NOTICIAS DE GALAPAGOS

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CONTENTS

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NEWS FROM ACADEMY BAY

ROYAL VISIT

Their Majesties the King and Queen of Spain, escorted by the Vice-President of the Republic, visited the Galapagos National Park and the Charles Darwin Research Station on 15 May 1980. They were received by the Superintendent of the Park, Lcdo. Miguel Cifuentes, who conducted the Queen and her ladies to the giant tortoise pens, and by the acting Director of the CDRS, Dr David Duffy, who accompanied the King to the tortoise rearing house and to the corrals where the land iguanas are being raised. The royal party then proceeded to the Van Straelen Hall where they met the staff of the National Park and the Darwin Station.

NEW DIRECTOR FOR THE DARWIN STATION

At their meeting in UNESCO's headquarters in Paris, the Foundation's Executive Council considered the applications of a formidable number of distinguished candidates and finally decided to appoint Dr Friedemann Köster as the next Director of the research station, in succession to Dr Hendrik Hoeck.

BREEDING ENDANGERED LAND IGUANAS

With the benefit of experience and further research work by Howard and Heidi Snell, (e.g. they discovered by experiment that the temperature in the artificial incubators was lower than in natural nests) the captive breeding of the endangered populations of the endemic Land Iguanas is now making more rapid progress. This was a pioneering experiment in an entirely new field and there were many initial set-backs but now Lcdo. Miguel Cifuentes reports that by July 1980 there were 116 hatchlings of various ages in the new, enlarged corrals. This is a notable success reflecting credit on all concerned. However before the iguanas can be returned to their traditional breeding grounds, the marauding dogs responsible for the previous massacres must be controlled.

CONTROL OF INTRODUCED MAMMALS

The Darwin Station is giving high priority to its programme for the eradication of feral dogs. After a great deal of preliminary study, a team led by Dr Hans Kruuk will go into action in December 1980, with the support of the Frankfurt Zoological Society. Their target areas will be Santa Cruz and southern Isabela. So far as is known, dogs have not yet succeeded in crossing the harsh lava of the Perry Isthumus and penetrating into northern Isabela. But they might do this at any time with disastrous consequences for the young tortoises, iguanas, fur-seals, penguins and flightless cormorants, all endemic species breeding on this island and largely defenceless against attacks by dogs.

At the same time the goat control campaign will continue with all vigour. With the help of German experts further success was achieved on Pinta where the goats are now reduced from their previous thousands to a mere hundred. The vegetation is recovering, which makes hunting more difficult, but only complete eradication of the goats can give the island permanent protection.

BEAGLE IV

In August 1980 the Darwin Foundation's new research vessel, Beagle IV, arrived to replace Beagle III at the CDRS. The change of vessels was made to meet the changing needs of the Research Station and the National Park Service, which are very different from what they were ten years ago. The new fibreglass ship is smaller, more economical to run and easier to maintain and service in the difficult conditions reigning in the Galapagos. With rising fuel and labour costs, Beagle III had become so expensive to operate that few visting scientists could afford to hire her and the CDRS had to charter her part-time to non-scientists just to make ends meet.

Beagle IV offers other advantages, notably a high speed (12 knots) which will reduce the time wasted by scientists and National Park personnel in travelling from island to island, an important factor which is often insufficiently appreciated. It will now be possible to reach any but the outermost islands (Wenman and Culpepper) in 12 hours' sailing from the Station. The new vessel is also better adapted for marine biological research.

Those who spent happy days in Beagle III will no doubt be glad to know that she remains in the Galapagos and now transports tourists. The new ship was purchased largely with the proceeds of the sale of the old one, supplemented by support from the WWF, the Frankfurt Zoological Society and the Smithsonian Institution.

FIELD ECOLOGY COURSE

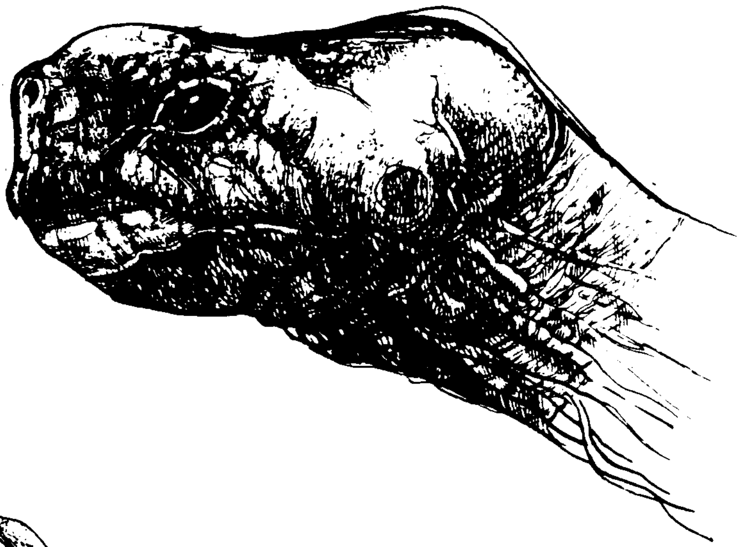
The Charles Darwin Research Station held its first course in field ecology 6 – 29 March 1980 for 8 students from 4 Ecuadorean universities. The principal objects of the course were to give senior students of natural sciences an introduction to the techniques of field research, which they could later apply in continential Ecuador; to demonstrate the nature of the Galapagos ecosystem; and to inculcate conservationist principles. The course was conducted by an imposing array of visiting and staff scientists and co-ordinated by Biologist Leonardo Maridueña.

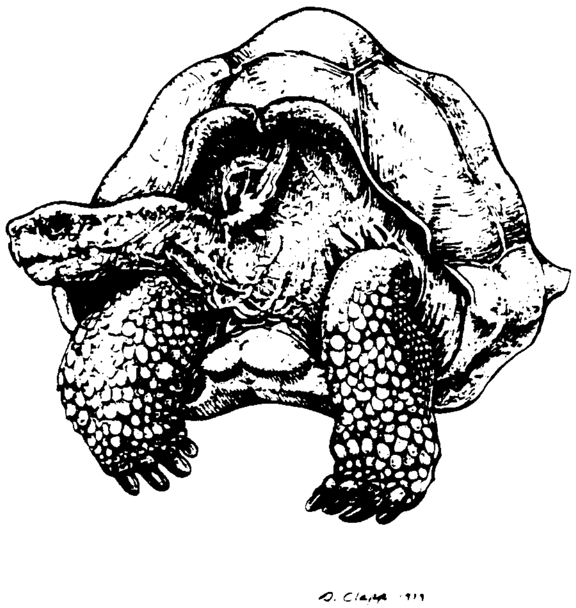
LONESOME GEORGE ACHIEVES IMMORTALITY – IN BRONZE

Lonesome George is the last known survivor of his race of giant tortoises, *Geochelone elephantopus abingdoni*. It had been hoped that a mate might be found for him either hidden in the wilds of his native Abingdon (Isla Pinta) or in some zoo or private collection. In spite of increased activity by the National Park Service on Pinta and appeals to possible owners of a female, it looks increasingly likely that *G.e. abingdoni* is doomed to extinction. In fact, one day recently, the cry went up at the Darwin Station that the race was already extinct: Lonesome George, like Humpty Dumpty, had had a great fall. However, the story of his death proved exaggerated, and, though badly hurt, he recovered after a period of hospitalization.

Nevertheless, it seems that posterity will only know *abingdoni* in bronze. The San Diego Zoological Society, from early days a loyal supporter of the Darwin Foundation and its tortoise-rearing programme, fortunately commissioned the sculptor, Daniel L. Clapp, to make a bronze casting of a Galapagos tortoise for its famous zoo. Mr Clapp insisted on visiting the islands to study the giants in their native habitat. He chose Lonesome George as his model and made endless detailed sketches as a basis for his sculpture. George proved shy – perhaps due to sensitivity about being the last of his race – and wanted to hide in the thorn scrub. Rumour has it that Dan finally induced him to hold his pose by singing cowboy songs to him. The final bronze, slightly larger than life and weighing half a ton, was unveiled in San Diego in October

It is good that *abingdoni* should have this splendid memorial. Dan Clapp and the Zoological Society deserve every congratulation. But what a pity that human greed and thoughtlessness should have brought this race of giants to the point where it only survives in a bronze replica! The CDF's purpose is to make sure that this does not happen to any more Galapagos endemics.





