

VOLUME 15, NUMBER 2 JUNE 2008

IGUANA

CONSERVATION, NATURAL HISTORY, AND HUSBANDRY OF REPTILES

International Reptile Conservation Foundation

www.IRCE.org

ERIAN K. MEALEY, INSTITUTE OF WILDLIFE SCIENCES

A Mangrove Diamondback Terrapin (*Malaclemys terrapin rhizophorarum*) pauses while navigating through the aerating roots ("pneumatophores") of a Black Mangrove Tree (*Avicennia germinans*) on an island in the lower Florida Keys. See article on p. 78.



BRYAN HAMILTON

Little is known about the natural history of Great Basin reptiles. This is especially true of secretive species such as the Sonoran Mountain Kingsnake (*Lampropeltis pyromelana*). See article on p. 86.



CEAIG BELKE

Equipment that must be hauled into the rugged Salina Reserve to track free-living Grand Cayman Blue Iguanas (*Cyclura lewisi*). See Travelogue on p. 106.



SHANNON TOMPKINS, HOUSTON CHRONICLE

Intentional and inadvertent trapping of Diamondback Terrapins (*Malaclemys terrapin*), here in a crab trap, have decimated populations along the Atlantic and Gulf coasts of the United States. See article on p. 78.



JOHN BINNS

A brutal attack at the Blue Iguana (*Cyclura lewisi*) breeding facility on Grand Cayman island resulted in the death of seven captive adult breeders. See article on p. 66.



OLIVIER'S, G. PAUWELS

Although discovered nearly four decades ago, Miriam's Legless Skink (*Davewakeum miriamae*) is still one of the least known Thai skinks. See article on p. 102.



CESAR, L. BARRIO ANDROS

A fascination with giant snakes, such as this Green Anaconda (*Eunectes murinus*), can fuel an ecotourism industry that may facilitate conservation efforts for this top predator in the Venezuelan Llanos. See article on p. 92.



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SUZANNE L. COLLINS, CMH

Although displaced from much of their natural habitat in peninsular Florida by invasive Cuban Brown Anoles (*Anolis sagrei*), Green Anoles (*A. carolinensis*), such as this male from Franklin County, Florida, remain abundant throughout much of the southeastern United States. However, we should remember to appreciate and conserve common species, lest they become the Passenger Pigeons of tomorrow. See Commentary on p. 105.



Archie a few days before I left; although his health was much better, he was still disoriented and moved about his pen cautiously.

The Seven Blues of May¹

John Binns

International Reptile Conservation Foundation

Photographs by the author except where indicated.



Sunday is a day of the week that typically provides peace and quiet, time to catch up on the work accumulated during the previous week. Sunday, 4 May 2008, started off no differently. The day would be dedicated to editing material for the June issue of *Iguana*, and replying to an assortment of emails, particularly one regarding the new signs that had just arrived at the docks in Grand Cayman for the Blue Iguana facility.

Downstairs, Sandy was taking advantage of the day to evaluate new web design templates for the Blue Iguana website, conferring with her developers on enhancements, functionality, and ease of maintenance. The decision to give the Blue website a new face had been made months before, but very recent activity with the European Union (EU) Grant, discussion of a new protected area, and facility signage enhancements were making the web-site upgrade a priority.

Some 2,733 miles away, Fred Burton, Director of the Blue Iguana Recovery Program, was enjoying the weekend break, the warm, tranquil early morning only occasionally interrupted by

the crowing of a rooster intent on being a nuisance. Sipping on a mug of coffee, Fred was immersed in polishing the details of a EU Grant that would consume the better part of his attention during the coming week.

Sam Hicks, personal assistant to Fred, and her partner, Giles Shaxted, had been out the night before celebrating their anniversary. They'd gotten in late and planned to sleep in.

In George Town, John Marotta, Head Warden at the facility, was leisurely enjoying his first day off in a month. John had his A-Team of regular local volunteers, Stu Petch, Gary Redfern, and Sheilagh Rickard, set to manage the day's work at the facility.

All that peaceful orderliness was about to change.

Stu, Gary, and Sheilagh converged at the QE II Botanic Park at 0900 h when the park entrance gate was to be unlocked.

¹ This story will serve as an account of these events in the archives of the Blue Iguana Recovery Program.



FRED BURTON

This photograph was taken as Fred Burton and John Marotta entered the main facility pen area. Eldemire (lower left) is lying on his side, his left leg missing; Jessica (upper right) lies motionless although still alive.

