguinea</i>	
2146	MAR2193	rouge	Delesseriaceae	<i>Delesseria sp</i>	<i>PNMI</i>	Linious hiver 2012	Lh	Q3	na			
2147	MAR2194	brune	Styocaulaceae	<i>Halopteris filicina</i>	<i>PNMI</i>	Linious hiver 2012	Lh	Q3	na			
2148	MAR2195	rouge	Kallymeniaceae	<i>Kallymenia reniformis</i>	<i>PNMI</i>	Linious hiver 2012	Lh	Q3	na		<i>Kallymenia reniformis</i>	
2149	MAR2196	rouge	Delesseriaceae	<i>Phycodrys rubens</i>	<i>PNMI</i>	Linious hiver 2012	Lh	Q3	na		<i>Delesseria sanguinea</i>	
2150	MAR2197	rouge	Phylloporaceae	<i>Phyllophora crispa</i>	<i>PNMI</i>	Linious hiver 2012	Lh	Q3	na		<i>Phyllophora crispa</i>	
2151	MAR2198	rouge	Phylloporaceae	<i>Phyllophora crispa</i>	<i>PNMI</i>	Linious hiver 2012	Lh	Q3	na		<i>Phyllophora crispa</i>	
2152	MAR2199	rouge	Plocamiaceae	<i>Plocamium sp</i>	<i>PNMI</i>	Linious hiver 2012	Lh	Q3	na			
2153	MAR2200	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	<i>PNMI</i>	Linious hiver 2012	Lh	Q4	na		<i>Callophyllis laciniata2</i>	
2154	MAR2201	rouge	Delesseriaceae	<i>Delesseria sanguinea</i>	<i>PNMI</i>	Linious hiver 2012	Lh	Q4	na		<i>Delesseria sanguinea</i>	
2155	MAR2202	rouge	Delesseriaceae	<i>Delesseria sp</i>	<i>PNMI</i>	Linious hiver 2012	Lh	Q4	na			
2156	MAR2203	rouge	Wrangeliaceae	<i>Halurus equisetifolius</i>	<i>PNMI</i>	Linious hiver 2012	Lh	Q4	na			
2157	MAR2204	rouge	Delesseriaceae	<i>Myriogramme sp</i>	<i>PNMI</i>	Linious hiver 2012	Lh	Q4	na		<i>Polyneura</i>	
2158	MAR2205	rouge	Delesseriaceae	<i>Phycodrys rubens</i>	<i>PNMI</i>	Linious hiver 2012	Lh	Q4	na		<i>Delesseria sanguinea</i>	
2159	MAR2206	rouge	Phylloporaceae	<i>Phyllophora crispa</i>	<i>PNMI</i>	Linious hiver 2012	Lh	Q4	na		<i>Phyllophora crispa</i>	
2160	MAR2207	rouge	Phylloporaceae	<i>Phyllophora sicula</i>	<i>PNMI</i>	Linious hiver 2012	Lh	Q4	na		<i>Phyllophora crispa</i>	
2161	MAR2208	rouge	Plocamiaceae	<i>Plocamium sp</i>	<i>PNMI</i>	Linious hiver 2012	Lh	Q4	na			
2162	MAR2209	rouge	Delesseriaceae	<i>Acrosorium uncinatum</i>	<i>PNMI</i>	Linious hiver 2012	Lh	Q5	na		<i>Callophyllis laciniata2</i>	
2163	MAR2210	rouge	Delesseriaceae	<i>Apoglossum ruscfolium</i>	<i>PNMI</i>	Linious hiver 2012	Lh	Q5	na		<i>Apoglossum ruscfolium</i>	
2164	MAR2211	rouge	Bonnemaisoniaceae	<i>Bonnemaisonia asparagoides</i>	<i>PNMI</i>	Linious hiver 2012	Lh	Q5	na		<i>Bonnemaisonia asparagoides</i>	
2165	MAR2212	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	<i>PNMI</i>	Linious hiver 2012	Lh	Q5	na		<i>Callophyllis laciniata2</i>	
2166	MAR2213	rouge	Delesseriaceae	<i>Cryptoleura ramosa</i>	<i>PNMI</i>	Linious hiver 2012	Lh	Q5	na			
2167	MAR2214	rouge	Cystocloniaceae	<i>Cystoclonium purpureum</i>	<i>PNMI</i>	Linious hiver 2012	Lh	Q5	na		<i>Griffithsia sp</i>	
2168	MAR											

Annexe 4

	A	B	C	D	E	F	G	H	I	J	K	L
2194	MAR1160	rouge	Gigartineae	<i>Chondrus crispus</i>	PNMI	Men Vriant hiver 2011	Ld	Q1	11			
2195	MAR1161	rouge	Champiaceae	<i>Gastroclonium ovatum</i>	PNMI	Men Vriant hiver 2011	Ld	Q1	1			
2196	MAR1162	rouge	Corallineae	<i>Corallina sp</i>	PNMI	Men Vriant hiver 2011	Ld	Q1	70			
2197	MAR1163	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	PNMI	Men Vriant hiver 2011	Ld	Q2	1			
2198	MAR1164	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	PNMI	Men Vriant hiver 2011	Ld	Q2	2			
2199	MAR1165	verte	Ulveae	<i>Ulva sp</i>	PNMI	Men Vriant hiver 2011	Ld	Q2	3			
2200	MAR1166	brune	Dictyotaceae	<i>Dictyota dichotoma</i>	PNMI	Men Vriant hiver 2011	Ld	Q3	1			
2201	MAR1167	rouge	Gelidiaceae	<i>Gelidium corneum</i>	PNMI	Men Vriant hiver 2011	Ld	Q2	1			
2202	MAR1168	rouge	Plocamiaceae	<i>Plocamium sp</i>	PNMI	Men Vriant hiver 2011	Ld	Q2	1			
2203	MAR1169	rouge	Corallineae	<i>Corallina sp</i>	PNMI	Men Vriant hiver 2011	Ld	Q2	40			
2204	MAR1170	rouge	Haluraceae	<i>Halurus equisetifolius</i>	PNMI	Men Vriant hiver 2011	Ld	Q2	2			
2205	MAR1171	rouge	Dasyaceae	<i>Heterosiphonia plumosa</i>	PNMI	Men Vriant hiver 2011	Ld	Q2	2			
2206	MAR1172	brune	Dictyotaceae	<i>Dictyota dichotoma</i>	PNMI	Men Vriant hiver 2011	Ld	Q3	1			
2207	MAR1173	rouge	Palmariaaceae	<i>Palmaria palmata</i>	PNMI	Men Vriant hiver 2011	Ld	Q3	1			
2208	MAR1174	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	PNMI	Men Vriant hiver 2011	Ld	Q3	1			
2209	MAR1175	rouge	Gelidiaceae	<i>Gelidium corneum</i>	PNMI	Men Vriant hiver 2011	Ld	Q3	4			
2210	MAR1176	rouge	Phylloporaceae	<i>Gymnogongrus sp</i>	PNMI	Men Vriant hiver 2011	Ld	Q3	3			
2211	MAR1177	rouge	Gigartineae	<i>Chondrus crispus</i>	PNMI	Men Vriant hiver 2011	Ld	Q3	3			
2212	MAR1178	rouge	Corallineae	<i>Corallina sp</i>	PNMI	Men Vriant hiver 2011	Ld	Q3	20			
2213	MAR1179	rouge	Wrangeliaceae	<i>Griffithsia corallinoides</i>	PNMI	Men Vriant hiver 2011	Ld	Q3	5			
2214	MAR1180	rouge	Dasyaceae	<i>Heterosiphonia plumosa</i>	PNMI	Men Vriant hiver 2011	Ld	Q3	1			
2215	MAR1181	rouge	Wrangeliaceae	<i>Halurus equisetifolius</i>	PNMI	Men Vriant hiver 2011	Ld	Q3	2			
2216	MAR1182	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	PNMI	Men Vriant hiver 2011	Ld	Q3	11			
2217	MAR1183	rouge	Wrangeliaceae	<i>Halurus equisetifolius</i>	PNMI	Men Vriant hiver 2011	Lh	Q1	1			
2218	MAR1184	rouge	Corallineae	<i>Corallina sp</i>	PNMI	Men Vriant hiver 2011	Lh	Q1	100			
2219	MAR1185	rouge	Champiaceae	<i>Gastroclonium ovatum</i>	PNMI	Men Vriant hiver 2011	Lh	Q1	2			
2220	MAR1186	rouge	Gelidiaceae	<i>Gelidium latifolium</i>	PNMI	Men Vriant hiver 2011	Lh	Q1	2			
2221	MAR1187	rouge	Gelidiaceae	<i>Gelidium corneum</i>	PNMI	Men Vriant hiver 2011	Lh	Q1	4			
2222	MAR1188	rouge	Gigartineae	<i>Chondrus crispus</i>	PNMI	Men Vriant hiver 2011	Lh	Q1	3			
2223	MAR1189	rouge	Kallymeniaceae	<i>Kallymenia reniformis</i>	PNMI	Men Vriant hiver 2011	Lh	Q2	1			
2224	MAR1190	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	PNMI	Men Vriant hiver 2011	Lh	Q2	6			
2225	MAR1191	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	PNMI	Men Vriant hiver 2011	Lh	Q2	6			
2226	MAR1192	rouge	Gelidiaceae	<i>Gelidium corneum</i>	PNMI	Men Vriant hiver 2011	Lh	Q2	6			
2227	MAR1193	rouge	Corallineae	<i>Corallina sp</i>	PNMI	Men Vriant hiver 2011	Lh	Q2	20			
2228	MAR1194	rouge	Gigartineae	<i>Chondrus crispus</i>	PNMI	Men Vriant hiver 2011	Lh	Q2	7			
2229	MAR1195	brune	Himanthaliaceae	<i>Himanthalia elongata</i>	PNMI	Men Vriant hiver 2011	Lh	Q2	2			
2230	MAR1196	rouge	Dasyaceae	<i>Heterosiphonia plumosa</i>	PNMI	Men Vriant hiver 2011	Lh	Q2	1			
2231	MAR1197	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	PNMI	Men Vriant hiver 2011	Lh	Q2	2			
2232	MAR1198	rouge	Phylloporaceae	<i>Gymnogongrus sp</i>	PNMI	Men Vriant hiver 2011	Lh	Q2	5			
2233	MAR1199	brune	Dictyotaceae	<i>Dictyota dichotoma</i>	PNMI	Men Vriant hiver 2011	Lh	Q2	1			
2234	MAR1200	rouge	Rhodomeleaceae	<i>Osmundea pinnatifida</i>	PNMI	Men Vriant hiver 2011	Lh	Q2	1			
2235	MAR1201	rouge	Wrangeliaceae	<i>Halurus equisetifolius</i>	PNMI	Men Vriant hiver 2011	Lh	Q2	1			
2236	MAR1202	rouge	Kallymeniaceae	<i>Kallymenia reniformis</i>	PNMI	Men Vriant hiver 2011	Lh	Q3	3			
2237	MAR1203	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	PNMI	Men Vriant hiver 2011	Lh	Q3	3			
2238	MAR1204	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	PNMI	Men Vriant hiver 2011	Lh	Q3	7			
2239	MAR1205	verte	Ulveae	<i>Ulva sp</i>	PNMI	Men Vriant hiver 2011	Lh	Q3	1			
2240	MAR1206	rouge	Delesseriaceae	<i>Apoglossum ruscfolium</i>	PNMI	Men Vriant hiver 2011	Lh	Q3	15			
2241	MAR1207	rouge	Dasyaceae	<i>Heterosiphonia plumosa</i>	PNMI	Men Vriant hiver 2011	Lh	Q3	20			
2242	MAR1208	rouge	Rhodomeleaceae	<i>Osmundea pinnatifida</i>	PNMI	Men Vriant hiver 2011	Lh	Q3	1			
2243	MAR1209	rouge	Wrangeliaceae	<i>Halurus fuscus</i>	PNMI	Men Vriant hiver 2011	Lh	Q3	2			
2244	MAR1210	rouge	Delesseriaceae	<i>Nitophyllum punctatum</i>	PNMI	Men Vriant hiver 2011	Lh	Q3	1			
2245	MAR1211	rouge	Phylloporaceae	<i>Membranoptera alata</i>	PNMI	Men Vriant hiver 2011	Lh	Q3	7			
