

GALAPAGOS NEWS

Summer 2020

GALAPAGOS "QUARANTEAM"

THE IGUANA FILES The Iguana Hybrid Zone

UNDERWATER INVADERS

GC PROJECT UPDATES:

Restoring an Island Paradise
Galapagos Vital Signs
Tortoises of Darwin Volcano
Tortoise with Pinta Genes Found!
Education for Sustainability

Back cover sneak peek:
**15 Española Tortoises
Go Home After 50+ Years**



**Galapagos
Conservancy**
Saving One of the World's Great Treasures

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On behalf of GC, Johannah Barry is thanked in March 2020 with a plaque that is now permanently installed at the Lonesome George exhibit in Puerto Ayora, Santa Cruz. © GC/Ros Cameron

FROM THE PRESIDENT Johannah Barry

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Cover Image
Marine Iguana pair.
Photo by Robert
Luecking of Berlin,
Germany.

Our news is dominated by, for many of us, a new term. COVID-19. The novel coronavirus, unleashed early in 2020, has transformed our world. We will remember our lives before and after this pandemic, and we will, I hope, marvel at the resiliency of the natural world.

This issue of *Galapagos News* focuses on resiliency and optimism. Marine iguanas span our cover, and their unique behaviors are the focus of two fascinating articles. The restoration of Floreana Island aims to reverse the impact of invasive species on this island and to bring back near-extinct species, including a tortoise population that went extinct in the wild in the mid-1800s. Our giant tortoise work has also brought us wonderful, uplifting news from the natural world which is discussed in correspondence from GC's Giant Tortoise Restoration Initiative (GTRI) leader, Wacho Tapia. Finding a Pinta tortoise hybrid gives us a possible avenue for restoring the Pinta population, which was thought to have ended with the death of Lonesome George in 2012. And while the act of bringing something to an end is generally considered unhappy, quite the opposite is true with the news that the Española tortoise breeding program has concluded (see back cover!), signaling the overwhelming success of this work over the last several decades.

GC's donors have supported a number of critical projects in the Islands, and the work on marine invasives is one such long-term investment. The marine team at the Charles Darwin Foundation, led by Dr. Inti Keith, has identified the vehicles for marine invasions and now seeks innovative solutions to ensure that non-native species harmful to the ecosystem do not become established. What we have learned from terrestrial invasions will now be brought to bear on the Galapagos marine environment.

We describe Galapagos Conservancy's newest project, *Galapagos Vital Signs*, as an early warning system to detect and predict the impacts of climate variability on Galapagos species and ecosystems. As importantly, it is a tool we are making available to anyone, including all resource users in the Islands to view biogeographical data (precipitation, sea surface temperatures, etc.) in real time to inform management decision-making, particularly in the face of more permanent shifts in climate associated with global climate change. You can learn about *Vital Signs* in our GC Project Updates, as well as the exciting deployment of wildlife cameras to assist in monitoring and evaluation. As always, our successes are made possible by the foresight and optimism of our donors and supporters. Thank you all for being part of this dynamic work.



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Galapagos News is a twice-yearly publication that is produced for Galapagos Conservancy supporters and friends. The information in this issue was obtained from various sources, all of which have extensive knowledge of Galapagos. The opinions expressed are those of the authors, and not necessarily of Galapagos Conservancy.
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GALAPAGOS CONSERVANCY MEMBERSHIP

GALAPAGOS CONSERVANCY STANDARD MEMBERSHIP

Thanks to all of our members who make our work possible. We could not preserve, protect, and restore the Galapagos Islands without your generosity and commitment to conservation. Our annual membership levels are as follows:

Friend: \$30 Supporter: \$100 Protector: \$500
Family: \$50 Advocate: \$250

GALAPAGOS AMBASSADOR SOCIETY

With your gift of \$1,000 or more (or cumulative annual giving of \$1,000), we will welcome you to the Galapagos Ambassador Society. Many of our Galapagos Ambassadors are often willing to become closely and regularly involved in our programs. Ambassadors receive special updates and briefings; invitations to attend special member events; recognition in the GC Annual Report; and a special Ambassador welcome gift.

Española Society: \$1,000 to \$4,999
Santiago Society: \$5,000 to \$9,999
Fernandina Society: \$10,000 to \$24,999
Isabela Society: \$25,000 and up

GALAPAGOS GUARDIANS SOCIETY - Monthly giving

Galapagos Guardian Society members give recurring monthly contributions that are charged automatically to a credit card. These members help us reduce our fundraising costs because we do not send them annual membership renewal notices for the duration of their support. This is an easy and secure way to provide GC with ongoing funds that we can use to address the most critical conservation challenges in Galapagos. To join, please see the mail-in form to the right or join online at www.galapagos.org/monthly or call **703-383-0077**.

If your employer matches charitable contributions, you could double your impact on Galapagos Conservancy's efforts. **GC's EIN # is 13-3281486.**



SAFEGUARDING GALAPAGOS through COVID-19

If your situation allows, and you are able to return a donation with this form, your gift will go directly to help Galapagos Conservancy support the efforts of the Galapagos National Park Directorate, the Galapagos Biosecurity Agency, and other partners working to safeguard the Islands during the COVID-19 pandemic.

☐ **YES!** Galapagos Conservancy needs my extra support during this unprecedented time for our planet.

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☐ My check is enclosed.

Or, please charge my:

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Name on Card: _____

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☐ I'd like to make this gift a monthly gift and become a member of the Galapagos Guardians Society. By checking this box, I agree to have my credit card charged once a month for the amount indicated above (\$10 minimum).

Questions?

Email: member@galapagos.org

Cut out, use centerfold envelope, or mail this form to:

Galapagos Conservancy - Member Services
11150 Fairfax Blvd. Suite 408
Fairfax, VA 22030 USA

To make your gift online, visit:

www.galapagos.org/covid

Note: We will be collecting gifts for this fund through 8/31/2020.

(B20GCOVID)

GALAPAGOS NEWS

VOLCANIC ERUPTION ON FERNANDINA

A volcanic eruption took place on January 12, 2020 at La Cumbre Volcano on Fernandina Island. The eruption took place from a fissure close to the summit on its eastern side and was preceded by an increase in earthquake activity. La Cumbre is the most active volcano in Galapagos and, on average, has an eruption every three years. The last few years have seen slightly higher activity with eruptions in 2017, 2018, and 2020. However, this is not unusual and is not expected to represent a fundamental change in the system. As with most volcanic activity on Fernandina, the January eruption was small, producing a cloud of volcanic gas, which could be seen by nearby boats and on neighboring islands. Lava flows stretched down the east flank of the volcano, though they did not reach the ocean.

Any risk to humans was low due to there being no settlements on Fernandina, and the wind carried the gas plume away from the populated islands (Isabela, Santa Cruz, Floreana, and San Cristóbal). The environmental risk was slightly higher, with other recent eruptions of La Cumbre causing significant fires which can cause habitat damage. La Cumbre is one of the best-monitored volcanoes in Galapagos, along with Sierra Negra which is located on the southern end of Isabela Island.



Fernandina lava flows, seen from a helicopter during a 2017 eruption.
© Wacho Tapia, GTRI

CONSERVATION DURING THE PANDEMIC

The ongoing COVID-19 pandemic and its resulting social distancing measures led to the temporary postponement of most fieldwork activities in the Galapagos Islands since mid-March. Conservation efforts carry on, as the Galapagos National Park staff are continuing to maintain the tortoise breeding centers in the Islands and to conduct key wildlife monitoring activities. The Biosecurity Agency of Galapagos (ABG) — who are on the front lines of the pandemic — are involved in daily monitoring, inspection, sanitation, and testing activities related to the pandemic in the Islands. Many scientists supported by Galapagos Conservancy (GC) are using this time as an opportunity to conduct research online, plan for future needs, write reports, and analyze data.

GC is continuing to secure funding (see form on page 3) to safeguard the Islands despite the current public health crisis, providing financial assistance to both the ABG and the Park, as well as to the Galapagos Governing Council. The current crisis has reinforced how much GC depends on member support, allowing us to fulfill the mission of protecting these enchanting Islands and their remarkable native species. Though the pandemic has changed many people's financial circumstances, more than ever, GC remains committed to protecting Galapagos.



Photos at right: Galapagos residents return to the Islands from mainland Ecuador. New biosecurity measures are now in place to ensure new cases of COVID-19 do not arrive in Galapagos. © Biosecurity Agency of Galapagos

GALAPAGOS SHARKS RECLASSIFIED

There was good and bad news for Galapagos sharks at the end of 2019 as thousands of species were reassessed on the IUCN Red List of Threatened Species. We were saddened to see that the scalloped hammerhead shark (*Sphyrna lewini*) has been upgraded to *Critically Endangered*. However, the Galapagos shark (*Carcharhinus galapagensis*) is now listed as *Least Concern*.

