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NEWS FROM ACADEMY BAY

NEW HEAD OF THE NATIONAL PARK

The National Park Service in the Galapagos has had a new chief since February. Lcdo. Miguel Cifuentes, a biologist, is no newcomer to the islands but an old friend who was formerly assistant to the director of the Darwin Station and who has an intimate knowledge of the archipelago and its problems.

On his return to the Galapagos, he found that the Park Service staff had increased to 33 and that, largely owing to the generosity of Frankfurt Zoological Society, they were now equipped with 4 patrol boats to help them in their various duties of conservation and control.

GOAT PROBLEMS ON ESPANOLA AND SANTIAGO

A dozen years ago, it seemed quite an achievement to eliminate the feral goats on tiny islets such as the Plazas. More recently a similar success was achieved on Barrington, a much more substantial island (24 km^2), laid waste by these thoughtlessly introduced animals. But on a large (58 km^2) and rugged island such as Espanola (Hood) it was generally agreed that the most that could be expected was that the goats might be brought under sufficient control to prevent irreparable degradation. When the National Park Service began their campaign in 1969 there were many hundreds of goats on the island. This year an intensive hunt lasting 20 days by an experienced team produced only 34 goats, which gave rise to hopes that total eradication might eventually be a possibility.

Once a final solution has been achieved on any island, men and resources are permanently released to concentrate on other islands such as Santiago (James) where astronomical numbers of goats play increasing havoc with the vegetation and the dependent wildlife. The alarming size of the goat population on Santiago has beeen re-emphasized by the ecological study recently completed by Tjitte de Vries and Luis Calvopina. The problem here is on an entirely different scale from Espanola and eradication by current hunting methods still seems quite out of the question – but then we said that about Espanola!

Until there is some new break-through, the best we can hope for is a holding operation. The degradation is so severe that some plant species are in immediate danger of extinction. To prevent this, quadrats of representative vegetation (between 100 and 600 m^2) have been enclosed with goat-proof fences. Inside the fences the vegetation has recovered dramatically. Because of the expense, the enclosures have been well below the optimum size but there are hopes that funds can be found to fence in seven 10,000 m^2 quadrats. In this way the threatenend species can be preserved until some satisfactory solution of the goat problem is found.

TOURIST IMPACT

Before the Darwin Research Station was inaugurated in 1964, relatively few visitors reached the remote Galapagos. Since then there has been a spectacular increase in tourist traffic which has become a national economic asset. Quite apart from scientific considerations, it is now vital to the tourist trade that visitors should not destroy the fragile ecosystems,

which are the very basis of Galapagos tourism. The National Park Service needs the fullest scientific information on which to base its policies regarding the numbers of visitors the delicate ecosystems can bear.

Dr M P Harris and Dr Tj de Vries have recently reported to the WWF (which funded their work) on the studies of tourist impact that they carried out in the years 1971-1975. Dr Harris had fortunately studied the seabird population before organized tours were begun and had already made preliminary investigations into tourist impact in 1970-1971, with the support of Mr Lars-Eric Lindblad. Others who took part in these studies included Dr Kramer, Dr MacFarland and Sr Gordillo of the CDRS; Sr Toro of the National Park Service; Madre Maria Leonor Ortega, Srta Cecilia Hernandez, Srs Flavio Coello, Leonardo Mariduena and Ipolito Ronquillo from the Catholic University of Quito and the University of Guayaquil.

The report concludes that, thanks to the regulations recently introduced by the National Park Service and to the general high standards insisted upon by the guides of the larger vessels, little obvious damage has been done so far – although irresponsible photographers remain a constant threat. But, the report continues, there is no justification for complacency. The number of visitors is growing and the patterns of tours are changing. How much can the wildlife stand? Our understanding of tourist impact is still superficial. Visitors may influence the breeding success of birds, iguanas and sea-lions in subtle ways. For instance do tourists upset the tidal feeding rhythms of marine iguanas, or the rate of suckling of sea-lions, or the feeding frequencies of seabirds? We need a body of tested fact. The authors strongly recommend continued and more detailed studies to make sure that the priceless treasure of Galapagos wildlife is not placed in jeopardy through ignorance.

COURSE FOR TOURIST GUIDES

In February the National Park Service, in collaboration with the Darwin Research Station, organized a six-day training course for guides. Lectures covered various aspects of the natural history of the archipelago and the organisation and objectives of the National Park, with special emphasis on the control of tourism. More than half of the 48 persons taking part were awarded diplomas and the others were offered the opportunity of trying again at a second course later this year.

EXTRACTS FROM THE PRESIDENT'S NOTEBOOK

(Dr Peter Kramer visited the Research Station again in January 1976)

Visiting Scientists

Jerry Wellington has just terminated his survey of litoral biota.

Derek Green continues Peter Pritchard's and Miguel Cifuentes' work on the green turtle ecology.

David and Debbie Clark are in the final phase of their investigations of black rats and (together with Ecuadorian students) rice rats and red ants.

Madre Leonor Ortega and Cecilia Hernandez continue an ongoing study on the reproductive ecology of both species of frigate birds and the potential effects of tourism on them and

on the boobies (partly with Sr Gordillo).

Peter Boag and Laureen Ratcliff (from the McGill University group) are at work on Darwin Finch ecology.

Guy Coppois continues his studies on the speciation and ecology of terrestrial snails.

Chantal de Ridder investigates proteinaceous corrals.

Stig Jeppensen (Unesco associate expert) is just starting his studies on problems related to introduced plants and on the effects of introduced mammals. He is also continuing the vegetation mapping program.

Tjitte de Vries left the Islands on 9 January. He has taken a post as adviser to the Biology Department of the Catholic University of Quito.

National Park Service Buildings: The new headquarters are terminated and in use. There is an intercom connection to the Station laboratory.

Control of Introduced Organisms: The National Park Service campaigns against goats on Española, Marchena and Pinta are continuing. Pig control on Santiago will continue for many months this year (last year 2000 were killed). An effort will be made to remove black rats from Bartolomé (with Norbormide, under supervision of the Clarks). Another interesting project is the effort to remove red ants from Santa Fe, where they were apparently introduced some 5 to 10 years ago and are spreading only slowly (method partly physical and one strike with DDT).

Tortoise Raising: The oldest Española and the oldest Santiago tortoises bred at CDRS have been released on their respective islands. The oldest group of Pinzon animals (1965/66 class, released in December 1970) weighed on the average 20 kg in December 1974. Everything seems in very good shape.

National Park Boundaries: They are all marked now with permanent cement posts. No further serious boundary problems in the last two years.

National Park Tourism: A reception center is functioning in the little airport building on Baltra. Tourist cards are stamped there and printed material is distributed. Alan Moore, FAO expert, is successfully promoting the tourism management side of the National Park organization (better instructions for boat owners, appropriate signs at the Park boundaries, formalized courses for tour guides with tests as a basis for licensing, etc.).

CDF COUNCIL MEMBER HONOURED

Professor Dr. M. F. Morzer Bruyns has been awarded the Order of the Golden Ark for his long and devoted contribution to the conservation of nature.

TWENTY YEARS AFTER

by

IRENÄUS EIBL–EIBESFELDT

In the nineteen-thirties, national and international efforts to save the unique resources of the Galapagos, provoked by the centenary of Darwin's visit in 1835, failed to produce any effective protection and the degradation of the archipelago continued. Professor Eibl-Eibesfeldt of the Max Planck Institute visited the islands in the nineteen-fifties and his alarming reports to UNESCO and the International Union for Conservation of Nature were the starting point for the creation of the Charles Darwin Foundation. Through the years his devotion both to the archipelago and to the Foundation has remained undiminished and he is still an active member of the Executive Council. As an ethologist, Professor Eibl-Eibesfeldt owes much to the Galapagos: all lovers of the Galapagos owe much to Professor Eibl-Eibesfeldt.

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18 April 1974: I have just landed on the small island named "Osborn" by William Beebe. It's a mere tongue of land pointing towards Hood Island (Espanola), rising to approximately 25 meters and then dropping to the sea as a sheer cliff. It's just one of the many tiny islands of the Galapagos but for me it is a very special place because twenty years ago, this was my first landing place on the archipelago. I spent a couple of days on this island, where I saw my first lava lizards and Darwin's Finches and a colourful subspecies of the marine iguana, which proved to be new. Here I learned that in the Galapagos hawks could be touched by hand and here I began my studies of the sea-lions above and under water. Now I am back again and my fifth visit to the islands is going to end where I started my first. In a couple of days the plane will take me back from Baltra to the mainland.

Upon the approach of our boat, a bull sea-lion comes at us, giving his hoarse roar, so familiar to me by now. He does not want me to go ashore, but I am too quick for him. It is the same situation I encountered twenty years ago, except that the bushes are greener than last time because we have just had some rain. Beneath the Cryptocarpus bushes along the shore, female sea-lions and pups are resting. A little higher up the cliff a cordia is in full bloom. And so is a little yellow composite flower on the reddish ash. Towards the top of the cliff lichens cover the lava-rocks. I do not recall them, but I am sure that they were here before. Time opens the eyes to the hidden wonders, to the microcosm.

