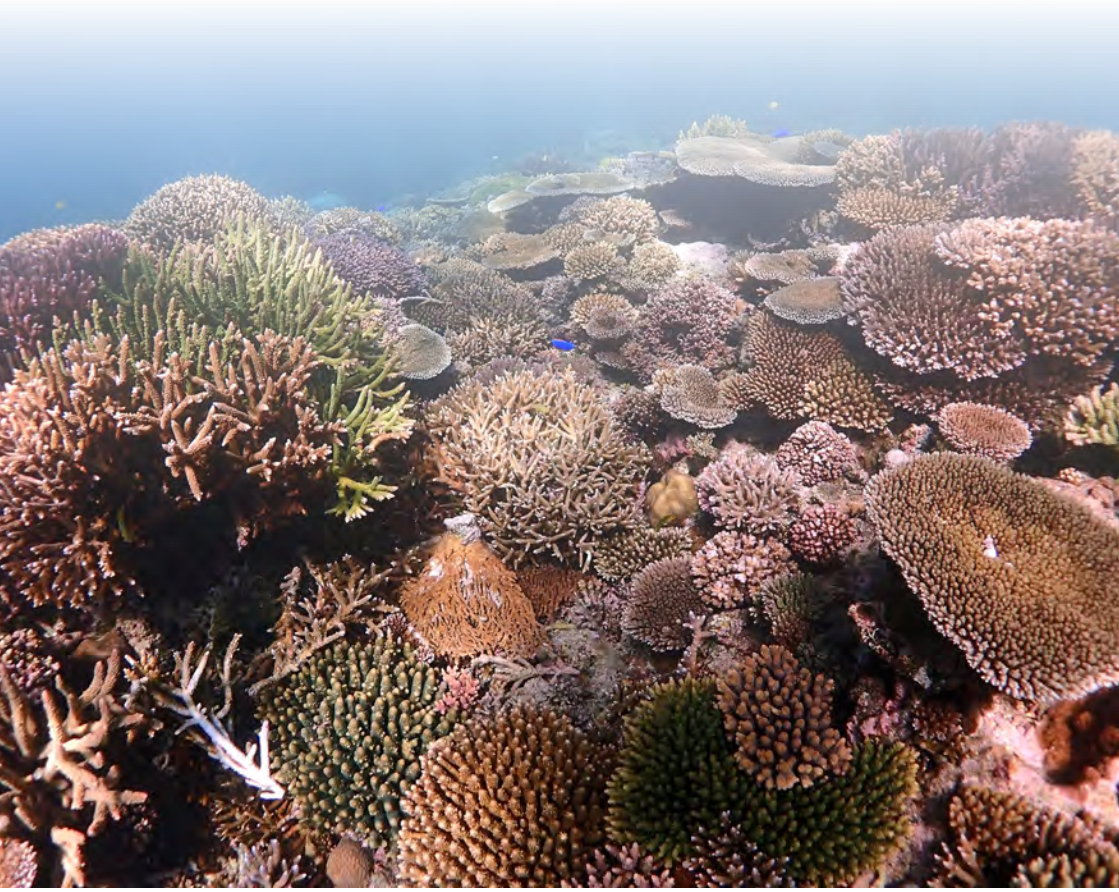
MANACO

SYMPOSIUM & WORKSHOP

Noumea, 4-6 December 2019

Seascape genomics:
a new tool to support Coral reef Management

conference book



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ManaCo | SYMPOSIUM & WORKSHOP

Seascape genomics: a new tool to support Coral reef Management

Noumea, New Caledonia

4 -6 December 2019

CONFERENCE BOOK

CONFERENCE SITE AND NEIGHBOURING HOTELS

SUMMARY

FOREWORD

In 2016, the International Coral Reef Initiative (ICRI) and the United Nations Program (UNEP) called for innovative projects to counter the global crisis that is striking coral reefs worldwide. It is in this frame that IRD, EPFL and CNRS conceived the SABLE project. SABLE stands for "A Seascape genomics Approach to improve coral reefs conservation strategies against BLEaching", a method based on the fundamental evolutionary principle of adaptation. In fact, corals already persisting in extreme environmental conditions might survive climate change, and this specific rare kind of corals is likely to exist anywhere around the world. The SABLE project aims at identifying these rare genetic variants making it possible for corals to resist to hot water temperatures and to favor their dissemination among a maximum number of populations. The corresponding proof of concept study was carried out in New Caledonia.

