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Unité Mixte internationale Franco-Chilienne

SCIENTIFIC PROJECT

2014-2018

EVOLUTIONARY BIOLOGY AND ECOLOGY OF ALGAE

CNRS UPMC Station Biologique Roscoff

UMI UPMC-CNRS (France) / PUCCh (Chile) / UACh (Chile)
Direction: Myriam VALERO

Récolte des populations de l'algue rouge Gracilaria chilensis dans le Sud du Chili, photo ML Guillemin

Vague D : campagne d'évaluation 2012-2013
Février 2012

agence d'évaluation de la recherche et de l'enseignement supérieur

Vague D : campagne d'évaluation 2012 - 2013

Unité de recherche
UMI: Evolutionary Biology and Ecology of Algae
EBEA

2.1. Projet scientifique de l'unité

I. General project of the French-Chilean UMI EBEA "Evolutionary Biology and Ecology of Algae" for the period 2014-2018

1. Presentation of the research Unit

a. Historical context

The proposed UMI "Evolutionary Biology and Ecology of Algae" (EBEA), is built on a solid history of scientific collaboration between the "Station Biologique de Roscoff" (SBR) and the "Pontificia Universidad Catolica de Chile" (PUCCh). Members of these two organisations have been working together since 1997 (PICS-CNRS, ECOS-CONYCIT projects, European INCO DEV project) and a strong collaboration has been built up over that time. Among those, four participants to the proposed UMI project (namely Juan Correa, Christophe Destombe, Sylvain Faugeron and Myriam Valero) were already involved in the collaboration since this date. The link between Roscoff and Santiago was reinforced in 2003 with the creation of an International Associated Laboratory ("Laboratoire International Associé" or LIA, co-direction Juan Correa in Chile, Myriam Valero in France) between the two institutions under the title "Dispersal and Adaptations in Marine Species". These interactions have proven to be very productive in terms of publications and highly valuable for the training of young scientists. During the eight years since the creation of the LIA, there have been more than 60 exchanges of personnel, including eight that lasted for more than 6 months, and 6 co-directed PhD theses. Five grant applications have been submitted (ANRs, FONDECYTs and European projects), more than 60 papers have been published and the participants have received 3 awards. Moreover, 5 previous co-tutelle students and post-docs that were actively involved within the LIA are now professors in Chilean universities (S. Faugeron, L. Cardenas, M-L. Guillemin, A. Brante, F. Tellier) reinforcing the strength of the research network in the domain of marine evolutionary ecology and population genetics between France and Chile. In this context, the UMI "Evolutionary Biology and Ecology of Algae" proposed here is the logical development of the LIA.

The aim of the LIA DIAMS was to look into the processes that cause changes in marine coastal biodiversity in relation to climate-oceanographic change and human activities at both community and population levels by combining researchers from the different fields of expertise (experimental ecology, population genetics, molecular ecology, genomics, transcriptomics). During the first period, the major achievement of the LIA was the comparative study of the two transitions zones, one located in the South-Eastern Pacific (30°S, Central Chile) and the other in the North-Eastern Atlantic (Brittany, France). For the first time genetic data were combined to ecological data from several species (marine invertebrates and algae) to establish the occurrence of an historical barrier in the 30°S transition zone along the Chilean coast. New cryptic species were described in both study zones. Another major achievement of the LIA was the development of tools for studying genomics of adaptation to abiotic and biotic stresses in marine algae. For the first time, defense-priming effects were shown in kelps using molecular and chemical defense markers. Since 2008, the LIA had concentrated its activity mainly on seaweeds as biological models, incorporating a new institution: Universidad Austral de Chile (UACH). The research activities were focused on the ecology, evolution and genomics of seaweeds in relation with cultivation and exploitation of these natural resources.

The UMI EBEA is proposed in continuity to the LIA. However, only part of the teams involved previously in the LIA (namely the Bedim team in Roscoff, the team of Juan Correa in PUCCh and team of Marie-Laure Guillemin in UACH will be involved in this structure (see the organization chart). In parallel a more flexible structure highly complementary to the UMI is also proposed: the GDRI "Diversity, Evolution and Biotechnology of Marine Algae". The GDRI will allow some of the themes developed in detail by the UMI to be extended to other fields (such as genomics and transcriptomics, for example). The GDRI will also provide a flexible mechanism to build a network of scientists around the central themes of the LIA/UMI and to extend the collaborative program to a third country, Brazil.

b. Framework of the research project

The main objective of the UMI EBEA is to develop basic research on the dynamics of biodiversity in marine algae. General evolutionary questions will be tackled, such as how the wide diversity of life cycles, mating systems and life history traits observed among algae has evolved, and what are the consequences of this diversity on adaptive processes (adaptation to global change, for example); the evolution of reproductive isolation and speciation are other key biological questions that will be addressed during this project. The partnership of the project combines different and complementary domains of expertise, and will allow us to address these questions using a combination of theoretical (mathematical models) and experimental approaches in the field and in the laboratory, on a group of organisms (marine micro and macro-algae) this is still little explored, but presents some extremely interesting characteristics such as huge variation for life cycles and mating systems among and within species. The expected

outcome of the project is primarily scientific knowledge about adaptation and its ecological and evolutionary limits. Our willing is also to focus on concrete challenges relevant to the society since the new concepts developed in the UMI are also expected to increase knowledge relevant for the conservation and management of marine algal biodiversity in natural and human-exploited marine environments. In addition, during the project new tools and methods for improving algal genetic resources and the domestication of seaweed specie are expected. Finally, the «raison d'être» of the UMI is to promote the collaborative links between France and Chile mainly in basic science and education in marine science, but also on more applied issues related to algal cultivation and conservation of marine resources. This new structure is also expected to facilitate new collaborations towards European and South American scientific communities (UMI participation to the GDRI project with Brazil).

- Quantitatively, we can divide the expected outcomes of the project as follow :

  Moving forward the frontiers of knowledge in Ecology and Evolution (80%): theoretical research and empirical tests of theoretical predictions are the main focuses of our research that is addressing fundamental questions regarding life cycles and algal biodiversity

  Participating to knowledge acquisition in order to develop identified applied issues (5%): basic research on life cycle and domestication processes are expected to provide useful results for the rapidly growing, and highly demanding conceptual developments in algal aquaculture.

  Proposing direct responses to economic challenges, social and cultural perceptions (15%): the expected outcome of the UMI is to reinforce the international collaboration between France and Chile promoting scientific and cultural exchanges between these two countries and to increase public understanding of ecology and evolution of marine organisms. In addition, the project is expected to raise awareness among a large public about the problems of conservation of marine biodiversity and to provide scientific background for rational algal resource management. Finally, the work on micro-algal models, which is relevant to questions of how planktonic microbial communities - and their biogeochemical functionality - will change with on-going ocean changes (acidification, increased stratification, increased intensity of oxygen minimum zones, etc...), is expected to raise awareness about possible consequences of global climate change. The work on *Alexandrium* is expected to increase the general understanding of harmful algal blooms and their importance to prediction of evolution of future ocean and marine ecosystem services with anthropogenic influence.

- The principal recipients of the research activities developped in the UMI are listed below

  The main target is *the scientific community* that will gain from the project through active publications and scientific conferences. Data arising from the proposed project will be submitted in high-impact journals.

  The priority is also given to *the students* since the UMI will promote co-tutelle PhDs and Masters between the three universities associated to the project (UPMC, PUCCh and UACH). In addition special courses will be planned within the framework of the UMI

  Another target will be *the main stakeholders of algal resources* (fishermen, aquafarmers, and managers of marine protected areas) for aspects related to algal domestication, conservation of biodiversity and management of genetic resources, and eventually some technology transfer. In addition, government agencies and policy makers will be recipients of our research concerning algal cultivation and algal resource extraction from natural populations. Special diffusion actions towards Chilean stakeholders are already taking place within the framework of the Millenium Nucleus "Marine Conservation Center", and will continue in collaboration with the UMI EBEA for topics more specifically related to seaweeds.

  Further dissemination activities to the general public (including school children) will be planned through various action of spreading (exhibitions, conferences, "fête de la science", "nuit des chercheurs" in connection with the communication service of the FR 2424 in Roscoff). Within Chile, the investigators activities will include the participation to the National Week of Science and Technology and to the EXPLORA Regional and National School Congress where schoolchildren assessed by scientists send their work to be evaluated by a Scientific Committee. The UACH is the regional coordinator for the Explora activities in the region of "Los Rios" (region XIV

c. Organization chart and rules of procedure

EVOLUTIONARY BIOLOGY AND ECOLOGY OF ALGAE

UMI UPMC-CNRS (France) / PUCCh (Chile) / UACh (Chile)

Direction: Myriam VALERO

Station Biologique de Roscoff : CNRS et UPMC (France)			
Evolutionary Biology and Ecology of Algae			*Myriam VALERO*
C. Destombe, PR D. Roze, CR **M. Valero, DR**	S. Mauger, AI J. Coudret, AI ½ (shared with UMR 7144) X. « Assistant en gestion administrative » (AI ½ position asked to UPMC/CNRS) XX. AI domestication (to be contracted in Idealg) AI 1/2	L. Couceiro Lopez, post-doc, CHC Y. Post-doc domestication (to be contracted in Idealg) CHC 1/2 YY. Post-doc life history (to be contracted in Idealg), CHC YYY. Post—doc statistic modeling CHC ½ (to be asked to UPMC/CNRS)	M. Robuchon, D A. Montecinos, D ½ M. Rescan, D
Pontificia Universidad Catolica de Chile (Chile)			
Departamento de Ecología		**José Miguel Fariña**	
J. A. Correa, PR **S. Faugeron, MC** P. von Dassow, MC	Jessica Beltran, AI Gioconda Peralta, AI ½(asked to the PUC) XXX Secretary, AI (asked to the PUC)	Daniela Mella, Post-doc, CHC Camille Sordet,Post-doc, CHC Federico Rengifo, AI (Fondecyt Magellan) Silvana Collado, AI (FONDECYT Emiliana) YYY. Post—doc quantitative genetics CHC ½ (to be asked to Fondecyt)	Fernanda Araujo,D Andres Meynard, D Javier Tapia, D ½
Universidad Austral de Chile (Chile)			
Instituto de Ciencias Ambientales y Evolutivas		**Christian Figueroa**	
M-L. Guillemin, MC	XX. AI domestication (to be contracted in Idealg) AI ½ XXXX. T (to be contracted in the frame of a new Fondecyt project)	Y. Post-doc domestication (to be contracted in Idealg) CHC 1/2	A. Montecinos, D ½

Situation predicted for the 1/01/2014, Persons with HDR or equivalent are noted in bold; Persons with a permanent position are underlined
PR:"professeur", MC: Maître de conférence", CR :"chargé de recherche", DR:"directeur de recherche", AI :"Assistant Ingénieur", T :"Technicien", CHC :"chercheur contractuel", D :"doctorant"

The Unit will be formed by a single research team localized in three different geographical locations that are listed in the organization chart. The list of personnel that are expected in the Unit for the beginning of the contract (01/01/2012); the UMI should be composed of about 30 persons: 10 permanent positions and 16 non permanent positions and 4 positions that will be asked to our institutions or research agencies. The main administrative site will be in Roscoff. Because of its international partnership, the rules of procedures will follow the agreement form that will be signed by the different participants to the UMI and that will be add as an annex to this document.

Stéphane Mauger has agreed to be the ACMO of the Unit (agent charged of the carrying out of the rules about health and security).

2. SWOT analysis and scientific objectives of the UMI

a. SWOT analysis

a.1. Strengths

- A multidisciplinary partnership characterized by an original and historical position of national and international leaders in the fields of theoretical modeling of the evolution of reproductive systems; molecular ecology and population genetics of marine algae; experimental and reproductive ecology in marine environment; environmental genomics of planktonic microbial ecosystems as well as in domains relative to the conservation of genetic resources and the management of marine algal biodiversity.

- A long history of active scientific collaboration between the Chilean and French teams, with special emphasis in post-graduate training. This collaboration has largely benefited from the complementarity in research lines from experimental ecology in the field and in controlled culture chambers, to computer modeling and simulations, including empirical studies in population genetics and molecular ecology

- The extension of the international collaboration towards the regions (outside Santiago) via the inclusion of the Universidad Austral de Chile, which will give an official status to previous research collaborations initiated with this institution. It will also facilitate access to southern ecosystems where important biogeographic changes are occurring and where most of the aquaculture is concentrated.

- An international positioning, thanks to strong external collaborations (outside France and Chile): Canada, the Netherlands, Portugal and USA, and the participation in national and international networks (GDR Marco on marine population genetics; project of GDRI on Diversity Evolution and Biotechnologie of Marine algal, French and European networks of Marine Stations: EMBRC, Assemble and Euromarine), allowing the mobilization of complementary skills, and the implementation of ambitious projects;

- A significant implication in education (undergraduate, graduate and PhD programs) both in France and Chile and the (co-) supervision of Master and PhD students with all three universities having signed already “co-tutelle” agreements.

- Success in obtaining research grants form funding research agencies in Chile France and Europe (since the five last year: pasted or current funding supports include partnerships in 8 ANRs, 4EUprojects, 4Fondecyt, 1 Fondap with a new Fondap that has been recently submitted, see detailed scientific project).

a.2. Weaknesses

- A still insufficient consideration of the development of statistical modeling of population structure for the study of non-model species such as haploid-diploid organisms. A research position will be asked to the UPMC /CNRS, to develop such models and methods and to complete the teaching in bio-mathematics and statistics done in Roscoff (Licence bidisciplinaire biologie-mathématique).

- Another weakness is our lack of expertise in quantitative genetics, because it is important to characterize the links between the phenotype and the genotype (and their variation) for the research on adaptation. We plan to attract post-doctoral fellows in this area who will be so-in the framework of existing collaborations (within IDEALG and the GDRI). In addition, Jérôme Coudret (AI “culture” in Roscoff) will follow a formation in order to help in crossing designs and data measurement.

- Finally, we do not have expertise in Next Generation Sequencing (NGS) methods in our group. However, the aim of the WP1 of the ANR Idealg is to develop such tools and we will benefit from existing expertise in Roscoff. We also plan to attract post-doctoral fellows that have such expertise in the research programs that will need the development of such tools. In addition, Stéphane Mauger, (AI “Molecular Biology” in Roscoff) will follow a formation to these technics.

a.3. Opportunities

- The natural evolution of the relationship between French and Chilean teams is framed within institutional agreements, especially between PUC and UPMC. The three institutions CNRS, UPMC and PUC are currently focusing their internationalization strategies towards existing and successful collaborative programs, among which is the LIA DIAMS. Internationalization towards Europe is a priority for the PUC and the UACH while Internationalization towards South America is a priority for the CNRS and UPMC, the UMI project is an important step strongly supported by these institutions.

- The marine station of Roscoff (UPMC) offer the help of research vessels, diving and sampling devices moreover it gives access to technical and technological platforms for biological and ecological research, with support from highly qualified technical staff and provide access to up-to-date equipments, such as histology, microscopy, imaging, flow cytometry, cell culture facilities, sequencing, transcriptomics, proteomics and bioinformatics. The marine station of Las Cruces (PUC) has considerably improved its research infrastructure and increased its international recognition as south-eastern Pacific coastal laboratory. These two marine stations greatly improve the capacities for accessing coastal ecosystems, doing experimental research and seaweed cultivation and organizing workshops and courses. The PhD program in Ecology and Evolution at Universidad Austral de Chile, to which M-L Guillemin is associated, has been awarded a MECESUP grant that is aimed to set up a core facility for functional genomics, bioinformatics and genotyping which will facilitate the data acquisition and treatment of doctorate and postdoctorate fellows within the frame of the "co-tutelle" agreements.

- A positive aspect of the Chilean context is the sustained increase in research and innovation funding, specifically in aquaculture and marine resources, which have been defined as top priorities for the country. Among the major initiatives is the recent call for the creation of a center of excellence (FONDAP center) in aquaculture, to which members of the UMI have applied (currently under evaluation). This kind of opportunities are important for Chilean research but also for the UMI as it offers the possibility to potentiate complementarities between the basic research proposed in the UMI scientific project and the applied research proposed in FONDAP project. Similar opportunities are offered by the ANR IDEALG which is also a long-term grant on basic and applied research on algal biology.

- Finally, French science has a long history in Chile, with many early examples (agronomy, mathematics, etc..). It currently continues its consolidation, in particular through the recent creation of several LIAs and UMIs, among other initiatives. As mentioned in the historical context of the UMI EBEA project, several of the former students with double-degree (i.e. trained within the framework of the LIA) have now permanent positions in Chilean universities. Moreover, 5 out of the 7-8 main population geneticists in Chile are French, and we can now consider that there is a French school of population genetics. This is clearly an indication that French-Chilean collaborations are leaving a strong signature on the Chilean scientific landscape. The UMI EBEA is therefore an initiative that will be framed within this background of strong Franco-Chilean scientific collaboration.

a.4. Threats

- The geographical distance separating the two countries is certainly an obstacle for the communication between Chilean and French personnel involved in the Unit. We think that it is essential to have a good system of videoconference in order to plan lab meetings once a month. In addition, administrative and legal policies from both countries are issues that we will have to anticipate in order to facilitate travel and accommodation for researchers and students, transfer of biological material, and transfer of money. Administrative positions are asked both for the PUCCh and Roscoff to our respective institutions to solve this problem.

- The lack of office space in Roscoff might be a real problem for the project since we will need at least a supplementary office for the visiting scientists and personnel since frequent and long term stays (in particular co-tutelle students) are expected in the context of this international structure.

b. Scientifc objectives of the UMI

b.1. State of the art

Understanding the widespread occurrence of sexual reproduction, given the important costs associated with this mode of transmission of genetic material remains one of the most fundamental questions in evolutionary biology. While many important theoretical models have been published on this question since the 70's (Otto 2009), our group has showed that ploidy and spatial structure are important factors that need to be considered in models (Roze 2009, Roze & Michod 2010). In addition, empirical validation on real organisms (both in the lab and in natural populations) has only started to emerge during the last decade but still on a limited number of organisms (Roze 2012). There is a need to explore this empirical approach in a wider spectrum of phyla. A major consequence of sexual reproduction is the alternation of haploid and diploid phases (separated by syngamy and meiosis) during the life cycle. Understanding the evolution of a wide variety of different life cycles (with different degrees of vegetative development in the haploid and diploid phases) is another key evolutionary question. Most of the theoretical models dealing with this question were published in the late 80's and 90's, but the maintenance of alternation of generations with substantial development in both haploid and diploid phases remains little understood (see for review Valero et al. 1992; Mabble & Otto 1998 and Coehlo et al. 2007); furthermore, empirical validation of these models is still largely lacking, most of the only few experiments having been performed on a unicell (yeast, Zeyl 2004; Gerstein et al. 2006).

The originality of the project is to focus on marine algae because: 1) both phyla of Phaeophyceae and Rhodophyta exhibit many very different life cycles, ranging from isomorphic haploid-diploid life cycles, in which both generations exhibit multicellular development, to diploid life cycles, where only the diploid generation of the life cycle is multicellular, 2) micro algae

(coccolithophores Haptophyta) life cycles are also characterized by independent haploid and diploid phases displaying radically different morphologies and distinct physiologies. Moreover, this complexity in terms of life cycles is associated with diverse form of sexual systems ranging from isogamy to oogamy and parthenogenesis to outcrossing.

Haploid, diploid and haploid-diploid algal life cycles may additionally exhibit obligate or facultative asexual reproduction. Clonal propagation via fragmentation of ramets may be an important mode of reproduction (e.g. in the invasive and/or cultivated genus *Gracilaria, vermiculophylla* and *G. chilensis* (Buschmann et al. 2001, Thomsen et al. 2007). Parthenogenesis or production of spores or gametes without meiosis or syngamy, such as apomixis or apomeiosis, occurs in both red and brown phyla (e.g., Maggs 1988, Hwang et al. 2005) and may become increasingly important in marginal populations, such as at latitudinal or elevation limits (e.g., *Mastocarpus papillatus*, Fierst et al. 2010; *Laminaria digitata*, Oppliger 2010) or along salinity gradients (*Ceramium tenuicorne*, Bergström et al. 2003). One of the best examples of life cycle variation is found in the brown alga *Ectocarpus siliculosus* (Peters et al. 2008). Unfertilized gametes, from either the male or the female gametophyte, can enter a parthenogenetic cycle producing a partheno-sporophyte. The partheno-sporophyte produces spores which develop into gametophytes (Figure 1). The sporophyte stage can produce spores via meiosis or mitosis which recycle the sporophyte stage (Figure 1). In Florideophyceae red seaweeds, cystocarpic reproduction (Figure 2) can be seen as a type of clonal propagation.

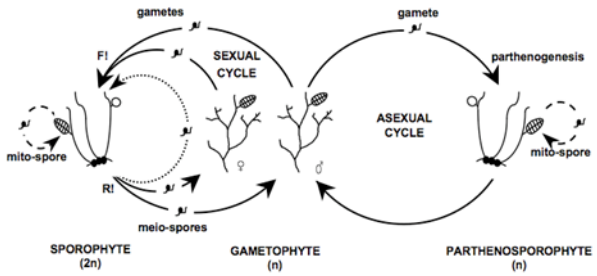

Figure 1. Life history of *Ectocarpus* in culture (from Peters et al. 2008).

The sporophyte and gametophyte generations are morphologically similar except that the sporophyte develops a prostrate system that is strongly attached to the substratum before it produces the upright filaments that bear most of the sexual structures. The gametophyte produces upright filaments directly and these are more branched than those of the sporophyte. See text for details of the life history.

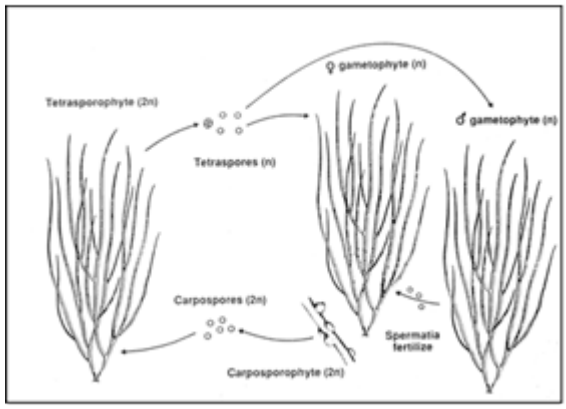

Figure 2: Haploid–diploid life cycle in G. gracilis (from Kain & Destombe 1995).

(n) haploid phase stages; (2n) diploid phase stages; arrows: dispersal. The cystocarp (carposporophyte) is composed of a haploid maternal envelope and a diploid sporogenic tissue that gives rise to thousands of genetically identical diploid spores (carpospores).

These organisms are thus particularly tractable models for exploring the consequences of life cycles on mating system and population structure. For example, theoretical models suggest that endogamous mating systems may be associated with life cycles characterized by a free-living prolonged haploid phase (Otto & Goldstein 1992; Richerd et al. 1993; Otto & Marks 1996). In fact, the purging of deleterious mutations, exposed to selection in the haploid phase reduces the genetic load, buffering inbreeding depression and/or creating favorable genetic associations, either of which promote selfing, inbreeding or asexual reproduction (Otto & Goldstein 1992; Richerd et al., 1993; Otto & Marks 1996). Yet, this has rarely been explicitly studied except in few models of brown and red seaweeds for which microsatellites markers were specifically developed. Our group is one of the first to have developed these tools in seaweed, providing the first basic data on gene flow, male gamete and spores dispersal as well as mating system (paternity analyses: Engel et al. 1999; Krueger 2011). Very different mating systems were observed even when the life cycles were similar (e.g. in *Gracilaria gracilis*, Engel et al. 2004; *Gracilaria chilensis*, Guillemin et al. 2008 and *Chondrus crispus*, Krueger et al. 2011) suggesting that mechanisms may have evolved to prevent inbreeding. However, our previous approaches were constrained by three major problems: (1) the difficulty to control the life cycle in the lab and then to test the importance of incompatibility or inbreeding in controlled experiment; (2) the necessity to develop new statistical and population genetics methods in these haploid-diploid organisms that do not fit textbook models; (3) the theoretical unsolved difficulty to estimate clonal reproduction in partial asexually reproducing species.

Another consequence of sexual reproduction is hybridization within or between species. The role of hybridization and its effect on speciation is another key evolutionary question (Seehausen 2004). On one hand, hybridization may contribute to an increase in species numbers by enhancing evolutionary potential through elevation of genetic variability and introduction of novel gene combinations (Arnold 2006). On the other hand, hybridization may decrease species numbers by collapsing existing species by continuously breaking down incipient linkage disequilibria between genetic loci (Kirkpatrick & Ravigne 2002). Contact zones, that include environmental margins, parapatric margins and hybrid zones, bring genetically distinct individuals in contact and offer them the possibility to interbreed. These are ideal situations to study hybridization and speciation processes. The Chilean coast offers remarkable characteristics to study this question since it forms a linear latitudinal gradient of three thousands km that cross three main biogeographic provinces (Camus 2001). A major contribution of our group during the LIA project was to demonstrate the repeated occurrence of previously non-described sibling species in two intertidal seaweed within the 30°S-33°S transition zone (Tellier et al. 2009; Montecinos et al. 2012), but the nature and the strength of present-day barriers to gene flow need to be determined (Figure 3). The work of Bierne et al. (2011) point out that most of these zones could be maintain by endogenous barriers to gene flow (i.e. environment-independent), linked to accumulation of genetic incompatibilities in allopatry or in parapatry, rather than local adaptation, but the link between adaptation to divergent environments and the evolution of reproductive isolation is still largely debated and needs to be better understood (Butlin 2012). It has been assumed that reproductive isolation could arise as an automatic by-product of adaptive divergence ("magic traits in speciation" see for review Servedio et al. 2011). This is because speciation is greatly facilitated when traits subject to divergent selection also contribute to nonrandom mating. Due to the rapid development of genomic technology, these questions become more answerable in studies of wild populations than ever before. The increased integration between ecological research and genomics has the potential to shed novel light on the origin of species (Rice et al. 2011) This area is very challenging and especially for the marine realm, since important gaps exist in our understanding of speciation compared to terrestrial organisms (Miglietta et al. 2011).

