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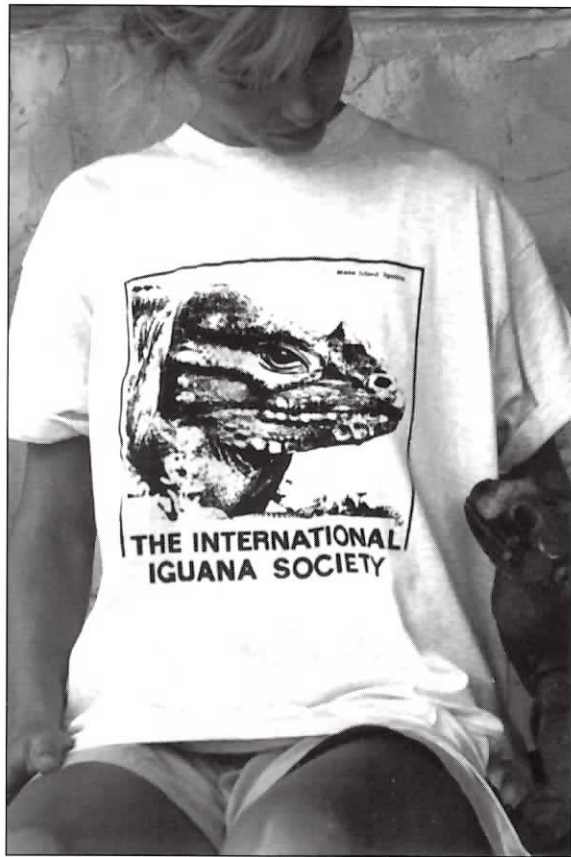
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6½ year-old male Grand Cayman
Blue Iguana, *Cyclura nubila lewisi*.
Photograph: Robert W. Ehrig

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ANY HOPE FOR GRAND CAYMAN'S BLUE IGUANA?

BY FRED BURTON, SCIENTIFIC PROGRAMS MANAGER
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It's soon after dawn in the Cayman Islands, and I'm working my way through the dense rocky thickets of eastern Grand Cayman, heading into the Salina Nature Reserve to track down Zadok.

Zadok is a male Blue Iguana, *Cyclura nubila lewisi* (the Grand Cayman subspecies of the Cuban Rock Iguana), who was released with a radio transmitter early in 1994. As I strain to hear his faint radio signal over the chorus of bird song, a pair of parrots launch into a vocal protest at my presence. These thickets and woodlands are undisturbed by man, teeming with the plant and animal life which has evolved into many unique forms on these isolated Caribbean islands.

As I step out into the first open glade at the release site, Zadok's signal strengthens and I see from a fresh tail drag that he's already moved out from the pile of rocks he's been using as an overnight retreat for the past few days. It doesn't take long to find him, spread-eagled on a patch of red earth, soaking up the early morning sun. As he warms, his skin turns pale blue, highlighting the blood-red color of his eyes. He licks up a few fallen Lancewood flowers and lumbers off into the thicket. I follow and record: another day's tracking is under way.

It's hard to believe, looking at this powerful, alert animal, protected in a 625-acre nature reserve, that I am looking at a classic endangered species story. Yet this magnificent reptile, which once roamed throughout Grand Cayman, now survives only as a remnant population of about a hundred individuals, scattered over a mere 3 square miles at the eastern end of the 92 square mile island.

Before humans first settled Grand Cayman, about 300 years ago, the Blue Iguana roamed throughout Grand Cayman; it was the island's

largest land animal. An adult male could weigh 20 lbs. and measure over 5 ft. long. As an adult, such a creature had no worries about predators, and the females's production of 15 to 20 eggs a year yielded enough surplus young to allow for some loss of hatchlings to native birds and snakes.

People have changed all of that. It's a familiar story, with the combination of habitat destruction, the introduction of dogs and cats, trapping and now road kills, combining to bring a once healthy population down to the brink of extinction. The Blue Iguana is now classified as critically endangered and is strictly protected both under local legislation and through CITES (the



A released 3-year-old, after a lifetime in captivity, soon finds food in the wild (here eating leaves of *Capparis flexuosa*). Photograph: Fred Burton

Projects for the National Trust of the Cayman Islands

- **Environmental programs:** The Trust owns and protects 1,300 acres of conservation land, distributed between all three of the Cayman Islands. On Grand Cayman the principal Trust nature reserves are the Salina Reserve (referred to in this article), the Mastic Reserve (a diverse old growth forest), and the Queen Elizabeth II Botanic Park. On Little Cayman the Booby Pond Nature Reserve protects a huge breeding colony of Red-footed Boobies, and on Cayman Brac diverse woodlands are protected in the Brac Parrot Reserve.

In addition to the Blue Iguana, priority endangered species programs include monitoring populations of the Cayman Islands' Amazon Parrot and West Indian Whistling Duck, and conservation programs for several endemic plants. The Trust maintains an active herbarium and insectarium, and hosts visiting scientists in an effort to increase understanding of the islands' biodiversity.

- **Historic programs:** The Trust is developing an inventory of the Cayman Islands' historic buildings, and owns or manages several sites of historic significance.
- **Education programs:** Both historic and environmental efforts are backed by ongoing public education efforts, including publications, school programs and involvement with school curriculum development.



C. n. lewisi egg hatching at the National Trust's breeding facility. Photograph: Fred Burton

Convention on the International Trade in Endangered Species), but sadly the destructive pressures continue to mount.

Grand Cayman is in the midst of a rapid development boom, with human population and land use accelerating at an alarming rate. The western half of the island is now dominated by man-made landscapes, and the destruction of natural habitats is moving inexorably eastward. For native plants and animals this is a gloomy scenario indeed, but the threatened loss of Cayman's natural heritage is beginning to alarm many local residents.

In 1987 a conservation organization, the National Trust for the Cayman Islands, was established. In 1988 its founding members joined, and in 1990 it embarked on a conservation program for the Blue Iguana, one of a series of programs directed at preserving natural environments and places of historic significance in the Cayman Islands (see Box).

The Trust's Blue Iguana program is an integrated one, meaning that it has many different elements all directed towards the same goal. We want to re-establish a stable wild population of Blue Iguanas in Grand Cayman, capable of perpetuating itself indefinitely without needing constant intervention. Five years into the program, it's still unclear whether that goal can really be achieved.

It was an early priority for us to learn more about the Blue Iguana in the wild, a difficult proposition since even in the best iguana areas you can go for days without seeing a single individual! Still, the Trust has been fortunate to receive generous support for field work from the Smithsonian Institution's National Zoological Park, in Washington, D.C., with technical backing and advice coordinated by the Zoo's Curator of Herpetology, Dale Marcellini. Steady financial support has come from the Friends of the National Zoo, including funding for field assistance by a student researcher, Kevin Gould. With that backing, we have been able to gradually accumulate enough information about the Blue Iguana's diet, habitat needs and behavior to be able to plan meaningful conservation strategies.



Adult male *C. n. lewisi* sunning in a thicket in eastern Grand Cayman. Photograph: Fred Burton

At the same time the Trust has been breeding increasing numbers of Blue Iguanas in captivity, gradually incorporating animals illegally held captive in various parts of the island, and bringing in hatchlings which roam into extremely high risk areas among traffic and domestic dogs and cats. The captive program is increasing in sophistication—DNA profiles carried out by Scott Davis' team at Texas A&M University have helped to optimize the genetic diversity of captive bred young. Thirty *C. n. lewisi* are now in the Trust's captive breeding facility, and a pair of yearlings were recently released in the Queen Elizabeth II Botanic Park.

Captive Blue Iguanas, particularly males, soon become very tame. That's a real bonus for publicity and education: our tamest males are local media personalities, and meet literally thousands of school children at the annual Trust Fair. Curiosity usually overcomes the traditional fear of reptiles, and a generation of Caymanian school children are growing up with some knowledge,

understanding and love for a beast which is regarded by many of their grandparents with fear and revulsion.