The view from the cliff top towards the white beach of Hood brings back happy memories. This is a good place to meditate, to recollect.

When our Research Vessel "Xarifa" anchored here, twenty years ago, we experienced days of euphoria. We were, of course, prepared for wonders by William Beebe's excellent reports but to experience them was something different. As our cruise continued, we visited Isabela, Fernandina, Tower and Santa Cruz. We were in virgin lands and virgin waters, but we found some sore spots too. Defacement of landscape had been started by visitors who came in yachts. Tuna fishermen from California were killing fur-seals in great numbers, and the sea-lions too were persecuted, since they were considered a nuisance by fishermen, whether local or foreign. There was a flourishing trade in giant tortoises to the mainland. Baltra, which had been a US air base during the war, was found crawling with imported

mice, but the endemic land iguanas, once reported as abundant by Beebe, were no longer to be seen. Excursions revealed that the giant tortoises were now very rare but were still persecuted for their meat and fat. The government had passed far-sighted laws for the protection of the wildlife in 1934 but there was still no organization or administration to enforce them. It was easy to foresee the future: another twenty years and this would be a paradise lost.

Since I was young and optimistic – in this latter respect I have not changed too much – I wrote a memorandum after my return to Europe. I dispatched it to the IUCN and UNESCO and to a number of American colleagues. I made various proposals and pointed out the urgent need for nature conservation if the Galapagos were to be saved. I received very enthusiastic support from Madame Marguerite Caram of the IUCN and Robert Bowman from California joined my efforts.

In 1957 I was entrusted with a UNESCO mission to carry out a survey of the Galapagos Islands. Robert Bowman and reporters Alfred Eisenstein and Rudolf Freund, from Life Magazine, accompanied me. Our findings were published in the UNESCO mission reports where I set out in detail what we considered necessary to ensure the protection of the unique fauna and flora. Amongst other recommendations, we proposed that a biological research station should be established. The results of our initiative are well known to the readers of this Journal and need not be repeated here. However it might be of interest to them to learn my impressions of subsequent developments in these islands, which I have followed up for the last twenty years.

They are positive and they have surpassed my expectations. Since the creation of the Charles Darwin Foundation changes for the better have occurred, despite the increase of population which has more than doubled. Due to the fact that the Ecuadorian Government restricted the areas for settlement and declared nine-tenths of the Archipelago as National Park and Nature Conservation Areas, a spreading of the population to parts other than to those already settled, has been prevented. Furthermore, tourism, although enormously increased, is now under control and visitors are informed about the peculiarities of the Islands and how they must be protected. So too are the settlers themselves by educational programs. The collecting of endemic species is under strict control and the pet-traffic to the mainland is practically abolished. These and many other measures have stopped further deterioration and this alone is already an enormous achievement.

But even more has been done. The Charles Darwin Research Station has been lucky to be headed throughout its existence by very capable and eager scientists, who were not only able to engage the Government of Ecuador in the problems concerning nature conservation on the Galapagos but were daring and imaginative. When twenty years ago I saw what goats had done to Barrington, Hood and other islands, and how rats were attacking the offspring of the endemic reptiles, I had little hope that anything at all could be done. At that time my intentions were primarily oriented toward protecting those areas not yet contaminated by man and the animals he had introduced. But the seemingly hopeless task of pest control was taken up and carried out with success. I knew Barrington as a desolate place. It was so over-run by goats that grass and herbs were eaten to the roots during the dry season, exposing the soil to erosion. Bushes were torn up and even the tree-cacti were attacked. The land iguana population could not have withstood this competition of a rival herb-eater for long and I reported that I had not seen any young animals. They are more

delicate and dependent on the finer herbs. In addition, they did not find any protective cover against the Galapagos hawk.

A hunting program led to the eradication of the goats on Barrington and the vegetation is coming back. There seems to be no need to worry about the future of the land iguana on this island and one might even think of putting a sub-species of tortoises there, since once there was an abundant race, but it definitely became extinct. On Hood (Espanola) a similar program is well under way. It will be difficult to get rid of the goats completely on such a large island, but the pressure on the flora has been relaxed and this will help to ensure the survival of the tortoises which are now extremely rare, but of a unique subspecies of the "saddlebacked" type. For the Darwin Station, the Hood tortoises were in the most critical situation of all the surviving races. There were perhaps a dozen elderly survivors but not a single young one and, on so large an island, prospective mates had little chance of meeting each other. This was demonstrated by the pathetic fact that lichens covered the females' backs, since tnere were no males to scrub them off during mating. The Foundation decided that the only course was to collect as many survivors as could be found and keep them in pens at the Station – where they eventually bred!

Another brave enterprise has borne fruit and should save the Duncan (Pinzon) subspecies of tortoise. Miguel Castro, the Darwin Station's first conservation officer, found that although there was still a viable breeding population on Duncan Island, there was not a single tortoise under forty or fifty years of age – each year every youngster without exception was eaten by the introduced black rats. So Castro dug out some of the eggs and took them to the Station where they were successfully hatched. When I was there, a happy lot of young tortoises were crawling around in the rearing pens and I heard that a good number had already been released on their home islands, when they were big enough to stand up to the rats. The new hatchery is indeed an impressive enterprise and gives us hope that even the most endangered subspecies of tortoises can be rescued. This would preserve one of the outstanding experiments of evolution, since it is the subspeciation with local adaptation which constitutes the peculiarity.

Among the local population I found an increasing concern with the islands' fauna and flora. Nevertheless the Station's educational program needs to be continued since there are, of course, settlers who dislike the restrictions imposed upon them by nature conservation.

Another problem yet unsolved, is the over-exploitation of the littoral. Overfishing has reduced the number of groupers in most areas, while lobster fishing is carried out by divers, people who seem to be interested in immediate profit only.* When we dove in 1954, 1957 and 1960, it took us only a couple of minutes to get a few lobsters for a meal. They were simply abundant. Today, it may take an hour to locate one. The gangs of lobster-fishers furthermore are beach-combing in search of turtle-eggs. They had just been to Hood before we arrived and had left their traces.

On my last visit, the two most striking changes were the vast expansion of tourist traffic and the creation of the Galapagos National Park Service. The former is a potential danger unless firmly controlled: the latter is the Government of Ecuador's pledge that there will

* Since Professor Eibl-Eibesfeldt's last visit, the Government of Ecuador has imposed a moratorium on the export of lobsters which has made commercial lobster-fishing in the Galapagos uneconomic.

be adequate controls. Twenty years ago there was no organized tourism but the small parties that arrived on their own were capable of doing serious harm and there was nobody to prevent them. Today there there are several thousand tourists a year but also wardens to inform and advise them and, if necessary, to enforce the strict regulations of the National Park. Not that police work is the only or even the main occupation of the Service. It works in the closest co-operation with the Darwin Station and is increasingly taking over the various conservation tasks initiated in past years by the Station. The collaboration of these two organizations has already produced highly encouraging results and could do even more if only the necessary funds were forthcoming.

There can be few who will not agree that, while it is desirable that visitors should be able to enjoy the wonders of the Galapagos, they must not be allowed to damage the very things they go to see. Some visitors, through ignorance or indifference, do disturb the astonishingly tame wildlife. Over-zealous photographers are an outstanding and obvious menace. But there are less obvious ways in which even the best behaved parties of tourists might upset the feeding and the breeding success of the birds, iguanas or sea-lions. The Darwin Station is diligently monitoring tourist impact but there is still much to be learned. Meanwhile the National Park Service is steadily extending its protective control of the environment both by education and by regulation.

For the ethologist the Galapagos archipelago is still the Garden of Eden where animals can be observed without the need of a hide. For instance, you simply sit in front of a colony of Blue-footed Boobies and watch their courtship parading and how males invite the females to the nesting site by offering a small pebble as a token. Or you will see how a baby booby will be attacked by a neighbouring adult if its own parents both move away. What follows is a little drama, but it will teach you something about the mechanism of appeasement. You can see how the attacked fledgling crouches, hiding its beak under its chest, exposing its neck to the attacker. This turns aggression-releasing stimuli (beak, face) away, and the attackers immediately shift from attacking to grooming and sometimes copulatory attempt. Or, if you spend a couple of hours on the Plaza Islands amongst the land iguanas, you have a good chance to see how they posture when a small ground finch approaches, how they rise on all four legs, inviting the finches to search for ticks both above and beneath. I already knew that Darwin's Finches removed ticks from marine iguanas, but they did not present themselves for cleaning in this particular way. Now Craig MacFarland has published a very thorough report on the cleaning symbiosis between Darwin's Finches and the tortoises, and he finds that the latter pose in a similar fashion to the land iguanas. It's fascinating to observe these convergent developments in different groups of animals.

