

NOTICIAS DE GALAPAGOS

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NEWS FROM ACADEMY BAY

The Galapagos National Park covers a land area of nearly 700,000 hectares (1,700,000 acres), divided among a number of islands which are separated by much larger expanses of sea. The terrain is always harsh and often fierce, with volcanoes rising up to a mile in height. Parts are still imperfectly explored. Since the creation of the National Park Service, the patrolling and protection of this vast area has been improved year by year but, for all the tasks in hand, wardens are still thin on the ground. Man, whether he comes as scientist or tourist, will prove amenable to the necessary controls – or so it is confidently hoped. Not so the domesticated animals which man has introduced and which have quickly become so much “wilder” than the phenomenally tame indigenous animals: they are, and will continue to be, desperately difficult to control. So we have our ups and downs, some of which are reported in this number. In spite of setbacks, it is good to think that, in a world where so much is lost each year, the Galapagos National Park is one place where, thanks to our supporters, the wildlife situation is actually improving.

TORTOISES, IGUANAS AND THE MENACE OF FERAL DOGS

It was a source of great satisfaction to learn that no trace had been found these last few years of the wild dogs which had killed such a high proportion of the young giant tortoises on San Cristobal (Chatham) Island. Consequently, in addition to those bred in the Station's hatcheries, some 80 youngsters of this rare subspecies have been found unharmed in the wild and measured, weighed and marked for future study.

Against this must be placed a severe setback when, quite unexpectedly and between two regular patrols by wardens, wild dogs invaded the most productive nesting area on Santa Cruz and destroyed the majority of the young tortoises of the 1971/72, 1972/73, 1973/74 and 1974/75 classes. This is not one of the rarer subspecies but the loss was a bitter disappointment after the breeding success of the last four years, due to the persistent efforts of the National Park wardens in keeping the feral pigs under control. Prior to this incursion, dogs had not been known anywhere near this nesting area.

A similar catastrophe has befallen the land iguana colonies on Santa Cruz and in the Cartago Bay area of Isabela. In both cases feral dogs have destroyed a high proportion of the population, killing iguanas of all sizes for the sake of killing and not merely for food. From one point of view, the iguanas are in greater danger than the tortoises, as the dogs kill even the biggest adults, whereas they do not tackle adult tortoises. Cats are also an increasing menace but there is as yet no proof that they do more than kill young iguanas for food – which is bad enough in all conscience. As Charles Darwin prophetically wrote when describing the extraordinary tameness of the Galapagos animals:

“What havoc the introduction of any new beast of prey must cause, before the instincts of the indigenous inhabitants have become adapted to the stranger's craft or power.”

However, we cannot wait for the iguanas to adapt. By introducing these predators, man has altered the balance of nature and only man can now save the native species.

Fortunately, this invasion of new areas by dogs has coincided with the return to the Charles

Darwin Research Station of Dr Dagmar Werner from Basel University to begin a three year study of land iguanas with the support of the National Geographic Society. Other scientists have already done work on this peculiar Galapagoan genus but this will be the first investigation in depth. Even the taxonomy of the land iguanas needs a radical re-assessment. Van Denburgh (1912) divided them into two species but there is reason to suspect that most populations, occurring as they do on a number of islands, have reached at least the sub-specific level of differentiation.

In addition to her contribution to "pure" science, Dr Werner's research into the population ecology of the land iguana should provide an invaluable aid to the immediate conservation measures which must be taken. Support from the WWF has been sought for an emergency programme. This includes the permanent stationing of wardens at some critical points; a campaign to reduce the dogs and cats to the lowest numbers possible; the transfer of survivors of the massacre to temporary pens at the Charles Darwin Research Station, with the possibility of eventually breeding some races of iguanas in captivity, as has been done so successfully with the endangered tortoises. This is all going to prove very expensive and it comes at the worst possible time, when the Darwin Foundation's resources are already badly stretched and the National Park Service cannot engage extra manpower owing to the national austerity decree forbidding the recruitment of additional staff by any government department. Nevertheless immediate action must be taken. The land iguanas on James Island were exterminated in the last century; those on Baltra during the Second World War. We cannot afford a further tragedy.

THE PACIFIC GREEN SEA TURTLE

Commercial exploitation is a potential threat to this species throughout its range. Fortunately, since the Japanese incursions of 1971 and 1972, there has been a government ban on large scale slaughter in the Galapagos (the local inhabitants' privilege of taking adult turtles for subsistence consumption has a negligible effect). Nevertheless the ban is only temporary and studies in depth are necessary as a basis for future policy. Between 1970 and 1975, P. G. H. Pritchard and Miguel Cifuentes did several months research on these problems. Now Derek Green, supported by the National Geographic Society, is engaged on an extended, full-time study of population ecology, including a calculation of the present population and an estimate of breeding potential and the size of population that the available food supply could support. The green turtle nests in considerable numbers on most of the Galapagos Islands (Pritchard, 1971, 1972). Concentrations of adults, sub-adults and even juveniles have been observed during all seasons of the year in several major feeding grounds; this raises the question whether the bulk of the Galapagos population, unlike all others, is permanently resident or whether a large proportion of it regularly migrates to distant feeding grounds where it may be exposed to commercial exploitation.

SEA LIONS AND FUR SEALS

Fritz Trillmich of the Max Planck Institute is engaged on a two year study of the social behaviour, thermo-regulation and ecology of the Galapagos sea lion and fur seal. While his main purpose is behavioural studies it is hoped that his long periods camping among the pinniped colonies will add to our knowledge of the distribution, population dynamics, food habits, growth rates and the effects of tourism on both species.



Land Iguana on Rim of Fernandina Volcano



Galapagos Park Service parades on Ecuador's National Day

photo: Craig MacFarland

His wife is accompanying him and proposes to study the marine iguanas, which inhabit much the same zones.