Galapagos Conservancy plays an important role in the protection and conservation of sharks through its involvement in the citizen scientist app called *Shark Count*, which allows users to help scientists by logging shark species (and other large marine animals) seen on dives and snorkels while in the Galapagos Islands. Data is shared with the Galapagos National Park to inform their management decisions focused on protecting marine life.

Visit sharkcount.org for more information.

FINCHES STRUGGLE WITH BLACK MANGROVE DIEBACK

Galapagos Conservancy has partnered with the Charles Darwin Foundation for years in landbird conservation, including efforts to save the *Critically Endangered* mangrove finch (*Camarhynchus heliobates*). Habitat loss combined with the presence of introduced black rats (*Rattus rattus*) and the invasive parasitic fly (*Philornis downsi*), for which the birds have no natural defense, has driven the species to the brink of extinction. However, thanks to extraordinary conservation efforts, population estimates have grown significantly from 60 birds in 2014 to 100 birds today.

Once found across many sites on Isabela and Fernandina, mangrove finch populations are now restricted to just two small patches of mangrove on Isabela Island; Playa Tortuga Negra and Caleta Black. These tiny strongholds are the species' last hope at survival in the wild.

During fieldwork in 2019, however, a research team noticed significant dieback of black mangroves (*Avicennia germinans*), the preferred tree for mangrove finch nesting, at Playa Tortuga Negra. Why this is happening and whether the trees are capable of recovering is still unknown, but members of the IUCN Invasive Species Specialist Group suspect that a beetle is partly to blame. The black mangroves are likely already stressed by an environmental factor that has made them more susceptible to beetle damage. Unfortunately, the loss of the finches' preferred nesting tree coupled with existing pressures on the population could have further negative impacts.

Assessment of what is driving the tree mortality will be a priority in 2020 when field work resumes, post-COVID-19 restrictions. Monitoring will be repeated in 2021 to confirm what is driving the dieback, as well as the scale and any impacts on other mangrove species. It is vital that these remaining habitats are protected and healthy in order for the mangrove finch to survive in the wild in perpetuity.



Scalloped hammerhead shark © Dr. Simon Pierce

"OIL SPILL" INCIDENT THAT WASN'T

On December 23, 2019, it was widely reported that an oil spill had taken place on San Cristóbal Island after a barge overturned while being loaded with a container, which led to a crane falling into the water. An operation to refloat and extract the 40-foot container was successfully implemented by the San Cristóbal Municipal Government and the Galapagos Governing Council.

Despite dramatic news coverage of the incident, the extraction of the container, holding an electric transformer carrying 600 gallons of oil in its tank, came out complete. The impact on the surrounding marine environment was minimal. The then Ecuadorian Environment Minister Raul Ledesma commented at the time, "Not a single species has been affected by the spill in San Cristóbal." Ledesma said that veterinarians tested several marine iguanas and two sea lions in the area for possible side effects from the spill, of which none were found. The Emergency Operations Committee, chaired by Minister Norman Wray, worked to reduce and mitigate any future impact on the San Cristóbal marine ecosystem.

REMEMBERING HENDRIK HOECK

Dr. Hendrik Hoeck, founder and president of the Swiss Association of Friends of the Galapagos Islands, passed away last November after losing his battle with cancer. Hendrik was a passionate advocate for Galapagos, who spent decades working toward the long-term conservation of these Islands.

Hendrik's unique background as a Swiss citizen born in Colombia gave him an important perspective as he assumed the role of Director of the Charles Darwin Research Station in 1978. During his two year tenure, he pushed forward measures to control feral animals, recognizing the critical importance of addressing the growing problem of introduced species in Galapagos. He also forged strong relationships with the Smithsonian Institution, managing a ham radio operation between the two institutions that provided a communication lifeline for an isolated research station. GC's president Johannah Barry said, "It was my privilege to know Hendrik and work alongside him and other dedicated volunteers to create the Swiss Association and to support his lifelong commitment to conservation throughout the world."

— A Local Perspective —

GALAPAGOS “QUARANTEAM” BUILDS A SAFETY NET FOR THE FUTURE



Roslyn Cameron plays a critical role as Galapagos Conservancy's local Galapagos “liaison.” She is a long-term resident of Puerto Ayora, Santa Cruz and worked as an educator for many years before changing her career focus to conservation. Ros has an integrated relationship with multiple sectors of the Galapagos community.

by Roslyn Cameron, Galapagos Liaison for Galapagos Conservancy

With hundreds of visitors entering each week from different parts of the globe, Galapagos was particularly vulnerable to the arrival of COVID-19. The limited local medical facilities in the Islands made it essential to avoid a widespread outbreak. Though early cases of the virus were confirmed in the populated islands, the decisive action by Ecuador’s government and local authorities quickly encircled our community in a protective quarantine net. Access to Galapagos closed on March 17, 2020. For 10 weeks we sheltered in place, adhering to a strict curfew, and abiding by social-distancing protocols. Our efforts were successful in keeping our community safe and a reactivation phase with less strict protocols began on May 26th. During the lockdown the 3,000+ residents stranded on the mainland began returning under meticulous entry protocols. The lockdown had coincided with school holidays so many were children and teachers.

Through it all, the Galapagos Governing Council has ensured basic services such as cargo, water, internet, and electricity, and is providing detailed daily updates to allay speculation and fear. While we stayed safe working from home, the organizations on the front lines worked tirelessly to implement mass testing for the virus and protocols for human movement. Biosecurity staff are inspecting and fumigating cargo and public areas. Park rangers continue to monitor the Marine Reserve and conduct other key conservation work. The reactivation phase allows for limited return-to-work options, and non-essential businesses have started to open their doors.

However, tourism, the base of the Islands’ economy, shut down overnight resulting in mass unemployment and severe economic losses. Mainland Ecuador opened borders to commercial passenger flights beginning on June 1st, and the reopening of Galapagos is anticipated soon, albeit with new control regulations. The pandemic has given pause to reflect on the relationship between nature, industry, and travel. The Galapagos Governing Council is coordinating local discussion forums involving all sectors of the community that are buzzing with ideas for ensuring public safety and how to sustainably rebuild the local economy.

The lifestyle adjustments of lockdown brought our community closer together. I am very proud of how we rallied to make sure no one felt alone or went without while adhering to the simple rules to keep us safe. Galapagos residents

have come up with smart new solutions and inspired ways of ensuring life goes on:

- Fishermen and farmers have kept fresh produce on the tables.
- Restaurants and other businesses have been creative with novel home delivery options.
- Food baskets have been delivered to the most vulnerable and isolated residents.
- Donation drop-off points have been established.
- Vegetable gardens have sprouted in home backyards.
- Local artists, musicians, and poets have hosted events to help fundraise and keep spirits high.



© Adrian Vasquez

I am working closely with Johannah Barry and my GC colleagues to keep everyone informed, as well as to help local institutions seeking emergency supplies and funding for post-COVID-19 recovery efforts.

This pandemic is an unprecedented crisis that has catapulted us all to face challenges — personally, professionally, and as a community. It has become an unexpected catalyst to propel the cooperation and goodwill of all institutions and individuals concerned about Galapagos today and for the future. While recovery will take time, this crisis has brought sectors together as a united “Quaranteam” and has provided us with an opportunity to take a new path in Galapagos — one built on a renewed understanding of the fragility of nature and the local economy.

At GC, we believe in the power of collaboration, and we have the flexibility to help address these important issues, ensuring long term conservation priorities are met and opportunities for innovation are encouraged. Galapagos Conservancy is needed now more than ever. ■



Restaurants offer home delivery by bike. © Ros Cameron

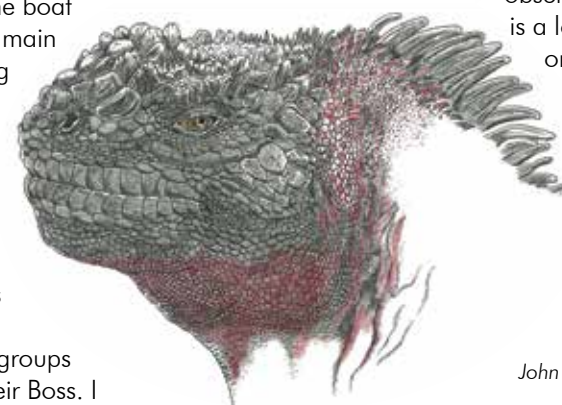
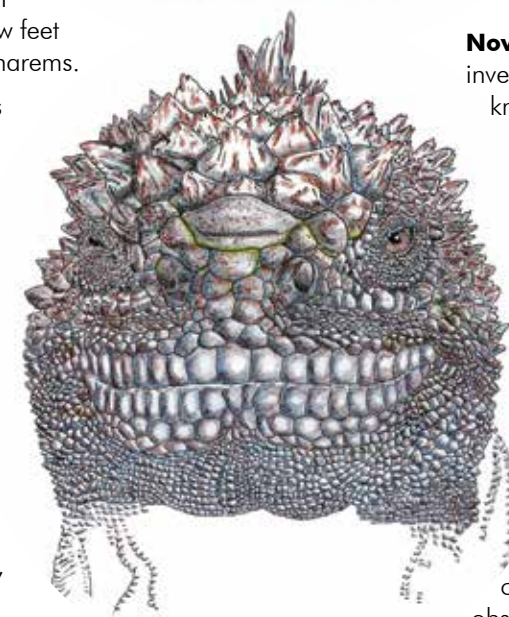
THE IGUANA FILES

John Bendon spent ten weeks over two years in Galapagos, mostly on Santa Cruz, where he wandered from beach to beach watching the marine iguanas, photographing them, and writing about the behaviors he witnessed. The photos were studied and copied in pen and ink, as accurately as possible and used to assess any differences between subspecies, of which there are now at least eleven. Below are snapshots written by John of the iguanas’ daily life on a beach in Santa Cruz.

