NOTICIAS DE GALAPAGOS

Published by

THE CHARLES DARWIN FOUNDATION FOR THE GALAPAGOS ISLES

An International Organization

created under the auspices of

THE GOVERNMENT OF ECUADOR

UNESCO

THE INTERNATIONAL UNION FOR CONSERVATION OF NATURE

CONTENTS

Published with the financial assistance of UNESCO

NEWS FROM ACADEMY BAY

PRESIDENTIAL VISIT

On 5 December 1982 His Excellency the President of the Republic, Dr Oswaldo Hurtado, and his wife, Doña Margarita P. de Hurtado, honoured the Charles Darwin Research Station with an official visit. This was Dr Hurtado's first visit since he became President but he came several times when he was Vice-President and even before that. The Acting Director, Ing. José Villa, escorted the presidential party on an inspection of the Station and staff scientists accompanied them on trips to the islands of Plaza and Santa Fé.

THE EXTRAORDINARY EL NINO YEAR

El Niño events, the onset of warm ocean currents that affect the climate, occur every few years in the Galapagos. They always influence both plant and animal life, though not drastically. But the El Niño of 1982-83 has produced cataclysmic effects in the archipelago and is charged with responsibility for floods and droughts over many parts of the world.

It had been intended that most of this issue of Noticias should be devoted to the event but its unprecedented duration and intensity are producing results which cannot yet be assessed. Land birds, sea birds, marine life, fisheries, native and introduced animals, vegetation in the National Park and cultivated crops in the settled areas have all been profoundly affected — but in different ways. Review of the overall consequences will have to be postponed until later, when the extent of the damage and the outlook for recovery become clearer. Meanwhile, this issue carries a graphic account of the preliminary stages of the El Niño phenomenon as witnessed on remote Wolf (Wenman) Island by Friedemann and Heide Köster; weather data on Floreana collected by Felipe Cruz and Tina Beach; and a preliminary study by Andrew Laurie of the disastrous effects on various populations of marine iguanas. Dr. Laurie has also provided the following brief survey of the general situation.

> "The 1982-83 Southern Oscillation-El Niño event is the most severe ever recorded: in Galapagos the monthly mean sea-surface temperature reached 4.3C above normal in June 1983: the tradewinds failed almost completely and at Puerto Ayora, where the mean annual rainfall (1965-81) is 374mm, more than 3,500mm of rain have fallen during the eight months since December 1982. Other marked effects of El Niño have been extremely high sea levels, heavy swells and rough seas. The changes wrought on the fauna and flora, and indeed on the islands themselves, have been astounding. Even in the arid coastal zone the vegetation is now so thick that one needs a machete to walk the cliff top from Puerto Ayora to Punta Nuñez. High sea levels and heavy wave action have caused widespread erosion, destroying, for example, most of the long black beach on Marchena's south-eastern coast so that one can no longer walk that stretch except at low tide, picking one's way between prickly pear cactus stranded on the shore or still hanging by the roots from the sandy cliffs.
>
> The land animals, of course, have flourished; according to L. Gibbs and R. Curry some pairs of finches and mockingbirds on Daphne and Tower have raised five or more clutches, and fledglings from the early clutches have already nested themselves. But for the marine life and the dependent sea-birds and marine iguanas it is a different story. Increased sea temperatures and decreased salinity have led to the disappearance of many marine organisms and disruption of whole food chains. The blue-footed booby colonies are deserted; not a single bird is to be seen on the nesting slopes of Roca Vicente where torrential rain has also cut deep erosion channels through the accumulated guano. The waved albatrosses of Espanola have attempted to nest but, according to Catherine Rechten, few have returned this year and many of those that laid have had their eggs swept away by flood waters."

It should be borne in mind that these sea-birds are long-lived and that the failure of a breeding season is not at all unusual. Nevertheless the effect on Galapagos wildlife of this quite unprecedented weather is bound to be important though the nature and extent of the repercussions are at present unpredictable.

THE LAST OF THE NORWEGIANS

Among the victims of the El Niño event, improbable though it may seem, was Alf Kastdalen. He was killed while trying to replace a high-tension cable that had been torn down during one of the stupendous thunderstorms which characterized this troubled year. He was a farmer in the uplands of Santa Cruz. He was also a good friend of the Darwin Station and his capacity as a naturalist was amply demonstrated in his paper, "Changes in the Biology of Santa Cruz, 1935-65", published in Noticias No. 35. He was buried at Bellavista on 24 June. He is survived by his aged father, now the last of all the band of brave Norwegians, who tragically endeavoured to found a settlement in the Galapagos between the two world wars.

VISITS AND EVENTS AT THE DARWIN RESEARCH STATION

December 1982

Delegation from the Central University, Quito, led by the Rector.
Visit by the President of the Republic, his family and officials.
Group of scientists arrived to study outbreak of avian pox.

January 1983

Bob Reynolds, staff marine biologist, and his wife left CDRS after two years service.
José Miguel Bernado, delegate of the Spanish government's Institute for Ibero-American Co-operation, began a course of lectures on biostatistics.
Three Chilean girls came to work as scientific assistants.

February

Darwin Station arranged a photographic exhibition and gave a series of lectures to the people of Santa Cruz.
Aracelly Fajardo took up duties as Director's secretary.
Grady Walker and assistant began study of cactus ecology.
Director and staff scientists to San Cristóbal to present photographic exhibition and give lectures to local people.

March

Juan Black, Secretary General of the Charles Darwin Foundation, came to discuss administrative matters.
Edith Herrera returned to Guayaquil University on ending her study of the population structure of the Sally Lightfoot crab for her doctorate thesis.
The sociologist, Mario Monteforte, came to write a series of articles for HOY.
Dominique Limberger and Brigitte Ogrisegg completed their studies of the Fur Seals on Fernandina Island.
Jaime Astudillo began as assistant in the herpetology programme.
Yolanda Célleri returned to Quito on terminating her Land Iguana study.

TWELVE DAYS AMONG THE "VAMPIRE-FINCHES" OF WOLF ISLAND

by

Friedemann and Heide Köster

Some 80 nautical miles to the northwest of the main group of the Galapagos Islands, roughly 180 miles from Puerto Ayora on Santa Cruz, a huge volcanic rock emerges from the deep blue of the surrounding waters. Wenman, or Wolf, according to its official Ecuadorian name, is definitely one of the most inaccessible islands of the archipelago.

With its highest peak rising to 253 meters, protected by steep basaltic cliffs, battered at their base by enormous oceanic swells, the island has rarely been visited by men.

However, when members of the University of California International Expedition to the Galapagos Islands in 1964 were landed by helicopter on one of it slower plateaus, Raymond Fosberg, a botanist, Robert Bowman and Stephen Billeb, ornithologists, discovered a most unusual and, as far as is known, unique feeding behaviour among birds: the blood-drinking habit of the Sharp-beaked Ground Finch *(Geospiza difficilis septentrionalis)* (Fosberg, The Elapio Vol. 25:8, 1965; Bowman & Billeb, The Living Bird Vol. IV, 1965).

Since then, the few scientific parties that have set out to conquer Wolf Island have had to make do without a helicopter and have had to jump and climb ashore amidst the most dreadful breakers, clinging to cracks and holes in the slippery rocks, in constant danger of being washed out to sea. Most of those who succeeded and safely reached one of the two lower plateaus on the northern end of the island (Fig. 1) have been able to observe the "Vampire-Finches" pecking at the bases of growing feathers on the "elbows" of Masked Boobies *(Sula dactylatra granti)* or the tails of Red-footed Boobies *(Sula sula)*, causing them to bleed and then sipping the blood. In addition to the pictures published by Bowman & Billeb (1965), several still photographs of the blood-sucking birds have been taken, but, so far as we know, only one or two attempts to film this fascinating behaviour have ever been made. As these attempts failed for various reasons such as inability to find a safe landing site, lack of time, or arrival at a time of year when the peculiar behaviour was not being exhibited, we felt that the challenge to try for a documentary film on the "Vampire-Finches" was too strong to be resisted.

When we heard of a reconnaissance trip by the Naval Oceanographic Institute of Ecuador and the National Institute of Galapagos, to the northernmost island, Darwin, which would pass close to Wolf, we jumped at the chance to visit this remote island. Thus, at 5 am on November 7, 1982, we left Puerto Ayora aboard the M/Y Ingala II in high spirits.

Just a few days before, a new battery for our Arriflex camera and the necessary film had arrived. Every piece of equipment had been double-checked and tested. Tents, sleeping bags and all those numerous items of camping equipment had been carefully packed and, most important for a stay on a waterless island, twelve *chimbuzos* (large water containers), were filled at the Darwin Station and hauled aboard.

The following is our diary of the 12 days we spent filming on Wolf Island, among Masked and Red-footed Boobies, Frigate Birds, agile centipedes, soft-spined cacti, slender *Croton* trees and — of course — the strange blood-sucking finches.

7 November 1982

Dawn marks the start of our journey. The first stop is the military base on Baltra Island. It takes four hours to fill the ship's tanks and many extra barrels with fuel for the long journey; then we are on our way to the two northernmost islands of the Galapagos archipelago, Wolf and Darwin, known in the old maps as Wenman and Culpepper. At dusk we cast anchor on the northwestern coast of Pinta Island, where a huge swell from the open sea rolls incessantly against the dark and jagged cliffs. A tiny fishing boat from San Cristobal rides alongside, enveloping us in a powerful odour of fresh and dried fish. Its deck is crammed with buckets, buoys, fishing lines and other equipment, between and on top of which, ten or twelve men can be seen huddling around a miserable lamp. The scene makes it easy to imagine the countless hazards and hardships that these men must endure while visiting the fishing grounds for stretches of a month or longer.

8 November
One o'clock at night, we leave Pinta Island and head for Wolf. As the sun rises, groups of Masked Boobies can be seen all around our ship, gliding just above the smooth water and from now on we are permanently accompanied by bands of juvenile Red-footed Boobies.

At seven in the morning we eventually arrive at Wolf, its towering cliffs dwarfing our ship while we anxiously search up and down the northern coast to find a possible landing site amongst the green foaming surf that beats against the rocks. Although discouraged by both the size of the pounding waves and the premonition of our dinghy being toppled over by the backwash during an attempt to jump ashore, we nevertheless decide to try a landing on a large rock nose that overhangs the swirling waters. We succeed. Then, as if lifted by an elevator, the long swells heave our Zodiac with all the precious equipment within reaching distance for just a few decisive seconds, before it drops back again, out of reach and far below. It takes half a morning's hard work before everything is put ashore and safely stored in rocky caves, high up, where no waves could possibly reach. A few minutes later, we see M/Y Ingala II disappear into the blue distance towards Darwin Island, barely visible to the north.

