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Adult Cuban Iguana, *Cyclura nubila*, and an example of the very dry habitats at Guantánamo Bay.

Conserving the Remarkable Reptiles of Guantánamo Bay¹

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Photographs by the author except where indicated.

When looking for a suitable place to study some of the world's rarest reptiles, a relatively isolated military base might at first seem like a surprising choice. However, the United States Naval Base at Guantánamo Bay, Cuba, like many military installations worldwide, supports large areas of undisturbed natural habitat and is home to an impressive abundance of wildlife. Guantánamo Bay lies in Oriente Province in the southeastern corner of Cuba. It is the oldest overseas United States military base, originally acquired as a coaling station in 1903, but reaffirmed by treaty in 1934 after the American fleet aided Cuba during the Spanish-American war. Because only 11% of the 20-square-mile base is actively used by the military, large areas of near-pristine cactus and thorn scrub, buttonwood and *Phyllostylon* forest, and mangrove tidal thickets remain.

Guantánamo lies in the rain shadow of the looming Sierra Maestra. Consequently, this starkly beautiful region is very dry, receiving only 40–75 cm of rain each year. With air temperatures averaging 28–30 °C throughout the year, it's no wonder that as many as 30 terrestrial species of amphibians and reptiles, 21 of which live nowhere outside of Cuba, make Guantánamo their home. Among these, the Cuban Iguana (*Cyclura nubila*) is one of the largest, undoubtedly the most visible, and certainly the most charismatic. No one completes a tour of duty at "Gitmo" without getting to know these inquisitive, prehistoric-looking giants.



Endemic Cuban Todies (*Todus multicolor*) take advantage of large areas of near-pristine habitats at the United States Naval Base, Guantánamo Bay, Cuba.

Giant Iguanas

Remarkably, these robust lizards have somehow managed to survive millennia of hurricanes and hunting by native peoples. Unfortunately, outside the fence line, iguana populations are now declining because their habitat is being eliminated by develop-



Typical undisturbed coastal habitat at the United States Naval Base, Guantánamo Bay, Cuba.

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ment or degraded by invasive species. A host of exotics, including mongooses, dogs, feral cats, and black rats, prey heavily on juvenile iguanas, and, in many areas, domestic ungulates are consuming the native vegetation on which iguanas critically depend. Since the early 1990s, my colleagues and I at the San Diego Zoo have had the privilege of visiting Guantánamo Bay many times, working to design conservation strategies for Cuban Iguanas and other threatened reptiles.

Getting to Guantánamo is no easy undertaking, but thanks to the United States Navy, we're able to fly in style aboard the base commander's C-12 aircraft, with a pleasant layover in Jamaica that allows us to spend time with friends and colleagues at the tiny yet fascinating Hope Zoo in Kingston. Since the rediscovery of the Jamaican Iguana (thought to be extinct since 1940) in a rugged limestone-floored forest outside Kingston, aptly named the Hellshire Hills, the Hope Zoo has been working to establish a headstarting program for young iguanas. A dedicated facility was built on zoo grounds, which currently houses 100 baby iguanas — all being raised in a safe environment until they are old enough to survive on their own in the wild. To date, 26 iguanas sporting radiotransmitters have been returned to Hellshire, all have established stable home ranges, and at least some released females appear to be nesting successfully. Education is a major part of the mission of the Hope Zoo, and they have recently completed a new learning center on zoo grounds that attracts thousands of school children each year. The brightly painted sign at the zoo's iguana exhibit sends a simple message that says it all: "Nuff Respect Due."

After a short plane flight out of Kingston, Cuba's rugged coastline comes into view, and one can begin to appreciate the strategic and economic importance of the many deep and shel-

tered harbors afforded by Guantánamo Bay. With the hazy mountains and bustling Guantánamo City in the distance, we board a military ferry to cross the bay, a journey that begins in calm waters favored by West Indian manatees, but becomes increasingly choppy as the crossing progresses. After about 45 minutes, we arrive on the windward side of the naval base, piled high with gear, and ready to begin our research.

Lizards and Howitzers

We initially began our field studies of Cuban Iguanas in 1993 along a windswept section of rocky coast called Firing Point, with the hope of gaining an understanding of the basic biology of these lizards, as well as developing practical strategies for their recovery. We quickly came to appreciate the origin of the site's name when we first experienced the thunderous testing of nearby howitzers, an event to which the local iguanas appear amazingly and blithely oblivious. Although frustrating trial and error characterized our early attempts to capture these often feisty five-foot-long lizards, the process was ultimately made easier by our fortuitous discovery that red grapes, like red flowers, were a favored food item and could easily be used to lure unsuspecting iguanas into hand nets. Over the course of a year, we captured each adult iguana at Firing Point once a month, and recorded its body length, weight, head size, and the diameter of the femoral scent glands lining the thighs, all of which seem to be important for successful defense of territories. After placing the animals in canvas bags to quiet them, we also collected a blood sample from the tail for hormone analysis.