2246	MAR1212	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	PNMI	Men Vriant hiver 2011	Lh	Q3	5			
2247	MAR1213	rouge	Corallineae	<i>Corallina sp</i>	PNMI	Men Vriant hiver 2011	Lh	Q3	20			
2248	MAR1214	rouge	Gelidiaceae	<i>Gelidium corneum</i>	PNMI	Men Vriant hiver 2011	Lh	Q3	2			
2249	MAR1215	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	BDSM	Nerput hiver 2011	Ld	Q1	4			
2250	MAR1216	rouge	Corallineae	<i>Corallina sp</i>	BDSM	Nerput hiver 2011	Ld	Q1	40			
2251	MAR1217	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDSM	Nerput hiver 2011	Ld	Q1	3			
2252	MAR1218	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDSM	Nerput hiver 2011	Ld	Q1	45			
2253	MAR1219	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	BDSM	Nerput hiver 2011	Ld	Q1	5			
2254	MAR1220	brune	Styopaulaceae	<i>Halopteris filicina</i>	BDSM	Nerput hiver 2011	Ld	Q1	1			
2255	MAR1221	rouge	Sphaerococcaceae	<i>Sphaerococcus coronopifolius</i>	BDSM	Nerput hiver 2011	Ld	Q1	4			
2256	MAR1222	rouge	Delesseriaceae	<i>Delesseriaceae</i>	BDSM	Nerput hiver 2011	Ld	Q1	2			
2257	MAR1223	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	BDSM	Nerput hiver 2011	Ld	Q2	20			
2258	MAR1224	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	BDSM	Nerput hiver 2011	Ld	Q2	3			
2259	MAR1225	rouge	Delesseriaceae	<i>Delesseriaceae</i>	BDSM	Nerput hiver 2011	Ld	Q2	1			
2260	MAR1226	rouge	Kallymeniaceae	<i>Kallymenia reniformis</i>	BDSM	Nerput hiver 2011	Ld	Q2	1			
2261	MAR1227	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDSM	Nerput hiver 2011	Ld	Q2	6			
2262	MAR1228	rouge	Corallineae	<i>Corallina sp</i>	BDSM	Nerput hiver 2011	Ld	Q2	2			
2263	MAR1229	rouge	Corallineae	<i>Corallina sp</i>	BDSM	Nerput hiver 2011	Ld	Q2	18			
2264	MAR1230	rouge	Corallineae	<i>Corallina sp</i>	BDSM	Nerput hiver 2011	Ld	Q3	60			
2265	MAR1231	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	BDSM	Nerput hiver 2011	Ld	Q3	2			
2266	MAR1232	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDSM	Nerput hiver 2011	Ld	Q3	30			
2267	MAR1233	rouge	Sphaerococcaceae	<i>Sphaerococcus coronopifolius</i>	BDSM	Nerput hiver 2011	Ld	Q3	2			
2268	MAR1234	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	BDSM	Nerput hiver 2011	Ld	Q3	3			
2269	MAR1235	rouge	Phylloporaceae	<i>Phyllophora pseudoceranoides</i>	BDSM	Nerput hiver 2011	Ld	Q3	5			
2270	MAR1236	rouge	Phylloporaceae	<i>Phyllophora crispa</i>	BDSM	Nerput hiver 2011	Ld	Q3	2			
2271	MAR1237	rouge	Delesseriaceae	<i>Delesseriaceae</i>	BDSM	Nerput hiver 2011	Ld	Q3	2			
2272	MAR1238	rouge	Sphaerococcaceae	<i>Sphaerococcus coronopifolius</i>	BDSM	Nerput hiver 2011	Lh	Q1	14			
2273	MAR1239	rouge	Corallineae	<i>Corallina sp</i>	BDSM	Nerput hiver 2011	Lh	Q1	11			
2274	MAR1240	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDSM	Nerput hiver 2011	Lh	Q1	>100			
2275	MAR1241	rouge	Phylloporaceae	<i>Phyllophora crispa</i>	BDSM	Nerput hiver 2011	Lh	Q1	6			
2276	MAR1242	brune	Dictyotaceae	<i>Dictyopteris polypodioides</i>	BDSM	Nerput hiver 2011	Lh	Q1	36			
2277	MAR1243	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	BDSM	Nerput hiver 2011	Lh	Q2	17			
2278	MAR1244	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDSM	Nerput hiver 2011	Lh	Q2	23			
2279	MAR1245	rouge	Delesseriaceae	<i>Delesseriaceae</i>	BDSM	Nerput hiver 2011	Lh	Q2	2			
2280	MAR1246	rouge	Phylloporaceae	<i>Phyllophora crispa</i>	BDSM	Nerput hiver 2011	Lh	Q2	6			
2281	MAR1247	rouge	Dictyotaceae	<i>Dictyopteris polypodioides</i>	BDSM	Nerput hiver 2011	Lh	Q2	4			
2282	MAR1248	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	BDSM	Nerput hiver 2011	Lh	Q2	3			
2283	MAR1249	rouge	Delesseriaceae	<i>Delesseriaceae</i>	BDSM	Nerput hiver 2011	Lh	Q2	14			
2284	MAR1250	rouge	Sphaerococcaceae	<i>Sphaerococcus coronopifolius</i>	BDSM	Nerput hiver 2011	Lh	Q2	10			
2285	MAR1251	rouge	Corallineae	<i>Corallina sp</i>	BDSM	Nerput hiver 2011	Lh	Q2	10			
2286	MAR1252	brune	Styopaulaceae	<i>Halopteris filicina</i>	BDSM	Nerput hiver 2011	Lh	Q2	1			
2287	MAR1253	rouge	Corallineae	<i>Corallina sp</i>	BDSM	Nerput hiver 2011	Lh	Q3	6			
2288	MAR1254	rouge	Sphaerococcaceae	<i>Sphaerococcus coronopifolius</i>	BDSM	Nerput hiver 2011	Lh	Q3	2			
2289	MAR1255	brune	Dictyotaceae	<i>Dictyopteris polypodioides</i>	BDSM	Nerput hiver 2011	Lh	Q3	14			
2290	MAR1256	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDSM	Nerput hiver 2011	Lh	Q3	30			
2291	MAR1257	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	BDSM	Nerput hiver 2011	Lh	Q3	2			
2292	MAR1258	rouge	Gracilariaceae	<i>Gracilaria sp</i>	BDSM	Nerput hiver 2011	Lh	Q3	1			
2293	MAR1259	rouge	Phylloporaceae	<i>Phyllophora crispa</i>	BDSM	Nerput hiver 2011	Lh	Q3	16			
2294	MAR1260	brune	Dictyotaceae	<i>Dictyopteris polypodioides</i>	BDSM	Nerput hiver 2011	Lh	Q4	na			
2295	MAR1261	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDSM	Nerput hiver 2011	Lh	Q4	na			
2296	MAR1262	rouge	Corallineae	<i>Corallina sp</i>	BDSM	Nerput hiver 2011	Lh	Q4	na			
2297	MAR1263	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	BDSM	Nerput hiver 2011	Lh	Q4	na			
2298	MAR1264	rouge	Rhodomeleaceae	<i>Polysiphonia sp</i>	BDSM	Nerput hiver 2011	Lh	Q4	na			
2299	MAR1265	rouge	Phylloporaceae	<i>Phyllophora crispa</i>	BDSM	Nerput hiver 2011	Lh	Q4	na			
2300	MAR1266	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDSM	Nerput hiver 2011	Lh	Q5	na			
2301	MAR1267	rouge	Dumontiaceae	<i>Dilsea carnosa</i>	BDSM	Nerput hiver 2011	Lh	Q5	na			
2302	MAR1268	rouge	Phylloporaceae	<i>Phyllophora crispa</i>	BDSM	Nerput hiver 2011	Lh	Q5	na			
2303	MAR1269	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	BDSM	Nerput hiver 2011	Lh	Q5	na			
2304	MAR1270	rouge	Corallineae	<i>Corallina sp</i>	BDSM	Nerput hiver 2011	Lh	Q5	na			
2305	MAR1271	rouge	Sphaerococcaceae	<i>Sphaerococcus coronopifolius</i>	BDSM	Nerput hiver 2011	Lh	Q5	na			
2306	MAR1272	rouge	Dasyaceae	<i>Heterosiphonia plumosa</i>	BDSM	Nerput hiver 2011	Lh	Q5	na			
2307	MAR1273	rouge	Rhodomeleaceae									

Annexe 4

	A	B	C	D	E	F	G	H	I	J	K	L
2323	MAR2318	brune	Dictyotaceae	<i>Dictyopteris polydoides</i>	BDSM	Nerput hiver 2012	Lh	O2	na			
2324	MAR2319	rouge	Phyllophoraceae	<i>Phyllophora crispa</i>	BDSM	Nerput hiver 2012	Lh	O2	na	<i>Phyllophora crispa</i>		
2325	MAR2320	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDSM	Nerput hiver 2012	Lh	O2	na	<i>Plocamium lyngbyanum</i>		
2326	MAR2321	brune	Sargassaceae	<i>Sargassum muticum</i>	BDSM	Nerput hiver 2012	Lh	O2	na	<i>Cystoseira baccata</i>		
2327	MAR2322	rouge	Sphaerococcaceae	<i>Sphaerococcus coronopifolius</i>	BDSM	Nerput hiver 2012	Lh	O2	na			
2328	MAR2323	rouge	Kallymeniaceae	<i>Calliphylis laciniata</i>	BDSM	Nerput hiver 2012	Lh	O3	na	<i>Calliphylis laciniata2</i>		
2329	MAR2324	rouge	Kallymeniaceae	<i>Meredithia microphylla</i>	BDSM	Nerput hiver 2012	Lh	O3	na	<i>Meredithia microphylla</i>		
2330	MAR2325	rouge	Phyllophoraceae	<i>Phyllophora crispa</i>	BDSM	Nerput hiver 2012	Lh	O3	na	<i>Phyllophora crispa</i>		
2331	MAR2326	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDSM	Nerput hiver 2012	Lh	O3	na	<i>Plocamium lyngbyanum</i>		
2332	MAR2327	brune	Dictyotaceae	<i>Dictyopteris polydoides</i>	BDSM	Nerput hiver 2012	Lh	O4	na			
2333	MAR2328	rouge	Phyllophoraceae	<i>Phyllophora crispa</i>	BDSM	Nerput hiver 2012	Lh	O4	na	<i>Phyllophora crispa</i>		
2334	MAR2329	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDSM	Nerput hiver 2012	Lh	O4	na	<i>Plocamium lyngbyanum</i>		
2335	MAR2330	rouge	Sphaerococcaceae	<i>Sphaerococcus coronopifolius</i>	BDSM	Nerput hiver 2012	Lh	O4	na			
2336	MAR2331	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	BDSM	Nerput hiver 2012	Lh	O5	na			
2337	MAR2332	rouge	Furcellariaceae	<i>Furcellaria lumbricalis</i>	BDSM	Nerput hiver 2012	Lh	O5	na		<i>Furcellaria lumbricalis</i>	