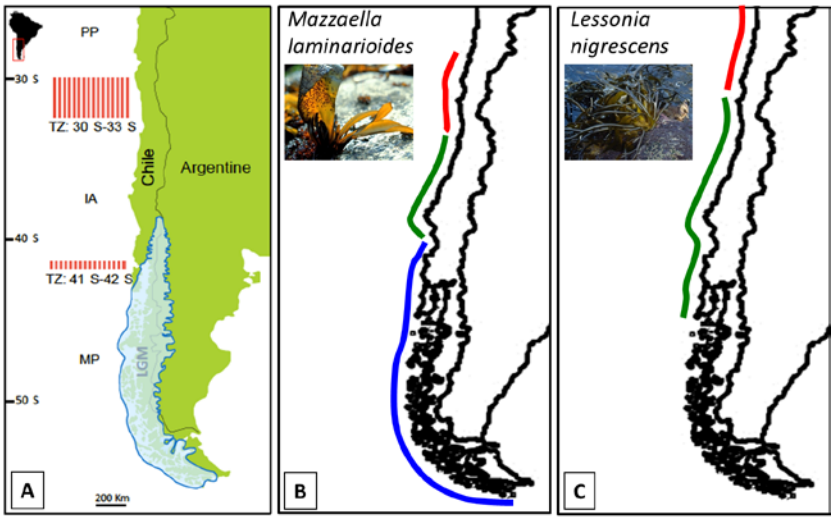

Figure 3: Map of the Chilean coast:

(**A**) showing the extension of the two biogeographic transition zones (TZ, red bars) (Camus 2001) and the extent of ice during the Last Glacial Maximum (blue area) modified from McCulloch et al. (2000). Abbreviations indicate the three biogeographic provinces described for the Chilean coast: (PP) Peruvian Province, (IA) Intermediate Area, and (MP) Magellanic Province. Geographical distribution of parapatric lineages of *M. laminarioides* (**B**) and *L. nigrescens* (**C**). Different colours represent different lineages.

The main aim of the UMI EBEA is to address these fundamental questions combining theoretical and experimental approaches. In addition, the partners of the UMI project are involved in aquaculture and resource management research programs Algae are essential components of the coastal ecosystems and produce large amounts of biomass. They are exploited as natural resources and cultivated for food, cosmetics, agriculture, bioactives and more recently as raw material for chemistry and bioenergy (biofuel production). Presently, most of the algal biomass used by the French and the Chilean industry is harvested from wild populations, with concerns about sustainability and biodiversity conservation. A decrease in standing stocks, specifically of kelps, has been reported in many parts of the world (Chile, California, Japan, Barren grounds, Norway, South Brittany), while industrial production of macroalgae is expanding rapidly. Consequently, open aquaculture of seaweeds are likely to become important in the context of a rising demand for biomass and several scientific programs on algal aquaculture have been funded recently in different European Countries. The project of UMI integrates logically upstream of these researches in aquaculture (fundamental knowledge on life history traits and their variation, management of genetic resources, domestication and environmental impacts) and is strongly involved in the program ANR " IDEALG " recently funded for a period of 8 years on the development of new products and processes and new cultivation approaches to grow native seaweeds. In Chile a 5 years project (Fondap) was submitted this year to address similar aspects linked to seaweed aquaculture.

b.2. Three main research axes

The project is structured in three main research axes that are summarized below (for detailed research program see Annex):

b.2.1. Evolution of sexual reproduction and its consequences

Three major lines of research will be investigated:

b.2.1.a. Habitat heterogeneity and selection for sex.

We will explore how habitat heterogeneity affects selection for sexual reproduction. Different types of models will be considered: island model with different types of demes, isolation-by-distance models with a gradient in an environmental factor. We will also explore the case where density varies across space, as it has been proposed that higher density may enhance the effect of deleterious alleles (Agrawal & Whitlock 2010), which may in turn affect the mutation load in structured populations (Roze 2012) and possibly selection for sex. This theoretical work will be done in close relationship with the empirical work on geographical parthenogenesis in South East Pacific (SEP) and North East Atlantic (NEA) species *Lessonia nigrescens*, *Mazzaella laminarioides* and *Laminaria digitata* at their distribution range limit. In a longer term, we aim at developing a biological system to perform experimental evolution in the lab. In this respect, the brown alga *Ectocarpus* offers interesting possibilities but other biological systems may also be considered, such as microalgae (*Alexandrium minitum*, *Emiliania huxleyi*) or monogonont rotifers (which alternate between sexual and asexual reproduction)

b.2.1.b The evolution of life cycles.

We will explore how genetical and ecological effects may interact, by constructing models that incorporates both types of effects, and studying how ecological differentiation among phases may evolve. We will also explore the interactions between the evolution of life cycles and the evolution of sex (how do ploidy and the rate of sexual reproduction coevolve? Is clonal reproduction expected to evolve more easily in the haploid or diploid phase of the life cycle?) The objective is to test the theoretical predictions on a different algae model species both in the field (spatial and temporal surveys of genetics and demography population structure) and in the lab (difference of response between haploid and diploid individuals). We have selected three species in which both approaches in the field and in the lab are feasible (genetic tools available and species are tractable in the lab): *G. chilensis, E. siliculosus*, *E. crouaniorum*. In a longer term we may also consider *E.huxleyi*.

b.2.1.c. Population genetics structure of non-model organisms

We will develop methods to infer rates of clonal reproduction in natural populations. These methods will be based on single-locus (excess of heterozygosity) and multilocus (linkage disequilibrium) measures, using theoretical models to explore how clonal reproduction affects the distribution of these statistics, and how these may be used for inference. These new methods will be applied to organisms with haploid-diploid life cycles, in *G. chilensis* we will take advantage of an available temporal sampling of asexual farms and sexually reproducing natural populations and new neutral molecular markers will be developed in this species using a genome scan approach. In a longer term, the objective will be to develop specific statistical population structure models for haploid-diploid species, allowing to infer the rate of haploid and diploid dispersal and clonality.

b.2.2. Speciation processes and the ecological and evolutionary limits of adaptation

b.2.2.a. Detection of hybridization and introgression in the genome.

We will continue investigating the conditions under which different forms of genetic incompatibilities may couple within the genome; in parallel, we will also consider the scenario of a secondary contact between two incipient species which can still form hybrids: under which condition can a stable tension zone be maintained, and the two species remain differentiated? In a longer term, the objective will be to get genomic data on some of our algae species models. We will explore the possibility to exploit the genomic and genetic tools that are being developed for the model brown alga *Ectocarpus* since hybridization between *E. siliculosus* and *E crouaniorum* was documented both in France and Chile (Peters 2010 a, b). The species complex of *Ectocarpus spp* is thus a very good candidate for studies of genetics and genomics speciation in algae.

b.2.2.b. Genetic incompatibilities, reproductive isolation and introgression in contact zones

We will continue with the investigation on changes in the mating system in contact zones between sister species and its role in the persistence of parapatric distribution. The two main models in Chile will be *L. nigrescens* and *M. laminarioides*, whereas *Fucus spp* will be considered in France. This work will involve a better characterization of the changes, including the genetic process of the parthenogenesis (Oppliger et al. 2010) and the role of mitochondrial duplications (Tellier et al. 2011), and detailed population genetic inferences of the mating system in contact zones.

b.2.2.c. Environmental heterogeneities and consequences on local adaptation: biotic and abiotic interactions

We will combine experimental ecology to measure traits and fitness of different genotypes in different environmental conditions using NGS methods (such as RAD sequencing) to investigate the molecular bases of adaptation and the balance between evolutionary forces. Natural heterogeneities of the transitions across biogeographic transitions will be considered to test the balance between selection and migration-drift in the divergence between parapatric sister species. Part of this research will be developed within the framework of the study of domestication (see below), i.e. the adaptation to cultivation conditions.

b.2.3. Domestication, management of genetic resources, and environmental impacts

b.2.3.a. Domestication processes.

We will explore the domestication process using molecular and quantitative genetics approaches to get insights into life-history constraints on the expression of traits and their response to selection. In algae, there is an additional complication with the change in ploidy level between phases. Current research in our group is focusing on life cycle variations and the fitness differences between haploid and diploid phases in isomorphic haploid-diploid species. We propose to focus more specifically on how selection acts in each phase. We have selected two species in which both approaches are feasible (genetic tools available and species are tractable in the lab): the brown seaweed *Macrocystis pyrifera* and the red seaweed *Gracilaria chilensis.* In this last species, domestication process took place close to wild populations. We will continue to survey the changes in spatial and temporal genetic structure of wild and cultivated populations in order to assess the consequences of domestication on the dynamics of genetic diversity.

b.2.3.b. Environmental risk assessment

We are willing to quantify the potential effect of the earthquake of 2010 on population genetic diversity in two seaweed species *Lessonia spicata* and *Gracilaria chilensis*. In these two species, we did have collected field samples for population genetics analyses before the earthquake event. We will thus compare spatial and temporal genetic diversity before and after the earthquake, in different localities more or less impacted in order to estimate the resilience of both natural (sexually reproducing) and farmed (clonally propagating) populations of *G. chilensis* and in natural populations of *L. spicata*. Source of new migrants and recolonization pattern will be investigated in these two species combining genetics and demography approaches.

b.2.3.c. Genetic resources and environmental impacts

We are willing to pursue the work that was initiated on the dynamics of biodiversity associated to kelp forest. We will explore the link between genetic diversity and species diversity. By sampling the dominant species *L.digitata* for genetic diversity and associated macroalgae species for species diversity, this project will test for connections between these two fundamental levels of diversity. In addition, we will compare several regions around Brittany (including the MPA “Mer d’Oroise” and the southern limit of this species) in order to investigate the effect of harvesting and global changes on these forests. Our data will be also analysed at the scale of Europe in order to implement Ecological Niche Models that aims to evaluate the effect of climate induce changes on the range distribution of this species.

b.3. Educational project of the UMI

The educational project is obviously connected to the scientific project described above and will be developed at the undergraduate and graduate levels. Moreover, one of the main goals of the UMI will be to organize thematic schools, workshop and seminar in both countries. The different partners in Chili and France already have a strong education implication in their own university (at undergraduate and graduate levels). In addition, they have a good experience with international teaching: PUC was involved in the International Master of “Biology of marine organisms”, BIP Master from UPMC whereas the French team was involved in the Erasmus Mundus MSC in “Marine Biodiversity and Conservation”. The UMI EBEA plans to develop an important role in marine education, dealing with phycology, ecology and population genetics.

Considering the "double competence" experimental and theoretical approaches in ecology and genetics, the future teaching investment of the UMI will be focused at the interface between Ecology and Genetics on one hand and Modeling and Mathematics, on the other hand. Most of these teachings are already delivered and will be developed in the future modules of the new five years project of the UPMC, but the ambition of the UMI will be to reinforce the collaboration and stimulate the creation of new modules in partnership within the three universities. The modules of doctoral schools or thematic schools are the opportunity to experiment such teachings, even if they will have authority to be declined, also, at the undergraduate levels.

In addition to the formal education, the contribution of the UMI to the training will be also applied to the supervision of undergraduate and graduate students as well as PhD and postdocs.

Three accredited PhD programs (one in France and two in Chile) will be participating in this UMI. Each research program considers the incorporation of one post-doctoral fellow (each tree years), at least one PhD co-advising student each two years. Besides the research activities related to their graduation requirements (Thesis), the Phd students will be concerned by the mobility between the different Universities involved in the UMI. Specifically, the UMI will stimulate multidisciplinary thesis among programs. The aim of the UMI will be to participate actively to the development of a "Programme doctoral international" within the GDRI network, regrouping 3 countries (Brazil, Chili and France).

c. Implementation of the UMI project

The UMI EBEA will involve three universities (PUC, UACH, UPMC) and the CNRS as direct partners. Among the strength and opportunities of the UMI project, we would like to insist on the fact that the UMI EBEA will integrate perfectly into the projects of the Biological Station of Roscoff (EMBRC France and Europe) and of both Chilean Universities (Fondap project) reinforcing the collaboration between France and Latin America. This project is based on the competences and the infrastructures of these different institutions. The UMI will be officially integrated in the Federation of Research CNRS (FR2424) in Roscoff (Center of Biological Resource), in the department of Ecology of the PUC and in the Facultad de Ciencias of the UACH. The UMI will benefit from the complementary infrastructure of the different institutes in France and in Chili as for example a genomic and bioinformatics platforms in Roscoff and in Santiago, a platform for experimental cultivations of microscopic and juvenile stages in Santiago, culture facilities for larger algae at ECIM (Estación Costera de Investigaciones Marinas, Las Cruces) and Calfuco (the marine biological station of the Universidad austral de Chile), a chemical laboratory for metal analysis in marine organisms and seawater in Santiago, a boat for coastal oceanography and sampling, a long term survey data base of coastal temperature and winds, electronic and confocal microscopy platform in Roscoff and Santiago, a platform for genomics and bioinformatics part of the Core Facility of the UACH.

Many research activities are already funded via several ANR projects or Chilean funding agencies, but we have identified weaknesses and threats that could be overcome by the support of our institutions. In that context, we are asking:

In France to CNRS and UPMC:

- a half-time position for a AI "gestion administrative et valorisation de la cooperation international" that would be shared with the UMR 7144 (see UMR7144 project)
- 75 K€ per year for travel exchanges, consumables and equipment
- Increase space (at least an additional office) in order to be able to house visiting scientist/students/technicians
- A two-years post-doctoral position in statistical modeling of population genetics of non-model organisms

In Chile to PUC and UACH

- a half-time secretary for International collaboration
- A two years post-doctoral position in quantitative genetics
- A half-time position of molecular laboratory technician (Gioconda Peralta)

To facilitate the interactions and communications among researchers we will consider the following activities: 1) meetings/workshops to collaborate on the design and integrated planning of experiments, sharing conceptual developments and results. During the course of the project, we aim to organize a meeting of the UMI at least in each of the three sites (Roscoff, PUC and UACH) with at least 3 representatives (researchers, technicians and students) per sites. Furthermore, e-meetings (using visio-conference) will be stimulated every month to ensure permanent interaction among researchers and to maintain the cohesion of the lab; 2) A web page will include an intranet to provide common documents to share and discuss experimental designs, analysis of data and other critical research developments. The educational project proposed in connection with the UMI and the GDRI is detailed in the previous chapter and is willing to develop an international doctoral program in order to favor exchanges between the doctoral schools.

As it has proven successful during the LIA, the strategy of publication is mostly centered on the activities of shared students (PhDs and Masters, but also undergraduate students). We will integrate post-doctoral fellows to reinforce this strategy. Finally the politics in terms of intellectual properties is defined in the follow the agreement form that will be signed by the different participants to the UMI

ANNEXE

II. Detailed scientific project UMI EBEA

The project is detailed for each of the three research axes presented above. Within each axis, we first present a short chapter about the main achievements that were done by our group during the previous five years before presenting the UMI research project. We also clearly distinguish the theoretical from the empirical aspects.

1. Evolution of sexual reproduction and its consequences

a. Main achievements:

a.1. Theoretical aspects

a.1.1 Effects of diploidy and spatial population structure.

Although many theoretical models have explored the possible benefits of sexual (over asexual) reproduction, most of these models considered haploid organisms (or diploids undergoing random mating). However, a previous model had shown that non-random mating in diploids may have strong effects on selection for recombination (Roze & Lenormand 2005). This may occur for example in partially selfing populations, or spatially structured populations, or even in single populations of finite size (as genetic drift generates a form of inbreeding). These effects have been explored in more detail over the last years, using a combination of analytical and simulation models. For this, a general mathematical framework was elaborated in order to construct multilocus models in structured or finite populations (Roze & Rousset 2008, Roze & Michod 2010). Applications of these methods showed that dominance interactions among alleles tend to disfavor sex and recombination, in finite or structured populations (Roze 2009, Roze & Michod 2010); however, some forms of epistatic interactions among loci (dominance × dominance epistasis) may generate a short-term advantage for sex (Roze 2009). In parallel, a general multilocus individual-based simulation program has been developed, allowing one to test the predictions of analytical models. In the future, we plan to use these analytical and simulation tools to study related questions (evolution of mating systems, evolution of life cycles).

a.l.2 Effects of male-female differentiation on the selection for sexual reproduction.

Male-female differentiation induces a cost for sexual reproduction (the cost of producing males). However, this cost may be compensated by a stronger selection on males (sexual selection) that eliminate more easily deleterious mutations. The notion that sexual selection may favor sex had been proposed verbally in several papers, while other articles compared the mutation load of sexual and asexual females, in the presence of sexual selection (Siller 2001, Agrawal 2001); however, no model had quantified the strength of selection acting on a modifier allele affecting the rate of sex, when selection differs between males and females. We explored this question using a general model that can also include sexually antagonistic selection (Roze & Otto 2012). The model showed that sexual selection may greatly enhance selection for sex, and also that the strength of selection for sex can be written in terms of variables that are in principle measurable (variances and covariances of fitness between sexes).

a.2. Empirical aspects

a.2.1 Geographic parthenogenesis in *Laminaria digitata* (Europe) and sex-ratio variation in *Lessonia nigrescens* (Chile).

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. The capacity for parthenogenetic development of brown algae has been documented in culture, but it is still unknown whether parthenogenesis occurs in nature or what role it might play. We explored this question in the kelp species *L. digitata* that exhibits a broad distribution along the European coast, with the southern limit clearly defined by the population at Quiberon on the Atlantic coast of Southern Brittany. Considering Quiberon as a marginal population, the reproductive system of populations at both the center and the edge of distribution was studied. More precisely, we tested the occurrence of geographical parthenogenesis through combinational approaches including: population genetic analyses, spore flow cytometry,

culture in vitro and microscopy observations. We showed that populations of *L. digitata* at its range limit displays irregular meiosis, a situation that is probably associated with the environmentally unstable conditions that affect the Southern Brittany coast (Oppliger 2010). Furthermore, the marginal population at Quiberon displayed a decreased genetic diversity compared to central populations. Diploid spores developed normally as gametophytes. The full heteromorphic life cycle of kelps was expressed, but without expected change in ploidy. Syngamy, one of the costs of this life cycle, could potentially be eliminated. These results demonstrate the existence of geographical parthenogenesis in marine environments through meiosis modification.

Moreover, we studied sex-ratio variation in two cryptic kelp species of *Lessonia nigrescens*. One locus of chromosomal sex determination generally leads to sex ratios close to 0.5 because of the random segregation of sex alleles (or chromosomes) during meiosis (Bull & Charnov 1988). However, deviation from these expected 0.5 values have been often reported in natural populations and explained by interactions with environmental factors (Zaborski et al. 1988, Guillon & Fievet 2003, Nakamura 2009). In both cryptic species of *L. nigrescens,* we first established that males and females generally occurred in equal proportions in natural populations (Oppliger et al 2011). These results suggest that sex determination is likely controlled by one or few genetic loci (i.e., GSD). We also showed that temperature modulates sex ratio in both species, advocating that there is an interaction between genetic (GSD) and environmental factors (ESD) during the expression of sex. It was further observed that marginal populations of both species displayed significant female excesses as well as the largest variances in sex ratios. This highest sex-ratio variability could be due to the increase of the frequency of deleterious (or lethal) mutations driven by genetic drift (Thomas et al. 2003). Whereas, the highest proportion of females recorded in the transition zone, could thus be the signature of the reduction of genetic variation at the margin compromising its ability to respond to selection. Finally, significant differences in sex ratio were revealed between the two cryptic species when exposed to diverse temperature conditions, demonstrating that these two phylogenetic species also correspond to ecologic species (Oppliger et al 2011).

a.2.2. Selection for clonality and diploidy in *Gracilaria chilensis*.

Gracilaria chilensis belongs to one of the most cultivated seaweed genus around the world. To study the changes in life history traits and genetic diversity due to farming practices we have completed a population genetic study comparing farms and wild populations (European Commission INCO-DEV Programme, coord. B. Kloareg, , collab. M. Valero, J.A. Correa S. Faugeron and M-L. Guillemin). Both phenotypic and genetic observations demonstrated that farmed populations are maintained almost exclusively by vegetative propagation (Guillemin et al. 2008). Moreover, the predominance of heterozygous diploid individuals in farms showed that farming practices had significantly modified life history traits of *G. chilensis* as compared to wild populations in which both haploid and diploid individuals were observed. Advantage of heterozygous diploids could be due to over-dominance and involuntary selection during the ongoing first step of the domestication process. The expected genotypic erosion due to cultivation bottleneck and subsequent clonal propagation was observed in farms. Clonal propagation that has occurred in farmed populations only within a few decades has resulted in massive replication of clonal individuals that can cover hectares of high-density biomass. Strong selection could have occurred at the beginning of domestication of the red alga *G. chilensis*, leading to dramatic changes in the cultivated stands and farmed populations could be threatened in the near future due to the narrow genetic basis upon which domestication is conducted in this alga.

a.2.3 Fitness differences between haploid and diploid phases in isomorphic haploid-diploid species, and the population dynamics of *Gracilaria chilensis*.

A wide variety of haploid–diploid life cycles can be found in different groups of seaweeds, and one of the challenges of biology is to understand how haploid–diploid life cycles have evolved. Several theoretical arguments have been proposed to explain the evolutionary stability of different life cycle strategies (see reviews by Mabble and Otto 1998; Coelho et al. 2007). Hughes and Otto (1999) argued that the stability of haploid–diploid life cycles could be promoted by slight, but ecologically significant, differences between haploid and diploid phases. We have tested this hypothesis using demographic field survey and experimentations in controlled laboratory conditions (FONDECYT 1090360, coord. M-L. Guillemin, collab. J.A. Correa, M. Valero and D. Destombe).

We first investigated the effect of light intensity and salinity on viability and growth of both gametophytes and tetrasporophytes of *Gracilaria chilensis* at different ontogenetic stages: spores, juveniles and adults. The results provide experimental support for the existence of some ecological differences among isomorphic gametophytic and tetrasporophytic individuals (Guillemin et al. 2012). Differences were detected in juveniles and adults exposed to various conditions of light and salinity. In this general context, juvenile gametophytes seem to exhibit a higher tolerance to stress (low salinity) than young tetrasporophytes, whereas adult tetrasporophytes grew faster than female and male gametophytes. These differences between phases could have led to the complete dominance of tetrasporophyte fragments of fronds observed in *G. chilensis* farms (Guillemin et al. 2008). We hypothesize that Chilean fishers could have unknowingly selected for tetrasporophyte thalli during domestication of the species, thus

enhancing the natural trend of tetrasporophytes dominance already present in estuarine natural populations of free-floating plants.

Second, a monitoring of the sex and phase-ratio was achieved for more than two years in two natural populations of *G. chilensis*. Generally, the gametophytes were always highly over-represented and the phase ratios were congruent with the ones aroused by previous models when no fitness difference between the two phases is assumed (Destombe et al. 1989). Differences detected between season and populations could be due to subtle differences in transient population dynamics or differential juvenile survival at these sites. To accurately determine the sex and phase ratio we have developed unequivocal sex-specific molecular markers for *G. chilensis* (Guillemin et al 2012a). The Mendelian segregation of these markers and their correlation to sexual phenotypes was verified in several progenies and suggested the existence of a monogenic sex-determining factor in this species where sex is expressed during the haploid phase. The development of these new sex markers allowed the study of phase and sex ratio for the totality of the sampled individuals, including the immature part of populations.

b. UMI Project:

b.1. Theoretical aspects

b.1.a. Adaptive landscapes, habitat heterogeneity and selection for sex.

Our previous theoretical work will be extended to explore effects of habitat heterogeneity in spatially structured populations. Indeed, the distribution range of many species (marine algae in particular) encompasses very diverse habitats; furthermore, a number of species reproduce sexually in part of their distribution range, and asexually in another part ("geographical parthenogenesis"). We will explore how habitat heterogeneity affects selection for sexual reproduction. Different types of models will be considered: island model with different types of demes, isolation-by-distance models with a gradient in an environmental factor. We will also explore the case where density varies across space, as it has been proposed that higher density may enhance the effect of deleterious alleles (Agrawal & Whitlock 2010), which may in turn affect the mutation load in structured populations (Roze 2012) and possibly selection for sex. Finally, we will consider different models of selection, such as Fisher's geometrical model of adaptation, in which a given number of quantitative traits are under stabilizing selection around an optimum (which may vary over time). Using such a framework, habitat heterogeneity may be represented by different positions of the phenotypic optimum at different spatial locations.

b.1.b. The evolution of life cycles.

