

NOTICIAS
de Galápagos

No. 47 March 1989

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- CHARLES DARWIN FOUNDATION, 836 Mabelle, Moscow, Idaho 83843, USA. Attention: President, Charles Darwin Foundation.
- CHARLES DARWIN FOUNDATION, Greensted Hall, Ongar, Essex, England. Attention: Mr. G.T. Corley Smith.
- CHARLES DARWIN RESEARCH STATION, Isla Santa Cruz, Galápagos, Ecuador. Attention: Director.

While emphasizing that the continuing success of conservation in the Galápagos is directly dependent 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 since the establishment of the Charles Darwin Research Station and the Servicio Parque Nacional Galápagos.

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NOTICIAS DE GALAPAGOS

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

No. 47 March 1989

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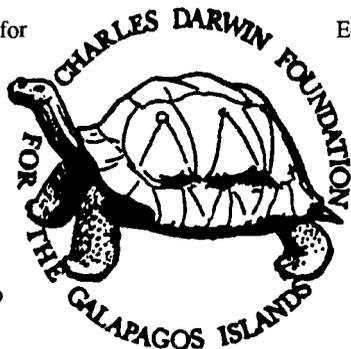
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NEWS FROM ACADEMY BAY

Oil Spill in Galápagos.—A strong smell of diesel oil woke the residents of Puerto Ayora on the morning of 11 June 1988. Scientists at the Charles Darwin Research Station looked out their windows to see one of the two supply ships for the Islands lying on its side in Academy Bay. The ship, the *M/V Iguana*, had apparently struck a reef, and as the level of the tide dropped, it rolled over onto its side spilling food, wood, general cargo, and 50,000 gallons of diesel oil into the clear waters of Academy Bay. Within hours, almost every small boat in Puerto Ayora had turned out to watch the spectacle and rescue floating cargo. The water- and diesel-saturated cargo was held by port authorities and soon returned to its owners. There was no loss of life or injury.

For the first 5 days of the diesel spillage, all scientists at the Charles Darwin Research Station were mobilized to determine the extent and effects of the pollution. The group was joined by the scientists from INOCAR (Ecuadorean Navy Oceanographic Institute) who were involved in collections of sea water to analyze the levels of diesel oil in the waters of Academy Bay.

The initial effects of the diesel spillage and the floating debris were short-lived and localized. Very small numbers of dead or dying animals were reported from the rocky reef adjacent to the Darwin Station, the shore closest to the ship. Species affected included octopi, chitons, sea urchins, hermit crabs, sea cucumbers, and some seaweeds. Larger species such as birds, sea lions, or marine iguanas appeared to be unaffected. Large quantities of wood, plastic materials, and food were washed ashore mainly at the Darwin Station, and in the week following the original spillage, the oil and floating debris dispersed eastwards along a 3-4 mile stretch of the Santa Cruz coast, ultimately turning southwards away from the coast. Large quantities of wood and plastic were cleared from the water and shore by the townspeople and CDRS and Galápagos National Park Service personnel on repeated occasions in the areas near the town of Puerto Ayora. Garbage was still present in October on the more distant and inaccessible areas of the coast. The ship itself, which was originally a prominent feature in the center of the bay, has been

gradually disappearing beneath the waves, and is not now visible at high tide.

This accident served as a sharp reminder that even one of the most pristine areas of the world, and a world heritage site, cannot consider itself immune from pollution. Fortunately in the case of this accident, it appears the hot weather, strong sunlight, and wave action caused most of the more volatile (and toxic) components of the diesel oil to be evaporated quickly and rapidly dispersed.

The seashore monitoring established in the aftermath of the accident has been continued, and funds are being sought to investigate the effects of this oil spill on a long-term basis. In the meantime, Galápagos has only one supply ship per month, and shortages of basic supplies are now a regular feature of life there. **Pat Whelan, Charles Darwin Research Station, Isla Santa Cruz, Galápagos, Ecuador.**

Derrame de Combustible en las Aguas de Galápagos.—A las 0415 horas del sábado 11 de junio, la *M/N Iguana*, barco de carga que abastece a Galápagos se varó en una zona rocosa de Bahía Academy, Santa Cruz, media milla frente a la Estación Charles Darwin. Al bajar la marea el barco ladeó lentamente y quedó de costado en el medio de la Bahía. No hubieron pérdidas de vida ni heridos.

Alrededor de las 0700 horas, el pueblo de Puerto Ayora se despertó con un fuerte olor a vapores de diesel ya que una mancha de éste comenzó a distribuirse en Bahía Academy. A las 0900 horas se veía como el viento y las olas habían llevado el diesel a la costa de la Bahía, mientras una flotilla de pangas salía y regresaba del muelle rescatando cajones, sacos de legumbres, cilindros de gas, tanques de gasolina, y otros artículos saturados con diesel o agua que eran depositados bajo custodia de la Capitanía del Puerto antes de ser entregados a sus dueños.

Este accidente nos hace reconocer que Galápagos, una de las áreas más prístinas del mundo y patrimonio de la humanidad, no puede considerarse excluida de las amenazas de contaminación ambiental. La contaminación más importante producida fue el derrame de 50,000 galones de combustible. En la costa rocosa alrededor de la Estación Darwin los

científicos, estudiantes, y personal de planta presentes allí, encontraron mortalidad de algunos animales y alteración del comportamiento considerado normal. Las especies más afectadas fueron pulpos, chitones (cancha laguas), erizos, cangrejos ermitaños, y algunas algas. Los efectos del combustible parecen estar restringidos y hasta ahora las iguanas y aves marinas no parecen estar afectadas, pero hay que averiguar si las aves marinas van a ser afectadas por el alimento de organismos contaminados. Hay reportes de dos piqueros patas azules muertos.

Aparte del problema del combustible en sí, en la mancha de diesel también se ven muchos objetos flotantes del naufragio como madera, fundas plásticas, sacos de harina, jabs, botellas plásticas, etc. Todos estos objetos están llegando a la costa y contaminado una sección que alcanza hasta 6 km.

La mayoría de los efectos del derrame estuvieron localizados y de corto duración. Los científicos de la Estación Darwin y de INOCAR (que vinieron apenas conocido el accidente), están monitoreando los cambios en la zona de la costa y recopilando información de los efectos del derrame. Los ciudadanos de Santa Cruz con su Municipalidad y el Servicio Parque Nacional Galápagos, han organizado una acción de limpieza en las playas y costa cercanas a la población. **Pat Whelan, Estación Científica Charles Darwin, Isla Santa Cruz, Galápagos, Ecuador.**

Beagle V: The Station's New Vessel.—

On 1 December 1988, the Charles Darwin Research Station purchased a vessel, to be christened the *Beagle V*, which will soon be working full time for conservation and science in the Galápagos Islands. The Charles Darwin Foundation and Station were extremely fortunate to find a secondhand vessel built in 1979 with only 1,300 hours on her Caterpillar engine and with her hull and all other structure, machinery, and equipment in excellent condition. Because of spiraling construction costs and inflation, a new vessel would have cost almost twice as much as the purchase price for this fine vessel. That price was doubly advantageous because she has a long life ahead of her and should serve virtually as long as a new vessel. Moreover, the vessel has a hull design and speed characteristics precisely suited for Galápagos conditions. The entire vessel was designed and built to exacting standards by the Lee Wilbur Company of Manset, Maine, the same organization which constructed the *Beagle IV*.

The *Beagle V* is a 46-ft long motor yacht with a semi-displacement hull and single diesel engine. She cruises comfortably at 10 knots with excellent fuel economy, and can do 12 knots for shorter periods of time as necessary. She will have a range of 800 miles, more than enough for the Islands and adequate for sending her to Guayaquil and/or Panamá for periodic refits. She will carry three crew members and will



The Station's new vessel recently transited from New York, where it was purchased, to Galápagos with intermediate stops for minor refitting in Maryland and Florida (photograph by G. Merlen). La embarcación nueva de la Estación recién hizo el viaje de Nueva York, donde fue comprada, a Galápagos con paradas intermedias en Maryland y Florida para renovaciones pequeñas.

have bunks for six passengers, an ample working deck, dive platform, and ladder aft for marine research. She will serve ably for interisland transport for large groups of scientists and Station/Park Service personnel, as well as for smaller groups of scientists who need to do longer trips and to perform research work on board the vessel.

The Foundation and Station have spent the last 8 months evaluating the advantages, disadvantages, and costs of building a new vessel or searching for a used vessel and refurbishing her. A number of boat yards were visited and bids sought on the cost of constructing a new vessel. At the same time, extensive searches were made from major boating centers such as Miami and New York in an attempt to locate secondhand vessels with the characteristics desirable for the Galápagos. This entire process was very ably conducted by the Darwin Station Director, Dr. Günther Reck, and a very experienced seaman and ship's engineer with long Galápagos experience, Godfrey Merlen, who has volunteered a large portion of his time to this worthy cause.

The total cost of purchase of the *Beagle V* plus minor refitting to add additional fuel and water tanks, more bunks for passengers, a diving platform and other improvements for marine research, a multipurpose davit for hauling out the rubber dinghy and general lifting work, modification of the saloon, plus insurance for 1 year, and costs for sailing her from New York to Galápagos will come to approximately \$295,000. The insurance company paid off on the *Beagle IV* for the entire amount insured, \$200,000, and the Swedish Galápagos Foundation has agreed to provide another \$20,000. The CDRS/CDF are still trying to raise most of the remaining \$75,000. In response to the article on "The Loss of *Beagle IV*" in the previous issue of *Noticias*, May 1988, several donations were received, for which the Station and Foundation are very thankful. The Frankfurt Zoological Society, Federal Republic of Germany, has indicated that it will donate part of the needed \$75,000. Specific contributions earmarked for the *Beagle V* can be made through any of the mechanisms on the inside of the front cover of this issue or sent directly to Craig MacFarland, President of the Charles Darwin Foundation, 836 Mabelle, Moscow, Idaho 83843, USA.

The *Beagle V* completed minor refitting in Oxford, Maryland, left for Galápagos on 9 November, and arrived in the Galápagos Islands mid-December 1988. She has immediately gone into service for the cause of conservation and science. As all readers can imagine, it is a tremendous relief to have a highly dependable, sea-worthy vessel working for the CDRS, the Galápagos National Park Service, and visiting scientists once again.

The Foundation and the Galápagos community owe a great deal of gratitude to Godfrey Merlen and Marsha Sitnik, who worked on the endless details of acquiring and preparing the new research vessel. A number of other people helped in completing the refitting of the vessel. John Todd of Todd Boat Works gave most generously of his time and energy in solving problems and helping to bring solutions to reality. Others at the boat works labored to achieve a high standard to the finished boat. Dave and Christie Crane provided a well-stocked hamper to Godfrey Merlen and the rest of the transiting crew for the trip south. Coast Navigation of Annapolis assisted with installation of a long-range SSB radio. Oxford Boatyard Inc. generously allowed the vessel to be hauled out of the water to allow various underwater attachments to the hull. Mrs. Bacon of Bacon's Associates in Annapolis provided a sail which will eventually be refitted as a steadying sail on the *Beagle V*. Peter Glynn arranged the vessel's docking at University of Miami facilities during the brief period spent in Miami on the way south. The help of these and many other people too numerous to mention is appreciated. **Craig MacFarland, Charles Darwin Foundation, 836 Mabelle, Moscow, Idaho 83843, USA.**

Children Conservationists.—Conservation skits and songs, diplomas and awards, readings by children and adult leaders, and a photography and art exhibit of the past year's activities made up a special evening program in Puerto Ayora in late November 1988. The program, which was attended by parents, institutional representatives, and community members, was held in celebration of the 1-year anniversary of the Children's Conservation Club "Renacer."

Meaning "to spring up" or "to be reborn," the

Spanish word *renacer* is an apt term to describe the energy, excitement, and creativity that surround the Club and what it is all about: the fostering and growth of a conservation awareness, appreciation, and consciousness in the children of Puerto Ayora.

The Club was created in November of 1987 by Coca Burneo de Reck and Amrit Work Kendrick, together with the help and collaboration of other interested adults—teachers, parents, CDRS staff members, and volunteers. The basic goal is

to provide area children with opportunities to learn about, explore, and appreciate the natural environment through participation in educational games and activities, outdoor recreation, and group interaction. Although the children learn about general environmental concepts, special emphasis is placed on Galápagos and all that makes “their” Islands so unique and special.

Three Fridays each month, the laughter and shouts of 25 to 30, and sometimes over 60, children between the ages of 8 and 12 can be heard throughout the Station. These weekly meetings usually consist of a combination of active educational games and projects, discussions with guest visitors, audiovisuals, and art and handicrafts. These activities take place outside as often as possible and always develop a chosen conservation theme through creative and participatory activities. There is also a group outing or hike each month that gives the children a chance to get out and explore new areas on the Island.

As with any group effort, a lot of planning and organization is required. Special mention should be made of the adult leaders and volunteers whose enthusiasm and dedication have been essential—especially Coca Burneo de Reck and Marco Robalino who have been the driving force behind the Club

since the beginning.

Although the Club “Renacer” is not officially affiliated with the Station, the CDRS plays a strong “behind-the-scenes” supporting role to the Club—providing meeting space, materials, and collaboration



An outing of the Conservation Club “Renacer” on Isla Santa Cruz. Niños del Club “Renacer” en el campo de Isla Santa Cruz.

and moral support from staff members and volunteers. The Galápagos National Park Service, the Municipality of Puerto Ayora, and other interested institutions and individuals have also provided volunteer, logistical, and material support.

To date, the Club has been successful, has the general support of parents and the community, and, most importantly, has had a positive and meaningful effect on a special group of children in Puerto Ayora—an effect that hopefully will be reflected in the conservation actions of tomorrow’s adults and decision makers.

