



PROJECT ECU/00/G31
“INVASIVE SPECIES IN THE GALAPAGOS”



Charles Darwin Foundation
Research Program
Based on the Experimental Framework of the Charles Darwin Foundation and
the Galapagos National Park

With support and participation from:



Global Environment Facility



Charles Darwin Foundation Research Program
Based on Experimental Framework

Blue: Pro-active research and management.

Green: Reactive research and management.

Yellow: Communication and community involvement transversal activities.

Subject	Identified Priorities	Current activities	Partially funded or unfunded activities
Base line generation	Actualised information about status and distribution of natives plants in Galapagos, including distribution maps		Inventories
	Complete List of Galapagos introduced plants	Inventories	
	Complete Inventory of Galapagos terrestrial invertebrates	Complete inventory of terrestrial invertebrates in Galapagos	Studies of invertebrate communities on Darwin and Wolf Islands
		Record of native, endemic and invasive invertebrates per island	Recruiting specific taxonomists for specific groups still unidentified.
		Inventory of agricultural plagues on Isabela, San Cristóbal, Santa Cruz and Floreana.	Studies of Galapagos invertebrates in international museums
	Base Line for marine ecosystems	Base line for costal marine ecosystem, rocky and submerged (to 20 m deep, max.)	Monitoring and follow-up, including sandy areas
			Biodiversity and environmental conditions beyond 20 meters depth

			Base Line (biological and physical) in open waters - Zone 1 of GMR ¹
			Ecological importance, distribution and richness of the mangrove area of GMR
			Extended studies of Base line about biodiversity in 2.4 sub-zones, mainly zones surrounding port areas on P. Ayora, Villamil, Baquerizo Moreno
	Base line studies on bird diseases and parasites		Base Line studies about avian malaria and West Nile virus on birds
			Distribution of introduced parasitic fly <i>Philornis</i> .
	eradication and restoration programs.		Bird survey on Alcedo volcano prior to implementing the goat <i>Capra capra</i> eradication program.
		Bird sampling in the highlands of Santa Cruz island prior to implementing the Quinine tree <i>Cinchona succirubra</i> eradication program.	
Communication and Participation	Base line of community perceptions	Base line of Galapagos community perceptions about introduced species and the inspection and quarantine system, 2002.	

¹ Stands for Galapagos Marine Reserve

		Perception studies on tourists and visitors about Introduced Species and Inspection and Quarantine System for Galapagos (SICGAL), and Base line for practices from residents and tourists regarding SICGAL, FCD 2003.	
		and supporters of conservation of the GMR about the PMS of the GMR, FCD 2002.	
Monitoring and surveillance	Long term monitoring of birds	Census of key native and endemic threatened species: Galapagos Albatross <i>Diomedea irrorata</i> , Galapagos Penguin <i>Spheniscus mendiculus</i> and Flightless Cormorant <i>Phalacrocorax harrisi</i> , Floreana Cuckoo <i>Nesomimus trifasciatus</i>	Monitory of Pachay <i>Laterallus spilonotus</i> , Medium tree finch <i>Camarhynchus pauper</i> , Galapagos hawk <i>Buteo galapagoensis</i> .
		Development of methodology for marine birds monitory	Comparison between bird populations on San Cristóbal and other inhabited islands
		Development of plan for Galapagos terrestrial birds monitoring	Implementing terrestrial birds monitoring plan in the Archipelago.
	Monitoring of introduced tree frog <i>Scinax quinquefasciatus</i>	Detection and monitoring of invasion by the tree frog <i>Scinax</i> in Southern Isabela, invaded and non-invaded areas. Development of alternative methodology for detection and monitory	
		Population Monitoring for the tree frog <i>Scinax quinquefasciatus</i> in Southern Isabela	

	Long term monitoring of endemic reptiles	Monthly monitoring of marine iguana <i>Amblyrhynchus cristatus hassi</i> in Punta Núñez.	Search for Galapagos <i>Geochelone elephantopus</i> in Pinzón and Fernandina islands
		Monitoring and search for Galapagos <i>Geochelone elephantops</i> and terrestrial iguanas <i>Conolophus subcristatus</i> in South Isabela	Monitoring of land iguanas <i>C. Subcristatus</i> on Baltra, Plaza Sur, Bahía Conway (Santa Cruz) and Bahía Cartago (Isabela).
	Monitoring of threatened endemic plants		Monitoring program for each endangered or critically endangered species, and representative vulnerable species (total of 60 species).
	Monitoring of threatened plant communities on priority sites	Monitoring on Alcedo and Santiago volcanoes	Monitoring of the whole range of rare communities (vulnerable) and threatened communities
	Monitoring of new plant introductions and distribution of introduced species		Monitoring program focused on invasive species or potentially invasive species on inhabited island and surroundings
	Monitoring system of biotic and abiotic changes implemented for invertebrates	Studies of lepidopteran fauna composition on natural, transitory and disturbed sites	Studies on indicator species en specific sites
		Periodical monitoring of the black fly <i>Simulium bipunctatum</i> in San Cristóbal.	
		Studies of ground arthropods in the <i>Scalesia</i> zone	Study of bio-indicator species
	(SICGAL) on surveillance and early detection for invasive species	Developing and implementing of surveillance system for SICGAL in Isabela, San Cristóbal, Santa Cruz and Floreana.	Application of surveillance system onto GNP zones

