GALAPAGOS
EDUCATION

ADVENTURES IN THE GALAPAGOS

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From the moment you step onto the lava landscape of a Galápagos Island and see your first marine iguana—a rather ugly, black creature that crawls to the edge of the ocean and then —you know you're in a special place. You look at that iguana, or any number of other species of animals and plants, and you realize that you are observing something that occurs nowhere else on the planet, something that originated here. But the thrill is more than just seeing something unique—you've almost certainly encountered endemic species (those that occur only at the location you're observing them) before—but in the Galápagos, the animals allow you to get very, very close. This is not the same as pigeons in the park that come annoyingly close in hopes of a meal; the Galápagos animals seem to have little fear of you as you approach them. This phenomenon is true both on land, where presumably the absence of large mammalian predators has bred a lack of fear of humans, and underwater, where possibly the absence of spear fishing and shooting has done the same, despite the presence of large predators such as sharks. So there you sit, face to face with this marine iguana—or land iguana, Galápagos owl, Galápagos sea gull, booby, tortoise, pelican, penguin, etc.— and ponder the origins of life on earth, and all the while you're ecstatic because you are so close to this captivating animal!

Now, take a marine biologist who studies the evolution of tropical marine and deep-sea fish and send her to the Galápagos Islands, the so-called Mecca of evolutionary biology. This label appropriately comes from the fact that the Galápagos Archipelago, located on the equator in the eastern Pacific Ocean about 1000 kilometers off the coast of Ecuador, was visited by Charles Darwin in the 1830s, and what he found there subsequently became crucial to his theories of natural selection and the evolution of species. Let this modern-day biologist experience and explore the dramatic terrestrial realm with its charming wildlife, underground lava caves, the shallow marine environment with its great numbers of fish schools, playful sea lions, gregarious eels, and big sharks, and then send her on her first trip in a mini-submarine to 900 m. The result? A biologist with new insights into the tapestry of the natural world… and a lot of adventure stories to tell!

Let's begin back on land at an underground lava tube, into which the trip's Ecuadorian naturalist guide, Mathias, and I repelled through a hole in the ceiling and then explored inside. Repelling in the Galápagos, I soon learned, is complicated by the fact that lava rock has a tendency to crumble beneath your feet; unnerving, I'm sure, even for experienced climbers—which I am not. In fact, the bottom of the lava tube was covered with piles of rocks that of course used to be on the ceiling; we wore helmets on the repel and did not look up! After making it beyond the crumbly ledge and into the wide-open space of the cave, I soon forgot the tricky beginning and became engrossed in the beauty of the structure around me. Magma from Galápagos volcanoes is rich in iron that, when exposed to air, oxidizes and over time changes black lava rock to brown and then red, and some lava rock is distinctly purple. The walls of the lava tube were a beautiful mosaic of colors! We sweated a lot in the cave as there was little air movement, but we were successful in finding some tiny fossilized bones from birds and small mammals that previously inhabited this haven.

Back above ground, I had encounters with all kinds of enchanting animals, including of course the marine iguanas, which Darwin aptly named the "imps of darkness." The iguanas blend in so well with the lava rock they sun themselves upon that sometimes you don't even see them until they move. These animals go into the ocean during the middle of the day to feed on

algae growing in shallow water, and they spend much of the rest of their time soaking up sunshine to raise the body temperature after the cold swim. Many lie prone on the lava rocks to heat up, but I saw quite a few hanging vertically on rock walls! If you approach them carefully, you can sit right next to them, an effort you're rewarded for by being bombarded by salt crystals shot out from their nostrils! This is the way marine iguanas rid their bodies of excess salt taken in while feeding underwater.

So, why do the iguanas have to spend so much time warming up? Because penguins occur in Galápagos! In other words, despite the fact that the islands are on the equator, the water is very cold, so cold that penguins, known otherwise only from much colder climates, thrive here. Only one species of penguin occurs in the archipelago, the endemic Galápagos penguin, a short bird that, like other wildlife there, allows you to approach it closely. In one scene during filming, I snorkelled up to a rock on which a penguin was standing, raised myself out of the water on my hands to look at it, and I was only a few feet away from this adorable little creature. I enjoyed getting to know lots of other birds on the expedition: frigate birds would hover over our ship creating scenes reminiscent of the flying monkeys from the Wizard of Oz. These are large black birds and mature males have a red throat pouch that they can inflate to a ridiculously large size (supposedly) to attract females. Duck-like cormorants occur in many parts of the world, but only in the Galápagos have they lost the ability to fly. They literally hop across the lava rock and into the water to forage for fish.