It has been a good first year. Let’s hope that the second year is better. **Jaime Schmidt, Charles Darwin Research Station, Isla Santa Cruz, Galápagos, Ecuador.**

Niños Conservacionistas.—Piezas de teatro, canciones conservacionistas, insignias, diplomas, palabras de niños y adultos, exhibiciones de fotografías y dibujos, sobre las actividades de un año de trabajo, cubrieron un programa especial en Puerto Ayora a fines de noviembre. Padres de familia, representantes institucionales, y miembros de la comunidad asistieron al programa que se realizó en celebración del primer aniversario del Club de Niños Conservacionistas “Renacer.”

La palabra “Renacer” es un término apropiado para describir el entusiasmo y la creatividad que caracterizan al Club y sus propósitos: el interés por el crecimiento de una conciencia conservacionista en los niños de Puerto Ayora.

El Club fué creado en noviembre de 1987 por Coca Burneo de Reck y Amrit Work de Kendrick, y contó con la ayuda y colaboración de otros adultos interesados, profesores, padres de familia, y empleados y voluntarios de la Estación Darwin. La meta principal es dar a los niños del Cantón la oportunidad de aprender, explorar, y apreciar el ambiente natural, a través de su participación en juegos y actividades educacionales, y la convivencia en grupo. A pesar de que los niños aprenden sobre conceptos generales del medio ambiente, se pone especial énfasis sobre Galápagos, y todo lo que hace a sus Islas tan únicas y especiales.

Tres veces por mes la risa y el bullicio de 25 a 30 niños, y a veces más de 60, entre las edades de 8 a 12 años puede escucharse a través de la Estación. Estas reuniones semanales consisten de una combinación de juegos educativos, discusiones con profesionales invitados, audiovisuales, arte, y trabajos manuales. Las actividades se realizan al aire libre siempre que sea posible, y versan sobre un tema escogido en el campo de la conservación, a través de actividades creativas y participativas. Cada mes hay una caminata o paseo que da a los niños la oportunidad de salir al campo y explorar nuevas áreas en la Isla.

Como en cualquier actividad de grupo, se necesita una cantidad de planificación y organización, el entusiasmo y la dedicación de los líderes voluntarios ha sido esencial para captar el interés de los niños, y garantizar su participación regular, especialmente por parte de Coca Burneo de Reck y Marco Robalino, quienes han sido la fuerza motor desde sus inicios.

A pesar de que el Club "Renacer" no es una actividad oficial de la Estación Darwin, sin embargo la Estación ha desempeñado un papel importante en su funcionamiento; proveyendo espacio para reuniones, materiales, y colaboración y apoyo moral por parte de empleados y voluntarios. El Servicio Parque Nacional Galápagos y la Municipalidad de Puerto Ayora, como otras instituciones e individuos interesados también han aportado con ayuda voluntaria, como logística y material.

A la fecha el Club ha tenido mucho éxito, y ha recibido el apoyo y simpatía general de padres de familia y la comunidad entera; y aún más importante, ha tenido un efecto positivo y significativo para un grupo especial de niños en Puerto Ayora—un efecto

que ojalá se refleje en acciones conservacionistas de los adultos del mañana, que serán quienes tomen las decisiones.

Este ha sido un buen primer año. Esperemos que el segundo sea mejor. **Jaime Schmidt, Estación Científica Charles Darwin, Isla Santa Cruz, Galápagos, Ecuador.**

Fruto del Empeño: Nuevo Edificio en San Cristóbal.—Hace aproximadamente tres años, el Dr. Günther Reck—nuestro Director actual—y el Sr. Jacinto Gordilla—representante de la ECCD en San Cristóbal en aquella época—se propusieron construir un edificio de la Estación en Puerto Baquerizo Moreno con el fin de difundir los trabajos que la Estación desarrolla. Esto a su vez incrementaría el contacto con la población y serviría de medio educativo: tal edificio debería estar dotado para servir como lugar de conferencias, seminarios, exposiciones, proyecciones, etc.

A pesar del buen empeño y el entusiasmo que despertó este proyecto, su realización se vio postergada muchas veces por motivos logísticos y de consecución de materiales, problemas a los que todos se enfrentan aquí en las Islas. Hubo que transportar todos los materiales desde Puerto Ayora, Isla Santa Cruz, lo que significó que mucho del trabajo se realizara previo al transporte a San Cristóbal, en los talleres de la ECCD.

Finalmente en septiembre de este año el edificio fue terminado gracias al empeño y dedicación puesta por todos los empleados de mantenimiento de la institución, especialmente la gente de carpintería y albañilería, Don Roberto Jaya y el Señor Pablo Oyaza, quienes participaron activamente en la última fase de construcción.

Es oportuno comentar que los albañiles de Puerto Baquerizo colaboraron en su construcción integrándose de esta forma a las actividades de la Estación. Aunque durante el período de construcción Don Jacinto Gordillo se jubiló y el Señor Alfonso Quimbiulco fué nombrado nuestro representante, Don Gordillo no perdió su entusiasmo acerca del proyecto y el Señor Quimbiulco se dedicó con empeño a la finalización del mismo.

El edificio en forma octogonal, completamente

blanco, con ventanas y techo de madera está finalmente terminado y despierta la admiración de los habitantes de San Cristóbal quienes ya comienzan a visitarlo con el fin de obtener diversa información y curiosearlo dado lo diferente de su estructura.

Felicitaciones de nuevo a todos. **Isabel Castro, Estación Científica Charles Darwin, Isla Santa Cruz, Galápagos, Ecuador.**

New Building in Isla San Cristóbal.—In September of 1988, construction of a new building on Isla San Cristóbal was completed. The building will serve as a focal point for distributing information developed by the Station on the Islands, the fauna, and environmental education in general. It will also serve as a site for conferences, meetings, and presentations. The facility is the culmination of a cooperative effort between Director Günther Reck and former Station Representative on San Cristóbal, Sr. Jacinto Gordillo. Since Don Jacinto Gordillo's recent retirement, the Station Representative and coordinator of Station activities on the Island is Sr. Alfonso Quimbiulco. **Isabel Castro, Charles Darwin Research Station, Isla Santa Cruz, Galápagos, Ecuador.**

CDRS Director in Argentina.—As the CDRS Director, I had the opportunity to discuss aspects of visitor management, carrying capacity, control of tourist groups, guiding, and interpretation with Argentinian experts and students, as an invited participant at the "IX International Seminar of Tourism in Nature Areas" held in southern Argentina in 1988.

Península Valdéz, in Argentina's Patagonia, is famous for its colonies of penguins, elephant seals, and sea lions. Right whales can be observed at close distance while they slowly and majestically move across the surface of St. James Bay. These nature treasures, of course, have supported the development of tourism at a considerable scale. Many aspects of control and management are comparable to situations in the Galápagos. Many concerns about responses of wild species to visitors were shared by scientists in Valdéz and those working in Galápagos.

I was accompanied by Ings. Ruth Quezada and

Angel Lobato from Ecuador's Department of Natural Areas and National Parks, and several Ecuadorian tour operators. We shared the experience and know-how developed and accumulated by managers and scientists in the Galápagos National Park with the Argentinian hosts. Relative to other areas, Galápagos is an outstanding example of how tourism can be realized and developed without negative impacts to the environment, if well conceived and handled. Argentinian and Brazilian participants at the seminar, many local politicians, and the Secretary and Subsecretary of Tourism of Argentina, were keen to learn from the Galápagos experience.

The host, Mr. Antonio Torrejón, President of Fundación Patagonia, and the Interamerican Institute of Tourism enthusiastically supported the suggestion for holding a similar seminar for 1989 in Ecuador's mainland and Galápagos Archipelago. **Günther Reck, Charles Darwin Research Station, Isla Santa Cruz, Galápagos, Ecuador.**

Van Straelen Gift.—The Charles Darwin Foundation is profoundly grateful to Mrs. Victor Van Straelen for her generous gift of \$200,000 given through the World Wide Fund for support of conservation and education in Galápagos. The gift will serve also as a base for initiating additional fund raising in North America and Europe. The Foundation is currently seeking to establish an endowment in Europe similar to the one begun in North America in 1985. Victor Van Straelen was instrumental in the formation of the Foundation in 1959, and the Van Straelen name graces the main visitor center which serves as a starting point for most tourists' visits at the Park Headquarters on Isla Santa Cruz. Once again, Galápagos has benefited from the dedication and generosity of the Van Straelen family. **Craig MacFarland, Charles Darwin Foundation, 836 Mabelle, Moscow, Idaho 83843, USA.**

Change in Directorship at the Charles Darwin Research Station.—After 5 years as Director of the Charles Darwin Research Station, Dr. Günther Reck has resigned to pursue his career elsewhere. For almost 15 years, Dr. Reck has been intimately associated with the Galápagos and has

demonstrated his devotion to the Islands through great dedication, hard work, innovative thinking, and imaginative solutions to conservation problems.

He began his association with the Islands as a naturalist guide for 2 years, 1973-74, after finishing his undergraduate university studies in biology in the Federal Republic of Germany. Dr. Reck was instrumental in helping to forge the strong relationship between the then National Fisheries Institute (INP) of Ecuador and the Charles Darwin Research Station. From 1975-79 he worked for the two institutions, conducting intensive

studies on the artisanal fisheries and lobster industry in the Galápagos. Those studies were designed to help the Ecuadorian authorities establish well-founded policies and regulations for fisheries management and conservation. In 1980, Dr. Reck continued his strong relationship with the Islands, serving as a fisheries and natural resources management advisor to the Vice-Minister of Natural Resources (Fisheries). Then, in 1981, he continued in a similar advisory capacity to the Director and staff of INGALA (Galápagos National Institute), the regional planning and development authority for the Islands. While working for the CDRS and the INP on Galápagos fisheries, he began studies towards his doctorate in fisheries biology at the University of Kiel in the FRG, finishing that degree in 1982-83. In early 1984 he became Director of the Charles Darwin Research Station.

During Dr. Reck's tenure as Director, the Station and its sister organization, the Galápagos National Park Service, have produced and overseen many notable accomplishments and advances in conservation, education, and science in the Galápagos.

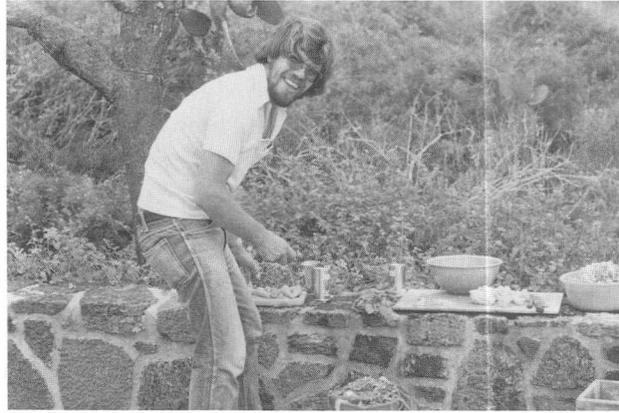
Many could be cited, but a few key ones follow:

—A thorough reorganization and strengthening of the Station's administration and operational procedures.

—Establishment and notable improvement of a systematic annual process of evaluation, planning, and prioritization of all CDRS and Park Service activities, in a joint, integrated manner by the two organizations.

—Reorganization and strengthening of the CDRS's scientific staff.

—A major improvement and expansion in the Station's cooperative program of scholarships and assistantships with Ecuadorian universities,



Dr. Günther Reck's involvement of more than a decade in the Darwin Station is evidenced here by his participation in a potluck dinner at the home of the Assistant Director in 1977. La participación del Dr. Günther Reck, por más de una década en la Estación Darwin, es captada aquí en una parrillada en la casa del Sub-Director en 1977.

which brings several dozen university students to the Islands each year for periods varying from a few months up to a year or more; the program has grown from 5 to 10 collaborating universities in the past few years.

—Laying the groundwork for a major increase and improvement of CDRS and Park Service involvement in educational activities in the Islands and in continental Ecuador with initiation of that planned expansion.

—Modification and improvement of the programs for breeding, raising, and restocking of endemic populations of giant tortoises and land iguanas, based upon a systematic review and evaluation of over 30 total years of experience working to save those species.

—Continuation of the very successful restocking of native areas with land iguanas and giant tortoises: the 1,000th young tortoise was returned in 1988 and over 250 young iguanas have been returned to their home areas on northwestern Santa Cruz and southeastern Isabela Islands.

—Starting of major programs to control introduced

pigs, which have devastated Isla Santiago for many decades, and black rats in the tortoise nesting areas on Isla Pinzón, and the successful continuation of the programs to control introduced dogs in land iguana and tortoise nesting and living areas on Santa Cruz and Isabela.

Dr. Reck also very ably led the CDRS through two major, unexpected crises: the total destruction of the main administration building by a fire in 1985 and the loss of the Station's research and transport vessel, the *Beagle IV*, which ran aground in foggy weather in August 1987. The new administration building has been functioning since 1986 and the new research vessel, the *Beagle V*, arrived in the Islands just before Christmas 1988.

Throughout all these years of dedication to the Galápagos, Dr. Reck has received the extremely able collaboration and support of his wife, Coca Burneo. She has been her husband's equal in devotion, hard work, and great energy in support of the Station and for the conservation of the Islands. She has been involved in a great number and a variety of CDRS activities, as well as in several educational programs with the local schools and the Station.

It is with mixed emotions that we all bid good-bye to the Recks and their two beautiful, intelligent children, Carlos Alberto and Monica Alicia. We are sad to see them go after many years of excellent professional work and personal relationships in the Islands. But, we wish them the absolute best in their personal and professional lives in the future. We know, Günther and Coca, that you will continue your great interest in and dedicated work (as time permits!) for the Galápagos. Many thanks from all of us who care so much about and support the conservation of these special and unique Islands.

