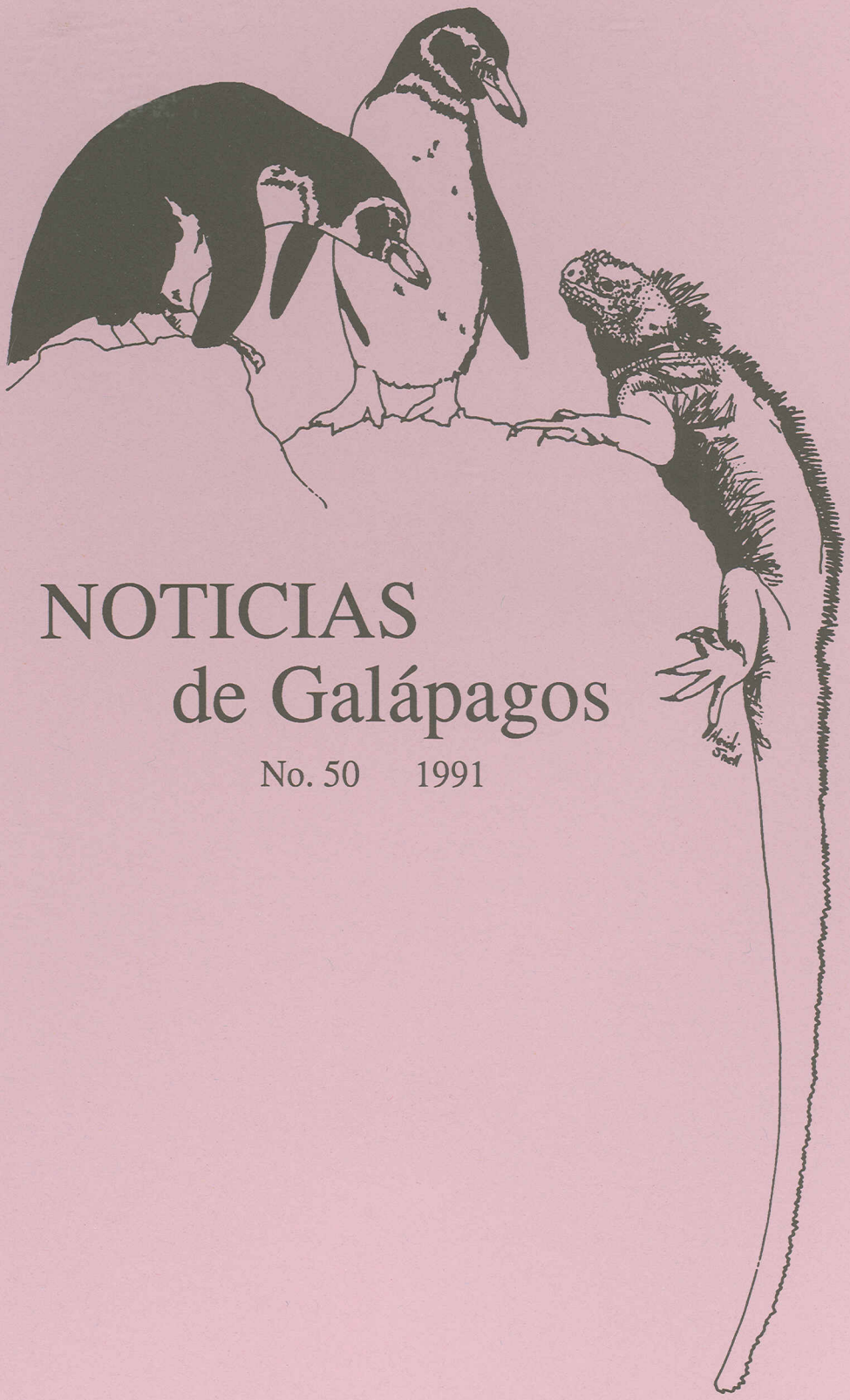


NOTICIAS de Galápagos

No. 50 1991

FUNDACION CHARLES DARWIN PARA LAS ISLAS GALAPAGOS
CHARLES DARWIN FOUNDATION FOR THE GALAPAGOS ISLANDS
FONDATION CHARLES DARWIN POUR LES GALAPAGOS

NOTICIAS DE GALAPAGOS

A Publication about Science and Conservation in Galápagos,
the Galápagos National Park Service, and the Charles Darwin Research Station

No. 50 1991

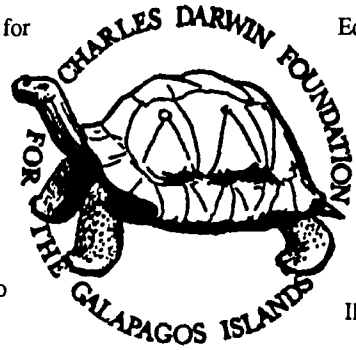
Contents

Published by The Charles Darwin Foundation for the Galápagos Islands

An International Organization created under the auspices of the Government of Ecuador, UNESCO, and the International Union for the Conservation of Nature & Natural Resources

Partial Financial Assistance from UNESCO and the Tinker Foundation, Inc.

Printed by the University of New Mexico Printing Services



Editor: Thomas H. Fritts, Noticias de Galápagos, National Museum of Natural History, Washington, DC 20560, USA

Associate Editor: Howard L. Snell, Biology Department, University of New Mexico, Albuquerque, New Mexico 87131, USA

Front Cover Design by Heidi Snell

Editorial Assistants: Rayann E. Robino and Laurence Hoess

Illustration on Inside Back Cover by Katie Lee

NEWS FROM ACADEMY BAY

Donation Made in Memory of Last Grandchild of Ecuador's First President.—General Juan José Flores, the First President of Ecuador, established Ecuadorian sovereignty over the Galápagos Islands in 1832. The Island of Floreana was named for him.

A generous donation has been received from Mr. Marcello De Giorgis in memory of his mother, Amalia Flores De Giorgis, who died in the spring of 1990 in Rome at the age of 94. She was the last living grandchild of General Flores. Although she never visited Galápagos, Mrs. Flores De Giorgis followed with great interest her son's descriptions of Isla Floreana.

The donation will be used by the CDRS and Galápagos National Park Service to support the program for protection of the endangered Dark-rumped Petrel on Floreana. **Craig MacFarland, 836 Mabelle, Moscow, Idaho 83843, USA.**

Deaths of CDF Board Members.—The world conservation movement and the Galápagos Islands lost two avid supporters with the deaths in August 1989 of Sir Peter Scott and in December 1990 of Dr. Kai Curry-Lindhal.

Sir Peter Scott was an internationally acclaimed artist and naturalist. He was founder of the Wildfowl Trust in Great Britain, a founder of the World Wildlife Fund International (now known as the World Wide Fund for Nature) of which he was Chairman and also of its British National Appeal, and for 15 years Chairman of the Fauna Preservation Society in the United Kingdom. He was a tireless exponent, traveler, and worker for international conservation efforts and a member of the Charles Darwin Foundation Executive Council for many years. He visited the Islands numerous times, especially in the 1970s, and was instrumental in helping to raise considerable funds for conservation of the Galápagos via WWF-International.

Dr. Kai Curry-Lindhal, of Sweden, was an active member of the CDF Executive Council, especially during the early formative years of the Foundation. More recently, he worked for many years as a key professional at the United Nations Environmental Programme at its headquarters in Nairobi, as well as being involved in international conservation activities for several decades through participation in many organizations.

They will be sorely missed by the international conservation community, but the many young people they helped inspire will certainly continue the work which they were so instrumental in starting and nurturing. **Craig MacFarland.**

Major Gift by Mrs. Louise Van Straelen-Poirier.—Mrs. Van Straelen, who sadly passed away in early 1990, has donated via her last will 5 million Belgian Francs (=US $140,000) to the Charles Darwin Foundation. Her will specifies the contribution to be "for conservation and science in the Galápagos Islands," and that it is "in remembrance of Dr. Victor Emile Van Straelen, Founder and First President of the Charles Darwin Foundation."

The donation was made via WWF-Belgium, which is in the process of transferring the funds to the Galápagos Darwin Trust-Europe, based in Luxembourg.

Three years ago Mrs. Van Straelen donated over US $200,000 for Galápagos conservation and science through the World Wide Fund for Nature. This gift formed the core of the major debt swap arrangement between that organization, the Government of Ecuador, Fundación Natura (Ecuador), and the CDF.

Once again the CDF has benefited enormously from the dedication and generosity of Dr. and Mrs. Van Straelen, who will be remembered forever for their pioneering efforts on behalf of the Islands and the Foundation. **Craig MacFarland.**

***Itasca* to Galápagos.**—Galápagos gained new friends and renewed old acquaintances as a result of a visit by Mr. and Mrs. Robert Daugherty of Omaha, Nebraska, USA, and by guests aboard their ship *Itasca* in March 1989. The group included Mr. and Mrs. Allen Jacobson and Mr. and Mrs. Stanley Hubbard. Generous donations from Mr. Jacobson, Chief Executive Officer of 3M Company, and Mr. Hubbard, President of Hubbard Broadcasting, helped purchase a fiberglass patrol boat for the Galápagos National Park Service. The 3M Company also made a large donation of their products for environmental education programs in the Islands.

Mr. Daugherty, President of Valmont Industries,

provided a large boost to the research and conservation programs of the Station by donating six computers with printers and battery backup units to the Smithsonian Institution for use in the Galápagos. This equipment brought the Station firmly into the computer age strengthening science and student training programs. The equipment is particularly applicable to the development of the biostatistics course to be taught periodically at the Station and in the establishment of a better data base for environmental monitoring.

