

Charlie Stine, SPH '76 (PhD), A&S '83 (MA), dreamed for decades of making a pilgrimage to the Galápagos Islands. What does an ecologist look for when he finally gets the chance to make that dream a reality?

In Darwin's Footsteps

STORY & PHOTOS BY JIM DUFFY



The booby assault came out of the blue. We had gathered at the stern of the *Flamingo* that February morning, 20 travelers going about routine details of preparing to pass another day in the Galápagos Islands. Two oversized jon boats, known locally as pangas, puttered in the ocean waters below, idling in wait to ferry us ashore for a hike.

Are life jackets buckled? Cameras packed? That's the sort of thing we were focused on when the first birds appeared. Splotches against a distant sky, these were the vanguard of the force. In an instant, scores of birds were bearing down on us along a cliff face etched in jagged striations. Then there were hundreds, all falling into a formation precise enough for a squadron of fighter jets.

The blue-footed booby is famous mostly for being goofy. That's what gets the bird so many star turns in coffee-table books. It's got crazy-hued feet. It's got goggle eyes. It waddles like a weeble. Then it fuses all that goofiness together in an endearing mating dance that has the male of the species aiming his beak skyward while rocking first on one foot and then the other while offering a precious twig in tribute to the object of his carnal desire.

There was no goofy in the booby assault. A wheeling, whirling, voracious gang of marauders, the birds descended on the school of fish just off the port

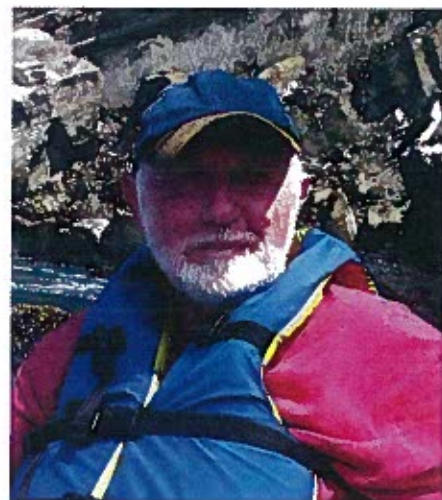
side of the *Flamingo* with astonishing speed and ferocious athleticism. They didn't bother to hover or skim or take any sort of aim at all; they just plunged headfirst into the ocean, where they'd zero in on their prey by twisting the long, specialized tails that make them such expert underwater swimmers.

It made for quite a show of oceanic fireworks. Stupendous splashes erupted as birds hit the water in rapid succession, generating sharp pops that resounded like bursts of machine-gun fire. Did the assault last two minutes, or more? Could it have been five? How many birds were there? Could it have been a thousand?

Charles J. "Charlie" Stine, SPH '76 (PhD), A&S '83 (MA), and I are a long way from the Galápagos now. Six weeks back from the trip, we're ensconced in a corner booth at a brightly lit restaurant in a strip mall in suburban Ellicott City. Between us, we should be able to settle questions as basic as these. But then again, there was a dreamlike quality to that whole episode, even as it unfolded before our eyes.

"It was a fusillade—just a fusillade, wasn't it?" Stine says.

It's a relief to hear the edge of thrill in his voice. I'd wondered whether my memory might be exaggerating things. Soon, Stine and I share a laugh over what came after, how all of us *Flamingo* travelers had stared out for a moment in stunned silence before



Charlie Stine aboard a panga off Isabela Island. Below left, blue-footed boobies swoop in.

bursting into wild applause and letting loose with whoops of delight. Basically, we'd acted like the home team had just scored a touchdown.

"What did we expect, that they were going to fly back in, form a line, and take a bow for us?" Stine says.

It was a completely silly thing to do, but there you have it—welcome to the Galápagos. And so our debriefing session begins. The coffees and desserts on the table are just excuses to dawdle awhile with our memories and perhaps put them into some perspective other than slack-jawed awe.

This is nothing new for Stine. An instructor in the Odyssey Certificate in Environmental Studies program of the School of Professional Studies in Business and Education, he's been teaching students how to look at the natural world for nearly half of his 80 years. I'm a student in that program, and it was through this connection that Stine and I both ended up on a trip organized by the Baltimore architectural preservationist and sculptor Bruce Boswell, himself a former student of Stine's.