After Dr. Reck made known his decision to leave the CDRS Director's position in early 1988, the Charles Darwin Foundation established a search and selection committee to look for, select, and recruit a new director. That process took almost all of 1988. Announcements were placed in over 25 professional journals, newsletters, and bulletins and also were sent to almost 500 universities, research centers, similar institutions, and selected individuals throughout Europe, Latin America, North America, and other areas of the world. Over 40 candidates

from 16 countries (Argentina, Austria, Chile, Colombia, Costa Rica, Denmark, Ecuador, Federal Republic of Germany, France, Great Britain, México, the Netherlands, Panamá, Perú, South Africa, and the USA) presented their applications. The final selection was difficult due to the numerous excellent candidates, but was finally made in early December after several rounds of reviewing credentials and conducting interviews with the top five candidates.

The new Director of the CDRS will be Dr. Daniel Evans, a native of Washington State in the USA. Dr. Evans is a systems ecologist and a specialist in introduced animal control, with two master's degrees in ecology and international agricultural development, and a Ph.D. in ecology, all from the University of California in Davis. He has extensive international experience in research, training, conservation project design and execution, and administration and leadership of programs. Dr. Evans spent 2 years in the U.S. Peace Corps in the Dominican Republic, 2 years establishing and administering a rodent control program in the Comoro Islands with local government agencies and villages, and a total of over 8 months conducting consultancies on introduced pest control in a number of other countries and island situations in various parts of the world. Most recently he conducted research for 2 years in Ecuador on pest ecology, agricultural practices, and biological and other control methods, while on a Fulbright-Hays Fellowship.

Dr. Evans will be joined in the Islands by his wife, Julia Tully, and their two young daughters, Mara (5) and Sierra (3). Julia Evans is a specialist in nutrition and recently obtained her master's degree from the University of California, Davis. She conducted and participated in a number of nutrition and education projects while in Ecuador over the past 2 years and is planning to continue with similar activities in the Galápagos, with local villages and the CDRS, as appropriate. She is also thinking of continuing her doctorate in nutrition or a related field and will investigate the possibilities of research topics in the Islands.

We all join in welcoming the Evanses to the new opportunities and challenges awaiting them in the Galápagos and at the CDRS. **Craig MacFarland.**

Cambio del Director en la Estación

Científica.—Después de cinco años de servicio, el Dr. Günther Reck ha renunciado para seguir su carrera fuera de Galápagos. Desde que empezó como Director en 1984, él ha obtenido muchos elogios y avances notables en conservación, educación, y investigación. La Estación benefició mucho por su labores.

Para todo, el Dr. Reck recibió la colaboración y apoyo de su esposa Coca Burneo. Ella tiene una devoción y energía extraordinaria para la Estación y conservación en las Islas. Ella participó en una cantidad de actividades de la Estación y varios programas educativos para las escuelas. Estamos muy agradecidos con los esposos Reck por su servicio y las relaciones personales desarrolladas en las Islas.

El nuevo Director es el Dr. Daniel Evans quien se graduó de la Universidad de California, Davis, en los Estados Unidos como ecólogo y especialista en control de animales. El Dr. Evans ha trabajado en la República Dominicana, las Isla Comoros en el Océano Indico y varias otras regiones del mundo. Recientemente él participó en un programa de ecología de plagas y métodos de control bajo una beca de Fulbright-Hayes en Ecuador.

El Dr. Evans vino a Galápagos con su esposa Julia Evans y sus dos niñas, María (5) y Sierra (3). Julia Evans es especialista en nutrición y educación. Estamos unidos para ofrecer nuestra bienvenida a la familia Evans a las Islas Galápagos y a la Estación Científica. El Dr. Reck y el Dr. Evans pasarán el mes de febrero juntos en la Estación coordinando el cambio de puesto. **Craig MacFarland.**

Change of Address.—Please note that the Editor's address has changed from the Department of Biology at the University of New Mexico to the National Museum of Natural History in Washington, D.C. The address of the Associate Editor, Howard L. Snell, will remain at the University of New Mexico. Craig MacFarland, Foundation President, also has a new address as given in the article on the Station's new vessel.

International Symposium/Workshop on the Herpetology of the Galápagos Islands: Research and Conservation.—Between 29 May

and 11 June 1988, over 75 scientists, managers, and students met at the Galápagos National Park Service Headquarters to participate in a series of presentations and workshops about Galápagos reptiles and their conservation. Participants came from South, Central, and North America; Europe; New Zealand; and Australia. We mixed brief field trips with formal research presentations, a poster session, and an intensive 5-day session of workshops. That format provided all participants with a summary of the current knowledge of Galápagos reptiles and armed them to tackle the real problems of determining the future research and conservation efforts needed to preserve these unique animals.

Several major topics of concern emerged during the continuous discussions. First, we do not know enough about the diversity of Galápagos reptiles. We do not understand the genetic relationships among island populations and, in many cases, we do not have accurate knowledge of their geographic distributions. Second, we must investigate the roles of reptiles as members of the ecological communities of islands so that we can make decisions about how to manage communities where some reptiles have become extinct. Third, we must continue to make advances in the captive breeding and repatriation of reptiles to reduce the number of populations that will go extinct. Fourth, everyone agreed that the greatest threat to all Galápagos reptiles are introduced organisms. Furthermore, until effective means of controlling and eradicating dogs, cats, rats, etc. can be found, all other conservation efforts are only temporary measures.

All participants left with a sense of amazement: both at what the CDRS and SPNG have accomplished in 25 years and at the magnitude of the problems that remain. A tremendous amount of work needs to be done, both in research and management, but the problems can be solved with sufficient resources and manpower.

We all gratefully acknowledge the financial support of the Tinker Foundation, Metropolitan Tours, TAME (Ecuador's military airline), and many other organizations. Without their generous help the workshop/symposium would have been impossible. **Howard L. Snell, Biology Department, University of New Mexico, Albuquerque, NM 87131, USA.**

RECOGNIZING FAMILIAR FACES RECONOCIENDO CARAS FAMILIARES

ALFONSO JAYA

Chief of Maintenance, Charles
Darwin Research Station

By: Alfredo Carrasco

Don Alfonso Jaya is a member of the large Jaya family who have lived in Puerto Ayora for many years. He is the son of valued Station employees Don Guillermo and Doña Zoila Jaya. He was born in the Province of Tungurahua, Ecuador, 10 December 1945. He is married to Rosa Llanos, and they have five children: Miriam Esperanza (16), Luis Enrique (15), Daniel Alfonso (13), Juan Carlos (9), and Xavier Alejandro (4).

In August 1975, only a few days after arriving in Galápagos, Alfonso Jaya joined the Station as a carpenter's assistant working on the construction of the iguana corrals. Later he was assigned to other duties involving maintenance and construction of facilities of the institution. Through time, because of his boundless energy and desire to learn, he earned the attention and respect of his co-workers and supervisors. At present he holds the position of Chief of Maintenance for the institution.

He learned masonry at the Station; his first real experience came from laying concrete blocks in the Subdirector and Gerente's house, popularly known as "the castle." He gained experience with plumbing water and gas lines largely on his own. To a large extent, the Station and Park depend almost continually on his talents to maintain their water systems. He is always available on weekends and holidays to solve a problem, repair pipes and hoses, etc. How many times has he been seen coming out of the tangled vegetation around the Station, completely wet after repairing something?

"I like the Islands and my work," he says. "I



Alfonso Jaya working on the construction of an essential building for the Station and Park programs on Isla Santa Cruz. Alfonso Jaya construyendo un edificio necesario para los programas del Parque y de la Estación en Isla Santa Cruz.

**Charles Darwin Research Station, Isla Santa Cruz,
Galápagos, Ecuador.**

ALFONSO JAYA

Jefe de Mantenimiento,
Estación Científica Charles Darwin

Alfonso, uno más de la larga familia de los Jaya, por muchos años establecida en Puerto Ayora, hijo de nuestros apreciados empleados Don Guillermo y Doña Zoila, nació en la Provincia de Tungurahua el 10 de diciembre de 1945. Está casado con Doña Rosa Llanos, de 32 años, con quien ha procreado cinco hijos: Miriam Esperanza (16), Luis Enrique (15), Daniel Alfonso (13), Juan Carlos (9), y Xavier Alejandro (4).

Pocos días después de haber llegado a Galápagos, Alfonso Jaya se vinculó a la Estación en agosto de

would like to have accompanied the scientists to different Islands and to have known more about what they do." Of course, he knows that through the work that he does, he has contributed to the different activities of the institution. He has been present in both good and bad times. In the end, one way or another, he has contributed to the history of the institution. His happy disposition and willingness to give contributes to the good work environment at the Station.

Don Alfonso is also driver of one of the Station vehicles, the "Tortuga," which transports Station employees.

At the beginning of this year, Alfonso's 13 years of uninterrupted service were officially recognized by the institution. He and other long-term employees of the Station and Park deserve our gratitude. Without them, Galápagos would be quite different. **Alfredo Carrasco,**

1975, en calidad de ayudante de carpintería para trabajar en la construcción de los corrales de las iguanas; posteriormente fue asignado a otras actividades de mantenimiento y construcción de la infraestructura física de la institución. Con el transcurso del tiempo y por el místico esfuerzo y ganas de aprender, fue ganándose la consideración y respeto de sus compañeros de trabajo y jefes: actualmente ocupa el puesto de Jefe de Mantenimiento de la institución.

En la Estación aprendió el oficio de albañil, sus primeras experiencias en este campo fue "asentando bloques en la casa 'el castillo'" como él mismo manifiesta. Por iniciativa propia fue ganando experiencia en plomería y gasfitería. En buena medida depende de él que la Estación y el Parque dispongan de agua de manera permanente. Siempre está disponible fines de semana, días feriados, para resolver algún problema, reparar tuberías y mangueras, etc. Cuántas veces se ha visto a Alfonso salir de la vegetación densa, completamente mojado,

al reparar alguna pieza.

"Me gustan las Islas y mi trabajo," manifiesta; "hubiese deseado acompañar a los científicos a las diferentes Islas y conocer más de cerca lo que hacen." De todas maneras, a través de la labor que ejecuta, él sabe que también ha aportado con su grano de arena a las diferentes actividades que la institución realiza.

Ha estado presente en épocas difíciles de duras pruebas, también ha participado de los momentos de éxito. En fin, en una u otra manera ha incrementado con su presencia la historia institucional. Siempre de buen humor y la mejor voluntad contribuye e influye considerablemente en el buen ambiente de trabajo, que rige en la Estación.

Don Alfonso también es chofer de la "Tortuga" que sirve para transporte del personal de la Estación. Fue condecorado y reconocido a principios de año, por haber cumplido 13 años de trabajo ininterrumpido en la institución. **Alfredo Carrasco, Estación Científica Charles Darwin, Isla Santa Cruz, Galápagos, Ecuador.**

INTRODUCED GECKOS IN PUERTO AYORA, SANTA CRUZ, WITH REMARKS ON OTHER AREAS

By: **Marinus S. Hoogmoed**

During the recent International Workshop on Herpetology in Galápagos (29 May-11 June 1988), several participants noted the presence of a large species of introduced gecko on buildings in Puerto Ayora, Isla Santa Cruz. All specimens seen were located on the walls of relatively large and new concrete or stone buildings. It seemed worthwhile to establish the identity and map the local distribution of this species, which certainly was not the endemic species, *Phyllodactylus galapagensis* Peters; according to J.W. Wright (pers. comm.), the large lizard was a recent introduction, first observed in 1979.

On the basis of information gathered in 1981 by former Station herpetologist, Robert Reynolds, when he first saw the species, the introduction probably occurred a few years earlier. According to the recollections of Tui De Roy and Gil De Roy, these geckos were seen at the Ninfa Bar as early as 1975. María Eulalia de Balfour was aware of this introduced

gecko in a house behind the Catholic Church in Puerto Ayora in 1976.

Wright (1983a) identified the introduced large gecko in Puerto Ayora as *Phyllodactylus reissi*, but later he (Wright 1983b) changed his opinion and tentatively considered it *P. pumilis*, not giving the reasons for this change. However, studying specimens soon convinced me that they actually belong to *Phyllodactylus reissi* Peters rather than *P. pumilis* because of the lizard's size, the fact that the scales on the dorsal surface of the thighs and on the proximal one-fourth of the tail are homogeneous, and the fact that the scales in the supraocular region are the largest of the interorbital series. Additionally, when the distribution of both species on the mainland was taken into consideration, it appeared much more likely that *P. reissi* would be introduced accidentally from the mainland to Galápagos than *P. pumilis*, which is only known to occur in a rather small, and relatively inaccessible, area with no major shipping

ports. *P. reissi*, however, inhabits coastal Ecuador from Manabi (Manta) southward to northern Perú, where it even enters the upper Amazon Basin (Dixon and Huey 1970). It also occurs in Guayaquil, a major shipping port with traffic to Galápagos. Dixon and Huey (1970:54) considered this species "the most abundant scansorial gecko of northern Peru" and stated that their nocturnal activities are "essentially on vertical surfaces, i.e., trunks of trees, walls of buildings, boulders, cacti, and fence posts . . ." Among the daytime retreats of this species they mentioned cracks in adobe walls and "beneath palm leaves, construction materials and fruit crates." Especially the last-mentioned daytime retreats could facilitate the transport of *P. reissi* from the mainland to the Galápagos Islands, when in close proximity to human settlements. The regular boat service from Guayaquil provides the Islands with numerous necessities like construction materials, vegetables, and other products.

