PRIORITY AREA: KNOWLEDGE MANAGEMENT

PROJECT 1: Knowledge Management for Galapagos
PARTNERS: Governing Council of Galapagos, Galapagos National Park Service, Charles Darwin Foundation, external experts
STATUS: International workshop completed; funding for implementation being identified

Galapagos is one of the most studied archipelagos in the world, but access to much of the information that has been generated is frustratingly limited. Information is held in disperse archives and databases around the world. Potential users of information often do not know information exists and as a result often duplicate research and data collection or make decisions based on incomplete and sometimes out-dated information. Opportunities to benefit from anecdotal information and information collected by scientists and others (including citizen scientists) are lost because these data do not presently have a home.

Through the Knowledge Management initiative, we are working with key institutions and individuals within and beyond Galapagos to bring together data collection mechanisms and protocols, data sets, anecdotal data, and published materials in an easily-accessed system. It will serve as a destination for new information and observations and will support and catalyze public policy, research, and management. Investments in building this system will increase the value and impact of information that already exists, as well as data collected in the future.

An international workshop held in September 2011 engaged local leaders and international experts in the development of a multi-year work plan to develop this system. We are now focused on implementing this plan.
Complimenting the broader, multi-institutional Knowledge Management Initiative, this project will focus on the development of the Galapagos Science Commons, a web portal which gives access to both local and worldwide audiences to the Charles Darwin Foundation’s biodiversity knowledge resources. In 2012, the emphases will be on meeting the needs of a diverse group of Galapagos and Ecuadorian stakeholders, and continuing to refine the web portal to provide relevant, accessible information according to audiences’ needs. Priorities will include: 1) enhancing the Checklist and Collections web materials by integrating images and geo-location information relevant to the species; 2) mapping the distribution of species; and 3) to complement our work on invasive species, recovering and incorporating the wealth of information gathered during a large project funded by the Global Environmental Facility during the 1990’s. This project will also make improvements to the CDF library itself through a modest investment in visitor computer and scanning facilities and to make the library catalog available online.

**PRIORITY AREA: ECOSYSTEM RESTORATION**

**PROJECT 1: Giant Tortoise Recovery Project**

**PARTNER:** Galapagos National Park Service, Charles Darwin Foundation and international scientists

**STATUS:** International planning workshop will take place in early 2012. Additional funding for workshop and follow-up activities is currently being identified

Since the early 1960s, the Galapagos National Park Service (GNPS), the Charles Darwin Foundation (CDF), and international scientists have made tremendous strides to address the critical state of giant tortoise populations in Galapagos. Successes of the tortoise breeding and eradication programs include the repatriation of more than 550 tortoises to Pinzón and more than 1,700 tortoises to Española; the removal of feral goats—a major threat to tortoise populations—from Pinta Island (5,940 ha), Santiago Island (58,465 ha), and the northern portion of Isabela Island (approximately 250,000 ha); and the release of 39 sterilized tortoises on Pinta to serve as “environmental engineers” 38 years after Lonesome George was removed from the island. Recent advances in the eradication of introduced mammals and our understanding of tortoise ecology and genetics have created opportunities that would have been impossible to imagine even a few decades ago. Galapagos Conservancy, the GNPS, the CDF and international scientists are working together to initiate the Giant Tortoise Recovery Project to build on these evolving opportunities. Over a 10-year period the project will: 1) restore tortoise populations, including those considered “extinct in the wild,” through a combination of in situ management; selectively breed, rear, and repatriate; and/or where appropriate, repopulate with analog species; 2) evaluate habitat conditions and restore where necessary; and 3) improve education/outreach in service of giant tortoise conservation.

**PROJECT 2: Tsunami Response**

**PARTNER:** Charles Darwin Foundation

**STATUS:** Funded in 2011 and currently being implemented

On Friday, March 11, 2011, the Galapagos coastal areas and populated port areas were subjected to the largest tsunami event in their recorded history — a consequence of an 8.9 magnitude earthquake originating off the coast of Japan. The resulting waves when pushed from deep water over the Galapagos platform caused unprecedented levels of coastal flooding and current surge across the archipelago. Reaching 1.77m above the already high tide, Academy Bay (Puerto Ayora, Santa Cruz Island) was among those areas worst affected, although several reports suggested similar impacts in remote bays across the archipelago. During the following week the Government of Ecuador declared a state of emergency in relation to the coastal areas of Ecuador and Galapagos affected by the tsunami.