In 1954, I had studied the phenomenon of "Cleaning Symbiosis" around these Islands – but under water. At that time, only scattered notes concerning the phenomenon existed and I discovered the mutuality of the process which involved communication between the species. The cleaner fish invited its hosts to allow cleaning by a particular dance, and the hosts invited the cleaner in turn, also communicating, when they wanted the cleaning to be ended. The cleaners were removing parasites. It was in fact here, twenty years ago, that I discovered "Cleaning Symbiosis" to be a particular phenomenon and coined the term. Now I was here again, this time on land, filming another cleaning symbiosis that had so far escaped attention.

But the Galapagos Archipelago is not an Eden for animal behaviour scientists alone. Ecologists, marine biologists, botanists and so many other disciplines are drawn to this outpost in the Pacific, and the list of the publications of the Charles Darwin Foundation shows the productivity of the Station and the diversity of research carried out. With the Station, Ecuador has attracted scientists from all over the world and stimulated international relations.

LAND IGUANA photo by Alan Root

A PROSPECTUS: PROPOSAL FOR A GALAPAGOS MARINE PARK

by

GERARD M WELLINGTON

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*The author, a US Peace Corps Volunteer, was assigned jointly to the Charles Darwin Research Station and the Ecuadorian National Park Service on a two year project to work out a comprehensive scheme for the inclusion of a marine zone in the Galapagos National Park, as contemplated in the "Master Plan" (see Noticias, No. 23). On the termination of his investigations he produced a massive and scholarly study, **"The Galapagos Marine Coastal Environments: a resource report to the Department of National Parks and Wildlife – Quito"**. He adapted the following article from part of Chapter VIII of this report.*

The task he was set was formidable. There were vast unknown areas to explore and the support the Darwin Station could afford him was inevitably less than its Director would have wished. Perhaps one result of this pioneering work will be the raising of funds to provide the Station with a marine laboratory, the lack of which gravely hampers scientific research in this most important field. It would be idle to contest Jerry Wellington's assertion that we still have little basic information about the Galapagos marine environment: but at least his report marks a notable advance in the reduction of our ignorance.

In keeping with the concepts and aims of "total ecosystem protection" as proposed by many of the participants at the Second World Conference on National Parks held in Yellowstone in 1972, the proposed marine zone to be included within the existing Galapagos National Park boundry, is an attempt to guarantee the protection of not only the marine environment, with its unique life, which surrounds the Islands, but also to preserve intact the all important marine-terrestrial relationships.

As has been explained in some detail in the report *"The Galapagos Marine Coastal Environments"*, the marine environment in Galapagos is characterized by :

- High diversity: a relatively rich and varied flora and fauna in comparison to other marine insular environments in the Eastern Pacific.
- Large percentage of endemism in most groups of plants and animals
- Relatively great numbers of species.
- Strong phyto- and zoogeographical affinities with the Tropical and Subtropical American continents, with many elements representing the Peruvian/Chilean and West Pacific Provinces.
- Large habitat-type diversity and highly complex marine communities (or ecosystems?) relative to other insular marine areas in the Eastern Tropical Pacific.

These phenomena, in turn, are largely due to the complex system of physical parameters (mainly currents which carry different water masses) which affect the Islands, and to their volcanic origin and isolated positions.

Additionally, there exists a complex and fragile relationship between the fauna, flora and habitats of the terrestrial and marine areas in Galapagos. Many of the fantastic animals such as the penguin, fur seal, sea lions, flightless cormorant, and marine iguana – not to mention the large array of other sea bird species, are directly dependent on the marine environment for their existence. To date little or nothing is known about the interesting and perhaps fragile interrelationships existing between the terrestrial and marine communities in Galapagos.

Unfortunately, we still have little basic information concerning the Galapagos marine environment. The aforementioned synoptic survey recently completed represents the first step in the investigation of the littoral and sublittoral zones to determine the abundance and diversity of major inshore faunal-floral groups, and the distribution and abundance of major habitat types. Most important is the fact that we know almost nothing about the biological processes of marine insular systems, especially concerning the structure and dynamics of their communities and ecological and evolutionary processes. All evidence so far demonstrates that the Galapagos marine environments may offer equally fascinating and rewarding opportunities for basic biological studies as does the terrestrial environment. One important consideration is the fact that the marine environment has been little modified compared to the majority of other marine areas in the world. The pristine waters surrounding these Islands offer conditions for monitoring global pollution levels (eg: increases of heavy metals and pesticides).

Finally, the educational and touristic values of the Galapagos marine area are obvious. In a few hours of diving one can see 40-60 species of tame and beautifully coloured fish, as well as great numbers of fascinating invertebrates and habitats. The underwater life and habitats of the Islands certainly offer opportunities equal to those of the terrestrial areas to observe and understand the structure and function of insular ecosystems and to learn about the processes of evolution in the marine environment. In the light of these considerations the surrounding seas of Galapagos certainly warrant the type of protection now afforded only to the terrestrial areas.

Because of all these values – scientific, aesthetic and educational – the *"Plan for the Inclusion of the Marine Area within the Galapagos National Park"* (first version, July 1974; revised in 1975) is aimed at total resource protection, calling for (i) extension of the National Park boundary a distance of 2 nautical miles from shore; this generally encompasses the 200 meter depth contour which includes over 90% of the faunal-floral elements characteristic to the islands, (ii) regulation and limitation of the disturbing activities of commercial and non-commercial interests via establishment of a delimitation and zonation scheme, and (iii) protection of the continuity of habitats and ectone types within the Park framework.

In assessing the various areas of the Archipelago it became obvious that certain areas were in need of nearly complete protection and, to avoid degradation of the environment, there should be certain limitations placed on their usage. These areas received either a Primitive Zone or Primitive-Scientific Zone classification (as below) based on one or a combination of the following criteria :

A. – UNIQUENESS

B. – FRAGILITY

C. – REFUGE OR SANCTUARY VALUE

D. – SCIENTIFIC VALUE

A. Certainly the whole Archipelago can be considered as unique, and although the majority of plants and animals which occur here are found in other parts of the Tropical and Subtropical Eastern Pacific, their species associations and inter-relationships in this complex community structure are quite different than those found in other Eastern Pacific situations. This, of course, has resulted in a high percentage of endemism (approx 25% in most groups) and the occurrence of several specific morph-ecotypes witnessed in the Islands. All of this considered apart, there are some environments present in Galapagos which are restricted to, or better developed under, island conditions and do not generally occur along mainland shores. One obvious environment characteristic of islands is the steep vertical rock wall face. Adhering and encrusting on these vertical walls are a multitude of colorful and varied invertebrates, many of which are confined solely to this habitat. For this reason a large percent of the small islets which rise abruptly from the abyss have been assigned to either Primitive or Primitive-Scientific Zones.

B. For the most part, the underwater topography in Galapagos is comprised of either large to small broken lava blocks or sands grading from very coarse to fine, or a mixture of the two. There do, however, exist two fragile marine habitats in Galapagos, the coral reef and vertical rock wall face communities. In the former case it is the branching calcareous coral, *Pocillopora*, and in the latter the delicate encrusting organisms, which are susceptible to extensive mechanical damage of the delicate branches or dislodgment of encrusting organisms, that often occurs when large numbers of swimmers, snorkellers (and to a lesser degree, SCUBA divers) are permitted to visit an area unsupervised. These areas are usually very limited in extent and are susceptible to perturbation if visited extensively. Another factor to consider in these areas is the potential damage caused by small boat or dinghy anchors. Examples of such habitats include Tagus Cove, Kicker Rock and Daphne Island for steep vertical wall habitats and Isla Onslow (Corona del Diablo), Isla Champion and the south shore of Isla Bartolome for coral reef formation.

C. Several species of fish and invertebrates are presently being exploited commercially and non-commercially in the Islands. Evidence indicates that in one particular case involving two spiny lobster species and the Spanish or slipper lobster – over utilization is occurring. Systems of refuges or sanctuaries are employed in other parts of the world as a conservation method which attempts to protect breeding stocks of commercially important species so that exploited areas are continually replenished. This concept has been employed in the proposed zoning scheme and has also been extended to include areas where commercial interests pose a potential or real threat to already protected marine mammals, reptiles and marine birds. An example illustrative of the need for this type of protection occurred several years ago in the Islands when local fishermen were considering the use of bottom nets as a method of increasing lobster catches. When the method was initially employed around Fernandina several penguins and flightless cormorants were caught and drowned. Although the threat of net fishing was immediately recognized and the use of nets stopped, it is conceivable that more subtly damaging activities could go unnoticed unless buffer zones are established. Therefore, the protection of nearshore areas bordering significant fur seal and sea lion colonies (eg: Cabo Hammond and Cabo Douglas, Fernandina), cormorant and penguin rookeries (eg: Punta Espinosa, Fernandina), as well as the areas adjacent to major

turtle nesting beaches (eg: Quinta Playa, Isabela) have been considered and placed under protection in the proposed scheme.

