

GALAPAGOS ATLAS



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Galapagos Giant Tortoise Shell-
Caparazón de Tortuga Gigante de Galápagos
Chelonoidis spp.
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GALAPAGOS ATLAS

A contribution to the knowledge and conservation of the Galapagos Islands

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Short snouted weevil -
Gorgojo de Pico Corto
Galapaganus howdenae
© Jeremy Squire



Star spider, crab spider -
Araña de Estrella
Gasteracantha cancriformis
© Jeremy Squire

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Pygmy Devil Ray, Smoothtail Mobula -
Diablo manta
Mobula munkiana
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ACRONYMS

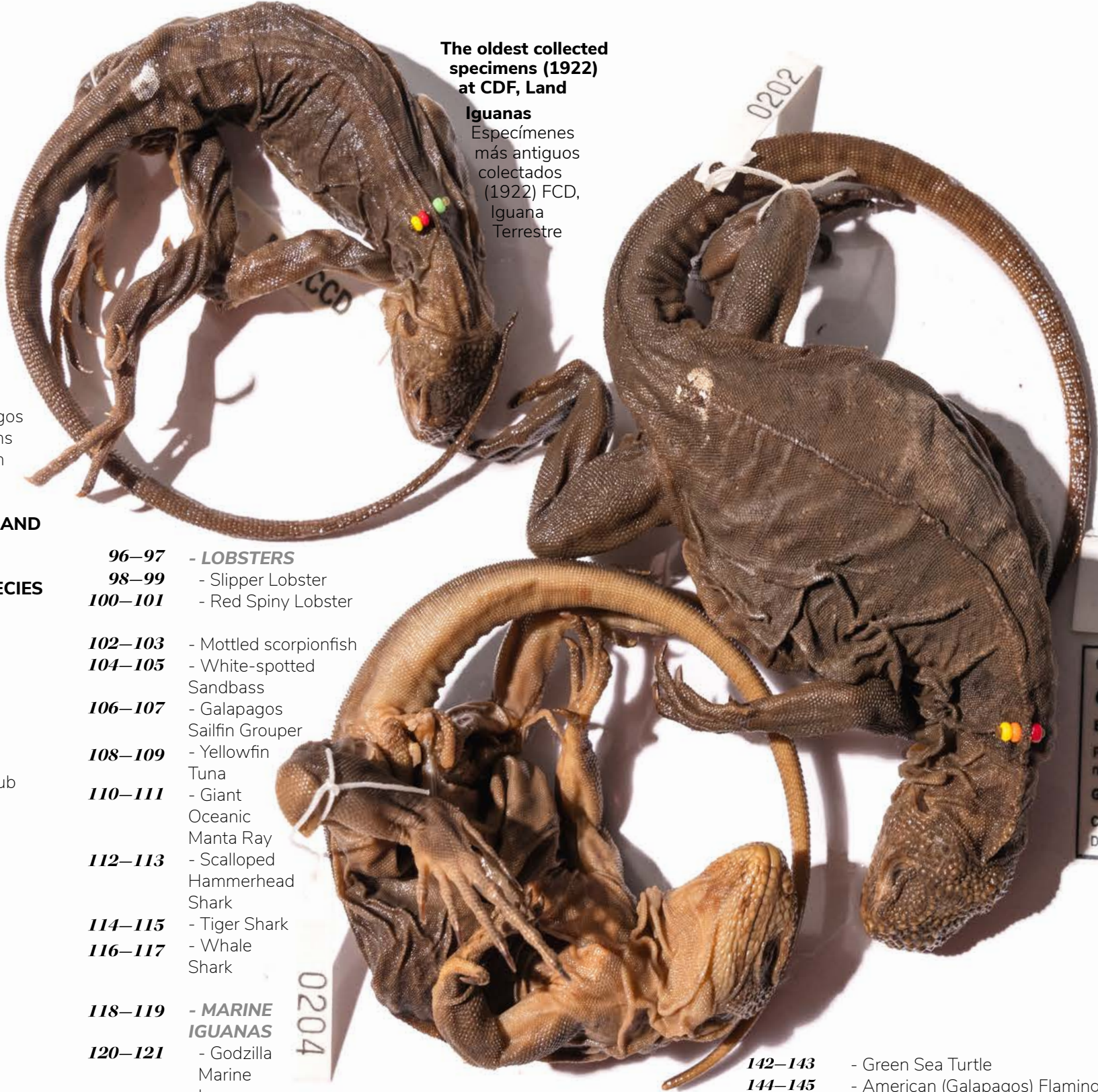
<i>Acronyms</i>	<i>English</i>	<i>Acronyms (ES)</i>	<i>Spanish</i>
ACAP	Agreement on the Conservation of Albatrosses and Petrels	ACAP	Acuerdo de Conservación de Albatros y Petreles
CDF	Charles Darwin Foundation	FCD	Fundación Charles Darwin
CDRS	Charles Darwin Research Station	ECCD	Estación Científica Charles Darwin
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora	CITES	Convención sobre el Comercio Internacional de Especies Amenazadas de Fauna y Flora
CMS	Convention on the Conservation of Migratory Species of Wild Animals	CMS	Convención sobre la Conservación de Especies Migratorias
DAG	Decentralized Autonomous Government	GAD	Gobierno Autónomo Descentralizado
ENSO	El Niño–Southern Oscillation	ENOS	El Niño-Oscilación del Sur
ETP	Eastern Tropical Pacific	PET	Pacífico Este Tropical
GBA	Biosecurity and Quarantine Regulation and Control Agency for Galapagos or Galapagos Biosecurity Agency	ABG	Agencia de Regulación y Control de la Bioseguridad y Cuarentena para Galápagos o Agencia de Bioseguridad para Galápagos
GIS	Geographic Information Systems	SIG	Sistemas de Información Geográfica
GMR	Galapagos Marine Reserve	RMG	Reserva Marina Galápagos
GNP	Galapagos National Park	PNG	Parque Nacional Galápagos
GNPD	Galapagos National Park Directorate	DPNG	Dirección del Parque Nacional Galápagos
ICCDRS	Invertebrate Collection CDRS	ICCDRS	Colección de Invertebrados de la ECCD
IUCN	International Union for Conservation of Nature	UICN	Unión Internacional para la Conservación de la Naturaleza
LOREG	Organic Law of the Special Regime for Galapagos	LOREG	Ley Orgánica de Régimen Especial de Galápagos
SICGAL	Galapagos Inspection and Quarantine System	SICGAL	Sistema de Inspección y Cuarentena de Galápagos
VCCDRS	Vertebrate Collection CDRS	VCCDRS	Colección de Vertebrados de la ECCD

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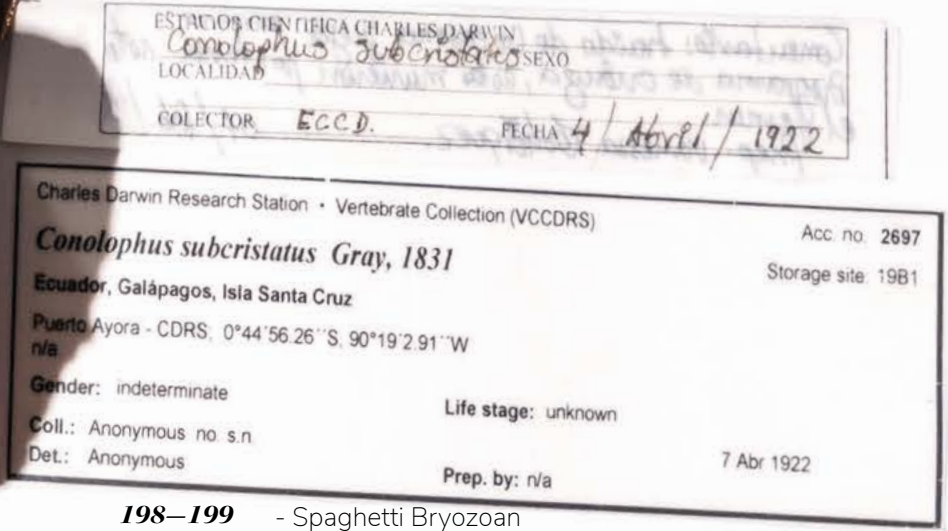
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PREFACE

The Charles Darwin Foundation (CDF) is proud to present the Second Edition of the Galapagos Atlas (2026) — a comprehensive and updated overview of the remarkable diversity of species (endemic, native, introduced, and invasive) and their habitats found across this unique volcanic archipelago. This Second Edition, published in English, expands upon and updates the information presented in the First Edition of 2018, which was published in Spanish, reflecting the most recent research and discoveries from the islands.

CDF gratefully acknowledges the outstanding support of the many individuals and institutions whose collaboration has been instrumental in advancing our programs, projects, and mission since our founding in 1959. In particular, we extend our deepest thanks to the Galapagos National Park Directorate (GNPD) for our decades-long partnership, granting research permits, offering logistical support — including personal assistance — to CDF's research teams. We also thank the Ministry of the Environment and Mines for granting genetic contracts and patents that have enabled the continued operation and development of CDF's Natural History Collections.

Our sincere gratitude also goes to the dedicated CDF staff who make our science possible every day, and especially the Atlas' Editorial Committee, who enthusiastically embraced the vision and production of this ambitious Second Edition. The Committee meticulously reviewed and translated content, expanded the species list, and enhanced every aspect of the Galapagos Atlas — from

its structure and information, to its photographs, maps, and references — all in close coordination with the contributing authors of each Fact Sheet.

The development of this Atlas represents a truly collaborative endeavor involving more than 80 experts and scientists, including authors and co-authors from diverse disciplines, as well as technicians, park rangers, and others who provided data, photographs, and invaluable field expertise.

The Atlas' Editorial Committee at CDF extends its heartfelt thanks to all scientists and institutions who collaborated in preparing the Fact Sheets, maps, and supporting materials that underpin this publication. We also acknowledge the lead scientists of CDF's research programs, whose sustained dedication and contributions have been essential to its realization.

Finally, the Atlas' Editorial Committee at CDF expresses its sincere gratitude to the donors and supporters who made the production of this Second Edition of the Galapagos Atlas possible — among them Connie Kwan-Wong, CKW LUXE Magazine, and Girl Chess Power and Beyond. We also wish to thank the various departments whose collaboration was essential to this effort, including the Science, Communications, Administration, and Executive Departments of the Charles Darwin Foundation. Their collective commitment and teamwork were fundamental to bringing this project to fruition.

Editorial Atlas Committee

Chief Rocksnail - Churo Blanco

Hexaplex princeps

© Nell Dethloff / CDF

Catshark Egg - Huevo de Tiburón Gato

Heterodontus quoyi

© Nell Dethloff / CDF

PROLOGUE

To look after our planet, humanity must understand its diverse ecosystems and how they respond to the array of anthropogenic threats. In this, as is so often the case, the Galapagos Archipelago is like a world in miniature. Just like the planet, Galapagos needs all of society to heed the science and join forces in tackling rapid ecological change and reversing the loss of biodiversity. This atlas is both a tool and inspiration for those who want to join the growing conservation effort — as citizen scientists, guides, educators, community conservation activists, regenerative businesses and supporters of all kinds. It summarises the biophysical and social context, lays out essential current information about both native and introduced species, and provides a window into the science of what makes this archipelago so special and so vulnerable.

It is an immense task to track the status of these species across 8,000 km² of land, including 13 major islands, and some 200,000 km² of marine reserves. Next time

you flip open the Galapagos Atlas and read about the distribution and status of a particular species, pause to reflect on the dedicated fieldwork, logistics, biosecurity measures, lab work, data analysis and mapping that underpin the scientific evidence on the page in front of you. It is a great, collaborative achievement.

The geological origin and unique flora and fauna are what make these oceanic islands a treasured part of humanity's natural heritage. The biggest threat to them is the relentless spread of invasive species in the form of predators, competitors, parasites and diseases. Climate change is the other dominant threat, especially in the marine realm, where it is disrupting the complex pattern of ocean currents and upwelling on which the endemism and abundance of the marine biota depend. These forces interact with other stressors, such as resource exploitation, pollution and transport, which have been driven by population growth. The Galapagos Atlas gives an overview of this challenging context,

to which managers, scientists and stakeholders are responding, then presents the evidence about how key species are faring — what you might call the bottom line for biodiversity. To provide a balanced picture, it encompasses a wide variety of ecologically significant species: cacti, *Scalesia*, lichens, ants, spiders, snails, rodents, landbirds, algae, sea urchins, corals, reef fish, pelagic fish, pests and diseases - as well as the charismatic species, such as tortoises, iguanas, seabirds and marine mammals, that usually hog the limelight. All miraculously condensed into one atlas!

Conservation is about social change and action, not just ecology, but the foundation for action has to be a solid understanding of the ecosystems and species. The global response to the climate and nature crisis shows that many governments and corporations around the world still don't get it. They act as if the biosphere were a simple machine, which can be fixed later by a couple

of skilled mechanics and a bit of new technology. But anybody who studies this atlas will realise that even a "simple" ecosystem like the Galapagos Archipelago is complex and vulnerable. Having exposed it to an array of threats, we must now monitor and manage the ecosystem with care and sound science, if it is to survive.

To achieve management and monitoring on the scale needed, Galapagos needs to mobilise more people to participate in a collective effort, informed by a common understanding of the islands' ecosystems and society. How that mobilisation can be achieved is the subject of another conversation but unquestionably this Galapagos Atlas is a fantastic resource for anyone wanting to get actively involved. It condenses a huge body of information into a concise, robust foundation of knowledge and invites you to delve deeper. Enjoy the dive!

Robert Bensted-Smith

Yellow morphotype Green Sea Turtle

Tortuga Verde morfotipo amarillo

Chelonia mydas

© Carlos Espinosa / CDF

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INTRODUCTION

The second edition of the Galapagos Atlas – years in the making – has landed! This seminal piece of work represents the collective effort of hundreds of dedicated scientists and collaborators, who, for decades, have painstakingly studied and documented the remarkable intricacies of the species that call the Galapagos islands home.

Anyone who visits these islands cannot but be moved by what they see, and that experience inevitably sparks countless questions. This book, with more than 68 species represented, provides answers to some of those queries, while providing an abundance of sources for those wishing to delve deeper into a particular subject. Galapagos is home to numerous iconic species found nowhere else on Earth. These endemics, the product of evolutionary processes that have taken place over thousands and millions of years, are what make Galapagos so special. It is here where an ancestral cormorant species arrived to the islands and, over time, lost its ability to fly – simply because it no longer faced predators. Instead, the cormorant found in Galapagos has evolved to become an expert diver and underwater swimmer, and uses its powerful feet to propel itself through the water.

Other species, too, arrived and flourished through rapid evolution – a process known as adaptive radiation, whereby a single ancestral species evolves into many distinct species, each adapted to fit a particular niche in the ecosystem. Darwin's finches, the Galapagos mockingbirds, as well as the iconic giant tortoises are all prime examples. Plants too have evolved in incredible ways: the genus *Scalesia* is an excellent demonstration of how one ancestral species arrived and spread across the archipelago, evolving into some fifteen recognized species today.

But Galapagos speaks not only to the uniqueness of each species, or group of derived species, but also to the collective assemblage of this bizarre suite of actors, adaptations, and behaviors gathered right on the equator. It is a place where tropical fish swim alongside penguins whose closest relatives inhabit the far southern regions of our hemisphere; where prickly pear cacti in the genus *Opuntia* have evolved into tree-like forms with a towering central trunk to impede herbivory by

land iguanas and giant tortoises with their long, stretchy necks; and perhaps most strikingly, a place where much of the fauna are indifferent to human presence. It is often this latter experience that leaves the deepest impression on first-time visitors. Yet the longer one spends on the islands, the more the myriad intricacies and oddities of Galapagos reveal themselves — and they never fail to astonish.

This new edition of the Galapagos Atlas not only speaks for the species of greatest conservation concern – the iconic penguins, marine iguanas, flightless cormorants, and giant tortoises of Galapagos – but also highlights the intruders: the introduced, and in many cases highly invasive and damaging species that are found across the archipelago. Some threaten the very fabric that makes these islands so unique, having altered and degraded thousands of hectares, while others are driving down populations of emblematic native and endemic fauna. An entire section of this book is dedicated to these introduced actors, in the hopes of shedding light on the fragile nature of these islands and the urgent need to support the many research and conservation initiatives striving to protect them.

And while this book does sound an alarm for the plight of Galapagos, it is above all a call to action — a reference library to inspire and revel in what makes these islands so incredible and unique. Remarkably, despite centuries of human contact, few species have actually gone extinct since the islands were first discovered nearly 500 years ago, which means that the community of species that make up Galapagos remains remarkably intact. This built in resilience offers hope. With focus and intent, we have an extraordinary opportunity to get things right — to allow Galapagos to continue to be not only a living laboratory of evolution, but also a global beacon of hope for conservation in a natural world that is at risk.

If we can achieve balance in Galapagos, and demonstrate that we can align conservation priorities with sustainable resource management, we can inspire change and spur similar action elsewhere. By protecting Galapagos, we can impact the world.

Rakan A. Zahawi

***Santa Fe Island -
Isla Santa Fe***

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GEOLOGY OF THE GALAPAGOS ISLANDS

Nearly all of the Galapagos Islands are volcanoes that were formed by the eruption of magma generated deep in the Earth. The islands are located south of a submarine ridge — the Galapagos Spreading Center (GSC) — which is the boundary between the Nazca and Cocos tectonic plates. The islands lie on the Nazca Plate, which moves almost 51 mm eastward each year. Galapagos magma originates in a mantle plume that extends to more than 1,000 km deep, and likely to the core-mantle boundary¹.

Owing to the movement of the Nazca Plate eastward over the mantle plume, the western volcanoes of the archipelago are historically active, and no rocks erupted before 200,000 years ago have been found in that region². Española Island, in the extreme southeast, is the oldest island in the archipelago, with lavas that erupted ~3 million years ago^{3, 4, 5}. Islands in the northern part of the archipelago, including Wolf, Darwin, and Genovesa, as well as many submarine volcanoes such as the Wolf-Darwin Lineament, were created by regional stresses generated by the interaction between the mantle plume and the Galapagos Spreading Center⁶.

The dominant rock type in the Galapagos Islands is basaltic lava*, which originates in fissures and vents at the top of volcanoes and in hundreds of satellite vents. The basaltic pyroclastic material (scoria and ash) is usually restricted to areas less than one kilometer from the vents. Alcedo (Isabela Island) and Rábida (Rábida Island) volcanoes are exceptional; both volcanoes have had explosive eruptions producing rhyolitic pumice^{7, 8**}. Tuff cones, which are hydrovolcanic in origin, are additional features on several Galapagos Islands⁹. This type of eruption occurs due to the rapid production of steam when hot magma makes contact with seawater or with water stored in calderas, creating volcanic tuff cones like the ones that line the coasts of many of the islands.

The archipelago is divided into several geologic sub-provinces based on the volcanoes' ages, shape, and composition of their lavas⁹. The oldest, or Eastern Subprovince, includes the islands of Española and San Cristóbal, which were active primarily 2-3 million years ago¹⁰. While Española has not erupted since that period, some of the lavas on San Cristóbal were produced as recently as 5,000 years ago^{10, 11}.

* Basalt is black lava rich in iron and magnesium, but with only approximately 50% silica by weight.
** Rhyolite is a light-colored rock, rich in silica (~70%), but lower in iron and magnesium than basalt.

The Central Subprovince comprises the major islands of Santa Cruz^{12, 13}, Santiago^{14, 15}, and Floreana^{16, 17}. Santa Cruz and Santiago have relatively gentle slopes, lack calderas, and have aligned systems of satellite vents, similar to San Cristóbal. Floreana, also located in the central archipelago, is distinct from its neighboring islands^{16, 17}. It has abundant scoria cones, and was formed more than 700,000 years ago. Many Floreana lavas contain fragments of olivine-rich material that was formed in the lower part of the Nazca Plate¹⁸.

The Western Subprovince comprises the historically active volcanoes of Isabela and Fernandina islands. The large shield volcanoes have symmetrical shapes, steep slopes, and large calderas. Volcano deformation studies indicate that magma resides in chambers less than two kilometers below each of the calderas^{19, 20}.

The Northern Subprovince comprises young volcanoes with lava less than one million years old. The islands are small and have different shapes from each other, because some of them have experienced major sector collapses (Wolf, Darwin)²¹. Darwin and Wolf islands are composed of layers of lava and volcanic ash generated by the energetic interaction between magma and seawater²¹ (**Figure 1**).

Dennis J. Geist and Karen S. Harpp.

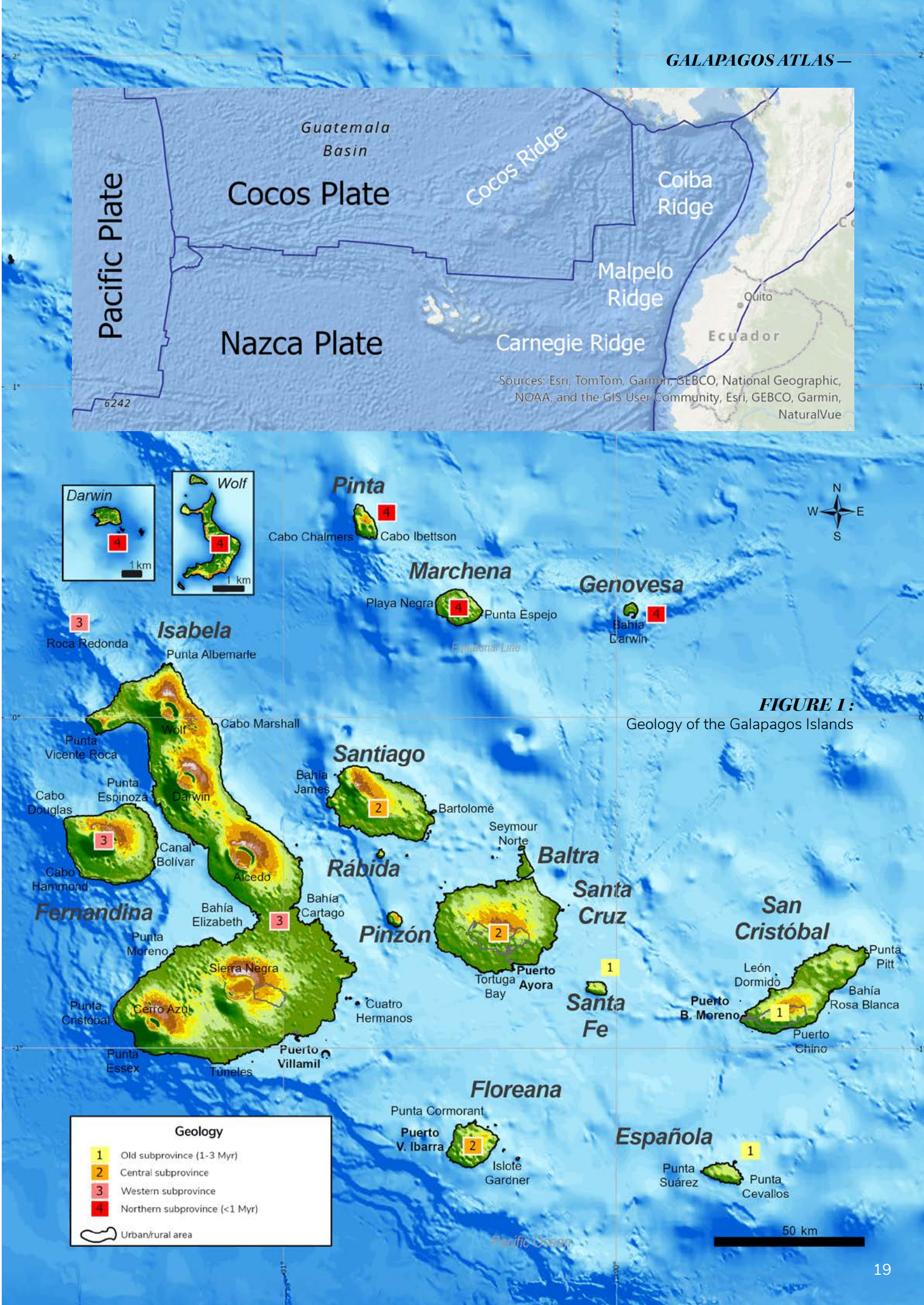


FIGURE 1:
Geology of the Galapagos Islands

CURRENTS AND CLIMATE

NORTH EQUATORIAL COUNTERCURRENT

The oceanic waters that converge around the Galapagos Islands are part of a climate system that influences the composition and health of ecosystems across the entire archipelago. These currents shape diverse habitats, sustain high biomass and a rapid turnover in marine life and foster considerable diversity. Despite lying on the north eastern margin of the Southern Tropical Gyre which is often described as a marine “desert” spanning the South Pacific, the Galapagos Marine Reserve (GMR) encompasses one of the most unique and dynamic oceanic environments on the planet. Four large-scale systems of marine currents converge upon the islands: The Equatorial Undercurrent (Cromwell Current), the Humboldt Current, the Panama Current and the North Equatorial Countercurrent (3-10° N) (**Figure 1**).

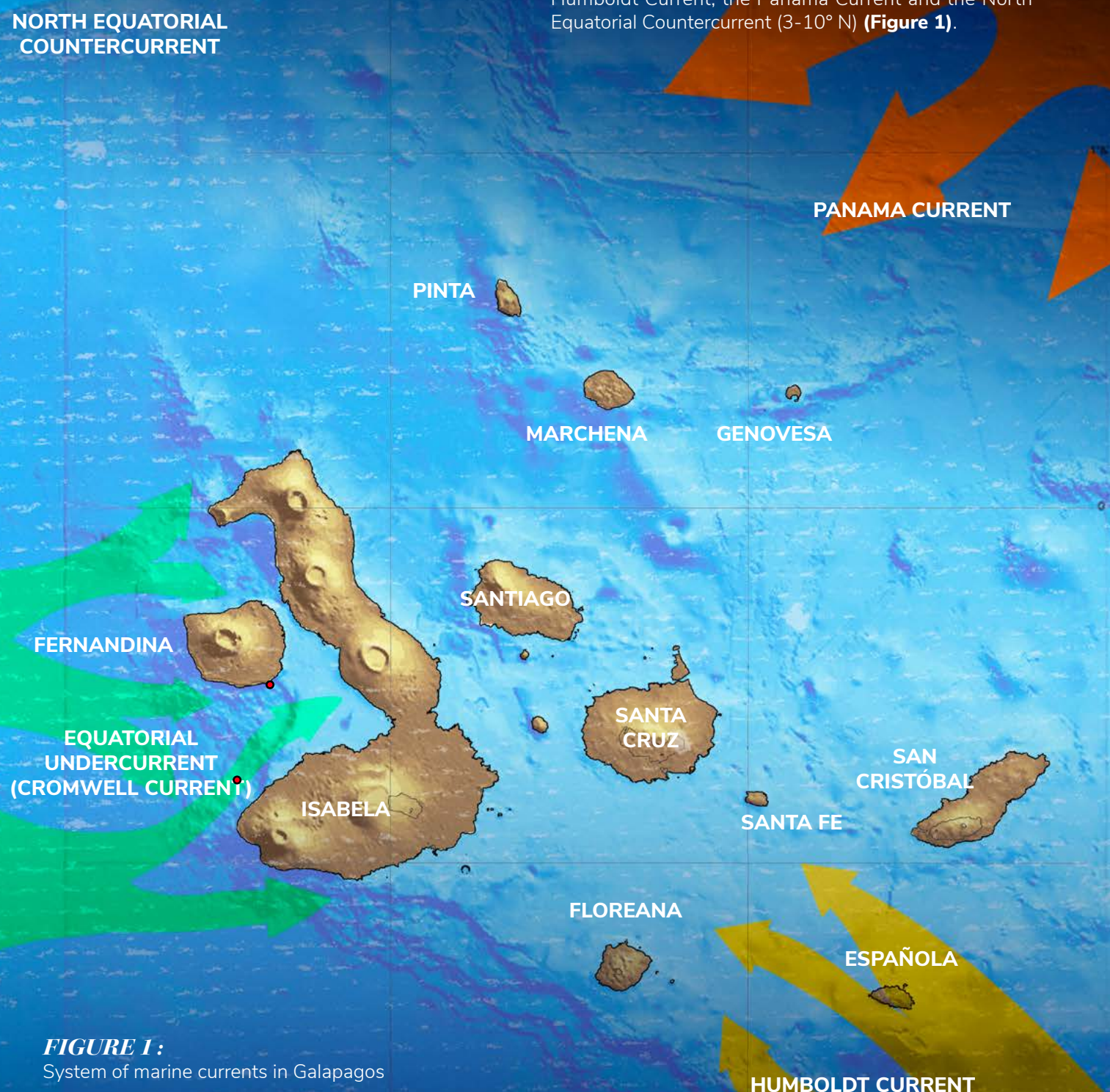


FIGURE 1:
System of marine currents in Galapagos

With productivity comparable to that sustaining huge Perú/Chile fisheries or the Benguela upwelling system of West Africa, the placing of the Galapagos Islands is fortuitous for the generation of life. The volcanic platform creates an “island effect” at a spot where four currents converge on the equator. As a result, immense phytoplankton blooms caused by upwelling of nutrients from deep waters deflect over the Galapagos Platform, sustaining complex trophic networks. Streaming to the west of the Islands, these blooms are so large that they are visible from space.

The Equatorial Undercurrent (Cromwell Current) is a deep compensatory flow that stimulates phytoplankton production as it meanders eastwards from the Indo-Pacific. Pushed into sunlit surface waters by physical processes such as internal waves, Ekman pumping (wind patterns that draw up water), collision with bathymetry and coastline, the overall effect is like a jet of undulating water hosed against a mound of rock. Filaments surge around the western edges of the platform, seamounts, and underwater ridges, curving around shorelines, forming surface eddies, generating a huge, localized influx of trophic energy into the coast and upper ocean. The resulting mosaic patchwork of cold productive habitat is a haven for marine endemism in the archipelago.

Such cold-water refuge “pockets” are most stable in the western isles of Isabela and Fernandina where they support unique marine biodiversity. Characterized by dense macro algal beds and green waters over vibrant rocky reefs, they are isolated areas likely encouraging speciation and create important nurseries for flora and fauna that depend on productive temperate waters.

At the surface, trade winds generally push the waters to the west and northwest, connecting GMR habitats to influences from both northern and southern hemispheres. The trade winds, so important for the first sailors, that cause upwelling along the coast of the Americas also push recently upwelled waters at the surface towards the equator. The stronger cold-water influence during the cool season (June – November), across the islands from the southeast is an extension of the strengthened Peruvian oceanic and coastal currents, during those months (collectively termed the Humboldt Current).

In contrast, to the north of the equator a warmer North Equatorial Countercurrent brings surface flow from the Indo-Pacific. Warmer water bathes the northerly islands and progresses southwest across the GMR as the trade winds weaken into the warm season (December – May). The confluence of warm and cool water masses typically forms a productive and transient oceanic front and an important foraging area for pelagic species. Such extremes and connections to the wider Pacific are what make the biogeography of the islands so remarkable. The contribution of cold Peruvian/Chilean waters interacting with the warmer, less salty circumtropical Panama flow

allows the coexistence of unlikely mixes of species such as penguins and corals.

In the far north, the islands of Wolf and Darwin are exposed to warmer waters for most of the year, providing shelter for the last surviving frameworks of large reef forming corals. Strong El Niño-Southern Oscillation (ENSO) events in 1982-1983 and 1997-1998 drastically bleached susceptible corals. The 1-3% of coral communities that persist today, although localized, exhibit a certain natural resilience and a slow recovery. The northerly islands are considered particularly sensitive conservation targets given productive coral habitat and the attraction of large migratory pelagic species to the cleaning stations and foraging areas that flank the exposed oceanic pinnacles.

Changes in climate in the Pacific are a distinctive feature that defines the natural history of the Galapagos Islands. The ENSO event has had the greatest natural influence on the ecology of the islands. As a weather pattern operating throughout the Pacific basin, with important teleconnections to the global climate system, ENSO has influenced the temperature and precipitation of the islands in cycles of two to seven years for millennia.

Climate shifts are critically important for island conservation, influencing the viability of local fisheries, the risk posed by invasive species, and the biosecurity of the islands. The alternating periods of extreme food limitation — when nutrient upwelling is reduced during El Niño events — and periods of re-supply during ENSO “neutral” years and La Niña conditions have significant impacts on marine life. Model predictions raise concerns that, as the tropical Pacific warms, the frequency of strong weather events generated by El Niño may increase, as recently observed during 2015-2016, thereby reducing natural recovery intervals. Cold upwelled water, although rich in vital nutrients, is also naturally more acidic than surface waters. pH values lower than 8.0 degrade coral reef structure and limit their capacity to recover. Combined with El Niño-induced bleaching and grazing by reef urchins, there is real risk that vulnerable species may disappear throughout the archipelago.

We are clearly entering an era of worldwide accelerated climate change. Research aims to resolve many of the concerns and implications of altered seasonality, intensity and period of climate events, recognizing that ENSO strongly influences the biodiversity footprint we see today. The interactions between how the GMR is used, alongside warming, acidification, shifting currents and productivity on Galapagos biota are under investigation. Understanding and mitigating the cumulative effects of climate change caused by global industry alongside the regional human footprint over the last 60 years is an increasingly important objective for the successful management of the GMR.

Stuart Banks and Jon D. Witman

ECOSYSTEMS AND BIOREGIONS

In a terrestrial environment, vegetation determines the different ecosystems. Its distribution is explained by climatic factors such as temperature, precipitation, winds, and the type of soil and altitude. Other biological variables such as competition between species, the capacity they have for dispersal and fauna-plant interaction are also very important when it comes to explaining their distribution in the archipelago.

According to the latest vegetation cover analysis¹, there are nine terrestrial ecosystems spatially defined in Galapagos (listed in order from the coast to the summits): Mangroves, Humid Beach Forests and Shrublands (Coastal Zone and Wetlands); Deciduous Forests, Deciduous Shrublands; Deciduous Grasslands (low Arid Zone); Seasonal Evergreen Forests and Shrublands (Transitional Zone); Evergreen Forests and Shrublands (*Scalesia* and *Miconia* zones); Humid Grasslands (previously known as Pampas Zone); and Deciduous Highland Grasslands (high Arid Zone). The Deciduous Highland Grasslands occur mainly in the upper elevations of the volcanoes on Isabela Island (Figure 1).

The marine ecosystems of the Galapagos are unique because the archipelago lies at the crossroads of several powerful ocean currents. From the northeast arrives the warm Panama Current, from the southeast flows the cold Humboldt Current, from the west the deep Cromwell Current rises as it collides with the Galapagos Platform, and the North Equatorial Countercurrent. This process, known as upwelling, brings cold, nutrient-rich waters to the sunlit surface of the ocean², creating ideal conditions for marine life. Although this is a simplified explanation of a more complex oceanographic system, it helps to illustrate why the Galapagos hosts one of the most productive marine ecosystems in the world³ — This is explained in more detail in the preceding section.

Another key factor shaping marine ecosystems is bathymetry, which refers to the depth and topography

of the seafloor. Around the Galapagos Islands, the surrounding ocean is very deep, reaching about 2,000 m. However, volcanic activity has created a relatively shallow submarine platform at approximately -500 m depth, which makes up only about 12% of the Galapagos Marine Reserve (GMR). The water column above this platform is known as the neritic environment. Beyond the platform, most of the GMR lies between -500 and -4,000 m, an area strongly influenced by ocean currents and nutrient availability. These conditions give rise to relatively deep upwelling zones where productivity is enhanced. Within this setting are also found seamounts — underwater mountains that rise hundreds to thousands of meters from the seafloor but do not break the surface⁴. Seamounts generate localized upwellings and host distinctive biological communities, contributing to the ecological richness of the region.

The Galapagos coastline extends for approximately 2,000 km and hosts a variety of ecological communities that vary with depth. These include the splash zone, the intertidal zone, the upper subtidal zone (which extends down to the limit where photophilic algae can grow, i.e. species that require abundant sunlight), and the lower subtidal zone. Most of the coastline is rocky, but it also features sandy beaches, which represent around 15–20% of the total shoreline, as well as mangrove forests, which cover approximately 35% of the coast⁵.

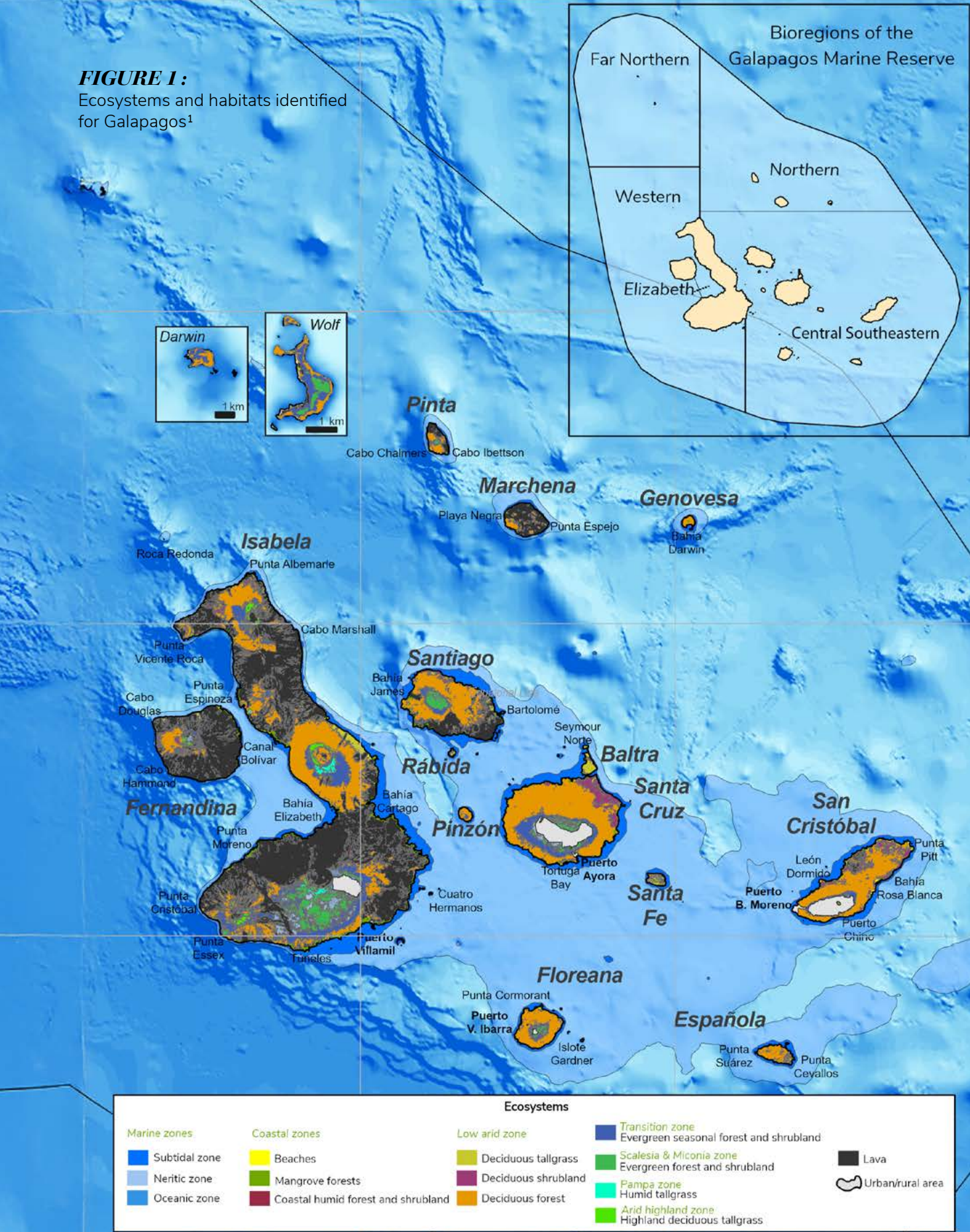
The benthic communities (those on the seafloor) vary according to whether the bottom is rocky (hard bottom) or composed of unconsolidated sediments such as sand or silt (soft bottom), as well as by slope, orientation, depth, and the influence of waves and currents. Based on the composition of reef fish and macroinvertebrate communities inhabiting the rocky upper subtidal zone, the archipelago is divided into three main bioregions: the Western Bioregion, the Far Northern Bioregion, and the Central Southeastern Bioregion. Additionally, two subregions are recognized: Elizabeth Bay–Canal Bolívar and the Northern Subregion, which includes Pinta, Marchena, and Genovesa islands⁶ (Figure 1).

Nicolás Moity and Gonzalo Rivas-Torres.



Wolf Island -
Isla Wolf
© Mara Speece / CDF

FIGURE 1:
Ecosystems and habitats identified
for Galapagos¹



HUMAN PRESENCE IN GALAPAGOS

Puerto Ayora, San Francisco Park -
Puerto Ayora, Parque San Francisco

© CDF Archive



Human Population

The Galapagos Islands, home to many unique species in the world, have been the protagonists of a captivating natural and human history. Officially — though accidentally — discovered by Fray Tomás de Berlanga in 1535, the islands served for centuries as a refuge and supply hub for a variety of seafarers, including pirates, whalers, and naturalists.

The Galapagos Islands were annexed to the Ecuadorian territory on February 12, 1832, and began to have global significance in 1835, when Charles Darwin visited the archipelago aboard the HMS Beagle. This event became more significant in the subsequent years

to 1859; the year in which Darwin published his book *On the Origin of Species by Means of Natural Selection*. The book caused great controversy at a scientific and academic level, generating worldwide interest, and quickly positioned the Galapagos Islands as one of the most recognized archipelagos on Earth.

Human presence however remained limited in Galapagos for nearly a century after Darwin's visit. It was not until the 1960s that the islands' global recognition encouraged the gradual development of various economic activities, especially tourism, as well as a greater human presence on the inhabited islands.

In the 1980s, demographic and socioeconomic changes began to increase considerably across the four inhabited islands. This shift was closely tied to the archipelago's rise as a world tourist destination following its designation as a UNESCO Natural World Heritage Site in 1978. Before that, the demographic and socioeconomic changes that occurred within Galapagos were based mainly on small-scale agriculture, fisheries, and trade.

With the rapid expansion of tourism, a new economic dynamic was established, which paved the way for new forms of income and, at the same time, boosted an increasing demand for products and services. On one hand, it created new sources of income for local and national populations; on the other, it heightened environmental pressures — raising the individual ecological footprint through increased consumption of energy and water, greater waste production, and expanding demands for goods and services.

As of the 1970s, the annual growth rate of the population rose to 4.6%, peaking at 7.7% in the 2000s. This trend led to a growth in the population from about 4,000 inhabitants at the beginning of the 1970s, to more than 20,000 by the end of the 2010s, and surpassing 28,000 inhabitants in 2022 — after which the annual growth rate declined to 1.6% (Figure 1)¹.

Such population growth has placed significant pressure on local ecosystems and their natural resources. It has contributed to the increased presence of invasive species, heightened demand for basic services, greater pressure for changes in land uses, and increased reliance on import of supplies arriving by air and sea, among others.



Cameraman and mockingbird -
Camarógrafo y cucuve
© CDF Archive

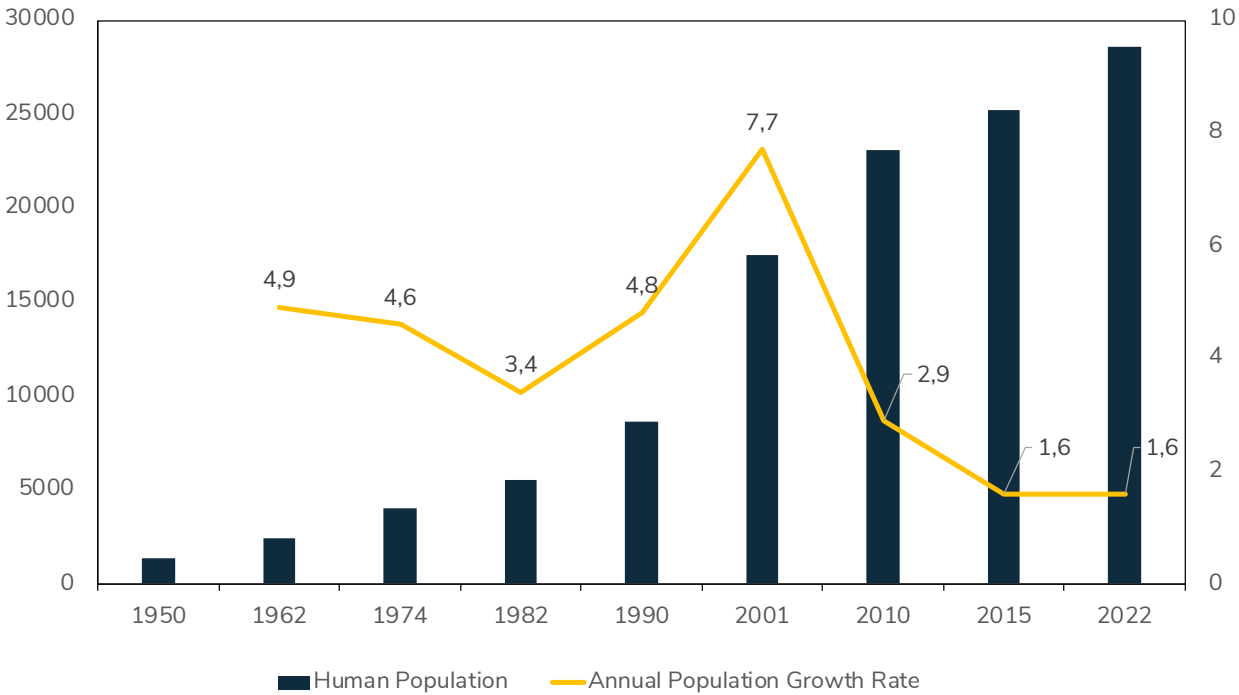


FIGURE 1: Galapagos Population and annual growth rates¹.

Fishing

Fishing is one of the oldest and most important cultural and economic activities in Galapagos. More than 60 marine species are captured inside the Galapagos Marine Reserve, including lobsters, groupers, albacore or Yellowfin Tuna, and sea cucumbers, which are among the valuable resources. This activity is conducted using traditional artisanal methods such as diving, trolling, handlining and pole and line fishing.

Fishers are organized into five fishing cooperatives and one association, all established across the four inhabited islands. The activity provides direct employment to more than 500 people in the archipelago and yields an annual gross income of more than four million U.S. dollars.

**Fishers -
Pescadores**
© Juan Manuel García / CDF

One of the ongoing challenges for conservation and sustainable development in Galapagos is the proper management of its fishing resources. Based on the existing management measures that promote responsible fishing, for example, it was possible to recover the populations of spiny lobster and Sea Cucumber on the islands. However, continued efforts are needed to ensure the recovery and long-term sustainability of other key fish species, such as the Galapagos Sailfin Grouper (locally known as Bacalao) and White-Spotted Sandbass (also known as Camotillo).



Solid Waste Management: The Case of Santa Cruz Island

Solid waste management remains one of the most pressing environmental challenges in Galapagos, closely tied to population growth, tourism, and changing consumption patterns. In 2024, Santa Cruz — the most populated island and main tourism hub — generated 5,321.7 tons of waste, averaging 14.6 tons per day. The per capita rate of 0.9 kg per inhabitant per day exceeds the national average, underscoring the urgency of robust systems and long-term planning.

The Parque Ambiental Fabricio Valverde (PAFV) serves as the central facility for classification, treatment, and transfer. Waste streams include organics, recyclables, and non-recyclables, alongside special categories such as sanitary residues, rubble, electronic waste, and used tires. In 2024, waste composition was 18% organic, 27% recyclable, and 55% non-recyclable, with recyclables achieving a 49.5% recovery rate (Figure 2)². While progress has been made, limited infrastructure, high transportation costs, and the dependence on continental evacuation remain significant challenges.

Partnerships have enhanced management efficiency. With Geocycle Ecuador S.A., 103 tons of non-recyclables — plastics, foams, textiles, fishing gear — were co-processed into fuel for cement plants. Through SEGINUS, 7,882 tires were evacuated, while more than 600 mattresses and bulky items were shipped to the continent for recycling. However, scaling up such initiatives requires stable funding, stronger regulations, and greater community participation.

Recent municipal investments in compaction equipment, trucks, and the planned Phase II expansion of the sanitary landfill reflect a commitment to sustainability. Yet, the future challenge is to balance increasing waste volumes with limited island capacity, ensuring that Santa Cruz continues to serve as a model for integrated management while safeguarding fragile ecosystems.

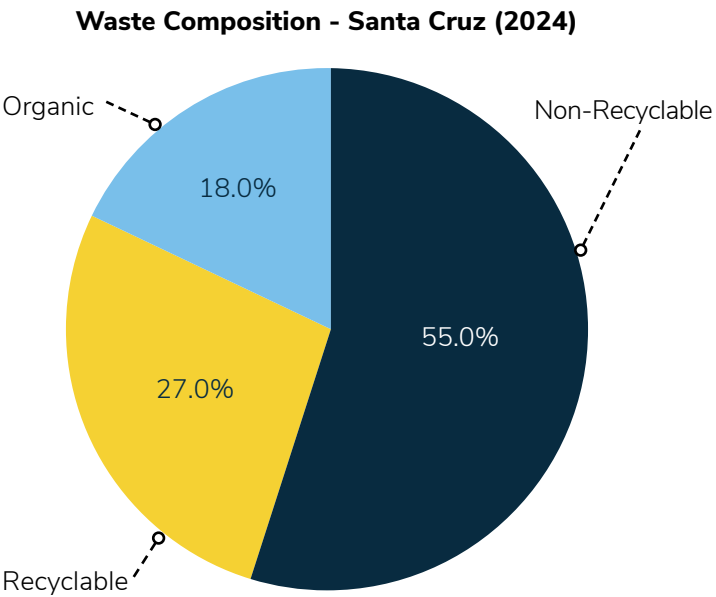


FIGURE 2: Waste composition, Santa Cruz Island, Galapagos 2024².



Tourism

Tourism, once a marginal economic activity in the 1970s, has evolved into the principal driver of local socio-economic development and one of Ecuador’s most significant sources of foreign revenue. In 1979, just over 11,000 visitors arrived in the Galapagos Islands. By 2019, that figure had risen to 271,238, representing a historic peak before the COVID-19 pandemic drastically reduced global travel in 2020. Since then, visitation has rebounded strongly: 267,688 visitors were recorded in 2022, an unprecedented 329,475 in 2023, and 279,277 in 2024, consolidating tourism as a resilient sector despite fluctuations caused by external factors (Figure 3)³.

A profound structural shift has reshaped the tourism industry. Whereas cruise-based tourism dominated for decades, since 2009, the majority of visitors have preferred land-based experiences on the inhabited islands. This transformation has been reinforced by the growth of accommodation, restaurants, and tour operators, along with the emergence of hybrid models that combine land stays with day tours. Specialized niches — including diving, educational and scientific programs, and community-based initiatives — have gained prominence, reflecting global trends toward authentic and sustainable travel experiences.

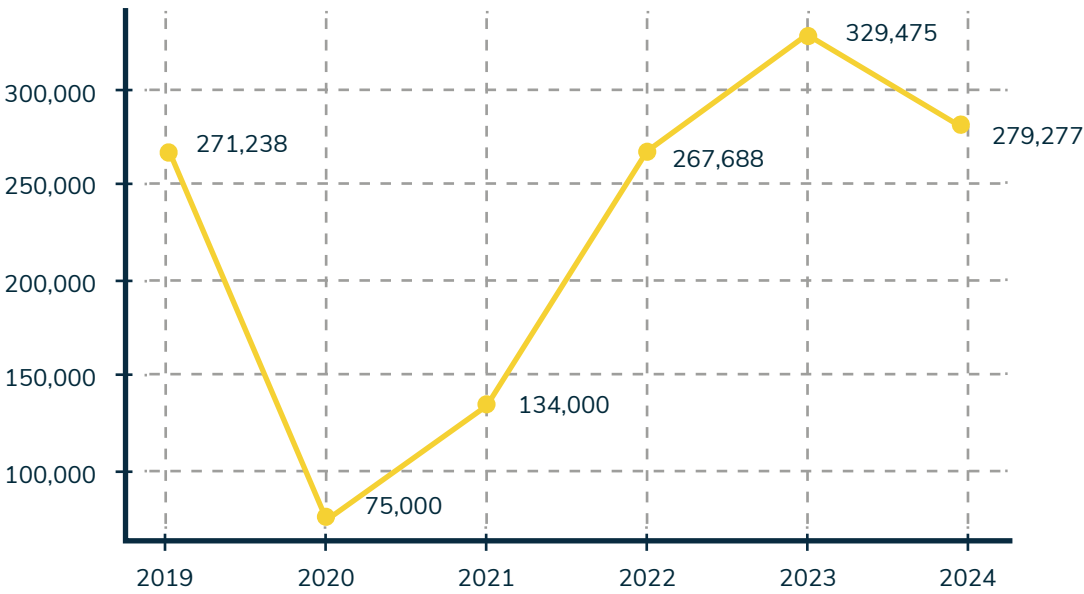
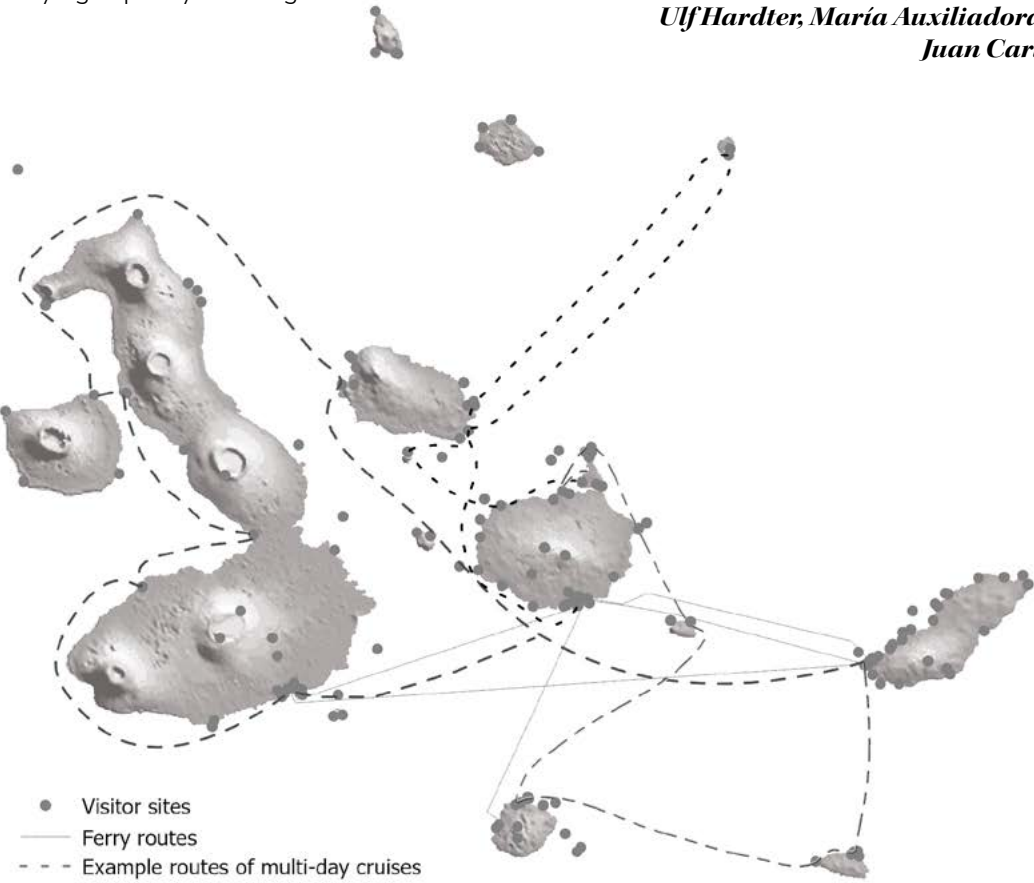


FIGURE 3: Tourist arrivals to Galapagos 2019-2024³.

The expansion of the tourism sector has had clear multiplier effects. Tourism stimulates construction, commerce, fisheries, agriculture, and transport, generating employment and income for both local and national economies. At the same time, rapid growth has placed significant pressure on fragile ecosystems, infrastructure, and basic services, particularly in terms of freshwater demand, energy consumption, food supply, and solid waste management. Popular visitor sites such as Tortuga Bay, Los Túneles, and Seymour Norte are already facing carrying capacity challenges.

As visitation stabilizes at historically high levels, the central challenge for the coming years will be to balance economic benefits with conservation imperatives. Strengthening regulatory frameworks, adapting visitor management systems, improving monitoring systems, and ensuring reinvestment of tourism revenues into conservation and community development are critical steps to guarantee that Galapagos remains a global benchmark for sustainable tourism.

*Juan Carlos García, Jorge Ramírez-González,
Ulf Hardter, María Auxiliadora Farias M.,
Juan Carlos Izurieta*



CHARLES DARWIN OBSERVATIONS

Reflecting on his five-year voyage aboard the H.M.S. Beagle (**Figure 1**), Charles Darwin wrote in his autobiography, published in 1876: "It has been by far the most important event of my life and has determined my whole career."

Why was this trip so important and transformative? Darwin's visit to Galapagos and his discovery of the geographical distribution of organisms on these islands were pivotal in shaping his conviction about the evolution of species. Yet before his work on species, the voyage had already established his reputation as a respected scientist through his contributions to geological science. Soon after returning to England, he was considered a leading expert on South American geology and gained recognition for explaining how coral atolls are formed from the subsidence of volcanic islands¹.

During the voyage aboard the H.M.S. Beagle, Darwin's primary role was that of a geologist, including during the time he spent in the Galapagos Islands. While biographies on Charles Darwin address his role as a geologist during the voyage, they often either omit or downplay his principal scientific work in Galapagos

by not referring to information contained within his Geological Diary — the most fertile source of insight into his scientific theories on the geology of the islands^{2,3}. In fact, in his scientific notes, Darwin wrote three times more on the geology of the islands than their zoology^{1,2,3}. He conducted the first geological survey of the Galapagos Islands and came up with explanations for the origin of the islands' geological formations. For example, he proposed explanations for the formation of volcanic tuff cones through the interaction of lava with water, and for how different rock types could originate from the same vent via gravity settling of crystals¹.

Darwin's zoological insights, by contrast, was largely retrospective — developed after his return to England, when specialists like John Gould, who described Darwin's bird specimens, were able to tell him what species he had collected and whether they were new to science, unique to Galapagos, and distinct on the different islands.

The primary mission of the voyage, dictated by the British Admiralty, was to conduct a hydrographic survey of the coasts of South America and, if time permitted, to examine the Galapagos Islands. The crew aboard the H.M.S. Beagle spent three and a half years developing the cartography of the coastlines of South America before reaching the archipelago. Fortunately for Darwin, there was time to continue the mapping in Galapagos. It was serendipitous that the first two islands he visited — San Cristóbal (Chatham) and Floreana (Charles) — each possessed its own species of mockingbird, exhibiting a high degree of endemism. The distinct species of this group of birds on the islands were key to Darwin's eventual understanding of evolution through geographical isolation.

Darwin first began to question the "stability of species" while examining his mockingbird specimens from Galapagos on his way back to England. In his book on the Origin of Species, he specifically refers to the mockingbirds, yet omits mention of the finches and the tortoises. Although the finches featured in Darwin's thinking on evolution, at the time of his visit to the islands he was not even sure that they were all finches and failed to record the islands from which each specimen came — unlike the mockingbirds whose localities he carefully noted. It wasn't until his return to England that he realized their significance after they were described by John Gould.

tortoises also contributed to Darwin's acceptance of the idea of evolution by geographic isolation. Although he did not personally observe these interspecies differences, he relied on the assertions of Floreana Island's acting governor and tortoise hunters on Santiago Island (James), who claimed that tortoises differed in morphology among the islands.

Plants, too, helped reinforce Darwin's evolutionary thinking. Fortunately, because he labeled his botanical collections by locality, he discovered that species like those in the genus *Scalesia* differed between islands. In the second edition of the Voyage of the Beagle, there is a table that shows the number of unique plant species on the islands of San Cristóbal, Floreana, Isabela (Albemarle) and Santiago.

Darwin's three years of geological observations in mainland South America — where he found evidence of the gradual change in the Earth's crust through uplift and subsidence — were followed by his observations on the geographical distribution of organisms in the Galapagos Islands. His observations of this gradual geological change led him to reflect on the idea of a gradual change from one species into another, due to isolation in Galapagos — and to contemplate the "mystery of mysteries: the first appearance of new beings on this earth"^{1,2,3}.

Official Charles Darwin impersonator -
Personificador oficial de Charles Darwin

© Carlos Espinosa / CDF

The differences Darwin observed in Galapagos giant

Gregory B. Estes

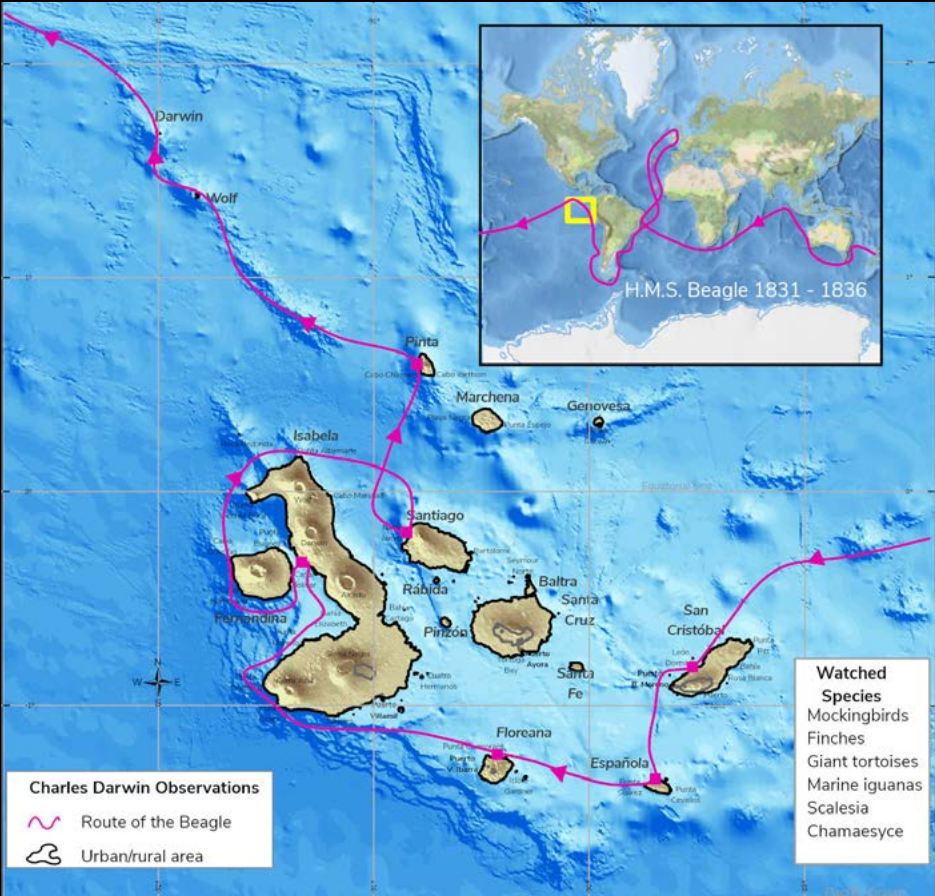


FIGURE 1: H.M.S Beagle voyage

THE ORIGINS OF CONSERVATION SCIENCE IN GALAPAGOS

The Ecuadorian diplomats, international scientists and institutional leaders who established the Charles Darwin Foundation (CDF) in Brussels in 1959 believed that the best way to achieve conservation of Galapagos was to first establish a research station on the islands.

Conservation problems had been identified in general terms in previous years, and the unsettled land had been declared a National Park by the Government of Ecuador¹, but it was not clear which of these problems needed to be tackled first — or how this could be done most effectively. Establishing a research station would provide the necessary knowledge to guide these efforts. In many ways, the timing was right to create this field research station. Similar stations had been established in various parts of the world, and with that experience, along with the strong support from the Government of Ecuador and funding from UNESCO and other institutions in Europe and the United States, setting up such a facility in Galapagos seemed a realistic undertaking. However, no National Park management expertise yet existed in Ecuador. The Galapagos National Park, created a few weeks prior to CDF's establishment, was the first of its kind in the country, and building such expertise would take time.

Concrete steps to set up the Station were taken immediately in 1959 when an enthusiastic young Swiss scientist, Raymond Lévêque, was hired by UNESCO to build what was needed. He arrived in the Galapagos Islands in 1960, with the mandate to build the research station at Tortuga Bay using wood as the primary building material. Tortuga Bay is a beautiful location, but massive infrastructural interventions would have been required to make it accessible.

Lévêque had to act quickly and was unable to communicate with his supervisors in faraway Europe in a timely manner. Following local advice rather than the recommendation of technicians, he courageously went against the original plan and built the first facilities — using lava rocks and locally produced blocks — in the spot where the Charles Darwin Research Station (CDRS) stands today, near Puerto Ayora.



Conditions were extremely challenging. Lévêque had to travel frequently to the continent to find support and building materials, yet he succeeded in constructing a dock, two buildings, and a footpath to the village. He returned home after two and a half years, believing that he had failed — but today it is clear that Raymond Lévêque was the one who truly put the Charles Darwin Research Station on the map.

Clearly, the CDF founders understood the need for solid research to determine conservation priorities and develop effective conservation methods. The history of the CDRS is full of examples showing how this principle has guided its work.

The earliest example was the effort to gather information on the surviving populations of giant tortoises, which began in the 1960s. This early research demonstrated how success depended on close collaboration between scientists and local field experts. One of the first such partnerships was between scientist David Snow and

*Charles Darwin Research Station 1989 -
Estación Científica Charles Darwin en 1989*
© CDF Archive

local experts such as Miguel Castro and tireless local field workers like Oswaldo Chapi. A few years later, the immediate threats to tortoise survival became better understood through the studies of Craig MacFarland, who again worked closely with local collaborators and with the first Galapagos National Park officers — José Villa, Juan Black, and Basilio Toro — who joined the team in 1968.

As a result of that research, the “what” and the “how” of Giant Tortoise conservation started to be much better understood, and the fact that most tortoise species are now expected to survive is a direct outcome of the applied conservation research initiated in the 1960s.

A current example of the enduring importance of this “science-first” principle is the ongoing search for methods to counter the threat posed by the introduced Avian Vampire Fly (*Philornis downsi*). Years of painstaking research are needed to find ways to mitigate this existential threat to all small Galapagos land bird species.

The threats facing Galapagos wildlife have not disappeared — on the contrary, the dangers posed by invasive organisms have only increased. Long-term solutions will depend, as always, on rigorous scientific research.

There is a second important reason why science-based knowledge is indispensable for achieving effective conservation: scientific understanding must also form the foundation of environmental education and training — and the CDF founders certainly understood that. When the Galapagos National Park and the CDF were created, most Ecuadorians understood Galapagos to be a faraway part of their country, suitable for settlement or where penal colonies were established. Outside Ecuador, the general public — if it had heard anything about the Islands — held more romantic, yet equally unrealistic ideas about the Islands. The CDF founders understood that, to achieve lasting conservation, it was not enough to accumulate scientific data; it was equally important to broadcast knowledge and foster an understanding of the unique natural values of the Islands.

The research station, where information would be produced and stored, was envisioned as a knowledge center, promoting real understanding of these values. Ecuadorians — and the world at large — needed to appreciate that these islands are irreplaceable, and that they are the only tropical archipelago whose ecosystems had not yet been destroyed by human intervention.

This educational and training work would best be carried out by professionals who were not necessarily scientists. It was likely no accident that the first natural history course for Galapagos school teachers was initiated in 1966 by Roger Perry, the third CDRS Director and one of the few who was not a career scientist, but made education a priority. Beginning with that course, the CDRS became a hub for providing information and training to teachers, journalists, tour guides, National Park rangers, and many other Ecuadorians and foreigners.

The first to directly benefit from informal training, through collaboration with early Station staff, were the three National Park officers mentioned above. Immersed in conservation work soon after their arrival in 1968, Juan Black wrote and published in 1973 the first and only general description of the Galapagos, in Spanish. It remains one of the best general descriptions of the Islands to date.

In the foreword, Black writes: “I chose the title *Galápagos, Archipiélago del Ecuador* in order to firmly connect the Islands and its wildlife to our homeland Ecuador”². This statement not only emphasizes that the Islands are part of Ecuador but also reminds the nation — and all Ecuadorians — of their responsibility to protect this unique archipelago forever.

Peter Kramer

***FACT SHEETS
OF SPECIES
AND GROUPS
— Methodology***

*West Santa Cruz Giant Tortoise -
Tortuga del Oeste de Santa Cruz
Chelonoidis porteri
© Carlos Espinosa / CDF*

STRUCTURE AND CONTENT

The endemic, native, introduced, and invasive species featured in this Galapagos Atlas were first defined during a 2016 workshop between the Charles Darwin Foundation (CDF) and WWF-Ecuador teams for the first Spanish Edition.

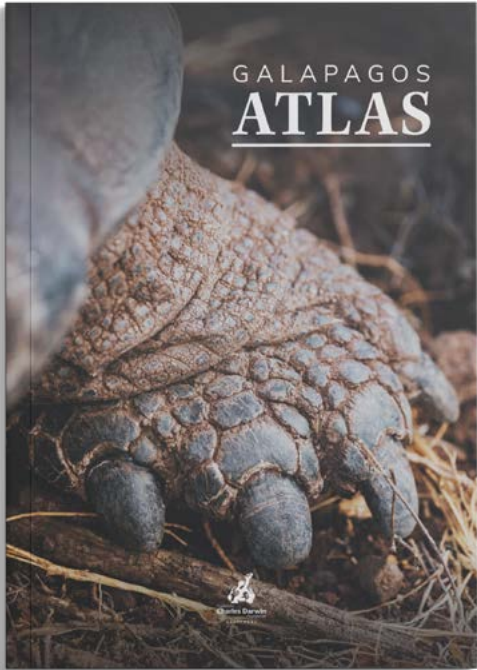
Following its strong reception and continued scientific research in Galapagos, a Second Edition was developed, incorporating updated **Fact Sheets**, additional species, and new topics. Selection of species and topics was guided by the Atlas's Editorial Committee and Editor-in-Chief, based on their ecological, economic, or cultural significance.

While the Galapagos Atlas is not intended as a comprehensive catalogue of all Galapagos species, it serves as a scientific and educational tool — offering an analytical overview of selected species and the current state of scientific knowledge about them.

Organization of Fact Sheets

Fact Sheets are categorized as **Endemic, Native, Introduced, or Invasive Species**. Each category includes **Fact Sheet Groups** and **Individual Fact Sheets** organized in taxonomic classification at the order level.

- **Endemic or Native Species Fact Sheets** describe endemic and native species naturally established in Galapagos ecosystems over thousands of years, that play a critical role within the bioregions or ecosystems they inhabit.
- **Introduced or Invasive Species Fact Sheets** describe non-native species that cause ecological harm to the ecosystem and/or one or more of its components¹.

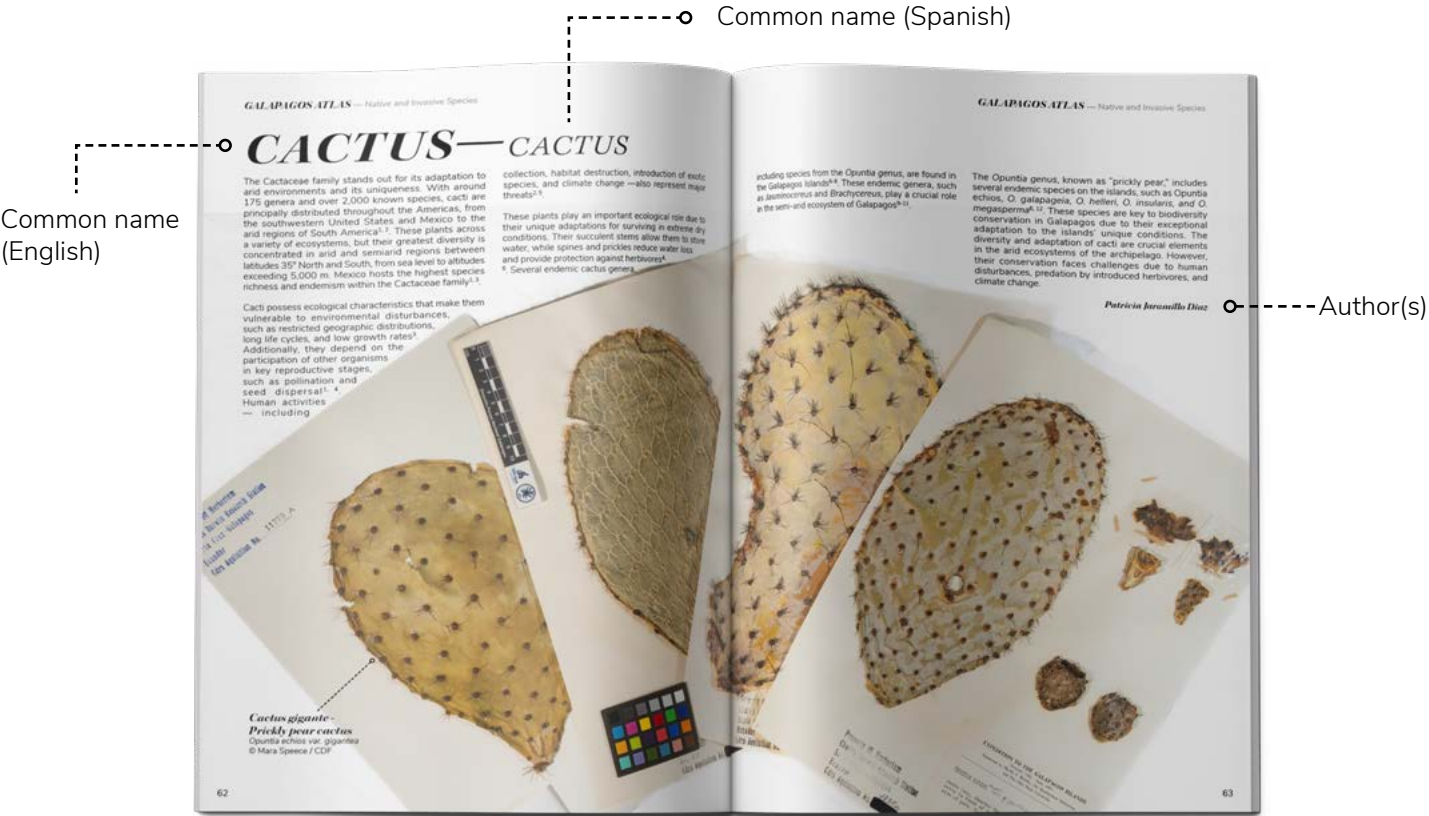


Fact Sheet Groups

These present information on groups of taxonomically related species (e.g., finches, tortoises, invasive rodents), and include **Individual Fact Sheets** for representative species. Some groups — such as endemic Asteraceae, giant tortoises, sea lions, and finches — include multiple

representative species. Each **Fact Sheet** contains the following information:

- Common name (English & Spanish)
- Relevant information
- Author(s)



Individual Fact Sheets

These focus on a single species and include the following information:

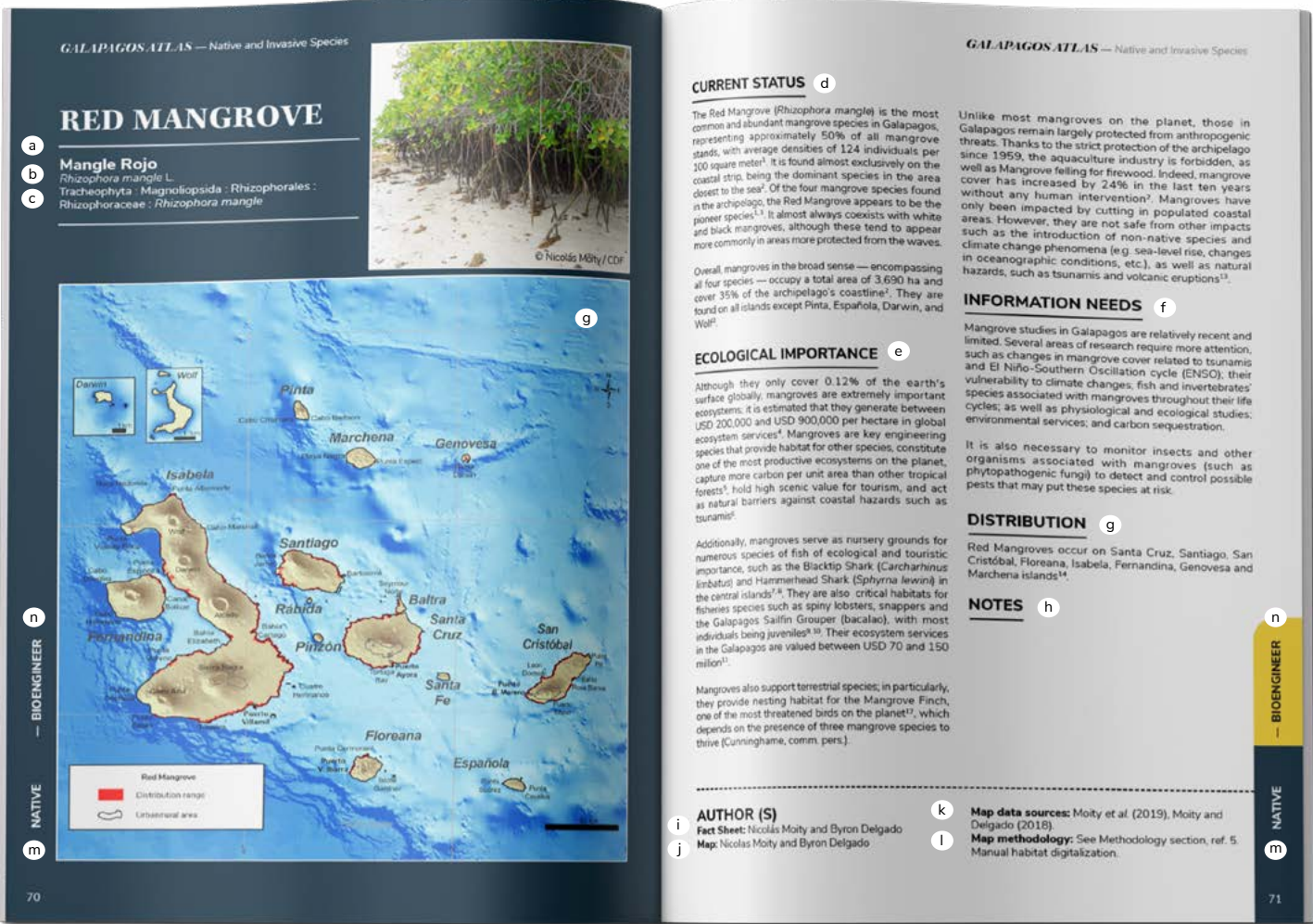
- a. Common name** (English & Spanish).
- b. Scientific name** (*Genus, species, authority, year*).
- c. Taxonomy** (Kingdom : Division : Class : Order : Family : *Genus species*).
- d. Current status.** Describes population status, habitat details, distribution, and other relevant information of *Endemic, Native, or Single-island Species*; and for *Introduced or Invasive Species* includes the invasion history.
- e. Ecological importance.** For *Endemic or Native Species*, this section outlines the species' ecological or functional role (*Keystone, Bioindicator, Sentinel, Bioengineer, or Single-island Species*), interactions with other species, habitat use, and other relevant aspects. For *Introduced or Invasive Species*, it details current and potential ecological impacts.
- f. Information needs.** Identifies the information gaps and research needs, as defined by the authors of each Fact Sheet.