However, a practical application of the concept to conservation strategies is necessary. The goal of the MANACO symposium is to discuss innovation in reef conservation strategies. However, innovation in coral reef conservation can be considered under different perspectives: the methods used in Australia, Japan and in the Red Sea will be presented by three eminent keynote speakers (M. van Oppen, N. Satoh and A. Meibom). But innovation also relies in cooperation strategies and SABLE but also the MANACO initiative constitute evidences highlighting the synergistic advantages of international collaboration integrating a wide range of key competences.

The MANACO symposium welcomes coral reefs stakeholders and scientists from all around the world. The organizers of the symposium hope to set the foundations for future collaborations between the participants and their institutions. Indeed, global challenges like coral bleaching require global responses and the three days of the MANACO symposium constitute an opportunity to define ours.

Véronique Berteaux-Lecellier is a senior researcher at the French National Research Center (CNRS) and is based at the ENTROPIE Unit (CNRS, UMR 250 / 9220 ENTROPIE - IRD), in Nouméa, New Caledonia (France). Her expertise lies in molecular and cellular biology, especially in cell behavior and intra- and inter-organism communication. Her research is focusing on coral comparative genomics and symbiont diversity analysis using cutting-edge technologies.

Stéphane Joost is a senior researcher and teaching associate at the Laboratory of Geographic Information System (LASIG) at the Ecole Polytechnique Fédérale de Lausanne (EPFL). He is the leader of the landscape genetics subunit and he pioneered the field of landscape genomics. His expertise in this research field is consolidated by the substantial number of featured works that described adaptation in numerous different organisms.

OBJECTIVES

Goal: promote seascape genomics as a new element in support of reef heritage management.

Means:

1- Bring together stakeholders and scientific from South Pacific, North Pacific, Caribbean, Indian ocean and Red Sea islands and territories.

2-Create an international consortium to disseminate and develop the approach.

CONTACTS

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DAY 1 : WEDNESDAY 4 DECEMBER 2019
STATUS REPORT ON CORAL REEFS AND THEIR MANAGEMENT FOR EACH PARTICIPATING COUNTRY

7h30 Registration and Welcome coffee
8h00 Customary Welcome
8h45 Group photograph
9h00 Opening Session

❖ *Morning session: South Pacific*

9h30 **Presentation (45 mn)** p.14
Pr. Madeleine van Oppen
University of Melbourne, Australia
Designer corals and the future of coral reefs

10h15 **Coffee break**

10h30 **Short Presentations (15 min)**

Cook Islands: Dr Lara Ainley p.15
Ministry of Marine Ressources
Status and trends of live coral cover in the Cook Islands

10h45 Fiji: Dr. Stuart Kininmonth p.16
University of the South Pacific
Vicinus symbiology and the future of coral reefs

11h00 French Polynesia: Raimana Doucet p.17
Direction of Environnement
Marine protected areas and their management in French Polynesia

15h00	**Caribbean** Antilles: Dr.Malika René-Trouillefou Antilles University ***PMA in the French West Indies, a strengthened network with contrasting situations, in the context of global coral reefs decline in the Caribbean***	p.24
15h20	**Coffee break**	
15h35	**Indian Ocean** Madagascar: Pr. Jean MAHARAVO (videoconference) Oceanographic Research Station of Vangaindrano ***Status of coral reefs, protected areas and restoration plans in Madagascar***	p.25
15h50	Reunion Island: Dr. Hélène Magalon University of La Réunion Island **Long-term coral reef monitoring data for assessment and management of the Reunion island marine reserve (Southwest Indian Ocean)**	p.26
16h10	New Caledonia: Dr. Nathalie Baillon Conservatory of Natural Areas of New Caledonia) **Health Status and management of coral reefs in New Caledonia**	p.27

DAY2 : THURSDAY5 DECEMBER 2019
PRESENTATION OF THE SABLE PROJECT TRAINING AND ROUND TABLES

9h00 **Presentation of the Seascape genomics SABLE project in New Caledonia** p.30

SABLE : project, results and perspectives
O. Selmoni, H. Magalon, L. Vigliola, F. Benzoni, G. Lecellier, S. Joost and V. Berteaux-Lecellier
- ✔ Overview
- ✔ Environmental Parameters
  Site Selection
- ✔ Genetic approaches

10h00 **Coffee break**

10h30 SABLE : project, results and perspectives (part 2)
O. Selmoni, H. Magalon, L. Vigliola, F. Benzoni, G. Lecellier, S. Joost and V. Berteaux-Lecellier
- ✔ Modeling
- ✔ Innovative ways for MPAs : examples in New Caledonia and Ryukyu archipelago

11h00 **Seascape genomics pilot project in Red Sea** p.33
Pr. A. Meibom
University of Lausanne, Switzerland
The Transnational Red Sea Center

12h00 **Lunch**

13h30 **Interactive training session**

14h30 **Round tables (videoconferences)**
Round table #1: Innovation in coral reef conservation strategies.