For the iguanas, the daily routine varies little, consisting of a vigorous burst of social activity after morning emergence, followed by relatively peaceful migration to nearby areas of vegeta-



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Adult Cuban Iguana, *Cyclura nubila*, at Guantánamo Bay.



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The most unfortunate iguana/human encounters, which iguanas invariably lose, involve motor vehicles.

tion for midday feeding, and ending with a second bout of social interaction late in the afternoon prior to entering nighttime refuges. Most adult males regularly engage in aggressive interactions with other males. These usually consist of a lumbering chase, but occasionally prolonged pushing, hissing, and biting matches ensue. Almost without exception, the most dominant males have the highest testosterone levels, are larger in body and head size, and possess more active scent glands than lower-ranking males. These despots defend small but superior territories that each overlap the ranges of several females. Lower-ranking males do not defend territories, instead moving between the territories of dominant males, from which they are continually evicted. Headbobbing, chases, and mouth-gaping, the typical



Study site at Firing Point, Guantánamo Bay, prior to 1995. About 60 adult iguanas inhabited the area shown here.

weaponry of iguana territoriality, are used almost exclusively by dominant males. These males also spend more time close to females during the breeding season, courting them with gentle nudges and headnods. Although dominant males appear to have better access to mates than subordinate males, they comprised no more than a third of all adult males at Firing Point.

The following year, we conducted an experiment to determine if temporary relocation of dominant males would increase the chances that sexually mature but genetically underrepresented subordinate male iguanas would have the opportunity to mate. This strategy represented a unique approach to lizard conservation, and has the potential to serve as an important management tool for critically small populations. For the duration of the breeding season, we moved the five most dominant males from Firing Point to a large outdoor holding enclosure at the base Army Veterinary Clinic. Within a few days, the five largest previously subordinate males began defending territories that were nearly spatially identical to those vacated by the relocated individuals. In the absence of the dominant males, subordinate males courted females vigorously and their testosterone levels rose dramatically. At the close of the breeding season, the previously dominant males regained their previous territories within two days, although the battles required were among the longest and most intense that we had ever observed. Temporary removal of dominant males may represent a valuable management tool for small or otherwise genetically compromised populations by potentially increasing the number of males contributing to the gene pool.



Giant Anoles (*Anolis smallwoodi*) are relatively common at the Guantánamo Bay Naval Base.

The World Intrudes

When you work at the same site year after year, you begin to take for granted that it will never change. Such had been the case for Firing Point and its enviably observable iguanas until the fateful Spring of 1995, when over 50,000 Cuban and Haitian migrants arrived unexpectedly at Guantánamo Bay, aboard literally anything that could float. In response to the crisis, extensive areas of forested habitat were graded along the coastline in order to construct temporary tented housing. Although military officials did an admirable job of keeping people and wildlife at a safe distance, Operation Sea Signal nevertheless resulted in a noticeable reduction in the local iguana population. At the height of the refugee crisis, the dry tropical forest surrounding Firing Point was reduced to less than 5% of its former extent, and we could only find a single forlorn adult male iguana inhabiting the area.

Our deep dismay at seeing the destruction of Firing Point's ancient cactus forest was slightly tempered by the realization that we now had the unique opportunity to study if and how rapidly iguanas would recolonize the area. Our aim was to document the extent to which this dry tropical forest ecosystem was sufficiently resilient to recover from severe disturbance, and to study the ecological role that iguanas might play in this process. By mid-1999, we were heartened to find that over 25 adult iguanas had resettled the area, and all appeared to be growing well and in good health. For both males and females, the relationship between body mass and body length had improved to the point where it was comparable to that of healthy undisturbed iguanas, indicating that despite the loss of significant habitat, iguanas were able to forage effectively following disturbance. At the same

time, vegetation at the site showed definite signs of regeneration and a number of new seedlings emerged.

Given that iguanas relish the fruits and flowers of many plants, we believed that they might play an important role in the recovery of native vegetation. Past research by us and others has shown that seeds that have passed through the digestive tracts of iguanas tend to sprout sooner and produce seedlings that grow faster than seeds that have not. In addition, repetitive cropping by iguanas, evidenced by an abundance of oddly-shaped flat-topped bushes along Guantánamo's limestone coastline, is likely to stimulate the development of new foliage. By aiding germination, providing nutrients to developing seedlings, promoting plant growth, and dispersing seeds into new areas, iguanas play a key role in keeping forest ecosystems healthy. As so often happens with scientific endeavors, one study leads to a host of new avenues for research. Seeing the recovery process first hand at Firing Point, a site that was so intimately familiar to us, led to a new line of inquiry into the relationship between local iguana populations throughout the base and the vegetation on which they depend. As unglamorous as it may seem, surveying different habitats to determine the density of local iguana populations is an important first step in assessing their ecological relationship with local plant communities.