The afternoon is spent carrying camping and camera equipment to the top of the eastern plateau, climbing over rocky terraces, though dense fields of soft-spined cacti *(Opuntia helleri)* and along clefts and cracks in the rock walls. At sunset our camp is set up at the edge of the bare cliff, overlooking the wide sea to the north. It is surrounded by courting and nesting pairs of Masked and Red-footed Boobies and protected to the south by a dense stand of low and slender trees *(Croton scouleri)*, beyond which the highest peak of the island forms an impressive silhouette against the darkening sky.

9 November
Walking through the booby colony early this morning, we notice several birds with stains of dried blood on their wings and many Sharp-Beaked Ground Finches hopping and flying about. Several of them scratch the loose ground in what appears to be the "bill-bracing technique", reported for the Large Cactus Finch, *(Geospiza conirostris)* and the Small Ground Finch, *(Geospiza fuliginosa)* on Española Island (DeBenedictics, The Condor Vol. 68, No. 2, 1966). A little later we observe our first "Vampire-Finch" at work. Riding on the lower back of a booby and clinging to the large flight feathers of its folded wings, the finch repeatedly buries its beak deep into the formerly white feathers of the "elbow", now distinctly marked red by extruding blood. Watching from within a couple of yards, we can clearly see the blood being sipped into the closed beak of the finch as if through a drinking straw.

In the afternoon, M/Y Ingala II surprisingly returns from Darwin Island. Five of its men climb up to our camp site and, then move on to inspect the interior of the island. At night we can see their camp fire through a drizzling rain. Later, the rain increases in strength as does the wind and towards midnight a fullblown storm is clattering and beating on our tent.

10 November
Our visitors tell us that only one member of the Ingala party had succeeded in jumping ashore on Darwin Island the day before. In view of the difficulties and dangers of landing there, they had abandoned their plan to build a lighthouse on Darwin. Instead they had come to see whether they could establish it on Wolf.

Deep in our hearts we painfully feel that, without the slightest doubt, such a scheme would jeopardize all conservationists' hopes to preserve Wolf as it has been until today: a virtually untouched and completely unspoiled island where, since it emerged from the sea millions of years ago, only nature's laws have ruled the pace of evolution.

On the proposals of the Government of Ecuador, the Galapagos Archipelago was one of the very first natural areas to be given World Heritage status under the UNESCO convention of 17 December 1975, establishing a system for protecting those parts of humanity's natural and cultural heritage which are of outstanding value. By law, both Darwin and Wolf, though located well to the north of the main islands of the archipelago, are integral parts of the Galapagos National Park. Today there are no residents and no private or military installations anywhere within the National Park's boundaries; even the offices of the National Park Service and the Darwin Research Station are situated outside the limits of the Park. A

lighthouse with a resident crew on either Darwin or Wolf would alter this admirable tradition, would infallibly result in the introduction of alien organisms and would produce irreversible changes in a virtually pristine ecosystem, with nothing else quite like it in the world.

In the afternoon, shortly after M/Y Ingala II has finally departed, the heavy rains start again. Worried about adequate protection for the camera and other equipment, we climb down the cliffs in the pouring rain to bring up one of our large aluminium cases in which to store everything, safe from the deluge. The rains last all night and we find ourselves camping in the midst of a mud puddle.

11 November

In the morning we find that the frequent crashes we heard during the night had been Croton trees, uprooted by the storm. A large bucketful of rainwater has collected in the folds of our tent roof, saving today's climb down to the rocky shore where our food and water provisions are stored. Our camp has now become the home and favourite foraging ground for two Cattle Egrets *(Bubulcus ibis)*. Walking gracefully over our pots, tins, cases and backpacks with their long legs and slender toes, they move with incredible precision, catching flies and hunting the geckoes *(Phyllodactylus gilberti)* which are quite common among the rocks.

Much to our surprise, with the exception of these recent colonizers of the Galapagos, no other day creatures, nor even the finches and mockingbirds, both numerous around the camp, show any interest in our kitchen. Not even the ants are attracted by this new source of food. Foot-long centipedes *(Scolopendra galapagoensis)* however, are a nuisance. Slowly crawling about at night, when frightened they swiftly dash for cover and are usually found in the morning curled up in our cooking utensils or food cans.

While drizzling rains and undiminished winds prevail during most of the morning, the sunny afternoon finds us at last filming "Vampire-Finches" and their victims on the western cliffs. From up here, with the green and white breakers crashing against the dark rocks far below, the island's impressive landscape and a large piece of the open sea can be seen. Hundreds of Masked Boobies that nest all along the cliff tops are floating through the air. Taking off in search of food or landing at their nesting sites, they are forced by the wind into spectacular flight manoeuvres. Light conditions are just perfect, so we make the most of our chances and shoot some film in slow motion.

12 November

Again, it rains all night and during most of the day. By now, all the downy young and nestlings of the Masked Boobies have been seriously affected by the wet and cold. Shivering, with water incessantly dripping from the tips of their lowered bills and drenched to their skin, the tougher ones manage to keep themselves in an upright position, similar to that of penguins in a snow storm, while the weaker ones lie motionless on the soaking ground, waiting for the rain to stop or death to come. Many of the parents have not been back since the previous day to feed their young and we find several that have not survived the wet and chilly night. Patrolling Frigate Birds *(Fregata minor* and *F. magnificens)* take some of the smaller chicks but most corpses are left to the Sally Lightfoot crabs *(Grapsus grapsus)* that populate even the upper reaches of the cliffs and which turn out to be very efficient carrion feeders. Much to our surprise we find these crabs to be generally dark in colour, instead of the bright red that is so typical of the larger individuals of the other Galapagos populations.

13 November

It is late in the afternoon before the sky clears again, allowing us to shoot a beautiful scene from the peak of the narrow ridge that separates the lower northern part of the island from its southern and higher plateau. Far below we see the larger, eastern plateau, with hundreds of Red-footed Boobies nesting in the *Croton* trees. The cliff edge is lined by thousands of white dots, which are in reality thousands of Masked Boobies. To the west, a smaller peninsula, shaped like a snake's head, protrudes into the sea. The sky, coloured by the sinking sun, provides a dramatic backdrop for the numerous Boobies, Frigate Birds and Audubon Shearwaters *(Puffinus inhemieri)* flying both above us and far below.

Climbing down the ridge again, we watch a Red-footed Booby on its nest in a *Croton* tree being bled by two finches perched on its tail. The booby is a white-phase individual of this normally chocolate-brown species, so the blood stains on its white tail feathers stand out strongly. Later, while on our way back to camp, we hear and see a group of five Sooty Terns *(Sterna fuscata)* flying high above. They must have come here from Darwin, their only nesting ground in the Galapagos.

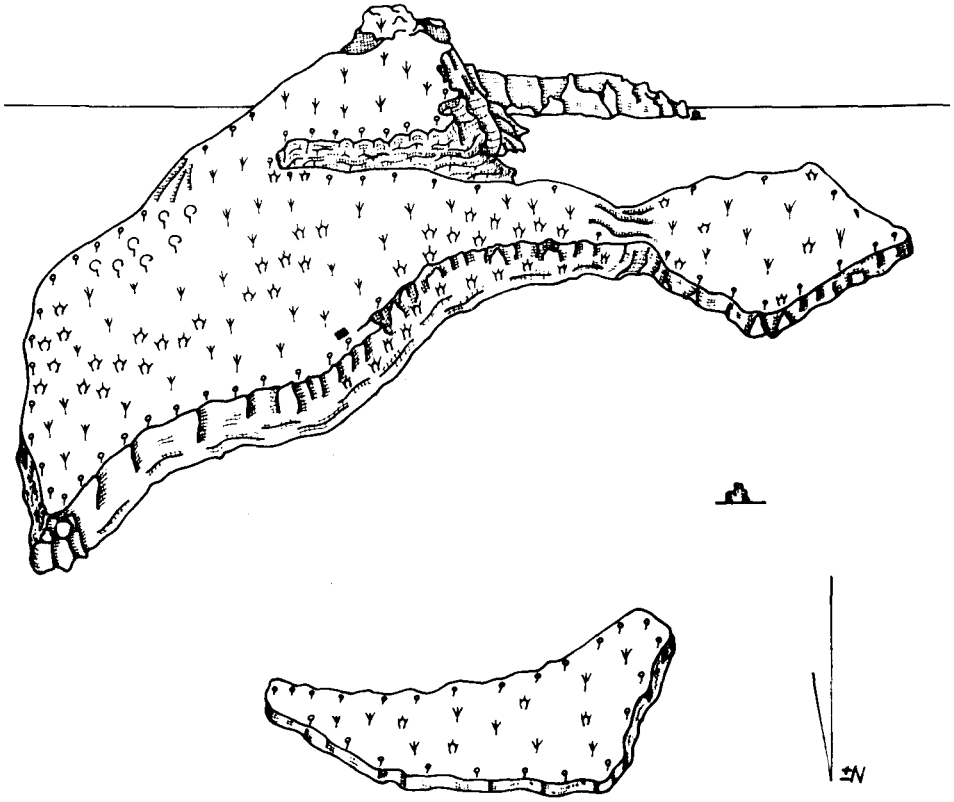

Fig. 1. By combining a map by Daniel Weber (D. Weber — Galapagos — 12.3.1970) with some of our photographs, experience and imagination, we have produced an aerial view of Wolf, such as a bird approaching the island from the north would probably see.
The symbols stand for:
- ♈ *Croton* sp., main breeding area of Red-footed Boobies and Frigatebirds;
- ♉ *Opuntia helleri,* breeding area of finches and mockingbirds;
- ♋ *Erythrina velutina,* migrating Summer Tanager and two Vireos were seen here;
- ♀ *Alternanthera helleri,* breeding areas of Masked Boobies and feeding sites of the "Vampire Finches";
- ▬ Camp

The distance between the eastern tip of "our" plateau and the outermost end of the lower platform to the west measures approx. 980m.

