



CARIBAEA  
INITIATIVE

4<sup>th</sup> RESEARCH & CONSERVATION  
● ● ● CONFERENCE

Crowne Plaza Hotel, Santo Domingo  
May 15<sup>th</sup> – 17<sup>th</sup>, 2019

BOOK OF ABSTRACTS

ABSTRACTS  
&  
List of Participants



ESCUELA DE BIOLOGÍA  
FACULTAD DE CIENCIAS - UASD



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**Introduction to the Conference**

*Professor Frank Cézilly*  
*President*

The Caribaea Initiative was launched in October 2014, with the aim of contributing to the study and conservation of the insular Caribbean fauna, mainly through training local students at the master and doctorate levels. Since then, we have broadened our mission through engaging in education at primary and secondary schools, developing new international master programs, and fostering cooperation in research on wildlife conservation and biodiversity between Caribbean research institutions and with selected research centres outside the Caribbean region. More than 20 Caribbean students have been enrolled in our higher education program, and we have signed official partnerships with local institutions in Barbados, Cuba, Guadeloupe, Haiti, Martinique, and St Kitts & Nevis. On the first of January 2019, our head office was transferred to the Université des Antilles, in Guadeloupe, making us officially a Caribbean-based institution. This is just the beginning and there is more to come.

An essential part of our strategy is the *Caribaea Initiative Research & Conservation Conference* (CIRCC). Over the last four years, this annual event has brought together an increasing number of students, researchers and conservationists working in the insular Caribbean. Following the three previous editions in Martinique (2016), St Kitts (2017), and Guadeloupe (2018), the fourth edition is organized this year in Santo Domingo, Dominican Republic, in close association with and support from the Universidad Autonoma de Santo Domingo (UASD), the French Embassy in the Dominican Republic, the Cámara de Comercio e Industria Franco Dominicana, and the MAVA Foundation.





With more than 100 participants and more than 50 oral presentations, this new edition looks very promising. I would like to thank our plenary speakers of the year, Janine Seetahal, Luz Margarita Figueredo Cardona and Ingo Schlupp, for kindly accepting to present very exciting talks that should be of great interest to the audience, and all the participants. I would like to express our warmest thanks to David-José Hernandez-Martich, Simon Guerrero, Sixto J. Inchaustegui, Francis Reyes, Joel Andres Rojas Gonzalez, all the staff at the Crowne Plaza Hotel, and Vincent Gleizes from the French Embassy for their invaluable help with the local organization of the event. Our gratitude also goes to Wilson Célestin, Chantal Comte, Anne-Sophie Gicquiaux, Silvina Gonzalez-Rizzo, Evans Louis, Simon Mériaux and the MAVA Foundation, Vera Michalski-Hoffmann, Michèle Duvivier Pierre-Louis and the FOKAL Foundation, Carlos Manuel Rodriguez, and Nicasio Viña.

We wish you all a very enjoyable, stimulating, and productive conference.

A handwritten signature in black ink, appearing to be 'Gleizes', written in a cursive style.



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## Nocturnal and Diurnal Time-Activity Budgets of Masked Ducks and Ruddy Ducks in Puerto Rico

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Habitat loss and degradation have contributed to declining populations of stiff-tailed ducks including the migratory northern ruddy duck (*Oxyura jamaicensis rubida*), and non-migratory masked duck (*Nomonyx dominicus*) and West Indian ruddy duck (*Oxyura j. jamaicensis*). Time-activity budgets are often used to facilitate appropriate management and to better understand ecological relations of species. We recorded 24-hour time-activity budgets for Masked Duck, migratory Northern Ruddy Ducks, and non-migratory West Indian Ruddy Ducks in Puerto Rico during 2015 and 2016. Behaviors varied among taxa, between sexes, and between diurnal and nocturnal sampling periods. Resting and sleeping were common behaviors. West Indian Ruddy Ducks spent 91% more time diurnally and 174% more time nocturnally feeding than Northern Ruddy Duck. Northern Ruddy Duck and West Indian Ruddy Duck time-activity budgets varied with 7 of 8 categories during the day and 5 of 8 categories at night differing. Female Masked Ducks spent 39% more time feeding at night than males. Male and female Masked Ducks spent substantially more time resting during the day than the Ruddy Ducks. All 3 taxa of stiff-tailed ducks varied substantially in their time activity budgets. We hypothesize that body size and migratory patterns account for observed differences in behavior.



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## Biodiversity and conservation value of cocoa plantation secondary forests through succession

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Biodiversity change in ecological communities has accelerated globally, probably as a result of anthropogenic alterations to the environment and landscape. In forests, change in species composition is principally linked to continued conversion of old-growth forest, and agroforestry plantations, to secondary forest (those re-growing after being deforested). Biodiverse tropical forests, including those in the Caribbean, currently have the highest rates of deforestation and transformation. An important challenge, then, is to consider how ecosystem functioning will be affected by this biodiversity change. My ongoing doctoral project is asking how shifts in tree composition during secondary succession affect forest functioning, and how this impacts the conservation value of forests. I am conducting fieldwork in secondary cocoa plantation forests in the Northern Range of Trinidad, collecting data on the tree, epiphyte, ground vegetation, birds and diurnal lepidopteran communities. Forest age since abandonment is my proxy for time. To date, my results suggest that cocoa plantations can support a rich plant community within a few decades of abandonment. Abandoned plantations (e.g. of cocoa and banana) are a potentially important repository of biodiversity throughout the Caribbean. My findings will thus support conservation initiatives and forest management, not just in Trinidad but across the region.



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## Diseases of the Caribbean spiny lobster, *Panulirus argus*

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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. As a result, it is important to investigate the factors that would affect population health and consequently a safe commercial yield. Although few lobster diseases and parasites have been reported, surveillance is important since existing diseases may affect yield and marketability of this species.

Microsporidians comprise a group of spore-forming, unicellular organisms, related to the fungi, which are obligate intra-cellular parasites that can cause disease in crustaceans such as crabs, shrimp and lobster. Many nemertean worms have commensal relationships with other organisms, but some are parasitic egg-predators of decapod crustaceans. To date, most of the host species are portunid crabs, but few spiny lobster species have been host to these parasites. These hosts have been reported to lose large proportions of their broods due to infestation.

Two hundred and sixty four lobsters were collected from fishermen from July 2017 to December 2018 as part of a PhD project. During necropsies, abnormally white skeletal muscle and myoliquefaction was observed in one lobster. Wet-mounts confirmed the presence of microsporidian spores. Samples of muscle, eyestalk, ovary, gill and heart tissue were placed in Davidson's fixative for histopathological analysis. DNA was extracted from muscle samples and subsequent PCR reactions allowed for the amplification of partial sequences for the ribosomal RNA gene. Thereafter, database searches were used to identify the closest known microsporidian sequences.

Although this parasite is seemingly not prevalent in wild lobster populations around the island (less than 1%), this could affect the potential development for aquaculture of the spiny lobster in the Eastern Caribbean region. Aquaculture may lead to higher levels of infection in the cages or tanks, which will likely reduce commercial yields and possibly impact local wild populations, as high numbers of resilient spores would be released in to the environment.

Additionally, the egg masses of egg-bearing female lobsters were examined under a dissecting microscope for the presence of worms. The gills of both sexes were also examined for any abnormalities. We have discovered nemertean worms in both the gill lamellae of male and female lobsters, and in the broods of berried lobsters. DNA was extracted from the



worms and the cytochrome oxidase gene was amplified. Molecular sequencing has demonstrated that there are two nemertean egg-predators in lobsters from Saint Kitts, one of which is closely related to *Carcinonemertes conanobrieni*, an egg-predator found in lobsters from Florida and the only one known to be associated with *P.argus*. The second isolate from Saint Kitts has not been fully identified to date and is not closely related to *Carcinonemertes* spp. The work on identifying these specimens is still ongoing, but there are possible implications to the health of the lobster population and this needs to be further studied.



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## Thermal ecology of the *Anolis rubribarbus* clade (Reptilia: Dactyloidae)

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The *Anolis rubribarbus* clade is endemic to Cuba and it is represented by four species: *A. ahli*, *A. allogus*, *A. imias* and *A. rubribarbus*. This group is associated to shaded conditions with three species that occur in humid forests (*A. allogus*, *A. ahli*, *A. rubribarbus*) and one in rocky-outcrops of semidesertic areas (*A. imias*). This diversity formulates the hypothesis that the species of the *Anolis rubribarbus* clade have discrete thermal preferences and adaptive responses to different ranges of temperature. This hypothesis will be tested with the design of laboratory experiments of thermal ecology in these species. The first experiment will be carried out to obtain the preference temperature of the lizards. The anoles will be placed in a corridor with a ceramic infrared heat lamp of 75 W at one side, and ice packs at the other side of the corridor to create a thermal gradient of temperature. The corridor will be divided in different sections, each one with different values temperature and the experiment we will record with a digital camera. Evaporative water loss rate (EWL) data will be obtained as result of the second experiment. The lizards will be placed on a digital balance with silica gel. The experiment will last 2 hours and every 10 minutes the weight will be written down. A camera will record the whole experiment to obtain the behavioral patterns as well. This study will provide a characterization and comparison of the thermal ecology of these species for the first time. It will be very useful 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.



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## Relationship between the diversity of odonate assemblages and the quality of freshwater aquatic environments in the West Indies: practical implications for habitat management and species conservation

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Around the world, freshwater ecosystems are under intense anthropogenic pressure that threatens to reduce both the biodiversity they support and the services they can provide (Allan 2004, Lepori et al. 2005, Couceiro et al 2007, Benetti and Garrido 2010, Astudillo et al 2016, Ferreira et al 2017, Calapez et al 2018). The island Caribbean is no exception, and the countries and territories that make up the island now face the challenge of reconciling the human needs of freshwater with the maintenance of the ecological integrity of aquatic environments (Charara et al. 2012, Blackman et al., 2014), a task made even more difficult in the context of climate change (Day & Chenoweth 2009, Cashman et al., 2010).

Numerous studies attest to the value of assembling odonates as bioindicators of the quality of aquatic environments (Chovanec et al., 2005, 2015, De Marco and Resende 2010, Rosset et al., 2012, Acquah-Lampthey et al., 2013). , Ferreras-Romero 2013, Monteiro-Junior et al 2015, Golfieri et al 2016, Martín & Maynou 2016), especially in island environments (Sato & Riddiford 2008, Villanueva 2010, Balzan 2012, Berquier et al 2016, Luke et al. 2017, Sakai et al 2017). The value of odonates as a bioindicator is largely due to their "umbrella" status (Bried et al., 2007, Oertli 2008) and their response to environmental disturbances (Corbe, 2004, Remsburg et al. Remsburg and Turner, 2009), with some differences between dragonflies and damselflies (Ameilia et al., 2006, Oliveira-Junior et al., 2015, Koparde 2016). In general, Odonate distribution and abundance is constrained by their sensitivity to environmental degradation (Scheffer et al., 1984, Vinson & Hawkins 1998, Che Salmah et al., 2005, Milesi et al., 2009). , particularly in that they affect pH, dissolved oxygen content, water temperature, turbidity or salinity (Salmah et al., 1998, Sato & Riddiford 2008, Rychla et al., 2011, Kitezka et al. 2014, Mendes et al., 2018).

From this observation, this study proposes to see the relationship between the diversity of odonate assemblages and the quality of aquatic habitats in Guadeloupe and Haiti. The Caribbean as a whole has 108 Odonata species, of which 36 (32%) are endemic to one or a few islands (Meurgey 2013). It shows that 28% of species are threatened, including one critically endangered, four endangered and four vulnerable. A better understanding of the factors that modulate the presence and abundance of different species of odonates in



Guadeloupe is necessary to ensure their conservation. The knowledge of Odonata stands in Haiti is much more fragmentary. Fifty-eight odonate species, including at least five endemic species from the island of Hispaniola, have been counted (Meurgey 2013). However, the status of different species and their relative abundance remains poorly documented. Given the persistent degradation of the environment, especially aquatic environments, there is an urgent need to increase knowledge of odonate assemblages in Haiti and the influence of environmental quality on their diversity.

