



3rd Caribaea Initiative Research & Conservation Workshop

May 28 – June 1st, 2018

Hôtel La Créole, Pointe de la Verdure, Le Gosier
Guadeloupe

Introduction to the workshop

Professor Frank Cézilly
President

The Caribbean region is one of the most important hotspots for biodiversity worldwide, and the insular Caribbean hosts a large number of endemic plant and animal species. This biodiversity is important to maintain the ecosystem services that the Caribbean people rely on, such as the provision of food, livelihoods, coastal protection, and tourism. However, the insular Caribbean and its biodiversity are particularly vulnerable to the effects of climate change (e.g. sea level rise, extreme events), habitat fragmentation, emerging infectious diseases, invasive species, globalization, population growth, and waste management.

In this regard, the ability of the Caribbean community to develop an integrated strategic plan for conservation and management of biodiversity, so as to sustain critical ecosystem services, might prove crucial in the near future. However, the development of such plan requires the establishment of a regional network of researchers, experts, and managers with a strong academic background in ecology and evolutionary biology and related biology fields, plus expertise in statistical analysis and ecological modelling. As such, there is a real need for tertiary education support within the region to develop a specific focus on wildlife conservation and biodiversity at the MSc and PhD levels.

In this context, the Caribaea Initiative (www.caribaea.org), a non-profit association registered under the French law, is dedicated to the development of research and tertiary education in biodiversity and wildlife conservation within the Caribbean region. Its mission is three-fold:

- To support the development of master and doctorate programmes in animal biodiversity and wildlife management in the insular Caribbean, so as to increase expertise and scientific excellence at the local level
- To launch an advanced training programme in the study of animal biodiversity and wildlife management for university students from the insular Caribbean, as well as for Caribbean researchers and conservationists at an early stage in their career, with the aim of fostering trans-national cooperation in the future





- To foster cooperation in research on wildlife conservation and biodiversity between Caribbean research organizations and selected research centres outside the Caribbean region.

Accordingly, the Caribaea Initiative Research and Conservation Workshop (CICRW) is an annual event that brings together students, researchers and conservationists working in the insular Caribbean. It is a unique opportunity to meet and exchange ideas and recent findings about the Caribbean fauna, as well as to forge partnerships between research institutions. After two previous editions in Martinique (2016) and St Kitts (2017), the 3rd CIRCW is taking in place in Guadeloupe, May 28 – June 1st, 2018, co-organized with the Université des Antilles.

I would like to express our warmest thanks to our sponsors, the Conseil Régional de la Guadeloupe, the Conseil Départemental de la Guadeloupe et le Grand Port Maritime de La Guadeloupe - Port Caraïbes, for their generous support and enthusiasm. In addition, I would like to thank Etienne Bezault, Christopher Cambrone, Thierry Cherizard, Charlotte Dromard, Lou Frotté, Anne-Sophie Gicquiaux, Sébastien Gilles, Silvina Gonzalez-Rizzo, Sylvie Gustave dit Duflot, Dominique Monti, Sita Narayanan, Ludovic Pruneau, Malika Trouillefou and Vanessa Weck for their invaluable help in the preparation of the workshop. I would also like to thank Christian Estrade at the French Embassy in La Havana and Laurent Bonneau at the French Embassy in Port-au-Prince for their help in obtaining visas for Cuban and Haitian colleagues and students.





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LIST OF ABSTRACTS





The biology, ecology and diseases of the Caribbean spiny lobster: A PhD study

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The Caribbean spiny lobster, *Panulirus argus*, is important to the economy of several countries in the Caribbean region, including Saint Kitts and Nevis. According to the IUCN red list, the *Panulirus argus* population is currently decreasing and is believed to be exploited throughout its geographical range. As a result, it is important to investigate the factors which would affect population health and consequently, commercial yield. This study has been converted from an MSc. to PhD study to collect more detailed information on the species in Saint Kitts and some other Caribbean islands.

Population studies and ageing of the species are integral to the generation of information, which may benefit agencies such as the Department of Marine Resources in Saint Kitts. This study has been expanded to other Caribbean islands such as Saint Vincent, Barbados and Tortola in order to collect as much information as is possible on this species in the Eastern Caribbean. This information may be used to suggest size restrictions for fisheries and closed seasons. Presently, the Department of Marine Resources in Saint Kitts restricts fishing all berried females and lobsters smaller than 95mm carapace length. Using Dr. Kilada's direct ageing technique, the lobsters in the study were collected, their gastric ossicles cleaned and embedded in epoxy resin. Visualizations of sections of the pterocardiac and zygo-cardiac ossicles revealed growth bands, which are assumed to form annually. However, we intend to validate this by counting growth bands of known-age lobsters.

Determining size at sexual maturity is also important, and has been instrumental in providing a wealth of information about different species of spiny lobster in other studies. The stage of ovarian development was assessed using both gross and histological observations. The ovaries were weighed and the gonadosomatic indexes (GSI) calculated, and association between GSI and histological grading was investigated.

Surveillance of the lobsters for diseases and parasite that may affect yield and marketability of the catch is therefore important. Microsporidians comprise a group of spore-forming, unicellular organisms which are also obligate and intra-cellular parasites. During a screen of one hundred lobsters, the skeletal muscle of one lobster was observed as undergoing liquefaction. A wet mount of the muscle was done and microsporidian spores were discovered. The parasite DNA was isolated from the muscle and subsequently amplified and sequenced, and when analyzed using BLAST, noted to be of the genus *Ameson*. A phylogenetic tree was constructed which revealed the previously undocumented *Ameson* isolate is closely related to *Ameson pulvis*. Surveillance on the presence of PaV1 in Saint Kitts is also currently being investigated as part of this study. However, based on molecular techniques, this virus has not been detected in the one hundred and fifteen lobsters screened.

This study will also include determining the monthly recruitment of postlarvae and the level of genetic connectivity between lobster stocks located in St. Kitts, Tortola, Barbados, Antigua and Saint Vincent, since this information may highlight the need for an even more synergistic approach to lobster management within the Caribbean.





Protect and capitalise on the Caribbean natural heritage: funding opportunities offered by INTERREG Caraïbes

Gilles Bajazet

INTERREG Caraïbes Joint Secretariat , Conseil Régional de Guadeloupe

The Interreg Caraïbes program is co-financed by the European Regional Development Fund (ERDF) and supports cooperation actions addressing common regional challenges in order to strengthen the territorial and sustainable economic development of the Caribbean area.

The Regional Council of Guadeloupe is the managing authority for this program. It finances win-win projects involving organisations from the outermost regions (Rup) of Guadeloupe, French Guiana, Martinique and Saint Martin in partnership with nearly 40 Caribbean countries.

This program has a total budget of 85.7 million euros including 64.2 million ERDF and 2.9 million EDF (European Development Fund).

The areas of cooperation are:

1. Competitiveness, innovation, employment creation, economic diversification, trade development in the caribbean,
2. Strengthening capacities to respond to natural risks,
3. Protecting and enhancing natural and cultural environment,
4. Developing concerted response to public health issues,
5. Supporting renewable energy development initiatives,
6. Strengthening human capital (training, mobility, language learning).





Thermal ecology of the *Anolis rubribarbus* species group (Reptilia: Dactyloidae)

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The *Anolis rubribarbus* clade is endemic to Cuba and it is represented by the species *Anolis ahli*, *A. allogus*, *A. imias* and *A. rubribarbus*. This group of closely related species is associated to shaded situations and they are considered to be thermoconforming lizards. However, they occur in extreme habitats: humid forests (*A. allogus*, *A. ahli*, *A. rubribarbus*) and the rocky-outcrops of semidesertic areas (*A. imias*). Two species are sympatric: *A. allogus* and *A. rubribarbus*, and in this case the first inhabits gallery forests and the second one pine forests. This diversity rises the hypothesis that the species in the *Anolis rubribarbus* species group actually have discrete thermal preferences and adaptive responses to different ranges of temperature. To test this hypothesis a comparative study of the thermal ecology of all species will be conducted. The study will cover five localities: Sierra del Rosario (*A. allogus*), Topes de Collantes (*A. ahli*), Parque Nacional A. de Humboldt (*A. allogus* and *A. rubribarbus*), and Macambo (*A. imias*). Body temperature will be recorded for both sexes of each species. Air temperature, relative humidity and light intensity will be monitored through data loggers. Additional information will include structural use of habitat (perches/substrates, height on perches), sunlight exposure (direct light, filtered light, or shadow), and activity patterns (lizard detection over time) that may be correlated to thermal ecology. The importance of this study is to provide, for the first time, a comprehensive characterization and comparison of the thermal ecology of species in this clade which is a key information for understanding the adaptive evolution of the group and also crucial for species management plans and conservation actions. As far is known, this group of lizards have a narrow thermal response and very likely represent critical indicators of global warming.





Spatial variation in the composition and diversity of communities of pollinating insects: influence of the proximity to a large green zone in the area of Port-au-Prince, Haiti

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Pollinator populations have undergone a general decline in recent years and this phenomenon has become of particular concern for conservation biologists. Indeed, pollination is a crucial ecosystem service within natural and cultivated systems. Despite the importance of ecological and economic ecosystem services for pollinating insects, little is known about their demographic trends beyond what can be drawn from comparisons with historical documents or museum specimens. This is why it is important to determine the size and composition of pollinator assemblages, in order to have a more or less accurate view of the number of individuals of a given species at a given location.

Considering the available information about population sizes of insect taxa, Hispaniola's entomofauna seems to be the least studied in comparison to other tropical systems. For instance, insects in Haiti have only recently received attention from foreign entomologists, despite the fact that this group seems very important in a country like Haiti where environmental and economic problems are only getting worse. Still, census and demography studies are the most useful tool to determine demographic trends of populations, conservation status of species, and, more broadly, conservation status of ecosystems (due to the importance of ecosystem services performed by pollinating insects). This lack of concern is certainly due to a lack of knowledge about the importance of pollinating insects within most of Haitian ecosystems, anthropized ecosystems as well as natural ecosystems. As for all other ecosystems, in Haiti, urbanization, fragmentation and deforestation are the main problems that contribute to the possible decline of pollinators through the loss of favorable habitats. In this context, this study is the first to focus on the demography of pollinating insects in Haiti. Firstly, it consists of a comparative study of the species' richness, functional diversity and the relative abundance of pollinating insect species inside two large green zones, Wynne Farm and the Martissant Park. Secondly, it aims at assessing to what extent Wynne Farm and the Martissant Park can be considered as local reservoirs for pollinator biodiversity and how their proximity influences pollinator insect assemblages in nearby wooded and agroforestry habitats.





Caribbean fauna conservation: a veterinary perspective

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Of the various brewing ecological crises of our time, the issue of declining biodiversity and emerging diseases are among the most complex and far-reaching. The Caribbean islands qualify as global biodiversity hotspots by virtue of their high endemism and high degree of threat, and are thus exceptionally important for global biodiversity conservation. To preserve biodiversity and leverage public understanding and support for protecting species and natural systems, co-equal collaboration of physicians, veterinarians, conservation biologists, ecologists and epidemiologists is needed. As exemplified by numerous research projects on the island St. Kitts, the veterinary community's biomedical perspective can add notably to conservation efforts. Projects focusing on marine species include amongst others the use of biotags for population studies of the invasive lionfish (*Pterois* spp.), deciphering the role of ciliates in sea urchins (*Tripneustes ventricosus*), health assessment of queen conch (*Strombus gigas*) and mapping the biology, ecology and diseases of the Caribbean spiny lobster (*Panulirus argus*). Another project included long-term monitoring of lesions on stony *Orbicella faveolata* corals and resulted in a detailed histopathological description and novel lesion classification. Surveys of sea fans (*Gorgonia ventalina*) with aspergillosis and multifocal spot disease also emphasize the need for more accurate disease diagnosis and microscopic case definitions, and unravelling the associated microbial consortium. Accurately identifying disease is an important measure to assess population health, inform different stakeholders and establish disease surveillance programs. For example, the St. Kitts Sea Turtle Monitoring Network has offered an opportunity for involvement with a significant education component and established baseline health parameters to guide leatherback sea turtle management on the island. Engaging local stakeholders is a central feature of biodiversity conservation and natural resource management projects. This is also of utmost importance when addressing the current conflict on St. Kitts between humans and the growing vervet (*Chlorocebus aethiops*) monkey population. On the one hand, vervets can amplify or maintain emerging diseases of public health concern but on the other hand, they have gained cultural and economic importance in the tourism industry. Harm-reduction studies have been initiated by veterinarians at RUSVM to manage the island's interspecies conflict. These studies aim to recognize shared values among the stakeholders and identify areas of action to promote and implement solutions. This approach could eventually be introduced as a viable strategy in conservation as well.





Future climate change in the Antilles: Regional climate, tropical cyclones and sea states

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Although small island nations and territories such as the Antilles have long been identified as among the most vulnerable to climate change and climate extremes, few studies have focused on future projections at spatial scales relevant to island communities in the Caribbean. While consistent future warming and drying trends have been recently documented, together with an increase in extreme rainfall events and in the frequency of category 4 and 5 hurricanes, most climate models do not have resolutions high enough for meaningful projections at the island scale and for adequate representation of tropical cyclones and of the associated storm surges.