14 November

While tape-recording the voices of the awakening colony of Masked Boobies at dawn, we come across a dozen Sharp-beaked Ground Finches hopping about and fighting over a broken booby's egg whose contents they drink. A little later, near the same place and with our camera all set, we observe a most fascinating behaviour: several finches manage to steal a booby egg from an unguarded nest by pushing and rolling it away. Two of the finches are especially clever at this. While the brown-feathered individual uses its bill purely as a lever, shoving it under the egg and lifting, the black individual anchors its bill in the soft

ground or against a nearby stone and kicks the egg forcefully with both its feet at the same time. With this fine demonstration of the "bill-bracing technique" mentioned earlier, the finch succeeds in pushing the egg away from the nest. Other birds of the group now and then join in the enterprise and in less than an hour the egg has travelled some three meters. It eventually comes to a final halt between two rocks but the birds continue pushing, kicking and levering so that the egg is turned and rolled around on the spot. We hear the sharp noises of the shell being repeatedly knocked against the rocks. Now and then the finches stop to inspect it, presumably looking for holes or cracks resulting from their activity. Finally a tiny opening in the shell, just enough for the tip of a bill to be inserted, marks the start of frantic fighting. All the finches of the group try to get possession of the egg. Within seconds ten or twelve beaks have chipped a large hole into the shell and all the birds crowd round drinking the liquid. When eventually the egg rolls over, spilling the rest of its contents on the ground, we see two or three finches in what could well be called a feeding frenzy, viciously fighting over the tiny embryo which they drag out of the egg, ripping it to pieces on the spot.

We now understand the reason for the many "lost" booby eggs that we have seen and the fact that many of them had large holes or were broken. The Sharp-beaked Ground Finches on Wolf Island are not only blood-sucking "Vampire-Finches", but they are very skillful egg-robbers as well.

15 November
For the third time during our stay on Wolf, we observe a large group of 80 to 100 juvenile Red-footed Boobies engaged in what appears to be a curious communal game. Flying high in a rather dense formation and calling our attention with their harsh voices, they are seen to pass a "toy" from one to the other. Even with the use of our fieldglasses we cannot detect the precise nature of the "toy". It might be a feather, a leaf or a stick. It is held in the beak by one bird and carried a little upwards in the circling cloud of birds; then it is dropped. After a few seconds of free fall it is caught by a second bird and carried upwards, only to be dropped again and subsequently picked up by yet another bird; and thus the process continues. The game, if we may call it so, always started near the summit of the island. The wind then carried the cloud of birds and their "toy" out to sea, where they eventually settled on the surface near the spot where, after numerous passes, the "toy" had finally fallen on to the water. A few days before, while climbing the peak, we had seen a juvenile Red-foot holding a long feather in its beak. Descending an hour later, we found it still holding the feather. Will it fly, we speculated, join others and then drop the feather, initiating a new game? Looking under nesting and roosting places of Red-footed Boobies on Wolf, we found the following objects: 3 short plastic thongs, 1 toy soldier and 1 toy bassoon, all made of bright, blue plastic and between 6 and 10cm long. Are these the boobies' "toys"? How else can these strange objects make their way to the top of Wolf Island?

16 November
Today, torrential rains and thick clouds hanging low over the sea force us to leave our camera in its case. No boobies are seen flying anywhere. Crowding along the cliff edge, their numbers seem to have doubled. As they stand motionless next to their unprotected young, the adults seem totally unaffected by the pouring rain. The downy chicks, however, become soaked and again we find that many have died. The only creatures that seem to enjoy the rain are the Frigate birds. Gliding up and down high above the island they appear literally to bathe in the air. Diving vertically and vigorously shaking their wing and tail feathers, at times they completely disappear into the clouds.

Taking the opportunity offered by a few moments without rain, we catch a Masked Booby with a prominent blood stain to see whether the blood-drinking habit of the finches has any harmful effect on the growing feathrs. No deeper probe than a simple visual inspection is possible but from this we conclude that there is no direct harm to the young feather, although the blood filled quills are punctured by the finches and partially drained of their blood. A more detailed study however may well prove worth doing.

We were surprised to see that most boobies do not react more vigourously against the finches. Courting pairs seem virtually unaware of the "vampires" riding on their backs, pecking and drawing blood from their feather quills. With single boobies however, a reaction of discomfort can frequently be observed. After several minutes of restlessly walking around on the cliff, now and then shaking its wings to throw off the persecutors, but nevertheless relentlessly followed by up to five or six finches taking turns in riding

and sipping blood, the booby eventually takes off and heads directly out to sea. Stiff-winged and on a straight course, it flies off the cliff and glides down to the water. There, after a shallow dive, a long wake of white foam marks the end of its ordeal. An extended bath with much wing-shaking, preening and rolling over follows, before the booby returns to its place on the cliff. As the bright red marks on its wings have now been washed away, marks that apparently guide the finches in choosing their victims, the returning booby may now enjoy a period of peace before being pestered again by the finches.

On more than one occasion we have come across a group of finches parasitizing Masked Booby nestlings of various ages. While adult Boobies may escape from their persecutors, downy young and flightless juveniles cannot. Crouching on their heels, the neck being prominently arched and the beak tucked away under the body, thus adopting their characteristic submissive position, the downy chicks are totally defenseless. Many of these young show bloody cuts and scratches along the bare sides of their necks, presumably the result of rather rough handling by their parents or other adults. Quite frequently we observe an adult clasping the neck of a chick with its beak and shaking it for a few seconds. The sharp cutting edges of the adult's bill produce at least some of the cuts and scratches that we have seen and these rapidly become an attraction for the finches. Downy young at an early age do not have blood-filled feather quills to offer and thus seem to suffer mostly from attacks on their bare necks. Larger chicks, with feathers already protruding on their wings and tails, are primarily parasitized at their tails. It is saddening to see how these comparatively large birds try to get rid of their tormentors by desperately walking backwards and forwards across the nesting area, but relentlessly followed by a group of sharp-billed finches pecking at their bloody tails.

17 November
It rains all day long. Our tent, built on arid ground with scanty vegetation less than two weeks ago, is now surrounded by fresh green *Alternanthera helleri* bushes; the bare *Croton* trees are now covered with green leaves; *Opuntias* and the beautiful *Portulaca howelli* are all in flower. Behind our camp, low in the scrub of *Alternanthera* bushes and flowering cacti, we find many dome-shaped nests built by our "Vampires" and lined with white booby feathers. The birds are feeding on the filaments of *Opuntia* flowers and hunting for insects under the loose bark of dried and fallen trees. It is in this area, which gradually changes from an open cactus field into a dense *Croton* stand, that we eventually manage to film some of the far less numerous Large Ground Finches *(Geospiza magnirostris)* and Warbler Finches *(Certhidea olivacea)* which we have seen only rarely near our camp on the cliff.

18 November
It is afternoon before the heavy rain changes into a steady drizzle. Most of the sea birds have left by now in search of food for themselves and their young, many of which endure these difficult conditions standing in shallow mud puddles, stoically awaiting their parents. Finches and Mockingbirds, *(Nesomimus parvulus)*, on the other hand, seem to be having a great time. Busy with singing, territorial fighting, nest-building and courting, they all prepare to make good use of the, for them, optimal conditions resulting from the rains.

In the evening, the wind changes direction and the rain becomes heavier again. Within seconds we are soaked while on our last trip on the western cliffs. Coming back to the camp, we find our shelter toppled over by the wind. Even our cold lunch has not escaped and tastes too watery to be any good.

19 November
Presumbaly our last day on Wolf Island. It is one of the few days of fine weather. As some introductory shots are needed for our film, we climb down the cliffs to the rocky shore where several pairs of the Great Frigatebird *(Fregata minor)* have their nests and young. Halfway down, in little caves along the foot of the steep rockwalls, we find what appear to be old nests of the Galapagos Dove *(Zenaida galapagoensis)* which is quite common around our camp. Well hidden behind a large stone in a hole in the cliff, we discover a Red-billed Tropicbird *(Phaeton aethereus)* with its yellow-billed young.

In the afternoon we walk over leaf-littered ground in a small grove of *Erythrina velutina* trees near the eastern cliff. This group of comparatively large trees seems to be rather out of place here as it contrasts strongly with the low stands of *Croton* forest. In its shade we find large stones and rocks, uprooted trees and rotting logs which had doubtless been carried to this place over many years by huge floods of

rainwater that had come down from the peak, cutting an impressive creek bed through the grove. On a twig in the grove a Large-billed Flycatcher *(Myiarchus magnirostris)* perches and not far from it the greenish female of the Summer Tanager *(Piranga rubra)*, a migrant from North America, is resting in the shade. At the edge of the grove two other birds attract our attention; our best identification leads to the conclusion that they must be Red-eyed Vireos *(Vireo olivaceus)*, migrants from the north as well. As far as we know, this species has not previously been reported in the Galapagos.

Summing up the migrant birds that we have noted: 5 Cattle Egrets *(Bubulcus ibis)* were recorded near our camp throughout our stay; on 14 November a cuckoo flew over our camp *(Coccyzuz melacoryphus* most likely*)*; two White-cheeked Pintails *(Anas bahamensis)* crossed the northern bay on 15 November and on 17 November numerous Bank Swallows *(Riparia riparia)* were seen flying along the edge of the cliffs. The only migrant marine species we saw was a Cape Pigeon *(Daption capense)* on 18 November, an antartic breeder that migrates north.

20 November
At 7am we hear the Darwin Station's M/Y Beagle IV cruising into the bay below. It takes us three hours to carry all our equipment down the steep cliff and over the slippery ledges to where the dinghy waits and another hour before all the precious gear and our invaluable film footage of the "Vampire-Finches" is put safely on board.

We have documented on film the most unusual blood-drinking and egg-robbing habits of the Sharp-beaked Ground Finches, on Wolf Island. We have had a lot of rain and poor light,with only a few sunny days, but we have certainly experienced our best time in the Galapagos so far.

Now (March 1983), several months later, it has become clear that the most unusual rains we endured on Wolf were the precursors of an "El Niño" year. Every 7 to 10 years, warm currents of the eastern Pacific, which normally stay north of the Galapagos, press southwards and prevent the cold Humbolt current from flowing north to the islands, thus changing the normal climatic pattern of the archipelago. The reasons for these changes are only poorly understood, though their drastic consequences are well known. Air and water temperatures are raised considerably and frequent rainfalls quickly change the barren and arid islands into lush green paradises. This is true not only of the Galapagos but also of the Peruvian coast. Peru suffers the widely known dramatic declines of fisheries and sudden reductions in Guano-bird populations.

MARINE IGUANAS SUFFER AS EL NINO BREAKS ALL RECORDS

by

Andrew Laurie

Among the consequences of the unprecedented severity of the El Niño event of 1982-83 has been the disappearance of most of the algae such as *Ulva, Spermothamnium, Centroceras* and *Gelidium* on which marine iguanas normally feed. The intertidal and subtidal zones have been colonised by several new species including *Giffordia* sp., with disastrous results for the iguanas. The change in algal flora coupled with extremely high sea levels and heavy swells, which restrict access to the feeding grounds, have been accompanied by massive mortality of marine iguanas on all the islands, although there are differences between islands in both overall and age-specific mortality rates.

