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CONTENTS

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NEWS FROM ACADEMY BAY

DARWIN STATION DIRECTOR'S REPORT

From both the scientific and administrative points of view, the most important event of the past three months was undoubtedly the Charles Darwin Foundation's meeting in Quito from 10-12 March. Before the traditional informal and formal meetings of 11 and 12 March in the Ministerio de Relaciones Exteriores, a series of public scientific lectures was given at the Universidad Católica and a round table workshop was held at the Museo de Ciencias Naturales. These scientific deliberations, for which all the scientific staff of the CDRS had come to Quito, were entirely dedicated to the innumerable problems caused by introduced plants and animals in Galápagos and their possible solutions. Talks centred on how best to tackle 100,000 goats on Santiago Island; how to cope with an estimated 20,000 feral pigs there; what to do about feral cattle, burros and cats; what to do about rapidly spreading guava and quinine trees; whether to recommend or oppose the use of herbicides and insecticides; and whether or not in this regard a distinction should or could be made between introduced, native or endemic "pests". Furthermore, possible answers to questions dealing with repatriations and re-introductions of endemic species were analized. Should Pinta Island, once the last remaining goats are eliminated, have a tortoise population again? If so, is there any hope of somehow crossbreeding old "Lonesome George" to save this Pinta race? And if there is no hope that this could ever be achieved, which race would be the most appropriate to be introduced onto that island? What about a re-introduction of tortoises to Floreana and Santa Fé islands? Why does the Floreana Mockingbird survive only on little Gardner and Champion Islands and no longer on Floreana itself? Should a repatriation be tried?

The answers to these and similar questions will, at least on a short term basis, serve us as guidelines for our conservational efforts in Galápagos. On 11 and 12 March, matters related to CDRS and GNPS administration, such as the permanent shortage of funds at both institutions, their activities during 1981, their operational plans for 1982, and similar domestic items were discussed. In all, the Quito meeting of 1982 was a very satisfactory one.

On February 12, I had the honor of presenting the *"Galápagos Reader"* to the Republic of Ecuador's Vice-President, Leon Roldós, on the occasion of his visit to celebrate the 150th anniversary of the annexation of the Galápagos Archipelago by the Republic of Ecuador. This book, containing a considerable number of scientific articles basic to Galápagos science, all translated into the Spanish language, was also presented to the Governor, ecclesiastic and military authorities of Galápagos as the Charles Darwin Foundation's and the Darwin Station's contribution to this important event.

Among activities we had planned for 1982, was to have two "Open Door Days" at the Station, in honor of the centenary of Charles Darwin's death on 19 April 1982. However, as we have received so far, with a small exception, virtually none of the funds approved, promised and so badly needed for this year, this project was not realized. We could not even have afforded to pay for the paint we needed, let alone the new chairs for Van Straelen Hall and other necessary repairs of the Station that we had in mind to make it more presentable. So, instead, I delivered a short address to the islanders via the local radio station on 17 and 19 April, emphasizing Charles Darwin's importance for Galápagos and its conservation. A possible new date for our "Open Door Days" at the Station will depend mostly on when and how much of the funds needed are eventually received.

When our resident ornithologist David Duffy left the Station last year, Sylvia Harcourt, by then a longterm "all-round conservationist" at CDRS, took care of our ornithological program, while at the same time helping with educational and other activities. Sylvia left Galápagos in mid-March to return to England, where she plans to take up university studies again. All of us at the CDRS thank her for the great efforts and personal sacrifices that she invested in the conservation of the Galápagos Islands.

We chose Malcolm Coulter as our new staff ornithologist. As a visiting scientist, he worked in Galápagos for most of 1981, doing research on the few remaining populations of Hawaiian Petrels in the islands,

mainly on Floreana. Malcolm joined the Station staff in March. He will be involved with a rat control program to protect the Hawaiian Petrels during their vulnerable incubation season on Floreana, with a follow-up project on the avian pox disease, that so far remains inadequately understood, and with general seabird monitoring.

As successors to Olga Herrera de MacBryde and Hugo Loza, Gonzalo Oviedo and his wife, Paola Silva de Oviedo, joined the Station staff in January as co-ordinator for education and human ecologist respectively. Together with their little daughter Ana Maria, they prove to be a happy addition to the Station's professional and private life.

By taking the opportunity now and then to leave my overcrowded desk at the Station to see some of the spectacular things in Galápagos, for whose conservation I came to work, I have been able to visit quite a number of tourist and other sites. Two trips during the past months took me to such diverse sites as the lava tunnel at Floreana's Post Office Bay and the gigantic caldera of the Sierra Negra volcano, to the steep cliffs of Vicente Roca and the fur seal grotto on Santiago Island. No words can possibly describe the overwhelming sight of Sierra Negra when, dwarfed in size and spirit, we stood on its rim and gazed into this monstrous crater. Whatever people do, I thought upon first view, human intervention could never destroy this immeasurable vastness of scenery. Down at the bottom of the crater, however, my field glasses revealed two feral burros grazing amongst the dry vegetation; and when we descended the steep slope to see the sulphur fumaroles, we found that most of our path led through thickets of introduced guava trees. The same kind of surprise struck me at Vicente Roca, on the northern tip of Isabela Island. We found there a splendid Bluefooted Booby colony, lively with activity. No obvious signs of human interference could at first glance be detected but, when searching around, we discovered four cats — a female and her young — that seemed to be patiently waiting for the first Booby chicks to hatch from their eggs.

I have seen numerous goats on Santiago, wild horses, cattle and traces of feral dogs on Isabela, square miles covered by guava trees and similar results of human carelessness in Galápagos. And always these sights impress upon me quite clearly that unless an effective extermination or, at least, a continuous control of all these and other introduced plants and animals can be implemented, the Galápagos Islands cannot be considered as safe from destruction in the future.

RELEASE OF CAPTIVE-BRED LAND IGUANAS

A new venture began in May when the first Land Iguanas ever born in captivity were released in their ancestral home near Cartago Bay on Isabela Island. In the 1970's the entire Cartago Bay population had been wiped out by feral dogs, apart from a few rescued to serve as the breeding stock in the Darwin Station's pens. The National Park Service's campaign to eliminate feral dogs has been so successful that in May 1982 it was thought justifiable to risk releasing 37 of the juveniles reared at the Station. As the CDRS herpetologist explains in an article in this issue, it may be years before the success of the operation can be judged. Transfering captive-bred animals to the wild, like the captive breeding project itself, involves moving into hitherto unexplored territory. There seem to be no dogs at present in this area but cats are only one of the other potential hazards for the young iguanas. At least the Cartago Bay stock has been saved from extinction and for this thanks are due to Bob and Donna Reynolds, Howard and Heidi Snell, Dagmar Werner and so many others from the National Park Service and the Darwin Station who have helped to carry this bold experiment in conservation to its present point.

LAND IGUANAS BREED ON VENECIA

After the slaughter of the Santa Cruz population of Land Iguanas by wild dogs (Noticias Nos. 25-29) it was thought prudent to divide the survivors: some were taken to the Darwin Station in the hope that they might breed in captivity but others were transferred to Venecia, a tiny islet separated from the main island by water wide enough to deter the dogs. Tons of soil were painfully carried to this little strip of land so that the iguanas could dig burrows. Yolanda Célleri, a graduate student from the Central University of Quito who is assisting with the iguana project, visited Venecia in April and was delighted to report that there

were many juveniles to be seen. Like the equally successful captive breeding scheme at the CDRS, this can only be a temporary solution; but it does mean that there will be a richer genetic stock when the dogs are eliminated and the Santa Cruz population can be restored to its traditional breeding area.