LAND SNAILS

Guy Coppo of the Free University of Brussels returned to the Charles Darwin Research Station to undertake a further 2-3 year ecological study of the land snails of which 60-80 species are endemic. Not only are they endemic to the Galapagos archipelago but most are endemic to one zone of a single island. For example, there are about 20 species on Santa Cruz, 3 or 4 of which are now restricted to a single hill or a remnant patch of forest. Destruction of habitat by settlement prior to the founding of the CDRS is one obvious cause of decline but predation by introduced fire ants and black rats seems to add to the problem.

FIRE ANTS

It had been known for years that the fire ant (*Wasmannia auropunctata*) had been introduced into the inhabited islands but it was only in 1975 that it was discovered at a camping area used by scientists on a non-inhabited island. The implications were obvious and steps were taken to prevent the spread to other islands. The strictest instructions were issued to scientists and wardens, prohibiting the carrying of certain fruits, vegetables etc., into the field and requiring the disinfection of camping gear. Tourists are no longer allowed to take food on shore in the Park. The infected area was drastically treated, apparently with complete success.

The ecological and distributional studies of the fire ants begun by Ecuadorean scholarship students (see *Noticias 24*) were continued in 1976 by a new team.

THE HAWAIIAN (OR DARK-RUMPED) PETREL

This large pelagic bird with a three foot wingspan is in danger of extinction on Hawaii. Its only other breeding places in the world are on five of the biggest islands of the Galapagos. Outside the breeding season these birds live entirely at sea. It is at the nest that they are in peril. They breed in holes in the ground in the humid, thickly vegetated uplands and it is while they are trapped in their tunnels that adults as well as their young are being killed by one or more of the introduced predators – rats, pigs or dogs – all three in the case of the population on Santa Cruz, where Darwin Station scientists have been at work in recent years, trying to devise protective measures. On James (Santiago) Island, the main threat to the petrel is the pig; it is therefore gratifying to learn that, in the course of their hunting campaigns (intended primarily to protect the tortoises) the Park Service wardens have discovered areas still completely free from pigs, where the petrels are apparently raising good numbers of young. The importance of preventing the spread of pigs to these areas is obvious. Once again, it is largely a matter of manpower and resources.

PROTECTING THE GALAPAGOS FLORA

Like the native fauna, much of the Galapagos endemic flora is subject to a variety of threats and resisting them puts a constant strain on the limited resources of the National

Park Service and the Charles Darwin Research Station.

On the inhabited islands, some of the alien plants and trees introduced by the settlers are spreading into the Park territory and endangering the indigenous species. Since 1973 a series of Unesco plant ecologists at the Station have been studying the situation and collaborating with the National Park Service in controlling or eradicating the intruders. Fortunately only 15 of some 250 introduced plants seem to spread actively on their own after the initial disturbance of the vegetation by man and his domesticated animals – but these few are causing problems enough. On Santa Cruz, for instance, elephant grass, citrus, guava, avocado and especially cinchona trees have proved difficult to destroy; in many cases nothing short of digging out the roots has been effective. Nevertheless positive results have been achieved and experiments continue with a view to finding less expensive methods, in terms of man-hours, of combatting these pests – because however desirable avocado trees may be in the right place, they are a destructive weed in the National Park.

On the uninhabited islands, the chief threats are the introduced grazers and browsers – donkeys, pigs and above all the thousands of prolific goats. The amount of destruction they can wreak is almost unbelievable. The NPS and the CDRS have two main types of defence: hunting and the establishment of fenced-in quadrats. On the smaller and medium-sized islands, hunting has already eradicated or seriously reduced the goat population and this has been followed by a most encouraging regeneration of the vegetation. How far and how quickly these successes can be repeated on the larger islands is primarily a question of the funds available to employ hunters. Meanwhile, as a holding operation, small areas have been fenced in to protect the endangered species of plants. To be really effective larger areas would need to be enclosed (at least 100 metres x 100 metres) but finance for this is simply not available. The CDRS is in contact with experts in different countries in its efforts to find more cost-effective ways of dealing with these various pests.

COURSES FOR WARDENS AND GUIDES

During 1976, a number of courses were held in the Van Straelen Hall, jointly organised by the Galapagos National Park Service and the Charles Darwin Research Station.

The third course for National Park Wardens was held in August on much the same lines as the one reported in *Noticias 24*. This time 30 wardens were awarded diplomas.

Two one-week courses were organised for Auxiliary Guides and one, lasting a full month, for Naturalist-Guides. It has always been recognised that properly trained guides are the first line of defence against possible damage to the environment by parties of visitors but hitherto they have not been available in adequate numbers. A new system has been introduced under which two types of guide are licensed by the National Park Service after completing satisfactorily the joint NPS-CDRS courses. Naturalist-Guides are required for vessels carrying more than 20 tourists (one guide to every 30 passengers) but smaller ships are only obliged to carry an Auxiliary Guide. Similar courses will be organised each year in future.

SUGGESTIONS FOR THE MANAGEMENT OF A GALAPAGOS MARINE PARK

This article is based on a further extract from Chapter VIII of Gerard M. Wellington's report to the Department of National Parks and Wildlife on his two years of exploration and research in the littoral waters of the Galapagos. In it he submits for consideration possible guidelines for the administration of the proposed underwater park. Mr. Wellington wishes to emphasise that this part of his report owes much to the constructive advice and collaboration of Dr. Craig MacFarland, Director of the Charles Darwin Research Station. The first extract from this report was published in Noticias 24 and explains the principles of "zoning" in the park.

REGULATION OF COMMERCIAL AND NON-COMMERCIAL ACTIVITIES

Commercial Activities

There are two major commercial fisheries in the islands at present plus several minor forms of commercial and non-commercial exploitation. All are conducted almost exclusively within the proposed marine park.