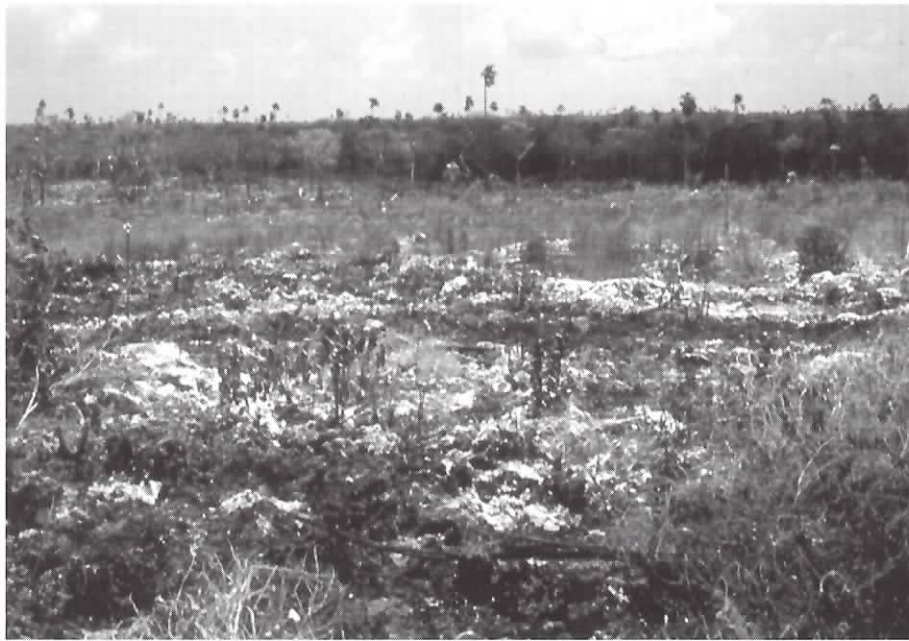
The whole program really came into focus in July 1993, when we released our first captive bred iguana to the wild. It was a three-year-old male, a sterilized hybrid excluded from the breeding program, with a radio transmitter implanted into his body cavity by zoo veterinarian Lisa Tell (then at the National Zoological Park). Hybrids resulting from a pairing of *C. n. lewisi* with *C. n. caymanensis* (the Little Cayman subspecies of the Cuban Rock Iguana) in the U.S. some years ago are now widely distributed in captivity, and it has taken painstaking genetic analyses to untangle the resulting confusion. In our efforts to conserve Grand Cayman's unique subspecies, we were anxious to avoid further interbreeding of the distinct bloodlines on Little Cayman and Grand Cayman. We had no idea what to expect from our preliminary repatriation study, so by using the sterile hybrid we played it very safe!

Kermit (as he later became known) was blocked into an artificial retreat at sundown, in the heart of the Trust's Salina Reserve, where we had identified apparently suitable iguana habitat. At 3 am, with Kermit cold and inactive, I opened the door so that as the morning sun rose he would wake up free to explore a new home. Marcellini, Gould and I watched him every waking hour for the next week, and we soon began to realize that a captive reared iguana can rapidly adapt to the wild, finding food and retreats without difficulty. We released two more sterile hybrids over the next month and observed the animals establish mutually exclusive territories and engage in classic ritualized fighting. The Blue Iguana's future was looking brighter with every passing day.

Kermit was the largest of the three, and unlike the other two he periodically wandered far away from the release site. Eventually he wandered right out of the reserve, and was bitten to death by a dog when he tried to raid its food bowl: a tragic illustration of how these animals have no innate fear of man's domestic animals. The other two iguanas survived a full year before we recaptured them, demonstrating that release of captive bred iguanas can work, and proving to us that the Salina Reserve study site can support at least a few free-ranging iguanas.

Kermit's fate turned out to be a warning. The following winter we released Zadok and an adult female into the same study site. The female established a fairly small, defined territory, but Zadok,

like Kermit, roamed far and wide. He often returned to the release site and during the mating season he guarded the female closely. But at other



Iguanas no more: habitat destruction is threatening all of Cayman's wildlife. Photograph: Fred Burton



Slung aside after being left to die in a trap — *C. n. lewisi* are still occasionally persecuted by farmers. Photograph: Fred Burton




3-year-old *C. n. lewisi*, in the wild after being released from captivity with an internal radio transmitter. Photograph: Fred Burton

times we tracked him down half a mile away or more. He spent a significant amount of time well outside the boundaries of the Reserve, and often wandered perilously close to a major road.

From observations of other adult males in the wild, this seems to be entirely normal behavior. It means that adult males wander miles over the east end of the island, and are unlikely to remain in the safety of relatively small protected areas. Zadok's radio transmitter failed prematurely, and he hasn't been seen for almost a year; the chances are that, if he still survives, he is spending little of his time on protected property.

This poses a serious challenge for the Blue Iguana conservation program. Although the National Trust now owns and protects some 1,200 acres of conservation land in the Cayman islands, very little of this is suitable for iguana breeding. Perhaps at most 4 acres in the Salina Reserve offer pockets of nesting substrate. There just isn't enough protected land in the Blue Iguana's remaining habitat to secure a future for this struggling remnant population.

The hope now lies in designing and securing a larger protected area for eastern Grand Cayman. Perhaps by integrating some extensive Government land with the purchase of key, privately-owned parcels, we may be able to protect core nesting and foraging areas within the existing mosaic of agricultural and wooded land. High land costs and competing conservation priorities are likely to be severe constraints.

Whether an adequate Blue Iguana Reserve can be established before real estate development alters the entire landscape is the fundamental issue. In the end it is protection of its habitat which will determine whether Grand Cayman's unique Blue Iguana has a future. The wild rocky interior of this small, fragile island is its one and only home. 

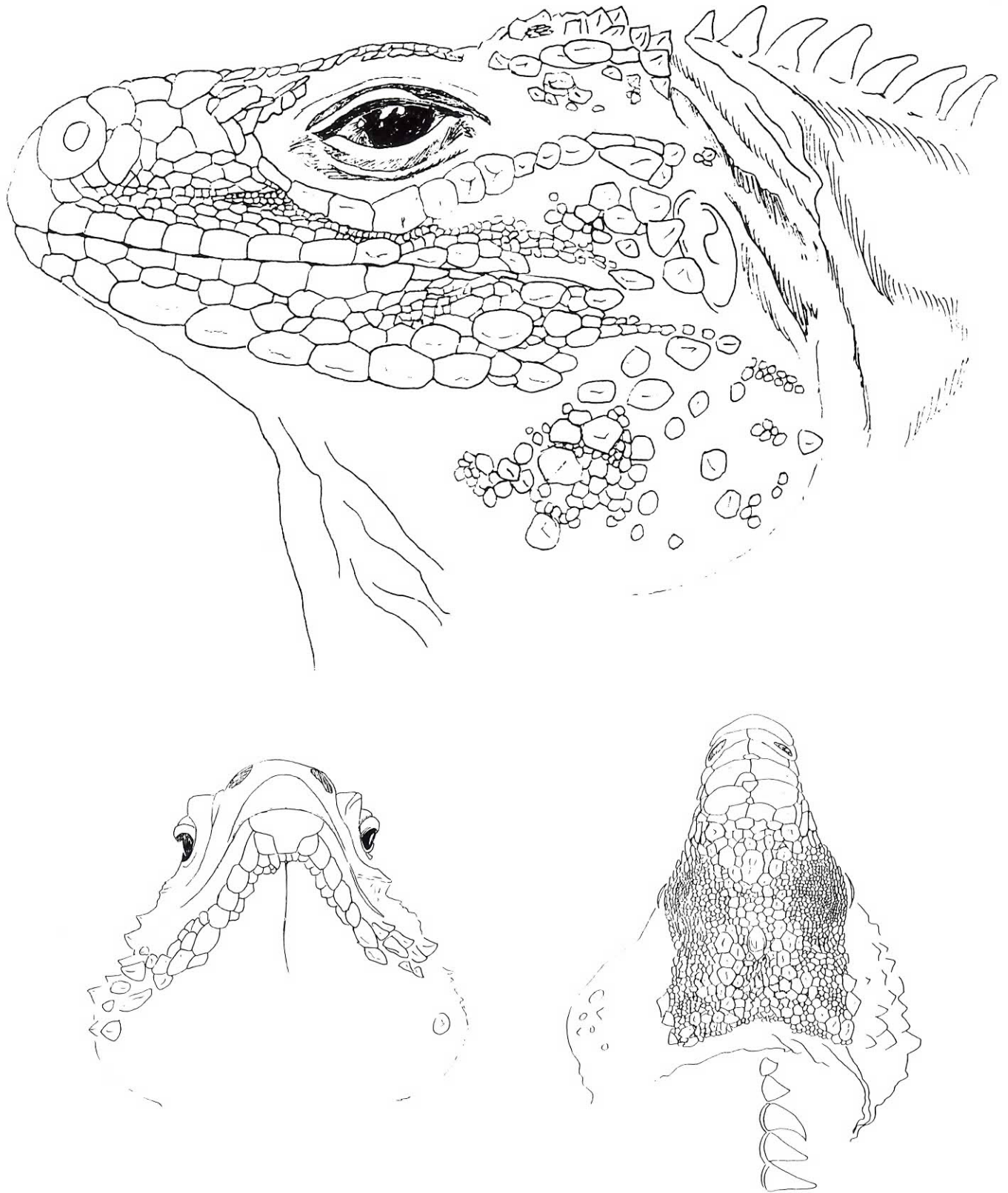
If you are interested in contributing to the Trust's Blue Iguana conservation fund, write to:

National Trust for the Cayman Islands
P.O. Box 31116 SMB
Grand Cayman

or call the Trust at (809) 949-0121.