During that week in February, the *Flamingo* hopped from island to island, and we travelers ventured out daily for two guided hikes and at least one swimming or snorkeling expedition. We weren't exactly roughing it: The *Flamingo* is an 83-foot motor yacht staffed with a crew of 11, including two



Blue-footed boobies on Isabela Island.

naturalists, two talented chefs, and a genial bartender who looks like a Latin American Harpo Marx.

Rising out of the Pacific Ocean 600 miles off the coast of Ecuador, the Galápagos have long been a mecca for ecologists and students of nature. In part, this is a straightforward matter of history. The amateur naturalist Charles Darwin visited the archipelago in 1835, encountering strange plants and animals that sparked key advances in the development of his theory of evolution. Here, then, is the place modern science learned to see nature anew, the whole world over.

But even as they speak to the broader world, the islands remain a singular place. Most of the creatures whose strangeness so struck Darwin are still here. Amazingly, many of them made it into the 21st century with scant fear of humans. In the Galápagos, a mockingbird may land on your shoulder. A sea lion may sniff curiously at your finger. Boobies may dance within a few feet of your point-and-shoot camera.

Stine had long dreamed about seeing all this stuff up close. A dentist by profession, he earned a midlife doctorate in ecology and animal behavior from the School of Public Health and then became a teacher, researcher, and nature travel guide, all the while continuing to practice dentistry.

After taking a sip of coffee, Stine reaches into his satchel and pulls out a wire-bound notebook with a thick cover arrayed in a checkerboard pattern of black and white. Inside are the handwritten lecture notes he uses to teach Principles of Ecology, a class I'd taken with him a couple of years back. He flips through a few dog-eared pages, then pauses over a scrawled rendition of a spider's web.

"Remember that one?" he asks.

It's the image Australian zoologist Herbert George Andrewartha devised to depict the ecological "web" at play in any given environment. A population of plants or animals occupies the center of the image, with outstretching strands of the web linking that population to elements of the broader environment. We're talking big forces



here—weather, predation, parasitism, nutrients, and the like.

Sorting through all the details of such a web in any particular place has a way of sucking up most of a scientific career. Stine, for example, has been studying for decades how an obscure population of salamanders fits into its environment on Maryland's Eastern Shore. But Andrewartha's Web can be a valuable tool for newcomers to a place as well. It helps point the eye beyond the proverbial tree and out into the forest that's sometimes easy to miss.

One afternoon in the Galápagos, Bartolome Island served up a long, hot slog that Stine tackled with his characteristic boyish relish, even while toting an overweight bag full of cameras and lenses. Our destination was a perch above gorgeous Sullivan Bay and its signature geological formation, Pinnacle Rock, but the volcanic landscape

en route was as striking. It seemed more Martian than earthly, an eerie expanse of harsh red rock that rose here and there in jagged formations known to geologists as spatter cones and cinder cones.

Life tends to be pretty sparse on such a lava flow. Here, it amounted mainly to some scraggly "pioneer" plants, including a matted herb called *Tiquilia* and the stubby lava cactus, with its rich olive coloring. These are early actors in the long geological drama that eventually creates a layer of soil thick and rich enough for larger plants.

When I made my way over to Stine that day, he was hunched down at the edge of a trail, aiming one of his cameras at a swatch of delicate whitish *Tiquilia* flowers. The thought he decided to share when he looked up ran right along a strand of Andrewartha's Web.

"Look at the spacing," he mar-

The Galápagos are a tough place to make a living, which is why the islands came to be such a famed “laboratory of evolution.”

veled. “Isn’t it incredible, that kind of equal dispersion?”

I gazed out again, and the pattern came into focus. Each of the plants running up the slope of rocks seemed to occupy its own square of real estate. They were laid out in the rigid pattern of houses in a new tract development. Using his shoe as a makeshift ruler, Stine set about measuring one of these property lines. Whatever scant nutrients are within reach of these plants on this landscape, he explained, they must be spread through the rocks as evenly as icing on a bakery cake.

Now, over coffee, I confess to Stine that I hadn’t noticed the pattern before he pointed it out. My attention had been fixed on the barren beauty of Bartolome, as if it were a painted landscape hanging in a museum.

“Perhaps that does offer some entrée into how ecologists might see a new environment,” he says. “It just struck me right away, mainly because it’s so different from what I’m used to seeing. Here in the Eastern U.S., plants and trees are always bunched together, along slopes or near streams. They crowd up where the nutrients are. Down on that island, it was a completely different story.”