Marine algae are characterized by a large diversity of life cycles: haploid life cycles of some green algae (in which the diploid phase is restricted to the zygote), haploid-diploid cycles of many green, brown and red algae, where the diploid sporophyte and the haploid gametophyte may be very different in size (*Laminaria*) or have very similar morphologies (*Gracilaria*), and diploid life cycles of some brown algae (*Fucus*) where the haploid phase is restricted to the gamete. While some previous models (Otto & Goldstein 1992, Otto & Marks 1996) showed that genetic factors (deleterious/beneficial alleles) should destabilize haploid-diploid cycles (and favor either haploid or diploid cycles), other models showed that ecological differences between phases may maintain haploid-diploid cycles (Hughes & Otto 1999). We will explore how genetical and ecological effects may interact, by constructing models that incorporates both types of effects, and studying how ecological differentiation among phases may evolve (ANR Bicycle, coord. M. Cock, collab. D. Roze, M. Valero and C. Destombe; PhD project of Marie Rescan). We will also explore the interactions between the evolution of life cycles and the evolution of sex (how do ploidy and the rate of sexual reproduction coevolve? Is clonal reproduction expected to evolve more easily in the haploid or diploid phase of the life cycle?)

b.1.c. Population genetics of clonal and partially clonal populations.

In collaboration with S. Stoeckel (INRA, Le Rheu) and Sophie Arnaud (Ifremer, Sète), we will develop methods to infer rates of clonal reproduction in natural populations (ANR Clonix, coord. S. Arnaud, collab. M. Valero, C. Destombe, D. Roze and M-L. Guillemin). These methods will be based on single-locus (excess of heterozygosity) and multilocus (linkage disequilibrium) measures, using theoretical models to explore how clonal reproduction affects the distribution of these statistics, and how these may be use for inference. These new methods will be applied to organisms with haploid-diploid life cycles, in *G. chilensis* we will take advantage of an available temporal sampling of asexual farms and sexually reproducing natural populations and new neutral molecular markers will be developed in this species using a genome scan approach (ANR IDEALG, coord. P. Potin, collab. M. Valero, C. Destombe, M-L. Guillemin, S. Faugeron and D. Roze).

b.1.d. Mating system transitions and there genomic consequences.

In collaboration with S. Glémin (CNRS Montpellier) and S. Billiard (Univ. Lille 1), we will use theoretical approaches to study transitions in mating systems and their genomic consequences (ANR TRANS, coord. S. Glémin, collab. D. Roze). More precisely, we will explore how population spatial structure affects mating system evolution – indeed, population structure affects several forces acting on mating systems, such as inbreeding depression and the automatic transmission advantage of self-fertilization; however, no analytical model has explored these effects. We will also study how a transition to self-fertilization affects the evolution of mutation rates and genomic architecture. Results from this project may be used in the future to conduct a genomic analysis of the genus *Fucus*, which comprises dioecious/outcrossing and hermaphroditic/highly selfing species.

b.2. Empirical aspects

b.2.a. Life cycle variations: Balance between haploid and diploid phases and between sexual and asexual reproduction in unicellular algae.

The toxic dinoflagellate *Alexandrium minutum* forms highly resistant cysts, through sexual reproduction, that accumulate locally in the sediment. The study of the balance between sexual (cyst production) and asexual (bloom events) is a crucial parameter to understand the resilience of the contaminated marine coastal ecosystems over time. The high genetic diversity observed in recent blooms in the Rance and the Penzé suggest that this species reproduce mainly by sexual reproduction (ANR Paralex, coord. L. Guillou, collab. C Destombe, S Mauger) and we can ask the question of the role of these resting cysts in this diversity. In modern sediments, this seed bank provides an inestimable living archive, allowing going back to the past by collecting local dormant strains likely adapted to prevailing ancient environmental conditions. Capacity for resting stages of *Alexandrium minutum* to germinate accordingly to their age will be explored using different incubating conditions (varying values of temperature and nutrient levels). Diversity of reminiscent communities will be assessed using different strategies. Moreover, in the collaboration with L. Guillou (UMR 7144, Roscoff) virulence and resistance of the parasites of *A. minutum*, will be tested between different strains of host from different ages (coming from different stratums of sediment) using different strains of parasites from different localities.

Coccolithophores are the most abundant calcifying cells in the ocean and play important roles in carbon cycles because of their photosynthesis and sequestering of organic carbon sinking with the calcite exoskeletons they produce. How coccolithophores may respond to ongoing climate change and ocean acidification due to rising CO_2 levels is of major concern. The most abundant coccolithophore is the cosmopolitan species *Emiliania huxleyi*, which, like other coccolithophores has a haplo-diplontic life cycle alternating between a diploid and a haploid phase, which differ in calcification and motility. A majority of *E. huxleyi* from low latitude open ocean origins have lost essential genes for the haploid phase, appearing to have become asexual, whereas the full haplo-diplontic life cycle, including sexuality, appears to be retained in coastal populations and high latitude populations. These differences are expected to cause differences in the capacity for adaptation to changing environments between coastal and open ocean environments. P. von Dassow will collaborate with ML Guillemin and D. Roze to analyze population genetics of co-occurring sexual and asexual *Emiliania huxleyi* using microsatellites (FONDECYT 1110575, coord. P vonDassow). In parallel, P. von Dassow will use population genomics approaches to understand how the natural acidification/high pCO_2 may exert selection at the genome and individual gene level in this species and whether selection signatures differ between co-occurring sexual and asexual populations.

b.2.b. Spatio-temporal distribution of haploid and diploid phases, and importance of parthenogenesis in population dynamics of *Ectocarpus siliculosus* and *E. crouaniorum*.

In collaboration with A. Peters (Bezhin Rosko, Roscoff) and S. Coehlo (UMR 7139, Roscoff), we have established a spatio temporal sampling design of the two sibling species of *Ectocapus (E. siliculosus and E. crouaniorum*) in order to address the following questions: Are sporophytes and gametophytes found in the same place at the same time or are they characterised by different ecological niches? What is the sex ratio and to what degree does asexual reproduction (parthenogenesis) occur in natural population? (ANR Bicycle, coord. M Cock, collab. M Valero, D Roze, S Mauger, C. Destombe, S Coelho, A Peters). Several hundreds of samples are kelp in culture in order to get enough material to extract DNA. Species identification and occurrence of hybrids are currently checked using bar-coding method (EU Marinexus project, coord. M. Cock, collaboration M. Valero, S. Mauger, C. Destombe, S. Coehlo and A. Peters) in order to determine their distribution on the shore and their potential specificity to algal host. Microsatellite markers are currently developed in several closely related species of *Ectocarpus* from the genetic map of the *Ectocarpus* sequenced strain published by Heesch et al. (2010) by S. Mauger that will be used to study the spatial and temporal variation in genetic structure and the importance of parthenogenesis in the field (post-doct L. Couceiro). In addition, sex markers have been recently developed by S. Ahmed (UMR 7139, Roscoff) allowing to compare the spatio temporal dynamics of sex-ratio and ploidy ratio with the dynamics of genetic diversity.

b.2.c. Experimental evolution of sex and life cycles.

In a longer term, we aim at developing a biological system to perform experimental evolution in the lab (EMBRC, coord. B. Kloareg, FR2424, Roscoff). In this respect, the brown alga *Ectocarpus* offers interesting possibilities, due to its relatively short life cycle and the possibility to generate mutants (by UV or chemical agents); furthermore, some life cycle mutants are already available (Coelho et al. 2012). In collaboration with S. Coelho (UMR 7139, Roscoff), experiments will be carried out in order to test different fitness measures, and compare the performance of lineages with different ploidy levels in different environmental conditions (PhD thesis of Marie Rescan). Other biological systems may also be considered, such as microalgae (*Alexandrium E. huxleyi*) or monogonont rotifers (which alternate between sexual and asexual reproduction). P. von Dassow is already leading research comparing the physiological responses to stresses (nutrient starvation, high pCO_2, and oxidative stress) of haploid, sexual diploid, and asexual diploid strains of *E. huxleyi* (for example, as the host scientist for post-doctoral project FONDECYT 3120014).

2. Understanding speciation processes and the ecological and evolutionary limits to adaptation

a. Main achievements:

a.1. Theoretical aspects

During a previous project (ANR Hi-Flo, coord. N. Bierne CNRS Sète, collab. D. Roze) we studied the accumulation of genetic incompatibilities in parapatry, and the conditions for coupling between different types of incompatibilities: endogenous incompatibilities (with no relation to the environment) and exogenous ones (stemming from adaptation to different habitats). Under isolation-by-distance, these different forms of incompatibilities generate clines in allele frequencies. In some conditions these different clines may become coupled and coincide in space, reinforcing reproductive isolation and promoting speciation (Bierne et al. 2011). We studied the dynamics of this coupling process, and the building of incompatibilities within the genome, using both analytical and simulation methods; this project will be continued over the next years.

a.2. Empirical aspects

a.2.1. Genetic incompatibilities, reproductive isolation and introgression in contact zones between sister species in the Atlantic and the Pacific.

Species complex or species presenting deep genealogical splits that distinguish regional sets of populations across their ranges represent a unique system in which to understand the interplay between population structure, phylogeographical divergence and species limits. Indeed, parapatric margin and hybrid zones have been extensively studied to better understand first, the process of population isolation and divergence and second, the factors that limit present-day gene flow and maintain genetic integrity of divergent entities.

In a recent review on speciation in red algae, Brodie and Zuccarello (2006) have hypothesised that red algae have a high potential to develop rapid reproductive incompatibility because of these unique characteristics. Using molecular markers belonging to the three different genomes we reported the existence of two cryptic species living in sympatry on the Atlantic coast of northern Europe: *Gracilaria gracilis* and *G. dura* (Destombe et al. 2010). The occurrence of "recombinant" cytotypes in individuals collected from Brittany, suggests inter-specific hybridization between these two related species. On the other hand, phylogeographic discontinuities were detected in *Mazzaella laminarioides*, a low-dispersal benthic intertidal red seaweed that inhabits the South Eastern Pacific rocky shore. The three main genetic lineages were distributed along the Chilean coast in strict parapatry (Montecinos et al. in press). The high genetic divergence between lineages and the lack of cytoplasmic incongruence observed lead to the idea that strong reproductive barriers have probably build up and that hybridization should be largely reduced even in the contact zones. However, the presence of hybrids in the contact zones needs to be checked using nuclear codominant markers.

During a previous project (ANR Ecokelp, coord. M. Valero, collab. C Destombe, S. Faugeron, J. Corea) a similar pattern was observed in the kelp *Lessonia nigrescens* for which the two sister species (*L. spicata* and *L. berteroana*., González et al. 2012) are in strict parapatry, with a contact region made of a mosaic of population of either species (Tellier et al. 2009). The parapatric region is located between 30°S and 28°S where a major biogeographic

discontinuity has been proposed (Camus 2001) and strong genetic break has been observed (LIA DIAMS) in several invertebrate species with low dispersal (A. Brante PhD thesis, FONDECYT Phylogeograhic break at 30°S, coord. S. Faugeron). We have shown that there is no hybrid in natural populations of *L. nigrescens* (Tellier et al. 2011) but strong ecological differentiation in both the haploid phase (Oppliger et al. 2012) and the diploid phase (Tellier PhD dissertation; Lopez et al. in press). Interestingly haploid and diploid phases showed opposite patterns of adaptation: whereas the gametophytes of the southern species cannot develop in northern conditions (high temperature), the sporophytes of the northern species are unable to survive in southern sites, but the gametophytes of the northern species and the sporophytes of the southern species are able to survive in both northern and southern conditions. These results highlight the importance of the alternation between haploids and diploids during the process of adaptation and speciation.

a.2.2. Identification of cellular, physiological and molecular mechanisms of response to biotic and abiotic stresses and comparison among species of different levels of tolerance to environmental heterogeneity.

During the past 12 years, within the LIA DIAMS framework, we have been involved in the identification of cellular, physiological and molecular mechanisms of response to biotic (EU-INCO Epifight on G. chilensis, coord. B. Kloareg, collab. J Correa, S Faugeron, P Potin; ANR Ecokelp on the kelps L. digitata and L. nigrescens, resp. M Valero, collab, S Faugeron, P Potin, C Leblanc) and abiotic (FONDAP CASEB, coord. J Correa, collab. L Contreras, P Potin; European Network of Excellence Marine Genomics, collab. P. Potin, J. Correa) stresses in algae. Specifically, we have demonstrated that different environmental conditions can induce an oxidative stress at the cellular level (Contreras et al. 2005, Andrade et al. 2006, Contreras et al. 2009; Contreras-Porcia et al. 2011). In addition, different metabolic pathways - never described in algae or in any other organisms – involved in the attenuation of this oxidative condition have been discovered (Ritter et al. 2008, 2010, Goulitquer et al. 2009, Contreras et al. 2010, Contreras-Porcia et al. 2011a,b, 2012). These studies take advantage of the wide phylogenetic diversity of marine algae to discover many important new genes and metabolic pathways, therefore contributing to the understanding of the genetic bases of phenotypes under critical environmental conditions.

b. UMI Project:

b.1. Theoretical aspects

The theoretical work initiated during the ANR Hi-Flo will be continued during a new ANR project (Hy-Sea, coord. F. Viard, UMR 7144, collab. D. Roze) aimed at studying hybridation in marine species. We will continue investigating the conditions under which different forms of genetic incompatibilities may couple within the genome; in parallel, we will also consider the scenario of a secondary contact between two incipient species which can still form hybrids: under which condition can a stable tension zone be maintained, and the two species remain differentiated? How can we detect footprints of adaptive introgression (the transmission of beneficial alleles from one species to the other) within genomes? The genomic data from different marine invertebrate species (i.e. produced by the different partners of this ANR project) will be used to test theoretical predictions. We will see in a longer term if some genomic data are produced in algae within the UMI framework if they could also be used to test these predictions

b.2. Empirical aspects

b.2.1. Cryptic speciation within and between major ecological/biogeographic transitions.

Marine intertidal seaweeds have characteristics that make them particularly susceptible to neutral processes of genetic differentiation. In these species, low dispersal capacity and small population sizes associated to habitat fragmentation could have led to the observed phylogeographic discontinuities, suggesting that genetic drift may be the major determinant of speciation process (Irwin 2002, Kuo and Avise 2005). Along the Chilean coast, unstable habitats and repeated local extinctions — due to ENSO events and/or to coastal uplift resulting from mega-thrust earthquakes — could be at the origin of the rapid divergence process between the *Mazzaella laminarioides* lineages (Montecinos et al. in press). We are willing to explore this hypothesis more in details using microsatellite loci that have been recently developed. The aim is to estimate long-term rates of gene flow between lineages in parallel with effective population sizes to better understand the divergence process (Hey 2006, Pinho and Hey 2010).

In the southern part of the Pacific Ocean, repeated local extinctions are also probably occurring to the cyclical dynamic of ice shelf. Repeated shifts in the distribution of species, with small fragmented populations isolated in refugia during glacial maxima, could have translated in high rate of allopatric speciation or intraspecific lineage divergence in several Antarctic ecosystems (the taxonomic diversity pump, Clarke and Crame 1992). Antarctica has

retained a highly endemic marine flora (Wiencke and Clayton 2002). However, even if the exploration of Antarctic seaweeds has begun more than 200 years ago, our knowledge of the diversity of the southernmost located seaweeds is still very incomplete (Hommersand et al. 2009). Using a barcoding approach and molecular phylogenetic /phylogeographic analyses, we will characterize patterns of species and genetic biodiversity of seaweeds within different Antarctic sub-regions (INACH T16-11, coord. M-L. Guillemin, collab. A. Mansilla UMAG Chile and B. de Reviers and L. Le Gall MNHN France).

b.2.2. Genetic incompatibilities, reproductive isolation and introgression in contact zones between sister species

b.2.2.1. Origin of heteroplasmy in *L. spicata* and its role in the evolution of reproductive isolation (S Faugeron, M Valero)

A surprising feature of the marginal populations of *L. spicata* is the existence of apparent heteroplasmy of mitochondrial markers which form new and highly divergent clades never observed in any other individuals of both the northern and the southern species (Tellier et al. 2011). One of the hypotheses that could explain this pattern is the existence of a selective advantage in the form of a genetic incompatibility between genomes. This is possible if the duplicated but divergent sequence is located in the nucleus (Richly and Leister 2004). Crossing experiments combined with mitochondrial and nuclear genotyping will be used to test this hypothesis.

b.2.2.2. Changes in the mating system in contact zones between sister species and its role in the persistence of parapatric distribution L*essonia* spp and Mazzaella spp, (M Valero, C Destombe, S Faugeron, ML Guillemin)

In parallel, we will continue with the investigation on changes in the mating system in contact zones between sister species and its role in the persistence of parapatric distribution. The two main models in Chile will be *Lessonia spp and Mazzaella spp*, whereas *Fucus spp* will be considered in France (EU Assemble project, coord. B. Kloareg, FR2424, Roscoff). This work will involve a better characterization of the changes, including the genetic process of the parthenogenesis, and detailed population genetic inferences of the mating system in contact zones (currently under progress with the Master thesis of L. Jaugeon).

b.2.2.3. Genetic of speciation (M. Valero, M-L Guillemin in collaboration with A. Peter)

The aim is to exploit the genomic and genetic tools that are being developed for the model brown alga *Ectocarpus* to study the genic basis of speciation in this species complex. The intertidal filamentous alga *Ectocarpus siliculosus* is a model organism for the genetics and genomics of brown algae (Peters et al, 2004, Cock et al., 2010). It has a cosmopolitan distribution but recent systematics and taxonomy studies, based on a worldwide collection demonstrated that *Ectocarpus* is a complex of closely related species separated by various degrees of inter-sterility. In particular hybridization between *E. siliculosus* and *E crouaniorum* was documented both in France and Chile (Peters 2010 a, b). The species complex of *Ectocarpus spp* is thus a unique candidate for studies of genetics and genomics speciation.

It is proposed to combine detailed analyses of gene flow across natural hybrid zones with the study of speciation that will be obtained from genetic studies of reproductive isolation in the laboratory during the Phd Thesis of A. Montecinos ("co-tutelle" UPMC / UACH, beca de Chile). We will use and complete the collection of Ectocarpus strains (EU Marinexus project, coord M. Cock, UMR 7139, Roscoff and EMBRC Project, coord. B. kloareg, FR2424, Roscoff). The sampling strategy is to sample across environmental gradient at different spatial scale. This strategy will be replicated in very distinct geographical region (France and Chile). For the first step of the study, all tools are available. The aims will be to measure and compare the importance of hybridization in contact zone (using a set of microsatellite loci already available) and in controlled crosses in the laboratory (the life cycle can be completed in 3 months). In a second step, next generation sequencing (NGS) methods will be used for locating chromosomal regions contributing to reproductive isolation (comparison among species) and to adaptative divergence (comparison among strains along environmental gradients). The tools necessary to complete this second objective will be developed within the framework of the ongoing ANR project IDEALG (coord. P.Potin, UMR 7144, Roscoff).

b.2.3. Environmental heterogeneities and their consequences on local adaptation: biotic and abiotic interactions.

Understanding the bases of evolutionary adaptations has recently received a renewed interest thanks to the development of genome wide markers by massive genomic sequencing. These markers can be used to estimate de relative roles of selection and migration-drift on the patterns of population genetic diversity. They also allow to detect markers associated to traits (i.e. QTL) such as those involved in the response to oxidative stress, and to

fitness. We will combine experimental ecology to measure traits and fitness of different genotypes in different environmental conditions with NGS markers (Post-doc to be hired) to investigate the molecular bases of adaptation and the balance between evolutionary forces. Part of this research will be developed within the framework of the study of domestication (see below, in the framework of the ANR IDEALG), i.e. the adaptation to cultivation conditions. This will allow a fine control of environmental conditions and the appropriate phenotyping of the candidates for mating and the progenies, and ultimately will allow to obtain a physical linkage map of the SNP identified by RAD sequencing. The main model will be *Macrocystis pyrifera* in a first instance, and eventually *G. chilensis*. Natural heterogeneities of the transitions across biogeographic transitions, as well as those observed in the region of Magellan (exposed Pacific islands, channels, glacier estuaries, inner seas, the transition between the Magellan strait and the Atlantic conditions) are the main environmental models to test the balance between selection and migration-drift.

3. Domestication, management of genetic resources, and environmental impacts

a. Main achievements:

a.1. domestication

Seaweed aquaculture has been developed primarily in Asia, particularly in Japan, Korea, and China, with new countries, including Chile, building up important seaweed farming operations only recently. However, knowledge about domestication process is very limited in these species. We have recently addressed this question in the red alga G*racilaria chilensis* (Guillemin et al 2008), This seaweed was a very good material to address such question since: 1) the history of domestication was well documented and very recent (35 years ago); 2) the effect of domestication in haploid-diploid species were never addressed before and 3) most of the knowledge of domestication comes from sexually reproducing rather than from clonally propagated species. Our results showed that cultivation significantly modified important life-history traits of the alga with the selection for diploidy in farmed populations. In addition, we established that strong reduction in genetic diversity occurred in clonally propagated farmed populations and we propose that involuntary selection could operate during the ongoing first step of the domestication process. These consequences of farming practices and their evolutionary implications are stimulating areas of research that we are willing to pursue in the UMI project.

a.2. kelp biodiversity and conservation issues

The goal of the ANR ECOKELP (coord. M. Valero) was to utilize a multidisciplinary approach in order to better understand the dynamics and to predict changes in biodiversity of these forests, and to evaluate their environmental, economic and social impacts. The challenge of this project was to raise awareness among a large public about the problems of resource management and conservation issues, using kelps as a model system of cold-temperate coastal waters.

A network of collaborations was built around this topic at different scales: regional (Station Biologique de Roscoff, between UMR7144, UMR7139 and FR2424), national (Marine Station of Wimereux) and international (Chile and Portugal). The network grouped scientists from different disciplines with industrials, stakeholders, managers (Parc Marin de la Mer d'Iroise) and NGOs of environmental protection (supported by the “Pole de compétitivité Mer-Bretagne”).

The project Ecokelp opened new perspectives for research on various fundamental aspects of biology and ecology, such as the discovery of remote signaling mechanisms thus far unknown, which could play a role in the ability of algae to resist environmental stresses (Thomas et al. 2011). This project also represents the first study of ecosystem services provided by marine algae, an issue which has managed to unite a partnership both regionally and internationally and is the source of new projects (such as the ANR IDEALG). Finally, in the context of creating the first marine park, Ecokelp provided basic knowledge needed for the delineation of Marine Protected Areas (Couciero et al. in press) and for sustainable management of marine resources (Valero et al. 2011), and also pointed out the need for reliable early warning systems for marine invasive species (Grulois et al. 2011).

b. UMI Project:

b.1. Domestication processes.

b.1.1. The evolutionary consequences of domestication in *G. chilensis*.

Domestication, as an evolutionary process dominated by adaptations to artificial conditions, not only modifies the expression of phenotypes of interest, but also leaves a genetic signature that affects both the genome structure and the genetic diversity of the domesticated species. Among the research lines currently in progress in our group is the domestication history of the red alga *G. chilensis*. We will pursue this research line by investigating the loss of sexual function due to extensive clonal propagation and will examine how clonal propagation, via increasing genetic drift may influence the outcome of domestication in *G. chilensis*. The role of mating system in the domestication process will be investigated through population genetics approaches by studying clonal and partially clonal populations *G. chilensis* (ANR IDEALG, collaboration with ML Guillemin, M. Valero and F. viard)

b.1.2. Development of a quantitative genetics of haploid-diploid life cycles

Transitions between phases are assumed to break developmental links between traits in the different phases of a complex life-cycle and thereby allow haploid and diploid phases to adapt independently. This offers important potential for the domestication of marine algae by allowing the selection of traits for different purposes across the developmental stages: whereas the final product of a cultivated species is usually in the adult phase, the handling of the alternate phase is fundamental to reduce the life cycle, to improve the survival and efficiency of the transition between phases. There are incipient evidences that life history stages can be genetically coupled, i.e. selection efficiency on a trait will depend on the genetic variance of this trait and on the co-variance across life-cycle stages (Marshall and Morgan 2011).