Odonata monitoring in the field will therefore run from mid-January to the end of May, for two consecutive years (2020 and 2021), thus increasing the degree of representativeness of the study. At each station, sampling will take place between 9 AM and 3 PM, during which time adults are usually the most active (Kutcher & Bried 2014). On each station, between one and three transects of 20 m length (depending on the size of the station), at least 100 m apart, will be regularly monitored during the two years. The distance between sampling points increases the probability of data independence and limits the interference between sampling points.

**Key words:** Bioindicators, biodiversity, Haiti, insect Odonata, species richness.



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## Pathology of fungal infections in Caribbean sea fans (*Gorgonia spp.*)

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Of the coral diseases reported thus far, sea fan aspergillosis was thought to be one of the best understood, with *Aspergillus sydowii* being the etiological agent. However, limited knowledge of the microbial ecology and mycoflora associated with healthy and diseased sea fans undermines a true understanding of this disease, and the role of *A. sydowii* as a primary pathogen has been challenged by its isolation from healthy sea fans. Aspergillosis is typically diagnosed from the observation of focal annular purple pigmentation surrounding an area of tissue loss. We hypothesize that such lesions may represent a nonspecific host response to other injuries, and are not unique to aspergillosis. Biopsies were collected from 20 sea fans (*Gorgonia ventalina*) with focal tissue loss and annular purple pigmentation, consistent with field diagnosis of aspergillosis, in three shallow fringing reefs of St Kitts. Histologically, the tissue loss margin was heavily befouled and often bordered by amoebocyte infiltrate. The purple pigmented area consistently showed intra-axial fungal hyphae of varying severity, but morphologically uniform and consistent with *Aspergillus* and many other genera of fungi. Coinfection was almost always present in the purple pigmented areas, including algae, cyanobacteria, and labyrinthulomycetes. Macroscopic and microscopic characteristics of the mycelia and reproductive structures from isolates cultured were however consistent with *Penicillium* spp. Sequencing the ITS1 and ITS2 region and subsequent BLAST query confirmed their identity. Differentially affected tissues within diseased sea fans have also been processed for metagenomics to characterize the spatial effect of disease-associated microbiomes. We hypothesize that the presence of fungi alone may be not enough to cause disease and underlying microbial dysbiosis likely influences susceptibility to fungal infiltration. We emphasize the importance of using a standardized biomedical approach to disease diagnosis in corals, and the propensity for misclassification when relying on macroscopic field diagnoses.



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## A Survey of Alien Fish Species in Certain Jamaican Rivers

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Invasive alien species are considered one of the most serious threats to biodiversity worldwide. These species cause harm mainly through competition with native species, the spread of disease, and habitat destruction. Their impacts are oftentimes more severe in island ecosystems. The island of Jamaica has high levels of endemism for certain terrestrial fauna but has only four endemic freshwater fish species. Three of these species, *Gambusia wrayi* Regan, 1913, *Gambusia melapleura* Gosse, 1851, and *Limia melanogaster* Günther, 1866, belong to the family Poeciliidae. The fourth species, the killifish *Cubanichthys pengelleyi* Fowler, 1939, is from the family Cyprinodontidae. The Poeciliidae is a family of live-bearing fishes whose members are often ecological generalists. Very little is known about the life history and current distribution of the Jamaican poeciliids. This is also true of the killifish. Over the years, Jamaica has had numerous freshwater fish introductions primarily for aquaculture and, to a lesser extent, for the aquarium trade. Some of these introduced species, including ones known to be invasive, have become established in natural habitats.

In June 2017 and June 2018 surveys were carried out of the poecilid populations in 15 freshwater habitats across the island. Most habitats were found to be home to at least one introduced fish species. Eight introduced fish species were encountered during the survey. Six of these species belonged to the Poeciliidae. Two of these species, *Poecilia mexicana* Steindachner, 1863 and *Xiphophorus variatus* Meek, 1904 were identified in Jamaican waters for the first time. Established populations of the highly invasive poeciliid species *Gambusia holbrooki* Girard, 1859 and *Poecilia reticula* Peters, 1859 were encountered in more than one habitat. The endemic *L. melanogaster* was found to be less numerous in some sites where it was previously abundant.



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## First characterization of bacterial ectosymbionts colonizing gills of various mangrove brachyura crabs

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We describe the first interactions between bacterial ectosymbionts and a few mangrove crabs: *Aratus pisonii* (Sesarmidae), *Gecarcinus lateralis* (Gecarcinidae), and *Uca rapax* (Ocypodidae). These crabs belong to the order Decapod and to the infra-order Brachyura, known as "real crab". Specimens were collected in Guadeloupe on mangrove trees *Rhizophora mangle* (*A. pisonii*), on mangrove mud (*U. rapax*), and on sand behind mangrove areas (*G. lateralis*). Ectosymbionts were observed colonizing the gills and the inner surface of the abdomen for all specimens investigated. Each species presented a different gill morphology, with gills being organized into several gill discs. For *A. pisonii*, two different bacterial morphotypes were distributed throughout the surface of gill discs and on the inner surface of the abdomen. In addition, different morphotypes were observed in *G. lateralis* and *U. rapax*. Symbionts did not cover the entire surface of gill discs, but formed irregularly distributed bacterial patches, while forming a bacterial biofilm on the inner surface of the abdomen. In order to evaluate symbionts transmission mode to the new host generations, ovigerous females were collected from the field. After egg hatching in the laboratory, larvae of *A. pisonii* were reared in order to obtain the different stages of development. This type of experiment will allow to determine the transmission mode of symbionts in this species. DNA extractions and PCR using universal 16S primer sets were performed from gills. The PCR products have been sent for sequencing and we are waiting for results concerning metagenomic data. From these results we will be able to test the different larval stages obtained by FISH and/or PCR using specific primers/probe in order to detect symbionts in larval stages. Such symbiotic relationships with bacterial ectosymbionts could represent an important evolutionary transition in crabs, through allowing them to live in particular environments (sulphide-rich, anaerobic...).



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## Enhancing biodiversity levels in farming systems to strengthen their resilience and restore ecological corridors

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It is now commonly admitted that agriculture can have detrimental impacts on natural biodiversity levels due to the massive use of pesticide and soil ploughing, mono-specific systems and the simplification of landscape that degrade ecological corridors. In parallel, agricultural systems have now to face climate change issues. They have indeed to adapt to cope with more frequent and intense climatic hazards (hurricane, dryness, flood, etc.) and to mitigate GHG emissions. As a response to this double biodiversity and climate change issues in small tropical Caribbean islands, we conceived KARUSMART, a climate-smart experimental micro-farm. Organized around seven sub-plots of very diversified cropping systems (banana, sugar cane, tubers, market gardening, livestock, maize), this system was set up at INRA's experimental station in Guadeloupe. The farm structure follows the principles of agroecology and territorial bioeconomy. This system is based on the use of 1) a mix of species in each block to stimulate soil fertility and ecological control of pests and 2) bio-inputs such as composts, mulches, bio-fertilizers and biopesticides to stimulate biodiversity.

In order to assess if such agro-diversified systems lead to increased natural biodiversity levels, we conduct a comparative study between the experimental micro-farm and four real farms representative of the North Basse-Terre area in Guadeloupe. Biodiversity in the agricultural context includes several components: grown biodiversity (farmed animals and plants), para-agricultural biodiversity (auxiliary species and pests) and extra-agricultural, wild and spontaneous biodiversity (MAAP, MNHN, 2009). In order to assess the level of biodiversity in each components, observations and field measurements were made to compute the Shannon, Simpson or Hill diversity indices, and then to reveal significant differences (Bockstaller et al. al., 2011), and attempt to establish relationships between cropped biodiversity, agricultural practices, the farm environment and natural biodiversity. The final sample includes measures of biodiversity in 5 farms and 21 plots.

The correlation obtained by modeling the relationship between farmed and natural biodiversity is significantly positive. A high level of farmed biodiversity improves the ecosystem function of the system and represent various ecological niches for other forms of biodiversity (Lin B., 2011). Comparison of the Simpson diversity indices calculated for the experimental micro-farm and the four real farms monitored shows higher levels of farmed biodiversity and total natural biodiversity within the agro-ecological system. ANCOVA analysis shows that the monoculture of sugarcane has a negative effect on the level of



natural biodiversity and that plowing adversely affects soil organisms, especially macrofauna. On the contrary, grasslands, which are neither plowed nor fertilized nor treated with pesticides, have a positive influence on levels of natural biodiversity. As expected, the use of pesticides has a very negative influence on natural biodiversity. Finally, our analysis shows that the level of biodiversity of soil fauna is positively correlated with farmers' declared concern to environment.

As a conclusion, crop diversification and agro-ecological practices would favor natural plant and animal biodiversity levels, and such farming systems could therefore be more resilient to climate hazards and be an opportunity to restore ecological corridors at the landscape level.



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## Bases for Conservation of the Most Threatened Cuban Toad, *Peltophryne florentinoi* (Anura: Bufonidae)

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Zapata's toad (*Peltophryne florentinoi*) is one of the eight endemic bufonids in the Cuban archipelago. This species inhabits coastal microphyllous evergreen forests on limestone landscapes near Playa Girón and Guasasas in the Zapata Swamp, Matanzas province. This is one of the most specialized species among Cuban bufonids, its reproduction takes place exclusively in small depressions of karstic soils ("casimbas") that temporally accumulate rainwater. This species has been considered Critically Endangered by the International Union for Conservation of Nature taking into account its reduced extent of occurrence, and potential threat of the sea-level rise. Although, recently a sub-adult male *P. florentinoi* was sighted in Guajimico locality, which extends the distribution of this species to the Cienfuegos province, in the central region of Cuba, its population dynamic, abundance, reproductive activity and its potential responses to predicted environmental pressures have been poorly studied. In this contribution we present the first data about relative abundance, phenology and ecological requirements of this poorly known Cuban endemic toad. We identify the major threats to the quality of this restricted habitat and to the survival of this local endemic toad, evaluating the potential effects of current anthropogenic activities and future scenarios of climate change and sea-level rise. We also exposed results of an educational campaign implemented to enrich the environmental knowledge of local people and stakeholders involved in species conservation and habitat protection at study area. Finally, we provide some recommendations to prevent and mitigate the impacts of the recent and future threats.



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## Migration routes and foraging habitat of hawksbill turtles with extended nesting history in Barbados

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The nesting population of hawksbill turtles (*Eretmochelys imbricata*) on Barbados has been monitored since 1992, with survey data suggesting that it is one of the largest rookeries for this species in the Wider Caribbean. Hawksbill turtles tagged on the island make up more than 95% of turtles captured (deliberately or incidentally), sighted, or stranded then subsequently reported to the regional Marine Turtle Tagging Centre. The return of tags from turtles captured in territories more than 2500 km away demonstrates that turtles nesting in Barbados, where they are legally protected, are vulnerable to exploitation on feeding grounds far from home. In completing their long-distance migrations, female turtles must also swim through the waters of territories near to Barbados where legal harvest is permitted for at least part of the year. Despite the dangers inherent in migrating between the rookery and foraging grounds, approximately 4% of the nesting turtles recorded on the island each year have been returning to nest for at least 10 years. These turtles may make use of foraging sites that allow them to avoid anthropogenic threats. The migration routes of females with a nesting history of more than 10 years were tracked with the use of KIWSAT K2G satellite tags which synchronise with the Argos global satellite system and are capable of determining location with an accuracy of up to 230m. QGIS was used to interpolate data seafloor and marine resource use data along migration routes as well as within the home range of turtles after arriving at their feeding grounds. Interpolated data were compared with regional spatial databases in order to identify areas similar to the migration routes and home ranges of the satellite tagged turtles.