Phyllodactylus reissi reaches a snout-vent length of 75 mm in males (mean 59.4 mm) and 73 mm in females (mean 57.5) (Dixon and Huey 1970). The largest specimen (male) from Puerto Ayora measured 75 mm. All specimens observed in Puerto Ayora were pale grayish, with indistinct, diffuse, darker spots that did not form distinct bands. The belly of most specimens was yellow or white with a yellow area. These two characters (size and color) are sufficient to distinguish *P. reissi* from the much smaller *P. galapagensis* (maximum snout-vent length 45 mm [Van Denburgh 1912; Lanza 1973]), which is distinctly patterned with bold, dark spots and bands on a brownish gray background (Wright 1984:26, lower lefthand picture). Upon closer examination, more differences between the two species become apparent: *P. reissi* has a distinct frontal depression; an oblique row of enlarged, projecting postanals; a midventral row of transversely enlarged subcaudals; truncate scansorial discs; and it lacks any pigment spots on the ventrals (which are white in preservative); *P. galapagensis* lacks the frontal depression, has no enlarged postanals and subcaudals, has rounded scansorial discs, and has a small black spot on each ventral (light brown in life [Van Denburgh 1912]).

During two surveys, parts of Puerto Ayora were checked for the presence of these large geckos.

During the first survey on 31 May 1988 (2000-2130), the dock area around the Catholic Church and the Hotel Las Ninfas was intensively searched by J.W. Wright, L.A. Fitzgerald, and myself. A total of 28 specimens was captured and another 10 were seen but escaped. I did the second survey by myself on 9 June 1988 (2000-2100), and at that time saw a total of eight specimens on the walls of the hospital, the Hotel Las Palmeras, the Hotel Lobo del Mar, the Municipal building, the Sala de Uso Multiple, and opposite the INGALA building (see Fig. 1, triangles). During the two surveys and on some additional, casual evening observations, only four *P. galapagensis* were observed, all on the walls of buildings belonging to the Hotel Sol y Mar (Fig. 1, stars), where they seemed to occupy the same niche as *P. reissi* did in the more central part of Puerto Ayora. The only difference observed was that the buildings on which *P. reissi* occurred were in less rural areas than those on which *P. galapagensis* occurred (surrounded by open areas). Nowhere were the two species observed together. Though the data collected so far only can be considered anecdotal, they nevertheless seem to indicate the following:

- 1) *P. reissi* is well established in the central part of Puerto Ayora, being much more numerous in the dock area than elsewhere in town, where I only observed single individuals and no concentrations as on the Catholic Church and in the Hotel Las Ninfas. It appears that it has not spread beyond Puerto Ayora, though no search was made for this species outside the village.

- 2) In the human environment, *P. galapagensis* seems to occupy the same niche as *P. reissi*. In the natural environment, it lives among and under boulders, as I observed in 1981 in the CDRS.

- 3) The species do not occur together on the same buildings. This might mean they are mutually exclusive. Whether this exclusion is an active one, with *P. reissi* eating or harassing the much smaller *P. galapagensis*, or whether other factors are involved, is unknown.

- 4) The present distribution of both species in Puerto Ayora seems to suggest a spreading of *P. reissi* into the village, with the dock area as the center of dispersal. Whether it just occupied an empty niche in this artificial habitat, or whether it supplanted *P.*

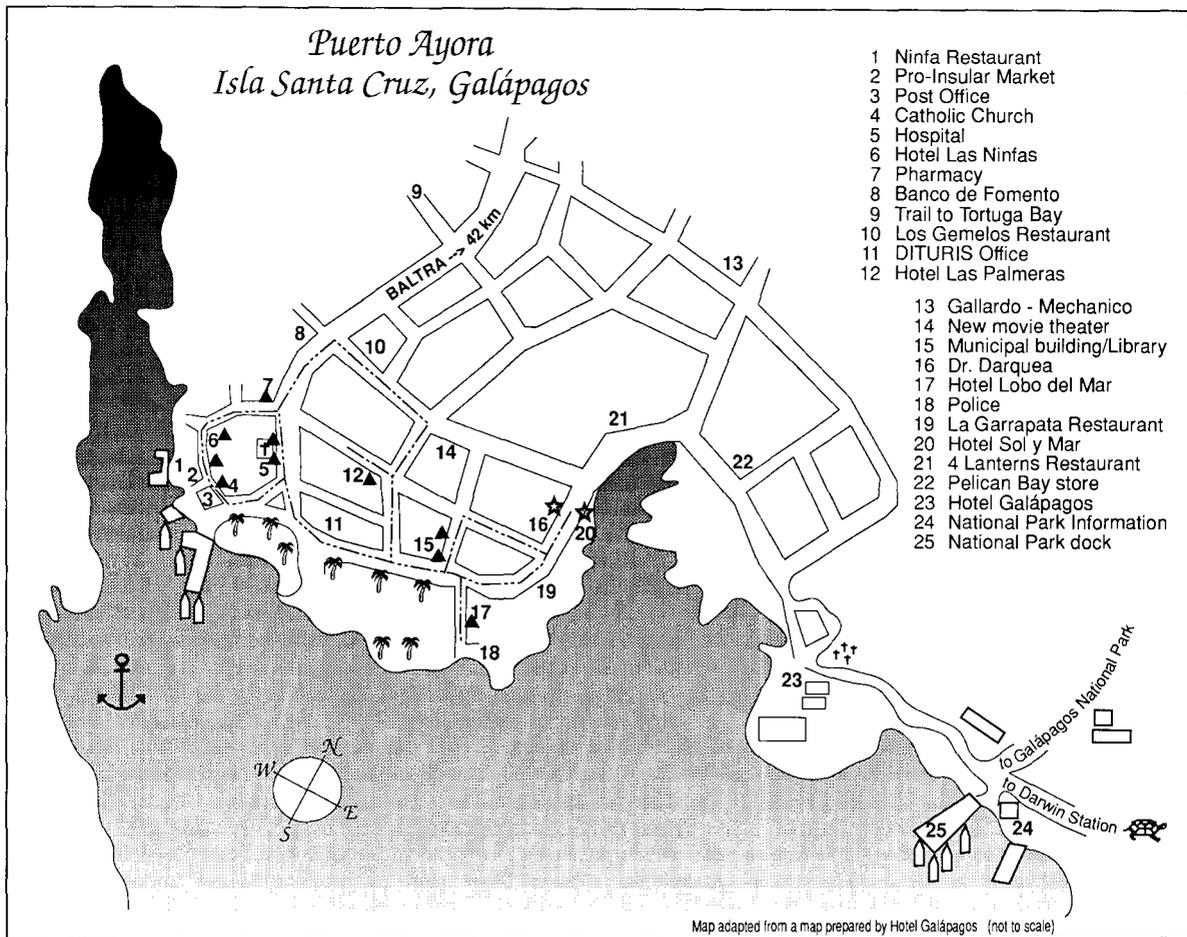


Figure 1. Map of central part of Puerto Ayora showing localities for *Phyllodactylus galapagensis* (stars) and *P. reissi* (triangles). The route of the two surveys is indicated with a broken line. Mapa de la zona central de Puerto Ayora enseñando localidades de *Phyllodactylus galapagensis* (asteriscos) and *P. reissi* (triángulos). La ruta investigada durante ambos censos está indicada por la línea rayada.

galapagensis, is not known.

5) The rate of dispersal from the point of introduction is not known, but by regular monitoring it could be established in the future.

The population of *P. reissi*, though largely in central Puerto Ayora, still might be controlled by a regular hunting and extermination program. Because no special skills are needed for this, and because logistics are not a problem, it should be possible to enlist the help of a variety of Park and Station personnel, visiting scientists, and students for "gecko-shoots," to eradicate this introduced species before it spreads into the natural environment, where it would really be impossible to control. The spread into the natural environment does not seem impossible,

because its mainland habitats (Dixon and Huey 1970) are similar to habitats found in Galápagos. A regular program to monitor the population of *P. reissi* in Santa Cruz would be advisable in order to ascertain whether the "gecko-shoots" do have an effect. I estimate that the species could be removed from the presently inhabited area within 2 years' time. At the same time, care should be taken that no new introductions stem from ship cargo arriving to Santa Cruz and air cargo arriving on Baltra. Rigorous inspection of cargo by the Port Captain before it is brought ashore would be important to preventing future introductions.

According to Wright (1983a, 1983b) another species of gecko, *Lepidodactylus lugubris* (Duméril

and Bibron), also has been introduced to Puerto Ayora, although I did not observe it during my visit. This is a small gecko, comparable in size to *P. galapagensis*; the species is distributed from Ceylon eastward throughout the Pacific to New Zealand and to western Central (Panamá) and South America (Ecuador, Colombia). Undoubtedly this species is of Southeast Asian origin. Due to its close association with man and human transport, this species has achieved its present distribution. It probably reached Galápagos from the east via the Ecuadorian mainland, where it is well established. Periodic surveys of this species will be necessary to keep track of its spread. The third introduced species of gecko in Galápagos (only on San Cristóbal) is *Gonatodes caudiscutatus* (Günther). Originally it was described as *G. collaris* Garman and considered to be endemic to San Cristóbal. As such, it was reported again by Mertens (1963). Vanzolini (1965), however, showed the type specimen of *G. collaris* to be identical with *G. caudiscutatus* from western Ecuador. This opinion was supported by Rivero-Blanco (1979) and Wright (1983c). Apparently this species has been reported only from Wreck Bay (Puerto Baquerizo Moreno) and from El Progreso. Wright (1983c) assumed that it was introduced on San Cristóbal with agricultural products from the Guayaquil area. In contrast to the other two introduced geckos, *G. caudiscutatus* is an inhabitant of relatively wet areas, and in San Cristóbal it is found in the wet highlands and in artificially wet gardens in the coastal area. It is unknown whether this species is spreading or not. A regular monitoring program would be desirable.

Not all introductions involve long-distance movements. Wood (1939) reported the presence of *Phyllodactylus leei* Cope, a species supposedly endemic to San Cristóbal, in Puerto Villamil on Isabela. Lanza (1973) thought that it was accidentally introduced into Puerto Villamil from San Cristóbal by human traffic between Islands. Wright (1983a, 1983b) mentioned its introduction to Isabela, but was doubtful whether the species still existed on Isabela.

Clearly, mammals, birds, insects, and plants are not the only introduced organisms in Galápagos. Geckos are notorious migrants that can cover large distances as stowaways in human cargo, either as eggs, as juveniles, or as adults. Of the three species

introduced from mainland Ecuador, the largest one, *P. reissi*, may pose the greatest threat to the smaller native species of *Phyllodactylus*. The effects of *L. lugubris* and *G. caudiscutatus* on the native geckos are not known but might be lessened because these species seem to prefer wetter habitats than *Phyllodactylus* from Galápagos. However, these are only speculations based on few observations, and careful research is needed in order to correctly estimate their impact (if any) on the native geckos and the ecosystem.

The fact that interisland transportation already seems to be responsible for the translocation of one endemic species of *Phyllodactylus* shows how careful one should be in transporting materials from one island to another. Possibly more interisland translocations have occurred but have gone unnoticed. One species (*P. galapagensis*) occurs on all the central Islands (Santa Cruz, Isabela, Fernandina, Santiago, Pinzón, Baltra, Daphne [Lanza 1973; Wright 1983a, 1983b]). Our present knowledge of this group does not enable us to distinguish between populations. Future research, especially in the field of genetics, might provide more data on recent movements of native species. For the time being, it seems advisable to start monitoring introduced gecko populations and, as soon as possible, to make decisions on whether their removal would be a high priority or not. My participation was made possible by a grant of the Van Tienhoven Foundation, Amsterdam, The Netherlands, and by the Tinker Foundation which sponsored the workshop in Galápagos.

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EFFECTOS DEL INCENDIO DE 1985 EN LOS INVERTEBRADOS DE SIERRA NEGRA, ISLA ISABELA

Por: Sandra Abedrabbo

El incendio del sur de Isabela, ocurrido en marzo y abril de 1985, permitió evaluar su impacto en las comunidades de invertebrados y examinar los procesos de recolonización. En junio y noviembre del mismo año se hizo un chequeo preliminar de los invertebrados del área quemada y desde febrero de 1986 se empezó con muestreas sistemáticas en el sector de la pampa de Sierra Negra (1,100 m); puesto que fue una de las áreas más afectadas por el fuego, y homogénea en cuanto a vegetación y tipo de suelo.

Con el fuego los invertebrados soportaron una gran mortalidad, pero estos empezaron a recolonizar fácilmente el área quemada pocos meses después del incendio. Invertebrados pioneros como Orthoptera (grillos y saltamontes) y carnívoros oportunistas como Araneae (arañas) y Carabidae (escarabajos) fueron los que iniciaron el proceso. Posteriormente con la regeneración de la vegetación empezó la recuperación de los invertebrados herbívoros que dependen estrictamente de ella, como Homoptera (pulgones) y larvas de Lepidoptera (mariposas).

La recuperación de los invertebrados en el área quemada esta íntimamente relacionada con la restitución de la capa orgánica del suelo y la vegetación. En refugios esta fauna no fue casi alterada y se consideran "Islas" que ayudan a

reestablecer el equilibrio. La recuperación del área quemada de Sierra Negra ha sido bastante rápida, tanto en la recolonización de la vegetación como de los invertebrados. Se estima que en uno o dos años se puede tener una "estabilidad" de estas comunidades.

EFFECTS OF THE ISABELA FIRE OF 1985 ON THE INVERTEBRATES OF SIERRA NEGRA

The fire on southern Isabela in March and April of 1985 created the opportunity to study the impact of fire on the invertebrate community and the processes involved in recolonization. In June and November of 1985, a preliminary survey of the invertebrates in the burnt area was completed. Subsequently, in February 1986, systematic sampling was begun in the Sierra Negra pampa (1,100 m) because this was one of the areas most affected by the fire, and previously was one of the most homogeneous in terms of vegetation and soil characteristics.