2338	MAR2333	brune	Styopcaulaceae	<i>Halopteris filicina</i>	BDSM	Nerput hiver 2012	Lh	O5	na			
2339	MAR2334	rouge	Dasyaceae	<i>Heterosiphonia plumosa</i>	BDSM	Nerput hiver 2012	Lh	O5	na	<i>Asparagopsis armata</i>		
2340	MAR2335	rouge	Phyllophoraceae	<i>Phyllophora crispa</i>	BDSM	Nerput hiver 2012	Lh	O5	na	<i>Phyllophora crispa</i>		
2341	MAR2336	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDSM	Nerput hiver 2012	Lh	O5	na	<i>Plocamium lyngbyanum</i>		
2342	MAR0154	rouge	Kallymeniaceae	<i>Calliphylis laciniata</i>	BDSM	Nerput hiver 2012	Lh	Vue	na	<i>Calliphylis laciniata2</i>		
2343	MAR0152	verte	Codiaceae	<i>Codium sp</i>	BDSM	Nerput hiver 2012	Lh	Vue	na			
2344	MAR0153	brune	Dictyotaceae	<i>Dictyopteris polydoides</i>	BDSM	Nerput hiver 2012	Lh	Vue	na			
2345	MAR0157	rouge	Dumontiaceae	<i>Dilsea carnos</i>	BDSM	Nerput hiver 2012	Lh	Vue	na			
2346	MAR0162	rouge	Furcellariaceae	<i>Furcellaria lumbricalis</i>	BDSM	Nerput hiver 2012	Lh	Vue	na		<i>Furcellaria lumbricalis</i>	
2347	MAR0163	rouge	Phyllophoraceae	<i>Gymnogongrus sp</i>	BDSM	Nerput hiver 2012	Lh	Vue	na			
2348	MAR0158	brune	Sargassaceae	<i>Halidrys siliquosa</i>	BDSM	Nerput hiver 2012	Lh	Vue	na	<i>Halidrys siliquosa</i>		
2349	MAR0156	brune	Styopcaulaceae	<i>Halopteris filicina</i>	BDSM	Nerput hiver 2012	Lh	Vue	na			
2350	MAR0161	rouge	Delesseriaceae	<i>Nitophyllum punctatum</i>	BDSM	Nerput hiver 2012	Lh	Vue	na	<i>Kallymenia reniformis</i>		
2351	MAR0159	rouge	Kallymeniaceae	<i>Meredithia microphylla</i>	BDSM	Nerput hiver 2012	Lh	Vue	na	<i>Meredithia microphylla</i>		
2352	MAR0155	rouge	Phyllophoraceae	<i>Phyllophora crispa</i>	BDSM	Nerput hiver 2012	Lh	Vue	na			
2353	MAR0160	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDSM	Nerput hiver 2012	Lh	Vue	na	<i>Plocamium lyngbyanum</i>		
2354	MAR1215	rouge	Gigartiniaceae	<i>Chondrus crispus</i>	PNMI	Pointe Gouin hiver 2011	Ld	Q1	15	<i>Chondrus crispus</i>		
2355	MAR1216	rouge	Plocamiaceae	<i>Plocamium sp</i>	PNMI	Pointe Gouin hiver 2011	Ld	Q1	27			
2356	MAR1217	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	PNMI	Pointe Gouin hiver 2011	Ld	Q1	1	<i>Lomentaria articulata</i>		
2357	MAR1218	rouge	Dumontiaceae	<i>Dilsea carnos</i>	PNMI	Pointe Gouin hiver 2011	Ld	Q1	33	<i>Dilsea carnos</i>		
2358	MAR1219	rouge	Corallinaceae	<i>Corallina sp</i>	PNMI	Pointe Gouin hiver 2011	Ld	Q1	34	<i>Corallina officinalis1</i>		
2359	MAR1220	rouge	Corallinaceae	<i>Corallina sp</i>	PNMI	Pointe Gouin hiver 2011	Ld	Q1	50			
2360	MAR1221	brune	Fucaceae	<i>Fucus serratus</i>	PNMI	Pointe Gouin hiver 2011	Ld	Q1	1			
2361	MAR1222	rouge	Callithamniaceae	<i>Callithamnion tetragonum</i>	PNMI	Pointe Gouin hiver 2011	Ld	Q2	1	<i>Callithamnion tetricum</i>		
2362	MAR1223	rouge	Wrangeliaceae	<i>Halurus equisetifolius</i>	PNMI	Pointe Gouin hiver 2011	Ld	Q2	1			
2363	MAR1224	rouge	Phyllophoraceae	<i>Membranoptera alata</i>	PNMI	Pointe Gouin hiver 2011	Ld	Q2	3	<i>Membranoptera alata</i>		
2364	MAR1225	rouge	Dasyaceae	<i>Heterosiphonia plumosa</i>	PNMI	Pointe Gouin hiver 2011	Ld	Q2	3			
2365	MAR1226	rouge	Rhodymeniaceae	<i>Rhodymenia pseudopalmeta</i>	PNMI	Pointe Gouin hiver 2011	Ld	Q2	5	<i>Rhodymenia pseudopalmeta</i>		
2366	MAR1227	rouge	Phyllophoraceae	<i>Phyllophora pseudoceranoides</i>	PNMI	Pointe Gouin hiver 2011	Ld	Q2	7			
2367	MAR1228	rouge	Delesseriaceae	<i>Delesseriaceae</i>	PNMI	Pointe Gouin hiver 2011	Ld	Q2	2	<i>Polyneura bonnemaisonii</i>		
2368	MAR1229	rouge	Gigartiniaceae	<i>Chondrus crispus</i>	PNMI	Pointe Gouin hiver 2011	Ld	Q2	17	<i>Chondrus crispus</i>		
2369	MAR1230	rouge	Corallinaceae	<i>Corallina sp</i>	PNMI	Pointe Gouin hiver 2011	Ld	Q2	100			
2370	MAR1231	rouge	Wrangeliaceae	<i>Plumaria plumosa</i>	PNMI	Pointe Gouin hiver 2011	Ld	Q2	5			
2371	MAR1232	verte	Cladophoraceae	<i>Cladophora pellucida</i>	PNMI	Pointe Gouin hiver 2011	Ld	Q2	1			
2372	MAR1233	brune	Fucaceae	<i>Fucus serratus</i>	PNMI	Pointe Gouin hiver 2011	Ld	Q2	4	<i>Fucus serratus</i>		
2373	MAR1234	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	PNMI	Pointe Gouin hiver 2011	Ld	Q2	7			
2374	MAR1235	rouge	Plocamiaceae	<i>Plocamium sp</i>	PNMI	Pointe Gouin hiver 2011	Ld	Q2	14	<i>Plocamium cartilagineum</i>		
2375	MAR1236	rouge	Wrangeliaceae	<i>Plumaria plumosa</i>	PNMI	Pointe Gouin hiver 2011	Ld	Q3	34			
2376	MAR1237	rouge	Phyllophoraceae	<i>Phyllophora crispa</i>	PNMI	Pointe Gouin hiver 2011	Ld	Q3	7			
2377	MAR1238	rouge	Plocamiaceae	<i>Plocamium sp</i>	PNMI	Pointe Gouin hiver 2011	Ld	Q3	6			
2378	MAR1239	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	PNMI	Pointe Gouin hiver 2011	Ld	Q3	7	<i>Lomentaria articulata</i>		
2379	MAR1240	rouge	Gigartiniaceae	<i>Chondrus crispus</i>	PNMI	Pointe Gouin hiver 2011	Ld	Q3	10			
2380	MAR1241	rouge	Corallinaceae	<i>Corallina sp</i>	PNMI	Pointe Gouin hiver 2011	Ld	Q3	60			
2381	MAR1242	rouge	Kallymeniaceae	<i>Calliphylis laciniata</i>	PNMI	Pointe Gouin hiver 2011	Ld	Q3	2	<i>Calliphylis laciniata</i>		
2382	MAR1243	rouge	Rhodymeniaceae	<i>Rhodymenia pseudopalmeta</i>	PNMI	Pointe Gouin hiver 2011	Ld	Q3	2			
2383	MAR1244	rouge	Ceramiales	<i>Ceramium sp</i>	PNMI	Pointe Gouin hiver 2011	Ld	Q3	3			
2384	MAR1245	rouge	Delesseriaceae	<i>Delesseriaceae</i>	PNMI	Pointe Gouin hiver 2011	Ld	Q3	1	<i>Polyneura bonnemaisonii</i>		
2385	MAR1246	rouge	Delesseriaceae	<i>Delesseria sanguinea</i>	PNMI	Pointe Gouin hiver 2011	Lh	Q1	8	<i>Delesseria sanguinea</i>		
2386	MAR1247	rouge	Plocamiaceae	<i>Plocamium sp</i>	PNMI	Pointe Gouin hiver 2011	Lh	Q1	3			
2387	MAR1248	rouge	Kallymeniaceae	<i>Calliphylis laciniata</i>	PNMI	Pointe Gouin hiver 2011	Lh	Q1	4			
2388	MAR1249	rouge	Phyllophoraceae	<i>Phyllophora crispa</i>	PNMI	Pointe Gouin hiver 2011	Lh	Q1	3			
2389	MAR1250	rouge	Phyllophoraceae	<i>Membranoptera alata</i>	PNMI	Pointe Gouin hiver 2011	Lh	Q1	1			
2390	MAR1251	brune	Dictyotaceae	<i>Dictyota dichotoma</i>	PNMI	Pointe Gouin hiver 2011	Lh	Q1	3			
2391	MAR1252	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	PNMI	Pointe Gouin hiver 2011	Lh	Q1	1	<i>Polyneura bonnemaisonii</i>		
2392	MAR1253	rouge	Bonnemaisoniaceae	<i>Asparagopsis armata</i>	PNMI	Pointe Gouin hiver 2011	Lh	Q1	3			
2393	MAR1254	rouge	Ahnfeltiaceae	<i>Ahnfeltopsis sp</i>	PNMI	Pointe Gouin hiver 2011	Lh	Q1	1			
2394	MAR1255	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	PNMI	Pointe Gouin hiver 2011	Lh	Q1	3			
2395	MAR1256	brune	?	<i>non identifie</i>	PNMI	Pointe Gouin hiver 2011	Lh	Q1	1	<i>Laminaria hyperborea</i>		
2396	MAR1257	rouge	Corallinaceae	<i>Corallina sp</i>	PNMI	Pointe Gouin hiver 2011	Lh	Q1	3			
2397	MAR1258	rouge	Phyllophoraceae	<i>Phyllophora crispa</i>	PNMI	Pointe Gouin hiver 2011	Lh	Q2	25			
2398	MAR1259	rouge	Delesseriaceae	<i>Delesseria sanguinea</i>	PNMI	Pointe Gouin hiver 2011	Lh	Q2	8			
2399	MAR1260	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	PNMI	Pointe Gouin hiver 2011	Lh	Q2	1			
2400	MAR1261	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	PNMI	Pointe Gouin hiver 2011	Lh	Q2	5			
2401	MAR1262	rouge	Delesseriaceae	<i>Delesseriaceae</i>	PNMI	Pointe Gouin hiver 2011	Lh	Q2	5			
2402	MAR1263	rouge	Phyllophoraceae	<i>Gymnogongrus sp</i>	PNMI	Pointe Gouin hiver 2011	Lh	Q2	5			
2403	MAR1264	rouge	Dasyaceae	<i>Heterosiphonia plumosa</i>	PNMI	Pointe Gouin hiver 2011	Lh	Q2	5			
2404	MAR1265	rouge	Wrangeliaceae	<i>Plumaria plumosa</i>	PNMI	Pointe Gouin hiver 2011	Lh	Q2	1			
2405	MAR1266	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	PNMI	Pointe Gouin hiver 2011	Lh	Q2	7	<i>Ectocarpus sp</i>		
2406	MAR1267	rouge	Plocamiaceae	<i>Plocamium sp</i>	PNMI	Pointe Gouin hiver 2011	Lh	Q2	3			
2407	MAR1268	rouge	Delesseriaceae	<i>Hypoglossum hypoglossoides</i>	PNMI	Pointe Gouin hiver 2011	Lh	Q2	5			
2408	MAR1269	rouge	Gelidiales	<i>Gelidium sp</i>	PNMI	Pointe Gouin hiver 2011	Lh	Q2	1			