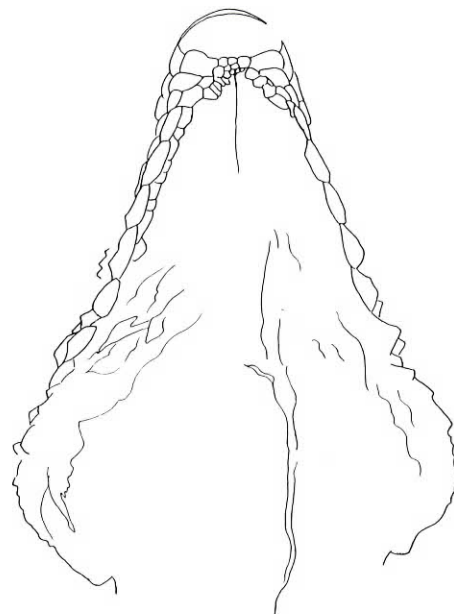
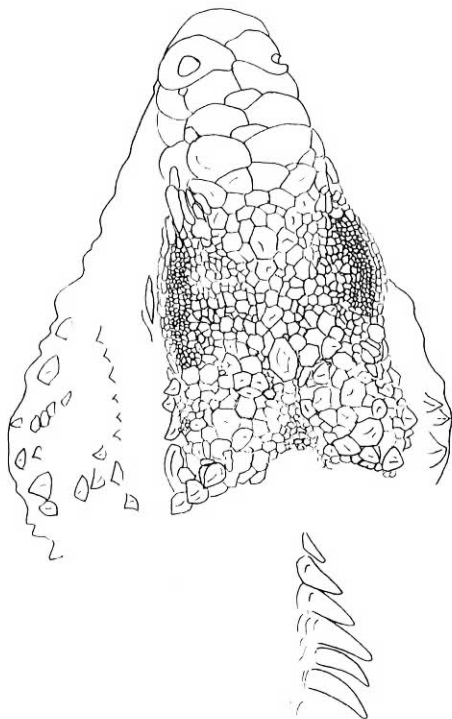
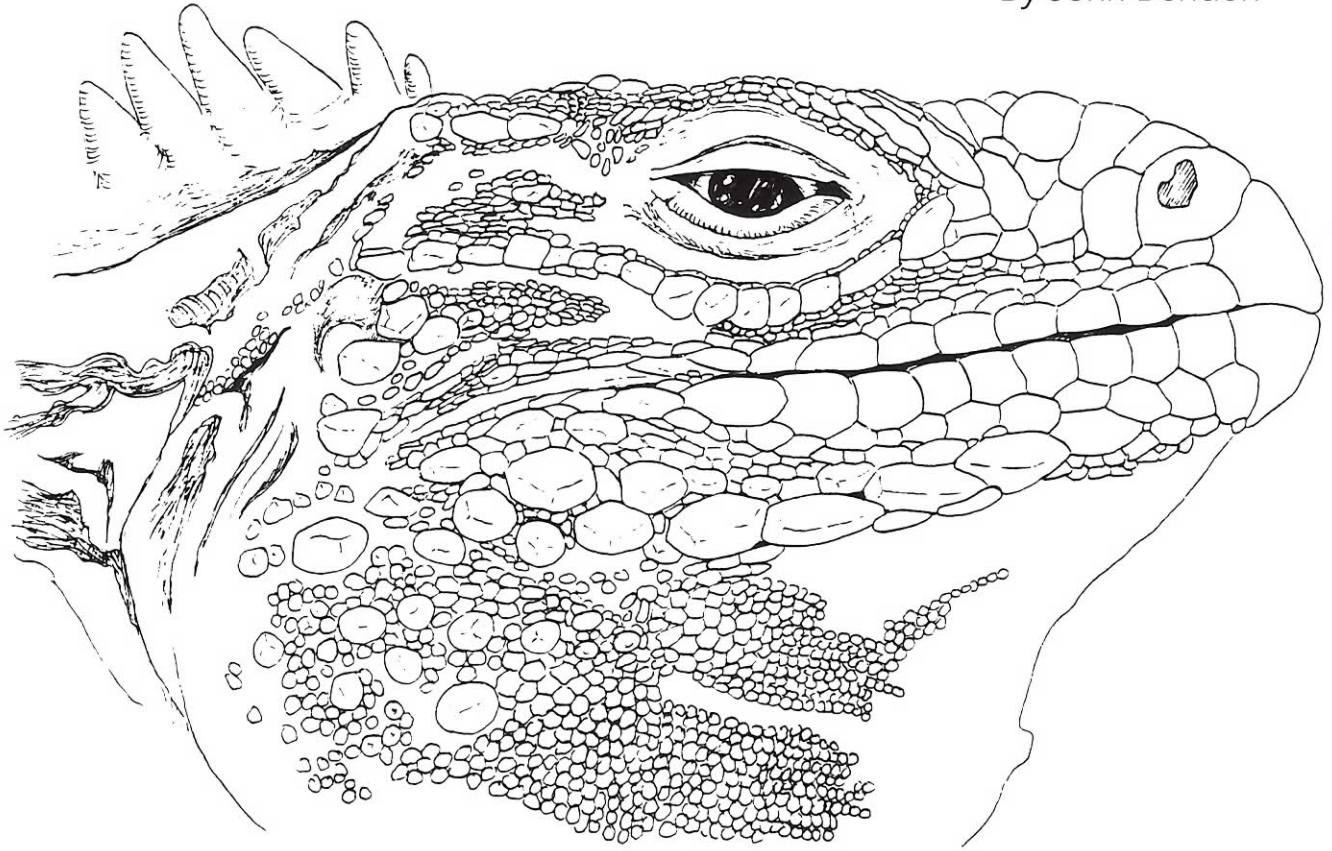
Scalation Rendering of *Cyclura nubila lewisi*

By John Bendon



Scalation Rendering of *Cyclura nubila nubila*

By John Bendon



RESEARCH UPDATE

SURVIVING ATLANTIS: THE MOLECULAR EVOLUTION OF THE GALAPAGOS IGUANAS

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The Galapagos archipelago is situated about 1000 km west of Ecuador, South America, the nearest mainland. It is of volcanic origin and has never been in contact with the American continent. The biota of the Galápagos is related to that of the Americas, but the species diversity, that is, the number of different species in the archipelago, is much smaller. The species composition is unbalanced, with few terrestrial mammals and no amphibians inhabiting the islands. Reptiles, on the other hand, dominate the scene. Capable of enduring weeks in tropical sun without fresh water, iguana, lizard, gecko and tortoise species are thought to have reached the islands on vegetation rafts, carried from the American coast by the waters of the El Niño or Humboldt current.

The Galápagos Islands are famous for the quick adaptive radiation of some of their taxa.