The invertebrates suffered a high mortality as a result of the fire, but they readily began to recolonize the burnt area only a few months after the fire. Pioneer colonists such as orthopterans (crickets and grasshoppers), opportunistic carnivores such as

spiders, and carabids (ground beetles) were among the first to begin the process. Later, with regeneration of the vegetation, the recuperation began for the herbivorous insects such as homopterans (aphids) and larval lepidopterans (caterpillars).

The recuperation of many invertebrates is related to the recovery of the vegetation and the layer of organic material on top of the soil. In isolated

refuges, this fauna was almost unaltered; and these refuges can be considered like islands, which help in the reestablishment of the invertebrate community. The recuperation of the burnt area of Sierra Negra has proceeded rapidly, with the plants as well as with the insects. **Sandra Abedrabbo, Estación Científica Charles Darwin, Isla Santa Cruz, Galápagos, Ecuador.**

INTERNATIONAL SYMPOSIUM ON THE BIOGEOGRAPHY AND EVOLUTION OF THE MOLLUSCAN FAUNA OF THE GALAPAGOS ISLANDS

By: **Matthew J. James**

On 18 July 1988, an international symposium on the biogeography and evolution of the molluscan fauna of the Galápagos Islands was held during the 21st Annual Meeting of the Western Society of Malacologists (WSM). As president of WSM for 1988, I organized the symposium to bring together researchers with interests in the taxonomy, biogeography, and evolutionary history of the living and fossil molluscan fauna of the Galápagos. WSM maintains a long-standing tradition of emphasis on eastern Pacific molluscan faunas, both in its symposia and contributed paper sessions. The symposium was held in Darwin Hall on the campus of Sonoma State University in northern California, and consisted of 10 speakers who presented 12 papers in a daylong session.

Jack Stein Grove (Los Angeles County Museum of Natural History) spoke on "El Niño 1982-83 and new records of Indo-West Pacific fishes at the Galápagos." He reported that following the 1982-83 El Niño Southern Oscillation (ENSO) event, five species of Indo-West Pacific fishes were reported for the first time in the eastern Pacific at the Galápagos. These records indicate the importance of the El Niño phenomenon as an eastward transport mechanism across the equatorial Pacific.

Matthew J. James (Sonoma State University) spoke on the "Geological setting and Cenozoic molluscan paleontology of the Galápagos Islands." He outlined reasons why the volcanic nature of the Galápagos would not make them likely sites for fossilization, although scattered sedimentary deposits containing

molluscan remains provide a record of the ancient shallow-water marine fauna of the Islands.

William D. Pitt (California Academy of Sciences) and Lois J. Pitt (Sacramento, California) presented "Notes on the marine molluscan fossil deposits of the Galápagos Islands." They reported verifying the correct location of an important limestone deposit on Isla Santa Cruz which had been incorrectly relocated by workers subsequent to its initial report by Ochsner following the 1905-06 California Academy of Sciences expedition. Also of historical interest, they reported on the possible location of Charles Darwin's fossil locality at Cerro Brujo on Isla San Cristóbal which had not been previously relocated following Darwin's visit in 1835.

Sally E. Walker (University of California, Berkeley) spoke on the "Taphonomy of two Pleistocene terrace localities on the Galápagos Islands." She reported that molluscan fossils from Isla Isabela and Isla Santa Fé reveal different taphonomic histories and explained how evidence from clionid sponge borings and predatory snails, octopods, and crabs can be used to reconstruct the taphonomy of molluscan fossils.

Mitchell M. Colgan (University of California, Santa Cruz) spoke on "The Urvina Bay uplift: Biological and paleontological implications." He explained how the shallow-water invertebrate fauna stranded during the 6 m vertical uplift of a segment of ocean floor in 1954 provides a unique opportunity for study of not only "fossils in the making" but also the record of several previous El Niño events as

revealed through isotope analyses of thick scleractinian coral skeletons.

Yves Finet (Muséum d'Histoire Naturelle, Genève, Switzerland) had a paper read on his behalf entitled "Recent molluscan fauna in the Galápagos: Taxonomic composition of the fauna." He provided an update of the faunal list he published in 1985, taking into account the biogeographic distribution of species and a newly revised estimate of the percentage of endemic species.

Donald R. Shasky (Redlands, California) reported on an "Update on mollusks with Indo-Pacific faunal affinities in the tropical eastern Pacific - VII." This update included records of taxa previously unreported in the Panamic province. Shasky also presented a second paper on "Additions and emendations to the preliminary faunal list of the marine mollusks of the Galápagos Islands by Yves Finet, 1985." In this paper he documented species occurrences that both increase the total number of known Galápagos mollusks and decrease the percentage of endemic species from 26% to 23.2%.

Frank R. Bernard (Pacific Biological Station, Nanaimo, British Columbia, Canada) spoke on the "Living Bivalvia of the Galápagos and other eastern Pacific offshore islands." He used a large compilation of biogeographic information to show that the Galápagos bivalve fauna consists of 187 species, of which only 4 species (or 0.02%) are endemic to the Archipelago.

Eugene V. Coan (California Academy of Sciences) spoke on "Unscrambling some Galápagos bivalve records." He examined several taxa in the bivalve families Bernardinidae, Semelidae, and Thraciidae in order to clarify distributional records and to pose several provocative biogeographic questions concerning such topics as the wide distribution from California to Perú of some brooding bivalves.

Shi-Kuei Wu (University of Colorado Museum, Boulder, Colorado) presented a paper coauthored with Syuzo Itow (Nagasaki University, Nagasaki, Japan) on "Distribution of land shells and plants on Santa Cruz and Santa María Islands, Galápagos." They found that while land snail distribution was related to altitude and plant zonation, it was more closely correlated with lichens and mosses covering tree trunks rather than with the shrubby plant species

themselves.

The final talk of the symposium was by Matthew J. James (Sonoma State University) entitled "Charles Darwin's contribution to the molluscan fauna of the Galápagos Islands: Historical perspective on endemism and biogeography." He analyzed a short passage in Darwin's *Journal of Researches* (1839) for insights into the biogeographic affinities of the fauna known in Darwin's time and also for an indication of Darwin's predilection to attribute unique status to the Galápagos as revealed 20 years later in the *Origin of Species* (1859).

A very strong desire expressed by symposium participants and other Galápagos workers in the audience was for specific documentation of species records (museum number or citation of published occurrence) for workers who compile lists of molluscan taxa found in the Galápagos. Such lists are often of little use without supporting information. In addition to indicating if a species is endemic or widespread in a molluscan species list, it was felt necessary to indicate the information source in order for later workers to verify or refute species occurrences in the Galápagos. Another recurring theme of the symposium was that too much emphasis has been placed on documenting the degree of endemism of the Galápagos molluscan fauna because apparent endemism is so strongly a function of collecting bias and taxonomy. Ongoing research in both the waters of the Galápagos Islands and Cocos Island (Costa Rica) has reduced estimates of endemism merely through more thorough sampling and taxonomic vigilance.

Several participants and attendees having familiarity with the present state of Galápagos ecosystems (which includes sentiments expressed in a letter to symposium participants by William C. Banta of the American University, Washington, D.C.) voiced grave concern over the possible alteration and/or destruction of both terrestrial and marine habitats in the Islands. These habitat changes are largely the result of increased human habitation of the Islands. Although the Islands are considered hallowed ground by biologists and geologists (as the result of Darwin's visit and publications), the pressures of increasing tourism, growing resident populations, and economic development create the

potential for environmental changes in the Islands. The symposium participants voiced their support for programs aimed at increased environmental awareness and conservation.

Copies of symposium abstracts may be obtained free of charge from M.J. James at the address below following publication of the Annual Report of the Western Society of Malacologists (Volume 21) in early 1989. **Matthew J. James, Department of Geology, Sonoma State University, Rohnert Park, California 94928, USA.**

Editor's Note.—A book entitled *Galápagos Marine Invertebrates* edited by Matthew J. James is planned for publication by Plenum Publishing Corporation as part of the Topics in Geobiology Series. Topics to be included are Taxonomic Composition, Biogeographic Affinities, Evolutionary Relationships, Stratigraphic Distribution, and Ecological Interactions. Any specialist interested in participating in this publication should contact Dr. James.

DESPLAZAMIENTO NOCTURNO DE LAS TORTUGAS TERRESTRES EN LA ISLA SANTIAGO

Por: Cruz Márquez y Solanda Rea

Toda la información publicada sobre las tortugas terrestres (galápagos) *Geochelone elephantopus* se refiere principalmente a comportamientos diurnos como: alimentación, desplazamientos, y copulación. El único comportamiento nocturno mencionado con frecuencia se refiere a las hembras en tiempo de excavación de sus nidos, que los hacen durante algunas horas de la noche y en ocasiones durante toda la noche. En general, los galápagos de los ambos sexos duermen todo la noche sin moverse.

En la presente nota nos referimos a galápagos de Isla Santiago observados en el año 1981 y 1982 en dos de las zonas más importantes: la Trágica, Zona II ubicada al Sur, uno de los lugares de mayor concentración de galápagos en la Isla, y los Guayabillos, (Zona D de anidación) ubicada al Norte de la Isla. Fue en estos lugares donde se presentaron los casos de galápagos observados en comportamientos nocturnos.

En octubre de 1981 los bebederos naturales usados para refrescarse los galápagos estuvieron secos, y particularmente la poza en la Trágica donde la mayoría de los galápagos se sumergen cuando la poza contiene agua. Pero aunque la poza estuvo vacía los galápagos vivían en los alrededores noche y día esperando que llueva y vuelva a llenarse. Es así como ocurrió el siguiente.

En la noche del 30 de octubre de 1981 dormíamos en nuestras carpas muy cerca a la poza sin agua, cuando a las 2230 empezó a caer una garúa. Después

de 30 minutos empezaron a oírse ruidos de galápagos que se desplazaban desde diferentes direcciones hacia la poza. Los ruidos producidos por el desplazamiento de las tortugas que ingresaban a buscar agua al lugar continuaron hasta unos minutos antes de las 2400. De estos animales registramos algunos parámetros de medidas durante la mañana y la tarde del día anterior. En la mañana del día 31 de octubre, amanecieron pequeños charcos entre el pedregal dentro de la poza seca y los 14 galápagos junto a ellos, por lo que procedimos a medir la distancia que había recorrido cada uno, revisando su número y posición al anochecer. Fue fácil determinar la distancia recorrida por cada uno de los animales; las distancias fueron de 25 hasta 60 metros. Tres de los 14 animales que amanecieron en la poza no fueron registrados por nosotros el día anterior, por lo tanto no conocemos su posición original o la distancia recorrida.

Los días 5, 6, y 8 de diciembre de 1981, en el campamento de La Poza Trágica se observó movimiento nocturno de tres galápagos diferentes, uno por cada noche. Los tres galápagos anochecieron no mas lejos de 12 m de nuestra carpa, pero en este caso, el desplazamiento de los tres no ocurrió por lluvia. En cambio, después del anochecer se los escuchaba iquietos; es decir, se movían dentro de su dormitorio cada media hora hasta que el galápagos No. 13.233 se trasladó 35 m hacia otro dormitorio donde amaneció. Durante la noche siguiente, el galápagos No. 13.137 se desplazó 30 m amaneciendo

en otro lugar. Durante la noche del 8 de diciembre, el galápagu No. 13.264 se movilizó 45 m a otro lugar. Estas observaciones nos indican que a veces las tortugas se mueven para conseguir mejor dormitorio.

Talvez la observación más estraña ocurió en la zona de anidación (D), los Guayabillos. Durante la noche del 15 de noviembre de 1982, C. Márquez acompañado por H. Serrano observó un galápagu juvenil No. 13.800 que anochió refugiado a unos 8 m de la carpa. A las 2050 se observó el animal inquieto y empezando a moverse. Al mirar el animal alumbrado con una linterna, se vio al galápagu pasar a 2 m frente de la carpa, escoltado por una lechuza, *Asio flammeus*.

El galápagu amaneció en otro refugio unos 60 m de distancia del primero.

En el caso de los animales que se desplazaron en la garúa, concluimos que andaban buscando agua. El motivo de los desplazamientos en diciembre cuando no había lluvia no es tan claro. No sabemos si el movimiento por el animal acompañado por la lechuza fue por efecto del ave o si ésta lo montó para aprovechar la oportunidad de cazar de una plataforma móvil. **Cruz Márquez y Solanda Rea, Estación Científica Charles Darwin, Isla Santa Cruz, Galápagos, Ecuador.**

IN SEARCH OF THE DARK-RUMPED PETREL

By: Rosi Dagit

"It's raining in the highlands!" This remark has come to have special significance for several students who, over the past 3 years, have spent many very wet days searching the area around Media Luna on Santa Cruz for nest burrows of the Dark-rumped Petrel (*Pterodroma phaeopygia*). The students came to Galápagos because they were intensely interested in the fate of the Dark-rumped Petrel, and were willing to put up with the cold, wet, dirty clothes and soggy sleeping bags in order to contribute to the study of these incredible birds. The Dark-rumped Petrel breeding areas are limited to the highlands of four Islands in the Archipelago, with declining populations on Santa Cruz (Baker 1980), Santiago, and Isabela (Harris 1970). Only on Floreana, where Felipe and Justina Cruz have instigated an intensive protection program, has the breeding success increased (from 32% in 1982 to 75% in 1986 [Cruz and Cruz 1986]).

Although most visitors remember the Islands as sunny, dry, blistering piles of lava rocks, the highlands of Santa Cruz can be just the opposite. Often draped in garúa, they call forth images of a prehistoric time, and life, amid a tangle of dense, wet vegetation. Into these thickets, the Dark-rumped Petrels come at night to dig their nests, mate, and raise their young. As darkness descends and the stars fade away in the encroaching clouds, the haunting calls of these birds echo through the night. How they find their burrows year after year remains a mystery. Why they choose

such an unlikely area is also unclear. Other members of the Procellariiformes are also ground nesters, but they tend to select isolated Islands and areas along cliffs for their breeding grounds.

