



CARIBBEAN NETHERLANDS SCIENCE INSTITUTE

Book of Abstracts



**Opening Seminar Caribbean Netherlands Science Institute
24 – 25 April 2014 St Eustatius, Caribbean Netherlands**



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Programme

Thursday 24 April

08.00 – 09.00 Registration and Welcome

09.00 – 09.10 Carlyle Tearn (Commissioner) Opening

09.10 – 09.30 Mark Vermey (Caribbean Research and Management of Biodiversity) Healthy reefs disproportionately contribute to the reproductive success of Caribbean coral communities

09.30 – 09.50 Franciane Le Quellec (St-Barth's Environmental Agency) Sustainable fishing in the Northern Leeward Islands

09.50 – 10.10 Fionn Farrell (Ross University-School of Veterinary Medicine. Conservation Medicine and Ecosystem Health Research Centre St Kitts) Past, Present and Future Research (with a focus on the field of Marine Biology and Fish Diseases)

10.10 – 10.30 Brigitte Delaitre (Réserve Nationale Naturelle de Saint-Martin) Reserve of St Martin: Management and Project

10.30 – 10.50 Break

10.50 – 11.00 Han Lindeboon (Institute of Marine Resources and Ecosystem Studies, Wageningen University and Research Centre)

11.00 – 11.20 Diana Slijkerman (Institute of Marine Resources and Ecosystem Studies, Wageningen University and Research Centre) Triple P@ sea: Small tropical island solutions – A research program of Wageningen UR related to Statia

11.20 – 11.40 Joost van den Burg (Plant Research International, Wageningen University and Research Centre) Green Statia: going for a balanced partnership between agriculture and nature

11.40 – 12.00 Pieter van Beukering (Vrije Universiteit Amsterdam) The Green Economy of the Caribbean Netherlands

12.00 – 12.20 René Henkens (Alterra, Wageningen University and Research Centre) Towards a Tourism Master Plan for Statia

12.30 – 13.45 Lunch (Lynch plantation)

- 14.00 – 14.10 Edwin van Huis** (Naturalis Biodiversity Centre)
- 14.10 – 14.30 John de Freitas** (Caribbean Research and Management of Biodiversity) Landscape ecological vegetation map of St. Eustatius
- 14.30 – 14.50 Hannah Madden** (St Eustatius National Parks) Small Island Biodiversity Monitoring: Priorities, Progress and Perspiration
- 14.50 – 15.10 Steve Piontek** (St Eustatius National Parks) Creating a Dialogue between Researchers and Protected Area Managers
- 15.10 – 15.30 Break**
- 15.30 – 15.40 Henk Brinkhuis** (NIOZ Royal Netherlands Institute for Sea Research)
- 15.40 – 16.00 Christopher Butler** (NUSTAR) St. Eustatius and NuStar, A collaborative Approach Operating for Over 30 years
- 16.00 – 16.20 Gay Soutekouw** (St Eustatius Caribbean Archaeology Research) The history of St Eustatius
- 16.20 – 16.50 Glenn Faires** (Golden Rock Dive Center) The rich diversity of Statia's waters
- 16.50 – 17.20 STENAPA Junior Rangers**
- 17.20 – 17.50 Schools of Statia**
- 18.00 OPENING**
- Henk Brinkhuis** (Director NIOZ)
- Edwin van Huis** (Director Naturalis Biodiversity Centre / Naturalis Caribbean)
- Corinne Hofman** (Chairman CNSI Steering Group)
- Father Raffy** (St Eustatius Catholic Church)
- Gerald Berkel** (Island Governor St Eustatius) **TBC**
- 18.30 Dinner**
- Willem Mouissie** (Mouissie Corporation) Marine Life promo loop