We will investigate the heritabilities of selected traits (based on our work in ANR IDEALG, INNOVA BAL-BIOFUELS, coord. A Buschmann, Univ. los Lagos, collab. S Faugeron, M Valero, C Destombe, ML Guillemin, with P. Boudry) and specifically test the role of alternation of life cycle phases. Although heritability is a central parameter in quantitative genetics because it determines the response to selection, its estimation in marine species with complex life cycles remains unclear and understudied (Marshall and Morgan 2011). Following Fellous and Lazzaro (2011) we aim at developing in the near future (i.e. within 3-4 years) integrated approaches of molecular and quantitative genetics to get insights into life-history constraints on the expression of traits and their response to selection. In algae, there is an additional complication with the change in ploidy level between phases. Current research in our group is focusing on life cycle variations and the fitness differences between haploid and diploid phases in isomorphic haploid-diploid species. We propose to focus more specifically on how selection acts in each phase and how phases are related, to predict how domestication should lead to adaptation to cultivation conditions.

b.2. Genetic resources and environmental impacts)

b.2.1. kelp biodiversity and conservation issues

We are willing to pursue the work that was initiated on the dynamics of biodiversity associated to kelp forest. We will explore the link between genetic diversity and species diversity. By sampling the dominant species L.digitata for genetic diversity and associated macroalgae species for species diversity, this project will test for connections between these two fundamental levels of diversity (PhD of Marine Robuchon). In addition, we will compare several regions around Brittany (including the MPA “Mer d’Iroise” and the southern limit of this species, Project in collab with MPA, L. LeGall, MNHN Paris and M; Valero) in order to investigate the effect of harvesting and global changes on these forests. Our data will be also analysed at the scale of Europe in order to implement Ecological Niche Models that aims to evaluate the effect of climate induce changes on the range distribution of this species (Biomare project, coord. G. Beaugrand, Univ Lille, collaboration with M. Valero, C. Destombe, F. Gevaert and D. Davoult). In addition, they will serve to establish a European data base on the status of kelp forests in european coats (Knowledge Network for EUropean expertise on biodiversity and ecosystem services, Kneu EU Network Euromarine).

b.2.2.Effects of major perturbations (ENSO; Earthquakes and tsunamis) on genetic diversity

Genetic variation may be particularly important in environments with high levels of natural and anthropogenic disturbances and rapid changes, where evolution must also be rapid if a population is to persist (Lande & Shannon 1996). These genetic changes could potentially affect the viability of populations and there is strong evidence suggesting that the absence of genetic variation may increase the risk of extinction in wild populations (Spielman et al. 2004). The capacity of populations to respond and recover from genetic disturbances is called genetic resilience,

which, at last, determines the survival probability of populations and an ecosystem's ability to recover following disturbance events (Reusch et al. 2005).

Earthquakes and tsunamis occur relatively frequently along the Chilean coast and these dramatic events could lead to massive mortalities in the intertidal communities of sessile organisms. These dramatic events have been reported after the 1835 earthquake by Darwin (1839) and have been observed again in 1985 (Castilla et al. 1988) and 2010 (Castilla et al. 2010). In the Biobío Region, the mega earthquake of February 2010 has strongly affected the landing of cultivated and exploited algae. While the landing of *Lessonia spicata* (formerly *L. nigrescens*, Gonzalez et al. 2012) have decreased by 90% from 2009 to 2010, the total landing of *G. chilensis* have decreased by more than 40% and a massive mortality caused by the coastal uplift (1.8 m) and the tsunami (7.8 m; Fritz et al. 2011) have dramatically affected one of the main sources of economic activity of various fishing villages in the region (Castro et al. 2010). We are willing to quantify the effect of the 2010 earthquake and tsunami on population genetic diversity of two macroalgae and evaluate their genetic resilience. We will compare temporal and spatial genetic diversity of *L. spicata* and *G. chilensis*, before and after the tsunami, in localities presenting a different level of impact. A proposal for funding this unique opportunity to significantly advance our understanding on the temporal response of biological systems to large-scale natural perturbations has been submitted to FONDECYT (Coord. A. Brante, Collab. M-L. Guillemin and M. Valero).

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Peters, A.F., van Wijk, S., Cho, G.Y., Scornet, D., Hanyuda, T., Kawai, H., Schroeder, D.C., Cock, J.M. & Boo, S.M. (2010b). Reinstatement of E. crouaniorum Thuret in Le Jolis as a third common species of Ectocarpus

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Tellier F, Meynard AP, Correa JA, Faugeron S, Valero M. (2009). Phylogeographic analyses of the 30°S south-east Pacific biogeographic transition zone establish the occurrence of a sharp genetic discontinuity in the kelp Lessonia nigrescens: Vicariance or parapatry? Molecular Phylogenetics and Evolution 53(3):679-693.

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agence d'évaluation de la recherche et de l'enseignement supérieur

Adaptation et Diversité en Milieu Marin
2.3. Fiche individuelle d'activité
VALERO Myriam

Unité de recherche d'appartenance en 2012 : *(label et n°, intitulé, établissement principal, responsable)* UMR 7144 Adaptation et Diversité en Milieu Marin UPMC François LALLIER	**Unité soumise à une reconnaissance prenant effet 1er janvier 2014 :** *(intitulé, établissement support, responsable)* Unité Mixte Internationale Evolutionary Biology and Ecology of Algae Myriam Valero

Nom : Valero
Prénom : Myriam
Date de naissance : 18/09/1957
Courriel : valero@sb-roscoff.fr

Établissement d'affectation ou organisme d'appartenance : CNRS

Enseignant-chercheur	☐	Thèse soutenue	☐	HDR	☐	Corps-grade :
Bénéficiaire de la PES :	☐					
Membre IUF junior	☐					
senior	☐					
Chercheur	■	Thèse soutenue	■	HDR	■	Corps-grade : DR2
Ingénieur	☐	Thèse soutenue	☐	HDR	☐	Corps-Grade :

Cadre scientifique ou autre personnel ayant une activité de recherche :

Préciser :		Thèse soutenue	☐	HDR	☐	Corps grade :

Situation particulière :
(délégation, détachement, mise à disposition, etc.)

Domaine scientifique principal :

☐ 1 Sciences de l'homme et de la société
☐ 2 Sciences et technologies
■ 3 Sciences de la vie et de l'environnement

Rattachement scientifique :

Section du CNU : 67

ou

Département(s) scientifique(s) et/ou commissions spécialisées d'un organisme : INEE / Section 29

1) Points forts des activités de recherche et résultats marquants :

Mes activités de recherches peuvent se résumer par les 5 grands points suivants :

1) Isolement reproducteur, spéciation et phylogéographie chez les Fucales : collaboration avec Ester Serrao de l'Université d'Algarve, Faro, Portugal (cotutelle des thèses d'Emmanuelle Billard (2007) et Joao Neiva (2012)) et avec Jeanine Olsen de l'Université de Groningen, Pays-Bas (articles : Billard 2010, Coyer 2011, Neiva 2010, Neiva 2012 a,b, Olsen 2010).
2) Différenciation génétique et écologique entre espèces cryptique au sein d'une zone de transition biogéographique : collaboration dans le cadre du LIA DIAMS avec Sylvain Faugeron de la Pontificia Universidad Catolica de Chile, Santiago, Chili (cotutelle de la thèse de Florence Tellier (2009)) (Tellier et al. 2009, 2011 ; Oppliger 2011,2012)
3) Importance des effets anthropiques sur le maintien de la biodiversité en milieu côtier effet de l'exploitation et du changement global sur les champs de laminaires : coordination du projet ANR ECOKELP impliquant des partenaires étrangers (Portugal et Chili) (Co-tutelle avec Ester Serrao, Univ Algarve, de la thèse de Tania Pereira en cours) ainsi que l'Agence des Aires Marines Protégées (co-direction de la thèse de Marine Robuchon avec Line Le Gall , MNHN, en cours). Ces travaux ont donné lieu à la publication d'un numéro spécial de la revue « Cahiers de Biologie Marine » sur « Biological and social aspects of kelp sustainability » en 2011.
4) Maintien des cycles de vie haploïde –diploïde : importance de la différence de niches entre individus haploïdes et diploïdes, système de reproduction et conséquence sur la structure génétique des populations chez l'algue rouge

haplo−diploide *Chondrus crispus* (collaboration dans le cadre du LIA DIAMS avec Juan Correa de la Pontificia Universidad Catolica de Chile, Santiago, Chili, co-tutelle de la thèse de Stacy Krueger(2011)) et chez l'espèce modèle d'algue brune *Ectocarpus siliculosus* (partenaire de l'ANR Bicycle) (Coehlo et al., 2007 ; Krueger et al., 2011)

5) Effet de la *domestication* sur les traits d'histoire de vie chez une algue:sélection involontaire pour la diploïdie chez Gracilaria chilensis (Guillemin et al., 2008).

6) Production scientifique :

Ma production sceintifique s'est traduite par la publication de 26 articles dans des revues indexes, 40 communications ou posters dans des congrès, la redaction d'un chapitre de livre et l'édition d'un numéro spécial de revue. Je ne présente ici que les principaux articles correspondants aux 5 points listés ci-dessus :

1) Coelho S., Peters A.F., Charrier B., Roze D., Destombe C., Valero M. & Cock J.M. (2007)**.** Complex life cycles of multicellular eukaryotes: new approaches based on the use of model organisms, *Gene.* 406, 152-170..
2) Guillemin M−L., Faugeron S., Destombe C., Viard F., Correa J. A., Valero M. (2008). Genetic variation in wild and cultivated populations of the aploid−diploid red alga Gracilaria chilensis: how traditional farming practices favour asexual reproductionand heterozygosity. Evolution 62: 1500−1519
3) Tellier F., Meynard A. P., Correa J. A., Faugeron S., and Valero M. (2009). Phylogeographic analyses of the 30°S south-east Pacific biogeographic transition zone establish the occurrence of a sharp genetic discontinuity in the kelp *Lessonia nigrescens:* Vicariance or parapatry? *Molecular Phylogenetics and Evolution* **53:** 679–693.
4) Billard E., Serrão E., Pearson G., Destombe C., and Valero M. (2010). Fucus vesiculosus and spiralis species complex: a nested model of local adaptation at the shore level. *Marine Ecology Progress Series* **405:** 163-174.
5) Neiva J., Pearson G. A., Valero M., and Serrão E. A. (2010). Surfing the wave on a borrowed board: range expansion and spread of introgressed organellar genomes in the seaweed *Fucus ceranoides* L. *Molecular Ecology* **19:** 4812-4822.
6) Olsen J. L., Hoarau G., Coyer J., Stam W., Valero M., and Åberg P. (2010). The phylogeographic architecture of the fucoid seaweed *Ascophyllum nodosum*: an intertidal "marine tree" and survivor of more than one glacial-interglacial cycle. *Journal of Biogeography* **37:** 842-856.
7) Coyer J. A., Hoarau G., Costa J., Hogerdijk B., Serrão E., Billard E., Valero M., Pearson G., and Olsen J. (2011). Evolution and diversification within the intertidal brown macroalgae *Fucus spiralis/F. vesiculosus* species complex in the North Atlantic. *Molecular Phylogenetics and Evolution* **58:** 283–296.
8) Krueger-Hadfield S. A., Collén J., Daguin-Thiébaut C., and Valero M. (2011). Distinguishing among genets and genetic population structure in the haploid-diploid seaweed *Chondrus crispus* (Rhodophyta). Journal of Phycology, **47 :** 440–450
9) Oppliger V. L., Correa J. A., Faugeron S., Beltrán J., Tellier F., Valero M., and Destombe C. (2011). Sex ratio variation in the Lessonia nigrescens complex (Laminariales, Phaeophyceae): effect of latitude, temperature and marginality. *Journal of Phycology* **47:** 5-12.
10) Tellier F., Tapia J., Faugeron S., Destombe C., and Valero M. (2011). The *Lessonia nigrescens* species complex (Laminariales, Phaeophyceae) shows strict parapatry and complete reproductive isolation in a secondary contact zone. *Journal of Phycology* **47**: 894–903
11) Neiva J., Pearson G. A., Valero M., and Serrão E. A. (2012). Drifting fronds and drifting alleles: range dynamics, local dispersal and habitat isolation shape the population structure of the estuarine seaweed *Fucus ceranoides* L. *Journal of Biogeography*, 39: 1167-1178
12) Neiva J., Pearson G. A., Valero M., and Serrão E. A. (2012). Fine-scale genetic breaks driven by the colonization past and present density barriers in the estuarine seaweed *Fucus ceranoides* L *BMC Evol. Biol*, 12: 78. doi:10.1186/1471-2148-12-78
13) Oppliger V., Correa JA, Engelen A., Tellier F., Vieira V., Faugeron S., Valero M , Gomez G., Destombe C. (2012). Temperature effects on gametophyte life-history traits and geographic distribution of two kelp cryptic species. *PLoS ONE* 7(6): e39289. doi:10.1371/journal.pone.0039289
14) Frangoudes K., Valero M. (2011) Guest Editors Cahiers de Biologie Marine, special issue « Biological and social aspects of kelp sustainability », 2011, volume 52, issue 4 pp 365−527.

3) Points forts des activités ne relevant pas de la production scientifique :

Rayonnement et attractivité académiques

- 4 séminaires ou conférences invitées
- Membre de l'editorial board de la revue « Journal of Applied Phycology »
- Reviewer pour de nombreuses revues
- Rapporteur 6 jurys HDR et 4 jurys de thèse
- Participation en tant qu'invitée à la première école internationale Daniel Jouvance – UPMC sur la Biologie Marine, Las Cruces, Chili, 16 −26 Janvier 2011

Interactions avec l'environnement social, économique et culturel ;

- 2 conférences invitées pour débat-public sur suivi et surveillance des forêts de laminaires » Thalado « Le comptoir des algues », Roscoff et Océanopolis, Brest
- Participation à des réunions / Table ronde sur la gestion des ressources algales, invitée par la Chambre Nationale Syndicale des Algues Marines et/ou le Parc Marin Mer d'Iroise
- Interview publiés dans plusieurs journaux régionaux et nationaux (Sciences et Vie, Science Ouest)
- Stands d'exposition et animations scientifiques (Nuit des chercheurs, Année Darwin, Grenelle de la Mer etc..)

Formation par la recherche ;

Encadrement de 3 étudiants en Master II :

- LAMY T 2008. Histoire de l'aire de distribution de Saccorhiza polyschides (Lightfoot) Batters:Importance des facteurs historiques et des flux géniques actuels. Master 2, Sciences de l'Univers, Environnement et Ecologie spécialité Océanographie et Environnements Marins, Université Pierre et Marie Curie.
- JAUGEON L. 2012. Les populations en limite d'aire de répartition font-elles moins de sexe ? Le cas de l'algue brune Lessonia nigrescens le long des côtes chiliennes. Master 2. Océanographie Biologie Ecologie Marines, Université de la Méditerranée Aix-Marseille II, (co-direction avec C. Destombe).
- KLEM A. 2012. Variation spatio-temporelle de la diversité génétique des populations sauvages et cultivées chez une algue rouge : effet du récent tremblement de terre de Février 2010 le long des côtes chiliennes. Master 2, Sciences de l'Univers, Environnement et Ecologie spécialité Océanographie et Environnements Marins, Université Pierre et Marie Curie.(Co-direction avec ML Guillemin, UACH : Chili)

Co-encadrement de 6 étudiants en Thèse (4 soutenues et 2 en cours) :

- BILLARD E. 2007. Evolution des systèmes de reproduction et leur implication dans les processus de spéciation et hybridation chez les algues brunes du genre Fucus. Thèse de doctorat en co-tutelle entre UPMC et Univ. Algarve, (co-direction 50% avec Ester Serrao) financement Centre des Sciences Marines, Ecole Doctorale Diversité du Vivant UPMC. Soutenue le 9 Novembre 2007.
- TELLIER F. 2009. Effet des changements environnementaux historiques et contemporains sur la diversité de deux algues brunes : analyse écologique et génétique des zones de transitions et de l'effet d'El Niño le long des côtes chiliennes. (Thèse financée par une bourse MRT en cotutelle entre UPMC et PUCh, co-direction 50% avec Sylvain Faugeron, Ecole Doctorale Diversité du Vivant UPMC. Soutenue le 10 Juillet 2009.
- KRUEGER S. 2011. Population structure in the haploid-diploid marine red alga, Chondrus crispus: mating system, genetic differentiation and epidemiology (financement ARED Région Bretagne – CNRS). : en cotutelle entre UPMC et PUCh, Ecole Doctorale Diversité du Vivant UPMC (co-Dir M. Valero & J. Correa) . soutenue le 17 Octobre 2011.
- NEIVA J. (2012) (Dir. E. Serrao & M. Valero; financement Centre des Sciences Marines, Université d'Algarve). Synchronous gamete release by fucoid algae in the intertidal zone: fertilization success and beyond (co-tutelle : Université d'Algarve- UPMC, Ecole Doctorale Diversité du Vivant UPMC). Soutenance fixée en Mai 2012.
- PEREIRA T. (2009-2012) (Dir. E. Serrao & M. Valero; financement Centre des Sciences Marines, Université d'Algarve). Population demography of two laminarian species in marginal and central populations (co-tutelle : Université d'Algarve- UPMC, Ecole Doctorale Diversité du Vivant UPMC). Soutenance prévue Dec 2012
- REBUCHON M. (2011-2014) (Dir L. Le Gall & M. Valero ; financement bourse MRT, ecole doctorale MNHN. Étude spatio-temporelle de la diversité des macroalgues marines des côtes françaises atlantiques : développement d'indices de suivi de la biodiversité

Autres (encadrement ou co-cadrements de 7 autres types de stagiaires) :

- REBUCHON M., stage première année apprentissage sur analyse de la diversité génétique de populations de Laminaria digitata en limite d'aire de répartition et comparaison à des populations en centre d'aire de répartition (AgroParisTech, Juin-Dec 2009).
- DIJOUX L. Etude démographique de l'algue rouge *Chondrus crispus***,** Master 1, Sciences de l'Univers, Environnement et Ecologie spécialité Océanographie et Environnements Marins, Université Pierre et Marie Curie.(Co-direction avec S. KRUEGER, Avril-Juin 2009)
- REBUCHON M., stage deuxième année apprentissage sur la recherche des locus du déterminisme du sexe chez l'algue brune Ectocarpus (co-encadrement avec Susana Coelho, AgroParisTech, Juin-Dec 2010.
- CAHN J., stage de césure INAPG Génétique du paysage et effet du séisme sur la structure des populations intertidales d'une algue haploïde-diploïde, Gracilaria chilensis (AgroParisTech, Juin-Dec 2010 (co-encadrement avec Marie-Laure Guillemin, UACH, Chili).
- HUNSPERGER H., Structure génétique des populations d'Ectocarpus siliculosus en Manche. Stage de Recherche dans le cadre des accords entre National Science Foundation's International Research Experiences for Students (NSF IRES) et le CNRS (School of Oceanography, University of Washington, Seattle, USA : Sept-Nov 2011, co-encadrement avec A. Peter)
- BOIS-ROBERT A. Etude de la biodiversité algale des forêts de laminaires des côtes bretonnes : variations saisonnières, historiques et développement d'un indicateur de biodiversité. Ecole Supérieure d'Agriculture d'Anger, Janv-Mars 2012, co-encadrement avec M. Rebuchon.
- BILLON, L. La consanguinité chez l'algue rouge Chondrus crispus est-elle le résultat d'une dispersion groupée des spores méiotiques ? Master 1,, Sciences de l'Univers, environnement, écologie, spécialité Environement, biodiversité et Ecologie Université Pierre et Marie Curie.(Co-direction avec C. Destombe, Avril-Juin 2012)

Responsabilités administratives et scientifiques

- Responsable de l'équipe « BEDIM » au sein de la station Biologique de Roscoff;
- Coordination de l'ANR ECOKELP (ANR06-BDIV-012) montant total 600 k€ Ce projet fait intervenir 5 partenaires français et deux étrangers (E.Serrao au Portugal et S. Faugeron au Chili, 2007-2010). Participation à 3 ANRs: ANR Biodiversité Paralex (2009−2013); responsable WP3 dans ANR Blanche "Bicycle" (2011−2013), responsable WP2 dans ANR Bioressource IDEALG (2011−2021) Responsable du Projet Jeli dans appel Biodiversité du Vivant (MNHN) Co−Responsable projet "biodiversité des algues marines" dans le cadre de la convention avec le Parc Marin Mer d'Iroise (2011−2012) Participation à deux projets européens: participation au WP13 dans Projet Infrastructure I3 « ASSEMBLE » FTP7 (Mars 2009−Fev 2013) et dans WP4 dans projet INTERREG IV A France (Manche) – Angleterre «Marinexus », (Janv 2010− Dec 2013)
- Membre élu du comité National du CNRS Section 29.
- Co-Responsable avec Juan Correa du Laboratoire International Associé : Dispersal and Adaptation in Marine Species «DIAMS ».
- Expertise pour le financement de projets de recherche niveau national (AERES) et international (Advisory board CASEB, Chili)

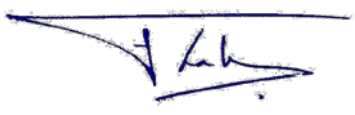
Signature de la personne concernée par cette fiche d'activité

Je certifie n'avoir demandé mon rattachement qu'à une seule unité de recherche.

Date : 13 Juillet 2012 Signature :

Signature du responsable de l'unité de recherche d'appartenance en 2012

Date : 31/08/2012 Signature :



agence d'évaluation de la recherche et de l'enseignement supérieur

Pontificia Universidad Católica de Chile

2.3. Fiche individuelle d'activité

CORREA Juan

Unité de recherche d'appartenance en 2012 : *(label et n°, intitulé, établissement principal, responsable)* Departamento de Ecología, Facultad de Ciencias Biológicas, Pontificia Universidad Católica de Chile.	**Unité soumise à une reconnaissance prenant effet 1er janvier 2014 :** *(intitulé, établissement support, responsable*) Unité Mixte Internationale Evolutionary Biology and Ecology of Algae Myriam Valero

Nom : Correa
Prénom : Juan
Date de naissance : 4 october 1955
Courriel : jcorrea@bio.puc.cl

Établissement d'affectation ou organisme d'appartenance : Pontificia Universidad Catolica de Chile

Enseignant-chercheur	■	Thèse soutenue	■	HDR (Equivalent)	■	Corps-grade : Professeur Titulaire
Bénéficiaire de la PES :	☐					
Membre IUF junior senior	☐ ☐					
Chercheur	☐	Thèse soutenue	☐	HDR	☐	Corps-grade :
Ingénieur	☐	Thèse soutenue	☐	HDR	☐	Corps-Grade :
Cadre scientifique ou autre personnel ayant une activité de recherche : Préciser :		Thèse soutenue	☐	HDR	☐	Corps grade :

Situation particulière :
(délégation, détachement, mise à disposition, etc.)

Domaine scientifique principal :

☐ 1 Sciences de l'homme et de la société
☐ 2 Sciences et technologies
■ 3 Sciences de la vie et de l'environnement

Rattachement scientifique :

Pontificia Universidad Católica de Chile

1) Points forts des activités de recherche et résultats marquants :

Mes activités de recherches portent essentiellement sur les intéractions entre les algues et leur environement biotique et abiotique. Durant les 10 dernières années, essentiellement dans le cadre du programme FONDAP Center for Advanced Studies of Ecology and Biodiversity et du LIA-DIAMS, ces activités se sont concentrées sur les effets de perturbations majeures de l'environnement sur la biodiversité marine. Elles peuvent se résumer par les 3 grands points suivants :

- Effets de la pollution côtière par les métaux lourds (en particulier du cuivre émis par les activités minières) sur la biodiversité marine intertidale (macroalgues, invertébrés et micro-organismes), et sur les interactions entre espèces (interactions algues-bactéries en particulier).
- Réponses physiologiques et moléculaires des algues a la pollution aux métaux lourds et comment celles-ci permettent d'expliquer les patrons de biodiversité associés à la pollution, en analysant en particulier les différences entre espèces tolérantes et sensibles.

- Effets de l'aquaculture sur les algues cultivées, à la fois sur l'algue elle-même (processus de domestication) et sur ses interactions avec les épiphytes.

Ces activités m'ont permis d'acquérir une bonne expérience dans l'étude des réponses au niveau biochimique et moléculaire des algues au stress d'origine biotique et abiotique pour une vaste diversité d'algues marines.