Preliminary sketches by Dan Clapp for his giant tortoise in bronze

CORRECTION

In Noticias 31 it was stated that the Van Straelen Hall was "designed and constructed by the former station manager, Mr Rolf Sievers." Mr Sievers was indeed responsible for building the hall but it was designed by the architect, Monsieur Daniel Weber, who rendered the CDRS so many valuable services during the years he lived in the Galapagos. Mr Sievers both designed and built the tortoise rearing centre, which was illustrated in Noticias 31, and this led to the regrettable confusion for which we tender our apologies.

VISITORS AND EVENTS AT THE DARWIN STATION – JANUARY TO JUNE 1980

JANUARY:

Prof. Merrit McGahan (Univ. of Highlands, New Mexico) to prepare for a group tour.

Karin Allgower began 6 month study of the predation by the beetle *Trox suberosus* on eggs of green turtle.

Margaret Kinnaird began a 4 month behavioural study of mockingbirds on Tower.

Circumnavigation of Isabela by Hendrik Hoeck, Ulrike Eberhardt, Arnaldo Tupiza, Sylvia Harcourt, Warwick Reed and Scott Lacour to ascertain the extent of the new lava flow from Volcan Chico, study its effect on fauna and flora and observe feral dogs and cats along the coast.

Mr David C. Duffy, took up post as staff ornithologist.

Dr Ulrike Eberhardt took charge of CDRS publications and herbarium.

Steven Shemeld became Librarian.

Mario Hurtado returned with 10 students from Univ. of Guayaquil to monitor the turtle nesting beaches.

Claas Andrés (Univ. of Gothenburg, Sweden) to evaluate possibilities of studying *Tropidurus* lizards.

Dr. A. Ryke (Univ. of Virginia) to collect feathers from endemic water fowl for analysis.

FEBRUARY:

Robert Dale began Visitor Contribution Campaign.

Marilyn Arn, wildlife artist, to sketch and photograph Galapagos vertebrates.

Enrique Grosse, Robert Ridgely and B. B. Patterson (Rare Animal Relief Group) visited CDRS.

Smithsonian Group with Dr David Challinor visited CDRS.

MARCH:

The First Field Ecology Course was held: 14 Ecuadorean students participated. Dr. T. de Vries and staff scientists lectured and gave practical instruction.

Dr Ole Hamann to continue his botanical studies.

Dr Victor von Hagen returned to Galapagos after 45 years and gave a Seminar.

The CDRS moved into its new administrative building, "Edificio Cristóbal Bonifaz."

Mr J. Clement (WWF/US) visited the Station.

Warwick Reed began as Director's Aide.

Seminar "The manatees of Florida" by Dr Gaelen Rathburn.

Dr Park S. Nobel (U.C.L.A.) visited the Station.

West German hunters gave a 4 week course for CDRS and Park personnel on hunting techniques to control feral animals.

Dr Ruth A. Baker began census of Hawaiian Petrels on Santa Cruz.

Prof. Jacobs (Univ. of Munich) gave a Seminar: "The role of predation in the co-existence of competing species."

Prof. J. Kaufmann (Univ. of Florida) arrived to advise Lynn Fowler and Mike Konecny on their studies of feral donkeys and cats.

APRIL:

Maria Catalina de Salcedo succeeded Maria de los Angeles Ortuño as Secretary.

Rodrigo Cisneros, Deputy for Galapagos, Ing. Ivan Alvarado (MOOPP) and Jorge F. Vaca (CONADE) visited the Station.

Dr Robert Tomkins left after 2 years of study of the Hawaiian Petrel.

(April contd)

Drs. Bill and Lynn Reeder arrived to continue their arachnid studies.

Malcolm Scully and John Phillips (Chronicle of Higher Education) visited CDRS.

Delegation from Military Geographical Institute to discuss resumption of aerial photography.

Dr Patty Moehlmann arrived to advise Lynn Fowler on the feral burro projects. Dr Moehlmann gave seminars on jackals and burros.

Seminar by Dolf de Groot on Breeding Behaviour and Ecology of the Short-eared and Barn Owl.

Dr Carmen Rohrbach arrived to study Marine Iguanas.

Seminar by Mario Hurtado on "Programa de Tortuga Negra".

Dr George Watson, Museum of Natural History (Smithsonian Inst.) visited the Station.

Dr Hendrik Hoeck, Director left the Station on vacation, leaving Dr D. Duffy as Acting Director.

Sr Garcia Feraud, Minister of Education, visited the Station.

MAY:

Dr Nicolai Klemm (Harvard Univ.) visited the Station.

Academia de la Marina visited the Station.

Tom Keating left after re-organizing the collections in the museum.

The King and Queen of Spain visited the Station and the National Park Service.

The Director of the Secretariat of Fisheries, accompanied by Gunther Reck, visited the Station.

Robert Dale gave a Seminar on "Funds and Trails".

Lcdo. Jaime Patiño and Eduardo Martinez from the Ministry of Finance gave a week-long seminar on Governmental Accounting.

Denis Puleston (Environmental Defense Fund) visited CDRS.

Chinese military group visited CDRS.

Lcdo. Tito Rodriguez (INP Representative at CDRS) left to work on the continent.

JUNE:

Dolf de Groot and Kim Chaddon ended 7 month study of owls.

Seminar on Feral Cat Study by Mike Konecny.

Sylvia Harcourt began Avian Pox Study.

Leonardo Mariduena, staff Ornithologist, resigned to continue studying.

Univ. of California, L.A. Extension Cruise visited the Station.

Prof Peter Grant and family returned to continue long-term Finch, Mockingbird and Dove studies.

Trevor Price (P. Grant group) gave a Seminar on Darwin's Finches on Daphne.

California Academy of Sciences Group visited CDRS.

INGALA (the National Institute for the Galapagos) visited the Station for a conference with representatives of the Station and National Park.

Alan Burger gave a Seminar on Sea Birds of South Africa and Marion Islands.

Hans Herman of West German Television arrived to film Plaza Island

Trevor Price (Finches on Daphne Major), Tom Will and Hugh McGuiness (Finches on Tower), all from Univ. of Michigan, left after another season's study.

Stephen Millington left after 18 months in Galapagos assisting with various projects.

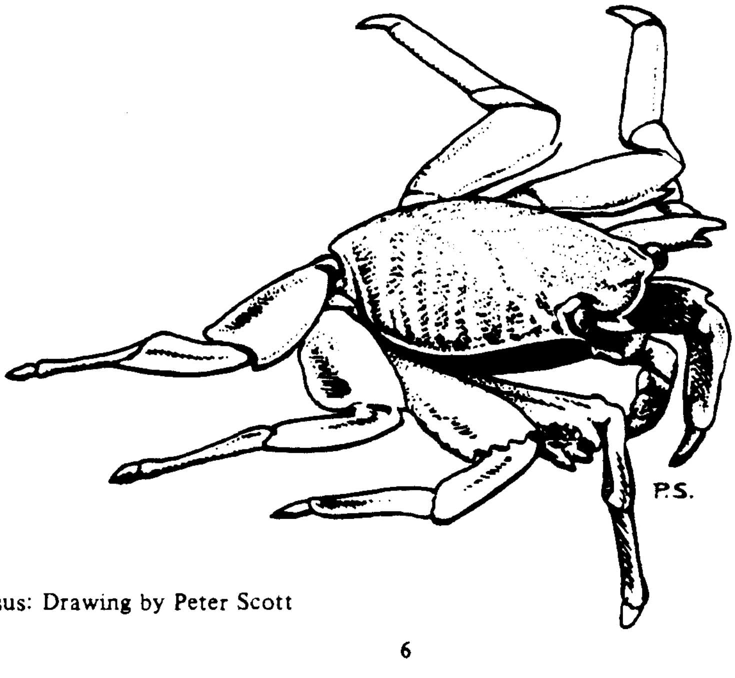
DR COOLIDGE AWARDED PAUL GETTY PRIZE

Dr Harold J. Coolidge, Founder Member of the Charles Darwin Foundation, was chosen by an international jury appointed by The World Wildlife Fund to receive the $ 50,000 Paul Getty Wildlife Conservation Prize for 1979.