The 13 Darwin finch species, for example, evolved apparently from a single ancestral species that colonized the islands not more than 5 million years (MY) ago (Grant, 1994). The Galápagos iguanas, on the other hand, display a very different pattern of evolution. The two endemic genera seem to have diverged long before the finches, but the Galápagos land iguana comprises only two species (*Conolophus pallidus* and *C. subcristatus*) and the marine iguana one (*Amblyrhynchus cristatus*). Morphological data suggest that the land and marine iguana are sister taxa, that is, like the Darwin finches they probably share a direct common ancestor (de Queiroz, 1987). Thus, it is possible that this ancestral iguana species colonized the archipelago, where it then diverged into the land and the marine iguana lineages. Yet, the oldest of the present Galápagos islands emerged only 5 MY ago,



The Galápagos marine iguana (*Amblyrhynchus cristatus*). "It is a hideous-looking creature, of a dirty black color, stupid and sluggish in its movements" (Charles Darwin). Photograph: Kornelia Rassmann

or less, while protein-based studies indicate a much longer separation time between the two Galápagos iguana genera (e.g. Wyles and Sarich, 1983). Are the Galápagos iguana lineages perhaps much younger? Or did they originate elsewhere and the archipelago was colonized at a later stage with iguanas from two independent ancestral stocks?

DNA based technologies offer a powerful tool to analyze the phylogenetic or evolutionary history of a species, as well as its current demography, such as the level of migration or gene flow among the populations. Since 1991, I have been working on the molecular evolution of the Galápagos iguanas, attempting to infer their present and past mode of evolution from their genetic make-up. The first part of the study centered on the phylogenetic background of the Galápagos iguanas, specifically on the question of where and when the two genera separated (Rassmann, 1997). Second, I evaluated the level and pattern of genetic variation within both the land and the marine iguanas, addressing two main questions: 1) how genetically related are populations from different parts of the archipelago; and 2) are their genetic relationships determined by evolutionary history (for example the sequential colonization of the islands) or by contemporary processes (such as migration among the populations)?

(Rassmann *et al.*, 1997). Finally, the genetic data were used to derive suggestions aiding the conservation of the Galápagos iguanas (Rassmann, 1996).

Phylogeny of the Galápagos Iguanas

Mitochondrial DNA (mtDNA) sequence data (c. 1 kb of the 16S and the 12S genes) were employed to re-evaluate the phylogenetic relationships among the nine genera of Iguanidae (sensu Frost and Etheridge, 1989), namely the Galápagos marine and land iguanas (*Amblyrhynchus* and *Conolophus*), the black or spiny-tailed iguana (*Ctenosaura*), *Enyaliosaurus* (often included in *Ctenosaura*), the green iguana (Iguana), the West Indian rock iguana (*Cyclura*), the chuckwalla (*Sauromalus*), the Fiji or banded iguana (*Brachylophus*), the desert iguana (*Dipsosaurus*), and as an outgroup the Malagasy iguana (*Oplurus*). The phylogenetic analyses largely confirmed the findings of the morphological studies. The desert iguana (*Dipsosaurus*) appeared to be the most basal lineage among the nine Iguanidae, followed by the Fiji iguana (*Brachylophus*) as the sister taxon to the seven remaining taxa, the so-called Iguanini. The molecular data suggested further that *Enyaliosaurus* and *Ctenosaura* were the closest living relatives of the Galápagos iguanas and that the latter shared a

The Galápagos land iguana (*Conolophus subcristatus*). "These lizards, like their brothers the sea-kind, are ugly animals; and from their low facial angle have a singularly stupid appearance" (Charles Darwin).
Photograph: Kornelia Rassmann



direct common ancestor. Hence, the molecular phylogenetic results agreed with the hypothesis that this ancestral iguana species possibly colonized the archipelago, where the land and marine iguana then evolved in situ.

Rate comparisons between the iguanid sequences and a corresponding set of sequences from ungulates (such as the cow and the sheep) with known evolutionary ages were used to estimate the separation time among the Galápagos iguanas. Such separation time estimates are only crude approximations, particularly when the rate of sequence evolution is adopted from a different taxon group. However, it has been shown that the rate of mtDNA sequence evolution is faster in endotherms, such as the ungulates, than in ectotherms, such as the iguanids (Rand, 1994). Thus, using an endotherm rate probably gave an underestimate of the Galápagos iguanas' separation time, and it seemed safe to conclude that their separation took place 10 MY ago, or more.

The molecular analyses strengthened the notion that the speciation of the Galápagos iguanas happened long before the emergence of today's Galápagos islands. Yet, new geological data reveal that this does not necessarily exclude their origin within the archipelago. Christie *et al.* (1992) analyzed submarine sea mounts southeast of the present

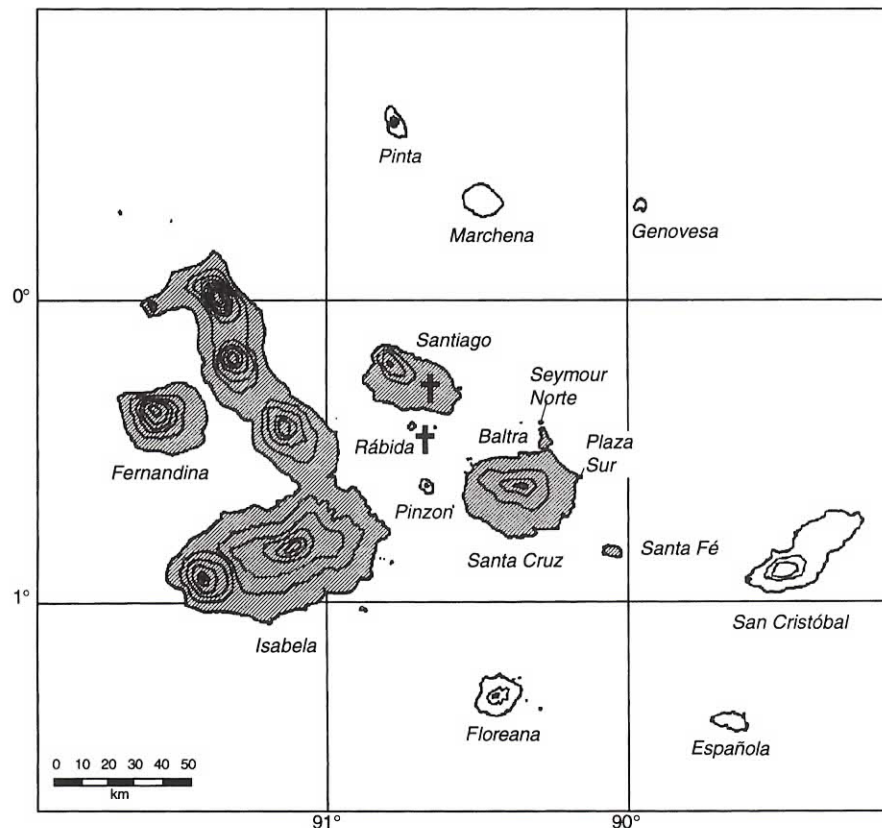
islands and suggested that some represent former, now drowned volcanic islands of the archipelago. The oldest of the studied sunken volcanoes was active over the Galápagos hotspot about nine to eleven MY ago, and Christie *et al.* suspect that islands may have appeared and disappeared for much longer. Thus, it may be that evolutionarily old Galápagos taxa, such as the iguanas, inhabited these former islands of the Galápagos and experienced more time for evolution within the archipelago than previously thought.

Microevolution of the Galápagos Iguanas

Employing again mtDNA sequence analyses (c. 450 nucleotides of the cytochrome b gene), I also tested the level of genetic divergence within both Galápagos iguana genera, including 150 marine iguanas from 15 islands and 46 land iguanas from five islands (Figure 1). The maximum sequence divergence within both genera was low (< 2%), that is, even among the most diverged land iguana or marine iguana sequences I detected only a few nucleotide changes. Such low

Figure 1. The Galápagos archipelago.

While marine iguanas are widely distributed throughout the archipelago, land iguanas inhabit only the central islands (Santa Cruz, Seymour Norte, Plaza Sur) and the western islands (Isabela and Fernandina). Two further land iguana populations from Santiago and Rabida are today extinct.



levels of mtDNA sequence divergence can accumulate within a relatively short period of time, possibly within the time frame the present Galápagos islands existed.