They drove down the road leading to the facility, parked, and, once the gate to the old wire-fenced cages and the gate leading into the large pen area were unlocked as customary, they began a walk-around to check on the iguanas.

At 0910 h, John's cell phone rang; caller ID indicated it was Gary. The call could only be one of a few things, John thought to himself, either Gary couldn't join the team today, a key to the facility gates was lost, or the iguana food he had collected the day before couldn't be found. What John wasn't prepared for was the tone of Gary's question and what followed: "*Does Eldemire have bead tags?*" A pause, then: "*Eldemire is out of his pen and dead.*" Before the words could be fully fathomed, John instinctively asked if any other iguanas had been injured. In the background, he could not quite make out what Stu was telling Gary, but he realized then that something insanely wrong had occurred. After a slight delay, Gary said: "*Jessica is out of her pen and injured, and Sara is dead.*" It was enough for John; he blasted out the door heading to the facility. John was aware that Fred's car was in for repairs and knew he'd have to detour to pick him up.

Gary then called Fred. Fred struggled to hear the soft-spoken clipped South African accent, but what got Fred's attention were the words: "*We've got a problem.*" Gary continued his update in a state of shock as he, Stu, and Sheilagh walked the facility, uncovering the enormity of the situation.

Fred knew he had to get to the facility quickly but he was without a car. The phone rang almost immediately; it was John saying he'd be there momentarily. As they drove toward the park, Fred called Mat Cottam of the Department of Environment to inform him of the horror and to discuss who needed to be alerted immediately. Unable to concentrate as they made their way through traffic, Fred left that for Mat to decide.

By the time they arrived, Carl Edwards from the Department of Environment Enforcement Office was already there. Fred and John made their way into the facility, already engulfed in emotion and working hard to get their heads around the scene. As they neared the main area, John recalled looking between the slats of the facility fence and seeing a large male Blue lying on its side with his left rear leg missing. Not far away was Jessica. John quickly recognized the large male as Eldemire. Over the past three years, John had taken a special liking to this iguana with his gnarly old-man looks and missing spines. Something special about his appearance and demeanor had captured John's heart.

By the time Fred, John, and Carl arrived, Gary and Stu had completed their inspection of the grounds and had a tally of fatalities, injured, and missing. Fred transcribed the list into his notebook. Sheilagh had taken it upon herself earlier to break away to feed and water the iguanas. Despite the mayhem surrounding her, she worked silently in background taking care of what needed to be done.

Fred, John, and the others walked the grounds taking in the unimaginable horror as well as anyone could. Eldemire, Sara, Yellow, and Digger were dead. Pedro's entrails were found just outside the entrance to his pen; his body was missing. Jessica was clearly injured, although she was alert and able to walk. She was carefully moved back into her pen. Billy, appearing disoriented, had sustained a huge gash on his right front leg and had a large hematoma over his right rib cage. Deborah, Billy's mate was first thought to be missing, but an intensive search revealed that she was underground nesting. Archie was beaten and almost unconscious. All but Eldemire, Jessica, and Pedro were found in their pens.



FRED BURTON

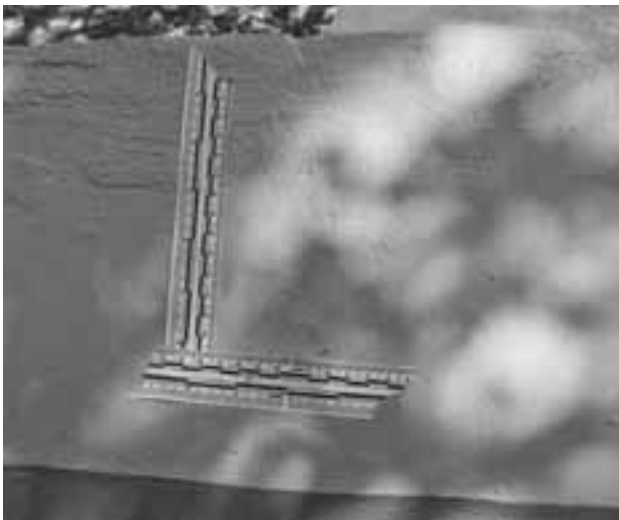
Billy stationary in his pen with a large gash on his right front leg.

The slaughter of the captive Blues immediately raised fears that the free-ranging Blues in the Park may have been hit as well. The search began. Biter, whose retreat is located next to the fence outside of Sara's pen, was okay. Mad Max Too was okay. One by one, each animal was found and all were healthy.