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## Pollinator assemblages of *Melochia* species: diversity and efficiency in disturbed habitats

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Pollinators are frequently a key issue in the conservation of biodiversity. About 90% of angiosperms rely on pollinators to warranty their fruit set. Furthermore, animal pollination ensures most of the world crop production for human food. However, the increasing habitat degradation is affecting pollinators, which decline has been alerted worldwide. In those degraded habitats some wide distributed plant species offer resources for pollinators. One example is *Melochia* genus (Malvaceae), which produce flowers throughout the year with significant fruit sets despite the unpredictable of pollinators in disturbed habitats where they inhabit. Therefore, the aims of this work are: i) to characterize the diversity of pollinator of six species of *Melochia* and ii) to examine the effects of the shifts in the pollinator assemblage, among populations, in the efficiency of pollination. We found a diversity of 67 taxa of floral visitors in the 19 populations studied for the six *Melochia* species. They were mainly insects of the orders: Lepidoptera, Hymenoptera, Diptera, Coleoptera and Hemiptera. All the species pollinate except one Hemiptera species which behaved as nectar thief. We found significant differences in the pollinator assemblages between *Melochia* species and populations. However, pollen deposition on stigmas was not significantly different among populations, except for *M. nodiflora*. This could point to different types of pollinators holding alike effectiveness and contributing similarly to reproduction. Such results could be related with the morphology of the flowers of *Melochia* species and it may represent a strategy to cope with the unpredictability of disturbed environments.



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## Redonda's Nearshore Marine Habitat and its associated Offshore Banks

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The island of Redonda is located 48 kilometers West-South-West of the mainland Antigua and forms the third island of the nation of Antigua and Barbuda. The island for decades was decimated by the impact of introduced goats and invasive rats, which had devastating effects on the terrestrial ecology of the island. A massive restoration effort was undertaken in 2016 and 2017 which removed the goats and eradicated the rats, which have led to remarkable improvements in the terrestrial biodiversity of the island. However, very little was known about the marine biosphere surrounding Redonda, and the effect that the debilitating effect of the introduced goats and the invasive rats were having on this marine ecosystem.

Marine surveys were carried out around the shores of Redonda in 2017 and 2018 using Global Coral Reef Monitoring Network (GCRMN) and Atlantic Gulf Rapid Reef Assessment (AGRR) methodologies respectively. The GCRMN method was deployed via the Waitt Institute while the AGRR methodologies were done by local (Department of Environment, Fisheries Division, Environmental Awareness Group) and international (Fauna & Flora International) environmental agencies. These surveys provided the first known marine benthic dataset for the island and allowed for a better understanding of the marine conditions that exist around the island. As it relates to coral health, live coral averaged at 9.5% cover while macroalgae was recorded at 21.65% cover, both of which was around average for what is seen in Antigua. Redonda exceeded national averages as it relates to coral recruits with a recorded value of 10.3/m<sup>2</sup>. Total Fish biomass was 6521.5 g/100m<sup>2</sup>, with herbivore species averaging 2466.8 g/100m<sup>2</sup> and commercial species averaging 1593 g/m<sup>2</sup>. This dataset provided an essential baseline from which the effects of the tremendous terrestrial recovery of the island to the marine environment can be monitored. Studies have shown linkages to marine recovery after alien mammal removal due to reduction in sediment run-off and rock falls choking surrounding marine habitat.

Surrounding the island of Redonda is Coral Bank, with a northern extension of ~16 kilometers southern extension of ~8 kilometers and a width of up to ~11 kilometers. This bank has an average depth of 50m and has been identified as a hotspot for the marine ecosystem. Initial assessment was conducted in 2018 using a SeaViewer Drop Camera system in an effort to better understand the benthic characteristics of the area. Depth and



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weather conditions made surveys of this deep-water habitat difficult with current technologies but revealed a benthic seascape with high sponge domination. This aligns with anecdotal observations made by both the terrestrial and marine survey teams of high densities of hawksbill turtles (*Eretmochelys imbricata*). Coral Bank is a part of the proposed protected area (marine and terrestrial) for Redonda, due to its potential significant contribution to the marine ecosystem of the area.

Future work will continue to assess the benthic conditions both nearshore and on Coral Bank around Redonda. In particular, options for doing an in-depth survey and classification of Coral Bank are being explored and are high priority.





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## Levels of genetic differentiation and gene flow between four populations of the Scaly-naped pigeon, *Patagioenas squamosa*: implications for conservation

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Island-endemic columbid species are particularly vulnerable to environmental degradation, extreme climatic events, competition with and predation by exotic species. The situation might be even more critical in the case of game species, where legal hunting and poaching can severely affect adult mortality, recruitment and, hence, population dynamics. Here we document for the first time the genetic structure of the Scaly-naped pigeon, *Patagioenas squamosa*, a Caribbean-endemic columbid species of cynegetic interest, over a large part of its range. Using both mitochondrial DNA and nuclear markers (microsatellites), we investigated gene flow, genetic diversity, and genetic structure among four islands populations originating from Puerto-Rico, Guadeloupe, Martinique and Barbados. We found evidence for a significant genetic differentiation only between the Barbados and the three other populations, consistent with the fact that the Barbados population originated from a few captive individuals escaped from a rooftop aviary in Bridgetown about 100 years ago. Given the absence of genetic differentiation between Puerto Rico and the French Antilles, our results suggest that, part from Barbados, the species may mainly consist in a single large, homogeneous population. We discuss the relevance of our findings in relation to management and conservation issues.



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## Trophic ecology of Cuban Psittacids in Lomas de Banao Ecological Reserve, Cuba

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We monitored trophic resource use by Cuban Parakeets (*Psittacara euops*) and Cuban Parrots (*Amazona leucocephala*) as well as the phenology and abundance of plants that are part of their diet in Lomas de Banao Ecological Reserve, in central Cuba. Comparing resource use between species, we found that the Cuban Parrot's diet is more diverse and equally apportioned than that of the Cuban Parakeet. Throughout the year, *Zanthoxylum martinicense*'s seeds comprise more than 50% of the Cuban Parakeet's diet, whereas Cuban Parrots seem to be more opportunistic, consuming seasonally abundant resources. The parrot also shows a wider trophic niche than the Cuban Parakeet, with low niche overlap between the two. Diets of both psittacids were more varied during the breeding season, a time when food availability in the area is higher and coincides with the maximum peak of rain in the year. In addition, we identified key plant species that psittacids rely on during periods of low food availability. Based on this, we developed a management plan that includes forest enrichment using these plant species. Currently, these species are being propagated in a nursery and many have been planted in the forest by local people and children from the nearby schools, as part of reserve's outreach activities.



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## Growth and spawning of a native fish *Cichlasoma haitiensis* and an exotic species, *Oreochromis niloticus*, in Azuei Lake, Haiti

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In lake ecosystems, ecological factors (e.g. interspecific competition and water quality) may interact with anthropogenic factors (e.g. effects of fishing practices) to negatively affect the growth and spawning dynamics of fish populations. In 2013-14, a study was carried out to test the impact of these factors on a native (*Cichlasoma haitiensis*) and an introduced (*Oreochromis niloticus*) fish species in Azuei Lake or *Etang Saumâtre* (Haiti). Biological characteristics such as size, total weight, gonad weight and number of oocytes, were evaluated. The batch fecundity of each species was estimated. Statistical models were also developed to determine the allometric rate and size at first sexual maturity of these species.

In *C. haitiensis*, length classes ranged from 72 to 221 mm. The derived weight-at-length growth model ( $W = 9 \times 10^{-5} L^{2.56}$ ,  $R^2 = 0.915$ ) had an allometric rate ( $b = 2.56$ ) significantly lower than 3 ( $t$ -test,  $p < 0.05$ ). As a result, growth of *C. haitiensis* in Azuei Lake was not isometric during the study period. The size at first maturity was estimated to be 83 mm and batch fecundity to be  $285 \pm 37$ .

In contrast, length classes of *O. niloticus* ranged from 98 to 265 mm. Batch fecundity was assessed to be  $423 \pm 54$ , while the size of the smallest mature fish was less than 98 mm. The derived weight-at-length growth model ( $W = 8 \times 10^{-5} L^{2.71}$ ,  $R^2 = 0.78$ ) had an allometric rate ( $b = 2.71$ ) which was not significantly lower than 3 ( $t$ -test,  $p > 0.05$ ). The somatic growth of *O. niloticus* was therefore isometric, demonstrating that this species could be a more efficient competitor than *C. haitiensis* in the lake. Based on these results, several recommendations were made to promote the sustainability of the Azuei Lake fishery and the conservation of the native *C. haitiensis* fish species.



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## Redonda Reborn: The Impact of Invasive Species Removal on a Caribbean Island Ecosystem

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Worldwide, invasive species pose the largest threat to native wildlife, especially on islands. Feral goats (*Capra hircus*) and black rats (*Rattus rattus*) have been incrementally introduced to islands as humans explored the world's oceans. On an island, without predators or competition, these animals can easily distort an ecosystem.

This was dramatically demonstrated on Redonda, the third island of Antigua & Barbuda. 1.5km long and uninhabited, the island is recognized as an Important Bird Area (being a globally important nesting site for seabirds), and Key Biodiversity Area, with a number of endemics including three species of Critically Endangered lizards. In 2009, Redonda was identified as the Caribbean's top priority island for restoration because a herd of feral goats and over 6,000 black rats were causing a catastrophic decline in the island's habitats and native wildlife. Very little vegetation remained by the early 21<sup>st</sup> century and several native animals and plants were extirpated.

Since the Redonda Restoration Programme was launched in 2016, the feral goats and rats have been removed and the island has been transfigured into a biodiverse haven. More importantly, the unique native plants and animals are making a rapid recovery.

The entire population of black rats was eradicated using Klerat, a bitter, waxy bait that contains 0.005% brodifacoum and has been used successfully to remove rats from Caribbean islands since the early 1990s. For over 2 months in 2017, our team distributed the bait at intervals of not less than 40 metres and monitored uptake. On the sheer cliffs, mountaineers used slingshots to disperse bait and this was further complimented by aerial drops to ensure that no rats remained. The goats, being considered a rare breed of national importance, were captured alive and transferred to Antigua: All were thin and stunted due to the lack of food on Redonda but have since gained weight and begun breeding.

As the island continues to recover, intensive wildlife monitoring is underway to record the impacts of the habitat restoration. Birds, reptiles, invertebrates, vegetation and soil are all monitored with specific protocols by a team of technical experts and local volunteers.



Within 24 months of the goats and rats being removed, vegetation growth has been surprisingly rapid, with notable increases in grasses, cacti and hundreds of new shrubs and tree saplings. Populations of at least two of the three lizard species have increased by more than three-fold and species of landbirds and invertebrates, not seen in decades, have returned. For the first time in centuries, a new generation of seabirds (including frigatebirds, boobies and tropicbirds) is growing up in the absence of non-native predators.

The next step for Redonda is establishing the island and its surrounding seas as a protected area. Further researches into the reptiles, and the seabirds' ecology, foraging and breeding success are priorities within the proposed management plan. Even at this early stage, Redonda is a model for island restoration. It is sure to provide valuable lessons for other biodiversity conservation and climate resilience-building projects in the region.





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## Research and conservation actions to protect the critically endangered Ridgway's Hawk (*Buteo ridgwayi*) in the Dominican Republic

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The critically endangered Ridgway's Hawk (*Buteo ridgwayi*) is one of the most endangered raptors in the world with a global population of around 400-500 individuals. It is endemic to Hispaniola, but is currently restricted to Los Haitises National Park (LHNP), its only known breeding stronghold, and, more recently, Punta Cana – the site of our current restoration efforts. The hawk faces many natural and anthropogenic threats, including human persecution of adult birds, mainly from fear that hawks will predate on domestic fowl, and capture of raptors and other birds (i.e. endemic parrots and crows) to be kept in cages as personal “pets” or to be sold. In fact, we know one community member living near Los Haitises National Park who claims to have killed more than 100 Ridgway's Hawks in his lifetime.