Almost all animals are under weight and in some populations on Fernandina there has been almost 50% mortality: at Cabo Douglas in June we picked up 400 carcasses along 800 metres of coastline. Where there is little intertidal feeding but mainly subtidal feeding by diving as at Caleta Webb (Isabela) adult mortality has been light but juvenile mortality very high. On the other hand, on Santa Fé, where most of the feeding is intertidal, both juveniles and adults have suffered heavily. About 40% have died and there has been a mean 30% weight loss among the surviving adults over the past twelve months. Most juveniles have not suffered actual weight loss but, compared with their normal annual weight increase of 35%, the mean annual weight increases this year of 3-5 year olds was only about 8%. Hatchlings normally more than double in weight during their first year (mean: 110% increase) but the mean weight increase of the 1982 hatchlings after one year was only 65%.

Autopsies of dead animals have revealed stomachs either completely empty or containing the largely undigested remains of the new species of algae mixed with items of carrion such as pieces of dead crabs, sea lions and iguanas, and earth and stones. The new algae seemed difficult to digest: they had hardly changed in appearance as they passed through the digestive tract, and the faeces, which are normally liquid and amorphous, were dry and fibrous, with food remains readily identifiable. Whether toxins active against the iguanas themselves or against bacteria or protozoa in the hind gut are responsible remains to be discovered by analysis of specimens of the algae, stomach and intestine contents, and faeces. Fixed specimens of iguanas which died in these circumstances are being examined in detail at the Royal College of Surgeons, London, to discover the exact cause of death. Some animals had particularly heavy loads of the trematode parasite *Iguanacola navicularis* in the gut, but this is unlikely to be a primary cause of death. Bones from more that 1000 dead animals on 10 different islands have also been collected in the hope that, as has already proved possible with temperate reptiles, their ages can be determined from annual rings visible in stained, decalcified sections. If successful, this will obviously be of immense importance for the study of population dynamics.

El Niño has taken a severe toll and although it was sad to see iguanas, many of them known individuals, dying, day after day, it has been a unique opportunity to study a natural disaster and its effects on the populations. The 1982-83 El Niño has not been matched for at least 100 years and in recent El Niño years there have been no records of mass mortality of marine iguanas, despite the presence of biologists working in the islands. It has been tremendously exciting to be in Galapagos during such an exceptional year after seeing the islands in two normal years beforehand, but the value of the study would be disproportionately increased by extension now for a fourth year to observe the recovery of the populations and the effects of El Niño on the next breeding season.

There are now (July 1983) signs that conditions are returning to normal: the sea temperature is dropping, and on Santa Fé the swallow-tailed gulls have returned and started nesting after a long absence. I hope to return to Galapagos in October to see which iguanas, in relation to age and breeding history, survive this year's exceptionally severe conditions and to determine the breeding success of the survivors in comparison to previous years. Such information is not only of purely scientific interest, but of vital importance for conservation. On islands without introduced predators there is no danger of extinction but, on islands where cats still kill large numbers of juveniles, this year's high natural mortality could prove critical to the survival of some populations.

Since the above was written, the Leverhulme Trust, which together with the Royal Society has funded Dr. Laurie's marine iguana studies, has generously agreed to extend its support for a fourth year.

UNA ALIANZA EXITOSA QUE DEBE MANTENERSE

por

Raúl Moscoso ALvarez

El Gobierno actual y probablemente el país entero tiene una conciencia muy clara del singular valor científico y escénico de las Islas Galápagos y del significativo aporte que la Fundación Charles Darwin, a través de su Estación de Santa Cruz, ha realizado en favor de la conservación del Archipiélago y de la formación de investigadores ecuatorianos.

De aquí el Presidente ecuatoriano Osvaldo Hurtado ha sido muy claro en señalar que el desarrollo de la provincia insular debe plantearse en "términos radicalmente distintos a los del continente" *(1)* y suficientemente explícito en reconocer la labor de la Fundación como "ejemplo de lo que puede hacer la cooperación científica en beneficio de los intereses de la naturaleza y del hombre" *(2)*.

A esta clara conciencia del valor de las Galápagos y de la contribución de la Fundación, se suma la voluntad del Gobierno ecuatoriano de apoyar al trabajo científico desarrollado en dicho sector del país, ya no sólo por extranjeros "a los que por cierto" reconoce y "agradece su contribución" *(3)* sino también por científicos ecuatorianos.

Esta voluntad gubernamental se ha manifestado en aportes económicos anuales, que por razones burocráticas, unas veces, y por penuria fiscal otras, no se han entregado con la oportunidad y en la cantidad originalmente ofrecida.

Pero esta circunstancia de entrabamiento de la ayuda estatal a la Fundación en ningún caso responde a una decisión política.

Ecuador es grato con instituciones científicas como la Fundación que únicamente han reportado beneficios y por otra parte al país le interesa mantener de modo permanente buenas relaciones con la comunidad científica internacional. El chauvinismo y la xenofobia afortunadamente no son defectos nacionales, pero sí son notorias susfalencias cuantitativas y cualitativas en la actividad de investigación científica en el área de las ciencias exactas y naturales.

Esta percepción honesta de los méritos ajenos y de las propias deficiencias ha llevado al país a la adopción de una política científica y technológica realista que, renunciando a una utópica autarquía, persiga, sin embargo, una mayor autonomía decisional en esta materia.

El prestigio cualitativo alcanzado por la Estación Santa Cruz, hace olvidar con frecuencia su pequeña dimensión cuantitativa y los pocos recursos con que lamentablemente cuenta.

Esta visión sobredimensionada de la Estación ha inducido muchas veces a pedirle más de lo que ella puede dar y ha devenido en blanco apetecido de mentalidades mezquinas, de politiqueros o seudo-científicos, de los que no faltan en ningún país, quienes con inocultables propósitos de promoción personal a cualquier costo, han puesto su mira y enfilado sus baterías en contra de la Fundación. La probreza de su argumentación no ha calado en la opinión pública, en la comunidad científica ecuatoriana y peor en el Gobierno Nacional.

Son tan pocos y descalificados los enemigos de la Fundación que su labor de zapa en contra de la institución no es ni será capaz de minar esta "alianza exitosa del Gobierno Nacional y la ciencia internacional".

Los vínculos del Ecuador con la Fundación, lejos de acabarse o debilitarse tienden — como debe ser — a prolongarse y fortalecerse.

Creemos que es menester apoyar esta tendencia favorable, pues no se puede deportivamente echar por la borda la inmensa tarea desplegada y los logros alcanzados, so pretexto de la culminación normal de un convenio o por atender, sin criterio, la argumentación sofista de unos cuantos desorientados.

Compartimos la opinión del Director de la UNESCO, Amador Mahatar M'Bow, respecto de la "necesidad du una empresa común para continuar las acciones muy bien iniciadas por la Estación Charles Darwin y por las instituciones nacionales e internacionales, en la perspectiva, no sólo por conservar estas islas, sino también por desarrollar un lugar de investigación científica nacional e international" *(4)*.

Este repertorio de opiniones nos inducen a desarrollar una serie de acciones orientadas a lograr lo siguiente:

— Elaborar un Plan Maestro de Conservación y Desarrollo Social de Galápagos.
— Incluir dentro de este plan una política de apoyo a la actividad científica de Galápagos.
— Mantener la ayuda económica a la Estación Charles Darwin.
— Suscribir un Convenio con la Fundación Charles Darwin orientado a prolongar, fortalecer y actualizar las buenas relaciones existentes con el Ecuador.
— Proponer a la Fundación Charles Darwin un conjunto de lineamientos de políticas de investigación científica, diseñado y aprobado por el Grupo Ecuatoriano de tal entidad, a objeto de que se incorporen al Plan Maestro y sirvan de guía en la investigación a realizarse en la Estación, aclarando que con ello no se quieren otras cosas que la pervivencia de esta entidad, con las características de excelencia en la investigación científica de campo, que ofrezca de modo creciente la oportunidad de formación de científicos nacionales, que continúe de modo más activo, en el trabajo de asesoría en materia de conservación de las Galápagos, a todas las entidades que en dicha provincia hacen desarrollo social y económico, que difunda en versión castellana los trabajos científicos más importantes realizados en la Estación y que intensifique sus programas educativos, socialmente trascendentes de Ecología Humana.

  Este es pues el alcance de la decantada "ecuatorianizaciór de la Estación Charles Darwin".

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(1) Discurso del Presidente del Ecuador Osvaldo Hurtado, de 3.12.82, al celebrarse el Sesquicentenario de la Fundación de Galápagos.
(2) Idem.
(3) Intervención del entonces vicepresidente del Ecuador Osvaldo Hurtado, de 12.2.80, con motivo de celebrarse el XX Aniversario de la Fundación Charles Darwin.
(4) Discurso del Director General de la UNESCO, en el acto oficial declaratorio de Galápagos como Patrimonio Natural de la Humanidad, el 28 de julio de 1979.

A SUCCESSFUL ALLIANCE WHICH SHOULD BE MAINTAINED

by

Raúl Moscoso Alvarez

Dr. Raúl Moscoso Alvarez is the legal adviser to the Office of the President of the Republic and he also represents President Hurtado in his capacity as ex-officio member of the Executive Council of the Charles Darwin Foundation. He has written this article specially for Noticias de Galapagos and, in view of its importance, we are printing a full-length English translation for the convenience of readers whose knowledge of Spanish may be limited. Only the Spanish text is authentic.

The present Government of Ecuador and no doubt the entire country is acutely aware of the scientific and scenic value of the Galapagos Islands and of the significant contribution that the Charles Darwin Foundation, through its Research Station on Santa Cruz Island, has made to the conservation of the Archipelago and to the training of Ecuadorean research workers.

The President of the Republic, Osvaldo Hurtado, has stated in the clearest terms that the development of our island province should be planned "on lines radically different from those suitable for the mainland" *(1)* and has explicitly recognized the work of the Darwin Foundation as "an example of what can be achieved by scientific co-operation for the benefit of nature and man. *(2).*

To this awareness of the importance of the Galapagos and the contribution of the Foundation must be added the desire of the Government to support the scientific work being carried out in the islands, not only by foreigners "to whom we are certainly grateful for their contribution" *(3)* but also by Ecuadorean scientists.

This intention of the Government has been implemented by annual financial assistance although, sometimes for bureaucratic reasons, sometimes because of fiscal penury, payments have not been made on time or in the amounts originally offered.