Twenty one years ago, Hal Coolidge was one of the small band of far-sighted conservationists who organised the CDF and he has remained a most active member of its Executive Council ever since. Meanwhile the Darwin Research Station has grown from a daring act of faith to a large and vigorous centre for science and conservation, working in conjunction with a National Park Service, while the Galapagos, from being a regretted but helpless victim of long-term degradation, has become one of the very first natural areas to be declared a World Heritage. Whether Hal and the other founding fathers ever anticipated such growth, only they can say. They certainly chose a good moment for take-off as in 1959 the world was just beginning to realise the urgent need for conservation, even though it still has not realised how much conservation costs, both in funds and in denying alternative development of natural resources.

But Harold Coolidge was a pioneer. His devotion to conservation began half a century ago and he already had a most impressive record, when he joined Victor Van Straelen and others in promoting the CDF. He was a founder of the International Union for Conservation of Nature and Natural Resources (IUCN) which, with UNESCO and the Government of Ecuador, sponsored the Darwin Foundation. From 1966 to 1972 he was President of IUCN and still today is its Honorary President. These are only a few of the international offices he has held and it is for his lifelong services to conservation in every continent that he has been awarded the Paul Getty prize. How fortunate and how appropriate that he should have been the one to conduct the inaugural ceremonies of the Charles Darwin Research Station in 1964!

G. T. C. S.



Grapsus grapsus: Drawing by Peter Scott

REPORT ON A CENSUS OF THE FLIGHTLESS CORMORANT AND GALAPAGOS PENGUIN

by Sylvia A. Harcourt

The aim of the census was to survey as much of the coastline of Isabela and Fernandina as possible, to obtain a count of the number of Flightless cormorants (Nannopterum harrisi) and Galapagos penguins (spheniscus mendiculus). The cormorant and penguin are only known to breed in these western waters of the Archipelago.

Similar counts were done in August/September 1970/71 by P. D. Boersma for penguins and by M. P. Harris for cormorants. R. Tindle did a second cormorant census in May 1977. The present census can be compared with the earlier figures to give some indication as to whether the populations appear stable or are fluctuating.

Increased tourism and fishing, particularly for lobster and tuna, could be having a detrimental effect on these birds. It was hoped that the census would throw light on whether this was happening. A more detailed report is on file at the Darwin Research Station.
(Please see map on inside of back cover).

METHODS

The census was carried out between August 19 – 29 1980 by Sylvia Harcourt and two assistants, Elizabeth Harcourt and Carlos Valle.

About half of the coastline of Isabela and all of Fernandina was surveyed in a Zodiac, an inflatable rubber boat which allowed closer access to the shore and into lagoons where otherwise colonies could be overlooked. When weather conditions were unfavourable, the survey was done from Beagle IV. The same three observers and one *pangero* were used all the time. Check sheets were made out for each day and information recorded on date, time, weather and wave conditions, air and water temperatures and distance from shore. It was also noted whether the birds observed were on shore or in the water, and if possible whether adults or juveniles. Counts were usually started between 06.00 – 07.00 and continued until about 12.00 – 13.00. A break was taken and then, if weather conditions allowed, the census continued in the afternoon. However on most days this was not possible except in more sheltered areas such as Elizabeth Bay.

At several of the cormorant colonies, it was possible to go ashore and thus an accurate figure was obtained for the number of birds, presence of eggs, chicks etc. Otherwise observations were made from the Zodiac. Binoculars were used if it was not possible to approach close to shore. When this was the case it was usually possible to count the number of nests but nest contents could not be seen unless there were large chicks.

Detailed figures were obtained at Cabo Douglas, Punta Espinosa and Cabo Hammond from other scientists working at these sites. Observations were made at Cabo Douglas and Cabo Hammond on the number of birds present at 2 hourly intervals between 06.00 and 18.00. This will aid in estimates of total numbers of birds in other areas, as counts could obviously not be made at the optimum time – early morning or late afternoon – in all areas.

Flightless Cormorant : photograph by Alan Root

CENSUS AND RESULTS

ISABELA

The census began at Cabo Marshall on the east coast of Isabela. There is one cormorant colony at Punta Garcia but logistics did not allow us to visit this spot. Numbers at this colony were obtained earlier this year.

All of Isabela from Punta San Vicente to south Elizabeth Bay was checked by Zodiac and from Punta Morena to just south of Caleta Webb. It was impossible to go further south because of weather conditions. In the past no cormorants and few penguins have been reported south of Caleta Iguana. The coastline from Cabo Marshall to Punta San Vicente was not checked because of bad weather and very thick fog. Again, few cormorants or penguins have previously been reported here. It was not possible to check south Elizabeth Bay in the Zodiac because of a shortage of gasoline. This area was covered in Beagle IV about 300m. offshore. From this distance it was possible to see cormorants and penguins but obviously those in little lagoons were missed. D. Green was surveying this area for turtles at the time and was able to supply some information. Part of this stretch of coastline has been considerably altered by the new lava flow from Volcan Chica in November 1979.

FERNANDINA

A small stretch of coastline around Punta Mangle and Cabo Hammond was not covered in the Zodiac because of very rough water. These areas were surveyed from Beagle IV, about 300–400m from the shore. It is probable that some birds were missed, particularly around P. Mangle but the coastline near C. Hammond seemed an unlikely area for any cormorant colonies.

Summary of number of birds seen

Cormorants	1980	1977
Fernandina	293	326
Isabela	509	357
Total	802	683

Penguins	1980	1970	1971
Fernandina	925	746	760
Isabela	795	838	1171
Total	1720	1584	1868

CORMORANTS

Colonies on both Fernandina and Isabela were found at all breeding stages, ranging from courtship through eggs to juveniles. There appeared to be little synchrony within or between colonies as to breeding stages. Size of colonies varied, from one to twelve nests. The average seemd to be about 3–4 nests.

All nests visited were constructed of seaweed with a few sticks and sometimes one or two sea urchin cases, except those at Cabo Marshall. Here, they were entirely made from terrestrial plant covering the back of the beach. It was similar to ***Sesuvium*** but I was unable to positively identify it. The old nests in this colony contained numerous sea urchins and star-fish, more than seen at any other site. Numbers of birds seen on land at any colony varies through the day and counts were taken at Cabo Douglas and Cabo Hammond at 2 hourly intervals for one day to see this variation in numbers.

PENGUINS

Four penguins were seen at Cabo Marshall and then no more sightings until near Piedra Blanca on the north of Isabela. From there on they were seen regularly, either in groups on land or in the sea. The size of the groups varied tremendously from often solo penguins to several groups of up to 30 birds swimming together. Most groups contained about 4 – 6 birds. Juveniles were seen, both on land and swimming. Nests with large young were seen on the little islands in Elizabeth Bay. Nesting birds were reported from Cabo Douglas.

DISCUSSION

CORMORANTS

Cormorant numbers seem to have remained remarkably stable since 1961 when R. Leveque counted 501 birds over about 75% of the present census area. M. P. Harris counted 406 pairs over that same area in 1970/71 and from his census work over the whole area estimated 700–800 pairs. R. Tindle in 1977 sighted 683 birds and this year the count was 802.

In 1977, 357 birds were reported around Isabela and 326 around Fernandina. For 1980 the figures are much higher for Isabela – 509 birds – but slightly lower for Fernandina – 293.

However, some birds were probably missed around P. Mangle. One interesting point is that previously there have been no report of cormorants further south than Punta Morena. On this census we sighted one nest with a juvenile about one and a half hours south of P. Morena, out on a small rock islet, separated from the coast by about 5m. of water and therefore presumably inaccessible to dogs. An adult was seen close to Caleta Webb, again out on a rock. It would be interesting to know if cormorants once occurred further south and are now no longer found there because of dogs.