We began working with this species in 2002 and began our reintroduction effort in Punta Cana in 2009. However, after several reintroduced hawks were found shot in communities around the Punta Cana release site, we began an intensive education program in 2013 in 12 communities. Since that time, we have reached more than 7,500 individuals and have already seen a positive change in people's attitudes and actions toward the hawks.

Through our work, we have shown that environmental education, local capacity development, and community engagement have all helped mitigate anthropogenic threats. In fact, the individual who had killed so many hawks in the past worked on our project for a number of years and then went on to work as a tourism guide – helping to protect the very hawks and other wildlife he once played a hand in destroying.

A successful education program involves more than simply giving presentations and passing out posters. In order to change behavior, it is necessary to understand why that behavior is occurring, to provide information to allow individuals to make informed decisions, and to provide communities with the resources to act on those decisions. Through formal and informal surveys, we understand that people shoot and/or capture Ridgway's Hawks and other raptors 1) because raptors will predate on domestic fowl, 2) out of ignorance, 3) to hold in captivity for personal “enjoyment” or to sell, 4) out of curiosity



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and, more rarely, 5) for human consumption. This information has enabled us to target specific concerns and to address issues in a way that is effective and culturally appropriate. Specifically, we have utilized these results to design our activities and educational materials (posters, booklets, brochures, etc.) that focus on the ecology of raptors, their importance to a balanced ecosystem, and how they benefit the human community. Specific actions include teacher and youth training workshops, celebration of Ridgway's Hawk Day, Community/school presentations, the hiring and training of local community members and the building and free distribution of chicken coop to mitigate human/raptor conflicts.





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## Potential distribution of a newly introduced frog in Cuba, *Leptodactylus fragilis* (Anura: Eleutherodactylidae): Predicting the invasion of acoustic niche

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Invasive herpetofauna are an important cause of the global decline in biodiversity. More than 100 amphibian and reptile species have established populations outside their natural geographical range with their consequent impacts over native biota. They can affect native amphibians through predation, competition, habitat degradation, diseases transmission, competition and hybridization. Invasive species that use acoustic communication can affect native species through interference in the acoustic niche, but this issue has not properly been assessed in Cuba. *Eleutherodactylus fragilis* is the second invasive amphibian reported in Cuba. This species was recently introduced and it is known from two localities of western Cuba and considering its natural history, could be expected different types of impacts, and included the acoustic interference on Cuban amphibian populations. In this contribution, we use species distribution models (SDM) as a useful tool to predict the establishment and spread of this species in Cuba, and evaluate the potential invasion of acoustic niche of native species. Records of *L. fragilis* available through the Global Biodiversity Information Facility (GBIF) and VertNet databases were used to generate the potential distribution models of species derived from its climatic niche 'using bioclimatic variables' from the WorldClim database. Environmental suitability at Cuba scale was modeled using maximum entropy modelling (Maxent). Projected suitability areas were selected to carry on sound propagation experiments, in order to measure the attenuation rates of playback calls of *L. fragilis* across four distances. Previous recordings of the advertisement calls were characterized and used to design the experiments that also will include sequences of pure tones of 1 kHz, series of consecutive calls, vocal interactions between two males and chorus of the species. The playback calls and pure tones were broadcast with a self-powered loudspeaker (Pignose No.7-100) connected to a laptop computer and placed at positions typically occupied by calling males at the soil. The broadcast signals will be recorded with a directional microphone (Senheiser MK6) placed successively at distances of 0.5, 1, 2, 4, 8 m from the loudspeaker, and a digital audio field recorder (Marantz PMD-660). At the same positions we





will put a sound level meter (RadioShack, Error=2dB) to estimate the broadcast level in each distance. Additionally, we consider other aspects of overlapping of acoustic niche such as: microhabitat used for calling, the time that calling activity takes place, and the acoustic structure of the advertisement calls.





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## Agonistic territorial behaviour of *Stegastes* (Pomacentridae) according to the topographic characteristics of reefs

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*Stegastes adustus* and *Stegastes planifrons* are two species of damselfishes (Pomacentridae) commonly found on Caribbean reefs. These two species practice a “weeding” activity inside their territories to optimize the amount of food resources available, in term of algal turf, small benthic invertebrates and detritus. Due to this activity, *Stegastes* actively contribute to the regulation of algal biomass on coral reefs.

To protect their resources, *Stegastes* use diverse agonistic behaviours, such as the production of sounds, the chase of intruders or others bullying behaviours. In this study, the different types of agonistic behaviours undertaken by the two species of *Stegastes* were censused with underwater video recordings, on two contrasted reefs: a relatively flat reef and a site located at the top of a drop off. The analysis of the recordings showed that *Stegastes planifrons* is more aggressive than *S. adustus*. At the same time, *S. adustus* chase a higher diversity of fish out of their territories. These results are suggestive of different strategies to defend food resources, and contrasted agonistic behaviours between the two species. Moreover, the number of attack per minute was higher when *Stegastes* were located at the top of the drop off (*i.e.* when a smaller area of reef was available), which shows that the lack of available substrate to settle upon can lead to an increase in competitive interactions between *Stegastes* individuals, and with the others fish species. Among the fish species that were chased out of *Stegastes* territories, herbivorous fishes dominated. This result is explained by the fact that herbivorous fishes are the main competitors for territorial damselfishes.

The increase in agonistic behaviour could represent a considerable energy cost for damselfishes, leading to a reduction of the time spent on weeding activities and, ultimately, in a proliferation of macroalgae (not consumed) inside *Stegastes*' territories.



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## Archaeobiogeography of extinct rice rats (*Oryzomyini*), and agouti (*Dasyprocta*) in the Lesser Antilles during the Ceramic Age (500 BC to 1500 AD)

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In the Lesser Antilles, rice rats (*Oryzomyini* tribe) – now extinct in the region – were one of the few non-flying terrestrial mammals, along with agouti (*Dasyprocta* sp.) to be present and eaten by the pre-Columbian ceramic societies inhabitants (between 500 BC to 1500 AD), before the arrival of European settlers. These two rodents have a dual interest, both biological and cultural: they help understanding island biogeography in the region and the morphological evolution of an extinct taxa, and in the same time allow to study the diet of pre-Columbian human populations.

Here, we aim at characterizing the spatiotemporal distribution of rice rats and agoutis, complete their systematics and taxonomy, and assess their relationship with humans. We used an integrative approach combining geometric morphometrics, genetics and archaeozoology.

Using a two-dimensional sliding semi-landmark based geometric morphometric approach, we quantified and visualized tooth size and shape differences between chronological cultural periods and between islands. To test whether the phenotypic groups reflect environmental adaptations or phylogenetic history we conducted ancient DNA analysis on the mitochondrial genome (Cytochrome b gene) of 70 archaeological specimens originating from all studied islands.



From archaeological specimens representing seven different islands of the Lesser Antillean archipelago, three morphological groups emerged. They were geographically consistent and present from the beginning of the Ceramic Age: one in Saint-Martin in the northern part of the archipelago characterized by very small molars, one in Martinique in the south, and one in the central region (*i.e.* Antigua, Barbuda and the Guadeloupe archipelago: Basse-Terre, Grande-Terre and Marie-Galante). Within the central region each island has its own morphotype.

Our morphometrics data reveal a strong archaeobiogeographic signal, which is stable over time, and suggests limited human influence on the spatiotemporal distribution of rodents, despite their importance to past human diet. The wet and hot environmental condition typical of the tropical regions do not favor DNA preservation and likely preclude DNA analysis of the ancient remains we have studied so far. Yet, the phenotypic geographic distribution appeared consistent with DNA clusters from previous studies and indicates that new taxonomic classifications should be designated for the extinct archaeological populations of Saint-Martin and Marie-Galante.



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## Shared ecosystems: a form of connectivity in the Caribbean

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Within the framework of the Biological Corridor in the Caribbean, several elements of connectivity are identified; among them, the shared ecosystems constitute one of the routes that most evidences the biological and evolutionary affinities of the Caribbean islands. Specifically, the ecoregion Cuban cactus scrub of the South East of Cuba, identified by the IUCN as threatened, could also be present in Hispaniola, not only in Cuba. The main characteristics of this ecoregion shared by both islands are presented.

En el marco del Corredor Biológico en el Caribe, se identifican varios elementos de conectividad; entre ellos, los ecosistemas compartidos constituyen una de las vías que más evidencia las afinidades biológicas y evolutivas de las islas caribeñas. Específicamente, la ecorregión Matorrales cactáceos del Sur de Oriente en Cuba, identificada por la IUCN como amenazada, pudiera estar presente también en La Española, no solo en Cuba. Se exponen las principales características de esta ecorregión que comparten ambas islas.



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## Population biology of a bird species endemic to Haiti, the La Selle Thrush (*Turdus swalesi*): applications to the management and conservation of the species

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Forest environments have the highest levels of species diversity in terrestrial ecosystems, and the loss of forest habitat is one of the major threats to biodiversity worldwide. Hispaniola Island (Haiti and Dominican Republic) was called the pearl of the West Indies in 1492, at the arrival of Christophe Colomb, because of lush vegetation. From forest cover estimated at 99% in pre-Columbian times and 60% in 1925, Haiti now retains less than 2 % of its original forests. Most of the remaining forest tracts occur in two regions, Massif of La Selle in the southeast and Massif of La Hotte in the southwest.

In the Massif La Selle, the La Visite National Park is home to the only large mountain complex forest. This area suffers from severe and ongoing deforestation. Thus, the extreme reduction of the area covered by primary forest is at the origin of the rarefaction or the disappearance of several species of vertebrates subservient to various types of habitats. Among these, the La Selle Thrush, *Turdus swalesi*, is endemic to the island of Hispaniola, and currently classified as "vulnerable" on the IUCN Red List. The species' range has been considered to be limited to the only Massif of La Selle in Haiti, before populations were discovered in different areas of the Dominican Republic. The morphological differences observed between the different populations led to differentiate two subspecies *T.S. swalesi* and *T.S. dodae*. According to IUCN, the global population of the species is estimated to be between 1500 and 7000 adult individuals. While recent evidence suggests that the species, once thought to be abundant, is declining sharply in Haiti, accurate quantitative data are still lacking and there are no reliable data on population trends.

In this context, we propose to carry out a study on the La Selle Thrush, in order to obtain demographic and genetic data on the Haitian populations of the La Selle Thrush and, possibly, on populations in the Dominican Republic, as well as on habitat selection in relation to the advance of deforestation in Haiti. Results will be of value to establish an action plan for the species.



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## Surveillance of Infectious Diseases throughout the Production Cycle of the Overharvested Wild and Cultured West Indian Top Shell Snail (*Cittarium pica*)

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The West Indian top shell snail, *Cittarium pica*, is a marine gastropod found on the shorelines of tropical and temperate waters and is locally referred to as a whelk in St. Kitts and Nevis. The whelk is an important marine resource for human consumption and is a popular Caribbean delicacy. It is easily harvested from the coastline by removing them from the rocks at low tide or by diving close to the shore. The popularity of the whelk as a food source, and the relative ease of collection, has led to the overharvesting of this aquatic resource. Therefore, there is a need to explore the potential for the aquaculture of this commercially important species. Literature on the West Indian top shell snail is scarce especially in relation to parasites and other infectious diseases. In this study, a comparison is going to be made between wild and cultured snails. Whelks will be collected from the shoreline around St. Kitts and Nevis and isolation and identification of infectious diseases will be made. Snails deemed to be free from parasites and gross signs of infectious diseases will be kept for culture. Continuous sampling will be performed on the cultured snails throughout the production cycle, followed by a comparison on the different pathogenic organisms isolated for both cultured and wild snails. Characterization and identification of parasites and pathogens will be assisted by histopathological studies and supported with phylogenetic analysis conducted after PCR amplification of the rRNA gene and subsequent DNA sequencing has been achieved. This study will contribute to the literature on infectious diseases of the West Indian top shell snail.