The birds select nest sites in moist soils along the banks of sinkholes, gullies, and streambeds, and they are especially vulnerable to predation by rats and dogs. On Santa Cruz, the close proximity of farms to the breeding areas has led to drastic losses of eggs and chicks to introduced animals. Since 1978, the number of active burrows has declined at a rate of 33% per year, leading to predictions of total extinction within 10 to 15 years (Coulter et al. 1982). A protection program for the Media Luna area on Santa Cruz, similar to the one on Floreana, has been planned and begun under the guidance of Felipe and Justina Cruz.

This program seeks to approach the problem of population decline from several directions. First, monitoring of known nesting areas is continued. Second, Mirador crater was set aside as an area to be enclosed by fencing. This would serve to keep out dogs and pigs and to complement the heavy poisoning to control rats in a limited area. Artificial burrows were dug in choice locations to encourage more birds to nest there.

Third, a team, under the direction of Dr. Stephen Kress and Dr. Richard Podolsky, began a project designed to determine the influence of social

stimulation on nest site selection (Kress and Podolsky 1987). By broadcasting tapes of recorded sounds of petrel colonies, pre-breeding birds might be attracted to sites within the protected area. During the summer of 1988, the researchers began the first stage of this experiment by broadcasting the sounds and setting up mist nets to capture any birds attracted by the broadcasts. In addition to the study area near the caseta at Media Luna, tapes were also broadcast within Mirador crater each night.

June 1988 was dry in Galápagos, and for the first time in 3 years our study team had hope that we might not get wet in the highlands. But, on 4 July when we arrived at the caseta, the garúa set in to stay. Dry paths quickly became quagmires and clothes took on a permanently wet and mildewed odor. The 10 students and two instructors from International Student Research (ISR) had offered to help the Cruz team with the large task of removing invading *Cinchona succiruba*, an introduced pest species, from Mirador crater so that the endemic *Miconia robinsoniana* would become reestablished. In addition, we planned to repeat our 1986-87 transects of several nest areas near Media Luna and to help monitor the mist nets during the all-night petrel vocalization project.

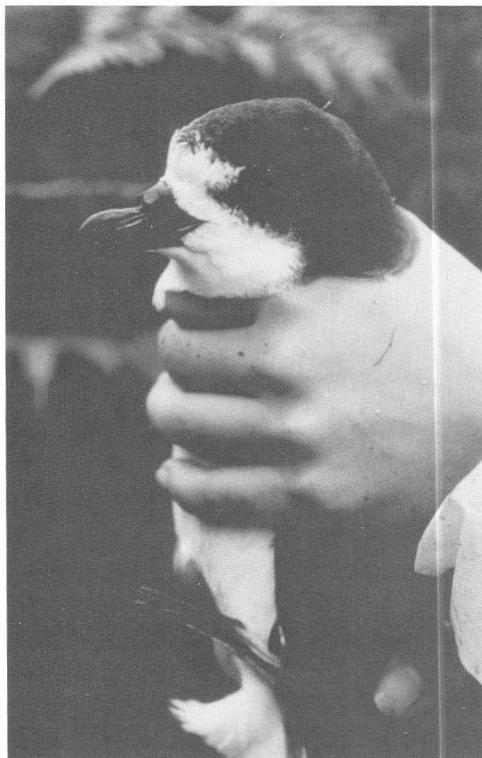
Life in the small caseta was pretty crowded, with 5 Park wardens, 5 members of the Petrel Project, and 12 people from ISR. All meals had to be cooked in shifts and, because the heavy mist never ceased, eaten inside. Bold "kitchen finches" competed with hungry researchers for crumbs. "Hey, you in the feathers, that's my breakfast!" became a constant chorus. Our tents quickly became ponds in the continuing rain. One particularly wet morning, a

soggy student came to breakfast somewhat disgruntled, complaining poetically that "Every morning I wake up in despair, with mildew growing in my hair!" Despite the fact that nearly every morning meant putting on wet, dirty clothes, our team kept up their spirits by singing and by attacking the *Cinchona* with a vengeance. After waiting our turn to cook and eat breakfast, we would hike through the Fern/Sedge zone to Mirador crater. Along the way we often encountered curious Short-eared Owls, which would sit and with puzzled gazes watch us pass.

The *Cinchona* eradication in the area was started years ago, and it seemed for awhile that the Park wardens were able to keep it under control. However, funding cuts and a changing focus meant that large areas were still vulnerable to being invaded by dense stands. *Cinchona* was introduced to Galápagos in the 1940s with the hope of selling quinine, which was made from its bark. The tree quickly became naturalized, and spreading vegetatively as well as by seeds, it out-

competed much of the endemic *Miconia*. It is not clear whether the Dark-rumped Petrel populations are directly affected by the vegetation shift, but everyone felt the protection of Mirador in its natural condition was important. Hence, the removal project.

In 4 backbreaking, blister-producing days, the team pulled up well over 4,000 trees. Earlier eradication efforts had left stumps with roots intact, and only years later did biologists realize that these had sprouted into large multiple shoots, capable of covering areas of 5 m². With only one axe but with lots of teamwork, we were able to successfully remove



A bird in the hand...in this case a Dark-rumped Petrel...is worth a lot of work (photograph by R. Dagit). Un pájaro en la mano...en este caso un petrel o pata pegada...vale mucho trabajo.

all *Cinchona* trees, large and small, from the crater, with the exception of those in the area with the recently dug artificial burrows. The Park wardens cheerfully assisted the students with the largest trees. Soon the area was dotted with large piles of trees on platforms prepared for us by the wardens. All roots and shoots had to be placed above the ground because new roots would appear quickly from excavated plants touching soil. Several days later, with a great sense of satisfaction, we stood at the rim looking down on the destroyed plants. We hoped that the *Miconia* would be able to regain its foothold. However, when we turned to hike back to the caseta and saw the extensive stands of *Cinchona* colonizing the outside flank of the crater, we realized how much work remains to be done. It will take constant vigilance to keep the *Cinchona* from reinvading.

Our plant work had other benefits for the project. In the course of crawling under the remaining *Miconia* in search of small shoots, several previously undiscovered burrows, two with birds inside, were discovered. Each afternoon we would take a break from pulling the *Cinchona* and hike transects with either Felipe or Justina Cruz to monitor nests. The nest burrows can be as deep as 2 m, so even when a bird is heard inside, it can be difficult to remove it for inspection. The preferred technique is to lie flat on your back, stick your hand in slowly, and let the bird bite your finger so that you can then drag it out. Despite the fears of some students who worried about disturbing the birds, previous experiments had shown little effect of investigator interference on breeding success (Bass 1980).

Even with bloody and bruised fingers, the students carefully held the birds so that measurements of wings, tarsus, and beaks could be taken. Each bird was also weighed and banded, if necessary. Any eggs found were also weighed and measured. The students enthusiastically crawled along the banks in search of burrows. Jane Gray became immortalized when she located a new nest with birds in it and Felipe named the nest after her! As each student assisted with the project by finding burrows or holding the birds, their determination to do whatever was in their power to save those birds increased visibly. Most interesting was an adult petrel found that had originally been banded as an adult by Michael Harris

in 1968-69 (ED22101). Because these birds don't begin nesting until they reach 8-9 years of age, this bird now was probably well over 20 years old! What stories it could have told, of nests destroyed, chicks fledged or killed by rats, and flights throughout the Archipelago in search of food.

Equally exciting were the results of the vocalization experiments. Using a variety of tapes of petrel colony sounds, a random selection was played for half-hour intervals all through the night. Large mist nets were unfurled to monitor the entrance of birds, and eager researchers waited, hidden under a tarp, for something to hit the nets. Data on birds heard calling or flying by were also noted. Any birds caught in the nets were weighed, measured, and banded if needed before being released.

On the last night of our visit, one female petrel flew into the net on her way out to sea after laying her egg. Her band number documented that we had just weighed her earlier that afternoon prior to her depositing an egg at her nest. It was great to have such specific information on pre- and post-egg weight, accurate date of laying, and nest location. Further monitoring of the nest promised to add information about incubation time by each adult, duration of incubation, and fledging.

On our way back the next day to the Darwin Station, showers, and dry clothes, one volunteer echoed the feelings of all when he remarked that he had never been so dirty, tired, wet, and happy in his whole life! Having the chance to work for the preservation of this species was definitely the highlight of all our projects in Galápagos.

The fate of the Dark-rumped Petrel as a species is by no means assured despite all the efforts currently being made. Further research and intensive monitoring are needed to continue their protection. There is also some concern about the wisdom of concentrating nests in only one protected area. This potentially exposes a large part of the remnant population to disease, predation, or some other catastrophe. The project will have to continue for several years. Despite the overwhelming odds, those involved with the Petrel Project continue to work with the hope of preventing the extinction of these wonderful birds.

ACKNOWLEDGMENTS

We gratefully acknowledge the support of Felipe and Justina Cruz, Ing. Humberto Ochoa, Dr. Günther Reck, Sylvia Harcourt, Dr. Richard Podolsky, and members of the vocalization project in organizing and supervising our role in the Petrel Project. Our educational program in Galápagos depends also on the enthusiasm of the students: Alison Downey, Robin Gager, Wing Goodale, Charlotte Gray, Jane Gray, Brian Hepler, Becky Lasky, David Lasky, Alexandra Prime, Jane Prime, and David Tisch. A special thanks to Bruce Rinker for co-leading this course for many years.

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FERNANDINA VOLCANO ERUPTS

Editor's Note.—The following report is adapted from two issues of the SEAN Bulletin, the monthly publication of the Smithsonian Institution's Scientific Event Alert Network (SEAN). This small group has been reporting on volcanic activity around the world since 1975. Readers interested in this aspect of natural history, in Galápagos and elsewhere, should know that the first 10 years of SEAN reports have been recompiled, on a regional basis and with a comprehensive index, as a 657 page book, to be published in February by Prentice Hall and the American Geophysical Union. Its title is *Global Volcanism 1975-1985*, and publication information can be obtained from the Scientific Event Alert Network, NHB stop 129, Smithsonian Institution, Washington, D.C. 20560, USA. The following report was written largely by Tom Simkin, Secretary for the Americas (Science) of the Darwin Foundation, and a volcanologist with the Smithsonian since 1967.

Fernandina Volcano, Galápagos Islands, Ecuador (0.37°S, 91.55°W).—All times are local (= GMT -6 hours). On 14 September an eruption of

Fernandina ended the longest period of volcanic quiet in the Galápagos Islands in the last 20 years. Fernandina's last eruption was in March/April 1984 (see SEAN Bulletin vol. 9, no. 33), and no eruptions have been reported from the Galápagos since then.

An unusual earthquake swarm was recorded by the U.S. Geological Survey's (USGS) Worldwide Seismic Station Network on 24 February 1988, and the most recent epicenter locations place six events within 25 km of Fernandina's caldera. These took place within a 10-hour period and were in the magnitude range 5.0 to 5.5.

Two more recent earthquakes have also been located within 25 km of Fernandina's caldera, a magnitude 4.8 event on 15 April and a 5.3 event on 20 May. Inquiries following the 24 February swarm revealed no observations of volcanism by scientists, residents, or tour vessel personnel in Galápagos, but Fernandina is uninhabited and cannot be seen from inhabited parts of the Archipelago. Inspection of low-resolution satellite imagery found no Galápagos plumes on 24 February.

On 14 September, residents of southern Isabela

felt earthquakes around 1100. About 1130, Cristóbal Jara, on the N rim of Isabela's Sierra Negra volcano, saw an eruption cloud from Fernandina's caldera, roughly 60 km to the NW. Alfredo Carrasco, Assistant Director of the Darwin Station, confirmed the seismicity on Station seismograms 140 km from Fernandina, and the USGS has since located a Fernandina earthquake (magnitude 4.6) at 1012 local time on the 14th.

Using National Oceanic and Atmospheric Administration (NOAA) geostationary satellite images, Otto Karst found no plume on an image returned at 1115, but noted a small, point-source cloud over western Fernandina at 1230. By 1830 the plume had spread 220 km to the SW and very preliminary inspection of infrared data suggested an altitude of 9 km for the cloud. Two and a half hours later the plume had started to separate from its source, indicating an end to the main eruption, and by 0030 on 15 September the cloud was fully dispersed and no longer visible on the image.

The Nimbus-7 satellite that passes Galápagos around local noon every day has provided some interesting (and puzzling) information on SO₂ distribution. Its orbit on the day of the eruption was far to the east of Fernandina and in the worst position of its 7-day cycle for measuring the eruption. It registered no SO₂ on 14 September, less than an hour after the eruptive cloud was first sighted in Galápagos, but its orbit improved in the following days and the volcano's production of gas increased. On 15 September a broad SO₂ plume extended from about 300 km NW of Fernandina to about 250 km SW, but no SO₂ was detected as far as 400 km W. On the 16th a weak SO₂ anomaly was clear from 400 to 700 km SW, but an internal satellite problem caused loss of all data in a roughly E-W band 0-300 km S of Fernandina. On the 17th there was a weak SO₂ anomaly for about 200 km SW of Fernandina, and a considerably stronger one from 700-800 km SW. This was the plume's greatest distance from the volcano, but the weak local plume suggests that the source (Fernandina) was no longer supplying much volcanic gas. On the 18th there was no anomaly at all within 300 km of Fernandina, but a strong SO₂ concentration (in fact, the strongest of the eruption) 500-600 km to the SW. It is not clear why the

strongest concentration of the eruption was that far (in time as well as space) from the eruption. On the 19th it had completely dispersed and no SO₂ anomaly appeared on the image.