While John continued his inspection, Fred took the opportunity to text-message me with the news and to update Mat, who had been working feverishly contacting others on the island. Shortly, Dr. Colin Wakelin, Department of Agriculture Veterinarian, Gina Ebanks, Director of Environment, Mat Cottam, Senior Research Officer for the Department of Environment, Carla Reid, Chair of the National Trust for the Cayman Islands, and a forensic team from the Royal Cayman Islands Police arrived at the scene.

Dr. Wakelin immediately began suturing the gash in Billy's leg. He then examined Jessica, who at that moment appeared hurt but not seriously injured. Dr. Wakelin advised Fred to keep a close watch on her condition and notify him immediately should her condition change. Next he examined Archie, advising that he also be monitored closely. Aside from Eldemire and Billy, the rest had no obvious external signs of injury. The speculation was that all of the affected animals had suffered internal injuries either from being stepped on or beaten. This raised the question of how many other captive iguanas had been brutalized and had yet to display any symptoms.

I was deeply entrenched in photo editing when the phone chimed to alert me of a text message. The screen read: Fred Burton: "The dead list... Eldemire. Sara. Digger. Yellow. Pedro. What can I say..." Confused, I messaged back to Fred: "What dead list???" Knowing my reply would take time to reach him, I returned to editing, but the oddness of Fred's message made me review it again. At that point, I realized that I had received three messages and had only read the last. The first message sent at 0913 h PST read: "Juan, we have a catastrophe at the facility. Four igs are dead. Police are on the case. Looks clearly like human agency. We are all in shock and still s..." The message was cut off and followed by a second garbled message: "?? ?G=" In alarm, I messaged back: "Oh Crap I just read the previous messages." Then I immediately dialed his cell. In a matter of seconds, I was



Crime scene evidence markers.

getting a complete rundown on what had happened. Fred was having a difficult time as he spoke and was noticeably shaken, as was I listening to the account of the carnage. As with all things Blue, I let Fred know that whatever support he needed, the IRCF was standing by. He requested that we get the news out as well as we could. Distressed, I sent out the broadcast messages. Sandy and I then began to prepare and organize for the firestorm that was sure to follow.

As the police and Department of Environment enforcement people took control of the crime scene, Fred and the others gathered under the visitors' tent in the main compound. Talk centered around how best to handle the media. Fred had been taking photographs for potential use in the investigation since he'd arrived on the scene; some of those and others he was yet to take would meet the media requirements.

John and Fred struggled to decide which of them should call Sam; it had to be done and both knew it would hit her hard. In the end, John made the call. Sam's downstairs phone rang some time after 1100 h. Sensing that the call might be important, she made her way down the stairs in a race with the answering machine. She didn't make it. The caller ID indicated it was John. Not unusual for him to call given the small size of the team. She hit redial.

John answered and came right to the point: "I'm at the Park. Someone hit the captive facility and some of the animals are dead." Sam flashed on Digger and she prayed his name wouldn't be mentioned. John continued: "Yellow, Sara, and Eldemire are dead. Pedro is dead," a pause... "Digger is dead." The news pierced her heart.

As she drove toward the park, she recalls her mood being fatalistic. Concerned that she'd have an accident in her haste to get to Digger, she was hoping all the time that this was some



FRED BURTON

Samantha Hicks in a cherished moment with Digger.

huge mistake. She arrived before noon. As she made her way to Digger, Stu and Gary followed. By this time both of them were mentally fatigued and emotionally drained, but their concern for Sam took precedence. Coming to terms with the fact that the iguanas were gone was hard, and Sam needed proof — which came all too quickly.

For a time, Sam crouched next to the pen wall devastated, weeping uncontrollably — but she needed to be closer. Asking the attending policeman for permission and without waiting for an answer, she jumped the wall. She recalls Digger being hot, not looking broken but not right, not a mess but certainly the lifeless body was not Digger anymore. She recalls: *“If I ever needed affirmation that such a thing as a soul exists, there it was. I crouched over this animal that I had spent so many hours with and I knew that were it not for the location and the unassailable circumstances, I would have never known him to be Digger. The particular cheeky slant to his eyes was hidden because he had squeezed them tightly shut, he looked too big and his body too long, so I suppose in life he had carried himself tall, but there is no great surprise there.”* She stayed with him clutched gently in her arms.

Once the police had finished gathering the forensics, the bodies were moved to the tent for a more thorough examination. When Dr. Wakelin completed his work, he handed the four bodies over to a policewoman for transport; they would be X-rayed and then placed in cold storage. Dr. Wakelin left the park shortly thereafter.