THE AGE OF THE GIANT TORTOISE

The question most commonly asked by visitors at the tortoise rearing center is, "How old do the giant tortoises live to be?" A brief search of the literature by Bob Reynolds, CDRS herpetologist, revealed some interesting speculations concerning tortoise age.

In 1901, Raymond Ditmars reported on a collection of Galapagos tortoises purchased by the New York Zoological Society (Sixth Ann. Report of the N.Y. Zool. Soc. Pp. 120-127). In this report Ditmars stated that "Many records demonstrate that a century constitutes but a fraction of the tortoise's existence." He also included the following portion of a letter from Mr. F.B. Webster quoting the Hon. Walter Rothschild's views concerning the age of tortoises:

"You may be interested to know what Mr. Rothschild says about the tortoises. You will remember I told you that, in my opinion, the ages of Nos. 1, 2, 3, 4, and 5 was about three hundred and fifty years each. There could be no great difference between them, although Nos. 4 and 5 looked the oldest. Now No. 1 was sent to Mr. Rothschild. While it was the largest, its shell did not show quite the age of the others. Its size and general appearance, however, indicated that it had lived in a smoother section, where it hadn't done so much rock-climbing. Mr. Rothschild says: 'I think No. 1 *must be at least four hundred years old.*' Now you can safely call No. 5 (the largest specimen in your Park) at least four hundred years old on the best authority."

How these estimates of tortoise age were arrived at was, unfortunately, not explained. Walter Rothschild, later Lord Rothschild, founder of the Natural History Museum at Tring, England, collected his Galapagos tortoises around the turn of the century.

Estimating tortoise age on the basis of size and general appearance is a rather doubtful procedure. The larger Galapagos tortoises are often presumed to be extremely old, but this is not necessarily true, as we now know that they grow very rapidly, attaining large size in a relatively short time.

More recently, Auffenberg and Iverson (1979, in Turtles: Perspectives and Research, Harless and Morlock, eds., Wiley & Sons, N.Y. (659pp.) stated that the oldest tortoise for which there is reliable data is "Marion's tortoise", a member of the extinct *Geochelone sumeirei* from the Seychelles. According to these authors, this tortoise was brought to Mauritius in 1766 where it remained for 152 years, until its accidental death in 1918.

Presently, there is no answer to our most commonly asked question. However, thanks to the CDRS's registration of tortoise births, our great-grandchildren should have more accurate information. It should not take quite so long to determine the considerable age at which Galapagos tortoises begin to reproduce.

VISITORS AND EVENTS AT THE CHARLES DARWIN RESEARCH STATION: JANUARY — APRIL 1982

JANUARY

Hugo Loza, human ecologist, left on completion of his one year contract.

Bruce Barnett and assistant, Linda Michelson, left for S. Isabela for six months to study the behaviour of the feral dogs.

Gary Robinson and assistants went to Tagus Cove for five days for the black coral study.

Members of Peter Grant's team doing long-term study of Darwin's Finches left for six months on Daphne and Genovesa.

Carlos Iguago, CDRS representative in Quito, arrived for a four-week stay in the islands.

Oswaldo Chappy and Lucho Torres went to Cartago bay and Punta Garcia to continue the dog eradication program.
Flamingo census organized by Sylvia Harcourt; simultaneous counts in Santa Cruz, Santiago, Rabida, Isabela and Floreana, by CDRS and GNPS personnel.
Bob and Donna Reynolds left for a week on Santiago, to supervise students doing tortoise study.
Alan Putney, Park Management consultant, arrived to start on the formulation of a revised Master Plan for Galapagos.
Luong Tan Tuoc, new staff botanist, arrived at CDRS.
Arturo Ponce, Head of the National Parks of Ecuador, arrived to take part in the formulation of the Master Plan.
Nigel Sitwell came to obtain material for an article on feral animals.
Lucho Calvopina and assistants, plus botanist Luong Tan Tuoc and journalist Nigel Sitwell, went to Santiago for five days to assess damage done by goats to vegetation.
Pepe Villa, Arturo Ponce, Fausto Cepeda and Alan Putney did a five-day trip on Beagle IV as part of the Master Plan assessment.
Theresa Kineke arrived from University of Florida as assistant to Linda Cayot on the tortoise-plant interrelationship study.
Howard and Heidi Snell, Colorado University, and their assistant Randy Jennings arrived for a further two months on Plaza to continue their land iguana study.
Dog eradication team returned to Isabela for further two weeks.
William Pitt and his group arrived from California Academy of Sciences for a three-week invertebrate palaentological study.

FEBRUARY

Gary Robinson, staff marine biologist, to Champion Island to continue his black coral studies.
Yael Lubin, staff entomologist, and Luong Tan Tuoc, staff botanist, to Pinta for their respective investigations.
Gonzalo Oviedo and his wife, Paola, joined CDRS staff, he to take charge of education, she as human ecologist.
Léon Baert and Jean-Pierre Malfait came from Belgium to study distribution and ecology of spiders.
Mario Hurtado of the National Institute of Fisheries arrived with fifteen students from the University of Guayaquil to continue the longterm marine turtle program.
Friedemann Köster and Pepe Villa represented the Darwin Foundation at the 150th anniversary celebrations of the annexation of the archipelago by Ecuador. They presented copies of the "Galapagos Reader" (an anthology of scientific papers, translated into Spanish) to the Vice-President of the Republic and to national and local officials.
A party of students from Puerto Ayora visited Isabela and Floreana on board Beagle IV.
Bob Reynolds (staff herpetologist), his wife and Oswaldo Chappi searched for land iguanas on Darwin Volcano, Isabela.
Andrew Laurie returned from another spell studying marine iguanas on Santa Fe.
Krista Connors arrived from the Smithsonian Institute of Tropical Studies as assistant entomologist to Yael Lubin.
Peter Grant arrived to supervise his team studying Darwin's Finches on Daphne and Tower (Genovesa).
Yolanda Célleri came from the Central University (Quito) to take charge of the first repatriation of captive-bred land iguanas to Isabela.

MARCH

Gary Robinson to N. Santa Cruz for further black coral studies.
Paola de Oviedo to San Cristobal for discussions with provincial authorities.
John Lastavica arrived with his wife to advise the CDRS on accountancy matters.
Peter Kramer, President of CDF, paid a brief visit to observe developments at the Station.
Director and staff scientists attended CDF Council Meetings in Quito.

Corley Smith (retiring Secretary-General of CDF) and Ole Hamann (Secretary for Europe, designate) arrived at Station.
Drs. Ole Hamann and S. Wium-Anderson (University of Copenhagen) began their survey of Galapagos mangroves.
Commission from the Ministry of Natural Resources, planning the distribution of fuel, discussed problems at CDRS.
Malcolm Coulter arrived with his assistant, Beth Silieff, to take up his post of staff ornithologist.
Sylvia Harcourt, acting ornithologist, returned to England.
Harold Coolidge, Founder Member of the CDF, visited the Station with his wife.

APRIL

Norbert Rauch concluded his marine iguana project and left for Germany.
Catherine Rechten and Ingrid Laamers to Española to continue studying the nesting of the Albatross.
Andrew Laurie back to Sante Fe for further work on the marine iguana project.
Priscilla Martinez, University of Guayaquil, came to assist marine biology programme.
Party left for Santiago: Yael Lubin and assistant to study fire ants and their effects on other ant species; Bob and Donna Reynolds to observe snakes; Léon Baert and Jean-Pierre Malfait to study spiders; and two Park wardens to eliminate cockroaches.
Reynolds, Baert, Malfait and Snell to N. Seymour, Venecia and Cartago Bay to observe land iguanas.
Gonzalo Oviedo to San Cristóbal for educational purposes.
Yael Lubin to San Cristóbal to study distribution of fire ants.
Gregory Estes and Barry Meatyard, University of Cambridge Darwin Centenary Galapagos Expedition, began their marine iguana study.
Paola de Oviedo to Quito to take part in conference at the Casa de Cultura.
Pepe Villa and Gary Robinson took part in discussions at the National Institute of Fisheries in Guayaquil on traditional fishing in Galapagos.