D. The last criteria considered, but by no means the least important when evaluating critical areas, is their potential scientific value. Our present knowledge of insular marine situation in general, and Galapagos specifically, is extremely limited. These islands are still largely undisturbed and in view of the increasing rate of human encroachment on insular environments, this fact in itself makes Galapagos a valuable resource to scientific investigators. It should be reiterated here that all evidence points to the conclusion that the Galapagos marine environment offers equally fascinating opportunities for basic biological studies as has the terrestrial environment.

ZONATION SCHEME

The zonation scheme proposed for the marine park extension will follow closely that already established for the terrestrial areas. Briefly, there will be four different types of zones as follows:

1. **Intertidal Zone** – This area will receive complete protection throughout the Archipelago (with the exception of colonized areas). It will be zoned for visitors' use exactly according to the terrestrial zoning scheme described in the **Master Plan**, except that limited, non-commercial exploitation of invertebrate species by local inhabitants would be permitted.

2. **Special Use Zone** – These areas, extending out to the two nautical mile limit, are those in which the existing commercial and non-commercial activities would be permitted to continue, but only at present levels and with presently used methodologies. Any expansion must be approved by the Park and based on thorough studies recommending sound management policies. This zone will cover approximately 96% of the coastline in the Islands. Where extensive use zones occur, they would be surrounded by the Special Use Zone. Available anchorages in this zone could be used freely.

3. **Intensive Use Zone** – In these areas, extending out to ½ nautical mile from the terrestrial park boundaries, all species and habitats would be completely protected and all commercial and non-commercial activities would be prohibited. These selected areas are those which large concentrations of visitors would be visiting. Carefully guided activities in harmony with the environment would be permitted, ie: swimming, snorkelling, SCUBA diving and underwater photography. This zone includes, primarily, all of the marine areas adjacent to the heavily used terrestrial visitor zones (Intensive Use in the **Master Plan**) plus a few additional sites (beaches, small islands). These areas present beautiful examples of virtually all Galapagos marine features. Available anchorages in this zone could be used freely.

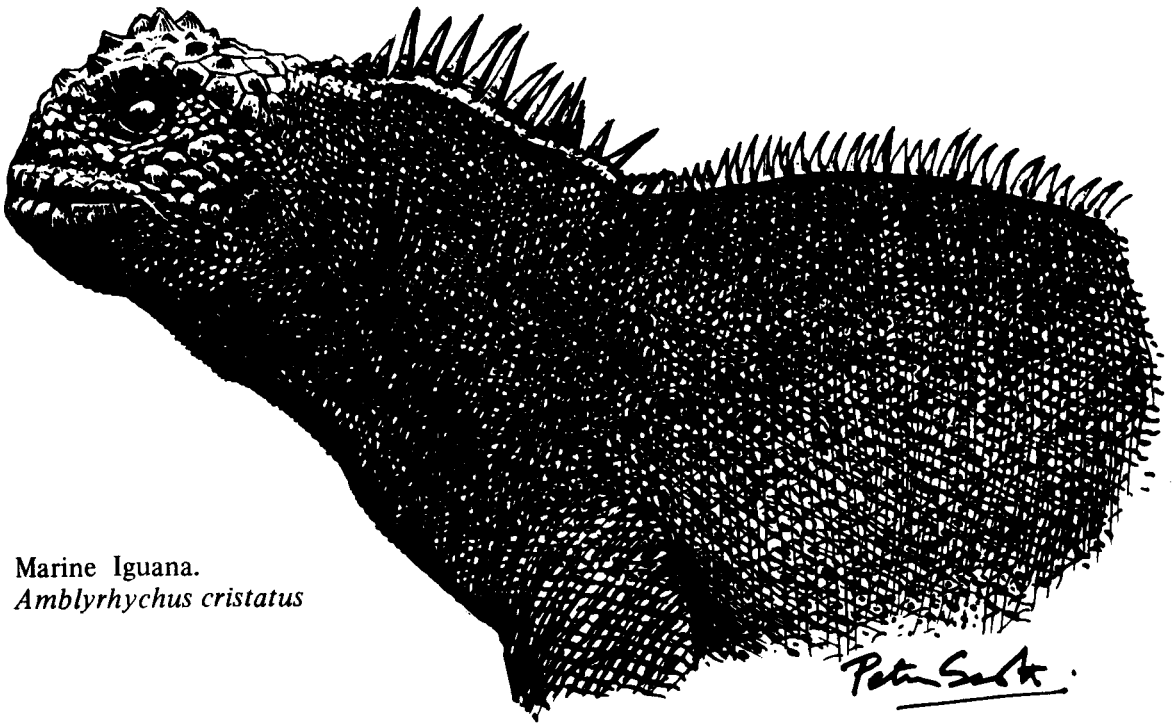
4. **Primitive Zone** – These areas, because of fragility and certain significant features, require special protection and only limited use. This zone would include almost all the small island ecosystems, where some of the rarest Galapagos marine communities are best developed. Small groups of guided visitors with special permission from the Park would be able to swim, snorkel, Scuba dive and photograph at these sites. These areas would also extend out to the ½ nautical mile from the terrestrial Park boundaries and all commercial and non-commercial exploitation would be prohibited. Anchoring in these

areas would be permitted as part of the visitation permit, unless otherwise indicated.

5. **Primitive-Scientific Zone** – Activity in these completely protected areas, extending out the full two nautical miles would be limited to scientific research, or other special visits.

While space does not permit the inclusion here of the detailed maps showing the specific sites proposed under this scheme, a total of 56 distinct locations have been assigned to zones 3, 4 and 5 with a respective breakdown of 24, 30 and 2. These areas receiving varying degrees of protection will encompass an area totalling over 18,000 hectares. This plan is still under consideration by Park and other government officials and will undoubtedly undergo some minor and perhaps major revisions before final enactment. It is presented here to give the reader an idea and understanding of the recent work being pursued by National Park and Darwin Station personnel in their attempt to secure total protection of the Galapagos phenomenon.

In closing I would like to stress again the potential scientific importance of the Galapagos marine environments in aiding scientists to gain a better understanding of the biological and evolutionary mechanisms operating in insular marine systems. We have barely scratched the surface of scientific exploration in this unique and relatively undisturbed environment. In addition the aesthetic and education values are of tremendous importance at a time when pollution and environmental degradation are prevalent. Obviously the need for protection is acute and hopefully we will see legislation proclaiming a new marine park in the near future.



Marine Iguana.
Amblyrhychus cristatus

INFORME SOBRE EL PROGRAMA DE BECAS PARA ESTUDIANTES ECUATORIANOS UNIVERSITARIOS EN EL ANO 1.975

Fué posible en 1.975 ampliar el Programa de Becas para incluir muchos más estudiantes que en cualquier otro ano, desde el inicio del mismo en 1.971, principalmente, debido a las contribuciones generosas y al apoyo de la Sociedad Zoológica de Frankfurt, la empresa Metropolitan Touring y el Fondo Mundial para la Naturaleza ("World Wildlife Fund"), más la activa y entusiasmada colaboración de los profesores de las universidades. Además, apoyaron el Servicio del Parque Nacional Galápagos, la Fundación Charles Darwin para las Islas Galápagos (a través de la Estación Darwin), la Escuela Politécnica Nacional, la Universidad Católica, varios individuos del Ecuador y otros paises, y algunos de los estudiantes becarios mismos.

Realizaron investigaciones cientificas en las Islas Galápagos un total de 2 profesores y 15 estudiantes de las cuatro universidades más importantes del pais, bajo los auspicios de este programa de colaboración entre las mismas y la Estación Darwin. Las investigaciones duraron entre 1 y 8 meses y, en casi todos los casos servirán para la tesis o monografia de grado de los estudiantes. Generalmente, los estudiantes fueron asesorados en el campo por personal cientifico de la Estación Darwin o cientificos visitantes auspiciados por la misma institución, y, en la elaboración de la tesis o monografia, por los profesores de sus universidades y los cientificos-asesores de la Estación Darwin. Además, en algunos casos, los profesores de la universida des asesoraron a sus proprios estudiantes en el campo en Galápagos, siendo este aspecto del Programa muy importante y prácticamente nuevo, ya que no fué parte del proyecto en años anteriores. Se debe enfatizar que el aspecto de asesoramiento dedicado por parte de los profesores de los estudiantes, es un punto clave para toda la investigación, pero especialmente la realizacion de una tesis, monografia o informe bién hecho.

Los estudios comprendieron aspectos muy variados de la biologia y geologia básica del Archipiélago, y muchos fueron directamente aplicados a varios problemas de conservación. Adjunto una lista de los profesores y estudiantes becados, los estudios realizados y otros detalles relacionados.