The interdisciplinary collaborative C3AF project (*Climate Change and Consequences over the French Antilles*) aims at studying trends and hazards associated with climate change in the French Antilles (Guadeloupe, Martinique, Saint-Barthélemy, Saint-Martin), as well as their environmental and socio-economic impacts. At Météo-France, a group of researchers study future changes in North Atlantic cyclone activity and in the associated swells that hit Antillean coasts. Atmospheric model simulations at mesoscale permitting resolution in the tropical North Atlantic allow tracking tropical storms and hurricanes in order to detect changes in their frequency, intensity and geographical distribution. These simulations are also used to drive wave models in order to estimate changes in cyclonic wave climate.

Preliminary results indicate mostly northward migration of tropical cyclone activity and of the associated swell (i.e. away from the Caribbean) and a shortening of the hurricane season, despite more frequent major hurricanes. Current work focuses on revisiting XXIst century temperature and precipitation trends for the French Antilles. Regional discrepancies in climate projections will also be discussed.





Developing an ecological and conservation genetics resource center and network in the Caribbean

Etienne Bezault

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The biodiversity hotspot of the Caribbean region has been greatly influenced by the high heterogeneity of the islands (*i.e.* including Greater and Lesser Antilles archipelagos) and the ecosystems (*e.g.* tropical forests, rivers, mangroves, seagrass-beds and reefs), therefore explaining the diversity of their associated fauna and flora. On a one hand, this island system represents a great natural model to study the dynamics of biodiversity and the underlying ecological and evolutionary mechanisms, especially in the context of colonization, adaptation, and diversification. On the other hand, this very dynamic system appears as highly sensible to environmental perturbations (*e.g.* biological invasion, anthropogenic pollution, climate change...), rising the concern of the conservation of the Caribbean biodiversity.

Since the popularization of molecular marker genotyping and more recently the development of Next Generation Sequencing (NGS) technologies, we have unprecedented capacity to bridge ecological and molecular data, even for non-model organisms, to lead to more integrative interpretations. As part of the tremendous development of molecular ecology, has emerged the field of conservation genetics and its recent extension to conservation genomics. Molecular markers provide a large range of opportunities for ecologist as well as for conservationist, as to measure genetic diversity and its structure at species or population level, to estimate reproductive regime or effective population size, investigate mechanisms of selection and adaptation, to identify species, community or to detect the presence of target species based on non-invasive samples as well as environmental-DNA (eDNA).

Considering the great importance of conservation genetics/genomics approaches for the study and the management of Caribbean biodiversity, we are exposing our aim to build up an ecological and conservation genetics center, based at the Université des Antilles, in close connection with local and regional research partners. Therefore, we are aiming at developing a scientific network within the Caribbean Islands in order to be able to perform the broader range of conservation genetics/genomics applications at the regional scale.





A climate-smart farming system for enhancing biodiversity conservation in the Caribbean

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It is now commonly admitted that agriculture can have detrimental impacts on biodiversity and ecosystems functions due for example to the simplification of landscape, the use of pesticide and water consumption. We conceived a climate-smart micro-farm as a solution to respond to these challenges, in particular that of climate change and biodiversity conservation, which are of major interest for the agricultural sector in Guadeloupe. Our project starts from a diagnosis of current agricultural models and proposes the experimentation of a system based on the application of a maximum of agroecological principles. This on-going project is part of several INRA research programs that meet different objectives. The RIVAGE project which aims to reduce the use of pesticides, the CAVALBIO project whose objective is the valorization of agro-biodiversity and varietal innovation, and the EXPLORER project which focuses on climate change, valorization biomasses and the principles of the bioeconomy. The societal challenges and aims of the micro-farm project are to 1) develop a climate-smart agriculture: adapting to climate change and reducing the vulnerability of agricultural systems to climate hazards; mitigate climate change: sequester carbon in soils and biomass (target 4P1000); maintain or even increase the productivity of agricultural systems; and 2) jointly manage other territorial issues such as the preservation of natural resources, particularly biodiversity, water and soil; maximize the recycling of waste in agriculture through bio-based inputs, the creation of jobs and innovative sectors, the satisfaction of consumer expectations and the improvement of the competitiveness of farms and the quality of life of farmers. To reach these sustainability goals, two levers are explored and mobilized: first agroecology at the level of production systems that aims to make maximum use of biological regulations as a factor of production and second the territorial bio-economy, which is an economy based on the production and valorization of the biomasses of the territory.





Conservation of Cuban Land Mammals: Gaps of Knowledge and Challengers

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Land mammals of the Caribbean Islands biodiversity hotspot have suffered a high rate of extinction since human arrival, principally in the last 500 years since colonialism began. Here, we present an extensive review about mammal conservation in Cuba, including details regarding the situation today, surviving endemic species of volant and terrestrial mammals and locations of species on 121 protected areas. We analyzed patterns of species richness, endemism, body mass, diet, habitat, geographic distribution of the observed richness, conservation threats, and possible causes and threats to future extinction. Cuban mammal biodiversity is comprised of 59 native species, 24 extinct species and 35 extant species, most of which are endemic (64.4%) to the Cuban archipelago. The 35 extant species of terrestrial Cuban mammals are represented by 8 capromyid rodents, 1 soricomorph (*Solenodon*), and 26 bats. Of the extant mammals, 17 are endemic to Cuba (48.6%). According to the Cuban Vertebrates Red Book, 10 species are considered threatened including 6 as Critically Endangered, 1 as Endangered, and 3 as Vulnerable. We compared the threats of habitat destruction and hunting, with emphasis on invasive mammal species as drivers of historical extinction in Cuba and the impacts of current hurricanes is commented. The mangrove forests and hot caves represent the critical habits for the conservation of many mammal species and other components of the fauna for the high level of endemism. A total of 44 mammal species have been introduced since 1509, with 33 invasive species living in the wild and exerting differing degrees of impact, principally by predation and competition. Additionally, we evaluated the impacts and some unknown interactions among invasive and native mammals, emphasizing predation of feral cats upon *Solenodon cubanus*, *Capromys pilorides*, and other small endemic vertebrates as determined from analyses of scat contents and we found that black rats (*Rattus rattus*) reach densities of 147–322 individuals/ha in *Solenodon cubanus* habitat, thus likely are major competitors for food and refuges to these evolutionarily distinct and endangered Cuban mammals. We analysis the major gaps for knowledge for the conservation of Cuban mammals and other factors that are effecting the Cuban conservation actions as: access to international funds for resources, equipment, and bibliography, lack of cooperation, capacity building access, exodus of biodiversity and conservation researchers, climate changes, paper of agroecosystem and forest fragmentation, etc. Moreover, some Cuban strength for regional cooperation in conservation is considered.





***Pterois volitans* in the French Antilles: from an invasive to a naturalized species**

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The lionfish *Pterois volitans* (Linnaeus, 1758) is nowadays a well-known fish invader in all the Caribbean area. From its first official sighting in Florida in 1985, that invasive species quickly spread from 1992 along the Atlantic coast of the USA as far as Cape Hatteras and Bermuda, throughout the Gulf of Mexico and the Caribbean (Whitefield *et al.*, 2002). In the Antilles Arch, the invasion began from the North in Sainte Croix (June 2008) and from the south in Bonaire (October 2009). The first documented lionfish captures in Guadeloupe was in October 2009. *Pterois* also expanded to Brazil in 2014.

P. volitans is now considered as one of the most important invasion in the marine coastal areas of the Caribbean and has been suspected to constitute a major threat to reef fish communities of the Caribbean (Albins and Hixon, 2011). In Guadeloupe, lionfish expanded all around the island, until more than 300 m deep, in spite of the setting up of several eradication programs. The species reproduce all year round and can be nowadays considered as naturalized.

Reef fish communities of Guadeloupe were quantitatively monitored on permanently settled band-transects since the year 2000. That technique allowed the gathering of data both on the occurrence and the abundance of *P. volitans* on the study sites and on the quantitative composition of the associated reef fish community, with special attention to juvenile fish recruitment.

Lionfishes appeared in the study sites in 2012. Their maximal abundance was reached in 2013, with 250 individuals per hectare on one reef site and declined since then. The decline was more discernable in fished zones than in marine protected areas. This phenomenon might correspond to a decline often observed in the abundance of an invasive species after a fast increase occurring during the first step of the invasion.

On the studied reef sites, the data examined do not reveal a noticeable impact on the biodiversity, abundance and juvenile recruitment of reef fish community since the occurrence of lionfishes. In the French Antilles they seem to have taken the place of the indigenous carnivores (groupers, snappers...) located at the top of the trophic web and that have strongly declined under overfishing pressure.





Biology and genetic of Caribbean populations of white-crowned pigeon, *Patagioenas leucocephala*: census and first genetic analysis of the Guadeloupean population

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The White-crowned Pigeon, *Patagioenas leucocephala* is a Caribbean endemic species, classified as “Near-threatened” (IUCN red list), for which available data on ecology and demography are very sparse, fragmentary and unequal across its distribution area. In particular, very few data are available for the Lesser Antilles, and especially Guadeloupe, where the species is much appreciated by local hunters and exposed to habitat loss. In this context, we compared two census methods, detection through call-broadcast or passive method, in order to provide reliable tools for the monitoring of population trends. Based on a survey including 10 transects, the density of White-crowned Pigeon in Guadeloupe appeared to be low. However, call-broadcast method proved to be more efficient than the passive method to detect White-crowned pigeons. Additionally, we performed a preliminary genetic study to investigate genetic diversity and structure of the Guadeloupean population using two mitochondrial genes (i.e. Cyt-b, COI). Genetic analyses revealed a relatively high diversity, *i.e.* above the level observed in other threatened columbid species, and a low genetic structure in Guadeloupe and potentially over the entire distribution area of the species. We discuss the significance of our results in relation to conservation strategies at the scale of the Caribbean region.





Twenty years of psittacids management in Central Cuba

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Formerly considered to be abundant on the whole island, the two Cuban psittacid species (*Psittacara euops* and *Amazona leucocephala*) are threatened at present. The main reasons for their decline have been identified, but efficient management measures for their conservation are still needed. We evaluated the current status of both species, the main limiting factors and their implication for long-term conservation. In particular, we analyzed the contributions of the different management practices implemented in different protected areas. Four main nest-box programs, with different purposes for each one, were successfully used in seven places in Cuba. We discuss the impact of supplying populations with artificial nest-boxes in terms of reproductive success and fledging recruitment into natural populations. Nesting in nest-boxes contributed to a better knowledge of the relationship between psittacids and other cavity nesting birds in Cuba.





Diversity of ants of Saint Barthélemy island

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Main objective of "St Barth-Essentiel Association" is to preserve, enhance and to restore St-Barthelemy's island natural heritage based on a deep knowledge of local Biodiversity and Ecosystems. Ants play a key role in ecosystems good process and represent a biodiversity meaningful index. Nevertheless Ants can disturb the balance between flora, fauna and human activities. We shared here the Ant diversity result from different Saint Barthelemy areas. Taxa are identified by determinations taxonomic and molecular (DNA Barcoding).





Conservation of two reptile species endemic to St Lucia

Aloysius Charles

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The Saint Lucia Racer (*Erythrolamprus ornatus*), is endemic to the island of Saint Lucia and considered to be one of the rarest snakes in the world. At present, it can only be found on Maria Major - a 12 hectare offshore island off the southeast coast of Saint Lucia - which represents only about 0.02% of its former range. It has been marooned on Maria Major where the population is unable to grow beyond what the small offshore island can support. Additionally, very little is known about the biology and ecology of the species. Therefore, there is a need for continued study of the species. In particular, the level of genetic variation (a factor in extinction risk) needs to be analysed in order to develop a strategy for conservation and multiplication of the species so as to avert the extinction of the same.

Another reptile endemic to Saint Lucia which faces the risk of extinction is the Saint Lucia Whiptail (*Cnemidophorus vanzoi*). The source population of this species is also found on the Maria islands. Based on the IUCN red list index of estimating Area of Occupancy, it at present only occupies a range of about 4km². It is currently listed as critically endangered due to the fact that the population is severely fragmented with only about 2349 individuals (*according to 2008-2009 estimates*; on four different small islands off the coast of Saint Lucia (*Daltry, 2016*), all of which may be at risk from rising sea levels as a result of climate change.

This study therefore seeks to train eight members of staff, who currently participate in regular biosecurity activities on our offshore islands, to opportunistically collect DNA samples from these two species using cloacal swabs and to insert PIT tags in all adult racers encountered. All of the samples taken will be stored under sterile conditions to be shipped to Cardiff University to be analysed. The project entitled, "Developing a protocol for analysing the genetic diversity of the Saint Lucia Racer and the Saint Lucia Whiptail", is scheduled to start off with the training of staff who will participate in the opportunistic collection of samples between June and December 2018.

The Maria islands are among the last remaining safe haven for the population of the Saint Lucia Racer and Whiptail lizard due to the fact that it has remained free of non-native predatory species (*Morton & Cole, 2013*). In March 2017 the Prime minister of Saint Lucia announced plans for the construction of a causeway to connect Maria islands (Maria Major and Maria Minor) to the mainland of Saint Lucia. Such a project will significantly increase the risk for the incursion of invasive alien species into the habitat of the Saint Lucia Racer. Therefore, we must intervene now in an effort to conserve the species from extinction.