Masked Booby and Swallow-tailed Gull *Photo by Fritz Pölking*

CORLEY SMITH
RETIRES AS SECRETARY GENERAL

It is very sad to learn that the Secretary General who has served our Foundation for many years is retiring. Corley Smith will remain however as an honorary member and so continue his association with our joint enterprise.

My first contact with him was many years ago when he wrote to me about some obscure but magnificent hummingbirds living in the high Andes of Ecuador. He was at the time British Ambassador in Quito, an established diplomat who had previously been at the British Embassy in Paris, and also an informed naturalist and dedicated conservationist.

Some years later, when our friend Tom Barlow expressed the wish to retire from the position of Secretary General, we urgently had to find a successor. Only one name came to mind: Corley Smith. He was unanimously elected.

As President of our Foundation, I had the privilege of working with him for many years. We exchanged letters and telephone calls and met quite often, either in England or France. I was immediately impressed by his quiet and consummate skill in handling the often complex problems that faced us — an accomplishment derived from his long experience as a diplomat in Latin America.

Even before joining the board of the Charles Darwin Foundation, he had been a tower of strength under the aegis of his ambassadorial position in Quito from 1962 to 1967. He first visited the islands at the time of the 1964 Symposium, representing the British Government, and later that year joined H.R.H. Prince Philip during his visit on the Royal Yacht Britannia. He also was largely instrumental in getting the Snow-Grimwood mission and report off the ground, a valuable background document long before the National Park Service and legislation came into force.

The duties of Secretary General of the Foundation took a great deal of his time, as I can well testify. Most crucially, he perceived and understood the way the Foundation had to meet and adapt to changing conditions in Ecuador. From the 1960s to the present has seen an evolution in thought and ideas; and the Galapagos must be enormously indebted to Corley for his part in moulding this.

But someone of his stature never completely retires. He will continue to have a role to play alongside scientists and conservationists from all over the world working to safeguard the future of the islands. So we do not say "goodbye", nor even "thank you"; we say simply "Stay with us, Corley, the Foundation and the Galapagos still need you!"

Jean Dorst
Membre de l'Institut

CHANGES AND CONSTANCY IN THE VEGETATION OF THE GALAPAGOS ISLANDS

by

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During nine months 1966 and 1967, I collected plants in the Galápagos Islands. All islands were visited except the remote islets of Darwin and Wolf. In December 1980 I returned to Galápagos. Although a three-month stay permitted visits to only a few islands, it was interesting to note some floristic and vegetational changes — as well as lack of changes — since the time of my first visit. Communications with the mainland have improved dramatically with almost daily flight connections and a concomitant increase in visitors. A road has been built across Santa Cruz, and the number of cars is now considerable. Fourteen years ago all connections with the mainland were by boat, and one might have to wait for weeks for a suitable boat. There was no road across Santa Cruz at that time, and cars were absent or nearly so. As a result of the changes several new weeds have been introduced and continue to spread along roads and in settled areas. Over vast areas, however, extreme terrain and climatic conditions will hopefully form a barrier against species not adapted to the Galápagos environment.

Santa Cruz. The formidable growth of the village of Puerto Ayora and the new road across the island have resulted in changes in the vegetation in areas influenced by the settlements. So far, however, the influence seems restricted to the immediate vicinity of the village and the road. Various ornamentals, several of them tall trees, are abundant in the village but generally do not invade undisturbed and indigenous vegetation. Weeds, such as *Tridax procumbens,* tend to spread along the road. This also holds for some indigenous plants and some long naturalized plants. Several weeds from the moist farmland are common along the road at elevations of 200-300 metres or higher. Among such species are *Bidens* spp., *Borreria laevis,* and others. Supposedly the road will facilitate the spread of new weeds into the *Scalesia* forest at 500-630m elevation.

The *Scalesia* forest bordering the farmland has for several decades been under pressure of introduced plants due to the activities of man and introduced animals. It is probable that some species, such as *Alternanthera halimifolia,* would have been less common in un undisturbed forest. The grass *Ichnanthus nemorosus,* which is locally common in the *Scalesia* forest, has been cited in literature as an example of a recently introduced species. However, its occurrence on some other islands and in places not influenced by man, seems to indicate that it is indigenous. That the species was not reported from Galápagos until about ten years ago may well depend upon confusion with *Commelina diffusa.* The two are quite similar in the sterile stage, and *Ichnanthus* is mostly sterile in the forest.

Cinchona succirubra is an aggressive invader into natural vegetation. The young specimens are shade-tolerant, and seedlings thrive in the semi-darkness under dense vegetation. In 1966, *Cinchona* had just started to invade the *Miconia* belt; I observed one single specimen, ca. 1m tall, and collected it. In 1981, *Cinchona* specimens were common in this zone. Although the National Park authorities are aware of the problem, the effective colonization strategy of the species will make it difficult to tackle.

Several weeds were common already in 1966 along the trail from Bella Vista to Mt. Crocker. The only conspicuous difference observed in 1981, apart from the numerous *Cinchona* specimens, was that *Cuphea racemosa* is quite common now. This species was not noted at all in 1967 and was first reported from Galápagos (Santa Cruz) by van der Werff in 1977. It seems to be spreading rapidly in the highlands of Santa Cruz. It has similar ecological demands as *C. carthagenensis,* and the two often grow together. The last-named species was common already in 1967.

Although negative changes are easily noted, it should be stressed that the vegetation in many frequently visited areas was found to be remarkably constant as compared to the conditions fourteen years before. A

Tree Cactus on Barrington: *Opuntia echios* var. *barringtonensis* *Photo by Roger Perry*

good example is Bahia Tortuga on the south side of Santa Cruz. There is a trail from Puerto Ayora to Bahia Tortuga, and the place is visited by tourists as well as local inhabitants. Despite the great number of visitors, the vegetation at Bahia Tortuga looked the same in 1981 as in 1967. No introduced species were noted, and the extension of such plants as *Sesuvium portulacastrum, Nolana galapagensis, Scaevola plumieri, Tiquilia* sp., *Sporobolus virginicus,* and others, was the same. Although the visit was made in the dry season and consequently possible introduced annuals were missed, the observations indicate that the vegetation may remain remarkably stable even in frequently visited areas in the dry region. Dry areas seem to be less vulnerable to introduced plants than are more mesic regions.

In the main, the vegetation at Academy Bay, between the Darwin Station and Puerto Nuñez, was the same in 1981 as in 1967. The floristic composition was the same and the range of different species more or less constant. Goats still occur in the area, but their impact on the vegetation is not stronger than in 1967; perhaps it is even weaker now. One notable exception from the constancy of the vegetation deserves mention. Some strange *Scalesia* specimens were found on the bottom of a small ravine ca. 2 km E of the Darwin Station in December 1966. About ten specimens were seen, varying in size from 3 dm to 2-3m. The shrubs were intermediate in morphological characters between *S. affinis* and *S. retroflexa* (Eliasson 1974, 1975). Samples from the plants were taken again by S. Itow in 1970 and by O. Hamann in 1972. No traces of the *Scalesia* could be found in the same ravine in 1980. Goats are probably not to blame in this case, since the plants were inaccessible for them. The scalesias might have disappeared because the population was under the critical size for survival and/or because of reduced fertility caused by a hybridogeneous origin. It would be interesting to know whether a likewise intermediate specimen collected by Taylor in 1939 on the south side of Santa Cruz was from the same locality.