15h30 **Coffee break**

15h45 **Short presentation:** Dr. A. Collin p.34
Ecole Pratique des Hautes Etudes - Dinard, France
Remote sensing of tropical waters: observing and modelling from 1Km to 1m

16h00 **Round table #2:** Technical advances in seascape genomics

DAY 3 : FRIDAY6 DECEMBER 2019
CONCLUSIONS AND PERSPECTIVES RESULTING FROM THIS MEETING

9h30 Creating a network of scientists and stakeholders of coral reef conservation to catalyze the cross-talk between science and policy makers and to promote this tool.

10h30 **Coffee break**

11h00 **Writing of a meeting review paper**

12h00 **Lunch**

❖ *Afternoon: Free*

13h30 ***Optional, on registration***
Visit of the New Caledonia aquarium (Aquarium des lagons)

17h–18h30 **Closing Cocktail**
at the Nouvata Hotel

DAY 1: WEDNESDAY 4 DECEMBER 2019

STATUS REPORT ON CORAL REEFS AND THEIR MANAGEMENT

FOR EACH PARTICIPATING COUNTRY

Designer corals and the future of coral reefs

Pr Madeleine VAN OPPEN
University of Melbourne, Australia
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Coral reefs have tremendous economic, biodiversity and cultural value, yet they are being lost at an alarming rate primarily due to climate warming. My team is using bioengineering approaches aimed at increasing coral climate resilience and the likelihood that coral reefs will survive this century.

These interventions include coral host hybridisation and conditioning, bacterial probiotics and directed evolution of microalgal symbionts. In my presentation I will provide an overview of the interventions we and other groups are exploring, and discuss the progress we have made in this field so far.

Professor Madeleine van Oppen is an ecological geneticist with an interest in microbial symbioses and climate change adaptation of reef corals. Her work has been published in >180 peer reviewed papers and book chapters. Her early career focused on evolutionary and population genetics of algae and fish, and subsequently corals. She obtained a PhD in the molecular ecology of algae in 1995 (U Groningen, Netherlands) and is currently an Australian Research Council Laureate Fellow with part positions at the University of Melbourne and the Australian Institute of Marine Science. Madeleine is driven by a desire to find biological solutions for mitigating the effects of climate warming that have resulted in a terrifyingly rapid loss of coral around the world.

Status and trends of live coral cover in the Cook Islands

Dr Lara AINLEY
Ministry of Marine Ressources, Cook Islands
L.Ainley@mmr.gov.ck

The Cook Islands is comprised of 15 islands spread across 2 million square kilometres of ocean and approximately 13 degrees of latitude. Every island has significant coral reef habitat which plays a fundamental role in supporting biodiversity and local communities.

These habitats are particularly susceptible to the continued environmental degradation resulting from both human pressures and the impacts of climate change. I present an overview of coral reef habitat status and trends in the Cook Islands and discuss an appetite for targeted conservation-based research, habitat restoration and sustainable management programs in the Cook Islands.

Dr Lara Ainley is a marine scientist with interests in applied science, marine resources, management and conservation. After completing a PhD in Marine Ecology in (Macquarie University, Sydney, Australia), Lara began working as Senior Marine Ecologist at the Ministry of Marine Resources in the Cook Islands.Here, Lara plays a leading role in developing and implementingmarine resource and coral reef monitoring and management activities.

Vicinus symbiology and the future of coral reefs

Dr Stuart KININMONTH
University of South Pacific, Fiji
stuart.kininmonth@usp.ac.fj

Coral Reefs are the foundation of life in the Pacific. Fiji has a vast array of coral reefs spread over an extensive archipelago. In general these are in very good condition although over fishing continues to reduce the resilience of the system. The majority of the corals have been spared temperature induced bleaching but in one case bleaching was averted with a category 5 tropical cyclone. Fiji like most of the Pacific island states does not have a regular monitoring program and relies strongly on the efforts of the NGOs. The Fijian national government is pushing for a 30% MPA by 2030 which is highly ambitious but potentially feasible.