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## ***Heterophyid dermatitis – a reason to pass on reef fish ceviche***

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*Acanthurus* spp. of St. Kitts and other Caribbean islands, including ocean surgeonfish (*A. bahianus*), doctorfish (*A. chirurgus*), and blue tang (*A. coeruleus*), frequently show multifocal cutaneous pigmentation. Initial reports in the Leeward Antilles raised suspicion for parasitic etiology. The aim of this study was to quantify the prevalence of the disease in St. Kitts' Acanthuridae and describe its pathology and etiology. Surveys demonstrated consistently high adjusted mean prevalence at three reefs in St. Kitts in 2017 (38.9%, 95%CI: 33.8-43.9) and 2018 (51.5%; 95%CI: 46.2-56.9). There were no differences in prevalence across species or reefs, but juvenile fish were less commonly affected than adults. Twenty-nine dermatopathy-affected Acanthurids were sampled by spearfishing for comprehensive postmortem examination. Digenean metacercariae were dissected from <1mm cysts within pigmented lesions. These were molecularly classified as Family Heterophyidae, whose members are commonly implicated in black spot disease of other fishes. Morphological features of the parasite were most typical of, but not entirely consistent with *Scaphanocephalus expansus*, and two genetic profiles were obtained suggesting more than one digenean species. Histologically, pigmented lesions had mild chronic perivascular dermatitis and increased chromatophores, often centered on encysted digenean metacercariae. In one *A. chirurgus*, metacercariae were also encysted in skeletal and cardiac muscle. Low mean lesion severity score and the mild nature of the pathology suggests that black spot disease has little overall impact on Caribbean Acanthuridae. Further research is needed to clarify impact on fitness and fecundity of affected hosts, and elucidate the other host species involved in the life cycle. In addition, as many members of the digenean family Heterophyidae are known to infect humans, it is imperative to investigate the zoonotic potential of this parasite.



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## Patterns of microhabitat use by two sympatric cleaner gobies *Elacatinus evelynae* and *E. prochilos*

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The gobies, *Elacatinus evelynae* and *E. prochilos* are small, sedentary reef fish that consume ectoparasites of other fish and inhabit barrel sponges and scleractinian corals. Theoretically, ecologically similar species such as these are not expected to co-exist in unless there is some level of resource partitioning. In this study, we investigate how two co-occurring populations of *E. evelynae* and *E. prochilos* partition microhabitat use in a shallow patch reef in Barbados. The study also provides the first long-term uninterrupted study of the population dynamics of any cleaner goby in the Caribbean region and also the first in examining the concurrent use of corals and sponges by two sympatric cleaner gobies. Monitoring entailed 90 biweekly surveys of a permanent 900m<sup>2</sup> reef plot, from January to December 2018. During these surveys, the abundance and size of all gobies were recorded on sponges and corals, which were recorded prior to surveying. Overall, 295 corals (out of 859) and 138 sponges (out of 150) had been occupied at least once by either species and *E. prochilos* (13,812 records) was four times more abundant than *E. evelynae* (5,684 records). Recruitment of both species was positively correlated ( $r=0.28$ ,  $n=90$ ,  $p=0.01$ ), suggesting that temporal resource partitioning is not an important factor in their coexistence. In contrast, there were marked differences between gobies in their microhabitat use: the majority of *E. evelynae* (63%), inhabited corals whereas most *E. prochilos* (89%) inhabited sponges (89%). However, the MacArthur and Levins' measure of niche overlap indicated that the extent to which the spatial distribution of *E. evelynae* overlapped with that of *E. prochilos* was greater (average index: 0.345) than the extent to which the spatial distribution of *E. prochilos* overlapped with that of *E. evelynae* (average index: 0.293). Thus, our data suggest an asymmetrical spatial partitioning between species, whereby *E. evelynae* is more likely to interact with *E. prochilos*, than *E. prochilos* with *E. evelynae*. Interestingly, in both species, the rate of colonization of unoccupied sponges was greater than that of unoccupied corals, suggesting that sponges are the preferred microhabitat by both gobies. Thus, it is likely that *E. prochilos* is competitively superior to *E. evelynae* on sponge microhabitat.



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## Nidification of Hispaniolan Trogon (*Priotelus roseigaster*, Aves: Trogonidae) and Hispaniolan Woodpecker (*Melanerpes striatus*, Aves: Picidae) in the Ébano Verde Scientific Reserve, La Vega, and in the University Campus, Santo Domingo, Dominican Republic

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Nidification of *Priotelus roseigaster* was studied in “Loma la Sal”, in the Ébano Verde Scientific Reserve, La Vega, Dominican Republic. Artificial nests are installed in this area since December 2013. They were installed in different kinds of trees, mainly pines (*Pinus occidentalis*). New artificial nests were installed in this area in 2019. In addition, three nests were installed this year at the university campus, where they raise six species of birds that nest in cavities, four of them endemic to Hispaniola and two endemic species of the Caribbean. This is part of a new project on the nidification of species that nest in cavities in urban areas. Two of the three nests installed on the campus were occupied: one by the endemic Hispaniolan Woodpecker (*Melanerpes striatus*) and the other by American Kestrel (*Falco sparverius dominicensis*) a Caribbean endemic subspecies. This new project pursues conservation, education and research purposes. Data included clutch size, incubation, fledging, participation of the pair during the incubation period, and the feeding and rearing of the chicks. Some morphometric data of the siblings were also collected. New techniques to prevent the infestation of the chicks by the fly *Philornis* sp. and the invasion of the bees in the nests are described.



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## Preserving the viscous coral surface mucus layer using low acid glycol methacrylate (GMA) resin

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The surface mucus layer (SML) is of critical importance in health, disease, and stress responses of corals, however visualising the intact SML is challenging. Dehydration during histological preparation causes shrinkage and deformation of the mucus gel layer, while fragile, unattached mucus exudates are typically lost altogether. Here we describe a novel technique using water-soluble glycol methacrylate resin embedding that more accurately preserves the *in situ* SML. Thickness of the preserved SML is similar to that previously measured on live corals using a glass micro-probe. The technique allows microscopic visualisation of the SML structure, as well as thickness and continuity measurements, which are important indicators of SML function in health and disease.



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## Conservation of the critically endangered Ridgway's Hawk (*Buteo ridgwayi*)

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Ridgway's Hawk (*Buteo ridgwayi*) is one of only three island-endemic buteos found worldwide and is the only buteo of 13 diurnal raptors listed as Critically Endangered by the IUCN. Historically, Ridgway's Hawk ranged throughout the island of Hispaniola and satellite islands. By 2009 the Ridgway's Hawk population had declined to approximately 300 individuals isolated to Los Haitises National Park, a 600 km<sup>2</sup> "paper-park" in Dominican Republic. Ridgway's Hawk is threatened by habitat loss and human persecution. Recent work has determined that parasitic nest flies (*Philornis* spp.) are a significant cause of hawk nestling mortality and a likely additional factor in the decline of the species. In 2011 we began treating hawk nests and nestlings to increase pair productivity. With our treatment, the number of young produced per pair has greatly increased, which has reversed the population's declining trend. Improved productivity has enabled us to translocate about 25 young hawks per year, creating a second population in the Punta Cana region of the Dominican Republic. Since 2009, The Peregrine Fund has reintroduced 120 Ridgway's Hawks and at least 30 young have fledged in the wild in the Punta Cana region. Currently, the new population consists of about 18 pairs. This year we are initiating reintroductions of young Ridgway's Hawks in Aniana Vargas National Park, where we expect to create a third population over the next several years.



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## Caribbean Network for coastal risks related with climate change

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The Regional Activity Center for Specially Protected Areas and Wildlife (SPAW-RAC) is in charge of the implementation of the SPAW protocol in the Wider Caribbean Region. SPAW-RAC works on marine and coastal environment preservation by bringing together Protected Areas (PAs), listed under the aforementioned protocol. This includes protecting related species and providing support to their managers. For instance, as Global Coral Reef Monitoring Network – Caribbean (GCRMN-Caribbean) Steering Committee members, SPAW-RAC organizes workshops to train PAs managers to the GCRMN biophysical monitoring guidelines in order to produce common coral reef data across the Caribbean region. Moreover, it takes part in regional initiatives such as the Carib'Coast project which has been launched in January 2019. Led by the French Geological Survey (BRGM) and mainly funded by Caribbean Interreg Program (European Union funds), it aims to gather, build and broadcast knowledge about coastal risks management in the Caribbean. Indeed, Caribbean coasts have to cope with many human and natural threats that cause intensifying erosion. For apparent reasons, research, knowledge sharing and environmental protection are key elements to coastal erosion mitigation. However, some ecosystems like reefs, mangroves, seagrasses, coastal wetlands or estuaries are often already damaged to an extent that their efficiency is no longer sufficient as regards coastal protection. In such cases, habitat restoration surfaces as a good solution to ensure these ecosystemic essential services are provided to their optimal potential. Among others, the Coral Restoration Consortium works on producing and sharing knowledge about coral reefs restoration. Acting as a regional and soon a global network, it is a precious organization to take into account for coastal protection and resilience.



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## Migratory Passerine Bird Habitat Selection in the Caroni Swamp, Trinidad

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Nearctic-neotropical migratory songbirds breed in temperate areas and normally spend the winter in tropical or sub-tropical environments. Several species of migratory songbirds have been previously recorded in Trinidad and Tobago, with many visiting the Caroni Swamp in Trinidad. This study investigated the value of the habitats at the Caroni Swamp to the neotropical migratory birds that use the swamp. The duration of occurrence, abundance, body conditions and site fidelity of migratory birds at seven locations at the Caroni Swamp was investigated. Mist netting and bird banding was conducted for a total of 838 netting hours. A total of 308 migrants from four species were encountered: 171 Northern Waterthrushes, 122 Yellow Warblers, 9 American Redstarts and 3 Prothonotary Warblers. It was found that the mangrove-marsh interface was the most significantly favourable habitat type and the coastal area was the least favoured habitat for the migrant species (Kruskal Wallis:  $H = 11.82$ ;  $DF = 3$ ;  $P = 0.008$ ). Factors such as vegetation height and canopy cover (Kruskal Wallis:  $H=9.33$ ;  $DF=3$ ;  $P=0.025$ ) influenced the use of these habitats. Increases in fat, Body Mass Index (BMI) and moulting indicated over-wintering of migrants at the Caroni Swamp. Approximately 10.5% (31) of birds banded during were subsequently recaptured. Within season site-fidelity ranged from three weeks to four months indicating that migrants are overwintering at the Caroni Swamp. In addition approximately 7.5% (23) of birds captured were retraped birds initially banded during the previous winter, indicating that migrants return annually. Overall, this study has indicated that the Caroni Swamp is an over-wintering habitat for neotropical migratory birds and as such closer attention should be paid to mitigating existing threats to the area, particularly those at the mangrove-marsh interface.



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## Biodiversidad amenazada del Caribe: Amenazada

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In the classic publication by Myers and collaborators in 2000, the insular Caribbean was included among the five hot spots most relevant to the planet's biodiversity. This, based on the high levels of endemism, as well as the prevailing threats on it. In the present work we review the available information on the global biodiversity and the biodiversity of the insular Caribbean (Red Lists, biodiversity strategies, others) and highlights how the seriousness of the threats to Caribbean biodiversity has increased in a worrying way since then. A call is made to the regional and international community to pay greater attention to this situation, which is of essential importance in order to advance towards the fulfillment of the commitments of the 2030 Agenda and the Sustainable Development Goals.