- g. Distribution.** Geographic occurrence in Galapagos and its surroundings.
- h. My notes.** A designated space for you to write your own observations and thoughts.
- i. Fact Sheets author(s).**
- j. Map author(s).**
- k. Map data source.** Information collected (see Methodological framework for Atlas Maps).
- l. Map methodological framework used for Atlas Maps.**
- m. Galapagos origin category label.** Endemic, Native, Introduced, or Invasive species.
- n. Ecological importance category label.** Species are categorized according to their ecological or functional role in Galapagos (*Keystone, Bioindicator, Sentinel, Bioengineer, or Single-island Species*).

Definitions of Ecological Roles

- Keystone Species:** These species play an important role in their bioregion or ecosystem. They are essential targets for conservation measures and often hold cultural, traditional, or contemporary significance and/or economic importance (e.g., in fisheries or tourism). This category combines the characteristics of *Sentinel* and *Bioindicator species*.
- Sentinel Species:** These species show measurable responses to environmental impacts (negative or positive), and can therefore signal shifts in ecosystem health. They are easy to capture and/or census, and their population size or density provides accurate indicators for monitoring².
- Bioindicator Species:** The biological or ecological characteristics (such as toxin levels, reproductive success, mortality, population levels, among others) of

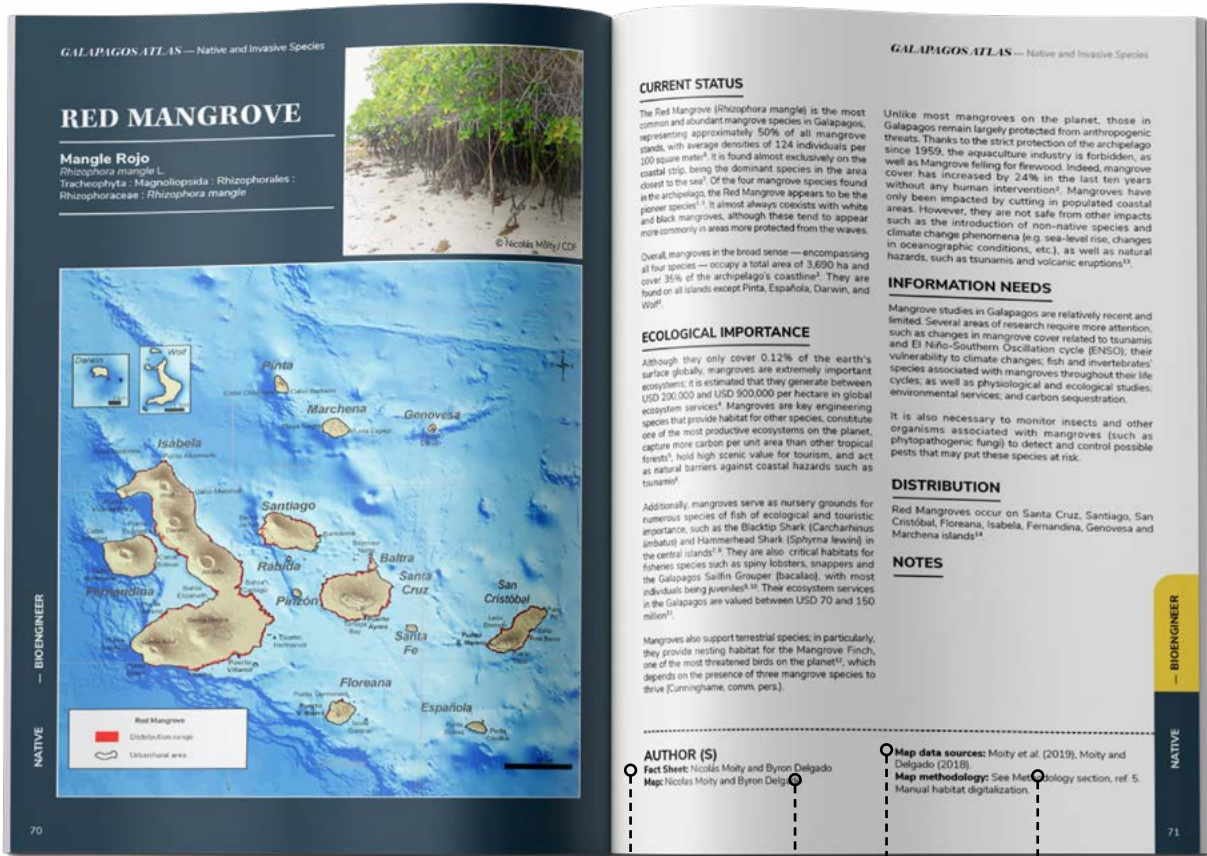
- these species can be used as measures of the health of a bioregion or ecosystem. Because of their connection to broader ecological processes, in certain cases, these species can serve as a tool to evaluate the effectiveness of management actions^{3,4}.
- Bioengineer Species.** These species significantly modify, create, or maintain habitats and ecological processes within an ecosystem, thereby influencing other species and the overall functioning of the system.
- Single-Island Species:** These species are endemic to the archipelago, with distributions restricted to a single island. Their limited geographic range makes them particularly vulnerable to external threats.



Methodological Framework for the Development of the Atlas Maps

The species Fact Sheets include maps of species distributions generated using Geographic Information Systems (GIS). GIS facilitates the collection, processing, analysis, synthesis, and visualization of spatial information, resulting in reliable and easily interpretable maps. Because comprehensive field data are rarely available, most of the maps presented in this Atlas are not simple representations of existing records, but rather modelled distributions that integrate multiple data sources and analytical approaches

Data collection combined Expert Knowledge (EK) from species specialists with the technical expertise of GIS professionals, supported by literature reviews and available datasets. Information on species distribution was translated into georeferenced ranges of distribution, ensuring scientific rigor and spatial consistency. Maps were iteratively refined through consultations between GIS specialists and species experts until the final outputs accurately represented each species' distribution.

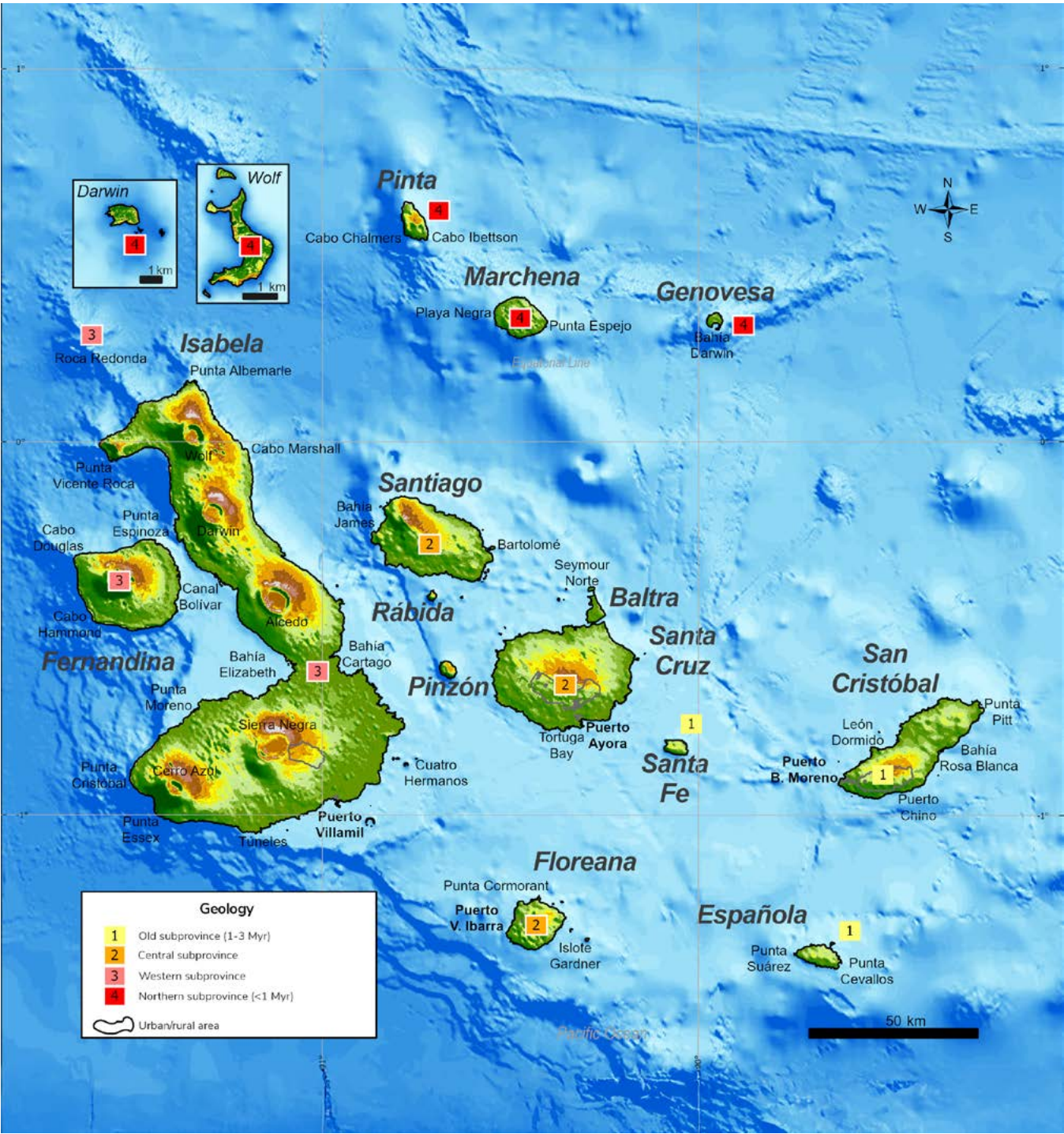


Author of the file Map author Map methodology Map sources

Several mapping approaches were applied depending on the type and quality of the available information:

- 1. Points:** Based on verified GPS records, particularly for species restricted to specific sites or with poorly known distributions.
- 2. Lines:** Derived from coastal strip delineations for species with coastal distributions.
- 3. Polygons (areas):** Applied when advanced studies

- provided robust evidence of distributional boundaries. These were either:
 - (a) Generalized from clusters of georeferenced records, or
 - (b) Delineated using expert knowledge for species with limited ecological data.
- 4. Raster models:** Used to represent spatial information as a grid of cells, where each cell stores a value corresponding to the probability of species presence. Four types of raster models were applied, each tailored



to the quantity and quality of available data and the ecological characteristics of the species⁵:

- (a) *Species Distribution Models (SDMs)*: Applied when ≥ 30 georeferenced records were available. MaxEnt was used to estimate suitable distributions based on environmental constraints.
- (b) *Knowledge-based models*: Built from expert interviews (e.g. naturalist guides, fishers, park rangers) and integrated into consensus maps through GIS analyses.
- (c) *Kernel density and sighting-intensity models*: Applied when detailed occurrence or tracking data were available but biophysical drivers were not well

understood. These models represent spatial intensity or relative use, based on either kernel-smoothed densities or gridded aggregations (e.g., number of sightings per cell over multi-year monitoring).

- (d) *Habitat models*: Developed using ecological knowledge combined with existing distribution records.

5. Digitization: Used for ecosystem engineers, habitat-forming species, or species dependent on habitats created by others.

ENDEMIC & NATIVE SPECIES

Galapagos Penguin -
Pingüino de Galápagos
Spheniscus mendiculus
© Carlos Espinosa / CDF



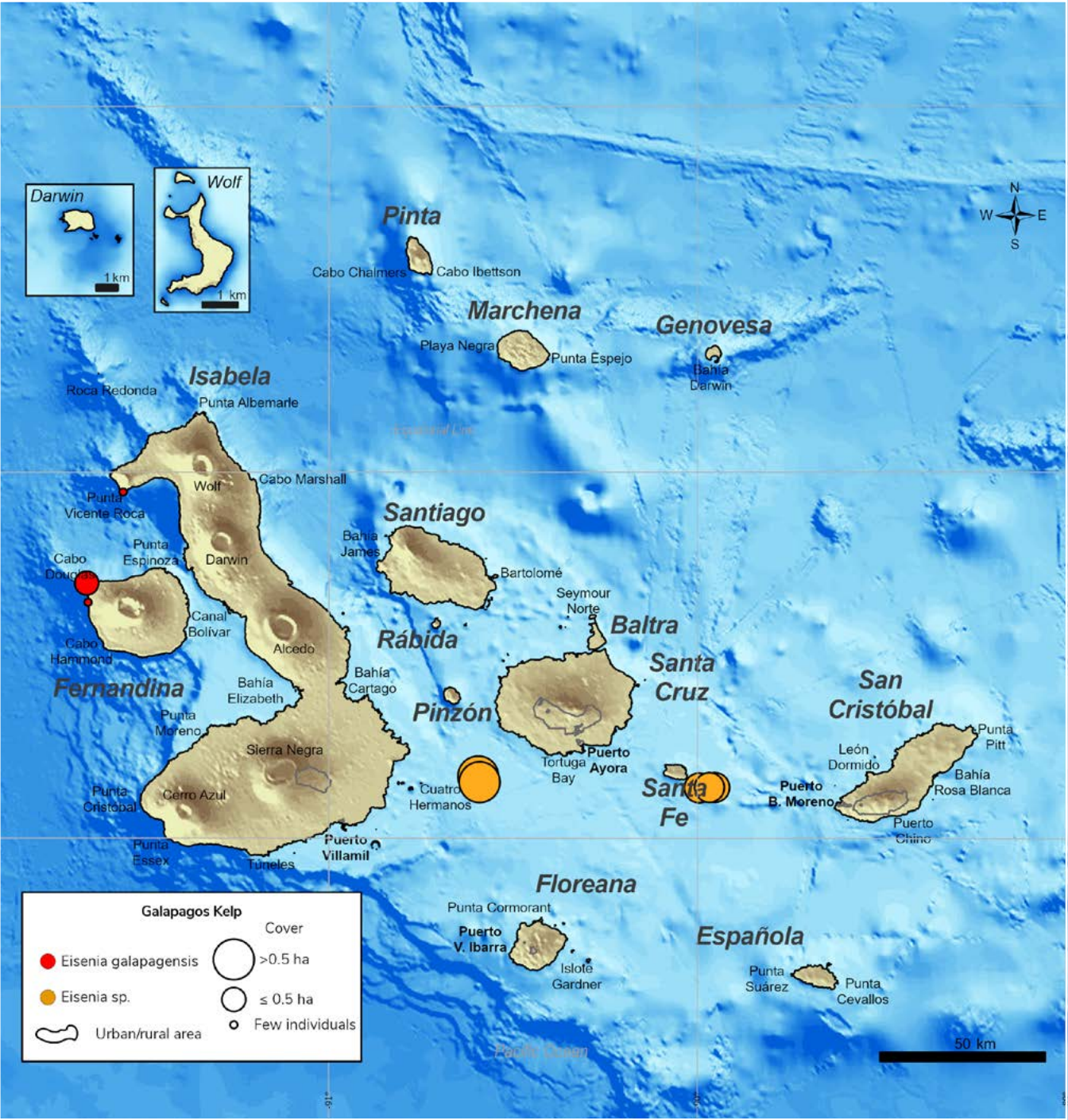
GALAPAGOS KELP

Quelpo (de Galápagos)

Eisenia spp.
Chromista: Ochrophyta: Phaeophyceae :
Laminariales : Lessoniaceae : *Eisenia* spp.



© Salomé Buglass / CDF



CURRENT STATUS

Galapagos kelps are a type of brown macroalgae that have a palm like appearance that grow on rocky or consolidated substrates along coastal shore but also in deeper mesophotic zones between 20-77 m depths. Growing over one meter tall. Galapagos kelps are the largest macroalgae found in Galapagos and Ecuadorian oceans¹. Galapagos kelps belong to the *Eisenia* genus, characterized by having a forked stipe (stem like structure) with a cluster of long serrated blades on each end. Like the Galapagos Penguin and Galapagos Sea Lion, Galapagos kelps also are unique tropical representatives of a group of organisms that usually are found in temperate or polar world regions². Until recently *Eisenia galapagensis* (W. R. Taylor, 1945) was the only known kelp species recorded in the Archipelago, which is endemic and listed as “Vulnerable” on the IUCN Red List of Threatened Species³. In 2018 an unknown kelp species was uncovered that is almost twice the size of *E. galapagensis* and has other distinct morphological characteristics¹. As the identification of this novel kelp population remains unresolved it is temporarily referred to as *Eisenia* sp.

ECOLOGICAL IMPORTANCE

Kelps are critical foundation species in marine ecosystems, as they are large, fast-growing, perennial species, that form dense year-round canopies known as kelp forests. Kelp forests are known to be among the world's most productive and biodiversity rich ecosystems⁴. Galapagos kelps have been found to form dense kelp forest patches at mesophotic depths between 30-70 m along coastal zones and off-shore seamounts¹⁻⁵. While Galapagos Kelp communities remain largely understudied, qualitative observations indicate that they attract and sustain diverse communities of fish, invertebrates and other macroalgae¹, that shelter and forage either directly on kelp or its associated species. Additionally observation of commercially important fish species have been recorded in kelp habitat, including the Sheepshead Wrasse (*Semicossyphus darwini*), Sailfin Grouper (*Mycteroperca olfax*) and Galapagos Porgy (*Calamus taurinus*), of which the latter two are both threatened species (IUCN Red List). Furthermore, drift material and detritus from these kelp forests that become exported to adjacent deep-sea habitats likely play a key role in supporting deep-sea food webs and carbon sequestration⁶.

AUTHOR (S)

Fact Sheet: Salomé Buglass
Map: Nicolás Moity

INFORMATION NEEDS

Like the majority of macroalgae in the Galapagos, there is a dearth of scientific knowledge or data on Galapagos kelps, limited to species identification and description, and occurrence reporting. Given the ecological significance of kelp forest play key information on their abundance and distribution, their phenology and baseline habitat characterization to help understand their vulnerability or resilience to climate change and ENSO. Understanding food web structure will also be key to understand the occurrence of trophic cascades; e.g. the explosion of kelp eating herbivores such as urchins due to the declining presence of predatory fish species.

Following the recent discovery of novel mesophotic kelp forest, CDF's Deep-ocean Program is currently carrying baseline surveys at all known kelp forests that aims to close some of the aforementioned information gaps.

DISTRIBUTION

Prior to the 1982-1983 El Niño event, *E. galapagensis* was once widely distributed across the archipelago between depths of 10 and 50 m². However since then, sightings have been limited to the western coastline of the most western Island where waters on average are colder due to upwelling activities^{5, 7}. The novel *Eisenia* sp. has only been found at between 48-77 m depths off-shore on summit of submarine knoll between Isabela and Santa Cruz, and on the sloping along the eastern coastal shelf of Santa Fe Island.

MY NOTES

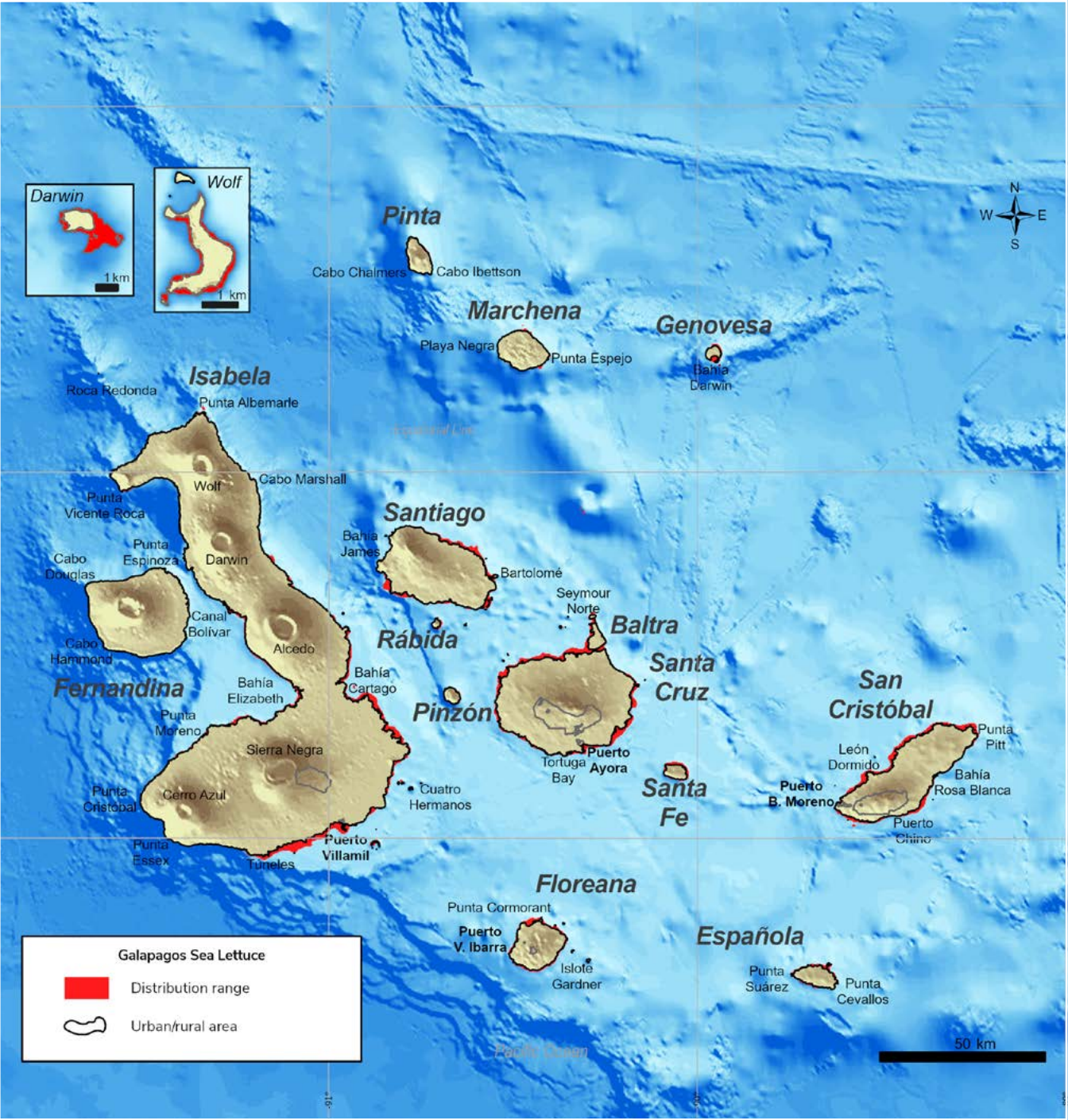
Map data sources: GBIF/OBIS, Buglass et al. (2022).
Map methodology: See Methodology section, ref. 1.
GPS data.

SEA LETTUCE

Lamilla, Lechuga de Mar (de Galápagos)
Ulva spp. Linnaeus, 1753
Plantae : Chlorophyta : Ulvophyceae : Ulvales : Ulvaceae : *Ulva* spp.



© Nicolás Moity / CDF



CURRENT STATUS

This green alga belongs to the *Ulva* genus and grows in intertidal and subtidal zones along coastlines of the archipelago, where waters are cool and nutrient rich. Its common name is “Sea Lettuce”, which is very appropriate as all *Ulva* species are edible and often have long curled up blades resembling the leaves of the lettuce vegetable. In Galapagos, seven species have been recorded that belong to the genus *Ulva*. Recent DNA barcoding of Galapagos specimens has resolved the leafy *Ulva* flora to four species: *Ulva adhaerens*, *U. lactuca*, *U. ohnoi*, and *U. tanneri*¹. Of these, *U. adhaerens* is the most widespread, occurring across multiple islands, while *U. lactuca* and *U. ohnoi* are more localized, and *U. tanneri* is a small, high-intertidal species that is easily overlooked. Three filamentous species have also been reported — *U. flexuosa*, *U. clathrata* and *U. prolifera* — but no recent genetic studies have confirmed these species². As of 2025, the species within the genus *Ulva* have not been assessed for the IUCN Red List, nor has a regional conservation status been established for the Galapagos population.

ECOLOGICAL IMPORTANCE

Sea Lettuce is a marine macro-alga that grows on rocks and lava flows in the intertidal and subtidal zone, where it forms carpets of algae that many species rely on for food³. Thus sea lettuce plays an important role in the maintenance and structuring of the Galapagos coastal food chains⁴ as a primary producer.

A multitude of marine species graze on Sea Lettuce, including sea turtles, crabs, fish and sea urchins. It is especially important for Galapagos’ iconic and endemic Marine Iguana (*Amblyrhynchus cristatus* spp.), as it almost entirely depends on sea lettuce as its main food⁴.⁵ Thus, fluctuations in the abundance of this alga are linked to changes in the population of marine iguanas. For instance, during episodes of El Niño in 1982-1983 and 1997-1998, a decline in local upwelling led to water temperature increasing and nutrients declining, causing a shift in the dominant alga population. Red alga species replaced the green and brown alga, including sea lettuce. The absence of sea lettuce leads to the mortality of the many species that rely on it including the marine iguanas and the zayapa crabs (*Grapsus grapsus*)^{5, 6}. Given its sensitivity to nutrient availability and water temperature, *Ulva* spp. may serve as a useful bioindicator for climate-related changes in Galapagos coastal ecosystems.

AUTHOR (S)

Fact Sheet: Salomé Buglass and Patricia Puig Martí
Map: Nicolás Moity

INFORMATION NEEDS

Currently, there is a scarcity of scientific knowledge or data on sea lettuce, which is the case for the majority of macroalgae in the Galapagos. The existing information on Sea Lettuce is limited to the identification of its species⁷, brief descriptions of its occurrence and coverage in the reports of the annual ecological monitoring carried out since 2001^{3, 8, 9}, and to studies in which its ecological role is indirectly monitored⁵. Future research on sea lettuce species should focus on establishing a baseline of its spatial and temporal distribution; on understanding the relationship between sea temperature and its abundance and productivity, special consideration of potential impacts related to climate change and ENSO; and on understanding the role of Sea Lettuce as an environmental indicator.

DISTRIBUTION

These species are more abundant in the regions of the archipelago where the water temperature is lower and nutrients are higher (west and parts of the central and southern region).

MY NOTES

Map data sources: Tompkins, P. (EK), GBIF/OBIS, Tompkins y Wolff (2017).
Map methodology: See Methodology section, ref. 4d. Habitat modelling.

LICHENS—LÍQUENES

In Galapagos, lichens are one of the most diverse groups of organisms. Currently, the reference list of the Charles Darwin Foundation (CDF) documents more than 600 species, of which approximately 20% are endemic. Lichens are symbiotic organisms, in which a fungus hosts green algae and/or cyanobacteria.

They are characterized by slow growth, prolonged generation cycles, and lack of protective tissues, absorbing all their nutrients and water from the air. As a result, lichens are sensitive environmental indicators, ideal for monitoring habitat degradation and climate change. Their diversity correlates directly with habitat diversification; consequently, they serve as important indicators of ecological continuity and ecosystem health. In Galapagos, lichens occur in all terrestrial habitats, though they generally abound in dry areas. The high and humid zones harbor the highest number of species, yet these are the areas where lichen decline has been most drastic due to the habitat degradation. Despite their diversity, little is known about the ecological role of Galapagos lichens. In the transition zone, long pale green-yellow “beards” resembling curtains abundantly hang from tree branches, contributing to the natural supply of water. These “networks” or “curtains” intercept drizzle and mist, and the surplus of water drips to the

ground, replenishing aquifers. In the lower zones, lichens cover the trees, protecting their bark against excess heat. Galapagos birds use them as cushioning materials for their nests. Lichens also have secondary metabolite antibiotic properties, which contribute to a healthier environment within nests.

Throughout the archipelago, lichens contribute to weathering of rocks and soil formation. They also provide habitats for invertebrates, offering shelter, camouflage, and food resources.

One particularly notable species is *Roccella gracilis*, commonly known as Orchilla. This abundant coastal epiphyte was historically collected in large quantities to obtain the purple-blue dye “orchil” — a color that varies from reddish-purple to blue depending on pH. Although the exploitation of Orchilla lasted only from 1860 to 1870, it was one of several economic resources that made the early colonization of the archipelago possible.

Frank Bungartz

Galapagos Heart Lichen -
Líquén de Corazón de Galápagos
Cora galapagoensis
© Frank Bungartz

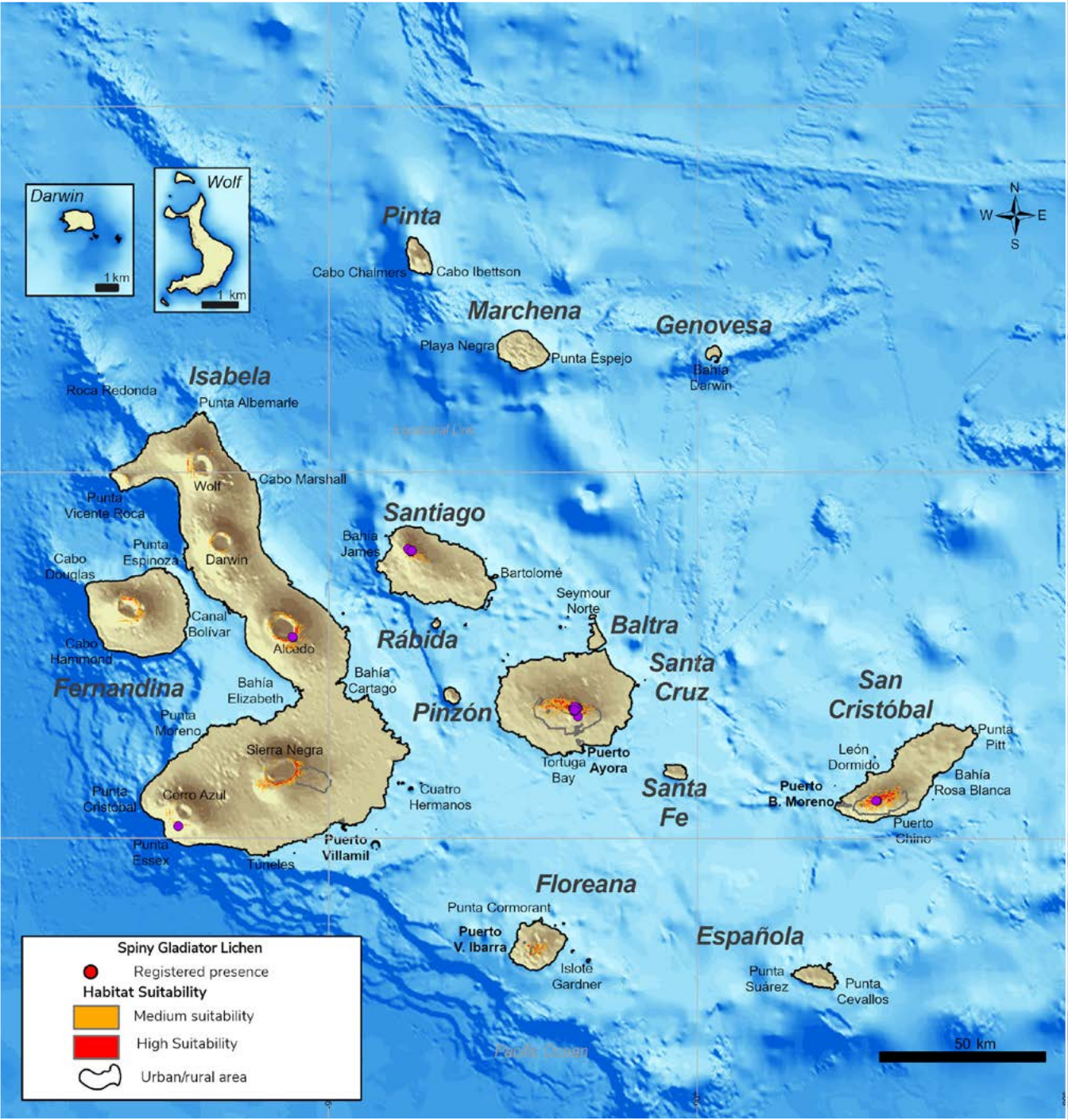
SPINY GLADIATOR LICHEN

Liquen con Clavas Espinosas de Gladiador

Acantholichen galapagoensis Dal-Forno, Bungartz & Lücking
Fungi : Basidiomycota : Agaricomycetes : Agaricales : Hygrophoraceae : *Acantholichen galapagoensis*



© Frank Bungartz



CURRENT STATUS

Most lichens are ascomycetes, that is, they are fungi with a septate mycelium that produce endogenous ascospores. The Spiny Gladiator Lichen belongs to the lichenized basidiomycetes^{4, 5}, which in Galapagos are all endemic. Considered Vulnerable and possibly Critically Endangered, it occupies moist, but well-lit habitats. Populations can be found in the most humid parts of the shrubland dominated by *Miconia*, and in fragments of *Frullania-Zanthoxylum* forests. There, the lichen grows on liverworts that hang from *Zanthoxylum* and *Psychotria rufipes* or it grows on the leaf sheaths of *Cyathea weatherbyana*. In the past, on Santa Cruz Island this arboreal fern was an abundant plant, towering above the *Miconia*. Today, *Cinchona* (an introduced species) provides a similar habitat.

ECOLOGICAL IMPORTANCE

The Galapagos Plants Specialist Group of the International Union for Conservation of Nature (IUCN) assesses the threat status of Galapagos plants and plantlike organisms like lichens. These assessments are based on the sensitivity and adaptability traits that increase a species' vulnerability to climate change². Using the IUCN criteria, the Spiny Gladiator Lichen has been assessed as 'Vulnerable', because the species is not well adapted to recent changes of its environment. The species is only found in the most humid parts of the highlands and restricted to habitats exposed to high solar radiation. The lichen thus serves as a sentinel for monitoring climate change.

The terrestrial vegetation of the Galapagos can be divided into several altitude zones. Global warming will result in species from the lowlands moving into higher, cooler zones, thus the dry zone is projected to expand, whereas the humid zone is expected to contract. A drastic decline of *A. galapagoensis* in Santa Cruz has been documented as recently as 2016-2017. Some of the most exuberant populations were previously present on *Cinchona*, covered by the liverwort *Frullania*, found between El Puntudo and Cerro Crocker. During the 2016-2017 drought, these populations almost entirely disappeared.

AUTHOR (S)

Fact Sheet: Frank Bungartz
Map: Byron Delgado M.

INFORMATION NEEDS

In the Galapagos lichens are good examples of a highly diverse and almost entirely neglected group of organisms. At least one-third of all species remain undocumented, and as part of our inventory more than 100 species new to science have been recorded. Research is urgently needed to evaluate survival rates of several species, such as the Spiny Gladiator Lichen, which was only recently recognized as an endemic species of the archipelago^{1, 3}.

The collapse of its population and in some parts even disappearance of this species from the high and humid parts are warning signs. Monitoring the species regularly will allow us to document how its decline in population is related to important climatic parameters (especially solar irradiation, rainfall, cloudiness, and humidity).

DISTRIBUTION

This species grows as an epiphyte on other plants, distributed among the high and humid parts of several islands: On Isabela, the species was found on Cerro Azul Volcano, growing on *Cyathea weatherbyana*. On Alcedo Volcano specimens were found in the fragments that are left there of the *Frullania-Zanthoxylum* forests. On Santiago *Acantholichen* grows on *Psychotria rufipes*; on Santa Cruz it can be observed on *Cinchona* trees towering above *Miconia* shrub; and on San Cristóbal the species inhabits *Miconia robinsoniana* and *Psidium guava*.

MY NOTES

Map data sources: CDRS Natural History Collections Database, Galapagos Lichen Biodiversity Inventory, Bungartz F. (EK).
Map methodology: See Methodology section, ref. 4a. Species distribution model, Maxent ML.

ENDEMIC ASTERACEAE

— ASTERÁCEAS ENDÉMICAS

The Asteraceae family is one of the most representative plant families on oceanic islands, where extraordinary endemic speciation has occurred. Of the four endemic genera found in Galapagos, the three considered in this Atlas have evolved into multiple species, while the fourth, *Macraea*, includes only a single species^{1,2}.

The genus *Darwiniothamnus* include two species (originally thought to have three until one was found to have a different origin)³. *Lecocarpus* includes four species — among them *L. leptolobus*, which was recently rediscovered (Tye and Jaramillo, unpublished data); and the most diverse genus, *Scalesia*, contains fifteen species. Additionally, several species of *Darwiniothamnus* and *Scalesia* have different subspecies occurring on different islands of Galapagos⁴.

An evaluation based on the criteria of the International Union for Conservation of Nature showed that most of these species are Endangered⁵, although the status of some has improved following the eradication and control of wild ungulates on many islands. In certain cases — such as that of *Scalesia affinis* on Santa Cruz Island — the main threat remains the direct impact of urban development.

These three endemic genera play an important role as dominant species in some areas of arboreal vegetation. They are also considered key species in the colonization on new lava flows, in both dry and wet areas.

Patricia Jaramillo Díaz and Alan Tye

**Galapagos Bonsai -
Bonsai de Galápagos**

Scalesia helleri subsp. *helleri*

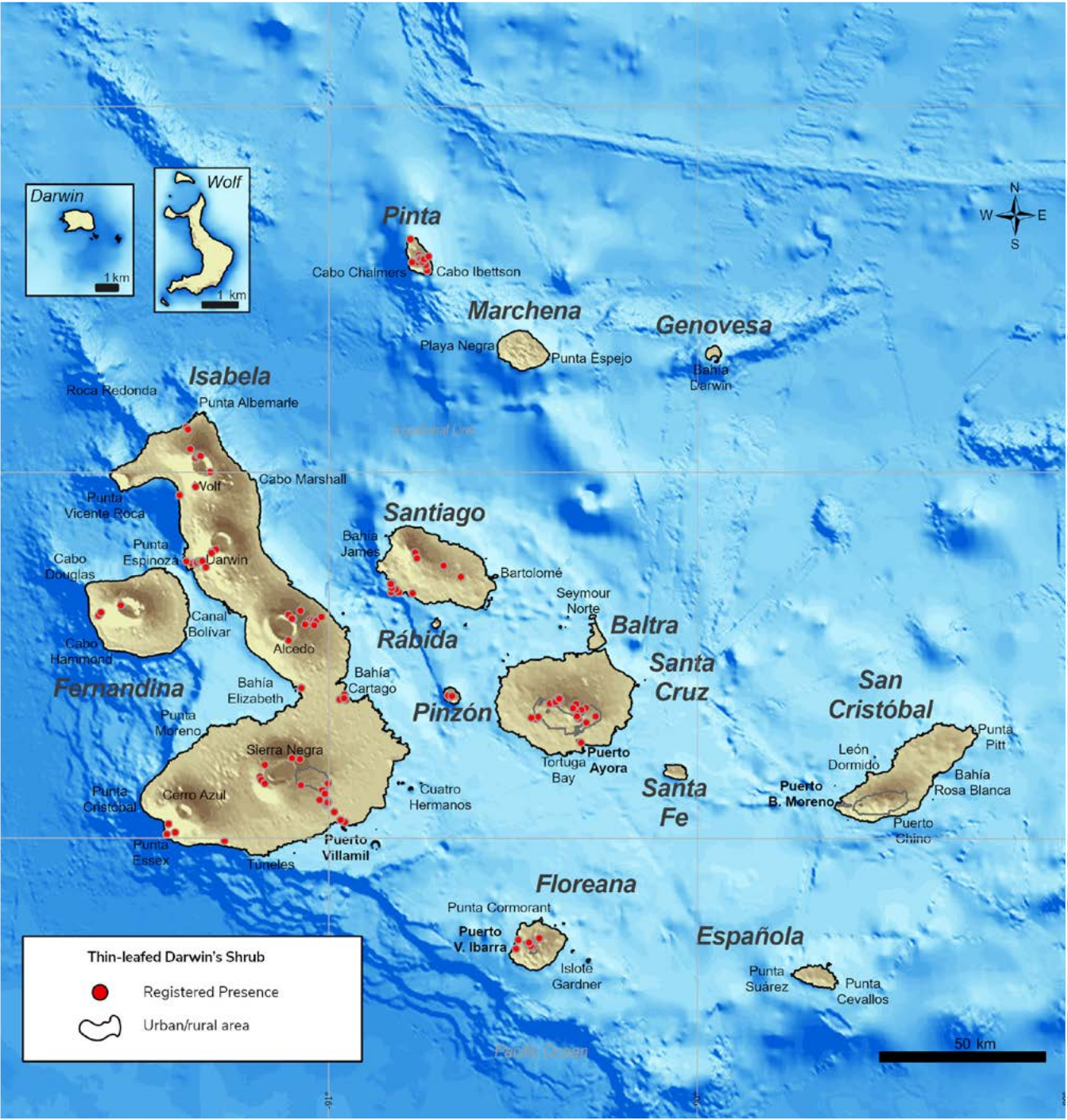
© Carlos Espinosa / CDF

THIN-LEAVED DARWIN’S SHRUB

Margarita de Darwin
Darwiniothamnus tenuifolius (Hook. F.) Harling
Plantae : Magnoliophyta : Dicotyledoneae : Asterales : Asteraceae : *Darwiniothamnus tenuifolius*



© Patricia Jaramillo Díaz / CDF



CURRENT STATUS

The genus *Darwiniothamnus* (Asteraceae) is endemic to Galapagos and comprises two species: *D. lancifolius* and *D. tenuifolius*. These species are believed to have derived from a single colonization by an ancestor from the region of Chile¹. The three subspecies of *D. lancifolius* described here are limited to Fernandina and Isabela islands, while the Thin-leaved Darwin's Shrub (*D. tenuifolius*), with at least two subspecies, has a wider distribution, extending to Floreana, Pinta, Pinzón, Santiago, and Santa Cruz, as well as some of its islets².

The Thin-leaved Darwin's Shrub is a woody shrub that usually grows up to 1-3 m in height, with leaves arranged in terminal whorls with very short internodes³. Its populations have declined on Santa Cruz and Isabela islands due to habitat degradation and infestation by the invasive cottony cushion scale insect, introduced in 1990s. On other islands, populations appear stable. Palynological (pollen), morphological, and seed studies have been conducted, as well as research on the relationships between species⁴⁻⁷.

ECOLOGICAL IMPORTANCE

The Thin-leaved Darwin's Shrub stretches from beach shores to humid shrublands and forests, and from lava fields to high altitude fern zones. It's an important component of shrub vegetation in some areas across the seven islands where it occurs, and it has also been cultivated as an ornamental species in ecological gardens on the populated islands⁸⁻¹⁰.

INFORMATION NEEDS

It is a threatened endemic species whose ecological relationships and population dynamics are not fully understood. Although some authors do not accept subspecies or varieties within this species¹¹, several were recognized in a comprehensive investigation conducted in 2009. However, further research is still needed to define them with certainty¹².

DISTRIBUTION

This species occurs on the four largest islands of Galapagos — Fernandina, Isabela, Santiago, and Santa Cruz — as well as several islets and three smaller islands: Pinta, Pinzón, and Floreana.

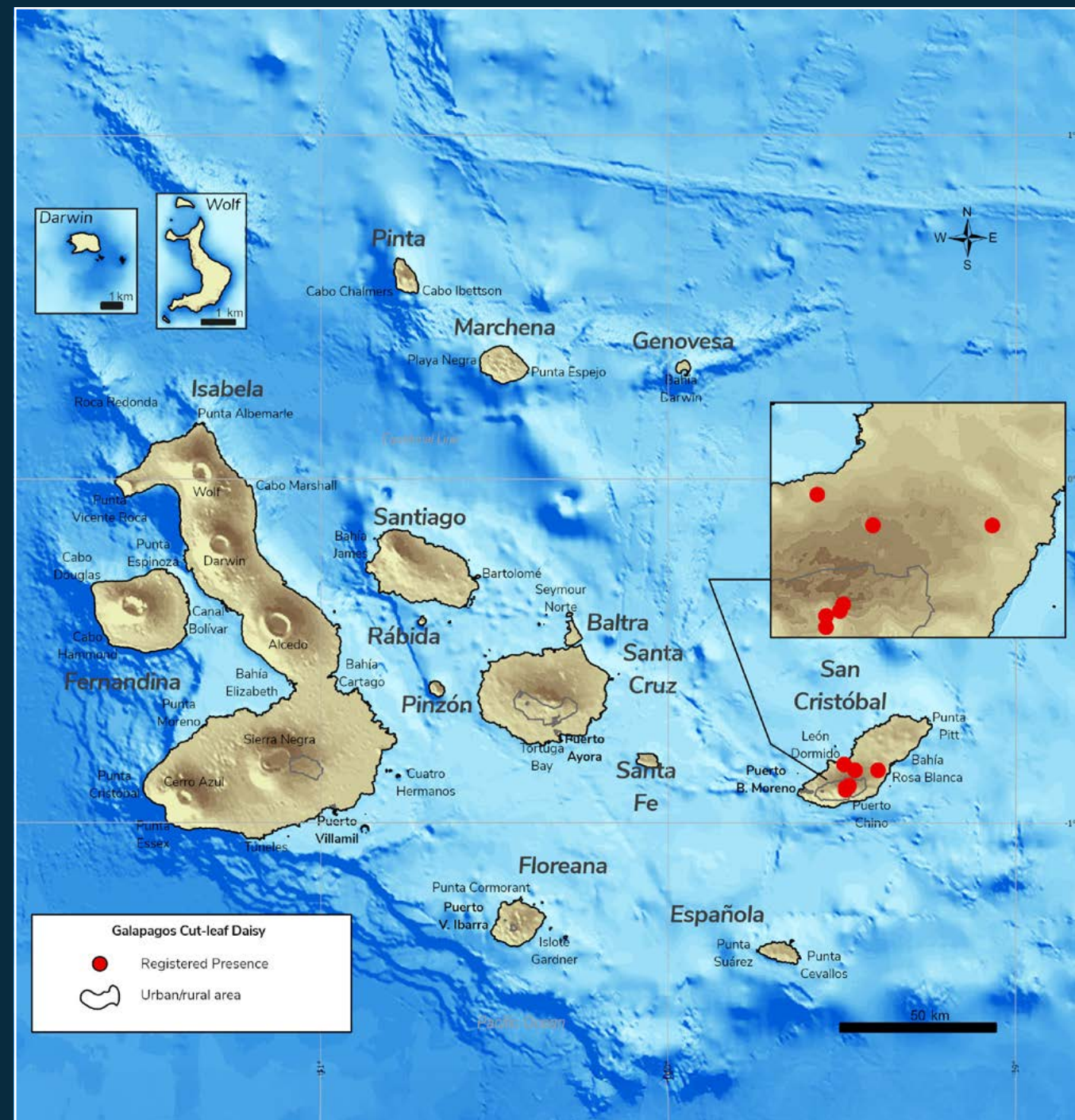
MY NOTES

AUTHOR (S)

Fact Sheet: Patricia Jaramillo Díaz, Washington Tapia and Alan Tye
Map: Byron Delgado M.

Map data sources: CDRS Natural History Collections Database, Conservation of Threatened Species, and Galapagos Verde 2050 Program.
Map methodology: See Methodology section, ref. 1. GPS data.

Lecocarpus leptolobus (Blake) Cronquist & Sueds
Plantae : Magnoliophyta : Dicotyledoneae : Asterales :
Asteraceae : *Lecocarpus leptolobus*



The Galapagos Cut-leaf Daisy (*Lecocarpus leptolobus*) can only be found in three locations, covering an area of less than 10 km² in San Cristóbal Island. In the past, it occurred in additional areas, including the sites where Darwin originally collected specimens. The species is seriously threatened and was severely impacted by feral goats in previous decades. In some localities, populations are protected from grazing by fences, but its distribution remains so restricted that the development of a recovery plan is considered urgent^{1, 2}.

ECOLOGICAL IMPORTANCE

The genus *Lecocarpus* is endemic to Galapagos, comprising four species and one subspecies, each restricted to a single island³. *L. pinnatifidus* only on Floreana Island; *L. leptolobus* in the southwest of San Cristóbal; *L. darwinii* in the northeast of San Cristóbal; *L. lecocarpoides* on Española and its western islet; and *L. l. brachyceratus* only on Gardner, Osborn and Xarifa islets⁴⁻¹¹.

From an evolutionary and adaptive radiation perspective, *L. leptolobus* is particularly important because it is one of only two species of the same genus, represented on one single island and, in some areas, individuals show intermediate morphological characteristics between this species and *L. darwinii*. In terms of functional biodiversity, very little is known about the ecological role of this plant in the ecosystem of San Cristóbal. However, given its distribution is restricted to outcrops of red scoriae, such as those found on the edges of ancient volcanic craters², and that its phenology includes the presence of flowers almost year-round, it undoubtedly plays a fundamental role in sustaining pollination networks in the arid zone of the island. These habitats host the largest and most generalized pollinator networks in Galapagos¹².

L. leptolobus often grows alongside another threatened plant, *Calandrinia galapagosa* St. John. Both have been severely reduced by feral goats. This close relationship has facilitated the establishment of protective enclosures, safeguarding critical populations of the two species simultaneously^{1, 9, 11, 13-16}.

AUTHOR (S)

Fact Sheet: Patricia Jaramillo Díaz, Washington Tapia, Jefreys Málaga and Alan Tye
Map: Byron Delgado M.

INFORMATION NEEDS

It is necessary to carry out genetic studies of this and other species within the genus to better understand their relationships and distribution patterns, both on San Cristóbal Island and across the archipelago as a whole. Additionally, more in-depth research is needed on the distribution, ecological role in the ecosystem, and the impact of feral goats on *L. leptolobus*, not only in terms of its population size but also spatial distribution.

In response to these needs, a restoration and conservation plan is currently being implemented for *L. leocarpoides* on Española Island, which includes active restoration, natural regeneration, germination studies, and threat assessment in key areas such as Punta Manzanillo¹⁷

DISTRIBUTION

This species is present only and exclusively in the El Rapioso crater, in the Galapagos National Park zone on San Cristóbal Island.

MY NOTES

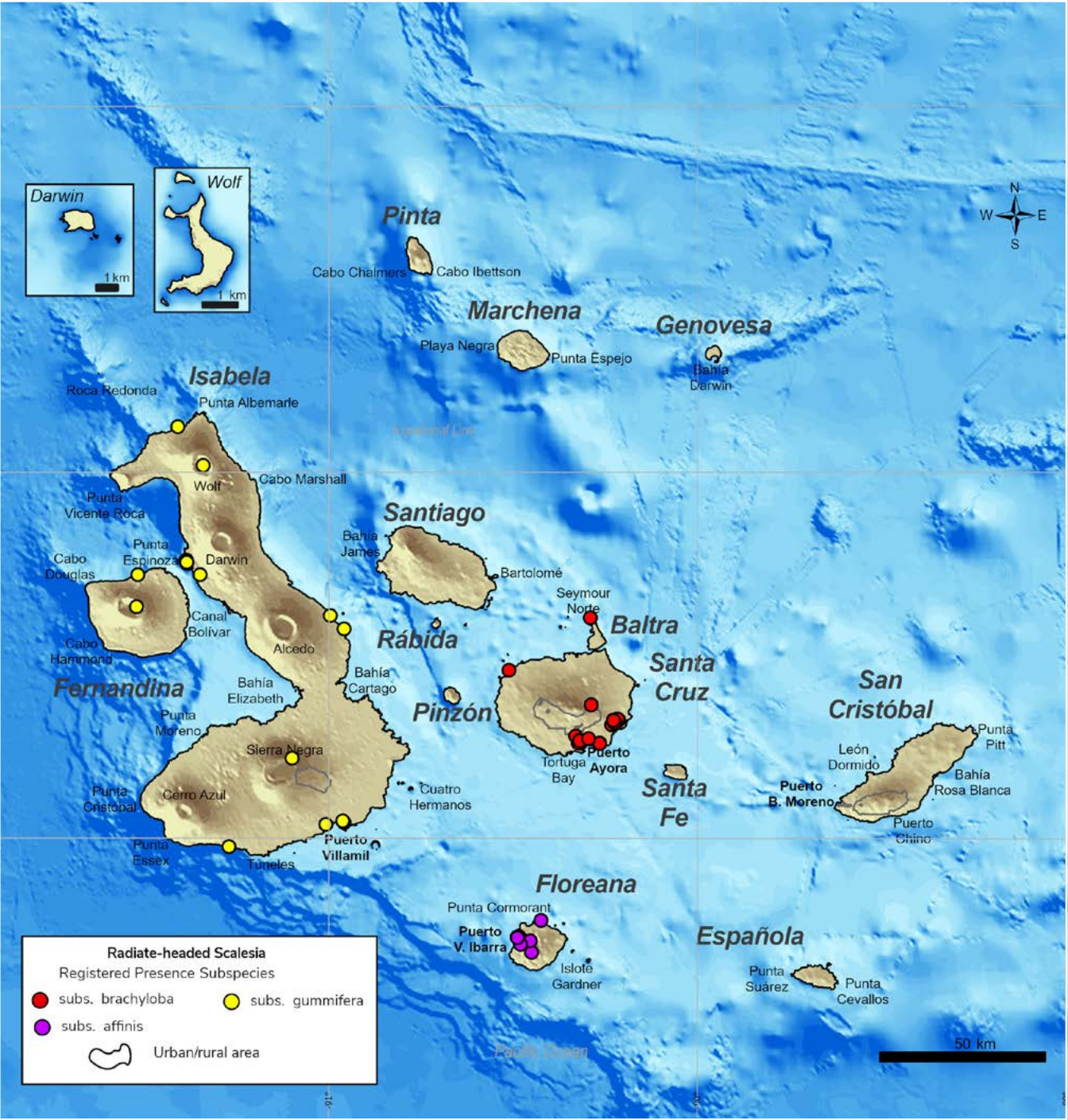
Map data sources: CDRS Natural History Collections Database, Conservation of Threatened Species.
Map methodology: See Methodology section, ref. 1. GPS data.

RADIATE-HEADED SCALESIA

Lechoso, Tabaquillo, *Scalesia*
Scalesia affinis Hook f.
Plantae : Magnoliophyta : Dicotyledoneae : Asterales :
Asteraceae : *Scalesia affinis*



© Patricia Jaramillo Díaz / CDF



CURRENT STATUS

The Radiate-headed *Scalesia* (*Scalesia affinis*) is a shrub endemic to the arid and transitional zones of the Galapagos Islands. It is widely distributed and common in Fernandina and Isabela, but has declined in Isabela, while populations on Floreana and Santa Cruz have been severely reduced due to introduced animals and human development.

According to literature and early settlers' accounts from Santa Cruz Island, the Radiate-headed *Scalesia* formerly occurred between El Garrapatero and El Cascajo, as well as east of the Charles Darwin Research Station (CDRS) and within the town of Puerto Ayora and its new urbanization of El Mirador^{1, 2}. Over the past decades, the species has experienced a sharp population decline linked to urban expansion, habitat degradation, and introduced animals.

The species has been the focus of targeted restoration efforts led by the Charles Darwin Foundation's (CDF) Galápagos Verde 2050 (GV2050) Program and the Galapagos National Park Directorate (GNPD), resulting in a steady recovery from around 60 individuals in 2007 to more than 320 individuals by 2025. Today, the Radiate-headed *Scalesia* grows in restored sites and native gardens across Puerto Ayora and nearby areas, where plants have begun to regenerate naturally^{6, 7, 13}. Fencing and seed banking protect the remaining wild populations, ensuring a vital source for future restoration.

ECOLOGICAL IMPORTANCE

Santa Cruz Islands hosts more *Scalesia* species than any other island in the archipelago, with a total of six species. The Radiate-headed *Scalesia* remains green during the dry season, with large tobacco-like leaves and striking crown-shaped flowers^{7, 13} that serve as an important nectar and pollen source for a variety of native pollinators — including bees, butterflies, and flies — as well as for seed-dispersing birds. It needs to be planted on stony ground.

Each population of Radiate-headed *Scalesia* found on each of the four islands^{3, 9} has unique characteristics, so it is important that each population is preserved^{10, 11}. In Puerto Ayora, the species' main threat remains introduced animals and urban development^{1, 4, 12}. In recognition of the species' importance to the region, *S. affinis* was officially declared an emblematic species of Puerto Ayora in 2024 by the Municipality of Santa Cruz.

AUTHOR (S)

Fact Sheet: Patricia Jaramillo Díaz, Washington Tapia and Alan Tye
Map: Byron Delgado M.

INFORMATION NEEDS

Given that the Radiate-headed *Scalesia* once occupied the area where Puerto Ayora now stands, this species has become the symbolic plant of the town. Its conservation and restoration, therefore, represent not only an ecological necessity but also a moral responsibility for the local community. This highlights the importance of implementing social projects that promote the restoration of urban ecosystems through active community participation.

It is also essential to investigate the causes and long-term impacts of habitat alteration across both historical and current distribution areas in order to define urgent conservation measures. Further research should focus on the survival and population dynamics of the species, as well as the viability of its seeds, germination protocols, and long-term monitoring.

Additionally, a strategic plan should be developed for the creation of ecological gardens in El Mirador Urbanization and other green areas of Puerto Ayora, along with genetic studies on emerging Radiate-headed *Scalesia* hybrids and their relationship with *Scalesia helleri*.

DISTRIBUTION

This species is present on Fernandina, Floreana, Isabela and Santa Cruz islands.

MY NOTES

Map data sources: CDRS Natural History Collections Database, Conservation of Threatened Species, and Galapagos Verde 2050 Program.
Map methodology: See Methodology section, ref. 1. GPS data.

CACTUS—CACTUS

The Cactaceae family stands out for its adaptation to arid environments and its uniqueness. With around 175 genera and over 2,000 known species, cacti are principally distributed throughout the Americas, from the southwestern United States and Mexico to the arid regions of South America^{1,2}. These plants occur across a variety of ecosystems, but their greatest diversity is concentrated in arid and semiarid regions between latitudes 35° North and South, from sea level to altitudes exceeding 5,000 m. Mexico hosts the highest species richness and endemism within the Cactaceae family^{1,3}.

Cacti possess ecological characteristics that make them vulnerable to environmental disturbances, such as restricted geographic distributions, long life cycles, and low growth rates³. Additionally, they depend on the participation of other organisms in key reproductive stages, such as pollination and seed dispersal^{1, 4}. Human activities — including

collection, habitat destruction, introduction of exotic species, and climate change — also represent major threats^{2,5}.

These plants play an important ecological role due to their unique adaptations for surviving in extreme dry conditions. Their succulent stems allow them to store water, while spines and prickles reduce water loss and provide protection against herbivores⁴.
⁶. Several endemic cactus genera,

including species from the *Opuntia* genus, are found in the Galapagos Islands⁶⁻⁸. These endemic genera, such as *Jasminocereus* and *Brachycereus*, play a crucial role in the semi-arid ecosystem of Galapagos⁹⁻¹¹.

The *Opuntia* genus, known as “prickly pear,” includes several endemic species on the islands, such as *Opuntia echios*, *O. galapageia*, *O. helleri*, *O. insularis*, and *O. megasperma*^{6, 12}. These species are key to biodiversity conservation in Galapagos due to their exceptional adaptation to the islands’ unique conditions. The diversity and adaptation of cacti are crucial elements in the arid ecosystems of the archipelago. However, their conservation faces challenges due to human disturbances, predation by introduced herbivores, and climate change.

Patricia Jaramillo Díaz



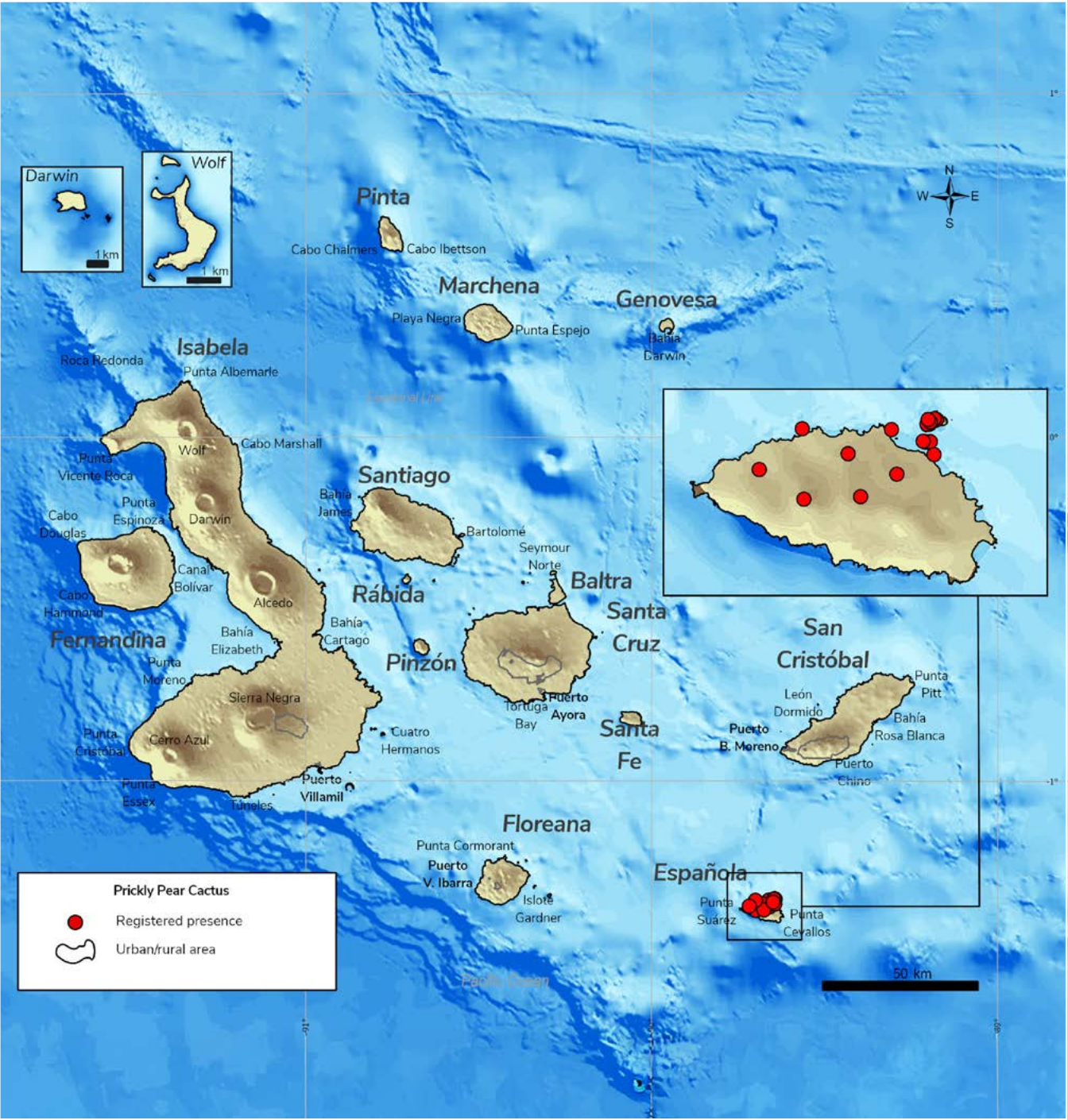
Prickly Pear Cactus -
Cactus Gigante
Opuntia echios var. *gigantea*
© Mara Speece / CDF

PRICKLY PEAR CACTUS

Cactus Gigante
Opuntia megasperma var. *orientalis* Howell
Plantae : Magnoliophyta : Dicotyledoneae :
Caryophyllales : Cactaceae : *Opuntia megasperma*
var. *orientalis*



© Carlos Espinosa / CDF



CURRENT STATUS

At present, most *Opuntia* taxa in Galapagos are not endangered, but significant knowledge gaps remain as to their distribution, ecology, and evolution^{6, 13-15}. The Giant Cactus *Opuntia megasperma* includes three varieties found on Floreana, San Cristóbal, and Española islands. One of these varieties, *O. megasperma* var. *orientalis* occurs only on Española and the nearby islets: Gardner, Osborn, Xarifa (Tortuga), and West^{8, 16}. According to the criteria of the International Union for Conservation of Nature (IUCN), it's an Endangered species^{17, 18}. Adversely impacted by the introduction of feral goats and the drastic reduction in the Island's endemic giant tortoises^{18, 19}.

ECOLOGICAL IMPORTANCE

In Galapagos, the *Opuntias* are long-lived trees and shrubs, with impressive sculpture-like shapes. They are considered Key Species in lowland ecosystems, serving as the primary food source for different vertebrates and invertebrates that pollinate and disperse their seeds^{6, 14, 16, 18}.

O. megasperma var. *orientalis* is one of Española Island's most important structural components of vegetation. It serves as the main food source for the island-endemic giant tortoise population, which has been restored over the past 50 years through a captive breeding program^{15, 18-20}. As one of the only trees on the island, *O. megasperma* is considered an umbrella species because of its physical and biological characteristics, as well as its strict habitat requirements. By preserving this species, an important number of other species with similar ecological requirements are protected. For example, the *Opuntia*'s branches serve as an important nesting site for endemic birds, and their flowers are one of the most important sources of nectar and pollen for the Cactus Finch^{15, 19, 21-27}.

AUTHOR (S)

Fact Sheet: Patricia Jaramillo Díaz, Washington Tapia and Alan Tye
Map: Byron Delgado M.

INFORMATION NEEDS

As a threatened species with very limited distribution, more information is required on its ecological relationships and population dynamics. In particular, information on ENSO episodes are required; during these episodes, the roots rot, and the plant absorbs such an amount of water that the branches fall off or the whole plant collapses.

Additionally, both the giant cactus and the other cactus species are vulnerable to the possible introduction of *Cactoblastis* sp.^{19, 23, 24}. It is necessary to document the changes that introduced animals that eat and damage the seedlings, produce on the *Opuntia* sp. populations. In response, active restoration actions are already being implemented for *O. megasperma* var. *orientalis* on Española Island. These include nursery propagation, reinforcement planting, and monitoring of the planted individuals, as part of the ecological restoration and species recovery plan 2025-2029²⁸.

DISTRIBUTION

This species occurs only in the south-central part of Española Island, as well as the nearby islets of Gardner, Osborn, Xarifa (Tortuga) and Tortuga Oeste. Other varieties of *O. megasperma* are found on San Cristóbal and Floreana^{8, 28-30}.

MY NOTES

Map data sources: CDRS Natural History Collections Database, Conservation of Threatened Species, and Galapagos Verde 2050 Program.
Map methodology: See Methodology section, ref. 1. GPS data.

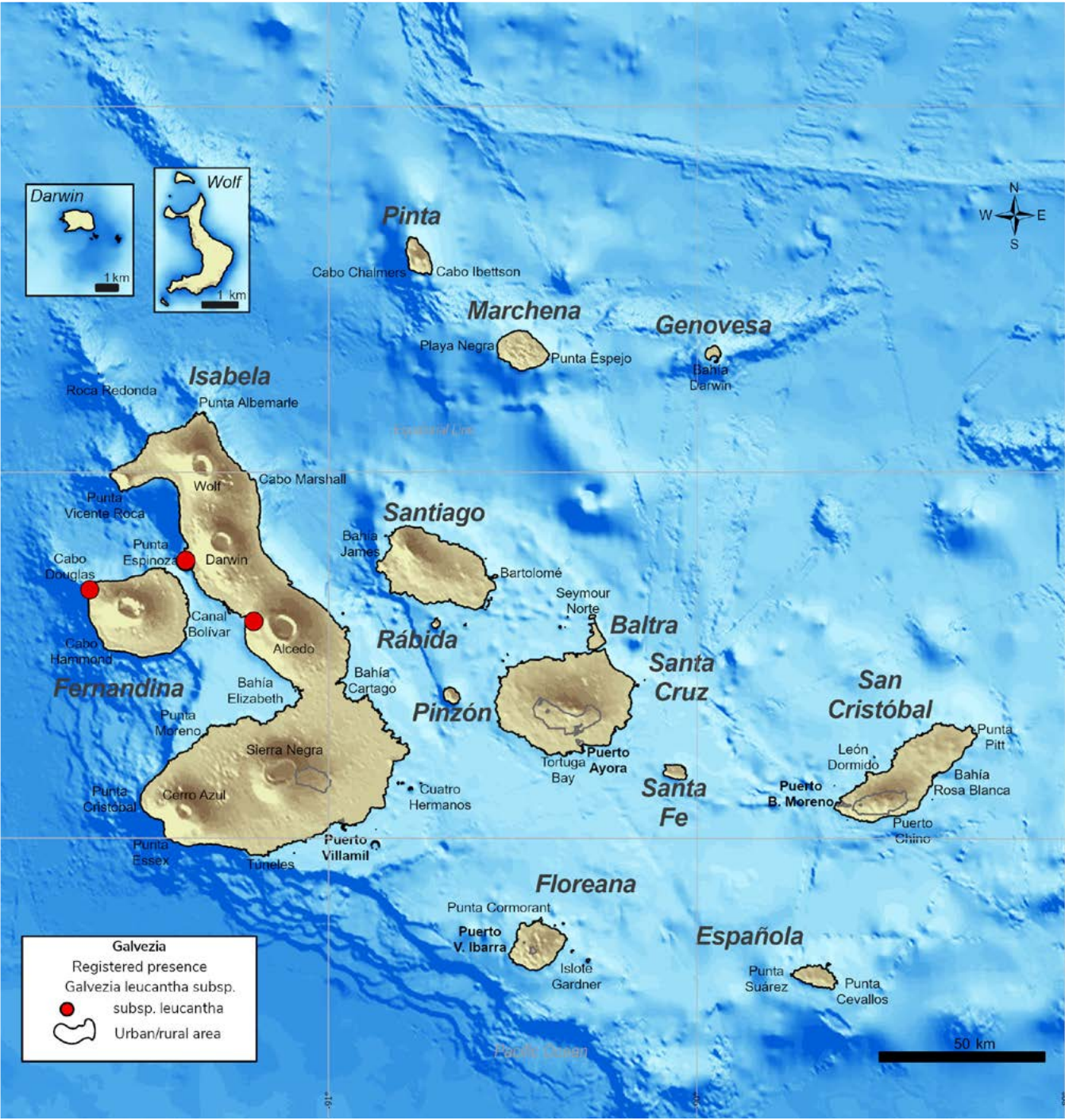
GALVEZIA

Galvezia

Galvezia leucantha Wiggins
Plantae : Magnoliophyta : Dicotyledoneae : Lamiales :
Plantaginaceae : Galvezia leucantha



© Patricia Jaramillo Díaz / CDF



CURRENT STATUS

Galvezia leucantha is an endemic plant of the Galapagos Islands, with populations recorded on four islands. There are three subspecies: *G. l. leucantha*, on Fernandina and Isabela; *G. l. pubescens*, on Rábida, and *G. l. porphyrantha* on Santiago^{1, 2}. All populations are very small, consisting of only a few individuals, and on at least three islands their number have reduced sharply compared to historical records. This significant reduction places the species at risk of extinction.

ECOLOGICAL IMPORTANCE

Galvezia leucantha is the only insular species of a genus otherwise found from South America to southern North America, where most species are pollinated by hummingbirds. In the absence of hummingbirds in Galapagos, Galvezia has evolved floral adaptations suitable for insect pollination, such as smaller flower size and reduced color intensity. Its flowers vary in hue depending on the subspecies — white (*G. l. leucantha*), pinkish white (*G. l. pubescens*), and purple (*G. l. porphyrantha*)¹⁻⁵.

Populations have been reduced in Santiago, Rábida, and Isabela due to the impact of introduced animals, so all subspecies are endangered. Two of them — *G. l. porphyrantha* and *G. l. pubescens* — are considered Critically Endangered¹. It is expected that the recent eradication of feral ungulates on Santiago will allow the recovery of *G. l. porphyrantha* on that island.

However, populations on Fernandina remain naturally rare, confined to eroded outcrops of red scoria. This restricted distribution suggests that the species will likely persist in low numbers and remain vulnerable to emerging threats.

INFORMATION NEEDS

All known populations — especially those of the two critically endangered subspecies — require continuous monitoring to confirm their survival and restoration. If recovery does not occur following the removal of introduced herbivores, targeted conservation actions may be necessary to ensure the species' persistence.

DISTRIBUTION

Small populations of this species occur only on Fernandina, Isabela, Rábida, and Santiago islands.

MY NOTES

AUTHOR (S)

Fact Sheet: Patricia Jaramillo Díaz and Alan Tye
Map: Byron Delgado M.

Map data sources: CDRS Natural History Collections Database, Conservation of Threatened Species, and Galapagos Verde 2050 Program.
Map methodology: See Methodology section, ref. 1. GPS data.

MANGROVES

— MANGLARES

Mangroves are assemblages of tree or shrub species distributed across tropical and subtropical regions, characterized by their remarkable tolerance to high salinity — some species can persist in conditions up to 100 times saltier than those tolerated by most plants. This adaptation allows them to thrive at the interface between marine and terrestrial systems^{1, 2}.

