



**SANTO
2006**

The most important ever Scientific Expedition in the field of Natural Science

Project synopsis

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Abstract

SANTO 2006 is a scientific expedition to document the fauna and flora, both marine and non-marine, of the island of Espiritu Santo (or Santo), in the South Pacific. It is the largest in the archipelago which constitutes Vanuatu. Over 150 participants from 25 countries will be involved in the field-work, with a peak between August and December 2006. Capacity building and repatriation of information for sustainable development and environmental education are priorities for the project.

The land area of Santo and its marine fringes host a mosaic of habitats that have remained largely unexplored. Santo's complex ecological diversity and its geographical position within the archipelagos of Melanesia suggest a very high level of biological diversity. Much of its flora and fauna are still to be discovered, most notably in mega-diverse groups like insects and molluscs. Santo lies away from centres of economic growth, so that it has been spared the global standardization that is affecting much of the planet. Culturally and linguistically, Santo is also uniquely diverse.

This biodiversity survey will document all the major environments (offshore deep-sea, reefs, caves, freshwater bodies, mountains, forest canopies) and will address issues of the impact on biodiversity from 2,500 years of human habitation. The project will make use of an array of resources. Divers, speleologists, professional climbers, ethnologists and botanists will make use of excellent logistical facilities; research vessels, the Canopy Glider (see separate document), etc.



General background

Biodiversity crisis. A slogan for the media or a scientific reality?

As with climate change, the messages sent by biodiversity scientists may at times appear to be contradicting each other. On one hand, tropical regions are portrayed as phenomenal reservoirs of unknown species. On the other hand, the rate of extinction is reported to be higher in the tropics than in any other region of the world. The fact is that fundamental questions which will allow us to understand the magnitude, stakes, and consequences of biodiversity loss remain unanswered.

Two teams of scientists from institutes in France have acquired an international reputation in the implementation of large-scale biodiversity inventory projects. They are now merging their skills to address these questions in this project, which will study all biodiversity facets of this large island in the South Pacific.

The Principal Investigators of earlier comparable projects, Philippe Bouchet for marine biodiversity, Bruno Corbara and Olivier Pascal for tropical forest canopy, have previously mounted a significant number of expeditions with exciting results, both from a scientific perspective and in terms of media coverage. This project includes the investigation of subterranean environments, so French speleologists who have a tradition of organizing major, and difficult, expeditions are also involved.

This project brings together scientific personnel, the equipment and logistics necessary to carry out the research, an active relationship with the host country and media coverage throughout the world which will make this a major, emblematic contribution to a 21st century understanding of biodiversity.



What is this 21st century understanding?

- Biodiversity is considerably more diverse than we believed even 20 years ago. Millions of species remain to be discovered. At the same time, biodiversity loss has never been as high as it is today; it is likely that at least a quarter, maybe even one third, of all species will be extinct by the middle of the 21st century. Global change through habitat loss and climatic changes are responsible for this accelerated loss.
- Research, conservation, sustainable use, training and data repatriation are closely interconnected. Scientists from developed countries have a moral responsibility to involve scientists, students and managing technicians from developing countries. This objective is today greatly facilitated by better communications from extensive use of websites for the exchange of information.
- Biological diversity and Cultural diversity have much in common. Linguistic diversity is listed among the indicators selected in the Convention on Biological Diversity for monitoring the 2010 target for reduction in the loss of biodiversity.

Why Vanuatu, why Santo?



Island biological communities have fewer species and are simplified when compared to continental systems. This makes tropical islands especially suitable for the study of the composition of faunas and floras. Tropical islands have very high species diversity characteristic of tropical ecosystems, but are contained within limits imposed by the island geography. A representative, if not exhaustive, survey of a large tropical island is thus an ambitious but realistic goal, similar to the ATBI (All Taxa Biodiversity Inventory) currently under way in the Smoky Mountains of North America.

Geographical and ecological isolation are also driving forces of evolutionary and species-formation processes: islands are reservoirs rich in endemic biota. These are also microcosms threatened by the introduction of invasive aliens. Currently, 75% of modern extinctions listed by IUCN have affected island taxa.