November 4: It is difficult to figure out an optimum time to observe iguanas in action, if action is the word for it. There are several stages in their day: get up; walk towards the sea; eat; crawl back; dry off; and go to sleep. From what I could tell, after an entire day, this happens twice a day as does the high and low tides. However, November is mating time here, the males are reddish and blotchy, aggressive and pretty active. I often note big reds sitting alone, and a few feet away were a group of females, big reds’ harems.

November 5: Finally figured out the tides here. Also the routine which, I suppose, will shift according to the tides. The order of the day seems to be: wake up; get warm; crawl to the water. If high tide, the heavier ones may dive and eat; if low tide, all sizes can graze on exposed, wet rocks. After eating, crawl to a rock and dry out and digest; sleep; wake up; do it again. This would appear to be twice a day. Around 5pm they crawl inland a little, to the Sesuvium and by 6pm it is bedtime and they magically vanish.

November 13: It was a drizzly day again, to get worse later. I discovered at the end of the day that the sea had come up the boat ramp in the town and had flooded the main street. The tide was noisy, and ramming into the rocks and pounding the shores, coming higher than normal. I made for the place where I usually see the most iguanas. They were all in the one place today, not much rock left to dry out on and not much dry air anyway. The iguanas and their females were dotted around, males all on their larger rocks. The colony had split into groups and each group had one red male, their Boss. I have now spotted the Big Boss, for the first time, more orange/red than the other ones. He started



strutting around, glaring at all the others and opening and closing his mouth, furiously nodding. Saliva was hanging off his jaw. I walked back along the path through the Sesuvium and saw a hole, not facing downwards but along, like a tunnel entrance. I was able to shine the flashlight into the hole, revealing a Sesuvium ‘cave’. Peering through it I saw several grey juvenile iguanas, all wrapped around both each other and a larger female.

November 15: I decided to do more investigating into the lizards’ places of rest. Now knowing what to look for, I found whole sets of ‘homes.’ As I stared and scrutinized the Sesuvium, a kind of ‘township’ came into view. Walking along the track between the lava rocks and the vegetation, looking again at those tunnels and domes, and I came across a hole. Inside this hole were two large back feet and two small legs and feet. This was Mr. and Mrs. Lizard’s house for sure. Not all species of iguanas have ‘families.’ In fact it is the adults that stay together, the young ones go off to be Bosses or part of a harem. I have seen ‘families’ here where there are young ones in the same hole. Some meet, couple up, and go their different ways. These observations are specific to this beach. There is a lot of vegetation here. At other areas, with only beach and rocks, the lifestyle would be different, for instance do they have specific places to sleep at night? Do they form groups? There is endless information and fun arising from watching these marine iguanas. I hope to return here again, and I know this colony will be here, waiting for me. ■

All illustrations were done by John Bendon. John is a member of the IUCN SSC Iguana Specialist Group that works in conjunction with the International Iguana Foundation. This piece is based purely on his observations and opinions. All iguana species have their own behaviors.

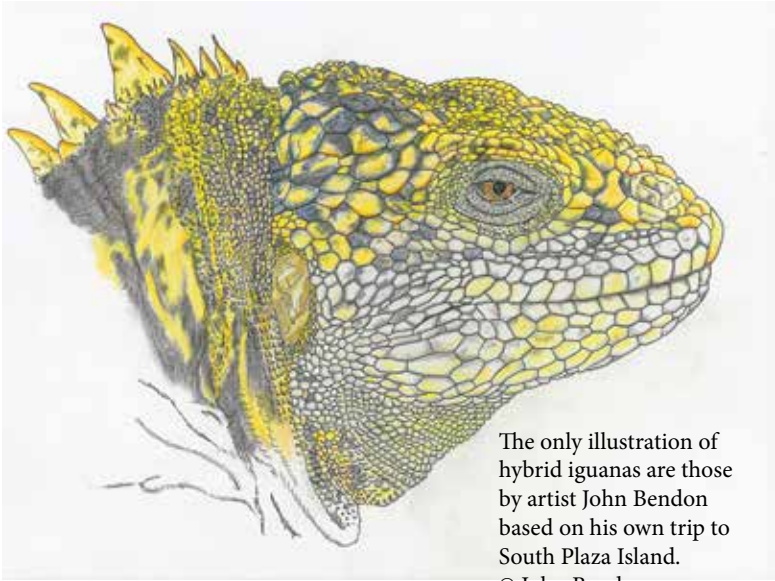


by Dr. Luis Ortiz-Catedral, Science Advisor to the Galapagos National Park Directorate

Since the early 1980s a number of unusual-looking iguanas has been noticed on South Plaza island, an apparent cross between land and marine iguanas. But why are there hybrids of these species?

Among animals, a species can be loosely defined as a collective of individuals that can mate and produce viable offspring, and that is reproductively isolated from other populations. Reproductive isolation is the line in the sand, the boundary that defines a species as a biological unit. The theory suggests that there are morphological and behavioral features that keep individuals from mating with the “wrong” species. After all, mating is expensive, and mating with the wrong individual is likely to affect an individual’s reproductive success and even survival. Take for instance the elaborate dances of blue-footed boobies: when a pair of these colorful birds engages in courtship dances, both individuals assess the quality of their partner, but also, the accuracy of the moves. If a booby belonging to a different species were to dance in front of a blue-footed individual with the intention of mating, chances are its efforts would go unnoticed or, worse even, the individual might be chased off or injured. Nevertheless, there are plenty of examples that show the line in the sand is sometimes crossed. In fact, hybrid offspring can end up giving rise to a new subspecies or even species, a lineage that is distinct from either of the parental species. The mockingbirds of Genovesa Island (*Mimus parvulus*

bauri) appear to be a case in point, where their genetic makeup strongly suggests there was once interbreeding between the San Cristóbal mockingbird (*M. melanotis*) and another mockingbird species from the northwest of the Archipelago (*M. parvulus*). In spite of their hybrid ancestry, Genovesa mockingbirds seem happy reproducing among themselves and produce healthy, fertile offspring. The same is true for the finches of Daphne Major, where Peter and Rosemary Grant have repeatedly seen hybridizations between finches from different *Geospiza* species. Over the last 20 years, it has also emerged that many of the giant tortoises, particularly those on Wolf Volcano on Isabela, are hybrids or the descendants of hybrids (see page 15).



A less well known but no less striking example of inter-species hybridization has been observed between the land iguanas (*Conolophus subcristatus*) and marine iguanas (*Amblyrhynchus cristatus*) on the small uplifted island of South Plaza. These crosses were first noted in 1981 and formally described in 1997. Since then, rangers from the Galapagos National Park and tour guides have reported a handful of other instances of iguana hybridization. The hybrids have a very distinctive coloration, a blend of dirty yellow and dark grey, and boast dorsal head scales that are intermediate between the two parental species. Genetic analysis of these peculiar individuals confirms that they are indeed hybrids, with a 50:50 mix of land iguana and marine iguana DNA. What is less clear is why these hybrids have only ever been seen on South Plaza, even though there are plenty of other islands where land iguanas and marine iguanas live alongside each other. It may be because this is such a small island — only 200 meters across at its widest point — that there is just more opportunity for the two iguana species to interact. There are other mysteries, too, like whether these hybrid offspring feed exclusively on land vegetation. No hybrids have been seen venturing into the water, which suggests that metabolically, they might be closer to land iguanas. It is also the case that every South Plaza hybrid that’s been studied appears to be the offspring of a male marine iguana and a female land iguana, rather than the other way around.