But in no case has the restriction of state aid to the Foundation been due to a political decision.

Ecuador is grateful to scientifc institutions such as the Foundation, which have brought nothing but benefits to the country, and remains anxious to maintain good relations with the international scientific community. Chauvinism and xenophobia are fortunately not among our national defects but on the other hand our shortcomings, both in quantity and quality, are notorious in the fields of scientific investigation and in the exact and natural sciences.

This honest appreciation of other people's merits and our own deficiencies has led the country to adopt a realistic policy for science and technology which, while renouncing a utopian autarchy, nevertheless preserves its overriding autonomy of decision in this field.

The prestige which the Darwin Research Station has won by the quality of its work leads us to forget its small size and the very limited resources on which it unfortunately has to operate.

This exaggerated notion of the size of the Station has frequently led to its being asked to undertake tasks beyond its capacity and it has thus become an attractive target for petty minds and politicking or pseudo-scientific critics, of which there is no lack in any country, persons who, with ill-concealed designs on personal promotion at any cost, have set their sights and turned their guns on the Foundation. The poverty of their arguments has not yet sunk into the minds of the public or the Ecuadorean scientific community or, worse still, the National Government.

The enemies of the Foundation are so few and so poorly qualified that they will fail in their efforts to undermine the institution and destroy this "successful alliance of National Government and international science".

The bonds uniting Ecuador and the Foundation, far from growing weaker or breaking, are being strengthened and extended — as indeed they should be.

We believe it is necessary to support this favourable trend because the immensity of the task to be faced and the successes that have been won cannot be lightly tossed overboard merely on the plea that the contractual date to end an agreement has been reached or that the sophistical arguments of a few crackpots should be accepted uncritically.

We share the opinion of the Director General of UNESCO, Amador Mahatar M'Bow, regarding "the need for a joint organization to continue the programme so well begun by the Charles Darwin Research Station and by national and international institutions with a view not only to the conservation of these islands but also to the development of a centre for national and international scientific investigation." *(4)*.

This catalogue of opinions induces us to put forward the following series of proposals:

— Elaborate a Master Plan for Conservation and Social Development in the Galapagos.
— Include in this plan a policy for the support of scientific work in the Galapagos.
— Maintain financial assistance for the Darwin Station.
— Sign an Agreement with the Charles Darwin Foundation designed to prolong, strengthen and update the good relations existing between it and the Republic of Ecuador.
— Propose to the Charles Darwin Foundation a series of measures covering policies of scientific investigation, drawn up and approved by the Foundation's "Ecuadorean Group", with the object of incorporating them in the Master Plan to serve as guidelines for future research at the Station. It should be made clear: that they have no other purpose than the continuance of this organization with its characteristic excellence in field research, which offers ever greater opportunities for the training of national scientists; that the Station should be increasingly concerned with giving advice on conservation matters to all the authorities involved in the social and economic development of the Galapagos; that it should publish Spanish translations of the more important reports on the scientific work at the Station; and that it should expand its socially invaluable programme of Human Ecology.

  This, then, is what the artificially inflated question of "the ecuadoreanization of the CDRS" really amounts to.

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(1) Speech by the President of Ecuador, Osvaldo Hurtado, on 3 December 1982, at the celebration of the 150th anniversary of the annexation of the Galapagos.
(2) Idem.
(3) Statement of Osvaldo Hurtado, then Vice-President of Ecuador, on 12 February 1980, at the 20th anniversary celebration of the Charles Darwin Foundation.
(4) Speech by the Director General of UNESCO at the official ceremony declaring Galapagos to be a World Heritage, 28 July 1979.

STRANDING OF CUVIER'S BEAKED WHALES ON BALTRA

by Gary Robinson, Friedemann Köster and Jose Villa

Charles Darwin Research Station, Isla Santa Cruz, Galapagos, Ecuador

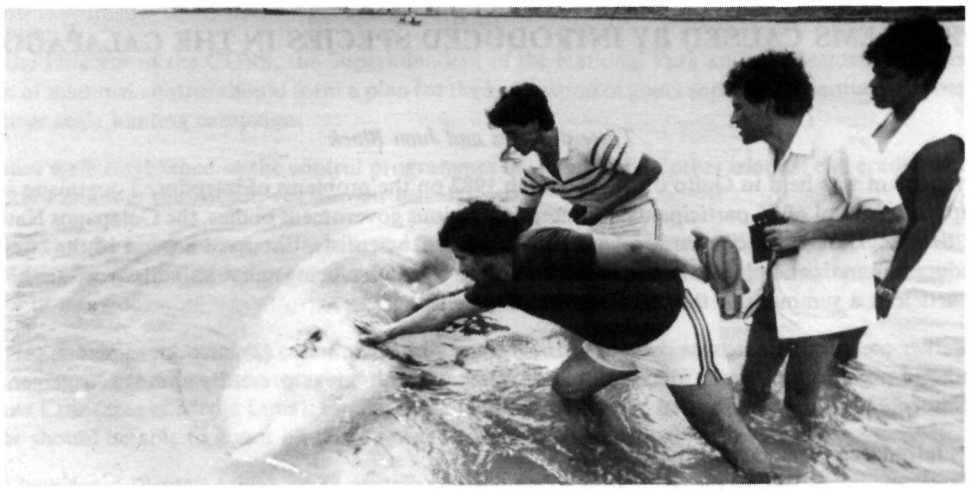
At 9 a.m. on March 1, 1983, tourists and guides observed a pod of six Cuvier's beaked whales, *Ziphius cavirostris*, entering the port of Baltra Island (approx. 0°26' S. Lat. and 90°17' W. Long.) in the Galapagos. The whales swam along the southern perimeter of the bay, turned northward after reaching shallow water, and then swam directly onshore, stranding themselves on a sandy beach in the northeast corner of the bay. The largest whale of the group, described as the leader by the tour guides present, was the first to head ashore where it thrashed about vigorously in the low surf. This individual was closely followed by a second. In this corner of the port there are remnants of steel pilings installed when Baltra served as a U.S. military base during World War 2. The two whales, both between 5 and 6 meters in length, were apparently lacerated by these pilings because the water soon became bloodied as they moved about. One of the two was positively identified as a male by the two teeth on the tip of the lower jaw. Only in the males of *Ziphius* do the teeth erupt from the gum (Mörzer-Bruyns, 1971; Heintzelman, 1981; Leatherwood, et al., 1982). The sex of the second individual was not ascertained. The other four beaked whales, which were also not identified as to sex, remained close by in slightly deeper water. Within a few minutes of the initial stranding, the group leader stopped all movement and drifted seaward with the waves, while the other five abandoned the beach and began swimming southward though still remaining close to shore. Soon afterward, two of the whales were no longer seen. Presumably, they dove and left the bay.

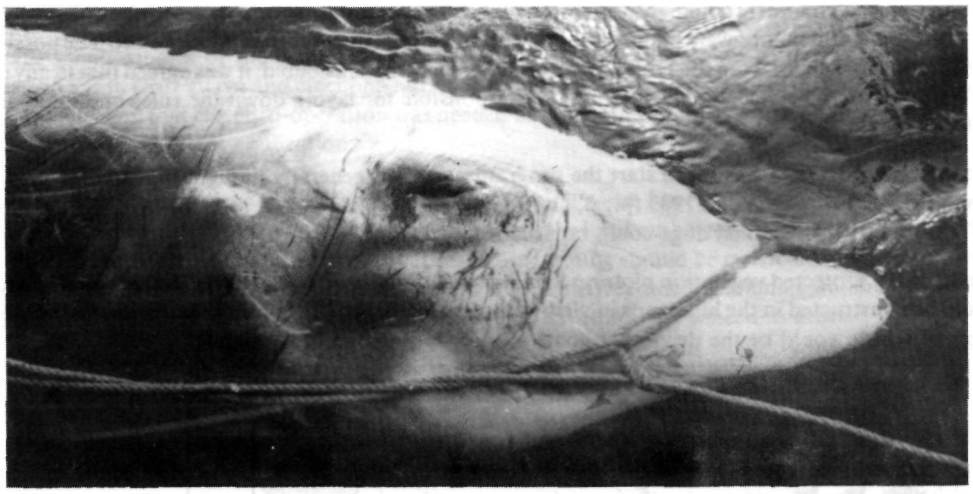
News of the stranding was communicated by radio to the National Park Service and the Charles Darwin Research Station on Santa Cruz Island. When we arrived at Baltra at 2.30 p.m. on the same day, 4 whales were still present in the bay. Both of the first whales to become stranded were now dead, one floating at the north end of the bay, the other at the south end. Two live whales were grounded in water of 1 meter depth on another sandy beach in the center of the bay next to a rocky outcrop. As the waves broke over the floundering animals, they rolled on to their sides, permitting a good inspection of the protruding lower jaw, head shape, and fin placement characteristic of Cuvier's beaked whales. Neither individual possessed visible teeth, indicating that they were either immature males or females. Though the two live whales had superficial scrapes they appeared to be otherwise unhurt and not stranded in water so shallow that they could not swim off. Nevertheless, they continued to swim toward shallower water despite the hordes of tourists who had gathered to watch the phenomenon.

At about 3 p.m. one of the whales rolled seaward and then swam off, only to turn around when several hundred meters out and swim directly on to another sandy beach 100 meters to the south. Within minutes the second live whale repeated the same scenario, coming alongside the first. Here, the beaked whales floundered in the surf for another twenty minutes or so before they again abandoned this beach and swam south towards one of the floating dead whales. However, instead of stranding themselves once more, the whales dove and were not seen again.

What could have prompted the beaked whales to enter Baltra port and purposely beach themselves? Reasons why whales become stranded are various but largely speculative. Scientists have identified illness, injury, parasitism and impairment of echo-locating ability as possible causes, but autopsy of dead stranded whales is necessary to provide clues. These are not the only reasons why whales become stranded. For instance, whales may occasionally pursue prey into water so shallow that they become accidentally trapped by receeding tides. Smaller whale species may endeavour to escape from predators by swimming into water too shallow for their hunters to follow.

Of the six beaked whales that entered the Baltra port, only the two whales that were injured on the steel pilings definitely died. This fact does not preclude illness or parasitism as potential causes of the stranding and death since an autopsy was not possible. Four of the whales left the area and there have been no further reports of dead whales washed ashore in this vicinity. This implies that they may have survived though it is impossible to be certain.





It is not likely that the beaked whales were pursuing prey since they are thought to feed on squid and fish in deep water (Leatherwood, et al., 1982). It is conceivable that they may have first entered the port to escape from predators such as killer whales which are often seen around Baltra. However, no reports of killer whales in the area were made on March 1 when the stranding occurred. Therefore, we are left with another curious report of whales stranding themselves for some unattributable reason.