We’d flown into the Galápagos at the airport on San Cristobal. From there we were shepherded onto a bus for a bumpy ride to the dock where pangas waited to ferry us out to the *Flamingo*. I’d done quite a bit of advance reading about the islands by this point, but it still came as a shock to see how brown and parched this renowned natural paradise is.

“Right away, you could see that this is a land of deprivation,” Stine says, recalling that ride. “The pauperousness of plant life was just so

striking. Pauperousness: Isn’t that the greatest word? I just heard it recently, and now I’m trying to use it whenever I can.” He flips through a few more pages in his notebook, then drops his finger on an underlined phrase, “Liebig’s Law of the Minimum.”

“I found myself thinking about this one almost everywhere we went,” he continues.

The 19th-century chemist Justis von Liebig studied agriculture, but his law applies in the wild. Basically, it posits that populations of plants and animals grow to a level determined not so much by the natural supplies that are abundant in a given environment but by the one essential supply that’s most scarce. To illustrate this, Liebig imagined a barrel crafted out of staves of mismatched lengths. Fill that barrel with water, and it will hold only to the height of the shortest stave. It doesn’t really matter how tall the taller ones are.



On Fernandina Island, a marine iguana snorts out salt crystals.

Ecologists call that short stave the “limiting factor” for a population. This factor varies from place to place, plant to plant, creature to creature, and even season to season. But whatever the focus of a given population’s short-stave fight—fresh water, food, safety from predators—that’s what usually drives the process of evolution.

Whenever Stine’s thoughts ran along these lines down in the Galápagos, his imagination would jump back in geologic time. The first plants and animals that arrived once the islands rose up out of the ocean most likely did so by accident—seeds stuck to a bird’s foot, perhaps, or lizards floating atop a raft of vegetation. In any case, that arduous journey landed them on a hunk of lifeless lava.

“I couldn’t stop thinking about it,” Stine says. “How in God’s name did any of these species ever get a population started in the first place? So much of the place is so harsh now. Imagine what it was like back then! Think about the first turtle—or better yet, the first plant! If they could talk, the story they’d tell would make the Mormons look like pikers, with that little hike of theirs across the plains.”

Barren first impressions notwithstanding, the Galápagos do boast touches of lushness. Thick groves of mangrove trees dot many island shores. Wispy palo santo trees dominate the slopes encircling Tagus Cove on Isabela Island. In the highland forests of Santa Cruz, *Scalesia pedunculata* trees grow to 65 feet, quite an accomplishment for a relative of the daisies. Closer to sea level on Santa Cruz, candelabra cactuses tower three and four stories overhead, like something out of a cartoon about dinosaur times.

Spectacular as they are, these are the sorts of exceptions that prove the rule. All in all, the Galápagos are a tough place to make a natural living, which is precisely why the islands came to be such a famed “laboratory of evolution.” The living things that landed here



needed to adapt quickly to surroundings much harsher than they were used to, and they had to do so with the limited gene pool of a small population of accidental arrivals.

That's how they veered away from their mainland relatives in such dramatic fashion. Scientists say it took as little as a few generations for some Galápagos animals to develop into new endemic species, existing only in the islands. Some of these populations then split further, developing into different species adapted to different islands in a process called adaptive radiation. The 13 species of finches that made such a big impression on Darwin all descended from a single species.

When Stine's nose points back into the notebook before him on the table, he's in search of a cautionary corollary to Liebig's Law. Barrel analogy notwithstanding, the English botanist Frederick Frost Blackman showed early in the 20th century that populations can be limited not only by their minimum essential needs, but also by their maximum tolerances. For Stine's purposes

at the moment, Blackman's Law of the Maximum amounts to a refutation of the old aphorism that you can't get too much of a good thing.

Hopping off the pangas and onto Fernandina Island one morning, we found ourselves staring out at several hundred marine iguanas, their motionless bodies splayed out on rocks under the sun. In *The Voyage of the Beagle*, Darwin had this to say about such a scene: They are "great black lizards, between three and four feet long. . . . It is a hideous-looking creature, of a dirty black colour, stupid, and sluggish in its movements."

Darwin got this completely wrong. In fact, marine iguanas are drop-dead gorgeous. Their bearing is regal, thanks to the row of scales that runs down their backs like feathers on a tribal chief's headdress. Their expression is serene, thick lips curled upward into such contented smiles of sun-soaked bliss.