1. Bacalao Fishery

The bacalao fishery is based on locally owned and operated boats. There is very little available data on this species but some general observations are possible. The bacalao or grouper (*Mycteroporca olfax*) fishery appears to be declining; there are no longer "bacalao" boats operating from Academy Bay, Villamil, or Black Beach, and a decline in the number of boats has occurred in the major fishing port of Wreck Bay as well. Both the total catch and the size of the individual fish caught have been decreasing over the past 10 years, although recently it appears to have stabilised. This reduction has resulted from two facts: (i) the numbers of fish have declined to the point where present fishing methods (pole and line, salting and drying for export) made fishing uneconomical, and (ii) increased tourism and visitation by scientists have enabled many fishermen to profit more from chartering their boats than from fishing.

2. Lobster Fishery

The lobster fishery (*Panulirus gracilis*, *P. penicillatus* and *Scyllarides astori*) until recently was the more important industry. However, a moratorium on all exports of lobster from Ecuador, established by the government in the early part of 1975 to halt the export of valuable protein from the country, has made the business unprofitable in the archipelago. Previous to this law the Galapagos catch contributed approximately two-thirds of the many tons of lobster tails which were exported from Ecuador annually. Today lobster populations have been severely reduced and are obviously over-exploited. Catch statistics for recent years and local observations demonstrate that not only has the total catch been slowly decreasing but the size of the individuals caught has also decreased markedly, this being due to continual improvements in methods (from free diving to hookahs and, most recently, to SCUBA).

This fishery, if the moratorium had not been established, would probably have died a natural death in 5-10 years by reducing the lobster populations to levels at which the fishery would have become uneconomical.

3. Other Commercial Activities

Within the past few years there has been a growing commercial interest in the utilisation and selling of one of the two black coral species (*Antipathes panomensis*) present in the Islands. Sizable quantities of this animal have been taken and it is being used locally in the production of jewellery for tourist consumption. Recent observations and reports indicate that large quantities were also being taken in crude form to the continent by lobster fishermen, when that industry was present in the islands.

In the interest of conservation and in the light of experience gained in the Mediterranean and Caribbean Seas, it is strongly recommended that the exploitation of this resource in any manner or form be strictly prohibited. Many alternative plans could be proposed which would theoretically allow rational exploitation of the coral on a sustained yield basis; however, management at this level has failed elsewhere in the world and there is no reason to suspect that it could work here.

Non-Commercial Activities

Non-commercial activities such as local subsistence fishing, and the occasional taking of marine invertebrates and green turtles* (*Chelonia mydas*) could continue to be allowed, but only for local inhabitants on a subsistence level, and only within the Special Use Zone.

Rules and Regulations

At present, with only one major fishery existing in the islands, and one which is growing more and more limited, it seems best to establish the following principles:

1. Existing commercial fisheries could be allowed to continue at present levels of exploitation throughout the greater part of the Park's marine extension (ie: the Special Use Zone). However, no expansion nor introduction of new methods nor the establishment of new fisheries would be allowed without the approval of the Park authorities and not until adequate studies had been conducted.
2. Areas zoned as Intensive Use, Primitive and Primitive-Scientific, where all commercial and non-commercial exploitation was prohibited, could serve as refuge areas, thus allowing exploited species, especially lobsters, to thrive and re-populate adjacent low density areas.
3. All existing fisheries regulations could be strongly enforced within Park waters.
4. The species of fish to be taken on a commercial basis in the Special Use Zone could be restricted to those listed in Table VIII-1.

* *Chelonia mydas* is temporarily protected in this way under Ecuadorean law.

TABLE VIII-1

PRELIMINARY LIST OF THE COMMERCIALY IMPORTANT
MARINE SPECIES OCCURRING IN GALAPAGOS WATERS

INVERTEBRATOS/INVERTEBRATES:

| | |
|---|-----------------|
| <i>Panulirus gracilis</i> Streets | “Langosta Azul” |
| <i>Panulirus penicillatus</i> (Olivier) | “Langosta Rojo” |
| <i>Scyllarides Astori</i> Holthius | “Langostina” |
| <i>Antipathes panamensis</i> | “Coral Negra” |

PECES/FISH:

De mayor importancia/Of major importance —

| | |
|--------------------------------------|------------------------|
| Peces costeros/Shorefishes | |
| <i>Mycteroperca olfax</i> (Jenyns) | “Bacalao o Camotilla” |
| <i>Paralabrax humeralis</i> (Jenyns) | “Camotillo” Serranidae |
| <i>Mugil</i> spp. | “Lisa” Mugilidae |

De menos importancia/Of lesser importance —

| | |
|---|--------------------------|
| Peces costeros/Shorefishes | |
| <i>Epinephelus labriformis</i> (Jenyns) | “Cabrilla” Serranidae |
| <i>Dermatolepsis punctatus</i> Gill | “Ca-Ca Leche” Serranidae |
| <i>Chanos chanos</i> (Forsk.) | Channidae |
| <i>Centropomus</i> spp. | “Robalito” Centropomidae |

Especies pelágicas cerca a la costa/Near-shore pelagic species

| | |
|---|---------------------------|
| <i>Coryphaena hippurus</i> Linn. | “Dorado” Coryphaeidae |
| <i>Acanthocybium solandri</i> (Cuvier & Val.) | “Peje Sierra” Scomberidae |
| <i>Scomberomorus sierra</i> Jordan & Starks | “Sierra” Scomberidae |
| <i>Katsuwonus pelemis</i> Linn. | “Bonito” Scomberidae |
| <i>Sarda Lineolata</i> (Girard) | “Bonito” Scomberidae |
| <i>Neothunnus macropterus</i> Kish. | “Atun” Scomberidae |
| <i>Seriola colburni</i> (Ever. & Clark) | Carangidae |



REGULATION OF WASTE DISPOSAL IN WATERS WITHIN AND SURROUNDING THE ARCHIPELAGO

As tourism and general prosperity have increased within the islands, so has the amount of refuse produced. This already has created disposal problems. There is evidence to suggest that at present an alarming amount of trash is beginning to build up at several locations in the islands, notably along the southern coasts of Santa Cruz and Santiago, the Banks Bay area along western Isabela and the southern beach of Marchena. A certain percentage of this trash arrives from outside sources via the northward moving Peru Current, this, of course, being beyond the control of the Park Service; however, more and more items of definite local origin are beginning to appear. Haphazard refuse disposal can result not only in aesthetic damage to the islands, but also in injury and death to marine animals: for example, plastics kill sea turtles.