After identifying eight key habitat types on the base, we returned to Guantánamo in 2000 to carry out a series of morning and afternoon walking surveys using a technique called distance sampling. This involved a team of three slogging through varying densities of thorn scrub (one must stay on an absolute straight-line course to meet the strict assumptions of this survey methodology — meaning that, as much as we wanted to, we



United States Marine with Cuban Boa, *Epicrates angulifer*, at Cuzco Beach nature area, Guantánamo Bay.

could never cheat and go around those nasty-looking cactus patches), for a half-mile or so per transect. Whenever an iguana was sighted, we paused our sweaty march to cheer, note the size and sex of the animal, and measure its perpendicular distance from the transect line. We used a Global Positioning System (GPS), which communicates with a series of navigational satellites orbiting the earth, to record the latitude and longitude of the start and finish of each transect line. The morning breeze, which blessedly and predictably picked up around 1100 each day, was a welcome break from the stifling heat. Additional delights included the occasional delicate pink orchid suspended in midair amid impenetrable thorn scrub, or the bright green, yellow, and azure hues of a sleeping giant anole, or “chipujo,” in a *Capparis* tree.

Despite hazardously steep terrain, we successfully completed 24 transect lines, and determined that iguanas are approximately four times as abundant along the coastline as inland. Most likely, this is due to the many holes and crevices in the crumbling limestone that characterize the shoreline. These provide a host of hiding places and refuges from the heat, particularly for young iguanas. Not surprisingly, iguanas are three to ten times as abundant in natural areas as in those that have been impacted by people. Perhaps because suitable refuges are fewer and farther between, habitat disturbance in the form of construction and replacement of native vegetation by introduced

grasses appears to have twice the negative impact on inland iguana populations as on those along the coast. During one of our transects, we did come across an unusual and unexpected sight — an adult male iguana with the telltale remains of a diminutive yellow juvenile Cuban Grassquit (a small passerine bird) in his mouth, testament to the fact that iguanas are not always vegetarian in their food choices.

Snakes, Turtles, and Banana Rats

With financial support from the United States Department of Defense, we have recently been able to expand our work to include population surveys not only for iguanas, but also for two other ecologically important reptiles on the base, boas and sea turtles. Taking on this additional task meant no rest for the weary — to make the most of our limited time on the base, each full day of iguana surveys was followed by an evening of searching for Cuban Boas and monitoring sea turtle nesting beaches.

The most efficient way to search for Cuban Boas (*Epicrates angulifer*) — a truly impressive snake, with rainbow iridescence on its scales and a body length of up to nearly four meters — is



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Populations of large rodents called Cuban Hutias (*Capromys pilorides*) or “Banana Rats” appear to be burgeoning on the base, and their exploding population is causing significant problems by destroying vegetation and damaging equipment. Cuban Boas (*Epicrates angulifer*) probably play a key role in naturally regulating hutia populations.



Eight of ten beaches at the United States Naval Base, Guantánamo Bay, Cuba, are used for nesting by endangered Hawksbill Turtles (*Eretmochelys imbricata*).

to slowly drive roads just after sundown. Nevertheless, one of our most intriguing boa encounters occurred when we were on foot. Researcher Glenn Gerber's practiced eye spotted a *Lignumvitae* "Tree of Life" which had been hollowed out by lightning — the perfect hiding place for a young male boa. We marked the snake with a microchip just under the skin for permanent identification, and collected a small blood sample for genetic analysis. On future trips, our goal is to use surgically implanted radiotransmitters to track the movements of these elusive and little-known snakes in order to better understand their home range dynamics and habitat requirements. We are especially interested in documenting the effects of an ongoing relocation program, in which boas are removed from urban areas by base personnel and released into more natural surroundings.

In recent years, populations of large rodents appear to be burgeoning on the base. These animals are known to science as hutias, but to most base residents as "banana rats," owing to the distinctive curvature of their scat. Although one can't help but smile at the ubiquitous hutias, which traipse around the base in ungainly family groups that communicate constantly with chirps and whistles, their exploding population is causing significant problems by destroying vegetation, chewing through radiator hoses, and perpetrating other undesirable antics. Cuban Boas probably play a key role in naturally regulating hutia populations, so we are keen to further investigate the ecological relationship between these two species.