We were all agog over the iguanas, but they were indifferent to our arrival, so much so that it was up to us to avoid stepping on them. Stine didn't need to

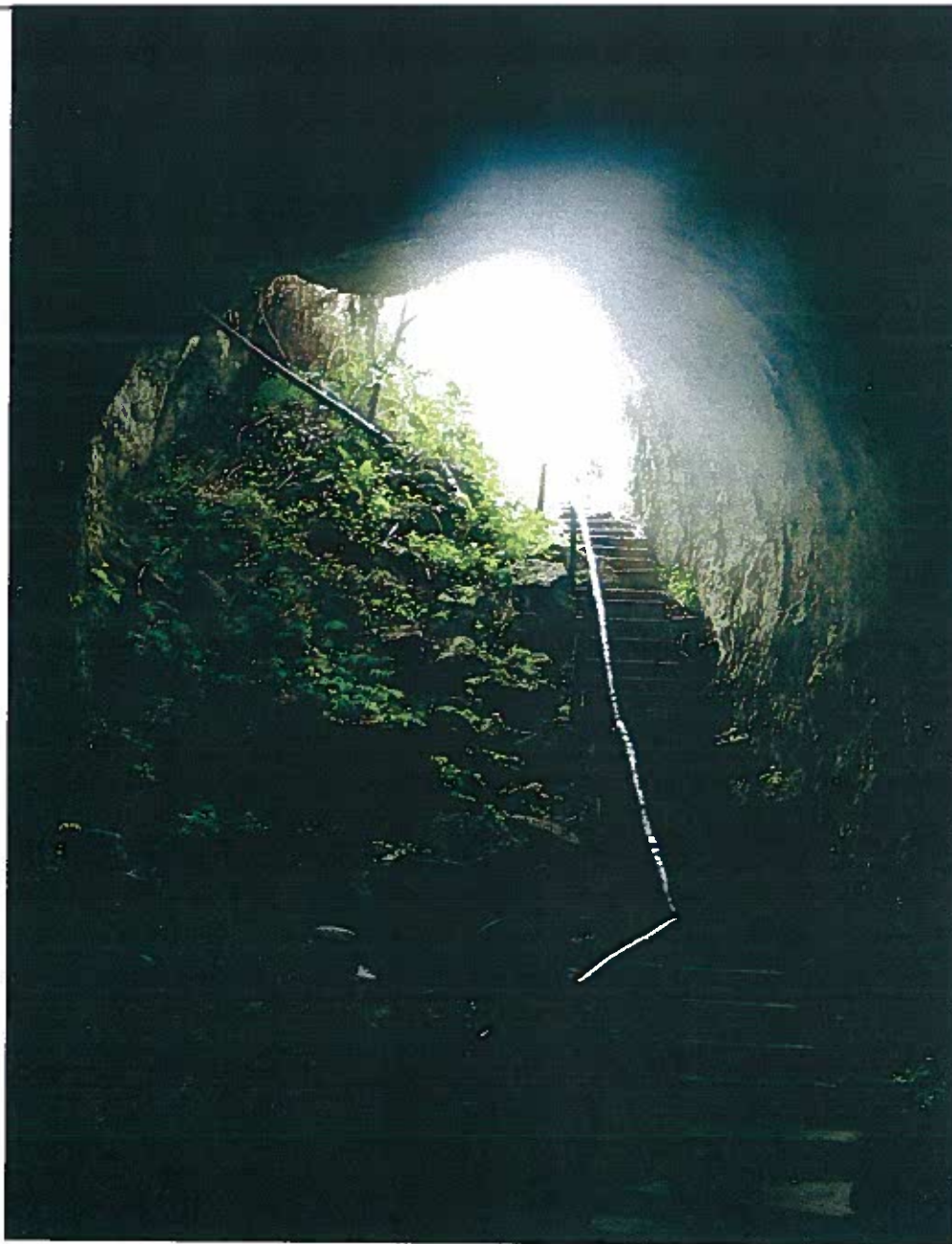
Flamingo traveler Cathy Dryden leans into a sea lion on Española Island.

worry about this as much as his fellow travelers. While we all stepped gingerly this way and that, he just plopped himself down cross-legged on the ground and stared straight at the snout of an iguana.

These are the only lizards in the world that make their living in the ocean, feeding mostly on underwater algae. The first iguanas to arrive in the Galápagos reached this food by venturing out on foot at low tide, but the creatures eventually evolved into phenomenal swimmers.