The Charles Darwin Research Station and Galápagos National Park Service are grateful to Messrs. Daugherty, Jacobson, and Hubbard for their generous support of conservation in the Galápagos. Their donations provided basic tools and resources needed for essential work. **Daniel Evans, Charles Darwin Research Station, Isla Santa Cruz, Galápagos, Ecuador.**

Station Research Vessel.—On 3 October 1990, the Charles Darwin Foundation acquired a new research vessel for the CDRS. The ship is a 42-ft fiberglass fishing vessel with a 20-ton capacity. It was built in Norway in 1978 and imported to Ecuador in 1979. The current sleeping capacity is for only four people; however, the cabin will be expanded to allow the ship to sleep at least eight. It is expected that the ship will operate at a speed of 9-10 knots, with a cruising range of over 1,000 miles. Due to its speed, size, cost, ample deck space, and range, this ship is ideally suited to fulfill the needs of the Station. It was decided to retain the name *Beagle*, without using a number.

The ship was found in Manta by Godfrey Merlen, who will be in charge of directing the necessary refitting prior to bringing the vessel to the Galápagos. Godfrey's assistance and knowledge have been invaluable in obtaining a suitable ship. **Daniel Evans.**

ERYTHRINA VELUTINA AND THE COLONIZATION OF REMOTE ISLANDS

By: Peter Grant, K. Thalia Grant, and B. Rosemary Grant

Erythrina velutina is a familiar tree at middle elevations on the south side of Isla Santa Cruz. Unlike most Galápagos trees it flowers when leafless in the dry season. The flowers are large, showy, red, and tubular, and are apparently adapted for pollination by long-tongued animals like hummingbirds (Faegri and van der Pijl 1971); yet hummingbirds have never been on the Galápagos as far as anyone knows.

It came as a surprise to us in April 1978 to find half a dozen large trees of this species on Isla Wolf. The Island is not very high: the maximum elevation is 253 m (Wiggins and Porter 1971). It is also remote. How did they get there? In November 1978 we had a further surprise in discovering one single tree on the west side of Isla Genovesa, probably no more than 20 m above sea level but an estimated 400 m inland. How did it arrive there?

Judging by the amount of colorful plastic to be found on uninhabited Genovesa and by the habit of Red-footed Boobies and frigate birds of carrying pieces of vegetation while flying around the coast, we might surmise that the bright red seeds (beans) of *Erythrina* have been picked up from the sea or the shores on which they have been washed and dropped on the Island. Or a landbird, such as a dove or a mockingbird, might have picked up a seed from the beach and taken it inland before discarding it. Either way the seeds would have to float in seawater for several days to reach remote islands like Genovesa, Wolf, as well as Darwin (Wiggins and Porter 1971).

To test this idea we placed 30 seeds in a jar of seawater on Genovesa, stirred the water whenever we were back in camp, and recorded how many floated and how many sank. Four immediately sank, and in the next 72 hours five more did. Thus, after 3 days, 21 of the original 30 seeds were still afloat. Three days travel at sea under natural conditions would have carried them an unknown distance from their island of origin. If they travelled in the range of 1-5 m per minute they would be displaced somewhere between 4.5 and 22.0 km in that time.

The experiment was carried out in November 1978.

Erythrina velutina blossom on Isla Genovesa. *La flor de* Erythrina velutina *de Isla Genovesa.*

In June 1983, near the end of the extraordinary El Niño event that lasted for 8 months, we found almost 100 *Erythrina* seeds on the beaches of Genovesa, as well as even more seeds of manzanillo (*Hippomane mancinella*), a species which does not grow on the Island. If the *Erythrina* seeds had been released from the single known tree on Genovesa, how had they got down to the sea? It seems more likely they floated in from another island, as the *Hippomane* seeds did. Had they been washed down to the sea in the torrents and temporary rivers that flowed frequently that year, on Santa Cruz for example, or Santiago, and then out to Genovesa? It is even possible they were carried all the way from the South American continent.

With the possibility of even longer than intra-archipelago transport in mind, we repeated our earlier flotation experiment, but this time extended its duration. Fourteen of the 20 seeds initially floated, and 11 were still afloat 3 days later, a result similar to the previous one. After an additional 4 days, 10 seeds were still afloat. Given the artificiality of the experiment (mainly still water, temperatures reaching the low 30°C), the results surely testify to a high potential for long-distant transport by sea. However, we stopped the experiment too soon to provide clear-cut proof. At the estimated maximum sustained rate of 5 m per minute a seed would be in the water for 14 days in travelling the 100 km from Santiago, the closest source Island, to Genovesa. The passage from Santiago to Wolf by sea would take more than a month, and from the continent to Galápagos it would take almost half a year.

Similar experiments (Grant et al. 1975) have demonstrated the same floating ability for 8 out of 22 common arid zone species of plants. Whether *Erythrina* and other seeds can germinate after a long spell in the sea is another matter. Experiments are needed to answer this question. We must presume the seeds can germinate, in order to account for the presence of *Erythrina* trees on Genovesa, Wolf, and Darwin.

Once a single tree has become established, is it doomed to leave no descendants? We thought it would be doomed because from 1978 to 1982 we found seeds beneath the single tree on Genovesa, but never a sapling. It would have been legitimate to conclude after 5 years of observation that *Erythrina velutina* was self-compatible (in being able to produce seeds) but that progeny were inviable. And our conclusion would have been wrong! In July 1983 there were nine small saplings growing beneath the tree ranging from 15 to 30 cm in height. Evidently the more than 2,400 mm of rain which fell that year (Grant and Grant 1989) were sufficient to germinate at least a few of the seeds. Seven were present the following (dry) year and five were present in the drought of 1985. We have visited the site every year since 1987, each time finding two were alive. Both survived to 1991 and were healthy and in bud in February. One, 20 cm tall, stands under the canopy of the parent, 1.5 m from its trunk. The other, 35 cm tall, stands just beyond the canopy 4 m from the trunk.

The parent tree on Genovesa is old. Thirty-five rings were counted in a dead branch less than 2.5 cm in diameter; thus, if one ring is laid down each year the branch was at least 35 years old when it died. Given the much greater diameter of the tree trunk (48 cm at 0.5 m height), we can extrapolate to a total age of 700 years or more. This seems extraordinarily old and needs to be verified. Tree-ring studies (e.g., Grant 1981) would help to determine if the reasoning is plausible. At the moment the tree stands 6 m tall, produces leaves and seeds each year, and looks basically healthy. If it dies before its offspring do, then it may be replaced by two, and very gradually a population may build up.

We suppose this happened on the even more remote and apparently inaccessible Islands of Wolf and Darwin. A single seed reaching one of these Islands by sea, being transported to the flat region on top, and germinating, seems improbable enough. Two seeds establishing themselves is even less likely. Nevertheless a single colonization assisted by a bird, followed by multiplication, would explain the puzzle of *Erythrina* trees on these remote Islands in the Archipelago.

LITERATURE CITED

Faegri, K., and L. van der Pijl. 1971. The principles of pollination ecology. 2nd edition. Pergamon Press, New York.

Grant, B.R., and P.R. Grant. 1989. Evolutionary dynamics of a natural population: the Large Cactus Finch of the Galápagos. University of Chicago Press, Chicago.

Grant, P.R. 1981. Population fluctuations, tree rings and climate. Noticias de Galápagos 33:12-16.

Grant, P.R., J.N.M. Smith, B.R. Grant, I.J. Abbott, and L.K. Abbott. 1975. Finch numbers, owl predation and plant dispersal on Isla Daphne Major, Galápagos. Oecologia 19:239-257.

Wiggins, I.L., and D.M. Porter. 1971. Flora of the Galápagos Islands. Stanford University Press, Stanford, California.

Peter R. Grant, K. Thalia Grant, and B. Rosemary Grant, Department of Ecology and Evolutionary Biology, Princeton University, Princeton, New Jersey 08544-1003, USA.

THE PASSING OF TWO BELOVED REPTILES: ONAN AND CHIQUITA

By: Linda J. Cayot

AN OBITUARY FOR A TORTOISE

The most individualistic, ornery, beloved tortoise in Galápagos died early last year. Onan, an ancient male tortoise, lived alone for most of this century in the central crater of Isla Pinzón. As a result of the overexploitation of tortoises in the 1800s and early 1900s, the tortoise population on Pinzón fell to dangerously low levels. The tortoise surveys in the 1960s showed less than 200 tortoises were left on Pinzón, and all but Onan lived on the outer western and southern slopes. In the central crater, Onan reigned alone.

Onan spent so many years alone that he began exhibiting amorous intentions with tortoise-shaped rocks. During a visit to Pinzón in 1970 by Craig

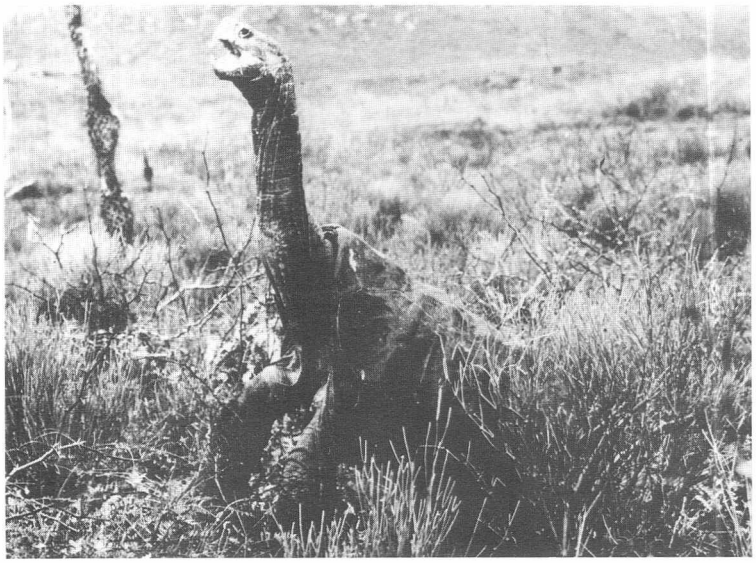


Figure 1. Onan was always alert to intruders entering his area and would do his utmost, for a turtle, to stand tall and control the situation (photograph by T.H. Fritts). *Onan siempre estuvo alerta de los trasgesores en su territorio, manteniéndose en pie y haciendo todo lo posible por controlar la situación.*

MacFarland and Peter Kramer, Onan's special rock-loving behavior was discovered. MacFarland named him "Onan" after the biblical character.