In Galapagos, mangroves comprise four species: Red Mangrove (*Rhizophora mangle*, Fam. Rhizophoraceae),

Black Mangrove (*Avicennia germinans*, Fam. Acanthaceae), White Mangrove (*Laguncularia racemosa*, Fam. Combretaceae), and Button Mangrove (*Conocarpus erectus*, Fam. Combretaceae)³. The White Mangrove is associated with the Red Mangrove, although it usually appears in areas farther away from the waves. The Black Mangrove is located in more peripheral positions, usually inland from the mangrove fringe. The Button Mangrove — a species some authors consider associated with the mangroves rather than a true mangrove — is

found in the transition zone between mangrove forests and dry coastal vegetation, alongside other species such as Manchineel (*Hippomane mancinella*) and Saltbush (*Cryptocarpus pyramidalis*), always beyond the intertidal zone.

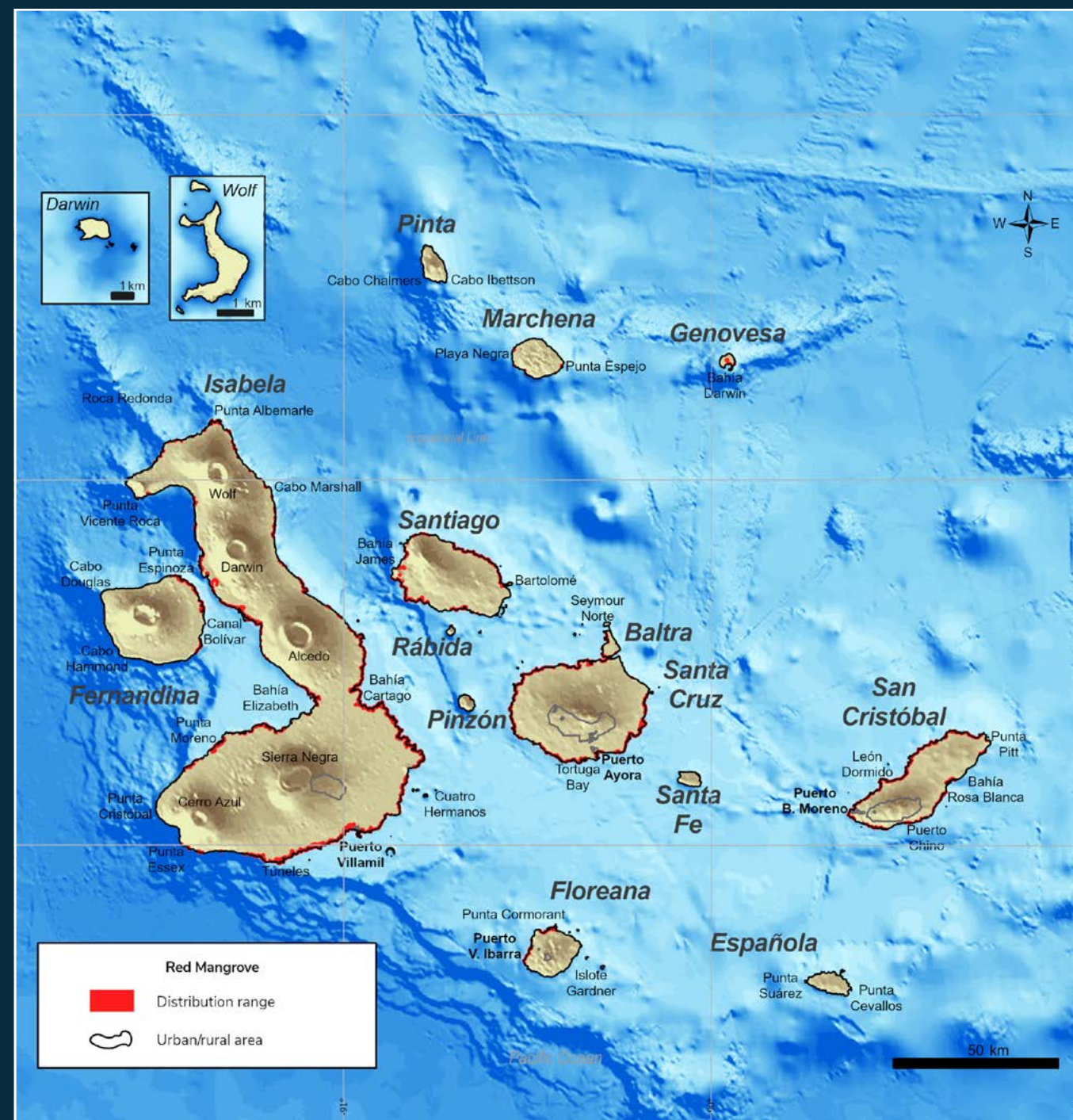
Mangroves typically occur in the intertidal zone, in protected coastal areas with little exposure to waves, such as in bays, coastal lagoons, and intertidal channels. Their extension depends largely on the intertidal range,

the coastline slope, salinity, and soil type. Galapagos' coastal area is largely inhospitable to mangroves; therefore, in some areas, they only constitute patches of underdeveloped vegetation (as in the southeast coast of Santiago Island). However, in more favorable areas — such as Bahía Cartago or Bahía Elizabeth (Isabela Island) — their development is considerable, with trees reaching 15 m or more.

Nicolás Moity and Byron Delgado M.



Tracheophyta : Magnoliopsida : Rhizophorales :
Rhizophoraceae : *Rhizophora mangle*



Map: Nicolás Moity and Byron Delgado M.

MY NOTES

Map methodology: See Methodology section, ref. 5. Manual habitat digitalization.

CORALS — CORALES

Corals collection -
Colección de corales
© Walter Pisco / CDF



Corals contribute significantly to the diversity and richness of the Galapagos Marine Reserve (GMR), as they provide refuge for hundreds of species, including endemic species. Most corals are located in the northern and eastern regions of the archipelago, where the sea temperature tends to be warmer, and thus most suitable for corals to grow there.

Reef-building species of Galapagos include *Porites lobata*, *Pocillopora* spp., *Pavona clavus*, and *P. gigantea*^{1, 2}. A total of approximately 38 species of scleractinian corals have been reported in the archipelago (e.g. Glynn & Wellington 1983)³. A revision of the number of valid species is warranted, given recent genetic and morphological studies revealing cryptic diversity within key genera such as *Pocillopora* and *Porites*⁴⁻⁶.

Seven species of corals in Galapagos are in danger of extinction: *Pocillopora* sp., *Polycyathus isabela*, *Fungia curvata*, *Cycloseris curvata*, *Psammocora stellata*, *Rhizopsammia wellingtoni*, and *Tubastraea floreana*⁷. *Rhizopsammia wellingtoni* was rediscovered in January 2024 after being listed as Critically Endangered (Possibly Extinct) in 2007. More than 250 colonies were observed in the waters off Isabela and Fernandina. While this is very encouraging, the species is still listed as CR(PE) by IUCN. *Tubastraea floreana* remains listed as Critically Endangered according to the IUCN Red List^{8, 9}.

The reproduction of corals can be sexual or asexual. While asexual reproduction dominates in Galapagos, it could limit adaptive capacity in the face of long-term environmental changes¹⁰⁻¹³. Climate change and acidification pose the largest threat to Galapagos

corals¹⁴. The increased anomalies in water temperature due to strong El Niño-Southern Oscillation (ENSO) events in 1982-1983 and 1997-1998 caused mass mortality, resulting in the loss of ~95% of all coral communities (95% in 1982-1983)¹⁵.

At present, not enough data exist on the spatial and temporal variations of seawater pH to know if and how acidification is affecting corals. Ongoing monitoring of pH and carbonate chemistry is therefore essential to understand how ocean acidification may be affecting coral calcification and recruitment in the archipelago.

Since their major die-off, coral communities have been recovering slowly across the archipelago. The most notable recovery has been observed in the northern islands, which also host the most remote

coral community¹⁷. The inclusion of corals within the conservation area of the GMR enhances their resilience and contributes to their long-term recovery. It is therefore essential that coral ecosystems are fully integrated in the zoning and management plan of the GMR.

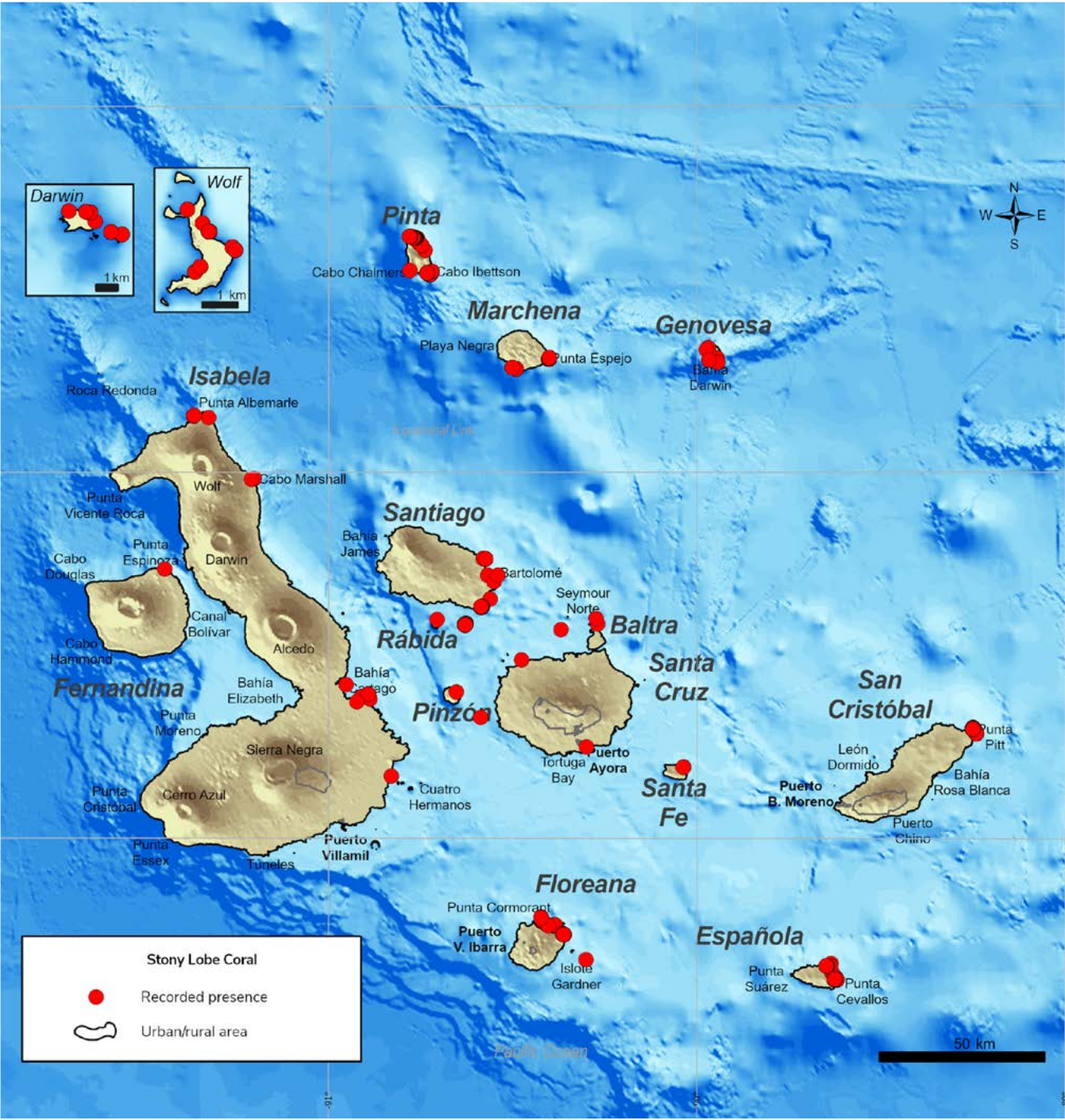
Patricia Puig Martí, Salomé Buglass and David A. Paz-García

STONY LOBE CORAL

Coral Pétreo lobata
Porites lobata Dana, 1846
Animalia : Cnidaria : Anthozoa : Scleractinia : Poritidae : *Porites lobata*



© Nicolás Moity / CDF



CURRENT STATUS

The Stony Lobe Coral is widely-distributed and probably the most common species of the genus *Porites* in Galapagos. The main impacts that affect this species are the extensive reduction of its habitat, climate change, diseases, and invasive species¹⁸. Bleaching, caused by the expulsion of symbiotic algae due to temperature changes, represents one of the most obvious symptoms of stress. In the Eastern Tropical Pacific (ETP), this species was severely affected by El Niño in 1982-1983^{19, 20, 21}. Galapagos corals suffered the highest mortalities of the TEP; a bleaching rate of 95 to 100% was registered in the central and southern islands, and an especially severe event was registered in Darwin. For these reasons, it's considered nearly an Endangered species.

Although coral recovered significantly in Darwin and Wolf, this did not occur in the other islands^{17, 21}. Its recovery is attributed to the fact that the coral structure remained intact — which allowed the asexual growth of the surviving tissue to regrow faster — and also enabled sexual recruitment. Lesions in the tissue of this species have also been recorded, caused by fish bites, algal overgrowth, and other factors^{22, 23}. *P. lobata* is also a key species and bioindicator due to its ecological importance and because its presence indicates a good state of conservation of the region.

ECOLOGICAL IMPORTANCE

The Stony Lobe Coral is one of the most important species of reef-building corals south of the TEP²⁴; It provides key habitats for many species, such as fish and invertebrates. It is frequently dominant on the margins of the reef, lagoons, and barrier reefs, and is also generally found in depths of up to 30 m. In Galapagos, it has a slow growth rate (8,1 mm/year), although it grows up faster in early life stages or under favorable conditions (14-19 mm/year)²⁴. Generally, it has separate sexes and expels gametes²⁵, though its fertility varies between regions and lower rates of recruitment have been reported in the Galapagos Islands compared to other regions of the TEP²⁵. After 1983, observations of sexual recruitment have been rare, although they have been recorded in some areas of the Galapagos Islands, principally from Darwin and Wolf islands²⁵. The Stony Lobe Coral also reproduces asexually by fragmentation^{24, 25}.

AUTHOR (S)

Fact Sheet: Patricia Puig Martí, Salomé Buglass and David A. Paz-García
Map: Nicolás Moity

Several species of fish feed on corals, causing damage to their skeleton or breaking their colonies. *P. lobata* is preyed on by Balloonfish *Arothron meleagris*^{26, 27}. Between threats to *P. lobata* are the cumulative impact of climate change, disease, and predation. *P. lobata*'s role as a bioindicator species could be emphasized given its ecological importance and sensitivity to stressors.

INFORMATION NEEDS

No specific information on the status of this species is currently available. More studies are needed on the genetic diversity, structure of their populations, abundance, ecology, and habitat.

Due to its morphological variability, it is difficult to distinguish from other species that exhibit massive growth. This is attributed to geographical variability and phenotypic plasticity, or a combination of both factors^{5, 29}. More studies are needed that combine genetics and skeletal morphology, to research the taxonomy of the genus *Porites*.

For conservation purposes, more research on the diseases, restoration using sexual recruitment, and establishment of this species is recommended, as well as the management of new marine protected areas, and the expansion of marine areas for its conservation.

DISTRIBUTION

This species is mainly present in the warmest waters, including Wolf and Darwin islands^{1-3, 30}.

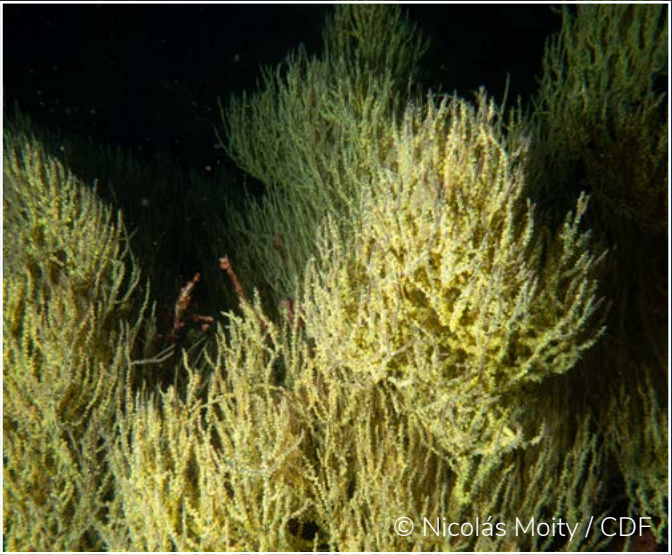
MY NOTES

Map data sources: GBIF/OBIS; Moity unpublished data, 2023-2025; DPNG, 2025; Glynn, 1983.
Map methodology: See Methodology section, ref. 1. GPS data.

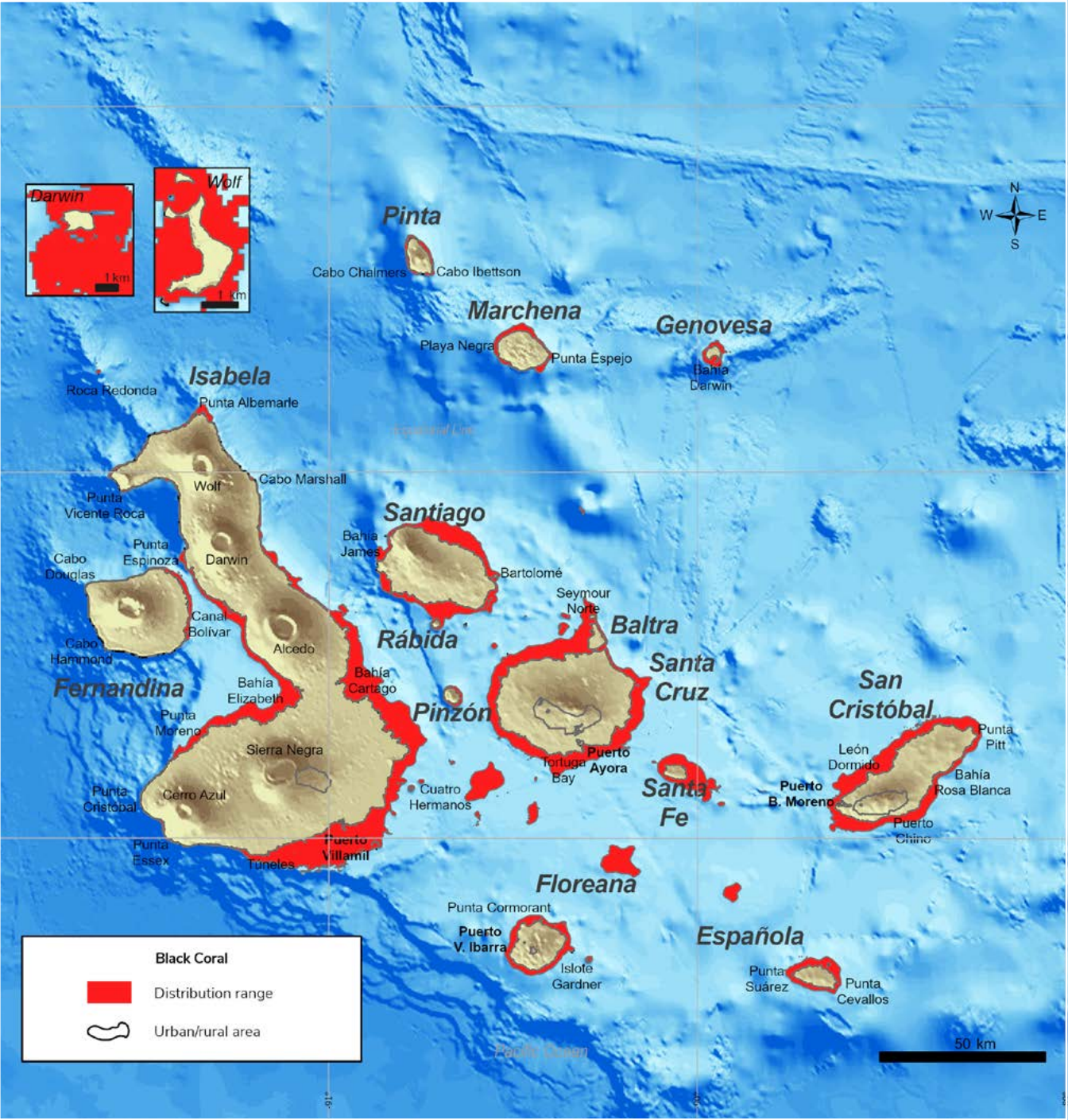
BLACK CORAL

Coral Negro

Antipathes galapagensis Deichmann, 1941
Cnidaria : Anthozoa : Hexacorallia : Antipatharia :
Antipathidae : *Antipathes galapagensis*



© Nicolás Moity / CDF



CURRENT STATUS

Black corals are colonial organisms found in all oceans, although most species live in the tropics and subtropics, from shallow waters to more than 8,000 m deep¹. *A. galapagensis* is distributed in the Eastern Tropical Pacific, from Baja California to Ecuador, including the Galapagos Islands² where they have been found down to deep waters (91 m)³. They can present extreme longevity, up to 4.5 millennia, although the genus *Antipathes* spp. has a lifespan of 12-140 years⁴. Growth rates for this genus range from 1.2-11.6 cm/y⁵. In the Galapagos, during the 1970s they were threatened by its commercial harvest for jewelry⁶⁻⁸. Since 1981 all black corals have been listed in Appendix II of the Convention on International Trade in Endangered Species (CITES), restricting their exportation/importation. *A. galapagensis* are branched into a bush, with colonies heights often surpassing a meter. Their structure is not formed by calcium carbonate but rather by chitin and protein layers, unlike scleractinian corals, antipatharian corals do not build hard reef structures. They require a hard substrate to which they can attach and are usually found in areas with currents, because they are suspension feeders, zooplankton is the major component of their diet⁵.

ECOLOGICAL IMPORTANCE

As habitat engineers, they provide three-dimensionality to the rocky reef that grant protection and substrate for other organisms like invertebrate and fish⁹. A myriad of associated organisms live within *A. galapagensis* including arthropods, annelids, echinoderms, mollusks, sponges and cnidarians⁵. In the central islands of the Galapagos (Central-Southeastern Bioregion), *A. galapagensis* is the most abundant biological habitat provider¹⁰, while in the Western bioregion it shares this role with gorgonians, macroalgae and *Myriopathes panamensis*. Most *A. galapagensis* in the central islands have some epibiont growing on them; up to 31 species of epibionts have been identified¹⁰. For example, *Antipathozoanthus hickmani* and *Terrazoanthus onoi* are parasitic zoanthids found exclusively on *A. galapagensis*¹¹ and *M. panamensis*¹². Some sessile invertebrates (such as red filamentous algae, sponges and crustose coralline algae) are indicators of colony stress, covering a large proportion of colonies, and sometimes completely covering the coral^{10, 12}. Above 10 m depth colonies tend to be scarce, while their density and height increases with depth¹⁰. In Darwin and Wolf, where the sea temperature is higher than in the rest of the islands of the Galapagos, *A. galapagensis* is almost

AUTHOR (S)

Fact Sheet: Nicolás Moity, Jennifer Suárez Moncada and Fernando Rivera
Map: Nicolás Moity

absent in shallow waters (with observed heights of ≤ 5 cm at -20 m) but forms dense, although patchy, coral communities together with *Muricea* sp. from -60 m to -90 m (per. obs.). Deeper and denser colonies have fewer epibionts than less abundant, shallower colonies. Sea temperature seem to influence *A. galapagensis* vertical distribution, this would explain the few colonies present above the 10 m thermocline, although other drivers, such as competition with obligate photosynthetic fauna might also be explaining factors⁵. Increased temperature related to El Niño events has caused its mortality to depths of < 20 m¹³; and the transitions into and out of El Niño periods increases the stress on *A. galapagensis* colonies (increasing the cover of epibionts)¹⁰. On the other hand, it seems that high temperatures during El Niño periods favor reproduction and recruitment¹³. In addition to climate change, current human impacts to the species include damage from anchoring and from diving tourism activities. The most frequent contacts of divers with their fins or body to a living organism (besides the algal mat that usually covers the rocky substrate) is with *A. galapagensis*¹⁴ (Moity, unpublished data), although the long-term consequences of diving tourism to the species are currently unknown.

INFORMATION NEEDS

Black Coral studies in Galapagos are scant and recent. More research is needed to know more about the geographical and bathymetric distribution; ecological indicators of the species (growth rate, age, abundance, morphometric, etc.); driving forces explaining vertical distribution; biodiversity associated to black coral populations; cover and density changes due to El Niño-Southern Oscillation cycle (ENSO), their vulnerability to climate changes; and their environmental services. The long-term impacts of marine tourism, including diving, on *A. galapagensis* needs to be investigated.

DISTRIBUTION

This species is found in rocky reefs of the entire archipelago from shallow waters down to 100 m. In the Western and Central-southeastern bioregions, this species is common from shallow waters to the lower limit; it is less common in the Northern bioregion (Pinta, Marchena, Genovesa) at shallow depths; and it is almost absent in Darwin and Wolf Islands at shallow depths, although it is abundant from -60m and deeper.

Map data sources: GBIF/OBIS; Moity & Suárez Moncada (EK).
Map methodology: See Methodology section, ref. 4d. Habitat modelling.

Naesiotus SNAILS

— CARACOLES *Naesiotus*

Of the 67 formally described species of *Naesiotus* land snails currently found in the Galapagos Islands, 40 have been evaluated and assessed as Endangered or Critically Endangered, according to the International Union for Conservation of Nature (IUCN)¹.

In Galapagos, snails are found in all vegetation zones except the littoral zone. Over the last 40 years, many species have undergone abrupt reductions in both their distribution range and population size. Notably, several species that were once abundant in the highlands of Santa Cruz Island seem to have disappeared (De Roy, pers. comm.)². Research efforts have been rewarded with the rediscovery of live snails in some of the areas where populations had declined severely (pers. obs.)³.

Although considerable progress has been made in describing the distribution of *Naesiotus* spp. species, their habitats require better characterization. While population changes in several snail species have been observed, our understanding of the causes of these declines remains very poor. Improved knowledge of these factors will be essential to identify the factors influencing survival and to develop effective conservation plans for this remarkable group of species.

Christine Parent

Snail Collection -
Colección de caracoles
© Mara Speece / CDF

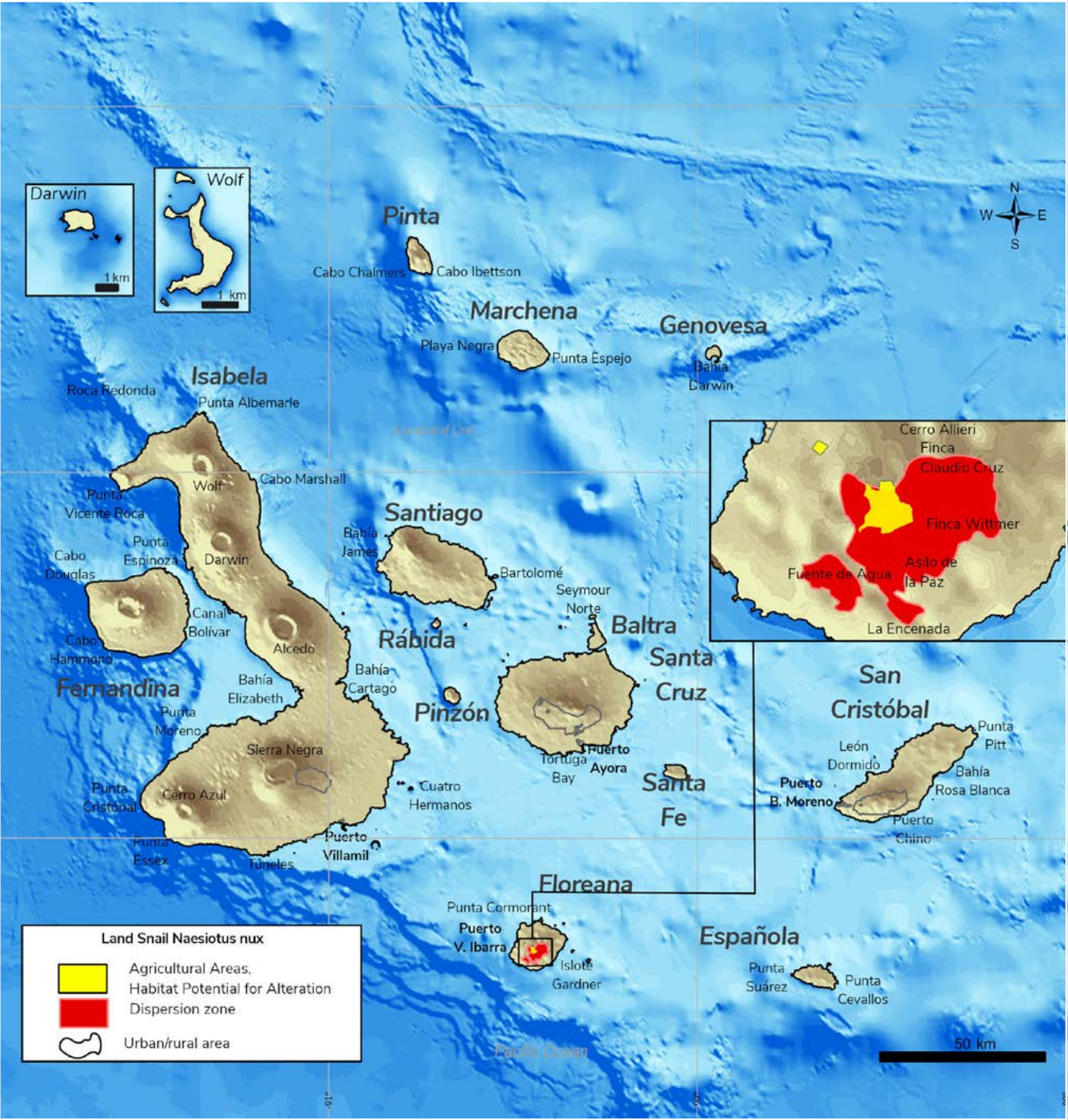
LAND SNAIL NAESIOTUS NUX

Caracol Terrestre *Naesiotus nux*

Naesiotus nux (Broderip, 1832)
Animalia : Mollusca : Gastropoda : Stylommatophora :
Orthalicoidea : *Naesiotus nux*



© Rashid Cruz / CDF



CURRENT STATUS

The Land Snail *Naesiotus nux* is in danger of extinction, according to the Red List of the International Union for Conservation of Nature (IUCN)¹. This species is suffering severe reductions in its area of occupancy. *N. nux* is humid zone species that was thought to be endemic to both Floreana and San Cristóbal islands, but recent morphological and phylogenetic studies suggest the two islands each have their own distinct species². Because of taxonomic priority, the lineage on Floreana should keep the name of *N. nux* whereas the San Cristóbal populations should be assigned a new species name. *N. nux* is known from several populations on Floreana that together cover a total area of approximately 16 km² combined. The reasons for the decline of this species remain unclear, but the alteration and destruction of its habitat by human activities and introduced species are likely causes.

ECOLOGICAL IMPORTANCE

For many years, mollusks, especially marine and freshwater species, have been used as biomonitors and bioindicators. Recently, the potential role of terrestrial snails as biomonitors or bioindicators has been emphasized⁵. As a taxonomic group, snails have wide distribution ranges, are found in a large number of habitats, and are particularly sensitive to environmental disturbance. However, each species typically occupies a restricted area and is therefore susceptible to environmental changes. Like many species of *Naesiotus*, the Land Snail *Naesiotus nux* is restricted to a small area in a single vegetation zone.

It is an arboreal species generally found on tree trunks and plant leaves, and sometimes under stones or fallen tree trunks, especially when the habitat is dry. In arid conditions, it hides under surrounding materials and retracts into its shell to avoid drying out. It can survive many weeks, possibly several months, in a state of estivation; during this time, it slows its metabolism and keeps the entrance of its shell covered with a thin layer of mucus (an "epiphragm"), to minimize the loss of moisture. It is uncertain whether the population reduction of *Naesiotus nux* and other Galapagos *Naesiotus* Snails is directly related to human activities, but the fact that its most drastic decline has been observed on inhabited islands, suggests a possible association.

AUTHOR (S)

Fact Sheet: Christine Parent
Map: Byron Delgado M.

INFORMATION NEEDS

Although considerable progress has been made in describing the distribution of *N. nux* and other related species on the islands, there's an urgent need to improve the characterization of their habitat and understand the causes for its decline.

Intensive monitoring of changes in many small snail populations, including the Land Snail *Naesiotus nux*, is taking place on several islands. However, understanding the observed causes of population reduction in most of these species is still very poor. Having this information would help identify the factors that influence their survival and provide necessary information for establishing a conservation plan.

DISTRIBUTION

This species is present in the humid zones of Floreana (six populations).

MY NOTES

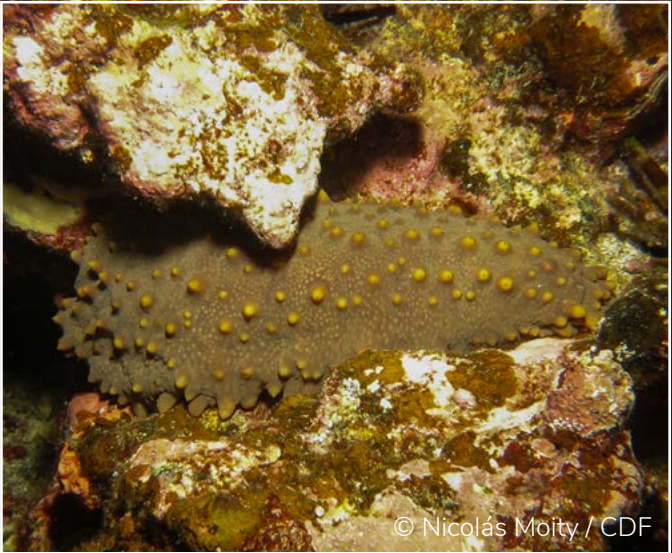
Map data sources: Parent C. (EK), Villanea et al. (2016).

Map methodology: See Methodology section, ref. 3b. Expert-based drawn area.

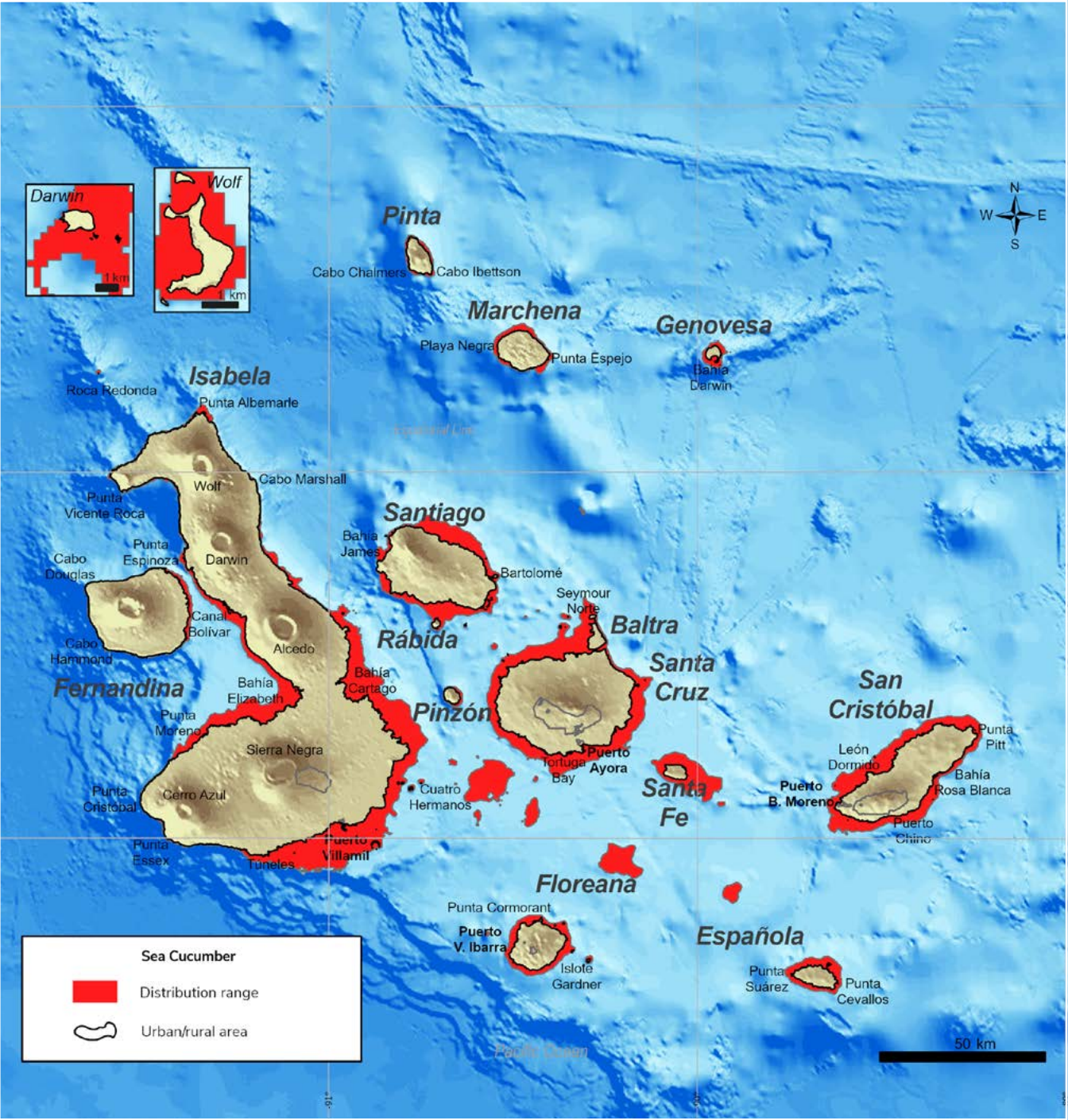
SEA CUCUMBER

Pepino de Mar

Isostichopus fuscus (Ludwig, 1875)
Animalia : Echinodermata : Holothuroidea :
Aspidochirotida : Stichopodidae : *Isostichopus fuscus*



© Nicolás Moity / CDF



— SENTINEL
NATIVE

CURRENT STATUS

Isostichopus fuscus is characterized by its greenish-brown color and yellow papillae¹. Currently, it is considered in recovery in Galapagos. The International Union for Conservation of Nature (IUCN) describes this species as in danger of extinction². In 2015, a five-year ban on fishing was agreed upon to help effect its recovery in Galapagos. Recent population assessments indicate that its population reached sustainable levels after the five-year closure³.

ECOLOGICAL IMPORTANCE

I. fuscus is the only species of sea cucumber that is caught in Galapagos, its fishery began in 1991⁴. However, the peak moment for fishing this resource was at the beginning of the first decade of this century. During that time, up to 1,229 fishers and 377 vessels participated in the fishery, more than 8 million sea cucumbers were caught, and a gross income of more than USD 4 ' 000,000 was obtained. Currently, its cost and demand are increasing in Asia, its main market. As for its role in the ecosystem, it is considered a cleaning species since it redistributes sediment and oxygenates the seabed^{5, 6}. Thus, it's also essential for maintaining marine productivity⁴. Its economic and ecological importance make it an indicator species of the Galapagos socio-ecosystem.

INFORMATION NEEDS

In order to recover the Sea Cucumber in Galapagos, it's necessary to genetically describe this species' population, identify the environmental and ecological factors that influence its abundance, identify the biological, ecological, and socioeconomic effects of banning it from fishing, and gather more information on its recruitment.

DISTRIBUTION

This species is present in the rocky bottoms where *Ulva* spp. algae predominate. It is found up to 40 m in depth^{1, 4}.

MY NOTES

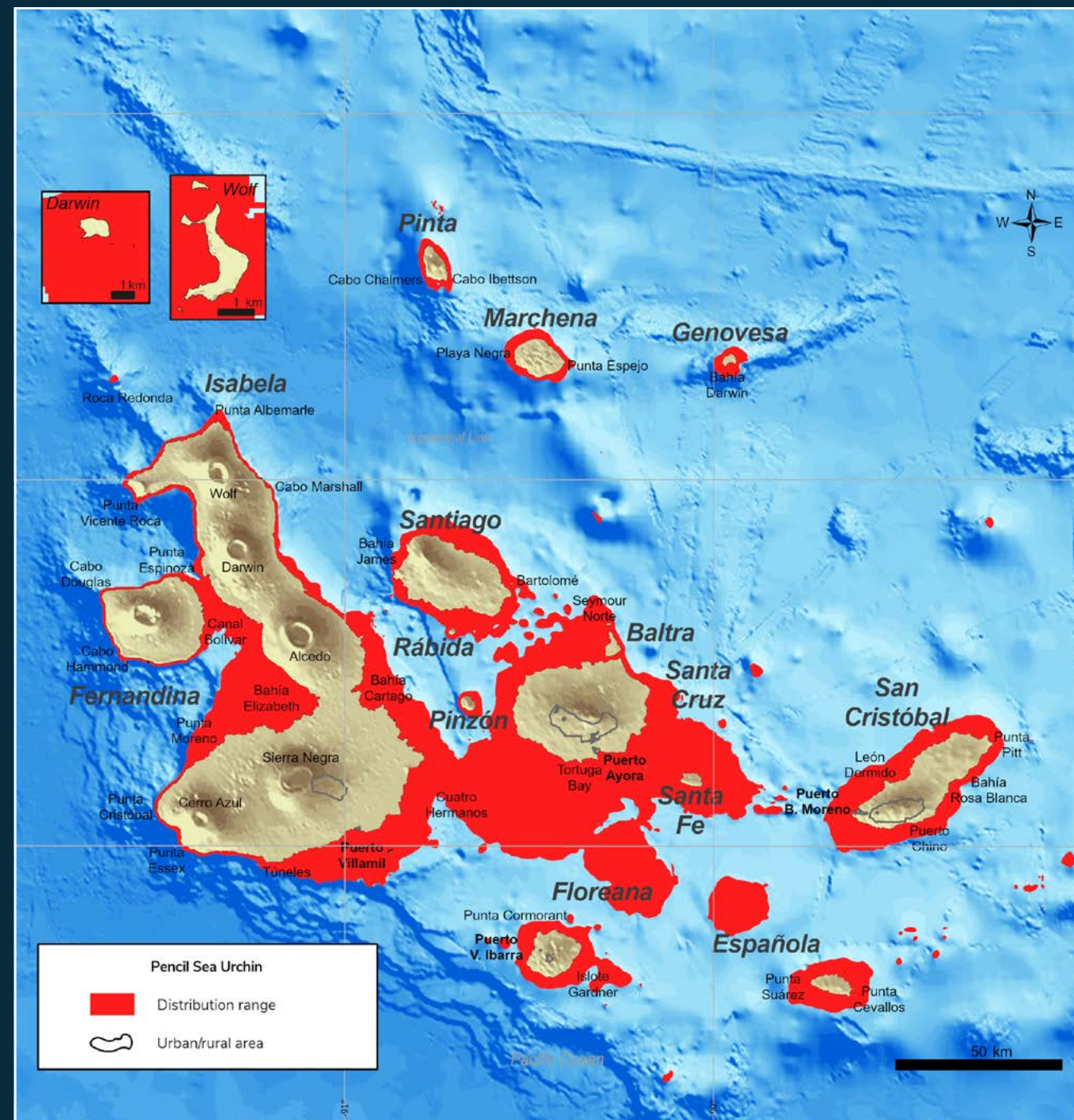
AUTHOR (S)

Fact Sheet: Jorge Ramírez-González and Harry Reyes
Map: Nicolás Moity

Map data sources: Moity and Ramírez-González (2019).
Map methodology: See Methodology section, ref. 4d. Habitat modelling.

— SENTINEL
NATIVE

Eucidaris galapagensis Valenciennes, 1846
Animalia : Echinodermata : Echinoidea : Cidaroida :
Cidaridae : *Eucidaris galapagensis*



The Pencil Sea Urchin is a common member of the subtidal rock communities of the Galapagos Islands, Cocos Islands, and the Clipperton Atoll. From 1999 to 2017, the average population densities in the central part of the archipelago — the most studied region, ranged from 0.4 to 51.6 individuals/m² (6 m deep). The population of this species has also remained generally stable during the three El Niño events that occurred during this period.

The Pencil Sea Urchin is omnivorous, feeds on corals¹, grazes on algal turf, diatoms, and algae². By bioeroding corals, *Eucidaris* can reduce the coral abundance and contribute to regional differences in coral recovery from El Niño events³. Since the subtidal zone in Galapagos mainly comprises rocky reefs rather than coral reefs, this species is most commonly observed grazing micro and macroalgae or crustose coral algae, forming "urchin barrens" where they are abundant. In this context, *E. galapagensis* is an ecosystem engineer because it reduces algal biomass and the spatial complexity of benthic habitats. In extreme situations, *Eucidaris* can leave patches of bare rock substrate while grazing.

The thick spines of *Eucidaris* represent a large area of suitable habitat for epifaunal invertebrates, a single urchin can host up to 20 species⁴. As a mobile foundation species, the pencil urchin increases the richness of invertebrate species by provisioning substrate and providing refuge against predation⁴. Pencil urchins are important prey for lobsters⁵, the Hogfish *Bodianus diplotaenia*, and triggerfishes, pufferfishes and porcupinefishes^{9, 12}; it is also negatively impacted by parasitic snails⁶. Several authors support the hypothesis that the current abundance of pencil sea urchins in the subtidal zone of the Galapagos Islands is the result of overfishing their predators^{7, 8}. However, most of the evidence related to its control by predation is correlative and based mainly on surveys on the abundance of urchins and predators. Recent field experiments indicate that the Pencil Sea Urchin is a key herbivore in the triggerfish - urchin - algae trophic cascade⁹. Due to its ecological importance, it's considered a Bioindicator Species.

Little is known about the population biology of this species, apart from information on its size structure, distribution, and abundance. Juveniles are abundant in rock rubble habitats, suggesting that this is a favored habitat for recruitment¹⁰, but the key processes of reproduction, larval supply, and recruitment required to understand their population growth, is something that hasn't been studied on any species of urchin in the Galapagos Islands.

Recruitment limitation appears to be a valid hypothesis alternative to predation, when explaining the low density of pencil sea urchins at a given site. Field experiments are required to test both hypotheses. Given its ecological importance^{2, 11}, it's necessary to understand how the consumption, abundance, and population growth of pencil sea urchins are affected by environmental (water flow, temperature, substrate), biological (recruitment, predation), and anthropogenic factors (overfishing, ocean warming).

The Pencil Sea Urchin is a subtidal species, nearly absent in depths less than 3 m, but common in depths between 5 m and 40 m. It is present throughout the archipelago, Cocos Islands, and the Clipperton Atoll.

MY NOTES

Fact Sheet: Jon D. Witman
Map: Nicolás Moity

Map data sources: GBIF/OBIS; Banks (EK).
Map methodology: See Methodology section, ref. 4d.
 Habitat modelling.

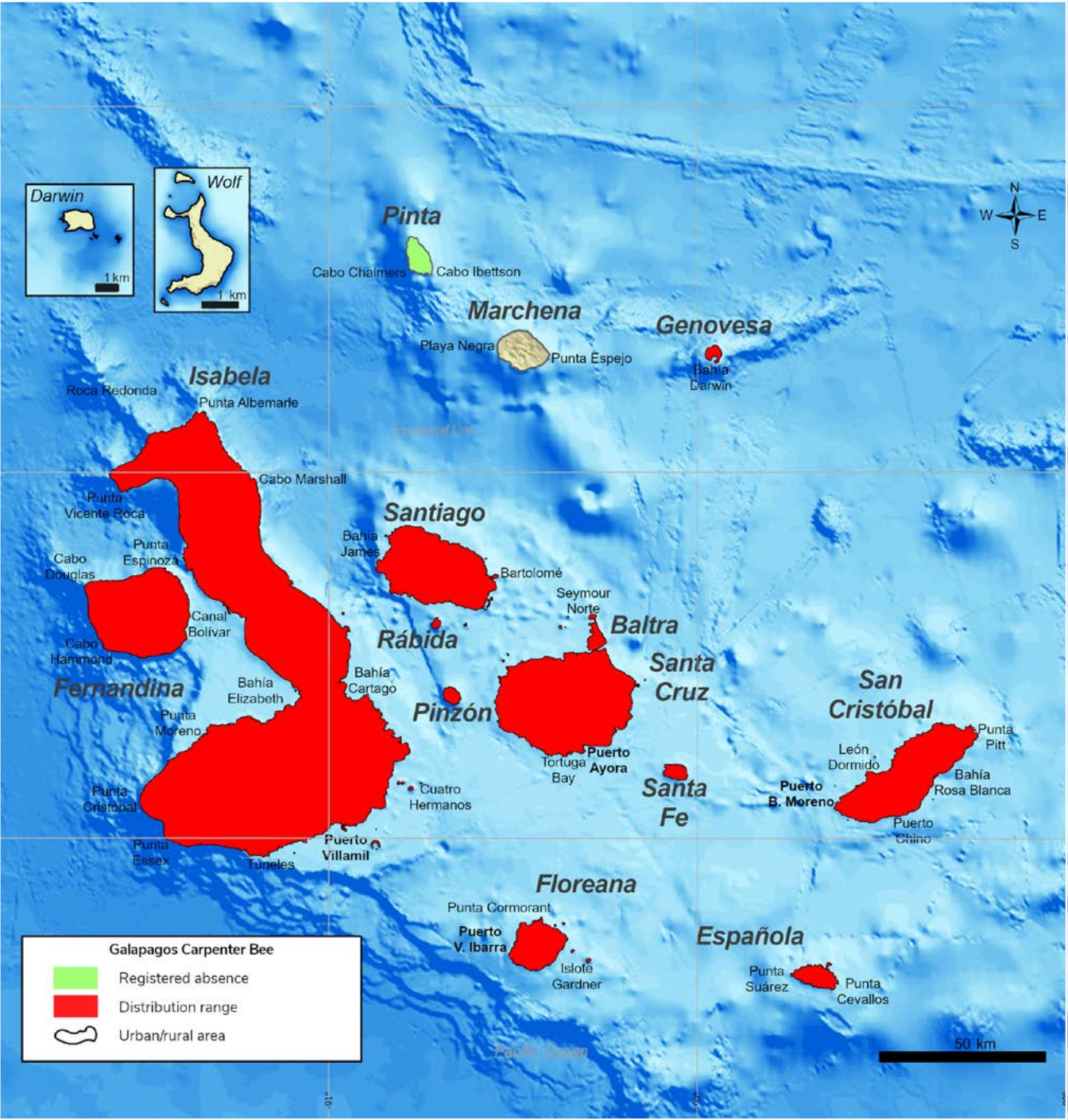
GALAPAGOS CARPENTER BEE

Abeja Carpintera de Galápagos

Xylocopa darwini Cockerell, 1926
Animalia : Arthropoda : Insecta : Hymenoptera :
Apidae : *Xylocopa darwini*



© Carolina Carrión Klier



CURRENT STATUS

The carpenter bee is endemic to the Galapagos Islands where it has an important role as a pollinator. It is reported from almost all the large islands of the archipelago (except on Marchena and Pinta) and is found in all vegetation zones.

The status of the Galapagos Carpenter Bee is thought to be stable, however human activities and the recent introduction of additional pollinator species (including two species of introduced bees)¹⁻³ has likely altered the dynamics between this species and Galapagos flora. Bee populations may also be affected by introduced predators, such as the Smooth-billed Ani (*Crotophaga ani*), which is known to feed on large numbers of bees⁴.

ECOLOGICAL IMPORTANCE

The Galapagos Carpenter Bee is the only bee species that is endemic to the archipelago and is the most important pollinator of Galapagos plants. The females (black) and the males (golden) transport significant amounts of pollen on the hairs of their body when flying from flower to flower, looking for the nectar they require to obtain energy. Females also collect and store pollen in cells they build inside tree trunks; this pollen is used to feed the immature stages of the next generation⁵.

The carpenter bee is known to visit the flowers of at least one-fifth of the native and endemic flowering plants (angiosperms) of the Galapagos Islands^{1,6,7}. It plays an important role as a pollinator of threatened species; for example, it is the main visitor of the Critically Endangered endemic plant *Galvezia leucantha* which is restricted to small populations on four islands⁸. Additionally, evidence suggests that pollination by the carpenter bee could help accelerate the establishment process of specific plant species, including species that may be important for agriculture⁹.

Pollination by animals, in particular by insects, is essential for the reproductive success of many plants, and thus, crucial for the maintenance and diversity of functioning terrestrial ecosystems, such as those of the Galapagos Islands^{6,9}. Therefore, the development of conservation strategies for the native flora should consider the associated pollinators.

AUTHOR (S)

Fact Sheet: Jacqueline Rodríguez and Charlotte E. Causton
Map: Nicolás Moity

INFORMATION NEEDS

Recent studies to understand the interactions between endemic and invasive pollinator species indicate that insect species introduced by humans now dominate many pollination networks in Galapagos⁶. Little is known about the effects of these invaders on the conservation of Galapagos biodiversity and the maintenance of ecosystem processes. There is also a lack of information on how other anthropogenic effects, such as the use of pesticides and habitat alteration, affect endemic pollinator species and the plants they visit. Finally, having additional information about the ecology of the Galapagos Carpenter Bee and its distribution would allow us to understand its role in ecosystem functions better and determine its current status in the inhabited and uninhabited islands.

DISTRIBUTION

This species is present on the following islands: Baltra, Daphne, Española, Fernandina, Floreana, Gardner, Genovesa, Isabela, Pinzón, San Cristóbal, Santa Cruz, Santa Fe, Santiago. It can be found in littoral, arid, and transitional vegetation areas.

MY NOTES

Map data sources: Traveset *et al.*, 2015; ICCDRS, <https://datazone.darwinfoundation.org/en/checklist/>.
Map methodology: See Methodology section, ref. 3a. Polygons from records, generalized from point data.

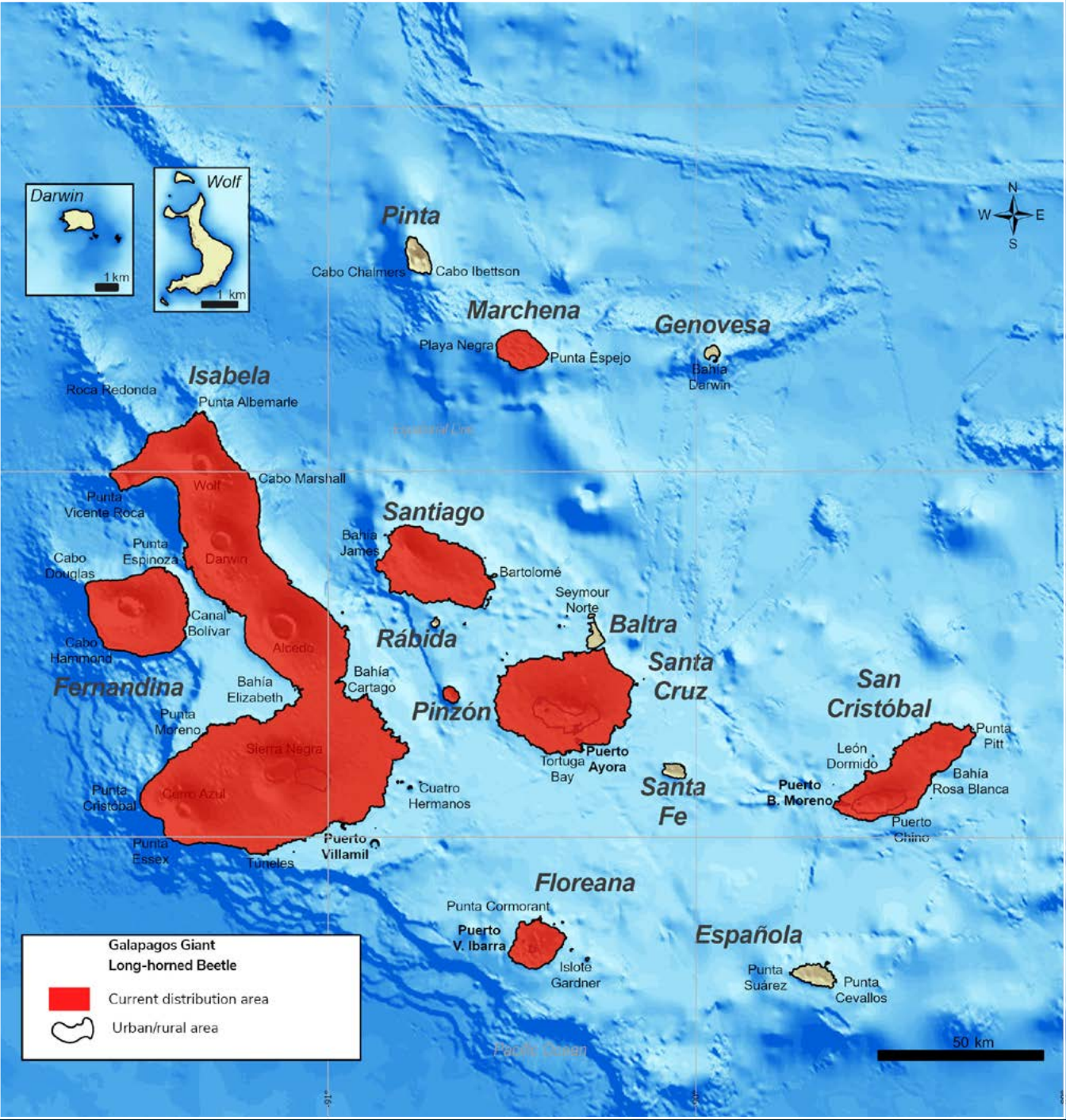
GALAPAGOS GIANT LONG- HORNED BEETLE

Escarabajo Gigante de Cuernos- largos de Galápagos

Mallodon chevrolatii galapagoensis (Mutchler,1938)
Animalia: Arthropoda: Insecta: Coleoptera:
Cerambycidae: *Mallodon chevrolatii galapagoensis*



© Patricio Picón Rentería / CDF



CURRENT STATUS

The Galapagos Giant Long-horned Beetle, *Mallodon chevrolatii galapagoensis*, and two other subspecies of *M. chevrolatii* (*M. chevrolatii glabratus* and *M. chevrolatii vandykei*) are endemic to the Galapagos Islands. They are the largest beetles in the archipelago reaching up to 8 cm in length in their adult stage^{1, 2}. Despite their size, nothing is known about the population status of these beetles. It is likely that some of their habitat has been reduced on islands where native forests have been replaced by agricultural lands or taken over by invasive plants^{3, 4}.

ECOLOGICAL IMPORTANCE

The Galapagos Giant Long-horned Beetle lives in *Scalesia* (*Scalesia pedunculata*), Incense Tree (*Bursera graveolens*), Poison Apple Tree (*Hippomane mancinella*), Matazarno (*Piscidia carthagenensis*), Kapok Tree (*Ceiba pentandra*), and Balsa Tree (*Ochroma pyramidale*) trees, among others⁵. In the larval stage, beetles inhabit logs, stumps, and decaying trees where they feed by boring into dead wood^{1, 6}. Giant long-horned beetles have an important role in forest ecosystems as their larvae help speed up the degradation process of dead wood enabling the circulation of nutrients in the soil^{7, 8}. These nutrients are important for forest growth as well as for other organisms in the ecosystem.

Adult giant long-horned beetles are crepuscular and can be found on bark or visiting flowers⁶. These insects are a food source for Galapagos landbirds such as the Barn Owl (*Tyto furcata punctatissima*) and the Short-eared Owl (*Asio flammeus galapagoensis*)⁹.

INFORMATION NEEDS

Very little is known about the role that these giant long-horned beetles have in the ecosystem or about the interactions that they have with other endemic and native species. Studies are needed to determine whether anthropogenic stressors, such as introduced species and land clearance, have impacted them. Lastly, studies are needed to clarify the taxonomic status and distribution of the subspecies of *M. chevrolatii* listed here as well as an undetermined subspecies that is found on several islands in the archipelago¹.

DISTRIBUTION

The genus *Mallodon* is present on Fernandina, Floreana, Isabela, Marchena, Pinzón, San Cristóbal, Santa Cruz, and Santiago islands.

MY NOTES

AUTHOR (S)

Fact Sheet: Julia Bolaños, Jacqueline Rodríguez and Charlotte E. Causton
Map: Byron Delgado M.

Map data sources: CDF Natural History Collections Database.

Map methodology: See Methodology section, ref. 3a. Polygons from records, generalized from point data.

ENDEMIC ANTS

—HORMIGAS ENDÉMICAS

Presently, nine species of ants are considered endemic to the Galapagos Islands: *Camponotus macilentus*, *C. planus*, *Cyphomyrmex nesiotus*, *Dorymyrmex pyramicus albemarlensis*, *Hypoponera beebei*, *Leptogenys cf. gorgona* (hh03), *Leptogenys santacruzii*, *Pheidole williamsi*, and *Solenopsis gnomia*. The origin of eight additional species still remains to be determined. The largest proportion of the Galapagos ant fauna is made up of species that have been introduced by humans, with 33 species recorded to date¹.

Little is known about the ants of the Galapagos Islands. As in other parts of the world, they likely play an essential role in maintaining the balance of the ecosystems in which they occur and are a fundamental element in the food network¹. Ants feed on invertebrates, plants, seeds, and decomposing material. They also serve as a source of food for other animals such as lizards and birds.

Ants benefit ecosystems as seed and pollen dispersers, facilitating the reproduction of plants. They are also known as "ecosystem engineers" because of the way they shape and model the environment in which they live. The tunnels they build underground aerate the soil, allowing water and oxygen to reach the roots of plants and improve their health. Tunnel building, combined with the food that they carry to their nests, alters the chemical, physical, and biotic characteristics of the soil. Ants that nest in wood perform similar functions, which facilitate the establishment of microorganisms that are involved in wood decomposition.

Due to their role as ecosystem engineers and their presence across a wide range of ecosystems, ants are considered good indicators of a healthy and functioning ecosystem¹⁻³.

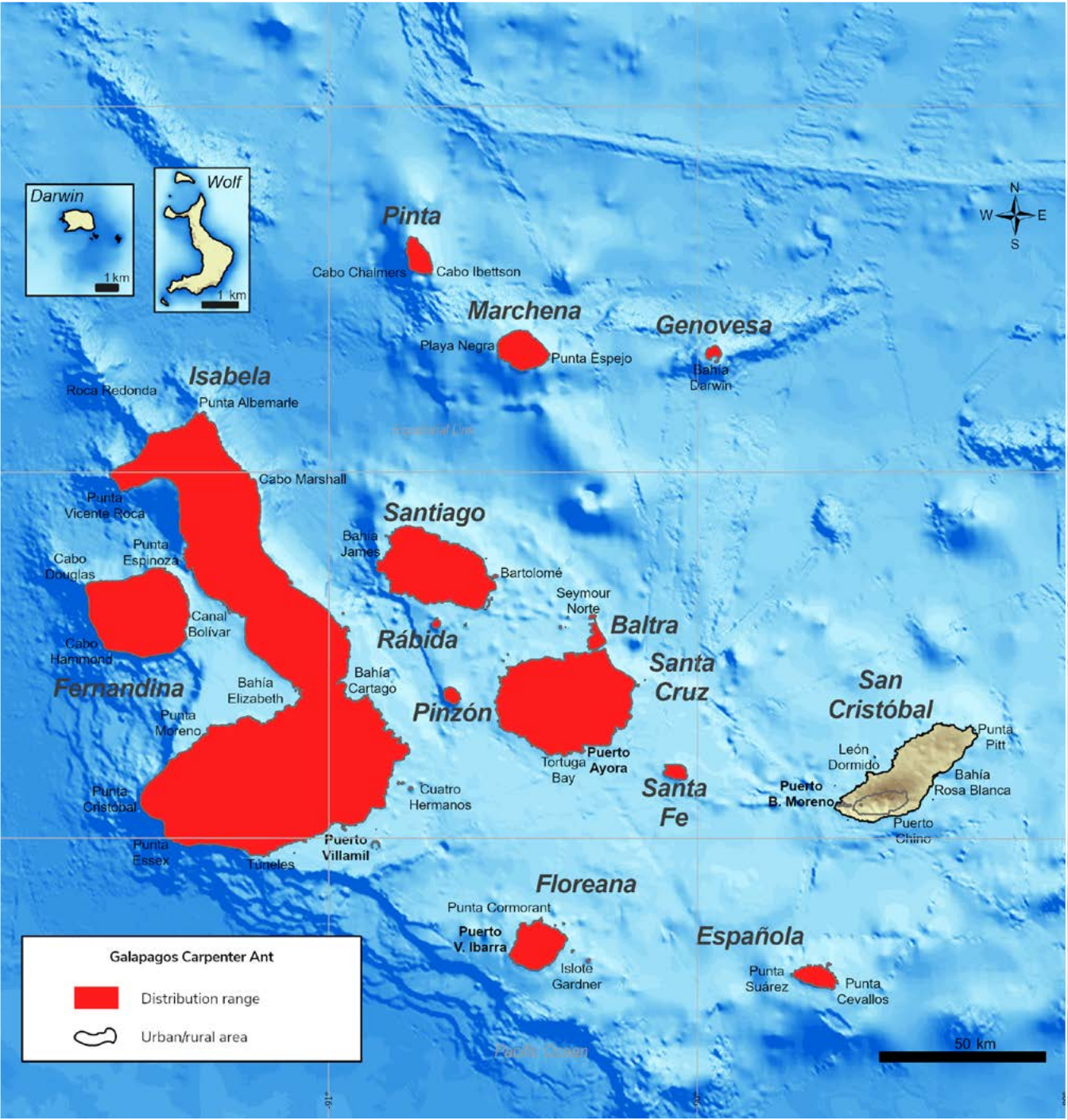
Charlotte E. Causton and Henri W. Herrera



Carpenter Ant -
Hormiga Carpintera
Camponotus planus
© Jeremy Squire

GALAPAGOS CARPENTER ANT

Hormiga Carpintera de Galápagos
Camponotus macilentus F. Smith, 1877
Animalia : Arthropoda : Insecta : Hymenoptera :
Formicidae : *Camponotus macilentus*



CURRENT STATUS

The Galapagos Carpenter ant is one of two species of carpenter ant considered to be endemic to the islands (the other is *Camponotus planus*, whose head, thorax, and abdomen are black). There are 13 subspecies distributed on 13 islands throughout the archipelago^{1, 4}. Recent studies have shown that the population size of this species has decreased dramatically on some islands (Baltra, Floreana, Española, and Santa Cruz), possibly due to the presence of invasive species, including ants¹. The carpenter ant has not been found on Santa Cruz since 2001, despite inventories carried out in all the vegetation zones. In uninhabited areas, such as on Alcedo and Darwin volcanoes (Isabela Island), it appears to be in a better state of conservation^{1, 4}.

ECOLOGICAL IMPORTANCE

The Galapagos Carpenter Ant plays an important role in the environment because it contributes to the processes of decomposition. It is also an important source of food for other animals; for example, its larvae are food for birds and invertebrates⁵. This species is nocturnal, feeding on insects and other invertebrates, the honeydew produced by scale insects and aphids, and on the extrafloral nectaries of plants^{1, 6-9}.

It also feeds on pollen and nectar, helping pollinate native plants^{1, 6, 9}. The Galapagos Carpenter Ant plays a particularly important role in accelerating the decomposition process of trees; by burrowing into the tree, the wood is exposed to fungi and other organisms associated with wood decomposition processes¹⁰. This is very important in dry environments where decomposition processes are slow.

The Galapagos Carpenter Ant is extremely shy and quickly escapes when threatened. It mainly nests in dry branches. Recently, its habitat has been invaded by the invasive carpenter ant, *Camponotus zonatus*, which is often mistaken for the endemic species (both are yellow/brown). This invasive species is now present on 48 islands and islets and in all vegetation zones. It most likely has replaced the Galapagos Carpenter Ant on several islands^{1, 11}.

AUTHOR (S)

Fact Sheet: Charlotte E. Causton and Henri W. Herrera
Map: Nicolás Moity

INFORMATION NEEDS

Very little is known about the ecology of this species. Its decline in the archipelago is a serious concern and studies are needed both to determine its status on the different islands and to identify its main threats.

DISTRIBUTION

This species prefers arid environments. It is present on Baltra, Española, Fernandina, Floreana, Genovesa, Isabela, Marchena, Pinzón, Pinta, Santa Cruz, Santa Fe, and Santiago islands, and Champion Islet.

MY NOTES

Map data sources: ICCDRS Database Collection, <https://datazone.darwinfoundation.org/en/checklist/>, Herrera, H., 2016.
Map methodology: See Methodology section, ref. 3a. Polygons from records, generalized from point data and 3b. Expert-based drawn area.

WOLF SPIDERS (LYCOSIDS) GROUP — ARAÑAS LOBO (GRUPO)

There are seven endemic Wolf Spider species living on the Galapagos Islands belonging to the same genus *Hogna*: *H. albemarlensis*, *H. espanola*, *H. galapagoensis*, *H. hendrickxi*, *H. jacquesbireli*, *H. junco* and *H. snodgrassi*¹. Reproductive isolation between the seven morphospecies was confirmed by allozyme cellulose acetate electrophoresis².

They are all hunting spiders living at ground level. They do not build a web for catching insects. They are easily recognizable by their brown appearance with a very clear median band of light hairs on the carapace. Lycosids have good eyesight and feed on all kinds of other invertebrates. Prior to mating, the male waves with its modified first legs and palps in front of the female in a courtship display.

The females construct an egg sac in which they lay their eggs. The egg sac is attached to their spinnerets and carried around. It is spherical and white or beige in colour. They will mostly orient themselves so that the egg sac with developing eggs gets the optimum exposure to the warmth of the sun. Once out of the sac, the spiderlings climb on to their mother's abdomen and are carried around by her for a few weeks.

To recognize the species a thorough examination of the epigyne (female ventral sex organ) and palp (male sex organ in front of the head) is required¹.

Léon Baert

Wolf Spider -
Araña Lobo
Hogna spp.

© Carlos Espinosa / CDF



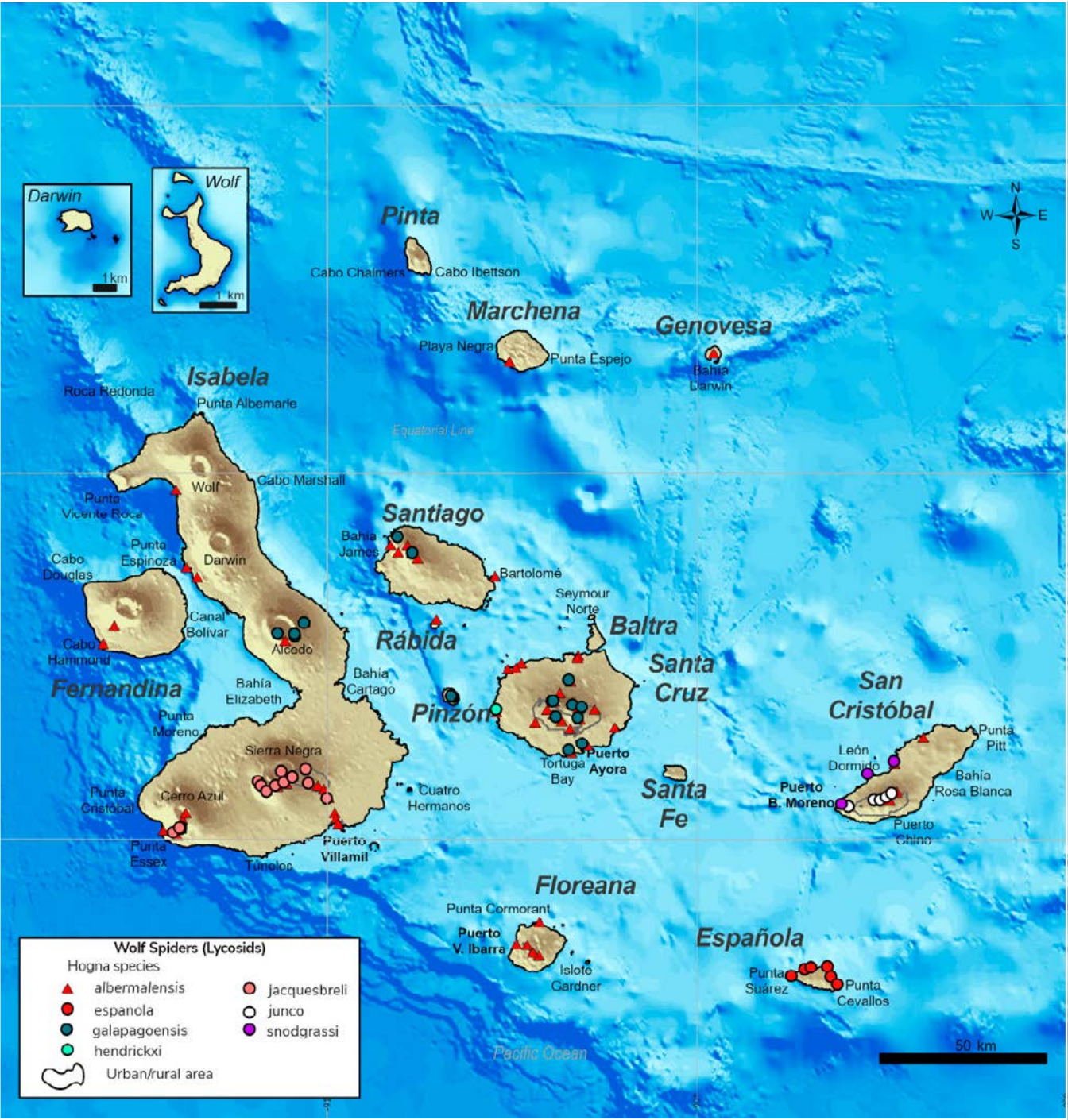
WOLF SPIDERS (LYCOSIDS)

Arañas Lobo (Licósidos)

Hogna albemarlensis (Banks, 1902), *H. espanola* Baert & Maelfait, 2008, *H. galapagoensis* (Banks, 1902), *H. hendrickxi* Baert & Maelfait, 2008, *H. jacquesbreli* Baert & Maelfait, 2008, *H. junco* Baert & Maelfait, 2008, *H. snodgrassi* (Banks, 1902)
Animalia: Arthropoda : Aracnida : Araneae : Lycosidae
: *Hogna* spp. Simon, 1885



© Mara Speece / CDF



CURRENT STATUS

Of the wolf spiders of Galapagos, three species groups can be distinguished, each with a particular ecological niche.

- a) three high elevation fern-sedge zone species.
- b) three coastal dry species.
- c) one generalist species.

ECOLOGICAL IMPORTANCE

Spiders being insectivores can play an important role in reducing and suppressing the densities of harmful insect pests in various ecological natural systems.

INFORMATION NEEDS

The seven wolf spiders known from the archipelago are described as new species for science and are endemic to the islands. There must normally have been a continental species (the genus *Hogna* is a worldwide dispersed genus) who first arrived on one of the islands, and then, adapting to the climatological situations and to the ecological niches developed into the seven different actual living species.

DISTRIBUTION

Of the wolf spiders of Galapagos, three species groups can be distinguished, each with a particular ecological niche¹. A first group of ecologically and morphologically similar species occurs on the top of the islands in the pampa zone and is called “high elevation fern-sedge zone species”: *H. jacquesbreli* lives on both southern volcanoes Cerro Azul and Sierra Negra of one of the youngest islands (Isabela); *H. galapagoensis* which occurs on islands of intermediate age (Santa Cruz and Santiago, Alcedo Volcano and Azul Volcano of Isabela), and *H. junco* which occurs on the oldest San Cristóbal Island.

A second group called “coastal dry species”, lives in the dry supra-littoral and arid zone along the coast in vegetated dunes and in the *Opuntia* Cactus zone. These morpho-species can only be found on the oldest San Cristóbal (*H. snodgrassi*), Española (*H. espanola*) and Santa Cruz (*H. hendrickxi*).