The heartiest among them can dive nearly 40 feet and stay submerged for an hour. They manage this in part by slowing their heartbeat to a crawl, obviating the need for more oxygen.

But the cold ocean water wreaks havoc with their body temperature. That's why they spend so much time idling on rocks under the sun. It is true that the iguanas seem to be in a bit of



Looking up and out of a cave-like geological formation, called a lava tube, on Santa Cruz Island.

a daze while tackling this ectothermal task of warming back up, but they have no natural predators in the Galápagos, so they can afford to be as sluggish as they darn well please.

Blackman's Law comes into this picture because of salt. Feeding in the ocean, marine iguanas consume such great gobs of the stuff that it would kill them if it weren't for specialized glands they've developed above their eyes. These glands suck salt out of the body and process it into white crystals that are then shuttled down through a duct into the nostrils. That's where it comes out every now and again, in sudden snorts.

"Sometimes, it's all about waiting," Stine says. "You just watch, and if you watch long enough, the chances are you might see something you've never

seen before. I saw maybe half a dozen snorts. It was funny. It was provocative. It was awesome.

"It's such an amazing example of evolution. You know, the iguana doesn't wake up one day and say, 'I've got to get rid of all this excess salt.' But over time, the individual that takes some little step towards excreting salt, that one has the greatest reproductive success. And there you go with the old Darwinian evolution."

At this, Stine's eyes return to his notebook. He has one last law to locate, one that describes an ecological Goldilocks zone between Liebig's minimum and Blackman's maximum. Animal ecologist Victor Shelford's Law of Tolerance says that populations of plants and animals thrive best when they find a way to sail safely past both

the Scylla of life-threatening scarcity and the Charybdis of toxic excess.

Rain fell steadily the afternoon we spent on Santa Cruz Island. This was the island Stine had been eager to see above all others, as it's home to a large population of Galápagos giant tortoises. Unfortunately, the day went a bit sour on Stine. He was too distracted by the task of keeping his camera equipment dry. Plus, there was the shock, after all those days aboard the boat, of a muggy bus ride up into the highlands. Something about diesel fumes and roadkill sightings put him in a fretful frame of mind.

The whole of the Galápagos archipelago is managed as an Ecuadorian national park, with just 3 percent of the islands' land area occupied by human settlements. But the human footprint looms large here nonetheless. Imported cats, rats, and goats have wreaked havoc with some island species. There is concern whether the surrounding ocean is being overfished. A thriving ecotourism industry now brings in more than 100,000 visitors a year. As careful and well-meaning as we might be, did we Galápagos travelers know for sure what imprint our own footprints might leave?

"I was feeling such a sadness for what might happen there," he says. "I thought I'd be blown away by those turtles, but all that stuff sort of got in the way. But the turtles were still wonderful, weren't they? I'm glad I finally saw them."

By far the most famous of Galápagos residents, the giant tortoises can weigh in at more than 500 pounds. While foraging for vegetation, they lumber around on thick legs that look like they belong under a baby elephant.

These animals are another example of adaptive radiation, having branched out on different islands into a total of 14 different species. But the last few hundred years have been tough on Galápagos tortoises. Three species are extinct. A fourth will likely disappear soon, as it looks like only a single male remains alive.

Ironically, their troubles can be traced to the very bit of evolutionary

genius that landed them in that Goldilocks sweet spot described by Shelford's Law. Faced with frequent droughts, the tortoises developed the ability to store water for extraordinary stretches. They can go as long as a year without it—and without food, too, for that matter.

That was all to the good of their population until humans came on the scene and caught on to the trick. In the 19th century, sailors in the midst of long voyages stopped here to gather up giant tortoises by the scores. It took as many as six men to lift one, but the labor was worth it once the tortoises were stacked one atop another upside down aboard ship. The crew now had a ready supply of fresh meat for many months of the voyage ahead.

Things took another turn for the worse later when rats, cats, and goats established themselves ashore and developed a taste for tortoise eggs and baby tortoises. This remains a serious issue today. It's why wildlife managers at the Charles Darwin Research Station on Santa Cruz remove eggs from nests and incubate them artificially. The young tortoises hatched this way live in a special protected reserve until they're too big to get eaten—as long as five years.

Stine flips his notebook closed at this point and drops it back into his satchel. Then he beckons our waitress over with a wave of his hand.

"We could stay here all night," he says. "I don't feel like we've even scratched the surface."