En la ya clásica publicación de Myers y colaboradores en el 2000 el Caribe insular quedo incluido entre los cinco sitios calientes más relevantes para la biodiversidad del planeta. Esto, en base a los altos niveles de endemismos, así como las amenazas imperantes sobre esta. En el presente trabajo se revisa la información disponible sobre la biodiversidad global y la biodiversidad del Caribe insular (Listas Rojas, estrategias de biodiversidad, otros) y se destaca como la gravedad de las amenazas sobre la biodiversidad caribeña se ha incrementado de manera preocupante desde entonces. Se hace un llamado a la comunidad regional e internacional a prestar mayor atención a esta situación, de esencial importancia para avanzar hacia la consecución de los compromisos de la Agenda 2030 y los Objetivos de Desarrollo Sostenible.



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## A thousand new species of beetles for Cuba (Mil especies nuevas de escarabajos para Cuba)

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Cuba is the largest Island in the West Indies, and would be expected to harbor the largest number of species in the region. The Coleoptera (beetles) are the largest single group of terrestrial species in the region. Cuba has less than 3,000 reported species of Coleoptera. We will present data to indicate this number is at least a 100% under-representation of the real Coleoptera biodiversity of Cuba. We will outline a proposed international campaign to discover 1,000 additional species of Cuban beetles as part of the Cuban Museo Nacional de Historia Natural's project "Taxonomía de algunos grupos zoológicos de Cuba y del Caribe, con acciones de capacitación especializada, divulgación, y educación ambiental" [Taxonomy of some zoological groups of Cuba and the Caribbean, with specialized training, dissemination, and environmental education actions], a part of the program "Uso Sostenible de los Componentes de la Diversidad Biológica en Cuba" [Sustainable Use Of The Components Of Biological Diversity In Cuba]. We propose to employ a novel method of insect inventory developed by the West Indian Beetle Project on other islands over the past two decades to drive this unprecedented level of discovery, and overcome the existing lack of understanding of the true biodiversity of this critical island.



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## Use of camera traps to estimate the relative abundance of Bridled Quail-Doves (*Geotrygon mystacea*) and Ruddy Quail-Doves (*Geotrygon montana*) on Guadeloupe Island

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Columbidae are essential in the dynamics of tropical ecosystems. As seed dispersing agents, they directly contribute to the regeneration of plant communities present in their habitat. However, columbid species are particularly vulnerable to deforestation, habitat fragmentation, and, for a large number of species, hunting pressure. The Quail-Dove, *Geotrygon mystacea*, and the Ruddy Quail-Dove, *Geotrygon montana*, are two species of Columbidae of patrimonial and cynegetic interest in Guadeloupe, both of which are dependent on tropical forests. The first species is endemic to the Caribbean region, ranging from Puerto Rico to Saint Lucia. The second species has a much wider range, from the Caribbean Basin to the northern half of South America. The two species are of minor concern according to the IUCN Red List. However, in Guadeloupe, where legal hunting of both species occurs, the fate of their respective populations remains uncertain, largely due to a lack of quantitative data. We currently use camera traps, a reliable and minimally invasive means of monitoring wildlife, to document the occurrence and relative abundance of the two quail dove species in several forests of Guadeloupe. To that end, 20 camera traps are used in rotation over 24 different areas. Five camera traps are set per area, where they remain in place for a period of 7 days. This procedure will allow us to sample 120 different sites twice during the course of the study. The final objective is to characterize habitat selection by quail doves and provide reliable data to support management of the two species.



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## Patterns of freshwater invertebrate communities over space: a comparison of recreational and non-recreational sites in Trinidadian rivers

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Trinidadian rivers contribute to the country's economy through agriculture, industry, recreational activities, religion, commercial fishing and scientific research. Studies showed that some rivers in Trinidad are negatively impacted by human activity, yet no study has been done on the spatial patterns body size of freshwater macro-invertebrates. In this sense, this study was carried out to explore and examine the effects of recreational disturbance on macro-invertebrate communities throughout Trinidad Rivers. In seven Northern Range rivers, two sites on each river: disturbed and undisturbed were selected for this study. The disturbed site was the section of the river that was subject to substantial human interference because of their location, their accessibility to humans and their use in hub for many recreational activities such as cooking, playing music, etc. The macro-invertebrates were sampled using a surber sampler along a 50-metre stretch. The specimens were identified to the morphofamily level and measured. For the analyses, Kernel density estimation and ecological index were used. The Kernel density estimation was used to calculate the mode body length, followed by a Generalized Linear Model (GLM) to determine whether body length was function of disturbance. The results showed that there was no significant difference in mode body length between river basins ( $p=0.610$ ) or between disturbed and undisturbed sites ( $p=0.890$ ). No significant difference was found in family diversity (evenness) between disturbed and undisturbed for any of the sites ( $p=0.43;0.63;0.99;0.83;0.83;0,16;0.43$  for respectively Acono, Caura, Lopinot, Lower Aripo, St Joseph, Turure amd Upper Aripo). No correlation was found between the proportional abundance of Psephenidae and the amount of trash ( $p=0.280$ ). Changes to biological diversity and body length patterns by disturbance were not observed at any of the rivers. It was concluded that human interference has no significant negative impact on macro-invertebrate family's body length and diversity in Trinidadian Rivers.



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**« SELA Biodiversité Same diversity of life but diversity of practices »  
Realisation of a Rapid a Biological, Sociological and Technological Inventory in  
the mangrove of the Cohé du Lamentin and Génipa Bay (Martinique, FWI)**

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In recent years, the Municipality of Lamentin has encouraged environment friendly projects and sustainable development. Among other things, on December 15, 2010, a convention was signed Santiago de Cuba, twin city of Le Lamentin. This convention increased the exchanges on the theme of biodiversity between the two cities. BIOECO, a renowned Cuban research center in charge of biodiversity and ecosystem conservation issues, is the partner of the municipality on this project. Between 2011 and 2015, this program of cooperation on the protection of the biodiversity in the Caribbean and more specifically the mangrove fostered exchanges of practices between scientists and naturalists of the two islands. This program was divided in 2 parts: Teaching the importance of this ecosystem and its purpose to all the children in elementary schools in Le Lamentin. Developing a program of protection and promotion of this ecosystem subjected to strong anthropogenic pressure within the next few months. Improved understanding of the biodiversity has resulted in the creation of a rapid biological, sociological and technological inventory of the mangrove of the Cohé du Lamentin and Génipa Bay, in the center of Martinique. This inventory has helped identify fungal species, flora (hepatics, moss, ferns, spermatophytes, invasive plants, plants for use), fauna (land and freshwater mollusks, spiders, daytime and nocturnal butterflies, other insects, amphibians, reptiles, birds), marine species, as well as the impact of anthropogenic or agricultural pressure and practices of social communities on the mangrove and its ecosystem. Besides the 960 or so identified species and those listed above, the threats the mangrove faces and the recommendations for its preservation and management are particularly important. The presentation will show some results of this 3-week field work implemented in June 2013, which resulted in the edition of a bilingual book (French – Spanish) highlighting the scientific cooperation. This book, rich in scientific reports, photographs of species and figures, will be made available to local decision-makers and researchers and then translated by educational tools to schools. In 2017, the Municipality of Lamentin obtained the label PACT3. It is a Support Program for Thematic Cooperation of local authorities of the Ministry of Europe and Foreign Affairs. This distinction was granted to the Municipality of Le Lamentin for the specific skills and expertise used for the environmental cooperation with Santiago de Cuba.





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## Mammalian and Avifaunal Monitoring Within a Semi Protected Area at Corbin Wildlife Sanctuary, Tobago

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This study surveyed mammals and birds within a semi-protected area at Corbin Local Wildlife Sanctuary, Tobago, a private nature reserve. It provided a comparison of the land use types and biodiversity and also a comparison of birds and mammal diversity in the habitat types present and of the mammalian encounters between Corbin Local Wildlife Sanctuary and the Main Ridge Forest Reserve, Tobago.

This is thought to be the first study of its kind comparing mammals and birds in different land use types in a private reserve area in Tobago. To achieve the objectives listed above, two main data collection methods, acoustic recordings and camera trapping, were used. These procedures were carried out between four different habitat types; namely, scrub, forest, enclosure area and transition area over a month long period.

The transition area had the greatest species richness and diversity of avifauna populations when compared to the other three habitat types, with 22 of 29 species recorded in the transition area compared with 10 species in the forest. The Blue-backed Manakin, *Chiroxiphia pareola*, a focus for birdwatchers in Tobago, was recorded in all habitats.

The acoustic recordings also indicated the presence in all habitats of the Rufous-vented Chachalaca, or Cocricco, *Ortalis ruficauda*, the National Bird of Tobago as it is not found in Trinidad. These birds tend to thrive in agricultural areas as well in natural forested areas.

Camera trap results indicated that the forest and transition areas had the highest mammal activity with the Agouti, *Dasyprocta leporine*, the most commonly recorded species, encountered with greater frequency than in the Main Ridge Forest Reserve when compared with a previous camera trap study. This previous study indicated that the Nine-banded Armadillo, *Dasyus novemcinctus* was the most common species on the Main Ridge, whilst this species was only recorded once on camera traps in Corbin Local Wildlife Sanctuary.

This study concludes that whilst there is a relationship between land use types and biodiversity all habitats present appear to be used by wildlife of importance to Tobago.

Private reserves like Corbin's Local Wildlife have the potential to contribute greatly to the conservation of native wildlife in Tobago. They possess a wide range of habitats both disturbed and undisturbed, harbour a high diversity of wildlife, are very accessible to tourists and have great potential value as an outreach educational tool, being closer to centres of population than most protected areas.





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## 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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The subfamily Arctiinae (Lepidoptera: Erebidae) is one of the richest groups of Lepidoptera in Cuba, with 101 species, of which 49.5% are endemic. However, little information is available about the ecological factors influencing the structure of in the communities of Cuban Arctiinae. Moreover, the diversity and endemism are particularly high in dry land xeromorph serpentine shrublands. This has been correlated with the high level of plant species richness and endemism of this type of vegetation which is supposed to favor in turn of Arctiinae, through specialization on specific plants. In the present work, we compare the structure of the communities of Arctiinae species of two contrasted xeromorph serpentine shrubland that differ in plant species richness and level of endemism, the Cajálbana dry land and the Lomas de Galindo. During several months we have sampled 20 different sites, i.e. 10 per plant formation, concerning both moth and plant species. We will present the preliminary results of a continuing investigation that compare the  $\alpha$  and  $\beta$  diversity, the abundance and the species richness between the two sites. We will also present our preliminary results that confront the structure of the vegetation with the community parameters of the moth assemblages.



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## Potential distribution of bats in Hispaniola

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The island of Hispaniola in the West Indies remains the least studied of the Greater Antilles and possibly the most complex from an ecological point of view. This is due to its complex relief, holding both the highest and lowest elevations in the region. Although a number of surveys have been conducted over the years, the information about the bat fauna of the island lacks coherence and synthesis. We provide a first approach to synthesizing this information and add 5212 unpublished records to the bat fauna of the Island, representing 76% of total records. Based on these records and bioclimatic and topographic variables, we constructed Habitat Suitability Models (HSM) and projected potential distribution maps from them. We later stacked the individual distribution maps for obtain a richness map, which showed an inverse relationship between species and the elevation, with only three out of the 17 species present on the island found above 1500 masl. According to our expertise, the HSMs of some species do not fit their actual distributions satisfactorily, suggesting that, plus climate and topography, other variables could best explain its distribution patterns (e.g. the potential distribution of roosts).