Friday 25 April

- 13.00 – 13.10** **Siem Dijkshoorn** (Economy and Infrastructure St Eustatius)
- 13.10 – 13.30** **Teresa Leslie** (Eastern Caribbean Public Health Foundation) Using Science to Improve Caribbean Public Health: The case of Arboviruses
- 13.30 – 13.50** **Indra Firmansyah** (Environmental Technology, Wageningen University) Reuse of Recovered Resources (water and nutrients) from domestic waste(water) in agriculture; Case Study: St. Eustatius
- 13.50 – 14.10** **Corinne Hofman** (Leiden University) Where nature and culture meet: major topics in pre-colonial and early colonial archaeology
- 14.10 – 14.30** **Menno Hoogland** (Leiden University) Seasonality and archipelagic resource mobility in the northern Lesser Antilles: a view from Saba
- 14.30 – 14.50** **Ruud Stelten** (SECAR and Leiden University) Historic St. Eustatius, Connecting People, Goods and Ideas
- 14.50 – 15.10** **Tjeerd van Weering** (NIOZ Royal Netherlands Institute for Sea Research) Marine geology
- 15.10 – 15.30** **Break**
- 15.30 – 15.40** **Corinne Hofman** (Leiden University)
- 15.40 – 16.00** **John Marks** (Netherlands National Commission for UNESCO) UNESCO, the Caribbean, the Caribbean Netherlands and the CNSI
- 16.00 – 16.20** **Carlyle Tarr** (Commissioner St Eustatius)
- 16.20 – 17.00** **Discussions**
- 17.00 – 18.00** **Closure and Drinks**



Healthy reefs disproportionately contribute to the reproductive success of Caribbean coral communities

Mark Vermeij, KL Marhaver, AH Hartmann

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Protecting coral reefs is dependent upon the preservation of existing populations and the success of future generations of corals. Marine protected areas can facilitate both by preserving robust populations and healthy individuals, a tool often employed with fishes and invertebrates in mind. We determined whether similar benefits of protection occur in corals. Specifically, we predicted that corals living on quasi-pristine reefs would be more energetically robust and reproductively active than conspecifics in degraded areas. In three of four species, we found that individuals in a quasi-pristine region indeed contained higher amounts of lipids critical for energy and reproduction. In two of three brooding species, fecundity was 350% and 200% higher in this region as well. Fecundity patterns were related to parental characters such as colony size and energy content, while the source of variation in larval size and per larva energy content was more difficult to constrain. We found that species-specific differences in larval lipid content, buoyancy, and fecundity revealed dramatic differences among three coral species with apparently similar life histories. Our results suggest highly-functioning reefs can be disproportionately important sources of coral offspring as a result of larger population sizes and the greater reproductive output of energetically robust individuals.

Sustainable fishing in the Northern Leeward Islands

Franciane Le Quellec

Director of St-Barth's Environmental Agency

The Northern Leeward Islands region gathers on a small maritime surface half a dozen States with as many different legislations on the same marine species. Our fishermen as marine species do not know borders and it is thus quite naturally that Saint Barthélemy wished to organize a meeting between all the actors to define a common strategy for the protection of the marine resources, the economy of fishing and more generally our territories. This new initiative showed itself surprising in term of motivation of all the participants, the quality of the debates and which is doubtless the beginning of an eagerly awaited strong and constructive collaboration.

Several ideas were given, in particular a coherent management of legislations on fish aggregating devices (FADs), harmonizing closing seasons for spiny lobsters and conch as well as the implementation of common scientific surveys. This event gave a great opportunity to fishermen and to administrations of all the islands to communicate and to create links. Numerous scientists were present and presented their works on all the islands, what gave an invaluable perspective on the current situation and allowed to feed the debates with concrete data. The Réserve Naturelle of Saint Barthélemy also organized one day for the marine mammals AGOA sanctuary in preliminary of the symposium. The objective was to present this French initiative for the protection of marine mammals to the nearby islands and to convince those who are not still a member of it to join the AGOA sanctuary and to include their own waters there. An opportunity also for the Réserve Naturelle of Saint Barthélemy to thank all volunteers who report 99 % of the observations of humpback whales and dolphins around the island and who participate so actively in the protection of marine mammals.

Ross University's Center for Conservation Medicine and Ecosystem Health, Past, Present and Future Research (with a focus on the field of Marine Biology and Fish Diseases)

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At the core of Ross University School of Veterinary Medicine's mission is our commitment to research. Since the school's inception in 1982, some level of research has always been undertaken at Ross. However in 2012 Ross underwent a research revolution and 4 centers of research were created in order to restructure and better utilize both the facilities available and the faculty's expertise. These four centers were "One Health Center for Zoonoses and Tropical Veterinary Medicine", "Integrative Mammalian Research", "Research and Innovation in Veterinary and Medical Education" and "Conservation Medicine and Ecosystem Health".