2409	MAR1270	verte	Ulvaecae	<i>Ulva sp</i>	PNMI	Pointe Gouin hiver 2011	Lh	Q2	1			
2410	MAR1271	rouge	Dumontiaceae	<i>Dilsea carnos</i>	PNMI	Pointe Gouin hiver 2011	Lh	Q2	20			
2411	MAR1272	rouge	Corallinaceae	<i>Corallina sp</i>	PNMI	Pointe Gouin hiver 2011	Lh	Q2	20			
2412	MAR1273	rouge	Delesseriaceae	<i>Delesseria sanguinea</i>	PNMI	Pointe Gouin hiver 2011	Lh	Q3	12	<i>Delesseria sanguinea</i>		
2413	MAR1274	rouge	Phyllophoraceae	<i>Phyllophora crispa</i>	PNMI	Pointe Gouin hiver 2011	Lh	Q3	10			
2414	MAR1275	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	PNMI	Pointe Gouin hiver 2011	Lh	Q3	50	<i>Acrosorium ciliolatum</i>		
2415	MAR1276	rouge	Delesseriaceae	<i>Delesseriaceae</i>	PNMI	Pointe Gouin hiver 2011	Lh	Q3	2	<i>Cryptopleura ramosa</i>		
2416	MAR1277	rouge	Kallymeniaceae	<i>Calliphylis laciniata</i>	PNMI	Pointe Gouin hiver 2011	Lh	Q3	7			
2417	MAR1278	rouge	Dasyaceae	<i>Heterosiphonia plumosa</i>	PNMI	Pointe Gouin hiver 2011	Lh	Q3	5	<i>Heterosiphonia plumosa</i>		
2418	MAR1279	rouge	Rhodomeleaceae	<i>Osmundea pinnatifida</i>	PNMI	Pointe Gouin hiver 2011	Lh	Q3	1			
2419	MAR1280	verte	Ulvaecae	<i>Ulva sp</i>	PNMI	Pointe Gouin hiver 2011	Lh	Q3	1			<i>Ulva sp2</i>
2420	MAR1281	rouge	Styopcaulaceae	<i>Halopteris sp</i>	PNMI	Pointe Gouin hiver 2011	Lh	Q3	4	<i>Halopteris filicina1</i>		
2421	MAR1282	rouge	Plocamiaceae	<i>Plocamium sp</i>	PNMI	Pointe Gouin hiver 2011	Lh	Q3	1			
2422	MAR1283	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	PNMI	Pointe Gouin hiver 2011	Lh	Q3	2			
2423	MAR1284	rouge	Corallinaceae	<i>Corallina sp</i>	PNMI	Pointe Gouin hiver 2011	Lh	Q3	10	<i>Corallina officinalis2</i>		
2424	MAR1285	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	PNMI	Pointe Gouin hiver 2011	Lh	Q3	1	<i>Lomentaria articulata</i>		
2425	MAR1497	rouge	Phyllophoraceae	<i>Mostocarpus stellatus</i>	BDM	Primer hiver 2011	Ld	Q1	8	<i>Mostocarpus stellatus2</i>		
2426	MAR1498	rouge	Gigartiniaceae	<i>Chondrus crispus</i>	BDM	Primer hiver 2011	Ld	Q1	2			
2427	MAR1499	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	BDM	Primer hiver 2011	Ld	Q1	30	<i>Lomentaria articulata</i>		
2428	MAR1500	rouge	Champiaceae	<i>Gastroclonium ovatum</i>	BDM	Primer hiver 2011	Ld	Q1	15			
2429	MAR1501	rouge	Wrangeliaceae	<i>Halurus equisetifolius</i>	BDM	Primer hiver 2011	Ld	Q1	1			
2430	MAR1502	rouge	Callithamniaceae	<i>Callithamnion tetragonum</i>	BDM	Primer hiver 2011	Ld	Q1	30	<i>Callithamnion tetricum</i>		

Annexe 4

	A	B	C	D	E	F	G	H	I	J	K	L
2452	MAR1524	rouge	Rhodomeleaceae	<i>Osmundea pinatifida</i>	BDM	Primer hiver 2011	Ld	Q3	10			
2453	MAR1525	rouge	Corallineae	<i>Corallina</i> sp	BDM	Primer hiver 2011	Ld	Q3	10	<i>Osmundea osmunda</i>		
2454	MAR1526	rouge	Callithamnaceae	<i>Callithamnion tetragonum</i>	BDM	Primer hiver 2011	Ld	Q3	5		<i>Callithamnion tetricum</i>	
2455	MAR1527	rouge	Wangiellaceae	<i>Halurus equisetifolius</i>	BDM	Primer hiver 2011	Ld	Q3	1			<i>Halurus equisetifolius</i>
2456	MAR1528	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	BDM	Primer hiver 2011	Ld	Q3	20			
2457	MAR1529	rouge	Champiaceae	<i>Gastroclonium ovatum</i>	BDM	Primer hiver 2011	Ld	Q3	5		<i>Gastroclonium ovatum</i>	
2458	MAR1530	rouge	Gigartineae	<i>Chondrus crispus</i>	BDM	Primer hiver 2011	Ld	Q3	10		<i>Chondrus crispus</i>	
2459	MAR1531	rouge	Phylloporaceae	<i>Mastocarpus stellatus</i>	BDM	Primer hiver 2011	Ld	Q3	15		<i>Mastocarpus stellatus2</i>	
2460	MAR1532	verte	Cladophoraceae	<i>Cladophora pellucida</i>	BDM	Primer hiver 2011	Ld	Q3	1			
2461	MAR1533	rouge	Ceramieae	<i>Ceramium</i> sp	BDM	Primer hiver 2011	Ld	Q3	1		<i>Ceramium5</i>	
2462	MAR1534	brune	Phyllariaceae	<i>Saccorhiza polyschides</i>	BDM	Primer hiver 2011	Lh	Q1	2			
2463	MAR1535	rouge	Delesseriaceae	<i>Delesseria sanguinea</i>	BDM	Primer hiver 2011	Lh	Q1	5		<i>Delesseria sanguinea</i>	
2464	MAR1536	rouge	Dumontiaceae	<i>Dilsea carnos</i>	BDM	Primer hiver 2011	Lh	Q1	1		<i>Dilsea carnos</i>	
2465	MAR1537	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	BDM	Primer hiver 2011	Lh	Q1	1		<i>Callophyllis laciniata2</i>	
2466	MAR1538	rouge	Corallineae	<i>Corallina</i> sp	BDM	Primer hiver 2011	Lh	Q1	1			
2467	MAR1539	rouge	Delesseriaceae	<i>Delesseriaceae</i>	BDM	Primer hiver 2011	Lh	Q1	1			
2468	MAR1540	rouge	Delesseriaceae	<i>Delesseria sanguinea</i>	BDM	Primer hiver 2011	Lh	Q2	3		<i>Delesseria sanguinea</i>	
2469	MAR1541	rouge	Delesseriaceae	<i>Phycodrys rubens</i>	BDM	Primer hiver 2011	Lh	Q2	1			<i>Phycodrys rubens</i>
2470	MAR1542	brune	Phyllariaceae	<i>Saccorhiza polyschides</i>	BDM	Primer hiver 2011	Lh	Q2	7			
2471	MAR1543	rouge	Dumontiaceae	<i>Dilsea carnos</i>	BDM	Primer hiver 2011	Lh	Q2	1			
2472	MAR1544	rouge	Kallymeniaceae	<i>Kallymenia reniformis</i>	BDM	Primer hiver 2011	Lh	Q2	1		<i>Kallymenia reniformis</i>	
2473	MAR1545	rouge	Plocamiaceae	<i>Plocanium</i> sp	BDM	Primer hiver 2011	Lh	Q2	3		<i>Plocanium lyngbyanum</i>	
2474	MAR1546	brune	Phyllariaceae	<i>Saccorhiza polyschides</i>	BDM	Primer hiver 2011	Lh	Q3	7			
2475	MAR1547	rouge	Delesseriaceae	<i>Delesseria sanguinea</i>	BDM	Primer hiver 2011	Lh	Q3	4		<i>Delesseria sanguinea</i>	
2476	MAR1548	rouge	Plocamiaceae	<i>Plocanium</i> sp	BDM	Primer hiver 2011	Lh	Q3	30			
2477	MAR1549	rouge	Kallymeniaceae	<i>Kallymenia reniformis</i>	BDM	Primer hiver 2011	Lh	Q3	1		<i>Kallymenia reniformis</i>	
2478	MAR1550	verte	Codiaceae	<i>Codium</i> sp	BDM	Primer hiver 2011	Lh	Q3	1			
2479	MAR1551	rouge	Delesseriaceae	<i>Delesseriaceae</i>	BDM	Primer hiver 2011	Lh	Q3	3			<i>Acrosorium</i> sp
2480	MAR1552	rouge	Delesseriaceae	<i>Delesseriaceae</i>	BDM	Primer hiver 2011	Lh	Q3	1		<i>Polyneura bonnemaisonii</i>	
2481	MAR1553	rouge	Delesseriaceae	<i>Acrosorium uncinatum</i>	BDM	Primer hiver 2011	Lh	Q3	5			
2482	MAR1554	brune	Dictyotaceae	<i>Dictyota</i> sp	BDM	Primer hiver 2011	Lh	Q3	2			
2483	MAR1555	rouge	Ceramieae	<i>Antithamnion plumula</i>	BDM	Primer hiver 2011	Lh	Q3	2			
2484	MAR1556	rouge	Corallineae	<i>Corallina</i> sp	BDM	Primer hiver 2011	Lh	Q3	1			
2485	MAR1098	rouge	Corallineae	<i>Corallina</i> sp	PNMI	Respects hiver 2011	Ld	Q1	50		<i>Corallina officinalis1</i>	
2486	MAR1099	rouge	Phylloporaceae	<i>Phyllophora crispa</i>	PNMI	Respects hiver 2011	Ld	Q1	12			
2487	MAR1100	rouge	Plocamiaceae	<i>Plocanium</i> sp	PNMI	Respects hiver 2011	Ld	Q1	20			
2488	MAR1101	rouge	Delesseriaceae	<i>Delesseriaceae</i>	PNMI	Respects hiver 2011	Ld	Q1	5			<i>Phyllophora crispa</i>
2489	MAR1102	rouge	Phylloporaceae	<i>Phyllophora pseudoceranoides</i>	PNMI	Respects hiver 2011	Ld	Q1	2		<i>Phyllophora crispa</i>	
2490	MAR1103	rouge	Rhodymeniaceae	<i>Rhodymenia holmesii</i>	PNMI	Respects hiver 2011	Ld	Q1	5			<i>Phyllophora crispa</i>
2491	MAR1104	rouge	Gigartineae	<i>Chondrus crispus</i>	PNMI	Respects hiver 2011	Ld	Q1	4			
2492	MAR1105	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	PNMI	Respects hiver 2011	Ld	Q1	1			
2493	MAR1106	brune	Phyllariaceae	<i>Saccorhiza polyschides</i>	PNMI	Respects hiver 2011	Ld	Q2	1			
2494	MAR1107	rouge	Gigartineae	<i>Chondrus crispus</i>	PNMI	Respects hiver 2011	Ld	Q2	15		<i>Chondrus crispus</i>	
2495	MAR1108	rouge	Plocamiaceae	<i>Plocanium</i> sp	PNMI	Respects hiver 2011	Ld	Q2	10			
2496	MAR1109	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	PNMI	Respects hiver 2011	Ld	Q2	20			
2497	MAR1110	rouge	Corallineae	<i>Corallina</i> sp	PNMI	Respects hiver 2011	Ld	Q2	30			
2498	MAR1111	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	PNMI	Respects hiver 2011	Ld	Q2	3		<i>Callophyllis laciniata2</i>	
2499	MAR1112	brune	Phyllariaceae	<i>Saccorhiza polyschides</i>	PNMI	Respects hiver 2011	Ld	Q3	2		<i>Laminaria digitata</i>	
2500	MAR1113	rouge	Gigartineae	<i>Chondrus crispus</i>	PNMI	Respects hiver 2011	Ld	Q3	9		<i>Ahnfeltiopsis devoniensis</i>	