Stuart is a Senior Lecturer at the School of Marine Studies teaching Coral Reef Ecology and Marine Spatial Planning. In 2011 he was awarded a doctorate in Philosophy from the University of Queensland under the supervision of Professor Hugh Possingham. This thesis explored the role of networks in the ecology and conservation planning of coral reefs. He has over 20 years of field experience in marine and coral reef ecology. Stuart's research focus is based on trying to understand the complex interplay between social and natural systems. To disentangle the drivers in the system he uses techniques such as emergent properties in networks and conditional probabilities in Bayesian networks. He still has active ongoing collaborations at Stockholm Resilience Centre examining the way resilience theory can be applied to socio-ecological systems.

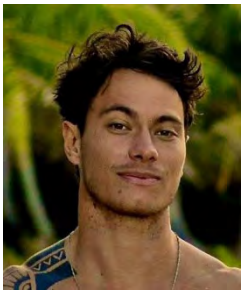
Marine protected areas and their management in French Polynesia

Raimana DOUCET
Direction de l'environnement, French Polynesia
raimana.doucet@environnement.gov.pf

The presentation will focus on the Polynesian marine protected areas and their management (laws, authorities, integrated management). Coral reefs' being the only habitat for lagoon fishes and other reef species, their protection is vital not only for the intrinsic conservation of the species but for the lagoon and marine ecosystem as a whole and for the resources for the fishermen and their outcomes.

Protected areas are regulated by the environment code of French Polynesia. This code displays an exhaustive list of all the protected areas of FP classified according to their goals within the 6 categories of protected areas.

According to their categories, management goals are likely to differ from one another, and some of them are mainly protected because of the habitats they represent.



Hi, I'm Raimana, 28 years old and working for the authority of environment of French Polynesia. I studied coastal and sea management in Montpellier, France. I've been working for the AE of French Polynesia since 2017. My main focus being the Biosphere reserve of Fakarava, I implement numerous projects in order to meet the protected areas scopes for habitat and species conservation.

The coral reef status and marine protected areas of Solomon Islands

Stephen MOSESE
Ministry of Fisheries and Marine Resources, Solomon Islands
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With 494 known coral species from 76 genera, Solomon Islands is located within the Coral Triangle Region, the region comprises the highest coral diversity in the world.
Coral reefs play an important role as a source of social, economic, food security and livelihood for many communities in Solomon Islands.
However, natural and anthropogenic impacts poses critical threat and challenges in coral management and conservation. The presentation will briefly look at the history of the coral fishery in Solomon Islands; coral reef status; management and conservation approaches, and the marine protected areas (MPAs).

Stephen Attallifo Mosese works as a Principal Fisheries Officer (PFO) in the Research Section of the Inshore Division within the Ministry of Fisheries and Marine Resources. A Bachelor in Fisheries and Marine Resources; other qualifications includes certificate in Coral Health Index Assessment, Advance SCUBA diver certificate (SSI), Fish Stock Population Dynamics, Ecosystem Approach to Fisheries Management (EAFM), etc. Core responsibilities includes; conducting scientific baseline assessment of marine resources which includes reef-fin fish, invertebrates and coral/benthic cover; stock assessment survey, and environmental impact assessment (EIA). Over the three years he has successfully engaged in a number of scientific baseline assessments within Marine Protected Areas (MPA's) in Solomon Islands. On November 2018-September 2019 he has taken the lead role in the coral assessment of Solomon Islands, a component to the National Invertebrate Survey of Solomon Islands-a survey which basically aims to provide updated information's on the stock status of key commercial invertebrates such as the giant clams, Trochus and coral species. Moreover, he was part of the team that conducted the Environmental Damage Assessment (EDA) Phase 1 of the MV Solomon Trader Oil Spill incident in Lavangu Bay in Rennell Islands, Solomon Island on July 2019the biggest Oil Spill Disaster in this region, under the supervision of lead scientist Professor Simon Albert of the University of Queensland (UQ).

Status of coral reefs, protected areas and restoration plans in Tonga

Siola'a MALIMALI
Ministry of Fisheries, Tonga
siolaamalimali@gmail.com

Historically Tonga's coral reefs have been largely understudied, with little information on their overall status. As a result of few coral reefs works in Tonga suggested a poor and unhealthy coral status throughout Tonga. In 2016-2018 ecological surveys of reef condition were conducted at 300 sites across the country as part of Patrick Smallhorn-West's PhD research, supported by the Tongan Ministry of Fisheries. Live coral cover increased from north to south. Mean live coral cover in Vava'u was seven percent, the lowest in the country, with widespread evidence of damage from cyclones, bleaching and poor water quality. Large urchin barrens with 0 % live coral cover were observed over large areas near the mouth of the estuarine lagoons. Average coral cover in Ha'apai was 21%, and 25 % in Tongatapu. Within Ha'apai the northern islands (Muitoa to Uiha) had widespread evidence of recent large-scale bleaching along the sheltered, western sides of the islands. The exposed southern islands of Ha'apai (Nomuka, Mango and Fonoi) had very high coral cover and were some of the healthiest reefs in the country. Coral cover in the Tongatapu lagoon, adjacent to the capital was high. However near the mouth of the Fanga'uta lagoon large urchin barrens and 0 % live coral cover was also observed.