A study was conducted in late 1974, involving interviews with local tour boat operators and analysis of Park Service visitation records from November 1973 to October 1974. It was estimated that approximately 3 million gallons of waste products go over the side of tourist vessels in Galapagos waters annually.

Realising the practical difficulties of long term storage of waste products aboard vessels, eleven sites in the islands have been designated where dumping of specified waste products would be permitted. This should enable all tourist vessels and other ships to dump on a daily or every-other-day basis.

The following rules and guidelines might be applied to all permanently island-based vessels including large and small tourist vessels, and also to boats involved in commercial fishing, inter-island transport and scientific activities, as well as to cargo supply ships, private yachts and tourist vessels which visit the islands on a regular basis. For those tourist, scientific, or other vessels which only occasionally visit the islands, special rules would be applied (see below).

1. Dumping of raw organic garbage, metal cans and glass bottles would be restricted to the sites designated. These localities have been chosen on the basis of our present knowledge of surface current patterns in the islands. Dumping at these locations should allow garbage ample time to disperse and sink long before reaching shore. It would be necessary to see that all tins are opened at both ends and glass bottles broken before dumping. All sites are located in waters greater than 200 metres depth and spaced so that dumping can be accomplished on a daily or every-other-day basis, according to the itinerary of the vessel.
2. Under NO circumstances would waste products be dumped within two nautical miles of the shore.
3. All paper, plastic materials and wood products would be retained aboard and deposited at either Academy Bay or Wreck Bay, where the National Park Service will have established a system for the collection and incineration of such products. It is hoped that a similar facility can be established at Baltra in co-operation with Navy personnel.

4. All petroleum waste products would be retained on board and either deposited at the above cited locations or taken to the continent for re-processing.
5. It is recommended that all vessels travelling between the continent and the islands restrict the waste dumping to those items described in section 1.
6. Disposal needs of scientific vessels and tour ships which only visit the islands occasionally should be evaluated on an individual basis by Park officials to determine the best procedure for handling such waste. In most instances boats of this nature are equipped to hold wastes for long periods.
7. International cargo and tanker vessels which presently pass through the interior seas of the islands en route to continental ports should be restricted to a distance of at least 10 nautical miles beyond the outermost limits of the Archipelago. This will help reduce the contamination which is occurring and prevent possible catastrophies by grounded vessels.

TOURISM

General Regulation of Tourism

Interest among visitors in the marine environment in Galapagos is increasing rapidly. More and more people are taking to the water and as many as 50% of the visitors may be snorkelling, diving or swimming in the near future. With annual limits on the number of visitors, channelling patterns and other controls which may be established in accord with the *Master Plan*, this should present no danger and, in fact, some of the pressure on terrestrial visitor sites would be alleviated. Visitation in marine areas will always be less than on land because water temperatures are cool for six months of the year and because many visitors prefer not to snorkel or dive. The educational value of snorkelling and diving in the islands is obvious. In order to preserve this unique resource several of the traditionally acceptable visitor activities, such as spearfishing and sport-fishing, would be prohibited.

Rules for Visitor Use in the Marine Environment

1. Collecting or damaging plant, animal or inorganic material within the Marine Park boundaries in any manner would be strictly prohibited. This includes dead organic materials such as sea shells, coral fragments, etc.
2. Spearfishing would be strictly prohibited, based on growing evidence from the Mediterranean and Caribbean that this activity can have far reaching effects on overall ecosystems. Not only do fish quickly become shy, but the removal of large predatory reef-dwelling fish results in decreased species diversity, which may take years to recover even after spearfishing is halted.
3. Sport-fishing with rod and reel for large predatory "game fish" would be prohibited. This activity is basically contrary to the conservation aims of the Park and any visitors interested will find better sport-fishing available on mainland Ecuador.
4. As the National Park Service is ultimately responsible for the safety of visitors, the

following regulations would apply to those tour operators offering SCUBA diving as part of the itinerary:

- (a) All divers would have to be certified by a recognised organisation or individual as to their proficiency and knowledge.
- (b) Tanks, regulators, compressors and other equipment offered for use by the tour operators must meet internationally recognised safety standards and would be subject to periodic inspection by National Park officials.
- (c) At all times divers would have to employ the "buddy-system".
- (d) At least one properly trained guide would be provided for every five divers.

PATROL BOAT SCHEME TO ENFORCE MANAGEMENT POLICIES

The protection scheme for the marine areas would follow that already proposed in the *Master Plan* for the protection and control of all terrestrial areas of the National Park.

The system of several small patrol boats and one large supply boat, and the personnel, equipment and maintenance funds provided for in the *Master Plan* would also be completely adequate for patrolling and controlling the marine area of the National Park.

SCIENTIFIC RESEARCH

As in the terrestrial areas, scientific research in the marine portion of the Park will be permitted in all zones and will be supervised by the Charles Darwin Research Station in accordance with the agreement between the Government of Ecuador and the Charles Darwin Foundation. The National Parks Committee will consider applications from scientists and scientific institutions, and the Darwin Station and Foundation will provide assessment of these applications to the Committee. The research terrain for each scientific mission will be determined according to conservation imperatives and research needs. National Park officials will supervise the activities of missions conducting research in the Park to ensure that conservation aims are respected.