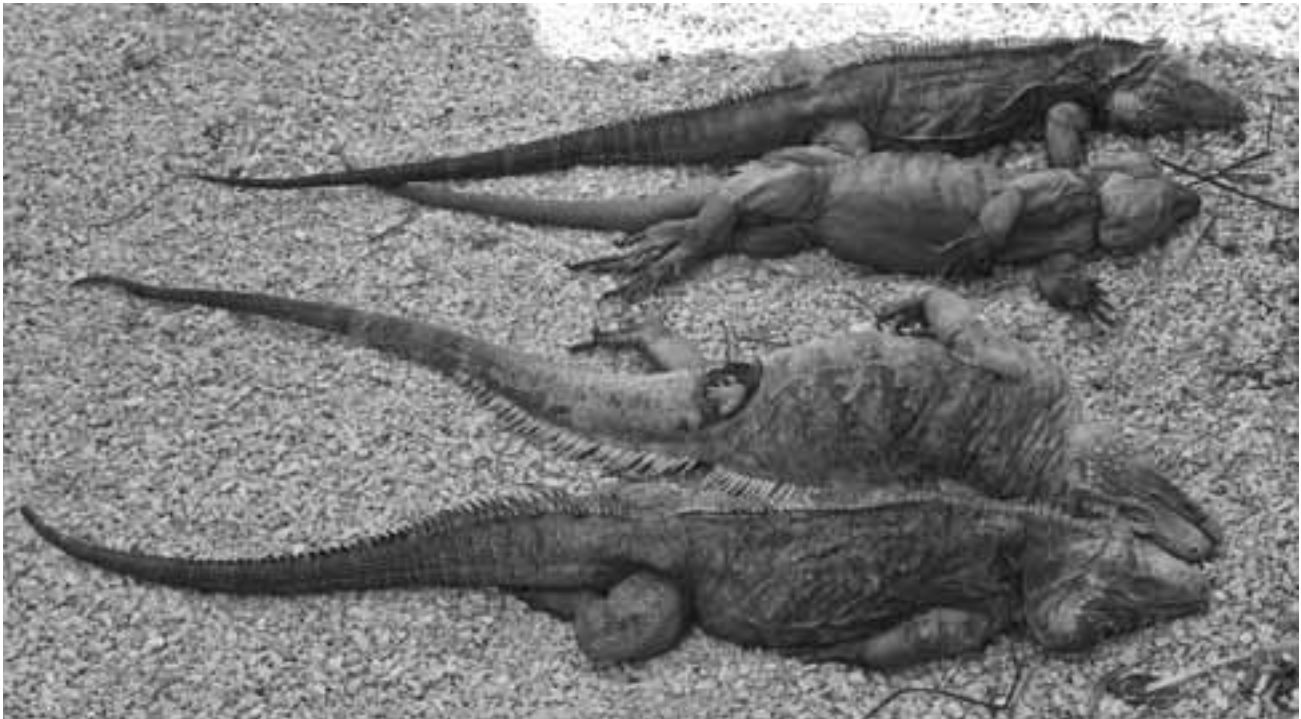
By this time John had resumed caring for the Blues; less burdened thanks to Sheilagh’s earlier efforts, he had more time to monitor health status and look for signs that any of the others had been injured. John noted that Matthias was acting mildly sluggish, possibly due to the weather, but since he was up in his tree he couldn’t have been seriously injured.

Fred called Carol Winker of the *Caymanian Compass* to break the news. He then made his way back to check on Jessica. She had stopped responding to touch, and her breathing was shallow. Fred then realized she was mortally wounded. Carol arrived about the same time. Fred was on the phone with Dr. Wakelin preparing to transport Jessica to his office; Carol snapped the shot. Carol’s front-page story and photograph of Fred on the phone with his hand on Jessica was the beginning of the weeklong media frenzy of front-page news and radio broadcasts as the Associated Press distributed the news to the worldwide media.

Jessica was lying on the clinic table as Dr. Wakelin did everything he could to bring her back, but it was hopeless. How she survived for as long as she did was anyone’s guess. The decision was made to let her live her last hours away from the clinic, and no place was more appropriate than Fred’s home. I received a message from him shortly thereafter: *“Jessica is now fading. The vet has done all he can with Bonnie’s² advice. She is on my lap with minimal life signs only.”* Jessica’s final moments were witnessed by a small group of people who stopped by Fred’s house. Present were Luigi Moxam, One-345 clothing line, Selita Ebanks, a Caymanian supermodel, Orneil Galbraith, a former BIRP warden, and Team Blue volunteer Clara Lawrence. By day’s end, the death toll had risen to six.