The explanation for this observation remains unclear,



though there are two main hypotheses. In both marine iguanas and land iguanas, males are territorial and display elaborate head-bobbing and posturing to communicate dominance to their fellow males and to attract females. With a hierarchy established, the most dominant males get to control a small group of females and prevent other males from mating with them. In marine iguanas, however, less dominant males may still be able to obtain some paternity by adopting a “satellite” strategy, hanging out at some distance from the main group and sneaking a copulation with one of the females should the chance arise. The appearance of hybrid iguanas on South Plaza could be explained if these satellite marine males occasionally direct their efforts at female land iguanas instead. Alternatively, hybridization could be the result of female choice, with some female land iguanas actively choosing to mate with male marine iguanas with the most exaggerated displays. Although we don’t yet understand exactly how these hybrids come about, they appear to be infertile, so unlike the Genovesa mockingbirds, the finches of Daphne Major or the giant tortoises on Isabela, the South Plaza hybrids cannot pass on their mixed-up genes to subsequent generations so could never give rise to a new subspecies or species. Nevertheless, they are still of great interest to science, individuals that seem to embody the processes of divergence for which Galapagos has become famous. On your next visit to South Plaza, make sure you ask your tour guide about these one-off iguanas and if you’re lucky, you might even see one. ■



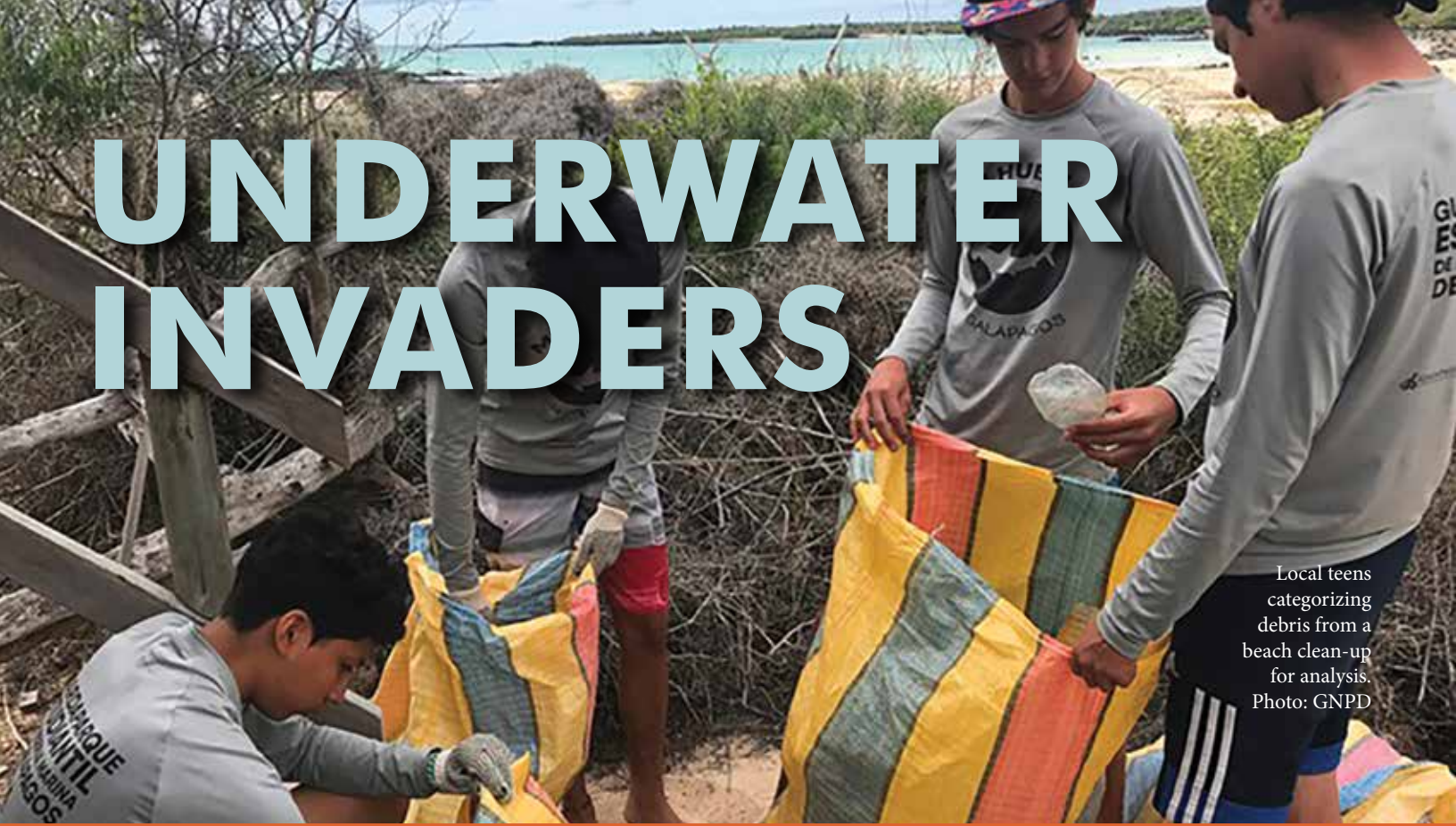
When you think of iconic reptiles, you think of the Galapagos Islands. The Islands’ most famous resident is of course the Galapagos giant tortoise. In fact, the very word ‘Galapagos’ derives from an old Spanish word for tortoises. Other well-loved Galapagos reptiles include the land and marine iguanas, but did you know that Galapagos is also home to a pink land iguana? Only recently described as a separate species, the **Galapagos pink land iguana** (*Conolophus marthae*) is now on the brink of extinction. There are only about 200 individuals left, and they are confined to the slopes of Wolf Volcano on Isabela Island, making them one of the most threatened species in Galapagos, as the volcano there is still quite active. GC’s Wacho Tapia is one of the most knowledgeable experts on pink iguanas in the world. In partnership with the Galapagos National Park, he is involved in ongoing conservation measures to protect these rare and special creatures.



AUTHOR

Dr. Luis Ortiz-Catedral is a lecturer in Environmental Science/Ecology at Massey University, New Zealand. Luis supports the conservation management of Galapagos as a science advisor for the Galapagos National Park Directorate. His research focuses on the Floreana mockingbird, Galapagos land iguana, and Galapagos racer snake.

UNDERWATER INVADERS



Local teens categorizing debris from a beach clean-up for analysis. Photo: GNPD

by Jessica Howard, Marine Biologist for the Charles Darwin Foundation

Galapagos is leading the charge in marine biosecurity, with one of the most stringent programs in the world. But, with increasing challenges facing the endemic species of Galapagos, is the ecological door open for marine invasive species to move in?

An invasive species is any living organism that has travelled into an environment in which it isn't found naturally, causing harm to the local environment, economy, or human health. The effects on local populations are wildly unpredictable, but they often disturb native populations either through predation, competition for space and food, or by introducing unfamiliar diseases.

The geographic remoteness of the Galapagos Islands has naturally limited the arrival of new species, giving the animals and plants there the opportunity to evolve in relative isolation, without much competition or predation to worry about. This has resulted in some amazing adaptations that are unique to the Islands, like the endemic algae-munching marine iguana.

However, this has also left the native species of Galapagos vulnerable to invasions, as they have few natural defenses. As such, invasive species are the ultimate threat to Galapagos wildlife, but with most of the awareness surrounding terrestrial invasions, we're going to dive under the waves to explore the lesser known world of marine invasive species.

The ocean has always been a dispersal mechanism for non-native species, and through swimming, following currents, or hitching a ride on anything that floats, these species have

found new coastlines in which to flourish.

Since humans began traversing the oceans, organisms have found more opportunities to stow away, travelling faster and further around the world. With increasing tourism and a booming local population, ship traffic to the Islands must also increase, bringing food and other goods to the community. Unfortunately, this is how most non-native species infiltrate new marine environments.

Ships can introduce new species through ballast water, which can be full of whatever traumatized species got sucked up where the ship was loaded. They can also piggy-back on the outside of boats, either by permanently attaching or by hiding in nooks and crannies, and by hitch-hiking a ride on anything else that floats. These species can attach to wood, algae, and of increasing concern, plastic pollution. This enables them to travel for even greater distances, as ocean plastic seems to be one of the only habitats that we are not destroying. (See sidebar on page 11.)

In the midst of the climate crisis, natural barriers in water temperature (which have previously limited the spread of non-native species) are breaking down, leaving invasive species better poised to exploit and populate new habitats where they once wouldn't have been able to. This, when paired with El Niño events potentially increasing in frequency and intensity, will challenge the survival of native species, making them even more susceptible to invasions.