The Center of Conservation Medicine and Ecosystem Health focuses on how environmental factors interact with infectious diseases as an increasing threat to agriculture, public health and endangered/threatened species, on a global basis. The Center focuses upon applied research, educational outreach and training and developing best practices for surveying and managing the health of populations, communities, and ecosystems. Collaborations with veterinarians, ecologists, wildlife biologists, physicians, conservationists, and other professionals play a critical role in setting priorities and providing novel solutions to complex ecological issues.

The center's ongoing research spans both terrestrial and marine environments. The ongoing marine program includes researching infectious diseases in both wild fish populations and aquaculture and the development of vaccines, reef monitoring and sea urchin ecology and provides support to a turtle monitoring program (local NGO).

Triple P@ sea: Small tropical island solutions – A research program of Wageningen UR related to Statia

Dr. Diana Slijkerman

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TripleP@Sea is a 4-year Wageningen UR research programme conducting multidisciplinary research in various research themes and 7 PhD projects, all related to a “triple P concept” of People–Planet-Profit. The objective of this research programme is to provide Small Tropical Island Solutions (toolbox) for a set of typical challenges (both environmental and socio-economic) related to small tropical island coastal communities to support sustainable exploitation of ecosystem services, in combination with a suitable governance structure. St. Eustatius aims for economic development while at the same time preservation and development of its ecosystems. The focus in our programme is on identifying the challenges and formulate actual solutions for St. Eustatius related to:

- Sustainable use of biodiversity and related ecosystem (services) by
 - Sustainable nutrient cycling and prevention of erosion combined with food production (horticulture, reforestation and mariculture)
 - Sustainable tourism
 - Sustainable land use scenario's
 - Sustainable (renewable) energy provision (including impacts)
- Governance of ecosystem services
- Education (via CNSI, WUR and VHL)

In 2012-2013 research was conducted on habitats of Statia, horticulture possibilities, impact assessments, land use scenario's and governance aspects of ecosystem services. Highlights are presented. In 2014-2015 the application of gained knowledge in mentioned topics is our focus and we will elaborate on a selection of topics (horticulture/green Statia, tourism, nutrient cycling, impact, land use scenario's).

Green Statia: going for a balanced partnership between agriculture and nature

Joost van der Burg* and Bert Smit

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Statia was a green island in pre-Colombian times, but due to deforestations for sugar cane growing, charcoal production, housing, and shipbuilding, very few forests remain. At present the most serious factors hindering natural vegetation recovery are grazing by roaming livestock and the overgrowth of fiercely competitive invasive alien plants.

A degraded vegetation and forest cover can even have negative effects on surrounding marine ecosystems. For instance, runoff (and aerial erosion) of nutrients and dust can damage the surrounding coral, by stimulating algal growth and smothering the coral polyps with silt. Conversely, lack of vegetation increases ecosystem vulnerability to salt spray originating from the sea as it can stress both vegetation and planted crops.

A greener Statia can only be achieved by long-term spatial planning, including a careful choice of species and planting methods, a combination of windbreaks and forests. In certain areas this could be enhanced by contouring and terracing to retain the natural precipitation and to restrict erosion.

(Re)introduction of native species involves knowledge on how to collect, store and germinate seeds, how to prepare them for planting out in the field, how to protect them from adverse environmental conditions, and how to protect them from roaming animals, insects and pests.

The end-result should be a dynamic but stable ecosystem that will contain many if not only native species of plants, birds, mammals and other animals. An ecosystem that protects the island from further degradation and at the same time will attract visitors.

Potential benefits of forests:

- Diversification of vegetation and new or restored niches for native plants and animals;
- Possibilities for non-timber forest products, but also high value tropical hardwood timber for selected purposes (e.g. mahogany and West-Indian satinwood);
- Attract foreign investment for forest development towards CO2 compensation;
- Reducing the effects of salt spray near the coast;
- Increase possibilities for nature tourism and employment;
- Water retention and reduction of runoff and aerial dust;
- More water available for the vegetation itself;
- More infiltration into the ground, replenishing the water table and lowering its salinity;
- Reduction of daytime temperatures;
- Providing wind shelters for rare species to recover;
- Creates its own rains;
- Shortens the dry period.