The human population was safely evacuated, but there remains a need to complete assessments of impacts to coastal ecosystems (e.g. corals, mangroves, lagoons), and to nesting endemic and IUCN red-listed species (e.g. marine iguanas, Galapagos penguins, flightless cormorants and green sea turtles). Systems exposed to the wave include sandy beaches used by nesting marine turtles and iguanas; rocky coasts and cliffs used as refuges for marine iguanas, and nesting areas for many sea birds; and mangrove stands which are important nursery areas for marine species and the only habitat worldwide for the extremely rare Mangrove Finch. The effects of the tsunami and scouring of extremely strong currents observed on bottom-dwelling marine species is also yet unknown. CDF is also concerned that their ability to address tsunami impacts and conduct ongoing research for conservation priorities has been greatly compromised by extensive tsunami damage to the Puerto Ayora CDF Marine Laboratory.
PROJECT 3: Population size of Blue-footed Boobies in Galapagos: Evaluation of indications of population decline

PARTNERS: Wake Forest University and the Galapagos National Park Service

STATUS: Funded in 2011 and currently being implemented

Blue-footed Boobies are an iconic Galapagos species, well-studied in some respects, but we lack even the beginning of an understanding of population size and trends. Related gaps include dispersal biology, foraging characteristics, and sex ratios. Thus, we lack the tools to evaluate recent concern that the population is declining and experiencing unsustainable reproductive failure. This two-year project will accomplish several goals: 1) use mark-resight techniques on colonies throughout the archipelago to estimate sizes of the breeding and non-breeding components of the population, sex ratio, and annual adult survival; 2) monitor reproductive success at major colonies at four-month intervals, and 3) use bird-mounted GPS units and diet samples to evaluate dependence on sardines, and possible limitation by this preferred food.

This project will provide: 1) a baseline population size for quantitative comparison with future data and qualitative comparison with past data; 2) an understanding of the role of food distribution and abundance in the timing and location of breeding, and 3) an understanding of most key demographic processes needed to parameterize a population model. An Ecuadorian student will earn his Master’s degree at Wake Forest University through this project, and the student, an expert consultant, and the Principal Investigator will publish the results in peer-reviewed scientific literature.

PROJECT 4: Feeding ecology of the Galapagos Hawk after the eradication of goats on Santiago Island

PARTNERS: The Peregrine Fund and the Galapagos National Park Service

STATUS: Funded in 2011 and currently being implemented

The removal of invasive species is presumed to have a positive impact as biological communities recover, and there are good examples of native species recoveries. However, there are often unforeseen negative consequences, particularly when the eradicated exotic had replaced the function of an extinct component of the ecosystem. This situation exists in Galapagos on Santiago Island, which is now largely without vertebrate herbivory after the successful eradication of goats in 2006.

Within this eradication effort, the largest island in the world ever cleaned of exotic ungulates is Santiago, where native herbivores had been driven extinct (land iguanas) or nearly so (giant tortoises) leaving the island largely without vertebrate herbivory. On Santiago, a well-studied population of the Galapagos Hawk (Buteo galapagoensis) resides as the apex terrestrial predator in the simple Galapagos ecosystem. The study proposes long-term monitoring of this population and its prey populations to test several hypothetical consequences of the eradication of ungulates and the subsequent recovery of the biological community.

Information from this project has impacts beyond strengthening our understanding of population dynamics of this apex predator. It will contribute importantly to conservation and management decisions by the Galapagos National Park in their efforts to preserve this Natural World Heritage Site with direct benefits to local residents, tourism, conservation and scientific sectors. The study also provides direct education and training opportunities for Ecuadorian students and park rangers.
Española Island in the Galapagos Archipelago is home to three globally endangered, interacting species: the Waved Albatross (the world’s only tropical albatross), a morphologically and genetically distinct lineage of giant tortoise, and a large-seeded, arboreal prickly pear cactus. The Galapagos Conservancy-supported Española survey in May–June 2010 focused on the interactions among these species. Results of that survey show that the native woody vegetation has reached extremely dense levels not seen in the last 1000 years. This incursion by woody plants on the island is likely the legacy of 73 years (1905 to 1978) of excessive goat densities, which may have fundamentally altered competitive relationships between woody and herbaceous plants in large part through changes in soil conditions that now favor woody plants.