These surveys found two broad and consistent patterns in the health of Tonga's coral reefs. First, large coral bleaching events have likely occurred in areas with low exposure to flushing by cool, oceanic waters (e.g. sheltered areas of Vava'u and Ha'apai). This is exacerbated in Vava'u and minimized Tongatapu by a 2^{o} C temperature difference which has protected the reefs of Tongatapu. Secondly, poor water quality flowing from the lagoons of Vava'u and Tongatapu (e.g. Fanga'uta) have resulted in widespread sea urchin barrens and decimated reefs, often with 0 % live coral cover. Bleaching conditions are directly associated with climate change and therefore action is needed on an international level. However, local action to improve water quality at the lagoon mouths may increase local resilience in the short-term.

Siolaa Malimali is a Fisheries Scientist at the Tonga Ministry of Fisheries, where he leads and coordinates the science activities within the Ministry of Fisheries in Tonga. After more than 20 years working at various at the fisheries sector he was appointed to head the Fisheries Science division of the Ministry of Fisheries in 2012 to date.

He played a key roles in leading the Special Management Areas (SMAs), an approach to better manage the fisheries under the community based fisheries and ecosystem management in Tonga. He also coordinates and involved with coral reefs research in relation to resource assessment such as seacucumber, marine habitats survey, community-based fisheries management, known as Special Management Areas (SMAs).

Genome Scientific Contribution to Coral Reef Preservation in Okinawa

Pr Noriyuki SATOH
Okinawa Institute of Science and Technology University, Japan
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Okinawa islands, south-western part of Japan, are surrounded by beautiful coral reefs. The coral reefs were severely damaged in 1998 but gradually being recovered. The Okinawa Prefecture has promoted the coral reef preservation project for nearly ten years, by successful plantation of approximately 150,000 coral seeds to cover 3 hectares of seashore. My research group decoded the genome of Acropora digitiferain 2011 (Nature 476: 320) and recently, in collaboration with Univ. Tokyo, has decoded genomes of 15 Acropora and 3 other coral species. The genomic informationhas been used as methodsfor better toolsof coral reef preservation. I wish to discuss here how the genomic information contributes to the present and future coral reef preservation in Okinawa, Japan.

PhD, Tokyo University in 1974. Prof. Emeritus of Kyoto University in 2009, Prof. of Okinawa Institute of Science and Technology Graduate School since 2019. Started coral genome scientific research around 2010.

Status of coral reefs (healthy and not healthy reefs), protected areas (MPAs) and restoration plans in Vanuatu

Hudson FEREMAITO
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Coral reefs are the biggest and most spectacular structures made by living organisms. Although they look permanent and indestructible, what we see is the only a thin veneer of living organisms. Vanuatu's coral reefs exhibit a range of characteristics expected of an archipelago including outer reefs, sheltered flats and lagoons, partially sheltered open embayment's and sheltered embayments. Exposed coral reefs slopes and crests were dominated by coralline algae and robust plating and branching corals (W. Naviti, J.Aston, 2006). There was no recent up to date survey of coral reefs done in Vanuatu to comment on the current status of the corals in Vanuatu. However, there was one survey done in the last 3 years which included many areas of exceptional visual quality while others had various degrees of coral death and physical damage, probably as a result of cyclones, climate change (increasing of temperature & coral bleaching) and most of all the Crown of thorns starfish (COTs) which is one main issue damaging Vanuatu corals compared to climatic factors (Done & Navine, 1990).
Therefore, there is need for more collaboration and partnership of all pacific island countries, stalk holders to improve coral reef management and come up with helpful approaches to minimise coral reef damage especially from situations such as high seawater temperatures, coral bleaching and most commonly the Crown of Thorns starfish.

Feremaito, Hudson, Vanuatu Fisheries Department, PMB 9045, Port Vila, Vanuatu.