Future Research

Future research should be especially directed along the following lines :

1. The basic survey of marine habitats and faunal/floral diversity, distribution and abundance should be continued and amplified. Studies have so far concentrated on seven taxonomic groups at seven sites, with short visits to other areas. These studies should be diversified and expanded to many other areas.
2. Regularly sampled permanent quadrats in the littoral and sub-littoral zones should be established at scattered sites in the islands (including tourist impact areas). Basic population studies should be begun for some cross-section of marine species, and primary productivity studies already completed should be continued, in order to provide baseline information for detecting and distinguishing between natural and human-caused future changes.

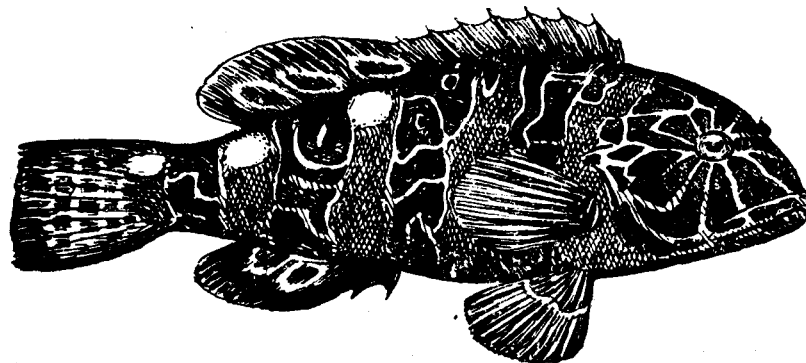
3. Regular checks should be made on actual and potential pollutants (petroleum wastes, plastics and other trash, pesticides and similar chemicals).
4. It is strongly recommended that studies of actually and potentially exploited species (spiny lobster, several fish species, black coral) begin soon; as a first step, accurate and detailed catch statistics should be collected and analysed.
5. The ecological investigation on green sea turtles being carried out at the Research Station should be continued.
6. Ecological studies of other marine related vertebrates (eg: fur seals, sea lions and some of the sea birds) should be carried out in order to determine their inter-relationships with the marine environment and to further assess the zonation scheme.

Beyond such basic investigations and monitoring, marine research of almost all types, which has been largely ignored in the Galapagos, will be encouraged by the Park Service and the Darwin Station. Much of the information provided by such studies is of primary significance for understanding the dynamic processes of marine ecosystems and for designing intelligent management and zoning schemes. For example, investigations in the following general areas are needed.

- (i) Studies of the exchange of biological and physical energy and matter between terrestrial and marine ecosystems (nutrient cycles, energy flow).
- (ii) Determination of the structure and function of insular marine ecosystems (eg: food webs, related chemical and physical parameters).
- (iii) Investigations of coastal geomorphological and hydrographical features.

The Darwin Station will attempt to build a small marine laboratory as soon as possible in order to improve island facilities for marine biological research.

GERARD M. WELLINGTON



Hieroglyphic Grouper of Galapagos
Cirrhitus rivulatus

Drawing by Peter Scott

SAVING THE GIANT TORTOISES OF THE GALAPAGOS FROM EXTINCTION

(This paper was read by the Secretary-General of the Charles Darwin Foundation at the Second International Conference on the Breeding of Endangered Species in Captivity, held at the London Zoo, 6-8 July 1976, under the auspices of the Fauna Preservation Society and the Zoological Society of London.)

The problem of saving the surviving subspecies of giant tortoises in the Galapagos archipelago varies greatly from one island to another and on the largest, Albemarle (or Isabela) it varies from volcano to volcano. Not only are there different subspecies, but there are also different dangers. Since the establishment of the Charles Darwin Research Station and the National Park Service, man has ceased to be a major threat and there is relatively little poaching today. But the alien animals introduced by man are a continuing menace to the tortoises – and for that matter to much of the native flora and fauna. On some islands the trouble is the black rats, on others feral pigs, goats, dogs, cats and even donkeys. Most islands are afflicted with more than one of these pests. Of the larger islands, only Narborough is entirely free; but apparently it is also free from tortoises, as only one specimen has ever been recorded there and that was collected in 1906. It was appropriately named *Geochelone elephantopus phantasticus* and Eric Shipton, who has vainly hunted for both, rates the chances of finding *phantasticus* lower than those for the Yeti.

When the Darwin Station began operations in the 1960s, it looked as though ten of the original fourteen or fifteen sub-species still existed but it was doubtful whether any one of them could survive without active intervention. Since then, three main types of protection have been afforded.

First, where there are still viable breeding populations, protection can in some cases be given on the spot – for instance, by building walls round the nests to keep the dogs or pigs from digging them out, or by reducing the numbers of these predators by hunting. However no satisfactory methods of controlling dogs, cats and rats have yet been discovered in spite of continued experimentation and hunting goats or pigs is a slow and expensive exercise. In the 1960s only three subspecies, each on one of the five major volcanoes of Albemarle, seemed to be self-replacing, let alone recovering their former vast numbers.