Key findings of last year’s survey include: 1) woody plant cover is extensive on Española to a degree anomalous in the island’s vegetation history; 2) woody plant cover is expanding and likely doing so to the long-term detriment of tortoises, cactus, and inland nesting albatross; 3) about half of all tortoises ever repatriated are alive but are not substantially “engineering” the island’s vegetation in the sense of hindering incursion of woody vegetation or affecting cactus populations; 4) cactus remains an important, yet scarce, resource for tortoises and is not competing well with woody plants; and 5) Española supports an inland nesting population of Waved Albatross that likely represents a substantial component of the species’ global population and that should become the focus of intensive monitoring and a better assessment of its size and distribution.

This research clearly indicates that there is an ecological imbalance on Española. However, how to proceed with conservation management is less clear. Key staff in the GNPS have concurred that in the near-term, small-scale manipulations of woody cover could greatly clarify two important, remaining “unknowns”: 1) the likely response of Española’s flagship species to removal of woody plants; and 2) costs and logistics associated with a large-scale manipulation of the woody cover on Española (a possible future course of action).

This project will carry out ecological monitoring as part of a joint management action/scientific experiment associated with creation of small-scale disturbances of woody vegetation on Española planned by the GNPS in late 2012. Other components of the work will clarify the history of the vegetation and albatross occupancy on the southern side of the island as well as complete a definitive assessment of inland nesting populations of waved albatross. This joint science/management effort will generate critical information to provide the GNPS with the necessary foundation for final decision-making about how best to proceed with island-wide conservation management. The project also involves substantial training opportunities for GNPS rangers (e.g., unmanned aerial vehicle or UAV operation) as well as technology transfer for other applications in the Park.

**PROJECT 6: Chemical attractants of Philornis downsi, an avian parasite of the Galapagos Islands**

**PARTNERS:** SUNY-ESF and the Galapagos National Park Service

**STATUS:** Under review, identifying end-of-year funding

Philornis downsi is a blood-feeding, parasitic fly that has been introduced to Galapagos (first discovered there in 1997) and is causing substantial levels of mortality in several species of endemic birds, including the critically endangered Medium Ground Finch, Mangrove Finch, and Floreana Mockingbird. Mortality is caused by blood loss to nestlings and the presence of Philornis in a nest often causes 100% brood failure. The proposed research builds on the past two and one-half years of unsupported research at SUNY-ESF with the primary objective of identifying chemical attractants that can serve as a cornerstone of a future pest management effort. Insect chemical attractants may be food odors or pheromones, and combinations of them can be used to monitor pest populations or to suppress populations through a variety of strategies that are well established in agricultural and forestry pest management.

The study will use established methods of field observation, trapping, chemical sampling, and analysis to identify the most effective combination of chemical attractants for *P. downsi*. Potential, specific uses of chemical attractants against *P. downsi* include population monitoring, detection, mass trapping, and
mating disruption; any or all of these may be combined with other pest management strategies such as the sterile insect technique to enhance efficacy and reduce or eliminate nestling mortality.

Note: Another GC-funded complimentary project currently run by CDF adjunct scientist, Charlotte Causton, specifically examines the threat of Philornis downsi to Darwin’s finches and seeks to define solutions and control methods for this very serious threat to Galapagos bird nestlings.