The Green Economy of the Caribbean Netherlands

Pieter van Beukering

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Ongoing developmental pressures in a context of global environmental change and economic liberalization challenge the physical and economic security of the islands of the Caribbean Netherlands. These challenges require an integrated, multi-scale research approach which supports the development of a strong green economy of the islands. In the period 2012-2014, The Economics of Ecosystems and Biodiversity for the Netherlands (TEEB-NL) program supported multidisciplinary research in Bonaire, St Eustatius and Saba to study the economics of nature in the Caribbean Netherlands. The study convincingly shows the strong link between the economy and the environment in the Caribbean Netherlands and therefore generates relevant information for supporting green economic development of the islands in different ways.

First, the research incorporates terrestrial as well as marine ecosystems taking into account the interlinkages between both environments. An ecological-economic simulation model was constructed for each of the three islands to explore the efficiency of various environmental management options. Among others, the study finds that measures in the terrestrial domain have substantial impacts on the economy depending on marine ecosystems.

Second, the study values nature through the perspective of various stakeholders such as local residents, visitors, tourist industry and residents in the Netherlands' mainland. More than 1500 local individuals and 2000 Dutch respondents were interviewed to learn about their relationship with nature and extract information about their willingness to pay for nature management on the islands. Among others, the study concludes that the benefits of nature in the Caribbean Netherlands are not only enjoyed by local stakeholders but also to a large extent by citizens in the mainland of the Netherlands.

Third, the study captures the spatial variation of the value of nature on the Caribbean Netherlands by constructing nature value maps of the three islands. Value maps identify the ecosystem hotspots, representing the locations which have the highest added value per unit of area in the marine and terrestrial domain, assisting decision makers in allocating the scarce nature budget to priority areas on the islands. The maps show that the per-unit-of-area values differ between the islands, yet overall it can be concluded that the value of marine ecosystems exceeds that of terrestrial ecosystems.

After presenting the main findings of the TEEB-NL study and comparing the results between the three islands, we will explore how these findings facilitate the exploration of the challenge of further developing the green economy of the Caribbean Netherlands. Moreover, we will demonstrate that by incorporating tools from various sciences (i.e. ecology, geography, economics, governance) and addressing the islands' challenges in an integrated manner, the TEEB-NL study is an excellent example of interdisciplinary research thereby supporting the objectives of the Caribbean Netherlands Science Institute (CNSI) and the NWO program "Caribbean research: a multi-disciplinary approach".

Towards a Tourism Master Plan for Statia

Ir. René Henkens

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Statia is often referred to as the Caribbean's Hidden Treasure for its impressive landscape values, its rare biodiversity and rich cultural history, both above and under water. To date tourism development is still limited but, according to the Sint Eustatius Strategic Development Plan (2010), it will become the main economic driver. Statia is small and fragile however. Conservation and careful management of key qualities and tourism flows in proportion to the islands capacity are a must. Many ideas for tourism development exist and the future direction requests a participatory approach with all stakeholder(group)s involved.

Wageningen UR applies the Landscape-based Approach for small islands like Statia. This approach clarifies the consequences of possible (local) choices and imagines future situations. It not only provides spatial solutions and visualizes them on different scales, but it also creates public awareness and local support for sustainable tourism development. The outcomes of the approach will be laid down in a tourism master plan.

The project "Towards a Tourism Master Plan for Statia" will start in 2014. It is part of and builds on prior output of the TripleP@Sea research program. A team of Wageningen UR scientists and students, with a different disciplinary background, will cooperate within the project.

Landscape ecological vegetation map of St. Eustatius

John de Freitas*, A.C. Rojer, B.S.J. Nijhof and A.O. Debrot

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In this study a semi-detailed landscape-based vegetation map (scale: 1: 37,500) based on field data from 1999 is presented. This is the first quantitative study of the vegetation of the island since Stoffers' 1956 map of the island.

Color aerial photographs (1: 8,000) taken in 1991 and field data from 1999 were used to produce the map. A total of 84 vegetation sample plots were analysed using a stratified random sampling design and TWINSpan cluster analysis.

Four main and 16 sub-landscape types were distinguished on the basis of geology, geomorphology and different mixes and expressions of the component vegetation types.

Analysis of the sampling data resulted in the distinction of 13 (semi-)natural vegetation types. The three principal vegetation types were, the *Pisonia-Justicia* type, *Pisonia-Ayenia* type and *Bothriochloa-Bouteloua* type which together accounted for 38 % of total (semi-)natural vegetation cover. The following well-developed vegetation types of St. Eustatius represent primary climax communities: Types 1, 2, 3, 5 and 7, all found in and around the Quill in the southwestern part of the island. A comparison of the vegetation types in the present study with those of STOFFERS (1956) showed that only one vegetation type closely resembles one in STOFFERS' study.