The third group comprises populations of the generalist species *H. albemarlensis* that lives in saline habitats along the coast (salt marshes, bays), along permanent pools (e.g. El Chato on Santa Cruz Island), and in permanent wetlands below 600 m of altitude (e.g. Los Gemelos on Santa Cruz Island). They reach however their highest densities in the salt marshes. It is widely spread over the whole archipelago with the exception of the northern Pinta Island and the south-eastern Española Island.

MY NOTES

AUTHOR (S)

Fact Sheet: León Baert
Map: Byron Delgado M.

Map data sources: ICCDRS Database Collection.
Map methodology: See Methodology section, ref. 1.
GPS data.

LOBSTERS— LANGOSTAS

Two species of spiny lobsters inhabit Galapagos: the Red Lobster (*Panulirus penicillatus*) and the Green or Blue Lobster (*P. gracilis*), along with one Slipper Lobster (*Scyllarides astori*). The most notable features of the spiny lobsters are the horn-like projections on the front of the carapace, which give rise to their common name. Both *Panulirus* species are distinguished by the color indicated by their common name¹. *S. astori* on the other hand has large, flat horns that give it a slipper-like appearance.

The Red Lobster is widely distributed throughout the Indo-Pacific Region, including the rocky-bottom areas of the Galapagos Marine Reserve. In contrast, the Green Lobster and the Slipper Lobster are found throughout the Eastern Tropical Pacific (ETP). In Galapagos, the Green Lobster's is mainly restricted to the rocky and sandy bottoms of Isabela Island. Within the ETP, the highest abundance of Slipper Lobster has been recorded in Galapagos, making it the only site in the region where the species supports a fishery².

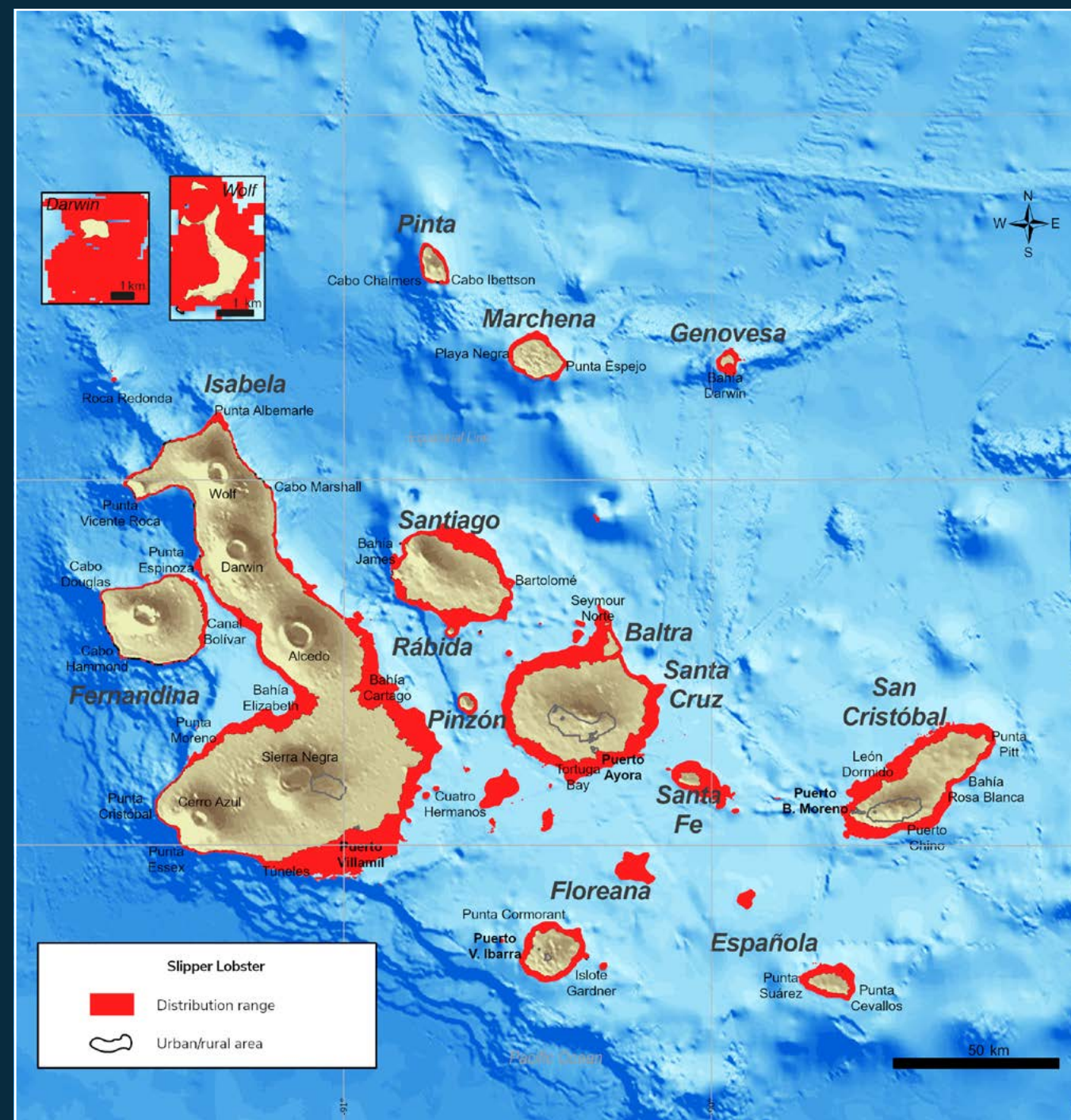
All three species are important resources for Galapagos' artisanal fishery. Based on catch volume, the Red Lobster is more important to the fishery than the Green Lobster²⁻⁵. Both spiny lobster species hold cultural importance, serving as emblematic symbols of Galapagos identity and are the centerpiece of the annual Lobster Festival.

**Jorge Ramírez-González and
Harry Reyes**



**Red Spiny Lobster -
Langost Roja**
Panulirus penicillatus
© Mara Speece / CDF

Arthropoda: Malacostraca: Decapoda: Macrura
Reptantia: Scyllaridae: *Scyllarides astori*



S. astori is considered an indicator of the state of Galapagos marine socio-ecosystem. Galapagos is the only place in the world where *S. astori* is commercially fished. In recent years, this species has been an important fishery resource that is used as food for the local population of the archipelago. GNPD data estimate that this resource produces an annual gross economic income of US\$200,000. Being omnivorous, the Slipper Lobster also plays an ecological role by controlling populations of other species, especially bivalves² of rocky reefs and habitats with muddy or sandy bottoms such as mangroves². The effect of the fishery on the ecological role of the species is unknown.

Despite its increasing importance for food and economic income, the population status of *S. astori* in Galapagos is unknown, as are the environmental and market factors that influence catches. Although the distribution of the species in shallow waters is known, its depth range is still unknown and the importance of deep waters as refuge from climate anomalies such as El Niño. We do not know if the species has ontogenetic changes in habitat use (e.g. if they use mangroves as larvae or juveniles). It is also important to know the relationship between sea temperature, salinity and dissolved oxygen and the abundance of this species, as well as the effect acidification might have in the larval stages in order to determine the impact of climate change. The metal concentration and nutritional value of the species and its importance in human health is unknown.

This species is present in rocky reefs (including in the coral reefs and vertical walls) and habitats with muddy or sandy bottoms up to 90 m deep in the entire Galapagos archipelago (all islands)^{2,3}.

MY NOTES

Fact Sheet: Jorge Ramírez-González, Nicolás Moity, Solange Andrade Vera and Jorge Baque
Map: Nicolás Moity

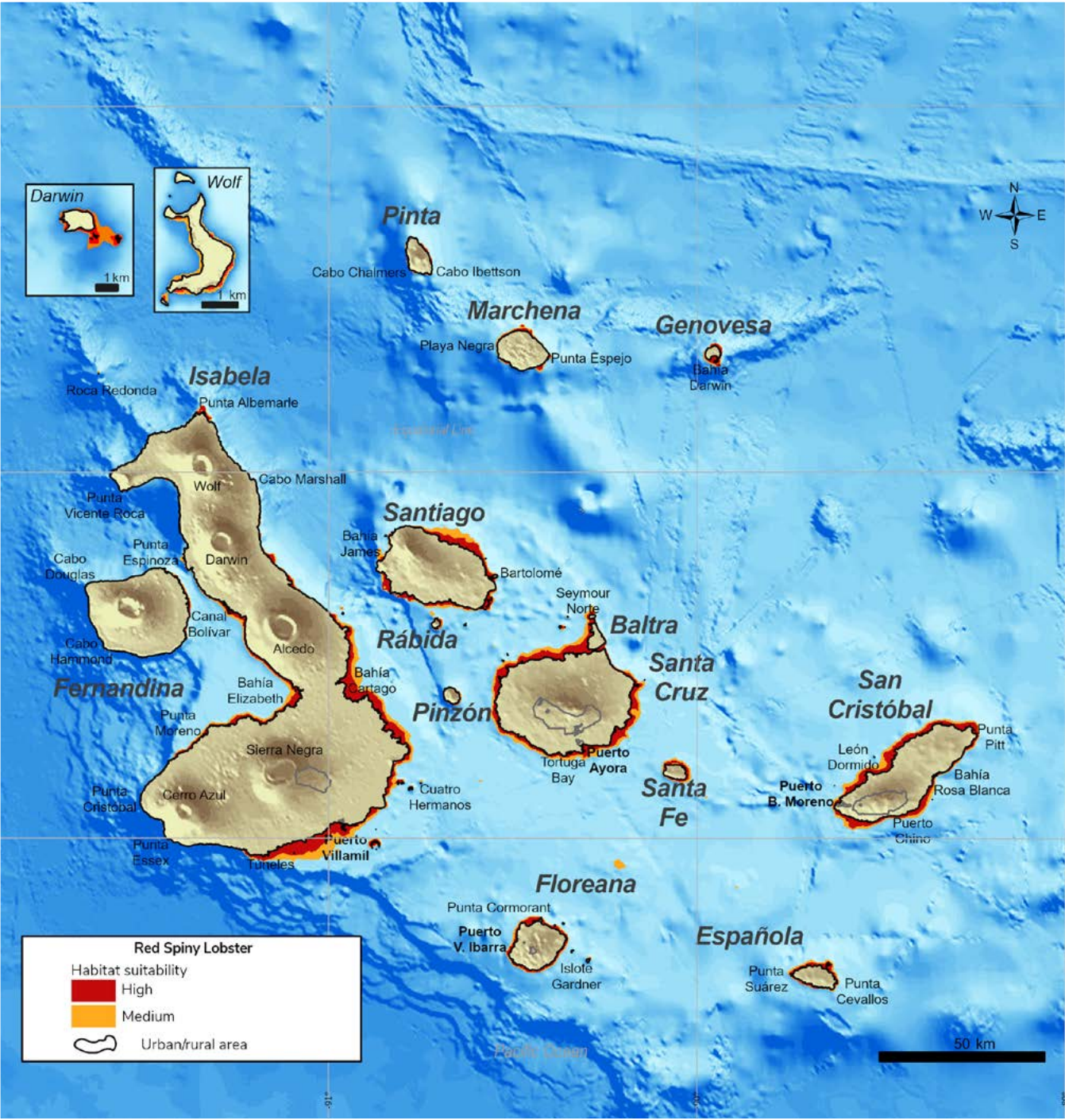
Map methodology: See Methodology section, ref. 4d. Habitat modelling.

RED SPINY LOBSTER

Langosta Roja Espinosa
Panulirus penicillatus (Oliver, 1791)
Animalia : Arthropoda : Malacostraca : Decapoda :
Palinuridae : *Panulirus penicillatus*



© Nicolás Moity / CDF



CURRENT STATUS

In Galapagos, the Red Lobster was considered over-exploited; however, as of 2008, populations began to recover thanks to management and market actions¹⁻³. In recent years, the population of this species has fluctuated, but its biological indicators (reproduction and mortality) are healthy^{4,5}.

ECOLOGICAL IMPORTANCE

The Red Lobster feeds on the remains of dead animals, and for this reason, it is considered a cleaning species in the ecosystem⁶. Because of the long time spent in the larval phase^{7,8}, it is assumed they have an important role as food for filter feeders.

Its fishery is considered an important economic resource. From 2011 to 2017, the 32 annual gross income generated by the spiny lobster fishery in Galapagos increased from USD 0.5 to USD 1.8 million⁹. Additionally, every year, its fishery provides jobs to 300-470 of the islands' fishers²⁻⁴. And since there has been an increase in lobster consumption on the islands, a greater distribution of this income is expected among the local population, and a greater contribution to the islands' food security as well. Because of this, the red lobster is considered a socio-economic indicator as well as an ecosystem indicator for the Galapagos fishing system.

INFORMATION NEEDS

It's necessary to identify the important reproductive sites of the Red Spiny Lobster in Galapagos, understand the relationship between sea temperature and lobster population levels, its movement patterns, and other environmental variables, and gain more knowledge on its biology and larval ecology, as well as the genetic relationship of populations within and beyond Galapagos. Determining optimal fishing efforts and identifying proper channels for commercialization, are also relevant investigative elements.

DISTRIBUTION

This species lives in clear shallow rocky reefs of the Galapagos Archipelago¹⁰.

MY NOTES

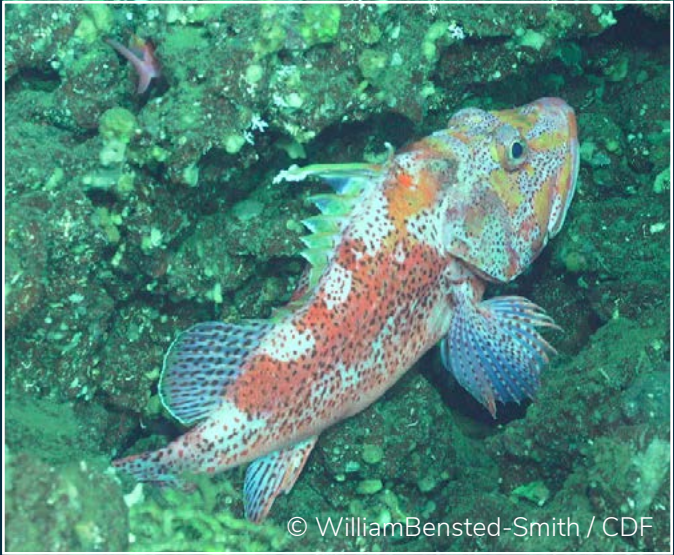
AUTHOR (S)

Fact Sheet: Jorge Ramírez-González and Harry Reyes
Map: Nicolás Moity

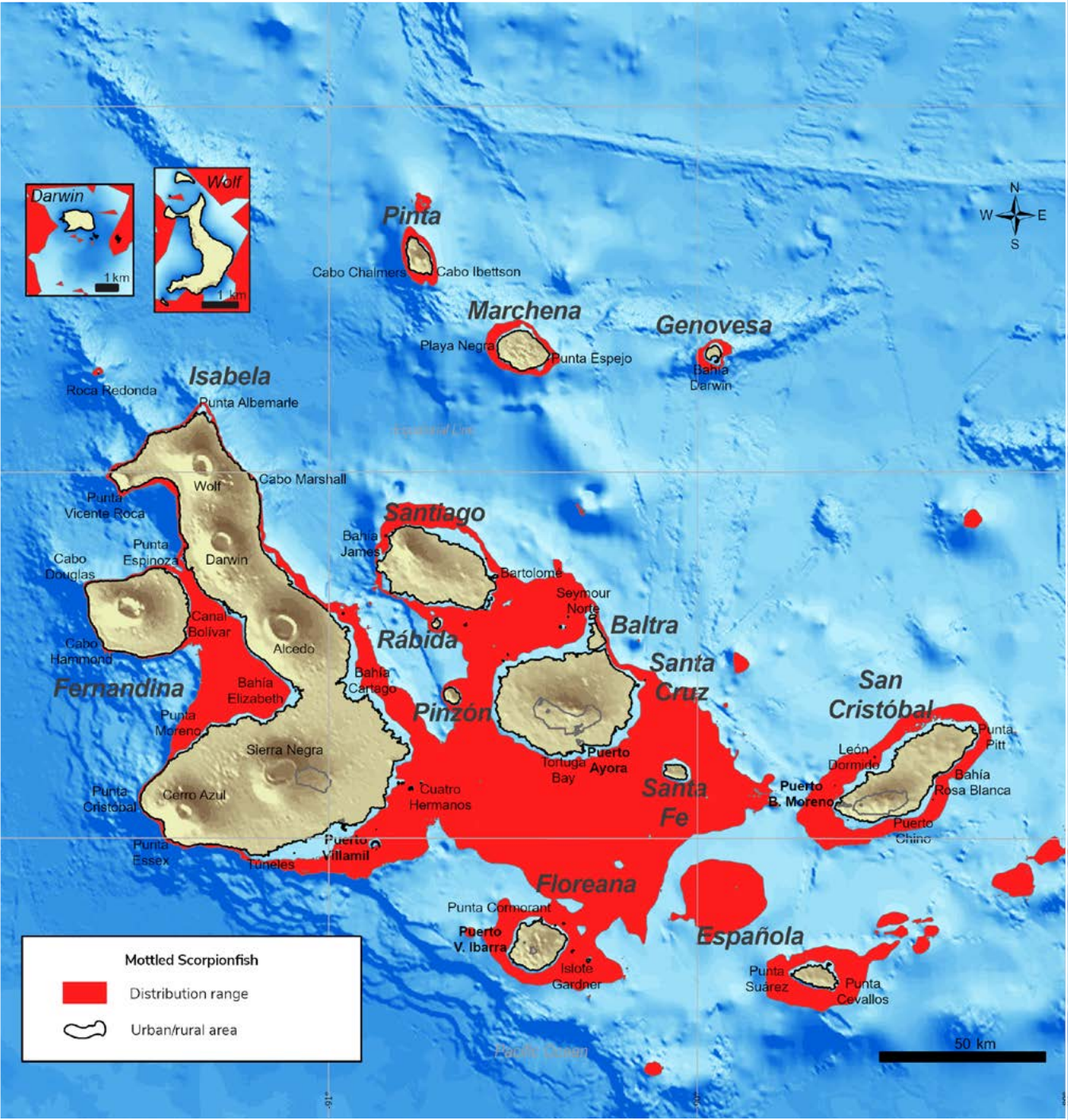
Map data sources: Fishing and population monitoring (2012-2016) (GNPD).
Map methodology: See Methodology section, ref. 4a. Species distribution model, Maxent ML.

MOTTLED SCORPIONFISH

Pez Brujo
Pontinus clemensi Fitch, 1955
Animalia : Chordata: Actinopteri: Perciformes: Scorpaenidae: *Pontinus clemensi*



© WilliamBensted-Smith / CDF



CURRENT STATUS

The Mottled Scorpionfish is a bony fish endemic to the Eastern Tropical Pacific¹. *P. clemensi* is considered as Least Concern by the IUCN Red List since 2010, owing to its wide distribution, including occurrences within marine protected areas, and the absence of major identified threats². However, the increased fishing effort in the last years has led to a possible overexploitation status for this species in Galapagos³, which is presumed to have caused the reduced genetic variation shown by the species⁴.

Locally known as Pez Brujo, it is one of the more than 50 commercially important fish species for the artisanal fishing sector⁵. This species is the fourth most caught fish in Galapagos with an average annual catch of 33 tons⁶. Research indicates that, to allow the species to reproduce, the minimum catch size should be 34 cm of total length which corresponds to an age of 12 years⁷, as it would allow almost 100% of the females to spawn at least once. The optimal capture length interval for *P. clemensi* is between 57 and 70 cm of total length, at these sizes the maximum profitability as well as sustainability of the species are achieved. Individuals greater than 70 cm should not be captured since they are mega-spawners³.

Despite being a slow-growing, long-lived species (lifespan of at least 17 years) that requires approximately 12 years to reach reproductive maturity, *P. clemensi* is not currently subject to specific management measures and remains one of the most commonly consumed fish species by tourists and local residents. Management recommendations have been made to decision-makers through the Galapagos Marine Reserve Fishing Management Plan, although these were not adopted yet.

ECOLOGICAL IMPORTANCE

P. clemensi is a tertiary- secondary consumer, that is, it regulates populations of other fish, mainly *Anchoa ischana* in the Galapagos^{8,10}. Besides, it is one of the most socio -economically important reef fish species and also the top-ten prey item for the endemic Galapagos Sea Lion (*Zalophus wolfebaeki*), highlighting its ecological importance¹¹. Thus, its overexploitation could have important ecological, economic and social impacts. This marine demersal fish is important for the food security of the local population since it has high concentrations

AUTHOR (S)

Fact Sheet: Solange Andrade Vera, Nicolás Moity, Jorge Ramírez-González and Jorge Baque
Map: Nicolás Moity

of polyunsaturated fatty-acids¹², and is a good source of iron, magnesium and calcium¹³ that are important for human nutrition. On the other hand, this species appears to bioaccumulate mercury, which implies a person of 80-90 kg to eat no more than 160-180 g of muscle tissue per week to remain within healthy levels¹⁴.

INFORMATION NEEDS

Despite its ecological and commercial importance, we do not know much about *P. clemensi*. It is necessary to increase research efforts to generate knowledge on its reproductive cycle, distribution patterns, abundance, life-cycle regarding the habitats used in larval and juvenile life-stages, and methods and incentives to reduce the proportion of immature fish caught in the fishery. Due to its importance for the local food security, it is necessary to know more about its nutrients and toxic metals concentration and also, include research questions about the impacts of climate variability and climate change in the populations of this species.

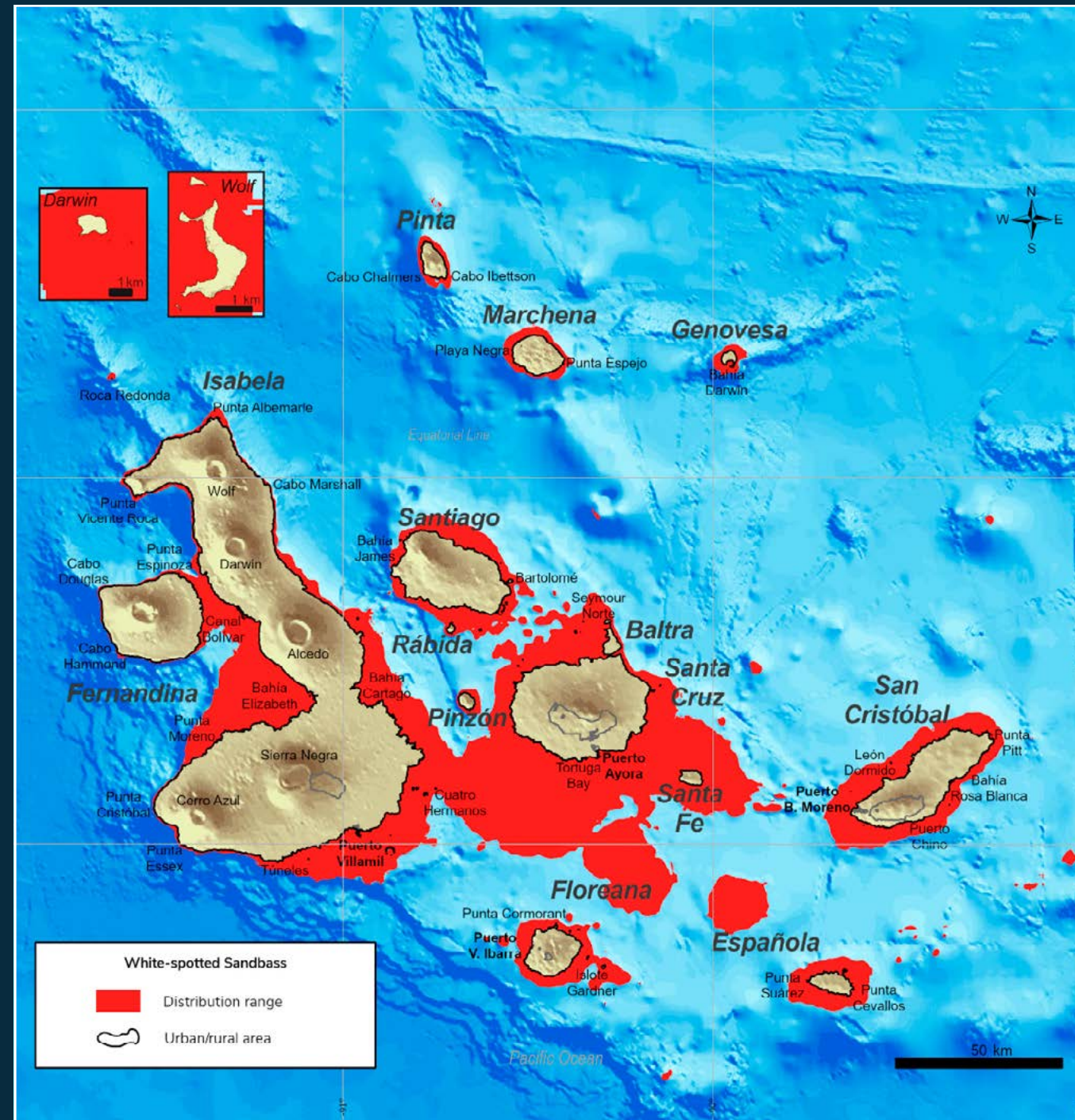
DISTRIBUTION

Fishes of the Scorpaenidae family have a strong preference for a benthic lifestyle among rocks, reefs and seaweeds. *P. clemensi* is distributed throughout the Eastern Tropical Pacific from Colombia to northern Peru, including the islands of Cocos, Malpelo, and Galapagos^{1,8}.

MY NOTES

Map data sources: Monitoring certificates (GNPD), CDF Fisheries dataset.
Map methodology: See Methodology section, ref. 4d. Habitat modelling.

A photograph of a Yellowtail Rockfish (Sebastes rubrivinctus) swimming over a rocky, algae-covered seabed. The fish has a yellowish head and body with white spots and a yellow tail. The background is a dark, textured rock surface with patches of green and red algae. The fish is positioned horizontally, facing left. The image is framed by a thin black border.



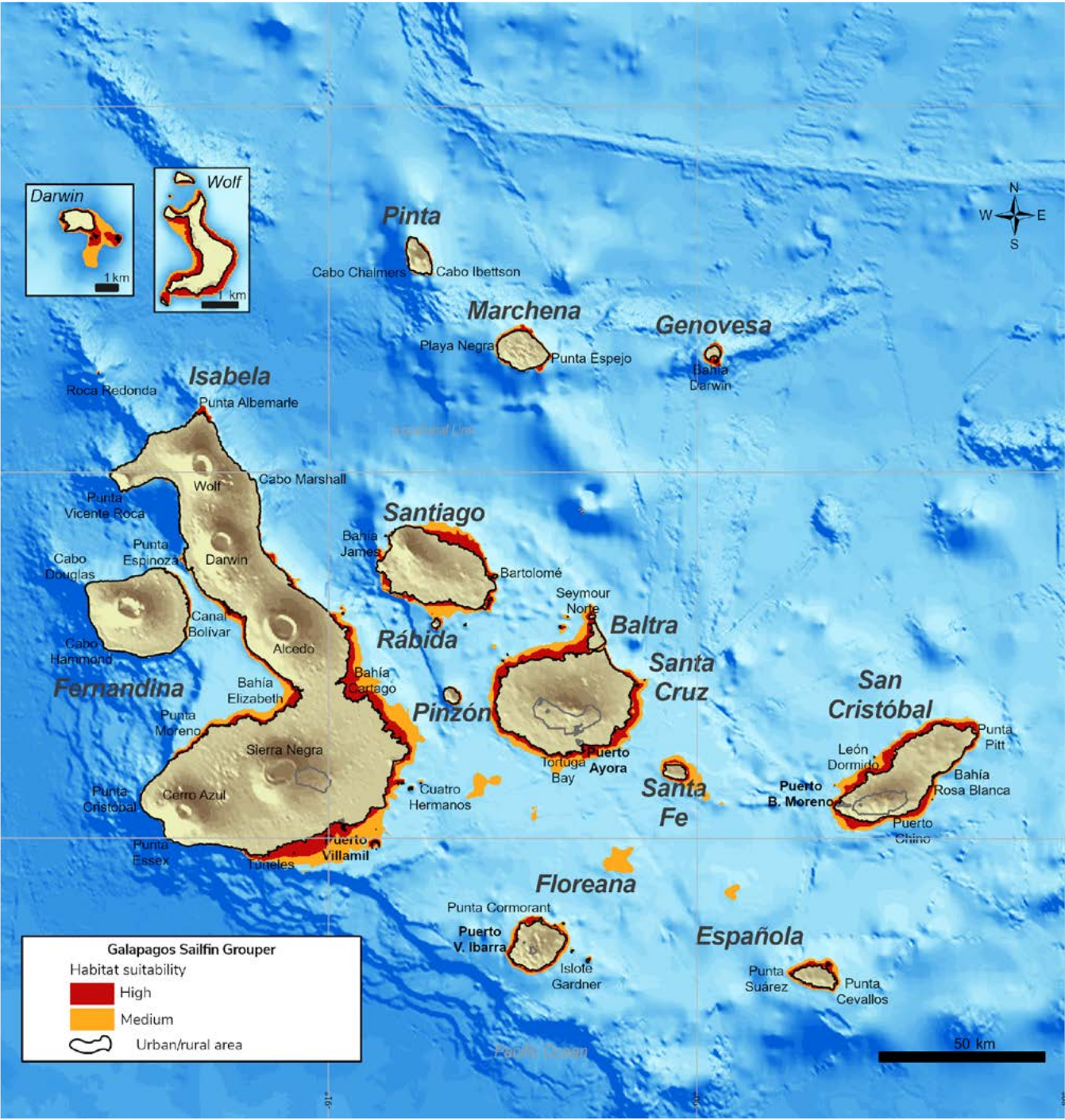
Map data sources: Monitoring certificates (GNPD), CDF Fisheries dataset, GBIF/OBIS.
Map methodology: See Methodology section, ref. 4d. Habitat modelling.

GALAPAGOS SAILFIN GROUPER

Bacalao
Mycteroperca olfax (Jenyns, 1840)
Animalia : Chordata : Actinopterygii : Perciformes :
Epinephelidae : *Mycteroperca olfax*



© Carlos Estape



— KEYSTONE
NATIVE

CURRENT STATUS

The Galapagos Sailfin Grouper is distributed mainly in the Galapagos Islands. However, this species is also present in Cocos Island, Costa Rica, and Malpelo Island in Colombia. In Galapagos, this species is found in all bioregions¹. Traditionally, it was the most exploited fish species in Galapagos, comprising almost 100% of the harvest in the 1940s². Currently, it is the fourth most frequently captured species and one of the most economically important for fishers³. However, its reproductive biomass has declined to less than 10% of the original level. The International Union for Conservation of Nature (IUCN) listed it as an Endangered species⁴⁻⁶.

ECOLOGICAL IMPORTANCE

The Galapagos Sailfin Grouper has cultural, commercial, and ecological importance for the people and biological communities of Galapagos. It is fished throughout the year, but particularly during the months before Lent (Easter) since it is the main ingredient of "fanesca", a traditional Ecuadorian dish⁷. This fish is a top demersal predator in the rocky subtidal areas of the islands⁸. This species is a hermaphrodite; females become males as they grow older⁹, and it reproduces by forming spawning aggregations, which makes it highly susceptible to overfishing^{10,11}. Due to its high trophic level, the reduction of its population size (due to fishing) has probably caused changes in the archipelago's ecosystems, such as the increase of benthic herbivores and a reduction of macroalgae¹². These changes are particularly dramatic in areas near the landing ports, because the access that fisher people have in these areas allows for overfishing to be even more severe¹³.

AUTHOR (S)

Fact Sheet: José R. Marín Jarrín, Nicolás Moity and Pelayo Salinas-de-León
Map: Nicolás Moity

INFORMATION NEEDS

Despite extensive information on this species, key knowledge gaps remain that must be addressed to implement a successful management plan. In particular, we need to know more about the biology of its larvae, the connectivity between larval, juveniles and adults habitats inside and outside of the archipelago; its spatial distribution within the Galapagos Marine Reserve, and its genetic population structure. We also need to identify spawning areas, natural predators, and their commercialization channels. Finally, it is important to determine an optimal fishing effort and its most important fishing areas, to estimate their fishing and natural mortality and the influence of physical factors on their population dynamics.

DISTRIBUTION

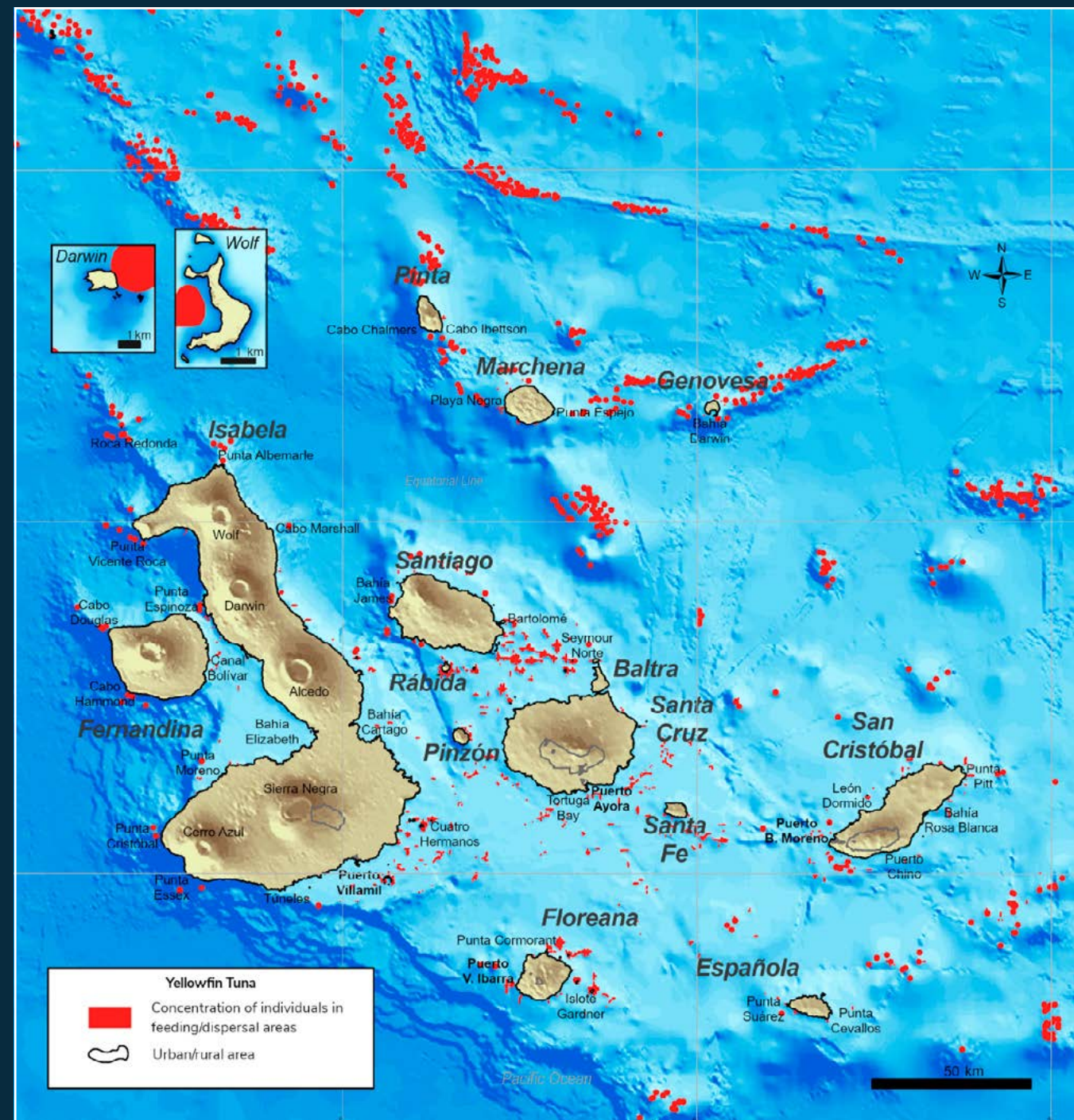
Adults are present in vertical rock formations, reefs, and seamounts. Juveniles are found in sandy lagoons, mangroves, reefs, and lava pools².

MY NOTES

Map data sources: Monitoring certificates (GNPD), CDF Fisheries dataset.
Map methodology: See Methodology section, ref. 4a. Species distribution model, Maxent ML.

— KEYSTONE
NATIVE

Thunnus albacares (Bonnaterre, 1788)
Animalia : Chordata : Actinopterygii : Scombriformes
: Scombridae : *Thunnus albacares*



This tuna species is distributed worldwide in tropical and subtropical seas, but it is absent from the Mediterranean Sea. It is the 5th most fished marine fish species in the world and the tuna with more captures¹. There are three different genetic stocks among the Atlantic, Indian and Pacific oceans², and within the Pacific, there are three genetically distinct populations (Western, Central and Eastern Pacific)³.

Globally 22% of the stocks are experiencing overfishing, however the Eastern Pacific Ocean stocks are at a healthy level of abundance⁴. The Galapagos Marine Reserve (GMR) is a refuge of the species from industrial fishing, and, since the creation of the GMR, the productivity of the tuna industrial fishery has increased, demonstrating the spillover effect of the reserve⁵. Within the GMR the species is caught by the artisanal fleet and represents the most important landings in volume (178 metric tons/y) while producing one of the least profitable annual gross economic incomes in the fisheries of the Galapagos (US\$ 1,300,000/y)⁶.

In the Galapagos, it is the most consumed fish species within the local population⁷ and proved to be even more important for the food security during COVID-19⁸. Conversely, it only represents 25% of the total consumption on-board tourism vessels⁹.

T. albacares is considered as an indicator of the state of the Galapagos marine socio-ecosystem. In recent years, this species has been an important fishery resource that is used as food for the local population of the archipelago. Its fatty acids composition, high concentration in calcium (Ca) and zinc (Zn), and low concentration of the heavy metals cadmium (Cd), lead (Pb) and aluminum (Al), makes *T. albacares* a healthy food choice^{10, 11}. Regarding mercury (Hg) concentration, this species appears to bioaccumulate this element, with bigger individuals having more concentration of Hg. Interestingly, *T. albacares* from the Ecuadorian continent have more than 2.5 times more Hg concentration than GMR individuals^{12, 13}.

According to Hg concentration in GMR tuna, a person of 80-90 kg should eat around 196-220 g of muscle per week to remain within healthy levels¹³. *T. albacares* is an apex opportunistic predator in the epipelagic

realm, feeding on crustaceans, fish, cephalopods and gelatinous organisms¹⁴. In the GMR, its diet is restricted to Giant Squid (*Dosidicus gigas*), whereas along the Ecuadorian Coast it feeds primarily on fish and small crustaceans^{15, 16}. The species reaches reproductive maturity at approximately two years of age (103 cm), and spawns between November to February, when sea surface temperatures exceeded 24°C¹⁷.

They spend most of their time within the surface mixed layer¹⁴, although their physiological adaptations allow them to tolerate the colder temperatures of deeper waters; in the Eastern Pacific, the species has been recorded at depths of up to 1,600 m¹⁸. Climate change (with a projected increase in sea temperature) is expected to decrease the probability of presence of this species, which will tend to go deeper (CDF, unpublished data).

Current *T. albacares* population size within the GMR is unknown, nor the population structure. In order to determine the impact of climate change, we need to understand further the relationship between species abundance and oceanographic parameters such as dissolved oxygen, salinity and chlorophyll. The socio-economic importance of this species within the Galapagos needs further investigation.

The tuna fishery in the Galapagos has the potential to become one of the most sustainable; however, further research is needed to assess the benefits of tuna certification and traceability for enhancing added value, reducing illegal, unreported and unregulated catches, and identifying opportunities to access new export markets.

This species is virtually present in the pelagic realm of the entire GMR, including coastal areas, although seamounts might be natural aggregators of pelagic predators such as tunas¹⁹.

Map data sources: Moity, N. (unpubl. data).
Map methodology: See Methodology section, ref. 4d.
 Habitat modelling.

Fact Sheet: Nicolás Moity, Jorge Ramírez-González, Solange Andrade Vera and Jorge Baque
Map: Nicolás Moity

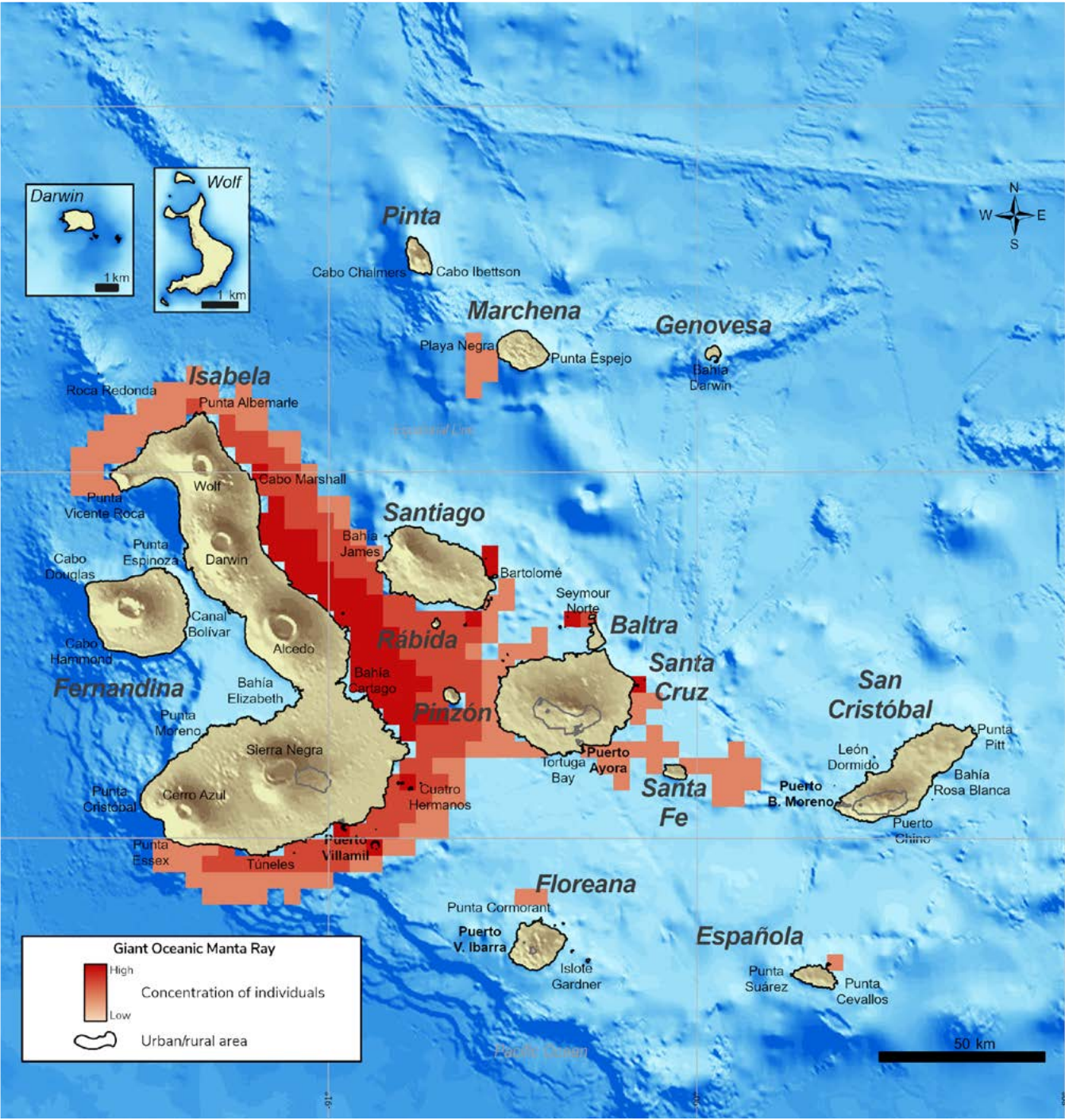
GIANT OCEANIC MANTA RAY

Manta Raya Oceánica Gigante

Mobula birostris (Walbaum, 1792)
Animalia : Chordata : Chondrichthyes : Rajiformes :
Myliobatidae : *Mobula birostris*



© Thomas P. Peschak



CURRENT STATUS

The Giant Oceanic Manta Ray has a circumtropical and semi-temperate distribution, although its populations seem fragmented and have limited connectivity between them¹. Giant manta rays have been listed as Endangered on the International Union for Conservation of Nature (IUCN) Red List of Threatened Species since 2022 based on a population reduction of 50–79% over the past three generation lengths (87 years)². In 2014 it was included in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), with a recent proposal in July 2025 to uplist it to Appendix I to prohibit international commercial trade, and in Appendix I and II of the Convention on the Conservation of Migratory Species (CMS), in order to reverse its population decline.

ECOLOGICAL IMPORTANCE

The Oceanic Manta Ray is the largest species of ray and one of the largest fish in the world, with a wingspan that can reach 7 m. Due to its size and curious nature, it's one of the favorite marine animals to encounter while diving, since it usually actively interacts with divers³. Although its economic value for the diving tourism industry in Galapagos is currently unknown, it is likely to be high, as many operators offer encounters with these ocean giants as an attraction on their tour packages. For example, in the Archipelago of Revillagigedo, off the Pacific coast of Mexico, dive tours with giant manta rays represent an estimated income of USD 10'000,000/year³. Besides its socio-economic importance, this species is an important nutrient vector in the ocean. It feeds mainly on zooplankton and recent studies have revealed that it obtains a large proportion of its diet in the mesopelagic zone (200-1,000 m depth), which makes it an important link between deep and shallow water⁴. It also frequently visits the cleaning services provided by various species of reef fish, contributing to the mobilization of nutrients between pelagic and coastal areas.

AUTHOR (S)

Fact Sheet: Pelayo Salinas-de-León and David Acuña-Marrero
Map: Nicolás Moity

INFORMATION NEEDS

Although the largest population of manta rays globally, is found in continental Ecuador⁵, and there is evidence of population connectivity between mainland Ecuador and Galapagos⁶ at present, limited is known about the ecology of giant oceanic manta rays within Galapagos Marine Reserve (GMR). Future research should focus on estimating the size and population structure of this species in the GMR, identifying and characterizing the main habitats and sensitive areas, determining site fidelity and habitat use, characterizing migratory and connectivity patterns within the GMR and in the Eastern Tropical Pacific (ETP) region, and understanding their feeding and reproductive behavior.

DISTRIBUTION

Although its presence has been recorded throughout the GMR, it is estimated that its incidence is higher in the eastern and southern areas of Isabela Island.

MY NOTES

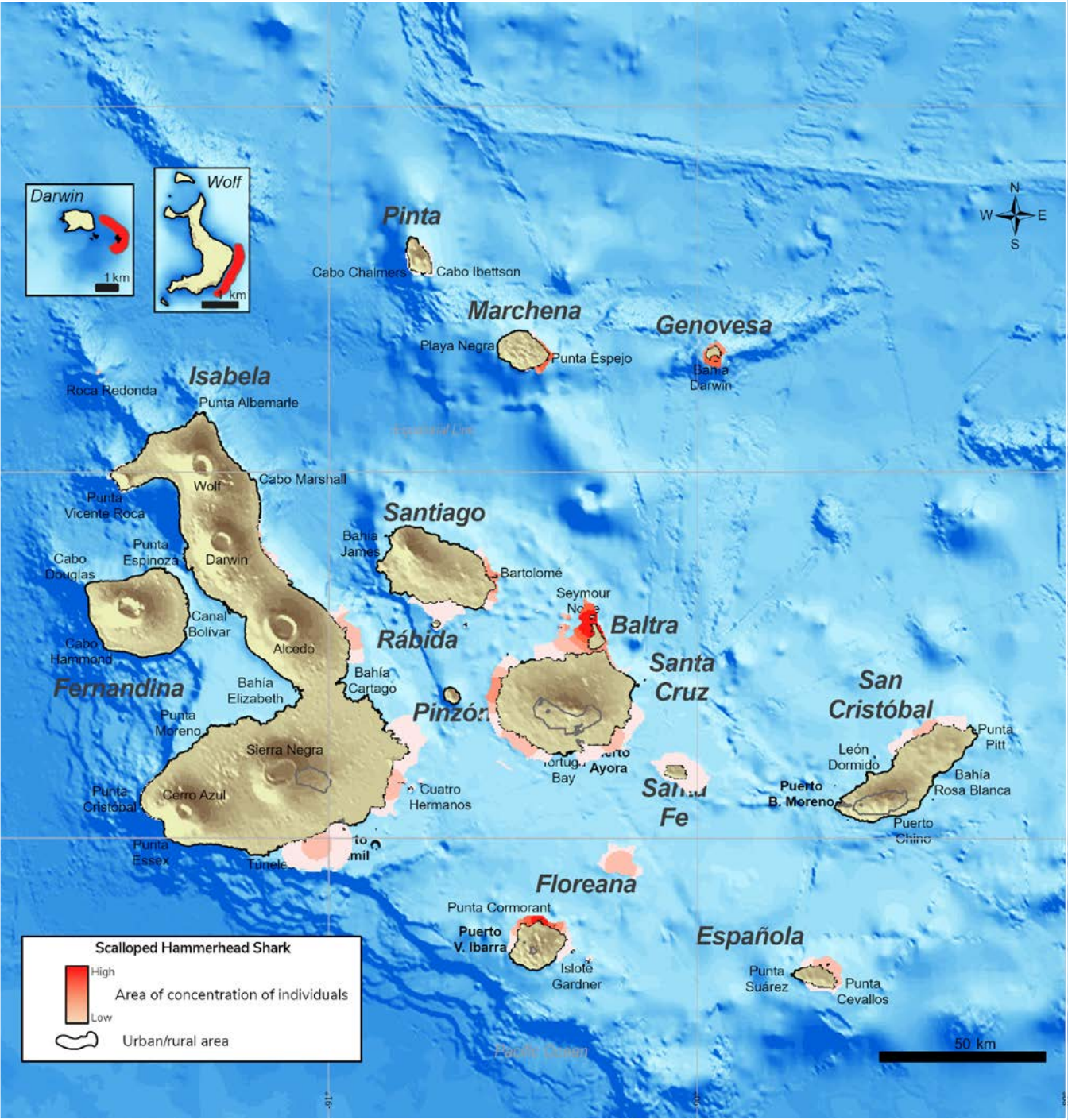
Map data sources: Mantas of the GMR Project, 2015.
Map methodology: See Methodology section, ref. 4b. Expert knowledge model.

SCALLOPED HAMMERHEAD SHARK

Tiburón Martillo Común
Sphyrna lewini (Griffith & Smith, 1834)
Animalia : Chordata : Chondrichthyes :
Carcharhiniformes : Sphyrnidae : *Sphyrna lewini*



© Jordi Chias



CURRENT STATUS

This coastal and semi-oceanic shark is common in the tropical and warm temperate seas of the globe. It has been listed as Critically Endangered on the International Union for Conservation of Nature (IUCN) Red List of Threatened Species since 2019, based on a >80% global reduction over three generation lengths (72.3 years). These are mainly caused by fishing for adults to obtain their fins and meat, which are most valued in the Asian markets, and by fishing for juveniles and neonates in coastal areas¹.

ECOLOGICAL IMPORTANCE

The Scalloped Hammerhead Shark is the most iconic shark species of the Galapagos Marine Reserve (GMR), and one of the main attractions for divers who visit the islands to encounter large aggregations of this species. It has been estimated that the average value of an alive shark in Galapagos for the diving tourism industry represents USD 350,000/year, and that an individual hammerhead shark can generate up to USD 12'000,000 throughout its life².

In addition to their socio-economic value, many sharks sit at the top of food webs and are key to maintaining healthy marine ecosystems³. The largest global biomass of scalloped hammerhead sharks has been reported at Darwin and Wolf islands, north of the GMR, a fact that highlights the unique ecological value of these islands globally⁴.

Scalloped hammerhead sharks make long-range migrations along the Eastern Tropical Pacific, including migrations to nursery areas in mangroves in coastal birthing areas located on the mainland of south America⁵. This highlights the need to establish regional biological corridors⁶.

INFORMATION NEEDS

Although there is information about the connectivity of scalloped hammerhead Sharks among oceanic islands of the TEP and on their trophic ecology⁷, it's necessary to carry out studies to understand their population status, the impact of the GMR on their protection, and their reproductive ecology. Also, nursery areas in the continental zones must be identified, philopatry to specific nurseries determined, as well as levels of interactions with fishing fleets operating around the GMR's determined.

DISTRIBUTION

The Scalloped Hammerhead Shark is commonly observed throughout the GMR, excluding perhaps the western part of the archipelago, with their highest incidence around Darwin and Wolf Islands from July to February.

MY NOTES

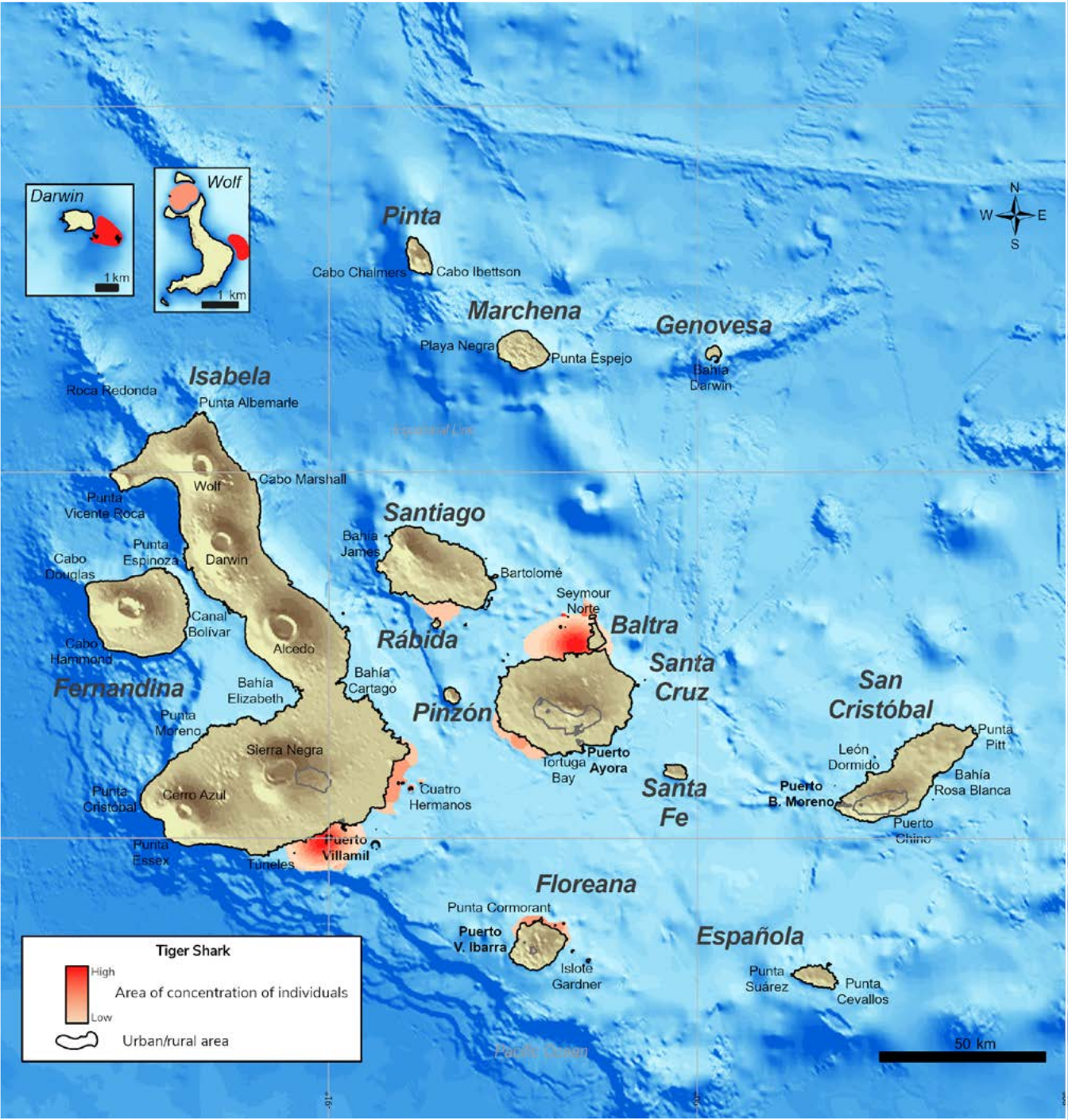
AUTHOR (S)

Fact Sheet: Pelayo Salinas-de-León and David Acuña-Marrero
Map: Nicolás Moity

Map data sources: Acuña-Marrero et al. (2018), GBIF/ OBIS, Hearn et al. (2010).
Map methodology: See Methodology section, ref. 1. GPS data, ref. 3a. Polygons from records, generalized from point data.

TIGER SHARK

Tiburón Tigre
Galeocerdo cuvier (Péron & Lesueur, 1822)
Animalia : Chordata : Chondrichthyes :
Carcharhiniformes : Carcharhinidae :
Galeocerdo cuvier



CURRENT STATUS

This large shark is common in tropical and warm temperate seas around the globe. Since 2009, it has been listed as a Near Threatened species in the International Union for Conservation of Nature (IUCN) Red List of Threatened Species due to the documented population declines, mainly caused by directed fishing and bycatch. Its fins continuously increase in demand for shark fin soup, and the demand for its meat, skin, cartilage, and liver oil will probably cause more pronounced declines in the future¹.

ECOLOGICAL IMPORTANCE

The Tiger Shark is the second-largest, non-filter-feeding shark in the world, only after the great white shark, reaching up to 5 m of maximum length². It plays the role of a top predator in coastal reefs food chains and, of all the shark species, it probably has the most varied diet, which includes crustaceans, marine mammals, cephalopods, seabirds, and sea turtles³. In Galapagos, they are highly resident to the GMR⁴ commonly patrol the main green sea turtles (*Chelonia mydas*) nesting beaches, and green sea turtles make the most of their diet⁵. In Galapagos, no dive operator is dedicated specifically to dive with this species, because it is rarely encountered during scuba dives. In other parts of the world, such as in Aliwal Shoal in South Africa, where sharks are lured with bait, the tiger shark diving income accounted USD 1'800,000 in that region in 2007, a fact that highlights its potential socio-economic value⁶.

INFORMATION NEEDS

Although important advances have recently been made in the research of movement patterns and spatial use of tiger sharks in the Galapagos Marine Reserve (GMR) and their trophic ecology, further studies should be made to understand their population status and reproductive ecology. It's also necessary to identify nursery areas and determine patterns of regional connectivity and genetic population structure, as well as their occurrence as bycatch of other fisheries.

DISTRIBUTION

The presence of this shark has been recorded occasionally throughout the GMR. It is common in the central area of the archipelago, especially in the main nesting beaches of green turtles in the southeast of Isabela and the north of Santa Cruz.

MY NOTES

AUTHOR (S)

Fact Sheet: Pelayo Salinas-de-León and David Acuña-Marrero
Map: Nicolás Moity

Map data sources: Acuña-Marrero et al. (2017), GBIF/OBIS, Galapagos Naturalist Adventure Guides observations.
Map methodology: See Methodology section, ref. 1. GPS data, ref. 4c. Kernel density models from telemetry data from point data.

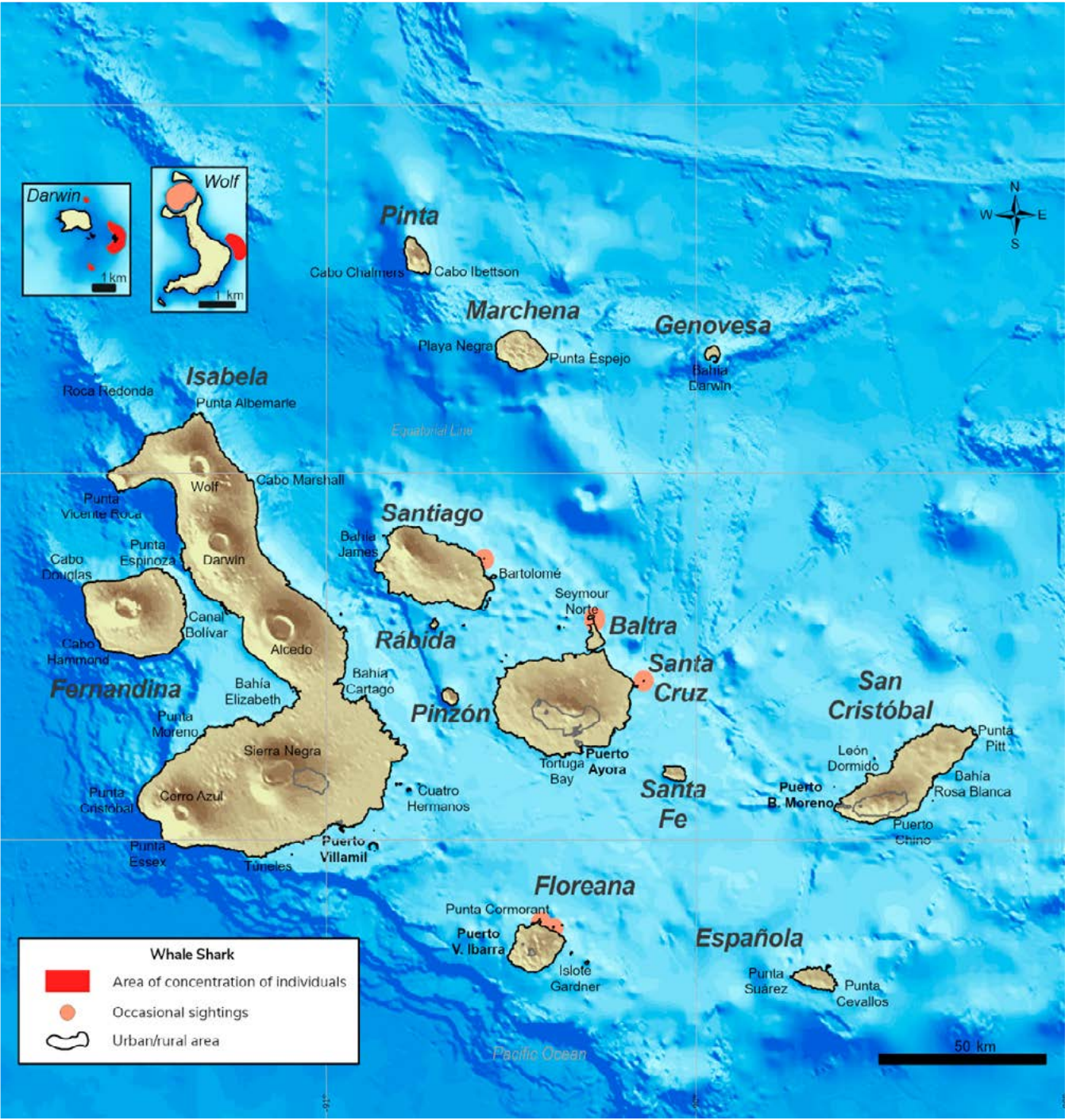
WHALE SHARK

Tiburón Ballena

Rhincodon typus Smith, 1828
Animalia : Chordata : Chondrichthyes :
Orectolobiformes : Rhincodontidae :
Rhincodon typus



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CURRENT STATUS

The Whale Shark has a circum-global distribution in tropical and warm temperate waters, excluding the Mediterranean¹. It has been listed as an Endangered on the International Union for Conservation of Nature (IUCN) Red List of Threatened Species since 2016, based on an overall global population decline of $\geq 50\%$, mainly caused by directed fishing and its occurrence as bycatch in other fisheries². The whale shark has been included in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) since 2002, with a recent proposal in July 2025 to uplist it to Appendix I to prohibit international commercial trade and in Appendix II of the Convention on the Conservation of Migratory Species (CMS) since 1999 and on Appendix I since 2017.

ECOLOGICAL IMPORTANCE

The Whale Shark is the largest fish in the world, reaching a maximum size of 20 m and a weight of 42 tons¹. Due to its size and its quiet nature, diving with whale sharks is one of the most sought-after experiences for sport divers. The average value of a live shark in Galapagos represents USD 350,000/year for the tourism industry; throughout its life, it generates USD 5'000,000³. Many tour operators offer encounters with these ocean giants as an attraction on their tour packages. Darwin Island, in the north of the archipelago, is one of the few locations worldwide where large females can be observed consistently between July and December⁴. After passing through Galapagos, they usually travel to the west, with their movements associated with the Equatorial Front⁵, and then head for the continental coasts of Ecuador and Peru⁶.

INFORMATION NEEDS

Although it is suspected that female whale sharks are in an advanced pregnancy stage while on the islands, based on their distended abdomens, this hypothesis has not yet been validated. The locations where they give birth to their young and where they spend the first years of their lives are unknown.

It is necessary to identify their mating areas and determine their diet and feeding areas around the archipelago. Additionally, further studies are needed on the incidence of this species as bycatch with tuna fisheries, as well as other aspects of its ecology.

DISTRIBUTION

Although whale sharks have been recorded occasionally throughout the Galapagos Marine Reserve (GMR), including a possible aggregation site to the southwest of Isabela island, most sightings are around Darwin Island from July to December⁴.

MY NOTES

AUTHOR (S)

Fact Sheet: Pelayo Salinas-de-León and David Acuña-Marrero
Map: Nicolás Moity

Map data sources: Acuña-Marrero (2014), GBIF/OBIS, Galapagos Naturalist Adventure Guides observations.
Map methodology: See Methodology section, ref. 3a. Polygons from records, generalized from point data.

MARINE IGUANAS— IGUANAS MARINAS

Upon arriving in San Cristóbal Island, Charles Darwin described the Galapagos marine iguanas as "frightful, disgusting and stupid monsters of darkness." However, his derogatory description was not accurate, as this particular reptile is a vegetarian and harmless to humans.

The Marine Iguana is the only modern lizard that is directly associated with the marine environment. It is distributed throughout the archipelago¹. The International Union for Conservation of Nature (IUCN) has listed its conservation status as vulnerable, due to various threats² such as introduced species, anthropogenic alterations of their natural habitat, and their sensitivity to climate change.

At present, little information exists about its population status at a subspecific level. However, its taxonomy was recently revised and presents 11 subspecies, which should be considered as independent-management

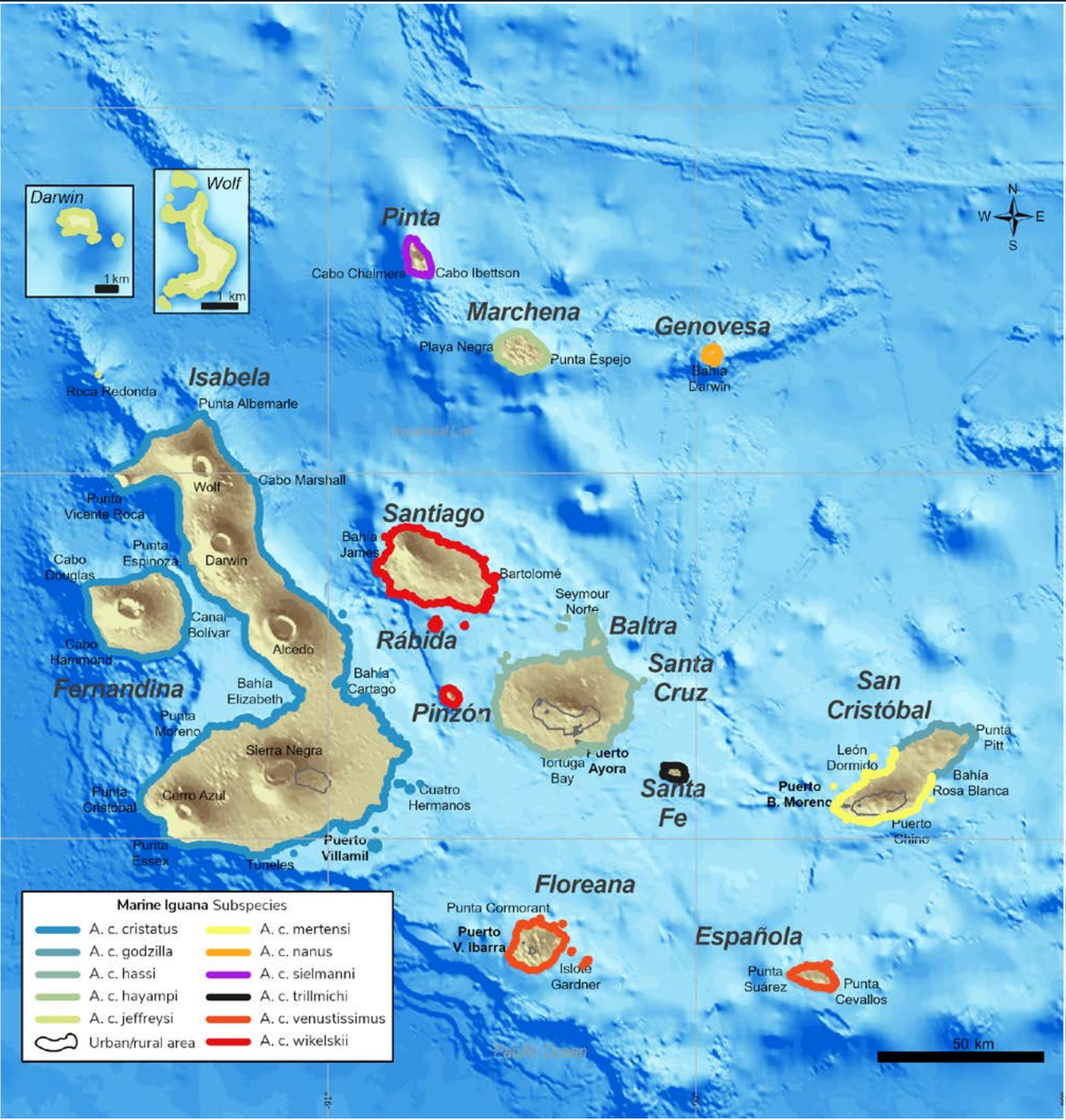
units³⁻⁴. These subspecies are: *Amblyrhynchus cristatus cristatus*, from Fernandina and Isabela islands; *A. c. jeffreysi* subsp. nov., from Wolf and Darwin islands; *A. c. sielmanni*, from Pinta Island; *A. c. hayampi* subsp. nov., from Marchena Island; *A. c. nanus* from Genovesa Island; *A. wikelskii* subsp. nov., from Santiago Island; *A. c. hassi*, from Santa Cruz Island; *A. c. trillmichi* subsp. nov., from Santa Fe Island; *A. c. venustissimus*, from Española and Floreana islands; *A. c. mertensi*, from the south of San Cristóbal Island; and *A. c. godzilla* subsp. nov., from the north of San Cristóbal Island.

*Alejandro Ibáñez, Sebastian Steinfartz
and Gustavo Jiménez-Uzcátegui*

*Marine Iguana -
Iguana Marina*
Amblyrhynchus cristatus spp.
© Carlos Espinosa / CDF

GODZILLA MARINE IGUANA

Iguana Marina Godzilla
Amblyrhynchus cristatus godzilla Miralles et al., 2017
Animalia : Chordata : Reptilia : Squamata : Iguanidae :
Amblyrhynchus cristatus : *A. c. godzilla*



CURRENT STATUS

The Galapagos Marine Iguana of northern San Cristóbal, recently described as *A. c. godzilla*, is present on the northeast coast of the island and on the nearby islets. The identification of this subspecies was determined from the genetic and morphological analyses of specimens collected at Punta Pitt. It is medium in size, compared to the other ten subspecies³. The threats it faces are similar to those of other subspecies, for instance, interactions with introduced species, such as feral cats that can prey on marine iguanas, and their sensitivity to climate change²⁻⁴.

ECOLOGICAL IMPORTANCE

Generally, the Marine Iguana is considered a key species because of its reaction to climatic variation. When the sea surface temperature changes, which is common during the occurrence of El Niño-Southern Oscillation (ENSO) in Galapagos, large fluctuations in population size occur⁴.

The Marine Iguana is herbivorous; it feeds almost exclusively on macrophytic algae from intertidal zone. Therefore, the availability of algae is a limiting factor that affects its growth size and survival^{5,6}.

Marine iguanas can also be considered a bioindicator of toxins in the environment, just like some species of marine algae; it is very sensitive to environmental contamination and poisoning. In 2001, during the oil spill of tanker Jessica near San Cristóbal, hydrocarbons were deposited on the seabed, which caused a mortality of 62% of the Santa Fe Island population during the following year⁶⁻⁸.

INFORMATION NEEDS

Knowledge on the conservation status of this subspecies varies significantly according to management units, which are determined regarding the taxonomy of Marine Iguanas³. It's necessary to research population size, survival rates, and the threats that the Galapagos Marine Iguana of northern San Cristóbal, and the other subspecies are facing.

Priorities for research should include the least-analyzed subspecies, the most threatened, and the relatively small populations, such as the two subspecies on San Cristóbal as well as Marchena, Española and Floreana islands. Understanding the possible effects of human interaction is important as well. Pathogens can affect entire populations, in particular when humans are a possible vector⁹. Finally, it is important to assess the control of invasive species in nesting areas during the breeding season in order to identify the impact on its survival¹⁰.

DISTRIBUTION

This species is present on the northeast coast of San Cristóbal Island and on the islets nearby³⁻⁴.

MY NOTES

AUTHOR (S)

Fact Sheet: Alejandro Ibáñez, Sebastian Steinfartz and Gustavo Jiménez-Uzcátegui
Map: Nicolás Moity

Map data sources: Miralles et al., 2017

Map methodology: See Methodology section, ref. 2. Coastal distribution.

LAND IGUANAS—

IGUANAS TERRESTRES

The Galapagos Islands are home to two groups of endemic iguanas: marine iguanas (*Amblyrhynchus* spp.), which include 11 subspecies distributed throughout the archipelago (see, Marine iguanas chapter)¹, and land (terrestrial) iguanas (*Conolophus* spp.) represented by three species. The Pink Iguana (*C. marthae*), which occurs exclusively on Wolf Volcano (Isabela Island)², the Santa Fe Land Iguana (*C. pallidus*), which is endemic to Santa Fe Island, and the Galapagos Land Iguana (*C. subcristatus*) which is found on Baltra, North Seymour, Santa Cruz, parts of Isabela, Fernandina and Plaza Sur. The Galapagos Land Iguana was historically present on Santiago Island, where it became extinct in the 19th century; however, individuals were successfully introduced in the 2020s^{3,4}.

feeding on Cacti — particularly *Opuntia* — as well as grasses and succulents, which also serve as a vital water source. They occasionally consume insects, carrion, and, in rare cases, small live animals or feces⁵ (CDF, unpublished data; observations by local guides).

A third group is represented by a hybrid iguana, resulting from interbreeding between male Marine Iguanas (*A. cristatus hassi*) and female Galapagos Land Iguanas (*C. subcristatus*) on Plaza Sur Island, where both species coexist and share overlapping territory.