Isla Caamaño. The low, flat islet Caamaño in the mouth of Academy Bay is an excellent example of an island harbouring indigenous, undisturbed vegetation. The islet was visited in March 1967 and revisited in January 1981. No floristic differences other than those caused by the different season were noted. Apart from some grassy spots with *Sporobolus virginicus,* and some "trails" kept open by the numerous sea-lions, the vegetation is dense and often difficult to penetrate. Dominating species are *Nolana galapagensis, Cryptocarpus pyriformis, Lycium minimum,* and *Sesuvium portulacastrum. Nolana* forms more or less pure stands over large areas, especially in the eastern part of the islet. The shrubs are mostly 1.5m tall with stems up to 1 dm thick at base. Dense thickets of *Sesuvium portulacastrum* occasionally scramble 1-1.5m above the ground over shrubs of *Nolana* and *Cryptocarpus.* A group of six specimens of *Opuntia echios* grow in the central part of the islet, two of them ca. 4m tall, four ca. 2m tall in 1981. A few scattered, mostly low-growing specimens of *Parkinsonia aculeata* occur. *Maytenus octogona* is rare, one single shrubbery was noted. Other species recorded from the island are *Amaranthus sclerantoides, Eragrostis cilianensis, Heliotropium angiospermum, H. curassavicum, Portulaca howellii, Tiquilia* sp., and *Trianthema portulacastrum.*

Santa Fé. As reported by Hamann (1979), the eradication of goats on Santa Fé (Barrington) has had a very positive effect on the regeneration of vegetation. To me the differences were striking, when the appearance of the vegetation in 1981 was compared with that fourteen years before. As the island was visited in December, the common grasses *Aristida subspicata* and *Setaria geniculata* were withered; small leaf-bearing plants of *Rhynchosia minima* scrambled over the lava rocks. Although most shrubs beyond the coast near *Cryptocarpus* border were leaf-less, it was evident that the shrubby vegetation — mainly *Lantana peduncularis* and *Cordia lutea* — had become much denser. An obvious difference was found in the frequency of *Scalesia helleri.* In 1967 only scattered specimens were seen, all growing on steep cliff sides beyond the reach of goats (Eliasson 1968). In 1981, *Scalesia* was much more common, seedlings as well as shrubs up to 2m tall were numerous. Although most specimens grew in places where it would not have been possible to survive if goats had still been present, they were mainly restricted to steep cliffs or to the immediate vicinity of cliffs. In the *barranco* in the north-eastern part of the island, *Scalesia* was observed from an altitude of 30-40m up to 100-110m. No specimens were noted on the flat lava plain above the *barranco,* where the vegetation was dominated by *Bursera, Castela, Cordia,* and *Lantana.* Lack of adaptations for long-distance dispersal might theoretically explain why *S. helleri* is still restricted to steep

cliffs. It is probable, however, that the plant is a pioneer adapted to this environment. Numerous specimens grow in the steep northern coast-cliffs of Santa Fé. Landslips have occurred in some places. It is possible that *S. helleri* is favoured in sites where competition from other species is weak.

Floreana. Although Floreana (Charles) has been influenced by man and introduced animals for a longer time than other islands in the archipelago, I regard it as one of the most interesting from a botanical point of view. The black lava fields at Black Beach harbour an interesting vegetation of *Scalesia affinis* and *Lecocarpus pinnatifidus,* the latter endemic to the island. *Scalesia* was less common on the open lava fields in 1981 than in 1967, probably due to the numerous feral donkeys in the area. In the innermost parts of the lava fields, a few hundred metres from the shore, *Scalesia* was still common, and found together with *Bursera, Cordia revoluta, Lecocarpus, Macraea, Maytenus, Prosopis,* and *Waltheria.*

Wild donkeys are probably also responsible for the scarcity of *alternanthera nesiotes.* This is an inconspicuous, more or less prostrate species, with ovate to suborbicular leaves 4-9mm wide. The leaves often have the same colour as the lava, and the plant is easily overlooked. The species is endemic to Floreana and has been collected at Cormorant Bay (by Stewart in 1906), Las Cuevas (Eliasson in 1966), and Black Beach (Eliasson in 1966, 1967, 1981). I believe that the existence of the species is threatened by the donkeys. Although rare at Black Beach already in 1966, it was even rarer in 1981, and only eight specimens were seen despite careful search. Another two endemics found at Black Beach are *Mollugo floriana* ssp. *floriana,* and *Chamaesyce nummularia* var. *glabra.* Although restricted in distribution, both are locally rather common.

Fig. 1. *Alternanthera nesiotes* on lava gravel at Black Beach, Floreana. This small species has the same colour as weathered lava and is very inconspicuous. It is endemic to Floreana. At Black Beach the plant suffers from browsing of feral donkeys. — *Photo: U. Eliasson 8 Jan. 1981.*

Several introduced species occur above an elevation of 200-300m along the trail from Black Beach to the highlands. *Citrus* and *Psidium guajava* are common and have invaded the natural vegetation in several places. Shrubs of *Lantana camara* are common along the trail and occasionally found elsewhere. *Kalanchoe pinnata,* an introduced succulent weed, forms a 2-3m wide bright green belt bordering the trail on both sides for a considerable distance. This species was seen already in 1966, but it was much less frequent then. Fortunately it sticks to trails and clearings and is not apt to invade densely vegetated areas.

Apart from the farm area, large parts of central Floreana have a dense, indigenous vegetation. Indigenous trees are small, and rarely exceed 4-6m. The extent to which the frequency of individual species has been changed by man and introduced animals is difficult to judge. Floristic composition and degree of cover of individual species at an elevation of 380m are shown in Table 1. Four quadrats with representative vegetation, each comprising $100m^1$, were analyzed. 'Cover' is defined as the area of ground occupied by a vertical projection of all epiterranean parts of individuals of a particular species. 'Degree of cover' is the extent to which the quadrat is occupied by a particular species. In the Hult-Sernander scale used, the figure '5' indicates a cover range of 51-100%, '4' 26-50%, '3' 13-25%, '2' 6.5-12%, and '1' a cover of less than 6-25% ($=1/16$).

Some species in Table 1 *(Tillandsia, Peperomia, Polypodium tridens)* occur as epiphytes as well as terrestrial plants. *Asplenium auritum,* normally an epiphyte, was recorded growing on the ground. The *Cordia* specimens key to *C. anderssonii* in the Galápagos Flora by Wiggins and Porter (1971), but the delimitation of the *Cordia* taxa endemic to Galápagos needs further study. The same is true — in my opinion — of the endemic *Peperomia* species with verticillate leaves.

Linum cratericola is endemic to Floreana and is known from two localities a few hundred metres apart. It was first found by me in December 1966. The type locality is a small, strongly weathered crater NE of Floreana Peak (Cerro Pajas), and ca. 100m NE of the trail from Black Beach to the Wittmers' farm. The altitude is ca. 370m. I revisited the locality in January 1981, and found *Linum* to remain there in about the same frequency. A few subshrubs, 3-4 dm tall, were seen. Although the place was infested with some *Citrus* trees, the surrounding vegetation was in the main natural. *Scalesia pedunculata* formed thin stands, ca. 5m tall. Some trees of *Lippa salicifolia,* a rarely collected species endemic to the island, grew in the vicinity, some specimens reaching 6m in height. Other remarkable species were *Psychotria angustata* - endemic to Floreana, but taxonomically perhaps hardly more than a glabrous form of *P. rufipes-, Darwiniothamnus tenuifolius,* and *Macraea laricifolia. Psychotria* shrubs were up to 1.5m tall, whereas *Darwiniothamnus* reached 2-3m, and *Macraea* 3-4m in height. *Tillandsia* was common as epiphyte as well as on the ground. As a whole, the vegetation was the same as in 1966.