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## Status and Assessment of the Herpetofauna in the Martissant National Urban Park, Haiti: Preliminary Results and Applications for Conservation

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The herpetofauna of Haiti includes 135 species of reptiles and 57 species of amphibians, with a rate of endemism of 95%. In particular, 57 species of reptiles and 20 species of amphibians have been recorded in the metropolitan area of Port-au-Prince, the densely-populated capital of the country. However, all species living in this area are threatened by habitat loss, pollution and human activities. Their persistence thus critically depends on the availability of suitable areas in which they can maintain populations. In the present study, we evaluated the herpetofauna present in the Park of Martissant. This area, that covers 17 ha, is located in Port-au-Prince and was declared as the first National Urban Park of Haïti and a protected area in 2017. It constitutes one of the only havens of protection for reptiles and amphibians in Port-au-Prince area. A monitoring-inventory was initiated in March 2019 to document the presence, and, possibly, the relative abundance of amphibian and reptiles species. The first results based on prospecting at sight over 8 weeks, have revealed the presence of 10 species of reptiles, including 1 vulnerable species (VU) in captivity, 6 species of anoles (out of which 5 have not yet been assessed by IUCN), 1 species of grass-snake, and 2 species of amphibians, one of which is classified as vulnerable. Of the 12 inventoried species, 6 were not recorded in a first inventory on the Park's fauna in 2004. Overall, the species present in the Martissant Park represent about 15% of the herpetofauna of the metropolitan area mentioned in the literature. However, most amphibian and reptile species inventoried in the Park (2004 and 2019) are poorly documented in the scientific literature, thus limiting conservation actions. It is therefore of high importance to continue research on the herpetofauna of Haiti, both at the Park level and national-wide. This preliminary work is mainly presented to demonstrate the species richness of the Martissant Park, but also to highlight the constraints and limits of conservation of the herpetofauna in Haiti.



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## Mitigating *Philornis* Parasitism on the Ridgway's Hawk: Mid- And Long-Term Control Methods

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*Philornis* (Diptera: Muscidae), is a genus of generalist parasitic flies that parasitize over 250 species of birds all over the Neotropics. Knowledge on the genus is limited to 28 of the approximately 50 described species and their effects on hosts vary from light to lethal; sometimes taking bird species to the border of extinction (i.e., parasitism of Mangrove Finch by *Philornis downsi*). This is also the case of the critically endangered Ridgway's Hawk (*Buteo ridgwayi*) where up to 75% of nestlings may die due to parasitism of *Philornis* (mainly *Philornis pici*). Although some control methods are being developed to eradicate the human introduced *P. downsi* from the Galápagos, differences in parasite and host biology required the development of unique control methods for Ridgway's hawks in the Dominican Republic.

We are currently investigating mid- and long-term control methods (MTM and LTM respectively) to minimize the impact of *Philornis pici* on Ridgway's Hawks. As a MTM we are testing different low-toxicity insecticides and natural repellents that may keep larvae and adult flies away from nests and nestlings. Advances towards LTM have been made by seeking biological control agents and attempting to reproduce *P. pici*'s life cycle in captivity; which will be key in allowing for the implementation of known control techniques like Sterile Male Release Technique. Predictive models of *Philornis* distribution are currently being built to detect suitable places for new hawk releases. Some aspects of life history traits and taxonomy of these parasites are under study as well.

By using a slow release Permethrin formula (Permacap™ 1%) applied to nest material at the incubation stage, we strongly reduced parasitic load of nestling. Results showed that organic compounds like "Bija" (*Bixa orellana*) could potentially be good repellents of *P. pici* since the majority of exposed flies (>78%) avoided it. Regarding LTM, over 500 flies were reared in our lab and survived up to 93 days, evidencing strong rearing capabilities. We also observed that *Brachymeria podagrica*, a generalist parasitic wasp, is abundant in the area and may act as a biological control agent. We confirmed that low temperatures (18°C) may delay *Philornis*' adults emergence up to 30 days, but is not lethal to the larvae. At the same



time, we collected evidence that there are more than a single species of parasites affecting Ridgway's hawks.

Although most of our research is still in progress and more research is needed, our findings made available a highly efficient short-term control method for *Philornis*. It also provided vital information on different techniques with potential to control *P. pici* and other *Philornis* species in the mid- and long-term.





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## Results of the first winter waterbird census over five major wetlands in Haiti

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More than 155 waterbird species have been recorded in Haiti, where they are facing several human-induced threats such as habitat loss, pollution, conflicts with aquaculture or hunting pressure. However, despite the alarming environmental situation in the country, little is known about trends in the populations of shorebirds passing through or wintering in Haiti, or the numbers of resident waterbirds at the various wetlands. In this context, a census was made from January 28 to February 1, 2019 -as part of the 10<sup>th</sup> annual Caribbean Waterbirds Census- on five different wetlands: Trou Caïman, Lake Azuei, Lagon-aux-Bœufs, Lake Miragoâne, and the Delta of the Rivière Massacre. Overall, we recorded the presence of 35 different species belonging to 13 different families. We used different indices of relative compositional similarity and differentiation to proceed to pairwise comparisons between the five assemblages. Both incidence-based indices abundance-based ones revealed only moderate overlap between the five assemblages. However, in the absence of repeated measures on the same sites at different dates, it remains difficult to evaluate to what extent variation in the diversity of assemblages between sites is more important than the variation in the diversity of assemblages within each site through time. We discuss our results in relation with the preservation of wetlands in Haiti and the need to implement a national program for wildlife monitoring and habitat restoration.



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## Thermal tolerance ranges in livebearing fishes of the genus *Limia* (Teleostei, Poeciliidae)

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Temperature gradients play crucial role in fish species distribution in natural ecosystems due their remarkable influence in physiology and fitness. Even in tropical ecosystems where annual average temperatures do not show extreme fluctuation because of lack of seasonality, altitudinal variations can create temperature gradients that promote environmental patches in which certain fish species may be more successful than others. In this study we investigated microvariations in tolerance to extreme temperatures, measured as critical thermal maximum (CT<sub>max</sub>) and minimum (CT<sub>min</sub>), and also compared temperature ranges for eight species of the Caribbean livebearing fish genus *Limia*: *L. dominicensis*, *L. melanogaster*, *L. perugiae*, *L. sulphurophila*, *L. tridens*, *L. versicolor*, *L. vittata* and *L. zonata*. The study also analyzed differences in thermal tolerance among four populations of *L. perugiae*, which is one of the most widely distributed species of *Limia* on Hispaniola. Results of our analyses showed species with broader distribution ranges, mostly in low-elevations, were in general more tolerant to extreme temperatures and those occurring in mid-elevations had narrower ranges of thermal tolerance. The analysis applied is relevant since it relates limits of thermal tolerance and current patterns of species distribution in this genus. Temperature can be an important environmental factor that combined with other biotic components may explain current species diversity and distribution in the Caribbean. In addition, the study is pertinent in the context of climate change and species resilience for adaptation to short-term temperature spikes.



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## The effects of disturbance on leks of the White-bearded Manakin, *Manacus manacus*, in the Arima Valley, Trinidad

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White-bearded Manakins, *Manacus manacus*, have been studied extensively in the past in the Arima Valley, Trinidad (10° 43' N, 61° 18' W). None of these studies, however, has considered in detail the effects of disturbance on White-bearded Manakin leks, where males gather to display and attract females. The Arima Valley has become more disturbed in recent years with a growing population, the presence of four quarry sites and a successful ecotourism industry, all of which could potentially impact lek activity. For this study, historical lek sites, first studied in the 1950s and 1970s, were visited and observed to determine whether they were still active. The number of displaying males and the number of courts, bare patches of ground cleared as part of the males' display, were recorded and compared with historical data to determine if active leks had changed in size. In mid-January 2019, a White-bearded Manakin lek at a popular ecotourism site, the Asa Wright Nature Centre, and leks at two less-frequently visited sites in the Arima Valley were subsequently observed for a period of one week for manakin activity. Onsite observations were made by a group of two or three persons at the lek counting the number of manakin calls and bill snaps heard for a period of one hour during the morning, mid-day and afternoon. Sound recorders were set up at each lek site to record manakin activity while the group was at the site and hour before they got there. Lek activity with and without observers was compared using ANOVAs in the R statistical software. In addition, long-term size and retention was contrasted alongside distance to active quarries. There was evidence of reduced lek activity at leks which were still active and a number of leks were no longer active. One lek was discovered which was not recorded in previous studies. One active lek was located within 300m of an active quarry suggesting that, at least in the medium term, leks can remain active despite significant quarry disturbance. There was some evidence of a negative effect of human presence on lek activity, which could inform the planning of tourist activities close to known leks and, in particular, lek-viewing tourist activities.



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## Freshwater fishes and water resources of the larger Caribbean Islands: problems and prospects

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Water is an indispensable resource for all lifeforms. Humans need clean water to drink, and so do all other organisms. Humans also use water for a large number of other purposes and one obvious result is conflict over usage models, especially when water is a limited resource. These conflicts are usually very complex and have many dimensions, ranging from ecological, to economic and socioeconomic, to political. As we all use water in some way, one important group is completely relying on natural water bodies: aquatic and riparian organisms. Much of my work is concerned with freshwater fishes, but they are really just a placeholder for all aquatic organisms. They illustrate a number of key problems we have with water as a resource worldwide, including the Caribbean. One is the already mentioned tension between different stakeholders over water usage and best practices. One concrete example is habitat alteration. This can be due to legal or illegal practices, like sand or gravel mining for building purposes. Many of these practices are not sustainable but highlight the important role of socioeconomics. Gravel and sand mining are often done locally by people who need an income. For them this may be a short-term practice, but the damage to the aquatic ecosystems is likely permanent. Another important issue is the presence of foreign and invasive species. While some invasive fishes have been introduced as a protein source, none of them are managed and some of them are extremely destructive to the local fauna, like the African catfish, *Clarias*. But these are only two examples of an apparently overwhelming avalanche of issues.

These important problems need solutions on all levels. We need to start with building knowledge and sharing it. Knowing more about Caribbean freshwater ecosystems is key. We can only protect what we understand. We need to train more local experts and empower citizens to be more involved and help us reach out to decision makers. And just like many problems are of global nature and have regional impacts, we need to cooperate regionally – across political and language barriers - and globally on working solutions. Let us create a win-win situation where everybody agrees that we all need clean water. Water is life!



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## Temporal dynamics of plant-frugivore networks in the tropical wet forests of Hispaniola: understanding the role of phenology in shaping community assembly

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Seed dispersal mutualisms play a critical role in structuring plant and animal communities in tropical forests. The relatively aseasonal climatic conditions in tropical environments favor year-round primary production and a variety of phenological patterns. The continuous turnover and abundance of different fruit resources across time and space drive movements and feeding behavior of avian consumers. Yet, how this spatiotemporal complexity shapes the plasticity (i.e. ‘rewiring’) of species interactions in mutualistic communities remains poorly understood in seed dispersal systems. To investigate the consequences of seasonal change on the composition of local communities and their interaction patterns, we monitored local communities at six private farms in the central Dominican Republic continuously over a full annual period. Specifically, we quantified the local abundance of all avian species and fleshy fruits by surveying along transect grids at each 25-ha study site on 21 visits. We sampled the attendance and feeding interactions of frugivorous birds through focal observations of all plant taxa encountered with ripe fruits on each visit. We recorded 6,092 frugivory interactions involving 45 avian species and 48 plant species. Weighted centrality analysis showed that mutualistic dependence of the plant community was highly skewed toward a core set of three endemic birds: *Dulus dominicus*, *Phaenicophilus palmarum*, and *Melanerpes striatus*. Fruit resources of disproportionate importance to avian frugivores included *Zanthoxylum elephantiasis*, *Trema micrantha*, *Clusia rosea*, *Cecropia schreberiana*, *Petitia domingensis*, and *Roystonea hispaniolana*. The composition of networks was strongly driven by the local abundance of resource and consumer taxa, which were highly heterogenous across the study region. Moreover, by explicitly accounting for the temporal changes in bird and fruit resource abundance at the local scale, we determined that the period over which birds and ripe fruits are present in the system correlated positively with the number of mutualist partners. Our results demonstrate the importance of phenology in determining species role within plant-frugivore networks and reveal new insights into the dynamic reassembly of plant-frugivore communities across seasons that could inform future habitat restoration strategies.