Darwin's finches are such drab, ordinary little birds. Considering the impact they made in Darwin's revolutionary thinking, you expect them to be magnificent. They're interesting of course because the different species have evolved different beak shapes and sizes and correspondingly different diets. I even saw one finch on the back of a marine iguana and another on the back of a land iguana; these birds survive by picking parasites off iguanas! And of course there were blue-footed boobies—white seagull-size birds with bright blue feet; although not restricted to Galapagos, blue-footed boobies are nevertheless an icon for the islands. (Shops in the tourist town Puerto Ayora on Santa Cruz Island abound with "I Love Boobies" T-shirts bearing two big blue feet appropriately placed on the front...) Although the large colonies of boobies were not in their breeding season during our expedition, I did see a few perform the mating dance; imagine the beak and the tail of a large bird going straight up into the air, and then each blue foot alternately being lifted high off the ground. That's the blue-footed booby mating dance and you simply cannot watch it without laughing. Well, I could go on and on with the terrestrial realm—there were brilliant orange Sally Lightfoot crabs, tidal pools filled with playful sea lions, the other-worldly giant Galápagos tortoises, etc. But then there were the fish....

I have been diving in a number of different tropical areas around the world and have certainly seen more diversity of fish in places than I saw in the Galápagos, but I have never seen greater numbers of fish anywhere. The upwelling that brings cold waters to the islands also brings an abundance of nutrients which forms the basis of a food chain that supports an incredible amount of life.

In 3-D Imax, an audience is going to have the same experiences I had, for example, of being surrounded by an enormous school of large, silvery pelagic jacks, or enclosed within a nine meter column of swirling barracuda. These are mesmerizing, awe-inspiring moments—at least so long as you don't look too closely at the big teeth in the mouths of the barracuda.

The audience will also swim with great numbers of large hammerhead sharks, some up to 180-225 kg. I had never been in really 'sharky' waters, so I was a bit nervous about this part of the expedition. I went underwater with cinematographer Al Giddings on the 'batmobile' (the nickname given to the camera in its underwater housing after four battery-powered dive-propulsion vehicles were added to it—Al and I soon became known as Batman and Robin as we flew through the water on this contraption), and he dropped me off on a rock pinnacle at about 12 m. As soon

as he moved off a bit, I immediately became aware that I was in the presence of hammerheads, not one or two, but 40 or 50 at least, maybe even 100 at times. Everywhere I'd look—to my right, left, above me, behind me, I'd see sharks. I probably looked like a spinning top, constantly whirling around to make sure nothing was sneaking up on me! The animals seemed docile and non-threatening, but being in their presence was an adrenaline rush nevertheless. It is one thing to study, as a scientist, preserved specimens of hammerheads in a museum; it's quite another to experience the 225 kg. living reality in the wild—especially when they're close. One large shark came right at me to within a few feet. My heart was pounding, and I was scared. You are betting your life here on the predictability of sharks, that is, unless you provoke them or they mistake you for their normal prey, they're not likely to bother you. This is no great comfort when they are merely feet from you! But this shark veered off eventually, and I got the most spectacular view of the bizarre head of this beast. A big rectangular head seems like such a dumb shape for an animal that must swim through the water, but when you look at a hammerhead shark head on, you see that the front of the head is tapered to a thin edge, so the design works hydrodynamically because water flows easily up and over it. Nature rewards successful designs with survival, and sharks have been around a long time.

Another underwater adventure involved large moray eels. In other parts of the world that I've been diving, one rarely sees moray eels out of their hiding places of caves and crevices in reefs. In the northern islands of Galápagos, I saw numerous spotted morays swimming out in the open. They were so interested in divers, and there were times that these animals were literally climbing all over us. This is a creepy feeling, and you just know you're going to get bit. Eels have powerful jaws, lots of sharp teeth, and very strong bites, and although you know you'd most likely survive a bite, the thought of the pain makes you cringe! My role in the filming sequence of eels was to swim to a spot located just to the left of a rock pile where several eels had congregated. Essentially I was to "discover" the eels gathered there and observe them before moving on. The best of plans... Each time I would swim into the scene, the eels would leave the rocks and come towards me. At first they came at me so purposefully I was convinced that someone had sabotaged my gear with bait! And they would come so close—no concept of personal space, those eels—definitely fodder for nightmares. I'm still not sure why the eels were so attracted to divers—possibly they were curious about the bubbles coming from our regulators (they seemed to approach the face more often than not), or perhaps in my case they could detect the tiny fish I would often have in my hand net that I'd collected for scientific purposes. At any rate, I will not soon forget my encounter with Galápagos morays.