In a recent study from the Smithsonian Environmental Research Center, Williams College, and the Charles Darwin Foundation, scientists found 53 non-native marine species living around the Islands, when previously we knew of just five. This study was limited to only one habitat (harbors), between

two islands, suggesting that the actual numbers of invasive species could be considerably higher. The alien species included worms, crabs, and mussels, which were observed burrowing into living coral colonies in Galapagos.

In 2012, the Charles Darwin Foundation initiated the **Marine Invasive Species Project**, a large-scale monitoring project targeting marine invasive species in Galapagos. The project, spearheaded by Dr. Inti Keith and funded by Galapagos Conservancy, has developed an early detection scheme through continuous monitoring of settlement plates in Ecuador as well as in Galapagos. These devices allow the controlled collection of data on colonization by new species.

The team is also monitoring a well established invasive alga, *Caulerpa racemosa*, which is especially dangerous for corals, as the rapid-growing algae may smother them if growth rates increase. Policy changes have been implemented to prevent future invasions, with every international vessel that enters the Archipelago inspected by divers for nonnative species. If they find any the ship is asked to leave and have its hull cleaned before returning for a second inspection. The generation of a central 'cargo hub' has been introduced to consolidate the threat of marine bioinvasions to just two areas of the Archipelago. A third recommendation is that ballast water should not be released in Galapagos, unless it has been exchanged at sea beforehand.

Despite these advances, the risk of marine invasive species remains high. The two biggest and most likely threats at the moment are thought to be the Indopacific lionfish, which may spread from the Caribbean through the Panama Canal and reach Galapagos, where it's likely to be very successful. Another possible arrival is the snowflake coral, which has already caused widespread death of native corals along the South American coastline.

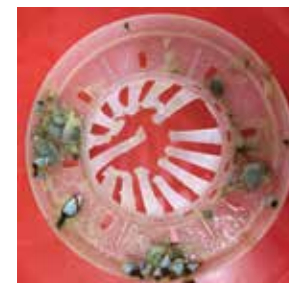
Now that we have a better understanding of what invasive species have already established themselves in Galapagos, the next steps will be to figure out how they are affecting native populations and how we can prevent further introductions. ■

AUTHOR



Jessica Howard is a marine biologist who worked in the Galapagos Islands as a researcher on the marine plastic and invasive species team at the Charles Darwin Foundation. Having moved back to the UK, she is now studying with the Science Communication Unit in Bristol.

Galapagos Conservancy has proudly funded the Marine Invasive Species Project annually since its inception in 2012.



Above: Goose barnacles in a plastic fish trap (All images © Jess Howard)

PLASTIC DEBRIS THREATENS MARINE RESERVE



In 2016, a new species washed up on the shore of Santa Cruz Island in the Galapagos Archipelago, securely fixed to a piece of floating plastic. Fortunately, the non-native one-centimeter stalked barnacle (*Dosima fascicularis*, at right) is not invasive. It is unlikely to outcompete other barnacles, take over their habitat, or alter ecosystem food webs. But, its ability to reach the Islands attached to plastic is a sign of the times, and a new challenge that Galapagos marine scientists are monitoring carefully.

Plastic debris has provided a novel and devastatingly abundant habitat for marine hitchhikers, creating diverse communities of species associated with floating plastic and transported over large distances by oceanic currents. Roughly 25% of all plastic found on beaches in Galapagos is colonized by at least one plant or animal that has adhered to the plastic surface.

Galapagos is situated at the confluence of several major marine currents, which enables the arrival of species from across the Pacific Ocean. In a place of origin far away from the Islands, plastic refuse tossed in the street can enter storm drains, be carried by rivers and sometimes, after years of floating across the ocean, eventually wash up on the shores of this important World Heritage Site.

In 2016, the Marine Invasive Species Project expanded the scope of its marine debris monitoring to the entire Galapagos Archipelago. They set up a marine debris drop-off point at the Charles Darwin Research Station on Santa Cruz, where anyone can bring plastic that they find on beaches in Galapagos. They partnered with other organizations undertaking beach clean-up expeditions in the Islands, and they also engaged the Naturalist and Dive Guides Associations, who distributed flyers to encourage the general public and tourists to bring in plastics found at visitor sites.

As of February 2019, the team had analyzed 1,442 plastic samples collected throughout the Archipelago. They documented a total of 11,267 individual organisms that represent 8 groups and created a database of all organisms found, cataloged by island and type of plastic debris. Fortunately, only one non-native species was identified, the stalked barnacle mentioned at the beginning of this sidebar. Nonetheless, the thousands of individual organisms encountered thus far clearly demonstrate that plastic debris provides an effective means for plants and animals to "raft" into the Galapagos Marine Reserve. Regular monitoring and research is essential so that early action can be taken for potentially dangerous species that could alter ecosystems, food webs, and human livelihoods.

Adapted from GC. 2019. **Galapagos Report 2017-2018**. Full article can be found at www.galapagosreport.org

Battery-operated drones
being used on North
Seymour Island.

RESTORING an ISLAND PARADISE

♦ GC PROJECT UPDATE ♦

by Karl Campbell & Andy Donnelly of Island Conservation

Over the last couple of centuries, the loss of global biodiversity has been described as the sixth great extinction event in Planet Earth's history, the last one having been responsible for wiping out the dinosaurs. What is less known is that 80% of species that have gone extinct in the last two centuries have been lost from islands.

A major cause of island extinctions has been the introduction of invasive species, with predators like cats, rats, and mice particularly devastating. But the work of organizations like GC's partner Island Conservation demonstrates that this impact can be reversed. There are now more than one thousand success stories, where the removal of invasive species has resulted in the recovery of native flora and fauna, and this approach is our best opportunity to slow down the current rate of extinction. Most of the examples, however, are from small and uninhabited islets because the bigger the island and the greater the human presence, the more complex and costly the eradication becomes.

The removal of cats, rats, and mice from Floreana Island in Galapagos is one of the most ambitious restoration projects anywhere in the world, from both a complexity perspective but also from the number of species that stand to benefit. The IUCN lists 55 native species on Floreana that are threatened with extinction, including the near-extinct Floreana mockingbird and Galapagos racer snake.

Floreana is about 42,500 acres of dry lowlands, highland Scalesia forest and lowland farmland managed by the local human population of about 100 people. The size of the island and the presence of both residents and a tourist population of several thousand a year poses huge technical challenges and raises the cost of eradication significantly. This is why Floreana has been identified as a strategic focus in Galapagos. This is a perfect opportunity to pioneer innovative, cost-effective solutions that can be used in similarly complex settings on islands elsewhere.

After several decades of conducting such projects, Island Conservation has identified two prerequisites that are particularly important to reduce the risks, the duration, and the costs of such eradication initiatives. First, it is essential that island communities have ownership of the project, are its greatest advocates, and that there is a simple, transparent process in place for resolving any conflicts that may arise. Without this, the project will not succeed and, even if eradication is achieved, it is almost inevitable that there will be a reinvasion of invasive species at a later date. Second is the efficient and effective delivery of poisoned bait across the island — the single most expensive component of any large-scale eradication. Up until recently, this was carried out using helicopters, which on an island the size of Floreana might take two months or more.

The development of drone technology over the last decade, however, has suggested a viable alternative. It is a method that could achieve greater precision, operate in all but the most extreme weather conditions as well as 24 hours a day, thereby reducing the duration and cost of delivering bait across vast, inaccessible areas. In January 2019, Island Conservation, the Galapagos National Park, and the start-up Environmental and Conservation Technologies (ECT) completed a world first, using battery-operated drones to deliver payloads of 20 kg across the small island of North Seymour. Floreana is nearly 100 times larger, but there are now military-scale drones capable of lifting more than 200 kg that could replace helicopters for 90% of the operation on Floreana.

The eradication event on Floreana is scheduled for 2021. Once complete, we are confident the effort will restore the lineages of several endangered species. But moreover, what we will have learned from the effort is also likely to change the landscape of restoration ecology the world over. ■

Galapagos Conservancy has funded many of the restoration efforts on Floreana Island, aka "Project Floreana," a multi-year, multi-institutional effort to restore balance to the ecosystem using a combination of community-based conservation and adaptive management techniques. The project focuses on the natural ecosystem (eliminating introduced species and restoring native species like tortoises) while improving the conditions of the small local human community.

© Island Conservation/GNPD

♦ GC PROJECT UPDATE ♦

GALAPAGOS VITAL SIGNS

Galapagos Vital Signs can be accessed at:
www.galapagosvitalsigns.org

by Kimber Wukitsch, Director of Digital Marketing at Galapagos Conservancy

In January, Galapagos Conservancy launched the highly anticipated Galapagos Vital Signs online dashboard, a satellite-based monitoring system of environmental indicators — including temperature, precipitation, and plant productivity — for the five principal protected zones of the Galapagos Marine Reserve, fourteen major islands, and five major volcanoes on Isabela Island. The goal of the project is to provide up-to-date information on environmental conditions and biodiversity in Galapagos to inform the efforts of conservationists, scientists, agriculturalists, tour operators, divers, visitors, and others in the Archipelago. The datasets are refreshed daily to bi-weekly, depending on the data source, with current conditions summarized in each zone relative to their historic baselines. Raw data are also available for download.