By Monday morning (5 May), news of the murders was spreading like wildfire. After a sleepless night, Fred was up early. The phone was ringing, and incoming email already numbered in the hundreds, just as it did for us in California. Sam arrived

² Bonnie Raphael, DVM, Dipl. ACZM, Senior Veterinarian, Global Health Programs, Wildlife Conservation Society, Bronx, New York.



FRED BURTON

After the initial crime scene investigation was completed, the bodies of the four Blues were moved under the tour tent prior to being transported for radiographs. From the top, Yellow, Sara, Eldemire, and Digger.

to relieve Fred so he could address official matters from law enforcement and government officials.

Sam established her workspace in the corner of Fred's office that came equipped with an outdated and temperamental PC, which I replaced when I arrived with one of Fred's upgraded computers that I had serviced. Another makeshift table was assembled in the middle of the room to act as central depository for printouts and other documents that would be needed. With a phone in place, her workstation neatly organized and com-



COURTESY OF THE CAYMAN FREE PRESS

Fred Burton on the phone with Dr. Colin Wakelin discussing Jessica's declining health.

puter humming, she began what would be a weeklong nightmarish test of every administrative skill imaginable under conditions for which none of us were prepared. Throughout the crisis, Sam did as Sam does; she entrenched herself, focused unemotionally, and met the challenges that under normal circumstances would have taken an office full of people to manage.

Park security, at a level no one had ever imagined necessary, was an immediate concern to ensure that the perpetrators would not hit again. The Blue program operates meagerly on funds derived from local and international contributions, and relies heavily on a volunteer base. No funds existed for any level of security. So, John, Fred, and volunteers from BIRP and the National Trust for the Cayman Islands took it upon themselves to guard the facility until a solution could be found.

John was up early and slept no better than the rest of us. With emotions high and a growing anger, he still had to manage the facility's daily operation. The work was complicated by having to monitor all the iguanas for possible signs of injury, as well as by the almost constant barrage of interruptions from police inspectors, Department of Environment personnel, and the press — but, like all others committed to the program, he reached deep and found the inner strength to expertly manage the task.

In California, we too were deluged with incoming email and phone calls. Of paramount importance was the creation of a new section on the Blue Iguana website to centralize and disseminate information on the unfolding story. Offers of assistance and donations, as well as letters of condolence for the fallen, started pouring in from around the world. Ironically, this outpouring provided



DR. IMAT DIACOSTA COTTAM

Dr. Colin Wakelin, Department of Agriculture Veterinarian, gives artificial respiration to Jessica as Fred Burton looks on. At this time, Jessica was fading and not responding to care.

confirmation that our years of effort to bring attention to the plight of the Blues had been successful. People obviously cared, but what a horrible price to pay for such attention.

Sarah Agnolin and a group of her friends were exploring some of Grand Cayman's caves near the Park when she received a call from one of her coworkers at the Ritz-Carlton tearfully informing her of the murders. Sarah works for the Ritz-Carlton's Ambassadors of the Environment program taking children and adults to visit the Blue facility as a part of their program. In her free time, she and other naturalists from the Ritz, like Kirsten Werner and Taya Maki, regularly volunteer at the facility. She called John to get more details on what had happened and to offer assistance. Over the days to follow, the girls from the Ritz dedicated every available hour to assisting John. However, their largest contribution to the crisis was a parallel fundraising effort. Sarah and her colleague Kurt Christian conceived, negotiated, and set up donation tables outside Grand Cayman's busiest stores with the goal of collecting \$3,000. With 50 volunteers and tables with nothing more than 5-gallon plastic water jugs with taped-on labels, they reached their goal the first day and, after three days, had amassed over \$16,000 in walk-by donations. The news had deeply touched and outraged everyone on the island from top government officials to the old folks on the East End, and everyone wanted to help.