Donkeys and goats are a serious problem for some plants on Floreana. Apart from the example of *Alternanthera nesiotes* already mentioned, *A. filifolia* spp. *nudicaulis* suffers from browsing, for example on the west side of the island. Donkeys seem to be more numerous than goats. Goat droppings were observed (January 1981) between Black Beach and Punta Saddle, and a piece of a stem of *Jasminocereus* seemed to have been gnawed off by goats. The problem of introduced animals needs attention on Floreana. Despite the fact that introduced animals have been present for a long time, the island has many unique botanical elements that are worth protection.

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TABLE 1. Floristic composition and degree of cover of different species in indigenous vegetation at alt. 380m on the west slope of Floreana, January 1981. Degree of cover according to the Hult-Sernander scale. Quadrat size 100m². Nomenclature follows Wiggins and Porter (1971).

	Quadrat No.	1	2	3	4
Trees					
Lippia salicifolia	Verbenaceae	—	3	—	—
Scalesia pedunculata	Compositae	—	—	—	4
Shrubs					
Baccharis steetzii	Compositae	—	1	1	1
Chiococca alba	Rubiaceae	—	1	—	—
Clerodendrum molle	Verbenaceae	—	1	—	—
Cordia cfr. anderssonii	Boraginaceae	1	—	—	—
Croton scouleri var. brevifolius	Euphorbiaceae	1	1	1	3
Darwiniothamnus tenuifolius var. tenuifolius	Compositae	2	—	2	1
Macraea laricifolia	"	5	5	2	3
Psychotria angustata	Rubiaceae	1	—	—	—
Zanthoxylum fagara	Rutaceae	—	—	1	1
Herbs and subshrubs					
Cissampelos pareira	Menispermataceae	—	—	1	—
Commelina diffusa	Commelinaceae	—	—	1	1
Galium galapagoense	Rubiaceae	1	—	—	—
Heliotropium angiospermum	Boraginaceae	—	—	1	1
Parietaria debilis	Urticaceae	1	—	—	—
Peperomia sp.	Piperaceae	1	1	1	1
Pilea baurii	Urticaceae	—	—	1	1
Plumbago scandens	Plumbaginaceae	1	—	1	—
Sida paniculata	Malvaceae	—	—	1	1
Tillandsia insularis	Bromeliaceae	2	2	1	1
Ferns					
Asplenium auritum va. auriculatum	Polypodiaceae	—	—	—	1
A. formosum	"	1	—	—	1
Polypodium dispersum	"	1	1	—	1
P. tridens	"	5	3	1	4
Trachypteris pinnata	"	—	—	1	1

Epiphytes
Quadrat No. 1: **Phoradendron henslovii, Tillandsia insularis.**
Quadrat No. 2: **Peperomia sp., Polypodium tridens, Tillandsia insularis.**
Quadrat No. 3: **Phoradendron henslovii.**

EXPERIMENTAL REPATRIATION OF CAPTIVE-REARED LAND IGUANAS *(CONOLOPHUS SUBCRISTATUS)* AT CARTAGO BAY, ISABELA

by

Robert P. Reynolds, Staff Herpetologist, CDRS

The captive rearing program for endangered Galápagos land iguanas *(Conolophus subcristatus)* was established at the Darwin Station in 1976 with the cooperation of the Galápagos National Park Service and the financial support of the World Wildlife Fund and the San Diego Zoological Society. Included in this program are breeding adults from the islands of Isabela, Santa Cruz, and North Seymour. Since 1978, when the first hatching occurred, in excess of 200 iguanas have hatched successfully in captivity.

Land iguanas on Santa Cruz and southern Isabela were threatened with extinction as a result of predation by feral dogs, which reached a peak in the mid 1970's. Feral dogs became abundant on Santa Cruz and in the Cartago Bay area of Isabela in the early 1970's (Kruuk 1979), and by 1976 they had almost completely eliminated land iguanas at these sites (Cifuentes and MacFarland 1976). Approximately 30 adults from Cartago Bay and 60 from Santa Cruz were rescued at that time, and these animals constitute the breeding stock for the current rearing program.

The ultimate success of this program depends upon the eventual return of the young iguanas hatched and reared at the Station to their ancestral habitats. Until recently we could not achieve this objective because of the continued presence of feral dogs on Santa Cruz and southern Isabela. In 1981, however, the National Park Service initiated a dog eradication campaign on southern Isabela with funds provided by the Frankfurt Zoological Society. This effort has proved highly successful, virtually eliminating dogs from the coastal regions and drastically reducing highland populations. National Park wardens encountered no dogs and no evidence of dogs during an intensive 17 day survey of Cartago Bay in early 1982 (Calvopiña 1982). In light of these results, we formulated plans to release captive-raised juvenile iguanas at Cartago Bay this year.

To follow the iguanas' progress after their return to the wild, we sought an Ecuadorian scholarship student. Lcda. Yolanda Célleri, from the Central University of Quito, arrived at the Darwin Station in February to begin a one-year study of the repatriation effort. She began by familiarizing herself with all aspects of the iguana breeding program at the Station as well as working on South Plaza Island with Howard and Heidi Snell (former principal investigators, land iguana conservation program). There, Yolanda prepared herself for the study of repatriated iguanas by learning such techniques as handling and marking iguanas and by gaining a basic understanding of the ecology and behaviour of iguanas in a natural situation.

In April, we made a reconnaissance of Cartago Bay to assess the availability of plant foods required by juvenile iguanas and to select a release site. As the rainy season had just ended, the vegetation on Cerro Cartago was quite lush, and many preferred iguana food plants such as *Opuntia, Lantana, Waltheria,* and various grasses were particularly abundant. We selected Cerro Cartago as the release site because of the abundance of vegetation as well as the presence of many old, uninhabited iguana burrows which would serve as shelter for the released animals. Also, we found no evidence of feral dogs in the area, in agreement with the Park wardens' findings previously mentioned.

We selected 37 juvenile iguanas from the 1980 and 1981 breeding seasons and measured, weighed, and permanently marked them for future identification. On 5 May 1982 the juveniles, accompanied by personnel of the National Park and Darwin Station (all of whom were silently wondering at what point Murphy's Law would intervene), were aboard the Beagle IV and under way for their new home. Thankfully, no problems were encountered during transport and by 0900h the following day, all 37 juveniles had been released at various sites along the base and sides of Cerro Cartago.

At present, the returned juveniles appear to have adapted well to their new environment. Yolanda's initial reports reveal that the iguanas are actively foraging on a variety of plant species and many have taken up

residence in the old iguana burrows. Additional releases at Cartago Bay are planned for 1983; the success of this repatriation experiment, however, will not be known for a number of years.

The Galápagos National Park Service will begin eradicating feral dogs on Santa Cruz later this year, and if this project proves to be as successful as the southern Isabela effort, juvenile iguanas will be returned to Cerro Dragon and Conway Bay on NW Santa Cruz in 1983.