After about 2100 hours, when nightly boa catching became significantly less likely, we headed out to investigate a series of beaches on the base that are potentially used by sea turtles for nesting. Because they are relatively undisturbed and protected from hunting, Guantánamo's scenic beaches are of regional importance for sea turtle conservation. Fortunately, it's fairly easy to distinguish which species of turtles are using these beaches simply by examining their tracks. The nesting crawl of all sea turtles generally resembles the path of a miniature bulldozer, with Hawksbill tracks showing an alternating flipper pattern and Green Turtles a more symmetrical, opposite pattern. Because Leatherbacks are one of the largest living reptiles, surpassed in size only by some crocodylians, their tracks are impossible to miss.

To date, we have mapped ten beaches on the base using GPS and surveyed them for evidence of sea turtle nesting activity. Eight of the ten beaches are used by Hawksbill Turtles, one by Green Turtles, and one by Leatherback Turtles, information that will help guide the Navy in successfully managing these beaches for both people and turtles. Two of the beaches have evidence of more than 100 nesting pits each, and appear to be especially important for Hawksbills. Given that Hawksbill populations are under intense hunting pressure throughout much of the Caribbean, it is crucial that these beaches be carefully managed to minimize human impacts. Together with natural resources personnel on the base, we are committed to evaluating alternative management strategies and raising public awareness about sea turtles and their nesting habits.

Without a doubt, the highlight of our sea turtle work at Guantánamo Bay was a particularly warm and humid night at Pebble Beach in June. This is a small, rocky beach, but one favored by turtles nonetheless. We hadn't dared hope that we would actually encounter a living turtle, but to our delight, as we approached the beach we heard the rasping sound of a female Hawksbill's plastron scraping over the rocks as she lurched onto land. With a special flashlight that emitted only a dim red beam, we were able to scrunch forward on our bellies close enough to observe the nesting process. She selected a site under an aged Sea Grape Tree that, judging from soil erosion that revealed old eggshells encrusted many layers deep, has probably been used for this purpose for decades. Oblivious to the eggs of previous



Iguana crossing signs installed at key locations throughout the naval base have helped reduce road casualties.



Annual iguana demonstrations are held for military and civilian personnel and their families.

nesters, which she dug up and flipped out of the nest cavity with impunity, this particular female took about an hour to dig her nest. With remarkable dexterity, she used her rear flippers to reach down, scoop out flipperfulls of sand, and carefully deposit them nearby. When the nest cavity was deep enough to suit her, she proceeded to lay over a hundred glistening spherical eggs, and then gently backfilled the nest cavity. Her task complete, she never paused to rest, instead making a direct line to the water and disappearing into the moonlit waves.

Reptile Outreach

Public education is key to the success of any conservation program. Over the years, we have attempted to educate both military servicemen and civilians through open lectures at our field sites, classroom presentations to elementary and secondary students, endangered species pamphlets, and newspaper and radio interviews. In response to a rash of unfortunate incidents in the mid-1990s, we designed a set of “Iguana Crossing” signs for high traffic areas where collisions had occurred. We have been thrilled to see that over 20 of these signs have been erected at critical locations, and to learn from our local collaborators that iguana road casualties are now a rare occurrence. In fact, the only “problem” with the signs has been their unanticipated popularity as impromptu souvenirs — an issue subsequently addressed by offering scaled-down versions for sale in a local giftshop.

With the help of the base TV station, which advertises regularly for us on the event scroller, we have had excellent turnouts for our semi-annual iguana demonstrations. These presentations are held in the evenings at Iguana House, a relatively remote building near the coast that always seems to have an iguana or two hanging around. Usually about 80 or so people attend, some of them getting their first-ever close up view of an iguana, with a chance to touch one if they wish. While we try to spread the message that iguanas should be neither harassed nor fed (an ever-present problem), we also spend a significant amount of time answering questions. These range from why iguanas bob their heads to how the large population of feral cats on the base is impacting them. Interest and curiosity among base residents

about iguanas and other native reptiles continues to be intense, and past interviews and surveys have shown that most people’s feelings about them are positive, boding well for the continuing successful co-existence of humans and wildlife on the base.

Public interest in Guantánamo’s extraordinary wildlife continues to be high, as evidenced by the more than 75 dedicated volunteers who have helped us with our work over the years. Part of the message we hope to send is that protecting wildlife need not conflict with the military mission. In fact, healthy natural systems are often those best suited to supporting the security and training functions central to military operations. For such a small piece of land, Guantánamo Bay has experienced an unusually tumultuous history. Despite its drastic transformation from the early days of open commerce to its more recent role as a safe haven for Cuban and Haitian refugees, the extraordinary biodiversity of Guantánamo has managed to survive intact. Whatever the future may hold, we can only hope that with awareness and dedicated stewardship, the distinctive reptiles, other native wildlife, and the natural habitats of Guantánamo Bay will continue to flourish.

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