Noticeable is the absence in the present study of vegetation types comparable to the valuable elfin woodland vegetation on the rim of the Quill crater and the 'Montane thickets' (Stoffers' study). We speculate that these losses may be most directly attributable to the impact of recent hurricanes and/or grazing by introduced livestock. On the lower slopes of the Quill some regeneration has taken place (abandoned farmlands).

The vegetation of the Mountains area showed some recovery since the 1950s. There were more evergreen bushes, and less *Acacia* and *Leucaena* than Stoffers described. The vegetation Stoffers described for the lowlands had more *Acacia* than found in the present study, but the invasive *Antigonon* has since dramatically increased as an ubiquitous and often dominant species. The former importance of *Opuntia* prickly pear cacti in disturbed vegetations has dramatically declined since the 1950s. We ascribe this to the likely effect of the invasive parasitic insect *Cactoblastis cactorum* (in the 1980s and 1990s).

Our field data show that all wilderness areas of St. Eustatius remained heavily affected by grazers. This reduces the resilience of natural vegetations and interferes with natural succession by imparting heavy losses to hardwood seedlings and saplings, by reducing plant biomass (which increases exposure to wind and sun), and by favoring hardy invasive plant species. In Curacao, large scale reduction in densities of feral grazers in the Christoffelpark since 1993 has led to rapid recovery of several rare plant species and vegetation types. The problem of feral livestock remains severe. Therefore the number one priority for terrestrial conservation in St. Eustatius will be to reduce feral grazer densities and impacts in key wilderness areas.

Small Island Biodiversity Monitoring: Priorities, Progress and Perspiration

Hannah Madden

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St Eustatius, a 21 km² (8.1 sq. miles) island in the northern Leeward island chain, is biologically diverse and home to several endangered species and a variety of globally threatened ecosystems. We have been monitoring biodiversity for several years using surrogate and indicator species. Studies involve standardized and repeatable methods and focus on species composition, relative abundance, and some productivity estimates of terrestrial birds, orchids, butterflies and tropicbirds.

Bi-annual bird surveys include point count, observation and transect surveys across all island habitats. Bird species diversity is highest in town and the Botanical Garden. Bananaquits and Pearly-eyed Thrashers are the most common species. Two species of epiphytic orchid occur primarily in the Quill and Boven National Parks, and annual viability monitoring conducted since 2008 shows the populations have a 50% chance of survivorship due to herbivory by goats. Butterfly monitoring has been conducted annually since 2009 between January and April in four distinct habitats with correspondingly different species composition and abundance. Intensive monitoring of Red-billed Tropicbirds indicates relatively low hatching success (due to egg loss), but high fledging success in non-predated areas. A 2012 population survey of the lesser Antillean iguana shows numbers have declined since the last assessment in 2004. Ongoing flora specimen collections have resulted in the discovery of a new endemic species inside the crater of the Quill.

Overall, our preliminary findings indicate that due to the island's limited area and small species population, biodiversity could be vulnerable due to habitat loss, fragmentation and degradation.

Reserve of St Martin: Management and Project

Nicolas Maslach and Brigitte Delaitre

Conservateur/Directeur RNN de Saint-Martin, Représentant de l'Antenne du Conservatoire du Littoral. Tél 0590 29 09 72 Fax : 0590 29 09 72 Cell : 0690 38 77 71, nicolas.maslach@rnsn.org

Creating a Dialogue between Researchers and Protected Area Managers

Steve Piontek

Director of National Parks, St Eustatius National Parks Foundation, manager@statiapark.org

Discussing the threats to biodiversity on St Eustatius and how CNSI can assist with providing relevant scientific information and make the information useful, with advice on the topics and issues on which we most need information.

St. Eustatius and NuStar, A collaborative Approach Operating for Over 30 Years

Christopher Butler

General Manager, NuStar Terminals N.V., St. Eustatius, Dutch Caribbean

NuStar Terminals N.V. is one of the largest petroleum terminals in the Dutch Kingdom and has been in operation on the Island of St. Eustatius for in excess of 30 years. Over those 30 years, a lot of change has been seen in both the Island of St. Eustatius as well as the Terminal. The Terminal has undergone several major phases of improvement to its infrastructure over these years and with those improvements, additional beneficial opportunities have evolved for both the Island as well as the Terminal. In recent years, with the onset of the BES regulations to the Island, new challenges have faced both the Island as well as NuStar. This too has again shown where in by joining resources, both the Island and NuStar, in a unified collaborative approach, can successfully work together for a sustainable future and the benefit of all.