2501	MAR1114	rouge	Plocamiaceae	<i>Plocanium</i> sp	PNMI	Respects hiver 2011	Ld	Q3	4			
2502	MAR1115	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	PNMI	Respects hiver 2011	Ld	Q3	2			
2503	MAR1116	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	PNMI	Respects hiver 2011	Ld	Q3	6			
2504	MAR1117	rouge	Phylloporaceae	<i>Phyllophora pseudoceranoides</i>	PNMI	Respects hiver 2011	Ld	Q3	6			<i>Lomentaria articulata</i>
2505	MAR1118	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	PNMI	Respects hiver 2011	Ld	Q3	5		<i>Lomentaria articulata</i>	
2506	MAR1119	rouge	Callithamnaceae	<i>Callithamnion tetragonum</i>	PNMI	Respects hiver 2011	Ld	Q3	2		<i>Callithamnion tetragonum</i>	
2507	MAR1120	rouge	Ceramieae	<i>Ceramium</i> sp	PNMI	Respects hiver 2011	Ld	Q3	2		<i>Ceramium siliculosum</i>	
2508	MAR1121	rouge	Rhodymeniaceae	<i>Rhodymenia pseudopalmeta</i>	PNMI	Respects hiver 2011	Ld	Q3	40		<i>Rhodymenia pseudopalmeta</i>	
2509	MAR1122	rouge	Kallymeniaceae	<i>Kallymenia reniformis</i>	PNMI	Respects hiver 2011	Ld	Q3	1		<i>Kallymenia reniformis</i>	
2510	MAR1123	brune	Phyllariaceae	<i>Saccorhiza polyschides</i>	PNMI	Respects hiver 2011	Lh	Q1	3			
2511	MAR1124	verte	Ulveae	<i>Ulva</i> sp	PNMI	Respects hiver 2011	Lh	Q1	1			<i>Ulva</i> sp2
2512	MAR1125	brune	Cladostephaceae	<i>Cladostephus spongiosus</i>	PNMI	Respects hiver 2011	Lh	Q1	1			
2513	MAR1126	brune	Dictyotaceae	<i>Dictyopteris polyodioides</i>	PNMI	Respects hiver 2011	Lh	Q1	1			
2514	MAR1127	rouge	Dasyaceae	<i>Heterosiphonia plumosa</i>	PNMI	Respects hiver 2011	Lh	Q1	25			
2515	MAR1128	rouge	Delesseriaceae	<i>Delesseria sanguinea</i>	PNMI	Respects hiver 2011	Lh	Q1	5		<i>Delesseria sanguinea</i>	
2516	MAR1129	rouge	Corallineae	<i>Corallina</i> sp	PNMI	Respects hiver 2011	Lh	Q1	10		<i>Corallina officinalis1</i>	
2517	MAR1130	rouge	Styocaulaceae	<i>Halopteris filicina</i>	PNMI	Respects hiver 2011	Lh	Q1	10			
2518	MAR1131	brune	Dictyotaceae	<i>Dictyota dichotoma</i>	PNMI	Respects hiver 2011	Lh	Q1	5			
2519	MAR1132	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	PNMI	Respects hiver 2011	Lh	Q1	1		<i>Callophyllis laciniata2</i>	
2520	MAR1133	rouge	Kallymeniaceae	<i>Meredithia microphylla</i>	PNMI	Respects hiver 2011	Lh	Q1	3			<i>Strange Kallymeniaceae</i>
2521	MAR1134	rouge	Delesseriaceae	<i>Delesseriaceae</i>	PNMI	Respects hiver 2011	Lh	Q1	1		<i>Strange Kallymeniaceae</i>	
2522	MAR1135	rouge	Kallymeniaceae	<i>Kallymenia reniformis</i>	PNMI	Respects hiver 2011	Lh	Q1	2			
2523	MAR1136	rouge	Rhodymeniaceae	<i>Rhodymenia holmesii</i>	PNMI	Respects hiver 2011	Lh	Q1	1		<i>Rhodymenia pseudopalmeta</i>	
2524	MAR1137	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	PNMI	Respects hiver 2011	Lh	Q1	15			
2525	MAR1138	rouge	Corallineae	<i>Corallina</i> sp	PNMI	Respects hiver 2011	Lh	Q2	30			
2526	MAR1139	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	PNMI	Respects hiver 2011	Lh	Q2	30		<i>Acrosorium</i> sp	
2527	MAR1140	brune	Dictyotaceae	<i>Dictyota dichotoma</i>	PNMI	Respects hiver 2011	Lh	Q2	2			
2528	MAR1141	rouge	Phylloporaceae	<i>Phyllophora crispa</i>	PNMI	Respects hiver 2011	Lh	Q2	5		<i>Phyllophora crispa</i>	
2529	MAR1142	rouge	Styocaulaceae	<i>Halopteris filicina</i>	PNMI	Respects hiver 2011	Lh	Q2	5			
2530	MAR1143	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	PNMI	Respects hiver 2011	Lh	Q2	1		<i>Callophyllis laciniata2</i>	
2531	MAR1144	brune	Dictyotaceae	<i>Dictyopteris polyodioides</i>	PNMI	Respects hiver 2011	Lh	Q2	10			
2532	MAR1145	brune	Dictyotaceae	<i>Dictyopteris polyodioides</i>	PNMI	Respects hiver 2011	Lh	Q3	1			
2533	MAR1146	rouge	Phylloporaceae	<i>Membranoptera alata</i>	PNMI	Respects hiver 2011	Lh	Q3	1			
2534	MAR1147	rouge	Plocamiaceae	<i>Plocanium</i> sp	PNMI	Respects hiver 2011	Lh	Q3	1		<i>Plocanium lyngbyanum</i>	
2535	MAR1148	rouge	Delesseriaceae	<i>Delesseria sanguinea</i>	PNMI	Respects hiver 2011	Lh	Q3	1		<i>Delesseria sanguinea</i>	
2536	MAR1149	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	PNMI	Respects hiver 2011	Lh	Q3	1		<i>Callophyllis laciniata2</i>	
2537	MAR1150	rouge	Dasyaceae	<i>Heterosiphonia plumosa</i>	PNMI	Respects hiver 2011	Lh	Q3	2			
2538	MAR1151	rouge	Gigartineae	<i>Chondrus crispus</i>	PNMI	Respects hiver 2011	Lh	Q3	3		<i>Chondrus crispus</i>	
2539	MAR1152	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	PNMI	Respects hiver 2011	Lh	Q3	10			
2540	MAR1153	rouge	Styocaulaceae	<i>Halopteris filicina</i>	PNMI	Respects hiver 2011	Lh	Q3	1		<i>Halopteris filicina1</i>	
2541	MAR1154	rouge	Corallineae	<i>Corallina</i> sp	PNMI	Respects hiver 2011	Lh	Q3	20		<i>Corallina officinalis2</i>	
2542	MAR1155	rouge	Wangiellaceae	<i>Plumaria elegans</i>	BDM	Santec 1 hiver 2011	Ld	Q1	15		<i>Plumaria plumosa</i>	
2543	MAR1158	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	BDM	Santec 1 hiver 2011	Ld	Q1	1		<i>Callophyllis laciniata2</i>	
2544	MAR1159	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	BDM	Santec 1 hiver 2011	Ld	Q1	4			
2545	MAR1160	rouge	Dasyaceae	<i>Heterosiphonia plumosa</i>	BDM	Santec 1 hiver 2011	Ld	Q1	2		<i>Heterosiphonia plumosa</i>	
2546	MAR1161	brune	Himanthaliaceae	<i>Himanthalia elongata</i>	BDM	Santec 1 hiver 2011	Ld	Q1	2		<i>Himanthalia elongata</i>	
2547	MAR1162	rouge	Corallineae	<i>Corallina</i> sp	BDM	Santec 1 hiver 2011	Ld	Q1	15			
2548	MAR1163	rouge	Cystocloniaceae	<i>Calliblepharis jubata</i>	BDM	Santec 1 hiver 2011	Ld	Q1	30		<i>Calliblepharis jubata</i>	
2549	MAR1164	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	BDM	Santec 1 hiver 2011	Ld	Q1	3			<i>Lomentaria articulata</i>
2550	MAR1165	rouge	Gigartineae	<i>Chondrus crispus</i>	BDM	Santec 1 hiver 2011	Ld	Q1	10		<i>Chondrus crispus</i>	
2551	MAR1166	rouge	Bonnemaisoniaceae	<i>Asparagopsis armata</i>	BDM	Santec 1 hiver 2011	Ld	Q1	1			
2552	MAR1167	rouge	Champiaceae	<i>Gastroclonium ovatum</i>	BDM	Santec 1 hiver 2011	Ld	Q1	4			
2553	MAR1168	verte	Cladophoraceae	<i>Cladophora</i> sp	BDM	Santec 1 hiver 2011	Ld	Q1	1			
2554	MAR1169	rouge	Rhodomeleaceae	<i>Osmundea pinatifida</i>	BDM	Santec 1 hiver 2011	Ld	Q1	6			
2555	MAR1170	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	BDM	Santec 1 hiver 2011	Ld	Q1	4		<i>Polyneura bonnemaisonii</i>	
2556	MAR1171	brune	Himanthaliaceae	<i>Himanthalia elongata</i>	BDM	Santec 1 hiver 2011	Ld	Q2	20		<i>Himanthalia elongata</i>	
2557	MAR1172	rouge	Cystocloniaceae	<i>Calliblepharis ciliata</i>	BDM	Santec 1 hiver 2011	Ld	Q2	10		<i>Calliblepharis jubata</i>	
2558	MAR1173	rouge	Gigartineae	<i>Chondrus crispus</i>	BDM	Santec 1 hiver 2011	Ld	Q2	30			
2559	MAR1174	rouge	Corallineae	<i>Corallina</i> sp	BDM	Santec 1 hiver 2011	Ld	Q2	20		<i>Corallina officinalis2</i>	
2560	MAR1175	rouge	Gigartineae	<i>Gigart</i>								

Annexe 4

	A	B	C	D	E	F	G	H	I	J	K	L
2581	MAR1596	rouge	Delesseriaceae	<i>Phycodrys rubens</i>	BDM	Santec 1 hiver 2011	Lh	02	1			
2582	MAR1597	rouge	Dasyaceae	<i>Heterosiphonia plumosa</i>	BDM	Santec 1 hiver 2011	Lh	02	4	<i>Heterosiphonia plumosa</i>		
2583	MAR1598	rouge	Kallymeniaceae	<i>Kallymenia reniformis</i>	BDM	Santec 1 hiver 2011	Lh	02	1			
2584	MAR1599	brune	Sargassaceae	<i>Sargassum muticum</i>	BDM	Santec 1 hiver 2011	Lh	02	2	<i>Sargassum muticum</i>		
2585	MAR1600	verte	Ulvaeeae	<i>Ulva sp</i>	BDM	Santec 1 hiver 2011	Lh	02	1			
2586	MAR1601	rouge	Cystocloniaceae	<i>Calliblepharis ciliata</i>	BDM	Santec 1 hiver 2011	Lh	02	1			<i>Gymnogongrus crenulatus</i>
2587	MAR1602	rouge	Rhodomeniaceae	<i>Rhodomenia holmesii</i>	BDM	Santec 1 hiver 2011	Lh	03	10			
2588	MAR1603	rouge	Phylloporaceae	<i>Phyllophora crispa</i>	BDM	Santec 1 hiver 2011	Lh	02	5	<i>Phyllophora crispa</i>		
2589	MAR1604	rouge	Corallinaceae	<i>Corallina sp</i>	BDM	Santec 1 hiver 2011	Lh	02	30			
2590	MAR1605	rouge	Rhodomeleaceae	<i>Chondria sp</i>	BDM	Santec 1 hiver 2011	Lh	02	3			