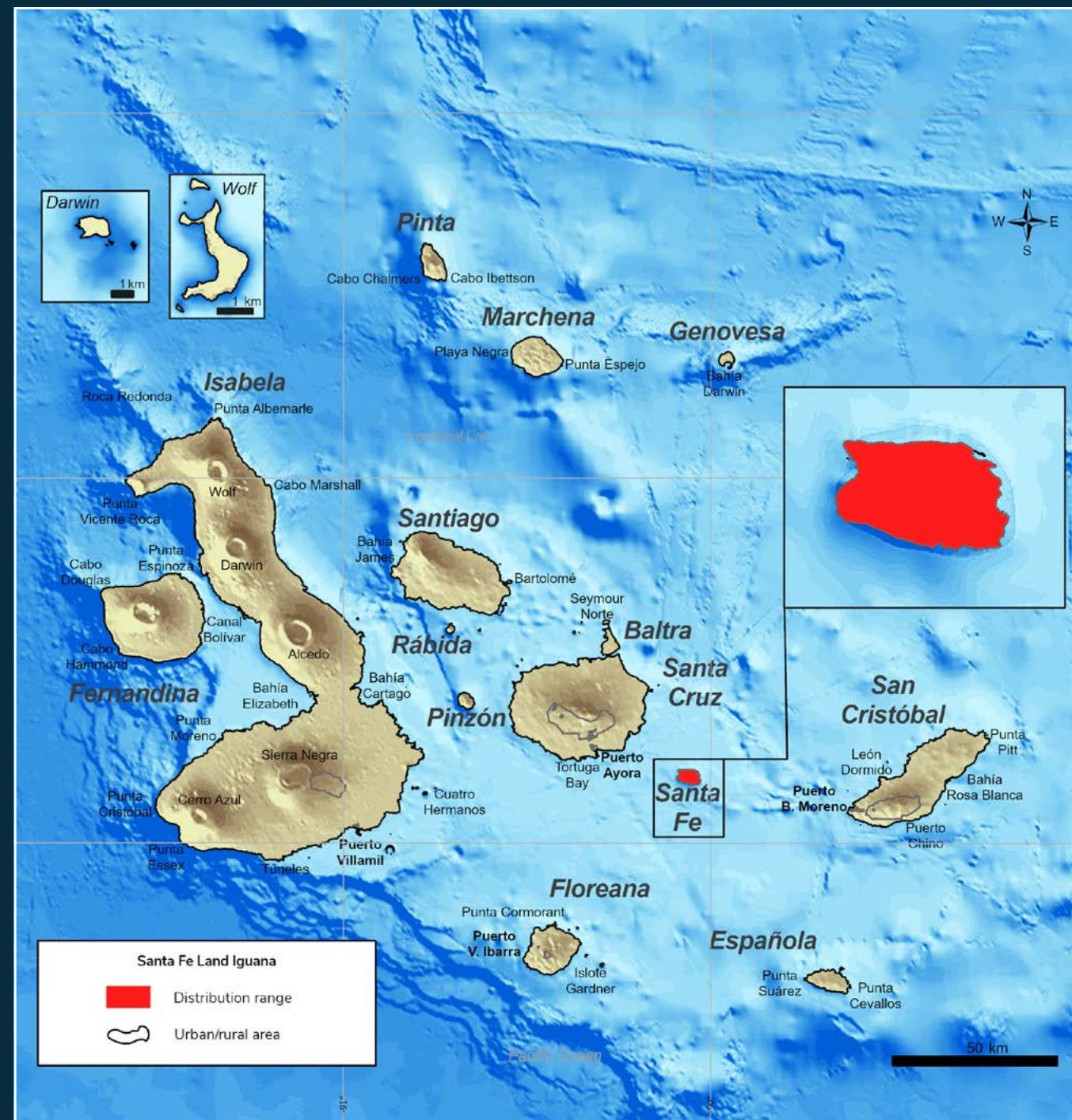
Gustavo Jiménez-Uzcátegui

Land iguanas are considered species threatened according the IUCN, mainly due to the impacts of introduced species, human activities, and climate change. All three species are primarily herbivorous,

Land Iguana -
Iguana Terrestre
Conolophus spp.
© Bernie Jácome

Iguana Terrestre de Santa Fe

Animalia : Chordata : Reptilia : Squamata : Iguanidae :
Conolophus pallidus



Like other members of the genus *Conolophus*, *C. pallidus* is endemic to Galapagos¹⁻³, and within Galapagos, it is endemic to Santa Fe Island^{2,4}. Its current estimated population is 6,500 individuals, with a population density of 6.1 iguanas/ha^{5,6}. Considering that the island is free of introduced animals, the only natural predator that may affect the recruitment of juveniles in becoming adults is the Galapagos Hawk (*Buteo galapagoensis*), which feeds on juvenile and subadult individuals^{1,5,7}.

ECOLOGICAL IMPORTANCE

Galapagos land iguanas are primary consumers and very efficient seed dispersers. They are key species in the islands where they live, for they maintain the ecological integrity and resilience of their ecosystems^{1, 5, 8, 9}.

Approximately 150 years ago, giant tortoises, the main herbivores of Santa Fe, became extinct on the island^{5, 10, 11}. At that time, land iguanas had a healthy population, today it comprises of approximately 6,500 individuals⁵. Since the extinction of the tortoises, iguanas have become the main herbivore on the island. As such, they have contributed to the development of ecological processes related to herbivory and seed dispersal, especially after the eradication of feral goats almost 50 years ago^{5, 4, 12}. The introduction of 743 Española tortoises (*Chelonoidis hoodensis*) between 2015 and 2020 added a second large herbivore to the island. Contrary to concerns of niche overlap, monitoring showed no negative impacts; iguana densities remained stable or even higher in areas with greater tortoise presence, suggesting facilitation rather than competition⁶.

INFORMATION NEEDS

Further research is required on the genetic variability and its ecological role, with emphasis on diet and interactions with cacti and woody vegetation. Equally important is the evaluation of its coexistence with Española giant tortoises and long-term monitoring of this interaction is essential to determine whether the relationship remains neutral or facilitative.

DISTRIBUTION

This species is present in the 24 km² of the ground surface of Santa Fe Island.

MY NOTES

AUTHOR (S)

Fact Sheet: Washington Tapia, Patricia Jaramillo Díaz and James Gibbs

Map: Nicolás Moity

Map data sources: Gentile and Grant (2020), Tapia, W. (EK).

Map methodology: See Methodology section, ref. 3b.
Expert-based drawn area

LIZARDS— LAGARTIJAS

There are 11 endemic species of lava lizards of the genus *Microlophus* in the Galapagos Islands^{1, 2}. In general, these species are abundant: five are classified as Least Concern (LC), four as Near Threatened (NT), one as Vulnerable (VU), and the recently described *Microlophus slevini* has not yet been evaluated. On the islands that are inhabited by humans — Isabela, San Cristóbal, Santa Cruz and Floreana — the main threat to lava lizards is predation by domestic cats^{3, 4}. On smaller uninhabited islands such as Marchena, Pinta or Pinzón, the main threats are unpredictable natural events, such as droughts¹.

Lava lizards are omnivorous; in addition to eating invertebrates — notably introduced ants⁵ — they consume plant material such as fruits, leaves and seeds. There are also reports of cannibalism⁶, and predation on finch chicks⁷. Conversely, lava lizards are preyed upon by introduced cats and rats, as well as by native predators such as racer snakes, owls, mockingbirds, and hawks^{3, 4, 7-11}. These lizards are active during the day, basking on elevated surfaces, and move between rocks and

vegetation to avoid hotter surfaces¹. At night they seek refuge under fallen leaves, inside rock cracks, or burrow into soft soil^{11, 12}.

Lava lizards are territorial, and use body movements to interact with other lizards: males perform “push-ups”, while females move their heads up and down^{12, 13}. Female lava lizards lay between one and seven eggs in nests located near rocks in sandy soils^{12, 14, 15}.

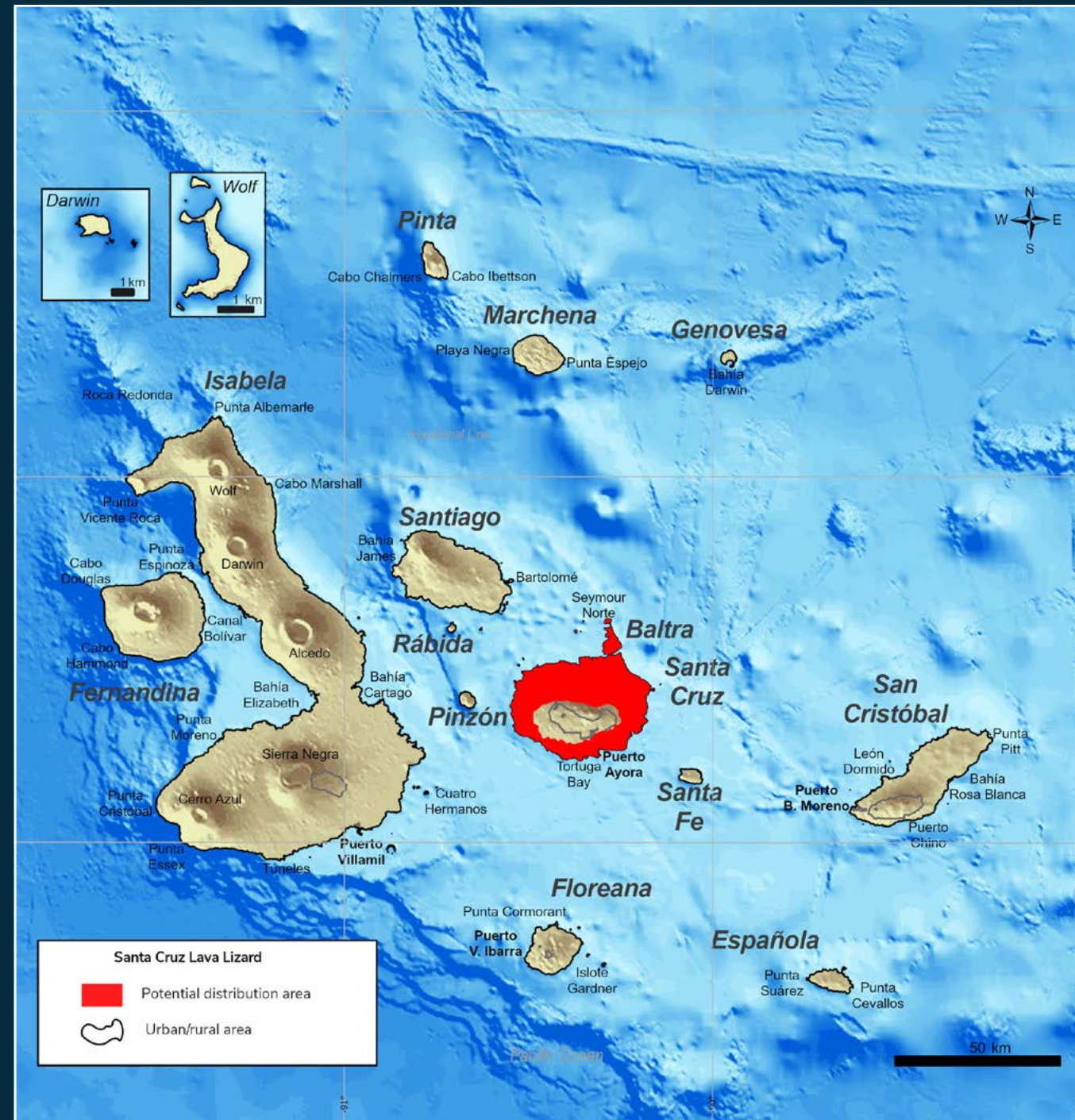
The 11 species of *Microlophus* exhibit allopatric distributions — no island harbors more than one species of lava lizards: *M. albemarlensis* occurs on Isabela and Fernandina, *M. barringtonensis* on Santa Fe, *M. bivittatus* on San Cristóbal, *M. delanonis* on Española, *M. duncanensis* on Pinzón, *M. grayii* on Floreana, *M. habelii* on Marchena, *M. indefatigabilis* on Santa Cruz and Baltra, *M. jacobii* on Santiago, Rábida and Bartolomé, *M. pacificus* on Pinta, and *M. slevini* on Gardner-by-Floreana islet^{1, 2}.

C. Miguel Pinto



Lava lizard-
Lagartija de lava
Microlophus spp.
© Bernie Jácome

Microlophus indefatigabilis (Baur, 1890)
Animalia : Chordata : Reptilia : Squamata :
Tropiduridae : *Microlophus indefatigabilis*



It is the only lava lizard in Santa Cruz Island and surrounding islands and islets (e.g.: Baltra, Caamaño, Daphne Major, Guy Fawkes, Plaza). This lizard is common and it is considered as Least Concern¹. However, this species is prey of domestic cats, and is frequently killed by cars on the streets and the road between Puerto Ayora and Baltra^{3, 16}. The habitat loss for agricultural activities is also a threat for this species¹.

This lizard is an avid consumer of invertebrates, including introduced species such as ants and cockroaches. There are records of this species preying on the introduced mourning gecko (*Lepidodactylus lugubris*)¹. It also eats fruits; a high percentage of seeds (ca. 80%) remains intact after passing the digestive tract, supporting the idea that this species is a plant disperser^{14, 17}. In addition, it is a pollinator of the endemic plant *Sesuvium edmonstonei*¹⁸. A curious aspect of its biology is the common occurrence of cannibalism⁶.

The Santa Cruz Lava lizard is one of the most studied lizard species of the Galapagos; however, some important knowledge gaps remain about their biology. For example, little is known about their parasites, and more information is needed to understand the impact of domestic cats and introduced rats on the populations of this species.

This species is distributed between 0 and 500 m in Santa Cruz Island. It is also present in islands and islets neighboring Santa Cruz, such as: Baltra, Seymour Norte, Plaza, Daphne Major, Caamaño, Guy Fawkes, Edén and Venecia. It is estimated that the total distribution of this lave lizard is less than 800 km²¹.

Map data sources: VCCDRS Collections Database.
Map methodology: See Methodology section, ref. 4b.
 Expert knowledge model.

Fact Sheet: C. Miguel Pinto
Map: Byron Delgado M.

TERRESTRIAL SNAKES—

CULEBRAS TERRESTRES DE GALÁPAGOS

The Galapagos Archipelago is home to nine species of terrestrial snakes, all belonging to the genus *Pseudalsophis*¹. They can reach lengths of 1.30 m, although they generally rarely exceed 70 cm ². Galapagos terrestrial snakes occur from sea level to 1,500 m, inhabiting arid zones, coastal scrub, and *Scalesia* forests³.

Their diet consists of small vertebrates such as geckos, lava lizards, juvenile land and marine iguanas, as well as rodents⁴. They generally hunt live prey, but occasionally consume carrion⁴. Evidence of cannibalism has been recorded in two populations, although this behaviour is considered rare⁵.

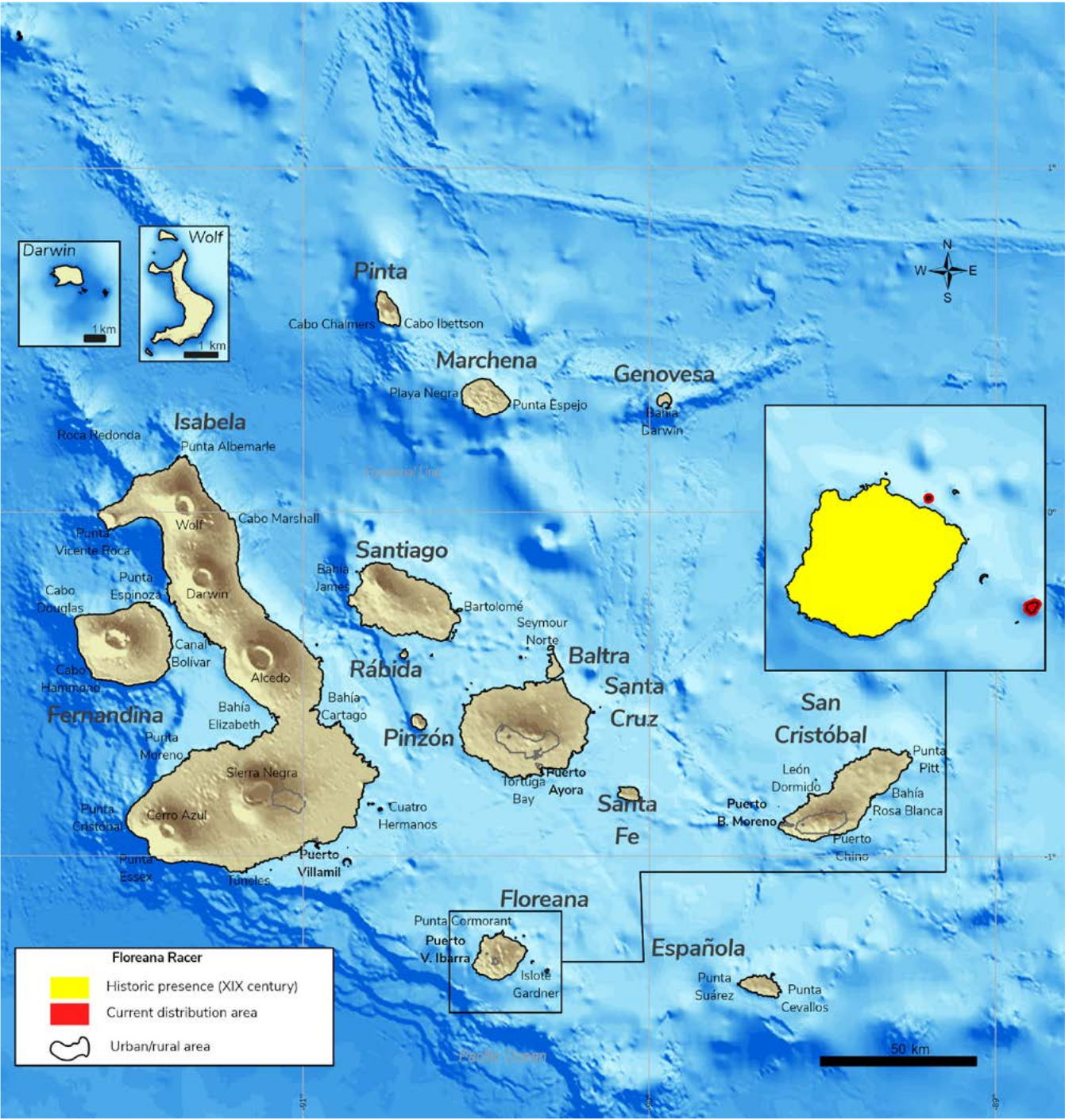
Their natural predators include centipedes, mockingbirds (which prey on juvenile snakes), owls, hawks and herons. Galapagos terrestrial snakes are non-venomous and harmless to humans, as their mild venom poses no risk to human health.

Luis Ortiz-Catedral

Fernandina Racer -
Culebra de Fernandina
Pseudalsophis occidentalis
© Rashid Cruz / CDF

FLOREANA RACER

Culebra de Floreana
Pseudalsophis biserialis biserialis (Günther, 1860)
Animalia : Chordata : Reptilia : Squamata :
Lamprophiidae : *Pseudalsophis biserialis biserialis*



CURRENT STATUS

The Floreana Racer is the nominal subspecies of the Eastern Snake (*Pseudalsophis biserialis*), which also includes the subspecies *Pseudalsophis biserialis eibli*, endemic to San Cristóbal Island¹, although it is likely that both subspecies represent distinct species. Genetic studies are currently being developed to determine their phylogeny and specific status². Due to its taxonomic ambiguity, the Floreana Racer has no formal assessment by the International Union for Conservation of Nature (IUCN). Historically, it had an ample distribution in the lowlands of Floreana Island; however, the species disappeared from the island at the end of the nineteenth century and the beginning of the twentieth century due to the modification of its habitat and predation by introduced mammals³. Currently, it has a limited distribution; it exists on two islets Champion and Gardner-by-Floreana, and possibly on the islets Enderby and Ballena⁴.

ECOLOGICAL IMPORTANCE

Floreana Snakes are active immediately after sunrise and a couple of hours before sunset⁴. On cloudy days, they are active throughout the day⁴. They are found individually moving slowly among leaf litter or between rock crevices. Occasionally they are found up to 2 m high in Muyuyo Tree (*Cordia lutea*) and Tunas (*Opuntia megasperma*) possibly inspecting nests of Finches and Mockingbirds (pers. obs). Their diet consists of Floreana Gecko (*Phyllodactylus baurii*), Floreana Lava Lizard (*Microlophus grayii*), invertebrates and Small Ground Finch (*Geospiza fuliginosa*) chicks⁵. Floreana Snakes are prey to the Short-eared Owl (*Asio flammeus galapagoensis*) and the Huaques (*Nyctanassa violacea pauper*) (pers. obs).

INFORMATION NEEDS

Little is known about the reproductive biology of Floreana's Snakes. Mating has been observed in August and November. Juveniles have been found in November and January. To date, no gravid females or eggs have been found. The longevity of Floreana's Snakes is unknown.

DISTRIBUTION

Present in Gardner-by-Floreana and Champion islets. Possibly this species is in Enderby and Ballena, but needs to be confirmed.

MY NOTES

AUTHOR (S)

Fact Sheet: Luis Ortiz-Catedral
Map: Byron Delgado M.

Map data sources: Ortiz Catedral L. (EK),CDF Natural History Collections Database.
Map methodology: See Methodology section, ref. 3b. Expert-based drawn area.

GIANT TORTOISES— TORTUGAS GIGANTES

The closest ancestor of the Galapagos Giant Tortoise is *Chelonoidis chilensis*, which arrived 5 - 10 million years ago at the ancient Galapagos Islands (now submerged and located 150 - 200 miles east of the present islands). As those islands submerged, the ancestors of the modern tortoises migrated to the islands of San Cristóbal and Española, which emerged 2.4 - 4.0 million years ago¹⁻⁴. Ultimately, the tortoises colonized the remaining islands, where they continue to live today.

A total of 15 species has been recorded, originating from *Chelonoidis chathamensis* and *C. hoodensis* — native to the islands of San Cristóbal and Española — and evolving over a period of 3.0 - 3.5 million years⁴. Pinzón Island was colonized more recently, about 1.3 - 1.7 million years ago. The 15 species of *Chelonoidis* spp. currently described, inhabit 10 of the 13 large islands. Isabela Island is home to five distinct species (from north to south): *C. becki* (Wolf Volcano), *C. microphyes* (Darwin Volcano), *C. vandenburghi* (Alcedo Volcano), *C. guntheri* (Sierra Negra Volcano), and *C. vicina* (Cerro Azul Volcano). On Santa Cruz Island, *C. porteri* (west, El Chato) and *C. donfaustoi* (east, El Fata) are found. The remaining colonized islands each host a

single species: Española (*C. hoodensis*), San Cristóbal (*C. chathamensis*), Santiago (*C. darwini*), Pinzón (*C. duncanensis*), Pinta (*C. abingdonii*), Floreana (*C. niger*), Fernandina (*C. phantasticus*), and Santa Fe (*C. sp.*)⁵⁻⁷.

In recent years, several notable events have taken place. *C. phantasticus* was rediscovered in February 2019, when a single female was captured on Fernandina Island and transferred to the Galapagos National Park's captive breeding center in Santa Cruz Island. Meanwhile, *C. niger* from Floreana Island was repopulated with hybrids from Wolf Volcano born and raised in captivity¹⁵. The Pinta Island population will also be restored with hybrids from Wolf Volcano, while Santa Fe Island was repopulated with 600 juveniles, originating from a captive colony of *C. hoodensis*.

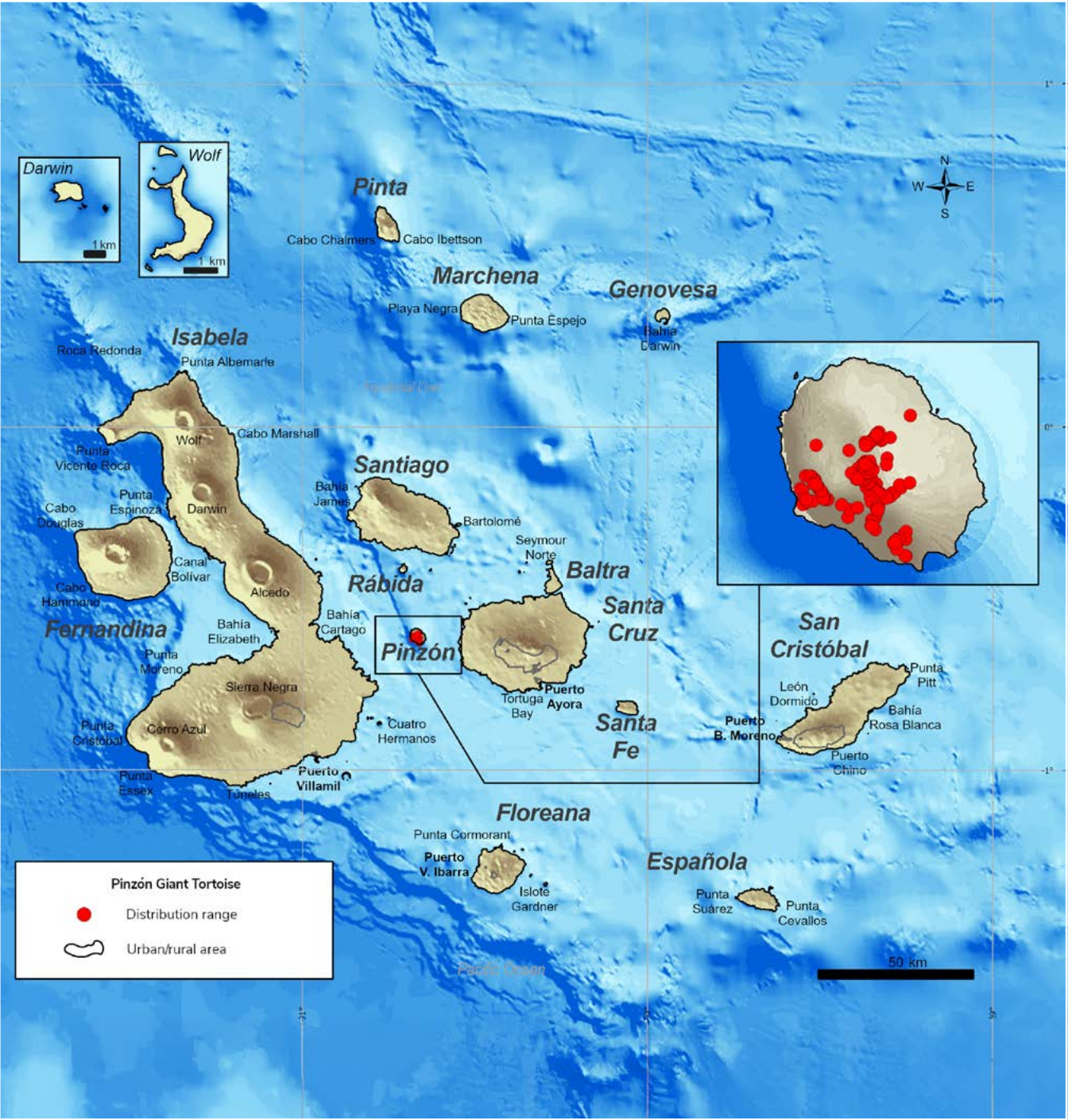
**Cruz Márquez, Danny Rueda, Lady Márquez
and Jefferson Márquez**

Fernandina Giant Tortoise -
Tortuga Gigante de Fernandina
Chelonoidis phantasticus
© Boris Herrera / CDF

PINZÓN GIANT TORTOISE

Tortuga Gigante de Pinzón

Chelonoidis duncanensis Pritchard, 1996
Animalia : Chordata : Reptilia : Testudines :
Testudinidae : *Chelonoidis duncanensis*



CURRENT STATUS

The Pinzón Giant Tortoise was originally described as *Chelonoidis ephippium*^{1,2}, and later as *C. duncanensis*³ in 1875 and 2017, respectively, with documented records from 1914 to 2017. In 1974, fewer than 100 mature individuals were recorded, and for more than a century, the recovery of the wild population was halted by predation from the introduced black rat. In the 2006 census, 138 mature individuals (males, females) and three juveniles were recorded^{1,3-5}. In 2010, 722 individuals were estimated to exist between the three population strata³⁻⁵ – corresponding to a density of 8.3-11.7 tortoises/km².

Although captive breeding efforts supported restoration, population growth remained limited due to the continued presence of black rats⁵⁻⁶. Between 2012 and 2015, black rats were eradicated, and although reproductive success was now viable, recruitment remained low, reflecting the long-term impact of more than 150 years of black rat predation. As of 2013, slight recruitment was registered on the island.

Most females nest in four zones (the South, the West, Pirámide, and Central) of the island, small surfaced areas isolated by abrupt lava terrain and dense, spiky vegetation dominated by *Prosopis juliflora* and *Acacia* sp.⁵.

ECOLOGICAL IMPORTANCE

This species is unique to Pinzón Island, and molecular analysis has confirmed that *C. duncanensis* genetically originated from *C. hoodensis* of Española. Giant tortoises are considered pioneering species and unique ecosystem engineers of the archipelago. They were named after the saddle-like morphology of the front part of their shell. They have a positive ecological role by consuming and dispersing seeds, which increases seed germination success^{10,11}. Additionally, thanks to their heavy bodies and large shells, they create broad trails – up to 1.20 m wide – as they move across the landscape and select the least abrupt paths through the island's rugged terrain¹²⁻¹⁴.

INFORMATION NEEDS

It is important to understand the species' distribution and ecological impact, given that, as a primary herbivore, it maintains plant community dynamics and contributes to seed viability, dispersal, and germination. Research is also needed to identify strategies to improve its population status, and it remains imperative that the number of tortoises bred in captivity continues to grow, so they can be repatriated to the island, helping to increase and accelerate population restoration.

DISTRIBUTION

This species occurs only on Pinzón Island, where it is found in the southern, western, and central areas, where it nests, as well as in the areas of Las Tunas and Pirámide. Its distribution ranges from 100 to 400 m above sea level, covering a total area of 12.9 km².

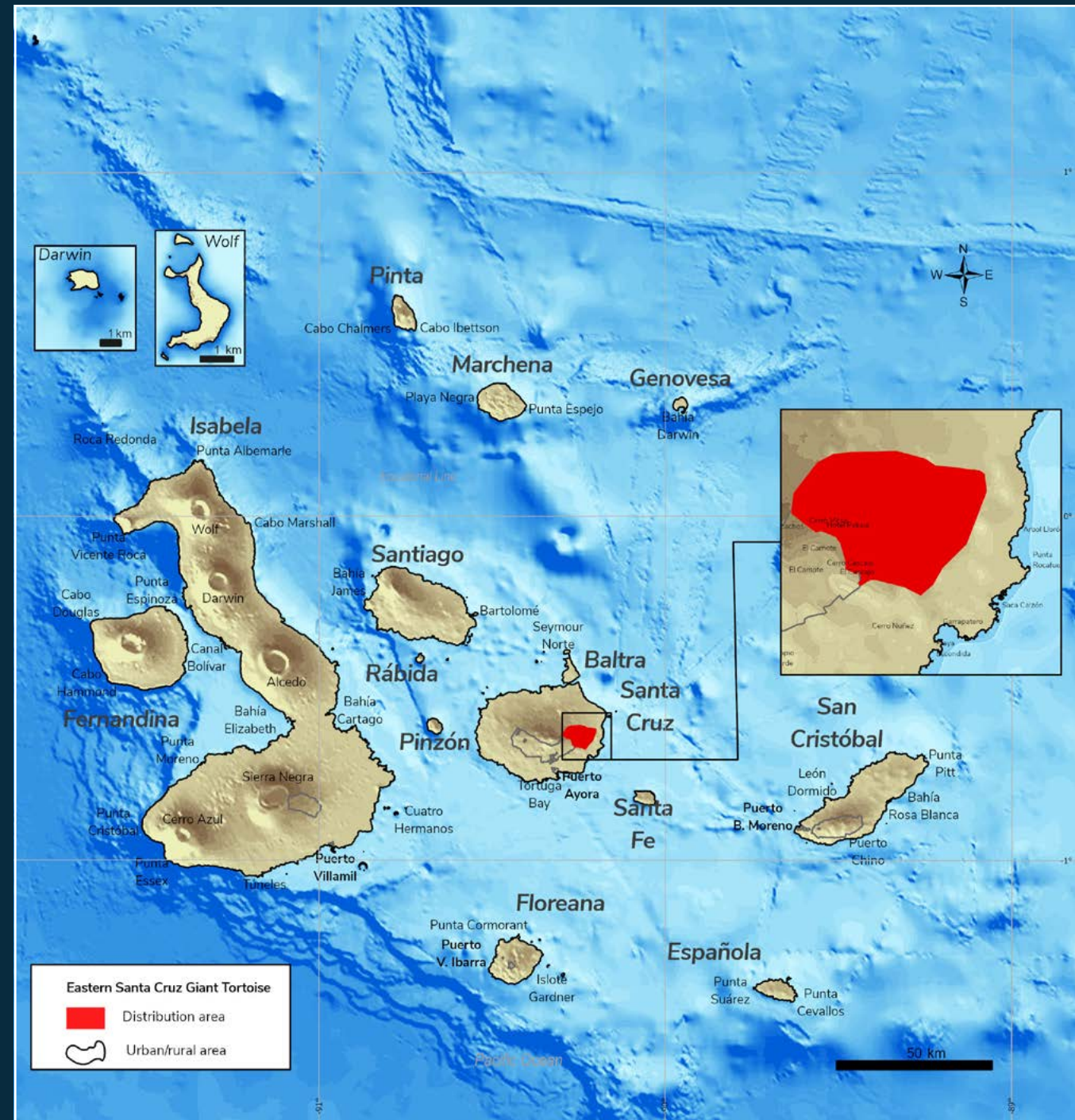
MY NOTES

AUTHOR (S)

Fact Sheet: Cruz Márquez, Danny Rueda, Lady Márquez and Jefferson Márquez
Map: Nicolás Moity

Map data sources: Márquez, C. (EK).
Map methodology: See Methodology section, ref. 1. GPS data.

Chelonoidis donfaustoi Poulakakis et al., 2015
Animalia : Chordata : Reptilia : Testudines :
Cheloniidae : *Chelonoidis donfaustoi*



CURRENT STATUS

It's currently estimated that the population of the Eastern Santa Cruz Giant Tortoise, *C. donfaustoi*, consists of approximately 427 individuals¹. There was a captive breeding program established by the Galapagos National Park Directorate (GNPD) in 2015 when this tortoise was first described as a species. However, its recovery in the wild has been limited due to the impacts produced by feral pigs, the black fire ant, and invasive plants, as well as the loss of a large percentage of its home range to agricultural use²⁻⁵.

ECOLOGICAL IMPORTANCE

The Eastern Santa Cruz Giant Tortoise, like the other species of the Galapagos giant tortoise complex, is endemic not only to the archipelago but to that specific area²⁻⁵. These chelonians are considered key species and ecosystem engineers for their role in maintaining the ecological integrity and resilience of the ecosystems where they live⁶. This is because their activities and movements shape ecosystems, as they act as primary herbivores, trample vegetation, and serve as the main agents of seed dispersal⁷⁻¹⁰.

For over one million years, giant tortoises have been ecologically essential in the Galapagos Islands^{11–13}. Historical reconstructions estimate that there were once around 200,000 individuals across the archipelago, whereas today only about 10–15% of that original population remains^{1, 14–16}. This dramatic decrease was mainly due to the overexploitation caused by whalers in the 1800s, followed by the systematic elimination of tortoises by scientists and the first settlers^{11, 12, 17, 18}.

However, giant tortoises are one of the main attractions for tourists and play an important role in the local economy^{11, 19}. The effective conservation of these animals is important on many levels for the sustainability of Galapagos¹⁰.

AUTHOR (S)

Fact Sheet: Washington Tapia, Patricia Jaramillo Díaz, and James Gibbs

Map: Byron Delgado M.

INFORMATION NEEDS

Genomic studies are required to assess the genetic variability and to refine knowledge of its population status, distribution, and main threats. Equally important is the completion of detailed studies on its diet, which remain limited, to better understand trophic ecology and interactions with native and invasive plant species. Finally, the ecological consequences of human–tortoise interactions, together with the effects of habitat alterations, by non-native vegetation is required.

DISTRIBUTION

This species is present on the east side of Santa Cruz Island, with a high concentration around El Fatal hill, it occupies approximately 23 km², representing about 22% of the 106 km² of suitable habitat available¹.

MY NOTES

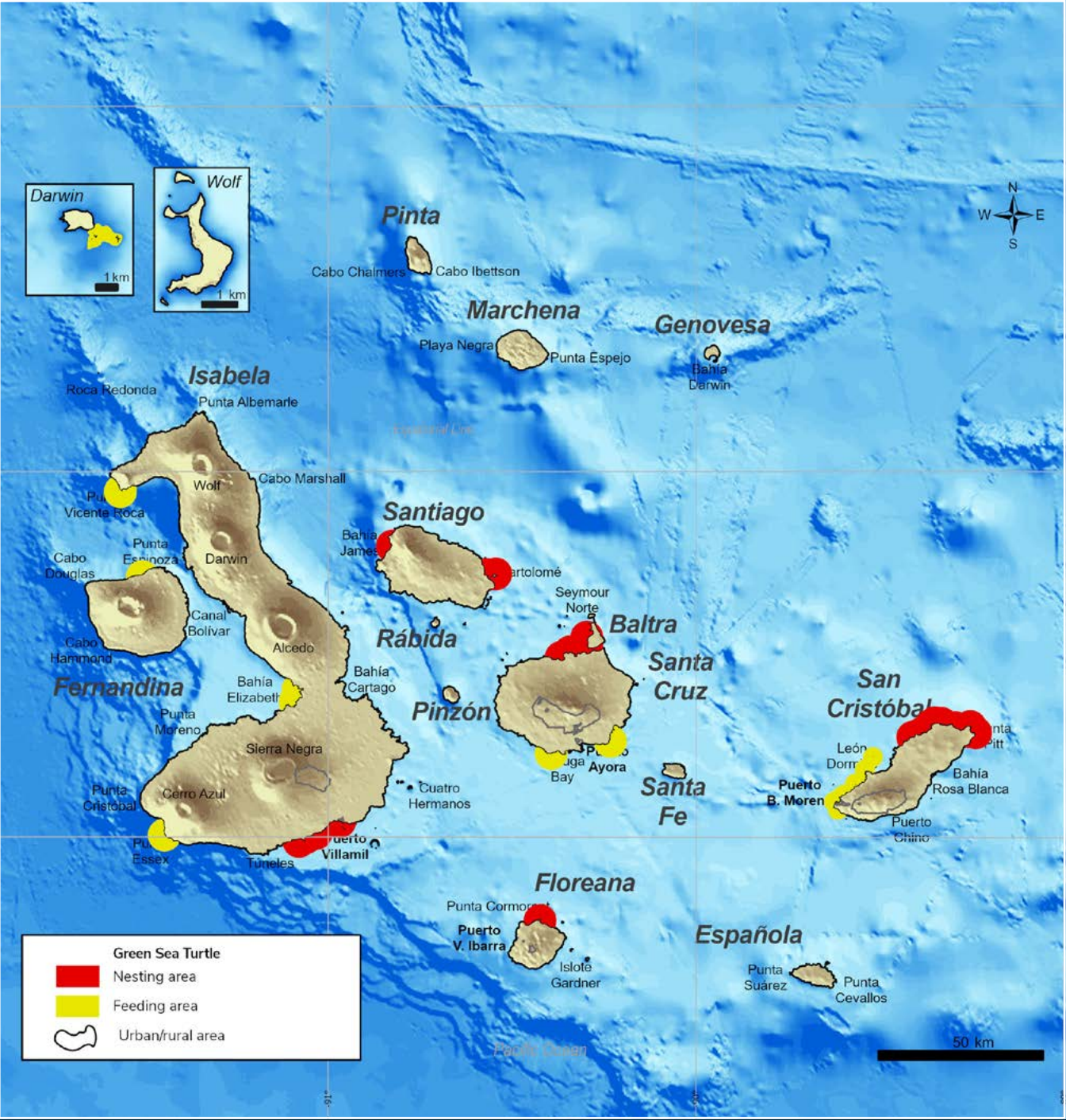
Map data sources: Tapia, W. (EK)

Map methodology: See Methodology section, ref. 3b.
Expert-based drawn area

GREEN SEA TURTLE

Tortuga Verde

Chelonia mydas (Linnaeus, 1758)
Animalia : Chordata : Reptilia : Testudines :
Cheloniidae : *Chelonia mydas*



CURRENT STATUS

The Green Sea Turtle is considered an Endangered species worldwide by the International Union for Conservation of Nature (IUCN). In the Eastern Tropical Pacific (ETP) region, the reproductive stock of Galapagos is considered stable. Since the last decade, the number of nesting females has remained at around 1,500 per year, arriving at their main nesting sites in the archipelago (Quinta Playa Lagoon – Isabela Island)¹. Galapagos represents the second most important stock of the species in the region^{2,3}.

The Galapagos Marine Reserve (GMR) provides important foraging areas for part of the stock of green turtles that reside in the archipelago, while the other part of the population migrates to feeding areas in Central and South America⁴. Despite the almost pristine conditions of the Galapagos, this species is exposed to threats within the GMR, which include being hit by vessels, being taken as bycatch, consuming and ingesting debris and trash, and being affected by tourism activities on important nesting sites^{5,6}.

ECOLOGICAL IMPORTANCE

In general terms, sea turtles are important for the maintenance of ecosystems, have cultural importance, and are species that attract tourists very much. As a megaherbivore, the sea turtle helps control algal coverage in its feeding habitats through foraging, which increases the reef's resilience to possible disturbances⁷. Additionally, the Green Sea Turtle plays an important role in its nesting sites; by laying its eggs in the sand, it annually transfers tons of organic matter, lipids, nitrogen, phosphorus, calcium carbonate, and large amounts of energy into the beach, all of which are essential in terrestrial environments that depend on the ocean-land exchange. This contribution of nutrients to the beach zones promotes the growth of the plants that stabilize them; in this way, the Green Sea Turtle protects its nesting environment and the habitat of many other organisms⁸.

INFORMATION NEEDS

It is necessary to know more about the connectivity between the stock of green sea turtles in Galapagos, mainland Ecuador, and other countries in the region, and about the threats both inside and outside of Galapagos; also determining the proportion of the migratory and resident stock, identifying the possible impacts of climate change on their feeding and nesting areas, and the interactions and impacts of anthropogenic activities developed within the GMR, such as tourism.

DISTRIBUTION

This species is present in coastal areas where there are mainly green and brown algae; these areas are used as feeding sites; shallow coastal areas, such as quiet bays or tide pools, are used as resting places⁹. During the mating season, it's found on sandy beaches along the entire archipelago, where it arrives to lay its eggs¹⁰.

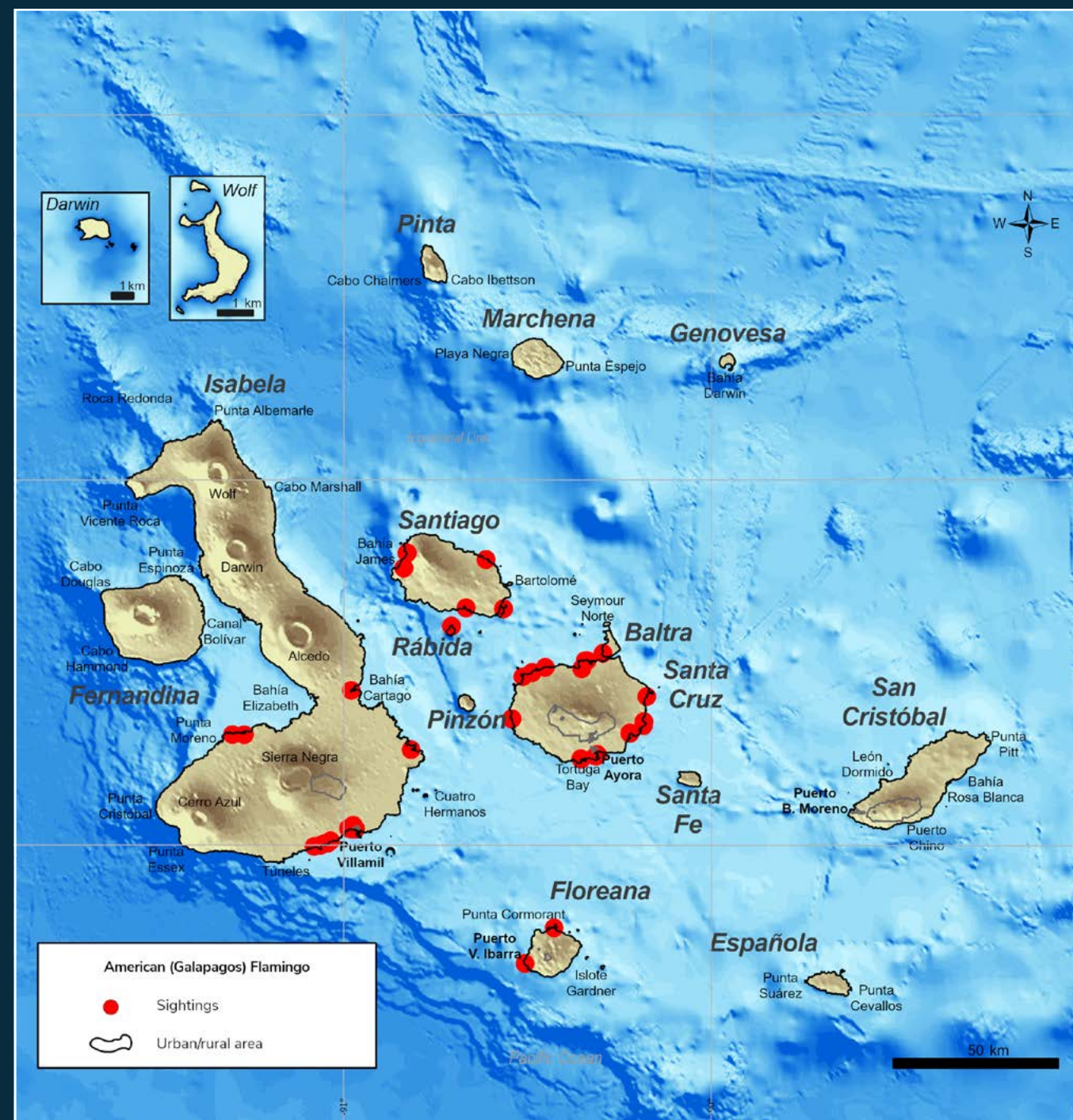
MY NOTES

AUTHOR (S)

Fact Sheet: Macarena Parra
Map: Byron Delgado M.

Map data sources: Parra, 2013; Pritchard, 1975; Zárte y Carrión, 2007.
Map methodology: See Methodology section, ref. 3a. Polygons from records, generalized from point data.

Phoenicopterus ruber glyphorhynchus Sclater, 1861
Animalia : Chordata : Aves : Phoenicopteriformes :
Phoenicopteridae : *Phoenicopterus*
ruber glyphorhynchus



CURRENT STATUS

The flamingo population of the Galapagos Archipelago is small and declining. Although the American Flamingo *Phoenicopterus ruber* is not a globally threatened species, the Galapagos subpopulation (*P. r. glyphorhynchus*) is classed as Endangered in the Ecuadorian Red Data Book by virtue of its limited range and small population size of fewer than 500 individuals¹⁻³. Population surveys conducted between 1967 and 2021 indicate that the population is declining after 2002⁴⁻⁶. Monthly and annual changes in numbers at lagoons suggest the frequent movement of individuals among lagoons located in different islands in response to climate variation, likely affecting food supplies through changes in water levels, and perhaps to other unknown factors⁶. However, recent genetic studies indicate that the population of flamingos from the Galapagos Islands is isolated from the closely related American Flamingo populations in the Caribbean Region⁷.

ECOLOGICAL IMPORTANCE

Filter-feeder flamingos forage in shallow lagoons and use their legs, feet, and head to stir up sediment from the bottom up into the water column, oxygenating and mixing organic material, and thereby avoiding anoxic conditions. In hyper-saline lagoons, the preferred habitat in the Galapagos, flamingos benefit from reduced food competition because there are few other species that are able to exploit these food sources from extreme – saline – ecological conditions⁸.

INFORMATION NEEDS

A marking program is essential to assess inter-lagoon and inter-island movements of adult birds, juvenile survival and natal dispersal. Archipelago-wide population surveys should be carried out every five years, and counts at selected important breeding sites such as Quinta Playa in Isabela Island, and Punta Cormorant in Floreana Island could be conducted annually. Breeding success and predation of eggs and nestlings by introduced pigs (*Sus scrofa*) on southern Isabela requires research. The potential hybridization of Chilean flamingos (*P. chilensis*) with Galapagos flamingos should be studied, and increases in abundance and distribution of the Chilean Flamingo in the archipelago needs to be closely monitored to assess possible competition for food with the Galapagos Flamingo⁹.

DISTRIBUTION

Flamingos in the Galapagos occur at high-salinity coastal and volcanic lagoons of six islands: Isabela, Floreana, Santiago, Santa Cruz, Rábida, and Bainbridge (off Santiago). Most lagoons are located on southern Isabela. Although, flamingos have been observed feeding in at least 37 saline lagoons of the archipelago, nesting activity has only been recorded in nine lagoons on five Islands: Quinta Playa, Cuarta Playa and Cementerio (on Isabela), El Sartén, Mina de Sal and Espumilla (on Santiago), Punta Cormorant (on Floreana), Rábida (on Rábida), Bainbridge # 3 (on Bainbridge islets) ⁶.

MY NOTES

AUTHOR (S)

Fact Sheet: F. Hernan Vargas

Map: Nicolás Moity

Map data sources: Jiménez-Uzcátegui, G & Naranjo, S. (2010), Vargas *et al.* (2008).

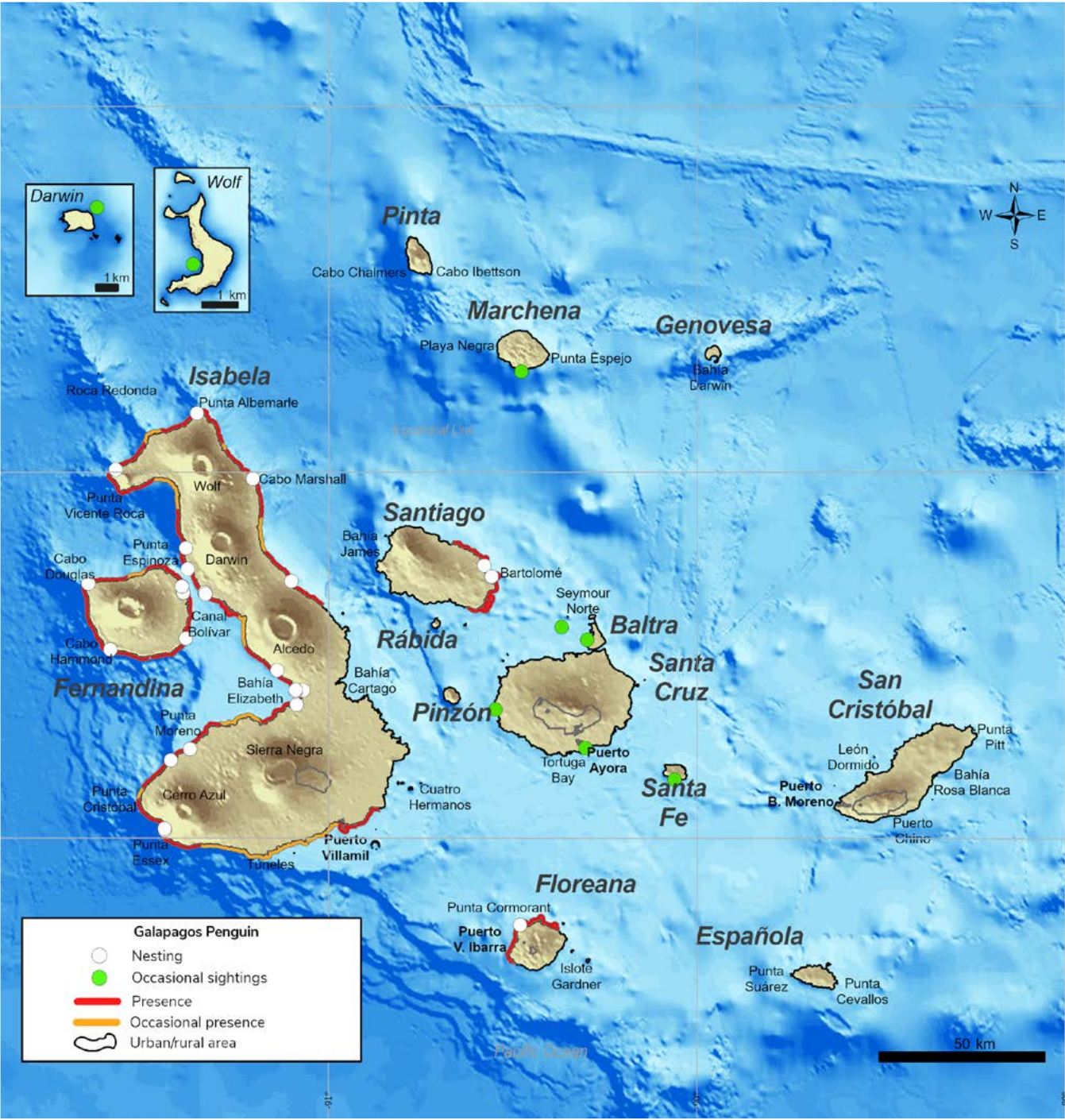
Map methodology: See Methodology section, ref. 1. GPS data.

GALAPAGOS PENGUIN

Pingüino de Galápagos
Spheniscus mendiculus Sundevall, 1871
Animalia : Chordata : Aves : Sphenisciformes :
Spheniscidae : *Spheniscus mendiculus*



© Carlos Espinosa / CDF



CURRENT STATUS

The Galapagos Penguin is restricted to marine upwelling areas with a “normal” population between 1,200 to 4,700 individuals. Its small size and limited range make it one of the world’s most threatened bird species¹. El Niño events, introduced species, human activities (fishing, pollution, habitat modification), pathogens and parasites have had negative effects on its population¹⁻⁷. The maximum recorded lifespan is 17.1 years⁸.

ECOLOGICAL IMPORTANCE

The Galapagos Penguin is a sentinel species⁷⁻⁹ as indicator of climatic variation. Its population size is closely linked to El Niño-Southern Oscillation (ENSO) phases: numbers decline during El Niño due to high sea temperatures and food scarcity, while La Niña, brings recovery through cooler waters, stronger upwelling, and greater prey availability¹⁰. During El Niño events of 1982-1983, 1997-1998^{1, 3, 10}, and 2015-2016^{2, 7}, when temperatures were higher than average, the penguin population crashed³.

Penguins are good indicators of marine productivity, diseases and pathogens⁵. They are also a bioindicator of ecotoxins; being a top predator in the food chain¹¹. Penguins feed on a variety of small crustaceans, fish larvae and larger prey like the Pacific Anchoveta (*Cetengraulis mysticetus*), sardines (*Sardinops sagax*), and Mulletts (*Mugil spp.*)^{10, 12, 13}, it is also a key species, helping to identify population changes on fish populations.

INFORMATION NEEDS

Human interactions are increasing in the islands, reducing their isolation^{6, 7}. Understanding the impacts of climatic variation is essential to assess the status of Galapagos Penguin populations and their associated marine ecosystem. Eradicating or controlling introduced species (rats, mice, dogs, cats, mosquito-vectors) in nesting areas is critical for breeding success^{6, 7}. If penguins can breed successfully the population’s resilience to climate change and other human impacts will be more robust^{2, 7, 10-12}. Understanding the species’ physical requirements (including natural and artificial nests), human impacts during El Niño events (e.g., fishing), and the presence and dispersal of vectors, among other factors, is needed to reduce the vulnerability of this species¹.

The Charles Darwin Foundation (CDF) in collaboration with the Galapagos National Park Directorate (GNPD) have an Ecological Monitoring Program that tracks the long-term survival of this species in the face of habitat change and their threats⁶ (see: <https://www.darwinfoundation.org/en/our-work/ocean/conservation-of-galapagos-marine-birds/>).

DISTRIBUTION

This species nests in Fernandina, Isabela, Floreana, Santiago, Bartolomé, and Sombrero Chino islands. Solitary individuals have been observed on other islands such as Santa Fe, Pinzón^{3, 10, 13}, Wolf, and Darwin (observations by local guides).

MY NOTES

AUTHOR (S)

Fact Sheet: Gustavo Jiménez-Uzcátegui, F. Hernán Vargas, Dee Boersma and Caroline D. Cappello
Map: Nicolás Moity

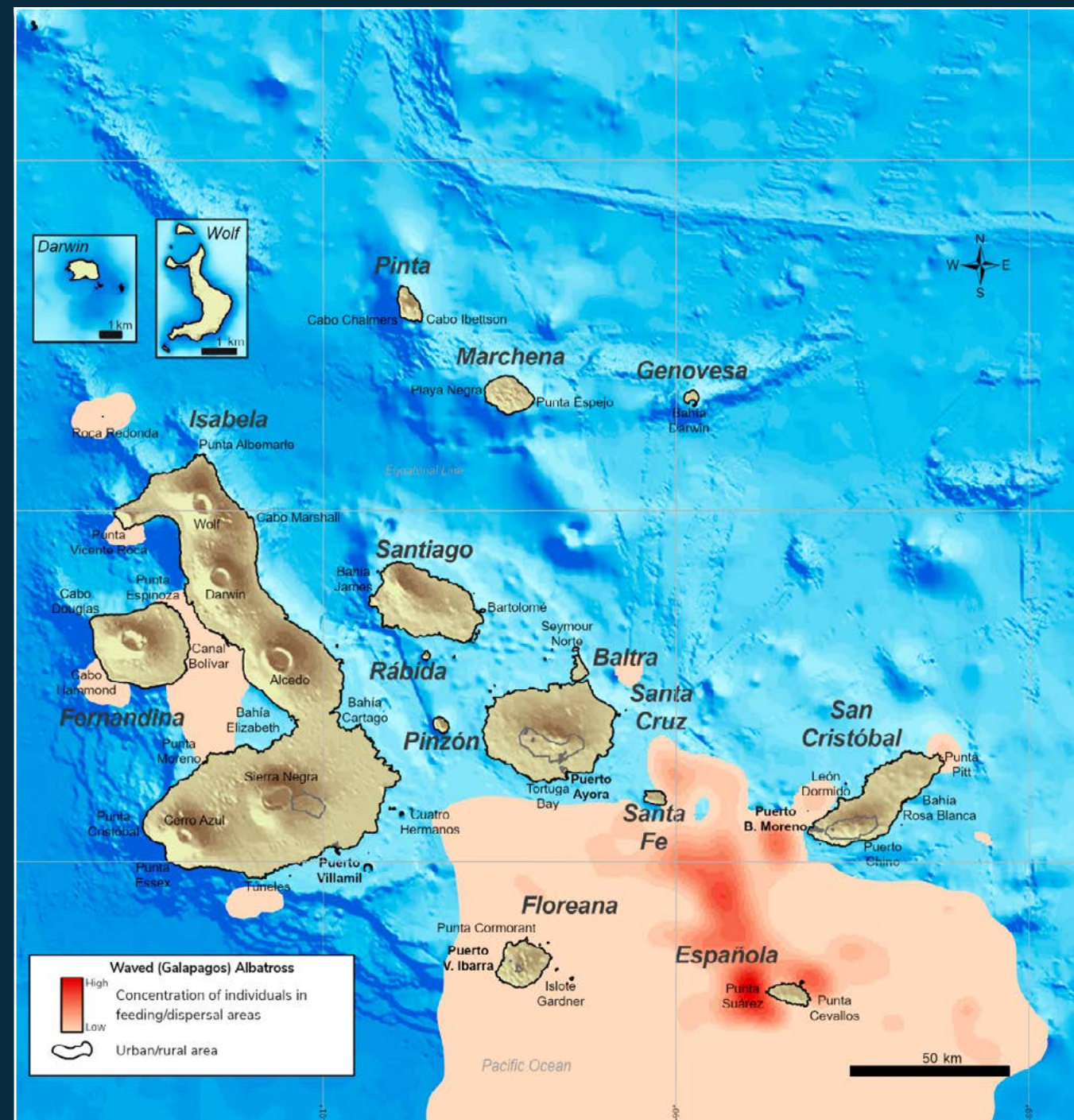
Map data sources: Jiménez-Uzcátegui, G. (EK), Galapagos Marine Birds Program (2003-2025)
Map methodology: See Methodology section, ref. 1. GPS data, ref. 2. Coastal distribution

Albatros de Galápagos, Ondulado, de Onda

Animalia : Chordata : Aves : Procellariiformes :
Diomedidae : *Phoebastria irrorata*



© Carlos Espinosa / CDF



The Waved or Galapagos Albatross faces various extrinsic threats^{1, 2}. In the 1990s, the population was estimated to comprise 33,000-35,000 individuals³, however, more recent work has shown population declines linked to bycatch in artisanal fisheries outside of the Galapagos Marine Reserve (GMR)^{1, 2}. Other threats include weather conditions caused by El Niño⁴, introduced species⁵, human interaction (tourism, intentional catch for consumption)⁶, pollution⁷, and the presence of pathogens^{8, 9}.

P. irrorata serves as a sentinel species for the marine ecosystems it inhabits: declines in the fish and squid prey species, which the albatross feeds on¹⁰, will likely be reflected in declines in reproduction or population size¹¹. This species is a bioindicator because it exhibits endogenous and exogenous bioaccumulation⁷.

Additionally, albatross populations can signal impacts of marine ecosystem events¹¹. For instance, reproductive success was very low¹² in the presence of El Niño events (ENSO) in 1982-1983, 1997-1998^{1, 3, 4, 12, 13}, and 2015-2016¹².

The presence of pathogens and parasites in this species has been noted^{7, 8}, so it's important to develop management plans and continue studies on this subject in the reproductive zones, particularly in tourist areas, where interactions with humans occur. Early detection of infectious pathogens could prevent disease outbreaks, contributing to the long-term persistence of this species, as happened when the HPAI H5N1 arrived to the islands (Jiménez-Uzcátegui, per. obs.)¹⁴.

Monitoring plastics in this species is a critical information gap as ingestion of plastics poses an important emerging threat to seabirds in general, and North Pacific albatrosses in particular¹³.

Research on albatross–fisheries interactions near continental Ecuador remains a high priority, as emphasized in the ACAP Action Plan¹⁵. Ongoing mark–recapture programs are essential for evaluating long-term survival, reproduction, and population growth, while also identifying and monitoring key threats to the species.

The Charles Darwin Foundation (CDF) in collaboration with the Galapagos National Park Directorate (GNPD) have an Ecological Monitoring Program that tracks the long-term survival of this species in the face of habitat change and their threats (see: <https://www.darwinfoundation.org/en/our-work/ocean/conservation-of-galapagos-marine-birds/>).

This species nests on Española Island, along the southern coast from Punta Cevallos to Punta Suárez, and in other small patches within the island¹⁴. A few pairs nest on La Plata Island, off the Ecuadorian continental coast^{1, 3, 9}. Some individuals and eggs have been recorded on Genovesa Island, although without reproductive success (observation by local guides).

MY NOTES

Fact Sheet: Gustavo Jiménez-Uzcátegui and Kathryn (Kate) P. Huyvaert
Map: Nicolás Moity

Map data sources: Jiménez-Uzcátegui, G. (EK), Galapagos Marine Birds Program, Dodge *et al.*, 2013; Awkerman *et al.*, 2014; Moity & Proaño, 2017.

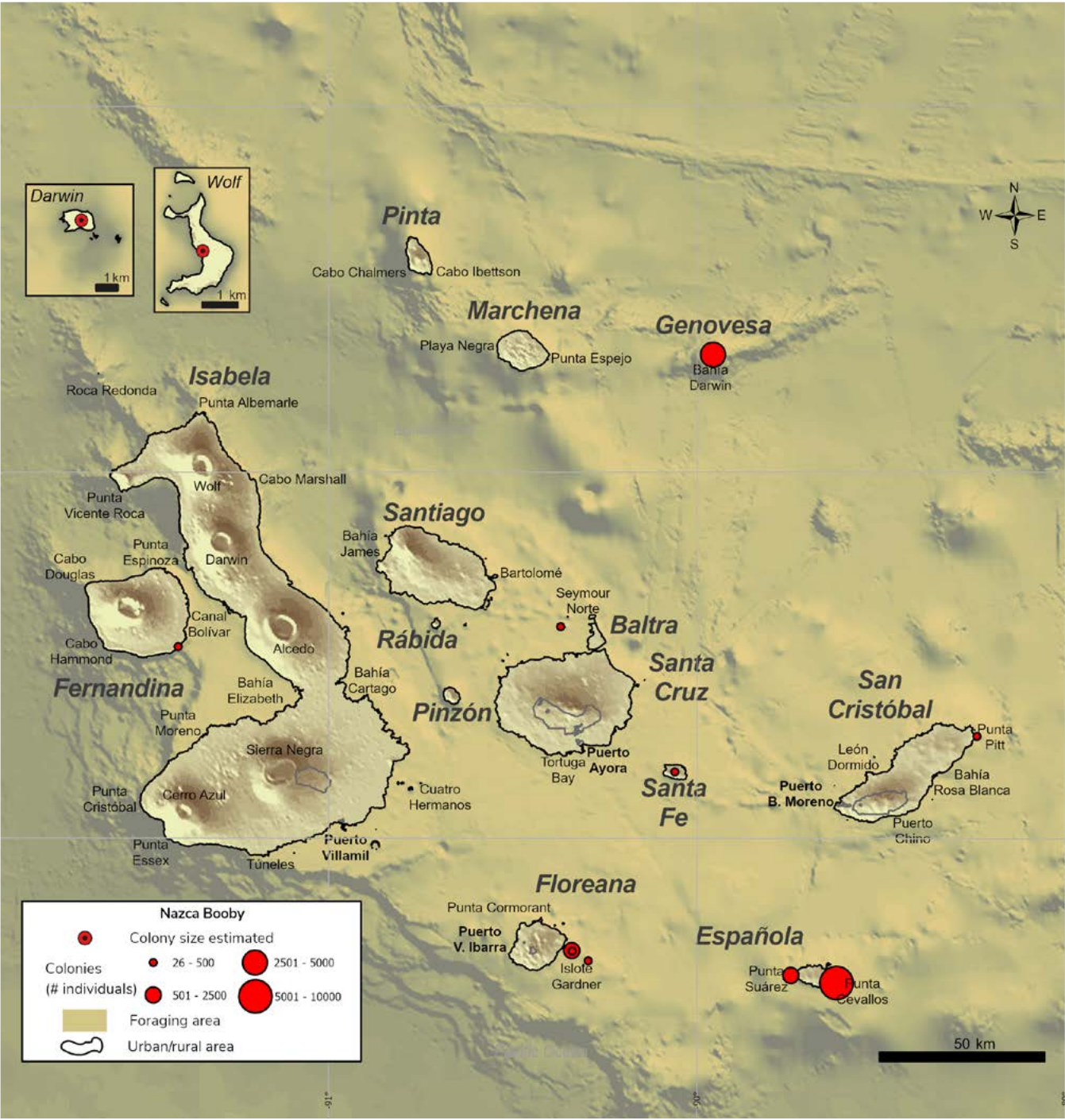
Map methodology: See Methodology section, ref. 1. GPS data, 4b. Expert knowledge model, 4c. Kernel density model.

NAZCA BOOBY

Piquero de Nazca
Sula granti Rothschild, 1902
Animalia : Chordata : Aves : Suliformes : Sulidae : *Sula granti*



© Rashid Cruz / CDF



CURRENT STATUS

Little information exists on population trends. No colony has disappeared in historical times, and no new establishment of colonies is known. The well-studied population at Punta Cevallos is predicted to have a negative population growth rate, based on demographic data¹, since a diet change in 1997, but actual change in population size is unstudied to date. Demographic modelling predicts slow decline of total Galapagos population size to zero, under the influence of ocean warming and its effects on diet quality. The long lives of these birds and the delayed warming in the local Galapagos area put extinction time in the region of several hundred years¹ under current climate change projections. Most nesting colonies and roosting sites have no non-native predators, but even on San Cristóbal (Punta Pitt), where cats visit the colony at night, they apparently cause no harm to the Nazca boobies. Most foraging occurs outside the perimeter of the outer islands^{2,3}, so interactions with local fisheries and humans in general are minimal, although some mortality is known from foraging birds chasing lures behind boats. Interaction with fisheries on the high seas outside Galapagos is unstudied. Anthropogenic effects on juvenile and sub-adult members of the population are possible, and unstudied, off the Central American and Mexican coasts, the apparent temporary location of this demographic group during the first two years of independence⁴.

ECOLOGICAL IMPORTANCE

Nazca boobies are upper trophic level predators, consuming large quantities of forage fish like sardines (*Sardinops sagax*) and Flying Fish (Exocetidae). They transport significant quantities of marine nutrients into the terrestrial environment⁵, and probably also marine pollutants. Their nestlings are food for Sally Lightfoot Crab, Galapagos Mockingbird, frigatebirds, and Galapagos Hawk⁶; the adults are attacked and probably eaten by marine fish² and are ectoparasitized by Darwin's finches.

AUTHOR (S)

Fact Sheet: David J. Anderson
Map: Nicolás Moity

INFORMATION NEEDS

In 1997, the composition of the diet in the Punta Cevallos sub-population changed from largely sardines to largely Flying Fish. This affected both adult survival and (especially) annual reproductive success, and changed population growth rate from zero to negative. Continued documentation of diet characteristics of this population, and of the diet and its effect elsewhere in Galapagos, is the most important information gap in conservation biology. Regular monitoring of population size in all colonies is needed to assess trend in population size; the facts that most of the population is absent during the daytime, that nighttime attendance is partial because foraging trips are often multi-day, and that breeding is asynchronous across Galapagos makes accurate estimation difficult. Surveillance of the entire population for communicable disease is warranted because the juvenile and subadult members of the population live near continental Central America and may interact with infected members of other species there.

DISTRIBUTION

This species nests on Española, San Cristóbal, Santa Fe, Genovesa, Fernandina, Darwin and Wolf islands, Daphne, and islets near Floreana (Caldwell and Champion).

MY NOTES

Map data sources: P. Huyvaert and J. Anderson (2004); Zavalaga et al. (2012).

Map methodology: See Methodology section, ref. 1. GPS data, ref. 3b. Expert-based drawn area.

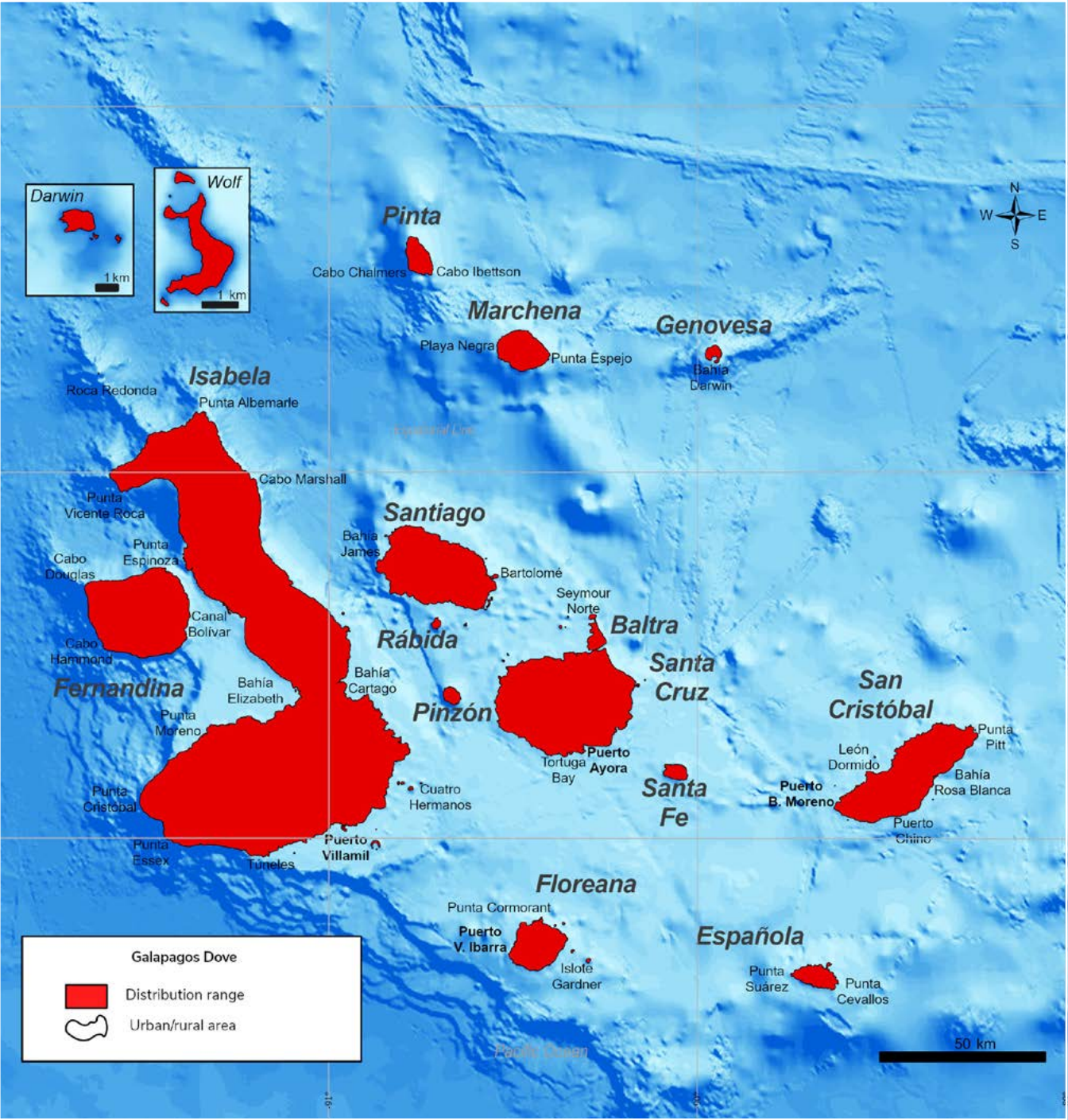
GALAPAGOS DOVE

Paloma de Galápagos

Zenaida galapagoensis Gould, 1841
Animalia: Chordata : Aves : Columbiformes :
Columbidae : *Zenaida galapagoensis*



© Carlos Espinosa / CDF



CURRENT STATUS

The Galapagos Dove, an endemic species, is represented by two subspecies: *Z. g. exsul* (Rothschild and Hartert, 1896) in Darwin and Wolf, and *Z. g. galapagoensis* (Gould, 1841) in the rest of the archipelago^{1,2}. This bird has healthy populations on islands with no cats³, and became very rare on inhabited islands, where free-ranging cats are all around. For example, during intense landbird census work in 2015-2016 in Floreana, only one individual was seen⁴ and for San Cristóbal with counts in 2010-2017 there were only eight individuals sighted⁵. It also seems that its population is in decline in Santa Cruz⁶. It was found to be host of the Avian Vampire Fly (*Philornis downsi*)⁷.

ECOLOGICAL IMPORTANCE

This bird is the only representative of the Columbidae family in Galapagos. It is adapted to the arid conditions of some islands, such as Española, Marchena, Santa Fe, Darwin, and Wolf, but it's also very common in the highlands of Santiago, where it sleeps and nests in lava areas on the coast. It feeds mainly on seeds, fruits, *Opuntia* flowers, and, sometimes, green vegetables and invertebrates⁸. Due to its high consumption of seeds, it's a disperser, although many seeds are destroyed as they go down the digestive tract⁹.

On the arid islands, it has been observed foraging at ground level, digging and removing plant material in search of food. It nests in cavities under lava rocks or uses old nests of mockingbirds (known from Genovesa⁹). Its reproduction starts approximately one month after the start of the rainy season and it can lay up to three clutches.

The very small populations on even remote sites coincide with the wide dispersal of cats (e.g., the areas around volcanoes Wolf, Alcedo and Sierra Negra in Isabela, remote areas of Floreana and San Cristóbal), and stand in contrast to high abundances observed on other islands free of cats like Baltra and Santiago (CDF webpage). Populations of different islands are not distinguished genetically, indicating that individuals move between islands¹⁰. It shows high levels of infection of different diseases, including *Trichomonas*, *Chlamydophila*, and *Haemoproteus* spp¹¹⁻¹³, and it's a potential transmitter of these diseases to other species¹⁴.

AUTHOR (S)

Fact Sheet: Birgit Fessl and David Anchundia
Map: Byron Delgado M.

INFORMATION NEEDS

It's unknown if the Avian Vampire Fly (*Philornis downsi*) affects the Galapagos Dove or if it acts as a reservoir species, and in general, little is known about its ecology and dispersal. It can be a vector/reservoir of infectious diseases¹¹, therefore monitoring these diseases is recommended.

Further studies are needed to investigate the potential causes of population declines observed in Floreana, San Cristóbal, and Santa Cruz⁶. Following the island-wide cat control on Floreana in 2023, doves have been observed more frequently, suggesting that cats are a significant threat to this species. Additionally, it is important to study other potential impacts such as diseases, pesticides, or habitat changes. The impacts/benefits of this species on topsoil are unknown.

