

# Islands at the Center of the World

by ROBERT C. DREWES

Photography by DONG LIN



*Above: Expedition leader Bob Drewes examines the blind, legless amphibian known to local people as “cobra bobo.”*

*Right: Found only on São Tomé, this caecilian’s nearest known relative lives in Kenya, on the opposite side of Africa. Its presence is one of many mysteries about the islands that scientists hope to solve.*

**T**HE GULF OF GUINEA Islands off the west coast of Africa are near the geographic center of the world. The equator passes right through the island chain, while the Prime Meridian lies but 600 kilometers to the west.

At the time of its first discovery by the Portuguese in 1470, then-uninhabited São Tomé was the center of the known world. Throughout the 150-year period of Portuguese domination of the high seas, São Tomé, together with the nearby island of Príncipe, became a major slave entrepot and the heart of Portugal’s agricultural, trade, and exploration activities.

Few people have heard of these islands today, but most biologists know of them and many have longed to visit. These two tiny volcanic islands—São Tomé is 50 km long, while the more northerly Príncipe is only 30 km in length—are famous for their endemic faunas and floras. A high level of endemism usually means that species have long been isolated from their forebears and have diverged significantly. Based on the limited data that do exist, including specimens more than a hundred years old, life must have found its way to São Tomé and Príncipe long ago. Fourteen percent of the flowering plants of São Tomé (including a two-meter-tall begonia) are found nowhere else in the world. We know that 80 percent of the stag beetles, 55 percent of the ladybugs, and over half of the spider species that have been collected are restricted to São Tomé, Príncipe, or both. Nearly two-thirds of the terrestrial snails of São Tomé and over half of those on Príncipe are unique to those islands.

The vertebrate faunas of the islands are equally curious. While each island has its own endemic species, other species are found on both islands. Nearly half the reptile fauna is unique. Strangely, 50 percent of these endemic reptiles are fossorial, or burrowing, species. There are 49 species or

*Research biologists*

*journey to São Tomé  
and Príncipe off Africa’s  
coast to study the unlikely  
animals that are found  
on these tiny islands.*





Right: An example of island gigantism, this 2-meter-tall begonia found on São Tomé has leaves more than 60 cm long.

Opposite top: Príncipe hosts the largest treefrog in Africa, *Leptopelis palmatus*. Most are olive green with orange spots, but males may range from silver to grass green.

Middle row, left to right: A good disperser, the hardy *Panaspis africanus* skink probably arrived on the islands atop rafts of debris.

Scientists added 15 species of lacewing to the three previously known from the islands, including this *Anapochrysa africanus* from São Tomé.

The gemlike eyes of a *Hemidactylus greefi* gecko fascinate visitors to both São Tomé and Príncipe.

Bottom row, left to right: This *Iso-metrus scorpion* had never been seen before by the islanders.

A fish that feels just fine out of the water, this mudskipper (*Periophthalmus papilio*) breathes on land by holding water in its gill chambers, and can obtain more oxygen by dipping its tail fins in a stream.

Among the largest spiders in Africa, *Hysteroocrates gigas* may grow larger than a human hand.



subspecies of breeding land birds on São Tomé and 19 on Príncipe, which are 57 percent and 54 percent endemic, respectively. Other than recent introductions such as the mona monkey, the African civet, and the omnipresent rats, the only endemic mammals are a couple of bats and a shrew.

Freshwater fish are about the last organisms one expects to find on islands surrounded by deep ocean and more than 200

km from a continent; yet, in 1895, Portuguese biologist Balthazar Osorio recorded twelve species inhabiting the numerous streams. Another group that almost never crosses saltwater barriers is the amphibians. Not only are they well-represented on the islands with at least five species of frogs, including Africa's largest treefrog, *Leptopelis palmatus*, and a legless, blind amphibian called a caecilian, but all of them appear to be endemic.