Secondly, where there is still an adequate population of adults but few or no young survive (as in the case of the subspecies on Duncan [Pinzon] Island, where the black rats have destroyed virtually every hatchling for over half a century) the solution is to transfer the eggs to hatcheries at the Station and rear the young until they are big enough to stand up to the rats. This method of removing the eggs to the hatchery was adopted for five other subspecies because, although some of their young survived, they were not numerous enough to ensure natural replacement. Only on Santa Cruz Island (where the chief offenders were feral pigs) has predator control been sufficiently successful so far to justify suspending the breeding programme and devoting the resources thus freed to other subspecies in greater danger. By April 1976 the following numbers were being raised at the Station from



Inside The Tortoise Rearing House at The Charles Darwin Research Station

eggs laid in the wild, or had already been returned to their native islands.

| <u>Subspecies from</u> | <u>Total raised</u> | <u>Total repatriated</u> | <u>Year Programme Began</u> |
|-------------------------------|---------------------|--------------------------|-----------------------------|
| Chatham (San Cristobal) | 50 | — | 1971/72 |
| James (San Salvador) | 179 | 67 | 1970/71 |
| Duncan (Pinzon) | 231 | 158 | 1965/66 |
| Albemarle (Isabela) San Pedro | 31 | — | 1971/72 |
| " " Las Tablas | 75 | — | 1970/71 |

In the case of the Duncan subspecies, this has already meant more than a doubling of the total population. By 1975-76 seven annual classes, totalling 158 young, had been returned to their native island where they were visited, weighed and examined every three months. They have had little difficulty in adapting and the first group of 20 (1965/66 class) increased in 4 years (1970-74) from an average weight of 3.3 kg. to 19.5 kg. At five years old they seem in no danger from the rats. There was some anxiety whether the first batch of 25 James tortoises could stand up equally well to the feral pigs when they were repatriated in 1975, but the fact that a further 42 have been returned this year shows that confidence is growing. Nevertheless the National Park Service killed 2,000 pigs there in 1975 to improve the odds and the campaign is continuing.

A purist might argue that this was not genuine breeding in captivity as the mating actually took place in the wild. However, there is now a third category to which even this objection could not apply. When the Darwin Station first explored Hood (Espanola) Island, it looked as though there was no hope for the local subspecies. Hood is a fairly large and very arid island. Its vegetation had been devastated by huge herds of goats and erosion had set in. Somewhere on its rugged 58 Km² surface perhaps fifteen tortoises wandered in search of such food as the goats had left. Apparently they never met for mating: at least there was no evidence of any tortoise having been born in this century. As a last resort, whenever a tortoise was found it was transferred to the Darwin Station and put into a pen. In due course one male and twelve females were collected and, after initial setbacks, successful breeding began in 1970-71. One big problem that had to be overcome was the construction of satisfactory artificial nesting sites.

The natural anxiety over insufficient genetic variability was recently relieved to some extent when a second male was found. It may be worth mentioning that the new male performed poorly as long as he was in the same pen as the first and dominant male; but since he has been provided with a separate pen and his own group of females he is giving every satisfaction. By April 1976, 88 young had been produced, thus increasing the known population from 14 to 102.

While the young Hood tortoises were growing up the National Park Service was engaged in an intensive campaign of hunting the goats on the island. As a result, there has been a notable recovery of the vegetation. In 1975 17 youngsters of the 1970-71 class were released on their native, or more correctly, their ancestral island. Checks show that they are thriving, while continued hunting pressure has reduced the goat population still further.



Geochelone elephantopus abingdoni - The only known survivor
photo: Jan MacFarland

Fortunately, goats are the only pest on Hood as there are no introduced predators. A further five youngsters have been released so far this year.

Dr. Craig MacFarland, who has worked for years on the Galapagos tortoises, is now satisfied that all the ten subspecies known to exist when the Foundation was set up can be saved for posterity, provided the captive breeding and pest control programmes are continued. But undoubted success in the past is no guide to the latest problem. The Abingdon (Pinta) tortoise, once declared extinct, has turned up again — but it is represented only by a single male. A female may still be found on the island, but repeated, arduous searches have so far disappointed. If there is no mate on Abingdon, then it is merely a question of time before the false rumour of *G.e. abingdoni's* extinction does become true.

Unless a female can be found in a zoo! This seems possible as there are about 300 Galapagos tortoises scattered in various zoos and therefore a distinct chance that at least one is a female *abingdoni*. The trouble is that most zoos do not know what subspecies (if that is what they are) they are holding. Projects are under discussion for a morphological analysis utilising multivariate statistical techniques as a means of finally working out the taxonomy and evolutionary relationships of the taxa and then applying this to the problem of identifying zoo specimens; and to use electrophoresis to solve tortoise systematics by examining a variety of protein systems in the blood sera and certain tissues.

However, MacFarland insists that the identification problem is less difficult than with most subspecies as, in his view, adult males or females of *abingdoni* could only be confused with *becki*, the somewhat similar saddle-backed subspecies from Wolf, the most northerly of the Albemarle volcanoes. He believes that, with the aid of accurate measurements and photographs, it should be possible to identify any *abingdoni*, even if it lacks an authentic birth certificate. This Conference could well serve as a matrimonial agency.

Meanwhile "Lonesome George", as the American press has named him, has been given feminine company of the most closely related subspecies so that sex-starvation should not result in the atrophy of what is potentially his most important asset. If no female *abingdoni* can be found either on the Galapagos or in one of the world's zoos, then, any offspring of his present but, we hope, temporary union could be back-crossed to produce through succeeding generations the closest feasible approximation to a pure breed. However, just as nobody knows how long a Galapagos tortoise lives, nobody knows at what age it begins to reproduce. Figures of 30-50 years are suggested which makes the time factor involved seem almost astronomical. Let us hope that the zoos can help with the rescue of *abingdoni* from the menace of extinction. For that matter, any contribution the zoos might make to the genetic stock of *hoodensis* would be valuable, but this is not of the same critical importance as finding female and indeed more male *abingdoni*.

The question arises, should breeding herds be formed outside the Galapagos as an insurance against a major disaster, such as the introduction of some virulent disease. In these uncertain times, any additional insurance is valuable; but given the restricted resources available and the fact that nothing of this nature has happened in the last 400 years, it would not seem to merit a particularly high priority. The Darwin Station has been more successful than the zoos in its breeding efforts. Fertility and hatching rates are high and only 10-15% of

hatchlings die, mostly in their first year. This may be partly due to the fact that the Station has deliberately concentrated on breeding each subspecies pure – as has the Honolulu Zoo, which has also had very considerable success – whereas most zoos have tended to cross subspecies. The San Diego Zoological Society, which has shown such interest in Galapagos tortoises and has given such vital support to the Darwin Station, has had much lower fertility and hatching rates from its breeding colony.