The figures suggest that the population of flightless cormorants is remaining fairly stable. However, I think this will only be so as long as the feral dogs do not spread any further north. The breeding colonies on Isabela could be wiped out relatively rapidly by dogs as they are so vulnerable to ground predators.

PENGUINS

The total number of penguins observed in the 1980 census is remarkably close to those obtained by Boersma in 1970/71. The numbers in different areas differ, with a noticeable decrease occurring in S. Isabela since 1971. As there has been no census since 1971, it is impossible to know when this decrease occurred: whether it has been gradual over the last 10 years or is a yearly fluctuation.

Two possible factors could have contributed to this decline if it is not just a yearly fluctuation.

One is that the feral dog population in this area could be slowly eradicating the penguins that normally breed along this stretch of coastline. So far, the dogs have not been sighted north of Perry Isthmus. There are no records for number of dogs south of this area in 1970/71 so there is no way of knowing whether they are on the increase. However, several groups of dogs were seen along this coastline, from Elizabeth Bay southward to Caleta Webb. Obviously nesting and young penguins are very vulnerable to these predators. It would be interesting to monitor the number of penguins in this area during and after the proposed dog eradication programme.

Penguins are not as sedentary as cormorants and thus disturbances in one area could result in adults moving off and breeding in a more suitable site. It is possible that this is happening. To be able to verify this a long term banding programme would be necessary.

The second cause of a decline in numbers could be related to the eruption of Volcan Chica in November 1979. Lava flows reached the sea and have considerably altered the coastline in part of Elizabeth Bay. Several fumaroles are still active. In January 1980 the sea temperatures were still very high, $40^{o} - 50^{o}$, with steam rising off the water for as far out as 25m. from the shore. This could have had a marked effect on food availability. In January 1980 H. Hoeck found a mummified penguin in a small lagoon along the coast that had been cut off from the sea by the lava. It is unknown how many penguins may have died in this way. It is likely the numbers are low but again this will have affected the population in this area.

CONCLUSIONS

The census methods used are fairly crude for estimating population numbers but are comparable with those used previously. The fact that the numbers seem fairly stable over the last ten years in spite of feral dogs on Isabela, increased tourism and fishing, is cause for great optimism.

To give a more complete impression of the situation, I would recommend that such a census continues for another two years, if not longer, and that it is carried out twice a year if funds are available.

For greater standardisation, it would be better if one of the observers or the same *pangero* from this census takes part in the next census.

If the census was done twice a year, possibly in May and August, we would get a more detailed view of the yearly cycle of these birds, the seasons of greatest numbers of birds in one area and how much movement occurs between areas. I would recommend that a long term programme is followed, particularly if there is going to be an increase of boats and tourists to these areas. It would appear necessary to conduct such a census every 2 – 3 years or so, if it were not possible to do it annually; in this way any decrease could be seen fairly quickly.

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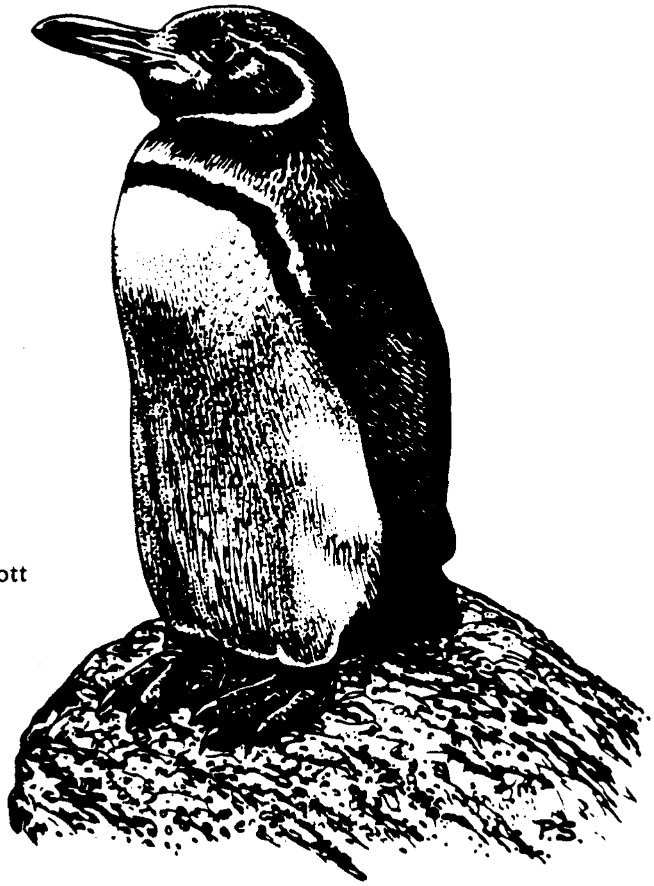

Galapagos Penguin:
Drawing by Peter Scott

GALAPAGOS ISLANDS SYMPOSIUM

Several abstracts of lectures delivered at the Galapagos Islands Symposium, held at the California Academy of Sciences in April 1979, were published in Noticias 31. Five more summaries, which the authors have been good enough to prepare, are printed here.

EFFECTS OF TOURISM: OBSERVATIONS OF A RESIDENT NATURALIST

by Tui De Roy Moore

Today there are about 5,000 residents on Galapagos, of which I am one. I was only two when my parents moved here from Belgium, and in the 23 years that I have lived here I have seen some tremendous changes in the human life style and, to a much lesser degree, in the island ecosystems.

In the early days the only contact with the outside world came through a small cargo boat that serviced the islands once every 3 to 6 months; when this failed to arrive people might run out of such simple necessities as matches. The local economy was based on fishing, farming and subsistence hunting of feral species such as goats and pigs. Some native animals were killed as well, as could be testified by dried remains of giant tortoises in some backyards, but already there was an early awareness and interest in these animals. This could be seen in tortoises kept as pets, or that fact that many people preferred to hunt wild pigs and goats rather than take the more readily available – and delicious - reptiles.

When in 1959 all uninhabited areas of the islands (about 88% of the total land surface) were declared the first National Park of Ecuador, tourism was still practically non-existant and limited to the cargo boat which by then had begun making monthly visits. So the rules and guidelines for the control of tourism were largely established to prevent future damage to the islands, rather than to repair the damage already done, as is more often the case. Organised tourism, based on cruise ships operating within the islands, began 10 years ago. I was a tour guide on those beginnings and already I could sense that there could be deep changes, not in the most usual way of animals being disturbed and becoming shy, but rather that they would get overly used to people and in some way become dependant on them. One example of this was on Plaza where land iguanas were at first being fed by the tourists. Although this appeared benign at the onset, soon almost the entire reptile population of the little island was flocking down to the landing place and waiting for the next tour group to appear. This began to seriously disrupt their social order and territoriality, so it had to be stopped.

By and large, from the beginning tourism in Galapagos was organised sensibly, preventing people from taking objects or leaving garbage and basically keeping their activities on land to a bare minimum: looking and photographing. While tourism was still in its early days, a detailed "master plan" for the national park was drawn up. One of its most significant contributions to tourism was the elaboration of marked trails taking people to the heart of the most spectacular scenic or wildlife spots with minimal disturbance to the animals or erosion to the terrain.

From the beginning, it seemed to me that the fragile volcanic terrain was in fact likely to suffer more, and more permanently, than might the wildlife, since animals in Galapagos are truly very flegmatic! Besides being extremely visible, such damage is virtually irreparable. Fresh lava flows are surprisingly fragile, and the slopes of tuff cones break down easily.

This became obvious on Bartolome Island only 5 years after serious tourism began. Almost every tourist who visits the Galapagos scrambles to the summit of this small island to appreciate the beautiful volcanic scenery. But, while in the earlier years the trail hed led up a firm slope of solidified volcanic ash, the tourists were now sinking ankle-deep in loose dust. It became necessary for the National Park to build log steps up this slope and more will be needed soon.