This stranding of *Ziphius cavirostris* is significant in that it confirms the presence of these little known whales in Galapagos waters. Cuvier's beaked whales have previously been identified as occurring in Galapagos only on the basis of visual observations and photographs made at sea (see Leatherwood, et al., 1982).

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OF MEN, GOATS & GUAVA — PROBLEMS CAUSED BY INTRODUCED SPECIES IN THE GALAPAGOS

by

Tjitte de Vries and Juan Black

A symposium was held in Quito on 10-11 March 1982 on the problems of introduced organisms in the Galapagos. A total of 26 participants, representing various government bodies, the Galapagos National Park Service, CDF Council members and CDRS resident scientists, discussed aspects of the effects of introduced animals and plants, as well as the feasibility of reintroducing native animals to certain islands. This article is a summary of the discussions and conclusions.

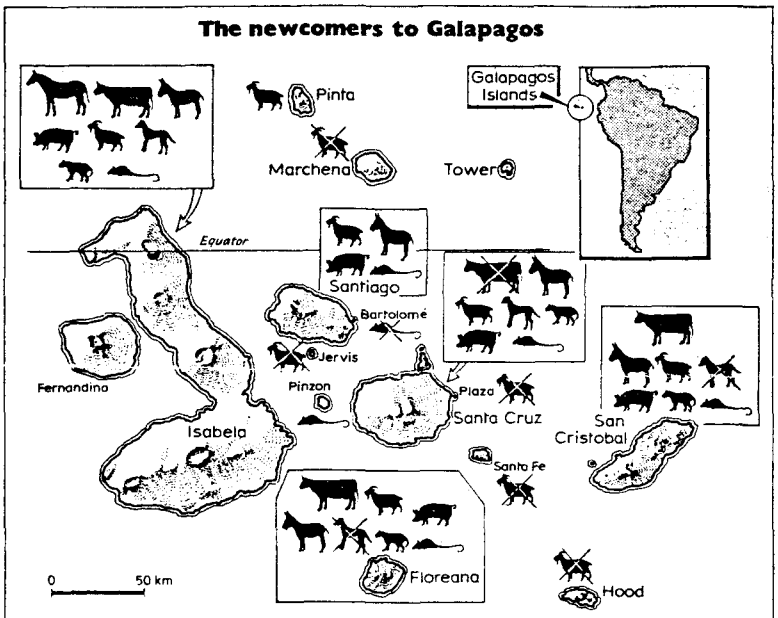
The rather complex subject was divided into (1) introduced mammals, (2) introduced plants, (3) other introduced organisms, (4) reintroduction of native animals into areas presently under management and (5) reintroductions in deteriorated areas.

1. Introduced mammals.

On Santiago (James Island) the population dynamics and ecology of the goats had been under study since 1974. The goat population was estimated at between 80,000 and 100,000, together with 20,000 pigs. It was thought that such numbers could only be eliminated if a major programme of eradication could count on sufficient funds and manpower right from its inception and throughout the entire project. The possibility of requesting assistance from the Ecuadorean armed forces was considered; it was agreed that in any event the National Park Service should be the body responsible for laying down the rules and maintaining control over the hunting campaign.

Although no exact date was set to start the programme, it was generally thought that studies should be completed in 1982 (goats) and 1983 (pigs), and that goats and pigs should be eradicated jointly, starting not later than 1985. Trained dogs could be used at certain stages of the campaign.

Studies of the protected vegetation plots on Santiago should be continued but no further fenced quadrats should be constructed in the highlands in view of the imminence of the hunting campaign, one of the first stages of which would be the driving of goats away from the humid highlands.



Isabela has the complete complement of destructive exotic creatures: horses, cattle, donkeys, pigs, goats, dogs, cats and rats. The rest have a selection. A cross over the symbol indicates the animal has already been eliminated

Map by Nigel Sitwell.

Reproduced by courtesy of the New Scientist.

Resolution 1
That the Director of the CDRS, the Superintendent of the National Park and the Resident Scientist in charge of mammal control should form a plan for the eradication of goats and pigs on Santiago, by means of a large scale hunting campaign.

Priorities were established in the control programmes of mammals on other islands; e.g. eradication of goats on Pinta and the Alcedo volcano on Isabela.

The dog control programmes on Isabela and Santa Cruz should be continued, and agreement with the local authorities in the settled areas should be sought in order to come to some understanding on the control of stray dogs.

The rat control programme at Cerro Pajas on Floreana should be continued and should serve as a pilot study for future programmes to control rats on Pinzon (Duncan Island), Eden, and parts of the highlands of Santa Cruz (area of Media Luna). Finally, it was thought of critical importance that the National Park Service should be able to count on more funds for conservation in 1983.

2. Introduced Plants

The most serious threats to the native vegetation by introduced plants are those caused by guava, cinchona, various grasses and, on some islands, *Lantana camara.*

On Isabela only studies of the dispersion and expansion rates of guava have so far been undertaken, whereas on Santa Cruz guava and cinchona have been eliminated with some success in parts of highlands. There was a feeling that closer co-operation was needed between the botanists of the CDRS and the park wardens in charge of plant eradication.

Since many introduced plants are dispersed from the farming zones into the National Park, a close co-operation is needed with the agricultural organisations and the local authorities. The dispersion of guava seeds is to a large extent due to free-roaming cattle. Cattle farming should be restricted to the availability of grazing grounds within the settlements and, in order to avoid free-ranging animals wandering into the Park, a policy should be developed to impel all farms to have properly fenced-in areas.

Resolution 2.
That eradication prorgammes of introduced plants on Santa Cruz should have priority.

3. Other introduced organisms

Various questions were asked: What would be appropriate methods to prevent further introduction of arthropods and other organisms, and to reduce to a minimum the inter-island transport of these organisms? What methods should be used to exterminate the fire ants *(Wasmannia auropunctata)* on the inhabited islands? What regulations should be made to control the import of insecticides, fungicides, and other chemicals used to control pests?

Resolution 3.
That control measures should be established in harbours and airports to prevent the introduction of organisms from the mainland to Galapagos and between the various islands of the archipelago.

Resolution 4.
That entomologists and officials of the Ministry of Agriculture should work out an agreement to determine which chemical substances may be used in the archipelago.

Resolution 5.
That an active education programme should be started to draw attention to the dangers of introduced organisms.

4. Reintroductions into areas presently under management

Several programmes are aimed at reintroducing animals into areas presently under management (i.e. within the National Park).

Pinta

One of the aims of the CDF is to preserve the natural environment and the reintroduction of a large herbivore on Pinta (Abingdon Island) would coincide with this objective. The absence of any large grazer (now that the native race of tortoises has virtually become extinct and that the introduced goats are close to being eliminated) has certainly had its effects on the dominant vegetation.

In particular, the problem of the sole surviving tortoise of the Pinta race (Lonesome George) was discussed. Various possibilities were put forward:

(1) Let George die in peace.
(2) Let George mate with females from Wolf volcano (Isabela), the most similar race.
(3) Introduce both males and females from Wolf in order to establish a suitable population of large herbivores on Pinta.
(4) Artificial insemination of Wolf females using George's sperm.

After a long and lively discussion the participants agreed:

Resolution 6.
To introduce in 1984 tortoises from Volcano Wolf to Pinta once it has been finally established that no further Pinta tortoises survive on the island. (This resolution was adopted after voting; 19 in favour, one against).

Resolution 7.
To start immediately an active breeding programme using George and five or more female Wolf tortoises.

Espanola (Hood Island)

By 1982, 132 young tortoises had been released on Hood as a result of the captive breeding programme of the CDRS and SPNG. It was discussed whether the adults (3 males + 13 females, at present in the Station's pens) could now be returned to Hood and the population allowed to find its own way of surviving.

Resolution 8.
That whilst so little was known about the sex ratio of the young, which is most difficult to determine, the breeding programme of Hood tortoises should be continued at the Station.

Pinzon (Duncan Island).

The breeding programme of Duncan tortoises (which started in 1965) had been most successful and 192 young tortoises had been returned to the island. Concern was expressed as to whether temperature during incubation could be a factor influencing the sex of the animals, which could lead to rearing animals predominantly of one sex.

Resolution 9.
That the breeding and repatriation programme of Duncan tortoises should be continued and the status and survival of the young on Duncan should be thoroughly studied periodically.

Santa Fe (Barrington Island)

The introduction of tortoises on Barrington was discussed as the vegetation was recovering after the removal of all the goats ten years ago. The first question was which race should be introduced. There was a concensus that no tortoises of unknown origin (tortoises from the odds-and-ends pen of the Station) should be used and the Duncan race could well be the most suitable, particularly as natural reproduction remains a problem on Duncan so long as the rat population remains high. However, there was a possibility that the introduction of tortoises might result in their competing for food with the endemic land iguanas.

Resolution 10.
That conditions for introducing tortoises on Barrington were not yet optimum; such an introduction would have to wait several more years.

5. Reintroductions in deteriorated areas

Some proposals were discussed of introducing animals into areas which have suffered through human

interference. The rearing of young land iguanas made it urgent to find safe places for returning the animals. The captive breeding programme had been so successful that it had become a burden to house and feed so many land iguanas for indefinite periods.

For reasons not yet clear (but possibly high predation by snakes) the land iguanas on North Seymour (introduced there from Baltra in the 1930s) have a very low reproductive success but young reared from a pair presently at the Station were available for release on their ancestral island of Baltra. Before embarking on this adventure in reintroduction, a complete ecological study was needed to assess the environmental conditions on Baltra, which is not a part of the National Park. Land iguanas became extinct on Baltra in the 1940s after the establishment of a military base, almost certainly through direct killing by man and the destruction of nesting areas by covering them with concrete and asphalting roads and airstrips. In addition, rats, mice and cats have been introduced, complicating any repatriation programme of iguanas.

An even more complicated situation was noted (e.g. several predators, poor habitat) for reintroducing the Floreana Mockingbird to Floreana and for transferring Galapagos Hawks from Santiago to Santa Cruz. Not only are the hawks occasionally killed in the inhabited parts of the highlands of Santa Cruz, but their main prey (doves and native rice rats) are no longer available. The original population of some 250 pairs is now reduced to 2 or 3 pairs around Saddle-back Hill, in the north western part of Santa Cruz; the presence of this relict population is a further reason for not introducing Santiago birds.

Resolution 11.
That a plan to reintroduce land iguanas to Baltra should be carefully elaborated, based upon ecological studies of the natural conditions on Baltra.

