

Rentrée 2021

PROPOSITION DE SUJET DE THESE

Formulaire demande de financement : ARED - ISblue - ETABLISSEMENTS - ...

Project identification

Acronym (8 caractères *maximum*) : CAFRINE

Title in French : Connectivité à large échelle pour la gestion locale dans l'Océan Indien

Title in English : Connectivity at lArge scale FoR local management in INdian ocEan

Thesis supervision

Host Research Unit : UMR AMURE (6308)

Head of research unit : Gaëlle Guéguen-Hallouet

Main Proponent (supervisor) : Lindwood Pendleton

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- Publications

1. Pendleton, L. Evans, K. and M Visbeck. 2020. Opinion: We need a global movement to transform ocean science for a better world. Proceedings of the National Academy of Sciences 117 (18), 9652-9655
2. Pendleton, L., Beyer, H., Estradivari, Grose, S., Hoegh-Guldberg, O. Karcher, D., Kennedy, E., Llewellyn, L., Nys, C., Shapiro, A., Jain, R., Kuc, K., Leatherhead, O'Hainnin, K., Olmedo, G., Seow, L. and M. Tarsel. 2019. Disrupting data sharing for a healthier ocean. ICES Journal of Marine Science <https://doi.org/10.1093/icesjms/fsz068>
3. Pendleton L, Comte A, Langdon C, Ekstrom JA, Cooley SR, Suatoni L, et al. 2016. Coral Reefs and People in High-CO2 World: Where Can Science Make a Difference to People? PLoS ONE 11(11): e0164699. doi:10.1371/journal.pone.0164699. 899 citations.
4. Pendleton LH, Hoegh-Guldberg O, Langdon C, Comte A. 2016. Multiple Stressors and Ecological Complexity Require a New Approach to Coral Reef Research. Frontiers in Marine Science. 2016;3: 1–5. doi:10.3389/fmars.2016.00036
5. Ekstrom, J., Suatoni, L., Cooley, S., Pendleton, L. and others. 2015. Vulnerability and adaptation of US shellfisheries to ocean acidification. Nature Climate Change. 5, 207–214 (2015)

- On going and past PhD supervision

On-going :

Fanny Châles (2019-2022) Priorisation des actions océan-climat dans les contributions nationales déterminées des petits états insulaires en développement : le cas des îles du pacifique sud. Financement: 50 % région Bretagne - 50 % ISBLUE. Co-encadrant : Denis Bailly.

Past :

1. Maxime Sèbe - 2020 - "An interdisciplinary approach to the management of whale ship collisions". Co-encadrants : Sophie Gourguet, Christos Kontovas. Actuellement en contrat post-doctoral
2. Fabien Riera - 2017 - " Trois classes de facteurs qui influencent le cours de la domestication des espèces marines. Une étude de cas : l'halioticulture biologique en France". Co-encadrante : Christine Paillard. Actuellement consultant indépendant.
3. Adrien Comte - 2017 - "Coral reefs ecosystem services under global environmental change : interdisciplinary

Co-supervisor : Rodolphe Devillers (Espace – Dev, IRD, Réunion)

1. Reimer, J. M., **Devillers, R.**, & Claudet, J. (2020). Benefits and gaps in area-based management tools for the ocean Sustainable Development Goal. *Nature Sustainability*, 1-9.
2. Proudfoot, B., **Devillers, R.**, & Brown, C. J. (2020). Integrating fine-scale seafloor mapping and spatial pattern metrics into marine conservation prioritization. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 30(8), 1613-1625.
3. Cominelli, S., **Devillers, R.**, Yurk, H., MacGillivray, A., McWhinnie, L., & Canessa, R. (2018). Noise exposure from commercial shipping for the southern resident killer whale population. *Marine pollution bulletin*, 136, 177-200.

Co-supervisor : Denis Bailly UMR AMURE (6308)

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Past and present co-supervision

1. Louinord Voltaire, Méthode d'évaluation contingente et Evaluation économique d'un projet de réserves naturelles dans le Golfe du Morbihan, soutenance en 2011, maître de conférences en économie à l'Université du Littoral, Dunkerque
2. Abderaouf Dribek, Vers un tourisme durable en Tunisie : le cas de l'île de Djerba, soutenance en 2012, autofinancement, expert-consultant international
3. Adrien Comte, Coral reefs ecosystem services under global environmental change : interdisciplinary approaches to guide science and action. Soutenance en 2017, consultant en bureau d'études
4. Raphaëla Le Gouvello, l'économie circulaire appliquée à un système socio-écologique halio-alimentaire localisé, soutenance en 2019, consultante internationale pour l'IUCN
5. Fanny Châles, Priorisation des actions océan-climat dans les contributions nationales déterminées des petits états insulaires en développement : le cas des îles du pacifique sud. En cours.

Project presentation in English

SUMMARY

The scientific approach of interdisciplinarity of the project is to inscribe the methodology of work in the international questioning of the governance of the Oceans to support in fine at the local scale the step of restoration of the coastal ecosystemic service to the island of the Reunion whose ecological integrity is indissociable from the plateau of the Mascareignes.