During the past 20 years, as part of the rearing and repatriation program run jointly by the CDRS and the GNPS, nearly 300 young tortoises have been repatriated to Pinzón, many of them to the central crater. Thus, Onan spent his last two decades in the company of many young tortoises.

Onan usually greeted the scientists and wardens visiting Pinzón's central crater, approaching with his mouth wide open and his head held as high as possible (Fig. 1), an aggressive posture typical of antagonistic interactions between tortoises competing for food, water, shade, or mates. Reaching for his maximal height, he would often lift one of his front feet and totter momentarily with a tripod stance. He was not large, but he stood tall. If you raised your hand or head above his or gently tapped him on the head, he would submit by withdrawing, at least for a moment. He was difficult to photograph because he walked straight at the camera, sticking his head right into the lens. One strategy was for the photographer to lie on the ground and snap the photographs just before being overrun by the tortoise.

Onan looked ancient, with little extra flesh on his bones and a scarred carapace covered with lichens. In his final years he was nearly deaf and blind. His presence on Pinzón made every visit to that Island special for all who had encountered him before. He was last seen alive during the tortoise census of February 1990. Then, on a trip 4 months later, Washington Tapia, German Morillo, and Gayle Davis found his remains.

By the turn of the century, rats were so abundant on Pinzón that Rollo Beck concluded that all hatchlings were consumed by rats. If so, the possibility exists that Onan was a product of the 19th century, one of the last generations produced before rats took over Pinzón. As to his exact age, no one knows for sure, but he was a true patriarch, likely well over 100 and possibly over 150 years old.

Onan was buried on Pinzón on 4 June 1990 and he shall remain there as a part of his Island. Future trips to Pinzón will not be the same for the Park personnel, Station biologists, and other scientists who knew him. We will all miss him.

AN OBITUARY FOR AN IGUANA

Chiquita, the unofficial mascot of the CDRS, died on 25 April 1990. In the early days of the Station, a young land iguana was found roaming the grounds. When Doña Magdalena Velez began working in the dormitories in 1965, she continually saw the small iguana and named it Chiquita because of the iguana's small size. Chiquita lived on to roam the Station grounds for more than 25 years (Fig. 2).

Doña Magdalena was Chiquita's best friend. In the years that Doña Magdalena worked in the dormitories (1965-82), Chiquita was most often found there. Magdalena often sat on the ground and Chiquita approached closely, often climbing onto her lap to be fed chocolates and bananas. Chiquita loved to be scratched and would stand in the typical upright posture that some iguanas use to encourage finches to remove ticks. After Magdalena retired, Chiquita frequented other homes at the Station to

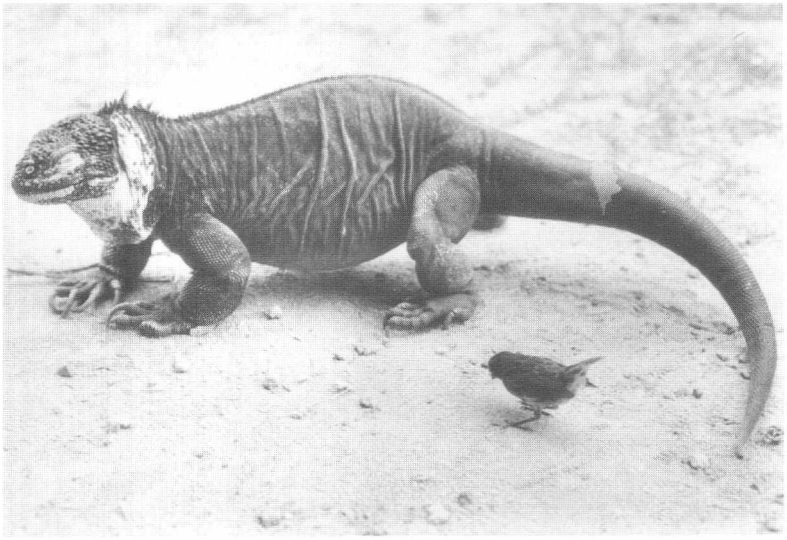
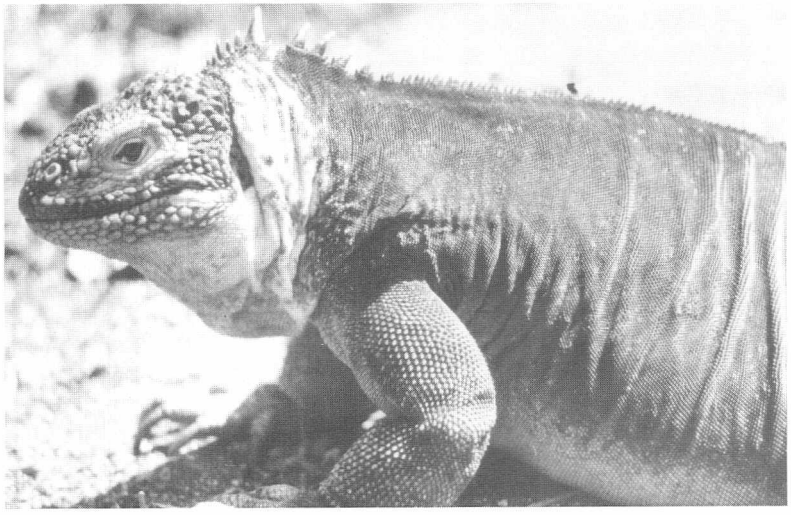


Figure 2. The aging of Chiquita was evidenced in part by a marked darkening of her pigmentation from hues of brown and orange in 1977 (above) to dull black in 1986 (below; photographs by T.H. Fritts). *La edad de Chiquita se pone en evidencia al mostrar un marcado oscurecimiento en su pigmentación, desde matices marrón anaranjado en 1977 (superior) a negro opaco en 1986 (inferior).*



receive her daily rations. (Of course, she also ate native vegetation.)

For many of us, Chiquita was our first encounter with a land iguana. Often within a day or two of someone's arrival at the Station, she surprised them by looking in the screen-door of their dormitory room.

Chiquita was found dead in front of Cruz Márquez's house (one of her favorite hangouts in recent years) early on 26 April. Unlike Onan, she was autopsied; her liver was found to have failed. Her skeleton will become a part of the museum collection at the Station. We will miss seeing her roaming around the Station.

With the passing of Onan and Chiquita and with the first record of hatchling tortoises on Isla Española ("grandchildren" of the native adults in captivity; see article this issue), we move into a new era, with the hope that current management programs will continue to protect Galápagos reptile populations well into the next century and the one after that.

Linda J. Cayot, Charles Darwin Research Station, Isla Santa Cruz, Galápagos, Ecuador.

BIBLIOGRAFIA DE LA HORMIGA COLORADA *WASMANNIA AUROPUNCTATA* (ROGER) (HYMENOPTERA: FORMICIDAE)

Por: Patricia Ulloa-Chacón, Daniel Cherix, y Rolf Meier

La hormiga colorada pertenece a la subfamilia Myrmicinae y es originaria de América tropical. La especie fue descrita por primera vez en 1863 por Roger, quién basándose en especímenes colectados en la Isla de Cuba, la denominara *Tetramorium auropunctatum*. En 1893, Forel, establece el nuevo género *Wasmannia* siendo *W. auropunctata* la especie típica. A partir de esta fecha, se informa sobre la presencia de esta hormiga en diferentes partes de América Central, América del Sur, y las Islas del Caribe (ver Kempf 1972). Además de su área de repartición geográfica, la hormiga colorada ha sido introducida accidentalmente por el hombre en varias regiones del mundo, llegando a convertirse en un insecto de potencial importancia económica y ecológica. La especie ha sido registrada en Florida (Smith 1929, Wheeler 1929, Creighton 1950), California (Nickerson 1983), y Canadá (Ayre 1977). También se encuentra en varias islas, especialmente en las Galápagos (Silberglied 1972; Clark et al. 1982; Lubin 1984, 1985) y en otras islas del Pacífico Sur, como Nueva Caledonia (Fabrés y Brown 1978), Wallis y Futuna (Gutierrez 1981), y en las Islas Salomón (Ikin 1984, Macfarlane 1985).

La hormiga colorada es considerada como una plaga no solamente en aquellos sitios donde ha sido introducida sino también en otras regiones neotropicales. Se destacan los problemas causados a nivel de la agricultura ya que esta hormiga protege otras especies dañinas (áfidos, moscas blancas, cochinillas) en varios cultivos. Mencionemos el caso de los cítricos en Florida (Spencer 1941); café, cítricos, y ornamentales en Nueva Caledonia (Fabrés y Brown 1978); café en Puerto Rico (Smith 1937); café y cacao en Colombia (Posada et al. 1976); y cacao en Brasil (Delabie 1988). Asociado a este aspecto, se ha hecho énfasis en sus hábitos de picadura, lo cual perturba las labores de cosecha, y mantenimiento de campos cultivados (Spencer 1941, Delabie 1988). La hormiga colorada también puede infestar las viviendas rurales y urbanas (Spencer 1941, Smith 1942, Fernald 1947).

Uno de los principales problemas originados por la importación de W. *auropunctata*, es la eliminación de otras especies de hormigas y de invertebrados en algunas regiones. El ejemplo que mejor ilustra este problema es el caso de las Islas Galápagos. Varios estudios ecológicos y etológicos adelantados por diferentes autores (Clark et al. 1982; Lubin 1984, 1985; Meier 1985a, 1985b) revelan el impacto causado por esta especie sobre la fauna endémica (hormigas, escorpiones, y arañas) de estas islas.