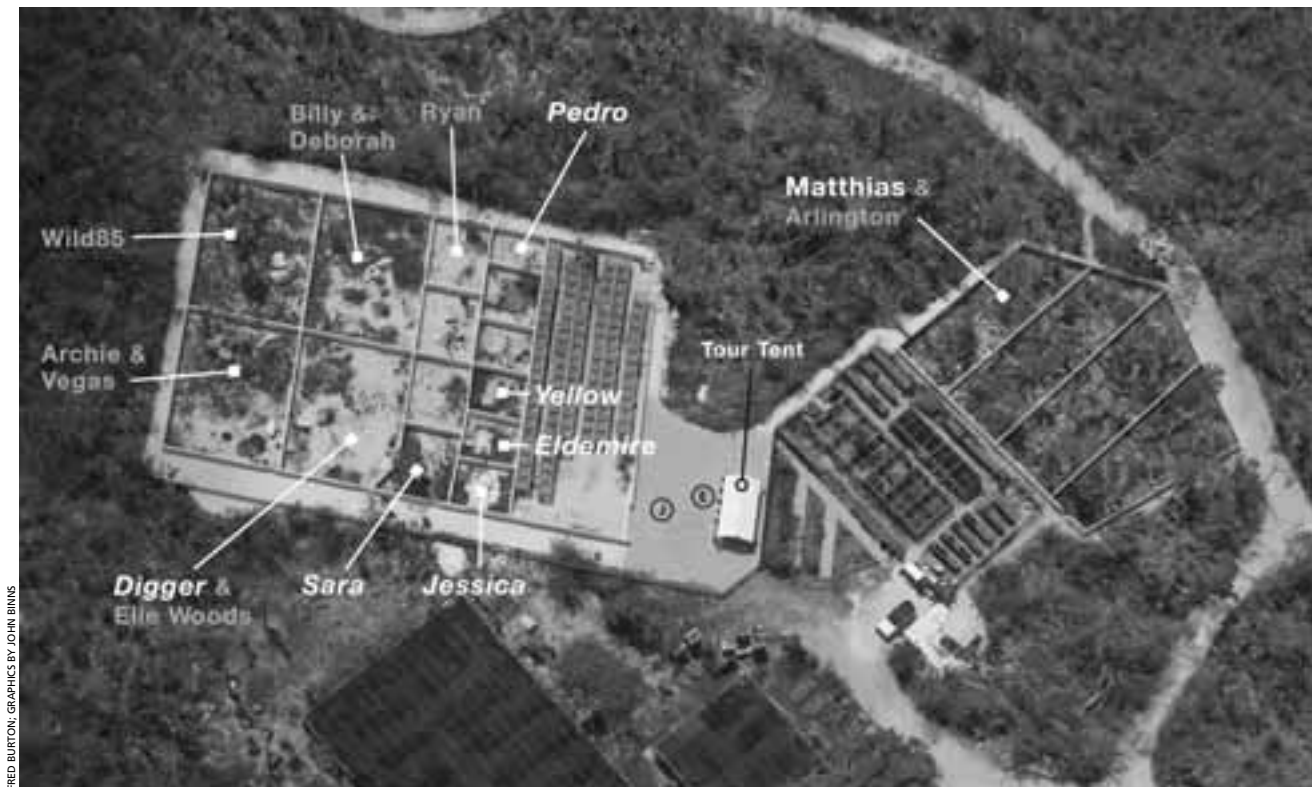
Behind the scenes, the police and other enforcement officials were working feverishly to put together the pieces of the crime. To facilitate identification of the perpetrators, talk of creating a reward quickly gained support. By the end of Monday, enough funds had been secured to target the reward at CI \$10,000. Crime Stoppers would handle the promotion, and

local security companies were offering to install security systems at the facility and in the Park.

On Tuesday (6 May), the Blue Team hit the ground running, operating at full efficiency. John had the security watch at the facility the night before, but was nevertheless up at first light. At the top of John's priority list was checking on Billy, Archie, and Matthias. He and Fred were closely monitoring any new symptoms or signs of health issues. Female Blues were laying their eggs about a month early, which also would have an impact on his schedule.

Fred was tireless. He was interviewed for four different morning shows prior to attending the autopsies conducted by Dr. Wakelin at the St. Matthew's Veterinary School's facility at Lower Valley. At days end, Fred's final email to me read: "*Nuts here too, Juan, I am so exhausted I am about to drop. Four different shows in the morning, the autopsy, on Radio Cayman after that, back to the Park, and on the phone since I got home. I am humbled by the effort that others are putting in at the same time, yourselves included, Sam, John, the National Trust, Department of Environment, and the community at large. I'm going to have to close down, shower, go out for some food, and a quiet drink to plan the burial ceremony. I simply can't keep focused without something a little restful and a decent night's sleep, perhaps. Thanks SO much Juan. Fred.*"

On Wednesday (7 May), John arrived early at the Park. To save time, he decided to take the shortest route and check on Matthias before checking the others. He found Matthias dead in his retreat; he had died sometime during the night. John had reached his breaking point. His eyes welled with tears of rage, angered that anyone could conceive and carry out such a hideous crime on such magnificent and unique creatures. The



FRED BURTON; GRAPHICS BY JOHN BINNS

Aerial photograph identifying pen locations for the dead and those that survived. The circle "E" marks the location where Eldemire was found, and circle "J" where Jessica lay when the murders were discovered.

death toll was now at seven. He composed himself before calling Fred.