*Top right: A view from the southeastern coast of São Tomé. The ancient, eroded volcanic plug of Pico Maria Fernandez rises over the island.*  
*Above: The Gulf of Guinea Islands lie just off the coast of western equatorial Africa.*  
*Below: Children frolicking on a São Tomé beach.*

jumping spiders of the family Salticidae, disperse by “ballooning”; as hatchlings, they spin a single strand of silk that increases their surface area, allowing them to be borne by air currents.

Some reptiles such as geckos and skinks are preadapted for dispersal over great distances: they are excellent climbers, taking refuge under the bark of trees which may float away after a storm; they lay shelled, resistant eggs; and, most importantly, they are ectothermic—they don’t have to eat continually to maintain a constant body temperature. Instead, their metabolisms simply slow down when temperatures fall.

When scientists discover such isolated species, the question always arises: How did the original founders of these populations get there in the first place? In the case of mountaintops or deserts, which in a biological sense are like islands, species are often “left behind” after major climatic shifts, becoming isolated from their forebears as the lower slopes grow warmer, or surrounding habitats grow cooler and moister. But to populate true islands, founding species must first cross formidable barriers. They can be blown out on the wind, traverse land bridges during periods when sea levels are lower, drift on rafts of debris that have washed out to sea, be dropped by storm clouds, or get carried there by birds. However, all of these routes are wholly dependent upon chance.

While successful dispersal and subsequent colonization are determined by physical parameters such as distance from source, size of island, and geologic history, there are also many biological factors. Certain plants and animals are good dispersers, able to traverse great distances and colonize remote places. A good example is the coconut, which has buoyant, saltwater-resistant seeds. Some spiders, including



Other organisms are poor dispersers, especially across stretches of ocean. Freshwater fishes cannot exist in saltwater; nor, for similar physiological reasons, can amphibians. The skin of adult amphibians is permeable, and if placed in saltwater they rapidly dehydrate and die. The gills of amphibian larvae cannot function in saltwater. With the exception of bats, both large and small mammals are poor dispersers. Endotherms, animals with constant body temperatures, cannot survive for long without food and water.

**T**HE FOUR GULF OF GUINEA Islands, of which São Tomé and Príncipe are the middle two, lie along the Cameroon Line, a 1,600-km-long magmatic fault running southwest to northeast. The line transects the oceanic Atlantic plate and the African plate. Eruptions of magma along this chain over the last 65 million years have not only formed these four islands, but also Mount Cameroon on the mainland, the many volcanoes that make up the Cameroon highlands, and the

Jos Plateau in Nigeria, far to the north. Unlike the Hawaiian Islands, the evolution of the Gulf of Guinea Islands has not been linear. The most northerly, Bioko (known in colonial times as Fernando Po), is a fairly recent island lying some 30 km off the Cameroon coast. The straits separating Bioko from the mainland are shallow, indicating that Bioko was connected to mainland Africa during the Pleistocene periods of lower sea levels. So, although this is the largest and most topographically diverse of the islands, its flora and fauna mostly consist of species also found on the mainland. An expedition to

*The decaying skeletons of buildings erected by the colonial Portuguese lend a ghostly air to downtown Santo Antonio, Príncipe's only city.*



Bioko in 1999 by the California Academy of Sciences confirmed that only one endemic reptile species lives there, a high-elevation chameleon, *Chamaeleo feae*, and one as-yet-undescribed treefrog which may or may not be endemic.

By contrast, 220 km southwest of Bioko lies Príncipe, the first of the three oceanic islands. Formed about 30 million years ago, Príncipe is the oldest member of the group. Some 150 km further is São Tomé, about 17 million years old. The last island in the chain, another 200 km to the southwest and about 350 km west of the coast of Gabon, is Annobon, a tiny three-by-seven kilometer volcanic crater, around 5 million years old. Curiously, Annobon has a Spanish colonial history and belongs to the Republic of Equatorial Guinea, as does Bioko. But the most important biogeographical fact about the three outer islands is that each is separated from the others and from mainland Africa by ocean depths exceeding 1,000 meters. None has ever been connected to either the mainland or to one another.