Given that the Galápagos iguanas experienced a long evolutionary history in the archipelago, the low level of genetic divergence within both genera seemed surprising. However, the distribution of the different variants of mitochondrial sequences (or haplotypes) in the archipelago suggested a possible explanation for this. None of the haplotypes detected in the western populations were also found in the eastern populations, and vice versa. Thus, there is apparently no mitochondrial gene flow among western and eastern iguana populations. Because only females transmit mtDNA to their offspring, this finding implies that female land and marine iguanas migrate little among different islands. With such low levels of mitochondrial gene flow among island populations, one would expect that only few mitochondrial variants from the former, now extinct island populations were passed on to today's populations. Hence, most of the observed mitochondrial variants originated probably within the present archipelago. The maximum mitochondrial sequence divergence among today's iguana populations is therefore probably limited by the age range of the surfaced islands, not the former islands of the archipelago.

To test the level and pattern of genetic differentiation among the populations in more detail, the marine iguanas were also analyzed using microsatellite DNA fingerprinting. Microsatellite fingerprinting detects variation in the nuclear genome. The technique is well-used today, for example, in forensic work, where it can serve to identify a specific individual among others from the same population. In the marine iguanas, however, the micro-

satellite analyses detected surprisingly little nuclear genetic differences among the different island populations. Although the fingerprints revealed a large number of different nuclear DNA markers, many were shared among the island populations, even among those that had no mitochondrial markers in common.

Did the mitochondrial or the nuclear data convey a wrong picture? The answer may be much simpler. Unlike mitochondrial DNA, nuclear DNA is inherited from both the mother and the father. In other words, males that reproduce in a foreign population transmit their nuclear genes to their offspring, but not their mitochondrial genes. For the marine iguanas this means that males probably migrate relatively frequently among different island populations, and thus spread nuclear alleles throughout large parts of the archipelago, whereas females migrate little, leading to the observed geographically restricted distribution of the mitochondrial haplotypes. A similar analysis of nuclear markers in the land iguanas is currently being conducted in collaboration with Melanie



ABOVE:
The Galápagos marine iguana (*Amblyrhynchus cristatus*). Photograph: Kornelia Rassmann



LEFT: The Galápagos land iguana (*Conolophus subcristatus*). Photograph: William Hayes

Markmann and Diethard Tautz at the University of Munich, Germany.

Conservation Genetics in the Galápagos Iguanas

Because of their isolation and late colonization by humans, the Galápagos Islands are still relatively pristine and their biota undisturbed. However, in some parts of the archipelago, the human impact over the last few centuries has taken its toll. Many of the Galápagos vertebrate populations are threatened by predation from feral animals, habitat destruction and competition for resources by plants and animals introduced by humans. The most urgently needed steps toward the rescue of Galápagos biodiversity are probably immediate ecological actions and the enforcement of political decisions. However, there is also potential in the data accumulating from molecular evolutionary studies in the archipelago.

The discipline of conservation genetics aims to document the contemporary and future level and pattern of genetic variation in endangered species and offers suggestions to aid their preservation. One of its applications is to rank the conservation values of populations or taxa based on their degree of genetic deprivation or their phylogenetic distinctiveness. This allows the targeting of limited conservation means toward specific projects and can lend support to political decisions.

During the sampling of marine iguanas in 1991 and 1993, Linda Cayot, Fritz Trillmich and I observed low population sizes and an absence of juveniles on islands with introduced predators, such as Isabela and San Cristobal (Cayot et al., 1994). The consequences of artificially increased levels of predation on natural populations, however, are not easily assessed when information on a population's demography and their genetic relatedness to other populations is missing. It may be, for example, that migration among different subpopulations from the same or neighboring islands is sufficiently high to make up for losses.

The microsatellite fingerprinting and mitochondrial sequence data of marine iguanas were employed to evaluate the relative level of genetic variation within each population and the level of

genetic relatedness among the populations. The population from Punta Pitt on San Cristobal clearly had the highest genetic distance to all other populations and also the lowest level of nuclear and mitochondrial DNA variation. Based on the molecular findings, and bearing in mind the low number of individuals, the absence of hatchlings in this population, and the conspicuous signs of predators, we strongly recommended the immediate eradication of feral animals and protection of the habitat in the Punta Pitt area.



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IGUANA REPORT FROM JAPAN

AKIRA YAMANOUCI, TAKAKO YAMANOUCI
YAMANOUCI IGUANA LABORATORY

From the end of 80's to early 90's, there was a little reptile boom in Japan. Many pet shops were constructed and other non reptile shops, including department store, tropical fish shops, and even some supermarkets, started to sell small cutie green iguanas. The number of imported juvenile iguanas had increased rapidly through 1992 to 1993. As compared with increasing number, the price of iguanas decreased in a short period. In approximately 1990, one juvenile was about 30,000 yen (about \$300) to 40,000 yen (\$400). By 1992, it dropped to 10,000 yen (\$100). Last year, it dropped to around 3,000 yen (\$30). It became 1/10 in 5 years. We don't think it is that iguanas are sold at a lower cost but there are some people who think they should not spend more money to create their environment than the animals' price. Of course it takes more than \$30 to make a good captive environment.

And \$30 is inexpensive enough for the elementary school children to buy iguanas as a

toy. We have seen many children buying them in the pet shops.

The problem was there was no information available for proper iguana care. There were no books, no magazines, no veterinarians specialized for exotic animals. Different explanations were heard if you asked different people. Most shops described the lizards as follows.

"Iguanas are easy to keep."

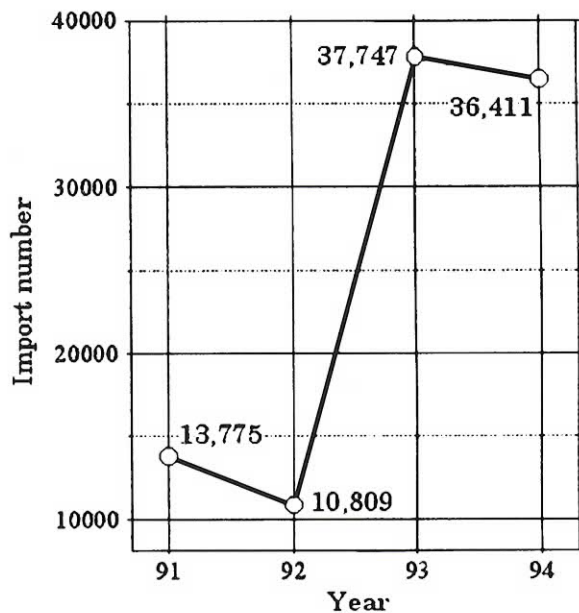
"Iguanas eats anything."

"They don't grow big."

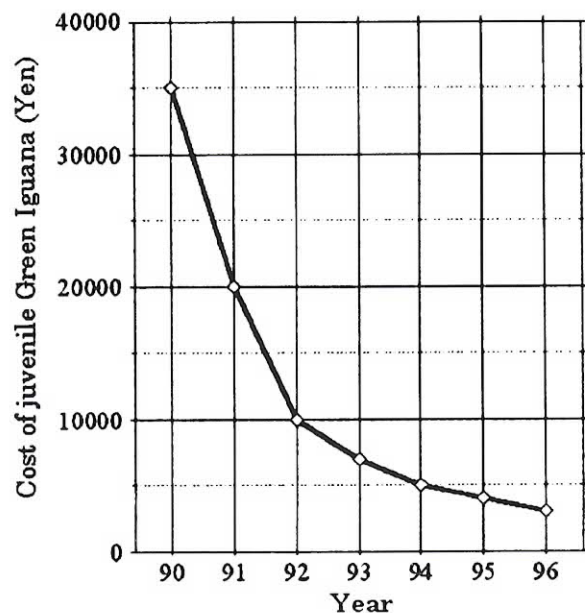
"Keep them in a 20° (Centigrade) environment."

"60 cm aquarium is enough."

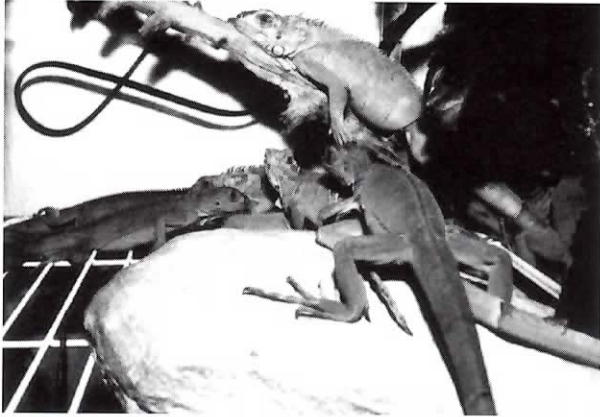
All these non-academic expressions were heard from many pet shops. And since there was no other information, people began to believe this wrong information. We heard that less than 10% would survive over a year. Thirty thousand iguanas are imported now, but we have rarely seen iguanas that are over 1 m.