PROJECT 7: Managing invasive ants effectively in Galapagos
PARTNER: Dr. Charlotte Causton, CDF adjunct scientist
STATUS: Funded in 2011 and currently being implemented

Invasive ants are considered serious threats to the biodiversity of the Galapagos Islands. They can also affect agricultural activities, domestic animals, and can produce allergic reactions in humans. The Galapagos National Park Service (GNPS) with the support of the Charles Darwin Foundation (CDF) and AGROCALIDAD-Galapagos are currently running 12 programs to control or eradicate four species of invasive ants: the little fire ant (Wasmannia auropunctata), the tropical fire ant (Solenopsis geminata), the Singapore ant (Monomorium destructor), and the big-headed ant (Pheidole megacephala). These programs are costly in terms of resources and effort and it is calculated that local organizations, principally GNPS, spend at least $225,000 annually on invasive ant control. Only two of the programs have had some kind of evaluation. Invasive species management programs need to be evaluated on a regular basis in order to build on knowledge obtained at the target site, thus tailoring management to that site. This project will provide a much needed adaptive management approach considering management objectives, ecological principles and processes, and contemporary assessment techniques to develop and prioritize strategies for these programs. Specifically, the project will develop a five-year strategy for reducing the impacts of invasive ants in the Galapagos Islands.

PROJECT 8: Marine Area Management: Health surveillance and monitoring of marine wildlife, and fisheries research
PARTNERS: Charles Darwin Foundation (CDF) and the Galapagos National Park Service
STATUS: Under review, identifying end-of-year funding

The Health and Surveillance component of the project will investigate man-made threats to Galapagos marine wildlife. The expected longer term impact is reduced morbidity and mortality among these species due to an emergency response network that can react 24/7 to reports of sick, injured, or dead marine wildlife. By recording and analyzing the injuries and/or causes of death of the reported individuals, we will acquire a deeper understanding that will be shared with the community of the impacts of human activities on iconic species, thus promoting greater community involvement in the protection and conservation of these coastal species. Specifically, the project will: 1) establish an emergency network for injured or sick marine wildlife, coordinated between the main populated islands, including development of standardized protocols for animal wildlife, coordinated between the main populated islands, including development of standardized protocols for animal management and sample collection in the field, as well as specific training for park rangers, CDF staff, and volunteers; 2) establish a baseline for species-specific diseases; 3) estimate the incidence of human-caused deaths; and 4) inform local residents to raise awareness and involve them in passive surveillance.

The Fisheries Research component will provide technical advice leading to regulation and therefore better protection of Wahoo, Grouper, and Tuna within the Galapagos Marine Reserve (GMR) and will increase our knowledge of these predator species and their role in the tropic system. The CDF will continue to carry out monitoring and research on these key finfish species, presenting our results on a regular basis to the Participatory Management Board and the Galapagos National Park so that decisions about marine resource management can be based on sound scientific results, with the goal of securing sustainable fisheries management and avoiding overexploitation.

Sea Lion populations, threatened by disease, and Galapagos Penguins, threatened by warming ocean temperatures, will benefit greatly from increased monitoring and health surveillance.

Photos, at right, by Ann Coulthard and Janet Laing.
of the resources. Specifically, the project will continue to: 1) establish growth, reproduction, and recruitment patterns of the target species Wahoo, Grouper, and Tuna, through collection and examination of biological samples; and 2) understand site fidelity of target species and the use of protected areas through investigating movement patterns within and outside the GMR. This will result in solid technical advice to decision makers enabling them, for the first time, to develop regulatory measures for these key species.

The third component is Marine Management Area Science (MMAS). The Galapagos Marine Reserve is at an important crossroads in its evaluation for future reform, requiring well balanced information regarding threat analysis, sub-tidal and near coastal biodiversity, population viability, functional diversity, and ecosystem resilience before climate and human disturbances. CDF began implementing a long term GMR-wide monitoring plan in 2004 which has since formed part of local and Eastern Tropical Pacific-wide analyses of Marine Managed Area effectiveness. With further development, these inputs should form part of an integrated Galapagos Observing System with key associates as part of a broader government-led initiative.