How to be a successful invader: lessons from the Trinidadian Guppy

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As a result of their invasive tendencies, Poeciliids, a family of livebearing fish that originate from the Americas, now enjoy a global presence. Here, I will examine how one poeciliid in particular, the Trinidadian guppy (*Poecilia reticulata*), offers a unique opportunity to learn more about invasiveness. Native to Trinidad and parts of north-eastern South America, the guppy has been introduced throughout the tropics both as a mosquito control agent and as a discarded aquaria fish. This species possesses an extraordinary flexibility in behavioural and life history traits. This flexibility, a product of its evolutionary history in the predator-rich ephemeral pools and streams of its native habitat, predisposes the guppy to establish and survive in a wide range of exotic habitats. Here, I review the traits that facilitate the invasive success of the guppy and describe recent experiments that have added to our understanding of the traits most important to the guppy's invasive success. Finally, I will discuss ways in which the behaviour of introduced poeciliids can be connected to their negative ecological impact within the Caribbean and beyond.





Use of PVC pipe refugia as a sampling and management design for Cuban endemic amphibians

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Cuban amphibians include 68 known species, 95% of which are endemic. Paradoxically, they are the less known native terrestrial vertebrate group in the island, as many aspects of their ecology and natural history are poorly known, precluding effective management actions. In particular, *Eleutherodactylus* species have experienced extensive intra-island radiation with subsequent morphological, behavioral, and ecological diversification, colonizing a wide variety of microhabitats. In this project, we aim at comparing the distribution and abundance of *Eleutherodactylus* species in contrasted habitats in Cuba, relying on PVC pipes, as such devices have been successfully used to sample amphibians in Brazil, Costa Rica, Equatorial Guinea, Japan, Peru, Puerto Rico and USA. Pipe retreats may attract frogs by augmenting a limited number of natural refuge sites or by providing a favorable thermal and hydric environment. Many studies have used artificial pipe-like refugia, to document demography, spatial and temporal distribution, breeding behaviour, changes in population size, response to perturbations (fire, fragmentation, clearcut, off-road vehicle use, pesticide use and hydrologic restoration), etc. We will use retreats made from polyvinyl chloride (PVC) pipes to capture frogs, and will determine how pipe design, placement and time period influence the frequency with which frogs use pipes as retreats. We will obtain information about species richness, density, habitat selection, reproductive biology, intra and inter-specific interactions, potential predators for an amphibian's assemblage in two forests from western Cuba, with different level of anthropogenic perturbation.

To that end, we will sample in two plots of 100 x 100 m, inside of the semideciduous forests from Sierra del Rosario mountain range, Artemisa province, Cuba. We will use six retreat shape pipes differing in diameter and length, and will place them at three different heights in the vegetation (N=432 pipes). Retreats will be checked during three consecutive days in representative months of the dry and wet seasons. We will also assess the influence of meteorological and site conditions on capture success during the sampling period.





The diversity of Cuban *Anolis* (Reptilia: Dactyloidae): new taxonomic challenges after molecular phylogeny

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Cuba is the Caribbean Island with the highest diversity of anoles (65 species, 95% of endemism). Taxonomic works have been based mostly on morphology over the last three decades. Species boundaries in Cuban *Anolis* are still a controversial issue. Some phylogenies exist but they aren't comprehensive (do not include all taxa), were focused in particular species groups or were performed for general classifications and evolution analyses, without making species-level taxonomic decisions. We sequenced 97% of the Cuban species and most subspecies, with a representative number of localities for widely distributed taxa. Our phylogeny is based in mitochondrial [NADH deshydrogenase (ND1, ND2)] and nuclear (ZNF521, ZEB2, BRPF1, FBRSL1, TNRC6C, RHO) genes. Twelve species groups were recognized in Cuba, and this classification has common points but also discrepancies with other contributions. We discuss the taxonomic implications of the new phylogeny regarding species boundaries and nomenclature.





Do herbivorous fish assemblages reflect the diversity of their trophic niche?

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Scaridae and Acanthuridae (parrotfishes and surgeonfishes) represent common families of herbivorous fishes on Caribbean reefs. They play a major role in controlling the algal dynamics of benthic reef communities and are widely exploited by Caribbean fisheries. In this study, we stated the hypothesis that the diversity of trophic niches could influence the assemblages of herbivorous fishes.

To investigate this fact, a first study was conducted on five species of Scarids (*Scarus vetula*, *S. iseri*, *S. taeniopterus*, *Sparisoma aurofrenatum* and *S. viride*) and two species of Acanthurids (*Acanthurus coeruleus* and *A. chirurgus*). Stomach and gut content analyses were used to estimate the proportions of ingested food resources and were coupled with stable isotope analyses (¹³C/¹²C and ¹⁵N/¹⁴N ratios) to determine the proportions of assimilated food resources. Contributions of food sources to fish diet were estimated using mixing models with SIAR. A redundancy analysis based on the proportions of ingested and assimilated resources allowed us to determine the existence of three types of trophic niches among the seven species. *Acanthurus coeruleus* presented a singular trophic niche characterized by a higher consumption of fleshy macroalgae, algal turf and benthic invertebrates. The diet of *Acanthurus chirurgus* was more similar to the one of *Sparisoma aurofrenatum* than that of *Acanthurus coeruleus*, due to the high contribution of algal turf in their diet. Finally, *Scarus iseri*, *S. vetula*, *S. taeniopterus* and *Sparisoma viride* appeared to share the same trophic niche characterized by some contribution of live coral and fleshy macroalgae to their diet. These results indicated the existence of a functional diversity among the Caribbean herbivorous fishes independent of fish families.

At the same time, the composition of herbivorous fish assemblages was studied at four sites located inside the marine park at Cayman Islands. The abundance of each herbivorous fish species was recorded inside three band-transects (50 x 5 m). The functional organization of the assemblage was tested with a matrix of correlations. Significant negative correlations were observed between the abundance of species sharing similar trophic niche (*Scarus taeniopterus* — *S. vetula* and *Acanthurus chirurgus* — *Sparisoma aurofrenatum*) while a significant positive correlation was evidenced between two species occupying different trophic niches (*Acanthurus coeruleus* — *Scarus vetula*).

This study suggests that the diversity of trophic niches among Scaridae and Acanthuridae could influence the composition of the herbivorous fish assemblages. However, these analyses should be further developed to take into account possible spatial variations in trophic niches. A large-scale geographic study would provide major insights into the partitioning of food resources among herbivorous fishes in the Caribbean.



Diversity of a now extinct rodent of the Lesser Antilles, eaten by the pre-Columbian Ceramic populations: The rice rat (*Oryzomyini* tribe)

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In the Lesser Antilles, which might have never been connected to the American continent, rice rats (*Oryzomyini* tribe) were one of the few non-flying terrestrial mammals, along with agoutis and dogs, present and exploited during the pre-Columbian Ceramic Age. Numerous questions remain about the past spatio-temporal distribution of the *Oryzomyini* which are now extinct in the region: were they part of the human exchanges between islands? Did they show an insular adaptation linked to the human societies changes?

To help answer those questions, we studied the morphological variation of rice rats, through time and geography, covering their whole known archaeological period of occurrence in these islands. We performed a landmark and sliding semi-landmark based geometric morphometric analysis of 658 first lower molars originating from 25 archaeological sites of human Ceramic occupation dating from 500 BC to AD 1500 and localised in 7 islands of the Lesser Antilles.

We identified 3 major tooth shape morphotypes that persisted during the whole Ceramic period: one occurring in the central islands (Antigua, Barbuda, Basse Terre and Grande Terre in Guadeloupe, Marie-Galante), a second and a third, close to each other in molar shape, coming from the southern (Martinique) and the northern (Saint-Martin) islands. Within these morphotypes, we found that the rice rat populations of each island can also possibly be further characterized in relatively distinct sub-groups.

These patterns tend to suggest limited or non-existing exchanges between rice rats' populations from the different islands. *Oryzomyini* populations, once installed, seem to have not been displaced and to have quickly gained a local morphology. This study demonstrates the interest of applying geometric morphometrics for the characterization of *Oryzomyini* and their evolution in time and space. It is also a first step to help determining the role of the rice rats in the Lesser Antilles pre-Columbian societies.





Haiti biodiversity, an urban experience

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For the past fifty years, most international reports about Haiti consistently characterize the country as an environmental catastrophe insisting on a vegetal cover of only 1 or 2%. While it is undeniable that the country suffers from severe environmental issues, the picture is not as grim as presented in those publications. As a well-known sociologist once stated, it is very possible that the primary forests of Haiti may have been depleted over time for several reasons since colonialism, but it's untrue that there is only 1 or 2% left of our trees and our vegetation.

Last year, in 2017, the Government of Haiti published several executive orders related to "Protected environmental areas" throughout the country, in Jeremie, Baradères, Iles Cayemites, Saut d'Eau, Grand Bois, etc. while Parc La Visite, Parc Macaya, Parc des Ramiers etc. where already singled out as areas to be protected and preserved for their biodiversity.

That same year, an executive order was also issued regarding the Parc de Martissant – Martissant Park, declaring the park officially a "Parc National urbain" (an urban national park) to be protected and preserved.

My presentation will focus specifically on the Martissant Park, the only public urban park in the country that is gradually becoming a unique space for studying ecosystems, biodiversity, for scientific experiments and pedagogical exhibits directed towards the public mostly children and youth. FOKAL advocated for saving these properties and in 2007 signed with the Government of Haiti a contract with a mandate to create and manage the park. The contract will expire in 2020, and is expected to be renewed. I will show how the transformation of a few private properties, the last wooded area in Port-au-Prince located in an impoverished sub-urban neighborhood, into a public park has had positive effects on people's lives, and drawn the attention of the public at large, including the Haitian diaspora, towards environmental issues, waste management, and many other educational and scientific experiments.

The presentation will also show the relationship with universities both Haitian and foreign for the creation of an Academic Board that can help us design a series of studies to have a better grasp of the complexity of our immediate environment in relations to other areas in the country or abroad.

This year, we plan to devise with a young cocoa entrepreneur an experiment in the park to preserve the genetics and characteristics of a variety of cocoa species. This will help to assure the traceability of the cocoa brand. Haiti's cocoa is in great demand in countries like France, Switzerland and Belgium. This type of experiment will hopefully be extended to other products.

The 3rd Caribaea Initiative Research and Conservation Workshop gives us an opportunity to make the Martissant Park and our work known, and we hope to create constructive relationship with other participants who can help us expand, connect and learn.





Spatial variation in the composition and diversity of avian communities: influence of the proximity to a large green zone in the area of Port-au-Prince, Haiti

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The Caribbean region is one of the most important hotspots of biodiversity in the world, as well as one of the most important bird areas in the world. In this region, the islands of the Greater Antilles such as Cuba, Jamaica, Hispaniola and Puerto Rico encompass almost 90% of the total land area of the West Indies and include the greatest biological diversity across the region. However, the natural habitats of many Caribbean bird species are exposed to several environmental threats. According to Birdlife international, 60 bird species are currently threatened in the Caribbean region.

Hispaniola Island, the second largest island of the Greater Antilles, is shared between two countries, the Dominican Republic and the Haitian Republic. This island has the largest bird diversity in the Caribbean region, being only surpassed, in terms of the number of endemic species, by Jamaica island. While Hispaniola habitats are vital for the survival of many endemic and migratory bird species, the island is facing several important environmental problems that threaten the sustainability of bird populations. In many ways, problems in the Dominican Republic and Haiti are the same, except that Haiti is facing a more extreme situation because of its serious economic, social and political problems. Some actions have been undertaken in response to environmental issues. For instance, three additional national parks have been created, as well as 10 IBA (Importance Bird Area) and 31 key biodiversity areas. These particular areas concentrate the majority of ornithological studies carried out in Haiti. However, other areas can be of ecological importance, particularly within or close to the urban environment. In this context, we carried out a study in two green zones of the department of Ouest-Haiti, close to Port-au-Prince, in order to obtain quantitative measures of avian diversity (species richness, relative abundance) and assess how the proximity to such green zones influences avian communities in smaller wooded and agroforestry areas.





The GCFI: An institution promoting education, research and cooperation in the marine sciences throughout the Gulf and Caribbean region

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The Gulf and Caribbean Fisheries Institute (GCFI), founded in 1947, with the mission to improve and promote the exchange of information on the use and management of marine resources in the Gulf and Caribbean Region has a membership comprised of scientists, resource users and managers, decision-makers, educators, and students.

Through its education initiative, the GCFI provides opportunities for students from universities within the region, to participate in the annual GCFI meeting and present their research in subject areas related to fisheries ecology, conservation, and management of coastal and marine resources within the Gulf and Caribbean region. Different types of awards support students, including the GCFI Student Award for Outstanding Achievement recognizing the quality of their work, the GCFI Student Travel Awards helping to cover the costs of attending the annual meeting, awards for research focusing on recreational fisheries, and another one for research dedicated to fish spawning aggregations.

The GCFI Education Initiative has now expanded to offer multiple opportunities for not only university students but also schoolchildren from primary to high school. Various local activities, including field or aquarium visits and participation in specific sessions during the annual meeting, have raised awareness of schoolchildren to conservation of local species and ecosystems, but also to biodiversity threats. In 2016 for example, through the Ocean Innovation program (a partnership with NOAA), the GCFI funded a group of high school students to conduct targeted research on ways to reduce the exposure of coral to increased sea surface temperatures. Since 2017, a new ad-hoc committee to the board of the GCFI is dedicated to education and awareness and is currently developing new educational activities involving local schools and civil society organizations at the annual meeting in the host country. An education strategy is under development to make this initiative more sustainable.