Resolution 12.
That reintroduction of native organisms in deteriorated areas has no priority.

6. Various other problems

Control of tourism should follow along the lines of the Special Report of the Government Commission on Tourism, which was accepted by the Government in March 1982. Access to Tortuga Bay from Puerto Ayora should follow the plan of SPNG, CDRS and INGALA for visiting the beach by a nature trail not exceeding 1.20m in width. The tortoises of unknown origin at the CDRS should be used for scientific studies and for exhibition purposes by Ecuadorean institutions.

Finally, before a decree establishing a National Marine Park can be passed, carefully defined regulations are required regarding the fishing rights of the local population.

GALAPAGOS SEA TURTLES

by

Derek Green

INTRODUCTION

Fritz and Carmen Angermeyer, resident in the archipelago these last 40 years, were the first to tag turtles: two in 1964, and ten in 1966. Between 1970-1975 Peter Pritchard tagged and measured females on several nesting beaches and gathered data on clutch size, hatchling size, and hatchling scalation. This work was expanded by Miguel Cifuentes during the 1973-1975 nesting seasons to include hatching success.

Between 1975-1980 I conducted an in-depth investigation of Galápagos sea turtles. Since the main objectives, materials, methods, and a general outline of the project have appeared in **Noticias** No. 33 and in reports on file at the CDRS, they will not be repeated here. The following, in very general terms, are a few of the results from the study.

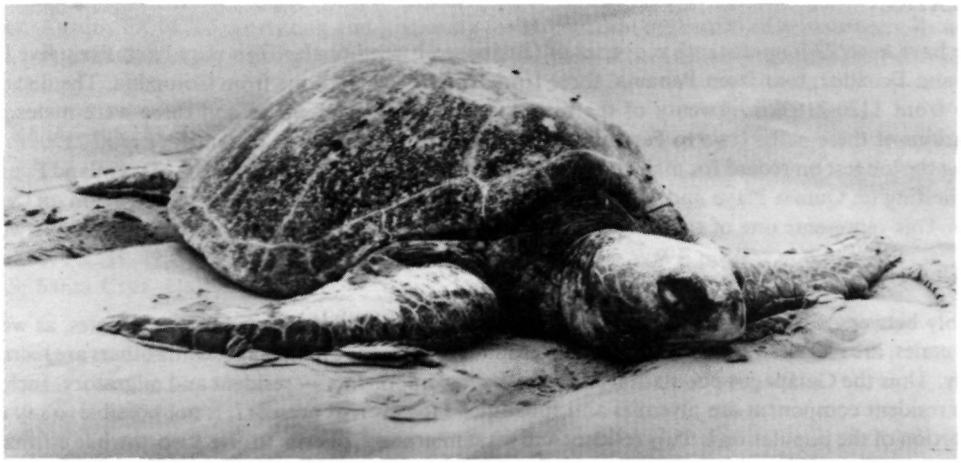
SPECIES PRESENT

The most common species in the Galápagos is the east Pacific green turtle, *Chelonia mydas agassizii* (Bocourt 1868), which occurs in large numbers and is the only species known to nest within the archipelago. Two morphotypes are recognized: the typical dark form known locally as *tortuga negra* and a rare sterile form with a yellowish carapace and a yellow-orange plastron, known locally as *tortuga amarilla.* The hawksbill turtle, *Eretmochelys imbricata* (Linnaeus) — local name *carey* — although encountered occasionally, is not known to nest. The leatherback turtle, *Dermochelys coriacea* (Linnaeus), has been sighted only three times in recent years.

REPRODUCTION

Copulating pairs of green turtles can be seen almost year-round (I lack sightings only for April) especially in protected bays, inlets, and lagoons such as Turtle Cove. However, the numbers vary greatly; they are rare from May through August, start to increase noticeably in late September, peak around mid-December, become sporadic during February, and rare again in March. The male, recognizable by his long tail which protrudes an average 26cm beyond the posterior edge of his carapace, mounts the female after courtship, from behind, hooks the pollex claws of his foreflippers under the anterior margin of her carapace, and hooks his powerful tail and sometimes his hindflippers under the posterior margin. Once settled in this position the couple may remain joined for as long as six hours. A mating pair is often accompanied by a 1-6 "escort" males which, presumably in an attempt to dislodge the successful male, often bite at his neck, shoulders, tail and flippers. The damage is sometimes severe enough to expose the bones, especially in the hindflippers. Occasionally the escorts are females.

Nesting occurs on all major islands except Rábida, Pinzón, Genovesa and possibly Fernandina. The most important beaches are Quinta Playa and Bahía Barahona on southern Isabela, Las Salinas on Baltra, Las Bachas on northern Santa Cruz, and Espumilla on Santiago. Oviposition starts around early December and lasts until the end of June, with a peak in late February/March. It thus coincides with the hot or wet season. Most nesting females emerge between 1900 hours and midnight, usually within two hours either side of high tide, rarely by daylight or at low tide. Upon reaching an area above the high-water mark, the female starts to sweep the sand backwards with her foreflippers. This gradually results in the formation of a pit; the top of the carapace is now level with the beach surface. Next, the hindflippers excavate the egg chamber into which about 84 eggs are deposited. The turtle then covers the eggs, fills the pit with sand and returns to the sea. The whole process takes 3-3½ hours and the eggs are left at a depth of 60cm. Not all landings result in successful nesting. Some turtles return to the sea without ever reaching the high-water mark; others excavate several egg chambers and yet still do not lay. At Quinta Playa there was an average of 2.7 landings to each successful nesting; at the other study sites the ratio was even higher. One female may lay up to seven clutches in a single season at intervals of approximately two weeks, with an average of about three clutches per female.



A female green turtle basking at Quinta Playa, southern Isabela *Photo by* Derek Green

The incubation period (the time between oviposition and the emergence of the largest group of hatchlings) ranges from 45-75 days with an average of 55 days. The hatchlings take some 3-7 days to reach the surface from the egg chamber. Hatching success varies from beach to beach. At Baltra, where there is little egg predation, about 70% of the eggs hatch. On the other hand, due to a predatory scarabeid beetle, *Trox suberosus,* and feral pigs, the hatch rate on Quinta Playa is only 40%, while on Espumilla nest destruction by feral pigs reduces the rate to a mere 1%.

Hatchlings usually emerge at night, 50% between 18.00-21.00 hrs. Emergence is rapid, the hatchlings seemingly bubbling out of the sand in a continuous stream. Then under cover of darkness they make their way to the sea, a journey of 1-15 minutes depending upn the distance to the water's edge. During this short journey, however, the young turtles run a gauntlet of predators. The most important of these predators is the ghost crab, *Ocypode gaudichaudii.* Another crab predator, the land hermit *Coenobita compressus,* although incapable of running down a normal healthy hatchling, will occasionally pick off weak or lethargic ones. The yellow-crowned night heron, *Nyctanassa violacea,* is the most prevalent nocturnal avian predator. However, these birds are highly territorial and, since it takes them approximately 15 minutes to swallow a single hatchling, only one turtle per nest is lost to them. Feral cats and black rats also occasionally take hatchlings. Despite this gauntlet, in excess of 96% of the hatchlings emerging at night reach the sea. Those that emerge by day, although rare, are less fortunate and suffer attack by frigatebirds, pelicans, lava gulls, great blue herons and possibly Galápagos buzzards. Hatchling loss is usually high — perhaps 50% in some cases. Once in the ocean, the neonates fall prey to a variety of fish including groupers and sharks, and to birds such as frigates. The extent of hatchling mortality through marine predators, although presumably high, is completely unknown.

FEEDING AND GROWTH

Green turtles in Galápagos feed predominantly on algae although they also take the leaves and bark of the red mangrove, *Rhizophora mangle,* and possibly other mangroves as well. Turtles can be found feeding along most coasts where algae are available. Growth rates are extremely slow. Juveniles and subadults with a straight carapace length (SCL) of 40-50cm grow about 1cm a year, and those with an SCL of 50-60cm, about 0.3cm a year. The rate becomes even slower as the turtle approaches sexual maturity. Thus a 40cm juvenile of unknown age (the smallest green turtle caught in Galápagos had an SCL of 39cm) may require some 50-90 years to reach 66.7cm, the size of the *smallest* nesting female recorded thus far in Galápagos.

MIGRATION

There have been 23 long-distance rcoveries of Galápagos-tagged turtles. Ten were from Peru, five from mainland Ecuador, four from Panama, three from Costa Rica, and one from Colombia. The distances range from 1120-2160km. Twenty of the recaptured turtles were females and three were males. The migrations of these males (two to Peru and one to Costa Rica, minimum distances of 1300-2150km) are among the longest on record for males. One of the females, recaptured off the coast of mainland Ecuador after nesting on Quinta Playa and re-released with her tags intact, subsequently nested again on Quinta Playa. This represents one of the few recorded instances of two-way migration anywhere in the world.

POPULATION SIZE

Possibly between 1200-3500 females nest annually in the archipelago. Some of these females, as well as some males, are recruited from distant feeding grounds outside the archipelago, while others are recruited locally. Thus the Galápagos population consists of two components — resident and migratory. Included in the resident component are juveniles and subadults. However, at present it is not possible to say what proportion of the population is truly resident and what migratory, or even to give a worthwhile estimate of its size.

DISCUSSION

The pig problem, especially at Espumilla, is a very serious one. In Galápagos, as elsewhere, green turtles are known to return to nest after absences of 2-6 years not only to the same vicinity but usually to the same beach. Thus a female, once established as an Espumilla turtle, is likely to remain as one. A hatching success of less than 1% over a long period of time, coupled with a 50-year wait for sexual maturity, might severely hamper the recruitment of young females into the nesting population and thus gradually result in fewer and fewer nesting females at Espumilla. The Galápagos National Park Service has been operating a pig eradication programme on Santiago for several years, but it seems to be having very little effect on the "beach pigs". I strongly urge that this programme be immediately extended to include the Espumilla pigs (and those on Quinta Playa and Bahía Barahona), followed by the erection of fences for long-term protection. The fences at Espumilla could perhaps be placed behind the lagoons to avoid clashing with tourism.

The problem of whether or not to deal with *Trox suberosus* involves how the beetle first arrived in the islands. If it was introduced inadvertantly by livestock imported from the mainland it should be considered an introduced species and steps taken to eliminate it. However, if it arrived under its own power (*T. suberosus* is a strong flier) it should be left alone, even though it does cause substantial damage to turtle nests.

A longer-term threat facing turtles is the removal of sand from the beaches for construction purposes. Much of this sand comes from beaches where very little nesting occurs, but some is also taken from Baltra, an important nesting site, although outside the boundaries of the National Park.