Import number of juvenile iguanas in Japan. From 1991 to 1994. There was a great boom in 1993.



Cost shift of one juvenile Green Iguana. It became less than 1/10 in five years. It is now 2,000 to 3,000 yen.



Rescued juvenile iguanas: they were all depressed and suffering from Metabolic Bone Disease (MBD). They were fed only lettuce and given no direct sunlight.

Every time we go to pet shops, we encounter poor-looking, suffering iguanas. Most of them have Metabolic Bone Disease. Many people didn't understand the necessity of sun-bathing and some didn't even know that they need a heater.

There were many respiratory infected, parasite infected, paralyzed limb, MBD juvenile iguanas all over. At one shop, with the worst conditions, we couldn't leave them and we bought them all. They all recovered and we are now keeping 14 iguanas in a small apartment. But there are more out there. We had to do something for these poor iguanas.



Yamanaouchi Iguana Laboratory

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IIS CONSERVATION AWARD

The International Iguana Society is proud to announce the decision to award Mr. Edwin Duffus of St. Catherine, Jamaica, our first **International Iguana Society Conservation Award**.

In May 1990, Mr. Duffus was hunting feral hogs in the center of the Hellshire Hills in southern Jamaica, when his hunting dogs gave chase to something. When he caught up, he discovered an animal wedged in a log that he had never before seen in his eight years of hunting in the Hellshire Hills. It was the first live Jamaican Iguana, *Cyclura collei*, found on the Jamaican mainland in this century!

Edwin, always the conservationist, carefully placed the iguana into his burlap sack and carried it out. He knew he had found something important. He took several buses to Mona Heights in Kingston, to question people at the Hope Zoo about what animals might exist in the hills. When he was satisfied with the answers, he told the people of what he had found.

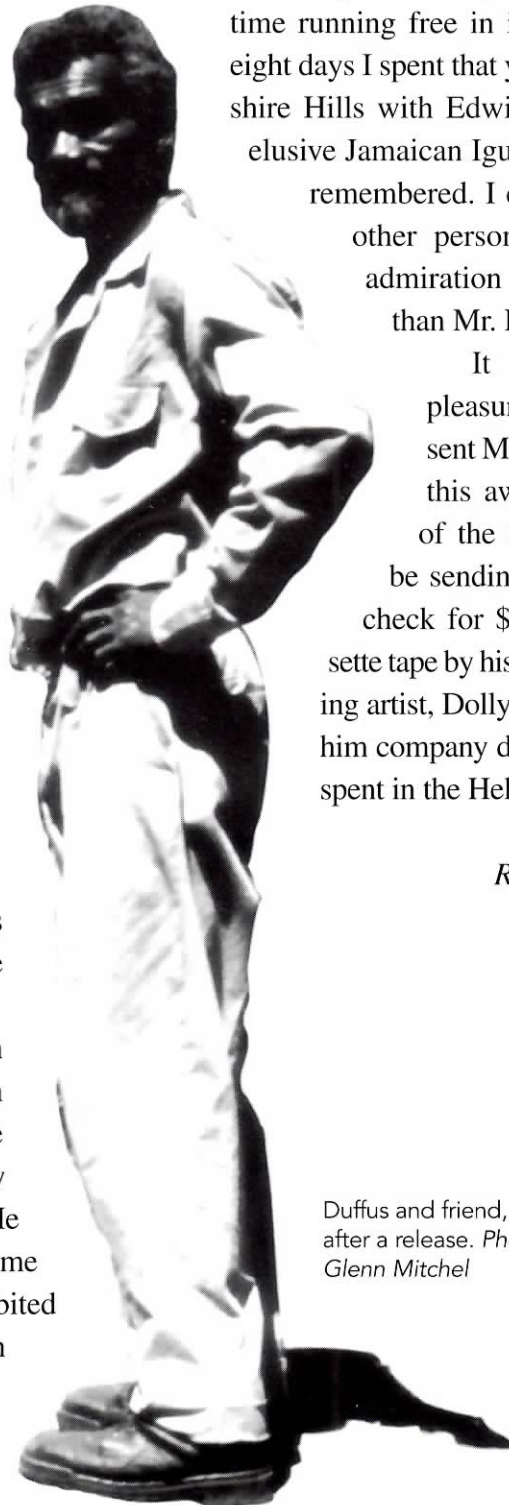
In the next six and a half years Edwin became the main protector of the Jamaican iguanas in the wild. He was hired by the Jamaican Iguana Program and spent as many as six weeks at a time in the Hellshire Hills. He would ride his bicycle 14 miles from his home to begin his duties. Edwin has always exhibited amazing endurance and tact in working on behalf of the Jamaican Iguana.

In August, 1990, I was fortunate to be in Edwin's company

when the iguana was spotted for the first time running free in its habitat. The eight days I spent that year in the Hellshire Hills with Edwin, tracking the elusive Jamaican Iguana, are fondly remembered. I can think of no other person I have more admiration and respect for than Mr. Edwin Duffus.

It is with great pleasure that we present Mr. Edwin Duffus this award. As a part of the award, we will be sending Mr. Duffus a check for \$100 and a cassette tape by his favorite recording artist, Dolly Parton, to keep him company during his nights spent in the Hellshire Hills.

Robert W. Ehrig
President

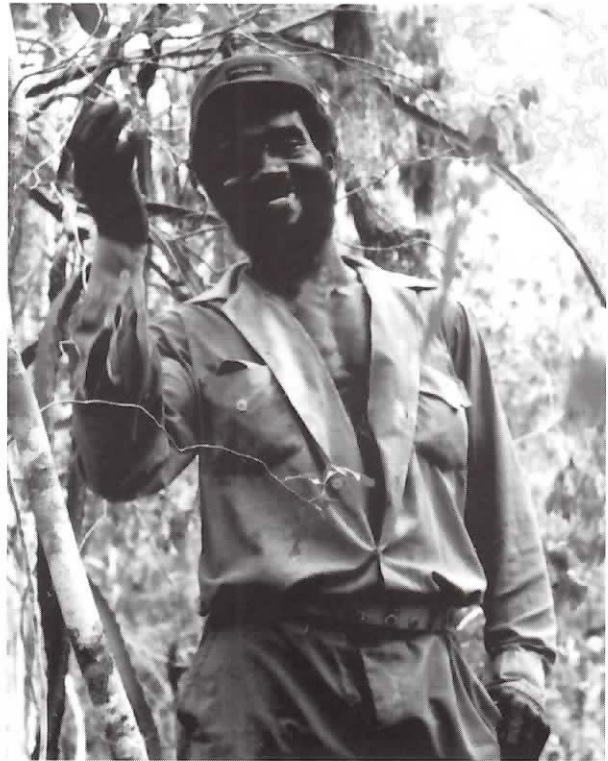


Duffus and friend, moments after a release. Photograph: Glenn Mitchel





Duffus at base camp with *C. collei* prior to trapping.
 Photograph: Glenn Mitchel



In the Hellshire hills, August 1990. Photograph: R. W. Ehrig



At a nesting site with tagged female *collei*. Photograph:
 Glenn Mitchel



Edwin with Richard Nelson, a Jamaican Iguana
 researcher, putting on a tag. Photograph: Glenn Mitchel

LIZARD LETTERS

Iguanas, Salmonella, and Herpetoculture

Obviously, your intentions in writing the article *Iguanas, Salmonella and Herpetoculture: A Conflict of Interest...and Conscience?* (IT, Vol. 5, No. 2) were in the right place: a concern for the welfare of iguanas in captivity. My main complaint to your article, however, is that it emphasized criticism but did not address what I see as the bigger ethnoherpetological picture or present solutions in terms of the bigger picture. Although you may know me best in the context of having authored the Green Iguana Manual, I am also the founder and president of the American Federation of Herpetologists (AFH) and key decision maker in the publishing of the Vivarium magazine. Advanced Vivarium Systems Inc. is also my company and its focus is publishing.