2591	MAR1606	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDM	Santec 1 hiver 2011	Lh	02	1			<i>Plocamium 1</i>
2592	MAR1607	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	BDM	Santec 1 hiver 2011	Lh	02	1	<i>Callophyllis laciniata2</i>		
2593	MAR1608	rouge	Furcellariaceae	<i>Furcellaria lumbricalis</i>	BDM	Santec 1 hiver 2011	Lh	02	30			<i>Furcellaria lumbricalis</i>
2594	MAR1609	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	BDM	Santec 1 hiver 2011	Lh	02	15			<i>Acrosorium sp</i>
2595	MAR1610	rouge	Hapalidiaceae	<i>Mesophyllum lichenoides</i>	BDM	Santec 1 hiver 2011	Lh	02	2			
2596	MAR1611	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	BDM	Santec 1 hiver 2011	Lh	03	6			
2597	MAR1612	rouge	Dasyaceae	<i>Heterosiphonia plumosa</i>	BDM	Santec 1 hiver 2011	Lh	03	2	<i>Heterosiphonia plumosa</i>		
2598	MAR1613	rouge	Gelidiaceae	<i>Gelidium corneum</i>	BDM	Santec 1 hiver 2011	Lh	03	2	<i>Gelidium 1</i>		
2599	MAR1614	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	BDM	Santec 1 hiver 2011	Lh	03	1			<i>Lomentaria articulata</i>
2600	MAR1615	rouge	Cystocloniaceae	<i>Calliblepharis jubata</i>	BDM	Santec 1 hiver 2011	Lh	03	1	<i>Calliblepharis jubata</i>		
2601	MAR1616	rouge	Rhodomeleaceae	<i>Osmundea pinnatifida</i>	BDM	Santec 1 hiver 2011	Lh	03	2			
2602	MAR1617	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	BDM	Santec 1 hiver 2011	Lh	03	1	<i>Polyneura bonnemaisonii</i>		
2603	MAR1618	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	BDM	Santec 1 hiver 2011	Lh	03	7	<i>Callophyllis laciniata2</i>		
2604	MAR1619	rouge	Cystocloniaceae	<i>Calliblepharis jubata</i>	BDM	Santec 1 hiver 2011	Ld	01	15	<i>Calliblepharis jubata</i>		
2605	MAR1620	rouge	Corallinaceae	<i>Corallina sp</i>	BDM	Santec 2 hiver 2011	Ld	01	100			
2606	MAR1621	rouge	Phylloporaceae	<i>Gymnogongrus sp</i>	BDM	Santec 2 hiver 2011	Ld	01	7	<i>Ahnfeltiopsis devoniensis</i>		
2607	MAR1622	rouge	Gracilariaceae	<i>Gracilaria sp</i>	BDM	Santec 2 hiver 2011	Ld	01	13			
2608	MAR1623	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDM	Santec 2 hiver 2011	Ld	01	4			
2609	MAR1624	verte	Cladophoraceae	<i>Cladophora sp</i>	BDM	Santec 2 hiver 2011	Ld	01	1			
2610	MAR1625	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	BDM	Santec 2 hiver 2011	Ld	01	1			<i>Acrosorium ciliolatum</i>
2611	MAR1626	brune	Desmarestiaceae	<i>Desmarestia sp</i>	BDM	Santec 2 hiver 2011	Ld	01	1	<i>Cystoseira baccata</i>		
2612	MAR1627	rouge	Phylloporaceae	<i>Gymnogongrus sp</i>	BDM	Santec 2 hiver 2011	Ld	02	2	<i>Ahnfeltiopsis devoniensis</i>		
2613	MAR1628	brune	Himantallaceae	<i>Himantalia elongata</i>	BDM	Santec 2 hiver 2011	Ld	02	6	<i>Himantalia elongata</i>		
2614	MAR1629	rouge	Cystocloniaceae	<i>Calliblepharis jubata</i>	BDM	Santec 2 hiver 2011	Ld	02	14			
2615	MAR1630	rouge	Gigartineae	<i>Gigartina pistillata</i>	BDM	Santec 2 hiver 2011	Ld	02	20	<i>Gigartina pistillata</i>		
2616	MAR1631	rouge	Gigartineae	<i>Chondrus crispus</i>	BDM	Santec 2 hiver 2011	Ld	02	20	<i>Chondrus crispus</i>		
2617	MAR1632	rouge	Gelidiaceae	<i>Gelidium corneum</i>	BDM	Santec 2 hiver 2011	Ld	02	12			
2618	MAR1633	rouge	Corallinaceae	<i>Corallina sp</i>	BDM	Santec 2 hiver 2011	Ld	02	80			
2619	MAR1634	rouge	Wrangeliaceae	<i>Halurus equisetifolius</i>	BDM	Santec 2 hiver 2011	Ld	02	2			
2620	MAR1635	rouge	Dasyaceae	<i>Heterosiphonia plumosa</i>	BDM	Santec 2 hiver 2011	Ld	02	1	<i>Plumaria plumosa</i>		
2621	MAR1636	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	BDM	Santec 2 hiver 2011	Ld	02	2			
2622	MAR1637	brune	Fucaceae	<i>Fucus serratus</i>	BDM	Santec 2 hiver 2011	Ld	02	1	<i>Fucus serratus</i>		
2623	MAR1638	brune	Himantallaceae	<i>Himantalia elongata</i>	BDM	Santec 2 hiver 2011	Ld	03	5	<i>Halopteris filicina1</i>		
2624	MAR1639	rouge	Cystocloniaceae	<i>Calliblepharis jubata</i>	BDM	Santec 2 hiver 2011	Ld	03	24	<i>Calliblepharis jubata</i>		
2625	MAR1640	rouge	Corallinaceae	<i>Corallina sp</i>	BDM	Santec 2 hiver 2011	Ld	03	100	<i>Corallina officinalis2</i>		
2626	MAR1641	rouge	Gracilariaceae	<i>Gracilaria sp</i>	BDM	Santec 2 hiver 2011	Ld	03	2			
2627	MAR1642	rouge	Wrangeliaceae	<i>Halurus equisetifolius</i>	BDM	Santec 2 hiver 2011	Ld	03	1	<i>Callithamnion tetricum</i>		
2628	MAR1643	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDM	Santec 2 hiver 2011	Ld	03	2			
2629	MAR1644	rouge	Dasyaceae	<i>Heterosiphonia plumosa</i>	BDM	Santec 2 hiver 2011	Ld	03	1	CONTA		
2630	MAR1645	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	BDM	Santec 2 hiver 2011	Ld	03	1	<i>Callophyllis laciniata2</i>		
2631	MAR1646	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	BDM	Santec 2 hiver 2011	Ld	03	3			
2632	MAR1647	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	BDM	Santec 2 hiver 2011	Ld	03	3			
2633	MAR1648	brune	Styopocaulaceae	<i>Halopteris filicina</i>	BDM	Santec 2 hiver 2011	Lh	03	1	<i>Halopteris filicina1</i>		
2634	MAR1649	rouge	Sphaerococcaceae	<i>Sphaerococcus coronopifolius</i>	BDM	Santec 2 hiver 2011	Lh	03	4	<i>Sphaerococcus coronopifolius</i>		
2635	MAR1650	rouge	Corallinaceae	<i>Corallina sp</i>	BDM	Santec 2 hiver 2011	Lh	03	2	<i>Corallina officinalis1</i>		
2636	MAR1651	rouge	Phylloporaceae	<i>Gymnogongrus sp</i>	BDM	Santec 2 hiver 2011	Lh	03	4	<i>Gymnogongrus crenulatus</i>		
2637	MAR1652	rouge	Phylloporaceae	<i>Phyllophora pseudoceranoides</i>	BDM	Santec 2 hiver 2011	Lh	03	1	<i>Phyllophora crispa</i>		
2638	MAR1653	rouge	Phylloporaceae	<i>Phyllophora crispa</i>	BDM	Santec 2 hiver 2011	Lh	03	23	<i>Phyllophora crispa</i>		
2639	MAR1654	rouge	Delesseriaceae	<i>Delesseria sanguinea</i>	BDM	Santec 2 hiver 2011	Lh	03	2	<i>Delesseria sanguinea</i>		
2640	MAR1655	rouge	Cystocloniaceae	<i>Calliblepharis ciliata</i>	BDM	Santec 2 hiver 2011	Lh	03	3	<i>Calliblepharis ciliata</i>		
2641	MAR1656	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDM	Santec 2 hiver 2011	Lh	03	1			
2642	MAR1657	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	BDM	Santec 2 hiver 2011	Lh	03	1	<i>Callophyllis laciniata2</i>		
2643	MAR1658	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	BDM	Santec 2 hiver 2011	Lh	03	3	<i>Polyneura bonnemaisonii</i>		
2644	MAR1659	brune	Dictyotaceae	<i>Dictyota dichotoma</i>	BDM	Santec 2 hiver 2011	Lh	02	1			
2645	MAR1660	rouge	Cystocloniaceae	<i>Calliblepharis ciliata</i>	BDM	Santec 2 hiver 2011	Lh	02	26	<i>Calliblepharis ciliata</i>		
2646	MAR1661	rouge	Sphaerococcaceae	<i>Sphaerococcus coronopifolius</i>	BDM	Santec 2 hiver 2011	Lh	02	1			
2647	MAR1662	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDM	Santec 2 hiver 2011	Lh	02	26	<i>Plocamium lyngbyanum</i>		
2648	MAR1663	rouge	Dasyaceae	<i>Heterosiphonia plumosa</i>	BDM	Santec 2 hiver 2011	Lh	02	13	<i>Heterosiphonia plumosa</i>		
2649	MAR1664	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	BDM	Santec 2 hiver 2011	Lh	02	9	<i>Callophyllis laciniata2</i>		
2650	MAR1665	rouge	Delesseriaceae	<i>Apoglossum ruscifolium</i>	BDM	Santec 2 hiver 2011	Lh	02	1			
2651	MAR1666	rouge	Bonnemaisoniaceae	<i>Asparagopsis armata</i>	BDM	Santec 2 hiver 2011	Lh	02	2	<i>Brongniartella byssoides</i>		
2652	MAR1667	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	BDM	Santec 2 hiver 2011	Lh	02	24			
2653	MAR1668	rouge	Corallinaceae	<i>Corallina sp</i>	BDM	Santec 2 hiver 2011	Lh	02	27	<i>Corallina officinalis2</i>		
2654	MAR1669	rouge	Wrangeliaceae	<i>Halurus equisetifolius</i>	BDM	Santec 2 hiver 2011	Lh	02	1			
2655	MAR1670	brune	Styopocaulaceae	<i>Halopteris filicina</i>	BDM	Santec 2 hiver 2011	Lh	02	6			
2656	MAR1671	rouge	Phylloporaceae	<i>Gymnogongrus sp</i>	BDM	Santec 2 hiver 2011	Lh	02	1	<i>Gymnogongrus crenulatus</i>		
2657	MAR1672	rouge	Phylloporaceae	<i>Phyllophora pseudoceranoides</i>	BDM	Santec 2 hiver 2011	Lh	02	1	<i>Rhodomenia pseudopalmeta</i>		