Late in March 2001, a group of scientists from the California Academy of Sciences came to São Tomé and Príncipe to investigate what lives there. Although early Portuguese naturalists like Francisco New-

ton, Adolpho Moller, and the German Richard Greeff laid the groundwork in the 19th century (Newton spent nearly ten years in the Gulf of Guinea), many animal and plant groups remain poorly sampled. Most of their collections were deposited in a natural history museum in Lisbon where they were studied and described by J. V. Barboza du Bocage, the preeminent Portuguese biologist of that century. Tragically, three years after São Tomé and Príncipe gained independence in 1975, the museum burned to the ground, and its collection of type specimens and materials from all over the Portuguese colonial world was lost.

This voyage to the Gulf of Guinea Islands was probably the Academy's most comprehensive scientific expedition since the great Galápagos Expedition of 1905-1906. Five academic disciplines were represented: ichthyologist Tomio Iwamoto, herpetologists Jens Vindum, Ricka Stoelting and me, entomologists Charles Griswold, Norm Penny, and Joel Ledford, diatomist Sarah Spaulding, and mammalogist Douglas Long. For the next two months there would be scientists climbing, swimming, walking, and crawling all over these two islands.

On the big island, we hiked into the aboriginal forests that became the major high-elevation forest sites for the herpetologists and the entomologists. The entomologists laid out lines of small pit traps and checked them regularly for contents, beat bushes, and sifted the forest litter both day and night.

Having been told that amphibians did not occur here above 600 meters, the herpetologists promptly found populations of the endemic puddle frog *Phrynobatrachus dispar* and the treefrog, *Hyperolius malleri*, both inhabiting Lagoa Amelia at 1,400 meters. Several specimens of the bizarre, legless amphibian *Schistometopum thomense*, the endemic caecilian known to the locals as “cobra bobo,” were taken from the soil of cultivated fields on the forest edge, indicating that the range of this seemingly sedentary burrower is surprisingly broad—from near sea level to 1,100 meters.

Later, Stoelting and Vindum found, in a pocket of water in the bole of a tree, a breeding group of two female and nine male *Nesionixalus thomensis* frogs together with eggs and tadpoles. This flamboyantly colored, green-and-bright orange frog is



Left: Ricka Stoelting shows off her latest find to local insect guide Delfin.

Right: A boy on São Tomé shows off the island's bounty in a leaf bowl filled with berries.

considered an endemic genus; its tadpoles have never been described.

Below 600 meters on both islands, the lowlands are a reflection of the regions' remarkable agricultural past, dotted with what were once large plantations of cacao, oil palm, banana, and coffee. Most have been abandoned since independence. However, crops like cacao and coffee do not harm native wildlife, unlike, say, sugarcane. Even though the trees themselves are alien, old plantations of these crops provide a fair number of hospitable niches for native species. Our group also spent time in the lowlands, collecting and comparing the species with those found in higher, more pristine habitats. By starting from their mouths, Iwamoto was able to access many of the rivers, seining and netting progressively upstream. He wanted to discover if

different assemblages of fish species inhabited higher levels of the streams.

The southwest coast is extremely rugged and inaccessible by road. But we were able to explore their forests and rivers by boat, camping on beaches and procuring and cooking our own food. We brought supplies ashore on a decrepit plastic skiff conspicuously patched with duct tape, and pulled it along with a 100-meter rope stretching from boat to shoreline.

The shoreline was too treacherous for the boat to land, so to sample the fish of the Ribeira Chimboto on Príncipe's south coast, Iwamoto and I swam some 200 meters into a rocky cove, dragging our equipment behind us. Ultimately, Iwamoto added three species to Osorio's 1895 list of twelve freshwater fishes, all of the family Gobiidae. One of the gobies bears a

**I**T'S A WONDERFUL place. Sort of like a paradise, beautiful with luxurious vegetation and so much available food. The people are really very friendly and everybody looks really healthy. There are banana plants all around, coconuts, and lots of fish in the ocean.