Hasta el presente, son muy pocas las investigaciones que han sido adelantadas sobre la biología, comportamiento, y control de *W. auropunctata*. De manera muy concisa resumimos las principales características biológicas de la especie. La hormiga colorada no construye nidos, las colonias se establecen principalmente a nivel del suelo; entre la hojarasca, en la base de árboles frondosos y de palmas, bajo corteza, al interior de ramas huecas, e incluso en substratos artificiales como las basuras (Spencer 1941; Kusnezov 1951; Ulloa-Chacón y Cherix, en prensa). Los nidos vecinos se encuentran relacionados unos con otros sin exhibir agresividad entre ellos; existiendo por el contrario, un intercambio importante de individuos (obreras, reinas, y cría). Lo anterior conlleva a la formación de sociedades llamadas unicoloniales (Hölldobler y Wilson 1977) que llegan a ocupar grandes espacios.

En cuanto a su régimen alimenticio, la hormiga colorada es típicamente polífaga y oportunista. Ella se alimenta de miel de homópteros (Spencer 1941); de una gran variedad de presas (Artrópodos) y de material vegetal (Clark et al. 1982; Ulloa-Chacón y Cherix, en prensa).

Wasmannia auropunctata es una especie con una estructura social poligínica en la cual las sociedades poseen varias reinas fértiles. Por ejemplo, en la región de Bellavista (Isla Santa Cruz, Galápagos), 1 m^2 puede contener un promedio de 9 a 10 nidos y albergar hasta 25 reinas. Las obreras por su parte, son completamente estériles (Clark et al. 1982, Ulloa-Chacón y

Cherix 1988a) y se dedican exclusivamente al cuidado y a la alimentación de reinas y su cría. Nuestras observaciones sobre la biología de las reinas, en condiciones de laboratorio, indican que se trata de una especie con un alto potencial reproductivo (Ulloa-Chacón y Cherix 1988a). Una reina vive aproximadamente un año y puede poner hasta 70 huevos en un lapso de 24 horas.

El control de la especie ha sido basado principalmente en el uso de insecticidas tradicionales como ciertos productos organoclorados y organofosforados (Fernald 1947, Nickerson 1983). Otros métodos de control cultural, como la utilización de bandas pegajosas (Spencer 1941, Delabie 1989) han sido también utilizados. En la búsqueda de otras alternativas de control, se recomienda el uso de productos reguladores del crecimiento como son los análogos de la hormona juvenil (Williams 1987). Los primeros estudios sobre el efecto de un análogo de la hormona juvenil (metopreno), muestran que dichos productos son bastante promisorios para el control de *W. auropunctata* (Ulloa-Chacón y Cherix 1990).

Dentro de nuestro proyecto de investigación sobre la biología y control de la hormiga colorada, hemos realizado la siguiente recopilación bibliográfica, que comprende un total de 73 publicaciones relacionadas con esta especie.

BIBLIOGRAFIA

Ayre, G.L. 1977. Exotic ants in Winnipeg, Canada. Manitoba Entomologist 11:41-44.

Borgmeier, T. 1928. Einige neue Ameisen aus Brasilien. Zoologische Anzeiger 75:32-39.

Bruneau de Miré, P. 1969. Une fourmi utilisée au Cameroun dans la lutte contre les mirides du cacaoyer *Wasmannia auropunctata* (Roger). Café, Cacao, Thé 13:209-212

Carrion, J.G. 1986. Ecología alimenticia de la hormiga colorada. Colegio Nacional Galápagos. 32 pp.

Carvajal, V. 1983. Mecanismo de difusión de la hormiga colorada *Wasmannia auropunctata* en la Isla Santa Cruz. Colegio Nacional Galápagos. 30 pp.

Clark, D.B., C. Guayasamín, O. Pazmiño, C. Donoso, y Y. Páez de Villacís. 1982. The tramp ant *Wasmannia auropunctata*: autecology and effects on ant diversity and distribution on Santa Cruz Island, Galapagos. Biotropica 14:196-207.

Creighton, W.S. 1950. The ants of North America. Bulletin of the Museum of Comparative Zoology 104:1-585.

Delabie, J.H.C. 1988. Ocorrência de *Wasmannia auropunctata* (Roger, 1863) (Hymenoptera, Formicidae, Myrmicinae) em cacauais na Bahia, Brasil. Revista Theobroma 18:29-37.

Delabie, J.H.C. 1989. Avaliação preliminar de téchnica alternativa de controle da formiga "pixixica" *Wasmannia auropunctata* em cacauais. Agrotrópica 1:75-78.

Delabie, J.H.C. En prensa. The ant problems of cocoa farms in Brazil. *En* R.K. Vander Meer, K. Jaffe, y A. Cedeño (eds.), Applied myrmecology: a world perspective. Westview Press, Boulder, Colorado.

Donisthorpe, J.K. 1915. British ants: their life-history and classification. William Brendon & Son. Ltd., Plymouth. 379 pp.

Donoso, C., y Y. Páez de Villacís. 1978. Distribución y ecología de *Wasmannia auropunctata* en Santa Cruz, Galápagos. Universidad Central del Ecuador, Quito. 104 pp.

Emery, C. 1894. Studi sulli formiche della fauna neotropica. VI-XVI. Bollettino della Società Entomologica Italiana 26:137-242.

Emery, C. 1905. Studi sulle formiche della fauna neotropica. XXVI. Bollettino della Società Entomologica Italiana 37:107-194.

Emery, C. 1914. Intorno alla classificazione dei Myrmicinae. Pp. 29-42 *en* Rendiconto dell'Accademia delle Scienze dell'Istituto di Bologna.

Fabrés, G., y W.L. Brown, Jr. 1978. The recent introduction of the pest ant *Wasmannia auropunctata* into New Caledonia. Journal of the Australian Entomological Society 17:139-142.

Feinsinger, P., y L.A. Swarm. 1978. How common are ant-repellent nectars? Biotropica 10:238-239.

Fernald, H.T. 1947. The little fire ant as a house pest. Journal of Economic Entomology 40:128.

Forel, A. 1884. Etudes Myrmécologiques en 1884, avec une description des organes sensoriels des antennes. Bulletin de la Société Vaudoise des Sciences Naturelles 20:316-380.

Forel, A. 1886. Espèces nouvelles de fourmis amér-

icaines. Annales de la Société Entomologique de Belgique 30:38-49.

Forel, A. 1887. Fourmis récoltées a Madagascar par le Dr. Conrad Keller. Mitteilungen der Schweizerischen Entomologischen Gesellschaft 7:381-389.

Forel, A. 1893. Formicides de l'Antille St.-Vincent récoltées par M.H.H. Smith. Transactions of the Entomological Society of London 4:333-418.

Forel, A. 1895. A fauna das formigas do Brazil. Capitulo II. Catalogo systematico das formigas Brazileiras ate hoje conhecidas. Boletim do Museu Paraense Emílio Goeldi 1:101-143.

Forel, A. 1897. Quelques Formicides de l'Antille de Grenada, récoltées par M.H.H. Smith. Transactions of the Entomological Society of London 3:297-300.

Guayasamín, C. 1977. Distribución de la hormiga colorada *Wasmannia auropunctata* en la Isla Santa Cruz, Galápagos. Pontificia Universidad Católica, Quito, Ecuador. 45 pp.

Gutierrez, J. 1981. Actualisation des données sur l'entomologie économique à Wallis et à Futuna. 24 pp.

Hogue, C.L., y S.E. Miller. 1981. Entomofauna of Coco Island, Costa Rica. Atoll Research Bulletin 250:1-29.

Hölldobler, B., y E.O. Wilson. 1977. The number of queens: an important trait in ant evolution. Naturwissenschaften 64:8-15.

Horvitz, C.C., y D.W. Schemske. 1984. Effects of ants and an ant-tended herbivore on seed production of a neotropical herb. Ecology 65:1369-1378.

Horvitz, C.C., y D.W. Schemske. 1986. Seed dispersal of a neotropical myrmecochore: variation in removal rates and dispersal distance. Biotropica 18:319-323.

Howard, D.F., M.S. Blum, T.H. Jones, y M.D. Tomalski. 1982. Behavioral responses to an alkylpyrazine from the mandibular gland of the ant *Wasmannia auropunctata*. Insectes Sociaux 29:369-374.

Ikin, R. 1984. Solomon Islands cocoa tree-ant. FAO Asia and Pacific Plant Protection Commission, Quarterly Newsletter 27:8.

Keller, L., D. Cherix, y P. Ulloa-Chacón. 1989. Description of a new artificial diet for rearing ant colonies as *Iridomyrmex humilis, Monomorium pharaonis* and *Wasmannia auropunctata* (Hymenoptera: Formicidae). Insectes Sociaux 36:348-352.

Kempf, W.W. 1972. Catálogo abreviado das formigas da Região Neotropical (Hymenoptera: Formicidae). Studia Entomologica 15:3-344.

Kusnezov, N. 1951. El género *Wasmannia* en la Argentina. Acta Zoologica Lilloana 10:173-182.

Levings, S.C., y N.R. Franks. 1982. Patterns of nest dispersion in a tropical ground ant community. Ecology 63:338-344.

Lubin, Y.D. 1983. An ant-eating crab spider from the Galapagos. Noticias de Galápagos 37:18-19.

Lubin, Y.D. 1984. Changes in the native fauna of the Galapagos Islands following invasion by the little red fire ant, *Wasmannia auropunctata*. Biological Journal of the Linnean Society 21:229-242.

Lubin, Y.D. 1985. Studies of the little fire ant, *Wasmannia auropunctata*, in a niño year. Pp. 473-493 *en* El Niño en las Islas Galápagos: el evento de 1982-1983. Fundación Charles Darwin para las Islas Galápagos, Quito, Ecuador.

Macfarlane, R. 1985. Coconut nutfall bug (*Amblypelta cocophaga*). Research Department, Agriculture Division (Solomon Islands), Annual Report 1984.

Martinez, N.L. 1988. Comparación de la effectividad de cuatro cebos en el control de la hormiga roja *Wasmannia auropunctata*. Tesis no publicada. 102 pp.

Meier, R.E. 1985a. Coexisting patterns and foraging behavior of ants on giant cacti of three Galapagos Islands, Ecuador. Experientia 41:1228.