Galapagos Vital Signs was conceptualized in 2018, and the many months since have involved a great deal of collaboration, identification of funding, testing and more leading up to its launch in January of this year. Since that time, site analytics have revealed an increasing number of users from around the world, much to our delight. What we didn't know when we launched, however, was that a global pandemic was looming that would catapult the world even further into an era where technology is paramount to our daily lives. In a sense, Vital Signs couldn't have come at a better time: as of this publication, most field work continues to be temporarily suspended in the Islands, travel within and to the Islands is a fraction of what it was before the pandemic began, and the Islands' residents — including its researchers — have been under quarantine orders. Yet Vital Signs is allowing researchers to monitor conditions on different islands within the Archipelago, without leaving the safety of their homes.

As restrictions begin to ease, we know that a "new normal" will begin to emerge in Galapagos — and the decision to invest in Vital Signs seems more cogent than ever. Satellite data continues to stream in during the pandemic and keeps us up-to-date on the status of even the most remote islands of Galapagos. We are in the early stages of developing a predictive tool for use with climate change modeling efforts.



A few screen shots
from the new
Galapagos Vital Signs
website.

And we are exploring how to add other on-the-ground monitoring efforts to the Vital Signs platform to provide a broader picture of what is transpiring in the Islands.

We hope that Galapagos Vital Signs will play an important role in allowing research and analysis to continue in the near term, while future updates promise even broader capabilities for the continued protection of the Islands. ■

VITAL SIGNS: The Fine Print

- The Vital Signs website also contains a robust section of related resources, which include links to the Charles Darwin Foundation's DataZone, the University of San Francisco Quito's Galapagos Vegetation Map, the Ecuador Navy Oceanographic Institute's Marine Data, the Shark Count Galapagos mobile app (<https://sharkcount.org/>), resources from NOAA and NASA, and others.
- The site can be viewed in both English and Spanish.
- Future phases of the project are planned and will depend on available resources.

CAMERA TRAP IMAGES for CITIZEN SCIENCE PROJECT



Last summer, members of the GTRI team installed 60 strategically placed **wildlife camera "traps,"** or motion-triggered cameras, on Santa Fe Island to collect data over time to help evaluate the impact, if any, of the reintroduction of tortoises on the island's ecosystem. The team recently collected the first set of images from all cameras and is in the process of setting up a citizen science project on Zooniverse.org, where people like you can help catalog the wildlife images "captured" by the cameras — such as the land iguana pictured here. Stay tuned for information on how you can get involved!

GTRI staff crossing the treacherous
lava terrain on Darwin Volcano.
© Wacho Tapia/GTRI

Darwin Volcano Mysteries Unraveled

by Wacho Tapia, Director of GC's Giant Tortoise Restoration Initiative

I do not consider myself an expert; just a humble biologist trying to contribute to the sustainability of my home — the Galapagos Archipelago. Over the last ten years, a frequent undertaking for me has been to organize and lead large scientific expeditions focusing on the search for giant tortoises. These expeditions are large both in terms of the number of people participating and in the area that is covered during each. Despite organizing many such expeditions, one has remained that has become almost a utopia in my mind due to the difficult and remote terrain, costly nature of working there, and the fact that we have very little knowledge of the tortoise population nor the site itself. This mystery is the giant tortoises of Darwin Volcano on northern Isabela Island.

Since the middle of the last century, several scientists have visited Darwin Volcano for various reasons — all using the same path (locally known as a “pica”) from Tagus Cove to the summit due to the great difficulty of walking between dense and thorny vegetation and rugged lava fields. In just a few hours of walking, even in the most expensive boots, they end up destroyed. This is without factoring in the exhaustion for any human to work in the difficult conditions associated with the intense equatorial sun. There are also ticks; although they prefer the tortoises, they latch onto humans as well.

Our challenge for this expedition to Darwin was to survey the entire area of the volcano that was covered by any type of vegetation and, as such, might host tortoises. We had invaluable help from satellite images and aerial photographs, which was very useful in designing an elegant plan, at least in theory — as are usually all the plans on paper!

After an intense and well-detailed preparation period, and with the help of a helicopter, 30 park rangers and scientists willing to give their best effort were deployed across the volcano. Upon arrival at their designated sites, each group looked for the best place to establish an improvised camp,

which would be their home for the next 10 days. It was then that we went from elegant planning to fieldwork reality.

For example, in my case I choose on the basis of my curiosity to explore new places, but especially with the purpose of being in a place where it was supposed to have permanent (radio) communication with all groups — the quadrant located on the volcano's summit. On the map, this circular summit area was quite long and narrow and seemed flat. However, the small detail that we did not take into account during the planning was that the maps are made in only two dimensions. So when we arrived at the site, we found that once the jaggedness of the area was considered it was in fact a much larger, longer, and more complex zone than expected, and it was not possible to have fluid communication with the other groups. Not only that, we had to walk 25 km on average daily, over rugged lava fields and through forests of very dense vegetation, but also up and down very steep slopes.



A detailed planning map (aerial view) used to outline the search zones on Darwin Volcano. © GTRI



One of the tortoises found on Darwin during this expedition. © GTRI

Not having good communication made me extremely tense. Not knowing the terrain of this remote volcano and not knowing what each group was going to find, I was worried about what was happening.

It was not until our fourth day when we were on the southern extreme of our zone that we managed to get communication with the other groups. We found out, for example, that the group assigned to one of the most difficult areas with little vegetation and where there were supposed to be few tortoises had found so many that the microchips had already run out for permanent marking. Ordinarily, this problem would have meant paralysis of the work program and census failure. However, the expertise, resourcefulness, and extreme physical ability of the park rangers had already surfaced. Having already established communication with the other groups, they coordinated in the same way in which “chasquis” or messengers who used to cross the “Inca Trail.”

Regardless of the distance or the difficult terrain, let alone the inclement sun and the limited amount of water to hydrate, the park guards had traveled many kilometers to obtain microchips from those groups that did not have many tortoises, sharing and distributing them as needed, to assure we were able to meet our objectives for the expedition.

We had not visited the volcano since 2002 when there were



A pair of new hiking boots destroyed after a few days on the rough lava on Darwin Volcano. © Wacho Tapia/GTRI

still goats all over it. At that time the presence of goats was very evident, not only because they were easy to spot but because the vegetation was completely open due to the voracious appetite of the goats. What we found 10 years after their eradication was an elixir for the soul of the biologist: the ecosystem was recovered and the forests again dense. All the ecological processes in full development yet again. ■

AUTHOR

WACHO TAPIA joined GC in 2014 as the Galapagos-based Director of the Giant Tortoise Restoration Initiative (GTRI). His work involves constant collaboration with the Galapagos National Park, he coordinates and leads all GTRI fieldwork, and plays a vital role in many areas of ecosystem conservation work.



The young female tortoise with Pinta ancestry. © GNPD

TORTOISE WITH PINTA GENES!

A team that traveled to Wolf Volcano on Isabela Island for a 10-day expedition in February 2020 returned with 31 hybrid giant tortoises with partial lineage of the *Chelonoidis abingdonii* and *Chelonoidis niger* tortoise species. Both species are considered extinct on Pinta and Floreana Islands, respectively.

Of the tortoises identified, 20 (twelve females and eight males) have known partial lineage of the species considered extinct on Floreana Island. One female has a 16% genome of *Chelonoidis abingdonii*, the extinct species from Pinta Island to which Lonesome George, who passed away in 2012, belonged. The latter is a young female presumed to be a direct descendant of a pure individual — who may still inhabit some area of this volcano in the north region of Isabela Island. Ten other tortoises (seven females and three males) had not been genotyped but had highly saddleback shells — typical of the Floreana and Pinta species. These will be genotyped soon to determine where they came from.