Santo (or Espiritu Santo) is the largest island in Vanuatu: at 3,677 km², it is roughly the size of Cornwall, or half the size of Corsica, with as few as 30,000 inhabitants. Astonishingly, this small population supports around 40 separate languages. Santo is also the highest island in the archipelago, being straddled by a mountain range with four peaks above 1,700 m, including its summit, 1,879 m high Tabwemasana. The natural assets of Santo are best summarised by the bullet comment of the Lonely Planet country guide: "*Sparkling blue holes, unlogged rainforests and the world's largest accessible shipwreck*". Considering its size, relief, and geological age (Miocene), Santo is clearly under-surveyed and we expect to make numerous discoveries in all branches of biodiversity. The last botanical survey of Santo, in 1988, found 6 new orchid species alone. Vanuatu is ranked by BirdLife International as an "*Endemic Bird Area*" and, among invertebrates, levels of endemism range from an average of 30 to 50%, rising to 80% amongst land snails.

There are real and immediate threats to Santo's biodiversity. Among small island states threatened by global climate change, Vanuatu stands in the first ranks. Santo will have to face up to violent climatic events and drastic changes in rainfall patterns. The consequences on the fauna and flora are difficult to predict, but changes will certainly occur, most critically in the mountain forests.

The simultaneous collection of biological data in each of the major biotopes of Santo will serve as a baseline for future evaluation and monitoring of changes incurred at the regional level, and will offer a sensitive means of measuring climate change.

Scientific Programme

The scientific programme targets four main areas of activity, or themes, which will each include extensive sampling. A fifth theme will be ethnoscience, which will cut across the other four. The survey will include all the habitats of the island (deep offshore, coral reefs, continental and marine caves, lowland and highland forests, rivers).

The four areas of activity will all address the same underlying questions, which are central to the project: what is the real magnitude of biodiversity in the richest habitats and most diverse taxa; what proportion of rare species is found in species assemblages; what is the spatial distribution of biodiversity; and how do we evaluate how representative a site is on a scale of regional ecology?

Similar scientific questions to those asked by SANTO 2006 were at the core of two expeditions recently implemented by three of the project coordinators, PANGLAO in the Philippines (2004) and IBISCA in Panama (2003). PANGLAO was a detailed study of molluscs and crustaceans, while IBISCA (Inventory of Biodiversity of Insects of Soil and Canopy) was the most thorough survey of invertebrate biodiversity in a tropical forest; its patron is Harvard University's Professor E. O. Wilson.

Undoubtedly, new species will be discovered in all animal and plant groups, and discovering new species biodiversity is one of the project goals. This is a goal shared by many similar projects, but SANTO 2006 is innovative in the range of sampling techniques deployed and the size of the research group involved, both in the field and in the laboratory after the expedition.

The 2006 survey is intended to be used as a baseline to document medium- to long-term changes in fauna and flora. Future changes will affect native species, which will become increasingly rare and will eventually disappear, but also non-native species that have been, or will be, introduced and established. As far as possible, the 2006 baseline study will attempt to document what is there - the current composition of the fauna and flora - but also what is *not* there - potential exotic species not yet present in Santo.

Marine Biodiversity Theme



Coordination: Philippe Bouchet, Claude Payri, Bertrand Richer de Forges (50-60 participants)

Similar studies conducted earlier in New Caledonia (1993, 2000), Rapa (2002), and the Philippines (2004), have demonstrated the efficiency of an intensive survey at a single site. The study site for SANTO 2006 will be located in the vicinity of Luganville, where a mosaic of habitats ranging from estuarine mangrove to offshore deep-sea, through coral reefs, can be found. This theme will involve a shore-based group; a temporary laboratory will be set up at the Maritime College for sorting, observing, and preserving samples.

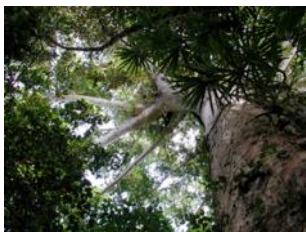
The French Research Institute for Development (IRD) Vessel *Alis* will be used to transport small groups to sampling stations each day. The theme will operate for ten weeks, of which four will focus on fish and algae, four will focus on small benthic invertebrates from near-shore and reef habitats (0-120 m), and the other two will focus on offshore communities (100-1000 m).