ACKNOWLEDGEMENTS

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National Park Superintendent Fausto Cepeda (right) and Warden Fausto Llerena with the first captive-bred Land Iguana to be released in the wild. *Photos by Donna Reynolds*

GALAPAGOS FLAMINGO CENSUS — 1982

by

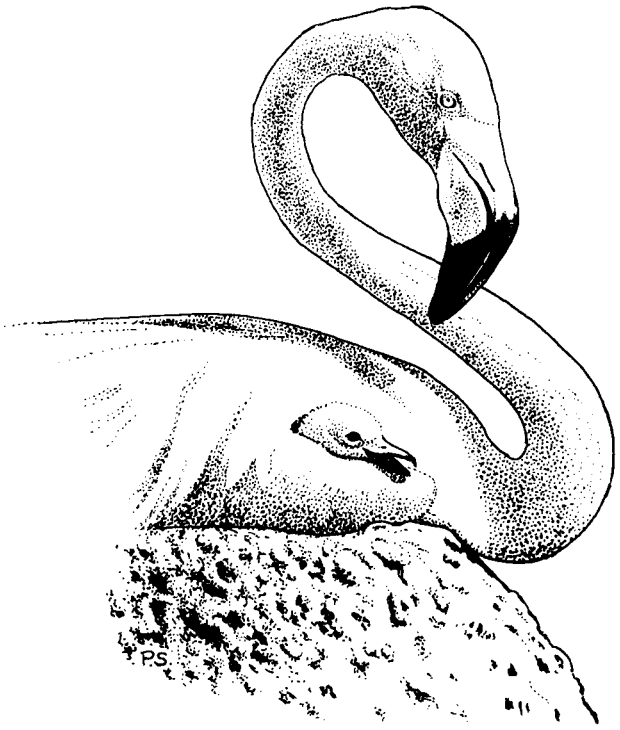
Sylvia Harcourt, Acting Ornithologist, CDRS

Organising a flamingo census is rather like mounting a military manoeuvre. 5 boats have to get 24 people to 6 different islands so that they all arrive in time to do the simultaneous count at 10.00 hours on the fixed day.

Plans can be made weeks in advance but with this number of people problems are bound to occur and this year was no exception. Everything was arranged and then there was a radio call from Isla Isabela:"Will you change the date; all my park wardens have to go to Western Isabela for the tortoise nest protection programme and will not be back in time." I could not change the date but I could arrange for a boat to pick them up 3 days earlier and drop them off at the lagoons on Southern Isabela. From there they could walk back to Villamil after the count.

Another call from National Park headquarters. One of their boats had developed engine trouble and could not make the trip to Floreana. That was one of the most important sites as the flamingoes were nesting there this year for only the second time since 1964. After two letters, a ham radio call and a chance meeting on the road, Rolf Wittmer, a resident of Floreana, agreed to use his boat and do the count.

Various other small problems. Someone did not have a watch so how would he know when it was 10.00?: the Darwin Station had just loaned out the last of their 5 gallon water containers and I needed six for the various people on Santiago: we were short of one tent, and had to borrow from the herpetology programme. Finally, all arrangements were complete and I departed on Beagle IV on January 12 to leave my "censadores" at various islands and sites around Santiago.



Galapagos Flamingo *Drawing by Peter Scott*

On January 13, at 10.00, we all counted flamingoes at our various lagoons — number of adults, juveniles, chicks and eggs. All that work and the census itself only took a few minutes!

The results were encouraging. There were 418 adults plus juveniles, 43 chicks and 9 eggs. This is a higher count than last year when the figures were 371 adults and juveniles, 21 chicks and 3 eggs. Results for 1976 were 442, 21 and 32 respectively. Hence the figures for 1981 seemed low and prompted me to arrange the census again this year. Previously it had been done on a four year basis.

What is most encouraging is the amount of breeding activity this year and particularly that the birds are again nesting at Punta Cormorant, Floreana. The nests are on a little islet so cannot be reached by feral animals; and their natural predator, the Galapagos Hawk, is very rarely seen on Floreana because of persecution by the inhabitants. Similarly at the 'Cementerio' lagoon on Isabela: to reach the nests involves wading and swimming through liquid mud for about 10 minutes, enough to deter any predator or curious tourist!

There are several lagoons that could not be checked for various reasons but most of these, apart from Bahia Tortuga, rarely have more than 2-4 birds. Possibly 50-60 more birds could be added to the total.

This still results in a low figure but a relatively stable one since 1968 when the first census was done and 512 individuals were counted. The flamingo population is definitely small, fragile and subject to disturbance. Their habit of making their mud nests at the edges of lagoons renders them vulnerable to trampling by feral goats and prey for dogs and pigs. Thus their present nesting sites, particularly the largest one in S. Isabela, must be protected from all disturbance if flamingo numbers are to remain relatively stable and these birds are to continue to be one of the special sights of Galapagos.

BOB SILBERGLIED MEMORIAL

The recent tragic death of Bob Silberglied in the Washington Air Florida crash was a shocking loss to tropical science, STRI and the Smithsonian Institution. It was also a crushing blow to the wide circle of his personal friends. At the Smithsonian Tropical Research Institute and at the Smithsonian Institution we have received a large number of enquiries and suggestions about how we can respond in a fitting way to this loss, and honor our memories of Bob. We feel that we should do this in a way consistent with his hopes and aspirations. Since his life was utterly dedicated to science and since tropical biology was his absorbing passion we have established, through the Smithsonian Institution, Washington, D.C. 20560, a Robert E. Silberglied Memorial Fund. At present the overwhelming view is that this fund should be devoted to providing Fellowships in Tropical Entomology for young biologists.

Should you feel moved to support the fund you can do so by sending your contribution to the Smithsonian Institution, Accounting Office, L'Enfant Plaza 3500, Washington, D.C. 20560. This fund will be administered without overhead and contributions are considered as charitable for U.S. income tax purposes.

EFFECTS OF FERAL PIGS AND DONKEYS ON THE DISTRIBUTION OF SELECTED FOOD PLANTS

by

Henk van der Werff

During an 18-month period of field work aimed at a description of the vegetation types of Santa Cruz and the Alcedo volcano on Isabela, (van der Werff, 1978), it became clear that there are significant differences in distribution and abundance of terrestrial orchids between the two localities.

Only one species, *Tropidia polystachya,* was found to be present in roughly the same habitat and the same abundance on both Santa Cruz and Alcedo.

Differences in distribution (a species present only on Santa Cruz or only on Alcedo, but not on both) can generally be attributed to differences in habitat: the required habitat is present in only one location and so is the species. Examples are *Cranichis lichenophila,* found once on a poorly weathered cinder cone on Alcedo; *Habenaria alata,* locally common on cinder or pumice slopes on Alcedo; and *Habenaria monorrhiza,* common in the Pampa zone on Santa Cruz. Other terrestrial orchids restricted to one of the two localities include an unidentified *Cranichis* species on Alcedo, probably the recently described *C. werffii* (Garay, 1978), known from the volcanoes Wolf and Darwin, and *Erythrodes weberiana* and *Govenia utriculata* on Santa Cruz. There is only one report of *Erythrodes* (Weber, 1974) and the *Govenia* has not been found lately and has probably disappeared.

Finally, there are two terrestrial orchids present both on Santa Cruz and Alcedo, but with different abundances and growing under different climatic conditions. This observation was rather puzzling, as one would expect the habitats for the species to be the same in both localities. On Santa Cruz *Liparis nervosa* is not rare in the *Miconia* scrub, but is very rare outside it (only two plants found, both in *Scalesia* forest on the eastern slope). On Alcedo *Liparis* occurs in evergreen forest comparable to the *Scalesia* forest on Santa Cruz and in even drier evergreen scrub. Although the Alcedo habitats are much drier than the *Miconia* scrub, the Alcedo plants were at least as large and vigorous as the Santa Cruz ones. *Prescottia oligantha* is, on Santa Cruz, a rare species in the Pampa vegetation. On Alcedo *Prescottia* occurs in evergreen forest or scrub, a much drier habitat than the Pampa zone. The Alcedo plants were distinctly larger and more vigorous than the Santa Cruz plants.