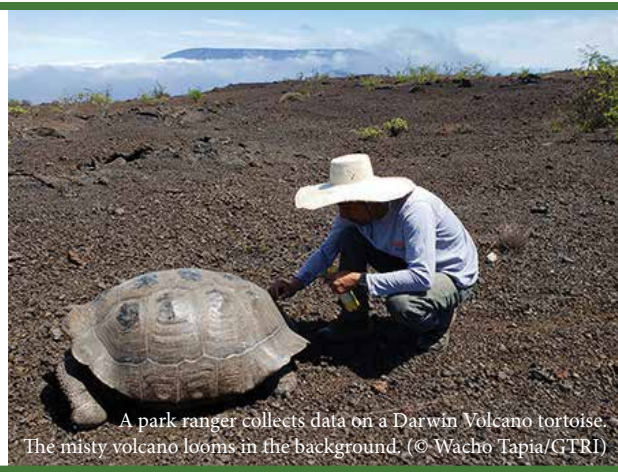
During this expedition, which was part of Galapagos Conservancy's Giant Tortoise Restoration Initiative (GTRI), a joint program with the Galapagos National Park Directorate, the field team consisted of 45 Park rangers and scientists divided into 12 search groups that traversed approximately 77 square miles of tortoise habitat on Wolf Volcano.

The team also collected approximately 50 blood samples from tortoises located for the first time, which were also given an identification microchip. The blood samples will be used to perform genetic analysis to determine the species to which they belong, since a large population of hybrid individuals inhabits Wolf Volcano — including species considered extinct. In previous centuries, pirates and whalers released tortoises collected on other islands and left them here.

The 31 tortoises collected on this expedition were transferred to the “Fausto Llerena” Tortoise Breeding Center on Santa Cruz Island. After a quarantine period, the Floreana hybrids will join the existing Floreana captive breeding program. The Park is still evaluating potential management actions for this lone hybrid Pinta tortoise. ■

From the GC BLOG

Our Galapagos Conservancy blog is a virtual bulletin board of engaging conservation stories about the projects and initiatives we support. Here, we share with you a few excerpts from recent posts. The full stories can be found online at www.galapagos.org



Night Adventures in the Enchanted Isles: In Search of Galapagos Short-Eared Owls on Floreana Island

posted November 25, 2019

“Galapagos short-eared owls are considered a sub-endemic species of the short-eared owl found in other parts of the world. They are widely distributed among the Enchanted Isles, but the Floreana population possesses unique genetic traits not found in neighboring populations, especially those on nearby Santa Cruz Island. Genetic population-level analyses have shown no evidence of owl movement from Santa Cruz to Floreana Island, although the same analyses suggest that owl movement does occur in the opposite direction — from Floreana to Santa Cruz. Why this happens is unknown...”

Prior to our field work, we carried out extensive research to identify the appropriate equipment to deploy on the species, with careful consideration of their crepuscular (twilight) and nocturnal habits. The short-eared owls required small satellite transmitters, which are only available as solar-powered units. We also had to determine the most appropriate data transmission schedule to increase our chances of gathering the most accurate information while reducing the amount of power required to do so.

After our preparation and research, we successfully deployed four transmitters on four short-eared owls (females and males). The data transmitted shows fascinating movement patterns within the owl population. After deploying the transmitters in August and September, in early October one of the owls fitted with a satellite transmitter translocated itself to Isabela Island (data shows the bird spending time in an area between Cerro Azul and Sierra Negra volcanoes). So far, the other three have remained on Floreana.”

Author: Paula A. Castaño is a wildlife veterinarian with an MSc in conservation medicine and a background in raptor medicine and island restoration. Since 2013, she has been working in Galapagos with Island Conservation, providing technical assistance to the GNPD to prevent extinctions and restore Galapagos ecosystems. Currently she is involved in the Floreana Island Ecological Restoration Project as a Native Species Specialist.



Unraveling the Mysteries of Darwin Volcano Tortoises, Part I

posted December 4, 2019

“In addition to the sporadic presence of ticks and cats, both invasive species, the only bad and ugly event during this expedition occurred at 1,450 meters above sea level, at the highest site of the volcano, when we bumped into the unpleasant presence of a balloon. It was a star-shaped party balloon, of the type inflated with helium. I don’t know if the balloon got there from any of the populated ports (the closest one is almost 100 km away), or more likely from a boat sailing in the surroundings and where they had a party.

This is the sort of object a tortoise, always full of curiosity at new things, would try to eat, and it would do the tortoise harm. The truth is that it was a clear example of how humans can pollute, even without ever visiting a site. Hopefully, we humans are changing our attitudes and behaviors.”

Author: Wacho Tapia is Galapagos Conservancy's Director of the GTRI and a Galapagos native and reptile expert with decades of field experience. Wacho previously led the science program and technical group at the Galapagos National Park Directorate for 15 years.

Unraveling the Mysteries of Darwin Volcano Tortoises, Part II

posted December 9, 2019

“I had the amazing opportunity to participate in the giant tortoise census on Darwin Volcano this year, which allowed me to traverse some of the most hostile and challenging terrain on Isabela Island — but also to be one of the few humans to ever have had the privilege of visiting this place. The expedition lasted ten days, but prior to the trip, weeks of preparation were necessary. Once the time came, the expedition launched aboard the R/V Sierra Negra, the Galapagos National Park’s ship. The trip from Puerto Ayora, Santa Cruz took 11 hours of navigation to arrive at the base of the volcano, anchoring on the coast in Beagle Crater. From there, teams were distributed into ten different research quadrants assigned by GTRI Director Wacho Tapia, the Expedition Leader, with the help of a helicopter.”

Author: Diego Andino Robalino holds a Biology degree from the Central University of Ecuador and is a Naturalist Guide with the Galapagos National Park Directorate. He is also a photographer and is passionate about wildlife.

On the Case: Galapagos Team Embarks on Search for ‘Most Wanted’ Giant Tortoise

posted January 21, 2020

“What happens when a 300-pound tortoise falls in to the ocean? They don’t drop straight to the ocean floor, as it turns out. Instead, they can float or even swim and, in the case of the Galapagos, you get millions of years of genetic evolution, says Dr. Peter Paul van Dijk, field conservation programs director at Turtle Conservancy.

‘It’s very possible that the animal found living on Fernandina last year is an animal that isn’t actually from the Fernandina Galapagos Tortoise lineage,’ van Dijk says. ‘That’s how all of these islands got settled originally. One way or another, sooner or later, some tortoise fell off one island and a current took it to another island. Of course a whole bunch of animals that fall off the islands get swept into the Pacific and are never seen again. But some of the lucky ones bump into another island, make it ashore, and then go crazy evolutionarily, with a whole new set of opportunities for their genetic toolbox.’”

Author: Lindsay Renick Mayer is the Director of Media Relations for Global Wildlife Conservation and has a particular interest in leveraging communications to inspire conservation action.



Heinke Jager of CDF is next to a moss-covered quinine “skeleton” that had been chemically controlled by the GNPD a long time ago. Underneath, the native vegetation is coming back (© C. Peabody)

Anatomy of a Dataset: Investigating Changes in Galapagos Highland Flora

posted May 4, 2020

“Days in the field typically begin at 6:30 AM. Starting from the Charles Darwin Research Station, a short drive into the highlands of Santa Cruz takes us through the village of Bellavista and onto a steep dirt road, winding through sugar cane and open pasture before coming to a dead end at the trailhead to our destination field site: Media Luna, named for the half-moon shaped crater that stands guard over the park entrance. A three-meter wide ‘buffer’ of bare ground marks the border between the Galapagos National Park and the island’s designated agricultural zone. But the real divide between humans and nature here at Media Luna is far more complicated.

Since the late 1800s, agricultural development has dramatically altered highland ecosystems in Galapagos — even in areas supposedly ‘untouched’ by humans. Over half of the approximately 1,500 introduced species on Galapagos are plants. The landscape at Media Luna was historically dominated by Miconia robinsonia, an endemic shrub with shiny, curled leaves and long stalks of purple-ish flowers, which form a dense chest-high canopy that shelters endangered Galapagos rails and petrels. The ‘Miconia Zone’ has been modified over the last century by grazing, fire, and invasive plants such as red quinine (Cinchona pubescens).”

Author: Clare Peabody joined the Charles Darwin Foundation in November 2019 as a Biostatistician for the CDF’s Terrestrial Invasive Species and Ecological Restoration Group. Clare is a graduate from Brown University with honors in Environmental Science.

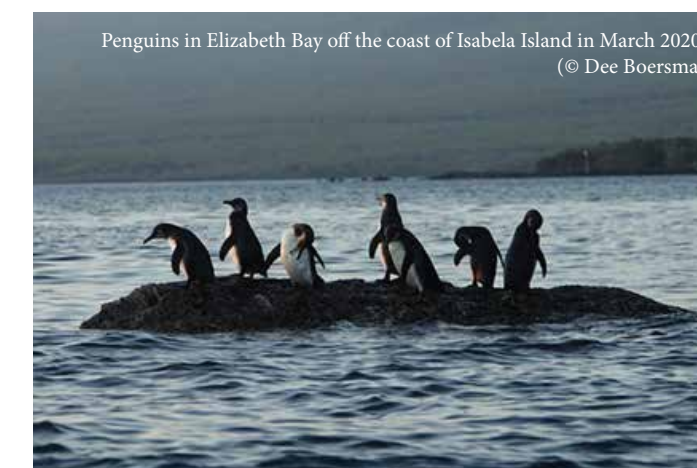
A Fragile Landscape for Galapagos Penguins

posted May 26, 2020

“When we think of a nesting penguin, we often imagine soon-to-be penguin parents huddled together on a vast, icy plane, with eggs balanced precariously on their feet. But this image comes from the emperor penguin, an Antarctic relative that lives in a much colder environment than the hot, equatorial Galapagos Islands. For a Galapagos penguin, minimizing the exposure of its eggs and chicks to the intense Galapagos sun is a top priority. To do this, penguins look for tunnels and crevices in the lava where they can lay their eggs. These shady spots keep the penguins cool while providing protection from native predators like hawks, gulls, and rice rats.