**PROJECT 9: Science and technical assistance for invasive species solutions in Galapagos**

**PARTNERS:** Charles Darwin Foundation (CDF), various

**STATUS:** Under review, identifying end-of-year funding

This project aims to provide training and technical assistance to Galapagos stakeholders involved in the management and control of invasive species. Collaborators include the Galapagos National Park Service, Galapagos Governing Council, the quarantine authority AGROCALIDAD, local government, Committees for the Control of Invasive Species (CIMEI), and the Ecuadorian Ministry of Agriculture. CDF’s extensive knowledge of invasive species control combined with its natural history and databases of invasive species will be of considerable value to all practitioners involved in controlling the most severe threats to Galapagos wildlife and conservation. The Galapagos Governing Council has already identified priorities for control and management of invasive species: black flies, giant African snails, the dengue fever vector *Aedes aegypti*, and invasive and fire ants. Other species of equal concern affecting Galapagos’ economic sustainability are: the fruit fly, *Rubus niveus* (a type of raspberry), and non-native rats. Invasives inhibiting the conservation and protection of Galapagos flora and fauna are: *Philornis downsi*, *Rubus niveus*, *Icerya purchasi* (Cottony Cushion Scale), and rats, to name a few.

Through this project CDF scientists and technical advisors, supported by a worldwide network of collaborators and specialist scientists, will provide support to government by: helping Government partners to optimize invasive species control project planning and coordination of those projects, and by providing accessible, web based information for Government institutions for optimal decision making and management of invasive species. The project will train practitioners in the use of adaptive management techniques and control methods, to provide operational training for invasive species management, and to coordinate support for multi-stakeholder control/eradication activities.

![Supplies being lowered by helicopter to initiate a large-scale rat eradication effort on Rabida Island in 2010. Photo by GNP.](image)

**PRIORITY AREA: SUSTAINABLE SOCIETY**

**PROJECT 1:** Education for a sustainable society: Strategic and Business Plans for Tomás de Berlanga School

**PARTNERS:** Scalesia Foundation(Galapagos), Stanford University School of Education and independent educators

**STATUS:** Funded in 2011, currently being implemented

Educating future generations of Galapagueños may be one of the most important challenges that the Galapagos National Park has to face. The local population in Galapagos is increasing rapidly, as is the number of schools. Existing study plans and models of curricula don’t match the Islands’ reality and professional needs.

The Scalesia Foundation is currently implementing a pilot school (Tomás de Berlanga School) where traditional learning structures are being questioned in order to design an educational proposal that matches the reality of students who live in a Natural World Heritage Site.

During the last three years, the Scalesia Foundation has started a reengineering process of the Foundation and the School in order to ensure that the educational objectives can be reached and to eventually serve as a model for other schools. After three years of changes and improvements, the Foundation identified the need to update its Strategic Plan, and accompany it with a Business Plan that will establish a clear strategy and the financial mechanisms to ensure institutional stability and long term growth.
PROJECT 2: Expanding best educational practices throughout Galapagos

PARTNERS: Scalesia Foundation (Galapagos), Ecuador’s Ministry of Education, Stanford University School of Education, and independent educators

STATUS: Currently identifying funding for implementation in 2012

Building on our work with the Tomás de Berlanga (TdB) School, we have begun to collaborate with a broad network of partners in the United States and Ecuador on an initiative that will: 1) share the best practices implemented at the TdB School with public schools throughout Galapagos, and 2) develop formative extracurricular activities (citizen science, leadership and entrepreneurship development, and environmental awareness-building) that will reinforce what is learned in the classroom. Parents, teachers, business leaders, and representatives of the Ecuadorian Ministry of Education believe there is a need for a local voice for education in Galapagos — an organization which can speak to the specific educational needs in the islands and support public and private efforts to improve both formal and non-formal education. To fill this need, we are seeking 3-year start-up funding to finance the Executive Director of the Galapagos-based Scalesia Foundation to broaden its education-related activities well beyond the TdB School.

Through this project, the CWG will implement a cell-phone-based text-messaging system through which residents will be able to report inefficiencies, corruption, or other problems related to the provision of public services or the enforcement of environmental laws and regulations. Observations will be sent simultaneously to the CWG and the responsible organizations. The CWG will ensure that the organizations report back on a monthly basis, with concrete steps to alleviate each reported situation. Indicators will be developed to monitor the evolution of public services in Galapagos.

The project will also sponsor and organize training workshops on the four inhabited islands for public servants and private citizens in order to increase awareness of the legal tools and administrative measures that exist to ensure public sector accountability and promote the participation of citizens in political processes. One workshop will focus on generating citizen feedback for public institutions regarding the new Special Law for Galapagos and its impact on and implications for local residents. The project also involves the publication and distribution of a monthly newsletter on civic engagement and the performance of public sector organizations.