But I don't think the fishery can sustain heavy commercial pressure as the population grows. That's the sad thing. A lot of these fishes will either be extirpated or just decline to the point that they're not going to be worth fishing anymore.

The economy is based

mainly on agriculture and fishing, although they are doing some oil exploration. The possibility of oil companies coming has a lot of locals excited. The people want a better lifestyle. I would like to see them develop the tourist industry a lot more.

There are only about a dozen freshwater fishes on the islands. Other fishes are associated more with the estuaries or marine environment and are all lowland things. I didn't realize there would be so few other fishes in these streams. In a typical stream on the continent, you find dozens and dozens of species of freshwater fishes. On these islands, as you get higher up you only find two species of gobies. That's because they're the only ones who are able to climb up through cataracts and

waterfalls and get up to the higher reaches using pelvic fins modified into a suction cup. I read about one observer who saw gobies going up a hundred-foot vertical fall.

The fish had to get to the islands one way or another, and the only way these gobies got there is because they have a marine connection. They spend their early stages of life in the ocean.

Females lay their eggs on rocks. When they hatch the young just free-float down the stream into the ocean. They start coming up freshwater streams when they're about one inch long. The locals use conical woven traps made out of leaves or something like that to trap the fish swimming upstream. They catch them in huge quantities.

TOMIO IWAMOTO





remarkable resemblance to a species hitherto known only from the West Indies, and one of the most common has turned out to be undescribed. Iwamoto was also able to add three species to the list of São Tomé marine fishes just by examining the contents of the fishermen's nets.

Certain orders of insects on the islands have gone largely unstudied; a case in point is the Neuroptera (lacewings and antlions), which are Norm Penny's specialty. Prior to our arrival only three species of lacewings were known to occur on the islands, based on but five specimens; antlions had never been recorded.

The first time Penny went out to the northern end of São Tomé, a habitat very different from any other on the islands, he struck it rich, collecting several lacewings in a manner of minutes. The area is low-

lying and in the rain shadow of Pico do São Tomé, the island's central volcanic massif. It was here that the Portuguese planted sugarcane in the 16th century. For a time, São Tomé was the world's foremost producer of sugar. Today, the area is very much like a grassland savanna, complete with baobab trees (*Adansonia digitata*). Penny returned here frequently, each time collecting more and different lacewings, indicating they may occur seasonally. Ultimately, he collected over 360 specimens of lacewings in a number of habitats on both islands; these are of at least 15 species in four families (some remain unidentified). He also brought home twelve antlion larvae—the first ever recorded from São Tomé and Príncipe.

The north coast is also the site of a series of basalt cliffs and a particularly bat-

rich road culvert. At night, the cliffs yielded numerous nocturnal geckos, the occasional house snake (*Lamprophis lineatus bedriagae*, supposedly an endemic subspecies) and our only scorpions. Working at night with an ultraviolet light, Ledford collected a fine series of the slender, poisonous *Isometrus* scorpion.

Griswold's efforts in the higher elevations have so far yielded representatives of three spider families previously unrecorded from the islands: ogre-faced and net-casting spiders (Deinopidae), spurred and starburst orb weavers (Mysmenidae), and midget ground weavers of the family Ochyroceratidae.

Sarah Spaulding is, so far as we can tell, the only scientist ever to examine the islands' diatoms. This flora seems to be primarily aerophilic, able to survive desiccation and being thrown about by the wind. Genera such as these characteristically live around waterfalls, the bases of trees, and the like. But these islands' diatoms are not the usual, predictable assemblage; in fact, they appear to be endemic.

Spaulding also found abundant diatoms in a lake up on the mountain. She managed to obtain a vertical core of muck about three-quarters of a meters long. Not only are the diatom cell walls in this sample well-preserved, but there is also an abundance of pollen. This means that the study of these elements in deeper cores taken from the lake will likely uncover the history of biodiversity and climate of the higher parts of the mountain.