Strenghtening the monitoring of coral reefs ans seagrass beds in Wallis and Futuna – 14h30

Ateliana MAUGATEAU
Environmental service of Wallis and Futuna
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In recent years, some coral reefs and seagrass meadows have been monitored to evaluate their evolution over time. These follow-ups are carried out by the Territorial Environment Department of Wallis and Futuna (cf.after named STE) concerning the seagrass beds, by CRIOBE in collaboration with the STE for the reefs located on the outer slopes of Wallis, Futuna and Alofi, and by the Reef Check association for the lagoon reefs of Wallis.The frequency of monitoring is irregular and the number of monitoring stations, coral in particular, remains low given the surface of the present reefs and their diversity.
The stations implanted by CRIOBE are allocated on the external slope: 2 on Wallis, 2 on Alofi and 2 on Futuna. The Reef Check network includes 4 monitoring stations, all located in the lagoon of Wallis. The seagrass network is exclusively located on Wallis and includes three monitoring stations, implemented in 2014 in collaboration with Sandrine Job and the CNRS (LEMAR unit, Brest). The STE wish to become more actively involved in the monitoring of the marine environment and strengthen its network of observation of Coral reefs.

Deputy Head of the Environment Department for less than a year, I have been involved in all areas of the Environment, particularly in Wallis and Futuna. I coordinate the actions of the Biodiversity and Water Division and the Waste and Energy Division of the Service. Before being promoted to assistant, I was recruited in Wallis as head of the Waste division for 2 years, following a year's experience as an environmental toxicology study engineer at ANSES in Fougères after having successfully completed my technical thesis on the evaluation of the toxicity of emerging biotoxins.

PMA in the french West Indies, a strenghened network with contrasting situations, in the context of global coral reef decline in the Caribbean

Dr. Malika RENE-TROUILLEFOU
Antilles University, Guadeloupe
malika.trouillefou@univ-antilles.fr

In the French West Indies, there are 51 MPAs, for a total area of 144,898 km2. This MPA network has been strengthened since 2012 with the creation of the AGOA Marine Mammal Sanctuary, which covers the entire maritime area in the FWI. However, the situations of the MPAs are very contrasting in the FWI. Enhanced protection zones are largely in the minority and coral reefs, seagrass beds and mangroves are generally poorly represented. Guadeloupe has a national park (1400 km2) covering about 15% of territorial waters. Two marine nature reserve, Ilets Pigeons and Petite-Terre, provide enhanced protective areas for reef communities. In Saint-Martin and Saint-Barthélemy, the two national nature reserves of 34 km2 and 13 km2 respectively, account for 1% of territorial waters.
They provide important but limited protection for ecosystems to coastal issues. In Martinique, a regional marine nature reserve was created in 2014. Then, the creation of the Marine Natural Park of Martinique in 2017, allows us to consider complete protection of all marine habitats and reef structures. Human pressures (agricultural practice, wastewater management), development of tourism and marine activities are increasing challenges for MPAs in the FWI.

Within BOREA research unit, Malika RENE-TROUILLEFOU is responsible for the Caribbean site. Biochemist, specialized in the microbiology of scleractinian corals since 2012, she completed her PhD at the University of Montpellier 2 in 2009. Very involved in the conservation of coral reef, her multidisciplinary and applied training has led her to develop, since her recruitment, a new theme based on the study of coral bacteria and their use as an indicator to monitor the health status of corals.

Status of coral reefs, protected areas and restoration plans in Madagascar

Pr Jean MAHARAVO (videoconference)
Oceanographic Research Station of Vangaindrano, Madagascar
jmmaharavo@gmail.com

Situated in the south western Indian Ocean, Madagascar is the world's fourth largest island, covering 587,045 square kilometres. The extensive coastline, spanning more than 5600km, harbours a wealth of biodiversity. Reef building corals that play a key role in the health of marine and terrestrial ecosystems as well as local human communities are particularly well represented. Coral reefs are vital for Malagasy communities because much of the population lives in close proximity to the sea and depend entirely on traditional fisheries for livelihood.

The monitoring of the state of coral reefs in Madagascar, which began in 1998, shows that there has been a decline in coral cover for the whole country from about 50% (in 1998) to 30% presently. The period 2004-2005 was a decisive turning point because it was during this period that there were continuous cyclones which caused havoc at several reef sites, even changing their geomorphology by transforming flats colonized by corals into sandy areas smothered by sedimentation. The degradation of reefs nationally is exacerbated by global warming that causes coral bleaching. Mortality due to severe coral bleaching has caused noticeable declines in coral in 1998 and 2004, and most recently in 2016. To counter this decline in coral reef health, the malagasy government has pledged to increase the area of marine protected areas by threefold. Currently, there are 18 marine protected areas totaling 1,216,637 hectares, managed by various bodies working in the field of the environment. In addition, there are 149 Local Managed Marine Areas covering 11,770,000 hectares that are scattered across Madagascar. Finally, there are various laws and regulations that regulate and control the exploitation of reef marine resources in ways that do not destructively affect reefs. Many experiences about coral transplantation are initiated in research centers in order to restore degraded coral reef areas.