2) Production scientifique :

Ma production scientifique s'est traduite par la publication de plus de 100 articles dans des revues indexées, dont 32 durant ces 6 dernières années, 3 chapitres de livres et la participation dans l'édition de 6 livres et proceedings. Je ne présente ici que les principaux articles correspondants aux 3 points listés ci-dessus :

1. Contreras, L., Medina, M.H., Andrade, S., Oppliger, V. & Correa, J.A. 2007 Effects of copper on early developmental stages of *Lessonia nigrescens* Bory (Phaeophyceae). Environ. Poll. 145: 75-83.
2. Hernandez-Gonzalez, M.C., A.H. Buschmann, M. Cifuentes, J.A. Correa & R. Westermeier. 2007 Vegetative propagation of the carrageenophytic red alga *Gigartina skottsbergii* Setchell et Gardner: Indoor and field experiments. Aquaculture 262: 120-128.
3. Medina, M.H., J.A. Correa & C. Barata. 2007 Micro-evolution due to pollution: possible consequences for ecosystem responses to toxic stress. Chemosphere 67: 2105-2114.
4. Oppliger L.V, J.A. Correa & A.F. Peters. 2007 Parthenogenesis in the brown alga *Lessonia nigrescens* (Laminariales, Phaeophyceae) from Central Chile. J. Phycol. 43: 1295-1301.
5. Guillemin M-L., S. Faugeron, C. Destombe, F. Viard, J.A. Correa & M. Valero. 2008. Genetic variation in wild and cultivated populations of the haploid-diploid red alga *Gracilaria chilensis*: how farming practices favor asexual reproduction and heterozygosity. Evolution 62-6: 1500-1519.
6. Medina, M.H., Morandi B. and Correa J.A. 2008 Copper effects in the copepod *Tigriopus angulatus*: natural broad tolerance allows maintenance of food webs in copper-enriched coastal areas. Mar. Freshwater Res. 59: 1061–1066. (made the cover)
7. Ritter, A., S. Goulitquer, J-P Salaun, T. Tonon, J. A. Correa & P. Potin. 2008 Copper stress induces biosynthesis of octadecanoid and eicosanoid oxygenated derivatives in the brown algal kelp Laminaria digitata. New Phytol. 180: 809-821.
8. Contreras, L., D. Mella, A. Moenne & J.A.Correa. 2009 Differential responses to copper-induced oxidative stress in the marine macroalgae *Lessonia nigrescens* and *Scytosiphon lomentaria* (Phaeophyceae). Aquat. Toxicol. 94: 94-102.
9. Tellier, F., A.P. Meynard, J.A. Correa, S. Faugeron & M. Valero. Phylogeographic analyses of the 30°S south-east Pacific biogeographic transition zone establish the occurrence of a sharp genetic discontinuity in the kelp *Lessonia nigrescens*: Vicariance or parapatry? Mol. Phylogen. Evol. 53: 679-693. 2009.
10. Contreras, L., A. Moenne, F. Gaillard, P. Potin & J.A. Correa. 2010 Proteomic analysis and identification of copper stress-regulated proteins in the marine alga *Scytosiphon gracilis* (Phaeophyceae). Aquat. Toxicol. 96: 85-89.
11. Andrade, S., M.J. Pulido & J.A.Correa. 2010 The effect of organic ligands exuded by intertidal seaweeds on copper complexation. Chemosphere, 78: 397-401.
12. Weinberger, F., M-L Guillemin, C. Destombe, M. Valero, S. Faugeron, J.A. Correa, G. Pohnert, C. Pehlke, B. Kloareg & P. Potin. 2010 Defense evolution in the Gracilariaceae (Rhodophyta): Substrate-regulated oxidation of agar oligosaccharides is more ancient than than the oligoagar-activated oxidative burst. J. Phycol., 46: 958-968.
13. Hengst M.B., Andrade S., González B. & Correa J.A. 2010 Changes in Epiphytic Bacterial Communities of Intertidal Seaweeds Modulated by Host, Temporality and Copper Enrichment. Microb. Ecol. 60: 282-290.
14. Peters A.F., A.D. Mann, C.A. Cordova, J. Brodie, J.A. Correa, D.C. Schroeder & J.M. Cock. 2010 Genetic diversity of Ectocarpus (Ectocarpales, Phaeophyceae) in Peru and northern Chile, the area of origin of the genome-sequenced strain. New Phytol. 188: 30-41.
15. González A., Vera J., Castro J., Dennett G., Mellado, M., Morales B., Correa J.A. & Moenne, A. 2010 Co-occurring increases of calcium and organellar reactive oxygen species determine differential activation of antioxidant and defense enzymes in *Ulva compressa* (Chlorophyta) exposed to copper excess. Plant Cell & Environ. 33: 1627-1640.
16. Ritter A., Ubertini M., Romac S., Gaillard F., Delage L., Mann A., Cock J. M., Tonon T., Correa J.A. & Potin P. 2010 Copper stress proteomics highlights local adaptation of two strains of the model brown alga *Ectocarpus siliculosus*. Proteomics, 10: 2074-2088.
17. Contreras-Porcia L, Dennett G, Gonzalez A, Vergara E, Medina C, Correa JA & Moenne A. 2011 Identification of copper-induced genes in the marine alga *Ulva compressa* (Chlorophyta) Mar. Biotech. 13: 544-556.
18. Oppliger V., Destombe C., Correa J.A., Valero M., Tellier F., & Faugeron S. 2011 Sex ratio in the Lessonia nigrescens complex (Laminariales, Phaeophyceae): effect of latitude, temperature and marginality. J. Phycol. 47: 5-12.
19. Weinberger, F., U. Lion, L. Delage, B. Kloareg, P. Potin, J. Beltrán, V. Flores, S. Faugeron, J. Correa & G. Pohnert. Up-regulation of lipoxygenase, phospholipase and oxylipin-production in the induced chemical defense of the red alga *Gracilaria chilensis* against ephiphytes. J. Chem. Ecol. 37: 677-686. 2011
20. Contreras-Porcia, L., S, Callejas, D. Thomas, C. Sordet, G. Pohnert, A. Contreras, A. Lafuente, M.R. Flores-Molina & J.A. Correa. 2012 Seaweeds early development: detrimental effects of desiccation and attenuation by algal extracts. Planta 235: 337-348.
21. Flores-Molina, M.R., D. Thomas, V. Flores, J.A. Correa & L. Contreras-Porcia. Tolerance response to desiccation stress influences the zonation pattern of intertidal macroalgae. Bot.Mar. in press 2012.
22. Oppliger V., Correa J.A., Engelen, A., Tellier, Vieira, V., Faugeron S., F., Valero M., Gómez, G. & Destombe C. 2012 Temperature effects on life-history traits and geographic distribution of two kelp cryptic species. PLoS ONE

3) Points forts des activités ne relevant pas de la production scientifique :

- **Interactions avec l'environnement social, économique et culturel ;**

- "Restoration of coastal zones impacted by copper mine tailings in northern Chile" (financé par CODELCO, entreprise nationale d'exploitation minière): programme de restauration des ecosystems intertidaux à partir de la réintroduction d'espèces « clé de voute » telles que *Lessonia nigrescens*, avec la participation directe de communautés de pêcheurs côtiers.

- « Comparative risk assessment of copper applications in aquaculture » (financé par INNOVA-CORFO): applications des connaissances sur les effets du cuivre dans l'aquaculture, en interactions avec des entreprises aquacoles et CODELCO

- **Formation par la recherche ;**

Co-encadrement de 15 étudiants, dont les plus récents sont :

- Paula Niell (Ph.D.). Distribución de la macroalga introducida Codium fragile (Chlorophyta) en Chile y sus efectos sobre la estructura de los ensambles del submareal rocoso del Norte Chico. Pontificia Universidad Católica de Chile, Ecology stream. Co-supervised with Dr. Sergio Navarrete. Graduated April 2007.

- Diego Aedo (Ph.D.). Factores que determinan asentamiento en grupo de esporas de algas rojas. Pontificia Universidad Católica de Chile, Ecology Stream. Co-supervisor with B. Santelices. Graduated August 2008.

- Martha Hengst (Ph.D.). Estructura de comunidades bacterianas asociadas a macroalgas marinas: efecto del cobre como factor modulador. Pontificia Universidad Católica de Chile, Molecular genetics and Microbiology stream. Co-supervised with Dr. Bernardo González. Graduated June 2008.

- Rodrigo de la Iglesia (Ph.D.). Efecto de altos niveles de cobre sobre comunidades bacterianas epilíticas asociadas a un sistema intermareal rocoso. Pontificia Universidad Católica de Chile, Molecular genetics and Microbiology stream. Co-supervised with Dr. Bernardo González. Graduated September 2008.

- Andrés Ritter (Ph.D.)*. Approches intégrées des mécanismes moléculaires de la tolérance au cuivre chez les algues brunes. Ph.D. program UPMC and Pontificia Universidad Católica de Chile, Ecology stream. Co-supervised with Dr. Phillipe Potin (CNRS-UPMC, Roscoff). Graduated January 2009.

- Valeria Oppliger (Ph.D.)*. Sexo en algas pardas: efectos ambientales y cambio climático. Ph.D. program UPMC and Pontificia Universidad Católica de Chile, Ecology stream. Co-supervised with Dr. Christophe Destombe (CNRS-UPMC, Roscoff). Graduated October 2010.

- Stacy Krueger (Ph.D.)*. First year thesis student. Ph.D. program UPMC and Pontificia Universidad Católica de Chile, Ecology stream. Co-supervised with Dr. Myriam Valero (CNRS-UPMC, Roscoff). Graduated 2011.

- Carolina Camus (Ph.D.). Taxonomía, filogenia y filogeografía de la familia scytosiphonacea (Phaeophyceae), con énfasis en el origen y distribución del genero Scytosiphon en la costa Pacífico sureste. Ecology Stream, co-supervised with S. Faugeron. Thesis finished, expected defense during 2012.

- Andrés Meynard (Ph.D.). Four year thesis student. Pontificia Universidad Católica de Chile, Ecology stream. Co-supervised with Dr. Sylvain Faugeron.

*Etudiants formés dans le cadre du L.I.A.; ont reçu le double diplôme PUC-UPMC

Encadrement de 7 Post-doctorants, dont les plus récents sont :

- Dr. Marie-Laure Guillemin. ECOS postdoctoral fellow. October 2005-April 2006

- Dr. Loretto Contreras. CONICYT post-doctoral fellow (Bicentennial Program). January 2005-Dcember 2007.

- Dr. Camile Sordet. Postdoctoral fellow funded by FONDAP and FONDECYT, October 2009 - October 2012.

- **Responsabilités administratives et scientifiques les plus récentes**

- PRESIDENT, International Seaweed Association Committee. 2001-2004.

- PRESIDENT of the Chilean Scientific Committee for ECOS-CONICYT. October 2001-March 2005.

- CHAIRMAN, Departamento de Ecología, Facultad de Ciencias Biológicas, P. Universidad Católica de Chile March 1997-July 2006.

- DIRECTOR OF RESEARCH AND GRADUATE STUDIES, Facultad de Ciencias Biológicas, P. Universidad Católica de Chile August 2006-December 2008.

- MEMBER of the Consejo Superior de Ciencia. FONDECYT. 2005-2008

- DEPUTY DIRECTOR. FONDAP Center for Advanced Studies in Ecology and Biodiversity. 2001-2011

- LOCAL DIRECTOR OF THE L.I.A. International Associated Laboratory (PUCCh-UPMC-CNRS). 2004-2011
- DEAN, Facultad de Ciencias Biológicas, P. Universidad Católica de Chile 2010-present

Signature de la personne concernée par cette fiche d'activité

Je certifie n'avoir demandé mon rattachement qu'à une seule unité de recherche.

Date : 11-09-2012 Signature : 

Signature du responsable de l'unité de recherche d'appartenance en 2012

Date : 11-09-2012 Signature : 

agence d'évaluation de la recherche et de l'enseignement supérieur

Adaptation et Diversité en Milieu Marin
2.3. Fiche individuelle d'activité
DESTOMBE Christophe

Unité de recherche d'appartenance en 2012 : *(label et n°, intitulé, établissement principal, responsable)* UMR 7144 Adaptation et Diversité en Milieu Marin UPMC François LALLIER	**Unité soumise à une reconnaissance prenant effet 1er janvier 2014 :** *(intitulé, établissement support, responsable)* Unité Mixte Internationale Evolutionary Biology and Ecology of Algae Myriam Valero

Nom : DESTOMBE
Prénom : Christophe
Date de naissance : 10 janvier 1957
Courriel :destombe@sb-roscoff.fr

Établissement d'affectation ou organisme d'appartenance : UPMC

Enseignant-chercheur	■	Thèse soutenue	☒	HDR	■	Corps-grade :PR2
Bénéficiaire de la PES :	■					
Membre IUF junior	☐					
senior	☐					
Chercheur	☐	Thèse soutenue	☐	HDR	☐	Corps-grade :
Ingénieur	☐	Thèse soutenue	☐	HDR	☐	Corps-Grade :

Cadre scientifique ou autre personnel ayant une activité de recherche :

Préciser :		Thèse soutenue	☐	HDR	☐	Corps grade :

Situation particulière :
(délégation, détachement, mise à disposition, etc.)

Domaine scientifique principal :

☐ 1 Sciences de l'homme et de la société
☐ 2 Sciences et technologies
■ 3 Sciences de la vie et de l'environnement

Rattachement scientifique :

Section du CNU : 67

ou

Département(s) scientifique(s) et/ou commissions spécialisées d'un organisme :

1) Points forts des activités de recherche et résultats marquants :

Mes recherches sont centrées sur l'étude de l'impact des composantes du succès reproducteur sur la biodiversité des espèces et leur évolution. Je me suis intéressé plus particulièrement ces dernières années à l'étude des cycles et des modalités de reproduction (rencontre des gamètes, isolement reproducteur, importance de la phase haploïde), du fonctionnement des populations, de la dynamique de la variabilité génétique, et des phénomènes de spéciation chez plusieurs espèces d'algues marines. Ces recherches ont été menées dans le cadre du LIA Franco-Chilien en collaboration avec l'Université de Santiago (PUCC) et de Valdivia (UACH).

Un des principaux résultats obtenus lors de cette période, nous a permis de monter le rôle primordial du stade microscopique (gamétophyte) dans le cycle de reproduction haploïde diploïde des grandes algues brunes pour expliquer la différence d'aire de distribution des espèces. En effet, jusqu'à présent le rôle de l'alternance de

générations (gamétophyte haploïde et sporophyte diploïde) sur la distribution des espèces était resté inexplorée en particulier en ce qui concerne la démographie des espèces. Notre étude montre clairement des différences écologiques entre les deux espèces jumelles de *Lessonia nigrescens* le long des côtes chiliennes en soulignant l'importance des gamétophytes dans leur répartition. L'aspect novateur de cette étude est d'avoir mis en évidence l'existence de plasticité du cycle de reproduction chez ces espèces qui semble fortement sélectionné en fonction de leur habitat. En conclusion, notre étude démontre l'importance des conditions écologiques dans les phénomènes de différenciations entre espèces et d'adaptation locale en limite d'aire de répartition.

Dans une autre étude, nous nous sommes intéressés aux conséquences de la culture de l'algue rouge à cycle haploïde-diploïde *Gracilaria chilensis* sur la diversité génétique et les traits d'histoire de vie associés. Cette étude a permis de mettre en évidence, pour la première fois chez les algues rouges, l'existence des phénomènes de domestication liée aux pratiques culturales et à une sélection des meilleures souches par les cultivateurs/pêcheurs du Chili. En effet, nos résultats montrent que les pratiques agricoles avaient significativement modifié les traits d'histoire de vie de l'espèce en comparaison des populations sauvages. Les populations cultivées maintenues presque exclusivement par la propagation végétative se caractérisent par une prédominance d'individus diploïdes dans des fermes et par une réduction de diversité génétique due à un goulot d'étranglement liée à la mise en culture et à la propagation clonale.

Enfin, nous avons mis en évidence chez les algues rouges du genre *Gracilaria* l'existence de phénomènes d'introgression entre espèces proches. En Europe du Nord, la distinction morphologique entre *G. gracilis* et *G. dura* est ambiguë et ces deux espèces sont généralement désignées sous le même nom d'espèce *G. gracilis*. L'utilisation de marqueurs moléculaires appartenant aux trois compartiments génomiques : mitochondrial (cox2-cox3), plastidial (rbcL) et nucléaire (ITS2), ont permis de montrer que ces deux taxa correspondaient effectivement à deux entités génétiques différentes. Cependant, la combinaison de ces différents marqueurs a permis de souligner l'existence de cytotypes "incongru" (c'est-à-dire, des mitotypes de *G. dura* associés à des chlorotypes de *G. gracilis*) ce qui suggère l'existence d'hybridation entre ces deux taxa.

2) Production scientifique :

COELHO S., PETERS A.F., CHARRIER B., ROZE D., DESTOMBE C., VALERO M. & COCK J.M. 2007. Complex life cycles of multicellular eukaryotes: new approaches based on the use of model organisms. Gene 406, 152-170.

GUILLEMIN M-L., AIT AKKI S., GIVERNAUD T., MOURADI A. VALERO M. & DESTOMBE C. 2008. Molecular characterisation and development of rapid molecular methods to delineate species of Gracilariaceae from the Atlantic coast of Morocco. Aquatic Botany 89: 324-330.

GUILLEMIN M.L., FAUGERON S., DESTOMBE C VIARD F., CORREA J.C. & VALERO M. 2008. Genetic variation in wild and cultivated populations of the haploid-diploid red alga Gracilaria chilensis: how farming practices favor asexual reproduction and heterozygosity. Evolution 62: 1500-1519.

DESTOMBE, C., M. VALERO & M.L. GUILLEMIN. 2010. Delineation of two sibling red algal species: Gracilaria gracilis and Gracilaria dura (Gracilariales, Rhodophyta) using multi dna markers: resurrection of the species g. dura previously described in the northern atlantic 200 years ago. Journal of Phycology 46: 720-727

BILLARD,E., E. SERRAO, G. PEARSON, C. DESTOMBE & M. VALERO. 2010. Fucus vesiculosus and spiralis species complex: a nested model of local adaptation at the shore level. Marine Ecology Progress Series: 405:163–174

WEINBERGER, F., GUILLEMIN, M.L, DESTOMBE, C., VALERO, M., FAUGERON, S. CORREA, J., POHNERT, G., KLOAREG B. & POTIN, P. 2010. Defense evolution in the Gracilariaceae, (Rhodophyta): substrate-regulated oxidation of agar oligosaccharides is more ancient than the oligoagar-activated oxidative burst. Journal of Phycology 46: 958–968.

DESTOMBE C & OPPLIGER LV 2011 Male gametophyte fragmentation in Laminaria digitata: a life history strategy to enhance reproductive success. Cahiers de Biologie Marine, 52:385-394.

ENGELEN AH., LÉVÈQUE L., DESTOMBE C., VALERO M. 2011. Spatial and temporal patterns of recovery of low intertidal Laminaria digitata after experimental spring and autumn removal. Cahiers de Biologie Marine, 52: 441 - 453

VALERO M., DESTOMBE C., MAUGER S., RIBOUT C., ENGEL C. R., DAGUIN-THIEBAUT C., TELLIER F. 2011 Using genetic tools for sustainable management of kelps: a literature review and the example of Laminaria digitata. Cahiers de Biologie Marine, 52: 467 - 483

LEBLANC C., SCHAAL G., COSSE A., DESTOMBE C., VALERO M., RIERA P., & POTIN P. 2011. Trophic and biotic interactions in Laminaria digitata beds: what influences on the persistence of the marine kelp forests? Cahiers de Biologie Marine, 52: 415-427

OPPLIGER, L.V., J. A. CORREA, S. FAUGERON, F. TELLIER, J. BELTRÁN, M. VALERO & C. DESTOMBE 2011. Sex ratio variation in the Lessonia nigrescens complex (Laminariales, Phaeophyceae): effect of latitude, temperature and marginality. Journal of Phycology 47: 5-12.

PEREIRA T. R., ENGELEN A. H., PEARSON G., SERRÃO E., DESTOMBE C., & VALERO M. 2011. Temperature effects on gametophyte development of L. ochroleuca and S. polyschides, kelps with contrasting life histories. Cahiers de Biologie Marine, 52: 395-403

TELLIER F, TAPIA J, FAUGERON S, DESTOMBE C, & VALERO M. 2011. The Lessonia nigrescens species complex (Laminariales, Phaeophyceae) shows strict parapatry and complete reproductive isolation in a secondary contact zone. Journal of Phycology: 47: 894–903

GUILLEMIN ML, SEPÚLVEDA RD, CORREA JA & DESTOMBE C. 2012 Differential ecological responses to environmental stress in the life history phases of the isomorphic red alga Gracilaria chilensis (Rhodophyta) Journal of Applied Phycology DOI 10.1007/s10811-012-9855-8

GEOFFROY A, LE GALL L., DESTOMBE C. 2012. Cryptic introduction of the red alga Polysiphonia morrowii Harvey (Rhodomelaceae, Rhodophyta) in the North Atlantic Ocean highlighted by a DNA barcoding approach Aquatic Botany100: 67–71

OPPLIGER LV, CORREA JA, ENGELEN AH, TELLIER F, VIEIRA V, FAUGERON S, VALERO M, GOMEZ G, & DESTOMBE C. 2012. Temperature effects on gametophyte life-history traits and geographic distribution of two cryptic kelp species. PLoS ONE 7(6): e39289. doi:10.1371/journal.pone.0039289

Participation à 46 communications dans des congrès nationaux ou internationaux

3) Points forts des activités ne relevant pas de la production scientifique :

Encadrement de 3 thèses

Responsabilités administratives :

2004-2008	Membre élu du Comité National (section 29)
2006-2008	Membre élu à l'Executive Council of the International Phycological Society
2008-2010	Membre nommé du Conseil de Laboratoire UMR 7144
2011-2012	Membre élu du Groupe d'Experts 67ème Section "Biologie des Populations et Ecologie' de l'UPMC
2012-2016	Membre élu de la Commission Nationale des Universités (CNU section 67)
2012-2016	Membre élu du Conseil d'Administration de la Station Biologique de Roscoff

Participation à 9 Jurys de thèse et à 5 jurys d'HDR

Membre du bureau éditorial de la revue « European Journal of Phycology » (1996-2012) pour la section Molecular Biology.

Responsable de 2 UE de licence et de 3 UE de master

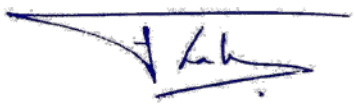
Signature de la personne concernée par cette fiche d'activité

Je certifie n'avoir demandé mon rattachement qu'à une seule unité de recherche.

Date : 12/07/2012 Signature :

Signature du responsable de l'unité de recherche d'appartenance en 2012

Date : 31/08/2012 Signature :



agence d'évaluation de la recherche et de l'enseignement supérieur

Pontificia Universidad Católica de Chile

2.3. Fiche individuelle d'activité

FAUGERON Sylvain

Unité de recherche d'appartenance en 2012 : *(label et n°, intitulé, établissement principal, responsable)* Departamento de Ecología, Facultad de Ciencias Biológicas, Pontificia Universidad Católica de Chile.	**Unité soumise à une reconnaissance prenant effet 1er janvier 2014 :** *(intitulé, établissement support, responsable)* Unité Mixte Internationale Evolutionary Biology and Ecology of Algae Myriam Valero

Nom : Faugeron
Prénom : Sylvain
Date de naissance : 27 Mai 1970
Courriel : sfaugeron@bio.puc.cl

Établissement d'affectation ou organisme d'appartenance : Pontificia Universidad Catolica de Chile

Enseignant-chercheur	■	Thèse soutenue	■	HDR (Equivalent)	■	Corps-grade : Professeur Associé
Bénéficiaire de la PES :	☐					
Membre IUF junior senior	☐ ☐					
Chercheur	☐	Thèse soutenue	☐	HDR	☐	Corps-grade :
Ingénieur	☐	Thèse soutenue	☐	HDR	☐	Corps-Grade :
Cadre scientifique ou autre personnel ayant une activité de recherche : Préciser :		Thèse soutenue	☐	HDR	☐	Corps grade :

Situation particulière :
(délégation, détachement, mise à disposition, etc.)

Domaine scientifique principal :

☐ 1 Sciences de l'homme et de la société
☐ 2 Sciences et technologies
■ 3 Sciences de la vie et de l'environnement

Rattachement scientifique :

Pontificia Universidad Católica de Chile

1) Points forts des activités de recherche et résultats marquants :

Mes activités de recherches portent essentiellement sur les inférences de processus démographiques historiques et contemporains à partir de l'étude de la diversité génétique des populations. Elles peuvent se résumer par les 5 grands points suivants :

- Approches phylogéographiques du rôle des discontinuités biogéographiques dans la structuration des populations et dans les processus de spéciation le long des côtes chiliennes. Différents modèles ont été abordés, tels que des algues (Lessonia, Mazzaella), des invertébrés (8 especes) et des mammifères (genre Lontra). Ces travaux ont été réalisés largement en collaboration nationale (au Chili : P. Haye, U Catolica del Norte, ML Guillemin, U. Austral, E. Poulin, U. Chile ; G. Medina-Vogel, U. Andres Bello) et internationale (en France : M. Valero, C. Destombe), et ont donné lieu à 2 thèses de doctorat (F. Tellier (cotutelle UPMC-PUC) et J. Vianna), un workshop et 5 articles.

- Différenciation écologique entre espèces cryptiques au sein d'une zone de transition biogéographique : collaboration dans le cadre du LIA DIAMS avec M. Valero (thèse Florence Tellier (2009), Master2 Lucie Jaugeon (2012)) (Tellier et al. 2011b,c; Oppliger et al. 2011, 2012).
- Effet de la domestication sur les traits d'histoire de vie chez une algue: sélection involontaire pour la diploïdie chez *Gracilaria chilensis* (Guillemin et al. 2008).
- Importance des effets anthropiques sur le maintien de la biodiversité en milieu côtier, sur les champs de laminaires en particulier, dans le cadre du projet ANR ECOKELP (Tellier et al. 2011c). Ces recherches se poursuivent dans le cadre du Nucleo Milenio « Marine Conservation Center » dont je suis le directeur adjoint (2 thèses en cours sur la connectivité des populations d'espèces côtières sous différents régimes de perturbation anthropique, Catherine Gonzalez et Mario Barahona).
- Rôle de la consanguinité dans la structuration des populations : découverte de la vie en groupe d'individus apparentés au sein de *Lessonia nigrescens* (Master Nicolas Segovia, article soumis, et thèse en cours de Fernanda Araujo).