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## The role of bat movement in viral translocation within the Caribbean

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Bats are the second largest species-rich mammalian order and have an essential ecological role in seed dispersal and pollination. There are about 130 bat species representing 10 families distributed throughout the Caribbean islands, with the greatest species diversity seen in Trinidad due to the close association with the South American mainland. Bats are recognized as reservoirs for several important zoonotic viruses and are increasingly implicated in the transmission of viruses that cross species barriers and emerge in human, domestic animal and other wildlife populations. Anthropogenic factors involving infringement on bat habitats increase animal-human contact and thus the risk of emergence of zoonotic viruses in human populations. Vampire bats (*Desmodus rotundus*), on account of their hematophagous nature, are efficient vectors for viral transmission, as seen with the rabies virus (RABV). Our previous studies showed that *Desmodus* variant viruses are responsible for rabies outbreaks in Trinidad and provided phylogenetic evidence for RABV importation from the South American mainland on at least three occasions between 1972 and 2010. We proposed that this was via infected bats flying from the South American mainland, and therefore examined the population dynamics and mainland-island movement of the *D. rotundus* bat. Genetic diversity and gene flow between *D. rotundus* populations from Trinidad and neighboring South American countries were investigated using nuclear and mitochondrial genetic markers. Results indicate two distinct population groups of bats in Trinidad, each closely related to mainland bat populations with varying levels of admixture. One way gene flow from the mainland to the island was demonstrated and supported the role of these bats in the translocation of rabies viruses between South America and Trinidad. Furthermore, results of serosurveys conducted in Trinidad and Grenada revealed high prevalence of rabies virus antibodies among *Artibeus* species bats. The latter are widely distributed throughout the Caribbean so this may have implications for the presence or introduction of rabies virus into other islands historically thought to be rabies-free.



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## Improving coastal ecosystem resilience to climate change in Anguilla

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In 2017, Anguilla experienced the worst hurricane in recorded history. While most of the catastrophic damage associated with hurricane Irma was to infrastructure, many of Anguilla's coastal ecosystems were significantly affected, with those already degraded due to human activities faring the worst. Studies indicate that intense hurricanes that were once expected every hundred years are predicted to occur more frequently; as ocean temperatures rise, hurricanes are expected to move more slowly and storm events will change with more rain, leading to increased flooding, erosion and wind damage. Anguilla's coastal ecosystems and natural capital play a significant role in limiting damage caused by climate-change induced weather events and predicted sea-level rise while also protecting coastal infrastructure. Previous modelling work in Anguilla has identified key coastal areas at risk and identified opportunities to maximise impact of mitigation action. Building on this work, we present on a new three-year project that will identify priority sites for restoration and re-establish degraded coastal ecosystems in Anguilla through government and community driven action.



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## Evolution of morphological traits in the White-Breasted Thrasher *Ramphocinclus brachyurus brachyurus*

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The White-breasted thrasher *Ramphocinclus brachyurus* is an endemic Mimid of Martinique and St-Lucia. Classified as 'Endangered' on the IUCN red list, relatively little information is available about Martinican subspecies (*Ramphocinclus brachyurus brachyurus*) compared to its St Lucian counterpart. Indeed, only two dated scientific descriptions including morphological measures exist, the more recent one being from 1989.

In this study, we update the description of *R.b.brachyurus* and we compare historical values of morphological measures with recently collected data. Historical data available corresponds to measures of wing, tail and tarsus lengths performed by Vieillot (1818) and with measures of wing, tail and tarsus lengths and also culmen's size and nostril length for males and females *R.b.brachyurus* performed by Storer (1989). recent data corresponds with all data gathered in Martinique on this species by ornithologists since 1994.

We examined the whole set of morphological characters using several statistical analysis such as Multivariate Analysis of Variance including the effect of year, sex, study site and their interaction and to complete our analysis, we computed scaled mass indexes of body condition (SMI). There was no significant difference in mean values between the two 'historical' datasets. However, we found differences between Storer's data and ours. Actually, the statistical analysis showed no differences for all measured traits except for wing and tail lengths between data collected in 1989 and ours. On those traits decisive for flight function, we discuss of potential reasons such as resource availability or specificity in the mating system that would have led to that changes.

This study is part of a more global research project named 'the DiSC project' which is under the collaboration between the French national center for scientific research (C.N.R.S) and the Parc naturel régional de la Martinique (P.N.M.). This project aims at contributing to obtain data that will be of importance for the establishment of conservation plans.



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## Population structure and abundance of *Limia zonata* (Cyprinodontiformes: Poeciliinae) in the Maimón river, Dominican Republic

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The population structure and relative abundance of the endemic livebearer, *Limia zonata* (Nichols, 1915) was studied in four locations in the Maimón River, Monseñor Nouel province, Dominican Republic. The sex and adult-juvenile ratio was calculated for all sampled localities. It was found that the sex ratio of *L. zonata* was significantly different from 1: 1 and is biased towards females. Juvenile fish were more abundant and frequent than adults (69.3%). More than 800 fish were measured and weighed to analyze the frequency of size classes, morphometry and body condition. Ten size classes were distinguished that vary in frequency according to sex. Total length of the specimens ranged from 6.50 to 65.69 mm, while weight varied between 0.004 and 3.941 g. The morphology varied between sexes and a pronounced sexual dimorphism was found. All the morphometric variables studied showed a high level of association ( $r$ ). The relative abundance of the analyzed species was estimated, by location and for the entire study area. *L. zonata* is a dominant and abundant species, in relation to the abundance of the others in the Maimón river (69.7%). Along with *L. zonata* other 10 species were identified, of which 64% (7) were of the family Poeciliidae. Emphasis is placed on the high diversity of exotic species reported in the study area.



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## Abundance, distribution, and growth of the excavating sponge *Cliona delitrix* on Barbados' south and west coasts

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Coral reef framework is being constantly eroded by physical and biological processes. Excavating sponges are among the most important bioeroders on Caribbean reefs and are of increasing concern as reefs continue to degrade. In this study, we sought to shed light on the population dynamics of the aggressive excavating sponge, *Cliona delitrix*, on Barbados' reefs. Surveys were conducted at six sites (>5km apart) selected to span the island's south and west coasts. At each site, six permanent 25m<sup>2</sup> quadrats were established and surveyed approximately every 5 months over a 26-month period. Surveys included measuring the surface area and depth of substrate excavation of each *C. delitrix* outcrop and identifying the coral species colonized. The potential role of anthropogenic nutrient inputs along the coasts as a driver of sponge growth was investigated using stable isotopes obtained from *C. delitrix* tissue. Additionally, the relationship between lateral surface growth and vertical growth into the substrate was specifically examined experimentally on limestone blocks (n=50) and *in situ* (n=60). On the blocks, the volume excavated by each sponge sample was measured at the end of the growth period. A total of 1019 outcrops were recorded during the study. There was considerable among-site variability in *C. delitrix* outcrop abundance (range: 93–217 outcrops per site), lateral growth rates (0.3–8.3cm<sup>2</sup>/year), outcrop surface area (1–600cm<sup>2</sup> per outcrop), and growth into the substrate (0.5–12cm), but preliminary analysis shows no consistent differences in these metrics between the south and west coasts. Specific *in situ* and experimental sponge growth showed considerable variation but was generally consistent between reefs, with south coast sites exhibiting the highest lateral growth (5-13cm<sup>2</sup>/year). Among-site variation in these metrics was not related to the sponge nitrogen stable isotope signatures, suggesting that land-based nutrients play a minor role in variation in growth. *C. delitrix* colonized ten coral species; the coral *Siderastrea siderea* was most commonly colonized, at a level disproportionate to its relative abundance. At sites <10m in depth, *C. delitrix* was predominantly found on live coral, while at deeper sites it was mainly found on dead coral substrate, suggesting that it kills corals more quickly at greater depths. These data provide the first large scale picture of *C. delitrix* population dynamics and quantification of excavation rates on Barbados' reefs.



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## Behavioural variation in a Cuban lizard in suburban environments

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Can native species face the environmental changes caused by urbanization? This is a particularly pressing question for the conservation of fauna in small territories with growing urbanization, such as the Caribbean islands. One way to respond rapidly to the selective pressure caused by urbanization is through behavioural adaptation. Tolerance to humans and exotic predators -more abundant in the city- is the first expected change in the behaviour of urban populations.

Our study aims at comparing suburban and forest populations of the Cuban endemic lizard *Anolis homolechis*, in terms of their tolerance to humans. For more than one year, we compiled direct observations and videos of individually-banded lizards in two suburban cities and two natural reserves of Western Cuba. We recorded behaviour during capture for the identification of individuals, flight initiation distance, and movements during filming. Based on multiple observations on the same individuals, we investigated to what extent individuals are consistent in tolerance to humans, and whether, overall, suburban populations are more tolerant to humans. This is the first time that inter-individual variation in behaviour is assessed in this species.



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## Conserve the Cuban corals for the world

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The world's coral reefs are severely affected by the effects of climate change and local human impacts. During the last three decades, the world lost 50% of its reefs. The combination of local pressures such as overfishing, pollution and the unsustainable development of coastal areas, combined with the rapid increase in ocean temperatures caused by climate change, led to bleaching and high mortality of corals in the world. Global bleaching events are becoming more frequent and they are expected to increase. The series of three bleaching events that took place between the years 2015-2017 awakened coastal communities, scientists, politicians and the conservation sector, convincing them of the seriousness of the situation. Scientists predict that by the year 2050, globally 90% of corals will be lost. This will be a catastrophe for the coastal communities that depend on them.

Research prevails that part of the Cuban corals is within the 10% with greater resistance; those are in a better state of conservation, with a greater resilience to the effects of climate change. In addition, their location allows them to function as a source of repopulation for the entire Caribbean, once the climate stabilizes.

Consequently, conserving Cuba's corals is of global importance. At the same time, the Cuban government is very aware of the effects Climate change will have on the island; especially sea level rising and an increase in hurricanes will affect the coastal area severely. In the national law *Tarea Vida* (Life work), protecting coral reefs is one of the main solutions presented: reefs function as wave breaker, and together with mangroves and beaches will protect the coastal communities.

WWF has been working in Cuba for 30 years, conserving together with the government and other NGOs the Cuban nature, with all its importance for Cubans via their ecosystem services. We are willing to help the country in its challenge to conserve corals for the well-being of all, seeking a balance between economy and ecology, satisfying the needs of its people in a sustainable manner.

Conserving Cuba's coral reefs requires collaboration among many actors: political, non-governmental and private sector; technicians in the field of ecology as well as in sociology and economics, and coastal communities, which depend directly on coral reefs. WWF wants to support those actors to achieve our shared goal: the conservation of resilient and connected Cuban coral reefs.





The probable main angles of action will be the following. Cuba has declared 27% of the coastal area as Marine Protected Areas, but their management needs more attention to really safeguard its treasures, including water quality issues. Overfishing is the main threat, so better fishing practices and alternative livelihoods will be part of the solution. At the same time, tourism represents both a big threat as an important solution opportunity.

Let's protect the Cuban reefs, for world's sake. Let's do this in a giant, shared effort. Together possible.





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## Improving small island resilience and self-sufficiency in habitat monitoring and management

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The 2017 hurricane season was the worst on record in the Caribbean, with a Category 4 and Category 5 hurricane hitting the British Virgin Islands (BVI) in September, and severe flooding earlier in the season. Climate change models predict that the intensity and frequency of tropical storms will increase. While increasing the resilience of infrastructure and economies to the effects of severe weather is forefront in the policy makers mind, the benefits of healthy ecosystems in terms of improving the resilience of islands to the effects of storms is often overlooked. Here we report on a project that aims to fill this gap, focusing on the small inhabited island of Jost Van Dyke, and its surrounding offshore cays, which are the location of several marine and terrestrial reserves. We report on the resiliency assessments of key coastal habitats to extreme weather and on the development of community led conservation management actions to increase the resilience of these habitats.



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