Much of the megafauna, especially the birds and mammals, is fairly well-known. There is even a field guide to the birds. Douglas Long's questions were primarily focused on the various, local species of insectivorous and fruit-eating bats. With the help of Angus Gascoigne, a local naturalist and snail expert, Long ferreted out bat colonies. He was particularly interested in their relationships to members of the same species on the other islands and to populations on the mainland. How long had the various populations been separated from each other, and had they begun to diverge? These are questions readily answered by molecular techniques.

**T**HE DISCOVERY OF A NEW SPECIES, as exciting as it is at the time, is not



**I**'VE BEEN TO A LOT of places in the world where people have words for foreigners that are not very nice. The word for foreigner on these islands is "amigo." These are as friendly a people as I've ever met, extraordinarily nice.

There are ruins of colonial Portugal everywhere. In the cities, people haven't rebuilt the old Portuguese structures, they've just built new structures on the peripheries of the town. In the center, especially Santo Antonio on Príncipe, the very center of the town is all ruins. There are trees

growing up through the old, elegant houses, and their fronts are tumbling down. Out in the jungle you find fragments of railroads, plantation houses, all kinds of formerly elegant but now ruined works of man.

We found micro-orb builders, the types of spiders I'm always looking for. They're tiny little things that live in moist forests. Those we found here are definitely new species. We found a trapdoor spider on Príncipe that hadn't been seen for a hundred years. That was probably the most exciting thing for me. This one was a real mystery known from a single specimen. Now we have several individuals.

We found whole communities of spiders: big ones that build sheet-webs and within these sheet-webs live other spiders, like mice in the house. Fifteen years ago I discovered these kleptoparasites

in South Africa. Then ten years ago I discovered another species in Cameroon. So they're all over the place in Africa, but because they're so small and inconspicuous, hiding in the webs of big spiders, no one had ever seen them before. How they got to São Tomé is a real mystery because the way we think of spiders dispersing is typically by chance—for example, a single gravid female may float on its silken lines to a new location. But these little spiders cannot live without their host. They've lost the mechanism to make silk to catch prey. Their lineage has been kleptoparasitic for a very, very long time. The chance of them floating and landing in the web of a host is infinitesimal. So maybe the Portuguese introduced them by bringing oil palms to the islands, and some of the palms had these spiders with a couple of parasites.

CHARLES GRISWOLD

IT'S A BEAUTIFUL country. I felt welcomed by the people, who were kind and friendly. They would freely offer their help, no matter how strange what we were doing might seem. But it was strange to explain my diatom research. I would say, “*pequeña, pequeña vida*,” little, little life, and point to a bottle of mud.

Several of us went collecting one day on a high ridge. We found frogs living in little pools that had formed inside tree trunks. Each pool was an island unto itself. And they were just loaded with diatoms, which formed the base of a microscale food chain in the water hole of the tree.

Another day we set out to climb the Pico de Príncipe. We took backpacks, tents, bought six to eight rolls of crackers from a local store, plus some tins of potted meat product. Mununo, who grew up on the island, was our local guide. It got really windy and Mununo said that we should stop as there was the danger of falling trees. So we stopped in a village, and in this little hut with muddy floors, everybody is drinking from jugs of palm wine. They climb the

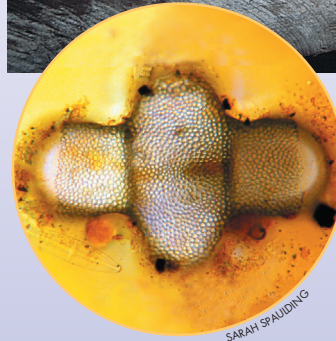
palms to tap them for a fizzy, slightly sweet, fermented beverage.

When we got going again, our route got really steep. It was primal, undisturbed forest here. Not even the local people go; it's too steep to plant on, and there is no path. We were climbing these sliding mudhills by lunging for tree roots. I'm a rock climber, and I felt glad I had that experience. These were places that, if we had fallen, we would have rolled downhill for a long, long time.