2) Production scientifique :

Ma production scientifique s'est traduite par la publication de 31 articles dans des revues indexées (17 pour ces 6 dernières années), environ 20 communications ou posters dans des congrès, incluant une plenary, 4 symposia (dont un en tant qu'organisateur). Je ne présente ici que les principaux articles correspondants aux 5 points listés ci-dessus :

1. Guillemin, M.L., S Faugeron, C Destombe, F Viard, J Correa, M Valero. **2008** Genetic variation in wild and cultivated populations of the haploid-diploid red alga *Gracilaria chilensis*: how traditional farming practices favour asexual reproduction and heterozygosity. Evolution. 62 :1500-1519
2. S. Faugeron, D. Veliz, G. Peralta, J. Tapia, F. Tellier, C. Billot, E. Martínez. **2009.** Development and characterization of nine polymorphic microsatellite markers in the Chilean kelp *Lessonia nigrescens*. Molecular Ecology Ressources. 9(3):937-939.
3. F. Tellier, A.P. Meynard, J.A. Correa, S. Faugeron, M. Valero. **2009.** Phylogeographic analyses of the 30°S south-east Pacific biogeographic transition zone establish the occurrence of a sharp genetic discontinuity in the kelp *Lessonia nigrescens*: vicariance or parapatry? Molecular Phylogenetics and Evolution. 53:679-693.
4. J. Vianna, P. Ayerdi, G. Medina-Vogel, J. Mangel, H. Zeballos, M. Apaza, S. Faugeron. **2010**. Phylogeography of the marine otter (*Lontra felina*): Historical and Contemporary factors determining its distribution. Journal of Heredity. 101:676–689.
5. L. V. Oppliger, J. A. Correa, M. Valero, S. Faugeron, F. Tellier, J. Beltrán, C. Destombe. **2011**. Sex ratio variation in the *Lessonia* nigrescens complex (Laminariales, Phaeophyceae): effects of latitude, temperature and marginality. Journal of Phycology 47: 5–12.
6. F. Tellier, J. Tapia, S. Faugeron, C. Destombe, M. Valero. **2011a.** The *Lessonia nigrescens* species complex (Laminariales, Phaeophyceae) shows strict parapatry and complete reproductive isolation in a secondary contact zone. Journal of Phycology. 47: 893-907.
7. Vianna J, G. Medina-Vogel, S. Faugeron. **2011.** Phylogeography of Patagonian otter (*Lontra provocax*): evidence of adaptive divergence to marine habitat or signature of southern glacial refugia? BMC Evolutionary Biology 11:53
8. Tellier F, S. Faugeron, M. Valero **2011b** Possible role of a mitochondrial genome rearrangement in maintaining the spatial segregation of two cryptic species of the *Lessonia nigrescens* species complex. Cahiers de Biologie Marine 52: 371-383.
9. Tellier F, Vega A, Broitman B, Vasquez JA, Valero M, Faugeron S **2011c** The importance of having two species instead of one in kelp management: the *Lessonia nigrescens* species complex. Cahiers de Biologie Marine 52: 455-465.
10. Montecinos A, Haye PA, Broitman B, Faugeron S, Tellier F, Guillemin M-L **2012** Evidence of repeated parapatric speciation along linear coastal habitat in the red alga *Mazzaella laminarioides*. BMC Evolutionary Biology 12: 97.
11. Oppliger LV, Correa JA, Engelen AH, Tellier F, Vieira V, Faugeron S, Valero M, Ayerdi P, Gomez G, Destombe C **2012** Temperature effects on life-history traits and geographic distribution of the kelp species complex *Lessonia nigrescens*. PLoS One 7(6): e39289

3) Points forts des activités ne relevant pas de la production scientifique :

- **Rayonnement et attractivité académiques**

- 4 séminaires ou conférences invitées
- Organisateur de Daniel Jouvence International School in Marine Biology. Workshop and summer school. ECIM, Las Cruces, Chile, January 2011.
- Membre de l'editorial board de la revue « Revista Chilena de Historia Natural »
- Membre actif des sociétés Chiliennes d'Evolution (co-fondateur et directeur 2008-2012) et de Génétique
- Reviewer pour de nombreuses revues
- Rapporteur 6 jurys de thèse, 3 jurys de Master et de nombreux jurys de «Mémoires de Licence » (Tesis de Licenciatura, 5^{e} année d'université au Chili)

- **Formation par la recherche ;**

Co-encadrement de 2 étudiants en Master II :

- JAUGEON L. 2012. Les populations en limite d'aire de répartition font-elles moins de sexe ? Le cas de l'algue brune Lessonia nigrescens le long des côtes chiliennes. Master 2. Océanographie Biologie Ecologie Marines, Université de la Méditerranée Aix-Marseille II, (co-direction avec C. Destombe et M. Valero).

- PLANAS J. 2007. Filogeografia de Macrocystis pyrifera en la región de Magallanes. Master "Manejo de recursos subantarticos", Universidad de Magallanes, Punta Arenas, Chili (co-direction avec A. Mansilla)

Co-encadrement de 8 étudiants en Thèse (4 soutenues et 4 en cours) :

- TELLIER F (2009) Effet des changements environnementaux historiques et contemporains sur la diversité de deux algues brunes : analyse écologique et génétique des zones de transitions et de l'effet d'El Niño le long des côtes chiliennes. (Thèse financée par une bourse MRT en cotutelle entre UPMC et PUCh, co-direction 50% avec Sylvain Faugeron, Ecole Doctorale Diversité du Vivant UPMC. Soutenue le 10 Juillet 2009.

- QUIRICI V (2010) Balance entre cooperación y competencia como determinante de los patrones de dispersión. Doctorat Ciencias Biologicas PUC, Co-advisor: L. Ebensperger.

- de ABREU VIANNA J (2010) Filogeografía y estructura genética de las poblaciones del chugungo, Contra felina (Carnivora: Mustelideae). Doctorat Ciencias Biologicas PUC.

- CAMUS C (2012) Taxonomía, filogenia y filogeografía de la familia Scytosiphonaceae (Phaeophyceae), con énfasis en el origen y distribución del género Scytosiphon en la costa Pacífico Sureste. Doctorat Ciencias Biologicas PUC. Co-advisor: J. Correa

- MEYNARD A (en cours) Grado de especialización ecológica y posibles escenarios evolutivos entre el patelogastrópodo Scurria scurra, su alga hospedero Lessonia nigrescens, y otras macroalgas pardas que estructuran comunidades en costas rocosas de Chile. Doctorat Ciencias Biologicas PUC. Started: 2008. Co-advisor: J. Correa

- ARAUJO F (en cours) Fusión de conespecíficos en el kelp Lessonia nigrescens Bory: consecuencias en fitness y niveles de selección. Doctorat Ciencias Biologicas PUC. Started 2010.

- GONZALEZ C (en cours) Variabilidad espacial de la conectividad efectiva en invertebrados marinos bentónicos de la costa de Chile. Doctorat Ciencias Biologicas PUC. Started 2012. Co-advisor : M. Fernandez.

- BARAHONA M (en cours) La oceanografía costera y selección post-asentamiento como determinantes del quiebre biogeográfico y filogeográfico de Notochthamalus scabrosus en la zona centro-norte de Chile. Doctorat Ciencias Biologicas PUC. Started 2012. Co-advisor : S. Navarrete.

Encadrement de Stages de Licenciatura (équivalent stage Master 1)

- A la PUC: Eva Mayol (2008), Max Blondel (2008), Lucas Chaparro (2009), Federico Rengifo (2011), Gabriel Montecinos (2011), Alejandra Fabres (2012)

- Dans d'autres universités chiliennes: Julien Marquié (2010, Master 1 Biologie et Physiologie Intégrative, UPMC), Nicolas Segovia (2011, U. Católica del Norte)

- **Responsabilités administratives et scientifiques**

- Responsable programme européen ASSEMBLE (www.assemblemarine.org) pour la PUC;

- Organisateur de l'école internationale Daniel Jouvance – UPMC « Marine Biology », Las Cruces, Chili, 16 –26 Janvier 2011

- Membre du comité pédagogique de Licence de Biochimie, de la Faculté de Ciencias Biologicas de la PUC

- Responsable du Laboratoire de Diversidad Molecular (Département d'Ecologie) et du Service de Séquencage et Génotypage de la Faculté de Ciencias Biologicas de la PUC

- Directeur adjoint du « Marine Conservation Center », crée dans le cadre du programme « Millenium Scientific Initiative » du Ministère de l'Economie du Chili, ECIM, Las Cruces, Chili.

Signature de la personne concernée par cette fiche d'activité

Je certifie n'avoir demandé mon rattachement qu'à une seule unité de recherche.

Date : 11-09-2012 Signature : 

Signature du responsable de l'unité de recherche d'appartenance en 2012

Date : 11-09-2012 Signature : 

agence d'évaluation de la recherche et de l'enseignement supérieur

Universidad Austral de Chile

2.3. Fiche individuelle d'activité

GUILLEMIN Marie-Laure

Unité de recherche d'appartenance en 2012 : *(label et n°, intitulé, établissement principal, responsable)* Instituto de Ciencias Ambientales y Evoltivas, Facultad de Ciencias Biologicas, Universidad Austral de Chile.	**Unité soumise à une reconnaissance prenant effet 1er janvier 2014 :** *(intitulé, établissement support, responsable)* Unité Mixte Internationale Evolutionary Biology and Ecology of Algae Myriam Valero

Nom : Guillemin
Prénom : Marie-Laure
Date de naissance : 13 Décembre 1972
Courriel : marielaure.guillemin@gmail.com

Établissement d'affectation ou organisme d'appartenance : Universidad Austral de Chile

Enseignant-chercheur	X	Thèse soutenue	X	HDR	☐	Corps-grade :
Bénéficiaire de la PES :	☐					
Membre IUF junior	☐					
senior	☐					
Chercheur	☐	Thèse soutenue	☐	HDR	☐	Corps-grade :
Ingénieur	☐	Thèse soutenue	☐	HDR	☐	Corps-Grade :

Cadre scientifique ou autre personnel ayant une activité de recherche :

Préciser :	Thèse soutenue	☐	HDR	☐	Corps grade :

Situation particulière :
(délégation, détachement, mise à disposition, etc.)

Domaine scientifique principal :

☐ 1 Sciences de l'homme et de la société
☐ 2 Sciences et technologies
■ 3 Sciences de la vie et de l'environnement

Rattachement scientifique :

Département(s) scientifique(s) et/ou commissions spécialisées d'un organisme :

Facultad de Ciencias Biologicas, Universidad Austral de Chile.

1) Points forts des activités de recherche et résultats marquants :

Mes activités de recherches peuvent se résumer par les 5 grands points suivants :
1- Effet de la domestication sur les traits d'histoire de vie chez une algue: sélection involontaire pour la diploïdie chez *Gracilaria chilensis* (collaboration avec J.A. Correa et S. Faugeron, PUC, Chili et M. Valero, SB Roscoff, France).
2- Maintien des cycles de vie haploïde–diploïde : importance de la différence de niches entre individus haploïdes et diploïdes, différences démographique entre les phases, mise au point d'outil de reconnaissance des sexes et des phases chez *G. chilensis* (collaboration avec C. Destombe, SB Roscoff, France).
3- Effet de l'endogamie sur la croissance et la survie des diploïdes chez *G. chilensis* (collaboration avec M. Valero, SB Roscoff, France).
4- Evolution temporelle de populations asexuées et sexuées d'une algue haploïde-diploide (collaboration avec M. Valero, SB Roscoff, France).
4- Zone de contact entre espèces sœurs: possible introgression entre *Gracilaria gracilis* et *G. dura* le long des côtes bretonnes et effet de grandes perturbations environnementale (ENSO et activités sismiques) et des traits d'histoire de

vie sur la structure génétique et sur la spéciation chez l'algue rouge *Mazzaella laminarioides* le long de la côte chilienne (collaboration avec C. Destombe, SB Roscoff, France; F. Tellier, UCSC, Concepcion, Chili; B. Broitman et P. Haye, CEAZA, La serena, Chili).
5- Utilisation d'outil de barcoding et de phylogéographie pour mieux comprendre quelles sont les ressources algales chiliennes: comparaison des ressources génétiques de l'algue rouge *G. chilensis* au Chili ou elle est cultivée et dans sa zone d'origine en Nouvelle Zealande, nouvelles espèces d'algues rouges et brunes et taux d'endémisme le long de la péninsule Antarctique (collaboration avec avec J.A. Correa et S. Faugeron, PUC, Chili; C. Destombe et M. Valero, SB Roscoff, France; W. Nelson, NIWA, Nouvelle zealande ; A. Mansilla, UMAG, Punta Arenas, Chili).

2) Production scientifique :

1. Engel, C.R., Guillemin, M.-L, Jacob, A.-M., Valero, M., Viard, F. **2008** Isolation of microsatellite loci from the kelp, *Saccorhiza polyschides* (Heterokontophyta, incertae sedis). Molecular Ecology Notes. 8:406-408

2. Guillemin, M.L., Faugeron, S., Destombe, C., Viard, F., Correa, J., Valero, M. **2008** Genetic variation in wild and cultivated populations of the haploid-diploid red alga *Gracilaria chilensis*: how traditional farming practices favour asexual reproduction and heterozygosity. Evolution. 62 :1500-1519

3. Guillemin, M-L., Ait Akki, S., Givernaud, T., Mouradi, A., Valero, M., Destombe, C. **2008** Molecular characterisation and development of rapid molecular methods to delineate species of Gracilariaceae from Atlantic coast of Morocco. Aquatic Botany. 89: 324-330

4. Destombe, C., Valero, M., Guillemin, M-L. **2010** Diversity and natural hybridization in two related red algae species: *Gracilaria gracilis* and *Gracilaria dura* using multi DNA markers: resurrection of the species *G. dura* previously described in the Northern Atlantic 200 years ago. Journal of Phycology. 46:720-727

5. Weinberger, F., Guillemin M.-L., Destombe, C., Valero, M., Faugeron, S., Correa, J.A., Pohnert, G., Pehlke, C., Kloareg, B., Potin, P. **2010**. Defense evolution in the gracilariaceae (Rhodophyta): substrate-regulated oxidation of agar oligosaccarides is more ancient than the oligoagar-activated oxidative burst. Journal of Phycology. 46: 958-968.

6. Guillemin, M-L., Oscar, R.H., Martínez, E.A. **2012** Characterization of genetic markers linked to sex determination in the haploid-diploid red alga *Gracilaria chilensis*. Journal of Phycology. 48:365-372

7. Guillemin, M-L., Sepúlveda, R.D., Correa, J.A, Destombe, C. **2012** Differential ecological responses to environmental stress in the life history phases of the isomorphic red alga Gracilaria chilensis (Rhodophyta). (In press). Journal of Applied Phycology. DOI: 10.1007/s10811-012-9855-8

8. Montecinos, A., Haye, P.A., Broitman, B., Faugeron, S., Tellier, F., Guillemin, M-L. **2012** Evidence of repeated parapatric speciation along linear coastal habitat in the red alga *Mazzaella laminarioides*. BMC Evolutionary Biology 12:97.

Participation à 26 communications dans des congrès nationaux ou internationaux

3) Points forts des activités ne relevant pas de la production scientifique :

- 2008-2012 : Membre du comité du Magister de Génétique, Facultad de Ciencias, Universidad Austral de Chile
- 2010-2012: Membre de la commission du doctorat en Sciences mention Ecologie et Evolution, Facultad de Ciencias, Universidad Austral de Chile
- 2012: Membre de la commission de la Licenciatura en Ciencias mencion Biologicas, Facultad de Ciencias, Universidad Austral de Chile
- Membre du jury de 1 thèse et rapporteur de 1 magister
- 2008-2010 : Comité de direction de la société Chilienne d'Evolution (SOCEVOL)
- Co-encadrement d'un étudiant en Master II et encadrement de 6 autres types de stagiaires.

SAUNIER A. 2012. Variation spatio-temporelle de la diversité génétique des populations sauvages et cultivées chez une algue rouge : effet du récent tremblement de terre de Février 2010 le long des côtes chiliennes. Master 2, Sciences de l'Univers, Environnement et Ecologie spécialité Océanographie et Environnements Marins, Université Pierre et Marie Curie. (Co-direction avec M. Valero, CNRS: France)

CAHN J., stage de césure INAPG Génétique du paysage et effet du séisme sur la structure des populations intertidales d'une algue haploïde-diploïde, Gracilaria chilensis (AgroParisTech, Juin-Dec 2010 (co-encadrement avec M. Valero, CNRS: France).

LAVADO N. 2011, Undergraduate student, Tesis de Grado "Diferencias de fitness entre las dos fases en una especies haploide-diploide: Gracilaria chilensis", Escuela de Ciencias, Universidad Austral de Chile, Valdivia, Chile.

HUANEL O., Undergraduate student, Tesis de Grado "Dinámica poblacional en un alga roja: Gracilaria chilensis", Escuela de Ciencias, Universidad Austral de Chile, Valdivia, Chile, 2011.

VALENZUELA P., Tesis de Grado "Estimación del costo de reproducción en Gracilaria chilensis", Escuela de Ciencias, Universidad Austral de Chile, Valdivia, Chile, 2011.

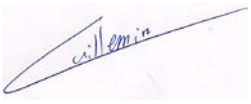
CONTRERAS K., Tesis de Grado "Efecto de la endogamia en un alga roja haploide-diploide isomórfica: Gracilaria chilensis", Escuela de Ciencias, Universidad Austral de Chile, Valdivia, Chile, 2011.

MONTECINOS A., Tesis de Grado "Filogeografía del alga roja Mazzaella laminarioides (Bory) Fredericq en Chile", Escuela de Biologia Marina, Universidad Austral de Chile, Valdivia, Chile, 2011.

- Professeur invité dans 3 cours intensif d'été pour la formation des doctorants
  1st International Theoretical-Practice Course, "Analysis of Sequences and polymorphic markers by population genetic software", Centro de Investigación y Estudios Avanzados CINVESTAV, Mexico City, Mexico, 2008.
  Filogenias como gráficos: hacia el entendimiento de procesos evolutivos, International Course MESESUP, Valdivia, Chile, 2010.
  International School in Marine Biology, Daniel Jouvance – UPMC, Las Cruces, Chile, 2011.
- Participation aux activités d'animations scientifiques: Feria Antártica Escolar et Feria Explora Región de Los Ríos.

Signature de la personne concernée par cette fiche d'activité

Je certifie n'avoir demandé mon rattachement qu'à une seule unité de recherche.

Date : 21/08/2012 Signature : 

Signature du responsable de l'unité de recherche d'appartenance en 2012

Date : Signature :

agence d'évaluation de la recherche et de l'enseignement supérieur

Adaptation et Diversité en Milieu Marin
2.3. Fiche individuelle d'activité
MAUGER Stéphane

Unité de recherche d'appartenance en 2012 : *(label et n°, intitulé, établissement principal, responsable)* UMR 7144 Adaptation et Diversité en Milieu Marin UPMC François LALLIER	**Unité soumise à une reconnaissance prenant effet 1er janvier 2014 :** *(intitulé, établissement support, responsable)* Unité Mixte Internationale Evolutionary Biology and Ecology of Algae Myriam Valero

Nom : MAUGER
Prénom : Stéphane
Date de naissance : 23/06/1974
Courriel : mauger@sb-roscoff.fr

Établissement d'affectation ou organisme d'appartenance : CNRS

Enseignant-chercheur	☐	**Thèse soutenue**	☐	**HDR**	☐	**Corps-grade :**
Bénéficiaire de la PES :	☐					
Membre IUF junior	☐					
senior	☐					
Chercheur	☐	Thèse soutenue	☐	HDR	☐	Corps-grade :
Ingénieur	■	Thèse soutenue	☐	HDR	☐	Corps-Grade : AI

Cadre scientifique ou autre personnel ayant une activité de recherche :

Préciser :	Thèse soutenue	☐	HDR	☐	Corps grade :

Situation particulière :
(délégation, détachement, mise à disposition, etc.)

Domaine scientifique principal :

☐ 1 Sciences de l'homme et de la société
☐ 2 Sciences et technologies
■ 3 Sciences de la vie et de l'environnement

Rattachement scientifique :

Section du CNU :

ou

Département(s) scientifique(s) et/ou commissions spécialisées d'un organisme :

1) Points forts des activités de recherche et résultats marquants :

Ma mission principale est d'optimiser et de réaliser des protocoles d'analyses moléculaires pour l'étude des populations d'espèces d'algues, ainsi que de gérer un laboratoire de biologie moléculaire et des collections d'algues. Etant le seul ITA de l'équipe, je coordonne tous les projets impliquant de la biologie moléculaire.

Mon activité se répartit de la façon suivante :
- 70% pour les analyses de biologie moléculaire, l'échantillonnage sur le terrain, l'encadrement et la formation,
- 20% pour la gestion du laboratoire,
- 10% pour les activités transversales.

1 – Activités de Recherche

Je travaille dans le cadre de deux projets financés par l'Agence Nationale de la Recherche (ANR), l'ANR Bicycle (ANR-10-BLAN-1727) et l'ANR Paralex (ANR-09-PEXT-12) et mon implication est de 25% dans chacun de ces projets. Le projet Bicycle a pour but l'étude du cycle de vie de l'algue brune Ectocarpus siliculosus. Dans ce projet, je suis responsable du développement de marqueurs microsatellites pour l'étude de différentes espèces européennes d'Ectocarpus. Plus spécifiquement, à partir d'une base de données de plusieurs centaines de microsatellites développés pour réaliser la carte génétique de l'espèce chilienne d'Ectocarpus dont le génome a été séquencé, je teste la conservation de ces locus en fonction de leur position dans le génome (régions codantes intron et exon, et régions non codantes) ainsi que leur polymorphisme chez les espèces européennes proches phylogénétiquement. Le projet Paralex a pour but l'étude du rôle des pathogènes naturels dans les écosystèmes marins côtiers. Dans ce projet, je suis responsable de l'adaptation des techniques de biologie moléculaire pour l'acquisition de données de génotypage / séquençage sur la micro algue Alexandrium Minutum. En plus de ces deux projets ANR, j'étais impliqué dans l'étude d'autres modèles d'algues brunes tels que les laminaires (ANR ECOKELP, ANR06-BDIV-012). Enfin, l'équipe fait partie d'un projet de Laboratoire International Associé (LIA), et dans ce cadre je travaille sur des algues des côtes du Chili (Lessonia, Gracilaria et Chondrus) en collaboration avec des chercheurs chiliens et différentes équipes Françaises, Portugaises, Espagnoles et Chiliennes.

Un des objectifs prioritaires était le transfert et la mise au point des méthodes de génotypage, à l'aide de multiplexes sur séquenceur capillaire pour toutes les espèces étudiées au laboratoire. Cet objectif est atteint car l'ensemble des analyses qui étaient effectuées auparavant sur séquenceur à gels (LiCor) sont maintenant faites sur séquenceurs capillaires. Ceci a considérablement accéléré l'obtention des données sur tous les modèles biologiques étudiés au laboratoire, en passant de 192 génotypes/jour à 768 génotypes/jour.

Etant donné que toutes les analyses sont maintenant faites sur séquenceurs capillaires, j'ai pris l'initiative de mettre au point un marqueur de taille « maison » pour diminuer les coûts de génotypage. Il faut savoir que le marqueur de taille commercial représente 50% du coût de génotypage (30€/plaque de 96 échantillons), il est maintenant remplacé par ce marqueur « maison » pour l'ensemble des analyses de l'équipe. Ce dernier permet de diminuer le coût du génotypage de façon considérable car il est 40 fois moins coûteux que le marqueur commercial.

2 – Encadrements et formations

Je recrute certains stagiaires de l'équipe et j'assure la formation et l'encadrement technique de tous les stagiaires et CDD de l'équipe qui utilisent les techniques de biologie moléculaire.

J'assure l'encadrement des stagiaires (BTS, IUT) jusqu'à la rédaction de leur rapport de stage. J'ai encadré 2 stagiaires du BTS de Biotechnologie pour leurs stages de 1er et 2ème années, d'une durée totale de 16 semaines. Le premier sujet de stage était l'étude de populations de Gracilaria gracilis avec le transfert des marqueurs microsatellites des séquenceurs à gels vers les séquenceurs capillaires. Ce transfert fut une réussite et a permis de reprendre l'étude de cette espèce, laissée de côté depuis plusieurs années. Le deuxième sujet de stage était la recherche et la mise au point de nouveaux marqueurs microsatellites dans l'espèce Chondrus crispus, dans le cadre d'un sujet de thèse. Ce stage a été couronné de succès avec la mise au point de 9 nouveaux marqueurs, permettant ainsi d'augmenter la puissance des analyses sur les populations de Chondrus crispus.

2) Production scientifique :

- Valero M., Destombe C., Mauger S., Ribout C., Engel C. R., Daguin-Thiebaut C., and Tellier F. (2011).Using genetic tools for sustainable management of kelps: a literature review and the example of Laminaria digitata. Cahiers de Biologie Marine, 52: 467-483
- Couceiro L., Maneiro I., Mauger S., Valero M., Ruiz J. M., and Barreiro R. (2012). Microsatellite development in Rhodophyta using high-throughput sequence data. J Phycol, 47: 1258-1265.

3) Points forts des activités ne relevant pas de la production scientifique :

On pourra mentionner les contributions significatives en termes de :

- formation par la recherche :
  - Margaux CALLOUET, BTS, Etude de populations de Gracilaria gracilis
  - Chloé BERTIN, BTS, mise au point de nouveaux marqueurs microsatellites dans l'espèce Chondrus crispus

- responsabilités administratives et scientifiques :
  - Membre comité utilisateur plateforme BioGenOuest
  - Coordinateur Unité pour SBR dans projet Bibliothèque de Vivant
  - Membre du Conseil Scientifique projet Bibliothèque de Vivant

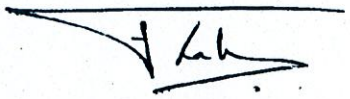
Signature de la personne concernée par cette fiche d'activité

Je certifie n'avoir demandé mon rattachement qu'à une seule unité de recherche.