Besides small painted stakes as trail markers and occasional reinforcement work where trail erosion occurs, the only other things the Park builds are small landing docks in the more difficult places to disembark. In 1978 14,000 tourists visited the Islands, which is above the 12,000 recommended by the National Park master plan. However, I will readily say that no overburdening is noticeable as yet. Certainly, some changes have occurred. In many cases animals have become tamer; but can this be termed "good" or "bad"? Probably neither. Frequently, animals invade the narrow trails. Anyone visiting Plaza will find that a disgruntled group of sea lions must usually be persuaded off the landing dock before people can disembark; or tourists are forced to step over and around seabirds that pugnaciously defend the nest they have built right in the middle of the path! The opposite has happened in the case of the Galapagos Hawk: where this bird rarely sees people it is extremely curious and will spend hours observing them, but where visitors are frequent it ignores them altogether. For several years the Charles Darwin Research Station has been carrying out tourism impact studies, marking and counting seabird nests in visitor sites and comparing their results with similar observations at control sites not frequented by tourists. So far no measurable effect has been noted on the birds' nesting success.

By and large, the Galapagos have a very effective built-in protection against tourism, which is their extreme ruggedness. Therefore, even if the Park rules had not specified it, almost all tourism would still have to be carried out from boats, with people eating and sleeping aboard and disembarking for only a few hours at a time. This, in my opinion, is the main reason why these islands are still so largely untouched, with many places left as pristine as they were before man even knew that they existed. When you stand on the edge of a dark cliff, listening to the cries of passing seabirds, you simply do not feel that thousands of people pass here each year.

THE INFLUENCE OF RAINFALL ON THE BREEDING OF DARWIN'S FINCHES

by P. R. Grant, University of Michigan

Darwin's Finches generally breed in the hot and wet season, but the controlling influences of climatic factors are not known. The single most important influence is likely to be rainfall, through its direct effect upon plant growth. Investigation of the supposed link between bird breeding and climate requires, as a first step, a knowledge of variation in rainfall.

Monthly rainfall has been registered at eight sites on four islands over a variable number of years. The longest continuous records come from Pto. Bacquerizo on San Cristobal for the period 1950–67. The records have been analysed and establish the following characteristics:
(1) Although rainfall is seasonal it is very variable, especially in the wet season months of January to May,
(2) Annual variation is very large, with the amount of rain tending to alternate in successive years. A four-year periodicity is possible.
(3) There is pronounced variation on a longer time scale, as many of the settlers know,

e.g. the 1950's were much wetter than the 1960's.
(4) There is more precipitation per year at high than at low elevations, it is distributed more evenly throughout the year and it varies less among years.

Current studies on Pinta, Genovesa and Daphne Major are providing information on the breeding of several finch species. For example P. T. Boag has been able to document the attempts of finches to breed during a drought year on Daphne Major. This was in 1977 and the attempts were largely unsuccessful. By contrast, certain individual finches successfully raised five families on Genovesa in the much wetter following year. The start of the breeding season followed shortly after the first heavy rainfall of the year, as is to be expected in environments where the onset of rainfall is largely unpredictable. However there were subtle differences among the finch species in their breeding responses to rainfall, and large differences in their breeding success. Investigation continues, since the association between rainfall and finch breeding can only be established reliably and in detail over a period of several years.

ECOLOGY OF SONG IN DARWIN'S FINCHES

by Robert I. Bowman, San Francisco State University

ABSTRACT

(This paper appeared in full version in "Journal für Ornithologie" October, 1979 under the title "Adaptive Morphology of Song Dialects in Darwin's Finches").

1. This study describes the structure and functional significance of numerous song dialects in island populations of Darwin's finches from the Galapagos Archipelago.

2. The following acoustical information was obtained from tape recordings made in the islands:
   a) For songs: Frequency bandwidth, relative amplitude distribution according to frequency, and absolute sound pressure levels (dB).
   b) For the environment: Attentuation characteristics of a broadband frequency spectrum ("pink" noise) broadcast into various vegetations.

Song data are displayed graphically as frequency/amplitude histograms, and pink noise attenuation as sound transmission isopleths.

3. A comparison of modal amplitudes of song frequency spectra with mean dimensions of the vibratory (internal tympaniform) membrane of the syrinx and mean body weights, indicates that larger bodied species of Darwin's finches sing songs with peak energy at a lower frequency than do smaller bodied species.

4. A scheme is proposed that relates modal amplitude distributions and sound pressure levels of song to body size and relative abundance of species. This four-way comparison, when applied to four sympatric species of Darwin's finches on Isla Genovesa, shows that smaller species, singing songs with higher "pitched" modal amplitudes, tend to have lower sound pressure levels and occur in greater relative abundance (and possibly defend smaller territories) than larger species.

5. Song dialects of *Geospiza conirostris* on Islas Genovesa and Española are described and

a correlation is made between the song bandwidth and the sound transmission peculiarities of their respective environments. The bandwidth is regulated by the sound attenuation characteristics of the vegetation so as to forestall the development of a frequency dependent disparity in sound pressure levels between highest and lowest song components that might be damaging to the integrity (information content) of the signal, long before it has travelled an effective communicating distance through the environment.

6. The Wolf Island environment is accoustically unique among those studied thus far in the Galapagos Archipelago because of the unusually high sound attenuation associated with the very dense vegetation. The latter causes a minimal disparity in rates of sound attenuation over unusually broad frequency spectra encompassed by the songs. The relatively high availability of foods has fostered a high population density of finches whose individual territories, when adjusted to differences in body size with conspecifics elsewhere, are, presumably, comparatively small and rendered acoustically compatable with the breeding ecology of the finches.

7. An ecoclinal shift in the song galaxy of *Camarhynchus parvulus* on the south side of Isla Santa Cruz is correlated with altitudinal differences in vegetation affecting sound transmission. The narrowband song most commonly heard in the humid highlands forest is less susceptable to frequency dependent disparity in sound transmission rates than would be the case with the wideband song of the lowlands, were it sung in the discordant highlands environment. There would appear to be little if any differential advantage of wideband song over narrowband song where they occur together in the lowlands environment of Isla Santa Cruz.

8. Several cases of parallel development of song structure by sympatric species of Darwin's finches may be due to selection favouring similar vocal responses to acoustically similar "sound niches."

THE ECOLOGY OF THE INTRODUCED LITTLE FIRE ANT *WASMANNIA AUROPUNCTATA* ON SANTA CRUZ ISLAND

by David B. Clark, Cecilia Donoso, Concepcion Guayasamin, Olga Pazmiño Morales and Yolanda Paez Villacis.

The little fire ant *Wasmannia auropunctata* was introduced onto Santa Cruz Island early in this century. Results of six months of field work on this species' feeding ecology, distribution and relation to other ants are reported. Primary foods were honeydew and invertebrates; an order of magnitude more workers gathered honeydew than carried invertebrates. Large (> 100) and persistent groups are frequently recruited to exploit rich food sources. No evidence of intraspecific competition was observed. During three 24-hour periods of observation one *Wasmannia* nest was continually active.

Seventeen species of ants were collected on Santa Cruz. Of the 13 taxa identified to species four were endemic at the species level and 9 were well known tropical "tramp" species. By comparing these collections with earlier ones it was found that as many as 11 species may have immigrated or gone extinct in the last 50 years. No known endemic species on Santa Cruz has gone extinct, but *Cylindromyrmex williamsi* appeared to be very rare.

Wasmannia density increased with altitude on the southern slope; the species was absent from the driest (northern) and wettest (summit) parts of the island. Baiting experiments and collections showed that in areas where density of *Wasmannia* was high, density of other ants approached zero. Extremely abrupt boundaries were found, where the proportion of *Wasmannia* increased from 0 to 100% in less than 200m. We attribute these boundaries, as well as the absence of other species from areas of high *Wasmannia* density, to interspecific competition.

Similar introductions on other islands will be discussed as well as the ecological implications of a primarily introduced ant fauna and the difficulties of containment and eradiction. Three unanswered questions are identified: is *Wasmannia* still spreading on Santa Cruz? does it reduce invertebrate diversity and density? what are the long-term effects on Galapagos flora and fauna?