The thesis is based on two major axes, the characterization of the oceanic connectivity of migratory species of major interest at the level of the two oceanic plateaus, Mascarene and Chagos-Laccadive and the development of scenarios for the regulation of human oceanic activities and their ecological, social and economic consequences.

The first axis focuses on the characterization of the oceanic connectivity of migratory species. This will be addressed in two operational steps. A first step is the census and the collection of data of migratory species at the level of the Chagos_Laccadive hotspot. Many research teams are working on different parts of this area internationally. At present, no effort to centralize the data for operational use has been undertaken. The thesis will be a first investment in this direction. It will allow to contrast a data set at both ends of the marine biodiversity hotspots concerned. A second step is the synthesis with the results of the work conducted in recent years on the whole of the two study areas, subject and agreement, managers and / or owners concerned. Then the data processing will be done according to a methodology of exploitation of data adapted to the heterogeneous and scattered data.

The second axis concerns the development of regulation scenarios for oceanic human activities. Their ecological,

social and economic consequences will be treated from the identification of the major sets of oceanic human activities in the area and the scope of their impacts on the species studied, whether they are pressures on the coast or offshore, including the open sea. For this last point, a simulation of human activity regulations will be proposed in the form of participatory experimentation.

The participatory process of the research-action is set up within the framework of a thesis. It relies on two committees, a "science-society" committee represented by the project monitoring committee and the second "science-academy" committee represented by the research team and the thesis committee which will be constituted at the beginning of the project. Thus, the CAFRINE project provides a framework for a thesis to co-construct a participatory approach aiming at valorizing the existing data, the achievements of the local partners' projects and the possible extensions of knowledge for applications in public policy at different scales in the network that CAFRINE carries from international to local. This corresponds to the implementation of a knowledge sharing to co-create a transdisciplinary oceanic science (Ocean Knowledge At Network Project) applied to the multiple scales of the Mascarene-Chagos-Laccadive oceanic space on which Reunion Island and the South Indian Ocean maritime basin partly depend.

Detailed presentation of the project

1 – Hypothesis and state of the art

The establishment of multi-year interdisciplinary scientific research programs in the marine environment such as the PADDLE project, whose objective is to plan in a liquid world with tropical issues, or the Migratory Connectivity project (Dunn DC, Harrison A-L et al. 2019) on the production of mobilizable knowledge on the connectivity of migratory species, testifies to the difficulty of understanding coastal and oceanic ecological connectivity. Recently, the publication of an analytical work on connectivity and protection of marine biodiversity highlights that the marine biodiversity monitoring methods used do not provide a global vision (Porro B. & al, 2019). Today, it appears necessary to integrate the concept of ecological connectivity, under its different approaches (oceanographic, demographic ...) in future strategies of governance of the Oceans (Popova E & al, Dunn DC & al, 2019 ; Letessier TB & al, Lambert C., Dorémus G. and Ridoux V. 2020). With the help of the technological means of information processing of the new digital era such as Neural Network, Big Data and other modeling systems, the concept of ecological connectivity at sea should be consolidated and allow the identification and prioritization of ecological issues in future strategies to fight against climate change and against the erosion of marine biodiversity through maritime space planning and marine conservation at all scales, from international to local.

Thus, Axis I is treated under the assumptions that species migrations are indicators of global or anthropogenic change factors from the open ocean to the coast. And under the hypothesis that there is a relationship between geomorphological structures and the migratory species studied, a comparison of the frequentation of coastal and marine habitats of the Mascarene and Chagos-Laccadives coasts by species will be undertaken. How can we use the different levels of organization of ecological connectivity at the oceanic mesoscale to shed light on the pressures from the open sea to the coastline?

Then axis II, under a hypothesis of regulation of oceanic human activities, we wonder how the associated system of its implementation constraints can be modified. During this phase, different questions will be addressed:

What are the operational objectives to evaluate and predict the ecological, social and economic consequences?

What method should be used to link the ecological state of the coastline to the pressures originating from the open sea?

What indicators should be used to describe the three dimensions of sustainable ocean development?

This thesis focuses on the methodological issue of global monitoring of marine biodiversity on a large oceanic scale, particularly in the context of the implementation of Sustainable Ocean Development. The strategy of maritime planning of human activities at the regional scale of the Indian Ocean and the objectives of the Blue Economy are dependent on the progress of scientific and technological data analysis. Indeed, the existing data and results on migratory marine species such as cetaceans and sharks are heterogeneous and scattered, which makes the

interpretation and ecological understanding of the marine environment in the coastal areas of oceanic island territories difficult.

The work here also poses a challenge of sharing knowledge to co-create a transdisciplinary science applied to the space of 2 oceanic geomorphological sets of biodiversity hotspot that would deliver a "regional" co-constructed knowledge.