In addition to its support for youth, the GCFI is also building capacities of mature stakeholders involved in the management of coastal and marine resources through cooperation with the MPA Connect program, a learning network of MPA managers and professionals in the Caribbean. An effective peer-to-peer learning program facilitates the sharing of experiences and builds effective cooperation among MPA managers who face common challenges and enables them to improve their ability to better manage protected areas.





Is food nutritional quality the stimulus to upstream migration of diadromous species?

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In the Caribbean islands, the freshwater macrofauna is predominantly constituted of diadromous fish and crustacean species. In the rivers of this region, the most common life cycle is amphidromy, defined by a reproduction in river, a downstream passive larval transport followed by a marine larval dispersal, and finally an upstream migration at juvenile stages. The growth of these organisms takes place mostly in freshwater habitats, both during their migration and when sedentarized along the river. We studied freshwater food consumption through lipids analyses of the five most abundant fish and crustacean species (Gobiidae, Palaemonidae and Atyidae) in one river representative of Caribbean islands volcanic functional type, in Guadeloupe. The study of the fatty acids assesses the food sources in various habitats and also the nutritional quality of the species diets. For comparison, adult and juvenile stages for each species were analysed. Preliminary results underline higher availability in essential fatty acids in upstream habitats than in downstream ones. These results give rise to the question of the food nutritional quality being a driving force for the upstream migrations of diadromous species. In this case, ecological continuity along the river systems would play an even greater importance than previously thought in the biology of diadromous species and for the conservation of Caribbean river biodiversity.





Brachiopod diversity around the French Lesser Antilles (Caribbean)

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Representatives of the phylum Brachiopoda exist in the world since Early Cambrian, but much more recently regarding their location in the Caribbean. Brachiopods have a biconvex bivalved calcite shell (ventral = pedicle valve and dorsal = brachial valve). These organisms live at various depths in the Caribbean, and may have a wide depth tolerance. They are filter feeders and obviously are sensible to modifications of the environment. As attached benthic marine invertebrates they are true witness of the close surroundings and precisely record random events, they grow also in accordance with seawater temperature and food availability.

Representatives of the phylum, sampled during the French Expeditions Karubenthos (around Guadeloupe, 2015) and Madibenthos (around Martinique, 2016), allow reveal an impressive diversity with a rich fauna belonging to the Rhynchonelliformea (one of the three subphyla of the phylum Brachiopoda), obviously no currently available Linguliformea and a few Craniiformea. Among the rhynchonelliform: *Terebratulina cailleti* is an endemic Cancellothyrididae first reported by Crosse (1865) around La Guadeloupe, a fairly common and widespread species. The sampled fauna is dominated by species of the genus *Tichosina* (Terebratulidae) along with a few *Erymnia* Cooper and *Dallina floridana* (Pourtalès) with their large shells. What draw the attention is the small size of the shell of species from several genera among which *Cryptopora* Jeffreys (surprisingly, it is the only rhynchonellid known in the Recent fauna of the Caribbean, in other respects world-wide in occurrence), *Eucalathis* (Chlidonophoridae), *Terebratulina cailleti* and some others belonging to several families of the Terebratellidina: *Argyrotheca* sp., *Platidia* sp, with a same similarity with late Cretaceous micromorph species from NW Europe. In addition, the brightly colour of *Argyrotheca* shells is revealed with an unmatched occurrence elsewhere while well represented in the Mediterranean. The significance of the colouration could be a protection against sunrays or to prevent predation.

The brachiopod shell, with the exception of that of the rhynchonellids, has a punctate shell. Specimens of the genus *Tichosina* (common) reveal brown traces of pollution that could obviously be from oil origin, while punctae can also act as accessory way of respiration, they can be blocked what will lead to the death of the organisms or even to the disappearance of part of the fauna.

To conclude, the micromorph brachiopods sampled around the French Lesser Antilles, as well as those in the vicinity of other Caribbean islands, off Columbia, Venezuela, Guyana and Brazilian coasts were for most part already established since the Late Cretaceous at the time of the North Atlantic opening.





Avian influenza in wild birds for risk mapping in the French West Indies and French Guiana

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Avian influenza is a major disease for poultry causing serious symptoms and high rate of mortality leading to important economic loss. In addition, avian influenza can be transmitted from poultry to human and involving symptoms and mortality, as we witnessed it for H5N1 and H7N9. However, there are different levels of diseases caused by low and high pathogenic viruses with different consequences.

Wild birds are well known as a great reservoir of avian influenza viruses, which means they can carry viruses and transmit them to other animals without being sick. Wild birds can transmit avian influenza viruses to poultry directly by contacts or indirectly by feces in the environment. Avian influenza spreading from wild birds to poultry has serious consequences because poultry population is naïve and less resistant than wild birds. Moreover, migratory wild birds can carry avian influenza viruses through long distances along their migration and bring it inside a free area. In Americas, there are three distinct flyways linking northern and southern America. Thus, many birds are crossing Americas and passing through the Caribbean, while they are heading north or south, and some birds stop for wintering or breeding in the Caribbean. Considering the avian influenza situation in some country (USA, Mexico, Dominican Republic...) wild birds are fully associated to avian influenza transmission and spread.

Within the framework of avian influenza risk mapping in French Guiana and the French West Indies, we analyzed the risk of introduction and spread of avian influenza in each territory. Although wild birds are not the only risk factor for avian influenza introduction and dissemination, we assessed their real role in the Caribbean among the other risk factors.

We determined the global risk of avian influenza introduction and dissemination in each department considering the family, the abundance and the habitat for all the wild bird species reported. To assess the risk of introduction by wild birds we only focused on migratory birds, whereas to assess the risk of dissemination we also took into account resident birds. The risk assessment was made using wetlands and protected areas, which are common locations for wild birds gathering, and so key locations for avian influenza introduction and dissemination. Combining all the risk factors, we obtained a risk map where every administrative division is associated to a specific risk level of introduction and spread of avian influenza.

Concerning wild birds, a risk map can be an efficient tool to communicate about the risk represented by wild birds and to support wild birds' surveillance in the most risked area. As avian influenza is not the only disease transmitted by wild birds, this method could be adapted to other diseases, such as the West Nile virus, a serious disease in which wild birds also play a key role.





Determinants of habitat use in cleaner gobies *Elacatinus evelynae* and *E. prochilos* in Barbados

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The broad striped goby (*Elacatinus prochilos*) and the shark nose goby (*E. evelynae*) are two ecologically similar cleaner fish common on Caribbean reefs. Both species can either be obligate cleaners (consume client gleaned material such as fish ectoparasites and mucous) or facultative cleaners (feeding on non-client gleaned items such polychaetes and plankton) depending on their geographic location. These adaptations are linked to their microhabitat use whereby individuals living on corals tend to be predominantly cleaners whereas those living on barrel sponges tend to be predominantly non-cleaners. Furthermore, such differential microhabitat use is also linked to their social behavior whereby singles and couples tend to inhabit corals whereas large groups with dominance hierarchies tend to inhabit barrel sponges. The drivers of this differential microhabitat use - whether settlement, mortality or post-settlement movement - and the implications for fitness (e.g. growth and mortality rates) for each species are still unclear. It is also still unclear how important are interactions between these two species in determining their microhabitat use. In this study we seek to fill these gaps by monitoring co-occurring populations of both species over time so as to quantify their microhabitat use (from settlement to adulthood), the extent of their spatial overlap, and their population dynamics over time.

Monitoring of goby populations has thus far involved conducting bi-weekly surveys (n=29) over four consecutive lunar cycles, from January to April 2018, on a 30m x 30m permanent reef plot in Carlisle Bay, Barbados. These surveys have entailed recording goby abundance and body size across a range of microhabitat types. Moreover, we have identified and are measuring all available coral and barrel sponge microhabitat units.

Over the study period, *E. prochilos* has been three times more abundant than *E. evelynae*, with 3,300 versus 1,635 individual fish records, respectively. We have identified 760 coral heads and 131 barrel sponges of available microhabitat at the site. So far, sponges have exhibited higher occupancy rates by gobies than corals (92% of sponges versus 29% of coral heads). Although both gobies can be found on corals and barrel sponges, most *E. prochilos* (85%) inhabit barrel sponges whereas most *E. evelynae* (75%) inhabit corals, highlighting marked differences between species in microhabitat use. These data also have revealed size-dependent differential microhabitat use for each species. For *E. evelynae*, bigger individuals were more likely to be found on corals than smaller ones. In contrast, for *E. prochilos*, bigger individuals were more likely to be found on sponges than smaller ones. It is still unclear whether these size-dependent changes in microhabitat use are driven by small-scale ontogenetic migration, by size-dependent mortality, or by a combination of both.

We will be soon conducting manipulative experiments (including fish removals and reintroductions) to help shed light on the drivers of this differential and size-dependent microhabitat use.





The Haemulidae and the mangrove exploitation in the Lesser Antilles since 6000 years

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From indigenous pre-Columbian subsistence to the European colonial economies, mangroves have played an important role, providing goods and services to human societies for millennia. In the West Indies, the pre-Columbian villages are very often located in the immediate vicinity of mangroves. From an ecosystemic perspective, they buffer the impacts of hurricanes and tropical storms, while stabilizing coastal shorelines, and while in times of calm, they provide a key resource where activities such as gathering, aquaculture, horticulture and harvesting of molluscs, crabs, fish, birds, turtles, and mammals take place. Many coral reef fish exhibit habitats partitioning throughout their lifetimes, as ontogenetic shifters: while coral reefs are dominated by adult fish, juvenile fish grow in the mangroves and seagrass beds. One such example is the Haemulidae family where the size of the fish is highly correlated with their age and growth maturity and hence their ecosystemic location. Zooarchaeological remains were excavated from 51 sites from the islands and islets of St Martin, Antigua, Barbuda, la Guadeloupe archipelago and la Martinique. They provided almost 7924 remains of Haemulidae, among which 3531 were measured. Indeed, bivariate and linear regression analyses from osteometrics are methods largely recognized and applied for the size reconstruction of archaeological fishes. The collection of modern osteometric reference created by Grouard in 2001 allowed to the models of fish size reconstruction for the Haemulidae family. Thus, this modern reference frame was applied to archaeological fish bones from different environments of Guadeloupe and Martinique (French West Indies), to restore over time the fishing practices of these pre-Columbian populations (between 500 yrs. B.C. and 1000 yrs. A.D.). Moreover, 324 otoliths were analyzed following the sclerochronology methodology, by studying the physical and chemical variations in the accretionary hard tissues of organisms, and the temporal context in which they formed. A second method was used to estimate the age of the Haemulidae, using the Von Bertalanffy's Growth Equation to Model Age and Size at Maturity.

The zooarchaeological evidence shows that the mangroves were exploited by the earliest peoples arriving in the islands during the Archaic Age 4000 BC and their exploitation continued in the Early Ceramic Age. While the earlier occupants only lightly exploited this resource, during the Late Ceramic Age we see an intensification of the mangrove products exploitation and a subsequent increase in the presence of juvenile Haemulidae. The size of the fish did not stop to decrease through the time. The resource exploitation of mangroves continued into the colonial era (AD 1492) until the XIX century, and in areas where they are still present, they still provide part of the daily menu.





Nidification of Hispaniolan Trogon (*Priotelus roseigaster*. Aves: Trogonidae) in the Ébano Verde Scientific Reserve, La Vega, Dominican Republic

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Nidification of *Priotelus roseigaster* was studied in the Ébano Verde Scientific Reserve, La Vega, Dominican Republic, from December 2013 to December 2015. The nidification was studied mainly in artificial nests, but some natural nests were also included. Artificial nests were installed in different kinds of trees, mainly pines (*Pinus occidentalis*) in two locations in the Reserve. Thirteen artificial nests were installed in “El Arrollazo” and seven in “Loma la Sal” in 2014. Since none of the artificial nests installed in “El Arrollazo” were occupied by trogons (only one was occupied but by Woodpeckers (*Melanerpes striatus*), all data was collected in “Loma la Sal.” Data included clutch size (one with 4 eggs, one with 2, and three with 3), incubation (16 ± 1 days), fledging (21 ± 1 days), participation of the couple during the incubation period, and the feeding and rearing of the chicks. A camera installed on the roof of the nest also recorded how much time the female stayed in the nest from pipping to fledging and the kind of food provided during this period. The reproductive activity was from March to July the first year, 2014. Four of the seven nests installed at “Loma la Sal” were occupied by trogons and in three of them trogons hatched. Three eggs vanished from one of the nests (*R. rattus* is the main suspect), but the couple double clutched and four chicks were hatched in this nest. Three of the five clutches observed had 3 eggs. One had 4 and the other one 2. The last clutch with 3 eggs was abandoned. Despite the fact that preventive measures were taken, all the hatchings were parasitized by *Philornis sp* larvae. A characterization of the vegetation close to the trees of the successful nests was conducted. Reproductive activity declined drastically during the second year, 2015, with only one active artificial nest, perhaps because of the severe drought which affected the Caribbean Islands that year. Three eggs were laid between May 20-23. They hatched between June 4-6 and they fledged on June 26-27. Some morphometric data of the siblings was collected and a camera installed on the nest’s roof recorded the nidification process from pipping to fledging. This time additional preventive measures were taken (like changing the substrate 11 days after hatching), and none of the three hatchings were parasitized by *Philornis sp* larvae. In 2016 five artificial nests were occupied. Four of them by trogons and one by Hispaniolan Woodpecker (*Melanerpes striatus*). In 2017 four artificial nests were occupied. Two for Trogons and two for Hispaniolan Woodpeckers (*Melanerpes striatus*).