MARINE PLANT AND ANIMAL DISTRIBUTIONS IN RELATION TO THE GALAPAGOS NEARSHORE THERMOCLINE

by Sylvia Earle, California Academy of Sciences

In the Galapagos Islands, an unusual combination of oceanographic conditions, history and geography has resulted in a side-by-side vertical distribution of tropical and subtropical plants and animals with cold temperate species, each living in its own realm, above and below a well-defined (although variable) nearshore thermocline. The effect of this unusual distribution is to have compressed on a vertical plane assemblages of plants and animals that ordinarily might be expected to occur along a horizontal plane covering hundreds or even thousands of miles of latitude. It is a situation comparable in some ways to the temperature-related change in flora and fauna sometimes present on mountain slopes that grade from warm to cold with increasing elevation.

Further, the familiar correlation of small, turfy, filamentous algae and numerous grazing fishes in the families Scaridae, Acanthuridae, Pomacentridae, Blennidae and others that characterize warm tropical seas, exists in the warm upper layer of nearshore water in the Galapagos, while these herbivores are notably lacking in the cooler waters below. Coincidentally, the cold water below, still well within the light-range for many species, supports "forests" of fleshy red and brown algae, including some distinctively cold-water species.

Observations made at various locations in 1964, 1966, 1972 and 1977, together with published data concerning the flora, fauna and physical conditions, have formed the basis for this report. Collections of marine plants and fishes made at the time of the above observations are being studied for later systematic and ecological treatment.

PHYSICAL BACKGROUND

Wooster and Hedgpeth in 1966 reviewed the oceanographic circumstances of the Galapagos succinctly describing what is known by saying, "The task of summarizing present ocean-graphic knowledge of the Galapagos region is a relatively simple one since so little intensive work has been done there."

But the points relevant to the present observations are well-defined. The generally tropical character of the Galapagos can be attributed to their location, intersected by the equator. The surface temperature and salinity are oceanic in character and are dominated by the location of the transition zone between warm, relatively fresh tropical waters to the north and the cold, salty waters of the Peru (Humboldt) South Equatorial Current System. The area around the Galapagos is characterized by upwelling, vertical mixing and high nutrients.

The surface water temperatures are lowest from August to November (21–22°C) and highest from February to April (25–27°C). The annual temperature range at the surface is about 6°C.

In general, the thermal structure of the tropical Pacific is characterized by a relatively shallow layer of warm, well-mixed water separated from colder water below by a strong thermocline. In the eastern Pacific, the thermocline is particularly shallow along the equator and, near the Galapagos, the average depth of the mixed layer is often less than 20m, throughout the year. Below 20m, at the area of mixing, the temperature is about 15°C and decreases steadily downward to 5°C.

REVIEW AND DISCUSSION OF PLANT AND ANIMAL DISTRIBUTIONS

Silva (1966) summarized existing information about the marine plants reporting 311 species, about 36 per cent endemic. Included in the coverage was the first marine plant collected in the Galapagos (by Charles Darwin), the records reported by W. R. Taylor in 1945, and the results of studies by E. Y. Dawson, who visited the islands in 1962. Norris (1978) recently described ecological studies currently under way.

Notes on depth recorded with plants collected verify the general pattern of plants with warm-tropical affinities occupying areas around mangroves, in tidal pools, and along shores to about 20m depth. Examples include *Caulerpa ambigua, Caulerpa peltata,* (Chlorophyta); species of *Sargassum, Padina, Dictyota* (Phaeophyta), and *Galaxaura* (Rhodophyta).

In general, plants are sparse, small, filamentous and fast-growing. Examples cited above are among the largest and most conspicuous present in the upper 20 meters, and their occurrence is not widespread.

This region is also characterized by the presence of numerous herbivorous fishes: surgeon fishes, parrotfishes, girellids, blennies, gobies and others. McCosker, Taylor and Warner (1977) note:

"Our diving observations indicated that there is a paucity of fishes below the nearshore thermocline. This zone of limited overlap occurred at 20 to 30 meters at most locations and probably changes elevation seasonally."

They added to the list of 289 species previously reported (although not specifically identified) by Rosenblatt and Walker (1963) and Walker (1966). Although the proportion of herbivores has not been specifically noted, several species of surgeonfishes and parrotfishes are present in large numbers and probably account for a high proportion of the plants eaten in the upper 20m.

Other vertebrate herbivores that locally may influence the abundance and distribution of plants present include the marine iguana (*Amblyrhynchus cristatus*) that may feed on algae below 10m (Hobson, 1965), but rarely goes below the thermocline. Marine turtles also may graze on attached vegetation, but to unknown depths.

Invertebrate grazers also influence the abundance and distribution of plants in shallow, warm water, as noted by Glynn, Wellington and Birkeland (1979) concerning the impact of the pencil urchin, *Eucidaris*, on corals and corraline algae.

Evidence of luxuriant plant growth below the thermocline is provided by the depth records noted by Taylor (1945). Dredging to depths sometimes greater than 55 meters resulted in large quantities of *Desmarestia, Eisenia, Sporochnus* among the *Phaeophyta*, and numerous large, leafy *Rhodophyta*, and smaller quantities of various *Chlorophyta.*

Diving observations by Earle on January 25, 1972, at Punta Espinosa, Fernandina Island, confirmed the general patterns of distribution noted above. Field notes were as follows:

> "Algae in 10 to 15m depth small, mostly filamentous, except for *Sargassum* and few fleshy red algae. Calcareous red algae, encrusting *Codium* in local patches, under ledges. Great diversity, but a "microflora" associated with thermocline. In upper warm water, girellids, surgeonfish, parrotfish abundant."
>
> "Below the thermocline, no grazing fish, but forests of flat and fleshy red algae conspicuous. Every rock surface covered, a "jungle of red, 15 to 30 cm. high. *Eisenia* scattered more abundant below 30m depth."

Later diving and dredging operations at various sites among several islands have confirmed this general distribution pattern. Although the basic character of the Galapagos marine algal flora is tropical, the absence of certain "expected" tropical genera (as noted by Silva, 1966) and the presence of certain "unexpected" temperate genera suggests that the islands have an unusual subtidal situation.

More definitive field observations should be made to determine the seasonal patterns of distribution relative to water temperature, depth of thermocline, number and kind of herbivores present. The Galapagos Islands appear to provide an unusual opportunity to explore the evolution of temperate and tropical marine biota with associated patterns of plant herbivore interactions occurring side-by-side on a vertical plane of a few hundred feet rather than the several hundred miles that elsewhere is required, horizontally, to show such phenomena.

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FLAMINGOS EN PELIGRO

por Arnaldo Tupiza, Representante ECCD, Isabela

El puerto de Villamil en la Isla Isabela, cuenta con muchos atractivos, entre ellos aves pertenecientes a ecosistemas lacustres contándose entre ellas a los flamingos.

A principios de 1979, se instalaron los postes de alumbrado eléctrico, fue entonces cuando éstas aves comenzaron a tener serios problemas, pues los cables de alta tensión colocados a 8 metros de altura interferían con el vuelo cuando estas aves comenzaron a volar hacia el Este en dirección de otra poza.

El primero de mayo murió el primero de ellos, y al transcurir mayo y junio murieron seis: tres instantáneamente y tres que habían sufrido fracturas en las patas y en las alas, mueren despues de tres dias que los mantuvimos en observación. Además, otros tres cayeron al golpearse contra los cables, pero se repusieron después de manterlos tres días en reposo, posteriormente los llevé a las lagunas donde continuaron su vida natrual.

Considerando que la población total de flamingos es de 500 a 700 en Galápagos (Tindle Anual Report: 1979), el mayor número de la población se encuentra en Isabela: estas muertes resultaban alarmantes y fue necesario buscar un método adecuado para evitar que estos accidentes continuaran.

Después de informar sobre el particular al Dr. Hendrik Hoeck, Director de la Estación Científica Charles Darwin, decidimos poner señales en los postes, los mismos que están constituidos por bolas plásticas de color y cintas del mismo material, las mismas que se encuentran aseguradas con piolas de nylon y se encuentran ubicadas a 1.50m. una de la otra.