			Specific plague detection, such as <i>Cactoblastis</i>
	System of ecologic monitoring for ecological changes		Implementing surveillance system in agricultural areas
	Monitoring of extractive fishery resources	Sea cucumber <i>Stichopus fuscus</i>	“Lisa” (Mugilidae)
		Spiny lobster <i>Panulirus penicillatus</i> and <i>P. gracilis</i>	Open water resources: Tuna, wahoo <i>Acanthocybium solandri</i> , halfbeak, <i>Hyporhamphus unifasciatus</i> , etc.
		Sleeper lobster <i>Scyllarides astori</i>	Lack of biological studies on reef fishes (Bacalao <i>Mycteroperca olfax</i> and others likewise)
		White fishery (several bony fishes)	Other resources: sea snails, chitons, octopus, etc.: Lack of more information about abundance, exploitation levels, etc. Lack of biological studies.
	Monitoring of non-extractive (at the moment) resources	Some preliminary information is being collected	Sea cucumber <i>Stichopus horrens</i>
			Sea urchin
	resources	Illegal shark fishery: Little data available mainly based on requisitioned records; qualitative/semi-quantitative data	Shark abundance and distribution, migrations
			Sharks biological features, behaviour, reproduction, etc.
		Sea lion <i>Zalophus californianus wollebacki</i> and fur sea lion <i>Arctocephalus galapagoensis</i>	Lacks wider coverage, mainly for Fur sea lion <i>A. Galapagoensis</i> , diseases.
		Green Turtle <i>Chelonia mydas</i> : 4 nesting sites	Another nesting places for the green turtle <i>C. mydas</i> , importance, migrations
			Pacific seahorse <i>Syngathidae</i>

	Tourism impact on diving places (N _{total} = 62)	Evaluation of biodiversity in 2 to 5 places	Biodiversity base line on sea tourism places which have never been studied before (N ≈ 15)
		Punctual data of impact on 15 sites	Impact of dive tourism and ships: Changes on fauna behaviours, sites pollution, physical damage (coral reefs, anchorage, inter-tidal, etc)
			Producing a guide of marine tourism sites
	introduced marine species	Costal lagoons (Line Base study of Agnes Gelin & Vincent Gravez)	Biological and ecological aspects of ictio-fauna in costal lakes
		Only data source available until today: Masters Thesis of May de la Cruz on epifauna over ship hulls	Abundance and distribution of "chmae" <i>Dormitator latifrons</i> in costal lakes
			Detection on inhabited islands, mainly in big ports, ship hulls, bulge water, port water.
Communication and Participation	Research on developing environmental education, communication and involvement (EECCI) programs including knowledge, perceptions, practices and involvement levels of the local population. Media infrastructure, reliable channels, public opinion, etc in order to refine awareness campaigns.	Study of perceptions on domestic doves, Isabela, 2000.	Monitoring of perceptions and practices of the local community, tourists and visitors about SICGAL and Introduced Species
		Quarantine retentions 2003, SESA, 2003.	
			Studies to determine the importance, values, cultural meaning, and usage of natural resources among migrant youth, indigenous communities and islanders community
		Opinion studies about CDF and its science programs	

			<p>Socio-economic studies on the impact of management politics of the Galapagos National Park and its Marine Reserve</p> <p>Management studies of the Galapagos National Park and its Marine Reserve</p>
Prioritisation and decision making	Complete taxa of endemic plants adequately recorded in the Red List		Mapping and registration in the Red List
	Publishing book of red data for plants		Publishing book
	Reviewing Red List of plants periodically		Reviewing Red List
	Prioritisation and evaluation system for plants (new introductions and already introduced)	Developing species system	Developing sites prioritisation
	Feasibility System for introduced plant eradication	Developing system	Implementing System.
	System of prioritisation and evaluation for invertebrates (new introductions and already introduced species)	Creating a tentative model for prioritisation	Creating a program for prioritisation model of invertebrates by a specialist.
Identifying more dangerous invertebrate quarantine species.			