As president of the AFH I have been involved with the legislative aspects of herpetoculture, primarily in trying to establish models for sound legislation and self-regulation. The pet trade and pet keeping are more complex in their ramifications than most people realize. Although initially my interest in herpetoculture was animal focused, it is becoming increasingly focused on the ethnoherpetological aspects. What are the cultural, social and psychological ramifications of herpetoculture? What human needs are fulfilled through herpetoculture? Are the long term effects of herpetoculture more beneficial than bad? As a result my interest has been in encouraging dialog and understanding between the various parties involved with amphibians and reptiles.

Although it is true that green iguanas are still mismanaged and abused in the pet trade, the fact is that more and more green iguanas are surviving, a percentage which I suspect at least equals the survival rate in nature and probably exceeds it. In general the pet trade has made considerable efforts in the last decade to try to improve the herpetoculture of green iguanas. The greatest problem with green iguanas today is that too many are surviving to become large. They are about to become an animal control problem. The economics of the green iguana trade have wide-ranging effects both in the countries of origin and in the importing countries. If you have followed the trends in herpetoculture, in the latter part of 1996 green iguana imports have gone down and are expected to continue to do so as the Australian Inland Bearded Dragon is being promoted as a better candidate for a reptile pet. More than a quarter million bearded dragons will hatch in the U.S. in 1997. The green iguana market will decline and find its level of equilibrium. Although it may seem I am pro pet trade, I am above all pro rights of individuals to keep and breed amphibians and reptiles, even in Oregon.

In the February/March issue of Vivarium I have a lengthy article titled the Spectrum of Ethnoherpetology which attempts to present a broad view of the relationship of herpetology, including herpetoculture, to human needs. It is my hope that this will lead to an understanding that could resolve the supposed chasm between herpetologists and herpetoculturists.

Philippe de Vosjoli
Advanced Vivarium Systems, Inc.
Santee, California

Impulse Buying

I am a sixth-grade elementary school student writing to you about iguana importing to the U.S., and mainly about impulse buying of the common iguana. I am a proud owner of a green iguana and I plan to hold that statement. From their native lands mainly in South [and Central] America, the common iguana is rapidly being captured and imported to the U.S. In time, maybe not too long, iguanas will be a threatened creature due to increasing wants in America. What many of those careless impulse buyers don't know is how large captive iguanas grow, and many stores don't [offer] adequate information to begin with. What I would like to know about this concern follows: What have we been doing to prevent this lack of knowledge many former and present owners have? Or is it still a concern that is undecided?

Geoff Todt
Bexley, Ohio

You have probably put your finger on a significant source of iguana abuse—impulse buyers who are poorly informed. In addition to the books and other sources on iguana care that are already out there (some of which IIS sells through the IIS Bookstore), Iguana Times does occasionally publish articles on iguana care (e.g., September 1995 issue). Perhaps the most critical means of getting knowledge to the buyers is to see to it that pet stores in your own area are providing adequate information to buyers. We appreciate your enthusiasm and concern for the green iguana.

Compassion

I am fortunate enough to have two green iguanas as pets. I feel love and fascination towards them and all members of their species. I am saddened but now very well informed thanks to your fine, compassionate article that I read in the June 1996 edition of Iguana Times [*Iguanas, Salmonella and Herpetoculture: A Conflict of Interest...and Conscience?*]. I too am appalled at the cheapness of the lives of these beautiful animals. Do you feel there's any chance that leg-

LIZARD LETTERS

isolation which prevents exploitation of these animals is a possibility? Would perhaps the ASPCA and other animal rights organizations give the green iguana their attention? Or are [iguana] unworthy because they are reptiles? Having a green iguana brings nature and its many wonders into my home. But I would rather never have another green iguana than to have one die at the hands of the misguided people without a conscience. I would appreciate any input as to how I may go about forming a successful support group in favor of the green iguana's lives over the greed of humans. *Iguana Times* is truly the most passionate, informative reptile publication in the U.S.

Donna J. Reid
San Diego, California

Legislation may well be enacted to regulate or ban the trade in green iguanas, but this would likely come about only as a response to public concern over the risk (though quite small) of salmonellosis infection from pet iguanas. It is difficult to predict whether such legislation might ever be passed, as was done a number of years ago to ban the sale of baby turtles. Regardless of the salmonella issue, some degree of regulation certainly could benefit the plight of iguanas bound for the pet trade. For example, by dramatically reducing the number of iguanas imported to the states, their value in dollars would increase. When a pet costs more to procure, it is generally given much better care and is purchased less often by those who don't take a serious interest in their pets welfare. Unfortunately, there will always be some abuse of pets regardless of whether they are reptiles, fishes, birds or mammals. Rather than seek to ban the sale of all iguanas (and other pets), the best way to ensure better care is to communicate your concerns with all involved in the pet trade—but especially the pet owners. The letter by de Vosjoli suggests that an Australian reptile has already begun to reduce sales of green iguanas.

— Editors

NEW
RELEASE

Until now, no books have adequately addressed the complete needs of pet iguanas. But **Green Iguana — The Ultimate Owner's Manual**, the culmination of 5 years of research, changes all that. The book reads like a novel — fun, interesting, exciting — but with the accuracy and impact of a scientific journal.

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This 6"x9" book has more than 600 pages of text, 10 appendixes, a comprehensive index, 16 pages of color photographs, 16 black-and-white photos, and 35 illustrations and charts. Weighing in at nearly 2½ pounds, the book covers just about everything from birth to death of an iguana.

The author has gathered information from the world's top iguana scientists and research institutions, hundreds of iguana owners throughout North America and Europe, veterinarians, people in the pet trade — and from his own field research in the jungles of Mexico and Central America. Plus the real-life experience of raising his own iguana, Za (pictured on the front and back covers).

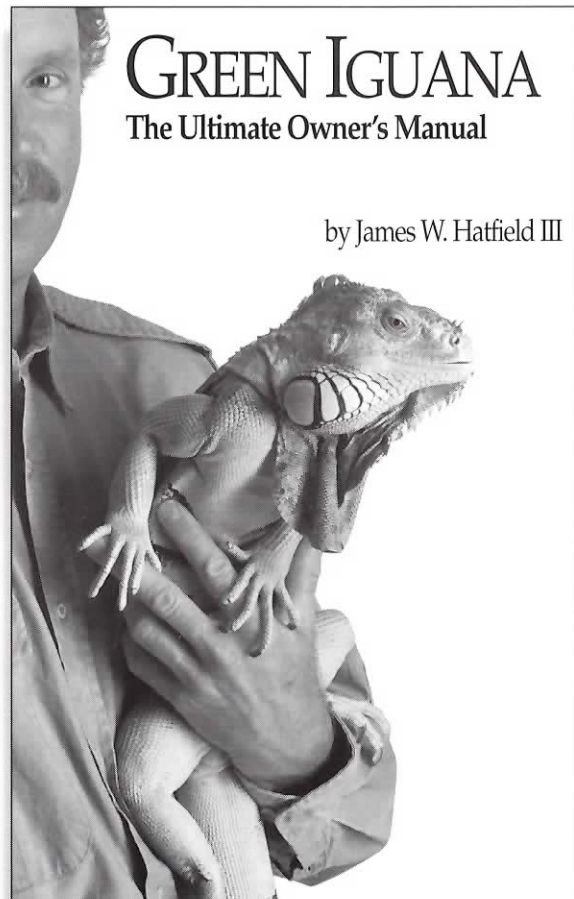
If you have an iguana, if you ever thought about owning one, or even if you simply like the idea of reading about these exotic, prehistoric-looking lizards, **Green Iguana — The Ultimate Owner's Manual** is for you. Remember this book - it's **The ULTIMATE!**

Green Iguana — The Ultimate Owner's Manual is available for a limited time at the publisher's discount price of \$28.50 (+ \$4.00 S&H for U.S. and \$5.00 for Canada; International orders, call for price list). Make your check or money order payable to **Dunthorpe Press** and mail it to:

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NEWS OF THE SOCIETY

Signs Head to San Salvador Island

Two informational signs manufactured for the International Iguana Society are in transit to the Bahamas. The signs will be installed on heavy galvanized steel posts mounted on concrete foundations on the shoreline of Green Cay north of San Salvador.