Para 1.976, la Estación Darwin espera mantener el alto grado de colaboración ya establecido con las universidades, y ofrecer por lo menos el mismo número de becas.

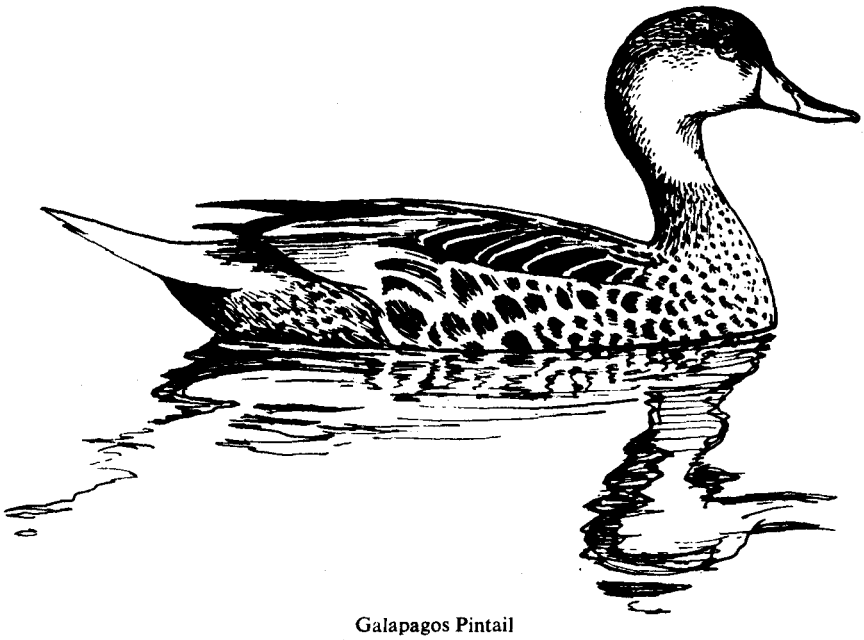
Craig MacFarland
DIRECTOR, ECCD

LISTA DE INVESTIGADORES E INVESTIGACIONES

Nombre	Universidad	Investigacion	Duracion (Meses)	Asesor del Campo
Srta. Margoth Armas	U. Católica, Quito	Eficiencia alimenticia y eficáz de la caceria del gavilan de Galapagos	3	T. de Vries
Sr. Miguel Bermeo	U. de Guayaquil	Taxonomia de las plantas, Tournefortia en I. Santa Cruz	3½	H. van der Werff

Nombre	Universidad	Investigacion	Duracion (Meses)	Asesor del Campo
Sr. Luis Calvopina	U. Católica, Quito	Estructura y reproducción de cabras introducidas y los danos causados en la vegetacion de I. San Salvador	18	T. de Vries E. del Pino
Srta. Maria J. Campos	U. Central y U. Catolica, Quito	Manejo y función del museo y hebrario de la Estación Darwin y producción de mapas de distribución de la flora	3	C. MacFarland
Sr. Flavio Coello	U. Católica, Quito	Distribución y densidad de nidos de, reproduccion cuantitativa de, y el impacto turistico sobre las fregatas de Islas Seymour y Genovesa	7	T. de Vries E. del Pino
Srta. Concepción Guayasamín	U. Católica, Quito	Distribucion de la hormiga roja introducida y las hormigas nativas en I. Santa Cruz	3	D. Clark
Dr. Minard Hall Sr. Renan Cornejo Sr. Galo Plaza Sr. Patricio Ramón Sr. Patricio Romero	Escuela Politecnica Nacional	Geomorfología y vulcanismo de Volcán Sierra Negra	1	M. Hall
Srta. Cecilia Hernández Madre Ma. Leonor Ortega	U. Católica, Quito	Distribución y densidad de nidos de reproducción cuantitativa de, y el impacto turístico sobre las fregatas de Islas Seymour y Genovesa; impacto turístico sobre los piqueros de las mismas islas y Daphne Mayor	4	T. de Vries C. MacFarland
Sr. Leonardo Mariduena	U. de Guayaquil	Distribución y densidad de nidos de, reproducción cuantitativa de, y el impacto turistico en los piqueros de Islas Daphne, Seymour y Genovesa	5½	T. de Vries E. del Pino

Nombre	Universidad	Investigacion	Duracion (Meses)	Asesor del Campo
Srta. Olga Pazmiño	U. Católica, Quito	Ecología y comportamiento de la hormiga roja introducida en I. Santa Cruz	3	D. Clark
Dra. Eugenia del Pino	U. Católica, Quito	Asesoría del campo de varios estudiantes	1	No aplicable
Sr. John Salazar	U. de Guayaquil	Microdistribución, abundancia, u ecología alimenticia de los caracoles terrestres *Bulimulus* en I. Santa Cruz	3½	G. Coppois



Galapagos Pintail
Anas bahamensis galapagensis

A BRUSSELS SEMINAR

On 11th October 1975, following the 29th meeting of the Darwin Foundation Executive Council, a half-day seminar was held in Brussels, where some of the Belgian scientists who have researched in the Galapagos, presented and discussed their results. The following summaries of the papers given at the seminar show the impressive range of projects originating from Belgium.

Van Mol, J.J., Observations sur les Mollusques Terrestres

La distribution des nombreuses especes de Gastéropodes appartenant à la famille des Bulimulidae est étroitement liée aux conditions écologiques. La découverte d'une espèce (Bulimulus gilderoyi) très étroitement confinée à une aire très réduite constitue le cas extrême d'un tel rapport entre la répartition d'une espèce et le milieu. Les résultats préliminaires déjá obtenus par G. Coppois montrent très clairement une corrélation entre la distribution des espèces at le type végétation.

Publication: Van Mol: Au sujet d'une nouvelle et remarquable espèce de Bulimulidae des îles Galapagos.
Bull. Inst. R. Sc. Nat. Belg. 48 (II) : 1-7 (1972).

Van Mol, J.J., Etudes d'un poisson endemique peuplant la nappe phréatique l'ile de Santa Cruz: Caecogilbia galapagosensis Poll et Leleup

Caecogilbia galapagosensis est un poisson de la famille des Brotulidae qui vit dans le milieu souterrain constitué par les fissures basaltques profondes de la zone aride. Cet habitat très particulier communique avec la mer: l'eau y présente une salinité variable suivant un gradient décroissant en fonction de l'éloignement de la mer, et, le niveau de la nappe phréatique varie synchroniquement avec les marées.

Ce poisson est dépigmenté et possède des yeux réduits mais fonctionnels (réduction de la couche nucléaire externe de la rétine, régression des muscles oculomoteurs). Ces altérations, en rapport avec un mode de vie cavernicole, sont cependant encore peu prononcées adaptatifs propres à ce milieu.

La découverte d'une espèce voisine (Caecogilbia deroyi, Poll et Van Mol) peuplant la zone littorale du milieu marin permit une série d'observations interessantes. Ces deux espèces de Brotulidae sont très étroitement apparentées. Bien que leurs milieux respectifs communiquent, ces deux espèces sont écologiquement et génétiquement isolees. Caecogilbia deroyi ne peut vivre longtemps dans l'eau dessalée ou vit Caecogilbia galapagosensis. Chez ces espèces la fécondation est interne, la configuration différente des organes d'accouplement interdit tout croisement entre les deux espèces.

Publications: Poll et Leleup: Un poisson aveugle nouveau de la famille des Brotulidae provenant des îles Galapagos
Bull. Acad. R. Belg. 51 (4) : 464-474 (1965)

Poll et van Mol: Au sujet d'une espèce inconnue de Brotulidae littoral des îles Galapagos apparentée à l'espèce aveugle Caecogilbia Galapagosensis.
Bull. Acad. R. Belg. 52 (II) : 1444-1461 (1966)

Van Mol: Ecologie comparée de deux espèces de Brotulidae des îles Galapgaos: Caecogilbia deroyi et Caecogilbia galapagosensis. Bull. Acad. R. Belg. 52 : 232-247 (1967)

Van Mol: Etude anatomique du genre Caecogilbia. Bull. Acad. R. Belg. 53 (10) : 1195-1218 (1967).