PhD, Director of Research in the Centre National de Recherches Océanographiques, Chief of the Research Station of Vangaindrano, SW Madagascar

Long-term coral reef monitoring data for assessment and management of the Reunion Island marine reserve (Southwest Indian Ocean)

Dr Hélène MAGALON
University of Reunion Island
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Monitoring of coral reefs [LIT methodology with belt transects (GCRMN protocols) for fish and corals] has become a major tool for management in a context of increasing degradation of coastal ecosystems. In Reunion Island, benthic and fish community structures have been regularly studied for 20 years, before and after the implementation of the Reunion Marine Reserve in 2007, providing an overview of the major environmental trends affecting the benthic communities Reunion Island West coast reefs. The main results of this long-term monitoring show different population "shifts" linked to specific anthropic disturbances or/and global change responses. For all sites, algal assemblages became dominant after 2000 and progressively increased on the reef slope (St Gilles, St Leu and Etang Sale).
Outer reef slopes from the South Coast (St Pierre) showed a progressive increase in coral cover during 17 years (from 40% in 2000 to 65% in 2016) and a slow decrease after 2018. On St Gilles outer reef slopes, temporal trends are associated with a strong decrease of coral cover (from 56% in 1998 to 30% in 2007 and 25% between 2008 and 2018) and a progressive shift of coral communities characterized by a homogenization of species. St Leu outer reef slope sites are characterized by high live coral coverage for Reunion Island (75% to 68 % between 2000 to 2008) followed by a small decrease during the next period (2008-2016) with local disturbances associated to mudslides during the last two years (42% of coral coverage in 2018 for the reef slopes; less than 1% of coral coverage in 2019 for the reef flat) showing the sentinel nature of these stations affected by anthropic disturbances. These contrasting patterns may be correlated with global change and natural disturbances (hurricanes) associated with chronic anthropogenic pressures on coastal zones.

Hélène MAGALON is population geneticist working on species delimitation and connectivity of marine species, especially corals, holothurians.

Health status and management of coral reefs in New Caledonia.

Dr. Nathalie BAILLON
Conservatory of Natural Areas of New Caledonia
dircen@cen.nc

The presentation will focus on the last results about health status of coral reefs in New Caledonia and will review the main management tools.

PhD Oceanography (1990). Chief of the aquatic environment and resources department of the Northern Province of New Caledonia (1999-2011). Since 2012, director of the Conservatory of natural areas of New Caledonia

DAY2 : THURSDAY5 DECEMBER 2019

PRESENTATION OF THE SABLE PROJECT, TRAINING AND ROUND TABLES

Presentation of the Seascape genomics SABLE project in New Caledonia

SABLE: project, results and perspectives

SABLE is a joint research effort between the Ecole Polytechnique Federale (Lausanne, Switzerland) and the Institute of Research for Development (IRD, New Caledonia), supported by the International Coral Reef Initiative (ICRI) and the United Nations Environment Program (UNEP).

SABLE is a pilot project for the application of the seascape genomics approach to study coral adaptation. In seascape genomics, the marine environment is used as a natural experimental set-up. By using satellite imagery captured over the last decades, we remotely detected reefs of New Caledonia that were experiencing the largest contrast in environmental conditions (in particular, differences related to thermal stress). We then organized a field campaign in 2018 to collect coral samples at these sites. The collected specimen underwent next-generation DNA-sequencing to discover genetic variants associated with stressful environmental conditions. Corals carrying these variants are expected to be more resistant to the climatic constraint imposed by climate change. In addition, satellite data was used to describe how sea currents connected distant reefs. By combining this information with genetic diversity indices, we could estimate coral dispersal patterns across whole reef systems

As sampling in seascape genomics covers large spatial scales, the results of these studies can be generalized for conservation management recommendations. Indeed, knowing the location of potentially adapted corals and their dispersal capacities to neighboring reefs are crucial information for planning preservation strategies. To this end, we developed a statistical framework to translate the results of seascape genomics analyses into spatial indices that describe reef connectivity and adaptive potential. These indices are objective, quantifiable, potentially transferrable and comparable for any coral or sedentary species in any reef system worldwide.
Team members present at the meeting:

Oliver Selmoni, PhD student at Laboratory of Geographic Information Systems (LASIG), École Polytechnique Fédérale de Lausanne (EPFL)
Expertise in bioinformatics, with focus on landscape and seascape genomics.