Introduced mammals like cats, dogs, and black and Norway rats can kill penguin eggs, chicks, and even adults. These introduced predators have spread across the coasts of Isabela, Floreana, and other islands, limiting where penguins can safely nest. As a result, the penguins are losing critical nesting habitat. An important, predator-free hotspot for penguin breeding is the Mariela Islands in Elizabeth Bay on the western side of Isabela Island. On these small islets, we frequently find penguins courting, breeding, socializing, and hauling out to spend the night. Of the seven active nests we found during our 2020 trip, five were on the Mariela Islands.”

Authors: Dr. Dee Boersma, Caroline Cappello, and Godfrey Merlen make up the dedicated research team that has traveled to Galapagos penguin breeding areas twice a year since 2010 to check both natural and constructed nests and study the penguins.



Education for Sustainability

by Richard Knab, GC's Director of Strategic Partnerships and Leader of the ESG Program

While our delivery methods have evolved, the Education for Sustainability in Galapagos (ESG) Program continues to support Galapagos teachers as they create learning opportunities to help pre-K through 12th grade students develop the environmental knowledge, skills, and commitment needed anywhere, but especially in protected areas like Galapagos.

The beginning of the new school year, originally planned for April 11, was delayed until June 1, when students and teachers began distance learning from home. Online education poses special challenges in places like Galapagos, where many homes do not have access to computers and internet. Fortunately, members of our training team have first-hand experience on how to facilitate distance education for students with limited access to technology, using cell phones and delivered printed class materials when necessary.

By the end of March, our Galapagos-based staff and members of our international training team reinitiated our regular schedule of collaborative work sessions (learning circles) using a variety of platforms (Skype, Zoom, WhatsApp, Google Hangouts, and Microsoft Teams) depending on the technology available to each group of teachers.

Since then we have been offering real-time online workshops and “office hours” and continue to develop downloadable videos and printed materials to help teachers adapt weekly units designed by the Ministry of Education to include local examples and sustainability principles. We have also engaged new partners, such as educators from Villanova University and Ecuador’s ESPOL University, to provide training for teachers and school principals on the use of different software platforms for distance education.

While there has been a steep learning curve, our increased use of technology has gone more smoothly than anticipated and will leave us better prepared to support Galapagos educators remotely over time. Thanks to the continued generous support of GC donors and our strong relationship with the Galapagos education community and leaders at the Ministry of Education, the ESG Program is continuing to work intensively with all Galapagos educators towards our goal of increasing the environmental literacy of young people in Galapagos, making these special islands a showcase of high-quality, place-based education for sustainability. ■

Galapagos children are now learning why their home islands are so special and what they can do personally to help protect them in the future.
© GC - ESG

MOBILIZING LOCAL KNOWLEDGE AND EXPERTISE

During its first four years, the ESG Program helped educators adopt proven teaching strategies and to begin to teach core subjects in the context of local examples and sustainability principles. Now, in a second phase of the program, we are helping teachers dig deeper and to engage local experts (scientists, conservation managers, conservation NGOs, public sector officials, naturalist guides, community leaders, business owners, etc.) in creating meaningful learning opportunities that extend the classroom well beyond four walls.

The first half of our October 2020 Institute will model the design process and selected classes and field experiences associated with six-week instructional units developed in collaboration with scientists and environmental educators from the Charles Darwin Research Station, the Galapagos National Park Directorate, and Ecology Project International. During the second part of the week, training facilitators and local experts will support Galapagos teachers as they work to design instructional units of their own. The integrating theme for these units is invasive species.

By working as a team, Galapagos teachers and local experts will blur the lines that have long existed between formal and non-formal education, significantly enriching the educational experiences of young people in Galapagos.

Richard Knab joined GC in 2004 and now coordinates our ESG Program and fundraises for all of GC's core programs. He is passionate about opportunities in Galapagos to strengthen education, civil society, and citizen engagement in conservation.



Galapagos Conservancy
Saving One of the World's Great Treasures

NEWS & VIEWS

NOTABLE UPDATES!

Shark Count Galapagos: Now for Snorkelers, too!

Shark Count Galapagos is a mobile app for Apple and Android devices that allows divers — and now snorkelers! — in the Islands to become “citizen scientists” by helping to monitor marine life in the Galapagos Marine Reserve. *Shark Count* users make important contributions to our understanding of marine ecosystems in Galapagos by recording the sharks, sea turtles, rays, ocean sunfish, and other marine life they encounter while in the water. All data are shared with the Galapagos National Park Directorate in order to ultimately benefit research and management decisions focused on protecting the biodiversity of the Galapagos Marine Reserve. **Visit:** <https://sharkcount.org>



Bring Galapagos to your Zoom Meetings!



The crater on Fernandina Island © GC

Give your colleagues, friends, and family a change of scenery on your next Zoom call with our virtual Galapagos backgrounds! We have five high-resolution virtual backgrounds from the Islands that you can download from our website for your next Zoom call.

Annual Galapagos Calendar Photo Contest **CANCELLED** for 2020

We are sorry to announce that, due to staffing limitations and concerns during the COVID-19 pandemic, we will not be holding our annual photo contest this year. We will still be producing a 2021 calendar featuring some of our favorite images from the past decade, as well as some incredible ones from our staff and partners. We plan to reinstate the contest for our members in 2021 (for the 2022 calendar) and will open up the submission period in early 2021. Please look for information on pre-orders and sales of our Galapagos 2021 calendar in our upcoming Galapagos e-newsletters, social media, and the next issues of *Galapagos News*.

GIVE the GIFT of GALAPAGOS

Temporarily, we are **ONLY** offering Gift Memberships and Honor & Remembrance Gifts in our online store.

Honor your loved ones by supporting the important conservation efforts in Galapagos! Gift levels start at \$25. Recipients will receive a beautiful card informing them of your gift, which you can personalize with a special message.

www.galapagos.org/shop/



amazonsmile

You shop. Amazon gives.

Visit smile.amazon.com and select Galapagos Conservancy as your beneficiary charity!

Margaret “Garth” Greene's Legacy Lives on in Galapagos



The Galapagos Islands lost a great friend and supporter with the passing of Margaret “Garth” Greene.

She was a long-time supporter of Galapagos Conservancy who led a life guided by her keen interests in science, nature, and conservation.

Upon graduation from college in Ohio, Garth headed west to Los Angeles, California where she taught high school Chemistry and Biology up until her retirement. She lived in the Playa del Rey neighborhood of Los Angeles where she and her husband Richard became advocates for the preservation of the nearby Ballona Wetlands. Like many true environmentalists, they loved hiking and traveling the world. After Richard's death, Garth took the trip of a lifetime to the Galapagos Islands, which appealed to her adventurous spirit and fueled her imagination with new botanical and biological knowledge and inspired her to do her part to care more for our planet. The Ballona Wetlands and the Galapagos Islands became Garth's major conservation passions, and she was very generous with both over the years.

Though she had no biological children, her students were her family. In fact, she took in one of her students, who was homeless, for two years until her high school graduation. That student's children are now her “grandchildren” today; two with PhDs and one with a Master in Education.

Garth was an inspiration to many and a genuine gift to our planet. Her legacy will live on in Galapagos with the very generous planned gift she designated to Galapagos Conservancy upon her death. We are grateful for her kindness.



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*we hope all of our members and friends are safe and well –
surviving and adapting like our favorite Galapagos creatures!*



© GNPD from June 14, 2020

THE ESPAÑOLA 15 GO HOME! And a sneak peek into our next issue ...

These two giant tortoises don't know it, but they are on the first leg of a one-way trip to their home island of Española where, after 50+ years at the tortoise center on Santa Cruz, they will live out the rest of their lives in the wild with their 13 fellow mates from captivity and all 2,300+ of their offspring. Our next issue of *Galapagos News* will bring you all the details and photos from this most amazing Galapagos conservation success story.

To learn more now, visit the "Newsroom" at www.galapagos.org