PROJECT 4: Creating sustainable human habitats: A rural zoning code for Santa Cruz and land use planning for Floreana

PARTNERS: The Prince’s Foundation for the Built Environment

STATUS: Under review, identifying end-of-year funding

The regional and municipal governments in the Galapagos Islands are currently undertaking a regional study to address their development framework that will shape the future of the islands. Government staff on the islands is attempting to cope with the everyday demand of an economy that is growing at an unprecedented 10% per year, as residents and politicians are pressuring for more economic opportunities and places to live more cheaply. The local planning departments lack the experience or the means by which to guide residents on how to build ecologically-friendly homes and to plan for a sustainable future. As a result, development practices on the islands follow conventional and unsustainable growth patterns, which do not take into account the local environment, nor do they consider ecological impacts or reduce petroleum use and rising automobile dependency.

Solutions to sustainable and low-impact living on the islands will require forward and transect-based urban planning, establishing appropriate island architecture, changing building practices and supply chains, and education of government and residents in such planning processes, skills, and awareness. Over the coming year,
this project will use a collaborative planning methodology (known as Charrette in the US and Enquiry by Design in the UK), working closely with residents, members of the governing body’s technical team, other NGOs, and external technical experts and universities. In such planning workshops all participants help shape the vision, plan, or code; all constraints needs and wants are considered, and together they arrive at innovative and comprehensive solutions. The project will focus specifically on a Rural Code for Santa Cruz Island, as well as a Land Use Plan, Sustainability Strategy, and Village Master Plan for Floreana Island.

In such planning workshops all participants help shape the vision, plan, or code; all constraints needs and wants are considered, and together they arrive at innovative and comprehensive solutions.

PROJECT 5: Understanding the human footprint in Galapagos: Geographic mapping, multi-cultural collaboration, and economic sustainability

PARTNERS: Charles Darwin Foundation

STATUS: Under review, identifying end-of-year funding

This first component of this provides continuity with CDF’s “Galapagos Geographic Index” initiative, supported by Galapagos Conservancy since its beginning, which aims to measure anthropogenic impacts or “The Human Footprint” in Galapagos with reference to environmental, cultural, and spatial impacts. A great deal of data relevant to this work has been obtained through observation and interviews with different social actors. The focus for 2012 is to complete the analysis of data on tourism, transport, water, construction, and other business sectors. The study will define indicators for weighting and measuring these impacts and use these to create visualizations and other tools for Galapagos decision-makers. The work will include geographical mapping through the voluntary use of innovative techniques such as smartphones for geographic and spatial analysis.

An important part of this work is discovering the differing impacts of distinct cultural groups. Research began with a collaborative study of the Salasaca population, which originates from the Tungurahua region of mainland Ecuador and, at an estimated 20%, represents the largest single culturally cohesive group among the resident population. Subsequently, the study will include work with the Afro-Ecuadorian population. Through this research, the CDF hopes to understand the relationships between distinct groups and their natural environment, and how this mediates both positive and negative impacts.

The final part of the project is an economics study that will examine the local food production sector. The objective is to study and develop market connections between local suppliers, consumers and the tourism sector. Goals are: 1) to consolidate the value chain, 2) to help producers to improve processes and product quality standards to make local production competitive, 3) to encourage the development of new business ideas that may include Fair Trade orientation, sustainable procedures, and social responsibility for commercialization of the local fishing, agriculture, and farming sectors. The study will include information on micro-financing options for this sector. The goal is to reduce Galapagos’ dependency on external sources of food, which carry a high risk of bringing introduced and invasive species to Galapagos, impacting local wildlife and the resident population.

For more than 25 years, Galapagos Conservancy has been connecting people across the globe to conservation efforts taking place in the most extraordinary islands in the world. We support innovative science and conservation management that seeks to protect and conserve the unique flora and fauna of Galapagos and which constantly strives to add knowledge and context to the world’s understanding of biodiversity conservation. We envision a healthy and engaged society within Galapagos that actively cares for and respects the sustainable and thoughtful use of local resources.