Meier, R.E. 1985b. Interference behavior of two tramp ants at protein baits on the Galapagos Islands, Ecuador. Experientia 41:1228-1229.

Nickerson, J.C. 1983. The little fire ant, *Ochetomyrmex auropunctata* (Roger) (Hymenoptera: Formicidae). Florida Department of Agriculture and Consumer Services, Division of Plant Industry, Entomology Circular 248.

Osburn, M.R. 1948. Comparison of DDT, chlordane and chlorinated camphene for control of the little fire ant. Florida Entomologist 31:11-15.

Pazmiño, O.E. 1976. Ecología de la hormiga colorada *Wasmannia auropunctata* en la Isla Santa Cruz, Galápagos. Pontificia Universidad Católi-

ca, Quito, Ecuador. 34 pp.

Posada, L., I.Z. Polania, I.S. Arévalo, A. Saldarriaga, F. Garcia, y R. Cárdenas. 1976. Lista de insectos dañinos y otras plagas en Colombia. Instituto Colombiano Agropecuario Boletín Técnico 43:1-97.

Roger, J. 1863. Die neu aufgeführten Gattungen und Arten meines Formiciden-Verzeichnisses, nebst Ergänzungen einiger früher gegebenen Beschreibungen. Berliner Entomologische Zeitschrift 7:131-214.

Sacoto, X.L. 1981. Pruebas en laboratorio para el control de la hormiga *Wasmannia auropunctata* mediante la utilización de cuatro cebos. Universidad Central del Ecuador, Quito. 180 pp.

Schemske, D.W. 1980. The evolutionary significance of extrafloral nectar production by *Costus woodsonii* (Zingiberaceae): an experimental analysis of ant protection. Journal of Ecology 68:959-967.

Silberglied, R. 1972. The "little fire ant," *Wasmannia auropunctata*, a serious pest in the Galapagos Islands. Noticias de Galápagos 19/20:13-15.

Smith, M.R. 1929. Two introduced ants not previously known to occur in the United States. Journal of Economic Entomology 22:241-243.

Smith, M.R. 1937. The ants of Puerto Rico. Journal of Agriculture of the University of Puerto Rico 20:819-875.

Smith, M.R. 1942. The relationship of ants and other organisms to certain scale insects on coffee in Puerto Rico. Journal of Agriculture of the University of Puerto Rico 26:21-27.

Smith, M.R. 1965. House-infesting ants of the eastern United States. USDA, Agricultural Research Service, Technical Bulletin 1326:1-105.

Snelling, R.R. 1981. Systematics of social Hymenoptera. Pp. 369-453 *en* H.R. Hermann (ed.), Social insects. Vol. 2. Academic Press, New York.

Spencer, H. 1941. The small fire ant *Wasmannia* in citrus groves—a preliminary report. Florida Entomologist 24:6-14.

Torres, J.A. 1984a. Niches and coexistance of ant communities in Puerto Rico: repeated patterns. Biotropica 16:284-295.

Torres, J.A. 1984b. Diversity and distribution of ant communities in Puerto Rico. Biotropica 16:296-303.

Ulloa-Chacón, P., y D. Cherix. 1988a. Quelques aspects de la biologie de *Wasmannia auropunctata* (Roger) (Hymenoptera, Formicidae). Actes et Colloques Insectes Sociaux 4:177-184.

Ulloa-Chacón, P., y D. Cherix. 1988b. Gynandromorphism in the little fire ant *Wasmannia auropunctata*. Bulletin de la Société Entomologique Suisse 61:398.

Ulloa-Chacón, P., y D. Cherix. 1989. Etude de quelques facteurs influençant la fécondité des reines de *Wasmannia auropunctata* (R.) (Hymenoptera, Formicidae). Actes et Colloques Insectes Sociaux 5:121-129.

Ulloa-Chacón, P., y D. Cherix. 1990. Perspectives de contrôle chimique de la petite fourmi de feu *Wasmannia auropunctata* au moyen d'analogues de l'hormone juvénile. Actes et Colloques Insectes Sociaux 6:187-194.

Ulloa-Chacón, P., y D. Cherix. En prensa. The little fire ant, *Wasmannia auropunctata* (Roger) (Hymenoptera: Formicidae). *En* R.K. Vander Meer, K. Jaffe, y A. Cedeño (eds.), Applied myrmecology: a world perspective. Westview Press, Boulder, Colorado.

Vega de la, I. 1987. Comportamiento en búsqueda de alimento de *Wasmannia auropunctata* y hormigas nativas, y competencia entre ellas. Pp. 99-108 *en* Informe Anual, Estación Científica Charles Darwin, Isla Santa Cruz, Galápagos.

Vega de la, J.M. 1988. Comportamiento en búsqueda de alimento de *Wasmannia auropunctata* y hormigas nativas, y competencia entre *W. auropunctata* y hormigas nativas en las Islas Santa Cruz e Isabela, Galápagos. Universidad Central del Ecuador, Quito. 102 pp.

Wheeler, G.C., y J. Wheeler. 1954. The ant larvae of the myrmicinae tribes Meranoplini, Ochetomyrmicini and Tetramoriini. American Midland Naturalist 52:443-452.

Wheeler, W.M. 1901. Notices biologiques sur les fourmis mexicaines. Annales de la Société Entomologique de Belgique 65:199-205.

Wheeler, W.M. 1908. Ants of Puerto Rico and Virgin Islands. Bulletin of the American Museum of Natural History 24:117-158.

Wheeler, W.M. 1908. The ants of Jamaica. Bulletin of the American Museum of Natural History

24:159-163.
Wheeler, W.M. 1929. Two neotropical ants established in the United States. Psyche 36:89-90.
Williams, D.F. 1987. Foreign travel report in Galapagos Islands. Attini (An International Newsletter on Pest Ants) 18:16-17.
Young, A.M. 1983. Patterns of distribution and abundance of ants (Hymenoptera: Formicidae) in three Costa Rican farm localities. Sociobiology 8:51-76.

Patricia Ulloa-Chacón, Departamento de Biología, Universidad del Valle, AA 25360 Cali, Colombia y Musée Zoologique, Palais de Rumine, Case Postale 448, CH-1000 Lausanne 17, Switzerland. Daniel Cherix, Musée Zoologique, Palais de Rumine, Case Postale 448, CH-1000 Lausanne 17, Switzerland. Rolf Meier, Glaernischstrasse 152, 8708 Maennedorf, Switzerland.

WHO KILLED THE IGUANAS?

By: John M. Woram

Popular wisdom has it that no iguanas remain on Isla Baltra because American troops used them up for target practice during World War II. It's a believable legend: imagine being barely 20 years old, newly drafted, and sent to a place that could very well be the next Pearl Harbor. You have nothing to do but stand around and wait for something terrible to happen. But of course, nothing terrible does happen. In fact, nothing happens, period. It will take about 20 more years until the Charles Darwin Research Station is born and the world wakes up to the nonmilitary significance of this godforsaken place. But in the meantime, your home so far away from home is just "The Rock," a term of endearment formerly reserved for Alcatraz, another prison watched over by gun-toting guards. But on this rock, the guards are also the prisoners, for there is no ferry service back to more congenial surroundings at the end of each boring day. So you pass the idle moment by taking a few shots at some stupid lizards. So the story goes.

But eventually the war does end and everybody gets to go home. Some years later scientists arrive and note the absence of land iguanas. They recall the Island was occupied by American troops during the big one and set down the following observations: iguanas were here before the war; Americans were here during the war; iguanas are missing after the war. This leads to the obvious conclusion: the Americans killed all the iguanas. In due time, hypothesis becomes theorem, and today there's hardly a wildlife study or discussion of the Island that does not include the obligatory "senseless slaughter" reference. Despite the absence of a single firsthand account, the hypothesis is so believable that it passes unchallenged. It is almost as though we *expect* young men to do such things. And so the American troops are judged—in absentia and without trial—guilty.

Perhaps the judgment should be appealed, if not on the basis of newly found evidence, then at least on re-examination of the old, specifically, World War II records now preserved on microfilm at the United States Air Force Historical Research Center at Maxwell Air Force Base, Alabama, supplemented by information from the archives of the Smithsonian Institution and the Franklin Delano Roosevelt Library at Hyde Park, New York. By studying these documents it is possible to reconstruct—at least partially—an account of what did, and what did not, happen to the iguanas during the war.

The earliest reported use of Baltra by American forces was as a seaplane base, starting on 6 January 1942, with construction of a runway beginning in February (Panama Canal Department 1946). Before the first plane could land, wildlife warnings had already been heard in Washington. Dr. Waldo LaSalle Schmitt, curator of the Smithsonian Institution's Division of Marine Invertebrates, took advantage of his acquaintance with President Franklin Delano Roosevelt to sound the alarm. In 1938, Schmitt was part of the presidential cruise to Galápagos aboard the U.S.S. *Houston*. And now, knowing of the President's continuing personal interest in the Islands, Schmitt wrote him on 4 March 1942 to warn of a "great danger that the iguanas, both land and marine,

which are no longer very plentiful, may be made the objects of target practice." He continued with the suggestion that the hunting of goats and other feral animals be encouraged (Roosevelt 1942). A month later, the first plane landed, followed by the arrival of an Army contingent on 9 May (Panama Canal Department 1947). Within the next 2 weeks, the commanding officer of the brand new Army Air Base, Colonel William Gravely, distributed a memorandum to draw attention to the status of the Islands as a game preserve. The 20 May memorandum stated that the "The killing of all animals and birds is prohibited" (Johnson 1942).

A few weeks later, the Smithsonian's Assistant Secretary, Dr. Alexander Wetmore, directed Dr. Schmitt to proceed to Galápagos to investigate the possibility of establishing a small laboratory adjacent to the Navy facilities (Wetmore 1942a, 1942b). This time, his cruise would be somewhat less than presidential; after a 5-day voyage out of Panamá, the tuna clipper *Liberty* dropped Schmitt on Baltra—now code-named Base Beta—on Thursday morning, 25 June. He returned to the mainland by plane on Saturday, 27 June 1942. In his 7 July report to Dr. Wetmore, Schmitt noted that:

> Some sections much favored by [the iguanas] have been completely denuded of all vegetation in the course of land leveling operations. The goats and remaining iguanas have been driven into, or concentrated in, perhaps half the range that they formerly occupied. Thus, the animals come into closer competition for food (Wetmore 1942b).