With the news of Matthias, and fearing that Archie and Billy's condition might decline, Fred called Dr. Bonnie Raphael, Senior Veterinarian, Global Health Programs at the Wildlife Conservation Society (WCS) in Bronx, New York to ask for emergency veterinary assistance. That afternoon, Fred gathered with others at the Department of Environment to attend a debriefing on the autopsies. Results indicated that besides humans, canines were involved, adding to the horror to which these poor creatures had been subjected. The decision was made to keep information specific to the investigation from the media and the public at large.

News of the murders reached Dr. Stephanie James, Senior Veterinarian, Global Health Programs, WCS, who recalls staring at the message for five minutes wondering how something so awful could happen. Over the next few days, treating gorillas, frogs, deer, and pheasants, she monitored what was unfolding in Grand Cayman. The news of Matthias' death reached Dr. James in the midst of packing for a trip to Anegada, British Virgin Islands, to perform health assessments on pre-release captive Anegada Iguanas at the headstarting facility. Dr. Raphael asked her if she would be willing to travel to Grand Cayman to assist with Billy and Archie. She agreed without a moment's hesitation and immediately began working on necessary paperwork. To practice veterinary medicine in the Cayman Islands, she needed to be licensed, requiring approval from the Department of Agriculture and the Cayman Islands Veterinary Board. In Grand Cayman, the senior government officers present took exceptional steps to facilitate the request so that she could start work on Billy and Archie as soon as she arrived. Within six hours of the initial call, she had her license, a process that normally takes weeks. She packed for the unknown (antibiotics, fluids, analgesics, vitamins, syringes, a blood gas analyzer, and other potentially useful supplies), and she was scheduled on the first flight out of JFK the next morning.

Later that same afternoon, Fred went to the Park, and, with the help of John and Cameron Richardson, a regular volunteer, carefully captured Billy and Archie so they could be taken to St. Matthew's Veterinary School for radiographs. Knowing Dr. James was due to arrive the next day, he subsequently took Billy and Archie home, which would better facilitate and expedite Dr. James' examination and minimize the stress imposed on the iguanas.

Fred called that evening to ask if Sandy and I would travel to Grand Cayman to attend the burial tentatively scheduled for 11 May, and to assist with the crisis. We agreed. Giles Shaxted, Sam's partner, worked miracles organizing flight arrangements, and securing free lodging for us at Compass Point Dive Resort and Ocean Frontiers Diving, East End, Grand Cayman. The next day and a half was a blur as we made arrangements to leave.

By Thursday (8 May), news of the murders had gained international attention and it dominated the news in Grand Cayman. The influx of condolences, offers of assistance, Blue sponsorships, and contributions were reaching epic proportions. The team was completely inundated trying to respond. Things were no different for John at the Park. The Department of Environment enforcement and police inspectors again were

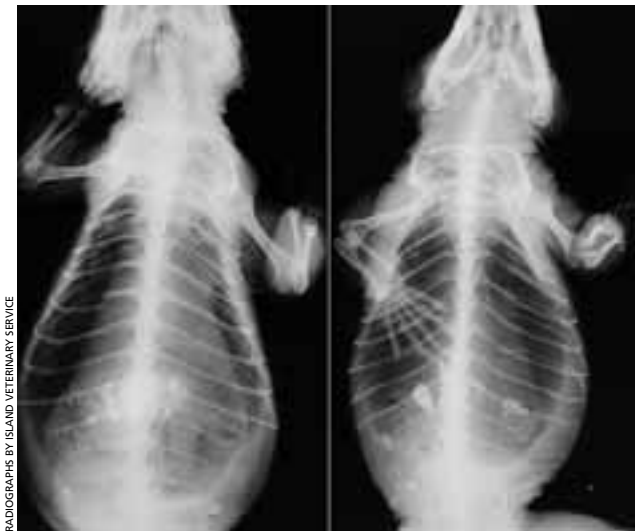


The circle marks the area in which Pedro's remains were found.

looking for any evidence they may have missed. At about 1130 h, they left and Stu arrived to catch up on any developing news and to give John a hand.