Date : 21/09/2012 Signature :

Signature du responsable de l'unité de recherche d'appartenance en 2012

Date : 31/08/2012 Signature :



Adaptation et Diversité en Milieu Marin
2.3. Fiche individuelle d'activité
ROZE Denis

Unité de recherche d'appartenance en 2012 : *(label et n°, intitulé, établissement principal, responsable)* UMR 7144 Adaptation et Diversité en Milieu Marin UPMC François LALLIER	**Unité soumise à une reconnaissance prenant effet 1er janvier 2014 :** *(intitulé, établissement support, responsable)* Unité Mixte Internationale Evolutionary Biology and Ecology of Algae Myriam Valero

Nom : Roze
Prénom : Denis
Date de naissance : 30/11/1975
Courriel : roze@sb-roscoff.fr

Établissement d'affectation ou organisme d'appartenance : CNRS

Enseignant-chercheur	☐	Thèse soutenue	☐	HDR	☐	Corps-grade :
Bénéficiaire de la PES :	☐					
Membre IUF junior	☐					
senior	☐					
Chercheur	■	Thèse soutenue	■	HDR	☐	Corps-grade :CR1
Ingénieur	☐	Thèse soutenue	☐	HDR	☐	Corps-Grade :
Cadre scientifique ou autre personnel ayant une activité de recherche :						
Préciser :		Thèse soutenue	☐	HDR	☐	Corps grade :

Situation particulière :
(délégation, détachement, mise à disposition, etc.)

Domaine scientifique principal :

☐ 1 Sciences de l'homme et de la société
☐ 2 Sciences et technologies
■ 3 Sciences de la vie et de l'environnement

Rattachement scientifique :

Section du CNU :

ou

Département(s) scientifique(s) et/ou commissions spécialisées d'un organisme :

1) Points forts des activités de recherche et résultats marquants :

Mes recherches portent sur l'évolution des sytèmes de reproduction et les mécanismes de spéciation, en utilisant des approches théoriques (modélisation):

- **Evolution du sexe:** la plupart des modèles étudiant les avantages potentiels du sexe ont considéré des organismes haploïdes. J'ai pu montrer que les pressions sélectives jouant sur le sexe diffèrent de manière importante chez les diploïdes (Roze & Michod 2010). Par ailleurs, j'ai étudié comment la sélection sexuelle entre mâles peut favoriser le sexe (Roze & Otto 2012). Des travaux en cours visent à comprendre les pressions de sélection jouant sur le sexe dans des modèles de type "paysage adaptatif" (stage de Master II d'Alexandre Blanckaert). Collaborations: Sarah Otto (University of British Columbia, Canada), Richard Michod (University of Arizona, Etats-Unis).

- **Evolution des cycles de vie:** nouvel axe de recherche visant à comprendre les avantages respectifs de l'haploïdie et de la diploïdie. Stage de Master II de Marie Rescan, qui a débouché sur l'obtention d'une bourse de thèse de l'école doctorale Diversité du Vivant pour poursuivre ce travail (par des approches théoriques et expérimentales en utilisant l'algue brune modèle *Ectocarpus siliculosus*). Collaboration: Thomas Lenormand (CEFE Montpellier).

- **Spéciation:** étude théorique du couplage entre incompatibilités génétiques en parapatrie, dans le cadre du projet ANR Hi-Flo (coord. N. Bierne); travail en cours.

- **Conséquences de la structure spatiale des populations:** mise en place d'un cadre théorique permettant de construire des modèles multilocus en population structurée (Roze & Rousset 2008). Applications à l'étude de l'évolution des comportements sociaux (Lehmann et al 2007), la sélection pour la recombinaison (Roze 2009), l'évolution de la dispersion (Roze & Rousset 2009) et le fardeau de mutation en environnement hétérogène (Roze 2012). Collaborations: François Rousset (Université Montpellier II), Laurent Lehmann (Université de Lausanne).

2) Production scientifique :

Roze, D. 2012. Spatial heterogeneity in the strength of selection against deleterious alleles and the mutation load. *Heredity*, 109: 137-145.

Roze, D. 2012. Disentangling the benefits of sex. *PLoS Biology*, 10, e1001321.

Roze, D. & Otto, S.P. 2012. Differential selection between sexes and selection for sex. *Evolution*, 66:558-574.

Baldock, K.C.R., Memmott, J., Ruiz Cajado, J.C., **Roze, D.** & Stone, G. 2011. Daily temporal structure in African savannah flower-visitation networks, and consequences for network sampling. *Ecology*, 92:687-698.

Roze, D. & Michod, R.E. 2010. Deleterious mutations and selection for sex in finite, diploid populations. *Genetics*, 184:1095-1112.

Roze, D. 2009. Diploidy, population structure and the evolution of recombination. *The American Naturalist*, 174:S79-S94.

Roze, D. & Rousset, F. 2009. Strong effects of heterosis on the evolution of dispersal rates. *Journal of Evolutionary Biology*, 22:1221-1233.

Lenormand, T. **Roze, D.** & Rousset, F. 2009. Stochasticity in evolution. *Trends in Ecology and Evolution*, 24:157-165.

Roze, D. & Rousset, F. 2008. Multilocus models in the infinite island model of population structure. *Theoretical Population Biology*, 73:529-542.

Coelho, S.M., Peters, A.F., Charrier, B., **Roze, D.**, Destombe, D., Valero, M. & Cock, J.M. 2007. Complex life cycles of multicellular eucaryotes : new approaches based on the use of model organisms. *Gene*, 406:152-170.

Rousset, F. & **Roze, D.** 2007. Constraints on the origin and maintenance of genetic kin recognition. *Evolution*, 61: 2320-2330.

Lehmann, L., Rousset, F., **Roze, D.** & Keller, L. 2007. Strong reciprocity or strong ferocity ? A population genetic view on the evolution of altruistic punishment. *The American Naturalist*, 170: 21-36.

Haag, C.R. & **Roze, D.** 2007. Genetic load in sexual and asexual diploids : segregation, dominance and genetic drift. *Genetics*, 176: 1663-1678.

Lehmann, L., Keller, L., West, S.A. & **Roze, D.** 2007. Group selection and kin selection : two concepts but one process. *Proceedings of the National Academy of Sciences of the USA*, 104: 6736-6739.

3) Points forts des activités ne relevant pas de la production scientifique :

Encadrement de deux stagiaires de Master II (spécialité Ecologie-Biodiversité-Environnement) en 2012 (Marie Rescan, Alexandre Blanckaert).

Enseignements dans le cadre de la licence Biologie-Mathématiques (Roscoff) et du Master EBE.

Organisation d'une conférence Jacques Monod en 2013 (Recent progress on the evolution of sex and genetic systems), avec Tanja Schwander (Université de Groningen).

Organisation d'un symposium au congrès de l'European Society of Evolutionary Biology, en 2011 à Tübingen (Adaptation in large populations, avec Nicolas Bierne).

Participation à la chaire Modélisation Mathématique et Biodiversité (Museum National d'Hisoire Naturelle, Ecole Polytechnique).

Signature de la personne concernée par cette fiche d'activité

Je certifie n'avoir demandé mon rattachement qu'à une seule unité de recherche.

Date : 12/07/2012 Signature :

Signature du responsable de l'unité de recherche d'appartenance en 2012

Date : 31/08/2012 Signature :

agence d'évaluation de la recherche et de l'enseignement supérieur

Pontificia Universidad Católica de Chile

2.3. Fiche individuelle d'activité

Von DASSOW Peter

Unité de recherche d'appartenance en 2012 : *(label et n°, intitulé, établissement principal, responsable)* Departamento de Ecología, Facultad de Ciencias Biológicas, Pontificia Universidad Católica de Chile.	**Unité soumise à une reconnaissance prenant effet 1er janvier 2014 :** *(intitulé, établissement support, responsable*) Unité Mixte Internationale Evolutionary Biology and Ecology of Algae Myriam Valero

Nom : von Dassow
Prénom : Peter
Date de naissance : 31 Mars 1974
Courriel : pvondassow@bio.puc.cl

Établissement d'affectation ou organisme d'appartenance : Pontificia Universidad Catolica de Chile

Enseignant-chercheur	■	Thèse soutenue	■	HDR (Equivalent)	■	Corps-grade : Professeur Assistant
Bénéficiaire de la PES :	☐					
Membre IUF junior senior	☐ ☐					
Chercheur	☐	Thèse soutenue	☐	HDR	☐	Corps-grade :
Ingénieur	☐	Thèse soutenue	☐	HDR	☐	Corps-Grade :
Cadre scientifique ou autre personnel ayant une activité de recherche : Préciser :		Thèse soutenue	☐	HDR	☐	Corps grade :

Situation particulière :
(délégation, détachement, mise à disposition, etc.)

Domaine scientifique principal :

☐ 1 Sciences de l'homme et de la société
☐ 2 Sciences et technologies
■ 3 Sciences de la vie et de l'environnement

Rattachement scientifique :

Pontificia Universidad Católica de Chile

1) Points forts des activités de recherche et résultats marquants :

My research activities are related to how life cycles, on-going genome evolution, physiology, and biological oceanography of phytoplankton influence their functional roles and adaptations to new or changing environments:

- The life cycle of coccolithophores, specifically focused on understanding the possible role of the haploid phase in the ecology of the organism through comparative transcriptomics, genomics, and physiology experiments (von Dassow et al. 2009; FONDECYT postdoctoral project of Dr. Daniella Mella, start date 2011).
- Effects of ocean acidification on calcification and understanding the molecular mechanisms of calcification in coccolithophores (Iglesias-Rodriguez et al. 2008; Richier et al. 2011; Mackinder et al. 2011).
- Genome evolution and variability of life cycles in phytoplankton (von Dassow et al. 2008; Bowler et al. 2008; Worden et al. 2009; Koester et al. 2010; Cock et al. 2010; von Dassow and Montressor 2011; Read et al. in review)

- The loss of the life cycle in some open ocean populations, but retention of the life cycle in coastal populations, of the cosmopolitan coccolithophore *Emiliania huxleyi* has implications for understanding how phytoplankton may adapt to changing oceans (FONDECYT project 1110575, start date 2011; FONDECYT postdoctoral project of Dr. Daniella Mella, start date 2011).
- Advanced flow cytometric techniques for distinguishing and analyzing phytoplankton (von Dassow et al. *in press*).

I am also investigating the occurrence of a noxious bloom of the macro-alga *Ulva* in a coastal bay of central Chile (Algarrobo), which is the subject of two undergraduate theses under my supervision or co-supervision (Wesselmann and Serramalera, both in 2012).

2) Production scientifique :

I have produced a total of 23 scientific publications. Since 2006 I have been author or co-author of 14 published papers, one in press, and one in revision on the 5 points emphasized above. These are listed here :

1. Chepurnov, V. A., Mann, D., von Dassow, P., Armbrust, E. V., Sabbe, K., Dasseville, R., Vyverman, W. (2006) Oogamous reproduction, with two-step auxosporulation, in the centric diatom *Thalassiosira punctigera* (Bacillariophyta). Journal of Phycology 42: 845-858.
2. von Dassow, P., Chepurnov, V. A., and Armbrust, E. V. (2006). Relationships between growth rate, cell size, and induction of spermatogenesis in the centric diatom *Thalassiosira weissflogii* (Bacillariophyta). Journal of Phycology 42: 877-899.
3. Iglesias-Rodriguez, M. D., Halloran, P. R., Rickaby, R. E. M., Hall, I. R., Colmenero-Hidalgo, E., Gittins, J. R., Green, D. R. H., Tyrrell, T., Gibbs, S. J., von Dassow, P., Rehm, E., Armbrust, E. V., and Boessenkool, K. P. 2008. Phytoplankton calcification in a high CO2 world. Science 320: 336-340
4. von Dassow, P., Petersen, T. J., Chepurnov, V., and Armbrust, E. V. 2008. Inter- and intraspecific relations between nuclear DNA content and cell size in selected members of the diatom genus *Thalassiosira* (Bacillariophyta). Journal of Phycology 44: 335-349.
5. Chepurnov, V. A., Mann, D. G., Sabbe K., Vanormelingen, P., von Dassow, P., and Vyverman, W. 2008. In search of a tractable diatom for experimental biology and genomics. BioEssays 30: 692-702.
6. Bowler, C., Allen, A. E., Badger, J. H., Grimwood, J., Jabbari, K., Kuo, A., Maheswari U., Martens, C., Maumus, F., Otillar R. P., Rayko, E., Salamov, A., Vandepoele, K., Beszteri, B., Gruber A., Heijde, M., Katinka, M., Mock, T., Valentin, K., Vérret, F., Berges, J. A., Brownlee, C., Cadoret, J.-P., Chiovitti, A., Choi, C. J., Coesel, S., De Martino, A., Detter, J. C., Durkin, C., Falciatore, A., Fournet, J., Haruta, M., Huysman, M., Jenkins, B. D., Jiroutova, K., Jorgensen, R. E., Joubert, Y., Kaplan, A., Kroeger, N., Kroth, P., La Roche, J., Lindquist, E., Lommer, M., Martin-Jézéquel, V., Lopez, P. J., Lucas, S., Mangogna, M., McGinnis, K., Medlin, L. K., Montsant, A., Oudot-Le Secq, M.-P., Napoli, C., Obornik, M., Petit, J.-L., Porcel, B. M., Poulsen, N., Robison, M., Rychlewski, L., Rynearson, T. A., Schmutz, J., Schnitzler Parker, M., Shapiro, H., Siaut, M., Stanley, M., Sussman, M. J., Taylor, A., Vardi, A., von Dassow, P., Vyverman, W., Willis, A., Wyrwicz, L. S., Rokhsar, D. S., Weissenbach, J., Armbrust, E. V., Green, B. R., Van de Peer, Y., Grigoriev, I. V. 2008. The *Phaeodactylum* genome reveals the dynamic nature and multi-lineage evolutionary history of diatom genomes. Nature 456: 239-244.
7. Lakeman, M. B., von Dassow, P., and Cattolico, R. A. 2009. The strain concept in phytoplankton ecology. Harmful Algae. 8: 746-758.
8. Worden A. Z., Lee J.-H., Mock, T., Rouzé, P., Simmons, M. P., Aerts, A. L., Allen, A. E., Cuvelier, M. L., Derelle, E., Everett, M. V., Foulon, E., Grimwood, J., Gundlach, H., Henrissat, B., Napoli, C., McDonald, S. M., Parker, M. S., Rombauts, S., Salamov, A., von Dassow, P., Badger, J. H., Coutinho, P. M., Demir, E., Dubchak, I., Gentemann, C., Eikrem, W., Gready, J. E., John, U., Lanier, W., Lindquist, E. A., Lucas, S., Mayer, K. F. X., Moreau, H., Not, F., Otillar, R., Panaud, O., Pangilinan, J., Paulsen, I., Piegu, B., Poliakov, A., Robbens, S., Schmutz, J., Toulza, E., Wyss, T., Zelensky, A., Zhou, K., Armbrust, E. V., Bhattacharya, D., Goodenough, U. W., Van de Peer, Y., Grigoriev, I. V. 2009. Green evolution and dynamic adaptations revealed by genomes of the marine picoeukaryotes *Micromonas*. Science. 324: 268-272.
9. von Dassow, P., Ogata,, H., Probert, I., Da Silva, C., Claverie, J.-M., Audic, S., Wincker P., de Vargas, C. 2009. Unveiling the hidden life of a very visible phytoplankton cell: Deep transcriptomic comparison of 1N and 2N life phases of the bloom-forming coccolithophorid *Emiliania huxleyi*. Genome Biology. 10:R114.
10. Koester, J., Swalwell, J., von Dassow, P., Armbrust, E., V. 2010. Genome size differentiates co-occurring populations of the planktonic diatom *Ditylum brightwellii* (Bacillariophyta). BMC Evolutionary Biology. 10:1.
11. Cock J. M, Sterck, L., Rouzé, P., Scornet, D., Allen, A. E., Amoutzias, G. Anthouard, V., Artiguenave F., Aury, J.-M., Beszteri, B., Billiau, K., Bonnet, E., Bothwell, J. H., Bowler, C., Boyen, C., Brownlee, C., Carrano, C. J., Charrier, B., Coelho, S. M., Collén, J., Corre, E., Delage, L., Delaroque, N., Dittami, S. M., Doulbeau, S., Elias, M., Farnham, G., Gachon, C. M. M., Gschloessl, B., Heesch, S., Jabbari, K., Jubin, C., Kawai, H., Kimura, K., Kloareg, B., Küpper, F. C., Lang, D., Le Bail, A., Leblanc, C., Lerouge, P., Lohr, M., Lopez, P. J., Martens, C., Maumus, F., Michel, G., Miranda-Saavedra, D., Morales, J., Moreau, H., Motomura, T., Nagasato, C., Nelson, D. R., Nyvall-Collén, P., Peters, A. F., Potin, P., Poulain, J., Quesneville, H., Read, B., Rensing, S. A., Ritter, A., Rousvoal, S., Samanta, M., Samson, G., Schroeder, D., Ségurens, B., Strittmatter, M., Tonon, T., Tregear, J., Valentin, K., von Dassow, P., Yamagishi, T., Van de Peer, Y., Wincker, P. 2010. The *Ectocarpus* genome and the independent evolution of multicellularity. Nature. 465: 617-621.
12. Richier, S., Fiorini, S., Kerros, M.-E., von Dassow, P. and Gattuso, J.-P. 2011. Response of the calcifying coccolithophore *Emiliania huxleyi* to low pH/high pCO_2: from physiology to molecular level. Marine Biology. 158: 551-560.
13. von Dassow, P., Montresor, M. 2011. Unveiling the mysteries of phytoplankton life cycles: Patterns and opportunities behind complexity. Journal of Plankton Research. 33:3-12.

14. Mackinder, L., Wheeler, G., Schroeder, D., von Dassow, P., Riebesell, U., and Brownlee, C. 2011. Expression of biomineralization related ion transport genes in *Emiliania huxleyi*. Environmental Microbiology and Environmental Microbiology Reports. 13(12): 3250-3265.
15. von Dassow, P., van den Engh, G., Iglesias-Rodriguez, M. D., Gittins, J. R. In press. Calcification state of coccolithophores can be assessed by light scatter depolarization measurements with flow cytometry. Journal of Plankton Research.
16. Betsy A. Read, Jessica Kegel, Mary J. Klute, Alan Kuo, Stephane C. Lefebvre, Florian Maumus, Christoph Mayer, John Miller, Andy Allen, Kay Bidle, Mark Borodovsky, Chris Bowler, Colin Brownlee, Jean-Michel Claverie, J. Mark Cock, Colomban de Vargas, Marek Elias, Stephan Frickenhaus, Vadim N. Gladyshev, Karina Gonzalez, Marco Groth, Chittibabu Guda, Ahmad Hadaegh, Emily K. Herman, Deborah Iglesias-Rodriguez, Bethan Jones, Tracey Lawson, Florian Leese, Yao-Cheng Lin, Erica Lindquist, Alexei Lobanov, Susan Lucas, Shehre- Banoo Malik, Mary E. Marsh, Thomas Mock, Adam Monier, Bernd Mueller-Roeber, Johnathan Napier, Hiroyuki Ogata, Antonio Pagarete, Micaela Parker, Ian Probert, Hadi Quesneville, Christine Raines, Stefan Rensing, Diego Mauricio Riano-Pachon, Sophie Richier, Sebastian Rokitta, Asaf Salamov, Analissa F. Sarno, Jeremy Schmutz, Declan Schroeder, Yoshihiro Shiraiwa, Darren M. Soanes, Klaus Valentin, Mark van der Giezen, Yves Van der Peer, Frederic Verret, Peter von Dassow, Thomas M. Wahlund, Glen Wheeler, Bryony Williams, Willie Wilson, Gordon Wolfe, Louie L. Wurch, Jeremy Young, Joel B. Dacks, Charles F. Delwiche, Sonya Dyhrman, Gernot Glöckner, Uwe John, Thomas Richards, Alexandra Z. Worden, Xiaoyu Zhang and Igor V. Grigoriev. *In revision*. Emiliania's pan genome drives the phytoplankton's global distribution. Nature.

3) Points forts des activités ne relevant pas de la production scientifique :

- **Rayonnement et attractivité académiques**

- Organizer, coordinator of session "Phytoplankton Life Cycles" at the ASLO Ocean Sciences Meeting 2010.

- Organizer of workshop: Comparative genomics and functional significance of the sexual phase in eukaryotic phytoplankton. 2007. Barcelona, Spain.

- Invited speaker at 4 workshops: *Emiliania huxleyi* genome pre-jamboree (Roscoff, France, 2007); Targeted Sequencing (Roscoff, France, 2007); Rennes Bioinformatic Meeting (Rennes, France, 2009); Reunion Souchothéque (Roscoff, France, 2009); BD Biosciences Environmental Biology Workshop (Institut de Ciènces del Mar- CMIMA, CSIC. Barcelona, Spain, 2010).

- Invited speaker at symposiums and seminars: Simposio "Evolución de ciclos de vida y reproducción" in the Reunión Anual de la Sociedad de Biología de Chile y la Reunión Anual de la Sociedad Chilena de Evoución. (Santa Cruz, Chile, 2010); seminars at Stazione Zoologica Anton Dohrn (Naples, Italy, 2009), Institute de Ciències del Mar (Barcelona, Spain, 2007), Universidad Católica del Norte (Coquimbo, Chile, 2010).

- External member of the jury for two PhD theses (Catharina Alves-de-Souza, UPMC and Universidad Austral de Chile, 2011; Barbara Jacob, Universidad de Concepción, 2012).

- Reviewer for many journals: *PLoS One, Journal of Plankton Research, Journal of Phycology, Marine Ecology Progress Series, Limnology and Oceanography, Limnology and Oceanography Methods, Protist, Aquatic Microbial Ecology, Cell Biology International, Deep-Sea Research II, Journal of Experimental Biology, Journal of Theoretical Biology*

- **Formation par la recherche ;**

Encadrement de Post-docs

- Dr. Daniella Mella (FONDECYT post-doctoral grant 3120014, 2011-2014).

Encadrement de Stages de Licenciatura (équivalent stage Master 1)

- A la PUC: Yerritza Herrera (2012)

- PUC-exchange with Universitat de Barcelona: Marlene Wesselmann (2012) and Leticia Serramalera (2012)

- Dans d'autres universités: Fiona Roche (2008, Master 1, UPMC).

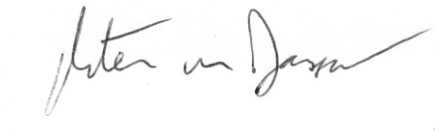
- **Responsabilités administratives et scientifiques**

- Member ad hoc committee on strengthening the Marine Biology Curriculum of the PUC

- External reviewer for FONDECYT (Chile, 2011-2012), CONICYT (Chile, 2010), National Environmental Research Council (UK, 2010), Fondo Clemente Estable - ANII (Uruguay, 2012).

Signature de la personne concernée par cette fiche d'activité

Je certifie n'avoir demandé mon rattachement qu'à une seule unité de recherche.