		Implementing surveillance system according to priority species list	
	System of prioritisation for controlling non eradicable sites	Developing prioritisation of sites	Implementing System
	Zoning of GMR	Available Base line data and some guidelines and preliminary conclusions	Review of preliminary zoning, Zone 2 (sub-zones 2.1, 2.2, 2.3, 2.4)
		Improvement of zoning for the Galapagos Marine Reserve (GMR)	Study about the Galapagos Penguin <i>Spheniscus mendiculus</i> .using the GMR
		Available costal line mapping for the GMR, and GIS maps	Actualising geo-referenced map of costal line to give support to delimiting physical management sub zones
			Zoning of Zone 1 (open waters)
			Regulating Sport Fishing, delimiting of authorized geographical zones, etc
	Activities on Marine Tourism		Regulations for tourism operators in Galapagos, control of marine itineraries, etc.
extractive resources		Regulations available / management plan for sea cucumber and spiny lobster	Regulation for Slipper lobster
			Regulations for octopus, marine snails, chitons, etc.
			Regulations White Fish (Mulletts <i>Mugil</i> spp. + and others)

Biological studies	Evaluating anthropogenic effects on terrestrial animals	Study of migration of the galápagos <i>Geochelone elephantopus</i> in Santa Cruz Island	Anthropogenic and natural effects on populations of Galapagos Penguin <i>Spheniscus mendiculus</i> , Flightless Cormorant <i>Phalacrocorax harrisi</i> and Mangrove Finch <i>Camarhynchus heliobates</i> .
			Analysis of long term data about Galapagos Petrel <i>Pterodroma phaeopygia</i> , Galapagos Albatross <i>Diomedea irrorata</i> , and Flamingo <i>Phoenicopeterus ruber</i> demography
	Evaluating relation between introduced species and terrestrial animals	Relation between introduced rats <i>Rattus rattus</i> and the endemic rice rat in Santiago <i>Nesoryzomys swarthi</i>	Studies of the effects of the introduced black fly <i>Philornis</i> on hatchlings of terrestrial birds
		Studies of the effects and sequels of avian pox on birds	
	Evaluating natural effects on terrestrial animals		Recording meteorological data, meteorological data bases updating and meteorological data analysis
			Improvement of net of stations for meteorological data
			Development and elaboration of map base for GIS System in Galapagos
	Understanding threatening factors that affects endangered plants and planning intervention.		Studies of every endangered and critically endangered plant species (50 spp).
	Understanding invasive species biology in order to plan their control	Studies of Quinine tree <i>Cinchona pubescens</i> and Guava tree <i>Psidium guajava</i> .	Studies of the most important invasive species (40 spp).

	Bionomics of various researched bio-indicator species	Studies of endemic invertebrates species bionomics, especially Lepidopteron.	Development of methods for choosing invertebrates bio-indicators
			Studies of invertebrates bionomics in Darwin and Wolf
	Marine environment: physics, chemistry, productivity and climatic changes	Processing satellite data about superficial temperatures of GMR	Analysis and interpretation of data (updated) and integration with biologic data
		Temperature data at specific depth registered through 'loggers' (sensors)	Analysis and interpretation of data from existing 'loggers' (updated)
		Satellite data on chlorophyll <i>a</i> (productivity)	Analysis and interpretation of data (updating), and validation <i>in situ</i>
			Occurrence and causes of red tides
			Studies of nutrients
		Insufficient and punctual data about currents strength and direction	Measuring and modelling currents
	Reproduction of marine fauna		Identification of seed bank areas
		Pilot project on lobster larvae (collectors)	Larval development and settlement (larval collectors)
			Temperature impact
			Larvae dispersal
	Extractive marine resources growth	Some data is being collected, about spiny lobster and slipper lobster (capture and marking)	Another fishery resources (churo, canchalagua, octopus)
	and no-extractive resources		Sharks: Hammerhead <i>Sphyrna sp.</i> , whale shark <i>Rhincodon typus</i> , Galapagos shark <i>Carcharhinus galapaguensis</i> .
			Resources from open waters: by example, tune

		Cetaceous sighting logs data	Lack of log collection and reporting to continue cetaceous survey; Implementing monitoring based on photo-identification of killer whales <i>Orcinus orca</i> and humpback whales <i>Megaptera novaeangliae</i>
		Preliminary data: 4 green turtle individuals (<i>C. mydas</i>) with transistors	Lack of further information, including other turtle species migrations.
		Galapagos sea lion <i>Zalophus californianus wollebacki</i> colony	Studies of interisland migration of sea lion <i>Z. C. wollebacki</i> and Fur sea lion <i>Arctocephalus galapagoensis</i> .
		Preliminary data: - Health parameters of sea lion <i>Zalophus californianus wollebacki</i> and Fur sea lion <i>Arctocephalus galapagoensis</i> . - Ocular disorders on sea lion <i>Zalophus californianus wollebacki</i> puppies by the the trematode (<i>Philophthalmus</i> sp.)	Registering health status of both sea lion species on north and west archipelago colonies Establishing life cycle for the parasite and last consequences of this disorder
			Establishing risk of possible transmission of pathologies related to introduced (terrestrial) animals over marine species, mainly over marine vertebrates
Experimental management	Improvement of quick response planning	Vulnerability map of Galapagos (in collaboration with Introduced Vertebrates Area of CDF)	Improvement of the vulnerability map of Galapagos