One sign is in English and the other translated into French for the benefit of the French tourists from Club Med that visit the cay.

The signs will be installed with help from the staff of the Bahamian Field Station, San Salvador, and members of the Bahamas National Trust.

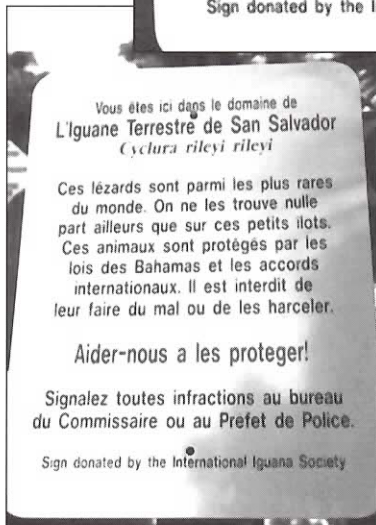
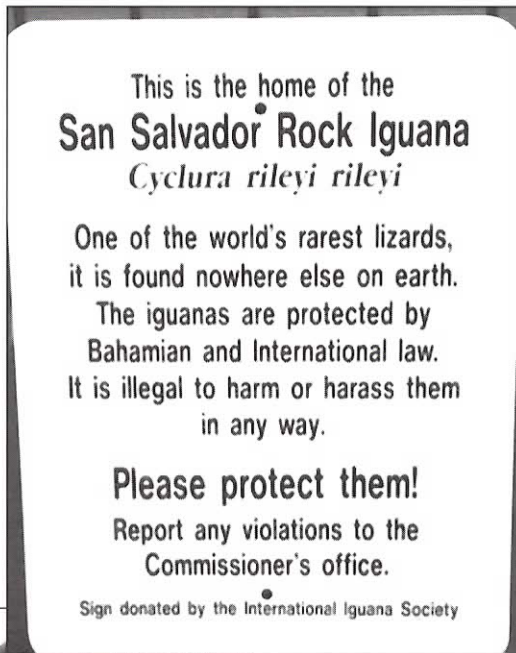
The signs were paid for primarily by a collection made during the November 1995 I.I.S. Conference on San Salvador. The participants raised \$240 and another \$240 from the I.I.S. was utilized.

Green Iguana Brochure

The I.I.S. is working on a brochure for the iguanas of the central american country of Belize.

Belize is a small English-speaking country with many natural areas with iguana populations. The iguanas are hunted for food when the females come to the riverbanks to lay their eggs in March. The brochure will provide Belizians with accurate iguana information and try to convey the problems of hunting gravid females. This practice has depleted many iguana populations in many areas.

Belize is a very conservation oriented country and it is likely that the message of the brochure will be effective. In protecting iguana populations the project will be a cooperation between the Belize Zoo and Tropical Education Center, and I.I.S. Other conservation organizations in Belize will help distribute the brochure after it is printed.



Photographs:
Joseph
Wasilewski



Sign at the entrance of Guanacaste National Park, Cayo, Belize. Photograph: R.W. Ehrig

NEWS OF THE SOCIETY

The Tragedy of Iguana Smuggling

In the past few years several hundred Rhinoceros Iguanas were stolen from the native habitats in Hispaniola, decimating several wild populations. These animals were sold by a number of reptile dealers around the U.S. as captive-bred iguanas. I.I.S. was one of the few herpetological organizations that attempted to stop this disgraceful abuse of protected animals.

These Rhinoceros Iguanas, *Cyclura cornuta*, had not eaten in a month or more. They had numerous injuries, severely smashed rostral scales, and were near death. A number of IIS members around the state of Florida successfully rehabilitated these animals. All survived.



<i>Category Description</i>	12/31/96
International Iguana Society, Inc. Annual Treasurers Report 1/1/96 to 12/31/96	
Income/Expense	
Income	
Contributions	927.00
Goods Sold	1,664.50
Interest	202.44
Membership Dues	7,316.00
Total Income	10,109.94
Expenses	
Advertising & Promotional Expenses	361.68
Annual Conference	20.00
Bank Debit	21.00
Conservation Assistance	579.95
Cost of Goods	423.49
Government & Prof.	211.25
Iguana Times:	
Postage	2,481.57
Printing	8,438.29
Supplies	80.32
Iguana Times-Other	323.90
TOTAL Iguana Times	11,324.08
Labor:	
Vicky Andrews	658.53
TOTAL Labor	658.53
Office Expense:	
Equipment	125.00
Miscellaneous	123.47
Telephone	611.36
Office Expense-Other	163.63
TOTAL Office Expense	1,023.46
Total Expenses	14,623.44
Total Income/Expenses	-4,513.50



Statement of Purpose

The International Iguana Society, Inc. operates as a non-profit, international organization dedicated to the preservation of the biological diversity of iguanas through habitat preservation, active conservation, research, captive breeding and the dissemination of information.

Subscription Information

Iguana Times, the journal of The International Iguana Society, is distributed quarterly to members and member organizations. Additional copies are available at a cost of \$6.00 including postage. Annual dues for The International Iguana Society are \$25.00 for individuals, \$35.00 for foreign memberships, and \$35.00 for organizations, which receive double copies of the newsletter.

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PO Box 430671
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Solicitations

Members of the I.I.S. are encouraged to contribute articles, letters to the Editor, news items and announcements for publication in *Iguana Times*. General articles can deal with any aspect of iguana biology, including conservation, behavior, ecology, physiology, systematics, husbandry, or other topics. Submission of photographs to accompany articles is encouraged.

Manuscripts based on original research are solicited to communicate recent findings not only to other scientists but to the general public as well. We wish to instill in our readers a greater appreciation for scientific research and a better understanding of how it can contribute to the conservation of threatened iguana populations or the well-being of captive specimens.

Research Articles will be subjected to peer review, and should be fairly general in scope (i.e., manuscripts having extremely detailed theoretical or statistical bases should be submitted to more appropriate journals). Manuscripts of any length will be considered, and must be accompanied by an abstract of corresponding length. Authors can expect rapid turnaround time for the reviews and quick publication of acceptable material. Research articles will be cited as appearing in the *Journal of the International Iguana Society*, and will be forwarded to the major citation and abstract journals.

Research Updates should be comparatively brief and written in non-technical language. They will not be subjected to peer review. Submission of photographs to accompany research reports is encouraged.

All manuscripts must be typed, DOUBLE-SPACED, with 1" margins, on 8 1/2" X 11" paper, following a format like that shown in the most recent issue of the journal. Original research articles must be submitted in triplicate. If at all possible, manuscripts should be accompanied by a disk (3 1/2" or 5 1/4") containing a word-processing file of the manuscript. We support most word-processing applications in DOS, Windows, and Macintosh formats. Please include file name, software name and version number on the disk; a hard copy printout is still required. Send manuscripts to the Editor at Department of Natural Sciences, Loma Linda University, Loma Linda, CA 92350. Shorter articles, research updates, letters, and announcements may also be submitted to the editor via e-mail (send to WHAYES@CCMAIL.LLU.EDU). For any contribution, please include your name, address and phone number.

Authors of one page or more of print are entitled to five copies of the issue in which their article appears. Reprints may be purchased upon request to the editor.

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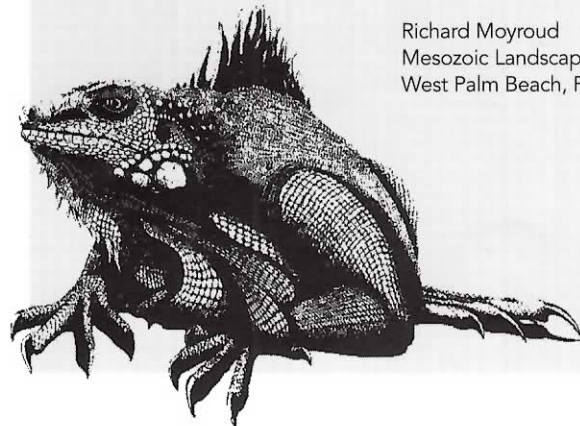
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Galapagos marine iguanas,
Amblyrhynchus cristatus, basking
on sun-drenched lava formations
on Fernandina. Photograph:
William K. Hayes