The history of St Eustatius

Gay Soutekouw

St Eustatius Caribbean Archaeology Research

A case for a reevaluation of our past historical identity.

Realizing that history is told from the point of view of the individuals telling the story and knowledge at the time, it is to be understood that at times it may not be accurate.

With the advent and advances in our technical abilities to gather information about historical events that have taken place on St. Eustatius, as well as research that has been conducted here over the last 30 years it is possible now to begin re-identifying our historical place in the events in our history. Statia's importance in trade throughout the Caribbean and her involvement in the American Revolutions has been told in a manner that we now know has been inaccurate and full of partial truths. It is time for us to rewrite that story, which is much more significant than was ever imagined. At the same time, efforts need to be made to gather as much of our past history back on this island so that future generations of Statians and others can appreciate its significance. To this end the CNSI, working with the cultural institutions and government, can be of tremendous help to raise awareness of Statia's past, present and future.

Statia's hidden beauty's

Mike Harterink

Owner Scubaqua, St Eustatius, mike@scubaqua.com

This little nutshell island in the Caribbean holds a unique flora and fauna for those willing to search for it, it's not piled up in a zoo. Climb up a cliff to look Tropic birds in their eyes or climb the Quill to meet our Monarch butterflies who don't migrate and why would they? To meet the hidden Statia beauty's you have to put a tank on your back and plunge into the protected marine park. In this presentation I take you down there and show why avid divers throughout the world come here to meet the specific and unique inhabitants of Statia's waters.

The rich diversity of Statia's waters

Glenn Faires

Golden Rock Dive Center, St Eustatius, grdivers@gmail.com

The diversity of marine structure, and life, as well as the fact that Statia's waters are home to a complete ecosystem from apex predators to the smallest creatures found in the region.

Predicting ARBO-viral threats in Sint Eustatius Using Geographic Information systems (GIS) and Remote sensing technology

Dr. Teresa Leslie¹, Narangerel Davaasuren² (MSc), Dr. Prof. Tinka Murk³

1 Eastern Caribbean Public Health Foundation, St. Eustatius, Caribbean Netherlands

2 Researcher, Remote sensing, Environmental sciences, Maritime department, IMARES Wageningen University, the Netherlands

3 Professor, official European Toxicologist, Environmental technology department, Wageningen University, the Netherlands

Evidence of ARBO-viral circulation has been documented in humans and other mammals in the Caribbean and Latin American Region. ARBO-viruses are unique in that they are transmitted by blood sucking vectors to vertebrate hosts, thus involving four essential components, virus, vector host, and environment. Over the past 40 years there has been a dramatic epidemic resurgence of a number of well known ARBO-viral diseases that were thought to be effectively controlled or unimportant (Gubler, 2002). For example, despite increased interest in dengue in recent years, the global distribution of dengue remains highly uncertain. Estimates for the population at risk range from 30% [1] to 54.7% [2] of the world's population (2.05–3.74 billion). Many of these ARBO viruses are, or have the potential to become emerging in the Caribbean region, having relevant impact for and on local health care systems in terms of care and prevention. As reported in December 2013, the presence of chikungunya virus (CHIKV) was confirmed in Sint Maarten and has been documented to have previously circulated in Sint Eustatius. Geographic Information Systems (GIS) and remote sensing tools can be used to accurately map disease areas and locate and detect the natural habitat of vectors. Using GIS, data can be stored, analyzed and visualized spatially (i.e. epidemiological data, land cover/land use, proximity to the roads, urban settlements, history of previous outbreaks, etc). High resolution satellite data can also assist in analyzing the present habitat of vectors and detect probable risk areas (such as swamps, stagnant water, waste/dumps, etc).