DISTRIBUTION

This species can be found on all islands but is less common on inhabited islands.

MY NOTES

Map data sources: Anchundia, D. (EK), Land Bird Project.

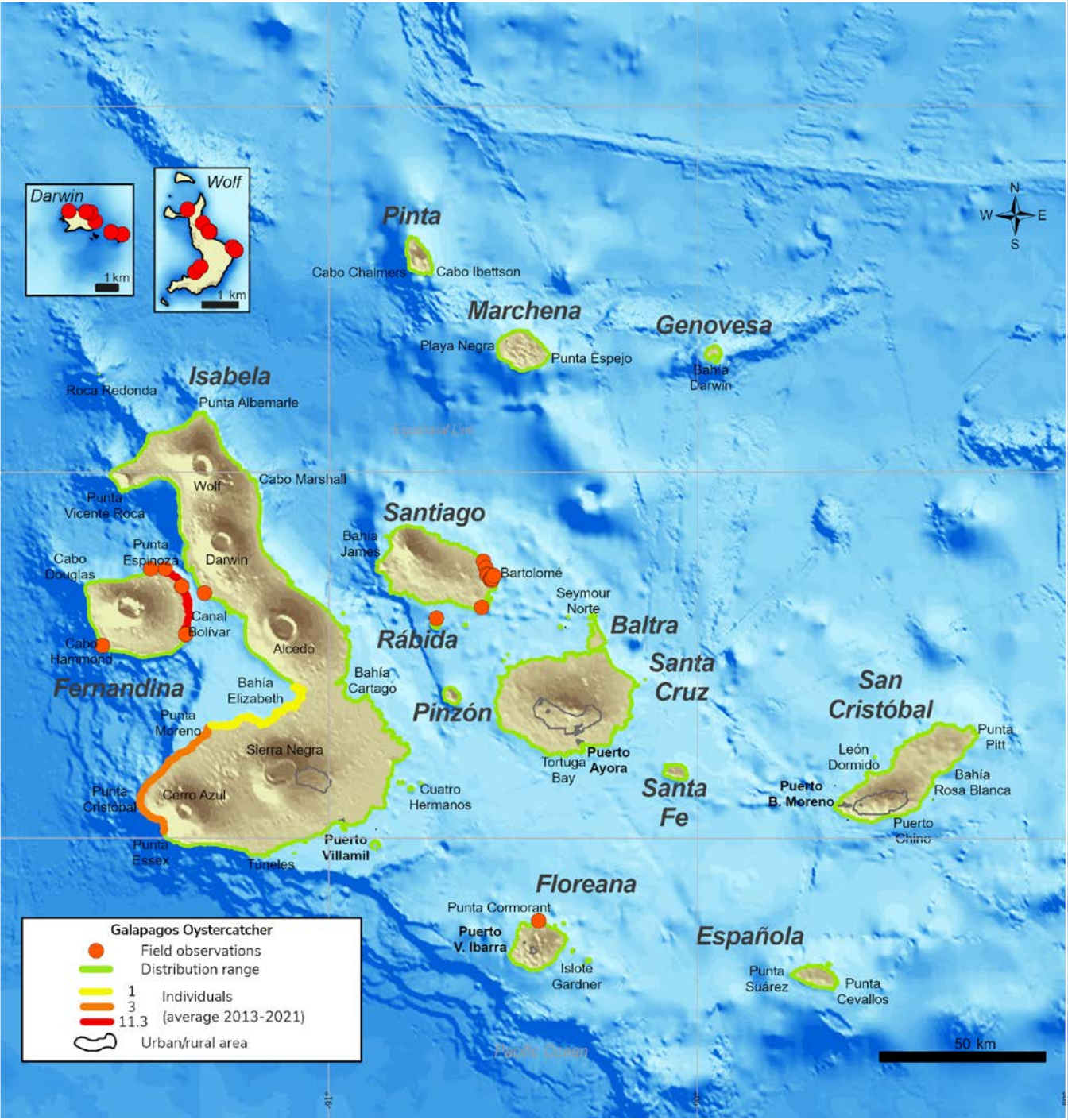
Map methodology: See Methodology section, ref. 3b. Expert-based drawn area.

GALAPAGOS OYSTERCATCHER

Ostrero, Cangrejero
Haematopus palliatus galapagensis Ridgway, 1886
Animalia : Chordata : Aves: Charadriiformes :
Haematopodidae : *Haematopus palliatus galapagensis*



© Bernie Jácome



CURRENT STATUS

The Galapagos Oystercatcher population is estimated at fewer than 500 individuals across the archipelago. Annual marine bird censuses carried out in selected areas of Isabela and Fernandina between 2010 and 2021 recorded fewer than 20 individuals, indicating that these populations have almost certainly always been small^{1, 2}. This endemic subspecies is categorized as Vulnerable on the Red List of Threatened Species³, because of its limited range and small population size. In addition, introduced species — especially cats (*Felis catus*) — affect all marine birds through predation, and natural events such as climate change and tsunamis may damage its nests, since the birds breed in areas at the high tide level⁴. The American Oystercatcher recorded on mainland Ecuador is categorized as Least Concern on the same list³. Morphological studies indicate that the Galapagos population is isolated from the closely related American Oystercatcher populations on the coast of Ecuador⁵.

INFORMATION NEEDS

An updated distribution and population estimate is needed to establish a baseline, particularly given that the Galapagos Oystercatcher is a sentinel species for coastal areas. Breeding success, and predation of eggs and nestlings by introduced cats (*Felis catus*; see Feral Cat chapter) on Isabela, both require research. A genetic study is also necessary to confirm the differences between the Galapagos and American oystercatchers.

DISTRIBUTION

The Galapagos Oystercatcher occurs in coastal areas of the main islands of the archipelago. It is most easily found on Fernandina, Isabela, Santiago, Santa Cruz, Santa Fe, Floreana, Española, San Cristóbal and Marchena. Oystercatchers are usually seen in pairs or small groups of three to five individuals, and larger groups of six to 15 have occasionally been recorded^{1, 2, 6, 7}.

MY NOTES

ECOLOGICAL IMPORTANCE

H. palliatus galapagensis is a sentinel species for coastal marine ecosystems, because declines in its reproduction or in its numbers can reflect the impacts of climate change and of natural events such as tsunamis, since these events affect its breeding areas. Oystercatchers are also good indicators of introduced species or pathogens when their populations decline^{4, 6}, and of coastal marine productivity, because they feed on a variety of small mollusks, sea urchins and crabs (all understudied species), which helps identify changes in those populations^{4, 7}.

AUTHOR (S)

Fact Sheet: Gustavo Jiménez-Uzcátegui
Map: Nicolás Moity

Map data sources: Galapagos Marine Birds Program (2009-2025)
Map methodology: See Methodology section, ref. 1. GPS data, ref. 2. Coastal distribution.

OWLS— LECHUZAS

In Galapagos, owls are represented by two families: Tytonidae and Strigidae¹. Family Tytonidae comprises 16 species worldwide which are characterized by large heads with a heart-shaped facial disk and long, strong legs. Its plumage is typically brown, whitish, or beige, and shows dots or lines². In Galapagos, a single member of this family is present and is commonly known as the Barn Owl (*Tyto furcata punctatissima*), a smaller subspecies with darker plumage than others of its species¹. The plumage of the female tends to be darker than that of the male.

The Strigidae family comprises 229 species worldwide². They're owls with a large head, round facial disk, compact body, and strong curved beak. Their plumage is similar to the environment where they hunt. In Galapagos, this family is represented by the Galapagos Short-eared Owl (*Asio flammeus galapagoensis*), a subspecies that distinctively differs from others of its species, due to its darker plumage and mask, as well as its smaller size. Köning¹ suggests that the taxon *A. flammeus* of Galapagos may be a separate species.

As raptors of nocturnal habits, the barn owl and the Short-eared Owl play the ecological role of controlling the population of their prey, which mainly consists of rodents. The Short-eared Owl hunts at dawn and dusk and has been known to include small birds in its diet.

Paolo Piedrahita

Barn Owl -
Lechuza de Campanario
Tyto furcata punctatissima
© Carlos Espinosa / CDF

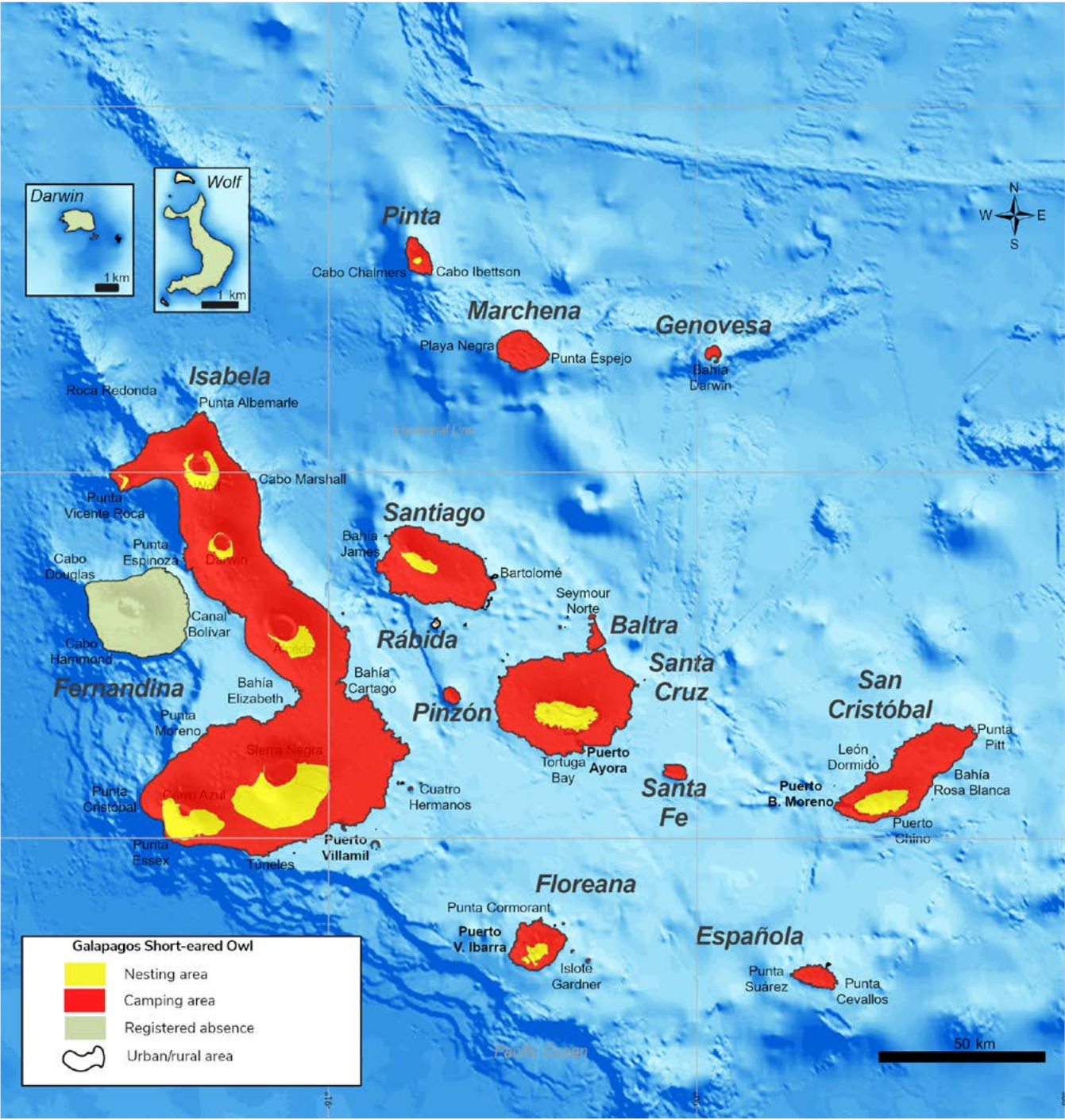
GALAPAGOS SHORT-EARED OWL

Lechuza de Campo

Asio flammeus galapagoensis Gould, 1837
Animalia : Chordata : Aves : Strigiformes : Strigidae :
Asio flammeus galapagoensis



© Carlos Espinosa / CDF



CURRENT STATUS

The Short-eared Owl is a nocturnal raptor. Its conservation status is of Least Concern and is not globally threatened, according to the Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES II). However, as is also true in the case of the steeple owl, its current population status is unknown. According to the Groot survey⁴, its estimated breeding population is 9,000 pairs throughout the archipelago.

ECOLOGICAL IMPORTANCE

The Short-eared Owl hunts during twilight hours: early in the morning and early in the evening. However, on islands where the Galapagos Hawk is present (in whose nests remains of owls have been found), its hunting habits become nocturnal^{3, 4}. One of its flight techniques to avoid being predated by hawks is to fly as high as possible, until losing their predator⁴.

The feeding of the Short-eared Owl consists of 51% small birds, such as Darwin's finches, larger birds, such as petrels and other seabirds (e.g., *Puffinus* spp, *Sterna* spp, *Anous* spp, *Pluvialis* spp), 47% mammals, and the rest is complemented by insects³. Although it prefers to inhabit humid areas, it also lives in areas near the coast or near seabird colonies.

This bird rests among the bushes and rock crevices, as part of its hunting technique. Due to the absence of the Galapagos Hawk on certain islands, the Short-eared Owl can be observed during the day more often than the Barn Owl. It mates between November and May, and reports suggest that it also mates during the "garúa season". It builds its nest directly on the ground, although there have been nests found among the roots of trees as well. It typically lays three to four eggs, but the incubation period and the juvenile fledging dates are unknown.

INFORMATION NEEDS

It's necessary to have information on the population status and the current distribution of *A. f. galapagoensis*. The last population estimate in the archipelago was done between 1979 and 1981³. It's unknown whether the composition of its diet in the vicinity of agricultural areas of the inhabited islands also includes poultry.

Little is known about its ecology, reproductive success, and the timing of key reproductive events. It's necessary to conduct environmental awareness campaigns for the Short-eared Owl and the Barn Owl since the interaction of these two species with human settlements is unfavorable⁵.

DISTRIBUTION

A highly-mobile species, short-eared owls are present on all of the islands.

MY NOTES

AUTHOR (S)

Fact Sheet: Paolo Piedrahita, Hermann Wagner and Galo Quezada
Map: Byron Delgado M.

Map data sources: Piedrahita, P. (EK).
Map methodology: See Methodology section, ref. 3b. Expert-based drawn area.

FINCHES— PINZONES

According to the Illustrated Checklist of the Birds of the World and recent phylogenetic data^{1, 2}, there are 17 species of Darwin's finch in the Galapagos Islands. The San Cristóbal Woodpecker Finch (*Camarhynchus pallidus striatipecta*) may be reconsidered as a separate species due to its genetic distinctness³.

In the 2020 update of the International Union for Conservation of Nature's (IUCN) Red List of Birds, nine of these species are classified as Threatened. All species — except those restricted to the islands of Darwin, Wolf, Española, and Genovesa — are impacted by the parasitic Avian Vampire Fly (*Philornis downsi*), particularly insectivorous finches with low clutch sizes and those inhabiting the humid highlands, where this introduced fly is most abundant^{4, 5}. The impact of the Avian Vampire Fly represents one of the greatest current threats, contributing to the decline of several populations on the inhabited islands, alongside habitat loss^{6, 7}. Additional pressures include competition and predation by introduced species, the potential arrival of new diseases, and ongoing habitat alteration⁷.

Darwin's finches play a crucial role in flower pollination, seed predation, and seed dispersal⁸⁻¹⁰. There are four

genera: *Geospiza* (nine species), *Camarhynchus* (five species), *Certhidea* (two species), and *Platyspiza* (one species).

Geospiza species — except for the Sharp-beaked Ground Finch (*G. difficilis*) — are mainly granivorous and more abundant in arid zones^{11, 12}. Males darken with age until they become completely black, while females and younger males share a brown plumage with spots and stripes. Species of *Camarhynchus* and *Certhidea* are mainly insectivorous, generally found in humid areas, except for the Mangrove Finch (*C. heliobates*), which inhabits mangrove ecosystems, and the Gray Warbler-finch (*C. fusca*), common in arid areas. *Platyspiza*, whose diet is largely vegetarian, is more common in arid and transitional areas. The plumage of most males of *Camarhynchus* and *Platyspiza* darkens with each molt until they acquire a black hood and chin, whereas the females and young males remain yellowish brown with faint streaking.

Birgit Fessl and David Anchundia

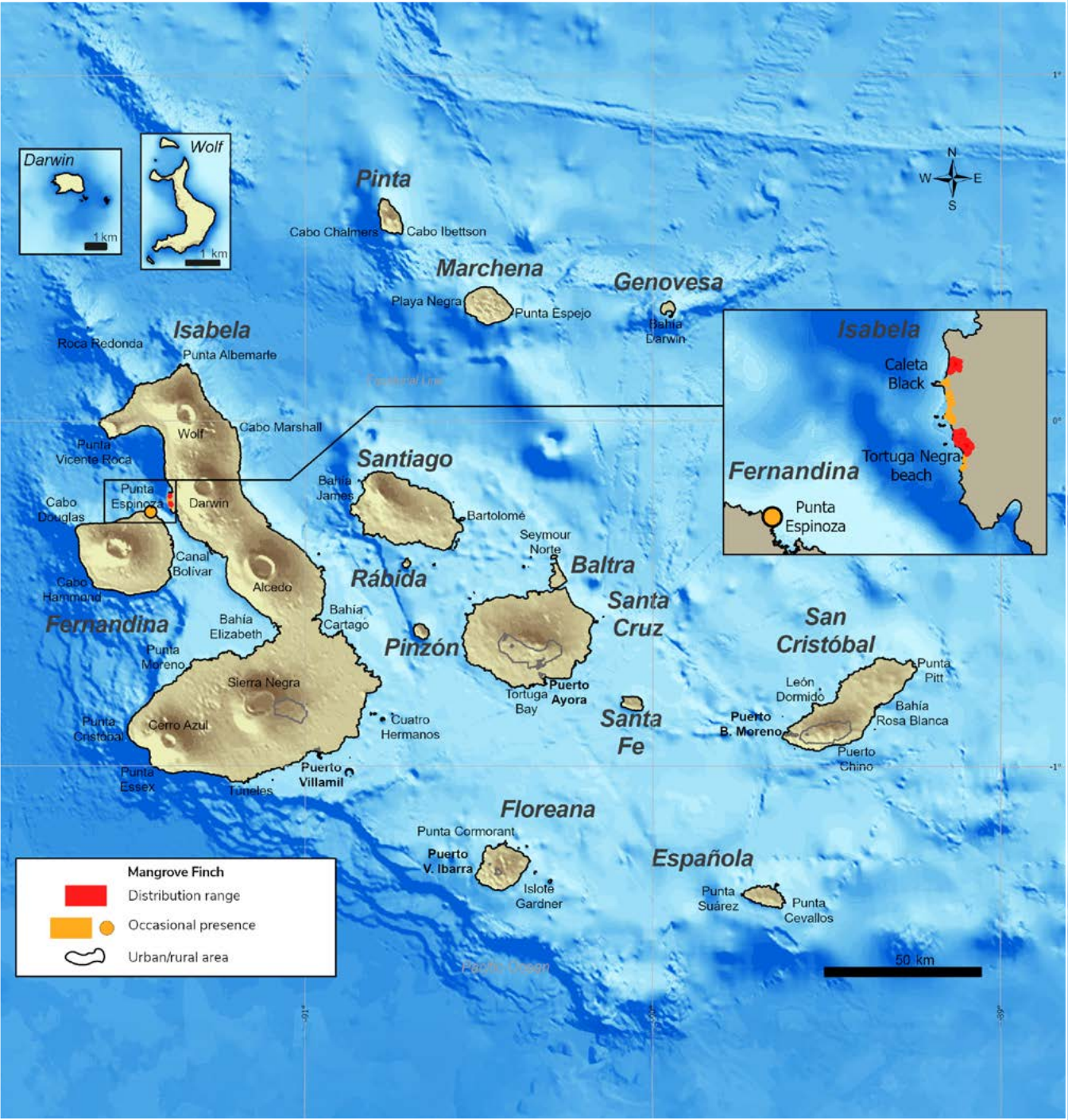


Small Tree Finch-
Pinzón de Árbol Pequeño
Camarhynchus parvulus
© Mara Speece / CDF

MANGROVE FINCH

Pinzón de Manglar

Camarhynchus heliobates Snodgrass & Heller, 1901
Animalia : Chordata : Aves : Passeriformes :
Thraupidae : *Camarhynchus heliobates*



CURRENT STATUS

The Mangrove Finch is Critically Endangered¹. It has an estimated population of 60-80 individuals (Cunninghame 2023, unpublished data) with fewer than 15 breeding pairs (2025, CDF unpublished data), making it the rarest bird in Galapagos²⁻⁴. The Mangrove Finch population faces numerous threats, including nestling parasitism from the larvae of the highly invasive Avian Vampire Fly (*Philornis downsi*), egg predation from introduced Black Rats (*Rattus rattus*), predation from feral cats, small population size, reduced genetic diversity, extreme climate variability affecting breeding success and potential habitat loss due to climate change²⁻⁶. Since 2006, an intensive management project is carried out for the conservation of the Mangrove Finch in its natural habitat. This includes the ongoing control of introduced species and intensive management (formerly head-starting and now in situ nest treatment) to increase chick survival^{3, 5-8}. Techniques to increase nestling survival in the wild are continuously refined. A promising method is the self-fumigation technique, where birds help themselves by incorporating material impregnated with a bird-safe insecticide into their nests^{9, 10}.

ECOLOGICAL IMPORTANCE

The Mangrove Finch is an iconic and representative species of the Isabela Island mangroves. It's one of the most specialized Darwin finches, having adapted to live and reproduce in the mangroves, a type of habitat naturally limited in Galapagos^{4, 11, 12}. Its current habitat comprises three mangrove species: The White Mangrove (*Laguncularia racemosa*), the Red Mangrove (*Rhizophora mangle*), and the Black Mangrove (*Avicennia germinans*). Its diet consists of invertebrates found in the foliage, bark, branches, and leaf litter of the mangroves^{5, 11, 12}. It also forages seasonally on ripe Palo Santo (*Bursera graveolens*) on the edges of the mangroves and in the vegetation in the adjacent arid zone^{3, 11}.

It reproduces during rainy seasons, laying eggs from the end of January to April, although this varies each year depending on the climate^{3, 5, 12}. The males establish reproductive territories and begin nest construction, singing to attract the females, which are in charge of finishing it^{3, 5, 12}. The nests can be found at a height of 3-26 m (average: 13 m)^{5, 11}. Egg-laying varies from 2 to 4 eggs (average: 2.3). Incubation, performed only by females, lasts 15 days^{3, 5}.

AUTHOR (S)

Fact Sheet: Maria Igual Beltrán, H. Francesca Cunningham and Birgit Fessl
Map: Nicolás Moity

The chicks take 15 to 20 days to fledge³. Adults move widely in search of food to feed their young; therefore, becoming independent takes more than a month³. If a nest fails, and climatic conditions are favourable, females can re-nest, laying up to six clutches per season³. Its hybridization with the Woodpecker Finch (*C. pallidus*), a close relative, has been documented^{4, 5}.

INFORMATION NEEDS

Information on long-term juvenile survival is scarce. Although a large proportion of the population is fitted with unique colour band combinations, including many wild-hatched chicks, and all head-started chicks, it is a challenge to observe any that are not breeding due to their cryptic behaviour. Several years may pass between observing some or any individuals³.

The current distribution of mangrove finches in other mangroves of Isabela and Fernandina is unknown, however verified records of individual birds from Fernandina do occur. Reports confirming the presence of individuals in other sites and evidence from acoustic monitoring during short periods after the hand-reared juveniles were released, have shown that these birds are capable of dispersal. But the large mangrove area and the complex topography of Isabela Island create a difficult monitoring process.

DISTRIBUTION

This species population is confined to two mangrove forests in the northwest of Isabela Island, at Tortuga Negra Beach (22 ha) and Caleta Black (11 ha). Sporadic sightings of individuals on Fernandina, at Punta Espinoza and Punta Mangle, do occur^{2, 13}. A small population in eastern Isabela (Bahía Cartago), was not recorded after 2010^{4, 14}.

MY NOTES

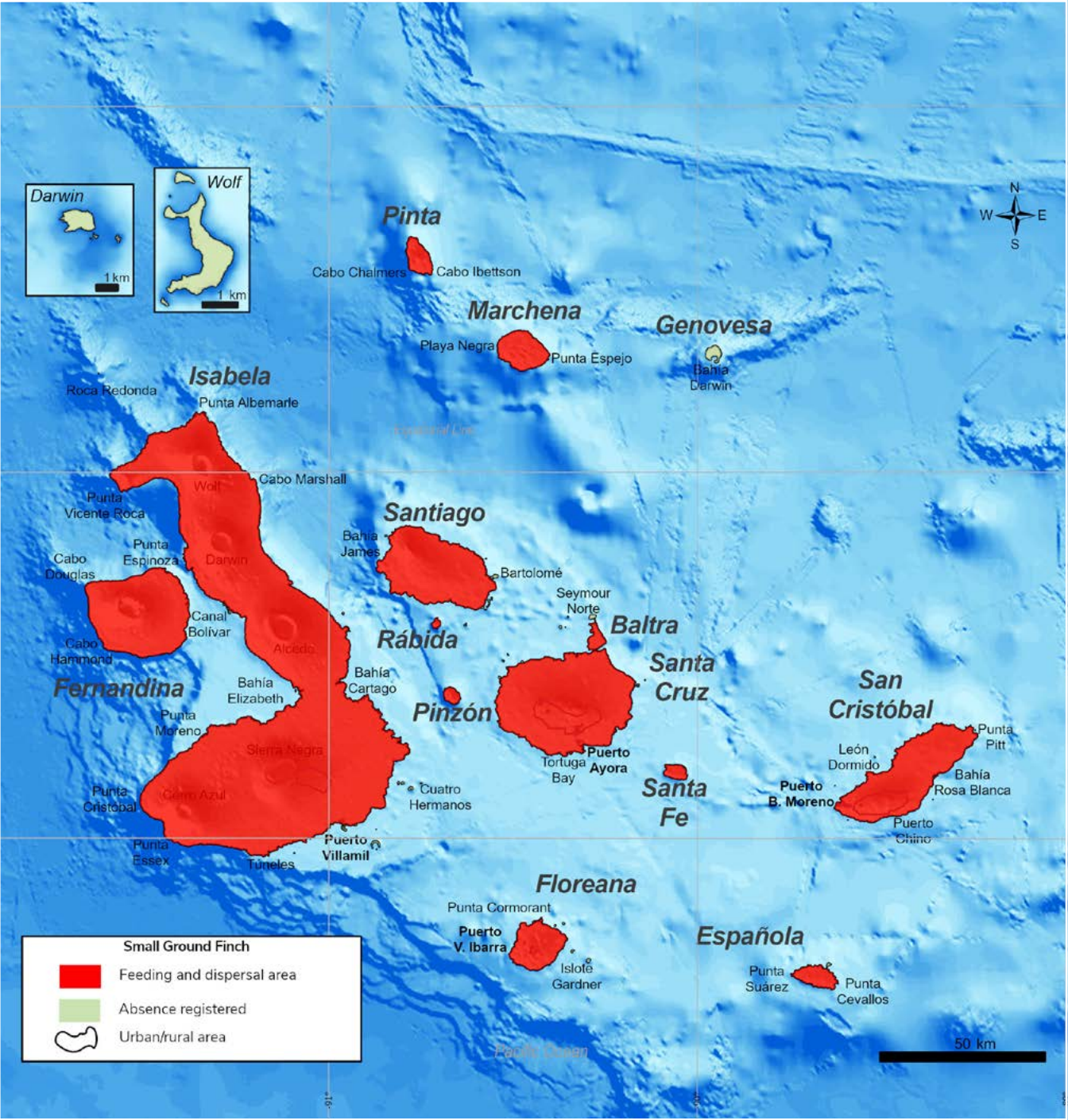
Map data sources: Cunningham, F. (EK), CDF Mangrove Finch Project.

Map methodology: See Methodology section, ref. 1. GPS data, ref. 5. Manual habitat digitalization.

SMALL GROUND FINCH

Pinzón de Tierra Pequeño

Geospiza fuliginosa Gould, 1837
Animalia : Chordata : Aves : Passeriformes :
Thraupidae : *Geospiza fuliginosa*



CURRENT STATUS

The Small Ground Finch is the most abundant and widely dispersed species of the Darwin's finches. It inhabits all vegetation zones, with highest densities found in arid areas with open vegetation. This species is currently expanding its range in the highlands of Santa Cruz. This expansion is most likely due to the reduction of forests, the increase of open habitat (e.g., agriculture), and/or the introduction of many herbaceous species into the *Scalesia* and fern zones, which constitute sources of seeds for birds¹ and attracts this species.

ECOLOGICAL IMPORTANCE

The Small Ground Finch preferably feeds on seeds, but also eats fruits and flowers. It possibly plays an important role in the pollination, predation, and dispersal of seeds²⁻⁵. It also consumes arthropods, especially during the nesting period, which normally falls into the rainy season (January to April). Studies on seed dispersal have determined that this finch excretes one of the highest viable seed ratios among all finches⁵. Being an abundant species, it may play an important role in the ecology of certain Galapagos plants, as well as in the dispersal of invasive plants. Juvenile finches have been reported to move from one island to another⁶, so they could also act as long-distance seed dispersers.

Their reproduction is opportunistic and occurs when environmental conditions are favorable⁷. Females choose the males based on their song and their nest. They can hybridize with other species of the same genus, such as with the Medium Ground Finch (*G. fortis*) and the Common Cactus Finch (*G. scandens*)⁸. Like all Darwin finches, they live up to 15 years.

This species is affected by the Parasitic Avian Vampire Fly (*Philornis downsi*), which causes chick mortality^{9,10} and rare deformations^{11, 12}, which may negatively influence song performance and thus mating success¹³. It's also affected by diseases such as Avian Pox^{14, 15}, *Isospora* spp.¹⁶, and others that can potentially become epidemic¹⁷.

In urban and agricultural areas, they adapt easily to new foods, causing problems for farmers¹⁸ and increasing the risk of transmission of diseases from domestic poultry (chickens) to wild birds¹⁹.

AUTHOR (S)

Fact Sheet: Birgit Fessl and David Anchundia
Map: Byron Delgado M.

INFORMATION NEEDS

This bird has been observed looking for external parasites on iguanas and tortoises; both species like to extend their neck and legs for this purpose. Little is known about the importance of cleaning for reptiles. Because this species is able to move between islands⁶, long-term monitoring must be performed to observe disease transmission, specifically on inhabited islands. It's important to develop ecological models to identify the impact of this species on Galapagos ecosystems and understand how its absence would affect the island ecosystem.

DISTRIBUTION

This species is common on all the main islands, except Genovesa, Darwin, and Wolf.

MY NOTES

Map data sources: Land Bird Project.
Map methodology: See Methodology section, ref. 3a. Polygons from records, generalized from point data.

MOCKINGBIRDS

— CUCUVES

There are four species of mockingbirds in the Galapagos Islands: the Galapagos Mockingbird (*Mimus parvulus*), San Cristóbal Mockingbird (*M. melanotis*), Española Mockingbird (*M. macdonaldi*), and Floreana Mockingbird (*M. trifasciatus*).

The Galapagos Mockingbird is the most widely distributed species, occurring on at least nine islands. The other three species are restricted to a single island and their associated islets that host the same species. All mockingbird species are omnivorous and live in family groups of up to 24 individuals. In general, mockingbirds inhabit lowland areas with bushy vegetation, although they are occasionally found in *Scalesia* forests. Mockingbirds are vulnerable to predation by introduced species.

Luis Ortiz-Catedral

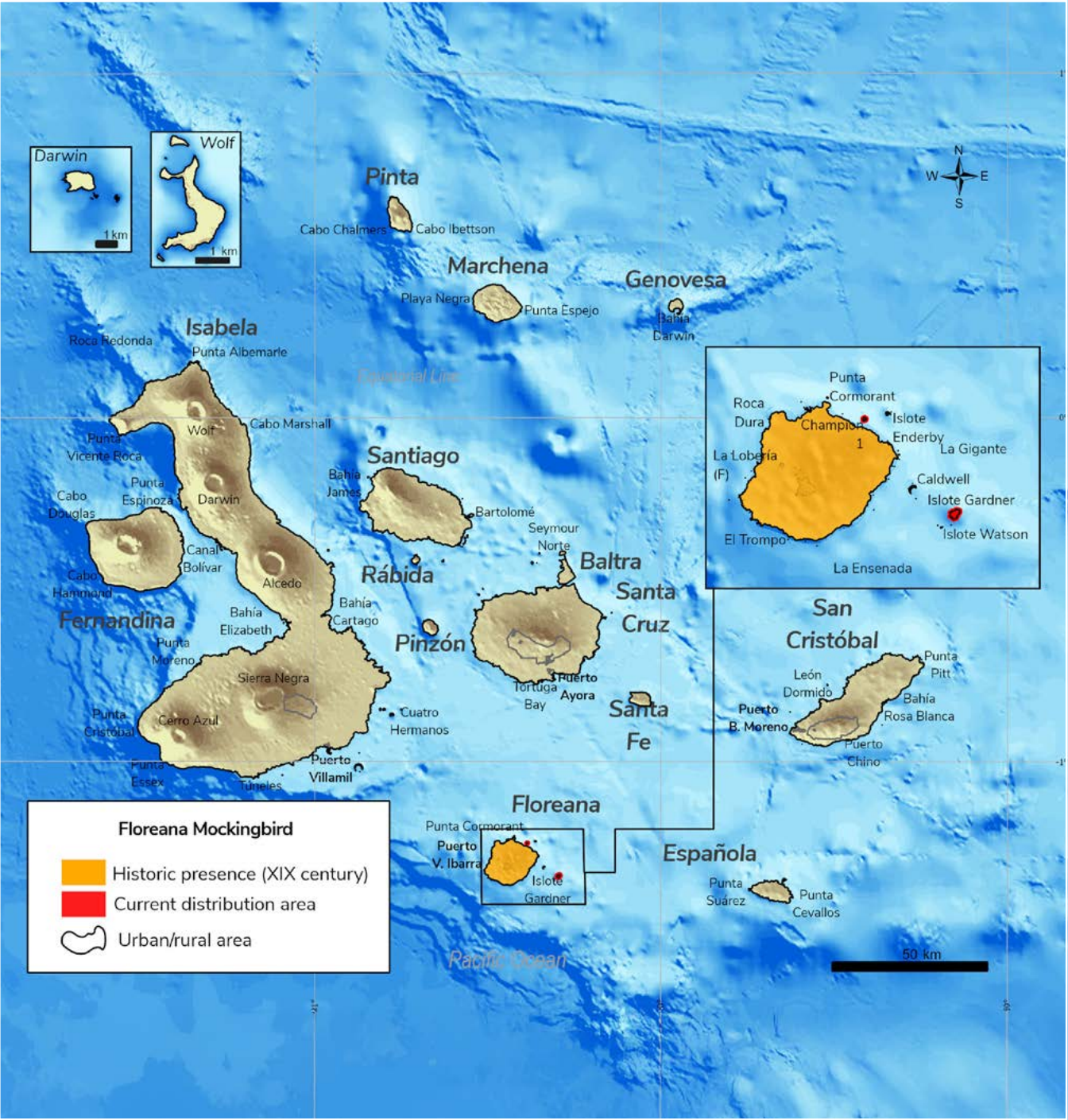
Mockingbirds- Cucuves

Mimus spp.
© Rebecca Rosado / CDF



FLOREANA MOCKINGBIRD

Cucuve de Floreana
Mimus trifasciatus (Gould, 1837)
Animalia : Chordata : Aves : Passeriformes : Mimidae : *Mimus trifasciatus*



CURRENT STATUS

The Floreana Mockingbird is Critically Endangered, according to the International Union for Conservation of Nature (IUCN). Historically, it had a wide distribution in the lower parts of Floreana Island¹. However, the species disappeared from the island at the end of the 19th century and the beginning of the 20th century, due to the modification of its habitat and predation by introduced mammals². Currently, it has a limited distribution. It exists in two islets (Champion and Gardner-by-Floreana) that are 14 km apart, with a mere total of 90 hectares in area³. Over a period of 14 years, the population has fluctuated between approximately 300 and 500 individuals. There is evidence of genetic diversity loss due to the isolation of these existing populations⁴.

ECOLOGICAL IMPORTANCE

Floreana mockingbirds are common on the islets and live in family groups of two to seven individuals, which maintain main feeding territories throughout the year. Field observations⁵⁻⁶ indicate that this species pollinates prickly-pear cactus (*Opuntia megasperma*), candelabra cactus (*Jasminocereus thouarsii*), and *Portulaca howellii*. Additionally, it disperses the seeds of several vegetation species in the lower elevations, including *Cordia lutea*, *Physalis galapagoensis*, *Croton scouleri*, *Exedecomus miersii*, and, potentially *Jasminocereus thouarsii*. It consumes small vertebrates such as geckos (*Phyllodactylus baueri*), Floreana lava lizards (*Microlophus grayii*), and potentially, newly hatched racer snakes (*Pseudalsophis biserialis biserialis*). Occasionally, it feeds on the content of the eggs of Nazca boobies (*Sula granti*) and Galapagos doves (*Zenaida galapagoensis*). It also predaes on Galapagos centipedes (*Scolopendra galapagoensis*) and other arthropods, including flies, spiders, beetles, and caterpillars. It plays an important role in plant communities and in the regulation of the populations of species that constitute its prey. However, juveniles of the Floreana Mockingbird are predated by the Short-eared Owl (*Asio flammeus galapagoensis*) and, potentially, by the Peregrine Falcon (*Falco peregrinus*), which visits the islets occasionally. It's suspected that adult snakes prey on chicks. Unlike other species of Galapagos birds, the Avian Vampire Fly (*Philornis downsi*) minimally affects the chicks of Floreana mockingbirds.

AUTHOR (S)

Fact Sheet: Luis Ortiz-Catedral
Map: Byron Delgado M.

INFORMATION NEEDS

There is little information about the areas of individual dispersal of *M. trifasciatus* and about the formation of breeding groups, information that is necessary for developing a reintroduction plan in the lower areas of Floreana Island, and ensure the establishment of breeding groups within patches of restored habitat. There is also limited information on the minimum habitat requirements for breeding groups.

Preliminary field observations indicate that large breeding groups (five to seven individuals) maintain large territories of approximately 1.5 ha in areas of *Opuntia megasperma* and *Cordia lutea*, although it's not clear if this species can be successfully established in other habitat types present on Floreana Island, such as areas of Palo Santo (*Bursera graveolens*) or Candelabra Cactus (*Jasminocereus thouarsii*).

DISTRIBUTION

This species is present on Champion and Gardner islets, near the coast of Floreana. Plans to reintroduce to Floreana Island are underway⁷.

MY NOTES

Map data sources: Jiménez-Uzcátegui *et al.*, 2011.
Map methodology: See Methodology section, ref. 1. GPS data.

ENDEMIC RODENTS— ROEDORES ENDÉMICOS

This group once comprised 11 species of the family Cricetidae, tribe Oryzomyini, consisting of two endemic genera (*Megaoryzomys* and *Nesoryzomys*) and one endemic species (*Aegialomys galapagoensis*)¹⁻⁸. Studies of their DNA show that *Nesoryzomys* and *Aegialomys* are closely related compared to other Oryzomyini rodents found on the mainland of South America^{9, 10}. Their ancestors probably drifted to Galapagos on vegetation rafts from the South American mainland¹¹⁻¹³.

Endemic rodents are the taxon of vertebrates with the highest number of extinct species in Galapagos^{2, 4}. The introduced Black Rat (*Rattus rattus*) is the probable cause of displacement of *Nesoryzomys darwini* (on Santa Cruz), *N. indefessus* (on Santa Cruz and Baltra), and *A. galapagoensis* (on San Cristóbal)^{2, 14}. Predation by feral cats is also a probable cause¹⁵. Other extinct species have never been observed alive, and the cause of their extinction remains unexplained^{2, 12, 16}.

Presently, three of the four extant species live on Fernandina Island (two species) and Santa Fe (one species) — it is therefore crucial to keep these islands

free of invasive rodents and cats^{4, 17} — and on Santiago, Cacti may reduce the impact of the Black Rat on *N. swarthi*, suggesting that similar refuge habitats could harbor relict populations of species previously considered 'extinct' on other islands^{18, 19}.

Our knowledge of the Fernandina species remains limited; however, it is known that *N. swarthi* and *A. galapagoensis* have developed a strategy of high survival and low reproduction. This strategy, unusual among the Oryzomyini tribe, is probably a response to the unpredictable availability of resources in arid zones of the archipelago²⁰⁻²². The high levels of genetic diversity found in the four extant species may also enhance their capacity for adaptation to this dynamic landscape²³.

In situ conservation of these species is recommended, along with the development of a captive-breeding center⁴ and the initiation of regular population monitoring across all four species.

*Donna Harris, Stephen Gregory, Robert Dowler
and David Macdonald.*



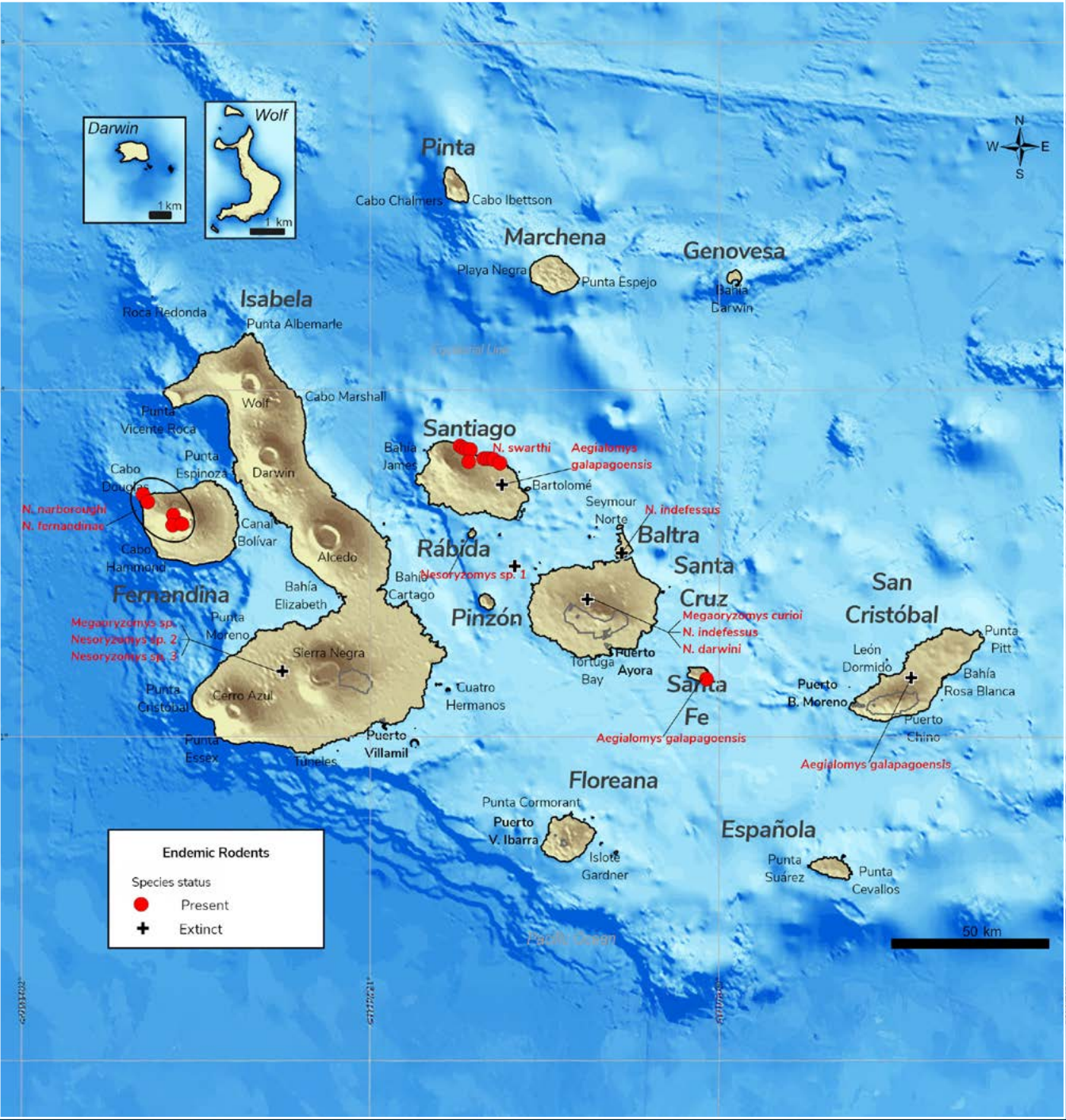
Galapagos - Rice rat-
Ratón de Galápagos
A. galapagoensis
© Mara Speece / CDF

SANTIAGO NESORYZOMYS

Nesoryzomys de Santiago
Nesoryzomys swarthi Orr, 1938
Animalia : Chordata : Mammalia : Rodentia :
Cricetidae : *Nesoryzomys swarthi*



© Donna Harris



CURRENT STATUS

The Santiago *Nesoryzomys* has been lost from parts of its original range, probably due to competition with the introduced Black Rat (*Rattus rattus*). The coexistence of the invasive and endemic rodent at the remaining site - which is very arid - seems to be facilitated by the contrasting life history strategies of the two species, and the resource refuge offered by the endemic Cactus *Opuntia galapageia*. However, the long-term population dynamics of the Santiago *Nesoryzomys* are unknown^{18, 19, 22, 24}.

Climate change may benefit the black rat and may negatively affect *Opuntia*^{18, 25, 26}. Other threats to the Santiago *Nesoryzomys* include the resident House Mouse (*Mus musculus*)^{18, 27, 28} and the potential introduction of *Rattus norvegicus*, cats, and exotic pathogens².

ECOLOGICAL IMPORTANCE

The endemic rodents have experienced the highest loss of species of all vertebrates in the islands. Only 4 of 11 species remain from which to learn about their ecological importance¹⁻⁷. The Santiago *Nesoryzomys* provides a unique opportunity to learn about the impact of introduced rodents on endemic rodents, as it's the only species to coexist with them in Galapagos¹⁸. *R. rattus* has likely played a significant role in some extinctions of endemic rodents^{2, 14}, although feral cat predation could also be an important cause¹⁵.

The Santiago *Nesoryzomys* is probably a prey of the endemic Galapagos Hawk (*Buteo galapagoensis*) and of the endemic subspecies of owls *Asio flammeus galapagoensis* and *Tyto furcata punctatissima*^{4, 29, 30}. It feeds on the seeds and fruits of many endemic and native plant species, including *Opuntia galapageia*, *Bursera graveolens*, and *Cordia lutea*¹⁹. However, the extent to which the Santiago *Nesoryzomys* disperses seeds remains unknown. Observations on the feeding of this species have revealed that it is a predator of many seeds, especially those of *O. galapageia*, the seeds of which it predares through coprophagy³¹.

AUTHOR (S)

Fact Sheet: Donna Harris, Stephen Gregory, Robert Dowler, and David Macdonald
Map: Byron Delgado M.

INFORMATION NEEDS

It's important to establish a long-term program that monitors the population; this way there can be knowledge of what has happened after the eradication of feral goats³⁰, and in response to climate change¹⁸. Localized selective control of the Black Rat may be required at times to prevent the competitive displacement of this endemic species, though this control will likely benefit the House Mouse, another introduced species^{17, 18, 28}. It's necessary, therefore, to quantify the impact of the house mouse on the Santiago *Nesoryzomys*.

It's also important to gather detailed information on captive management and breeding of this species should any of the multiple threats it faces cause a decrease in its population^{4, 32}. Additionally, a screening program for all rodent species on Santiago would help identify any potential threats posed by invasive pathogens.

DISTRIBUTION

This species is endemic to Santiago Island. Originally, it was captured alive in 1906, in Sullivan Bay³³, and a partial skull was found in 1965, in James Bay³⁴. Recent research did not find *N. swarthi* in these historical sites; it currently appears to be restricted to a 14 km stretch of the north-central coast, centered in the area of La Bomba^{4, 24}.

MY NOTES

Map data sources: Harris et al., 2006; Dowler et al., 2000; Weksler et al., 2006; do Prado and Percequillo, 2017.
Map methodology: See Methodology section, ref. 1. GPS data.



BATS— MURCIÉLAGOS

The native mammals of the Galapagos Islands include two species of bats: the Galapagos Red Bat (*Lasiurus borealis brachyotis*) and the Hoary Bat (*Lasiurus cinereus villosissimus*)¹⁻³. The endemic Red Bat, *Lasiurus brachyotis* was first recorded on Floreana Island in 1891⁴. Fossil remains of the Red Bat from the Holocene, recovered from owl pellets, suggest that this species has inhabited the islands for several thousand years⁵. The first confirmed record of the Hoary Bat in Galapagos dates back to the 1950s; no fossil remains have been found, suggesting a more recent colonization^{2,6}.

The flight pattern of the Hoary Bat is longer, faster, and more direct than that of the Red Bat, and typically occurs above the forest canopy. In contrast, the Red Bat is more frequently observed close to the ground and within vegetation². In North and South America,

both species are migratory, so it is thought that regular or seasonal movements occur within Galapagos, both between coastal habitats and the highlands, as well as between islands^{2,3}.

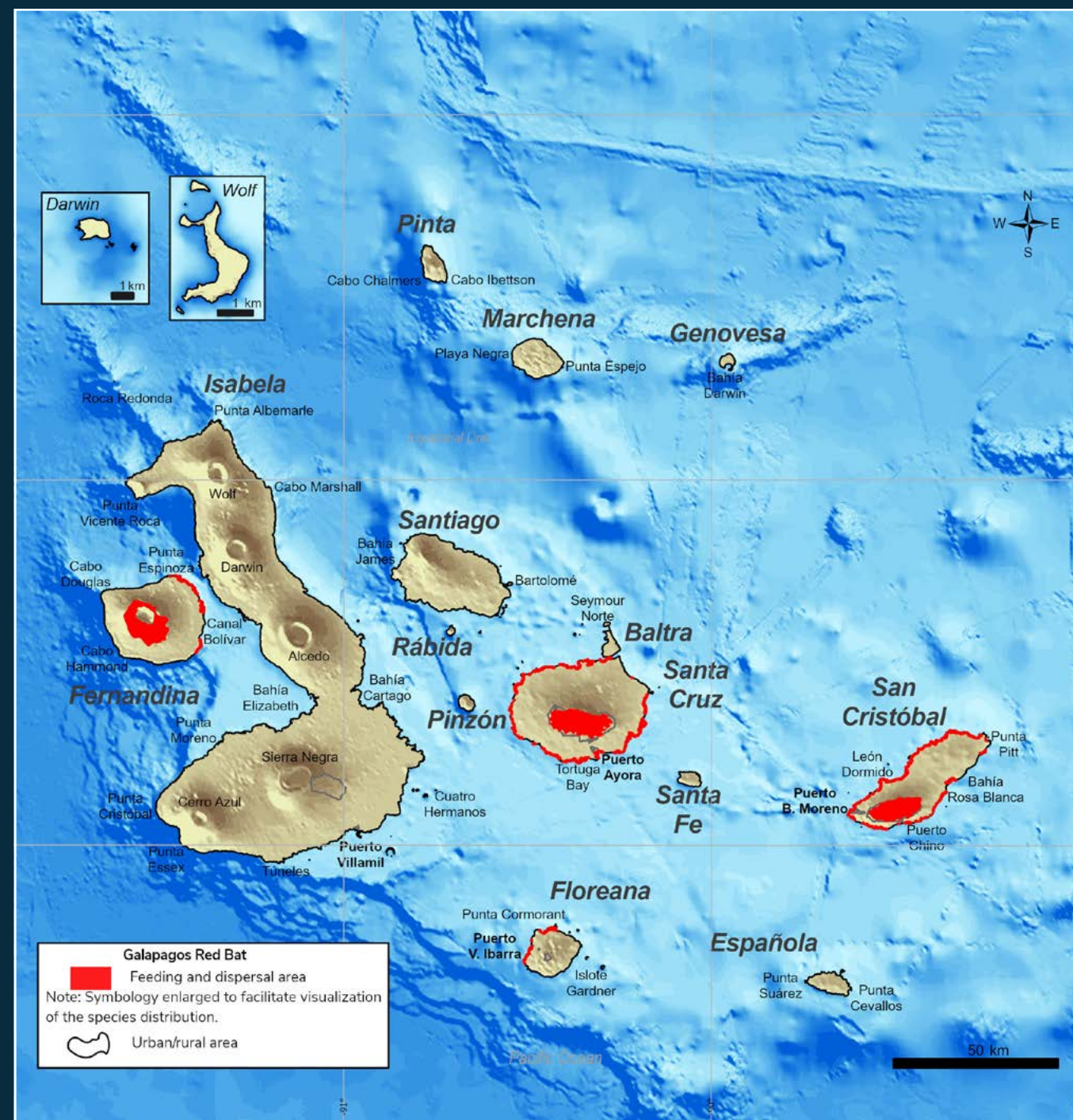
Acoustic studies indicate that the flight zones of the two species do not overlap^{2,3}. Both species have been recorded on the islands of Santa Cruz, San Cristóbal, Floreana, and Fernandina, while the Hoary Bat has also been documented on the islands of Isabela and Santiago.

**Gary F. McCracken and
Gustavo Jiménez-Uzcátegui**



**Galapagos Red Bat -
Murciélago Rojo de Galápagos**
Lasiurus borealis brachyotis
© Walter Pisco / CDF

Animalia : Chordata : Mammalia : Chiroptera :
Vespertilionidae : *Lasiurus borealis brachyotis*



CURRENT STATUS

The Galapagos Red Bat is present in the highlands and coastal areas of Santa Cruz and San Cristóbal². It also lives in the coastal area of Floreana and the higher areas of Fernandina³.

In the coastal regions of Santa Cruz, during the garúa season, females use small feeding areas (10-20 ha) and forage alone and within the foliage of a variety of trees and shrubs, including mangroves. It's abundant in populated areas, where it's frequently observed feeding around street lamp posts^{2,3}.

ECOLOGICAL IMPORTANCE

The analysis of the fragments of insects found in the feces of 11 individuals and the stomach content of two preserved specimens showed that moths (Insecta: Lepidoptera) constituted 86.8% of the volume of their food⁷; Coleoptera, Homoptera, and Hemiptera were also found⁷. Red bats are important because they contribute to ecosystem services such as pest control, by consuming insects that are harmful to crops. In North America, it has been documented that they consume moths that are pests in organic gardens⁸.

Red bats use red mangroves, trees, and shrubs in coastal areas as roosting places. The use of the small foraging zones surrounding these areas suggest that red bats are at risk due to coastal development in Galapagos². The introduced Yellow Paper Wasp (*Polistes versicolor*), recorded in 1988 and now found in all ecological zones could pose an additional threat. This wasp is aggressive and makes its nest at similar heights and in the same vegetation as the red bat. Therefore, the red bat would be key to understanding the impact of this wasp on the ecosystem.

Studies in other parts of the world have documented the impacts of wind turbines on red bats⁹. The models produced to estimate the long-term survival of the red bat in North America suggest that the development of wind energy is a threat to its populations¹⁰. The recent development of this type of energy in San Cristóbal and Baltra, which coincides with the known and limited distribution of the Galapagos Red Bat¹¹, could be a threat to the population of this species; however, studies prior to establishing the wind farms showed that their impact is minimal.

AUTHOR (S)

Fact Sheet: Gary F. McCracken and Gustavo Jiménez-Uzcátequi

Map: Byron Delgado M.

INFORMATION NEEDS

It's necessary to collect current information on population size, reproductive biology, habitat use, and movement patterns in order to assess conservation risks. Additionally, it's important to carry out genetic analyses to verify its classification as subspecies *L. b. brachyotis*, a designation that is currently based on morphological analyses.

Due to limited data, the potential positive impacts of red bats on Galapagos agriculture due to their predation on pests are still unknown. Similarly, the negative impact of the introduced yellow wasp on the Galapagos Red Bat is unknown.

DISTRIBUTION

This species is present on Santa Cruz, San Cristóbal, Floreana, and Fernandina Islands. Fossils have reportedly been found on Floreana Island.

MY NOTES

Map data sources: Jiménez-Uzcátegui, G. (EK).

Map methodology: See Methodology section, ref. 3b.
Expert-based drawn area.

SEA LIONS— LOBOS MARINOS

Pinnipeds are carnivorous mammals characterized by front and hind fin-shaped limbs, and a fusiform body that enables their adaptation to aquatic life. These marine mammals spend much of their time feeding at sea, although reproduction is limited to sandy or rocky beaches. This suborder has about 36 species distributed across three families: Phocidae (Seals), Otariidae (Sea Lions), and Odobenidae (Walruses). Together, they inhabit the coasts of all polar, temperate, and even tropical seas. In general, pinnipeds are species of cold or temperate environments, where high levels of marine productivity can sustain their energy requirements.

Two endemic otariids occur in the Galapagos Islands: the Galapagos Sea Lion (*Zalophus wollebaeki*) and the Galapagos Fur Seal (*Arctocephalus galapagoensis*). These two species represent one of the few examples of pinniped adaptation to a tropical environment. Both otariids are covered by a fur coat of varying thickness, depending on the species. They possess an external

auditory pavilion, and their pelvic structure is mobile, which allows them to support the hind limbs to move on land. In contrast, seals have a thinner fur coat, lack auditory pavilions, and their pelvis is not mobile, limiting their mobility on land. Like many marine mammals, they give birth to one pup per year. During the mating season, females settle down in harems, where they and their pups are protected by territorial males.

Both species are considered bioindicators of the ecosystem dynamics of the Galapagos Marine Reserve because, as top predators, they represent the final stage of most energy flow within the region's marine ecosystems. For this reason, they are the focus of management and long-term monitoring programs conducted by the Galapagos National Park Directorate.

Diego Páez-Rosas

Galapagos Sea Lion -
Lobo Marino de Galápagos
Zalophus wollebaeki
© Carlos Espinosa / CDF

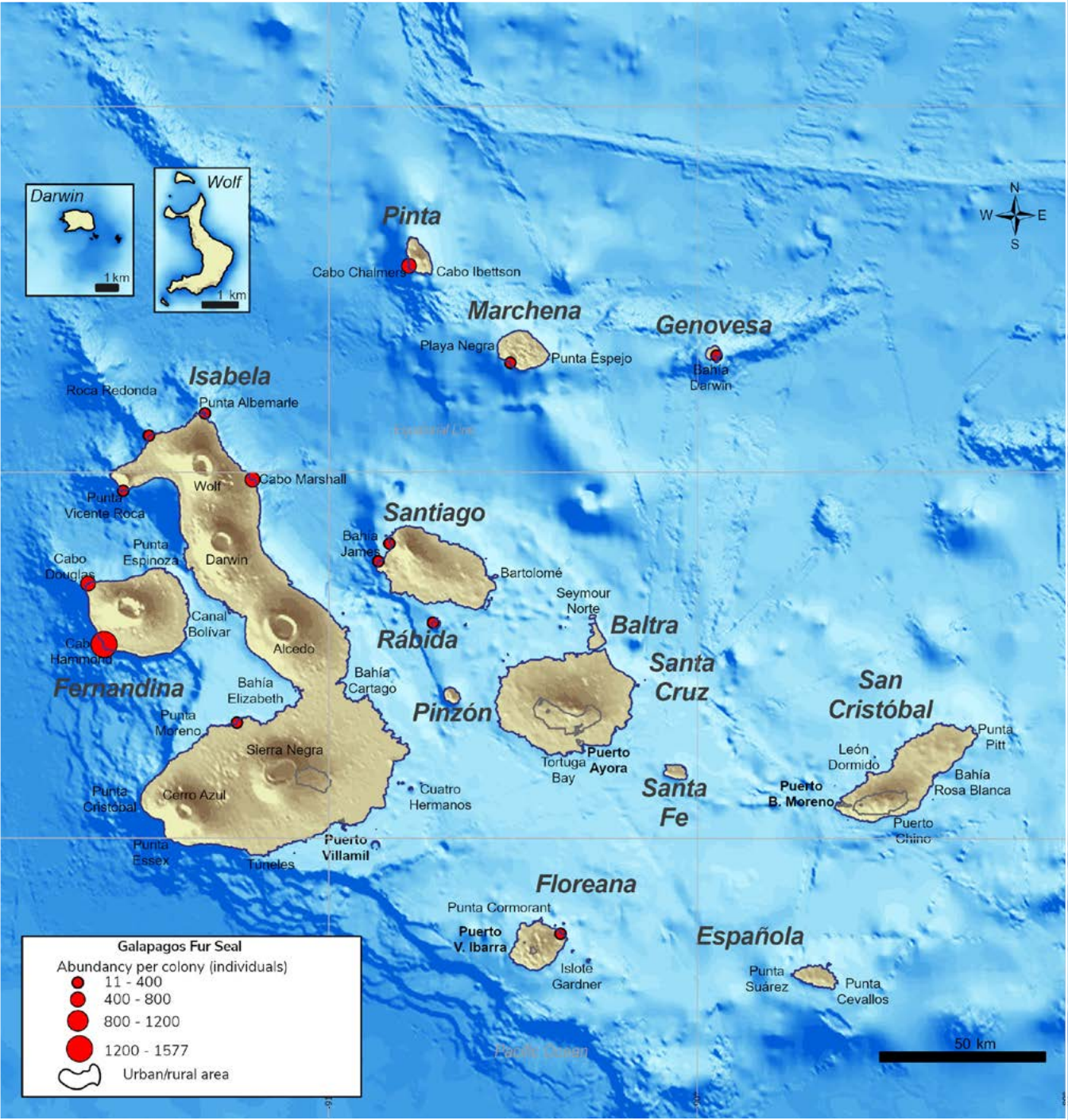
GALAPAGOS FUR SEAL

Lobo Fino de Galápagos, Lobo de Dos Pelos

Arctocephalus galapagoensis Heller, 1904
Animalia : Chordata : Mamíferos : Carnívoros :
Pinnípedos : Otariidae : *Arctocephalus galapagoensis*



© Camila Bermúdez /CDF



CURRENT STATUS

The Galapagos Fur Seal is one of the few endemic mammals on the islands. Its population has declined alarmingly over time, even reaching the verge of extinction due to hunting and the impact of climate events such as El Niño-Southern Oscillation (ENSO)¹. It is included in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), and the International Union for Conservation of Nature (IUCN) has declared its conservation status as Endangered².

There is not sufficient data on its population structure; censuses carried out in recent years estimate that there are approximately ~ 16,000 individuals distributed in eleven breeding rookeries located on the islands of the northern and western region of the archipelago^{3,4}.

ECOLOGICAL IMPORTANCE

Phylogeographic studies suggest a reduced genetic diversity in Galapagos fur seals, a characteristic that exposes them to the effects of consanguinity and genetic drift^{5,6}. It's believed that the demographic decline to which this species was exposed to at the end of the 19th century (as a result of hunting), may have been the main factor in the reduction of its genetic diversity⁶.

Oceanographic events, such as ENSO, cause considerable disturbances in their diet, even increasing the species' mortality levels⁷. Like other otariids, they have a strategy of polygynous reproduction (a male with several females), which is evidenced by a marked sexual dimorphism, with the territorial males being notably larger than the adult females¹. Its reproductive period spans from August to December, and the females have one pup per year⁸. However, reproductive success is based on births every two to three years, since the species' long lactation period (more than a year) causes the one-year-old juvenile to be very strong competition for the newborn⁹.

This species inhabits rocky cliffs, forming small rookeries where it rests and thermoregulates during the day. At night, it goes out to feed, traveling long distances away from the coast^{10,11}. It presents a certain level of specificity in its eating habits, focusing its diet on prey from deep areas that rise to the surface at night, such as squid and several lanternfishes (family Myctophidae)^{12,13}.

AUTHOR (S)

Fact Sheet: Diego Páez-Rosas
Map: Byron Delgado M.

INFORMATION NEEDS

It's necessary to carry out studies on population dynamics to validate the current status of Galapagos fur seals and to understand the demographic impacts that anomalous oceanographic events such as the ones like ENSO could cause^{1,3}. Due to its conditions and conservation needs, it is important to thoroughly research the phylogeography and genetic diversity of this species, to establish its biological and ecological effectiveness^{6,14}.

DISTRIBUTION

This species is present in the northern and western region of the archipelago: Its most numerous colonies are located in the western part of Fernandina Island^{3,4}. Adult individuals have occasionally been sighted on the islands of the central and southern region of the archipelago¹. There are even northernmost records such as the Central American and Mexican coasts, as a result of anomalous oceanographic effects in the region^{15,16}.

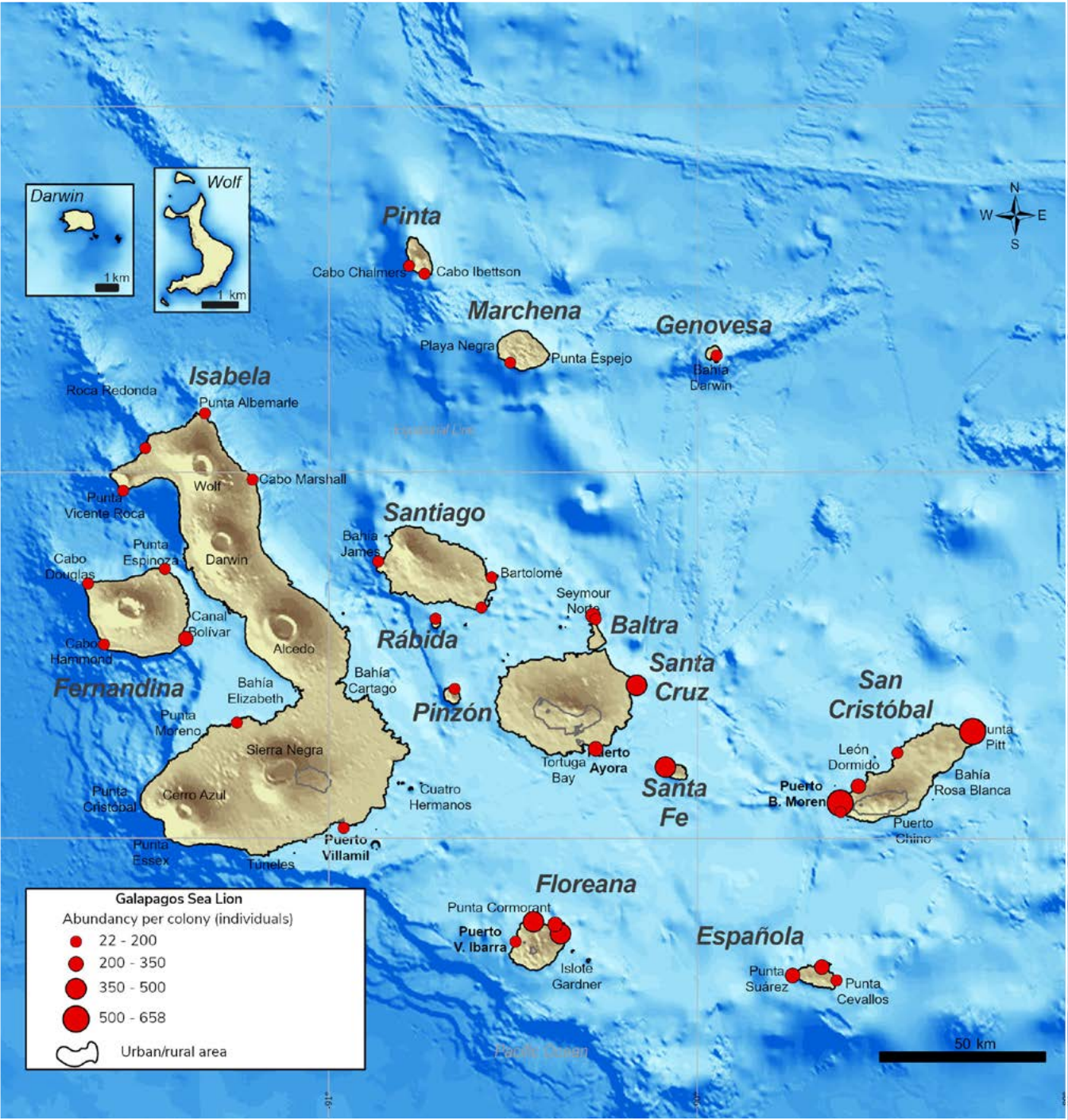
MY NOTES

Map data sources: Páez-Rosas et al., 2021, Pinnipeds Trophic Ecology Research Project USFQ-DPNG.
Map methodology: See Methodology section, ref. 1. GPS data.

GALAPAGOS SEA LION

Lobo Marino de Galápagos, Marino Común

Zalophus wollebaeki Sivertsen, 1953
Animalia : Chordata : Mamíferos : Carnívoros :
Pinnípedos : Otariidae : *Zalophus wollebaeki*



CURRENT STATUS

The Galapagos Sea Lion is an endemic species of the archipelago. Its population has decreased approximately 50% during the last 40 years due to environmental variability (El Niño-Southern Oscillation, ENSO event) and, to a lesser extent, to anthropogenic impact^{1, 2}. This has caused the International Union for Conservation of Nature (IUCN) to categorize its state of conservation as Endangered³. Currently, it is estimated that its population reaches 21,000 individuals, which are distributed in ~40 rookeries located on most of the islands of the archipelago^{4, 5}. During recent years, it has been the object of several studies that classify it as a Sentinel Species with relevant characteristics used to monitor climate change in the Galapagos Islands^{2, 5}.

ECOLOGICAL IMPORTANCE

In general, Galapagos sea lions are gregarious and adapted to coastal ecosystems. These attributes indicate their important role in the dynamics of the ecosystems, for they represent the final stage of most of the energy flow in their habitat⁶. It has been proven that this species can respond quickly and clearly to environmental disturbances, such as ENSO, which can lead to changes in their diet and use of feeding areas^{7, 8}. Some studies indicate they feed mainly on fish, especially pelagic species that tend to form large schools near the coast⁹. However, they supplement their diet with larger demersal fish found in the rocky bottoms¹⁰. These characteristics reveal a certain level of specialism in their trophic behavior, which reduces the levels of competition in their populations, and facilitates their survival^{9, 11}.

They inhabit sandy beaches and places protected from predators, forming small rookeries. Their territory includes an aquatic area for thermoregulation purposes and a terrestrial one for resting¹². The reproductive period includes the months of August through December, during which they maintain a polygynous mating system, represented by a territorial male able to form a harem¹³. This type of strategy leads to a marked sexual dimorphism, characterized by adult males that are noticeably larger than females. Both sexes reach sexual maturity at 4-6 years of age, while physical maturity occurs between 8-9 years¹⁴. Longevity is 20-22 years in females and 17 years in males^{13, 14}.

AUTHOR (S)

Fact Sheet: Diego Páez-Rosas
Map: Byron Delgado M.

INFORMATION NEEDS

Population studies are needed to validate its current distribution and to evaluate the impact of oceanographic events, such as ENSO, on its survival rates^{1, 15}. The scarcity of information on health issues represents a serious conservation problem since several rookeries are vulnerable to bacterial and viral agents due to their proximity to human settlements on the islands^{16, 19}.

DISTRIBUTION

This species is present throughout the archipelago. The islands of the southeast region (Floreana, Española, Santa Fe, and San Cristóbal) have the highest demographic concentration^{4, 20}.

MY NOTES

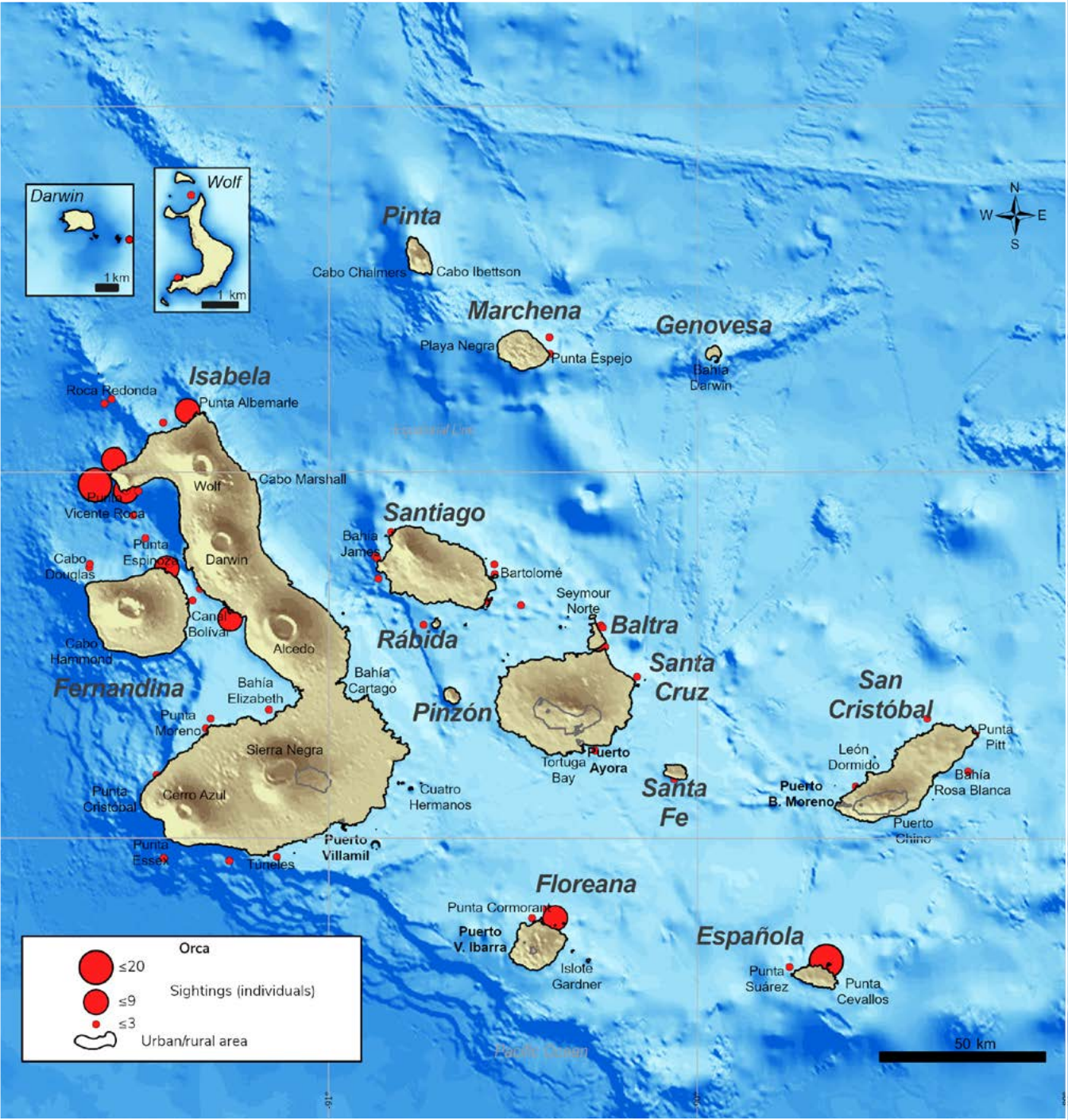
Map data sources: Páez-Rosas *et al.*, 2021, Pinnipeds Trophic Ecology Research Project USFQ-DPNG.
Map methodology: See Methodology section, ref. 1. GPS data.

ORCA

Orca
Orcinus orca (Linnaeus, 1758)
Animalia : Chordata : Mammalia : Atiodactyla :
Delphinidae : *Orcinus orca*



© Inti Keith / CDF



CURRENT STATUS

The Orca (*Orcinus orca*) is considered Endangered in Ecuador due to its reduced population numbers^{1,2,3}. The species is included in Appendix II of CITES.

In Galapagos, 64 orcas have been identified, of which 18 are considered residents based on repeated sightings². The average group size is approximately 34 individuals per observation. Between 1991 and 2017, the average sighting rate was 0.68 sightings per year.