Preliminary sea turtle hatchling gender analysis using TSOX9, DMRT1, β -ACTIN, and FOXL2 mRNA analyses

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Shifts in sea turtle hatchling gender is important in the face of climate change given that sea turtle gender is not genetically determined by X-Y chromosomes, but temperature-dependent. Males tend to be produced in cooler temperatures as opposed to females in warmer temperatures, with the pivotal temperature being around 29.2 - 29.5 C depending on species. At this temperature, a ratio of 1:1 male to females would be expected. With global average temperatures increasing, there is a risk of nest temperatures reflecting a similar rise in temperature, particularly for the hard shell species which tend to have shallower nests compared to leatherback turtles. This would result in a bias towards female sea turtle hatchlings, which in turn could eventually have a major impact in population dynamics and reproduction. A preliminary assessment of sea turtle gender from tissues, using a combination of mRNAs responsible for SOX9, DMRT, β -ACTIN, and FOXL2 gene activity. These genes are well known for gonadal development. Changes in sub-surface sand temperatures at various nesting sites, as well as potential implications to hatchling gender would also be explored.





God Save the Queen! : An approach to the sustainable management of Trinidad And Tobago's Queen Conch resources

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Trinidad and Tobago's queen conch fishery, despite its suggested decline in productivity from the 1970's to present, currently remains unmonitored and unregulated. As a result, the country remains unable to report on the status of the fishery, lending to the perpetuation of poor management. This study then seeks to address this key issue and recommend suitable methods for the sustainable management and recovery of Tobago's local queen conch population.

The dispersal of local conch resources at larval stages via current flow can be a key factor in its depletion, taking into consideration the magnitude of currents found in and around the Tobago coastal region. Further to prior research done on the connectivity of populations and gene flow in Tobago's queen conch population (Henry, 2016), the study will first examine the transport of the *Lobatus gigas*' larval population within Tobago and analyse gene flow of local samples as a means of differentiating the conch metapopulation. The potential movement of the larval population to regional countries susceptible to the stock's larval drift will then be observed and genetic linkages amongst populations determined.

Determination of larval dispersal patterns and migrations can aid in the development of a relevant local management plan for the *Lobatus gigas* population. Also, the understanding of local population structure, larval dispersal and migration patterns for this protected species will be highly relevant in improving existing conservation efforts. Therefore, subsequent to these determinations, with an improved understanding of the local queen conchs' genetic population structures, suitable approaches can be taken to develop local guidelines and regulations for effective and sustainable management of Trinidad and Tobago's queen conch resource. These regulations and policies will include the drafting of a national queen conch conservation and management plan, which will be done in alignment with the Food and Agriculture Organization's Regional Queen Conch Fisheries Management and Conservation Plan (2017) for the Wider Caribbean region.





Recovery of an island ecosystem after eradication of rats and goats: the lizards of Redonda

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Redonda is a small volcanic island that is home to three endemic lizard species – one anole (*Anolis nubilis*), one ground lizard (*Pholidoscelis atrata*), and one yet-unnamed dwarf gecko (*Sphaerodactylus*). Because of the guano mining that took place between 1860 and the 1920s, rats and goats were introduced on the island. This had a devastating effect on the island, resulting in the loss of nearly all trees and most of the vegetation. In 2017, as rats and goats were eradicated from the island, we estimated population densities of the three lizard species. We also measured the morphology and quantified escape behavior of the anole and the ground lizard. One year later, we returned and repeated the same measurements of population density, morphology, and behavior. Our results show a significant and positive impact of the removal of rats and goats on the lizard densities. Moreover, we observed differences in the escape behavior of both *A. nubilis* and *P. atrata*. While the increase in vegetation in the last year was substantial, the anoles have not shifted habitat use. The morphology of the lizards remained mostly similar except for a few traits that appear to have changed. These results show how the removal of invasive species can have rapid effects on lizard densities and behavior. As the vegetation starts growing back, we expect the anoles to start utilizing this resource again, which we predict will result in subsequent morphological adaptations.



Historic and pre-historic landscape changes within Caribbean coastal wetlands: disentangling natural disturbances from anthropogenic activities

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Coastal Caribbean wetlands display quite various landscapes, from fringe mangrove forests to wet meadows. Current, critical management issues such as water management and cynegetic regulation require a sound understanding of ecological processes involved. For this purpose, a long-term, comprehensive perspective of coastal wetland dynamics has been conducted, focussing on the Grand Cul-de-sac Marin Ramsar site, in Guadeloupe (FWI). Combined paleological, historical and contemporary approaches led to disentangle the respective impacts of natural vs. anthropogenic disturbances on wetland landscapes and biodiversity. Extensive, monodominant herbaceous communities actually proved to be successional. They durably replaced forested ecosystems following sustained burning or grazing activities. On a same way, most long-lasting mud flats appeared to be cynegetic landscaping. Though such anthropogenic landscapes appear to mimic early successional stages following natural disturbances, the underlying human activities prevent these areas from ever reaching the mature forest stage. As a result, these activities exacerbate the expected impacts of the so-called climate change on Caribbean wetlands. Moreover, they likely contribute to weaken populations of local, endangered forest bird species (e.g. Mangrove Rail, Forest Thrush, White-crowned Pigeon), while promoting open-space, transient communities of shorebirds.





Genetic diversity and connectivity of *Acropora* corals of the Lesser Antilles

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Branching corals such as *Acropora* species are highly responsible for the structural complexity of coral reefs providing habitats for an important part of the reef fauna and protection for littoral ecosystems and human infrastructures against erosion. The two Caribbean *Acropora* species, *A. palmata* and *A. cervicornis*, used to dominate shallow Caribbean reefs. However, since the 1980s, *Acropora* coral populations have dramatically declined and *A. palmata* and *A. cervicornis* has been classified as 'critically endangered' by IUCN. Previous genetic studies on Caribbean *Acropora* populations have mainly been conducted along the reefs of the Gulf of Mexico (Florida), the Bahamas and the Greater Antilles, the populations of the Lesser Antilles remaining less studied. Here, the genetic diversity, population structure and connectivity in *Acropora* populations among 42 sampled sites from eleven islands of the Lesser Antilles were investigated using 14 hypervariable microsatellite loci. *A. cervicornis* populations revealed to be in decline, that favoured hybridization between *A. palmata* and *A. cervicornis* species. This hybrid described as *A. prolifera* (Lamarck, 1816) was encountered at several sampled sites of the Lesser Antilles. Globally, in comparison with other Caribbean populations, *A. cervicornis* and *A. palmata* presented a lower genetic diversity in the Lesser Antilles. The analysis of the genetic structure of *A. palmata* populations, crossed with spatial autocorrelation analysis, revealed a genetic isolation-by-distance pattern at both the reef and the Lesser Antilles scales. A northward gene flow direction, in agreement with ocean surface currents in the region were found. Altogether, these results suggest a short distance dispersal of *A. palmata* larvae within the Lesser Antilles, further limited by geographic distances among suitable habitat patches, and that populations from the southern islands likely have a key role in *A. palmata* conservation, being potential sources of larvae for the most northerly islands. Conservation efforts for these populations would be realized at a local scale, favouring southward populations of the Lesser Antilles.



Invasive subterranean termites (*Coptotermes* spp., *Heterotermes* spp.) in the Caribbean Region

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In the Caribbean Region (the Bahamas, Greater Antilles, and Lesser Antilles), members of the genera *Coptotermes* and *Heterotermes* (Dictyoptera, Blattaria, Termitoidae, Rhinotermitidae) are economically important invasive termites. *Coptotermes gestroi*, the Asian subterranean termite, is an extremely aggressive and destructive termite that damages wood in structures and also attacks dead wood in living trees, often hollowing them out and extending galleries into living tissues causing the demise of the trees. During the past century, this species has spread throughout the Caribbean Region (reviewed by Evans et al. 2013. *Annual Review of Entomology* 58: 455–474). It appears to be a relatively recent invader on the main island of Puerto Rico and was reported only in San Juan (north-central coast) in 2003. Subsequently, *C. gestroi* was collected in southern Puerto Rico in 2004, and it was found at numerous locations on the island during 2006, 2010, and thereafter (Jones, personal observations). Its presence at San Juan's Isla Grande Airport in April 2017 (Jones, personal observations) is of particular concern given that numerous daily flights depart to various islands in the Caribbean. The Asian subterranean termite has crepuscular dispersal flights and is drawn to lights, and it can be spread via airplanes, ships, boats, and other human conveyances. It has the potential to cause widespread destruction to trees in the Caribbean Region. A closely related species, *C. formosanus*, the Formosan subterranean termite, has a limited distribution in the Caribbean as it has been recorded to date only on Grand Bahama (Jones et al. 2017. *Journal of Entomological Science* 52(4): 445–449).

Termites of the genus *Heterotermes* are pantropical wood feeders capable of causing significant structural damage. The *Heterotermes* fauna in the Caribbean Region is thought to consist exclusively of pest species that have been introduced from the South American mainland. Despite their economic importance, *Heterotermes* remains understudied, perhaps partly due to a lack of robust morphological characteristics enabling reliable identification (Griebenow et al. 2017. *ZooKeys* 725: 17–29.). We now have a much better understanding of *Heterotermes* species diversity in Puerto Rico based on phylogenetic analyses of the mitochondrial 16S rRNA and cytochrome oxidase II (COII) genes (Eaton et al. 2016 *Journal of Insect Science* 16(1): 111; 1–9). These data indicated that *H. cardini* and *H. convexinotatus* are widespread in the arid coastal regions of the main island, whereas *H. tenuis* is uncommon and may represent a relatively new introduction to Puerto Rico. Additionally, we reported the first record of *H. cardini* on Grand Bahama. Our recent research using a nuclear locus, the internal transcribed spacer (ITS) array, provides further insights into Puerto Rican *Heterotermes* species diversity.





Freshwater fish diversity in the Caribbean: a review

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The Caribbean supports important freshwater fish assemblages, and is home to several endemic species. At the same time, these island nations are vulnerable to invasive species. In order to collate information about the diversity of freshwater fish species in the Caribbean, we conducted a literature search, collated data from the online database Fishbase, and disseminated an email survey to professionals working on freshwater habitats throughout the Caribbean. This revealed large differences between countries in terms of research effort and knowledge of freshwater assemblages. One of the biggest gaps was observed between Haiti and Trinidad and Tobago, with a total of 39 and 66 recorded species of freshwater fish respectively (excluding estuarine species). Of these species, 11 are endemic to Haiti and 3 are endemic to Trinidad and Tobago. A comparison of the two countries suggests there is a big gap in terms of research effort. Many more studies have been completed in Trinidad and Tobago, including comprehensive biodiversity surveys as well as many investigations into the biology and ecology of individual species. Meanwhile, Haiti appears to be data deficient, aside from an estimation of fish species richness conducted in 1990 as part of the Aquaculture and Continental Fisheries Project, and a study on the diversity of freshwater species in an ecological inventory of the National Park of Three Bays in the north in 2016. In order to begin to bridge this gap, we plan to carry out comparative field research on freshwater fish species in Haiti and Trinidad. We will compare the diversity and capacity of well-studied stream sites in Trinidad with sites in Haiti, using the same methodologies (seining and electrofishing), to expand our understanding of Haitian freshwater fauna.





A new five-year grant-making phase for Biodiversity Conservation made available through CEPF to the Caribbean Civil Society

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The Critical Ecosystem Partnership Fund (CEPF) is a global program that provides grants to non-governmental organizations (NGO) so they can conserve the most biologically diverse yet threatened ecosystems, the world's biodiversity hotspots. The Caribbean Islands is one of the 36 terrestrial biodiversity hotspots recognized worldwide. The Caribbean Islands Biodiversity Hotspot is under the pressure of serious threats including habitat destruction and fragmentation, invasive alien species and climate change.

From 2010 to 2016, CEPF invested a total of US\$6.9 million in eight different countries of the Caribbean. In 2017, following a competitive process, CEPF contracted the Caribbean Natural Resources Institute (CANARI) to prepare the Ecosystem Profile that constitutes the strategic document that will lead CEPF investment in the Caribbean from 2018 to 2023. The information contained in the Ecosystem Profile is the result of a bottom-up process involving the consultation of many stakeholders from governments, private sector actors, academic institutions and civil society groups.

In January 2018 a workshop took place in Kingston, Jamaica, to validate the Strategic Directions, the Priority Corridors and the Priority Key Biodiversity Areas (KBA) that will benefit from the forthcoming investment of CEPF in the Caribbean Islands Biodiversity Hotspot.

The six Strategic Directions are:

1. Improve the protection and management of 33 priority KBAs for long-term sustainability;
2. Increase landscape-level connectivity and ecosystem resilience in 7 priority corridors;
3. Safeguard priority Critically Endangered (CR) and Endangered (EN) globally threatened species;
4. Improve the enabling conditions for biodiversity conservation;
5. Support Caribbean civil society to conserve biodiversity by building local, national and regional institutional capacity and fostering stakeholder collaboration;
6. Provide strategic leadership and effective coordination of CEPF investment through a regional implementation team (RIT).

Seven Priority Corridors located in five countries have been selected, including one bi-national corridor: The Dominican Republic, Haiti; Jamaica; St. Lucia, and St. Vincent and the Grenadines. The 33 Priority KBAs are located in nine countries including: Antigua and Barbuda, The Bahamas, Dominica, the Dominican Republic, Haiti, Jamaica, St. Lucia, and St. Vincent and the Grenadines. Barbados and Grenada have no Priority KBAs but will be eligible for support under Strategic Direction 1, in the case of Barbados and under Strategic Direction 3 in the case of Grenada.