2 - Methodological approach and techniques envisaged:

Ecological connectivity, in particular of migratory species, is the subject of particular attention in public discussions on ocean governance. Marine ecological connectivity is addressed in different disciplinary fields in life and earth sciences and at different spatial and temporal scales. These species, such as humpback whales or sharks, have a life cycle that directs them to coastal habitats where populations will interact with them and in some cases depend on their presence in a social and economic manner. The CAFRINE participatory research project proposes to establish a framework for interdisciplinary and transdisciplinary dialogue to translate the complexity of oceanic and coastal ecological connectivity into knowledge that can be mobilized with and for society. This formal circle will promote the implementation of a process of diagnosis, sorting, analysis and sharing of existing and future data in order to contribute to the identification of conservation issues, from the open sea to the coast. In this field, as in all issues related to sustainable development, the relevance of the choices that societies will make depends strongly on the state of knowledge. However, if there is one area where knowledge is lacking, it is the interdependencies between large-scale ocean connectivity and the ecological status of coastal ecosystems. This is particularly true in the context of the Indian Ocean. The different methodologies used to monitor and measure marine biodiversity are acoustic, visual, natural tagging methods (genetic, photo-identification, eDNA...) and artificial tagging (satellite telemetry, tagging...). Thus, the assessment of these heterogeneous data and results will be discussed in a context of reproducibility and transferability of methodologies for global monitoring of marine biodiversity.

From the inventory of data and processing of existing and collected data, the physical and biological characteristics in the form of knowledge that can be mobilized at the scale of the two oceanic shelves, from the same hot spot, will be identified. A data collection is also envisaged from a transoceanic participatory science campaign from June to September and a campaign of satellite imagery collection of the same study area is also envisaged. This initiative aims to seek to coordinate traditional naturalist approaches and approaches known as advanced technologies, such as satellite imagery. The objective is to improve the robustness of naturalist data and to raise awareness of in situ coastal observers to advanced technologies by increasing the reliability of advanced technologies. It is thus envisaged an approach by an analysis of the studied area from data interpretation, experts' statements, observable practices and local knowledge.

3 - Positioning and scientific environment in the regional, national and international context:

Within AMURE, the CAFRINE project is part of a series of actions on the theme of governance of the high seas in connection with the ongoing negotiation of the agreement on biodiversity beyond national jurisdictions, known as "BBNJ", and in particular the project "Hybrid governance for the Thermal Dome and the Sargasso Sea: SARGADOM" financed by the French Global Environment Facility (FFEM). This project focuses on the development of a strengthened governance framework for two sites of major ecological interest in the Pacific and Atlantic Oceans due to their biological richness but also their functional role for many migratory species. It is built in partnership with the political authorities and management structures concerned and has recently started. The CAFRINE project constitutes a complementary site, in another region of the world ocean, with a different configuration, namely that of the interactions between the large-scale marine ecosystem and an island socio-ecosystem.

4 - Scientific and partnership context

Faced with the ecological stakes and the socio-economic and cultural developments of the French overseas territories of the Indian Ocean, the Non Governmental Organizations, the local authorities and the managers of the marine protected areas must reinforce their competences in terms of integrated management on the scale of the South maritime basin of the Indian Ocean in the continuity of the integrated management of the coastal zone

(GIZC), and of the sea and coastline (GIMEL).

Indeed, the Southern Indian Ocean Basin (OCEAN METISS Project, DiDEM Project) is subject to the impacts of anthropogenic activities such as maritime transport, cruise ships, telecommunication networks, submarine cables, research and mining, piracy and poaching, fisheries, discharges from watersheds, and impacts of natural climatic origins (cyclones,..), global changes and biodiversity loss. These impacts can then have remote consequences on part or all of the tropical continental coastal ecosystems (African; Malagasy;...) and coastal islands (Mascarene; Chagos-Laccadives ...). For example, in Reunion Island, the problems of identifying the origin of pollution diffuse reef waters, the modification of the period of migration of whales (HWWC, 2017) and the modification of the behavior of populations of Tiger and Bulldog sharks on the west coast of the island (CHARC , ECoReCoRun), raise the question of the importance and origin of the stress factor, either an influence of the oceanic basin and / or the watershed. The understanding of these events and the processes involved requires exploratory research both at the level of the coastal ecosystem of Reunion Island (Project ECOYSTEMES MARINS) and in the neighboring coastal and island ecosystems (Projects pIOT & IOT , Project MEGAFUNA) via the marine protected areas of the area for example. Consequently, the project articulates its participatory research framework with the public maritime animation policy led by the DMSOI in charge of the secretariat of the Conseil Maritime Ultramarin du Bassin (CMUB) Sud Océan Indien and the implementation of the Document Stratégique de Bassin Maritime, DSBM Sud Océan Indien (Réunion, Mayotte, TAAF). The approach to integrated management of the oceanic sub-basin requires an understanding of oceanic connectivity (ecological, oceanographic, etc.) on a larger scale than that of Reunion Island, based on the SARGADOM project network, which is working on so-called adaptive and dynamic management in a context of hybrid governance on the high seas.

The candidate

Desired profile of the candidate

Interdisciplinary background in conservation science, initial training in ecology or environmental management. Mastery of or strong interest in the management of large databases. Motivation for participatory research with local stakeholders in Reunion Island. Ability to work in the framework of international cooperation.