Meanwhile, Mununo collected huge endemic snails, as big as oranges, along the way. He would poke holes in their shells and string them on his walking stick, to bring back to his family for a meal.

When we stopped to camp, we noticed a glow coming from the ground in the spaces we had cleared for the tents. Mununo said it was a phosphorescent fungus and advised us not to touch it, because it causes rheumatic fever. I wondered if that was true and what properties it has.

On another day I went out to collect old Miocene marine deposits, which were white sediments in



**Above: Diatom expert Sarah Spaulding inspects her subjects (left) through a portable diatom viewer. She may be the first researcher to study the diatoms of the Gulf of Guinea Islands.**

the island's black volcanic soil. In the villages the women and children would throng around me, but I had no translator. So with racks of fish drying around us, the women spoke to me in sign language. They said, where are you from? And do you have any babies? I said no. Then they said, but you need a baby. You would be so happy. Here, have this baby and see how wonderful it is. I was a complete stranger, and they had handed me their child to hold and enjoy.

SARAH SPAULDING

usually what drives field biologists. Their primary objective is to understand relationships between organisms, their natural history and behavior, find out where they came from, and how they have evolved. When the herpetologists landed on São Tomé and Príncipe, we were already aware of the reptile and amphibian species recorded there and had little anticipation of discovering new ones. What we were looking for were answers to some questions.

For example: Is *Hyperolius malleri*, the green treefrog found on both islands, really the same species? If so, have the populations begun to diverge? Is Africa's largest treefrog, *Leptopelis palmatus*, really found only on Príncipe, or might it live somewhere on the African mainland as well and been overlooked? There are two tiny, cryptic, leaf-litter puddle frogs known from the islands: *Phrynobatrachus dispar* is common at all elevations on São Tomé,

but on Príncipe this species is thought to coexist alongside a remarkably similar relative, *P. feae*. It is biologically unlikely that two nearly identical puddle frogs should be found in similar habitats on the same island. Similar questions arise regarding snakes. The diurnal green snake, *Philothamnus thomensis*, known to the locals as “cobra verde,” belongs to a genus that is widespread throughout Africa. So, too, does the nocturnal house snake (*Lamprophis lineatus bedriagae*). Did earlier scientists describe them as endemic just because they occur on remote islands? Will today's more refined techniques confirm that they are distinct species? Most of these questions will be answered by morphological examination or comparison of DNA sequences from fresh samples.

However, the more profound question that led me to design and lead this expedition is why this reptile and amphibian assemblage is found on these islands at all, for much of it is made up of the most unlikely dispersers, ill-suited to survive long voyages. It is difficult to imagine amphibians—especially the terrestrial species in the genera *Ptychadena* and *Phrynobatrachus* and the legless, burrowing caecilian (“cobra bobo”)—the legless, burrowing lizard (*Feylinia*), the blind snakes (*Typhlops*), or the worm snakes (*Rhinotyphlops*) clinging to some sort of floating object and transiting from mainland to island, for such creatures live in the soil.

I WAS INTERESTED IN the bats because they're probably the only native mammals on the island. The monkeys were introduced and have become agricultural pests. The locals eat them. The rats, cats, pigs, dogs, and everything else related to humans were also introduced. Even the civets were most likely brought in for rat control in the cane fields, or domesticated as pets, or used for musk perfume. There's supposed to be a native shrew but we never saw it. Shrews can't "raft-out" because they have to eat every few hours to stay alive, and they're burrowers.

We managed to observe or capture about six species of bats, including a couple of species of fruit bats, large flying foxes that are also harvested as food. Most of the others are small, insect eaters. I was interested in their potential for pest control because there is both commercial and subsistence agriculture. By eating insects, they also control disease. There's yellow fever and malaria present, and where bat colonies have been wiped out elsewhere, the incidence of mosquito related diseases has increased.