In 2009, the estimated abundance of orcas in the Galapagos Marine Reserve (GMR) was 0.001 individuals per km² ⁵, suggesting that approximately 1% of the Eastern Pacific Orca population may reside in Galapagos⁴.

ECOLOGICAL IMPORTANCE

O. orca are apex marine predators and exhibit some of the highest recorded levels of persistent organic pollutants (POPs) — including PCBs and dioxins/furans — due to their diet and long lifespan⁶. In the northeastern Pacific, adult Orcas have been found to exceed immunotoxin and endocrine disruption thresholds, posing significant risks to their health and long-term conservation^{6, 7}.

In Ecuador, several Orca populations and at least two ecotypes have been identified, distinguished by their prey preferences. However, these ecotypes remain poorly defined. The second ecotype is most frequently sighted in the GMR, feeds on sharks, rays, sea turtles, fish, and marine mammals, with an increase in observed sea turtle predation in recent years^{3, 5, 14, 15}.

Male Orcas reach sexual maturity at approximately 15 years of age, while females reach sexual maturity between 12 and 14 years old. Females produce on average one offspring every five years (with intervals ranging from 2-14 years between births)⁸, and reproduction ends at 40 years of age⁹. The gestation period ranges from 15 to 18 months⁹, and weaning occurs between 1 and 2 years^{9, 10}.

INFORMATION NEEDS

To better understand the health and conservation status of Orca populations, it is essential to conduct ecotoxicological studies focusing on persistent organic pollutants (POPs) and mercury (Hg) levels in collected biopsies. Research on stable Hg isotopes in relation to Hg concentrations, as well as natural stable isotopes in Orca skin biopsies and prey, is needed to assess the pathways and extent of Hg exposure throughout the Orca food chain. Research should also include studies on the bioaccumulation of emerging contaminants like microplastics within their diet.

Additionally, it is necessary to estimate population size, distribution, and structure of Orcas in the Galapagos and adjacent waters. Understanding population connectivity is crucial to determine whether Orcas in the region are part of a larger migratory network and to assess potential gene flow between populations. This information will be key to evaluating the effects of environmental and anthropogenic pressures on Orca movement patterns, population dynamics, and long-term viability.

DISTRIBUTION

O. orca is cosmopolitan and one of the most widely distributed species in the world, found in all oceans and most seas¹⁰. In Ecuador, Orcas have been reported throughout the coastal zone and in Galapagos. The species is distributed throughout the region and can be observed year-round. Most of sightings have been recorded at various coastal locations such as La Plata and Salango islands in Manabí Province, Santa Clara Island in El Oro Province, the north of Esmeraldas Province, and Santa Elena Province^{2, 11, 12}. It is continuously observed in Galapagos, placing it as one of the most frequently sighted species in the archipelago^{12, 13}.

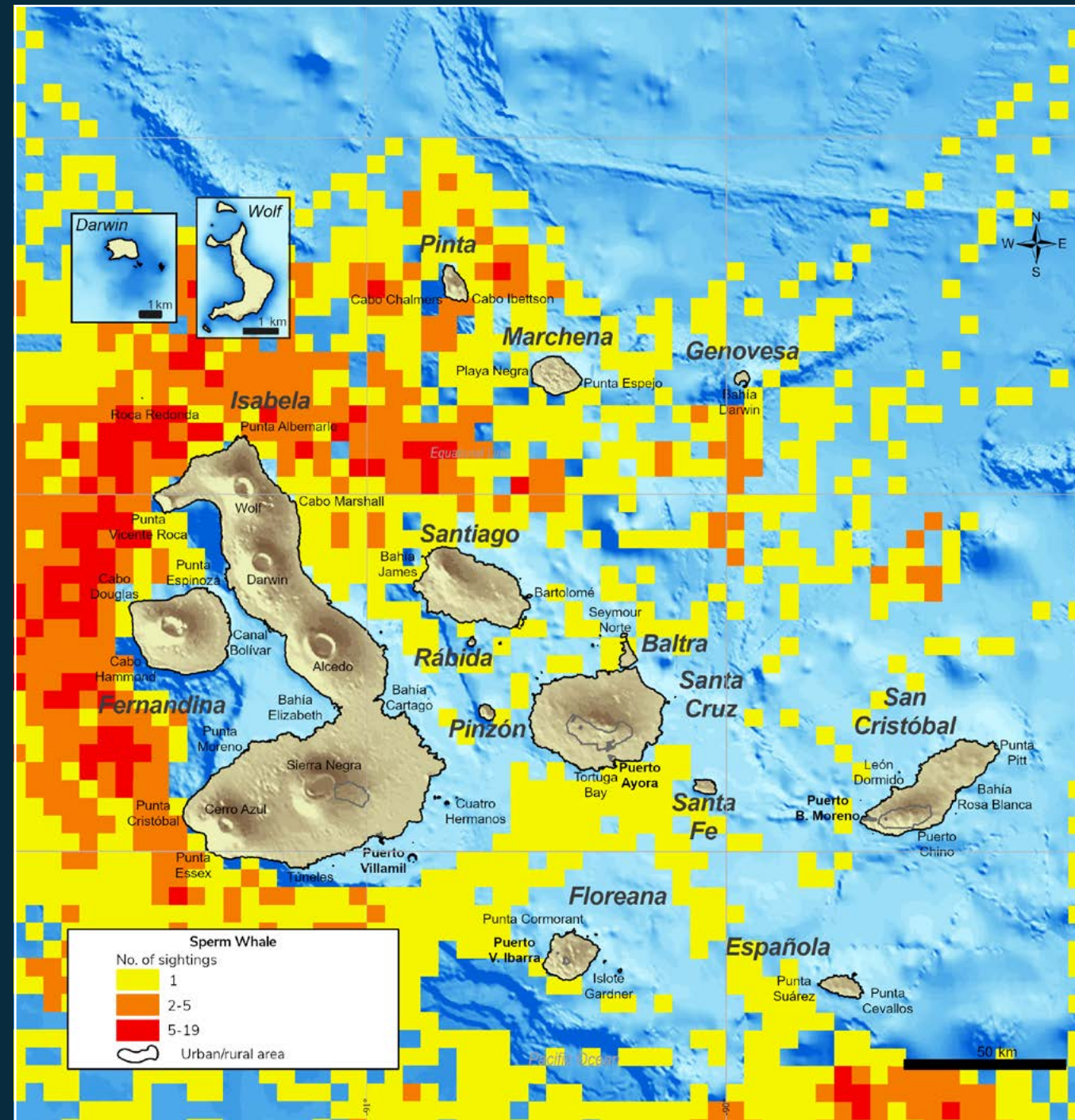
MY NOTES

AUTHOR (S)

Fact Sheet: Patricia Rosero R. and Daniela Alarcón
Map: Nicolás Moity

Map data sources: Patricia Rosero R. (EK), Galapagos Naturalist Guides observations, GBIF/OBIS.
Map methodology: See Methodology section, ref. 1. GPS data.

Physeter macrocephalus Linnaeus 1758
Animalia : Chordata : Mamíferos : Artiodactyla :
Cetacea : Physeteridae : *Physeter macrocephalus*



Sperm whales found off the Galapagos Islands are part of a nomadic population that roams throughout the Eastern Tropical Pacific^{1, 2}. The majority of individuals sighted in this area are females and juveniles that live in highly stable social units³. Members of different social units occasionally interact for a few hours or days, but only with members of their own *cultural clan*, with whom they share distinct vocal repertoires, movement patterns, distributions, foraging strategies, and social behaviors⁴⁻⁸. Around the Galapagos Islands, four clans have been identified over time⁹. Between 1985 and 1995, most of the sperm whales sighted belonged to the Regular and Plus-One clans⁷; however, since the 2010s, these have been entirely replaced by members of the Short and Four-Plus clans¹. This shift most likely reflects the migrations of Sperm Whale clans throughout the Eastern Tropical Pacific¹.

Globally and locally, the Sperm Whale is classified as Vulnerable by the IUCN^{10, 11}. The global population declined between 50–70% as a result of historical whaling¹²; between 1830 and 1850, around 5,000 individuals were hunted in waters around the Galapagos Islands¹³. Although whaling was banned in 1986 by the International Whaling Commission, the global population has yet to recover. In the Eastern Tropical Pacific, Sperm Whale populations have continued to decline over recent decades¹², partly due to the intrinsically low reproductive rates¹⁴. Additionally, the complete removal of mature males from the Eastern Tropical Pacific during modern whaling operations has resulted in extremely low pregnancy rates that persist even decades after the end of whaling¹³. Moreover, anthropogenic threats such as entanglement with fishing gear, vessel collision, plastic ingestion, and pollution may affect the population's ability to recover^{15, 16}. In continental Ecuador, most recorded Sperm Whale strandings are associated with gillnet entanglements¹⁷.

Sperm whales are top predators of deep waters (> 400 m), where they feed primarily on squid^{18, 19}. Since sperm whales defecate in surface waters, they inject iron in the upper layers of the water column, enhancing primary production^{20, 21}. By contributing to the proliferation of phytoplankton, sperm whales not only have a major impact on oceanic food webs, but also participate in carbon sequestration^{20, 22}. In this sense, sperm whales contribute to maintaining the carbon cycle and regulating the global climate^{20, 22}.

Because sperm whales are long-lived (up to 70 years) nomads — covering thousands of kilometers every year — understanding their population dynamics and behaviors requires long-term studies that cover similarly vast areas^{23, 24}. Likewise, as sperm whales in the Eastern Tropical Pacific inhabit offshore regions hundreds of kilometers from the coast, little is known about the impact of various anthropogenic threats on their wellbeing.

Given that different clans exhibit distinct distributions and ecologies, they may experience anthropogenic threats at varying levels²². It is therefore essential that vulnerability assessments are carried out at the clan level if we are to preserve the cultural diversity of Sperm Whale clans²⁵.

Sperm whales are found in deep waters (1,000–4,000 m) west of Isabela Island, in the Marchena Channel, and South of the archipelago²⁶.

Fact Sheet: Ana Eguiguren
Map: Nicolás Moity

Map data sources: Eguiguren et al. (2019, 2020).
Map methodology: See Methodology section, ref. 4c.
 Sighting-intensity models from gridded aggregations.

INTRODUCED & INVASIVE SPECIES— ESPECIES INTRODUCIDAS E INVASORAS

Smooth-billed Ani -
Garrapatero, Ani
Crotophaga ani

**Fowler's Snouted
Tree Frog -**
Rana Arbórea
Scinax quinefasciatus

Feral Dog -
Perro Feral
Canis lupus familiaris

Giant Marine Toad -
Sapo Común Gigante
Rhinella marina

Feral Dog -
Perro Feral
Canis lupus

Giant Land Crab -
Cangrejo Azul
Cardisoma crassum

Feral Cat -
Gato Feral
Felis catus

Black Rat -
Rata Negra
Rattus rattus



Feral Cat -
Gato Feral
Felis catus
© Rashid Cruz

SPECIES INTRODUCED TO GALAPAGOS

In 2017, a landmark study¹ was carried out to determine the number of species introduced to Galapagos through human activity, as well as their pathways of introduction. The study was based on information from the Charles Darwin Foundation (CDF), the Galapagos Biosecurity Agency (GBA), and the Galapagos National Park Directorate (GNPD).

Building on this — and to ensure that the information is current and is available to the public — the CDF has developed an online interactive dashboard that provides real-time data about what species have been introduced to Galapagos, their numbers, how they got there, and whether they are causing harm to the fragile ecosystems of the archipelago.

Since the discovery of the archipelago in 1535, it is estimated that at least 1,641 species have been introduced through human activity, with 1,573 of these becoming established (**Table 1**). Most of these species are plants or insects. The actual number of introduced species is anticipated to be greater than the number currently reported; for example, some organism groups still need to be inventoried.

At least 4% of the introduced species that have established in Galapagos are classified as invasive, and 11% as potentially invasive. Introduced species typically become invasive when they lack natural enemies in their new environment, allowing them to proliferate unchecked. They prey on Galapagos species, compete with them for food and habitat, and can spread disease. Notably, 50% of the introduced species have insufficient data about their invasion level, highlighting the need for further studies to address these unknown risks.

The dashboard is available at: <https://introduced.darwinfoundation.org/>

Charlotte E. Causton, Francisco Martínez, Dolma Alonso, Mónica Gutiérrez and Juan Carlos Izurieta

TABLE 1: Number of Species Introduced to Galapagos: Current and Invasive Status, and Mode of Introduction.

CURRENT STATUS	Plants	Invertebrates (inc. Insects)	Vertebrates	Fungi	Virus	Bacteria	Others	TOTAL
ESTABLISHED IN GALAPAGOS	846	655	27	29	8	6	2	1573
Naturalized *	272	593	19	4	1	1	1	891
Human dependent**	557	8	8					573
Co-exists with introduced species***		20		1	6	5	1	33
No data	17	34		24	1			76
INVASIVE STATUS OF ESTABLISHED SPECIES								
Invasive	36	12	11					59
Potentially invasive	52	29	2					83
Lesser Concern		25						25
Unlikely to become invasive	395	150	2		2			549
Under watch	1	56						57
Quarantine species		2	1					3
No data	362	381	11	29	6	6	2	797
NOT ESTABLISHED IN GALAPAGOS	4	47	16	0	1	0	0	68
Intercepted+	2	35	11					48
Historic record only++		12	2		1			15
Eradicated+++	2		3					5
No data								0
TOTAL INTRODUCED (ESTABLISHED & NOT ESTABLISHED)	850	702	43	29	9	6	2	1641
MODE OF INTRODUCTION								
Intentional§	713	3	26					742
Accidental§§	124	691	15	29	9	6	2	876
Unknown	13	8	2					23

Key: (*) Organism that reproduces and propagates in the wild without human intervention; (**) organism that can only reproduce with human help and/or is limited to human settlements; (***) organism exclusively associated with introduced species, not necessarily restricted to human settlements; (+) organism seized in biosecurity procedures and destroyed or returned to mainland Ecuador; (++) organism known only from publications with no current record; (+++) organism eliminated from the archipelago through deliberate intervention; (§) organism intentionally brought by humans; (§§) organism that arrived in goods, animals, plants etc. (contaminants) or on transport vehicles (stowaways).

PATHOGENS AND PARASITES— PATÓGENOS Y PARÁSITOS

The pathogens and parasites that affect the fauna and flora of Galapagos are a heterogeneous group that includes viruses, bacteria, fungi, yeasts, protozoa, nematodes, trematodes, cestodes, lice, fleas, flies, among others¹. To date, a large number from these groups have been recorded in the archipelago and documented in the *Zoopathogens and Parasites Checklist of the Charles Darwin Foundation* <https://datazone.darwinfoundation.org/en/checklist/checklists-archive>¹.

Many of these organisms co-evolved with the native fauna and flora² following their simultaneous colonization, while others are more recent arrivals. However, endemic and native species, due to their isolation and endemism, are much more vulnerable to virulent pathogens or emerging diseases, which can cause serious impact and reductions in population and even extinctions, as occurred in Hawai'i and New Zealand during the nineteenth century²⁻⁵. However, given the group's diversity, much remains to be understood.

Among those most important and high-impact agents affecting native species are Avian Pox, Hemosporidiosis (*Plasmodium* spp, *Haemoproteus* spp, *Leucocytozoon* spp), Toxoplasmosis (*Toxoplasma gondii*), Avian Vampire Fly (*Philornis downsi*), and the high-pathogenicity avian influenza (HPAI) (H5N1)^{2, 3, 6-8} (per. obs).

In addition to studying these new pathogens, it is essential to investigate their hosts, pathways of introduction or arrival, prevalence*, incidence, dispersal, distribution, and ecological and species-level impacts across the archipelago. At the same time, preventive measures must be implemented to reduce the introduction of these agents in order to conserve Galapagos species², a priority underscored by the arrival in 2023 of HPAI H5N1 to the islands¹⁰ (per. obs.).

Gustavo Jiménez-Uzcátegui



Common Cactus Finch with Avian Pox -

Pinzón Común de Cactus con Viruela Aviar

Geospiza scandens / *Avipoxvirus*

© Rashid Cruz / CDF

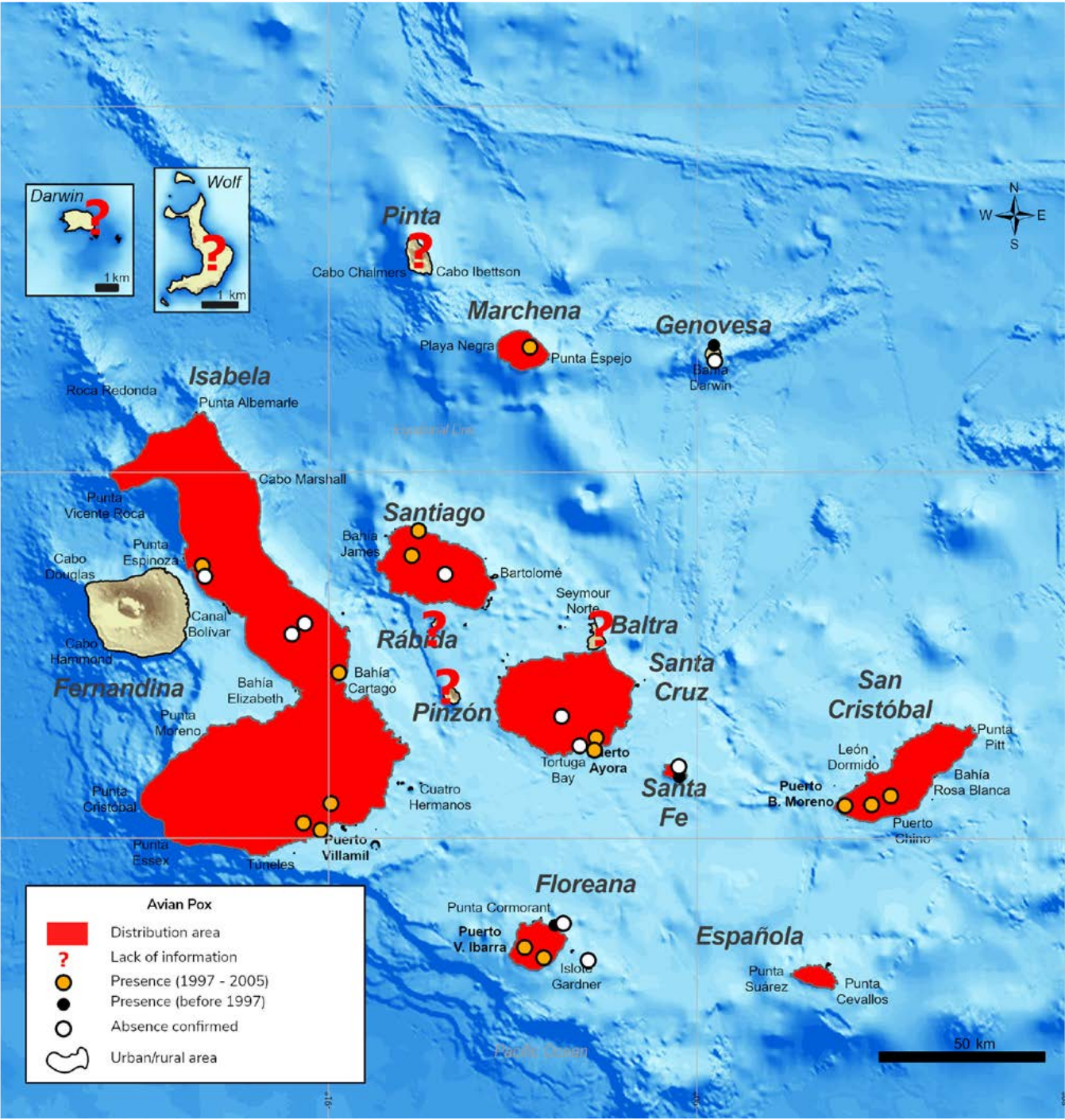
* The prevalence of a disease refers to the proportion of individuals in a population who are affected by the disease at a given point in time or over a defined period.

AVIAN POX

Viruela Aviar, Pox Virus, Epitelioma Contagioso
Avipoxvirus
Incertae sedis : Incertae sedis : Incertae sedis :
Incertae sedis : Poxviridae : Avipoxvirus



© Rashid Cruz / CDF



CURRENT STATUS

Avian Pox (historically referred to as contagious epithelioma) includes several viral varieties — such as *Canaripoxvirus*, *Fowlpoxvirus*, and *Gallipoxvirus* — that affect different groups of birds. Two forms of Avian Pox have been recorded: **1. Cutaneous form**, characterized by the development of proliferative nodules on the skin, forming thick crusts. **2. Diphtheritic form**, characterized by lesions in the digestive and upper respiratory tracts^{3, 9}. Clinical manifestations (symptomatology) of Avian Pox have been documented in ten endemic species of birds across ten islands of the archipelago^{3, 6, 9, 11, 12}.

Avian Pox has been recorded on the islands since 1899¹³, and according to genetic analyses in 2011¹⁴. Other cutaneous gross lesions were recorded in 1905, 1980s, and various studies since 2003^{3, 13, 15}.

ECOLOGICAL IMPORTANCE

Mortality in birds affected by the cutaneous form of Avian Pox is generally low, whereas it is high in those presenting the diphtheritic form. The impact of diphtheritic Avian Pox on wildlife remains largely unknown due to the difficulty of detection¹². In combination with *Plasmodium* infections, this virus has contributed to the extinction of several bird species in Hawaii and New Zealand. In the Galapagos, several bird species are affected by Avian Pox and by *Plasmodium* spp., raising concern that native avifauna could be severely impacted^{2-7, 16, 17}.

Avian Pox is mechanically transmitted by biting insects, primarily mosquitoes (three species occur in the Galapagos: Black Salt Marsh Mosquito – *Aedes taeniorhynchus*, Yellow Fever Mosquito – *Aedes aegypti*, and Southern House Mosquito – *Culex quinquefasciatus*)¹⁸. Transmission is expected to increase during rainy periods, particularly under ENSO conditions^{3, 15-19}.

INFORMATION NEEDS

It is essential to monitor the presence of Avian Pox on islands such as Genovesa, Darwin, and Wolf, which host vulnerable populations like the Vampire Ground-finch (*Geospiza septentrionalis*). Confirmation of Avian Pox requires laboratory analyses^{6, 14}, as similar skin lesions may be caused by other factors, as observed in the Española Mockingbird (*Mimus macdonaldi*) and San Cristóbal Mockingbird (*M. melanotis*), which were clinically diagnosed based on cutaneous lesions. Monitoring of species other than the Floreana Mockingbird (*M. trifasciatus* — an endangered species) should continue in pristine areas, such as Champion Islet, where infected individuals have been recorded⁹.

Furthermore, it is important to identify the Avian Pox virus lineages affecting seabirds and to clarify the role of insects as viral vectors in order to develop more effective management and control strategies^{16, 17}.

DISTRIBUTION

This disease is present on the following islands: Isabela, Santiago, Santa Cruz, Marchena, Floreana, San Cristóbal^{3, 6}, Santa Fe and Española (per. obs.) and Champion Islet⁹.

MY NOTES

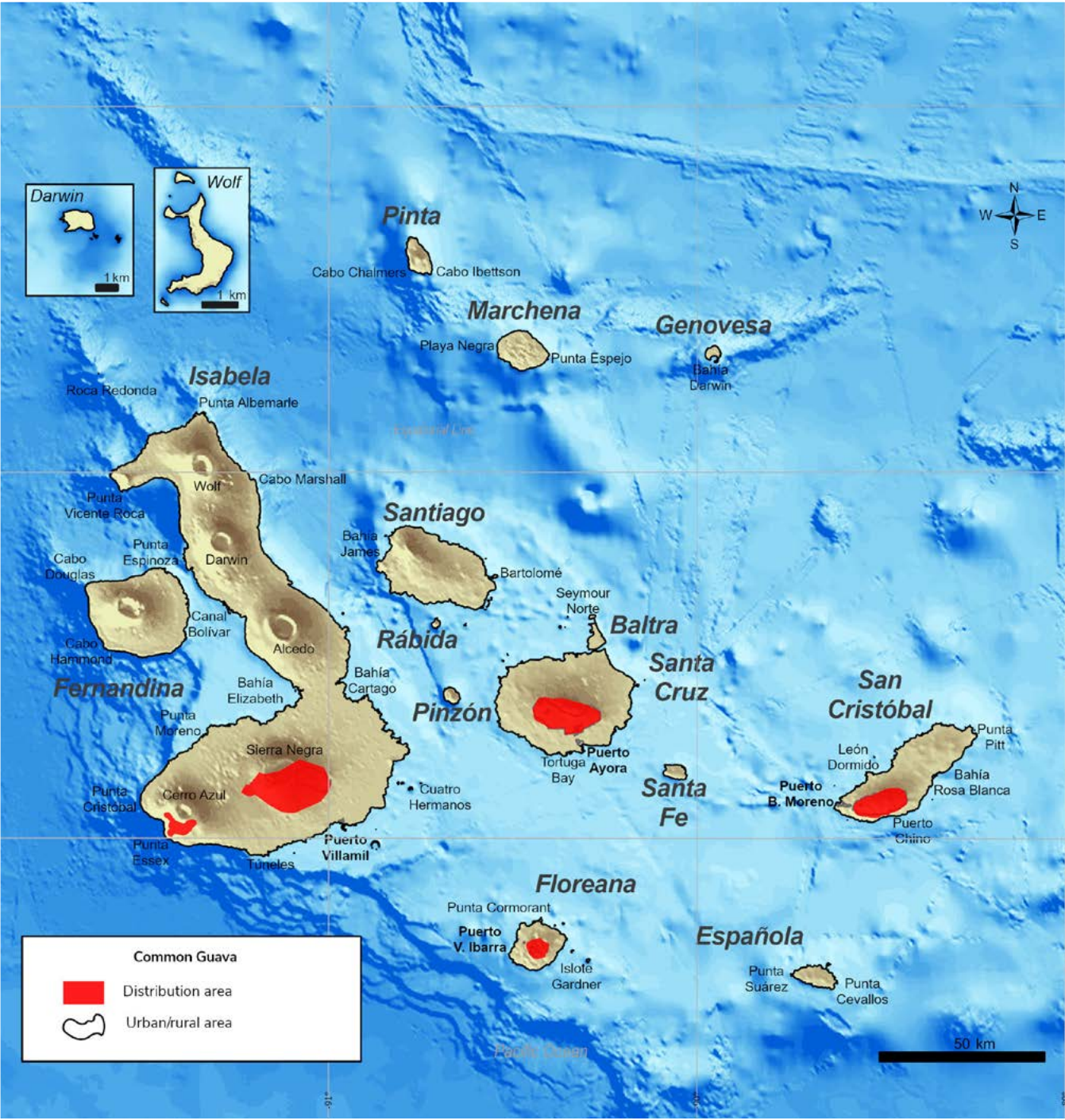
AUTHOR (S)

Fact Sheet: Gustavo Jiménez-Uzcátegui
Map: Byron Delgado M.

Map data sources: Jiménez-Uzcátegui, G. (EK), Parker et al. (2007).
Map methodology: See Methodology section, ref. 3a. Polygons from records, generalized from point data 1. GPS data.

COMMON GUAVA

Guayaba
Psidium guajava Linnaeus, 1753
Plantae : Magnoliophyta : Dicotyledoneae : Myrtales :
Myrtaceae : *Psidium guajava*



CURRENT STATUS

The native range of the Common Guava is tropical America. It was introduced to Galapagos in 1869, first to San Cristóbal. It reached the south of Isabela in 1910 and Santa Cruz in 1930. It was not considered an invasive species until the 1950s. Today, it is one of the most invasive plant species in Galapagos because it spreads rapidly and can alter extensive areas of the ecosystem.

ECOLOGICAL IMPORTANCE

Common Guava is also an invasive species on other Pacific islands, such as Hawai'i, New Zealand, the Marquesas, New Caledonia, Fiji, and Tonga, as well as in Australia, southern Africa, and the southeastern United States. In the Global Invasive Species Database, it is listed among the 100 worst invasive species. In Galapagos, Common Guava has invaded the humid zones of the agricultural and protected areas of the inhabited islands, where it spreads rapidly and outcompetes native vegetation, and invades crops and pastures. It threatens the Endemic Guava *Psidium galapageium* through competition and possible hybridization. The Common Guava is highly adaptable to different environments, tolerates shade, and can withstand temporary droughts and resprout after fires. It reproduces by seeds and also vegetatively, sprouting from roots or stumps. The large number of seeds produced by Common Guava are eaten and dispersed by tortoises, cattle, pigs, rats, birds, and lava lizards. The seeds in the soil remain viable for more than a year, and their ability to germinate is not lost after passing through the tortoises' digestive tract. Adult plants tolerate and even benefit from agricultural activities, browsing pressure, and disturbance in general. In Galapagos, Common Guava plants bear fruit at 2-4 years. The fruits are used to make juice and the trees provide shade for the cattle in the area. Studies showed that farmers mainly have a negative perspective regarding the usefulness of guava or the challenges its control represents but this differs between islands.

Due to the wide distribution of Common Guava in Galapagos, control can currently only be carried out in conservation priority areas, since it is very labor-intensive. Manual control started in 1971 and chemical control in 1974. The most effective control methods involve cutting the tree or administering cuts to the bark and subsequently applying a suitable herbicide.

INFORMATION NEEDS

Climate change may allow Common Guava to expand into lowlands, increasing risks to vulnerable species and biodiversity in general. More information is needed on the impacts of Common Guava on the native biodiversity of Galapagos. In addition, the development of a biological control agent is needed to control Common Guava more sustainably in the future.

DISTRIBUTION

Common Guava is very widespread on Floreana, Isabela, San Cristóbal, and Santa Cruz, in the humid zone of the highlands, both in agricultural areas and in the Galapagos National Park. The area covered by Common Guava is increasing constantly and a mapping of its distribution is currently underway.

MY NOTES

AUTHOR (S)

Fact Sheet: Heinke Jäger
Map: Byron Delgado M.

Map data sources: Galapagos National Park Directorate (GNPD), Jäger, H. (EK).
Map methodology: See Methodology section, ref. 4b. Expert knowledge model

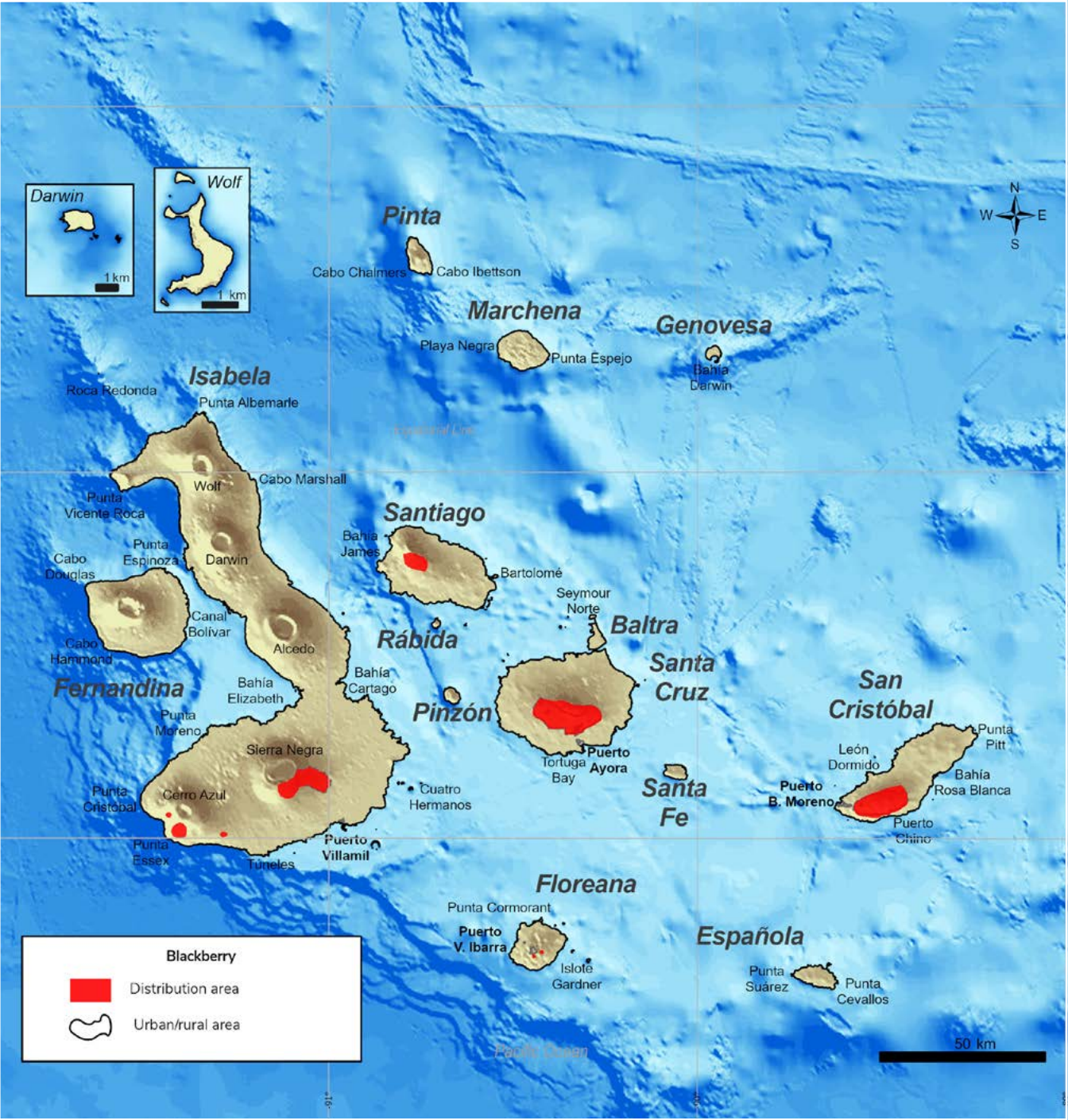
BLACKBERRY

MORA

Rubus niveus Thunb., 1813
Plantae : Magnoliophyta : Dicotyledoneae : Rosales :
Rosaceae : *Rubus niveus*



© Leslie León / CDF



CURRENT STATUS

The Blackberry *Rubus niveus* is native to Asia and was introduced to Galapagos in 1968 from continental Ecuador, first to Santa Cruz, then to San Cristóbal, Isabela and Floreana. Five Blackberry species were introduced to Galapagos, but this is the only one that has spread over large areas. It has invaded the humid zone of all inhabited islands and of Santiago, forming impenetrable thickets up to 3 m high.

ECOLOGICAL IMPORTANCE

Rubus niveus is invasive in several regions of the world, including Hawai'i, Central and South America, Australia, and South Africa. In the Global Invasive Species Database, it is listed among the 100 worst invasive species. It reproduces quickly by seeds and vegetatively, by sprouting from roots or by rooting from layering branches. In Galapagos, it produces flowers and fruits at three months of age. It is not known how long the seeds remain viable in the soil but it is assumed to be at least ten years. *Rubus niveus* has a faster growth rate and biomass production than the native species as well as a broad tolerance to light and water stress conditions. It displaces resident vegetation and threatens native plant communities, such as the *Scalesia* forests.

Studies have shown that a high cover of *R. niveus* (>50%) can result in a 60% decline in native and endemic species. In the absence of *R. niveus* control, not a single *Scalesia pedunculata* recruit was encountered over ten years in the *Scalesia* forest on Santa Cruz. In the agricultural area, *R. niveus* has spread aggressively, making the land unsuitable for agriculture and causing serious economic problems for farmers.

Many animals, including rats, different Darwin's finches, flycatchers, mockingbirds, smooth-billed anis, lizards, and tortoises, ingest the berries and disperse their seeds. The most common control method is manual control (using machete), in combination with the application of a suitable herbicide. However, constant monitoring and follow-up control are required, due to the large seed bank of *R. niveus* (7,000 to 22,800 seeds/m²), high germination rate (~80%), rapid growth, and the vigorous re-sprouting from cut stems. The control costs of *R. niveus* for 1 ha is around USD 20,000 for 20 years (CDF, unpublished data).

AUTHOR (S)

Fact Sheet: Heinke Jäger
Map: Byron Delgado M.

INFORMATION NEEDS

Due to the vast distribution of *R. niveus* in Galapagos, its long-lasting seed bank, and its rapid growth, manual and chemical control are merely tools to control this species in conservation priority areas. Although recent studies showed that the control of *R. niveus* temporarily changed the composition and structure of invaded plant communities and affected resident bird species, it is indispensable to preserve biodiversity. Since manual and chemical control of *R. niveus* are not sustainable, the development of a biological control agent is currently underway. This biological control agent would reduce the populations of *R. niveus* to densities below known levels of biological and economic impacts.

DISTRIBUTION

Rubus niveus is widely distributed on Santa Cruz and San Cristóbal. It used to be less abundant on Isabela, Floreana, and Santiago, but is now spreading rapidly, especially on Santiago, with a total distribution of more than 5,000 ha on all islands.

MY NOTES

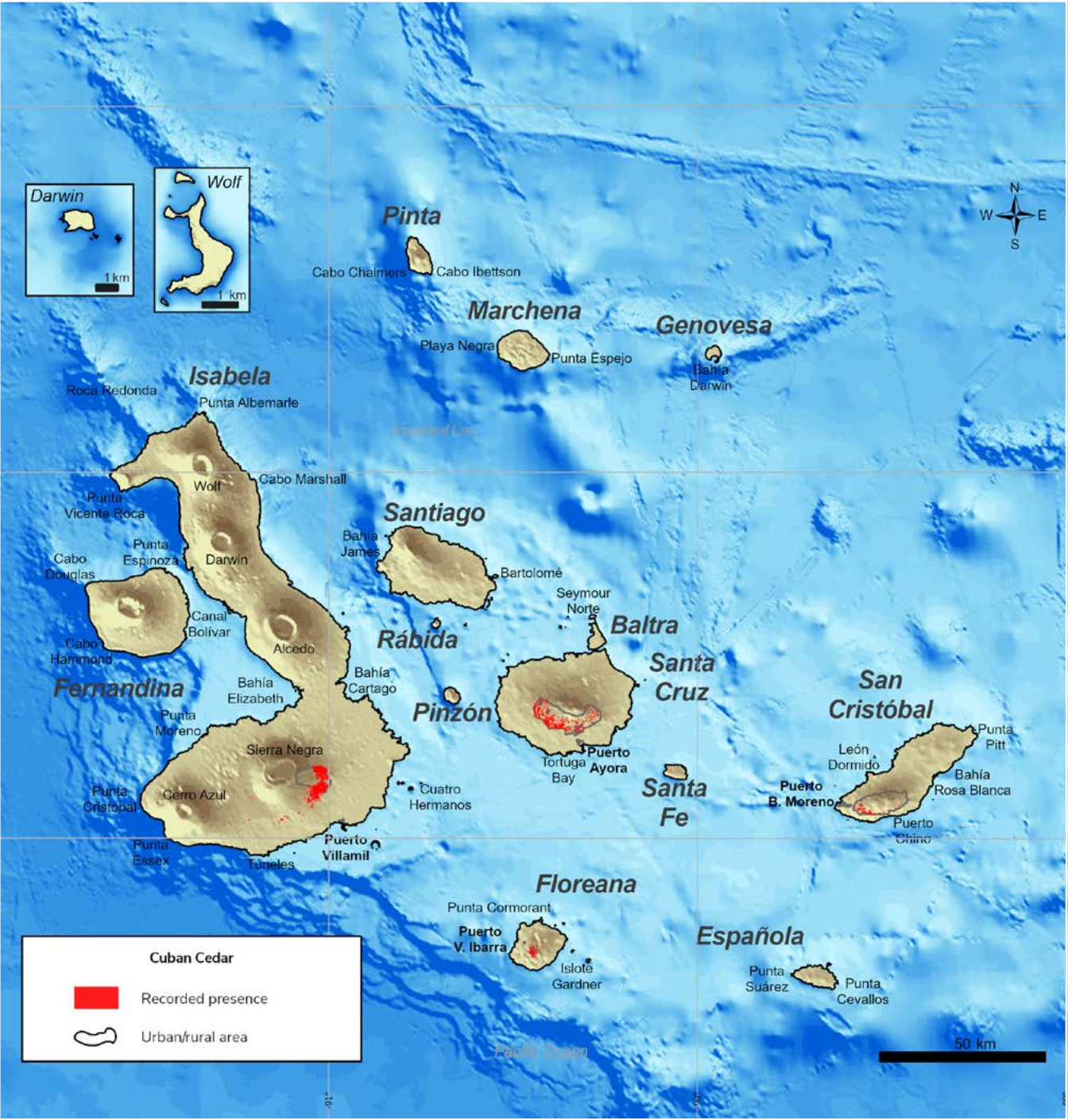
Map data sources: Galapagos National Park Directory (GNPD), Jäger, H. (EK).
Map methodology: See Methodology section, ref. 4b. Expert knowledge model

CUBAN CEDAR

Cedrela, Cedro Americano
Cedrela odorata Linnaeus, 1759
Plantae : Magnoliophyta : Magnoliopsida : Sapindales :
Meliaceae : *Cedrela odorata*



© Paúl León / CDF



CURRENT STATUS

Cuban Cedar or Spanish Cedar is a hardwood and timber tree species, native to the Neotropics and distributed from Mexico to Argentina. In some tropical Pacific Islands, it is recognized as an invasive species. In the Galapagos Islands, in the second half of the 1940s, some farmers brought cedar seeds and saplings from Ecuador's northern Coastal region to San Cristóbal and Santa Cruz first, and from there to Isabela and Floreana islands^{1,2}. This species had not been considered invasive until the trees reproduced and began to produce thousands of viable seeds that, dispersed by the wind, have colonized the humid zones of the Galapagos National Park (GNP)³. Cuban Cedar currently covers ~4,000 hectares in total on the four inhabited islands, and Santa Cruz has the largest population⁴.

In 2007 the Ecuadorian Government nationally protected the species, however, due to its invasion in the Galapagos Islands, its protection status in the islands was modified in 2009. Nowadays, it is harvested in agricultural areas, and is the main wood used for furniture, handicrafts, and building on the islands⁵. In some of the protected areas of the GNP, its abundance is controlled manually, mechanically and chemically.

ECOLOGICAL IMPORTANCE

Cuban Cedar is frequently found in the highlands of inhabited islands, in well-drained soils, and tolerates long periods of drought³. Seedlings are shade tolerant and can quickly grow beyond the native canopy. It reaches reproductive maturity at 10 years and produces capsule-shaped fruits, each with 40-50 winged seeds, which are wind-dispersed⁶.

This tall tree (>30 m) causes dramatic changes in the plant community⁷⁻⁹: (1) It drastically changes the vegetation structure as its height is twice the height of the endemic trees it replaces; (2) It chemically inhibits the growth of endemic plants (allelopathy), such as *Scalesia pedunculata*; (3) It favors the species richness and diversity of introduced plants; (4) It transforms the light conditions of the area where it grows; (5) It modifies the flow of nutrients in the ecosystem since, being a deciduous tree, it loses its leaves every year between October and January.

In Santa Cruz, in the southeast of the humid zone, a complete replacement of *Scalesia* forest by Cuban Cedar forest has been recorded⁷. This substitution also has impacts on the endemic fauna. For example, Cuban Cedar forests can affect giant tortoises by blocking migration routes and decreasing their ability to thermoregulate¹⁰. In agricultural areas dominated by these trees and other invasive plants, declines in Darwin's finch populations have been observed¹¹. Finally, the removal of Cuban Cedar has been shown to promote the growth of *Scalesia pedunculata* and other endemic plant seedlings¹².

INFORMATION NEEDS

More information is needed on the ability of native and endemic plants to establish or persist in the new habitat created by Cuban Cedar, as well as on the responses of the plant community to the removal of this invasive tree. In addition, there is little or no information on the direct impact of these trees on other groups, such as invertebrates and birds, or on soil chemistry.

DISTRIBUTION

Found on the four inhabited islands: Santa Cruz, San Cristóbal, Isabela, and Floreana. This species is distributed in the humid zone in the highlands of the islands and in the urban areas of San Cristóbal and Santa Cruz (located in the coastal and arid zones). Present in both agricultural areas and in the GNP^{1,4}.

MY NOTES

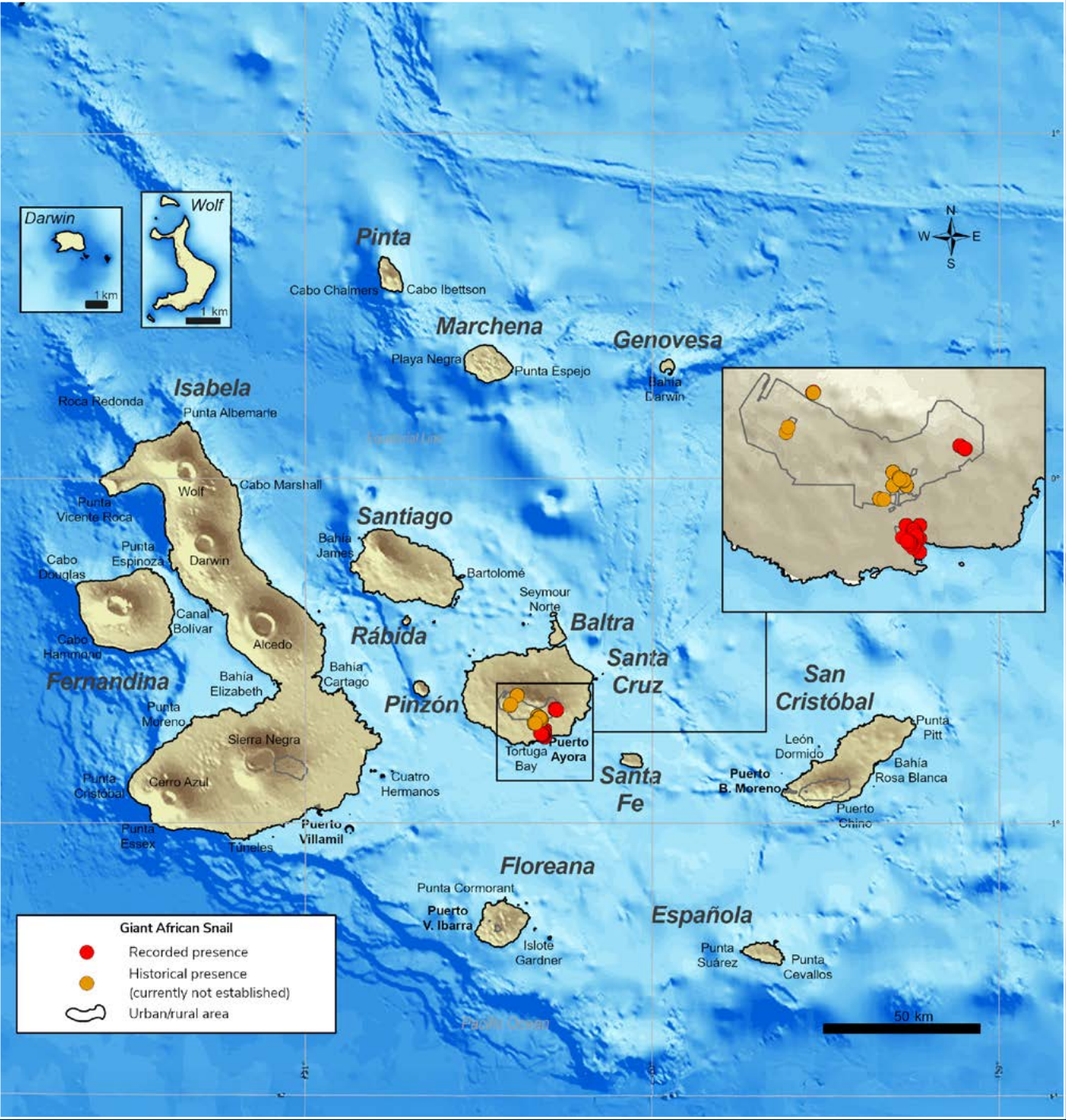
AUTHOR (S)

Fact Sheet: Miriam San José
Map: Nicolás Moity

Map data sources: Carrión-Klier et al. (2022), Laso et al. (2020)
Map methodology: See Methodology section, ref. 4d. Habitat modelling

GIANT AFRICAN SNAIL

Caracol Gigante Africano
Lissachatina fulica (Bowdich, 1822)
Animalia : Mollusca : Gastropoda : Stylommatophora :
Achatinidae : *Lissachatina fulica*



CURRENT STATUS

The Giant African Snail may have been introduced intentionally to the Galapagos Islands following a trend on mainland Ecuador for making creams with snail mucus. The mucus was believed to have skin regenerative properties¹. The first report of this species was on Santa Cruz in 2010, by which time it was found in Puerto Ayora and Bellavista and the surrounding agricultural areas. In 2018 it was estimated that approximately 20 hectares of Santa Cruz were invaded with snails, however, there was no evidence of colonization of other islands despite a single snail being collected on San Cristóbal in 2011. After its discovery, the Galapagos Biosecurity Agency (GBA) coordinated an intensive campaign to stop the spread of the snail². Currently, GBA coordinates control efforts in areas for human settlements, and the Galapagos National Park Directorate monitors in the Galapagos National Park, particularly in Los Gemelos, where it was found in 2011, but from where it was eradicated.

Management efforts involve the collection and incineration of snails during the night when they are active. In areas where they are difficult to find, vegetation is cut. Since 2014, GBA uses trained dogs to locate snails. Due to the hard work of governmental organizations, the distribution of the snail is currently limited to a few sectors of Puerto Ayora and the agricultural sector of El Cascajo.

ECOLOGICAL IMPORTANCE

This species is extremely difficult to control and eradicate. Snails are easily transported by humans on shoes, plants, soil, garbage, building materials, vehicles, and equipment. When conditions are very dry, snails can protect themselves by hibernating under rocks or in loose soil, making them difficult to find. During rainy years, population numbers can increase rapidly. These snails take up to six months to become sexually mature and can live up to nine years, during which they can lay up to 1,000 eggs.

Since the Giant African Snail population is currently kept at low numbers through active control, there is little evidence of the damage that could be caused if its population were to expand. In other parts of the world, it feeds on more than 500 plant species, has had

devastating effects on agriculture, and has been shown to compete for habitat with native snails.

In other parts of the world the Giant African Snail has been found to vector diseases such as *Phytophthora*, which affects plants. It is also known to transport a parasite (*Angiostrongylus cantonensis*) that causes eosinophilic meningitis in humans^{1, 3, 4}. Recent studies in Galapagos did not find evidence of this parasite in snails⁵.

INFORMATION NEEDS

An effective trapping method is needed to monitor snails. In the meantime, continuous searching is required to ensure that the snail is contained and doesn't spread to other islands or areas. The development of control techniques that have a low impact on non-target species is a high priority. Currently, most of the control techniques available negatively affect native animals and cannot be used in Galapagos.

DISTRIBUTION

This species is present on Santa Cruz Island.

MY NOTES

AUTHOR (S)

Fact Sheet: Charlotte E. Causton and Galapagos Biosecurity Agency (GBA).
Map: Nicolás Moity

Map data sources: ABG, 2012-2022.
Map methodology: See Methodology section, ref. 1. GPS data.

INVASIVE ANTS— HORMIGAS INVASORAS

From an ecological and socioeconomic perspective, invasive ants are among the most damaging insects found in the Galapagos Islands. They affect native and endemic species, as well as agricultural activities and livestock¹. They invade houses and the sting of some species can cause allergic reactions in humans.

Through a risk analysis², it was possible to identify four species of invasive ants that seriously threaten the Galapagos Islands and require intervention: the Little Fire Ant (*Wasmannia auropunctata*), the Tropical Fire Ant (*Solenopsis geminata*), the Destructive Trailing Ant (*Trichomyrmex destructor*), and the Big-headed Ant (*Pheidole megacephala*). Additionally, a fifth invasive species, the invasive Carpenter Ant (*Camponotus zonatus*), has invaded all islands in the archipelago, likely displacing endemic carpenter ants.

The Little Fire Ant and the Tropical Fire Ant were introduced more than 100 years ago and are now widespread throughout most of the archipelago. In contrast, the introductions of the Destructive Trailing Ant and the Big-headed Ant are more recent — 1997 and 2008, respectively^{3, 4}. Islands of high ecological value such as Fernandina, Española, Pinta, and Genovesa, haven't been invaded by these two species and must be protected².

The management of invasive ants is resource-intensive, requiring significant effort and funding. It is therefore important to act strategically, focusing on urgent and feasible management interventions. Biosecurity measures and continuous monitoring are essential to respond quickly to any new invasions.

*Charlotte E. Causton, Jacqueline Rodríguez and
Henri W. Herrera*

**Carpenter Ant -
Hormiga Carpintera**
Camponotus zonatus
© Jeremy Squire

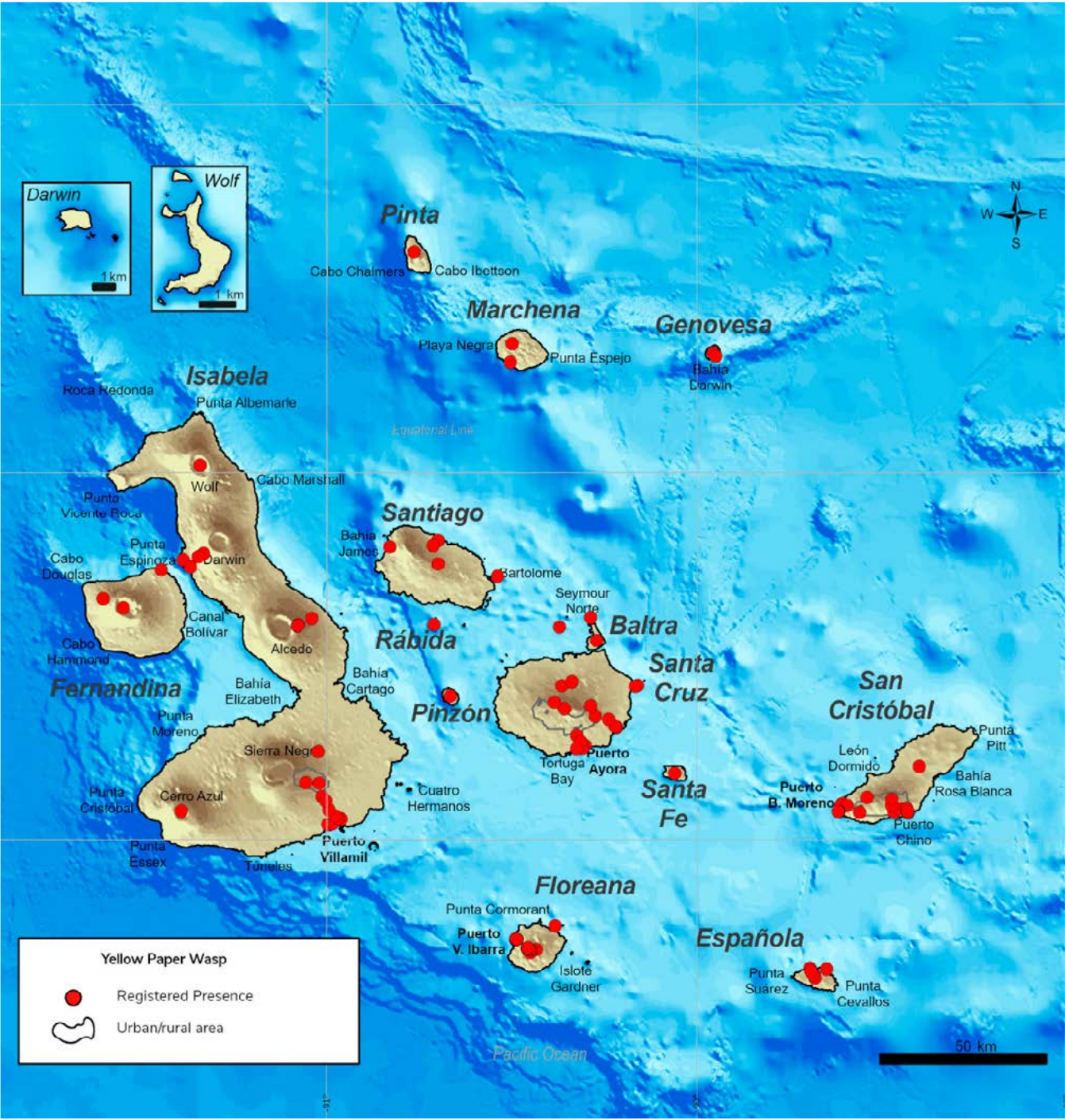
YELLOW PAPER WASP

Avispa Amarilla de Papel

Polistes versicolor (Olivier, 1791)
Animalia : Arthropoda : Insecta : Hymenoptera :
Vespidae : *Polistes versicolor*



© Juan Manuel García / CDF



CURRENT STATUS

The Yellow Paper Wasp (*Polistes versicolor*) was first registered in 1988 on Floreana Island and was most likely introduced to the archipelago on a cargo ship. It is now reported on all of the larger islands (except Darwin and Wolf) and is found in almost all vegetation types as well as in urban and rural areas^{1, 2}. Wasps make their nests by masticating into a pulp small bits of vegetation or wood (hence the name paper wasp), which they attach to trees or man-made structures¹. Wasps prey on invertebrates and also take nectar and pollen from plants, affecting biodiversity and ecosystem processes. They have a powerful sting, which can cause allergic reactions in humans. Wasps are especially impacting towards the end of the hot season, when they can be found in very high numbers, affecting the activities of farmers, tourists, and the Galapagos community, in general. Control methods tested to date have not proven effective in reducing wasp numbers.

ECOLOGICAL IMPORTANCE

The Yellow Paper Wasp is one of the most invasive insect species in Galapagos¹. It is a voracious predator of insects and other invertebrates, especially the caterpillars of butterflies and moths. It has been calculated that wasps transport an average of 115 caterpillars per week to a nest with 120-150 wasp larvae. Wasps likely compete with native and endemic species that rely on invertebrates for food; such as lava lizards, geckos, and Darwin's finches. They are also known to visit and collect nectar from flowers of approximately 93 plant species including 66 species that are endemic or native to the Galapagos Islands¹. Studies indicate that there are important interactions between endemic and invasive pollinator species and that introduced insect species like the Yellow Paper Wasp occupy many pollination networks in Galapagos³.

Although the Yellow Paper Wasp has some natural enemies in the Galapagos Islands, none of them are effective in keeping wasp numbers in check. Known natural enemies include the introduced predatory moth (*Taygetes sphecophila*), the Little Fire Ant (*Wasmannia auropunctata*), the fungus (*Hirsutella saussurei*), and the introduced Smooth-billed Ani (*Crotophaga ani*)^{1, 4, 5}.

AUTHOR (S)

Fact Sheet: Jacqueline Rodríguez and Charlotte E. Causton
Map: Byron Delgado M.

INFORMATION NEEDS

Studies are required to understand the impacts of the Yellow Paper Wasp on the conservation of Galapagos ecosystems; for example, information is lacking on the level of competition for food sources between the Yellow Paper Wasp and the endemic and native insectivorous species.

Importantly, methods for controlling the wasp need to be investigated. Currently, researchers are looking into baits that can be carried by wasps to nests to feed and kill developing larvae. Biological control is an option for controlling wasps in the long-term and at a larger scale¹.

DISTRIBUTION

This species is present on the following islands and islets: Bartolomé, Champion, Daphne Mayor, Española, Fernandina, Floreana, Gardner, Genovesa, Isabela, Marchena, Pinta, Plaza Sur, Plaza Norte, Pinzón, Rábida, San Cristóbal, Santa Cruz, Santa Fe, Santiago, and Seymour.

MY NOTES

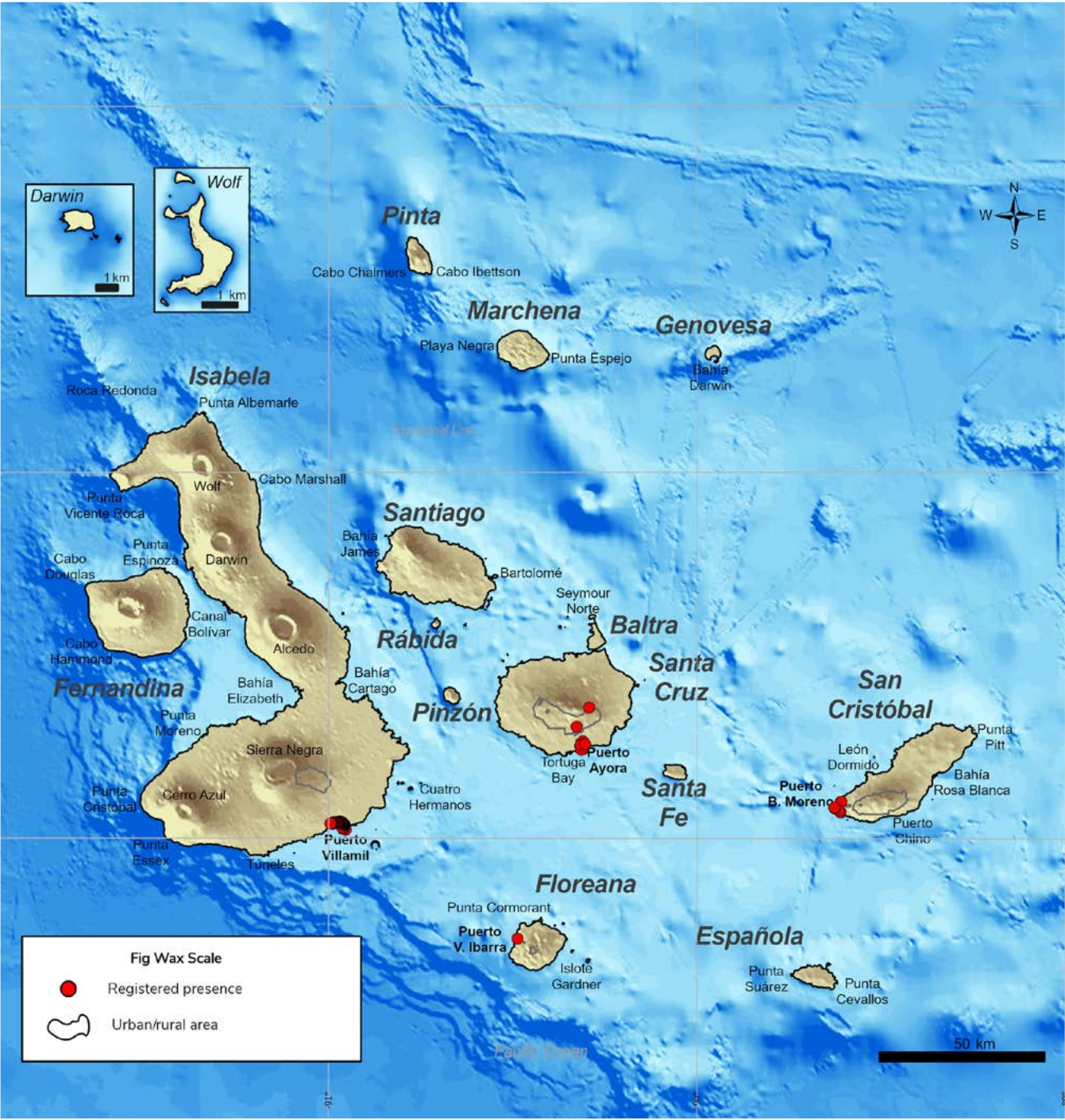
Map data sources: Lasso, 1997; Parent *et al.*, 2020, ICCDRS Database.
Map methodology: See Methodology section, ref. 3a. Polygons from records, generalized from point data.

FIG WAX SCALE

Escama Blanca de la Higuera
Ceroplastes rusci (Linnaeus, 1758)
Animalia: Arthropoda: Insecta: Hemiptera: Coccidae:
Ceroplastes rusci



© Piedad Lincango



CURRENT STATUS

The Fig Wax Scale, *Ceroplastes rusci*, is native to the Afrotropical region, but is now found throughout the world where it is a pest of many plant species¹. In Galapagos, it was first registered in 2001², but was not reported as a serious pest until 2013, when large numbers were observed on trees in coastal areas on Isabela Island. Following this, large populations of this scale insect were also found on Santa Cruz Island^{3, 4}. These heavy infestations resulted in the death of large stands of White Mangrove (*Laguncularia racemosa*), raising the alarm for conservation organizations^{3, 4}. In 2016, the Galapagos National Park Directorate (GNPD) and the Galapagos Biosecurity Agency (GBA) initiated a program to control the Fig Wax Scale using a soy-based product⁵. Currently, populations of the Fig Wax Scale are contained by applications on an as-needed basis.

ECOLOGICAL IMPORTANCE

The Fig Wax Scale feeds on the sap of plants, which can stunt plant growth. In addition to this, they excrete a sugary substance (honey dew) on leaves, which encourages sooty molds to grow. These molds cover the leaves, making it difficult for the host plant to photosynthesize, thus weakening the plant^{1, 6}.

The young of scale insects are dispersed by wind. They can also be transported from tree to tree by ants. Scale insects reproduce for the most part by parthenogenetic reproduction, which means that they can produce offspring without males^{2, 7}.

In Galapagos, the Fig Wax Scale is reported on at least 54 introduced and native plant species including four mangrove species; the White Mangrove (*Laguncularia racemosa*), Black Mangrove (*Avicennia germinans*), Button Mangrove (*Conocarpus erectus*), and Red Mangrove (*Rhizophora mangle*)^{8, 9}.

As in other parts of the world, the protection of mangroves in Galapagos is a high priority. Mangroves provide essential ecosystem services, including providing refuges for young fish, marine invertebrates, and birds¹⁰.

AUTHOR (S)

Fact Sheet: Julia Bolaños, Jacqueline Rodríguez and Charlotte E. Causton
Map: Byron Delgado M.

INFORMATION NEEDS

Insect-plant relationships are poorly studied in the Galapagos Islands and additional information needs to be collected about the host range and the effects of the Fig Wax Scale on plants, in particular species of conservation value. Molecular studies are needed to confirm the identifications of the five species of *Ceroplastes* that have been registered in the Galapagos Islands⁹, while surveys are needed to determine if there are additional species present.

DISTRIBUTION

This species is present on Floreana, Isabela, San Cristóbal and Santa Cruz islands.

MY NOTES

Map data sources: ICCDRS Database.

Map methodology: See Methodology section, ref. 1. GPS data.

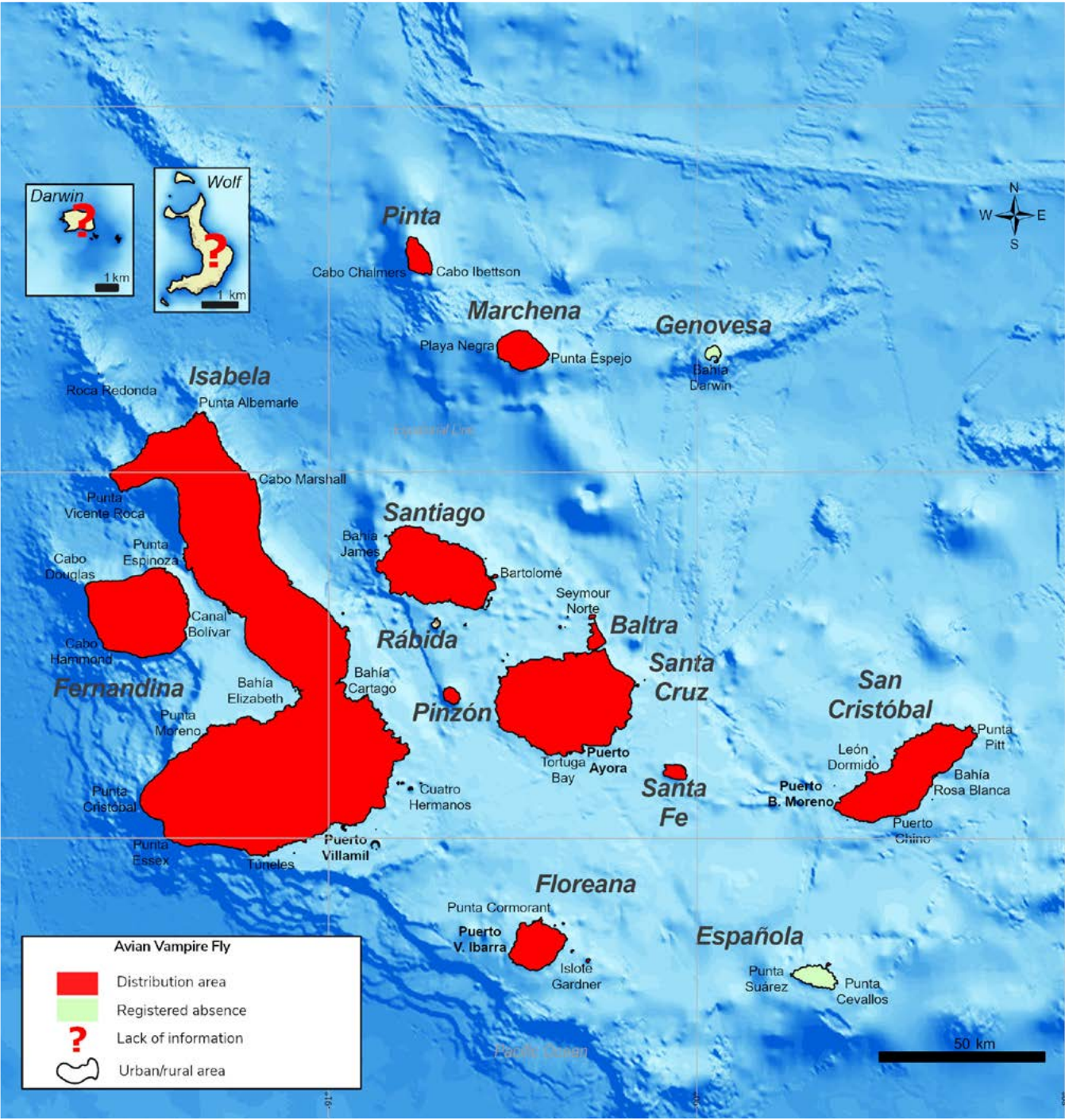
AVIAN VAMPIRE FLY

Mosca Vampiro Aviar, Parásita Aviar

Philornis downsi Dodge & Aitken, 1968
Animalia : Arthropoda : Insecta : Diptera : Muscidae:
Philornis downsi



© Juan Manuel García / CDF



CURRENT STATUS

The Avian Vampire Fly is one of the most invasive insects in Galapagos; in recent years, it has been responsible for the decline of land bird populations. Introduced accidentally from mainland Ecuador about 60 years ago, it attacks almost all small landbirds; 12 of the 17 species of finches, three of the four species of mockingbirds, and the Little Vermilion Flycatcher, among others, have been affected^{1, 2}.

ECOLOGICAL IMPORTANCE

Adult flies lay eggs in bird nests. The larvae feed on the blood of the nestlings and, occasionally, on the mother's blood when she incubates her eggs. Adult flies mainly eat decomposing fruits².

Up to 200 fly larvae have been found in a single bird nest. The larvae cause the nestlings to lose blood resulting in anemia, reduced growth rates, and sometimes death. This has serious consequences for bird species with low population numbers, such as the Mangrove Finch, which currently is Critically Endangered²⁻⁴. Nestlings appear to be particularly susceptible to the fly in years when food is less abundant. However, some birds, such as the Galapagos Mockingbird, seem to be more resistant⁵. Those nestlings that are able to survive parasitism may have deformed beaks. Although the ecological consequences of this are largely unknown, it is likely that the foraging and singing abilities of these individuals are altered, affecting their survival and reproductive success.

The low reproductive success of finches and other small landbirds likely has an impact on Galapagos ecosystems. The reduction of bird populations, especially those that are considered pollinators or seed dispersers of important plant species^{6, 7}, could potentially affect the composition and functioning of the ecosystems.

INFORMATION NEEDS

An international research group, coordinated by the Charles Darwin Foundation (CDF) and the Galapagos National Park Directorate (GNPD), has made significant advances in understanding the biology of this fly. The goal now is to continue improving management tools to protect threatened birds in the short-term (e.g. fly traps or the application of bird-safe insecticides to nests), while researching long-term solutions, such as biological control using the fly's natural enemies^{2, 8}.

The Galapagos Biosecurity Agency (GBA) is monitoring ports of entry to see if the Avian Vampire Fly continues to be introduced from mainland Ecuador. Efficient control at island entry points and consistent monitoring will be essential to protect the iconic Galapagos avifauna from future invasions.

DISTRIBUTION

The Avian Vampire Fly is found in all of the vegetation zones and is found on at least 15 of the larger islands. In rainy years, when conditions are favorable, flies are also found on small, arid islands².

MY NOTES

AUTHOR (S)

Fact Sheet: Charlotte E. Causton
Map: Byron Delgado M.

Map data sources: ICCDRS Database.
Map methodology: See Methodology section, ref. 3a.
Polygons from records, generalized from point data.

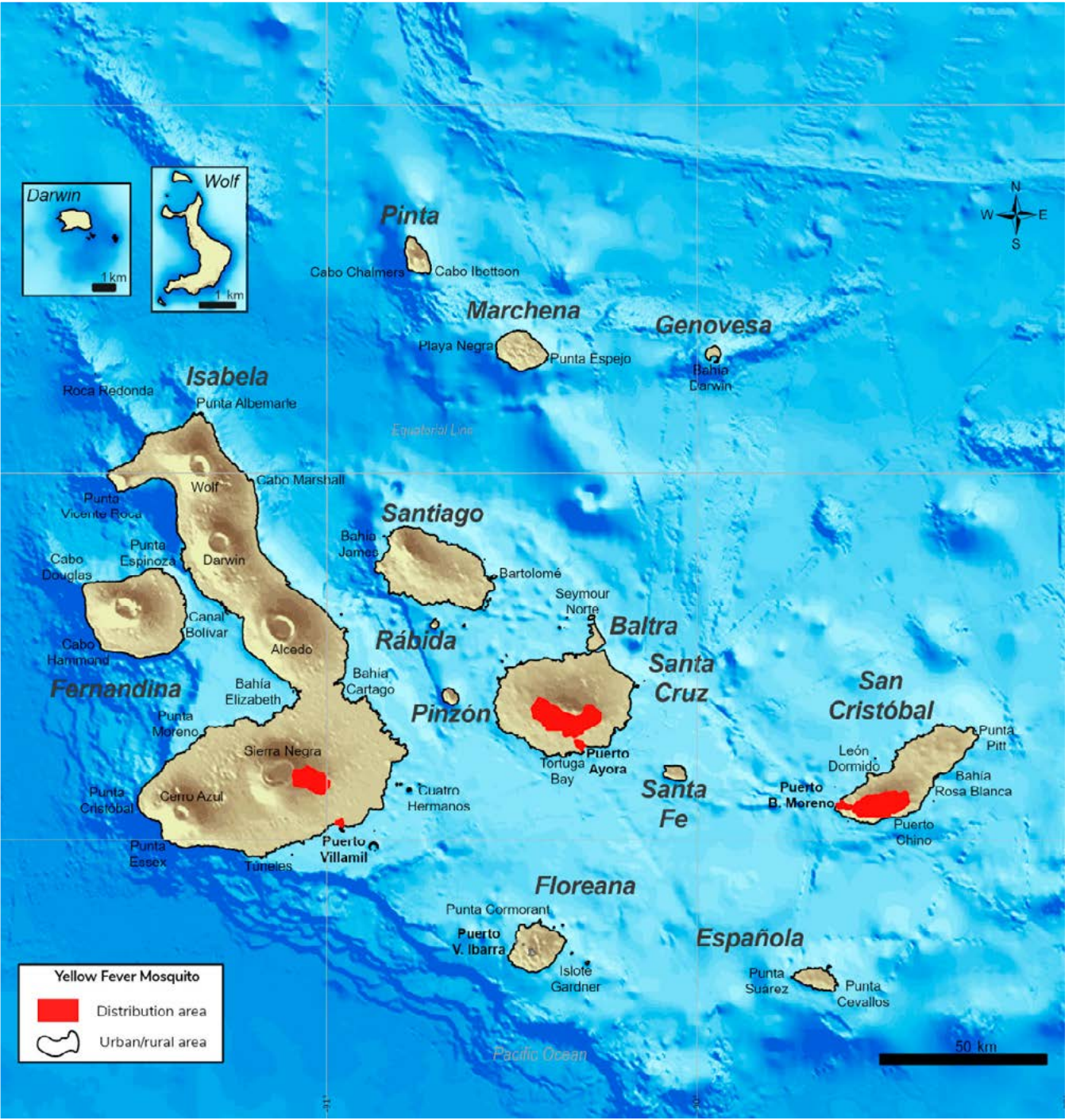
YELLOW FEVER MOSQUITO

Mosquito de la Fiebre Amarilla

Aedes aegypti (Linnaeus, 1762)
Animalia: Arthropoda: Insecta: Diptera: Culicidae:
Aedes aegypti



© Centro de Investigación en Enfermedades Infecciosas y Vectoriales & Instituto Nacional de Investigación en Salud Pública



INTRODUCED

CURRENT STATUS

The Yellow Fever Mosquito (*Aedes aegypti*) is originally from Africa, but is now found in tropical and subtropical regions around the world^{1, 2}. It is considered one of the principal vectors of viruses that cause important human diseases such as chikungunya, Zika, dengue, and yellow fever^{1, 3}.