Schmitt also reported that:

> Due to the indiscriminate use of pistols during the early phases of the military occupation, so many iguanas were killed that a severe epidemic of carrion flies resulted. [But] this, of itself, brought about some degree of protection, in order to eliminate the pest of flies (Wetmore 1942b).

Unfortunately, Schmitt's report does not elaborate on this, but we do know the remark about the pistols was not based on personal observation. For in his diary, Schmitt (1942) wrote, "Army killed iguanas with pistols, & let carcasses die . . . I guess [this] made a bad flie [sic] pest." However, this entry was made on 15 June—10 days *before* he arrived in Galápagos. By the time he actually got there he was able to jot down a cheerier note: "Killing of animals [is] out," perhaps as a result of Colonel Gravely's order (26 June entry, but misdated 25 June). But in any case, the Smithsonian did not want to take any chances on the future. The following excerpt is taken from a 20 November memorandum to the State Department, signed by Dr. Wetmore.

> It is recognized that disturbances through construction and actual occupancy are unavoidable, but it is important and necessary that all hunting for game or sport, and all other unnecessary molestation of the wild life [sic] be controlled and prohibited by the military authorities .... Should any [animals] be destroyed needlessly, much resentment inevitably will arise (Wetmore 1942c).

On 9 December 1942, Wetmore's memorandum was forwarded to the Commanding General, Caribbean Defense Command, along with a directive, by order of the Secretary of War, that:

> . . . you take appropriate action to prevent any unnecessary molestation of the wild life [sic] in the Galapagos Archipelago and to prohibit the introduction of domestic animals that may prey on the native fauna (Daily 1942).

Action was also needed on another front: during a brief visit to Washington, Commander J.J. Gest told Dr. Schmitt of "native laborers killing iguanas for their skins, but he put a stop to it so far as he was able" (Wetmore 1942d). Again the Smithsonian alerted the State Department:

> We have report of native laborers engaged in various work on the islands killing iguanas for their skins. This was stopped by one of the officers but may begin again at any time (Wetmore 1942e).

Both the State Department and the Smithsonian were aware that interested foreign agencies were monitoring the situation and could be expected to take action if the United States permitted the Galápagos habitat to deteriorate needlessly (Wetmore 1942e, 1942f). To say nothing of monitoring by the President himself, who throughout the war always found a little time to urge the preservation of the Galápagos as an international park. In a memorandum to the Secretary of State, Roosevelt wrote "I have been at this for six or seven years and I would die happy if the State Department could accomplish something [to persuade every country from Canada to the Straits of Magellan to get behind the idea]" (Roosevelt 1944).

In short, the protection of the flora and fauna was taken very seriously, even to the point of interceding in the actions of the civilian labor force.

But could the servicemen themselves be expected to take their orders as seriously as did their President

and the Smithsonian? In retrospect, perhaps they took them a little bit *too* seriously. For example, the orders made no distinction between endemic and feral animals—an unfortunate loophole that the Island's goats used to their advantage. A two-column headline in a 1945 edition of the base newspaper ominously reported that:

GOATS MAY BE BANNED FROM PX BEER GARDEN

It seems that some (human) newcomers had complained to the PX officer about the presence of the beasts, much to the disgust of the old-timers, who regarded the goats as fixtures. No action was taken, pending further study of the matter (Anonymous 1945). And so, along with their PX privileges, the animals prospered under a well-intentioned but misguided Uncle Sam. Alas, Schmitt's early recommendation to encourage goat hunting had apparently not reached the Island. And as a result, a 1946 inspection report from Major-General Harmon to the Chief of Staff noted that:

> The large number of native goats, protected by Executive Order, make a continuous practice of upsetting garbage and trash cans. They are a great annoyance and a menace to sanitation. Initiate request... for authority to round them up and transport them either to Little Seymour [i.e., Seymour Norte] or to Santa Cruz Island (Harmon 1946).

When not raiding the trash cans or drinking with their army buddies down at the PX, the goats had the unsettling habit of wandering (staggering?) across the runway at the most inconvenient moments, and at least a few landings had to be aborted on their account. But such close calls notwithstanding, it would seem that troops and herds lived in more-or-less peaceful coexistence, with the prohibitions against harming the wildlife still in effect.

But what of the iguanas, which is after all the subject of this inquiry? Is it likely that the troops would cheerfully spare the goats yet systematically risk official displeasure by taking the iguanas? The evidence, such as it is, suggests not. For whatever else the airmen did to pass their leisure time, they took pictures, some of which came to light recently as the result of the following chain of events.

In 1988, a veteran of the 29th Bombardment Squadron revisited the site of his wartime service. Former U.S. Army Air Force navigator Allan Beucher arrived aboard a Boeing 727, a far cry in time and technology from his earlier flights here in a Consolidated B-24 *Liberator*. His squadron had operated from Baltra during the period from May 1943 to April 1944 and again from May 1945 through the end of hostilities. During the inevitable wait for the bus to dock, Beucher reminisced out loud about his tour of duty and was overheard by a local guide who said for all to hear, "Oh, you're one of those Americans who murdered our iguanas" (A. Beucher, pers. comm.).

Beucher, who had no idea what the guide was talking about, recalled the unpleasant incident a few days later while visiting the Darwin Research Station. While there, Ms. Gayle Davis explained the cause of the guide's hostility, and Beucher protested vehemently. A month or so later, I arrived looking for help with the human history of Galápagos. Gayle recalled her recent meeting and gave me Allan's address. When we met, I found him *still* angry about his encounter. By happy circumstance the 29th was planning a reunion (their third) for June 1989, and a member mailing list was available. We quickly collaborated on a questionnaire in which the squadron members were challenged to dust off their memories and try to answer a few questions: Do you have any recollection of the iguana population when you arrived? When you left? While you were there, did the population increase/decrease/remain stable? Did you see any young iguanas? Do you have any first- or secondhand accounts of hunting iguanas, or of eating them?

Within a few weeks we received 24 responses to the 98 questionnaires we mailed out. The respondents were unanimous: although some recalled taking shots at sharks and rays in Canal de Itabaca, as for the iguanas, all denied anything more sinister than occasionally picking one up by the tail, trying to stage iguana races (unsuccessful) and iguana fights (ditto). At this late date, most respondents were uncertain about population fluctuations though none recalled seeing any young iguanas. Many said that the only hunting they did was with their cameras. Some had tasted green iguana (*Iguana iguana*) at Río Hato in Panamá, but none had done so in Galápagos. However, one respondent did recall seeing a single iguana that had been shot. He reported that this was an isolated case and definitely not the norm.

Our little survey is certainly not the last word in

scientific inquiry, and perhaps some will discount it for its obvious flaws. But, given the maturity that comes with the passage of almost a half a century, we would have expected a few remarks such as "Well of course we took a few shots at the damned animals. What would you expect from a bunch of kids?" Instead, we received a unanimous rejection of the very concept, followed by no shortage of angry comments at the subsequent reunion in June when the squadron members learned the full extent of the legend that has become part of Galápagos folklore.

At that reunion, many squadron members brought along their scrap books full of pictures of their buddies, of the planes they flew in, and of course, of the ubiquitous iguanas. The pictures, some of which are printed here, have one thing in common; the iguanas are reasonably plentiful, and all are quite large. Although there's no shortage of baby goat pictures, there is not one juvenile iguana to be seen. The same general situation was also noted by others stationed on Baltra. Dr. William Kennon was attached to the base hospital from August 1943 to March 1944. In a recorded interview he recalled that:

Dr. Edwin Rowe and a young patient (photograph courtesy of Dr. Edwin Rowe). *Dr. Edwin Rowe y un paciente juvenil.*

Not exactly a tiger by the tail, but . . . (photograph courtesy of Dr. Edwin Rowe). *No precisamente teniedo la cabra cogida por los cuernos . . . .*

> There were plenty of land iguanas. I never recall seeing or hearing of anybody deliberately killing one. Someone who acted as though he spoke with authority said, "You know, you only see large iguanas here on The Rock. You never see any small ones." After that I specifically noticed the size of the iguanas that we had, and all of them were fairly large (Kennon 1981).

Now, who (or what) do *you* think was killing off all the young iguanas while sparing their elders? It could hardly be the work of bored humans, who if so inclined would surely find the larger ones—to say nothing of the goats—far more attractive targets. And whatever the cause of the missing young, its effects had been observed long before World War II. William Beebe noted it in 1923 (Beebe 1924). Some 10 years later, the members of the Hancock Expedition observed that the iguanas were not thriving on Baltra and transported some of them to Seymour Norte (Banning 1933). Still later, Dr. Loren P. Woods visited Baltra with the Leon Mandel Galápagos Expedition, and it was remembered that "when he

visited Seymour in 1940, prior to the establishment of the military base, he found only a very few Land Iguanas—*all of them large adults*" (emphasis in original; Dowling 1964). And even as Dr. Schmitt prepared for his 1942 trip, he noted to himself that "Young land iguanas seem never to have been taken [on Baltra]" (Schmitt 1942).

Base Beta was formally turned over to the Ecuadorian authorities on 1 July 1946, by which time the American forces had been withdrawn, save for a small contingent which remained at the request of Ecuador. Apparently, a contingent of goats remained as well, for *Time* magazine reported that during the transfer ceremony, "Galápagos goats idled nearby" (Anonymous 1946).

With all of this offered for consideration, it would seem grossly unfair to continue blaming the American troops for a phenomenon that had been at work long before their arrival. To be sure, the heavy construction work, with subsequent air and road traffic, took a heavy toll on the surviving adults. But even this did not totally finish them off. For in January 1954, Dr. Irenäus Eibl-Eibesfeldt (1960) reported finding an iguana carcass on Baltra. He writes "The sun had shriveled up the creature's body but still I could make out from the bullet holes that the lizard had been shot." After noting that the Island had made life miserable for so many bored troops, he generously adds that "... we really cannot blame them for what they did."