Reuse of recovered resources (water and nutrients) from domestic waste(water) in agriculture; Case Study: St. Eustatius

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Currently cities have a linear metabolism where the available resources, such as water or nutrients, are used once and discharged to the environment. To become sustainable this linear metabolism must be changed into a circular metabolism, where water and nutrients are as much as possible recovered and reused. Domestic waste and wastewater contains resources (water, nutrients, and organic matter) that can be used in agriculture to produce food and this increase (re-) use efficiency nutrients and water. While such circular systems are of importance for cities and their hinterlands globally, it is even more significant for small islands that have limited fresh water resources and need to import fertiliser and food. Three knowledge gaps for the implementation of circular urban resource systems will be tackled in this research: little integrated analysis of options for recovery and reuse, lack of investigations at a lower (e.g. functional) scale, and no considerations of uncertainty and development trends when developing planning strategies. In addressing these knowledge gaps the aim of this research is to develop a planning method to support development towards circular urban resource management systems. The study will take St. Eustatius as a case study to develop the method. As an initial step, a baseline assessment is carried out to assess current practice of water use and waste(water) management as well as agricultural production on Statia. A preliminary results of mass flow analysis of water and nutrients on the island, including City Blue Print (CBP) assessment will be presented.

Where nature and culture meets: major topics in Caribbean pre-colonial and early colonial archaeology

Corinne Hofman

Faculty of Archaeology, Leiden University

The earliest human occupation of the insular Caribbean dates back to 7000 BP when fisher-collector-gatherer communities from various parts of continental south and central America settled the islandscape. From upon their arrival in the archipelago Amerindian populations have been very active in exploiting and modifying their new environment and domesticating the landscape. They also intentionally or accidentally introduced plant and faunal species from the mainland which they integrated into their new insular world. On the other hand, indigenous Caribbean societies were confronted with major natural constraints such as sea level rise, climatic changes and catastrophic events like hurricanes, earthquakes and volcanic eruptions which called for creativity and continuous readjustment of their lifestyles.

This paper reviews major topics in Caribbean archaeology that have been broached by Leiden University over the past 30 years and in which the interplay between nature and culture is one of the overarching research themes.

Seasonality and archipelagic resource mobility in the northern Lesser Antilles: a view from Saba

Menno Hoogland

Faculty of Archaeology, Leiden University

The documentary Prehistoric Saba (Jimmy Mans, 2006) covers the archaeological excavations by Leiden University at the Archaic Age campsite of Plum Piece which dates back to 3500 years BP. The site is situated at an elevation of 400 amsl in the interior tropical forest of the island of Saba. The numerous grasses and fruit trees, the multiple plant materials for subsistence, manufacturing and construction and the presence of volcanic and tropical soils which are well suited to the growing of important cultigens make the location of Plum Piece very favorable. Main subsistence resources were the landcrab and the Audubon shearwater. Plum Piece has functioned alternately and complementarily with sites on other islands. It is not unlikely that the inhabitants maintained a yearly mobility cycle that took advantage of seasonality of biotic resources across the archipelago in those areas that could be targeted for non-subsistence activities: a form of archipelagic resource mobility in its broadest sense.

St. Eustatius, Connecting People, Goods and Ideas

Ruud Stelten, MA.

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For the past 4 centuries, St. Eustatius has played an important role in the Atlantic World. For an island so small and seemingly insignificant, it has had a profound impact on the history of the region. For example, it played a pivotal role in the formation of the United States of America. Connecting goods, people and ideas from around the world through time, St. Eustatius remains an important player in the global economic, political and social landscape.

The Marine Sciences; Modern technology and its applications

Prof. Dr Tjeerd C.E. van Weering

NIOZ Royal Netherlands Institute for Sea Research

Knowledge and understanding of the seas and oceans, their hydrography, seabed structure and composition, and biodiversity is crucial for a number of economic sectors such as fishing, shipping, (deep sea)mining, communication, pharmaceuticals and not in the least for the assessment of the driving factors and their variability governing global change and its effects.

Exploration of the oceans on a global scale developed in the second half of the 19th century with the voyage of the Challenger around the Globe and has ever since increased, driven by technological developments.

A number of techniques and their applications will be highlighted.

UNESCO, the Caribbean, the Caribbean Netherlands and the CNSI

John Marks

Netherlands National Commission for UNESCO

This presentation will very shortly give a general and concrete overview of what UNESCO and the National Commission for UNESCO do and then zoom in on what they both can mean to the Caribbean region and the Caribbean Netherlands in particular. The presentation will take a closer look at two UNESCO programmes: the UNESCO schools and the Man and Biosphere (MAB).



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