A group including National Park and Darwin Station personnel left Isla Santa Cruz for Fernandina on the nights of 16-17 September. They reached the top of the volcano on 19 September, and found the most dramatic changes to the caldera since its floor dropped 350 m in 1968. The following account is based mainly on reports from Tui De Roy and Alfredo Carrasco and from photographs by Carrasco. Quoted material is from Tui De Roy.

The E wall of the caldera, oversteepened since the 1968 collapse, failed, and the resulting debris avalanche covered the caldera floor, burying a 110-m-high tuff cone that had survived the 350 m drop in 1968. The caldera lake had been about 2 km in diameter, with a maximum depth in 1970 of 75 m at the SE end of the caldera. The avalanche drove it to the W and NW as a tsunami, and when it was first viewed from the rim (18-21 September) the lake had been raised by as much as 150 m, displaced to the NW, and greatly reduced in volume. The water level dropped rapidly during those 3 days, as water percolated into the avalanche deposit below, and the lake was expected to disappear soon.

The eruption that apparently triggered the avalanche deposited up to 1.5 m of scoria on the caldera's ESE rim, ignited several fires in the dry brush vegetation, and destroyed the principal nesting area for Fernandina's large population of land iguanas. De Roy recognized that "fire storm" winds must have been strong, for wood on the side "away" from the caldera had been severely abraded by scoria and no branches thinner than a finger survived. She also measured a temperature of 45°C 20 cm below the surface of the scoria, noting that "near the margins of the scoria field, where ground vegetation was not fully smothered, smoldering soil fires were running under the scoria, with occasional flareups spreading through the dry scrub." This is the first known example of naturally caused fire in Galápagos. Pele's hair (filaments of basaltic glass formed in fountaining eruptions) was liberally distributed on the S rim ("wind-drifted heaps 5 cm thick around clumps of grass") and W flank. Pumice-like scoria was found



Fernandina caldera in 1978. The large cone in the foreground, over 110 m high, was buried in September by debris avalanches from the caldera's east wall (background). The 1,000-m-high east wall failed during an eruption that devastated an iguana nesting site on the east rim and started the first naturally generated fires known in Galápagos (photograph by T. Simkin). La caldera de Fernandina en 1978. El cono grande con una altura de 110 m sobre el suelo, fue cubierto en septiembre por un derrumbe del lado este de la caldera (atrás). El muro al lado este con una altura de 1,000 m cayó durante una erupción que destruyó la zona de nidos de iguanas terrestres y prendió encendios naturales los primeros conocidos con confianza en Galápagos.

floating 20 km S of Fernandina (and already colonized by larval crabs) 3 days after the eruption's start.

Lava flows continued after the avalanche, principally from a vent area about 100 m N and E of the 1973 vents, at an elevation around 750 m on the inner E wall. Flows coated the lower slopes and were filling in low spots on the caldera floor 18-21 September. De Roy described the hummocky avalanche deposits as "large heaps of rubble, including substantial rocks similar to the landslide accumulations along the caldera walls. They are scattered at random over the floor, some at least 20-30 m high, as though dumped by giant truck loads." Such hummocks are common in the avalanche deposits of the 1980 Mount Saint Helens eruption. Carrasco's photographs show low lava flows advancing to the WNW between rubble masses, and to the NNW into the steaming lake remnant. These flows were moving during the 18-21 September observations, and "showed various glow points during the nights," but seemed to De Roy to be the redistribution of still-molten lava on the floor rather than continued feeding from vents. The vents were still active on the nights of 17-18 September, however,

because the group saw glow over the caldera from their boat on the night before their climb.

Several phreatic explosions—the interaction of hot rock and cold water without necessarily involving molten lava—were witnessed from the rim, and small secondary explosion craters pockmarked many parts of the caldera floor. The largest explosion was at 1022 on 17 September as De Roy and others were ascending the NW flank of the volcano. A rumble and explosion were heard and "a billowing cloud rose rapidly over the caldera, then drifted SW, trailing black curtains of scoria or ash as well as a plume of brownish dust." Other explosions, mostly from the lava flow margins, were timed by David Day at 2330 on 17 September, 0415, 0658, and 0708 on the 18th, and 1005 on the 19th.

The E rim of the caldera, at an elevation of 1350-1450 m, was little changed by the 1968 collapse, but inner slopes averaged nearly 45° and were the caldera's most common sites of rockfalls throughout the last 20 years. The lake lay at an elevation of about 430 m along the foot of this wall. De Roy estimates that a width "possibly as much as—but no more than—250 m" of the rim was removed in the

avalanche, and smaller avalanches were continuing while the group was on the rim. A zone of nearly 3 km along the E wall has been affected. At 1403 on 19 September, David Day was on a cone about 200 m from the E rim when a huge landslide removed a slice of rim perhaps 10 m thick by 40 m or so wide. This was followed immediately by a violent E-W jolt which he described as a rebound sensation. "This jolt was not felt by the rest of the team on the S rim, nor were any other tremors felt during our stay." Fissures were observed in the new scoria within 50 m of the rim "sagging like glacier crevasses under snow." Landslides were common ("sometimes going on uninterrupted for an hour or more") during the group's 3 days on the rim, and the caldera was obscured by rock-fall dust during much of 20-21 September.

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WHAT'S IN A NAME?

By: John M. Woram

In doing some research on the human history of the Galápagos Islands, I thought it would be interesting to compile a list of names that have been used over the years for this or that island. My "little list" has subsequently gotten a bit out of hand; there are now some 200 names on it. Some are, of course, well-known (Fernandina, Isabela) but others are not (Foche, Mazarredo). Some are in popular usage (Floreana), others never got much beyond their author's pen (McCain's Beclouded Isle). To help further confuse the issue, at least a few names have moved from one island to another over the years. Perhaps the migration of Charles from the present San Cristóbal to Santa María is the most noteworthy of these. (Space permitting, this move will be covered in detail in the next issue of *Noticias de Galápagos*.) And of course there is the presumed juxtaposition of Crossman and Brattle (Grant 1975) and the various collections of hermanos and hermanas.

But there is one notable switch that seems to have slipped by almost unnoticed. It is described here, followed by a few other island-naming problems that I have had no luck in resolving. I would be delighted to hear from any readers who can help answer the questions put forth below.

In 1813, the American frigate *Essex*, sailing under

Captain David Porter, cruised the Galápagos while generally making a nuisance of itself to the British. Porter kept a log which later became a *Journal of a Cruise Made to the Pacific Ocean*. At one point in his *Journal*, Porter writes:

I now made sail [from Floreana to] Chatham island, running along to windward of Barrington island, which appears bold and free from danger. Towards sunset, the man on the look-out cried out, *a sail to the N.W.!* All sail was made in chace, but in a short time we discovered from the mast-head, by our glasses, that it was one of two rocks that lie off the north end of Porter's island (Santa Cruz), which we have called Bainbridge's Rocks.

In a chart bound into the second edition of the *Journal* (Porter 1822), the rocks appear to the east of Porter's, at about the position of today's Gordon Rocks and the Plazas. Actually the move was probably a simple correction of a manuscript editing error; rocks to the north of the Island could not have been seen by ship's glass from a point near Santa Fé. And unless Porter's lookout was atop an unusually high mast, he certainly could not have seen the twentieth-century Rocas Bainbridge, which now reside off the coast of San Salvador (as seen on the chart on the back cover of *Noticias*). Do any readers know how Porter's Bainbridge's Rocks made the journey to their present location? Perhaps Gordon moved them.

Come to think of it, who was Gordon?

There are at least two well-known island names whose origins are, if not lost, then certainly mislaid—Baltra and Tower. The former seems to have originated during World War II, when American forces occupied South Seymour. U.S. Government records of the period alternately refer to the Island by both names, but do not offer any explanation of Baltra. Some residents of Santa Cruz recall that it might have been an acronym, but so far, none can recall more than that.

As for Tower, the name seems to have originated at about the time of Charles Darwin's visit. But who (or possibly, what) was it named after? One French chart (Duperrey 1822) labels the same Island with the English name Hawk. Could this be the bird of the same name? Perhaps not; Harris (1982) describes the Galápagos hawk as "Previously common on all main islands *except* Tower" (emphasis added).

In his "The Encantadas," Herman Melville referred to the present Española as both Hood's and McCain's Beclouded Isle. Interestingly enough, the Melville literature does not turn up any leads to the origin of McCain. Melville scholar Harrison Hayford (pers. comm.) speculates that McCain might have been a shipmate who observed that the Island lay under some clouds and that Melville's pen did the rest.

On a final note, there are the three O's: Olmedo

(José Joaquín), Osborn (Henry Fairfield), and Onslow. The first was the Ecuadorian poet/warrior (Von Hagen 1949), the second was the president of the New York Zoological Society (Beebe 1926), and the third was . . . ?

Information on the origin of any of these names, or of others that may occur to the reader, will be much appreciated by the author.

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REVIEW: A FIELD GUIDE TO THE FISHES OF THE GALAPAGOS

Authored and Illustrated By: Godfrey Merlen

Published 1988, US - \$12.50, UK - £6.95. Wilmot Books, 243 King's Road, London SW3 5EL, England. Coedition published by Ediciones Libri Mundi, Juan Leon Mera 851, Quito, Ecuador.

Reviewed By: John E. McCosker

It has been suggested that if Charles Darwin had been an avid fishwatcher during his 1835 visit to the Galápagos, he could have based his theories of *The Origin of Species by Means of Natural Selection* on the ichthyofauna alone, without even having to venture above the high-tide line. The only things he lacked were swim fins, goggles, a scuba tank, and an adequate knowledge of the local fishes and their nearest

relatives. In point of fact, Darwin did collect 15 specimens of the local ichthyofauna and returned with them to England. They were all subsequently described as new by his friend and fellow-naturalist, the Reverend Leonard Jenyns; and one of them was named *Cossyphus darwini* in his honor.

The subsequent century and a half has experienced a checkered history of ichthyological investigation

and now, for the first time, Godfrey Merlen's field guide allows Galápagos fishwatchers an opportunity to identify 101 of the most common species. His guide includes: a map with the main diving and snorkeling sites identified; brief discussions about the oceanographic setting, the effect of fishing, advice to snorkelers and divers such as water temperature and the danger of shark attack (as yet, there has been none); comments on the coloration and size of fishes; and a brief list of further references (notably lacking the 1984 *Key Environments: Galápagos* and the 1987 *Oceanus* "Galápagos Marine Resources Reserve" volumes). However, it is the 17 color plates which make up more than half the guide that are the real value of this effort. Although none are fine art illustrations, all are color correct and more than adequate to allow for proper identification. A brief paragraph about each of the 55 families (I recognize the presence of 92 families in Galápagos) represented includes notes about their behavior, distribution, and habits. For example, it is interesting to discover that some parrotfishes sleep in mucous cocoons, or about the mating behavior of sex-changed serranids; however, I would have preferred that the author make some mention of the number (even approximate, if available) of Galápagos species within each family, thereby allowing one a feeling for the kinds of fish diversity that exist. Nevertheless, his warning that the skin of pufferfishes of the family Tetraodontidae "is also covered in a highly poisonous mucus . . ." is well worth the price of the volume to any incautious Galápagos gourmet. The author notes, "Dead pufferfishes have been seen surrounded by thousands of dead flies. A human, too, can die from eating a pufferfish . . ."

Island biogeographers will benefit from the

knowledge that the endemism of Galápagos shorefishes is comparable to that of many terrestrial plant and animal groups. This is particularly true for those forms that have short-lived larval forms and are particularly unsuited to pelagic transport. Of the 309 shorefish species now known from Galápagos, at least 51 (16.5%) of them are endemic or shared only by Islas Cocos and Malpelo. The ichthyofauna is primarily Panamic in origin, with 60% coming from the eastern tropical Pacific mainland and 16% from the western Pacific. The remainder are pantropical in distribution or are shared with the western Atlantic. The recent El Niño event has brought records of several new Indo-Pacific species to our attention, as well as a major change in the abundance and distribution of many key species.

Errors are rare in this field guide, which apparently benefited from careful proofreading by the author and fact checking by ichthyologists Leighton Taylor of the California Academy of Sciences and Alwyne Wheeler of the British Museum. Those few errors that I noticed and deserve correction are: substitute "North Equatorial Countercurrent" for "North Equatorial Undercurrent," and "Equatorial Undercurrent" for "Equatorial Countercurrent" on page 4; substitute *Halichoeres dispilus* for *Stethojulis bandanensis* on page 15; and *Semicossyphus* for *Pimelometopon* on page 42 (this is a fine nuance of ichthyological nomenclature).

In brief, Godfrey Merlen is to be commended for his fine work, and all Galápagos visitors, be they amateur or professional naturalists, will be wise to include this in their libraries. At \$12.50 (U.S.) or £6.95 (British Isles), it is quite a bargain. **John E. McCosker, California Academy of Sciences, San Francisco, California 94118, USA.**

REVIEW: GALAPAGOS: THE ENCHANTED ISLES

Authored By: David Horwell

Published 1988, 64 pages, UK - £7.95. Dryad Press Limited, 8 Cavendish Square, London W1M OAJ, England.

Reviewed By: Gay Ver Steeg

This book is one of a series of books published by Dryad Press on the subject of islands. To quote the

publisher, "This is very much a geographical view of islands, but the ideas and study skills used in the

books are not limited to those of the geographer.” This short text (64 pages) is packed with facts about the Galápagos Islands: location, volcanic origin, currents, weather, discovery and settlement, Darwin’s voyage, origin of the plant and animal life, sea life, and man and the Galápagos today.

The history of the Galápagos Islands is well done, covering the buccaneers, the whalers, the early settlers, and the importance of the visit by young Charles Darwin.