But we have anyway, even though they didn't do it. For if American troops had indeed exterminated the last iguana prior to 1 July 1946, where did the one discovered in 1954 come from? How long had this unfortunate creature baked in the sun before Dr. Eibl-Eibesfeldt discovered it? One year? Two years at best? At risk of stating the obvious, it would seem that the very existence of an iguana carcass in 1954 is sufficient evidence that the American troops have been the victims of an ungenerous press.

As for the last iguana, whether it died in competition with a goat, in the jaws of a feral dog now also gone, or because of reproductive failure is not yet known. But since a few descendants of the original population do live on at Seymour Norte and in the CDRS breeding program, there is now the possibility of reintroducing land iguanas to Baltra. But first, knowing that their recent disappearance was not entirely due to bored American soldiers provides a stimulus for carefully examining all other possibilities, in search of the real truth. The eventual discovery of the cause of their demise may help us (and them) to prevent history from repeating itself.

LITERATURE CITED

Anonymous. 1945. Goats may be banned from PX beer garden. Goat's Whisker (U.S. Army newspaper published on Baltra) 2(23):1.

Anonymous. 1946. Ecuador: beachhead on the moon. Time 48(3):45.

Banning, G.H. 1933. Hancock expedition to the Galapagós [sic], 1933, general report. Bulletin of the Zoological Society of San Diego 10:1-30.

Beebe, W. 1924. Galápagos: world's end. G.P. Putnam's Sons, New York.

Daily, J.R. 1942. War Department letter, AG 680.25, 9 December. USAF Historical Research Center, Reference Division, Maxwell Air Force Base, Microfilm reel 32953 [Contained in deleted section of microfilm 32953, classified FOUO (for official use only), but subsequently released in hard copy (1989) through the Freedom of Information Act].

Dowling, H.G. 1964. Goats and hawks—a new theory of predation on the land iguana. Animal Kingdom 67(2):51-56.

Eibl-Eibesfeldt, I. 1960. Galapagos. Macgibbon and Kee, London.

Harmon, H.R. 1946. Memorandum of 29 March. USAF Historical Research Center, Reference Division, Maxwell Air Force Base, Microfilm reel 32953 [Contained in deleted section of microfilm 32953, classified FOUO (for official use only), but subsequently released in hard copy (1989) through the Freedom of Information Act].

Johnson, V.B. 1942. Memorandum of 20 May. USAF Historical Research Center, Reference Division, Maxwell Air Force Base, Microfilm reel 32953 [Contained in deleted section of microfilm 32953, classified FOUO (for official use only), but subsequently released in hard copy (1989) through the Freedom of Information Act].

Kennon, W. 1981. Transcript of taped interview, recorded for Alan Moore.

Panama Canal Department. 1946. Galapagos: preliminary historical study. Part II:3. USAF

Historical Research Center, Reference Division, Maxwell Air Force Base, Microfilm reel 32958.

Panama Canal Department. 1947. Galapagos. USAF Historical Research Center, Reference Division, Maxwell Air Force Base, Microfilm reel 32958.

Roosevelt, F.D. 1942. Letter of 4 March from Dr. Waldo LaSalle Schmitt. Franklin D. Roosevelt Library, Box OF 4017: Galápagos Islands.

Roosevelt, F.D. 1944. Memorandum of 1 April to the Secretary of State. Franklin D. Roosevelt Library, Box OF 4017: Galápagos Islands.

Schmitt, W.L. 1942. Diary. Smithsonian Institution Archives, Record Unit 7231: Waldo LaSalle Schmitt Papers, Box 100, Folder 8.

Wetmore, A. 1942a. Letter of 5 June to Dr. Waldo LaSalle Schmitt. Smithsonian Institution Archives, Record Unit 7006: Alexander Wetmore Papers (unprocessed) Box 90.

Wetmore, A. 1942b. Letter of 7 July from Dr. W.L. Schmitt. Smithsonian Institution Archives, Record Unit 7006: Alexander Wetmore Papers (unprocessed) Box 90.

Wetmore, A. 1942c. Memorandum of 20 November to Mr. M.L. Leap, Department of State. Smithsonian Institution Archives, Record Unit 7006: Alexander Wetmore Papers (unprocessed) Box 90.

Wetmore, A. 1942d. Letter of 25 August from Dr. W.L. Schmitt. Smithsonian Institution Archives, Record Unit 7006: Alexander Wetmore Papers (unprocessed) Box 90.

Wetmore, A. 1942e. Letter of 10 December to Mr. M.L. Leap. Smithsonian Institution Archives, Record Unit 7006: Alexander Wetmore Papers (unprocessed) Box 90.

Wetmore, A. 1942f. Letter of 17 December from Mr. M.L. Leap. Smithsonian Institution Archives, Record Unit 7006: Alexander Wetmore Papers (unprocessed) Box 90.

John M. Woram, 45 Lakeside Drive, Rockville Centre, New York 11570, USA.

A 25-YEAR MANAGEMENT PROGRAM PAYS OFF: REPATRIATED TORTOISES ON ESPAÑOLA REPRODUCE

By: Cruz Márquez, German Morillo, and Linda J. Cayot

The first indisputable evidence of successful reproduction by repatriated Galápagos tortoises (*Geochelone spp.*) was recorded on Isla Española on 30 November 1990. Two hatchlings were found approximately 90 m north of El Caco (one of the two release sites). Both were approximately 1 month old and had been eaten by hawks. Female No. 57 was observed completing a nest (0930), and female No. 61 showed evidence of recent nesting activity (dried mud covering her posterior region). The females were also located within 80-100 m of El Caco.

A total of four nests were found and were estimated at 1, 2, 5, and 8-10 days old. All were located within 100 m to the northwest of El Caco. Attempts at nesting (scrapes or holes in the soil) were found in the area surrounding El Caco, encompassing approximately 800 m to the north, 500 m to both the east and west, and 200 m to the south. Nest attempts were also seen in the region above Las Tunas (alternate release site). C. Márquez and T. Fritts had noted similar scrapes resembling nesting attempts on Española in December 1985 but now the evidence that the repatriated tortoises were reproducing is irrefutable.

Española tortoises (*G. hoodensis*) are the only race bred in captivity at the Charles Darwin Research Station (CDRS) as part of the breeding and rearing program run jointly by the CDRS and the Galápagos National Park Service (GNPS; MacFarland et al. 1974a, Márquez et al. 1990). Tortoises from other Islands are reared in the program, but using young extracted from natural nests. By the mid-1960s, the native population was too low for successful reproduction (MacFarland et al. 1974b). Beginning in August 1963, all tortoises found on Española were transferred to the breeding center at the CDRS. A third male, returned to the CDRS from the San Diego Zoo in July 1977, augmented the breeding population of 12 females and 2 males (Bacon 1978, Fritts 1978).

The first successful reproduction by Española tor-

toises in captivity was in 1970-71. The first hatchlings reared in the center were repatriated to Española (at El Caco) in 1975 (Fig. 1). Thus the oldest repatriates were nearly 20 years old in November 1990. The two females that showed evidence of having nested (Nos. 57 and 61) are both from the 1973-74 cohort, and were repatriated to El Caco in March 1978. They were nearly 17 years old when they nested. Whether or not their nests are successful will be determined at the end of the incubation season. Based on the November 1990 observations, Española tortoises first reproduce between the ages of 16 and 19 years.

Figure 1. Tortoise no. 27, one of the tortoises hatched in captivity in 1971 and returned to Española at the age of four, moves across the rock terrain in 1985 as a young adult male tortoise. *Tortuga no. 27, una de las tortugas criadas en cautiverio en 1971 y devuelta a Española a los cuatro años de edad, aparece aquí en 1985 en terreno rocoso como un macho subadulto.*

The breeding, rearing, and repatriation program of the GNPS and the CDRS has been very successful in increasing the threatened tortoise populations to a level of security. However, until the repatriated tortoises begin to successfully reproduce on their islands of origin, the ultimate success of the program is not assured. Although the only hatchlings found had been eaten by hawks, their appearance on Española is a major indicator of the ultimate success of this long-term program and the possibility exists that other young have escaped the notice of hawks and scientists alike.

LITERATURE CITED

Bacon, J.P. 1978. A tortoise goes home. ZooNooz 51(2):4-7.

Fritts, T.H. 1978. Española tortoise returns to Galápagos. Noticias de Galápagos 28:17-18.

MacFarland, C.G., J. Villa, and B. Toro. 1974a. The Galápagos giant tortoises (*Geochelone elephantopus*) part II: conservation methods. Biological Conservation 6:198-212.

MacFarland, C.G., J. Villa, and B. Toro. 1974b. The Galápagos giant tortoises (*Geochelone elephantopus*) part I: status of the surviving populations. Biological Conservation 6:118-133.

Márquez, C., S. Rea, and F. Llerena. 1990. Reproduction and rearing of giant tortoises and land iguanas in captivity. Pp.71-75 *in* CDRS Annual Report 1986-87.

Cruz Márquez, German Morillo, and Linda J. Cayot, Charles Darwin Research Station, Isla Santa Cruz, Galápagos, Ecuador.

REVIEW: PORTRAITS OF GALAPAGOS

Authored By: Tui De Roy and Mark Jones
Published 1990, First Edition, 98 pages, Imprents Mariscal, Quito, Ecuador.

Reviewed By: Gay Ver Steeg

This new "coffee-table" volume of photographs of the animals of Galápagos is a sensitive effort by Tui De Roy and Mark Jones, both permanent residents of Galápagos. It is primarily a photographic collection of close-ups by species of the most common land animals (various birds, giant tortoises, land iguanas, and lizards) and sea animals (marine iguanas, sea lions, fur seals, sperm whales, hammerhead

sharks, rays, crabs, and sea turtles) found in Galápagos. The book does not cover the fish (except for one shark and one ray), plants, or landscape of Galápagos. This book is not and does not claim to be a "field guide." The focus of the book is well stated in the title: *Portraits of Galápagos*.