AT FIRST THE LOCAL people were a little shy and stand-offish. The only visitors they normally see who aren't black are Portuguese and the occasional British tourist. So here is this rag-tag group of Americans, including our photographer Dong Lin who is a 6'2" Chinese guy, and Jens Vindum with his white beard and big belly who looks like Santa, and Ricka Stoelting, a young woman who runs around collecting snakes. But once Fabio Penny, our transla-

tor (and computer specialist) explained what our purpose was, people would warm up right away.

We had a huge amount of assistance, especially from the younger people. Once we were at this very old plantation where many people still lived. Fabio explains that we're studying the wildlife on the islands and if you know where things are, tell us or bring it. Within 15 minutes, a group of kids shows up with a variety of reptiles, including a plastic bag holding this huge, huge frog. We take it back to Bob Drewes. He says "Oh my God! This is incredible! This is the biggest tree frog I've ever seen in my 35 years in Africa!"

In much of West Africa there's a lot of tension between different tribal groups or migrants and between the haves and have-nots. We didn't see that here. Most of the people were quite poor. Some of the subsistence farmers that were living out in the jungle had no electricity or running water but had at least a dry place to sleep in thatched huts. And nobody was really

hungry. There's food everywhere. In the parks, in the cities and the rural areas there are bananas and plantain, mango, papaya, avocado, coconut, and sugar cane. You would see breadfruit and all types of wild citrus, wild gourds, wild melons. There is a huge abundance of fish and squid and octopus. For the most part there is good medical care. We didn't see a lot of sick people, and we didn't see that malaria or yellow fever had serious effects.

There are still many areas of pristine or near pristine habitat. They tend to be higher up on the mountains. But the population is growing quickly. Somebody told me that 54 percent of the population is under 15. The challenge will be to balance the population growth with habitat preservation. There will be more demand for logs and agriculture. I think the work we're doing now is instrumental in putting into motion some of the conservation efforts that will bear fruit down the line.

DOUGLAS LONG



**Mammalogist Doug Long shows off the wingspan of a local *Hipposideros ruber* bat.**

Geckos, on the other hand, are good dispersers. One such is Greef's gecko, *Hemidactylus greefii*. It is the only member of its genus, which contains over 50 African species, that has a rudimentary, clawless thumb. At nearly 200 millimeters long, *H. greefii* is a giant relative to all other members of its genus. Whether due to the absence of predators or reduced competition for food, the tendency for some species isolated on islands to attain a larger size than their nearest relatives has fascinated biologists for centuries. There are many giants on São Tomé and Príncipe; the two-meter begonia and the endemic passerines—the São Tomé white-eye and the São Tomé giant sunbird—are the largest members of their respective groups. Even though it is an

amphibian, the arboreal nature of the Príncipe treefrog, *Leptopelis palmatus*, together with the fact that it is the largest treefrog in Africa (its undoubted point of origin) suggest that it may be a true endemic, rafting to the island in the distant past and having since diverged from its mainland ancestral population.

ONE OF THE GREAT ADVANTAGES of a multidisciplinary team is that many perspectives can be focused on the same questions. Our assumption that the species we were collecting belonged to a natural oceanic island fauna began to erode as we worked in aqueduct tunnels in the Contador Valley. Griswold had just found the spider kleptoparasite *Isela* living in the webs of some curtain-web tarantula.

These kleptoparasites are species-specific, always inhabiting the webs of the same kind of spider host. Their natural dispersal to the islands, according to Griswold, "is very unlikely."

As we continued to observe improbable species, we entertained each other by imagining wildly complex rafts: large, many-hectare chunks of riverbank containing deep soil, fallen logs, trees, and swamps, populated by great numbers of poor dispersers breaking off from the mainland millions of years ago, and, like Noah's Ark, crossing the ocean to ultimately populate São Tomé and Príncipe.