Leleup, N.: Les implications de l'existence d'une faune entomologique senescente variee aux iles Galapagos

La mission zoologique belge aux îles Galapagos effectuée en 1964-65 (J. et N. Leleup) a dévoilé l'existence d'une faune rélictuelle aveugle dans l'archipel. En considérant la pauvreté de fond de la faune insulaire originelle de ces îles, ces éléments sénescents, dont l'inventaire est loin d'être terminé, apparaît d'ores et déjà qualitativement nombreuse et répartie en des orders très divers (Isopoda, Aranea, Pseudoscorpiones, Opiliones, Dermaptera, Coleoptera). Une telle faune rélictuelle n'existe généralement que sur de vieux "asiles" dont l'émersion définitive remonte au moins au Tertiaire. Sa présence aux Galapagos apparaît donc anormale puisque l'on attribue actuellement un âge maximum de 2.4000.000 années à l'archipel. Si l'accélération de l'évolution des faunes insulaires est notoire, il faut souligner qu'elle ne s'applique qu'aux phénomènes de spéciation (diversification des espèces en fonction de la vacance de niches écologiques) et nullement aux phénomènes d'évolution régressive. C'est ce qui ressort de l'inventaire de la faune entomologique des Hawaii et de Sainte-Hélène toutes (ou presque) d'émersion largement antérieure a 2,400.000 millions d'années, Si l'âge actuellement alloué aux Galapagos devait être confirmé, l'existence de sa faune anophtalme exceptionnellement variée ne pourrait s'expliquer que par une accélération de l'évolution régressive affectant des lignées très diverses. Ce phénomène, qui serait propre à l'archipel des Galapagos, poserait une énigme qu'il ne sera pas aisé de solutioner.

La répartition atypique de la faune édaphonte rélictuelle des Galapagos – tout au moins celle de Santa Cruz – ne peut être que la conséquence d'un climat révolu nettement plus frais et plus humide. Cette faune est en effet confinée en grande majorité dans les profondes crevasses des basses régions périphériques. Lors de l'assèchement et du réchauffement du climat, elle s'est adaptée au mode de vie clasiophile au lieu de se réfugier en altitude.

Van Moorleghem, Cl., The study of the alkaloidic content of Vallesia glabra var. pubescens, an endemic variety of Apocynaceous collected in the Galapagos, led to the isolation of 32 alkaloids.

Among them, a great number were new substances. All are closely biogenetically related to tryptophan.

Because of the great difference in the chemical content, the studied plant is totally different from the closely related variety Vallesia glabra, also found in the Galapagos and on the continent.

Stoops, G., Pedological Studies of the Belgian Scientific Mission to the Galapagos Islands, 1962

In 1962 a scientific mission of the State University of Ghent made a preliminary study of the

soils of Isla Santa Cruz, under the leadership of the late Prof. Dr. J. Laruelle.

During a first survey, a hypsometric sequence of soil types clearly appeared on the southern slopes of the island. After more detailed observations, five pedological zones were recognized by Laruelle, corresponding partly to the vegetation belts described by Bowman 1961.

The coastal zone is formed essentially by rock outcrops (of basaltic lava), and only a small surface is covered by reddish soils, interstitial between the lava blocks. Two types may be distinguished: (1) loose superficial soils, developed essentially on pyroclastic material; they have a high base saturation and pH and show traces of an intense biological activity; (2) deeper, clay-rich soils, considered as truncated paleosoils, formed under less arid conditions than prevail today. Mangrove soils and saline soils occurring in the coastal fringe were not studied.

On the lower and the middle slopes, where a mesophytic vegetation gradually appears, brownish soils are formed on *in situ* weathering products of the basalt, mixed with variable amounts of pyroclastic material in the top layers. Soil development increases in general with altitude. They have a lower base saturation and a neutral to slightly acid pH. Most have a textural B-horizon.

In the uplands, soil characteristics are determined by the pyroclastic parent material and a higher precipitation. They show a low to very low base saturation. Their clay fraction is dominated by allophane, and they can be mostly considered as andosols. In general, influence of biological activity seems to be important.

The soils of the northern slopes, which are covered by a xerophytic vegetation, could not be studied.

References of scientific papers issuing from these studies can be found in:
De Paepe and Stoops, Noticias de Galapagos no. 21, pp. 14-18, 1973.

De Paepe, P., The pedological reconnaissance survey undertaken on the southern slopes of the Santa Cruz shield volcano offered the opportunity for geological field observations and for large-scale rock sampling, not only in the coastal area, where innumerable lava flows are exposed, but also at higher elevations (120m and more) where a thick cover of ash, tuff and soil normally prevents any direct observation of the underlying lava sheets. Profile pits and hand soundings made it also quite easy to determine the thickness and the horizontal extent of these pyroclastic deposits which so far had never been described. These poorly consolidated or loose ejecta without doubt originate in the central highlands of Santa Cruz where a relatively young chain of parasitic cinder and tuff cones is located. Unfortunately many samples were affected by weathering making investigation rather difficult.

Petrographical and chemical data prove that the greater part of the volcanic rocks outcropping in southern Santa Cruz have an alkali olivine basalt composition. The lavas almost display a porphyritic texture with rather small olivine phenocrysts (and rarely plagioclase phenocrysts) in a matrix of lath-shaped plagioclase, clinopyroxene, olivine, magnetite and ilmenite. Picotite inclusions in the olivine phenocrysts are rather common. In the lavas containing abundant plagioclase phenocrysts, the latter commonly are up to 1 cm in length. More tholeiitic basalts and high-alumina basalts may also occur but

highly differentiated rock types, as those found by McBIRNEY & WILLIAMS (1970) on Pinzon and Rabida, are completely lacking. Plutonic ejecta have never been observed either in the lavas or in the pyroclastic deposits. Some outstanding features of the lava flows in the arid coastal region are fault scarps and large lava tunnels.

During a ten day trip, other islands of the central part of the archipelago were visited (Plaza Meridional, Daphne Mayor, Bartolome, San Salvador and Pinzon) as well as some other zones of northern Santa Cruz. The rock samples gather somewhat haphazardly on this trip, together with some material from Baltra, Darwin, Espanola, Genovesa, Isabela, Marchena, Pinta, Rabida, Santa Maria and Wolf, kindly placed at our disposal by M. Castro, yielded additional data about the nature of the volcanic rocks occurring on islands other than Santa Cruz. These data, of course, did not allow us to draw general conclusions about the petrological evolution of the archipelago. During the G.I.S.P. meeting of 1964, Laruelle visited Santa Fe for many days. Samples collected at that time point to an unquestionable likeness with the rocks found in southern and central Santa Cruz.

Houvenaghel-Crevecoeur, Nadine, Ecological aspects of intertidal zonation on the rocky shores of the Galapagos

Features of the intertidal zonation on the rocky shores of the Galapagos Islands are described and discussed in relation to the environment factors, in particular temperature – which varies with regional hydrology and climatology. Owing to the thermal properties of the coastal waters and to the nature of the substrate (mainly basalt), intertidal organisms are exposed to a wide range of temperatures, which fluctuate with tide, day and season. As a result, life is mostly restricted to the lowest levels of the shore, the middle- and upper-level populations are sparse. Local variations (biofacies) resulting from water agitation may be found. Biota consist of tropical, sub-tropical and warm-temperature components. Tropical species dominate in sheltered areas and in middle and upper shores.

Houvenaghel, Guy, The Oceanography of the Galapagos Islands

Hydrological observations including nutrient chemistry and plancton production made in 1967-1969 and additional data obtained from the archives of the National Oceanographic and Atmospheric Administration (NOAA) were used to describe the oceanography of the Galapagos.

The main pattern in water circulation is the presence of deflections and local upwelling when the flow of the east-going Undercurrent is hitting the pedestal of the islands. These cold subsuperficial waters – spreading in surface with an intensity fluctuating according to the season – are determining or influencing all local hydrological, chemical, biological and climatological phenomena. Moreover, the presence around the islands of the recently upwelled waters provides a periinsular insulating crown of waters preventing the surface waters, which are potential carriers of immigrating species, from reaching the shores and promoting colonisation.

This also demonstrates that citing the Humboldt (or Peru) Current as the explanation of the cold waters and cool climate of the Galapagos is no longer correct.

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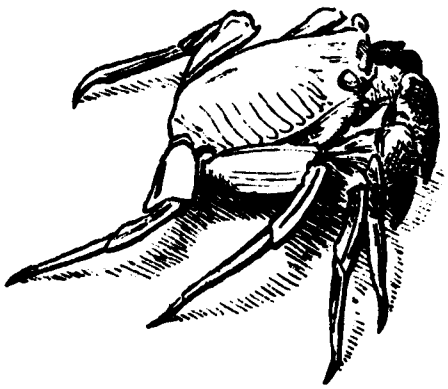


Red Crab
Grapsus grapsus

David and Deborah Clark have devoted three years to studying the black rat which, since its disastrous introduction into some of the Galapagos Islands, has done so much damage to the native wildlife. Much of their time has been spent camping in the humid highlands of Santa Cruz, where the rats are threatening to exterminate the rare Dark-rumped (or Hawaiian) Petrel in one of its last breeding places. Their investigations have produced information (such as that rat reproduction is closely associated with the rainy season) which will be of great help in efforts to control this alien pest. Their full report will be awaited with interest. Meanwhile we print their account of a two week campaign early this year against the rats on little Bartholomew Island.