Date : 11-09-2012 Signature : 

Signature du responsable de l'unité de recherche d'appartenance en 2012

Date : 11-09-2012 Signature : 

Vague D :
campagne d'évaluation 2012 - 2013
Dossier d'évaluation des unités de recherche

2.2. Formulaire « Projet »

intitulé complet de l'unité de recherche

intitulé en français : UMI Biologie Evolutive et Ecologie des Algues
intitulé en anglais : UMI Evolutionary Biology and Ecology of Algae (EBEA)

responsable

M./Mme	Nom	Prénom	Corps-Grade	établissement d'enseignement supérieur d'affectation ou organisme d'appartenance
Mme	Valero	Myriam	DR2	Station Biologique de Roscoff

☑ J'autorise la diffusion de mon nom sur internet (annuaire des unités de recherche)

établissement(s) de rattachement de l'unité (tutelles)

établissement(s) d'enseignement supérieur et de recherche
UPMC
établissement de rattachement : UPMC
…

organisme(s) de recherche
organisme : CNRS
département ou commission de rattachement : …29……..
…
…

préciser l'établissement ou organisme responsable du dépôt du CNRS
(sauf exception, le dossier est déposé par l'hébergeur de l'unité de recherche)

préciser le cas échéant le délégataire unique de gestion : ……

autres partenaires de l'unité (hors tutelles)

établissement(s) d'enseignement supérieur et de recherche : Pontificia Universidad Católica de Chile Universidad Austral de Chile
organisme(s) de recherche : ……
entreprise(s) : ……
autres : ……

type de demande et type d'unité demandé

☐ nouvelle unité (création « ex-nihilo »)
☐ renouvellement de l'unité *(avec ou sans changement de label)*
☑ unité issue de l'éclatement d'une unité reconnue
☐ fusion de plusieurs unités reconnues
☐ « autres »

o EA (équipe d'accueil universitaire)
o UMR mono organisme (*)
o UMR multi organismes (**)
o UP (unité propre organisme, fondation, écoles...)
UMI

(*) Unité mixte de recherche entre un seul organisme (EPST, EPIC, entreprise…) et un ou plusieurs établissements d'enseignement supérieur et de recherche
(**) Unité mixte de recherche entre plusieurs organismes (EPST, EPIC, entreprise…) et éventuellement des établissements d'enseignement supérieur et de recherche

filiation de l'unité *(éventuellement plusieurs unités)*

Etablissement de rattachement	Label(s) et n° dans le cadre du contrat précédent	Nom du responsable précédent	Intitulé de l'unité
CNRS/UPMC	UMR 7144	Lallier François	……
……	……	……	……

rattachement prévu à une école doctorale en 2014-2018
(établissement de rattachement envisagé, n° en cas de demande de renouvellement de l'ED, intitulé et responsable s'ils sont connus)
ED du Muséum
"Une unité de recherche ne participe qu'à une seule école doctorale. Toutefois, si la taille de l'unité et l'étendue du spectre scientifique le justifient, les équipes de recherche qui la composent peuvent être réparties entre plusieurs écoles doctorales." (art. 3 de l'arrêté du 7 août 2006). Dans ce cas, préciser sur le tableau suivant l'ED de rattachement de chacune des équipes internes.

participation prévue à une (exceptionnellement plusieurs) structure fédérative en 2014-2018 *(établissement, intitulé, responsable)*
GDRI "Diversity, Evolution and Biotechnology of Marine Algae"
(Chile, Brazil and France)
FR 2424

classement thématique
indiquer, en début de cellule, "P" pour le domaine scientifique principal, "S" pour le ou les domaines scientifiques secondaires éventuels
domaine(s) scientifique(s)

1 Mathématiques et leurs interactions
2 Physique
3 Sciences de la terre et de l'univers, espace
4 Chimie
5 Biologie, médecine, santé
6 Sciences humaines et humanités
7 Sciences de la société
8 Sciences pour l'ingénieur
9 Sciences et technologies de l'information et de la communication
P 10 Sciences agronomiques et écologiques

secteur(s) disciplinaire(s) *(cf. nomenclature)*
reporter les codes des secteurs par ordre d'importance :
SVE2_LS8

mots-clés *(cf. nomenclature mots-clés)*
prédéfinis : Evolutionary, population and environmental biology : evolution, ecology, population biology, biodiversity, marine biology
libres (*4 maximum*) : reproduction sexuée, génétique des populations théorique et expérimentale , biodiversité marine, écologie moléculaire

domaine applicatif, le cas échéant
indiquer, en début de ligne, "P" pour le domaine principal,
"S" pour le ou les domaines secondaires éventuels
Santé humaine et animale
P Alimentation, agriculture, pêche, agroalimentaire et biotechnologies
Nanosciences, nanotechnologies, matériaux et procédés
Technologies de l'information et de communication
Production de biens et de services & nouvelles technologies de production
Énergie nucléaire
Nouvelles technologies pour l'énergie
P Environnement (dont changement climatique)
Espace
Aménagement, ville et urbanisme
Transport (dont aéronautique) et logistique
Cultures et société
Economie, organisation du travail
Sécurité
Autre

coordonnées de l'unité
Localisation et établissement : Station Biologique de Roscoff
Numéro, voie : Plage Georges Tessier
Boîte postale : BP74
Code Postal et ville : 29682 Roscoff cedex
Téléphone : ……
Adresse électronique : ……

Date et signature du responsable de l'unité

Dossier d'évaluation des unités de recherche

2.2. Formulaire « Projet »

Ce formulaire comporte les feuilles à compléter intitulées :

Info.adm.
1. Thématiques et équipes
2.1. Personnels (FProjet)
2.2. Synthèse effectifsP
3. Surfaces

1 – Thématiques de recherche et structuration de l'unité proposée au 1er janvier 2014

N°	Intitulé de l'équipe interne (sous-composante fonctionnelle correspondant à l'organigramme de l'unité, une ligne par équipe)	Responsable	Etablissement ou organisme hébergeant l'équipe interne	Effectifs EC, chercheurs EPST et cadres scientifiques EPIC en ETPT (1)	Effectifs ITA, IATOS et non-cadres EPIC permanents en ETPT (2)	Le cas échéant, ED de rattachement des équipes internes (n°, intitulé, étab. support)	Thèmes de recherche par équipe*			
Cas d'une unité sans équipes internes : inscrire ci-contre les thèmes de recherche de l'unité. →							Evolution of sexual reproduction and	Speciation processes and the ecological and	Domestication, management of genetic resources	
Cas d'une unité comprenant des équipes internes : remplir la partie ci-dessous *Ce découpage est principalement destiné, pour les unités de grande taille, à permettre une évaluation différenciée des équipes composant l'unité.*										
E1										
E2										
E3										
E4										
E5										
SC	FR2424 Station Biologique de Roscoff	B. Kloareg								
	Si nécessaire, insérer des lignes au dessus de la ligne SC et compléter les N° : E6, E7…		**Total en ETPT**	5.50	2.50	ED SNHEE (Sciences	* *Insérer des colonnes si nécessaire*			

(1) Equivalent temps plein travaillé. Les enseignants-chercheurs et chercheurs intervenant dans plusieurs équipes internes seront décomptés au prorata des temps respectifs.
Exemples : Un EC travaillant dans une seule équipe interne = 0,5. Un EC travaillant dans deux équipes internes à égalité de temps = 0,25 dans chacune d'entre elles.
Un chercheur travaillant dans une seule équipe interne = 1. Un chercheur travaillant dans deux équipes internes à égalité de temps = 0,5 dans chacune d'entre elles.
On pourra décompter du temps dédié à la recherche, celui consacré aux autres missions confiées aux personnels concernés. Par exemple, pour la réalisation d'expertises …
Les cadres scientifiques des EPIC seront comptabilisés dans cette colonne.

(2) En équivalent temps plein travaillé. Les ITA/IATOS intervenant dans plusieurs équipes internes sont décomptés au prorata des temps respectifs.
Exemple : Un personnel à temps plein dans l'unité qui travaille dans 2 équipes internes à égalité de temps comptera 0,5 dans chacune d'entre elles (0,25 s'il est à mi-temps).

2 – Ressources humaines

2.1 - Liste nominative des personnels de l'unité de recherche (connus au 30 juin 2012)
liste proposée pour le 1er janvier 2014 (hors recrutements escomptés)
(à classer par établissement de rattachement ou, s'il en existe, par équipe interne)

Nomenclatures à respecter, voir :
feuille MenusP (corps-grade et secteurs disciplinaires)
feuille UAI_Etab_Org (UAI établissements-organismes)

Code établissement = 0753639Y/0751722P

Type d'emploi (EC, Ch, AP)	Nom	Prénom	H/F	Année de naissance (XXXX)	Corps grade (1)	Secteur disciplinaire (2)	HDR (3)	PES (4)	Fiche d'activité déposée (5)	Etablissement ou organisme où est localisée l'activité de recherche (6)	Code UAI de l'établissement ou organisme hébergeur (7)	Etablissement ou organisme employeur (8)	Code UAI de l'établissement ou organisme employeur (7)	Ministère(s) de tutelle (9)	Date d'arrivée dans l'unité (10)	N° de l'équipe interne de rattachement, le cas échéant (11)	N° des 5 productions les plus significatives dans la période évaluée (12)	Participation à l'unité en ETPT (13)
EC_tit	Destombe	Christophe	H	1957	PR2	SVE2_LS8 Ev	oui		oui	Station Biologique de	0753639Y/0751722P	UPMC	0751722P	*MESR*	sept-2001		15,3 ,8,30,29	
Ch_tit	Valero	Myriam	F	1957	DR2	SVE2_LS8 Ev	oui		oui	Station Biologique de	0753639Y/0751722P	CNRS	0753639Y	*MESR*	janv-2002		15,43,3,18,27	1.00
Ch_tit	Roze	Denis	H	1975	CR1	SVE2_LS8 Ev	non		oui	Station Biologique de	0753639Y/0751722P	CNRS	0753639Y	*MESR*	nov-2006		20,33,34,37,38	1.00
AP_tit	Coudret	Jérome	H	1980	AI	A SV	non		non	Station Biologique de	0753639Y/0751722P	CNRS	0753639Y	*MESR*	févr-2011			0.50
AP_tit	Mauger	Stéphane	H	1974	AI	A SV	non		oui	Station Biologique de	0753639Y/0751722P	CNRS	0753639Y	*MESR*	déc-2008		5, 46	1.00
Ch_aut	Couceiro Lopez	Lucia	F	1980	POST-DOC	SVE2_LS8 Ev	non		non	Station Biologique de	0753639Y/0751722P	Gouvernement Espagnol			sept-2010		5, 23	1.00
EC_aut	Faugeron	Sylvain	H	1970	Autre_EC	SVE2_LS8 Ev	oui		oui	PUCC		PUCC					sans objet (a)	
EC_aut	Correa	Juan	H	1955	Autre_EC	SVE2_LS8 Ev	oui		oui	PUCC		PUCC					sans objet (a)	
EC_aut	Von Dassow	Peter	H	1974	Autre_EC	SVE2_LS8 Ev	non		oui	PUCC		PUCC					sans objet (a)	
AP_aut	Beltran	Jessica	F		Autre_AP	SVE2_LS8 Ev	non		non	PUCC		PUCC					sans objet (a)	
EC_aut	Guillemin	Marie-Laure	F	1972	Autre_EC	SVE2_LS8 Ev	oui		oui	UACH		UACH					sans objet (a)	
	Insérer les lignes supplémentaires juste au dessus de la ligne jaune, ne pas laisser de ligne non remplie																	

ne pas supprimer cette ligne

(a) les publications de ces personnels n'apparaissent pas dans le document « 1.1. Résultats et auto-évaluation » voir fiches individuelles
(1) Respecter la nomenclature de la feuille MenusR.
(2) Utiliser les secteurs disciplinaires AERES (ou les catégories BAP pour les emplois administratifs) de la feuille MenusR.
(3) Inscrire « oui » dans les cases correspondant aux personnels habilités à diriger des recherches.
(4) Inscrire « oui » dans les cases correspondant aux personnels titulaires de la prime d'excellence scientifique au 30 juin 2012.
(5) Inscrire « oui » pour les personnes ayant fourni la fiche individuelle d'activité.
(6) Etablissement mettant à disposition de l'unité une surface consacrée à la recherche (cf. feuille 3), ou établissement support.
(7) Sélectionner l'établissement d'enseignement supérieur et de recherche dans la liste ci-dessus pour afficher le code correspondant ou se reporter aux listes de la feuille « UAI Etab Org » pour les autres établissements, les organismes, les fondations, etc.
(8) Pour les enseignants-chercheurs : Etablissement d'enseignement supérieur et de recherche figurant sur l'arrêté d'affectation. Pour les autres personnels : organisme ou établissement employeur.
(9) Voir nomenclature proposée en bas de la colonne (en cas de tutelles multiples, il est possible de compéter la saisie, ex. MESR, MCC).
(10) Mois et année.
(11) Le menu associé correspond à la liste des équipes de la feuille « 1. Thématiques et équipes » (en cas de multi-appartenance, il est possible de compléter la saisie, ex. E1-E4)
(12) Inscrire les numéros permettant d'identifier les productions dans la liste figurant dans le document « 1.1. Résultats et auto-évaluation » ; ces numéros seront séparés par des virgules.
(13) Cette colonne n'a pas à être renseignée pour les enseignants-chercheurs, mais seulement pour les chercheurs et autres personnels. Inscrire la part du temps d'activité passée dans l'unité (1 = temps complet dans l'unité ; 0,5 = mi-temps dans l'unité etc…). Exemple : Un personnel administratif ou technique qui travaille à temps plein, mais partage ce temps à égalité entre 2 unités de recherche, comptera 0,5 dans chacune d'entre elles (0,25 s'il est à mi-temps ; 0,4 s'il est à 80%).

MESR
MAP
MCC
SANTE
MINEFI
MEDDTL
MEN
SPORTS
INTERIEUR
DEFENSE

établissement-organisme	Nombres de personnes titulaires (ou stagiaires)									ETPT					
de recherche de l'UR	EC	HDR	Produis-ants	Ch	HDR	Produisants	AP	HDR	Produisants	EC	Produisants	Ch	Produisants	AP	Produisants
Station Biologiqe de Roscoff CN	1	1	1	2	1	2	2	0	1			2.00	2.00	1.50	1.00
Total titulaires	**1**	**1**	**1**	**2**	**1**	**2**	**2**	**0**	**1**	**0.00**	**0.00**	**2.00**	**2.00**	**1.50**	**1.00**

établissement-organisme	Nombres de personnes d'autres statuts (CDD, retraités…)									ETPT					
de recherche de l'UR	EC	HDR	Produis-ants	Ch	HDR	Produisants	AP	HDR	Produisants	EC	Produisants	Ch	Produisants	AP	Produisants
Station Biologiqe de Roscoff				1	0	1						1.00	1.00		
PUCC_	3	2	3				1	0	0						
UACH_	1	1	1												
Total autres	**4**	**3**	**4**	**1**	**0**	**1**	**1**	**0**	**0**	**0.00**	**0.00**	**1.00**	**1.00**	**0.00**	**0.00**

établissement-organisme	Nombres de personnes titulaires (ou stagiaires)									ETPT					
de l'emploi	EC	HDR	Produisants	Ch	HDR	Produisants	AP	HDR	Produisants	EC	Produisants	Ch	Produisants	AP	Produisants
UPMC_0751722P	1	1	1												
CNRS_0753639Y				2	1	2	2	0	1			2.00	2.00	1.50	1.00
Total titulaires	**1**	**1**	**1**	**2**	**1**	**2**	**2**	**0**	**1**	**0.00**	**0.00**	**2.00**	**2.00**	**1.50**	**1.00**

établissement-organisme	Nombres de personnes d'autres statuts (CDD, retraités…)									ETPT					
de l'emploi	EC	HDR	Produisants	Ch	HDR	Produisants	AP	HDR	Produisants	EC	Produisants	Ch	Produisants	AP	Produisants
Gouvernement Espagnol_				1	0	1						1.00	1.00		
PUCC_	3	2	3				1	0	0						
UACH_	1	1	1												
Total autres	**4**	**3**	**4**	**1**	**0**	**1**	**1**	**0**	**0**	**0.00**	**0.00**	**1.00**	**1.00**	**0.00**	**0.00**

3 – Surfaces recherche en m² SHON (1) prévues pour l'unité de recherche au 1er janvier 2014

Les surfaces occupées par les structures fédératives feront l'objet d'une identification spécifique dans le dossier de la structure fédérative.

Etablissement(s) d'enseignement supérieur et/ou organisme(s) prenant en charge des coûts d'infrastructures « recherche » de l'unité	Ventilation des surfaces en m²
Etablissement de rattachement : *CNRS*	à définir[1]
Etablissement de rattachement : *UPMC*	à définir[1]
Etablissement de rattachement : …….	
Organisme de recherche : …...	
Organisme de recherche : …...	
Autres (AP-HP, CHU, CHR, autre à préciser) : …….	
TOTAL des surfaces	

[1] Ces questions n'ont pas encore été résolues sur le site de Roscoff. La consigne a donc été donnée de remplir "à définir" pour chaque porteur de projet

(1) Surface hors œuvre nette. Surface SHON = surface utile x 1,4.

Projet Unité Mixte Internationale : "Evolutionary Biology and Ecology of Algae"

Résumé et liste des publications des partenaires impliqués dans le projet

Partenaires:

France: CNRS INEE, UPMC ; Chili : Pontificia Universidad Católica de Chile (PUCCh), Universidad Austral de Chile (UACh)

Ce projet s'appuie sur une collaboration solide avec la PUCCh. Initiée en 1997 (PICS-CNRS, projets ECOS-CONYCIT, projet Européen INCO DEV) cette collaboration a abouti à la création d'un LIA en 2004 entre le CNRS, l'UPMC et la PUCCh. De 2004 à 2011, ce laboratoire sans mur a permis la mise en place de nombreux échanges d'étudiants, de chercheurs et d'enseignants-chercheurs (total 62 voyages, soit 7.75/ans en moyenne), la soutenance de 6 thèses en co-tutelle, une production scientifique soutenue (62 publications et 73 présentations dans des congrès) et l'obtention de projets de recherche (ANRs, FONDECYTs et Européens). Cette collaboration est à l'origine du recrutement de 5 professeurs en biologie évolutive dans le domaine marin au sein de trois universités chiliennes différentes, ce qui a permis la mise en place d'un réseau de recherche dans ce domaine. De plus, elle a contribué à la mise en place d'enseignements communs entre la PUCCh et l'UPMC.

Objectifs

L'objectif de l'UMI est centré sur l'étude des traits d'histoire de vie et leur évolution afin de comprendre les limites écologiques et évolutives de l'adaptation. L'originalité du projet est de regrouper des compétences dans différents domaines : écologie, évolution, génétique des populations, interactions durables, océanographie et phycologie en alliant approches théoriques et expérimentales. L'autre originalité du projet est de s'intéresser à des algues marines à cycles particuliers caractérisés par la coexistence individus haploïdes et diploïdes et une grande variation dans les modes de reproduction (autofécondation, allofécondation et pathénogénèse …). Il s'agit de modèles très originaux parmi lesquels certains génomes ont été entièrement séquencés (algue brune : *Ectocarpus siliculosus* et algue rouge : *Chondrus crispus*) permettant ainsi d'utiliser la génomique des populations pour étudier la dynamique et la structure des populations, ainsi que l'histoire évolutive des populations et des espèces : la spéciation, l'adaptation, les pressions de sélection agissant sur l'évolution des génomes. De par sa dimension géographique, ce projet permet de tester la généralité des processus évolutifs en comparant des espèces dans des écosystèmes similaires mais avec des histoires naturelles différentes. De plus, les côtes Chiliennes présentent des caractéristiques géographiques et écologiques tout à fait remarquables pour étudier les questions clés de notre projet sur les limites écologiques et l'adaptation : fort gradient latitudinal, effet d'El Niño, milieu très oligotrophe. D'un point de vue économique, le Chili est un des premiers pays producteur d'algues au monde et la création de l'UMI constituera donc un véritable atout pour l'étude des espèces d'intérêt économique. Dans ce contexte, les recherches en aquaculture sont en plein essor actuellement en Europe, en Asie et en Amérique Latine avec pour objectif la mise en place de cultures d'algues. Le projet d'UMI s'intègre donc logiquement en amont de cette recherche (connaissances fondamentales sur les traits d'histoire de vie et leur variation, évaluation des

ressources génétiques, domestication et impacts environnementaux) et il se trouve fortement impliqué dans le projet ANR Bioressource « IDEALG » développé au sein de la station Biologique de Roscoff (un projet Fondap regroupant plusieurs institutions chiliennes, sera soumis courant 2012 sur ces aspects liés à l'aquaculture). Enfin, la collaboration internationale mise en place dans l'UMI va permettre d'intensifier les échanges vers l'Europe et vers l'Amérique Latine et nous travaillons parallèlement à la mise en place de nouvelles collaborations vers le Brésil via l'écriture d'un projet de GDRI.

Ce projet d'UMI s'intègre parfaitement dans les projets de la Station Biologique de Roscoff (EMBRC France et Europe) lui donnant une ouverture vers l'Amérique Latine. Il s'appuie sur les compétences et les Infrastructures de la Fédération de Recherche (Bioinformatique, Génomiques, Centre de Ressource Biologique, Moyens à la mer) et des deux Universités Chiliennes (Centre d'Ecologie, Stations Marines de Las Cruces et de Valdivia, dispositifs en aquaculture).

Les différents axes de recherche :

Le projet de recherche se structure autour de 3 axes de recherches

1. Evolution des systèmes de reproduction et des cycles de vie, et leurs conséquences sur la structuration de la diversité génétique.
    a. Etudes théoriques sur les pressions sélectives favorisant la reproduction sexuée et l'importance relative des phases haploïde et diploïde du cycle de vie; évolution expérimentale sur espèce(s) à cycle rapide.
    b. Variations spatio-temporelles de la diversité génétique chez des espèces à cycle complexe (études théoriques et empiriques)
2. Comprendre les processus de spéciation et les limites écologiques et évolutives de l'adaptation par une double approche théorique et empirique
3. Aspects sociétaux : conservation de la biodiversité, gestion des ressources et domestication

Les méthodes et les outils :

- Expérimentation en conditions contrôlées (Salles de culture et chambres de culture, Plateforme de microscopie)
- Echantillonnage, suivis et expérimentation en milieu naturel (Accès à l'estran, moyens à la mer, gestion des collections de culture, projets EMBRC-France et OBLIC)
- Génotypage et séquençage (Plateforme de Génomique)
- Modélisation (Plateforme de Bioinformatique).

La composition des équipes :

Une trentaine de personnes dont 8,5 permanents

4,5 permanents à Roscoff :
Christophe Destombe (Prof), Denis Roze (CR1), Stéphane Mauger (AI), Myriam Valero (DR2), Jérôme Coudret (AI, 50%)

4 permanents au Chili :

Juan Correa (Prof, PUCCh), Sylvain Faugeron (Ass. Prof, PUCCh), Peter von Dassow (Ass. Prof, PUCCh) et Marie-Laure Guillemin (Ass. Prof, UACH).

Production et rayonnement 2007-2012 :

- Publications internationales :
  - Equipe BEDIM : 41 articles publiés de rang A (publiés ou sous presse) soit 2,3 articles par an et par chercheur
  - Equipes Chiliennes : 62 articles de rang A (publiés ou sous presse) soit 2,6 articles par an et par chercheur
  - Publications co-signées entre équipes françaises et chiliennes dans le cadre du LIA: 23 articles de rang A
- Implication dans l'enseignement et dans des actions de diffusion de l'information scientifique envers différents publics
  - Les enseignants chercheurs venant des 3 universités sont responsables de différents modules d'enseignement (Ecologie et Evolution, Génétique et Génétique des Populations, Océanographie Physique et Biologique, Phycologie)
  - Rédaction de chapitre dans deux ouvrages (cours et vulgarisation)
  - Conférences grand public, fête de la science, Nuit des chercheurs, pôle mer et participation à diverses réunions avec les gestionnaires et industriels (ECOKELP)
- Participation et coordination de projets scientifiques 2007-2012 :
  - Equipe BEDIM : Participation à 7 ANR (dont une en coordination) avec trois qui débutent fin 2011 ou 2012 et à 2 projets européens (projet Infrastructure I3 « ASSEMBLE » FTP7 (2009- 2013) et projet INTERREG IV « MARINEXUS » (2010-2013))
  - Equipes Chiennes : Participation à 7 FONDECYT (dont trois en coordination), 1 projet Iniciativa Cientifica Milenio MIDEPLAN, 2 projets Instituto Antártico Chileno (INACH), et 3 ANR
  - Dans trois des projets ANR obtenus, les équipes françaises et chiliennes du projet d'UMI sont impliquées officiellement: ECOKELP (2007-2011), IDEALG (2011-2021), CLONIX (2012-2015)
- Administration de la recherche :
  - Implication forte dans des actions d'évaluation et administration de la recherche comme par exemple la Section 29 du Comité National et la section 67 du CNU

Liste de Publications dans des revues de rang A, 2007-2012 :

* : publication des équipes chiliennes, [μ]: publication des équipes françaises**, ° : publication en collaboration entre les équipes chiliennes et françaises dans le cadre du LIA DIAMS**

2007

1. [μ] Coelho S., Peters A.F., Charrier B., Roze D., Destombe C., Valero M. & Cock J.M. (2007)**.** Complex life cycles of multicellular eukaryotes: new approaches based on the use of model organisms, *Gene.* 406, 152-170.
2. *Contreras, L., G. Dennett, A. Moenne, R.E. Palma & J. A. Correa (2007). Molecular and morphologically distinct Scytosiphon species (Scytosiphonales, Phaeophyceae) display similar antioxidant capacities. J. Phycol. 43: 1320-1328.
3. *Contreras, L., Medina, M.H., Andrade, S., Oppliger, V. & Correa, J.A. (2007) Effects of copper on early developmental stages of Lessonia nigrescens Bory (Phaeophyceae). Environ. Poll. 145: 75-83.
4. [μ] Engel, C.R., Guillemin, M.L., Jacob, A.M., Valero, M., Viard, F. (2007). Isolation of microsatellite loci from the kelp, *Saccorhiza polyschides* (Heterokontophyta, *incertae sedis*). *Molecular Ecology Resources*. 8, 406–408
5. *Gómez R.*, J.J. Magaña, B. Cisneros, E. Pérez-Salazar, S. Faugeron, D. Véliz, C. Castro, J. Rubio, L. Casas, M. Valdés-Flores. (2007). Association of the estrogen receptor α gene polymorphisms with osteoporosis in the Mexican population. Clinical Genetics 72: 574-581.
6. [μ] Haag, C.R. & Roze, D. (2007). Genetic load in sexual and asexual diploids : segregation, dominance and genetic drift. *Genetics*, 176: 1663-1678.
7. *Hernandez-Gonzalez, M.C., A.H. Buschmann, M. Cifuentes, J.A. Correa & R. Westermeier. (2007) Vegetative propagation of the carrageenophytic red alga Gigartina skottsbergii Setchell et Gardner: Indoor and field experiments. Aquaculture 262: 120-128..
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