We were impressed by the relative abundance of some endemic species, especially the bright lemon-yellow caecilian of São Tomé found everywhere



*A colony of Hipposideros ruber bats hanging from the roof of a road culvert on São Tomé near Praia Mutamba. Years of bat residency have left a springy, stinky layer of guano underfoot.*


from banana plantations near sea level to plowed fields at 1,100 meters, and the Príncipe burrowing skink, *Feylinia polylepis*. While on a single afternoon's trek in northeast Príncipe, we found burrowing skinks under almost every stone we turned over, a far denser population than I've seen of a single species on the mainland. Griswold mentioned that he, too, had seen in one night more individuals of a single ground beetle species and of a species of tropical wolf spider than he had ever seen in Africa. High population numbers and fewer species seem to be

the rules on these islands; with fewer species, there is less predation and competition for resources.

The main debate continues to be whether or not these taxa actually evolved together, or if some of the more enigmatic organisms were transported here, perhaps unnoticed, by human agency. Although the treefrog *Nesionixalus* is currently considered a genus unique to São Tomé, most of the endemic amphibians and reptiles belong to genera that are either exclusive to, or widespread in, continental Africa. The one remarkable exception is the caccilian; there

is but one other species in its genus, *Schistometopum*, *S. gregorii*, known only from the other side of the continent in Kenya. Curiously, the few studies have shown that *Schistometopum* is more closely related to the Central American genus *Dermophis*, found from southern Mexico to northwestern Colombia, than to any African genus.

In the 500 years since the islands became a major hub of Portuguese commerce, it is just as likely that the more enigmatic inhabitants arrived by ship in the roots of plantation trees, as it is that they somehow rafted there. But if this is true and some of these species did not evolve on the islands from ancestral dispersers, why don't the same species occur elsewhere on the African mainland or Brazil or even southeast Asia? The answer may be that we simply haven't found them yet. The old Portuguese colonies of tropical Africa—Guinea Bissau, Cabinda, Angola, and Mozambique—are among the most poorly known biologically. And we are only just beginning to catalog the herpetofauna of Brazil, Portugal's erstwhile enclave in South America.

We hope to answer many of our questions using molecular analysis. If these organisms are not endemic but were brought to the islands from somewhere else within the past 500 years, then genetic differences between populations from different parts of the islands should be very small. On the other hand, true endemic species that have evolved in isolation over millions of years should demonstrate considerable genetic differentiation between populations separated by, say, São Tomé's central volcanic mass. These unanticipated twists in this evolutionary process mirror the presence of the unexpected plants and animals we encountered during our journey to these small, unique islands at the center of the world. 

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**I**GAVE TWO LECTURES on technology in a classroom made for maybe 50 kids. We squeezed a hundred-plus people in there, from kids to ministers, and they stayed for hours. Later, as we walked through the high school with the principal, there were over 250 people following us. That school ranged from about age 14 to people in their mid-20s.

The town had an ecology group, the Clube de Natureza de São Tomé, the Nature Club of São Tomé. It has about a hundred members and is comprised of kids whose membership fee is a can of soda. We gave a slide show explaining what the scientists were doing. Many were amazed to see parts of the island that

they don't get to. I showed them a map of the world on my laptop. For many of them, even people who worked at the airport, this was the first time they had seen a map, and discovered how small São Tomé is in relation to the world.

This group wants to start an antilitter campaign to make their town clean. They want to find easy ways to promote waste management and recycling. They can't afford to buy supplies, so they use scrap metal and wood to create little trashcans. They comb the beaches, they pick up garbage, they become guides to the local culture at the museum. They want people to visit so they can get jobs at the hotels. Everybody they grew up with is still here, and it's not often that new

people come. When they do, it's for the birdlife. We set them up with a web address. Now, they have chats with people in Portugal and Cape Verde who are doing the same thing.

One day we went camping on Príncipe. We all had backpacks on and carried still more luggage—tents, stoves, silverware, even a teapot. It seemed like we were climbing Everest. We looked at our guide, Tino, and all he had was his machete, some water, his shoes, and a hat. When it was time to camp, he went over to a banana plant. Within 15 minutes he had a nice cool hut with its own floor. Meanwhile some of our guys were still reading instructions on how to put up the tent.

FABIO PENNY