The Research Vessel ALIS

For the near-shore and reef environment, three methods will be run in parallel: (1) All-species inventory (45 participants); sampling will use a vacuum collector, brushing baskets, and visual collecting in the inter-tidal seabed and by diving; fish, algae, molluscs and decapod crustaceans will be the main target taxa; (2) Quantitative approach (3 participants); sampling will be based on grabs, plots and transects; (3) Rapid Assessment approach by conservation NGOs.

Theme : Forests, Mountains, Rivers



The Canopy-Glider



Coordination: Bruno Corbara & Jérôme Muzinger (40-50 participants)

Biological diversity lies not only between habitats, but also geographically. An adequate inventory of the fauna and flora on land has to find a compromise between rapid surveys of many sites and the thorough survey of one or a few sites.

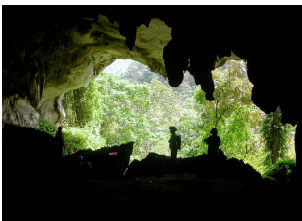
It is expected that the intensive survey of the marine invertebrates around Luganville will yield about 70% of the species present all around Santo. By contrast, a fish survey in the Jordan River would not yield more than 25 % of all endemic freshwater fish. The same applies to mountain plants, snails, or strandline invertebrates, the sampling of which requires many sites scattered all around the island. In particular the mountain range extending from Santo Peak and Mt Tabwemasana to the Cumberland Peninsula can only be properly sampled through trekking. In addition to terrestrial vertebrates and plants - the traditional focus of surveys for conservation purposes - the expedition will attempt as much as possible to cover more neglected areas of the biodiversity of tropical forests: fungi, algae, lichens, mosses, insects and other arthropods, molluscs, etc. Non-forest habitats will also be covered, e.g. freshwater fish and invertebrates, or terrestrial arthropods from coastal sandy beaches.

Intensive surveys will be focused on two or three sites, in the most pristine but least known mountain regions, covering an altitude gradient from lower slopes to stunted high montane forest (1,500-1,800 m). Large-scale canopy access systems (including the Canopy Glider) will be used to reach the tree tops to take a comprehensive sample of all the forest strata, from the soil fauna to the canopy. The main target taxa are insects, for which the strategy and research goals have been shown by IBISCA (2003-2005) in Panama to be relevant and adequate.

This is a logistically complex theme which will require 40 to 50 participants in the field. Base camps will be established for domestic and scientific facilities (for sorting, observing, and preserving the biota sampled, and also for extracting the soil fauna), and specific reconnaissance trips have highlighted three regions where we will focus our research effort: (1) the highlands of the volcanic mountain cluster of Tabwemasana-Santo, to be reached from the village of Kerepoa; (2) the region above the village of Penauru, which has a kauri forest probably unique in the South Pacific; (3) the Butmas - Tankara area in central

Santo, which has the best forest on limestone. As far as will be necessary, more superficial surveys (2-5 days tours) will be carried out elsewhere on East Santo, in particular Vathe Conservation area, the Sarakata river catchment, and on West Santo, in particular the limestone areas near Tasmate and the tip of Cape Cumberland.

Karst Theme



Coordination: Louis Deharveng & Anne-Marie Sémah (12 biologists participants; 6 non biologists)

Caves are well known to host very peculiar life forms, among others taxa that are relict from ancient climates. The geological age and isolation of Santo will favour a high level of endemism. Karstic environments are remarkable windows on paleoenvironments, both in caves (stalagmites and stalagmites, fillings) and at the surface (lacustrine or marsh doline-like basins), and record changes in habitat (vegetation cover, climate, soils) and testimonies of human occupation during the last millenia.

The eastern part of Santo is a massive karst dotted with cavities: caves, blue holes, and anchialine caves (at the contact between the freshwater lens and seawater). None of these cavities has been adequately surveyed by biologists. Reconnaissance surveys in August and October 2005 have gathered local knowledge of sites, evaluated the extent of cavities, and documented ownership and access.

During SANTO 2006, three subgroups will work in parallel. One will explore dry cavities and non-flooded networks, the second will dive the flooded networks and anchialine caves, and the third will sample sedimentary deposits through cuttings and coring. Surface soils and interstitial aquatic fauna will also be sampled to understand the pathways to colonizing the island's underground habitats.