Dr. Hélène Magalon, researcher and lecturer at the University of Reunion Island (Reunion)
Expertise in molecular ecology and genetics, with focus on species delimitation and connectivity.

Dr. Gaël Lecellier, researcher and associate professor at the University of Versailles Saint Quentin en Yvelines (France)
Expertise in molecular biology, with focus on cellular genetics and functional genomics.

Dr. Véronique Berteaux-Lecellier, senior researcher at the French National Research Center (CNRS, UMR 250 / 9220 ENTROPIE - IRD)
Expertise in molecular and cellular biology, with focus on cell behavior and intra- and inter-organism communication.

Team members on the field or present via videoconference:

Dr. Laurent Vigliola, senior researcher at the French Institute for Research and Development (IRD) in New Caledonia (France)
Expertise in coral reef ecology and environmental genetics.

Dr. Francesca Benzoni, assistant professor in Zoology at the University of Milano-Bicocca (Italy)
Expertise in marine biology, with focus on ecology and systematics of corals.

Dr. Stéphane Joost, senior researcher and teaching associate at LASIG, EPFL
Expertise in GIS analysis, with focus on landscape genomics.

The transnational Red Sea Center

Pr. Ander MEIBOM
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In collaboration with the Swiss Foreign Ministry, EPFL has established the Transnational Red Sea Center with core mission to study and protect the unique Red Sea coral reef ecosystems through a broad, international research effort. This Center will unite scientists from the Middle East region and serve as an example of 'Science for Diplomacy and Diplomacy for Science'. Direct diplomatic and political collaboration at the highest level between the nations that are fortunate to have this reef on their shores must be brokered in order to ensure effective environmental policies, laws, and monitoring to protect the reef. This is achievable with the diplomatic assistance of countries like Switzerland.

Anders Meibom uses correlated EM and subcellular level isotopic imaging (NanoSIMS) to study the metabolic interactions in corals (and other photosymbiotic marine organisms) under homeostatic as well as environmental stress conditions. Working together with Israeli and Saudi Arabian colleagues, it has recently been discovered that the corals in the northern Red Sea and Gulf of Aqaba are extremely resistant to thermal stress and might be the 'last reef standing' at the end of this century. A direct outcome of this work has been the establishment of the Transnational Red Sea Center, which he leads.

Remote sensing of tropical waters: observing and modelling from 1 km to 1 m

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Satellite remote sensing has been a great asset to provide biophysical properties of the continuous marine realm such as sea surface temperature (SST), chlorophyll concentration (CHL), water clarity (Kd), particulate organic content and calcite content at the MODIS Aqua level 3 (around 4 km pixel size) in a standardized way, over the last twenty years (2002). The processing and analysis of the MODIS level 2 further enable the spatial patterns of all previous variables to be elucidated at 1 km, and even at 500 m for the CHL and Kd variables. More recently, the European Sentinel-3, launched in 2016, can routinely collect SST at 1 km, CHL and Kd at 300 m pixel size. At a finer-scale, the US Landsat-8, in orbit since 2013, can provide adequate spectral thermal and optical bands to spatially model SST, as well as CHL and Kd at 100 and 30 m, respectively, but with non-standardized algorithms, which require own calibration and validation.

Likewise, the European Sentinel-2 MSI, launched in 2015, has the potential to deliver the CHL and Kd at 10 m. This high spatial resolution becomes interesting to detect coral reefscape geomorphology, while the benthic features can be acquire using the 1-m WorldView-3 imagery. The trade-off between spatial extent-resolution, time-series, revisit, and spectral resolution will be discussed.

Antoine COLLIN is a coastal geospatial ecologist motivated by defining and modelling interactions between ecosystems with their environment. He has more than ten-year-old experience in the ecological spatial patterns and processes of the seamless coastal fringe across temperate, polar and tropical climates using airborne LiDAR, blimp-borne/drone camera, spaceborne sensors and spatialized databases. Since 2015 he delves into the coastscape socio-ecology analyzed by multi-scale remote sensing technologies. He is a permanent associate professor in coastal remote sensing within EPHE-LETG-Dinardlaboratory.

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