The Ecosystem Profile for the Caribbean Islands Biodiversity Hotspot still needs to be approved by the CEPF Donor Council before granting could start. It is expected that the selection of the Regional Implementation Team (RIT) will happen in the third quarter of 2018 followed by the first call for proposals for implementation grants in the fourth quarter of 2018. The first grants should be signed by the second quarter of 2019. It is estimated that the investment for the five-year period will be approximately US\$8 million.





Metagenomics as a tool to uncover ecological diversity in Mangroves

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Mangroves ecosystem cover 60 to 75% of the coastline of tropical and subtropical regions of Earth. The mangroves are known to stand as a buffer to protect the coasts and are one of the most important environments as they produce a very high rate of biomass. Mangroves ecosystems are considered a hotspot for microbial diversity and the microbial community plays an essential role in the functioning and maintenance of this ecosystem. Microbial diversity and activity are fundamental for the productivity, conservation and recovery of mangroves. However, to date, a comprehensive description of microbial life in marine mangrove ecosystem is lacking.

Metagenomic analyses supported by high throughput sequencing provide a method to evaluate the microbial community in terms of both taxonomy and potential functioning. Thus, this approach was used to describe the microbial diversity of a long transect covering different types of marine sediments going from lagoon to cropland at Manche à eau, in Guadeloupe (F.W.I). These results were based on metagenomic data obtained by Illumina MiSeq targeting 16S rRNA.

Our data, allow us to better understand the complexity of the microbial communities in the mangrove swarp and reveal the major metabolic function of bacteria potentially involved in the functioning of this ecosystem. Moreover, we have developed a web tool to visualize the metagenomic data from Guadeloupe in order to make them available to the research community. It will serve as a basis for comparison with other mangroves' metagenomes among different tropical regions.

Mangrove ecosystem was described as one of the most critical ecosystem and vulnerable to global climate change. Thus, studying the microbial diversity of mangroves is an essential key to understand this type of ecosystem and could be used to protect it.





West Nile Fever – a European perspective

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West Nile virus (WNV) infection is a non-contagious disease mainly transmitted by the bites of infected mosquitoes from the *Culex* genus. WNV is maintained in a mosquito–bird–mosquito cycle, and can accidentally be transmitted to mammalian hosts. Among these hosts, equines and humans are the most sensitive to WNV infection and can develop severe meningoencephalitides. Clinical signs in horses are only present in around 5 to 20% of animals infected by the virus and horses exhibit neurological signs in only 10% of clinical diseases. West Nile virus activity has dramatically increased over the last five years in Europe.

We will describe the WNV outbreak occurring in 2015 in the Camargue area, the French epidemiosurveillance network in horses (RESPE) as well as the importance of integrated and coordinated monitoring in horses, humans, other animals and vectors.

West Nile virus introduction and circulation have been demonstrated on multiple occasions in southern Europe and the Mediterranean basin since the 1960s, with WNV activity having dramatically increased over the last five years. In 2015, 106 neuroinvasive cases were reported in humans in European Union (EU) countries, a situation similar to that observed in 2014. Nevertheless, WNV activity was primarily reported in Western Mediterranean countries in 2015 (in Italy, France and Portugal in humans and equines, as well as in Spain in equines).

In France, Equine surveillance for WNV allowed the early detection of WNV infections in 2015, as already described during the previous French outbreaks. The RESPE network played a major role in the detection of the first two equine WNV cases in 2015, while most of the clinically suspect cases reported by field surveillance veterinarians were recorded directly by the local Veterinary Services rather than by the RESPE network. RESPE has proved useful in maintaining a minimum level of vigilance in a French endemic area, the Camargue area. The RESPE neurological syndrome sub-network should also enable more effective and rapid monitoring for encephalitis associated endemic or emerging pathogens through syndromic surveillance.

In conclusion, modelling of WNV circulation indicated that clinical surveillance in horses was a cost-effective and sensitive system. Clinical examination of horses with neurological signs that are not vaccinated against WNV could provide important clues for the early clinical detection of WNF and therefore serve as an alert for possible human viral infections.





Genetic diversity and differentiation patterns in the tropical butterfly genus *Papilio* (sensu lato)

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We present a systematic phylogenetic and phylogeographic analysis of the genus *Papilio* (sensu lato) looking for evidence/rationale for the elevation of some or all its sub-genera to generic status. Along the way, it has branched into major undertakings lead by other researchers answering important questions in diversity, differentiation patterns, and historical biogeography. The overall goal remains to look systematically at the putative genera inside *Papilio* (sensu lato). However, it is not limited to the investigation of apomorphic characters that can be used to delimit groups within *Papilio*, but includes a wider investigation of biogeographic history of the group by using phylogenetic inference. Work began with an investigation between the species in the subgroup *Heraclides*. The utility of alpha taxonomy, as well as the importance of using morphological characters in an age when molecular systematics is king was shown. 133 morphological characters yielded a proposed phylogeny which agreed very closely with analysis of molecular data derived from 2.292 kb of mitochondrial genes COI, tRNA-leu and COII, and 1.234 kb of the nuclear gene EF-1-alpha. Stemming from initial work on *Heraclides*, a total-evidence phylogenetic approach was used to reconstruct the evolutionary history of the butterfly subgenus *Heraclides*. We used data from the above research augmented with additional sequences to uncover a robust and well-resolved phylogeny using several analytical approaches; molecular dating and biogeographical analyses indicated an early Miocene origin (22 Mya) in the Caribbean Islands. Six independent dispersal events from the Caribbean to the mainland were uncovered, with three dispersals from the mainland to the Caribbean. It was suggested that cooling climates with decreasing sea levels may have contributed to these events. This study was one of the first few to show that islands may act as a source of diversity rather than a sink. Research continued with an expansion of the species investigated to include 61 of 66 currently recognized species in the clade of New World *Papilio* (*Agehana*, *Alexanoria*, *Chilasa*, *Heraclides* and *Pterourus*). Data from the most complete current phylogeny of this clade with geographical distributions of each species inferred from ecological niche models (ENMs) was used. No strong support was found for ecological opportunity or macroevolutionary processes as the drivers of latitudinal diversity. Instead, discordant patterns in phylogenetic reconstructions of latitudinal geographical range and suitable abiotic climate conditions were recovered. *Heraclides* likely originated and diversified in climatically and latitudinally tropical environments before some lineages dispersed to temperate habitats. The *Alexanoria-Chilasa-Pterourus* clade likely originated in climatically and latitudinally temperate habitats before dispersing and diversifying; some





lineages are likely to have dispersed into the latitudinal tropics via highland temperate-analogue environments. Both out-of-the-tropics and into-the-tropics processes have contributed to the latitudinal diversity gradient. Results present an example where temperate zones appear to be a source, instead of a sink, for biodiversity and emphasize the need to consider biogeographical history not only from the perspective of shifts in geographical space, but also in terms of constraints enforced by ecological niche conservatism.





Diversity and level of endemism of Arctiinae (Lepidoptera: Erebidae) in relation to the diversity and level of endemism of the vegetation in Western Cuba

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Arctiinae (Lepidoptera: Erebidae) is one of the most speciose groups of Lepidoptera in Cuba, with 101 species, of which 49.5% are endemic. Although little information is available about the ecological factors influencing the composition of assemblages in Cuban Arctiinae, it has been suggested that diversity and endemism are particularly high in dry land xeromorph serpentine shrublands. Indeed, this type of vegetation shows a particularly high level of species richness and endemism, that is supposed to favour in turn that of Arctiinae, through specialization on specific plants. As species richness and level of endemism of plants are higher in the Cajalbana dry land xeromorph serpentine shrubland than in Lomas de Galindo, we expect to observe higher richness and endemism of Arctiinae in the former. To test this idea, we plan to sample 20 different sites, i.e. 10 per plant formation. Species richness and abundance of Arctiinae will be estimated at each sampling, from which we will obtain α and β diversity, abundance - range curves, and ecological indexes. Then multivariate analysis will be carried out to compare between sites. In addition, to evaluate the relationship between the structure and composition of vegetation and the composition and structure of Arctiinae's assemblages, richness of plant species, percentage of plant endemism of each plot, density of trees and shrubs and vertical coverage vegetation will be measured in plots of 10m x 10m on each site.





The OHM Port Caraïbe: an interdisciplinary tool to study the trajectories of socio-environmental ecosystems

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The Caribbean, an archipelago of habitat-rich tropical and semi-tropical islands, is considered as one of the biodiversity hotspots, with the greatest concentration of marine species in the Atlantic Ocean. It is one of the world's greatest centers of endemic biodiversity, and presents emblematic marine ecosystems: coral reefs, seagrass beds, and mangroves. This biogeographic province also provides wintering and nursery grounds for many migratory species. Urbanization of the coastal zones, modification of lands usage, overfishing, environmental pressures, pollution and climate change correspond to threats but also challenges for conservation of species diversity in particular in aquatic ecosystems.

We recently created a new observatory to develop interdisciplinary researches on human-environments interaction and dedicated to the modification of the social-ecosystem associated to the expansion of the Pointe-à-Pitre harbors (Guadeloupe, French Antilles). Through annual calls, the OHM Port Caraïbe is developing observations, experiments and modelling to understand the evolution of the urban, coastal and marine ecosystems. Based on historical data analyses, we are also investigating the development and the co-evolution of the socio-ecosystems with regards to harbors expansion, city-port governances, landscape changes and ecological footprint.





Investigating favorable environmental characteristics of a global invasive carnivore, *Procyon lotor*, at both the global scale and the West Indies scale

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The development of human activities, trade, and mobility impacts biodiversity and ecosystem stability in different ways, including allowing introduction and spread of exotic organisms beyond their original areas. Biological invasions, and their consequences on biodiversity, are now a major problem in ecology and conservation biology, particularly in fragile insular environments. The recent improvements in statistical tools and geographic information systems led to the emergence of new approaches, which may be used to investigate the environmental factors influencing dispersal and occupancy of exotic invasive species. As such, Species Distribution Models (SDM) can be used to study and visualize potential biogeographic scenarii, such as the potential for range shifts associated with climate change. At a more regional scale, occupancy modeling allowed us to identify habitat characteristics that may influence the distribution of organisms. Our study investigated the environmental characteristics that may favor *Procyon lotor*, a wild carnivore native of North and Central America, which has colonized different areas worldwide, including Europe, Iran, Japan and the West Indies.

We computed niche models for *Procyon lotor* using current and future (2050) bioclimatic conditions. This study is based on 906 occurrences, taken from observations in the native and invaded areas, coupled with 19 bioclimatic variables. Favorable bioclimatic envelopes for *P. lotor* were modeled using ensemble forecasting approach, with seven statistical models. Results show a wide favorable environmental envelope for *P. lotor* at the global scale, covering most temperate biome regions, as well as some areas in Middle East and South-East Asia. The modeled favorable bioclimatic envelope is also visualized through the prism of climate change. Projections for 2050, realized from a consensus of three global circulation models bring to light an increase in favorable areas for *P. lotor*, particularly in Eastern Europe. This work highlights the invasive potential of *P. lotor*, and especially the perspectives of the species distribution in Europe, where several populations are already in rapid expansion.

Furthermore, habitat characteristics that may influence the distribution of *P. lotor* within the West Indies were investigated using an occupancy modeling approach. Based on data collected through a two-month campaign of camera trapping in Guadeloupe in 2017, this study reveals disparities in the probabilities of presence throughout the variety of forest types. Evergreen forests, as well as swamp forests and mangroves, seem to represent privileged habitats for this species. More complex models, using several additional environmental variables (such as distances to ponds and rivers, distances to urban areas, slope), are studied to visualize in greater detail the distribution of *P. lotor* within the West Indies.





Biodiversity change in island ecosystems

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The world's biodiversity is under unprecedented threat due to the pressures that humans are imposing on the environment. To understand how biodiversity is changing, and to help protect our irreplaceable ecosystems, we need data, not just on the structure and composition of ecological communities, but also on how the diversity of these communities varies over space and time. This is particularly urgent in the case of tropical island ecosystems which may be exceptionally vulnerable to anthropogenic impacts.

Dawn Phillip made hugely important contributions to our knowledge of the distribution and abundance of freshwater fish species in Trinidad & Tobago. In this talk I will show how her work has helped uncover key aspects of biodiversity change. In particular, it is now evident that many ecological assemblages in the Caribbean and elsewhere are experiencing marked temporal turnover in species composition at rates that exceed the predictions of ecological theory, even when the richness of these communities is relatively constant over time. Moreover, our recent work shows that the extent and nature of biodiversity change is uncorrelated amongst the taxonomic assemblages that comprise ecosystems. A pressing research challenge, therefore, is to establish how much temporal turnover is needed to maintain community properties, and when and where elevated turnover jeopardizes community resilience. Improved understanding of the causes and consequences of biodiversity change has a crucial role of play in effective conservation policy.