The Station's very limited experience suggests that the subspecies, or at least some of them, are not very compatible genetically. The eggs of the only mixed breeding herd the Station ever maintained were mostly infertile and about a third of the young that did hatch were albinos and short-lived. Zoo populations of mixed "subspecies" yield fertility rates of 5-10% in the eggs, compared with 80-90% in the wild and in the pure captive stocks at the Darwin Station. In fact, doubts have arisen whether "race," "subspecies" or "species" is the correct word to use. But quite apart from this issue of mixed breeding, the Station has obvious advantages such as natural climatic conditions, habitat, food species and nesting soils. Costs are low and results are high. Eggs for most endangered races (or whatever they are) can be brought in large numbers from the wild with relatively little effort and this avoids the problem of inbreeding for six of the eight endangered races. Restocking the various islands is also a simple operation.

Nothing here should be construed as discouraging zoos from organising breeding herds, particularly if, by selection or exchange, they could form racially pure groups. Indeed, with fewer and fewer tortoises leaving Ecuador, thanks to protective legislation and the patrolling of the National Park Service, such breeding seems the only way in which zoos can re-stock. The only contention is that breeding the endangered varieties of tortoises in their native Galapagos has been surprisingly successful and seems both the most effective and the most economical way of saving them for posterity.

Finally, a very few words about the running of the tortoise programme. Since the National Park Service was organised, it has increasingly taken over the administration of conservation from the Darwin Station but the latter continues to give support and advice. Much of the research has been and is still being done by visiting scientists using the Station as a base. For instance, it was as a visiting scientist that Dr. MacFarland, the present Station Director, did his most important work on the tortoises.

G. T. CORLEY SMITH

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Since this paper was written it has been learned that the San Diego Zoological Society, with its habitual generosity, has offered to return a male Hood tortoise (*G.e. hoodensis*) to its native Galapagos, where it will increase substantially the genetic variability of the breeding herd at the Darwin Station and thus improve still further the survival prospects of this race, once considered doomed to extinction.

No mate for the lonely male *G.e. abingdoni* has yet been discovered either on Pinta Island or in a zoo, but the following "WANTED" notice has been issued by the World Wildlife Fund.

"Dr. Craig MacFarland, Director of the Charles Darwin Research Station in the Galapagos Islands, is searching for a female Galapagos tortoise, Pinta Island subspecies, to be paired with the only known male tortoise of this subspecies, which was discovered in 1971. Should any zoological park or other wildlife collection possess a Galapagos tortoise, subspecies unknown, Dr. MacFarland recommends that photos be taken (black and white) with a ruled two meter gauge near the animal. The photos should be taken from the following angles:

- from straight in front
- from the side, straight on
- from the rear, straight on
- from directly above the shell
- from the side-front

Photos should be sent to: Dr. Tom Fritts, Curator of Reptiles, San Diego Natural History Museum, P.O. Box 1390, San Diego, CA 92112. Dr Fritts is working on the identification of species through a complicated statistical analysis of the shell characteristics."

RINGING OF GALAPAGOS SEABIRDS

by

M. P. Harris

One of the tasks undertaken by Raymond Leveque when he was the first Director of the Research Station was a survey of the rarer vertebrates of the archipelago. During his travels he ringed large numbers of seabirds in 1960-1. Many of these birds are still alive. Since then, other scientists have spent years studying the seabirds in considerable detail until we know as much about them as about those of any other tropical islands. These studies have resulted in the following birds being ringed – Waved Albatross (6,800 individuals), Band-rumped Storm Petrel (1,948), Swallow-tailed Gull (1,327), Flightless Cormorant (810), Audubon's Shearwater (820), Blue-footed Booby (665), Red-billed Tropicbird (600), Galapagos Penguin (303), Masked Booby (252) plus smaller numbers of all the other breeding seabirds except Sooty Terns.

Nine of these ringed birds have been recovered away from the islands :-

| | | | |
|-------------------------|---------------|----------|---|
| Waved Albatross | Young ringed | 29.11.61 | Hood Island |
| | shot | 8. 2.62 | Manta; 1°00'S 80°47'W Ecuador |
| | Young ringed | 4.12.66 | Hood Island |
| | dead | 8. 1.67 | Esmeraldas; 0°35'N 79°58'W Ecuador |
| Blue-footed Booby | Young ringed | 12. 7.62 | Hood Island |
| | dead | 20.10.63 | Santa Elena; 2°10'S 80°55'W Ecuador |
| | Young ringed | 24. 5.63 | Daphne Island |
| | dead | 0. 2.67 | La Tola; 1°09'N 79°02'W Ecuador |
| | Young ringed | 5.11.72 | North Seymour |
| | Killed | 5. 8.73 | Esmeraldas; 0°50'N, 79°50'W Ecuador |
| Red-billed Tropicbird | Young ringed | 7. 7.61 | Daphne |
| | alive on boat | 15. 1.64 | at sea, off Casma; 9°33'S 83°35'W, Peru |
| | Young ringed | 15.12.65 | Plaza |
| | alive on boat | 19. 9.66 | at sea, Gulf of Panama, 7°30'N, 79°30'W |
| | Young ringed | 17.12.75 | Plaza |
| | alive on boat | 7. 4.76 | Esmeraldas, 01°00'N, 79°41'W, Ecuador |
| Magnificent Frigatebird | Young ringed | 30.11.74 | San Cristobal |
| | | 25. 3.76 | Golfe de Nicoya, 10°00'N, 84°50'W, Costa Rica |