Informe sobre programa de control de la introducida rata negra *rattus rattus* en la isla Bartolome, 22 enero-4 Febrero, 1976

Personal: David Clark, Deborah Clark, Estación Charles Darwin;
Fausto Llerena, Jorge Larrea, Servicio Parque Nacional "Galápagos".

Para discutir la isla Bartolomé es conveniente dividirla en cuatro partes. El área de vegetación y manglares tiene al sur y al norte dos playas de arena. Atrás de ellas, se encuentran bajos arbustos, y en la parte central de esta área hay densos manglares. La parte oriental es casi completamente lava sin vegetacion; occurren pequenas y aisladas manchas de cactillo (*Brachycereus*); por la orilla hay aisladas manchas de rompcolla (*Maytenus*), *Scalesia, Cryptocarpus,* y tomatillo (*Lycopersicon*). La parte occidental esta compuesta de tufa; casi toda la vegetación se encuentra por la orilla, en manchas aisladas. La parte central tiene vegetación dispersa, principalmente *Scalesia, Bursera, Waltheria,* y *Opuntia* en el centro , y *Maytenus, Sesuvium,* y *Cryptocarpus* a la orilla.

Pusimos trampas solamente en la parte de vegetación y manglares. Para pasar los manglares, había que abrir 10 caminos, uno cada 25 m. Los caminos son bajos, y porque los manglares son altos y tupidos, no se ven los caminos del sitio de visita de los turistas. En la parte central, pusimos cañas más o menos regularmente, uno cada 20-40m, según la vegetación. En las partes occidental y oriental, pusimos tubos solamente en manchas de vegetación.

Descubrimos huellas de ratas (comidas y excrementos) por toda la isla, lo cual fue una sorpresa para nosotros, considerando la escasíssima cantidad de vegetación en el centro de la parte oriental. Chequeamos cada mancha de *Brachycereus* en esta zona, y quizá la mitad mostraron viejas o nuevas señales de ratas. Huellas de ratas también se encontraban por casi todas las manchas de vegetación por la orilla, por toda la isla.

En cada tubo de cana pusimos uno de dos tipos de veneno. Uno fue un veneno agudo (marca "Raticate", ingrediente activa "Morsormide"), y el otro fue un veneno crónico (marca "Racumin", ingrediente activa cumarina). Para el "Raticate", pusimos cebo (avena) sin veneno para dos días, y después seguimos con cebo envenenado. Con el "Racumin", porque es crónico, esto no fue necesario, y desde el principio pusimos cebo (arroz) con veneno. Principiamos con poner agua en el cebo, pero averiguamos que el cebo pudrió dentro de dos días. Entronces con el primer cambio de veneno pusimos el cebo seco. Parecía que las ratas no comían tanto del cebo seco, de manera que en el último cambio de veneno volvimos a poner agua con el cebo. Nos parece que functiona mejor el cebo mojado, pero solamente actúa entonces una noche, y

después se pudre.

Con trampas (2/3 trampas que matan, 1/3 trampas que cogen vivo) matamos a 28 ratas en el área de vegetación. De estas, 2 fueron hembras prenadas, una muy cerca a dar luz. Todas se cayeron en las tres primeras noches de atrapar. Encontramos a 7 ratas envenenadas. Es probable que matamos a unas 10-20 más que no encontramos. En total, entonces, matamos a unas 45-55 ratas.

No es posible decir si matamos a todas las ratas o no. Creemos que pusimos trampas o tubos de veneno en cada mancha de vegetación por toda la isla. Si el veneno funcionó en todos los casos, es posible quo hemos eliminado a todas. Nos parece más probable que matamos a algo como 95%, y quel algunas escarparon. La manera de averiguar esto es de ir en tres meses, después de la temporada de reproducción, y atrapar una noche, además de hacer una recorrida de inspección por toda la orilla. Si se descubre que todavia hay ratas, se debe repetir el trabajo. Noviembre sería el mes mas favorable, cuando la población de ratas está baja, y no hay reproducción.

Durante el viaje de regreso, paramos en el islote de Sombrero Chino. Aparte de una pequena zona de playa, la isla tiene una vegetación dispersa, principalmente *Brachycereus* y tomatillo. Había abundante señales de ratas; especialmente notables eran los huecos comidos en el *Brachycereus*. Estimamos que hay una población de no más de 50 ratas allá, pero distribuida por todo el islote.

RECOMENDACIONES:

(1) Que se haga un viaje de chequeo a Bartolomé durante el mes de Mayo, para averigüar si algunas ratas sobreviven allá. A la vez, se podría pasar por Sombrero Chino y atrapar una noche con trampas que cogen vivo, para asegurar que las ratas allá son introducidas, y no una población sobreviviente de la rata nativa de Santiago.

(2) Si se encuentran ratas en Bartolomé, debe repetirse el trabajo. Nos parece que si será posible (si ya no está hecho) eliminar las ratas de Bartolomé.

(3) Una vez concluido el programa de Bartolomé, se debe hacer el mismo trabajo en Sombrero Chino.

Queremos notar especialmente el valioso trabajo de los Guardianes F. Llerena y J. Larrea. A más de su completa cooperación en llevar a cabo el programa, hicieron muchas sugerencias que facilitaron el trabajo. Ambos ya son capaces de encargarse de los futuros viajes de control. Esperamos tener una oportunidad de hacer unas disecciónes con ellos, esto siendo la única cosa necesaria para tal trabajo en que todavía no tienen experiencia.

David Clark
Deborah Clark
Biólogos, Estación Charles Darwin

Training Course for National Park Personnel

THE SECOND TRAINING COURSE FOR PERSONNEL OF THE GALAPAGOS NATIONAL PARK SERVICE

by

ALAN MOORE, FAO
Adviser to the Galapagos National Park Service and Director of the Course
August 30th, 1975

The only previous full-length training course for National Park Service Wardens was held in 1971. Although at least one half of a warden's training can only come from first-hand field experience, and short courses of a few days duration are held occasionally, reasonably frequent, longer, formal courses are an indispensable part of a full training program. Since a large percentage of the present Wardens' Corps entered the Park Service in the past 18 months, 1975 was a very advantageous year to conduct the most complete training course ever given.

Planning for the course began in May 1975. The Director of Darwin Station and myself, together with the Superintendent of the Park, worked in close collaboration to define the subject areas to be treated and choose the individuals to present each particular theme.

The Course was held during the period 29 July to 8 August 1975 and was attended by 27 Park Wardens, six of whom had recently been hired, attending the course being their first duty as Park Service employees. Of the other Park Wardens only four had attended the previous extensive training course.

Compared to the seven-day 1971 course, it was possible this year to expand it to 11 days and cover a considerably broader range of topics. It was oriented to give the wardens basic knowledge of :

- The concept of National Parks in general and their problems
- The natural history of the Galapagos Archipelago
- The organization and administration of the Galapagos National Park Service
- The conservation problems of the Galapagos Islands and related management programs
- Several special sessions were devoted to public relations and the Warden's responsibilities as the key Park personnel in the new patrolling system*, which was put into operation immediately after the course, using several newly acquired patrol boats
- First Aid
- Use and maintenance of Park Service arms and equipment

Instructors were primarily Park Conservation officials, the Superintendent, myself, and Darwin

* This is the scheme of "floating" and land-based guard districts called for in the *Master Plan for the Protection and Use of the Galapagos National Park.*

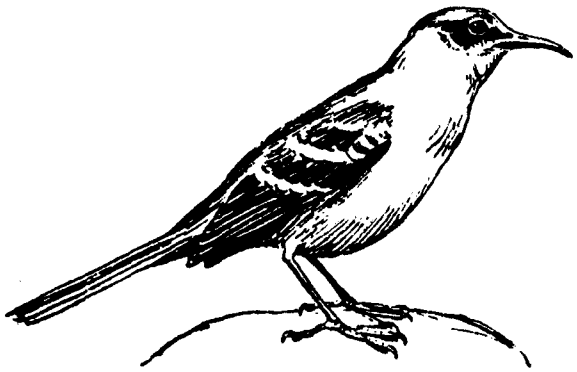
Research Station staff and visiting scientists.

A total of 28 lectures were given, interspersed with over 20 discussion periods, during which the speaker presented 5 or 6 questions to the wardens concerning his presentation. The wardens were divided in small groups to discuss one of the questions and to present, later, their answer to the entire group. Questions and general participation, by the wardens during the lectures, were strongly encouraged.

In addition to attending the course, it was required that each warden read the natural history of Galapagos entitled *Galapagos, Archipielago del Ecuador*, written by Juan Black, a former conservation official of the park.

At the end of the course, a written exam consisting of 20 essay questions, and an anonymous evaluation questionnaire was given to the wardens. Although a few did not fare too well, the vast majority did an excellent job. The purpose of the exam and questionnaire, however, were not to qualify or categorize the wardens in any way, but instead to discover in which areas the course had failed, in which areas it was a success in getting across certain ideas and concepts, and in which the wardens needed additional training.