2658	MAR1673	rouge	Phylloporaceae	<i>Phyllophora crispa</i>	BDM	Santec 2 hiver 2011	Lh	02	17	<i>Phyllophora crispa</i>		
2659	MAR1674	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	BDM	Santec 2 hiver 2011	Lh	02	3			
2660	MAR1675	rouge	Delesseriaceae	<i>Delesseria sanguinea</i>	BDM	Santec 2 hiver 2011	Lh	02	1	<i>Apoglossum ruscifolium</i>		
2661	MAR1676	rouge	Kallymeniaceae	<i>Kallymenia reniformis</i>	BDM	Santec 2 hiver 2011	Lh	02	1			
2662	MAR1677	verte	Cladophoraceae	<i>Cladophora sp</i>	BDM	Santec 2 hiver 2011	Lh	02	1			
2663	MAR1678	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	BDM	Santec 2 hiver 2011	Lh	03	6			
2664	MAR1679	brune	Dictyotaceae	<i>Dictyota dichotoma</i>	BDM	Santec 2 hiver 2011	Lh	03	6			
2665	MAR1680	rouge	Delesseriaceae	<i>Apoglossum ruscifolium</i>	BDM	Santec 2 hiver 2011	Lh	03	4			
2666	MAR1681	rouge	Kallymeniaceae	<i>Kallymenia reniformis</i>	BDM	Santec 2 hiver 2011	Lh	03	2			<i>Kallymenia reniformis</i>
2667	MAR1682	rouge	Phylloporaceae	<i>Gymnogongrus sp</i>	BDM	Santec 2 hiver 2011	Lh	03	1	<i>Gymnogongrus crenulatus</i>		
2668	MAR1683	rouge	Delesseriaceae	<i>Delesseria sanguinea</i>	BDM	Santec 2 hiver 2011	Lh	03	6			
2669	MAR1684	rouge	Delesseriaceae	<i>Polyneura bonnemaisonii</i>	BDM	Santec 2 hiver 2011	Lh	03	13	<i>Polyneura bonnemaisonii</i>		
2670	MAR1685	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDM	Santec 2 hiver 2011	Lh	03	7	<i>Plocamium lyngbyanum</i>		
2671	MAR1686	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDM	Santec 2 hiver 2011	Lh	03	1	<i>Pterothamnion sp</i>		
2672	MAR1687	rouge	Cystocloniaceae	<i>Calliblepharis ciliata</i>	BDM	Santec 2 hiver 2011	Lh	03	9	<i>Calliblepharis ciliata</i>		
2673	MAR1688	rouge	Sphaerococcaceae	<i>Sphaerococcus coronopifolius</i>	BDM	Santec 2 hiver 2011	Lh	03	1	<i>Sphaerococcus coronopifolius</i>		
2674	MAR1689	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	BDM	Santec 2 hiver 2011	Lh	03	7	<		

Annexe 4

	A	B	C	D	E	F	G	H	I	J	K	L
2710	MAR2224	rouge	Kallymeniaceae	<i>Calliphylis laciniata</i>	BDM	Santec 2 hiver 2012	Lh	Q1	na			
2711	MAR2225	rouge	Corallinaceae	<i>Corallina sp</i>	BDM	Santec 2 hiver 2012	Lh	Q1	na			
2712	MAR2226	rouge	Cystocloniaceae	<i>Cystoclonium purpureum</i>	BDM	Santec 2 hiver 2012	Lh	Q1	na		Griffithsia sp	
2713	MAR2227	rouge	Delesseriaceae	<i>Delesseria sanguinea</i>	BDM	Santec 2 hiver 2012	Lh	Q1	na		Delesseria sanguinea	
2714	MAR2228	rouge	Delesseriaceae	<i>Delesseria sp</i>	BDM	Santec 2 hiver 2012	Lh	Q1	na			
2715	MAR2229	brune	Dictyotaceae	<i>Dictyopteris polydoides</i>	BDM	Santec 2 hiver 2012	Lh	Q1	na			
2716	MAR2230	rouge	Dumontiaceae	<i>Dilsea carnea</i>	BDM	Santec 2 hiver 2012	Lh	Q1	na		Calliblepharis ciliata	
2717	MAR2231	rouge	Phylloporaceae	<i>Gymnogangrus sp</i>	BDM	Santec 2 hiver 2012	Lh	Q1	na			
2718	MAR2232	brune	Styocaulaceae	<i>Halopteris filicina</i>	BDM	Santec 2 hiver 2012	Lh	Q1	na			
2719	MAR2233	rouge	Dasyaceae	<i>Heterosiphonia plumosa</i>	BDM	Santec 2 hiver 2012	Lh	Q1	na		Heterosiphonia plumosa	
2720	MAR2234	rouge	Kallymeniaceae	<i>Kallymenia reniformis</i>	BDM	Santec 2 hiver 2012	Lh	Q1	na			Strange Kallymeniaceae
2721	MAR2235	rouge	Delesseriaceae	<i>Myriogramme sp</i>	BDM	Santec 2 hiver 2012	Lh	Q1	na		Polyneura bonnemaisonii	
2722	MAR2236	rouge	Phylloporaceae	<i>Phyllophora crispata</i>	BDM	Santec 2 hiver 2012	Lh	Q1	na		Phyllophora crispata	
2723	MAR2237	rouge	Phylloporaceae	<i>Phyllophora pseudoceranoides</i>	BDM	Santec 2 hiver 2012	Lh	Q1	na		Calliphylis laciniata1	
2724	MAR2238	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDM	Santec 2 hiver 2012	Lh	Q1	na		Plocamium cartilagineum	
2725	MAR2239	brune	Sargassaceae	<i>Sargassum muticum</i>	BDM	Santec 2 hiver 2012	Lh	Q1	na			
2726	MAR2240	rouge	Sphaerococcaceae	<i>Sphaerococcus coronopifolius</i>	BDM	Santec 2 hiver 2012	Lh	Q1	na			
2727	MAR2241	rouge	Ahnfeltiaceae	<i>Ahnfeltia plicata</i>	BDM	Santec 2 hiver 2012	Lh	Q2	na			Ahnfeltia plicata
2728	MAR2242	rouge	Delesseriaceae	<i>Apoglossum ruscfolium</i>	BDM	Santec 2 hiver 2012	Lh	Q2	na			
2729	MAR2243	rouge	Cystocloniaceae	<i>Calliblepharis ciliata</i>	BDM	Santec 2 hiver 2012	Lh	Q2	na		Calliblepharis ciliata	
2730	MAR2244	rouge	Cystocloniaceae	<i>Calliblepharis jubata</i>	BDM	Santec 2 hiver 2012	Lh	Q2	na		Calliblepharis jubata	
2731	MAR2245	rouge	Corallinaceae	<i>Corallina sp</i>	BDM	Santec 2 hiver 2012	Lh	Q2	na			
2732	MAR2246	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	BDM	Santec 2 hiver 2012	Lh	Q2	na			Fucus sp
2733	MAR2247	rouge	Delesseriaceae	<i>Delesseria sanguinea</i>	BDM	Santec 2 hiver 2012	Lh	Q2	na			Phycodrys rubens
2734	MAR2248	rouge	Delesseriaceae	<i>Delesseria sp</i>	BDM	Santec 2 hiver 2012	Lh	Q2	na			
2735	MAR2249	brune	Styocaulaceae	<i>Halopteris filicina</i>	BDM	Santec 2 hiver 2012	Lh	Q2	na		Halopteris filicina1	
2736	MAR2250	rouge	Dasyaceae	<i>Heterosiphonia plumosa</i>	BDM	Santec 2 hiver 2012	Lh	Q2	na			
2737	MAR2251	rouge	Delesseriaceae	<i>Myriogramme sp</i>	BDM	Santec 2 hiver 2012	Lh	Q2	na		Polyneura	
2738	MAR2252	rouge	Phylloporaceae	<i>Phyllophora crispata</i>	BDM	Santec 2 hiver 2012	Lh	Q2	na		Phyllophora crispata	
2739	MAR2253	rouge	Phylloporaceae	<i>Phyllophora pseudoceranoides</i>	BDM	Santec 2 hiver 2012	Lh	Q2	na		Schottera palmettoïdes	
2740	MAR2254	rouge	Phylloporaceae	<i>Phyllophora sicula</i>	BDM	Santec 2 hiver 2012	Lh	Q2	na		Phyllophora crispata	
2741	MAR2255	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDM	Santec 2 hiver 2012	Lh	Q2	na		Sphaerococcus coronopifolius	
2742	MAR2256	brune	Sargassaceae	<i>Sargassum muticum</i>	BDM	Santec 2 hiver 2012	Lh	Q2	na			
2743	MAR2257	rouge	Sphaerococcaceae	<i>Sphaerococcus coronopifolius</i>	BDM	Santec 2 hiver 2012	Lh	Q2	na			
2744	MAR2258	rouge	Delesseriaceae	<i>Acrosorium uncinatum</i>	BDM	Santec 2 hiver 2012	Lh	Q3	na			
2745	MAR2259	rouge	Bonnemaisoniaceae	<i>Asparagopsis armata</i>	BDM	Santec 2 hiver 2012	Lh	Q3	na			
2746	MAR2260	rouge	Cystocloniaceae	<i>Calliblepharis ciliata</i>	BDM	Santec 2 hiver 2012	Lh	Q3	na		Calliblepharis ciliata	
2747	MAR2261	rouge	Cystocloniaceae	<i>Calliblepharis jubata</i>	BDM	Santec 2 hiver 2012	Lh	Q3	na		Calliblepharis jubata	
2748	MAR2262	rouge	Kallymeniaceae	<i>Calliphylis laciniata</i>	BDM	Santec 2 hiver 2012	Lh	Q3	na			
2749	MAR2263	rouge	Corallinaceae	<i>Corallina sp</i>	BDM	Santec 2 hiver 2012	Lh	Q3	na			
2750	MAR2264	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	BDM	Santec 2 hiver 2012	Lh	Q3	na			
2751	MAR2265	rouge	Delesseriaceae	<i>Delesseria sp</i>	BDM	Santec 2 hiver 2012	Lh	Q3	na			
2752	MAR2266	rouge	Phylloporaceae	<i>Gymnogangrus sp</i>	BDM	Santec 2 hiver 2012	Lh	Q3	na		Gymnogangrus crenulatus	
2753	MAR2267	brune	Styocaulaceae	<i>Halopteris filicina</i>	BDM	Santec 2 hiver 2012	Lh	Q3	na			
2754	MAR2268	rouge	Dasyaceae	<i>Heterosiphonia plumosa</i>	BDM	Santec 2 hiver 2012	Lh	Q3	na			
2755	MAR2269	rouge	Kallymeniaceae	<i>Kallymenia reniformis</i>	BDM	Santec 2 hiver 2012	Lh	Q3	na			
2756	MAR2270	rouge	Kallymeniaceae	<i>Meredithia microphylla</i>	BDM	Santec 2 hiver 2012	Lh	Q3	na		Polyneura bonnemaisonii	
2757	MAR2271	rouge	Delesseriaceae	<i>Myriogramme sp</i>	BDM	Santec 2 hiver 2012	Lh	Q3	na		Cryptonemia seminervis	
2758	MAR2272	rouge	Phylloporaceae	<i>Phyllophora crispata</i>	BDM	Santec 2 hiver 2012	Lh	Q3	na		Phyllophora crispata	
2759	MAR2273	rouge	Phylloporaceae	<i>Phyllophora pseudoceranoides</i>	BDM	Santec 2 hiver 2012	Lh	Q3	na		Calliphylis laciniata2	
2760	MAR2274	rouge	Plocamiaceae	<i>Plocamium sp</i>	BDM	Santec 2 hiver 2012	Lh	Q3	na		Plocamium cartilagineum	
2761	MAR2275	verte	Ulveae	<i>Ulva sp</i>	BDM	Santec 2 hiver 2012	Lh	Q3	na			
2762	MAR2276	rouge	Cystocloniaceae	<i>Calliblepharis ciliata</i>	BDM	Santec 2 hiver 2012	Lh	Q4	na		Calliblepharis ciliata	
2763	MAR2277	rouge	Cystocloniaceae	<i>Calliblepharis jubata</i>	BDM	Santec 2 hiver 2012	Lh	Q4	na		Calliblepharis jubata	