The most interesting records are those of the boobies. Blue-foots are typically inshore feeders as compared to the offshore Masked and the pelagic Red-footed. Obviously Galapagos Blue-foots can cross the 1000 kilometres to the mainland and it would be nice to know if this is a regular migration, as occurs with the Waved Albatross and Swallow-tailed Gull, or whether these three were just lost birds. The species can no longer be considered sedentary. Neither can the Magnificent Frigatebird, for the recovery of an immature 1300 km north in Costa Rica

was entirely unexpected. This is the first indication that the many birds seen on the mainland between California and north Peru may not all come from the 12 or so colonies there. The other recoveries are less exciting but show how far Galapagos tropicbirds may roam. The finder of the 1965 young tropicbird reported it as having a red beak even though when it fledged in February 1966 it had a yellow beak. This is the first indication of how quickly the beak colour can change, something which cannot be determined in the archipelago because young birds do not return until four years after fledging. It will be interesting to see if any Waved Albatrosses from Hood turn up in the newly-discovered small colony on Isla de la Plata (Ecuador) (Owre, Ibis (1976): 419-420).

Useful as these recoveries are, it must be a matter of contention whether or not they were worth the time and effort involved. However they are really only a bonus as the birds were ringed during detailed ecological studies where it was imperative to have birds individually identifiable. More important than distant recoveries is the collection of such data as the following :—

| | Breeding Interval (months) | Age at first breeding (years) | Annual Adult Survival | Oldest Bird (years) |
|-----------------------|-------------------------------|----------------------------------|-----------------------|------------------------|
| Waved Albatross | 12 | 4 | 95 | 15* |
| Audubon's Shearwater | 9 | ? | 92 – 95 | 11* |
| Red-billed Tropicbird | variable | 5 | 78 | 10* |
| Masked Booby | 12 | 3 | 83 | 6* |
| Blue-footed Booby | 9–12 | 3 | ? | 11 |
| Flightless Cormorant | variable | 2 | 90 | 13* |
| Swallow-tailed Gull | 9 | 4 | 97 | 14 |

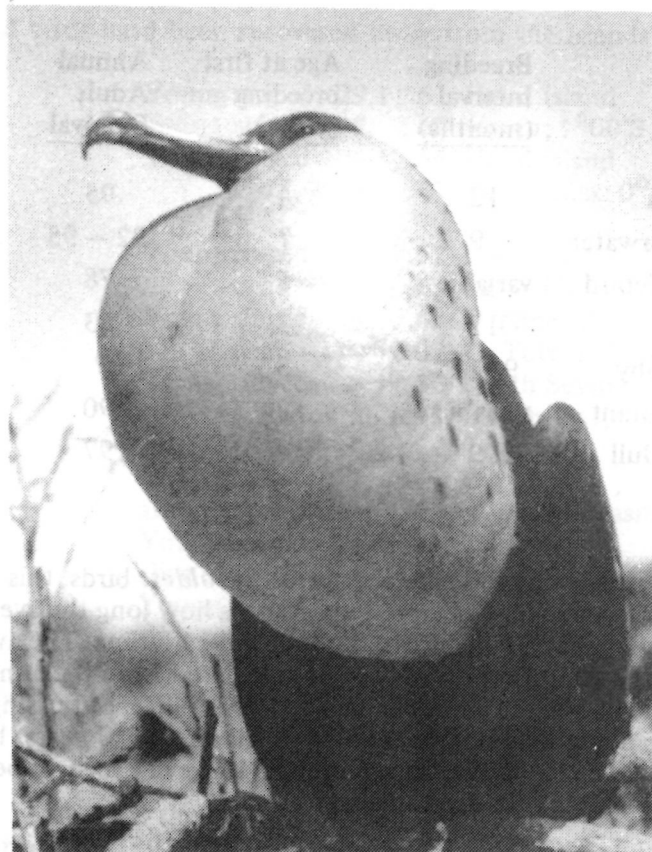
* ringed as young

Although it is always interesting to know the age of the *oldest* birds, this is of little consequence as far as the species is concerned. Far more important is how long the average breeding adult is likely to live and how many young it can produce in its lifetime. The average expectation of life after the time the adult first breeds can be calculated from the annual survival rate. The higher the survival, the longer the adult can be expected to live. Surprisingly the record for *calculated* life expectancy is held not by the Waved Albatross (20 years) but by the Swallow-tailed Gull at 33 years. The future will give more real longevity records because many birds ringed as adults in the early 1960s are still alive.

Ringling has shown that most seabirds have a strong fidelity to their breeding site and mate. More than this, young birds tend to return to the same part of the colony where they were reared. An exception is the Flightless Cormorant, as individuals nest more than once a year with different mates in different colonies. Measurement of site and colony tenacity, using ringed birds, is the best way in which we can monitor the impact of tourists on these seabirds. It would need severe disturbance, perhaps even physical violence, to make adult albatrosses move their colonies but far less to persuade immatures, which spend several years prior to

breeding displaying at the colonies, to move a few hundred metres into the bush. Our ringing of young albatrosses and once or twice yearly sampling of breeding and immature birds will be sufficient to monitor tourist impact at a crude but nevertheless acceptable level.

There have been a couple of complaints concerning the ringing of seabirds, mainly because of the adverse aesthetic effects of rings in photographs. These views are understandable but most people appreciate the reasons for the rings once things are explained. New studies should, and will be, undertaken away from the most frequently visited areas. It is unfortunate, though inevitable, that tourists now visit areas where ringing has been carried on longest. However, the information collected when only a few dozen people a year landed in these areas will enable present observations on breeding success, return of young birds, etc. to be put into proper perspective. Ringing for its own sake is never likely to occur in Galapagos but it is an essential part of constructive conservation and planning of tourist control and development.



Male Magnificent Frigatebird. Photo: Alan Root.

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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 études 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.

L'Association veille à la diffusion, par tous moyens appropriés, du résultat des travaux de la Station et de toutes informations scientifiques relatives aux réserves naturelles.