It was first registered in Galapagos in 2001 on Santa Cruz Island and is currently found on Santa Cruz, San Cristóbal, and Isabela islands⁴. It is one of three species of mosquitoes that are found in Galapagos. The other species are the Southern House Mosquito (*Culex quinquefasciatus*), an introduced species, and the native species, the Black Salt Marsh Mosquito (*Aedes taeniorhynchus*)³.

The Yellow Fever Mosquito is highly anthropophilic, which means it prefers humans to animals as hosts^{1, 2}. This is the reason why it is typically restricted to human settlements on the Galapagos Islands³.

The Ministry of Health is working in collaboration with other local institutions in Galapagos to prevent illnesses transmitted by the mosquito. Control interventions have included fumigation of urban areas to reduce populations of adult mosquitoes and the treatment of standing water³. In 2023, the Ecuadorian Government initiated a control program using the “Sterile Insect Technique”, which involves the release of thousands of sterile males. These males mate with females producing infertile eggs, gradually diminishing the size of the population⁵.

ECOLOGICAL IMPORTANCE

Adults typically live for 2-4 weeks and are found in houses, gardens, and surrounding areas. Mosquitoes are diurnal (active in the daytime) and feed mainly on nectar from flowers. The females, however, also need nutrients from blood to produce the hormones needed to stimulate egg development. After a blood meal, females produce on average 100 to 200 eggs per batch and can produce up to five batches during a lifetime^{1, 2}. Eggs can be found on the sides of any kind of container with fresh water; such as cisterns, septic tanks, plant pots, or spare tires¹. The eggs can survive desiccation for up to 1 year and hatch once submerged in water. Mosquito larvae are

aquatic, feeding on organic material in the water. The mosquitoes can develop in very small amounts of water making control or eradication very difficult^{1, 2}.

The Yellow Fever Mosquito is considered a low threat to wildlife in Galapagos because of its strong association with humans⁶.

INFORMATION NEEDS

Studies are required to determine the current distribution of Yellow Fever Mosquito. Studies are also needed to evaluate if there are other viruses transmitted by the mosquito.

DISTRIBUTION

This species has been reported on Santa Cruz, San Cristóbal and Isabela islands.

MY NOTES

AUTHOR (S)

Fact Sheet: Jacqueline Rodríguez and Charlotte E. Causton

Map: Byron Delgado M.

Picture: © Centro de Investigación en Enfermedades Infecciosas y Vectoriales & Instituto Nacional de Investigación en Salud Pública

Map data sources: Molina 2018; ICCDRS Database.
Map methodology: See Methodology section, ref. 3a. Polygons from records, generalized from point data.

INTRODUCED

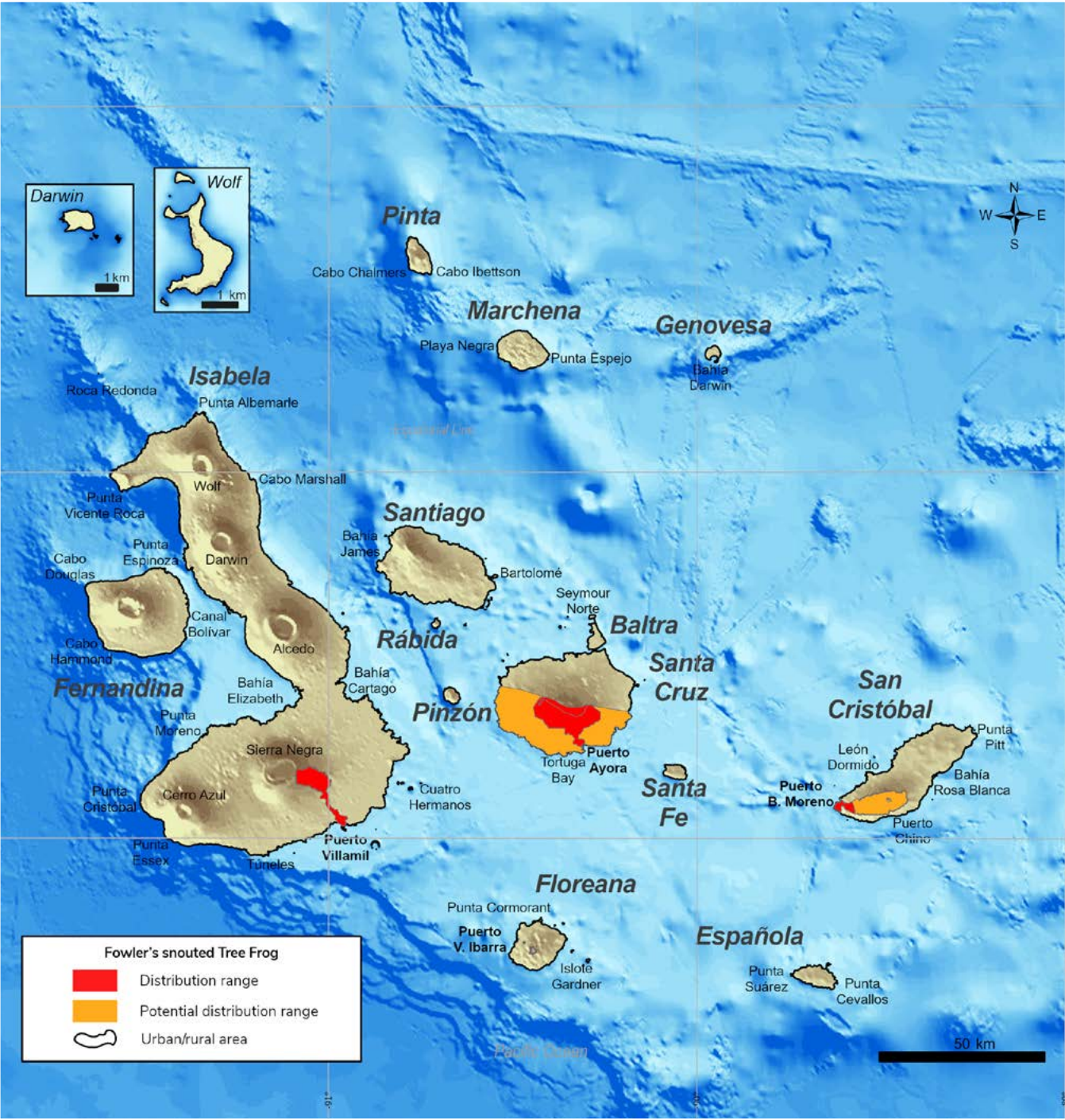
FOWLER'S SNOUTED TREE FROG

Rana Arbórea

Scinax quinquefasciatus (Fowler, 1913)
Animalia : Chordata : Amphibia : Anura : Hylidae :
Scinax quinquefasciatus



© Joshua Vela



CURRENT STATUS

Scinax quinquefasciatus is the only amphibian known to have established in Galapagos. This tree frog was first recorded in the late 1990s¹ and genetic analyses showed that it arrived to the islands from the littoral zone of continental Ecuador². Since its introduction to Galapagos, the tree frog has spread and is now widely distributed in the arid zones and highlands of Santa Cruz and Isabela. On Isabela, it is abundant in fresh or brackish water, like in the lagoons in Puerto Villamil^{1,3}. The tree frog was also present on San Cristóbal but has not been recorded there since 2001³.

ECOLOGICAL IMPORTANCE

Stomach-content analysis of adult specimens from Isabela and Santa Cruz showed that the tree frog feeds on a large range of invertebrate orders. On Isabela, analyses from 2001 and 2005 revealed that at least 76 different species of the orders Araneae, Diptera, Heteroptera, Odonata, Coleoptera, Hymenoptera were consumed, with 22 of these species being either endemic or native⁴. On Santa Cruz, this same analysis carried out in 2017 showed that 160 specimens identified belonged to 11 different orders, mainly Lepidoptera, Acarina, Araneae, Hymenoptera and Orthoptera⁵. The abundance of the tree frog on Santa Cruz has increased rapidly over the last years, likely because of the increased establishment of artificial ponds and rainwater reservoirs in the agricultural areas⁵. As a consequence, in a recent study, up to 1,100 individuals were estimated in a rainwater reservoir and over 6,500 in a single natural pond (San José, unpubl. data). In addition, up to 1,700 eggs were laid by a female in a single laying on Isabela⁶ and the frog tolerates up to 21% salinity in the water it breeds in⁷. This, in combination with the large number of insects consumed and the ability to tolerate dry environments, makes *Scinax quinquefasciatus* a very invasive species with potentially large impacts on the environment. With an increasing number of this frog population, there will be an increase in the consumption of local insects. Especially Araneae, Diptera and Lepidoptera are important food sources for insectivorous birds, like the Darwin's finches or the Vermilion Flycatcher, and for other endemic animals and competition with these will increase. Although there is predation of the frog in Galapagos, like the introduced Smooth-billed Ani (*Crotophaga ani*)⁸, a reduction in population size due to this is unlikely.

AUTHOR (S)

Fact Sheet: Heinke Jäger, Gustavo Jiménez-Uzcátegui, Edison Encalada and Miriam San José.
Map: Nicolás Moity

INFORMATION NEEDS

Despite its introduction at least 25 years ago, there is little information available on the ecology and distribution of the frog and its tadpoles in Galapagos, as well as their impacts on the environment. Attempts in the past to control the tadpoles by increasing the salinity of the water of the lagoons they inhabited and by adding caffeine to these, had not been successful⁶.

To be able to develop a management strategy, information on the ontogenesis of the tadpoles is essential. Furthermore, through their effect on nutrient cycling, primary production and energy flow, tadpoles may cause ecosystem changes in the ponds, habitats they share with endemic Galapagos giant tortoises and aquatic invertebrates. One way to study this and the tadpole's survival mechanisms would be a mesocosm experiment, which provides standardized conditions and the opportunity to manipulate environmental conditions.

To obtain information on the magnitude of the invasion the space distribution and abundance of the frog in the arid and humid zones of Santa Cruz and Isabela is currently being assessed. For this, automatic recorders are being deployed within Galapagos National Park and agricultural areas to carry out bioacoustics monitoring. This method is especially effective in remote areas, where visual and acoustic observations are not possible during the time the frog is active.

DISTRIBUTION

This species is present on Isabela and Santa Cruz. In the past, it was also present on San Cristóbal but not currently so.

MY NOTES

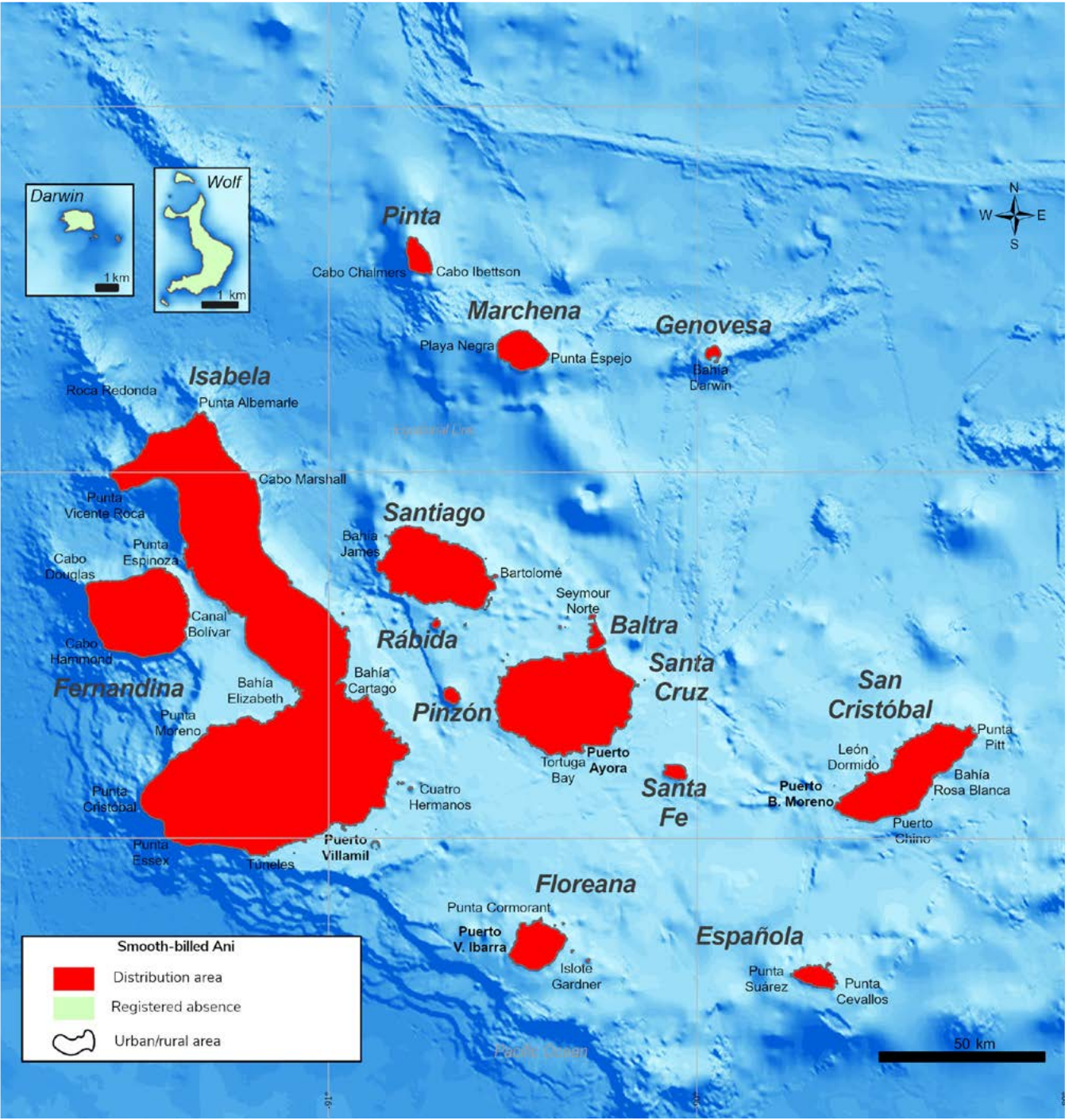
Map data sources: Jiménez-Uzcátegui, G. (EK), CDF Terrestrial Invasive Species project
Map methodology: See Methodology section, ref. 3b. Expert-based drawn area.

SMOOTH-BILLED ANI

Garrapatero, Ani
Crotophaga ani Linnaeus, 1758
Animalia : Chordata : Aves : Cuculiformes :
Cuculidae : *Crotophaga ani*



© Michael Dvorak



CURRENT STATUS

The Smooth-billed *ani* was most likely introduced to Galapagos to control cattle ectoparasites. The first records were made in 1962 (Isabela), 1966 (Santa Cruz), and 1967 (Santiago)^{1, 2, 3}; in 2010, it was estimated that there was a total of 250,000 smooth-billed anis throughout the archipelago³, which might be an overestimation and numbers closer to 150,000 (CDF, unpublished data).

This species has adapted to all vegetation zones and different types of climate across the archipelago. However, their preferred type of habitat is sites with open vegetation areas, mainly found in pasturelands within the agricultural zone of inhabited islands. Ani numbers went up during severe El Niño years (1982-83, 1997-98) and during periods of droughts, populations declined and even disappeared from some smaller islands to be recolonized in later years³. Their self-sustained and expanding population turned them into an invasive species in the archipelago⁴.

ECOLOGICAL IMPORTANCE

The Smooth-billed *ani* is an opportunistic forager with a broad dietary range. They forage primarily in grassy environments, and occasionally in trees and bushes⁵. It is known to predate upon a range of native and endemic species including the Galapagos Carpenter Bee, endemic grasshoppers and Lepidopteras (both caterpillars and moths). To a lesser extent, they also take small vertebrates, such as lizards, introduced tree frogs, and bird chicks^{6, 7}. There is also evidence of aggressive interactions between anis and endemic birds, specifically mockingbirds, that may lead to the death of the smaller landbird species⁷. As a result of these observations, the ani is thus considered a serious competitor for feeding and habitat and potential predator of native landbirds. It also feeds on fruits and seeds of several introduced plant species and contributes to their dispersal as seen for the invasive Blackberry⁶⁻⁸, which competes with native vegetation and threatens plant communities and ecosystems in general⁹.

The Smooth-billed *ani* is the only gregarious bird in Galapagos that shares food, roosts, and nesting sites, as well as the incubation and the care of juveniles⁵. Little is known about their nesting habits and phenology in Galapagos; however, unpublished data on social group composition suggests that their breeding season mostly

overlaps that of other landbirds in the archipelago (January-May)¹⁰. Breeding groups can nest three to four times a year, depending on environmental conditions. This bird nests in the canopy of thorny trees, such as *Acacia* trees, or in very dense vegetation, such as bamboo³.

INFORMATION NEEDS

Little is known about its nesting habits in Galapagos, including group size and stability, clutch size, and nesting success. Anis are known to be hosts of the Avian Vampire Fly (*Philornis downsi*)¹¹, but given their size and short nestling time (by day 5 nestlings start to explore the surroundings of the nest)⁵, it is unlikely that they suffer reduced nesting success. On the contrary, the species could be a reservoir host for this parasite. It's more territorial during the breeding season⁵, but little is known about its movements throughout the year and about its dispersion criteria: essential for the development of management plans for this introduced species. Comparative and more detailed research is required in order to understand their actual impact on local biodiversity in Galapagos.

DISTRIBUTION

Although being considered poor flyers, smooth-billed anis are known to be capable of flying over water, inhabiting several West Indies^{12, 13}. This trait may explain their dispersion across the archipelago, having been reported in almost all the major islands except Wolf and, irregularly, in some smaller islands and islets³.

MY NOTES

AUTHOR (S)

Fact Sheet: Birgit Fessl, David Anchundia and Cristian Poveda
Map: Byron Delgado M.

Map data sources: VCCDRS Database, CDF Terrestrial Birds Project, Delgado and Carrión-Cortez (2014), eBird.
Map methodology: See Methodology section, ref. 3b. Expert-based drawn area.

INVASIVE RODENTS— ROEDORES INVASORES

The invasive rodents found in Galapagos are the Black Rat (*Rattus rattus*), the Norwegian Rat (*R. norvegicus*), and the House Mouse (*Mus musculus*), all of which arrived with human activity¹. The first record of the Black Rat was made by Charles Darwin on Santiago Island, in 1835, and then later on Pinzón in 1891². The Norwegian Rat was detected on Santa Cruz and San Cristóbal islands between 1980-1983^{1, 3} while the House Mouse was first recorded on Santa Cruz in 1940⁴.

Currently, the Black Rat occurs on the four inhabited islands — Santa Cruz, San Cristóbal, Isabela, Floreana^{1, 2}, as well as on Baltra, Santiago, Sombrero Chino and Bartolomé. It has also been recorded on Pinzón Island, Marielas², Beagles and Bainbridge islets, as well as North Plaza where it has been eradicated by the Galapagos National Park Directorate (GNPD), the Charles Darwin Foundation (CDF), and other collaborators such as Island Conservation.

The Norwegian Rat has been observed on three inhabited islands (except Floreana), as well as on Baltra and Rábida^{1, 5}, from which it was eradicated in 2011. The House Mouse has been recorded on

14 islands, including all populated islands⁵, but was eradicated on South Plaza. Both Black and Norwegian rats were eradicated on North Seymour in 2008, but registered in 2018, and eradicated again in 2019.

Control and monitoring programs are currently implemented across GNPD-managed areas, as well as in rural and urban zones of affected islands. Some scientific programs and projects led by CDF and collaborating NGOs support these efforts by focusing on critical habitats and breeding sites of endangered species, aiming to mitigate the impacts of invasive rodents and other introduced species.

These invasive rodents affect native fauna through predation and competition for habitat and food, and may also act as vectors of diseases impacting wildlife and humans alike. Introduced rodents are presumed to have been one of the primary causes of vertebrate extinctions, particularly of endemic rodents, in Galapagos.

Gustavo Jiménez-Uzcátegui and Víctor Carrión González

Invasive rodents skulls -
Cráneos de roedores invasores
© Nell Dethloff / CDF



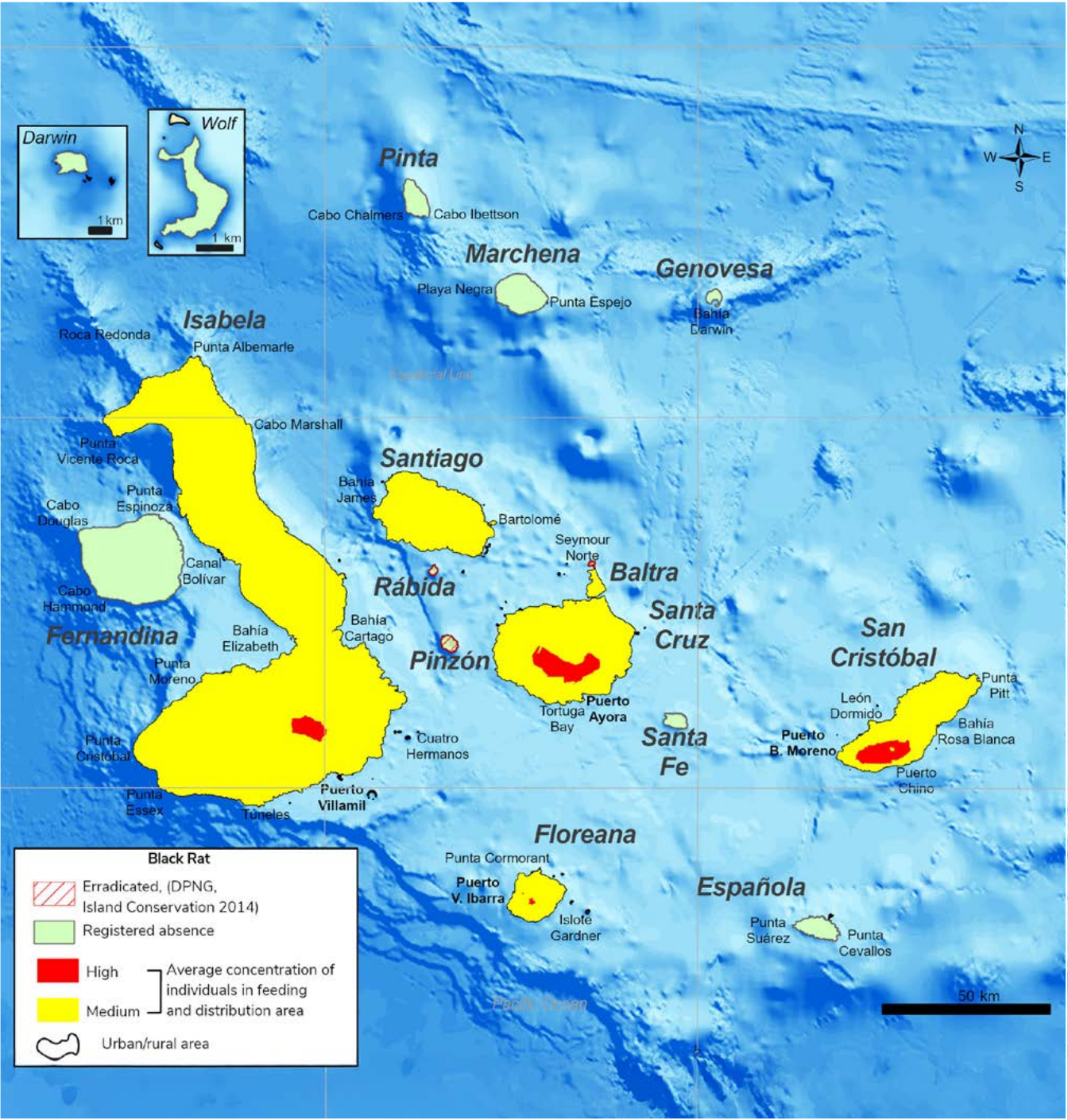
Invasive rodents -
Roedores invasores
© María Fernanda Mejía / CDF

BLACK RAT

Rata Negra
Rattus rattus Linnaeus, 1758
Animalia : Chordata : Mammalia : Rodentia : Muridae:
Rattus rattus



© Mara Speece / CDF



CURRENT STATUS

The Black Rat (*Rattus rattus*) is found in nearly all vegetation zones of the Galapagos Islands, from arid regions to humid forests^{1, 6}. It remains uncertain whether they can move between islands or islets, and their population numbers on each island — which varies depending on the season—remains unknown⁷. The species' remarkable adaptability has been key to its successful establishment in the archipelago.

A mid-term project is underway to eradicate rodents on Floreana Island, led by the Galapagos National Park Directorate (GNPD) and the Agency for Regulation and Control of Biosecurity and Quarantine for Galapagos (GBA), with international technical assistance, and carried out in collaboration with the local community.

ECOLOGICAL IMPORTANCE

Introduced rodents are one of the principal causes of species extinctions on the islands. They impact agricultural production, consume and damage stored products, and spread diseases that threaten human health^{8, 9}. In Galapagos, the Black Rat is considered a pest: its short gestation, frequent reproductive cycles⁶, and high adaptability allow for rapid population growth.

As an omnivore, the Black Rat exerts strong pressure on multiple trophic levels — feeding on seeds, stems, leaves and fruits, and preying on invertebrates (arthropods, snails, worms) and vertebrates (small birds, chicks, eggs of birds, and reptiles)⁵⁻⁸. In Santa Cruz, Black Rat predation causes up to 70% mortality in Galapagos Petrel (*Pterodroma phaeopygia*) populations¹⁰, and circumstantial evidence suggests that it is responsible for the extinction of several other species¹¹⁻¹³. It is thought to contribute to habitat displacement and competition with endemic rodents, such as the Santiago *Nesoryzomys* Rodent (*Nesoryzomys swarthi*)⁵. The Black Rat is also a vector and reservoir for pathogens affecting both native fauna and humans¹⁴.

INFORMATION NEEDS

The effectiveness of control actions must be quantified, as their ecological impacts within treatment zones remain poorly understood. For example, on Santiago Island, where endemic mice and black rats potentially share habitats, it remains unclear whether control actions negatively affect the endemic rodent, despite the use of targeted methodologies⁵. Similarly, the broader trophic impacts of these interventions need to be assessed.

These rodents are preyed upon by native species such as the Galapagos Hawk (*Buteo galapagoensis*), the Galapagos Short-eared Owl (*Asio flammeus galapagoensis*), and the Barn Owl (*Tyto furcata punctatissima*), species that could secondarily be affected by rodent control measures.

There is also at present no information on the pathogens carried by black rats in Galapagos, nor their potential impact on the native fauna and human population¹⁴. Such studies need to be conducted in order to inform emerging management plans.

DISTRIBUTION

Rattus rattus is present on Santa Cruz, San Cristóbal, Isabela, Floreana, Baltra, Santiago, Sombrero Chino and Bartolomé islands^{1, 2}.

MY NOTES

AUTHOR (S)

Fact Sheet: Gustavo Jiménez-Uzcátegui and Víctor Carrión González
Map: Byron Delgado M.

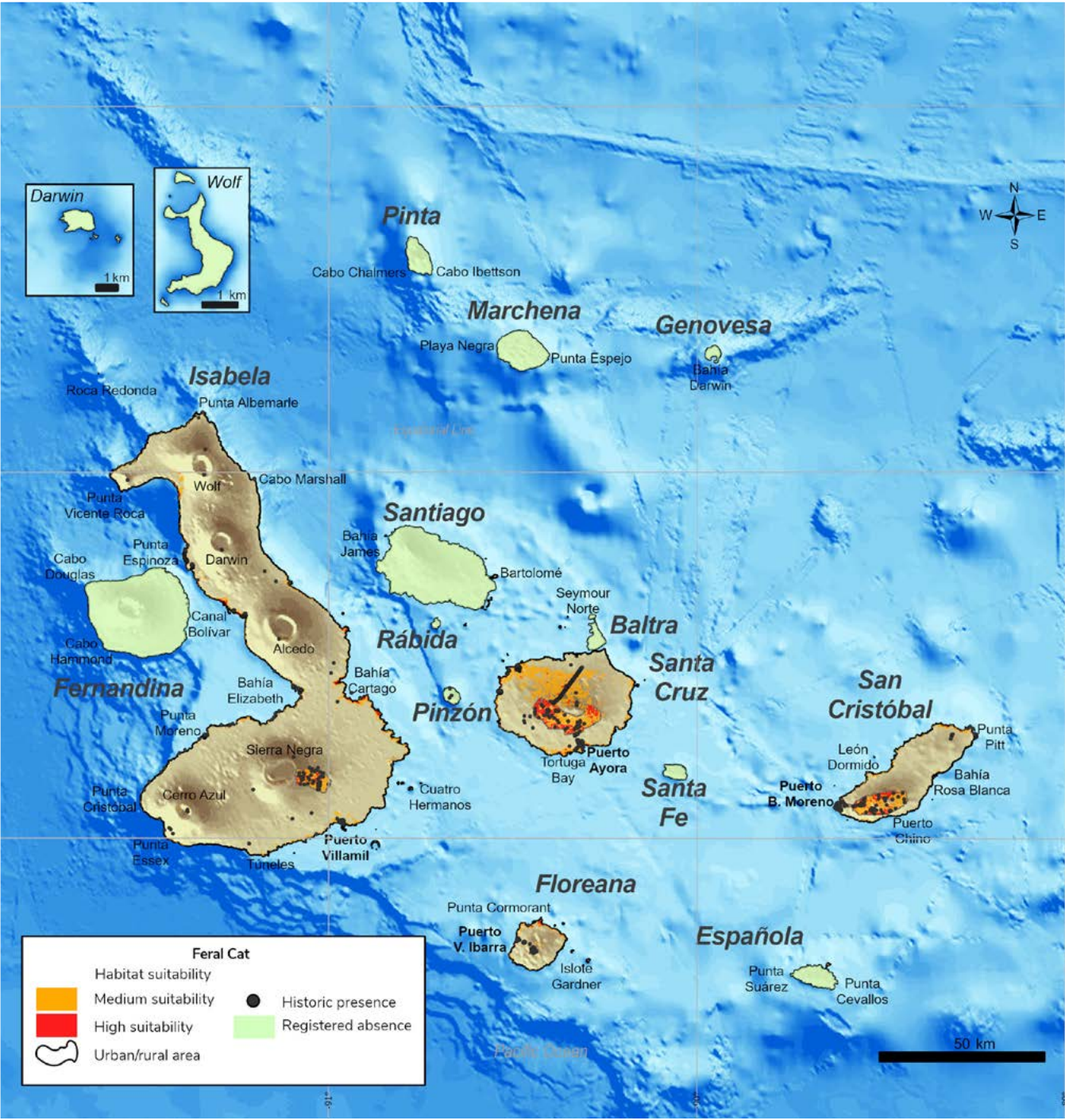
Map data sources: Harris et al., 2006.
Map methodology: See Methodology section, ref. 3a. Polygons from records, generalized from point data 4b. Expert knowledge model.

FERAL CAT

Gato Feral, Asilvestrado
Felis catus Schreber, 1775
Animalia : Chordata : Mammalia : Carnivora : Felidae :
Felis catus



© Rashid Cruz



CURRENT STATUS

The first cat was recorded on Floreana Island in 1832¹; and was later observed on Isabela Island in 1869². In San Cristóbal¹ and Santa Cruz, cats were likely introduced by settlers as these islands became populated. On Baltra, cats were apparently introduced during World War II, but they were successfully eradicated after three years of work carried out by the Galapagos National Park Directorate (GNPD) and the Charles Darwin Foundation (CDF) in 2004³.

Today, cats are present in all four populated islands, both as domestic animals and as feral populations. The GNPD and the Agency for Regulation and Control of Biosecurity and Quarantine for Galapagos (GBA) are actively engaging to control this invasive species. Management actions to eradicate feral cats on Floreana Island began in 2023, led by the GNPD and GBA, and co-executed by Jocotoco Foundation, Island Conservation, and CDF, with the support of local authorities and Floreana's local community.

In addition, invasive species management — including feral cats — is supported through research programs led by the CDF, such as the Seabird and Lagoon Conservation Program (<https://www.darwinfoundation.org/en/our-work/ocean/conservation-of-galapagos-marine-birds/>). These control efforts are typically implemented in the breeding areas of sentinel species.

ECOLOGICAL IMPORTANCE

Felines can adapt easily to different environments. Despite climate variability and limited water availability, their adaptation to the islands has been straightforward. Cats hunt for food or for play, behaviors that cause irreversible damage to populations of many native species. Cats have been responsible for the extinction of more than 33 species of birds worldwide since the year 1600^{4,5}. Due to their inexperience with mammalian predators, native oceanic species and native island species are particularly vulnerable to predation by cats⁵. In the specific case of Galapagos, the Feral Cat affects birds (passerines, penguins, petrels, cormorants, blue-footed boobies), reptiles (marine and land iguanas, lizards, “baby” turtles), and invertebrates (grasshoppers, centipedes), among other species^{3, 6, 7}. Cats, together with rodents, human interaction or activities, and fires, contributed to the extinction of at least 10 species of birds (e.g., Floreana Mockingbird, Pachay) on Floreana Island^{8,9}.

AUTHOR (S)

Fact Sheet: Gustavo Jiménez-Uzcátegui and Víctor Carrión González
Map: Byron Delgado M.

Worldwide, the Cat has had a negative effect on islands such as Jamaica, Macquarie, Fiji, Marion, Dassen, New Zealand, among others⁸. Additionally, it is a transmitter and reservoir of diseases that affect other groups, such as birds, reptiles, and mammals—including humans^{10,11}.

INFORMATION NEEDS

Despite efforts to control feral cats on several islands, effectiveness has only been confirmed on Baltra, where the cat was eradicated^{3,12}. The impact of control measures on other islands remains unknown. However, monitoring is underway on Floreana to ensure successful eradication in the short term, similar to what occurred on Baltra.

The approximate number of cats within the Galapagos National Park (GNP) area remains unknown. While some information exists for populated areas, data on abundance are still lacking. In the 1980s, the density of feral cats was estimated at 1 individual per km², with a population composed of more males than females and approximately 80% adults^{7,10}. More recent data from 2023 indicate a density of 3.4 individuals per km² in marine bird breeding areas on Isabela Island (Coloma et al., unpublished data).

Strengthening information and education campaigns that promote responsible pet ownership, including sterilization and keeping pets contained, remains essential. These measures will help prevent the spread of feral cats across the islands.

DISTRIBUTION

Felis catus is present on Floreana, Santa Cruz, Isabela, and San Cristóbal Islands in both domestic and feral status. It was eradicated from Baltra in 2004^{3,12}.

MY NOTES

Map data sources: VCCDRS Database, Delgado and Carrión-Cortez (2014).
Map methodology: See Methodology section, ref. 4a. Species distribution model, Maxent ML.

CONCLUDING REMARKS

Galapagos represents different meanings to different people. Yet, the meaning that unites them all is its association with extraordinary biodiversity, endemism and the key ecological, marine and terrestrial processes that sustain them.

The first edition of the *Atlas de Galapagos – una contribución al mejor conocimiento y conservación de Galapagos*, co-produced by the Charles Darwin Foundation (CDF) and WWF-Ecuador in 2018, marked a milestone in the generation and dissemination of knowledge about the islands. For the first time, the notion of biodiversity in Galapagos has been extended beyond the emblematic and charismatic species that have long served as symbols of the archipelago — such as marine iguanas, Waved Albatross, *Scalesia*, and the iconic Galapagos giant tortoises — to include invasive species and pests that seriously threaten the conservation of this highly diverse, unique and fragile group of islands, as well as the livelihoods of the people who inhabit them.

The second edition, *Galapagos Atlas*, published almost five years later and for the first time in English, reflects a truly interdisciplinary approach when looking at the rich Galapagos diversity. It contributes to a new paradigm of science in Galapagos — one that promotes shared conservation and sustainability across the archipelago

while confronting the risks, threats and extinction pressure faced by its biological, ecosystemic and genetic diversity.

The review process for this edition followed two main lines of reasoning. First, it incorporated species that, since the First Edition, have been identified as sentinel or bio-indicator species, for which limited information existed regarding their distribution, abundance, ecological importance and current conservation status and needs. Second, it included 20 additional species not present in the First Edition, each selected for its ecological importance and value in illustrating the diversity and complexity of Galapagos ecosystems. The complementary cartographic component once again plays a fundamental role, presenting the most recent species records — including new occurrences on islands where they had not been previously reported.

The Galapagos Atlas represents an important initiative between the CDF's experienced scientists and its myriad long-term collaborators with deep knowledge of the archipelago. Their collective expertise has guided the inclusion of new data, the refinement of previous criteria, and the enhancement of descriptions for both previously featured and newly added species.

With this Second Edition, the Charles Darwin Foundation, together with the Editorial Committee, the Editor, and the co-authors, aim to challenge the pre-conceived notion that diversity in general, and diversity in Galapagos in particular, is limited to visually appealing and charismatic species. Instead, the Galapagos Atlas adopts an integrated perspective — one that not only recognizes iconic species that inspire admiration, but also the invasive species that are causing profound ecological disruption across the marine and terrestrial environments of the archipelago.

This English-language Second Edition also expands the reach of the First Edition, allowing international audiences to access decades of scientific knowledge on the key species shaping the Galapagos Islands today, and to understand the conservation challenges they face.

The practical implications of this book are varied. First, the information about taxonomic groups featured in this volume has been assessed and updated by world-class experts, ensuring that the information presented is accurate, reliable, and globally validated. This represents a substantial contribution to the growing body of knowledge about Galapagos. Second, naturalist guides and tour operators will be able to share scientifically grounded information with visitors

seeking accurate details about the species of the islands, their ecology, distribution, and the threats they face — particularly from invasive species. Third, teachers across Galapagos and mainland Ecuador will have access to new material to enrich their curricula and promote environmental awareness among students. Fourth, local communities who coexist with these species will benefit from accessible, trustworthy information about their ecological importance and the need for long-term conservation.

Finally, in alignment with the CDF's values and principles of equitable access to knowledge, this Galapagos Atlas complements the first Spanish-language edition by broadening the dissemination of scientific findings and experiences shared by the researchers who dedicate their work to understanding and protecting this extraordinary archipelago.

We are confident that this second edition helps fill important knowledge gaps regarding the species and ecosystems featured in its pages. In the long term, a deeper understanding of Galapagos biodiversity will not only strengthen conservation efforts but also enhance the governance of the social and natural systems that make this archipelago one of the most remarkable places on Earth.

Waved Albatross -
Albatros de Galápagos
Phoebastria irrorata
© Carlos Espinosa / CDF

María José Barragán Paladines



COMPLEMENTARY
DOCUMENTS—
Annexes

Flamingo wings -
Alas de Flamenco
Phoenicopterus ruber glyphorhynchus
© Carlos Espinosa / CDF



Devil's Crown -
Corona del Diablo
© Carlos Espinosa / CDF

GIANT TORTOISES, MOCKINGBIRDS AND FINCHES DISTRIBUTION ON GALAPAGOS

The Galapagos giant tortoises are undoubtedly the most emblematic species of the archipelago, representing a living example of the extraordinary evolutionary processes that occur in isolated environments without natural predators.

Darwin's finches, on the other hand, are considered the fastest-evolving vertebrates; their speciation into 17 species and one sub-species occurred over just 1.5 million years, making them iconic subjects in evolutionary biology classes around the world. Mockingbirds may be less well-known than giant tortoises and finches, but they were actually the first animals that led Charles Darwin to question the fixity of species after his visit to the islands — indeed, they were a key inspiration for his Evolution Theory.

This section presents the geographical distribution of 16 phenotypes (representing 15 species) of Galapagos

giant tortoises, four species of mockingbirds, and 17 species of finches across the archipelago. These species are among the most studied in the Galapagos, with scientific records spanning nearly two centuries, particularly in the case of mockingbirds. For each group, one or more maps are provided to illustrate their distribution across the islands.

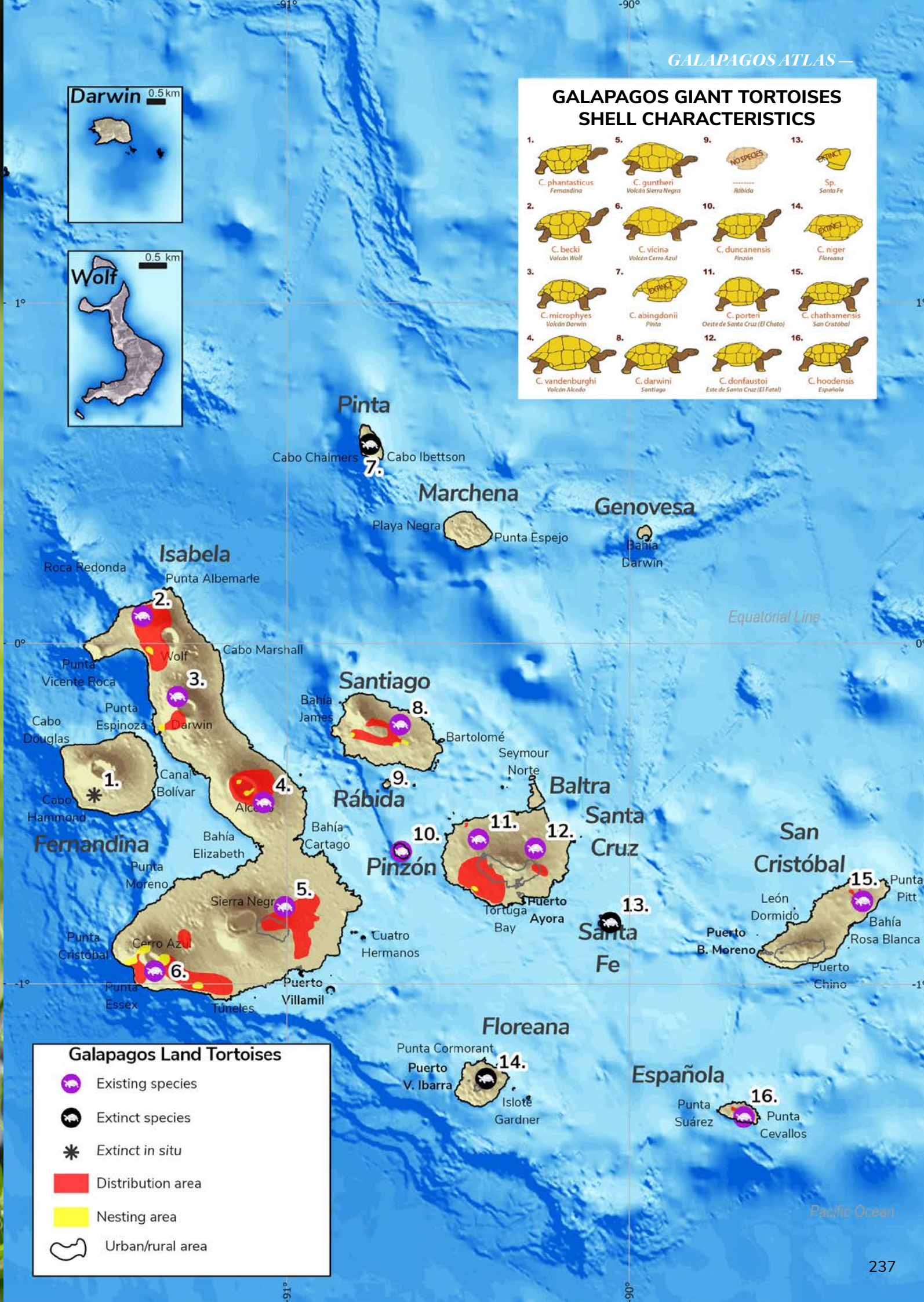
Beyond their scientific and evolutionary significance, these iconic species also serve as flagships for conservation efforts in Galapagos, helping to raise awareness and support for the protection of the unique biodiversity of the archipelago.

Nicolás Moity and Paola Díaz Freire



GALAPAGOS GIANT TORTOISES DISTRIBUTION

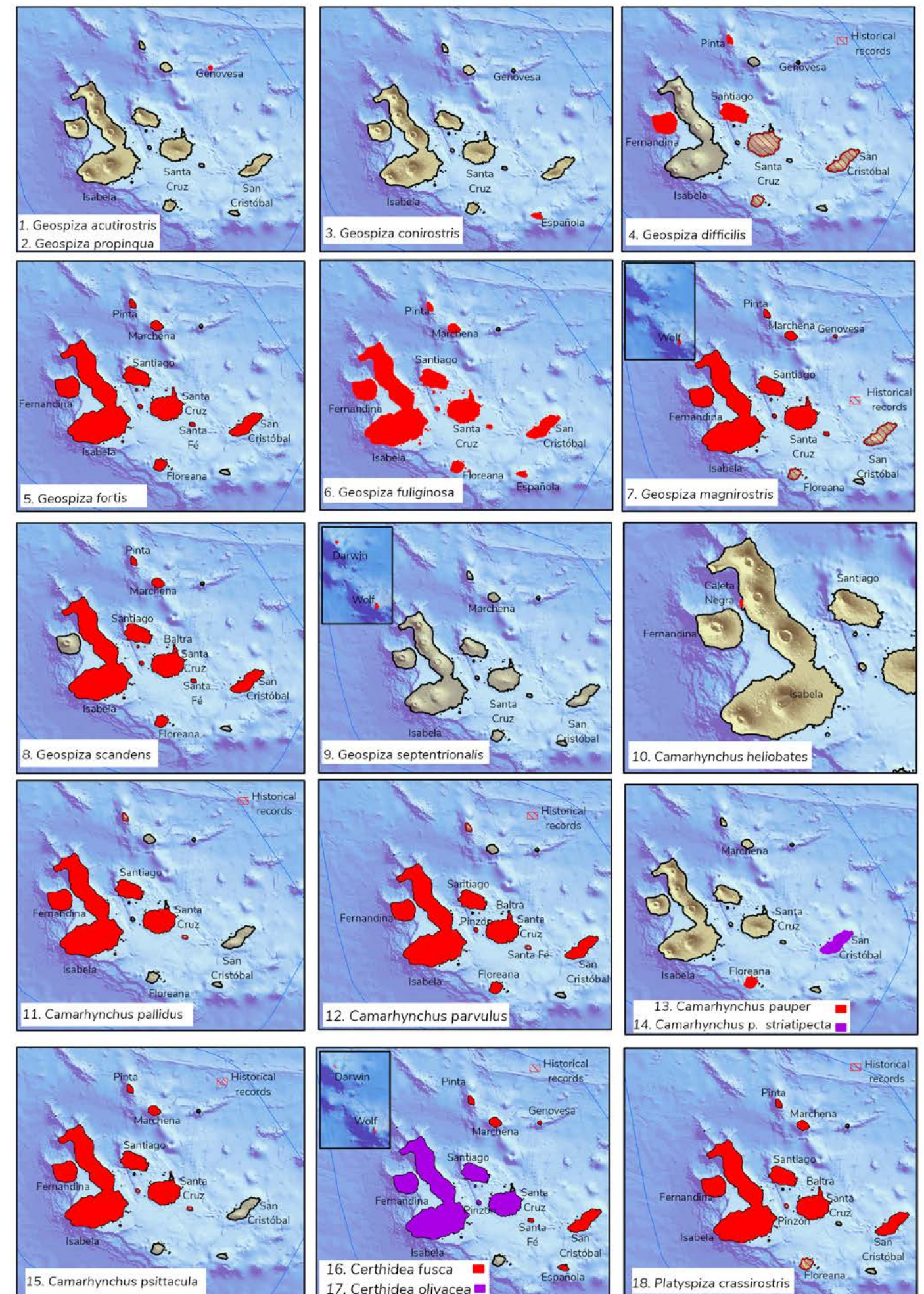
West Santa Cruz Giant Tortoise -
Tortuga del Oeste de Santa Cruz
Chelonoidis porteri
© Mara Speece / CDF





FINCHES DISTRIBUTION

Small Tree Finch -
Pinzón de Árbol Pequeño
Camarhynchus parvulus
© Mara Spéece / CDF





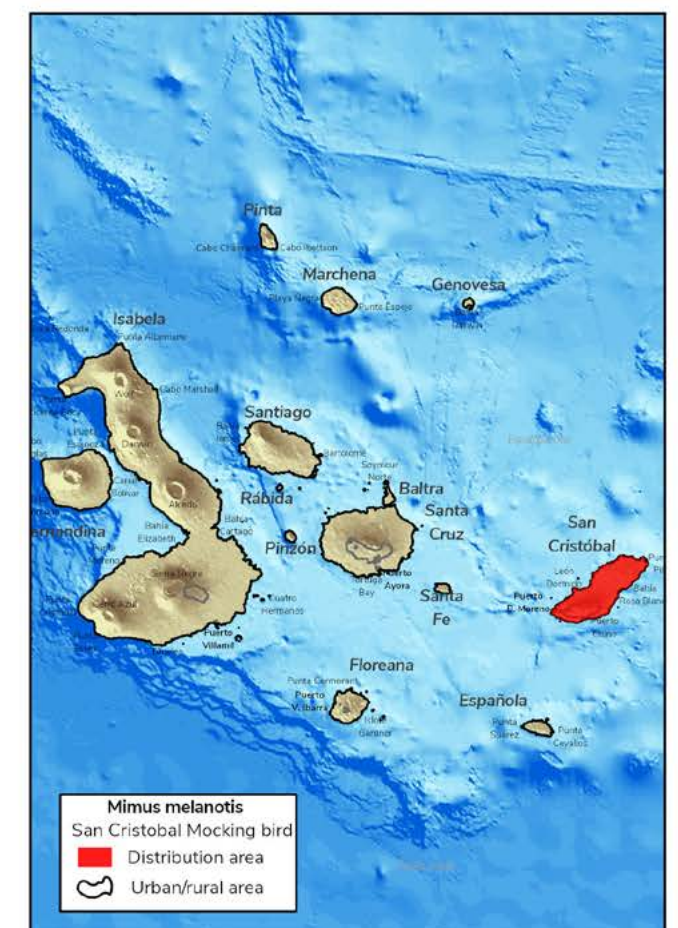
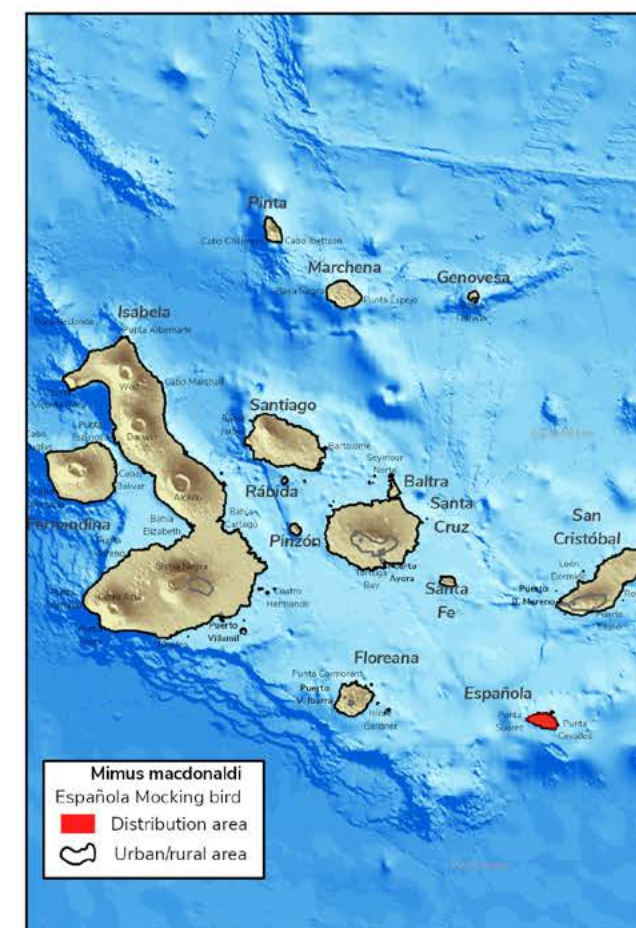
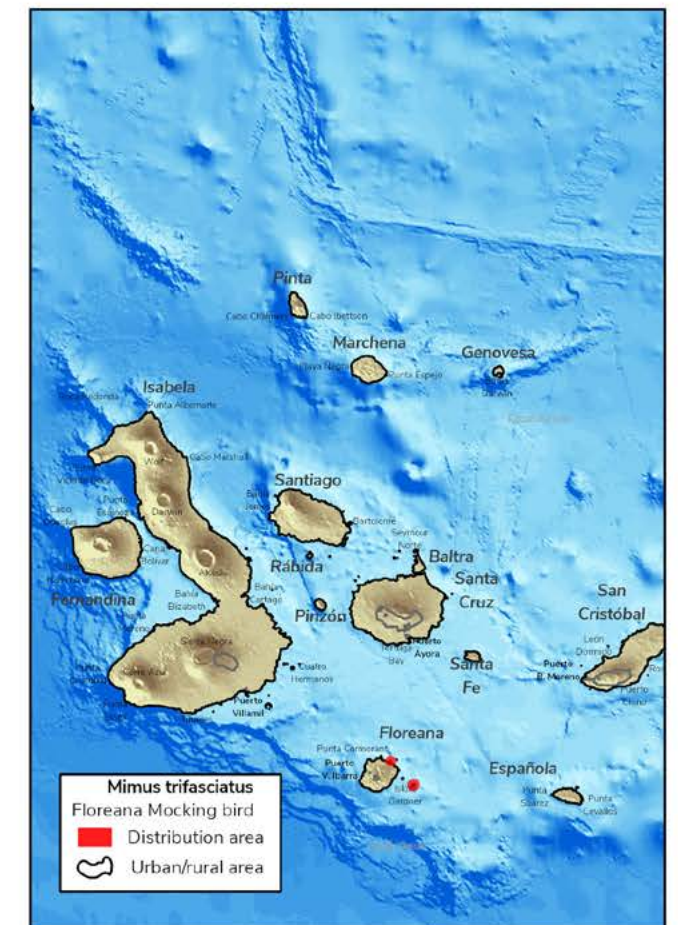
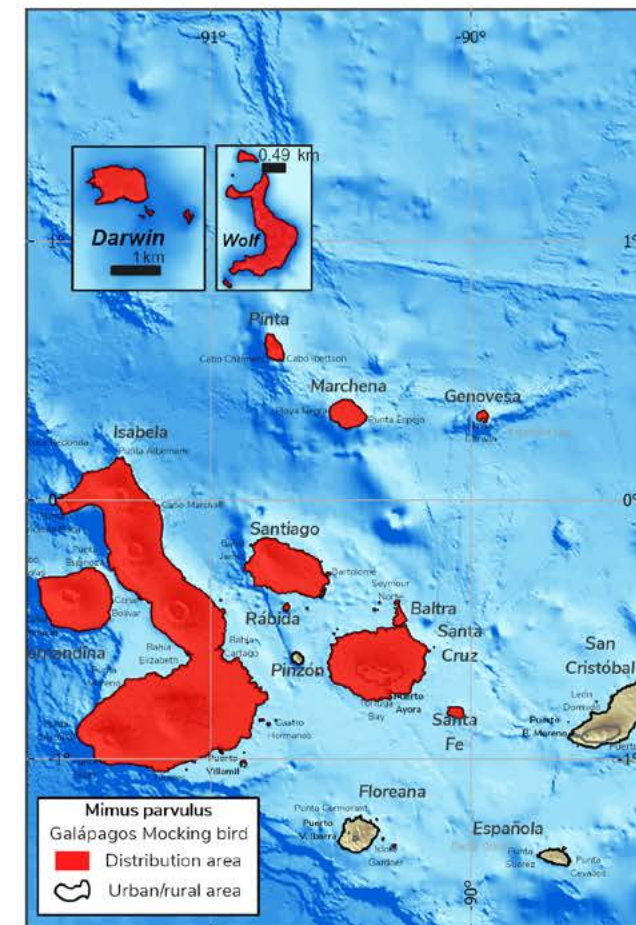
MOCKINGBIRD DISTRIBUTION

Floreana Mockingbird -

Cucuve de Floreana

Mimus trifasciatus

© Carlos Espinosa / CDF



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EASTERN SANTA CRUZ
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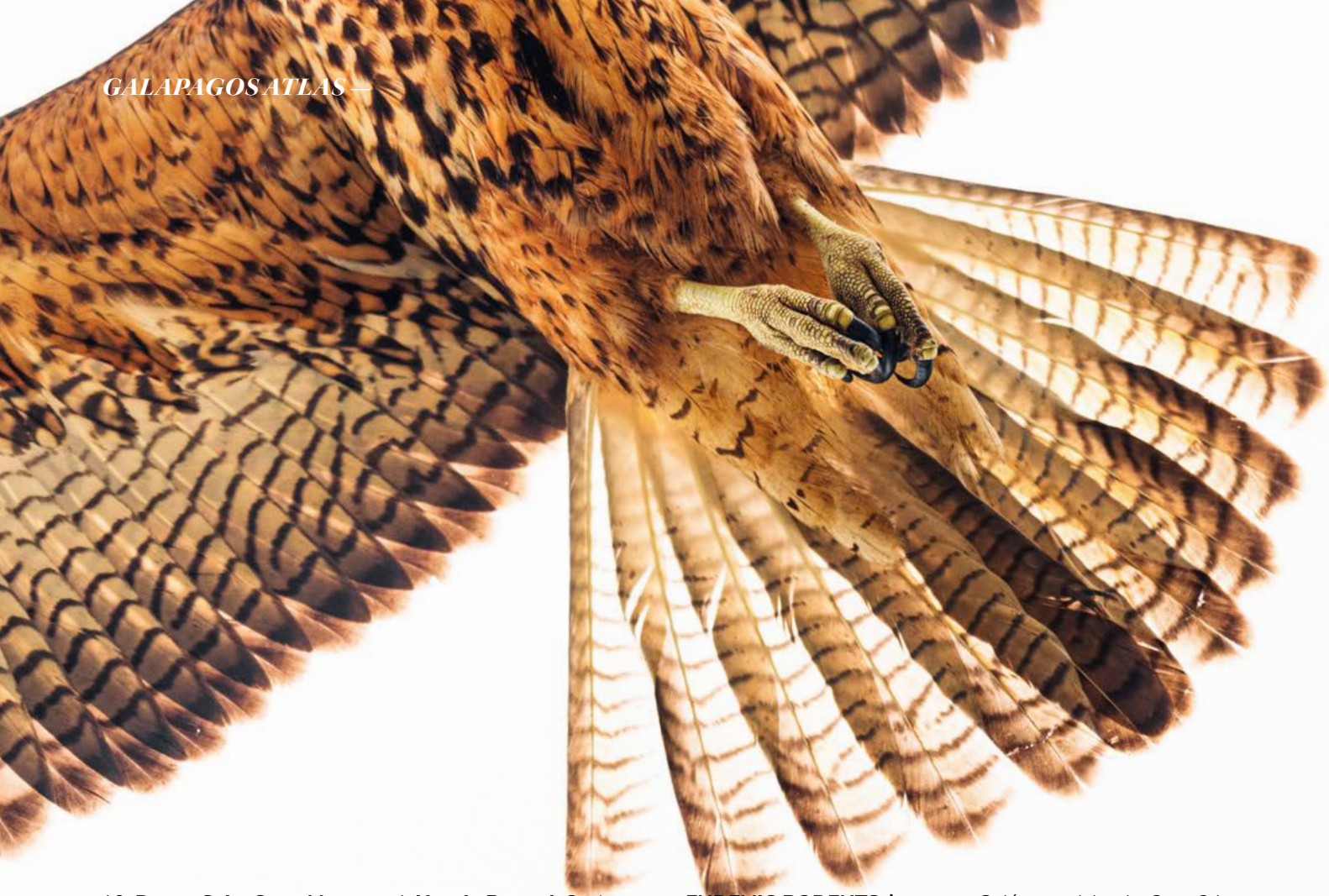
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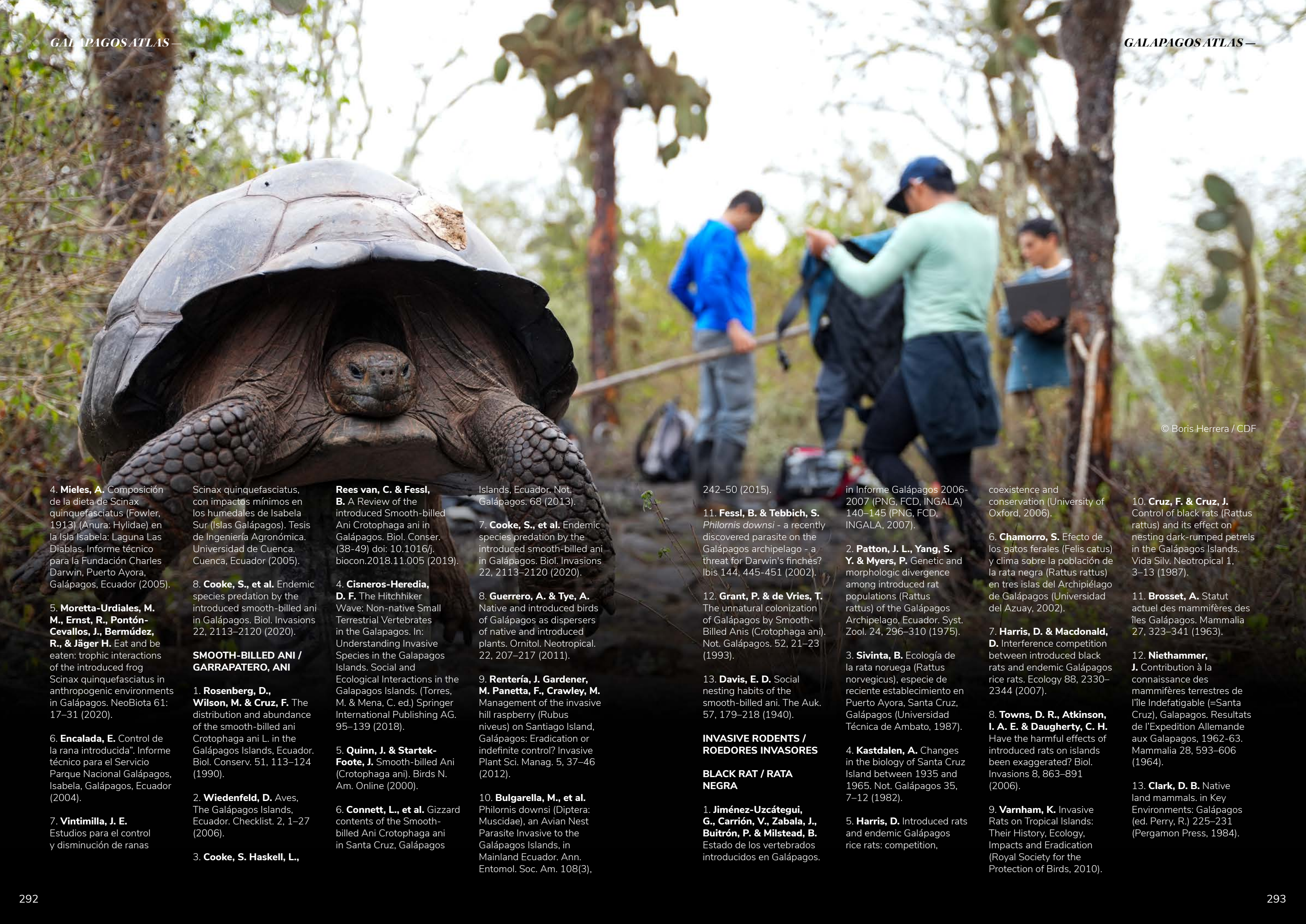
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CHECK LIST SPECIES

English	Spanish	Scientific	Observation
American (Galapagos) Flamingo	Flamenco de Galápagos	<i>Phoenicopterus ruber glyphorhynchus</i>	
Avian Pox	Viruela Aviar, Pox Virus, Epitelioma Contagioso	<i>Avipoxvirus</i>	
Avian Vampire Fly	Mosca vampiro aviar, Mosca parásita aviar	<i>Philornis downsi</i>	
Black Coral	Coral negro	<i>Antipathes galapagensis</i>	
Black Rat	Rata negra	<i>Rattus rattus</i>	
Blackberry	Mora	<i>Rubus niveus</i>	
Common Guava	Guayaba	<i>Psidium guajava</i>	
Cuban Cedar	Cedrela, cedro americano	<i>Cedrela odorata</i>	
Eastern Santa Cruz Giant Tortoise	Tortuga Gigante del Este de Santa Cruz	<i>Chelonoidis donfaustoi</i>	
Feral Cat	Gato feral	<i>Felis catus</i>	
Fig Wax Scale	Escama blanca de la higuera	<i>Ceroplastes rusci</i>	
Floreana Mockingbird	Cucuve de Floreana	<i>Mimus trifasciatus</i>	
Floreana Racer	Culebra de Floreana	<i>Pseudalsophis biserialis biserialis</i>	
Fowler's Snouted Tree Frog	Rana arbórea	<i>Scinax quinquefasciatus</i>	
Galapagos Blue-footed Booby	Piquero de patas azules	<i>Sula neboxii excisa</i>	
Galapagos Carpenter Ant	Hormigas carpintera de Galápagos	<i>Camponotus macilentus</i>	
Galapagos Carpenter Bee	Abeja carpintera de Galápagos	<i>Xylocopa darwini</i>	
Galapagos Cut-leaf Daisy	<i>Lecocarpus</i> de Darwin	<i>Lecocarpus leptolobus</i>	
Galapagos Dove	Paloma de Galápagos	<i>Zenaida galapagoensis</i>	
Galapagos Fur Seal	Lobo fino o lobo de dos pelos	<i>Arctocephalus galapagoensis</i>	
Galapagos Giant Long-hor-ned Beetle	Escarabajo gigante de cuer-noslargos de Galápagos	<i>Mallodon chevrolatii galapagoensis</i>	
Galapagos Kelp	Kelp	<i>Eisenia spp.</i>	
Galapagos Oystercatcher	Ostrero, cangrejero	<i>Haematopus palliatus galapagensis</i>	
Galapagos Penguin	Pingüino de Galápagos	<i>Spheniscus mendiculus</i>	
Galapagos Red Bat	Murciélago rojo de Galápagos	<i>Lasiurus borealis brachyotis</i>	
Galapagos Sailfin Grouper	Bacalao	<i>Mycteroperca olfax</i>	
Galapagos Sea Lettuce	Lamilla o lechuga de mar	<i>Ulva spp.</i>	
Galapagos Sea Lion	Lobo marino de Galápagos o lobo común	<i>Zalophus wolfebaeki</i>	
Galapagos Short-eared Owl	Lechuza de campo	<i>Asio flammeus galapagoensis</i>	
<i>Galvezia</i>	<i>Galvezia</i>	<i>Galvezia leucantha</i>	
Giant African Snail	Caracol gigante africano	<i>Lissachatina fulica</i>	

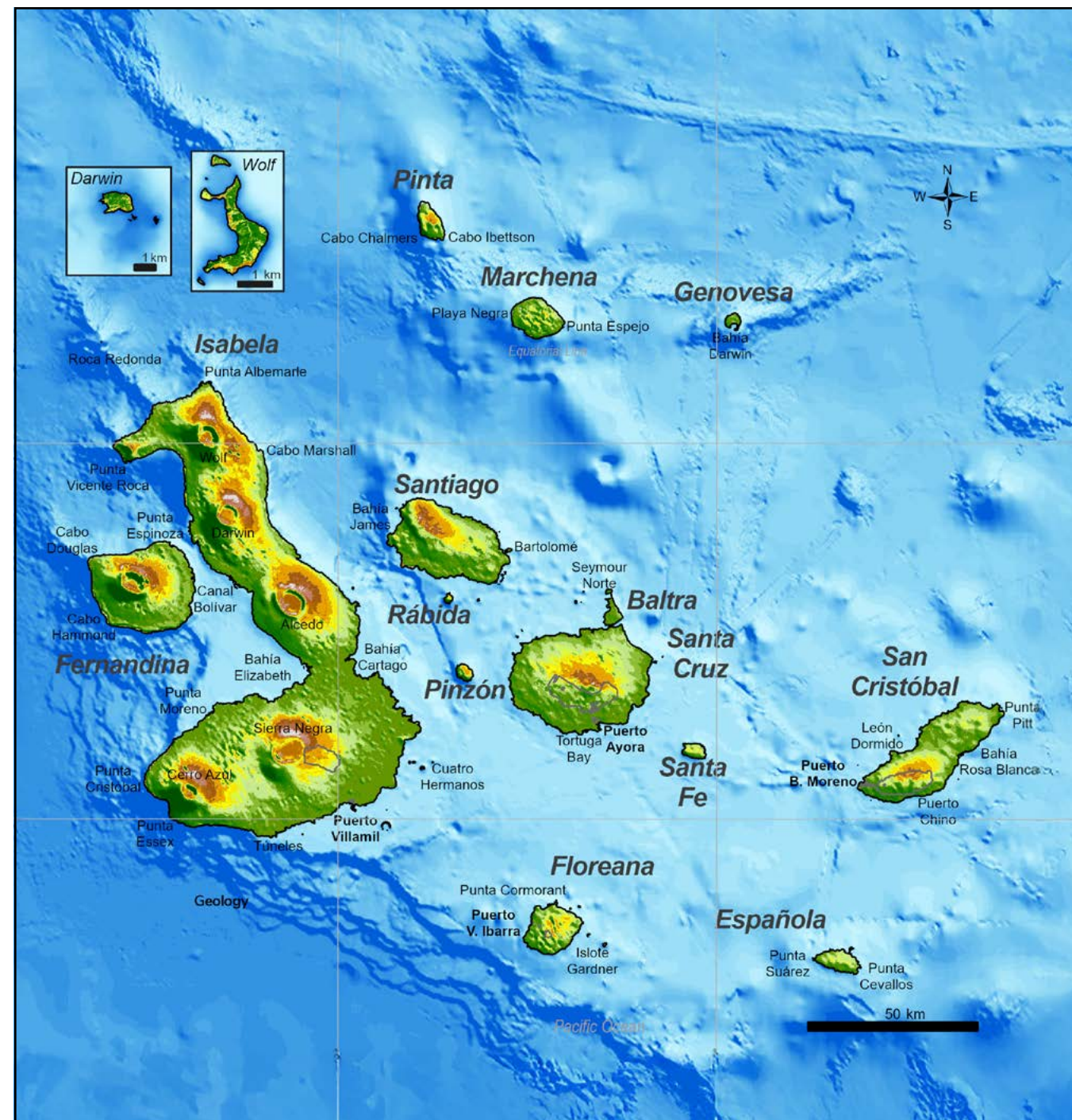
English	Spanish	Scientific	Observation
Giant Oceanic Manta Ray	Manta oceánica gigante	<i>Mobula birostris</i>	
Godzilla Marine Iguana	Iguana marina godzilla	<i>Amblyrhynchus cristatus godzilla</i>	
Green Sea Turtle	Tortuga verde	<i>Chelonia mydas</i>	
Land Snail <i>Naesiotus nux</i>	Caracol terrestre <i>nux</i>	<i>Naesiotus nux</i>	
Mangrove Finch	Pinzón de manglar	<i>Camarhynchus heliobates</i>	
Mottled Scorpionfish	Pez brujo	<i>Pontinus clemensi</i>	
Nazca Booby	Piquero de Nazca	<i>Sula granti</i>	
Orca	Orca	<i>Orcinus orca</i>	
Pencil Sea Urchin	Erizo lapicero	<i>Eucidaris galapagensis</i>	
Pink Land Iguana	Iguana rosada	<i>Conolophus marthae</i>	
Pinzón Giant Tortoise	Tortuga gigante de Pinzón	<i>Chelonoidis duncanensis</i>	
Prickly Pear Cactus	Cactus gigante	<i>Opuntia megasperma var. orientalis</i>	
Radiate-headed <i>Scalesia</i>	Lechoso o tabaquillo	<i>Scalesia affinis</i>	
Red Mangrove	Manglar rojo	<i>Rhizophora mangle</i>	
Red Spiny Lobster	Langosta roja	<i>Panulirus penicillatus</i>	
Santa Cruz Lava Lizard	Lagartijas de lava de Santa Cruz	<i>Microlophus indefatigabilis</i>	
Santa Fe Land Iguana	Iguana terrestre de Santa Fe	<i>Conolophus pallidus</i>	
Santiago <i>Nesoryzomys</i>	Santiago <i>Nesoryzomys</i>	<i>Nesoryzomys swarthi</i>	
Scalloped Hammerhead Shark	Tiburón martillo	<i>Sphyrna lewini</i>	
Sea Cucumber	Pepino de mar	<i>Isostichopus fuscus</i>	
Slipper Lobster	Langosta china, zapatera	<i>Scyllarides astori</i>	
Small Ground Finch	Pinzón de tierra pequeño	<i>Geospiza fuliginosa</i>	
Smooth-billed Ani	Garrapatero	<i>Crotophaga ani</i>	
Spaghetti Bryozoan	Briozoo Espagueti	<i>Amathia verticillata</i>	
Sperm Whale	Cachalote	<i>Physeter macrocephalus</i>	
Spiny Gladiator Lichen	Liquen con clavas espinosa-sa de gladiador	<i>Acantholichen galapagoensis</i>	
Stony Lobe Coral	Coral pétreo lobata	<i>Porites lobata</i>	
Thin-leaved Darwin's Shrub	Margarita de Darwin	<i>Darwiniothamnus tenuifolius</i>	
Tiger Shark	Tiburón tigre	<i>Galeocерdo cuvier</i>	
Tropical Fire Ant	Hormiga tropical de fuego, hormiga negra	<i>Solenopsis geminata</i>	
Waved Albatross	Albatros de Galápagos	<i>Phoebastria irrorata</i>	
Whale Shark	Tiburón ballena	<i>Rhincodon typus</i>	
White-spotted Sandbass	Cabrilla, mancha blanca, camotillo	<i>Paralabrax albomaculatus</i>	
Wolf spiders (Lycosids)	Arañas lobo	<i>Hogna spp.</i>	
Yellow Fever Mosquito	Mosquito de la fiebre amarilla	<i>Aedes aegypti</i>	
Yellow Paper Wasp	Avispa amarilla de papel	<i>Polistes versicolor</i>	
Yellowfin Tuna	Atún aleta amarilla	<i>Thunnus albacares</i>	

Common name (English & Spanish).

Scientific name (Genus, species, authority, year).

Taxonomy (Kingdom : Division : Class : Order :

Picture



CURRENT STATUS

Current status. Describes population status, habitat details, distribution, and other relevant information of *Endemic, Native, or Single-island Species*; and for *Introduced or Invasive Species* includes the invasion history.

ECOLOGICAL IMPORTANCE

Ecological importance. For *Endemic or Native Species*, this section outlines the species' ecological or functional role (*Keystone, Bioindicator, Sentinel, Bioengineer, or Single-island Species*), interactions with other species, habitat use, and other relevant aspects. For *Introduced or Invasive Species*, it details current and potential ecological impacts.

AUTHOR (S)

Fact Sheet: _____

Map: _____

INFORMATION NEEDS

Information needs. Identifies the information gaps and research needs, as defined by the authors of each Fact Sheet.

DISTRIBUTION

Distribution. Geographic occurrence in Galapagos and its surroundings.

MY NOTES

My notes. A designated space for you to write your own observations and thoughts.

Map data sources: _____

Map methodology: _____





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CARING KINDNESS WISDOM



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