Participants in the karst theme will for the most part be based at the VARTC facility near Luganville, and travel from there to field destinations on a daily basis. When necessary, light bivouacs will be installed closer to the field.

Fallows and Aliens Theme



Coordination: Michel de Garine, Michel Pascal (6-8 participants)

Anthropogenic environments (cultivated fields, fallows, roadsides, etc) are often neglected, or even despised, by naturalists, who tend to concentrate their sampling efforts on habitats as pristine as possible. However, accidentally or voluntarily introduced species settle first in disturbed habitats, where they build up populations before expanding towards less disturbed environments. If we want to be able to predict future changes in the biodiversity of Santo, our 2006 baseline must also consider the non-native species of fauna and flora.



The Fallows and Aliens theme will therefore inventory disturbed and anthropogenic habitats, to measure the load of aliens, including potentially invasive taxa already locally present. The genetic structure of local populations of selected species will be used to formulate hypotheses on their geographical origin and pathways to their introduction. Local and scientific knowledge will be used in combination to understand the ecological role and dynamics of such species in natural and modified ecosystems on Santo.

Two different areas in terms of human disturbances will be compared: one much impacted, the south-eastern part of Santo, near Luganville, where plantations and cattle ranches have been transforming the landscape for 100 years; the harbour and airport which are located in this area are also gateways to new introductions; and a less impacted area, probably Vathe Conservation Area, now a mosaic of natural and secondary vegetation types.

Cultural Diversity, Perception and Usages Cross Theme



Coordination: Florence Brunois (10 participants)

Knowledge of biodiversity does not come as a "revealed truth". For the local people, it is inherited orally from their fathers and forefathers and expanded through personal experience, with an emphasis on plants and animals that have an effect on the well-being and sustainability of the community. For non-resident scientists, knowledge of biodiversity is the result of a learning process through scientific literature and questioning of evolutionary processes, biogeographic patterns, and ecological processes; it typically involves brief periods in the field (a few weeks) followed by longer periods of time (months to years) comparing observations with the literature and reference collections. The success of conservation policies and management strategies depends on how successfully the two approaches can be blended. The challenge is that local residents and non-resident scientists do not speak the same language and have different education and cultural backgrounds. Local people may value animals or plants that feed them or have symbolic value, even if these species are not indigenous to Santo, while scientists may value a rare species endemic to Santo that is seldom seen even by local people. These differences in perspectives and perceptions will be addressed by visiting ethnologists in collaboration with



Vanuatu Cultural Centre's field-workers, who will be working with the thematic field groups.

The project will also document how knowledge of the biota of Santo in particular, and Vanuatu in general, has historically been acquired, either by individual collectors/travellers/residents or by programmed team work, and where the resulting collections are being held worldwide in museums, herbaria, and other research institutions. A relevant bibliography will be digitized and made available to the Vanuatu Government.

Facilities deployed

The facilities that we are providing for SANTO 2006 are unmatched in their scope. In terms of logistical facilities - the RV 'Alis', the Canopy-Glider - and human resources - besides scientists, we will be bringing divers, speleologists, and professional tree-climbers - in total over 150 participants.

Together, these will allow us to have a global approach to the fauna and flora, from coral reefs and offshore waters to the forest canopy, including terrestrial and marine caves as well as freshwater habitats.

The RV *ALIS* will be the central focus for inventories of marine biodiversity.

Its terrestrial counterpart, the Canopy-Glider, will be used to explore tree canopies and to facilitate sampling by the biologists on board.

Scientific accommodation for laboratory space, preliminary processing of the samples, communication, etc. will be provided by two Luganville-based institutes:

- Vanuatu Maritime College for the Marine Biodiversity theme;
- Vanuatu Agriculture Research and Training Centre (VARTC) for the Karst and Fallows and Aliens themes.

A base camp will be built near the village of Penaoru to be used as a technical base for the Canopy Glider and as a domestic and scientific base for the participants. A much lighter, bivouac-type facility will be established near 1,200m altitude to provide support for the scientists exploring the highlands above the village of Kerepoa.

Training, Capacity Building, and Data Repatriation

The SANTO Project will be a beacon for the ethical and political commitments of a developed country (France) to a country that was formerly a dependant territory (formerly New Hebrides condominium). The Convention on Biological Diversity sets the context for "benefit sharing" originating from knowledge of biodiversity, and the Convention's Global Taxonomic Initiative is an attempt to bridge the gap between species richness and intellectual resources in tropical developing countries.