Desde el 9 de julio de 1979, en que instalamos estas señales, han transcurrido cinco meses y durante este período hemos comprobado que este método ha dado magníficos resultados. Por ello, es conveniente mantener estas señales permanentemente a fin de protejer a los flamingos.

SUMMARY

Most of the Galapagos flamingoes are found on the island of Isabela. Early in 1979 high tension cables were erected at the port of Villamil and this caused the death of seven flamingoes in May and June as they moved from one lagoon to another. Three more were injured but recovered after treatment, yet the losses were still very severe, when one considers that the total population is only 500-700. Senor Arnaldo Tupiza, CDRS representative on Isabela, reported the disaster to the Research Station and Dr. Hoeck advised attaching coloured plastic balls and ribbons to be cables. Since this was done there have been no further accidents.

Galapagos Flamingo: Drawing by Peter Scott

DONKEY-WORK ON ALCEDO

by Lynn Fowler

A feature of recent years, and particularly of 1979-80, has been the large number of women scientists studying or working at the Darwin Research Station and not only at Academy Bay but also on remote beaches and high mountains. Lynn Fowler gives a lively impression of the first stage of her year-long solitary life above 5,000 feet on the Alcedo volcano, while gathering material both for her Ph.D. and to provide a basis for conservation policy.

The *Piquero* disappeared, sailing north, and I sat on the beach waving goodbye with a wild mixture of emotions flooding through me. The captain, marinero and scientists aboard were the last humans I would see, except possibly for a couple of groups of tourists, for the next two months. Behind me Volcan Alcedo looked uninviting, hidden by a thick wet wall of *garua* (mist). Heaped around me was an immense pile of supplies and equipment; food for 60 days, 80 gallons of water, 10 gallons of kerosene, tent, sleeping bags, stove, clothes, several pairs of shoes, binoculars, camera, books and much more.

I had come to Isabela island to begin a study of the introduced burros (donkeys) which are numerous on the slopes, rim and *caldera* (crater) floor of Volcan Alcedo. Feral burros have roamed Alcedo since the mid 1800's when they were presumably introduced by tortoise oil seekers. The Alcedo burro population now numbers between 500-700 animals and National Park and Darwin Station personnel fear they may be damaging the native flora. Alcedo harbours the largest remaining population of Galapagos tortoises, (estimated 3-5000) and it is possible that the burros may also be disturbing the tortoises by competing for food and destroying nests.

During the last two months of 1979 I planned to make general observations of burros and tortoises, and to initiate a more detailed one year research project investigating their diets and feeding behaviours, their distributions and other pertinent aspects of their ecologies. But before I could begin data collection, I had to set up a base camp on the rim of the volcano; a good seven hour hike from where I sat contemplating my huge pile of supplies.

I cached extra food, water and gear under a bush in a lava flow just south of the landing beach and in a week's hard work relayed the rest of the equipment up to my camp site. During that week I made early morning and late afternoon trips daily to the foot of the volcano. The hike from beach to slope was over six miles and generally took me three hours. After unloading my pack and caching things under a pega-pega tree I would jog down to the beach. I'd spend the hottest part of the day sprawled in the sun or splashing in the cool ocean among friendly sea lion and fur seal pups and fishing pelicans, terns and boobies. Lunch was always chocolate, melted on crackers by the sun. In the afternoon I would hike up with another heavily loaded pack and race back down to the beach as the sun set behind the crater. After a quick, refreshing, skinny dip, I'd gobble a can of tuna or sardines and crawl to my tent to escape the mosquitoes. Almost immediately I would fall asleep, to the sound of the sea lions barking and the waves gently lapping the shore.

I next moved two weeks of food and water plus my research and camping gear up the slope and two hours south around the rim of the volcano to my base camp site. From there the view of the Perry Isthmus, Alcedo's caldera and all five of my neighbouring volcanoes was magnificent. As soon as I had begun to pile up water containers, tent and cans of food huge nosey tortoises lumbered over to investigate. They turned out to be intriguing and amusing, but pesky neighbours. Tortoises sniff, bite and trample anything that is carelessly left within their reach. Hence my first job for setting up camp was to build sturdy fences around my tent and my kitchen supply area. Finding, hauling and arranging enough dead wood to turn back curious 300 or 400 pound tortoises took an entire day. And even after I was satisfied with the strength of my fences, my neighbours were not so easily defeated. Several times I returned to camp to find a tortoise had pushed through the fence and was guzzling my precious "bath tub" water, or worse, smelling and tearing at my tent. I fiddled with and added to those fences for several weeks before they were at last tortoise proof.

Galapagos hawks arrived immediately also to inspect my camp and me. They alighted only a few feet away and watched my every move attentatively with beady eyes. For the most part they, like the tortoises, were delightful neighbours. But occasionally I would discover that a sock or wash cloth which had been hung out to dry was missing. Usually within a few days I'd stumble across the lost article, torn to shreds and discarded after a hawk had thoroughly investigated it.

Since there is no source of fresh water on Alcedo, and since packing in water is very hard work, I constructed a *garua* water trap. The idea and original setup was suggested to me by a long time Galapagos resident who is full of clever ideas. I suspended a large sheet of plastic under a tree and by poking a hole in the centre, leading a string though this hole and into a five gallon container I was able to catch the fog water that condensed on mosses and branches of the tree and dripped onto my plastic. The setup worked perfectly and, though the water was a bit green in colour, I never had to carry water up from the beach again.

Rapidly I settled into a regular routine. I was often awakened before sunrise by the sounds of a sluggish tortoise beginning to move about in his dusty bed next to my kitchen fence. Or the chirps and chatters of countless Darwin's finches and the scolding of mocking birds might wake me. More effective yet, loud, startling and close by, a male burro braying might chase all sleepiness from my head. Frequently heavy, blowing *garua* outside would encourage me to eat my breakfast in bed. Breakfast was almost always the same: raw oatmeal mixed with sugar, nuts, raisins and milk, to which I added water. Sometimes I would brave the cold and wet to cook pancakes on my kerosene stove. Each morning I would braid my hair and tie the braids across my head. That proved to be the only way I could keep it from tangling or bothering me, especially by the end of my second week without a shampoo.

I would spend the days observing burros or tortoises. Around noon I'd break for a quick lunch of chocolate and crackers. After an afternoon's research I would take a chilly sponge bath and cook rice and tuna, beans and noodles, spagetti, or the like, for dinner. Because of the risk of introducing plants or insects to Alcedo I did not have fresh fruits or vegetables. But, by employing a little creativity, the meals were good. I would end the days with a cup of tea, cocoa or pudding while I wrote up data or made an entry in my diary. Alcedo was wonderfully quiet during the night. I might hear an owl, or the "chomp, chomp, chomp" of a grazing burro just outside my tent, but little else ever disturbed me.

Every two weeks I made a trip down to the beach. I always looked forward to "beach day" with eager anticipation. With a light pack containing only filthy clothes and trash I hurried towards the ocean. Nothing can beat the marvellous sensation of a swim, bath and shampoo among seals and seabirds, after two weeks of dust and sweat. I would wash my clothes with woolite in the ocean and late in the afternoon raid my lava cache of food for the next two weeks. Early the following morning I'd reluctantly leave the beach to hike back home.

November and December were dry months on Alcedo. The south east section of the volcano, where my camp was located, received a good deal more *garua* moisture than did the remainder of the crater. Apparently because of this, many burros congregated along this section of the rim. To observe burros I had only to crawl quietly out of my tent, or at most walk for a few minutes along the rim. They would be found grazing on the short grasses, alone, in pairs, or in groups of up to 20 animals. Alcedo burros are extremely unalert, particularly on foggy or windy days. I could sneak right up to them and on a number of occasions got to within meters before I was noticed. Then, their amazement would be so great that they would snort, fall over in surprise, scramble up and finally gallop off.