The information gained from it will be used in planning a similar course next year. The Park plans to continue these courses on an annual basis, or more often if the need arises. The vast majority of the wardens were extremely interested and enthusiastic about the course, and had a great many suggestions for future such endeavours. Most seem to be eager to learn more about their own work and conservation in general, a good sign for the future of the Park. Hopefully, together with the continued collaboration of the Darwin Station, the Park can continue to offer more educational opportunities to its personnel and maintain their enthusiasm for their work.



Santa Cruz Mockingbird
Nesomimus parvulus

A BOTANIST'S NOTES ON PINTA

by

HENNING ADSERSEN

For many visitors, Pinta (Abingdon) Island is like a miniature of the entire Galapagos Archipelago. Here one finds abundance of sea-lions as along so many Galapagos shores; pungent Palo Santo (Bursera) as on Marchena; mysterious Pega-pega (Pisonia) forest like that near Puerto Ayora; small spots of dry Scalesia woodland similar to Alcedo's upper flanks; dense Catclaw (Zanthoxylum) forest rich in epiphytes as on Santiago; a top cone like a miniature San Joaquin; a crater like Santa Rosa's *huecos*; and a fern zone vegetation very similar to the Cerro Crocher area. Furthermore the barren lava fields of Fernandina and the fumaroles of Marchena are reflected in the scenery.

Conservation problems, unfortunately, are also encountered. Tortoise hunting before the establishment of the Darwin Research Station, has left only one sad-looking specimen of the Abingdon (Pinta) subspecies and the population explosion of introduced goats has led to the destruction of much of the vegetation, as reported by Weber 1971. However, the actions taken by the National Park Service and the Darwin Station to deal with these problems are proving the worth of vigorous conservation policy. Pinta,if not restored, is already at least recovering. (See Hamann 1975.)

During my year as Unesco associate expert in plant ecology at the CDRS, I had the opportunity to stay one week on Pinta. My main aims were to record vegetation and plant occurrences. Pinta is a very interesting island for a botanist. The *"Flora of the Galapagos Islands"* (Wiggins & Porter 1971) reports the presence of about 100 plant species and subspecies on the island but our observations reveal that 200 is a more probable figure.

Other islands were also found to have many more species than noted in Wiggins & Porter: eg: Fernandina, where in one week we collected about 150 species, whereas the *Flora* mentions only 69. So one should be cautious when using the *Flora* as a source of plant species numbers. The maps in the *Flora*, as stated,are not complete distribution maps.

Several authors have studied the relationships between species diversity and island area (Hamilton et al 1963, Johnson & Raven 1972, Simpson 1974) and have found good correlation between area and species number. In relation to the original approach of Hamilton et al, the last two papers mainly provide corrections based on new information not available to Hamilton.

Based on field experience, I have tried to introduce new corrections into the data. For each island I have preliminarily established a qualified guess of the plant species number. These figures have been analyzed in relation to island area, and a stronger correlation than shown in the cited papers has been found (correlation coefficient r between ln A and ln S = 0.8962).

I have also tried to correlate estimates of the vegetated area of each island with the species number, considering the fresh barren lava fields as areas no more fertile than the sea. In fact, such an analysis gives the strongest correlation of the mentioned approaches (r [ln RA, ln S] = 0.9062). An exhaustive treatment on this issue will be given elsewhere.

Thus Pinta, being a small island, should be expected to have rather few species. The area (60 km^2), is comparable to Espanola (Hood) with 58 km^2. From the empiric relationships between total area and species number one would expect 123 species on Pinta and 121 on Espanola. My estimates show 200 for Pinta and 110 species for Espanola. Disregarding the barren lava fields of the areas, Pinta has an area of only 30 km^2. In this approach it is most comparable to Marchena with a vegetation area of approximately 30 km^2 and Santa Fe (Barrington) with 24 km^2. Expected species numbers for the three islands are 109, 109 and 101, respectively, whereas the actual species numbers were 200, 60 and 70. Indeed Pinta has a surprisingly rich flora !

This high diversity is probably due mainly to the elevation of the island. The upper regions of Pinta reach the *garua* belt, which means that the upper vegetation zone may stay humid during the period from July to January. However, Pinta seems to be lower than indicated by the U.S. hydrographic map. Here the greatest altitude is stated to be 2550 feet (777 metres). For several days we noted an altitude of 650 m (2133 feet). Since this was the only time when our altimeter was not in accordance with map annotations, and since our observation is in accordance with the level range stated by Hamann 1974 for his finds of Histiopteris at the very top, we must conclude that the map is incorrect by about 125 m.

An important factor for the development of vegetation is time. This, in the Galapagos islands, generally means the time since the last volcanic event. Since Pinta has a rich vegetation the vegetated areas are likely to have remained undisturbed by volcanic activity for a long time. It is very difficult from vegetation analysis to estimate even the range of time in question since nobody knows how long lava or ash fields remain barren before colonization takes place. Furthermore the vegetation succession is incompletely described, and information on the duration of the succession stages is completely lacking. Therefore, any accurate age determination is important for the understanding of the ecology of the Galapagos islands.

One of the methods of measuring age is to use carbon^{14} dating of organic remains from defined undisturbed deposits. This approach has been applied by Colinvaux, who contributed to the quaternary history of the archipelago in a most interesting way, by dating sediments from lake El Junco on San Cristobal. Unfortunately El Junco is probably the only lake of appropriate size and age, so this source of information may already be exhausted. Other places where deposits may have remained undisturbed are potholes and lava tunnels. To my knowledge material from these sites has not been used for age determination. A third possibility is to examine aged organic matter accumulated in the soil profiles in land vegetation. Such accumulation is exceptional in tropical environments because of the rapid decay of any organic litter. But exceptions do occur. In the fern zone of the Galapagos the decay of roots and rhizomes is very slow, probably due to toxic substances which make them inacceptable to micro-organisms. Thus a substantial terrestrial peat accumulation may occur.

On Pinta such a fern peat area exists around the top cone. This has been clearly demonstrated by the detrimental activity of the goats: in some places the peat layer has been destroyed by trampling and subsequent erosion, so that only scattered "islands" or columns of the original peat remain. These columns may rise more than 1 metre above the bared lava rocks.

From one of these columns we collected a sample for age-determination. The column was more or less cylindrical, approximately 2 m in diameter and remains of the fern vegetation grew on top (mainly the bracken, *Pteridium aquilinum*). The height of the column was about 1 m.

The sample was taken at a depth of 70 cm. It was analysed after our return to Denmark at Radicarbon Dating Laboratory, Geological Survey of Denmark and the National Museum, Copenhagen. The age of the sample was determined as 460 $\pm$ 75 years before 1950. Thus the upper 70 cm of the profile has accumulated during approx. 500 years.

Several important conclusions may be drawn from this. An average yearly minimum peat production may be estimated for the fern zone. The yearly growth of the profile amounts to 1.4 mm. Assuming a bulk density of the peat of 0.2 g/cm^3, a minimum productivity of 3 g/m^2/year can be calculated. Thus the first data-based estimate of productivity of a natural vegetation of Galapagos can be submitted.

The thickness of the peat layer is about 1 m, and the sample was taken at a depth of only 70 cm. Assuming a constant accumulation rate, the fern vegetation can be deduced to have been present for about 700 years. It seems likely that pioneer stages of vegetation had preceded the fern zone type for a considerable time, possibly 300 years. Before that, the area must have been barren lava field for a long time. All in all, my estimate (or rather guess) is that the vegetation top zone of Pinta has not been subjected to lava outflow for 2.000 $\pm$ 500 years.

In conjunction with the known facts about the introduction of goats on Pinta, a third and alarming conclusion may be drawn from this single age determination: three goats brought ashore on a tropical island may give rise to a population that in a mere 15 years can destroy an entire and unique plant community, which has taken thousands of years to become established.

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CHARLES DARWIN FOUNDATION FOR THE GALAPAGOS ISLANDS

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Buts et objectifs de la Fondation Charles Darwin pour les Galapagos (Art 2 des Statuts, Bruxelles, 23 juillet 1959)

L'Association est chargée de l'organisation et de la gestion de la Station de recherches "Charles Darwin", dont le gouvernement de la République de l'Ecuador a autorisé l' établissement dans l'archipel des Galápagos à l'occasion du centenaire de l'énoncé de la doctrine de l'évolution (1858–1958).

L'Association propose aux autorités compétentes toutes mesures propres à assurer, dans l'archipel des Galápagos et dans les mers qui l'entourent, la conservation du sol, de la flore et de la faune, et la sauvegarde de la vie sauvage et de son milieu naturel. Elle arrête le programme de recherches de la Station biologique et la charge de toutes etudes scientifiques en rapport avec les objets ci-dessus.

Elle recueille et gère les fonds destinés au fonctionnement de la Station et à la promotion des recherches qui y ont leur base.

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