He's right, of course, but there's nothing to be done for it. He asks how I'm coming along with sorting my pictures, and I ask him if he's listened yet to any of the recordings he made in the islands. One day



from his week in the Galápagos has nothing to do with Darwin or evolution. Late one afternoon, as the *Flamingo* made her way between North Seymour and Isabela islands, the vessel overtook a school of bottlenose dolphins. They numbered well in the hundreds, and they were in quite a playful mood, assuming that's what all that daredevil boat racing and spectacular leaping was about.

I remember the way Stine looked that day, stretched quite precariously up on his tiptoes while leaning out over the *Flamingo's* prow. His eyes were ablaze with a mix of wonder and hunger over the scene unfolding before him.

So it occurs to me now that Stine has neglected to mention one key principle about the study of ecology that he manages to communicate quite effectively to his students. I'm not sure this one has an official name, but something along the lines of Stine's Law of Wild-Eyed Wonder might work.

"All that time I spent dreaming of going to the Galápagos," he says. "You know what? I'd go back in a heartbeat. Wouldn't you? In fact, I plan to go back! Wanna come?"

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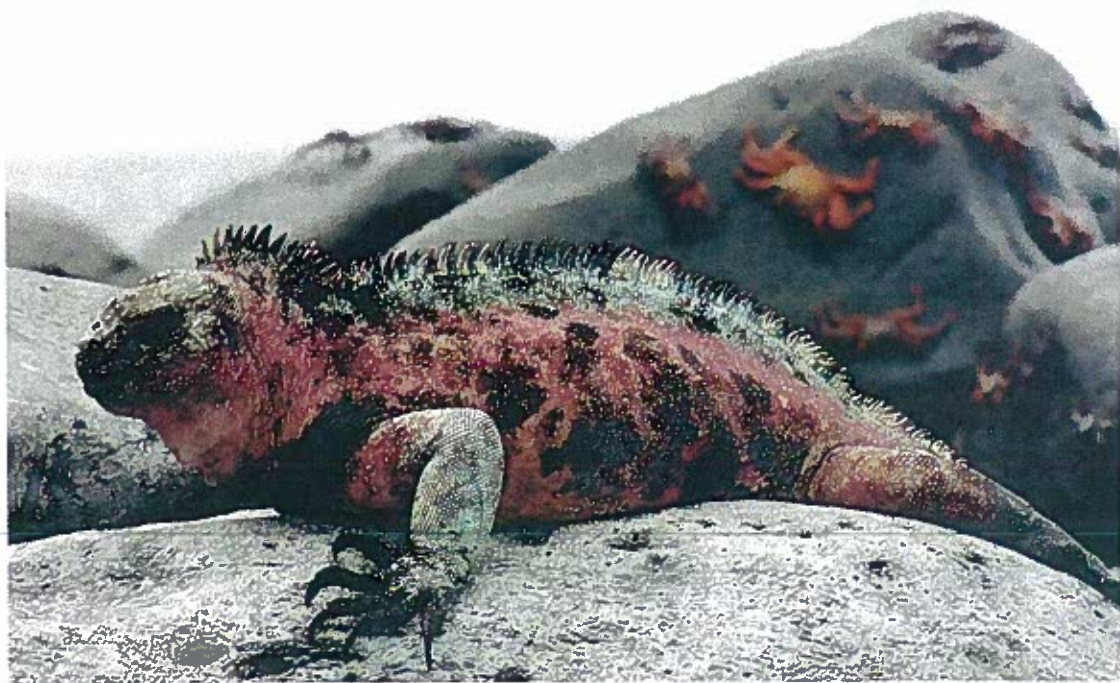
on Española, I watched from a distance the striking scene of Stine pointing an oversized boom microphone into the face of a barking sea lion.

"Weren't those sea lions great?" he says now. "I thought it was the funniest damn thing, the way two of them would get into those big blustering fights. But the fights would never last more than a minute, and then afterwards they'd both lie down, with their flippers sprawled all over each other. It reminded me of that John Wayne movie, the one with Maureen O'Hara, the one where he's in Ireland . . ."

"The Quiet Man?"

"That's it. Those sea lions were just like a bunch of brawling Irishmen who fall all over each other with their fists and then become the best of friends the minute the fight is over."

Ironically, Stine's favorite moment



Above, Pinnacle Rock on Bartolome Island. Right, a Christmas marine iguana on Española Island.