During and after the field expedition, special attention will be given to training, capacity building and repatriation of information:

- *During the field expedition*, the project will involve community workers as well as other biodiversity officers from Vanuatu, technicians, Vanuatu Cultural Centre fieldworkers and students at all stages of the project, including field parties, data collection, and data analysis;
- *At the end of the expedition*, the project will set up in Vanuatu collections of biological specimens, in particular plants (Forest Dept), fish (Fisheries), fossil vertebrates (Cultural Centre), insects and other biota of quarantine interest (Quarantine).
- *After the expedition*, the project will sustain its commitment to the training of biodiversity officers from Vanuatu, technicians and students by facilitating their access to grants and training in institutions in France and New Caledonia.
- All research publications resulting from the project will be placed on a dedicated website, freely accessible and downloadable. Digital images of sites, animals and plants observed and/or collected during the project will be placed on the website. A selected bibliography of historical academic publications on the biodiversity of Santo will be digitised and made available on the website.

Education and outreach

The SANTO 2006 Biodiversity Project has a high education and media potential because its ambitious programme of scientific exploration is located on an island and country that are still a mystery to the rest of the world. Communication and outreach have several different audiences; we are targeting each one with a different approach.

- *Within Vanuatu*, we want to use the project to generate new education tools for those who teach natural history, ecology, and geography. Contacts have been made with the Institut de Formation des Enseignants du Vanuatu (IFEV) and the Centre de Recherche et Documentation Pédagogique (CRDP). We are evaluating the feasibility of producing a trilingual (French, English, Bichelamar) book to be published late in 2007, to bring the results of the expedition to the teachers of Vanuatu, as well as to the local general public.
- *Outside Vanuatu*, we will be using the know-how of Atom Productions, a Paris-based film producer and media agency. Atom Productions has already covered the Laperouse expeditions in Vanikoro and has experience in the production of high-quality TV and web-based products for the general public and for our sponsors. Pro-Natura will also liaise with Atom Productions to coordinate the coverage of the expedition by print magazines, news media and photographers.
- *The scientific community* has its own special requirements for specialist, long-lasting information. We will dedicate a special section of the SANTO 2006 website to post-expedition news, images of sites, animals and plants observed and/or collected during the project. We are also contemplating the publication of an accessible English-language book on "*The Natural History and Ecology of Santo*", which would be useful to ecotourists and armchair naturalists.

Institutions

The project was presented in March 2005 to the government of Vanuatu (Minister of Land, Geology and Mines; Vice-Prime Minister/Minister of Foreign Affairs; Minister of Finances; Minister of Agriculture; Minister of the Interior), to the authorities of SANMA (Santo/Malo) Province, and to various officers in charge of Environment, Fisheries, Forests, and Culture. A Letter of Intent has been exchanged with Paul Telukluk, then Minister of Lands, and this contact was confirmed in October 2005 with Willy Jimmy, the current Minister of Lands. A formal Memorandum of Understanding, the terms of which are being finalised at the time of writing, will guide the partnership between the foreign institutions and the Government of Vanuatu.

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Frontline Institutions

- Muséum National d'Histoire Naturelle (French National Museum of Natural History, Paris, MNHN)
- Institut de Recherche pour le Développement (French Institute for Research for Development, IRD, formerly ORSTOM)
- Pro-Natura International (PNI). PNI is the NGO which has organised Canopy Raft expeditions since 1996. Its goals are, among others, to promote the scientific study of tropical forest canopies.
- The Ministry of Lands of the Government of Vanuatu, acting as the umbrella for Vanuatu administrations and government units.

Overall Coordination

Philippe Bouchet, French National Museum of Natural History, Paris

Hervé Le Guyader, IRD, Paris

Olivier Pascal, Pro-Natura International, Paris

SANTO 2006 will be widely opened to the local and international scientific community. Geoff Boxshall (Natural History Museum, London) will co-ordinate access for caves; Peter Ng (National University of Singapore) and John Gray (University of Oslo) will co-ordinate marine biodiversity; Mick Clout (University of Auckland) will co-ordinate introduced species. We foresee that 40-60% of the participants will be non-French scientists.

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