The sections on the life on land and in the sea cover food webs, speciation, niches, and island ecology. This is a big undertaking, but the examples are good. There is an informative chapter on how the different animals and plants may have arrived on the Islands.

Scattered throughout the text are questions which the reader is supposed to answer with newly acquired knowledge from the text, through deduction, or by using a reference such as an atlas. This makes the book seem like a “school book.” The drawings add

to the text, but some use very small print or are complicated.

The book has a major weakness in that it lacks a definitive focus. The text tries to cover a large scope in very few pages. It tries to be all things to all readers. The last chapter attempts to discuss man’s impact on the Galápagos today. As a summary chapter, it is not adequate, lacking in depth. The book needs an effective summation, but instead ends with a fizzle.

However, the book does not talk down to teenagers and it is a serious effort. It would be appropriate in a science, social studies, or history class. It would be a good resource book for “across the curriculum” projects and classroom or school libraries. It would not be the best choice if it were the only source of information on the Galápagos Islands, but this book would be a good addition to a collection of books about the Islands or about geography. **Gay Ver Steeg, Route 4, Porterville, California 93257, USA.**

REVIEW: GALAPAGOS: DISCOVERY ON DARWIN’S ISLANDS

Authored By: David W. Steadman and Steven Zousmer

Artwork By: Lee M. Steadman

Published 1988, 208 pages, 74 figures, 51 color plates, 2 appendices, and bibliography, US - \$24.95. Smithsonian Institution, Washington, D.C./London.

Reviewed By: Robert I. Bowman

This new “coffee-table” volume, in 8.5 x 11.0 inch format, is a gem! It conveys to the reader in photographs, paintings, and prose, the enchanted feeling of these isles of evolution. This end was achieved through the cooperative efforts of David W. Steadman, a scientist with a “well-honed professional instinct;” Steven Zousmer, a professional writer with two “prestigious film projects” about the Galápagos under his belt; and Lee M. Steadman, a promising young artist whose full-page, lifelike watercolors, depicting all native vertebrate groups (except fishes), are spread lavishly over half the pages of this book.

This ambitious publishing venture begins with a 4-page color spread of dramatic Galápagos photos, followed by a title page, table of contents, 4 more pages of color photos, a page of explanatory remarks

about the writing of this book, a 2-page listing of the color plates, a charming 3-page foreword by S. Dillon Ripley—Secretary Emeritus of the Smithsonian Institution and a longtime champion of Galápagos conservation and founding member of the Charles Darwin Foundation for the Galápagos Islands—who recounts his first visit to the Galápagos in 1937, and finally 1.5 pages of acknowledgments. The succeeding pages, forming the bulk of the book, are divided into two parts. Part I is composed of five chapters cooperatively penned by David Steadman and Steven Zousmer. Part II is devoted to the watercolor paintings of Lee Steadman, with accompanying descriptions of habitats, behaviors, and evolution by David Steadman.

Part I begins with the story of David Steadman’s

encounter with the introduced black rat on Isla Pinzón, the impact of this and other exotic animals on the endemic biota, the significance of isolation in the arrival of colonizing propagules in the Galápagos, and the historical breaching of the isolation by man. The chapter concludes with a statement of his research objective in the Galápagos, which was to trace evolutionary histories of contemporary endemic species using a prodigious number of fossils he excavated in the Galápagos.

In Chapter 2, titled "Colonizers," the authors review the now-debunked theories on the origin of the Islands, principal means of transport of terrestrial Galápagos colonists, pointing out that colonization is a function of time, distance to be covered, size of the target area, and suitability of the ancestral propagules for chance long-distance travel and for establishment on foreign terrain. Steadman agrees with the generally held view, based on paleomagnetic datings of lavas and biochemical analysis of animal proteins, that the Islands are only a few million years old and that the ancestors of most resident species of reptiles, birds, and mammals arrived less than one million years ago.

In Chapter 3, titled "At Last Gleams of Light Have Come . . .," there is a recounting of the historical facts leading up to the publication of Darwin's *Origin*. The authors set to rest the erroneous idea that Darwin was converted to an evolutionary perspective of living things during his 6-week stint in the Galápagos in 1835. Rather, as the recent historical findings of the distinguished Darwin scholar Frank Sulloway have shown, Darwin's conversion to an evolutionary theory of life took place in the second week of March in 1837, after hearing from the experienced British ornithologist John Gould, who examined Darwin's Galápagos specimens, that all except one of the land birds were peculiar to the Galápagos and that different species of mockingbirds lived on different Islands. It was this identification of the mockingbirds which Darwin had previously said would "undermine the stability of Species."

In Chapter 4, titled "Beneath the Surface," we come to the heart of the material of Steadman's research in the Galápagos, namely, species extinction as evidenced by the fossil record. We learn about the treasure-house of fossilized vertebrate remains that

he uncovered in lava tubes on five major Islands. The fossil evidence indicated that some species became extinct suddenly, recently, and all at about the same time, such as on Isla Floreana. This he correlates with the history of human colonization beginning in 1832, and the introduction of domesticated animals, many of which became feral and destroyed the habitat of such species as the Large-billed Ground Finch, or preyed directly upon it and the mockingbirds, thus leading to their extinction.

Relying once again on the research of Sulloway, Steadman reviews the tangled history of labeling and identifying the Island sources of the finches collected by Darwin in the Galápagos, which explains why Darwin, the serious scientist, was unable to use his finches as evidence of evolution through natural selection in his writing of the *Origin*.

In the concluding chapter of Part I, titled "On Friends and Enemies of Species," Steadman deals with the vulnerability of insular species to the destructive influences of man, both direct and indirect. The lack of fear of humans (i.e., tameness toward man) of Galápagos animals has led him to remark that "Galápagos creatures have *forgotten* fear." This notion is partly in error. Darwin was careful to point out that the lack of fear of man on oceanic islands is not related to any fear reaction that they show towards other enemies in their environment with which they evolved. For example, the finches, although tame by human standards, show mobbing responses toward their Galápagos predators (hawks, owls, and snakes) just as continental species do to similar predators. The native birds were especially vulnerable to man as a newcomer whose destructive habits were unknown to the finches. The fact that man is a relative newcomer to the Islands, whose destructive habits were foreign to the finches, made insular residents vulnerable to attack by him, because of their tameness toward him. Similarly, feral dogs and cats did not initially elicit evasive reactions in the native terrestrial vertebrates.

Although conservation of natural resources has never been a top priority of man in any culture, the Galápagos today may be an exception. Even though there has been significant damage by man, "by comparison with other islands, the state of nature in the Galápagos is healthy and as promising as it can be

in a dangerous world.” This optimistic state of affairs is credited to the conservation efforts of the Government of Ecuador as early as 1935, and more recently to its joint efforts with the Charles Darwin Research Station. Quite properly and deservedly, the authors give high praise to the leadership role of the Galápagos National Park Service as exemplified by its recently retired Superintendent, Miguel Cifuentes.

In concluding this chapter, the authors make a case for the reintroduction of tortoises and land iguanas to Isla Rábida where they once were known to occur (based on Steadman’s fossil finds) and thereby restoring the Island’s ecosystem to a more natural state by including large herbivores that once lived there. Despite this suggested intervention, it is Steadman’s philosophy that conservation “must concentrate on what is rather than what was: the Galápagos remains comparatively unspoiled and we should apply our energies to keeping it that way.”

A few criticisms of Steadman’s evolutionary commentary are in order. On page 42 he states that “Largely because of Darwin’s visit, many scientists have regarded Galápagos as hallowed ground supporting species so distinct that their evolution would never be grasped. I disagree . . .” The author seems to have erected a “straw dummy” because he fails to state who these persons are or to put some of the early opinions into a framework that speaks to the limitations of the intellectual perspectives of the times. Certainly, within the past two decades, biologists have been searching for clues to ancestries of Galápagos vertebrates through new analytical techniques involving morphology, genetics, biochemistry, and behavior. To be sure, for modern scientists, the Galápagos is “hallowed ground” in the sense that they are honored because of their physical beauty, as revealed by the relative simplicity of the patterns of diversity displayed by the endemic plants and animals, as well as by the geological constructions, a situation which makes them so attractive for evolutionary studies, as first recognized by Darwin!

The senior author, presumably, has implied that, in the past, scientists have devoted little attention to the relationships between Galápagos and mainland species, being more concerned with the divergences seen among the endemic insular forms. While this is not true of the focus of all past evolutionary studies,

it was prompted by the fact that knowledge of the structure, distribution, and relationships of mainland species was rather poorly known, and therefore links between them and their possible Galápagos derivatives were difficult to discern. Caution was considered to be a scientific virtue. Today, the objective tools for assessment of relationships have brought about a radical change in the evolutionary biologist’s modus operandi. Confusing “look-alikes,” resulting from superficial evolutionary convergences in such structures as beaks and plumages of birds, have often led ornithologists down the path of incorrect phylogenetic interpretations. Indeed, David Steadman himself would seem to have fallen victim of this “convergence hazard” by suggesting that the mainland Blue-faced Grassquit (*Volatinia jacarina*) is the living direct ancestor of Darwin’s finches. Recently, Baptista and Train (1988, *Auk* 104:663-671) have concluded from their detailed analyses of 10 behavioral character states of Darwin’s finches and the grassquit, that “the bulk of the available evidence does not support Steadman’s identification of *Volatinia* as the congener and direct ancestor of geospizines.” Ongoing biochemical analysis of proteins also gives support to this conclusion.

Part II of the volume is devoted to the watercolor paintings of Lee M. Steadman, with accompanying descriptions of the habitats, behaviors, and evolution of the subjects illustrated by David Steadman. This gallery of plates depicting all resident mammalians, reptilians, and the avian groups is presented as “the first comprehensive ‘fieldguide’ to Galápagos wildlife.” Considering the fact that none of the fully aquatic vertebrates—fishes—is illustrated, and the page size is 8.5 x 11.0 inches, one wonders why this 2.5-pound volume is so incorrectly portrayed by the publisher! Nevertheless, the watercolor paintings are a truly novel and beautiful complement to the textual and photographic materials in Part I.

David Steadman introduces this portfolio of paintings as “both art and science,” and the artist, Lee Steadman, in a four-page essay, describes his methodology and philosophy of Nature.

Some of this reviewer’s impressions of the paintings are prompted by his experience in working with his wife who has also used the watercolor medium to illustrate a children’s book about the

Galápagos. Firstly, as the artist correctly states, "watercolor is such an unforgiving medium" requiring considerable skill to do things correctly the first time. Secondly, there is the matter of deciding how much detail one should include in order to project scientific accuracy of the subject matter. Thirdly, how well does the finished painting radiate the qualities of a vibrant Nature? If one judges Steadman's paintings by these perspectives, it is clear that his work is stylistically uneven. For example, the eyes of his subjects often lack the sparkle typical of the living animal, as in the case of the Red-footed Booby and Flightless Cormorant, with the latter showing none of the turquoise green so typical of the adults of the species. Regarding scientific accuracy and detail, the tortoise painting fails to show the otherwise conspicuous toenails on the feet or the leathery texture with scales on the neck (plates 1 and 42). The scaly skin of the marine iguana (plate 5) is not well shown, although this feature is handled somewhat more skillfully in the land iguana painting (plate 4). Among the most artful and scientifically pleasing paintings are the Waved Albatross (plate 12), with its excellent rendition of feather detail on the flanks, and the pale yellow wash on the neck and head, and the realistic texture of the water-worn lava on Isla Española. Plate 18 of the Brown Pelican and Brown Noddy shows an interesting behavioral interaction between these species, along with realistic colors and details. The Swallow-tailed Gull (plate 26) is outstanding for the realistic posture of the adult and fledgling birds and for the realistic colors and feather detail.

In general, there seems to be a problem with consistent handling of the light source and with concomitant highlights and shadows, as in the Paint-billed Crake (plate 33), bats (plate 7), Barn Owl (plate 39), and Oystercatcher/Lava Gull (plate 25). The lack of lifelike qualities seems most apparent in the finch plates 49 and 51, and the Black Rail plate 32. Poor composition distracts from the esthetic quality of the penguin (plate 11), the Audubon's Shearwater (plate 14), the stilt and pintail (plate 34), the flamingo (plate 35), the hawk (plate 36), the

Galápagos and San Cristóbal Vermilion Flycatchers (plates 41 and 42), and finch (plate 51). The vegetation and backgrounds are rather poorly executed, especially in the penguin, crake, and dove plates (numbers 11, 33, and 37, respectively).

Not to be overlooked are the elaborate captions to the color plates, with their wealth of intriguing information (much of it speculative) about the origin of many Galápagos vertebrates. Many comments excite one's curiosity because they open up new lines of thinking about ancestral relationships of classical Galápagos species.

Two appendices containing English and Spanish names of the Galápagos Islands, and lists of resident species of reptiles, birds, and mammals with their common and scientific names, are followed by a two-page list of references to a variety of popular and scientific publications on the natural history of Galápagos and related topics. The book closes with a one-page list of picture credits. The endpapers have a simplified map of the Galápagos with English and Spanish names applied to the Islands (except for Culpepper and Wenman).

Overall, this is an impressive volume, written in free-flowing literary style, which brings a fresh approach to a general natural history of terrestrial vertebrates of Galápagos. As a paleontologist, knowledgeable about his science, with a broad base of field experience in the Galápagos and other oceanic islands of the Pacific, David Steadman has both unearthed and illuminated fossil evidences of vertebrates which have given new temporal and evolutionary dimensions to our understanding of such important problems as biological extinction and conservation of insular biotas. Although intended for a general audience, this book has much to offer both amateur and professional naturalists. It will stand as one of the more enduring of the many glamorous natural history books about the Galápagos to have appeared in the last two decades. **Robert I. Bowman, Department of Biological Sciences, San Francisco State University, San Francisco, California 94132, USA.**

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