The authors chose over 100 finely detailed photographs to demonstrate their captivation with the animals of the Islands. They obviously know their subject and have had the time to capture the rare moments. The layout is appealing, with coordinating colors on most of the pages and frequent use of effective borders. The photographs flow harmoniously from page to page; the book is not a jumble of individual images as some photographic essays are. Only occasionally does a photograph seem ill-chosen (such as one of the flamingos which has a somewhat distracting landscape). The quality of the paper seems to have slightly affected the brilliance of the photographs, but this would not keep me from buying the book, especially at the current price.

The book contains an introduction which emphasizes the impact Galápagos seems to have on all who venture there. We are given a brief insight into the philosophy of the authors as it relates to their experiences in Galápagos. Tui has lived in Galápagos since the age of two and Mark has lived there for about 10 years.

The table of contents contains a descriptive paragraph about each species to go along with the corresponding section of photographs. Each paragraph contains pertinent and memorable information about each animal. And for those who wish to know more about each photograph, there is a section at the end of the book with information about where each photo was taken and under what conditions.

The book I am reviewing is the first edition. The second edition (the one for sale at present) has more photographs, better color separation where needed, and a few editorial corrections (it is hoped that more of the pages will be numbered and the map will be interpreted). With these changes, this will be a valuable book for tourists or others who desire a "coffee-table" book. It is a book of captivating photographs with the amount and type of information which is perfect for the nonscientist. Or, for those of us who have been to the Galápagos, the book is a vivid and handy reminder of our experiences with the animals. Many of these photos are the ones we wish we could have taken. I consider the book a welcome addition to my library of Galápagos books.

This book is available only through the authors and not in US bookstores [order through: Mark Jones, "Calendars and Books," Isla Santa Cruz, Galápagos, Ecuador; $22.00 plus $5.00 shipping and handling ($7.00 outside of USA); checks in US dollars on US banks or equivalent in pounds sterling on UK bank]. A Spanish version is planned for the near future. **Gay Ver Steeg, Route 4, Box 205-B, Porterville, California 93257, USA.**

REVIEW: THE GALAPAGOS ISLANDS: THE ESSENTIAL HANDBOOK FOR EXPLORING, ENJOYING & UNDERSTANDING DARWIN'S ENCHANTED ISLANDS

Authored By: Marylee Stephenson
Published 1989, 160 pages, US - $12.95. The Mountaineers,
306 2nd Avenue West, Seattle, Washington 98119, USA.

Reviewed By: Gregory C. Mayer

The Galápagos continue to attract visitors from around the world who are interested in the rich natural and human history of the Islands. A number of books are now available to assist them in appreciating this history and in planning their visits. The newest of these is Marylee Stephenson's *The Galapágos Islands*. The book, as indicated by its subtitle, is specifically aimed at the visitor. It is divided into three sections: an overview, a description of visitor sites, and travel tips, followed by brief appendices.

The book is illustrated with numerous black-and-white photographs, 8 pages of color photos, and 13 sketch maps of visitor sites.

The first section, of 42 pages, attempts to briefly outline in nine chapters the history, wildlife, plants, and conservation problems of the Galápagos. Given the amount of space devoted to it, the account is necessarily very sketchy and only partially succeeds in conveying the reasons why the Galápagos are so widely hailed as a laboratory of evolution. There is, for example, no adequate discussion of adaptive radiation, natural selection, or speciation. Also, the author, to my mind, overstresses somewhat the extent to which the environment of the Islands has been degraded by man. Unlike other island archipelagos, such as Hawaii, which have a long history of human occupation, the Galápagos' brief period of disturbance has allowed much more of the natural ecosystem to survive. This is not to deny the great damage done by man and introduced organisms, but one of the great attractions of the Galápagos is their relatively pristine condition. It is also somewhat curious that the author contends that the "sheer scientific value of the Islands alone" justifies their preservation, yet maintains that the effects of scientific exploration have not been "benign" and that early scientific work (Darwin's?) was of "dubious value." It is, of course, through the efforts of collectors such as Darwin and his collaborators and successors that the uniqueness and value of the Galápagos ecosystem have been uncovered.

The second section, "Major Islands and Visitor Sites," is the heart of the book, and the reason why it is a worthwhile addition to the Galápagos guidebook literature. It consists of accounts of visitor sites throughout the Islands from the point of view of the tour boat visitor. The accounts include the nature of the landing, topography, trail layout, and plants and animals likely to be encountered. The 13 sketch maps in this section (similar to those in Jackson's *Galapagos: A Natural History Guide*, 1985, University of Calgary Press, Calgary) illustrate a number of the visitor sites. Reading these accounts and looking over the maps in the morning before going ashore would be the perfect preparation for the visitor; this is a book to be taken along on the trip, not for studying at home.

The third section provides some practical tips on costs, clothing, equipment, etc., and gives some idea of the physical and mental requirements of hiking on the Islands and living on a boat. The cost information is, of course, only current as of the date of writing (January 1989). There are also hints on photography; although I found the Galápagos to make anyone a good photographer—with such cooperative subjects, it is hard to take a bad picture. One piece of photographic equipment not mentioned, but which I regard as essential, is a flash unit for macrophotography, which allows close-up work with fine-grained film on flowers, lizards, etc., regardless of light conditions.

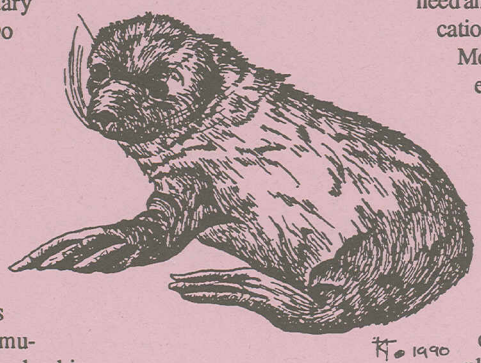
The appendices give information on mainland Ecuador, suggested reading, conservation funding, and a "Trip Log." The book concludes with an index.

By filling a niche only partially occupied by other books on the Galápagos, *The Galápagos Islands* secures for itself a place on the Galápagos traveler's bookshelf and suitcase. This niche is that of a guide to the specific sites the visitor will encounter. This role is filled by the accounts and maps in the second section, which will be valuable not only as preparation, but as reminder of places visited and things seen after the trip is over. It is not a complete guide. The overview of natural and human history in the first section is too brief, and the visitor will need a more detailed general guide, such as White and Epler's *Galapagos Guide* (1986, Libri Mundi, Quito) or, my preference, Jackson's *Galapagos: A Natural History Guide* for natural history and Hickman's *The Enchanted Islands* (1985, Anthony Nelson, Oswestry, UK) for human history. Nonetheless, I would recommend it, along with Jackson and Harris's *A Field Guide to the Birds of Galapagos* (1982, Collins, London), as the basic take-along library for the Galápagos visitor. **Gregory C. Mayer, The Zoological Museum, University of Wisconsin, Madison, Wisconsin 53706, USA.**

Help! We Need Your Help!

The goats are on the run, and the Park wardens are in pursuit. A steady stream of tourists eagerly move along the paths toward the tortoise pens while scholarship students return to the incubation facility to monitor temperatures of nests. The botanists pour through the storage facility patching together enough camping equipment to sustain a group of students involved in plant surveys on a remote volcano. A frenzy of activity is in motion in the education department in anticipation of a visit by a primary school group from Puerto Ayora. Do we have enough handouts for everyone and where is the spare bulb for the movie projector? Hasn't anyone located the altimeter or figured out a way to repair our decrepit salinity meter?

This is everyday activity at the Station and Park. Our activity grows and our needs continue to mount up. As a means of encouraging the Galápagos community at large (YOU) to become involved in the day-to-day activities of Galápagos, we have assembled a wish list of small, and not so small, items that we need and use regularly as part of our research, education, and conservation programs in Galápagos. Modesty and space keep us from mentioning everything we need, but we hope you understand from the variety of items given as example below—we will put any donations to our research, conservation, and education programs to good use. If you can help with a gift and take pride in being a part of the effort to make a difference in Galápagos, we will do our best to do our part. Please read over the list and consider making a donation that will be applied to this diverse range of activities.



Books.—Environmental Education needs to buy a variety of environmentally educational books to be used in conjunction with its educational program broadcast on the Santa Cruz radio station. Even a modest cash donation will add vitality to this effort. We will be appreciative of your help.

Camping equipment.—The harsh ultraviolet light and daily use produce a regular need for renewing our camping equipment. Of special need are lightweight tents (two and four person), sleeping bags, and quality daypacks.

Surveying and field equipment.—Compasses, steel surveying tapes, altimeters, inclinometers, field thermometers, pruning saws, machetes, and yes, even a chain saw, are needed for reptile, introduced mammal, and plant surveys, as well as for the Park programs aimed at control of introduced plants and animals.

Salinity refractometer, pH meters, and sand filter apparatus for saltwater.—Marine biology needs these basic additions to their equipment to continue work in progress.

Desktop publishing software, memory additions for laser printers, tape backups, and diskettes.—As computers become more essential tools for all programs and especially for production of research reports and educational materials, our needs increase for help in acquiring adequate computer accessories and supplies.

Digitizing tablets, rubbish bins for roadside collection sites, fire extinguishers, film, and hair dryers.—The hair dryers are a proven inexpensive intermittent heat source for our tortoise incubators.

Laboratory oven, an introduced-plant poster, Park truck, or even a donation toward an in-service training seminar focused on environmental education for Galápagos teachers.

No donation is too small or too large. If you would like to donate any of these items or contribute to our success in securing some of our wish-list items, please contact Lisa Minichiello (202-673-4705), Smithsonian Institution, Craig MacFarland, Foundation President, or the Director of the Station. Addresses for all of these offices can be found on the inside front cover of *Noticias de Galápagos*.