Despite so many years of field study it is still not possible to make a good estimate of the size of even the nesting population, let alone the total population. This stems largely from the fact that the beaches under study total only 6.8km, albeit the most intensively used 6.8km of the archipelago's 50km of beaches. Thus a census of all the nesting beaches during the peak of the season is badly needed. In the interests of safety, the census of the non-study beaches should take place in the daytime and should be timed so that the counting of nests (or tracks) is made over the same 2-3 day period. Any possible fluctuations over such a period can be checked against counts on the same days at the normal study beaches. Although ideally the census should be of fresh nests/tracks, i.e. either from the night before or from the previous 2-3 nights, distinguishing one night's nests from another's may be difficult; hence minimum and maximum counts should be included. Such a project would prove expensive, as it would exceed the normal resources of the National Park Service and the Darwin Station in ships and manpower. The more personnel used the more varied would be the experience and thus the interpretation of "fresh" tracks. However, it is a necessary step. Pritchard (1972, 1975) has made the only known survey of the beaches and his reports, on file at the CDRS, should be consulted in planning any census.

Since leaving the islands in September 1980 I have been working at the Texas Memorial Museum, 2400 Trinity, Austin, TX 78705, analyzing and preparing for publication the results of my research. Research on sea turtles in Galápagos is being continued by Mario Hurtado of the Instituto Nacional de Pesca (INP), Guayaquil.

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TAENIOCONGER KLAUSEWITZI, A NEW GARDEN-EEL FROM THE GALAPAGOS

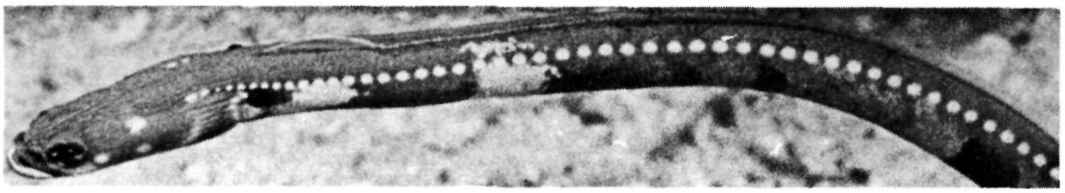
by

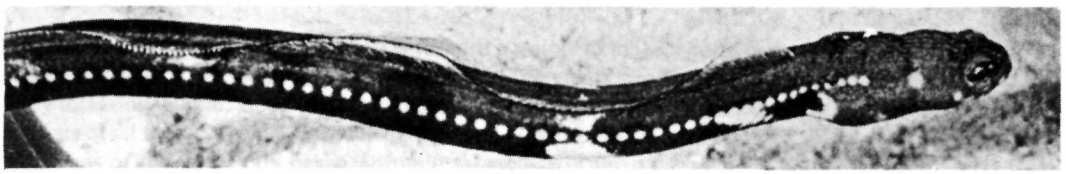
I. Eibl-Eibesfeldt and Friedemann Köster

Garden-eels are undoubtedly among the most specialized and interesting families of the large order of eels. Unlike all others, they lead a rather sessile life. Living in sand flats and mud bottoms in depths varying from a few meters down to a maximum of perhaps 50 meters, when observed by a diver they are seen to spend most of their time standing upright out of their vertical burrows, to roughly three-quarters of their length, facing the current and feeding on plantonic animals such as microscopic crustaceans that they pick out of the water drifting by. Groups varying from a few individuals to large colonies of hundreds or even thousands of these foot-to-armlong eels, none thicker than a thumb, can be found in all tropical seas. Their eggs and larvae are believed to be pelagic. It is thought that, after drifting in the open water for some time, the larva changes into the adult form, returns to the sea bottom in suitable areas, burrows tail first into the ground and from then on leads an almost permanently sessile life. Despite much effort by recent observers, many mysteries remain concerning the life histories of Garden-eels.

While diving off the northwestern point of Gardner Island near Española (Hood), we discovered a colony of Garden-eels living on a gently sloping sand bottom at 20 to 22 meters depth. Surrounded by a large school of curious, yardlong Jacks, amidst clouds of sand stirred up by our frantic digging vigorously assisted by the Darwin Station's Marine Biologist, Gary Robinson, we managed eventually to collect four of these Garden-eels. A closer examination on board Beagle IV and later in the Forschungsinstitut and Naturmuseum Senckenberg at Frankfurt, W. Germany, revealed that they belong to a so far undescribed species of the genus *Taenioconger.* The new species's technical description is to be published in the Senckenbergiana Biologiae, so a more general portrayal is given here.

As an overall description, its color could be given as chocolate brown, varying from a lighter to a darker tone.





Galapagos Garden-eels, *Taenioconger klausewitzi:* observe their characteristic pigmentation and the undulating dorsal fin of the lower animal. The pictures were taken from the living specimens when kept in a tank aboard Beagle IV *Photos:* Eibl-Eibesfeldt.

Beginning just behind the head, a conspicuous row of circular, whitish dots extend along each side of the body towards the tail, each of these dots surrounding a lateral line pore. As they near the tail, these dots become less evident. Extending from the anterior region of the body towards the anus, beneath the lateral line, the sides and belly are marked by large white, irregularly sized and shaped blotches, the rest of the body being of the brown color seen on the upper side of the animal. In addition, to this pattern there are a pair of bright patches on each side of the head next to the gill openings, on occasion subdivided by an area of a darker color. At a distance of 7 to 10 lateral pores, another patch of white is evident, reaching up to the white dots of the lateral line as do the previous ones. At eye-level, between the eye and the gill opening, the otherwise brown head bears a conspicuous white spot on each side.

The iris of the eye is brown, crossed horizontally by a dark stripe. While the color of the tiny pectoral fins is black, the dorsal fin is transparent, showing a bright margin along the anterior third, bordered to the outside by a fine line of a brown color. The total length of the collected animals varies from 405mm to 444mm, with between 162 and 176 lateral pores. The Galápagos Garden-eel is closely related to the Californian Garden-eel, *Taenioconger canabus* McT. Cowan & Rosenblatt (1974), differing from this species, however, by the stouter structure of its body and its more colorful pigmentation. The latter characteristic makes this new species one of the most attractive Garden-eels known so far.

In honour of the wellknown ichthyologist, Prof. Dr. Wolfgang Klausewitz, who visited the Galapagos with the senior author in the 1950's, we decided to call the Galápagos Garden-eel, *Taenioconger klausewitzi* Eibl-Eibesfeldt and Köster.

The collected specimens are catalogued at the Forschungsinstitut and Naturmuseum Senckenberg, in Frankfurt a. M., West Germany:

Taenioconger klausewitzi n. sp.
Material: 4 specimens.
Type specimen: SMF 17700; Paratypes SMF 17701, 17702, 17703.
Locality: Pacific Ocean, Galápagos Archipelago, northwestern side of Gardner Island near Española on a sand slope in 20 to 22m depth, near shore at foot of cliff.
Leg.: I. Eibl-Eibesfeldt, 18.3.1982.

WEATHER DATA, ON FLOREANA, 1982-83

by

Felipe Cruz and Tina Beach

The year 1983 has been a fascinating one in the Galápagos. The effects of "El Nino" have been profound for all island life; plant, animal and human. On Floreana Island five weather stations have been in place for a little over a year and the information collected at these sites demonstrates the drastic changes in weather patterns produced during this exceptional year.

Station I is located in the interior S.E. portion of the island at approximately 300m above sea level. The total rainfall for the first five months of 1983 was 119.16 inches for 23.82 inches per month, while in 1982 the January through May total was 8.12 inches or 1.62 inches per month. This is an increase of 1,468%. In addition, winds that normally blow consistently from the S.E. during these months, as in 73.9% of the time in 1982, came from diverse quarters in 1983: N. and N.W. 11.6%; E. and N.E. 25.8%; S. and S.E. 35.8%; W. and S.W. 24.8%.

Station II is located in the crater of an extinct volcano at approximately 340m altitude in the center of the island. Accumulated rainfall from May through December 1982 was 22.55" for an average of 2.8" per month, and from January to May 1983 129.18" or 25.8" per month, an increase of 92%. Wind directions also showed a shift from the predominant S.E. in 1982 (97% of the time) to more varied directions: N. and N.W. 17.0%; E. and N.E. 52.0%; S. and S.E. 10.2%; W. and S.W. 20.8%.

Station III, at the island's highest point (600m) also showed a dramatic rise in rainfall; from 27.59" for the last eight months of 1982 (an average of 3.4" per month) to 109.2" (or 21.84" per month) for the first 5 months of 1983, an increase of 642%. The shift in wind direction from S.E. in 1982 to a varied pattern in 1983 was also evident.

Located at approximately 150m above sea level, Station IV is in a transition area between highland vegetation and the arid coastal zone. Although receiving less rainfall than the areas already discussed, a 2,965% increase occurred between the months of 1982 and those of 1983; in May through December 1982 an average of 0.60" fell per month while January through May 1983 recorded 17.79" per month. Wind directions from 1983 indicate more variation than in 1982 (93.7% from the S.E.) but the highest percentage of time still blew from the S. and S.E., 51% (N. and. N.W. 2.5%; W. and S.W. 26.0%; E. and N.E. 20.25%).

Unfortunately only rainfall data is available from Station V located at Black Beach on the N.W. coast, sea level. Still the largest percentage increase, 4,924%, is seen here, although total rainfall levels are the lowest on the island. 1.01" of rain fell between June and November 1982, or 0.17" per month, while 49.73" fell between December and March of 1983 or 12.43" per month.

Although minimum and maximum daily temperatures are recorded at all 5 sites there is no substantial difference between the mean maximum and mean minimum temperatures for the two years under discussion.

SUMMARY

Consistent with normal weather patterns, more rainfall was recorded in the humid highlands in the 1983 "El Niño" year than in the more arid transition and litoral zones on Floreana. However, the entire island has received an average of 20.33" of rain per month, an increase of ovr 2,000%. Wind directions have fluctuated greatly over the first five months of 1983 as compared with the previously predominant S.E. trade winds. There appears to be none of the usual seasonal variation between "wet" and "garúa" seasons this year as the S.E. trades have failed to make their usual impact on the island's weather. It remains to be seen how long "El Niño" will affect the island's climate.

ACKNOWLEDGEMENTS

We are grateful to the Cruz and Wittmer families on Floreana for aid in collecting data. Our thanks to Malcolm Coulter, of the Darwin Research Station, without whom this work would not have been possible, and to Bruce Barnett for his help in preparing this report.