And then there was the submersible experience.... When a colleague initially contacted me regarding whether he might submit my name as a possible candidate for participating in the Galápagos Imax project, I knew I wanted to sign up as soon as he told me that I'd have a chance to do some deep-sea dives in the 4-man Johnson Sea Link Submersible. As you can gather from the preceding account, I had a lot of new experiences on this film project, but diving into the dark depths of the sea was the highlight. It might seem risky to most people to climb into a small sphere and plummet 900 m. into the ocean, and I admit to some initial trepidation. But, as a biologist, the thought of visiting places that nobody had ever seen and having the opportunity to explore and collect unknown species of life there were irresistible.

As it turned out, the whole sub-diving experience was fascinating. I climbed a ladder from the deck of the ship to the top of the sub and entered a round opening on top. The hatch was then closed and locked (your heartbeat quickens here), and then the sub was lifted from the ship by an enormous hoist and plopped over the stern. Once in the water, it felt as though we were in a car in a car wash, as waves washed over the top of the sub. Once a seal in the sub was ensured (marked by the exclamation "We've got a seal" from the sub crew member in the rear chamber of the sub, who literally studies the seal around the bottom hatch door for leaks), the sub began to descend. As soon as the sub submerged, the ride was calm and peaceful, a stark contrast to the jostling at the surface. The view from the "bubble" was fabulous, and I felt no claustrophobia at all. The ride down (and back up) in the water column in the sub was stunning! Once we descended into complete darkness (ca. 250-300 m.), sub pilot

Don Liberatore turned off all the sub lights, and we were entertained with a spectacular light show of bioluminescence. The experience was like being surrounded by billions of fireflies or, when the sub was ascending, like it was snowing fireflies.

On the way down to 900 m., Don warned me that there might be some moisture dropping on us during the dive from condensation forming within the sphere and that there might be some cracks and pops from the pressure changes. He was right on both accounts, and it was a good thing he clued me in; otherwise I'd have thought the bubble was leaking and getting ready to implode from the pressure changes! On the bottom, I felt as though we were on the moon—aliens in our protective sphere—exploring another world. Because of our limitations in exploring the oceans with scuba gear, only the tiniest fraction of the world's marine environments have been observed. A good analogy to represent how much of the ocean bottom man has seen may be a slice of pepperoni (or maybe just a grain of black pepper?) on an extra large pizza. And this is just the bottom, the average depth of which is about 4000 m—there's all that water between the ca. 60 m. scuba diving limit and the bottom. It is mind boggling how little we know. Fortunately Don is an expert at manipulating the Johnson Sea Link and collecting gear on the bottom, and he was instrumental in taking samples of numerous different marine organisms. The sub is equipped with an 'arm' with various attachments at the end for slurping, grabbing, or scooping critters. As I and other scientists begin now to sort through and identify the material collected, we are finding numerous new species of marine life from the dives, including perhaps a dozen new species of fish.[1]

As with Darwin's revolutionary theories, our continued understanding of the natural world progresses in tiny increments, and we had the opportunity on the Galápagos expedition to contribute to this understanding by observing and collecting organisms in a remote locality in a variety of habitats, including parts of the ocean that no one has ever seen. The tapestry of life is overwhelming in its vastness, but each new species discovered is a tiny piece of the puzzle. And while you can study all the individual pieces in detail in a museum, unless you accept the challenges of, for example, diving with hammerhead sharks, you'd never know that a very small, colorful angelfish in Galápagos acts as a 'cleaner' of parasites on sharks there (brave little fish). So, expeditions such as our Galápagos one help scientists discover the pieces and see how they fit together; the result is a picture far more informative than its individual parts.

In closing, although I have dealt primarily here with the enchanting aspects of the islands and their inhabitants, we witnessed on our expeditions the great struggle for existence of Galápagos wildlife. Faced with dramatic changes in climate due to periodic El Nino events, life on the islands episodically perishes or flourishes. It was sickening to see so much death during the recent El Nino event but heartening to see so many species recovering from it later. Life is tough on the Galápagos, but jump in the water there and play with a dozen precious sea-lion pups and see if you don't find yourself cheering for the survival of Galápagos wildlife! As someone once said, "no place on Earth is quite like any other place, but the Galápagos Islands are less like all other places."[2] Come see for yourself, in 2-D and 3-D Imax!

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1 Part of the job of describing new species is naming them, and I have decided to name two of the new Galápagos species of fish in honor of ultralight pilot, Bill Raisner, and IMAX stereographer, Noel Archambault, who died in a tragic plane crash in the Galápagos during the filming in June 1998. As a scientist, this is the most lasting gesture I can make in memory of these friends.

2 Hedgpeth, J.W. 1964. The Oceanographic Setting of the Galápagos. Galápagos International Scientific Project. University of California, Berkeley.