Biodiversity and climate change In the Caribbean: Coral reefs of the future

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The impact of climate change on the ocean's dynamics, chemistry, and biological diversity has far reaching implications for humanity. Coral reefs offer a vivid example of how marine systems can be transformed from thriving vibrant ecosystems to degraded landscapes by high temperature stress events, hurricanes, or by man. However, reefs can recover from episodic events over relatively short periods of time when ecological balances are intact. We know that the structural complexity of coral reefs supports 25% of all marine species and that the high productivity on coral reefs is inextricably linked to the entire ocean's biological diversity. Healthy coral reefs have the capacity to absorb up to 90% of wave action making these topographically complex structures significant defenses for coastal communities. This natural defense, however, is compromised by prolonged elevated seawater temperatures due to changing climate and by direct human impacts. Over the last 40 years, reefs have become dominated by fleshy algae and coral cover has been reduced to below 10% at many locations across the Caribbean.

The long-term climate trend of rising sea level, ocean temperatures, and ocean acidification promises to transform reef communities within the next 50-100 years. Of great interest is whether some coral species can adapt to rising temperatures and ocean acidification. Experiments and simulations indicate that some calcareous algae (which produce sand for beaches) and corals can acclimatize to a higher CO₂ world. It is the potential capacity of corals to adapt, resist, and rebound from climate stress that has scientists exploring possible solutions.

Time is not on our side and we urgently need to find innovative solutions if we are to protect the future for coral reefs. We need to work toward sustainable development goals that specifically reduce human impacts. Solutions should include efforts to restore key fish, coral, and urchin species that are responsible for maintaining the balance between algae and coral cover. Herbivorous fish (and urchins) help manage the delicate balance between algae and coral dominance. However, not all herbivorous fish are capable of reducing large volumes of harmful algae from the reef. Developing biodiversity action plans for key herbivorous fish species is proposed as a potential solution to the near term need to boost reef resilience at a local scale. At a time when climate change is pushing competitive interactions to a tipping point, solutions that boost reef resilience and resistance should become the highest priority for island nations.

In order to achieve the UN Sustainable Development Goal 14 (SDG), "Conserve and sustainably use the oceans, seas and marine resources for sustainable development," global leaders, scientists, and stakeholders must all nurture and communicate a deeper understanding of the complex interspecies dynamics that determine the balance of life under the sea.





Cáyoli, Guadeloupe Port Authority Natural Areas Management Plan

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Guadeloupe Port Authority (GPA) oversees five port facilities located across the archipelago of Guadeloupe. The two main islands of Grande-Terre and Basse-Terre are separated by Rivière Salée (“Salty River”), a strait that opens into the bay of Grand Cul-de-Sac Marin in the North and into the bay of Petit Cul-de-Sac Marin in the South. The bulk of GPA activities takes place in these waters. GPA is fully committed to stewardship of natural areas by implementing a coherent and effective strategy for sustainable development of Guadeloupe’s maritime assets over the next 15 years. The GPA Natural Areas Management Plan is a long-term action plan promoting biodiversity, especially in the Petit Cul-de-Sac Marin. It is a tool that recognizes the economic, social and ecological value of these sites.

One indicator of ecosystem health is the number and variety of species. However, fish, mollusks and crustaceans are particularly vulnerable during the larval and juvenile stages of growth. To increase the number of these marine species reaching reproductive adulthood, GPA program restocks the inshore shallows. Juveniles are collected offshore, reared to sufficient size and then released in artificial marine microhabitats and around eco-moorings. The goal is to increase the number of juvenile fish, mollusks and crustaceans in zones that are vital biotopes for coastal marine biocoenoses. The creation of an underwater educational trail helps raising awareness among users about the biodiversity of the Petit Cul-de-Sac Marin and provides information on ongoing restoration initiatives.

GPA initiatives restore and conserve forest habitats by protecting and replanting vegetation. In addition, the protection and development of wetland constitute an important part of environmental protection. This involves building user infrastructure that allows sustainable use while maintaining the quality of sites. Similarly, the development of eco-friendly tourism installations ensures conservation of coastal wetlands forest and related ecological zones.

Rich in biodiversity, the Guadeloupe coastal ecosystem is comprised of three emblematic spheres that are closely linked: marine phanerogam meadows, mangroves and coral reefs. GPA ongoing or future projects for habitat rehabilitation and conservation target all three habitats. The GPA project restores or recreates damaged meadows by transplanting young plants grown in a marine phanerogam nursery. One objective of the GPA project is to regenerate degraded areas of mangrove forest. Mangrove tree seedlings are collected from the wild and cultivated in a mangrove tree nursery. The GPA project rehabilitates coral reef areas that have been degraded. Similar to plants, coral can be propagated from cuttings. In practice, cuttings are affixed to supports (“trees”) within a coral nursery.

GPA uses its Management Action Plan to guide its implementation of practical actions to rebuild habitats, thereby preserving biodiversity while maintaining ecological corridors.





An approach to Cuban marine science from CIM-UH

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The Cuban coral reefs are considered exceptionally beautiful compared to others found worldwide. Additionally to be attractive, they constitute key ecosystems in the marine environment. But, different factors are affecting coral reefs in all their distribution range, endangering their integrity and the ecosystem services than they provide. These are enough arguments to make coral reefs the main focus of the researches in the Center for Marine Research of the Havana University (CIM-UH). Species and habitats associated to coral reefs are being studied there, through three main research lines: Marine ecology, Conservation genetic, and Management and conservation of marine resources. Interdisciplinary projects include analysis based on diversity patron and structure in corals, fishes and invertebrates, in areas with different levels of both impacts and protection. At the same time, they are a baseline to integrative analysis from a management and conservation perspective. In association with coral reefs and the others interconnected habitats, species of interest for conservation are being studied, using ecological and genetic tools. Taking into account the availability of Cuban habitats in good conditions, the connectivity pattern between Cuban areas or between Cuba and others regions, new research proposals have been presented. These projects were proposed taking into account the necessity of deeper studies and management strategies in species to regional level, e.g. tarpon. CIM-UH have been dedicated to preserve the marine environment for 48 years; and nowadays continues doing that through teaching, committing, international collaboration and the modern science.





Unravelling vector-borne transmission networks: dynamics of West Nile virus, mosquito communities and their hosts across different habitats in Guadeloupe

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West Nile virus is a Flavivirus that is maintained in nature through transmission cycles involving ornithophilic mosquitoes and birds. Humans, horses and other dead end hosts are periodically infected when bridge mosquito species guide the spill over of the virus. WNV was introduced for the first time into the American continent in 1999. Since 2002, periodic circulation of WNV has been detected in Guadeloupe. However, there is no information concerning the specific transmission networks which might support autochthonous WNV transmission cycles in Guadeloupe, primarily interactions among bird and mosquito species.

Here we show results of previous West Nile virus circulation in Guadeloupe, followed by preliminary results of the dynamics and composition of mosquito communities across a set of different habitats in two areas recently affected by Flavivirus circulation. Temporal and spatial distribution of mosquito populations was characterised in three habitats: rural habitat around farm facilities and nearby natural habitats, swamp forest and mangrove. Species richness and abundance was similar among the same habitat types in different areas. Most species showed marked seasonality with peak of abundance along the rainy season. Mosquito species with the potential to act as enzootic and bridge vector species for West Nile virus have been identified and their epidemiological relevance for other pathogens is discussed. Trophic preferences of the candidate vector species are currently under characterisation by genetic analysis to better define the potential transmission networks.



Status and population monitoring of the Hispaniolan-endemic freshwater turtle, *Trachemys decorata*, population of Trou-Caïman, eastern Haiti.

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Trachemys decorata is an endemic freshwater turtle, endemic to the island of Hispaniola. Although the species is considered to be vulnerable in relation to habitat loss, unregulated harvest, and hybridization with introduced congeneric species, little information is available on population numbers and demographic trends. In Haiti, the species is found in five different areas, including Trou-Caïman, a wetland area of ecological importance covering about 8.23 km². We conducted a study of the *T. decorata* population of Trou-Caïman pond, together with a socio-economic investigation of its exploitation by local fishermen, from October 2017 to February 2018. To that end, we initiated a capture-mark-recapture (CMR) program using traditional fishing gear (fish-traps and fish-net). Captured individuals were sexed from external morphology, marked at the level of the marginal scales of the carapace, measured, and weighed, before being released. In addition, the same measurements were recorded on several *T. decorata* maintained in captivity by local people. The socio-economic survey revealed that *T. decorata* is regularly consumed by the local population, used in voodoo rituals, and sold to local tourists and local collectors as a pet. During the CMR study, 44 *T. decorata* were captured, 4 were recaptured and 4 were found dead in traps (accidental mortality). Analysis of capture locations revealed that *T. decorata* is mainly distributed in quadrats with high abundance of Typhaceae. However, a high rate of human disturbance (80.6%) of study gears was observed during the study period, making any population estimate of *T. decorata* unreliable. Sex ratio among both free-ranging (n = 44) and captive individuals (n = 48) did not differ significantly from 1:1. However, no female was found gravid during the study period, suggesting seasonal reproduction. These preliminary results pave the way for a more detailed study of the current conservation status of *T. decorata* in Haiti.





BEST a funding mechanism to promote Biodiversity and Ecosystem Services in outermost regions and overseas countries and Territories

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The EU Overseas Countries and Territories (OCTs) and Outermost Regions (ORs) harbour an incredible natural capital with a variety of ecosystems (from tropical coral reefs to polar seas, rain forest and dry forest) home to many endemic and key fauna and flora species. The richness of habitat and biodiversity provides numerous ecosystem services to local, regional and also worldwide population. These biodiversity hotspots have been recognised of international importance with urgent conservation actions needed to stop the loss of biodiversity, habitat degradation and help mitigate climate change.

One of the strategic orientations from the International Conference on Biodiversity and Climate Change held in Guadeloupe in November 2014 stressed the need for facilitated access to funding for European Overseas entities' stakeholders, especially to small-sized grants.

Recognizing this necessity to help fund environmental projects in the OCTs and ORs, the European Commission's Directorate General for International Cooperation and Development has developed a new funding mechanism over a 5 year period (2014-2019) through a program called BEST.

The **Biodiversity and Ecosystem Services** in outermost regions and overseas countries and Territories is a funding facility that seeks to build capacities, enable and strengthen local authorities and civil society organizations involved in nature protection (in the 7 identified geographic regions: Caribbean, Amazonia, South Atlantic, Pacific, Indian Ocean, Sub Polar region). More specifically BEST provides grants from €50k to €400k to support on the ground actions for biodiversity conservation, sustainable use of ecosystems and ecosystem services including ecosystem-based approaches to climate change adaptation and mitigation in the key biodiversity areas identified through the participative ecosystem profiles process led by the BEST knowledge hubs.

Several calls for proposals targeting all the geographical regions and offering various-sized grants/small and medium grants have been organised in 2015, 2016 and 2017. A total of 90 projects worldwide were selected and awarded a grant. In particular for the Caribbean region 18 projects in the OCTs and 4 projects in ORs have been funded.

A dedicated website, detailed guidelines and operational manual, specific tools and templates as well as regular and close assistance to the project beneficiaries are provided by the BEST Secretariat and regional hubs to ensure success of the projects and achievement of their conservation objectives.





Ticks & Tick borne pathogens: about the importance of active surveillance

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Ticks are the second vectors of pathogens in the world after mosquitoes. Knowledge on ticks infesting human and animals, their distribution, the pathogens they can transmit and the consequences of tick bites on animal and human health remain scarce in many parts of the world. In particular, knowledge on tick species infesting wild animals in Caribbean and consequences on animal health and conservation of species is poor.

The study of ticks distribution and epidemiology of tick borne disease requires extensive sampling campaigns, with high time and financial costs. Some researchers of the French National Institute of Agronomic Research (INRA) proposed to involve citizens in an active surveillance network through an ambitious scientific project called CiTICKS. As part of this project, the CiTIQUE team developed in 2017 a smartphone application (« signalement-tique ») that allows tick bites declarations, geolocalization and specimen collections.

Initially developed to allow surveillance of ticks responsible for Lyme disease in Europe, this surveillance tool could be very useful to enhance knowledge on ticks and their distribution throughout the world in particular in Overseas France.

The presentation will address the diversity of tick species throughout the world, their biology and difficulties encountered to prevent tick bites and tick-borne pathogens, with a specific focus on tick species present in the Caribbean. The possibility of extending the use of the « signalement-tique » smartphone application to Overseas France will be proposed in conclusion.





Context-dependence shoaling tendencies and collective reactions in free-ranging marine fishes: A conservation tool?

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In many fish species, schooling is primarily considered as a strategy that provides important safety benefits through the action of several mechanisms including risk dilution, predator detection and confusion, or synchronized escape maneuvers. Schooling can also offer further advantages as a greater efficiency to locate food items, facilitates migration, or provides energetic advantages. It is well recognised that aggregated animals face the ever-present challenge of making optimal decisions, within a collective context, to minimize their predation risk while optimizing other fitness-enhancing activities.