2764	MAR2278	rouge	Kallymeniaceae	<i>Calliphylis laciniata</i>	BDM	Santec 2 hiver 2012	Lh	Q4	na			Calliphylis laciniata
2765	MAR2279	verte	Cladophoraceae	<i>Cladophora sp</i>	BDM	Santec 2 hiver 2012	Lh	Q4	na			
2766	MAR2280	rouge	Corallinaceae	<i>Corallina sp</i>	BDM	Santec 2 hiver 2012	Lh	Q4	na			
2767	MAR2281	rouge	Cystocloniaceae	<i>Cystoclonium purpureum</i>	BDM	Santec 2 hiver 2012	Lh	Q4	na			Griffithsia sp
2768	MAR2282	rouge	Delesseriaceae	<i>Delesseria sp</i>	BDM	Santec 2 hiver 2012	Lh	Q4	na		Calliphylis laciniata1	
2769	MAR2283	rouge	Dasyaceae	<i>Heterosiphonia plumosa</i>	BDM	Santec 2 hiver 2012	Lh	Q4	na			
2770	MAR2284	rouge	Kallymeniaceae	<i>Kallymenia reniformis</i>	BDM	Santec 2 hiver 2012	Lh	Q4	na			
2771	MAR2285	rouge	Delesseriaceae	<i>Myriogramme sp</i>	BDM	Santec 2 hiver 2012	Lh	Q4	na		Polyneura	
2772	MAR2286	rouge	Phylloporaceae	<i>Phyllophora crispata</i>	BDM	Santec 2 hiver 2012	Lh	Q4	na		Phyllophora crispata	
2773	MAR2287	rouge	Phylloporaceae	<i>Phyllophora pseudoceranoides</i>	BDM	Santec 2 hiver 2012	Lh	Q4	na		Schottera palmettoïdes	
2774	MAR2288	rouge	Phylloporaceae	<i>Phyllophora sicula</i>	BDM	Santec 2 hiver 2012	Lh	Q4	na		Phyllophora crispata	
2775	MAR2289	brune	Sargassaceae	<i>Sargassum muticum</i>	BDM	Santec 2 hiver 2012	Lh	Q4	na		Cystoseira baccata	
2776	MAR2290	rouge	Sphaerococcaceae	<i>Sphaerococcus coronopifolius</i>	BDM	Santec 2 hiver 2012	Lh	Q4	na			
2777	MAR2291	rouge	Bonnemaisoniaceae	<i>Asparagopsis armata</i>	BDM	Santec 2 hiver 2012	Lh	Q5	na			
2778	MAR2292	rouge	Cystocloniaceae	<i>Calliblepharis ciliata</i>	BDM	Santec 2 hiver 2012	Lh	Q5	na		Calliblepharis ciliata	
2779	MAR2293	rouge	Kallymeniaceae	<i>Calliphylis laciniata</i>	BDM	Santec 2 hiver 2012	Lh	Q5	na		Calliphylis laciniata	Chondracanthus acicularis
2780	MAR2294	rouge	Gigartinales	<i>Chondracanthus acicularis</i>	BDM	Santec 2 hiver 2012	Lh	Q5	na			
2781	MAR2295	rouge	Corallinaceae	<i>Corallina sp</i>	BDM	Santec 2 hiver 2012	Lh	Q5	na			
2782	MAR2296	rouge	Cystocloniaceae	<i>Cystoclonium purpureum</i>	BDM	Santec 2 hiver 2012	Lh	Q5	na			
2783	MAR2297	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	BDM	Santec 2 hiver 2012	Lh	Q5	na			
2784	MAR2298	rouge	Delesseriaceae	<i>Delesseria sp</i>	BDM	Santec 2 hiver 2012	Lh	Q5	na			
2785	MAR2299	brune	Dictyotaceae	<i>Dictyopteris polydoides</i>	BDM	Santec 2 hiver 2012	Lh	Q5	na			
2786	MAR2300	rouge	Furcellariaceae	<i>Furcellaria lumbricalis</i>	BDM	Santec 2 hiver 2012	Lh	Q5	na		Furcellaria lumbricalis	
2787	MAR2301	brune	Styocaulaceae	<i>Halopteris filicina</i>	BDM	Santec 2 hiver 2012	Lh	Q5	na			
2788	MAR2302	rouge	Dasyaceae	<i>Heterosiphonia plumosa</i>	BDM	Santec 2 hiver 2012	Lh	Q5	na		Heterosiphonia plumosa	
2789	MAR2303	rouge	Delesseriaceae	<i>Hypoglossum hypoglossoides</i>	BDM	Santec 2 hiver 2012	Lh	Q5	na			
2790	MAR2304	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	BDM	Santec 2 hiver 2012	Lh	Q5	na		Lomentaria articulata	
2791	MAR2305	rouge	Phylloporaceae	<i>Mastocarpus stellatus</i>	BDM	Santec 2 hiver 2012	Lh	Q5	na		Mastocarpus stellatus1	
2792	MAR2306	rouge	Kallymeniaceae	<i>Meredithia microphylla</i>	BDM	Santec 2 hiver 2012	Lh	Q5	na		Cryptonemia seminervis	
2793	MAR2307	rouge	Delesseriaceae	<i>Myriogramme sp</i>	BDM	Santec 2 hiver 2012	Lh	Q5	na			
2794	MAR2308	rouge	Phylloporaceae	<i>Phyllophora crispata</i>	BDM	Santec 2 hiver 2012	Lh	Q5	na		Phyllophora crispata	
2795	MAR2309	rouge	Sphaerococcaceae	<i>Sphaerococcus coronopifolius</i>	BDM	Santec 2 hiver 2012	Lh	Q5	na			
2796	MAR2310	verte	Ulveae	<i>Ulva sp</i>	BDM	Santec 2 hiver 2012	Lh	Q5	na			
2797	MAR0193	rouge	Delesseriaceae	<i>Apoglossum ruscfolium</i>	BDM	Santec 2 hiver 2012	Lh	Vue	na			
2798	MAR0180	rouge	Cystocloniaceae	<i>Calliblepharis ciliata</i>	BDM	Santec 2 hiver 2012	Lh	Vue	na			
2799	MAR0188	rouge	Cystocloniaceae	<i>Calliblepharis jubata</i>	BDM	Santec 2 hiver 2012	Lh	Vue	na		Calliblepharis jubata	
2800	MAR0190	rouge	Kallymeniaceae	<i>Calliphylis laciniata</i>	BDM	Santec 2 hiver 2012	Lh	Vue	na		Calliphylis laciniata2	
2801	MAR0192	rouge	Corallinaceae	<i>Corallina sp</i>	BDM	Santec 2 hiver 2012	Lh	Vue	na			
2802	MAR0181	rouge	Kallymeniaceae	<i>Meredithia microphylla</i>	BDM	Santec 2 hiver 2012	Lh	Vue	na		Cryptonemia seminervis	
2803	MAR0187	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	BDM	Santec 2 hiver 2012	Lh	Vue	na			
2804	MAR0197	brune	Sargassaceae	<i>Sargassum muticum</i>	BDM	Santec 2 hiver 2012	Lh	Vue	na		Cystoseira baccata	
2805	MAR0184	rouge	Delesseriaceae	<i>Delesseria sanguinea</i>	BDM	Santec 2 hiver 2012	Lh	Vue	na		Delesseria sanguinea	
2806	MAR0178											

Annexe 4

	A	B	C	D	E	F	G	H	I	J	K	L
2839	MAR1308	rouge	Corallinaceae	<i>Corallina sp</i>	PNMI	St Mathieu hiver 2011	Ld	Q3	10	<i>Corallina officinalis1</i>		
2840	MAR1309	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	PNMI	St Mathieu hiver 2011	Ld	Q3	4			
2841	MAR1310	rouge	Delesseriaceae	<i>Delesseriaceae</i>	PNMI	St Mathieu hiver 2011	Ld	Q3	20			
2842	MAR1311	rouge	Plocamiaceae	<i>Plocamium sp</i>	PNMI	St Mathieu hiver 2011	Ld	Q3	1			
2843	MAR1312	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	PNMI	St Mathieu hiver 2011	Ld	Q3	5			
2844	MAR1313	brune	Phylariaceae	<i>Saccorhiza polyschides</i>	PNMI	St Mathieu hiver 2011	Ld	Q3	7			
2845	MAR1314	brune	Phylariaceae	<i>Saccorhiza polyschides</i>	PNMI	St Mathieu hiver 2011	Lh	Q1	4			
2846	MAR1315	rouge	Kallymeniaceae	<i>Callophyllis laciniata</i>	PNMI	St Mathieu hiver 2011	Lh	Q1	3		<i>Callophyllis laciniata</i>	
2847	MAR1316	rouge	Corallinaceae	<i>Corallina sp</i>	PNMI	St Mathieu hiver 2011	Lh	Q1	20			
2848	MAR1317	rouge	Lomentariaceae	<i>Lomentaria articulata</i>	PNMI	St Mathieu hiver 2011	Lh	Q1	1			
2849	MAR1318	rouge	Delesseriaceae	<i>Delesseriaceae</i>	PNMI	St Mathieu hiver 2011	Lh	Q1	4		<i>Strange Kallymeniaceae</i>	
2850	MAR1319	rouge	Phylloporaceae	<i>Phyllophora crispa</i>	PNMI	St Mathieu hiver 2011	Lh	Q1	3			
2851	MAR1320	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	PNMI	St Mathieu hiver 2011	Lh	Q1	30	<i>Acrosarium</i>		
2852	MAR1321	rouge	Phylloporaceae	<i>Phyllophora pseudoceranoides</i>	PNMI	St Mathieu hiver 2011	Lh	Q1	1			
2853	MAR1322	rouge	Phylloporaceae	<i>Gymnogongrus sp</i>	PNMI	St Mathieu hiver 2011	Lh	Q1	1			
2854	MAR1323	rouge	Dumontiaceae	<i>Dilsea carmosa</i>	PNMI	St Mathieu hiver 2011	Lh	Q2	11			
2855	MAR1324	rouge	Phylloporaceae	<i>Schottera nicoensis</i>	PNMI	St Mathieu hiver 2011	Lh	Q2	12			
2856	MAR1325	rouge	Delesseriaceae	<i>Myriogramme sp</i>	PNMI	St Mathieu hiver 2011	Lh	Q2	10	<i>Polyneura</i>		
2857	MAR1326	rouge	Phylloporaceae	<i>Phyllophora crispa</i>	PNMI	St Mathieu hiver 2011	Lh	Q2	10			
2858	MAR1327	rouge	Wrangeliaceae	<i>Halurus equisetifolius</i>	PNMI	St Mathieu hiver 2011	Lh	Q2	1		<i>Halurus equisetifolius</i>	
2859	MAR1328	rouge	Rhodymeniaceae	<i>Rhodymenia pseudopalmeta</i>	PNMI	St Mathieu hiver 2011	Lh	Q2	17			
2860	MAR1329	rouge	Corallinaceae	<i>Corallina sp</i>	PNMI	St Mathieu hiver 2011	Lh	Q2	5	<i>Corallina officinalis1</i>		
2861	MAR1330	rouge	Delesseriaceae	<i>Delesseriaceae</i>	PNMI	St Mathieu hiver 2011	Lh	Q3	20			
2862	MAR1331	rouge	Kallymeniaceae	<i>Kallymenia reniformis</i>	PNMI	St Mathieu hiver 2011	Lh	Q3	1			
2863	MAR1332	rouge	Phylloporaceae	<i>Phyllophora crispa</i>	PNMI	St Mathieu hiver 2011	Lh	Q3	13	<i>Phyllophora crispa</i>		
2864	MAR1333	rouge	Delesseriaceae	<i>Cryptopleura ramosa</i>	PNMI	St Mathieu hiver 2011	Lh	Q3	20		<i>Acrosarium ciliolatum</i>	
2865	MAR1334	rouge	Delesseriaceae	<i>Myriogramme sp</i>	PNMI	St Mathieu hiver 2011	Lh	Q3	1			
2866	MAR1335	rouge	Corallinaceae	<i>Corallina sp</i>	PNMI	St Mathieu hiver 2011	Lh	Q3	10	<i>Corallina officinalis1</i>		
2867	MAR1336	brune	Dictyotaceae	<i>Dictyota dichotoma</i>	PNMI	St Mathieu hiver 2011	Lh	Q3	1			