In general, my field observations indicate that terrestrial orchids on Alcedo are more abundant and occur in drier habitats than on Santa Cruz, where terrestrial orchids are mostly confined to the Miconia and Pampa vegetation.

DISCUSSION

Climate or substrate factors do not offer an explanation for the different distributions of *Liparis* and *Prescottia* on Santa Cruz and Alcedo. These differences are probably a result of foraging by feral pigs, which dig up and eat orchids. Feral pigs are present on Santa Cruz and absent from Alcedo. Most terrestrial orchids in the Galapagos have either thick, fleshy roots *(Cranichis, Erythrodes, Prescottia),* pseudobulbs *(Govenia, Liparis)* or tubers *(Habenaria)* in which food is stored. The exception is *Tropidia polystachya,* which has thin, dry, fibrous roots and which is the only species present on both Santa Cruz and Alcedo in similar habitats and with similar abundances. Pigs do not forage with equal intensity in all climatic zones, but seem to prefer to the drier ones. Examples of their damage to animal life are from rather dry areas (destruction of sea turtle nests on Santiago (Green, 1981); destruction of tortoise nests, which are mostly in the arid zone (MacFarland et al., 1974)). Thus, the *Miconia* and Pampa zones on Santa Cruz serve as refuges for terrestrial orchids with fleshy roots, pseudobulbs and tubers. These vegetation zones are marginal habitats for some orchids *(Liparis, Prescottia,* possibly *Erythrodes)* and outside the tolerance limits for other species *(Govenia, Cranichis* sp.), which are presently not known to coexist with feral pigs on Santa Cruz.

The distribution of terrestrial orchids on other islands is in agreement with the feral pig effect. For instance, only two terrestrial orchids are known from San Cristobal, an island with feral pigs (but also otherwise severely disturbed); one of these, *Govenia,* was last collected by Captain Wood in 1846 (Weber, 1974). On the other hand, six species of terrestrial orchids occur on Pinta, a much smaller island than San Cristobal but without feral pigs. Pinta is the only island in the Galapagos where *Govenia* still occurs. It is not likely that feral goats, which were present on Santa Cruz but absent from Alcedo at the time of my field work, reduce the numbers of terrestrial orchids to the extent that pigs do. Ten years ago the vegetation of Pinta was severely damaged by goats (Weber, 1971), but since hunting programs were initiated, the vegetation has shown a strong recovery and terrestrial orchids are now rather common.

There are other indications that introduced animals can reduce the abundance of their preferred food plants. *Opuntia insularis* is rather scarce on Alcedo and is largely confined to the edges of steep *arroyos,* where donkeys cannot trample the plants, or to the center of dense thickets. The largest plant I saw in 1975 was in the center of a thicket of spiny shrubs; in 1977 the thicket was broken open, the *Opuntia* pushed over and eaten. Andersson (1857), who visited Alcedo in 1852 (he did not name the locality he visited on Isabela, but reported thick pumice deposits; according to McBirney & Williams (1969) such deposits are only known from Alcedo), mentioned that *Opuntia* cacti were very common. This is not the case any more. *Nicotiana glutinosa,* known in the Galapagos only from Alcedo, is restricted to vertical *arroyo* walls. Seedlings occur in flat terrain as well, but apparently do not survive the donkeys. *Galvezia leucantha,* a rare endemic, was found once on Alcedo inside a dense thicket; all peripheral branches were eaten. Again, some seedlings were present outside the thicket, but no older plants.

Although the damage to the vegetation by pigs and donkeys is far less serious than that by goats, or damage to the endemic reptiles by rats, cats, pigs and dogs, it is nevertheless useful to signal it. Future studies will probably reveal more instances of such damage and this knowledge may eventually influence the conservation programs of the National Park Service.

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SANTA FE NEWSLETTER

by

Andrew Laurie

Dr. Laurie continues the account, begun in Noticias No. 35, of his three year investigation into the population dynamics of that extraordinary Galapagos speciality, the marine iguana. Research in depth is required as a basis for protection programmes on other islands where the species is under threat.

Two, or sometimes three, people on this island for a few months have already made a clear trail from the landing place to our campsite and from the campsite down to the shore below. It shows us just how fragile these islands are and how easily they can be changed by man. We have to be constantly on guard against the introduction of exotic invertebrates with our food supplies, and the arid conditions make us treasure each and every island plant and animal. The struggle for survival is starkly demonstrated to us by the death from avian pox in December of one of the two young mockingbirds which lived near the camp. What efforts we had seen going into the rearing of that bird last year! And this year the rains never really materialized and despite several attempts at nesting the parent mockingbirds failed to raise any young this season.

Marine iguanas, feeding in the sea where the food supply is more constant, are less dependent on the vagaries of the weather, although they are sometimes prevented from feeding by high seas and heavy swells. Numbers are high and consequently death is a more frequent occurrence: each day we collect information on predation and deaths from other causes. Most of this season has been spent on Sante Fé continuing work on survival and growth rates and making detailed observations on breeding behaviour to determine the reproductive potential of marine iguana populations. Our days start at dawn, whether in the mists and drizzle of October or under the clear skies of December. Mockingbirds land beside us and wake even the sleepiest of us by singing noisily in our ears. The resident land iguanas come out from their shelters and watch us go about our business. Later in the day we shall find one in the tent sheltering from the sun and another knocking over the organic waste bucket in search of banana skins. A young hawk visits camp quite often and uses our tents as refuges from attack by his parents who are trying to drive him away from the area. He has a fascination for all things rubber and spends hours toying with rubber tent guys or the rubber feet of my tripod. I am so accustomed to living here now that I hardly move when an owl lands on my sleeping bag in the middle of the night: we look at each other, I check the time by the stars and perhaps go to sleep again.

In November Diego Villalba and I captured 200 adult marine iguanas (100 males and 100 females) in a colony on a convenient peninsula below camp and marked them with large numbers painted on both flanks so that they were easily identifiable from a distance of 50 metres or more with binoculars. Mark Eckstein and I then maintained an almost continuous daytime watch on the colony during the territorial and mating season, and later did the same at the main nesting area when the females were nesting. As expected, we found that a large proportion of the males did not breed. Only 32 of the 100 males were known to hold territories and of the 25 which held territories on the peninsula only 14 are known to have mated; and two males between them accounted for 24 of the 49 matings observed there. Only one non-territorial male managed to mate — and once only.

More surprising was that we found strong evidence that a large proportion of the females did not breed either. Of the 100 marked females, 74 were resident mainly on the peninsula during the mating season and only 12 of these were seen mated. Most females spent some time off the peninsula, so some matings could have been and undoubtedly were missed. However, during the nesting season, of 24 peninsula females seen nesting 10 were known to have mated and 14 had not been seen mated but presumably must have mated while off the peninsula. Thus 10 out of 12 or 83% of those known to have mated were seen nesting but only 14 out of 62 or 23% of those not seen mated; implying either that some females are not reproducing at all or that they reproduce only in alternate years or less often. This is perhaps understandable when one calculates that the production of two 100 gm eggs by a female of 700 gm is comparable to a 130lb woman giving birth to twins weighing 19lbs each! The fact that adult females do not breed every year is important

when considering the potential reproductive rate of other populations confronted by introduced predators such as cats, dogs and pigs.

Similarly important is knowledge of the age at which the iguanas reach sexual maturity and start to breed. Already, from measurements of the growth over one year of animals of various sizes, marked at the beginning of the study, we are starting to come to some tentative conclusions. It appears that females do not reach sexual maturity until about 6 years of age and males not until the age of 7 or 8 and they may not breed until even later.