	Inspection and Quarantine system working and implemented	Strengthening of the quarantine system, SICGAL.	Building adequate infrastructure for SICGAL control points
			Developing a plan to prevent bird diseases arrivals into the islands
		Producing legal framework for the Emergency Plan, including all participants	Implementing the Emergency Plan
		SICGAL inspectors training	
	Reducing the risk of marine species introductions		Establishing procedures to prevent marine species introductions
	Contingency Plans (For oil spills, etc.)		Producing plans
	Development of eradication methodology for introduced species	Experimental eradication of introduced vertebrates: <ul style="list-style-type: none"> - Domestic dove <i>Columba livia</i> from another islands in the archipelago; - Anies <i>Crotophaga ani</i> on Pinta, Fernandina, and Genovesa; - Introduced rats <i>Rattus rattus</i> on Bainbridge Rocks 	Rat eradication methods for 10-10,000 hectares islands
		Development of methods to eradicate feral cats <i>Felis silvestris catus</i> on Baltra.	
		Study of salinity tolerance of the introduced tree frog <i>Scinax quinquefasciatus</i> .	Development of methods for the application of toxicants (cafein) to control the tree frog <i>Scinax</i>

		Experimental eradications of introduced plants <i>Rubus niveus</i> in Isabela, <i>Rubus adenotrichos</i> , <i>R. ulmifolius</i> , <i>R. glaucus</i> , <i>R. megalococcus</i> , <i>Aristolochia odoratissima</i> , <i>A. elegans</i> in Santa Cruz, <i>Citharexylum gentryi</i> in Santa Cruz and Isabela. Costs assessment	20 more introduced plant species
		Feasibility studies for Quinine tree <i>Cinchona pubescens</i> eradication.	Completing studies.
		Fire ant <i>Wasmannia auropunctata</i> eradication	Studies on eradication feasibility for black fly, <i>Simulium bipunctatum</i> in San Cristóbal.
		<i>Simulium bipunctatum</i> eradication in San Cristóbal.	Implementing Dengue mosquito <i>Aedes aegypti</i> control program
	Improvement of methods for native species restoration in order to stop decrease population and habitat degradation of endangered species, to restore their original state	Improvement of methodology and support to the Giants Tortoises <i>Geochelone elephantopus</i> Reproductive Centres	
		Improvement of methodology and support to the Land Iguana <i>Conolophus subcristatus</i> Breeding Centre	
		Restoration of <i>Opuntia megasperma</i> in Española.	Plant protection and restoration projects
	mitigate introduced species effects over native species		Study on the extent of rat <i>Rattus rattus</i> control with partial poisoning programs in big islands
			Development of methodology for protecting galápagos <i>Geochelone elephantopus</i> nests from predation by rats <i>Rattus rattus</i>

			Development of methodology for protecting marine turtles nesting areas from predation by rats <i>Rattus rattus</i> .
	introduced species more difficult to eradicate	Lab control of the <i>Simulium bipunctatum</i> , with <i>Bacillus thuringiensis israelensis</i> (Bti)	Implementing control studies for the ant <i>Solenopsis</i> in inhabited islands
		Control of <i>Icerya purchasi</i> with <i>Rodolia cardinalis</i> .	
Environmental Education and Communication, and Community involvement (EECCI)	Staff training and preparation for identifying wildlife diseases and parasites	III Workshop of Birds and other species Diseases	
	EECCI strategy to support introduced species wide control	Producing communication strategies and campaigns at local, national and international levels about SICGAL Forum of discussion about introduced species to support with conflict management among related groups. Inter-institutional Committee for Introduced Species Management (IICISM) already established in three main villages Systems of community monitoring (vertebrates, invertebrates and introduced plants). Species already identified, manuals already produced, related groups already trained	Funding needed for implementing long term application of EECCI (IS) strategy

	EECCI strategy for GMR conservation	Improvement of users participation in monitoring fishing resources populations Organization improvement for GMR management related groups Awareness campaigns per each fishery	Partial implementation of GMR EECCI strategy
	Institutional image campaign and activities diffusion program of CDF	Curriculum develop for strategic application of environmental education for non formal education programs by CDF	Funding needed for implementing environmental education curriculum of CDF
			Funding needed for producing a strategy/plan and its long term implementation