One morning in mid November I was hiking down the southern slope of Alcedo to explore towards Volcan Sierra Negra. I suddenly became aware of a loud but distant rumbling. I glanced towards Sierra Negra and what a surprise! An enormous billowy white cloud ... Sierra Negra was erupting! Terribly excited and even a little frightened, I raced up the slope to camp for my camera. Soon, between the heavy clouds that were building up, I could see the brilliant red lava rivers streaming down the flanks of the volcano. That night I slept out, in a roll of plastic, directly opposite the eruption. I was treated to a spectacular private fireworks show. Though Sierra Negra was over twenty miles away, I could clearly make out more than 40 lava fountains and five major rivers advancing towards the sea. I was thrilled to have the opportunity to witness Nature's magnificent show, but I prayed that Alcedo would not follow Sierra Negra's example!

My research is now almost finished. I've lived on Alcedo for nearly a year. It has been a year full of absolutely unforgettable experiences. Shortly I'll be returning to the University of Florida to analyze my data and complete my doctoral programme. I am glad to think that my findings will add to our understanding of the Galapagos Islands system and help provide the National Park Service with guide lines concerning control or erradication of the feral burros.

PATILLO – *Anas bahamensis*

THOMAS EDMONDSTON IN THE GALAPAGOS ISLANDS

by Roger Perry, CDRS Director, 1964-70

I was interested recently to inquire into the history of Thomas Edmondston, the young British botanist who appears briefly and tragically in the story of discovery in the Galapagos Islands. As others who had worked at the Charles Darwin Research Station, I had from time to time come across the name *edmonstonei*, learning that Joseph Hooker of the Royal Botanical Gardens at Kew studied Edmondston's collections in conjunction with those of Darwin and Macrae. What I did not realise, until Alan Hayes, entomologist at the British Museum (Natural History), drew my attention to the possibility, was that other Galapagos type material could be traced to the voyage and saga of Edmondston.

Thomas Edmondston was born on 20 September 1825 at the family home at Buness*, a small hamlet near the head of Balta Sound on Unst, the most northerly of the Shetland group of islands. From an exceptionally early age he developed an interest in natural history, a pursuit evidently encouraged by his father, Laurence Edmondston, M.D., himself a keen naturalist. An upbringing, too, amid remote and lonely surroundings, where climate made difficult any regular attendance at school, must have had its influence on a child who was both sensitive and observant by nature. These interests were channelled at first into ornithology but a chance meeting at the age of twelve with Dr.Gilbert Macnab, a botanist of some repute who was then on a tour of the Shetland Islands, gave a sudden zeal for the study of plants. And if an incentive were needed it was his discovery at that early age of a species (the Arctic sandwort, *Arenaria norvegica*), new to the British list. Two years later Edmondston was working on a *Flora of Shetland*, an initial draft of which was published in *The Annals and Magazine of Natural History* in 1841 (whilst its author was still barely sixteen years old).

That same year Edmondston went to Edinburgh where he studied botany under Dr. Robert Graham. Thereafter his career was condensed into a few brief but exceptional years. He became Assistant Secretary to the Edinburgh Botanical Society and, in his twentieth year, was elected to the professorship of Natural History in the Andersonian University at Glasgow. However, before he had time to commence his lectures he had accepted, on the advice of the naturalist and traveller Edmund Forbes, F.R.S., the post of naturalist on board HMS *Herald*, shortly to sail on a surveying voyage to the Pacific.

HMS *Herald*, under the command of Captain (later Sir) Henry Kellett, accompanied by her tender, the *Pandora*, departed from Plymouth on 26 June 1845. The enthusiasm of Edmondston for his assignment must have been considerable, for he joined the expedition without even having had time to take leave of his family. This he must have felt keenly at a port-of-call in the Falkland Islands, where the scenery was a last, perhaps poignant reminder of his Shetland home. Thence the two ships rounded Cape Horn and sailed northward along the coasts of Chile and Peru. From Callao they headed out to the Galapagos Islands.

On 6 January 1846 Gardiner Island was reached and at noon the same day they lay to the south of Floreana. Two days later a landing was made at Black Beach and a party, which included Edmondston, followed the trail into the interior of the island. From an Englishman they met there named Gurney, who was married to a sister of the Ecuadorean administrator, it was learnt that about a year before political prisoners exiled to the island had been recalled by the party newly acceding to power. About forty people then remained on Floreana, and it had something of a deserted air, with cattle, pigs, goats and dogs all roaming in the wild. Yet the moist season had brought an impressive abundance of plants and such fruits as melons, bananas and pumpkins,which were tended in enclosures safe from the animals. Edmondston collected whatever he could in the time, though he must have been disappointed to find that the legendary 'terrapins' or tortoises were no longer living on the island.

From Floreana Capt. Kellett made the almost mandatory quest in those days to San Cristobal to replenish supplies of water. The *Herald* anchored in Stephen's Bay and from there *Pandora* went round to Freshwater Bay. Edmondston meanwhile continued his collecting but there is no word that he found tortoises in the wild even on San Cristobal; later, several of the reptiles were purchased at Wreck Bay, each some 65 cm long and priced 6 shillings ($ 1.25) apiece. The last call in the archipelago was at Santiago, where at James Bay the young naturalist duly noted pintails, the hawk and immigrant waders. On the evening of 16 January the two vessels weighed anchor and headed back to the South American mainland.

A week later, as *Herald* and *Pandora* lay off the estuary of the Sua river, some 30 miles along the coast to the southwest of Esmeraldas, disaster overtook a party returning from an excursion on shore. A gun carelessly placed in a boat was accidentally discharged and a ball passed through Edmondston's head. He died instantly and was buried on shore the following day.

Thomas Edmondston's best known contribution to Galapagos science has been his botanical collection. This comprised 41 numbers and was made with the assistance of John Goodridge, the surgeon to the expedition. The material eventually came to Kew Gardens where Hooker, moved by Edmondston's untimely death, named five plants (belonging to the genera *Iresine, Phaca, Sesuvium, Solanum* and *Spondias*) in his honour. 21 of the 41 plants were considered to constitute new records for the archipelago.

Unfortunately, owing to Edmonston's untimely death, confusion arose with the labelling of the collection. Several plants, initially assigned to the Galapagos Islands, were later suspected of having come from the mainland. Among these were *Iresine edmonstonei, Phaca (Astragalus) edmonstonei* and *Solanum edmonstonei* – none of which has since been found in the archipelago. As each occurs naturally at spots on the mainland coast visited by the *Herald*, errors in labelling must be an obvious possibility. With *Spondias edmonstonei*, the Palo Santo tree, now assigned to the genus *Bursera*, the only one of Hooker's five to have stood the test of time is *Sesuvium edmonstonei*. Nevertheless this strand endemic is a good species, known to visitors as providing the reddish ground hues to vegetation on Plaza and in other littoral areas.

Edmonston's zoological collection (if in fact he was entirely responsible for these up to this point) similarly suffered from a dearth of authentic labelling. Material presented by Kellett and Wood to the British Museum (Natural History) consists of 82 Lepidoptera, 14 Aptera, 17 Rhynchota (bugs) and an isopod of the genus *Cymothoa* – many summarily identified as collected on the *West* or *Northwest Coast of America*. Two moth species however have since been determined as Galapagos endemics, namely *Psaphara interclusa* (a male, holotype) and *Gonodonta biarmata evadens* (two females, syntypes). Material of the Giant Painted Grasshopper *(Schistocerca melanocera)* may almost certainly be traced to Edmonston's collecting, to specimens taken during the first day ashore at Floreana when 'large locusts were seen in extra numbers'. It is possible that other specimens in this historic collection will come to be referred to the Galapagos Islands as particular groups are studied or revised.

It is little to the point to speculate on the future of a life so tragically cut short. None the less, it is interesting to reflect that at the time of that fatal accident another young naturalist, with a perhaps less auspicious scientific background, was yet pondering thoughts and ideas that had come to him in the Galapagos Islands. Edmonston's successor as naturalist on the *Herald* was the able Berthold Seemann, who joined ship at Panama in July 1846 and eventually undertook the writing of the narrative of the expedition. This was in fact the only published account for Kellett himself was sent upon another commission soon after his return to England. A mainland plant was named *(Edmonstonia)* by Seemann to commemorate his predecessor: this too was not to stand and was later assigned to the previously described genus *Tetrathylacium* of Poeppig.

*The house at Buness, Baltasound still belongs to the Edmonston family, hereditary udallers of Shetland.

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