The survival rate of hatchlings on Santa Fé where there are no introduced predators is still over 40% after one year, which greatly exceeds that of less than 0.5% after six months reported by Norbert Rauch at Punta Nuñez, Santa Cruz, and those indicated by my censuses on many other islands in 1981. However, the censuses were made either before or well after the 1981 hatching season and although there was strong evidence of high hatchling mortality it was not possible in some areas to discount a low reproductive rate (laying or hatching) as the reason for the very small proportion of young animals in the population. This season, therefore, we visited colonies on Fernandina and Isabela during or just after the hatching season and found much larger numbers of hatchlings than in 1981: for example, 51 at Punta Espinosa in May 1982 compared with 6 in July 1981, and 70 and 8 respectively at Muñeco, northern Isabela. Reproductive rates are low initially in many sites but early hatching mortality is nevertheless important. The Great Blue Heron, *Ardea herodias,* a native predator, seems likely to be responsible at Punta Espinosa and cats are the culprits at Muñeco.

Complete analysis of cat faeces collected on Isabela and Santa Cruz in 1981 and 1982 showed that cat predation on marine iguana hatchlings was most severe at Muñeco, where 66% of July 1981 faeces and 50% of May 1982 faeces contained hatchling remains. At other sites however there is little or no cat predation on marine iguanas. The main food remains found vary enormously between sites and between seasons, with remains of crabs, boobies, rats, mice and grasshoppers all being locally abundant and other remains including those of lava lizard, snake, penguin, shearwater, fish, Darwin's finches, cormorant, ants, beetles, centipede, cat, sealion, furseal, pelican, various unidentified plants, bones, feathers, hairs, eggshells and mollusc shells.

The other major introduced predators, the dogs, have been the target of an intensive eradication project by the National Park Service and there were no dogs or fresh signs of them at Caleta Webb by early 1982. Their eradication probably came just in time to save the iguanas. A total of 1536 marine iguanas were counted in May 1982, compared with 2099 counted over the same stretch of coastline by Hans Kruuk and Howard Snell in March 1979; the number of large adult males, the main prey of the dogs, was down from 270 in 1979 to only 68 in 1982.

Nest sites, food, condition of females and predation are all possible limiting factors for marine iguana populations. Which of them is the most important probably depends on the location and the particular conditions prevailing. The fact that even native predators appear capable of substantially reducing hatchling abundance suggests that predation is an important limiting factor. There is an interesting comparison in this respect between land iguanas and marine iguanas in that Howard Snell found that the survival of land iguana hatchlings was almost entirely dependent on their condition at emergence. He used as an index of condition the ratio of weight to body length and found that survivors after one year had significantly higher indices of condition at emergence than those that died. The same index used on marine iguanas on Santa Fé showed no such relationship, implying that survival of marine iguana hatchlings is less dependent on relative condition at emergence. Perhaps this is due to the greater constancy of the marine iguanas' food supply. Many questions remain to be answered and during the coming season on Santa Fé we shall attempt to answer at least some of them.

DOES *SCALESIA HELLERI* OCCUR ON SOUTH ISABELA?

by

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Scalesia helleri Robins. is known from Sante Fe (Barrington) and southern Santa Cruz, on both islands preponderantly inhabiting steep coastal cliffs. Some years ago, Dr. Henk van der Werff drew my attention to two sheets of *S. helleri* in the U.S. Nat. Herbarium in Washington. These specimens were assumed to have been collected on south Isabela (Albemarle). Through the courtesy of the Director of the Herbarium, I was allowed to borrow them for examination. They were found to represent *S. helleri* typical of specimens collected on Santa Fe and in some places on Santa Cruz. The information on the labels is as follows:

> *Scalesia helleri* Robins., Albemarle Island, coast west of Villamil, June 6, 1960, Coll. Raymond Lévêque, Nos. 92, 109 (U.S. Nat. Herb., Nos. 2826939, 2826940).

I sent a letter to Dr. Lévêque, suggesting that the specimens might have been mislabeled and in reality had been taken on Santa Fe. The following is an excerpt from his reply of 7 February 1978:

> "I have checked my diary and find that on 4th of June 1960 (not 6th) I was indeed at Villamil, Albemarle, in company of Jacob Lundh. We walked 3 hours west of Villamil, along the coast, along some ponds where we looked for flamingoes etc., and reached a place called Baraona, 2 lagoons after a small coastal hill. Where exactly the *Scalesia helleri* was taken I cannot now remember, if at all, and I never made a list of the plants I collected. ... Another thing: although I went twice to Barrington at least, for short trips, I almost surely did not collect *S. helleri* there ..."

Although I regard occurrence of *S. helleri* on south Isabela as unlikely, I would like to ask scientists and others visiting the actual area, kindly to watch for any *Scalesia* with lobed leaves. I do not think it will be found. If I am wrong, the record would be extremely interesting, and I would be grateful for all information.

Known range of *Scalesia helleri* (within dotted line). The arrow points at the approximate location, where the species is said to have been found on Isabela.

BOOK REVIEWS

Race with Extinction

Herpetological Field Notes of J.R. Slevin's Journey to the Galapagos 1905-06.

Edited by Thomas H. Fritts and Patricia R. Fritts. 106 pages.

This is Herpetological Monograph No. 1 of the Herpetologists' League (Publications Secretary, W. Ronald Heyer, Smithsonian Institution, Natural History Building, Washington D.C. 20560 U.S.A.). It reproduces Slevin's actual herpetological notes made almost daily during the year-long collecting cruise in the Galapagos, mounted by the California Academy of Sciences. These notes have hitherto existed only in a fragile manuscript and should not be confused with Slevin's "Log of the Schooner Academy", published in 1931.

The monograph contains much herpetological detail of value only to specialists but there are many observations of more general interest and some light is thrown on the abundance of both native and feral animals in the early days of this century. Your reviewer, a non-scientist, found much to interest him. The toughness of the present generation of Galapagos scientists, regardless of sex, has rightly won great admiration but it is sobering to read this record of the hardships their grandfathers (there were no women on board the Academy) could apparently take in their stride.

Galapagos: Islands Lost in Time

By Tui de Roy Moore. George Allen & Unwin (London), £15 and Viking (New York), $25.

Tui de Roy, now Mrs. Moore, arrived in the Galapagos as a baby and sees the islands as a native, not as a tourist. Her book is the story of a child growing up in the wilderness and learning about nature by direct experience. Later, as she explored the remoter shores and volcanoes she took up photography to give expression to her love of the islands and her search for beauty. She ends her story by explaining that she must now leave the Galapagos because the quiet hamlet where she lived has suddenly boomed into a sprawling tourist village, dominated by the profit motive. Her feelings are understandable, although she might agree that the commercialization of this little human settlement is a small price to pay for the preservation of nine-tenths of the archipelago as a National Park, free from residents, buildings, private property or development and with strict protection for wildlife and wilderness.

Mrs. Moore's book stands or falls by its copious illustrations. They are different from the ordinary run of Galapagos photographs and may disappoint some visitors because she does not see her islands through a tourist's eyes: but then, the same could be said of Turner's greatest pictures. Moreover few visitors are on the rim of the volcano before dawn to observe and record the fascinating play of light and shadow. It is a matter of taste, but personally I find several of the reproductions too dark, and I would gladly have sacrificed some of the 300 colour photographs in return for a less cramped lay-out of the rest. But by any standards the book is full of unusual and outstanding pictures of the land, the sea and the peculiar animals and plants of the wild Galapagos.

G.T.C.S.

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While emphasizing that the continuing success of conservation in the Galapagos is directly dependant on the receipt of future contributions, we wish once again to place on record our deep gratitude to all those supporters whose generosity has made it possible to achieve so much during the last twenty years.

G. T. Corley Smith
Editor of "Noticias"

Peter Kramer
President
Charles Darwin Foundation

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