Variation in shoaling tendency in marine free-ranging fishes is commonly observed in response to environmental factors, predation risk or anthropogenic disturbance. This is strengthening the idea that fish shoals can display a high degree of behavioral and structural plasticity. Shoal-level modifications are thought to reflect changes in the way fish in shoal balance their fitness tradeoffs; with shoal structural flexibility considered as an adaptation improving information transfer among school members. I will present the results of my research with colleagues from several universities demonstrating that shoaling fish (from estuarine or pelagic fishes to migratory or reef sharks) can make acute and rapid adjustments at the level of their collective structure (e.g., high levels of alignment between fish, reduced inter-fish distances) in response to increasing predation risk or disturbances in such a way that enhances collective information transfer among individuals, and improves collective responsiveness and thus survival. Our results indicate that by adopting a spatial organization that facilitates the propagation of information among individuals, shoaling individuals may gain benefits through rapid and highly-coordinated collective escape maneuvers. I will present the different methodologies employed during these studies to collect high quality data in aquatic systems with no direct disturbance such as high-resolution imaging sonar technology, unmanned aerial vehicle or plane surveys, and automated tracking procedure to quantify fine-scale dynamic behavioral patterns. Because school-level behavioral adjustments represent reciprocal responses to external stimuli performed instantaneously and can be directly linked to fitness, I will discuss the potential of plastic collective behavior as reliable bio-indicators for conservation or impact studies. Using results obtained during my research in various systems (estuaries, salt marshes, open ocean, oyster and coral reefs), I will introduce how context-dependent collective responses can serve as a valuable source of information to develop noninvasive assessment tools to evaluate how fishes perceive rapid environmental or anthropogenic disturbances (such as underwater noise pollution, fisheries activities, or wildlife ecotourism); information of prime importance for the development of sound conservation and management plans.





Evidence for seasonal reproduction in two species of Cuban anurans

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As reproduction in amphibians is generally regulated by climatic variables, it has been suggested that amphibians in the Caribbean could reproduce throughout the year, given the stability of high temperatures, humidity, and the absence of true seasons. However, the existence of two distinct periods, rainy and dry, and the known dependence of amphibians upon water, could influence the reproduction of these species, specifically in the gametogenic state of their gonads. Therefore, the objective of this work was to check whether the annual gonadal development of two amphibian species is continuous or seasonal in Cuba, and related to climatic variables such as temperature, relative humidity and photoperiod.

Two species of Cuban amphibians were included in the present study, *Eleutherodactylus planirostris* and *Osteopilus septentrionalis*, the so-called banana tree frog. Individuals from the former species lack larval stages whereas the latter shows a large plasticity in the selection of sites for reproduction. Three females and three adult males of each species were collected once a month during one year, in Havana for *E. planirostris* and in Matanzas for *O. septentrionalis*. During each sampling event, dry and wet ambient temperatures were recorded in situ with a thermometer (to the nearest 0.1°C) and subsequently checked using information from Centro del Clima, Instituto de Meteorología de Cuba. Data on photoperiod, including civil twilight, and average monthly rainfall were also obtained by the Instituto Nacional de Recursos Hidraulicos (INRH). In the lab, gonadal development was investigated in both females and males of the two species using classical histological techniques.

Ovaries were found to be organized into follicles corresponding to oocytes in different degrees of development, surrounded by follicular cells. Within them, during the period of reproductive activity, vitellogenesis occurred by which reserve substances accumulated in the cytoplasm, or vitello. The period of development of vitellogenesis was found to coincide with the rainy season. Testicles presented an ovoid shape that increased in size as the process of production of sexual cells advanced during the reproductive period. During the dry season, which coincides with the months of lower temperatures, gonads went into recrudescence and it was then only possible to differentiate sexual cells in the first stage of development. Spermiogenesis resumed at the beginning of the next rainy season, which coincides with summer months.

Overall, our results indicate that populations of the two species of amphibians from western Cuba show a seasonally cyclic reproductive pattern, similar to that of anurans from temperate and tropical regions with a marked seasonality. The environmental conditions that exist in western Cuba might induce this type of pattern, which has been well reported in other tetrapods.



Identification of major feeding areas of *Chelonia mydas* (Testudines, Cheloniidae) in the Cuban archipelago

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Marine turtles travel large geographical distances during their life cycle. In particular, adults regularly migrate between breeding and feeding areas. Understanding the connectivity between these two distant habitats is therefore of particular importance for management and conservation. Previous research indicated that the contribution of the *C. mydas* Cuban rookeries to the Wider Caribbean feeding grounds is minimal, suggesting that their main feeding grounds have not been yet identified. However, potential feeding grounds exist both in the north and south of the Cuban platform. In particular, the southeastern coast seems to provide food in sufficient quality and quantity, which, together with the shorter distance to the breeding sites, could lead to a reduction in the remigration intervals. In this context, the objectives of the present research are: (i) to determine the contribution of *Chelonia mydas*' Cuban rookeries to the connectivity between rookeries and feeding areas around the Gulf of Mexico, (ii) to identify potential feeding sites and developmental habitats for Cuban turtles inside the Cuban platform and in the Wider Caribbean, and (iii) to characterize Cuban feeding grounds from both a geospatial and ecological point of view. To that end, three main tools will be used: contribution analysis of mtDNA sequences, physical tagging and satellite tagging. Ecological and geospatial characterization of feeding areas will consist in a monitoring of seagrass to determine seasonal changes and map distribution through remote sensing imagery. All these findings will provide the starting point for the characterization of the marine aggregates of green turtles in the Cuban platform in order to improve conservation strategies for this species in the country.





Trou Caïman as an important bird area in eastern Haiti: confirming evidence from recent census

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Trou Caïman is a shallow, freshwater lake situated about 20 km north-east of Port-au-Prince (18°38'N 72°08'W), in the Plaine du Cul-de-Sac. The area covers about 8.23 km² and consists mainly of wetland, mangrove, and shrubland. Although this ecosystem is of outstanding biological value and is considered as one of the most important bird areas in Haiti, data on the local abundance of waterbird species remain scarce. An inventory of waterbirds at Trou Caïman was therefore conducted by boat and from fixed points from mid-November 2017 to mid-February 2018, whereas hunting of migratory birds and waterfowl throughout the national territory was prohibited on January 11, 2018, for a period of three years. Composition, abundance, and distribution of species were determined in 60 censuses conducted, during which levels of anthropogenic disturbance and climatic conditions were recorded. A total of 68,713 individuals of 32 species and 10 families were recorded. In particular, the Near Threatened Caribbean Coot *Fulica caribaea* was observed on 97% of census, with number of individuals ranging between 3 and 74. In contrast, the Vulnerable West Indian Whistling-duck *Dendrocygna arborea* was observed on only 15% of census, with a maximum of 7 individuals per census. Flocks of Caribbean Flamingo *Phoenicopterus ruber* were present throughout the study period, with up to 82 individuals counted on a single census. However, numbers of flamingos declined significantly from November to February. Overall our results suggest that anthropic disturbances, particularly hunting pressure, affected variation in the local abundance of waterbird species through time. However, we found no evidence for an increase in waterbirds at Trou Caïman in the days after hunting ban was promulgated. Although our results are limited, they confirm both the importance of Trou Caïman for waterbird management in Haiti and its potential for developing ecotourism and environmental education.





Behavioural patterns for the White-breasted thrasher *Ramphocinclus brachyurus* *brachyurus* : the socio-ecological conservation approach

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Other the past three decades, conservation biology advertised as the most important discipline for helping to preserve biodiversity carry on struggling for achieving conservation goals. Currently, worldwide biodiversity is described to have reached a critical state. Many authors thinks that it is necessary to integrate practice studying the natural object and the impacts of its preservation on human activities in the Conservation biology.

Several scientists agree with the physiological and the biological continuity between the human species and other species. The human capacity to use culture and reasoning to modify its environment, forces the consideration that human species behave in a more complex way than other species. However, its ability to transform strongly its environment shows drawbacks. Most of the studies demonstrates that human activities have negative impacts on wild population and biodiversity. Few studies in natural sciences highlight the benefits that conservation activities involve for human activities. Scientific literature on this topic is included in the social sciences framework. Social sciences consider that the preservation of biodiversity is more important for the economic, politic and social development.

We propose to study the socio-ecosystem of the White-Breasted Thrasher *Ramphocinclus brachyurus*, a very rare and Caribbean endemic species. The White-breasted Thrasher, *Ramphocinclus brachyurus brachyurus*, is surviving at the tip of the Caravelle peninsula in Martinique, on a 5 km² territory. Once widespread throughout the island, this passerine was on the verge of extinction in the 1950s but managed to recover. The creation of the Caravelle Nature Reserve in 1976 contributed to the protection of its habitat, but little is known about the interactions between preservation management and White-breasted thrashers' behaviours.

In 2016, we found that capture effort increased with increasing vigilance rate suggesting that human disturbance or predation could affect foraging effort. Indeed, we recorded 40 videos of White-breasted thrashers in the Reserve Naturelle de la Caravelle including 18 videos recorded during March 2016 and 22 videos recorded in March 2017.

The goal of this study is to compare and to discuss what we found for 2017 knowing management decisions that took place in the reserve for the year 2016-2017. This study is part of a research program named 'the DiSC project' working under the collaboration between the French national center for scientific research, and the Parc naturel régional de la Martinique. This project aims at contributing to obtain data that will be of importance for the establishment of conservation plans.





A preliminary analysis of spatial and temporal trends in the benthic composition of Barbados' coral reefs between 1997 and 2012

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Coral reefs currently represent one of the most diverse, but also threatened, ecosystems worldwide. A combination of recent global stressors (e.g. anomalous high water temperatures) and pervasive regional and local stressors (e.g. poor water quality, overfishing and/or disease) have resulted in many coral reefs shifting from systems that were once dominated by corals to systems now dominated by algae in just a few decades. Such changes cast serious doubts on the long-term persistence of the structure and function of these ecosystems and about their ability to continue to provide the critical ecosystem services upon which many human societies heavily depend.

The Caribbean is no exception to such glooming trends and this has prompted a growing number of initiatives at regional and local scales aimed at closely monitoring the state of coral reefs in the region.

In Barbados, the Barbados Reef Survey Programme (BRSP) was officially launched in 1997. This program involved the establishment of permanent monitoring reef plots across 43 reefs located on the west and south coast of Barbados spanning approximately 30 km of coastline. These reefs were selected to provide a representative sample of the range of reefs typically encountered in Barbados, i.e. patch (n=16, depth: 3-10m), fringing (n=21, depth: 2-7m), and bank (n=6; depth: 15-25m) reefs.

On-going monitoring at these reefs has taken place every five years and has included collecting data on per cent cover of sessile benthic organisms such as corals, algae and sponges at different levels of taxonomic resolution. These efforts have thus yielded a dataset of 172 reef surveys between 1997 and 2012.

Here, we provide for the first time a detailed preliminary examination of spatial and temporal trends in reef benthic composition during the aforementioned 15-year period and discuss the implications of these trends for the future of Barbados' reefs.





Dispersal of invasive carnivores in the French West Indies

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The introduction of exotic species by humans is one of the major threats to biodiversity. Two species of alien wild carnivores present a worrying expansion in islands of the French West Indies, among which is the small Indian mongoose (*Urva auropunctata*). It is said to have been introduced from the Indian region at the end of the XIXth century to Jamaica and from there to other West Indies islands as well as South America mainland. It has also been introduced to Croatia, Fiji, Hawaii, Japan, and Mauritius. This invasive species is of major concern, due to its potential ecological, economic and human health impacts. Despite this, we lack crucial information on the past and current dynamics of its dispersal. This species presents a unique opportunity to investigate colonization and dispersal events of such an invasive species. For this purpose, we conducted a genetic study by sequencing two mitochondrial markers, in order to benefit from sequences from databanks for comparison. The objectives were to assess the origin and dispersal to and within islands of the French Antilles and evaluate polymorphism within these islands, which have not been investigated before. Our results based on over a hundred sequences from both native and introduced regions confirm that the mongooses from the French Antillas belong to the species *U. auropunctata*, rather than to *Urva javanica* or any other mongoose species. Our results suggest that, within the introduced regions, the most genetically diverse population is that of Jamaica, while the least diverse are those from Martinique and Guadeloupe. Cytochrome *b* mean distances between localities range from 0 to 3.1% for the whole distribution, while within the introduced regions, they range from 0 to 1.6%. Mongooses from Guadeloupe, Martinique and Guyana shared their haplotypes, while individuals from Saint-Martin are closer to the mongooses from Jamaica and Puerto Rico. Haplotypes of mongooses from Jamaica form two main haplogroups, one including other West Indies islands, as well as Japan, Guyana and Croatia, and another haplogroup with individuals from Puerto Rico and Saint-Martin, suggesting independent events of introduction. All introduced populations appear closer to individuals from Bangladesh and Pakistan, rather than to those from India and Myanmar. Further analyses using population genetics approaches are conducted within the West Indies populations to study dispersal between and within islands and will provide a more in depth structure of populations.





Progress in the study of the adaptation of a Cuban forest lizard to suburban environments

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The lizard *Anolis homolechis* is an endemic species widely distributed throughout the Cuban archipelago. Being a common species in forests, it can be also found in suburban habitats, in the trees of backyards and parks. In a few hundred years (as most Caribbean cities have barely 200 years), such populations have then adapted to the suburban environment, mostly drier, less woody and with a greater abundance of predators. The present research aims at i) documenting to what extent individuals living in suburban environments differ from those living and ii) understanding suburban populations consist of individuals particularly adapted to that environment or depend on a regular flow of individuals from nearby forests. Such information is of prime importance to understand the rapid evolution of populations and their conservation, in the context of the current human development. To that end, we have initiated a mark-capture-recapture program in both individuals of suburban populations and forests, allowing us to compare certain behavioural (personality, diet), morphological (size, shape, weight) and demographical (population structure and gene flow) traits. In the last five months, more than 200 individuals, of both sexes and age classes, have been marked, measured and biopsied on two suburban sites (cities of San José de Las Lajas and Guanajay) and two forests (nature reserves Escaleras de Jaruco and Sierra del Rosario). Because the number of captures per site is still insufficient to make comparisons, we present here descriptive results of the population sample marked so far.





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