At noon, John received a call from Carl Edwards, Department of Environment Enforcement; "*I think we have found Pedro, and I need you to come take a look.*" John and Stu followed Carl's directions. Along the Botanic Park road leading to the Park's entrance is a rather obscure side road that leads to a group of three homes. As they arrived, they saw Carl, police, and other investigators standing near what appeared to be a dead Blue Iguana in the apron of the driveway. What was odd about the location was that a police officer had been there the day before asking questions, and he could not have missed seeing a dead iguana. They had returned only to ensure that no details had been overlooked in the investigation. The body was decomposing. John recalls that the body appeared to have been skinned rather than torn by a dog or other animal. He scanned the remains with a PIT-tag reader even though the tissue where the tag is routinely placed was missing — no ID response was obtained. Then John noticed the right eye had burst. Pedro suffered from a thinning cornea in the right eye, leading to the tentative assumption that this was Pedro. At that point, Carl took the remains to the Department of Agriculture for examination and identification. Later, Fred confirmed that the remains were those of Pedro by using photographs to identify Pedro's unique scale pattern.

Dr. James arrived at noon and was escorted quickly through Customs with the help of an employee from the Department of Agriculture. She and Fred immediately headed to the house to evaluate Billy and Archie. The radiographs taken by Dr. Elisabeth Broussard, veterinarian, Island Veterinary Service, the day before demonstrated that Billy had fractured ribs and Archie had fluid in his lungs. The physical exam and blood work indicated that both iguanas had some internal bleeding, but whether the bleeding was into the lungs or the coelomic cavity was unclear. Dr. James considered the factors needed to develop a treatment plan. Both iguanas were large breeding males unaccustomed to being handled; both had internal bleeding and muscle trauma, so handling would have to be minimized. Such severe injuries required heat to help the iguanas metabolize some of the



RADIOGRAPHS BY ISLAND VETERINARY SERVICE

Radiographs of Billy (left) and Archie that Dr. Stephanie James reviewed at Fred's house after her arrival.



Dr. Stephanie James, Senior Veterinarian at WCS Wildlife Health Services (right) and Dr. Elisabeth Broussard discuss treatment procedures for Billy and Archie.



Dr. Stephanie James injects fluids into the posterior flank of Billy, while Dr. Elisabeth Broussard injects other meds into his left front leg.

toxic by-products of the trauma, minimize their stress levels, and allow their immune systems to function optimally. Dr. James and Fred discussed the cases and decided Billy and Archie should be placed back in their pens. Being in their established territories would reduce stress and allow them to thermoregulate, which would facilitate immune functions.

Once husbandry was decided, a treatment regimen was determined. Pain medications, antibiotics, and vitamins could be administered orally, but oral medication could disturb their normal gastrointestinal flora and curb eating habits. If the iguanas stopped eating, determining if anorexia was attributable to worsening conditions or because they didn't like the taste of medication in the food would be difficult. Also, because iguanas don't like to soak and rarely drink, increasing their fluid intake would be problematic. The decision was made to manually restrain them every three days and administer the treatments. Billy and Archie received their initial treatment and were moved back to their pens.

Later that afternoon, Fred and Dr. James went to St. Matthew's Veterinary facility to examine and review details of the autopsies. Some of the post-mortem samples would have to be sent to the U.S. for further forensic evaluation. *Cyclura lewisi* are protected under CITES Appendix I, which meant Dr. James had a mountain of paperwork ahead of her to obtain the necessary permits, all of which needed to be completed before she departed in



Dr. Stephanie James working on obtaining CITES permits for export/import of forensic materials.



Vials containing samples of the remains that were exported for further examination.

less than a week. Fred was on the phone contacting the Cayman Island officials, and Dr. James contacted WCS so they could start filing paperwork for exporting/importing the samples. Within 48 hours, the CITES export permit was delivered to Fred's door as a document from the U.S. Fish and Wildlife Service allowing the samples to be brought into the U.S.

By Friday (9 May), responding to the aftermath of the crisis had become routine. Sandy and I were airborne when Fred



Dr. Caroline McKinney, St. Matthew's Veterinary School (left), Fred Burton, Dr. Stephanie James, and Shana Chin, Scientific Assistant, Cayman Islands Department of Agriculture preparing samples for export and crosschecking the Chain of Custody forms for each of the samples.



The crisis center in Fred Burton's home office. Samantha Hicks (far left) and John and Sandy Binns work to respond to the barrage of incoming correspondence and website updates.

learned that the remains of the seven could not be buried and would have to remain in cold storage as potential evidence for any legal proceeding. John Marotta continued his vigilant monitoring of Billy and Archie, both of whom appeared to be responding to the treatment, and began to focus his efforts on the females who were already or about to begin nesting. Fred remained preoccupied with the criminal investigation, media, and incoming contributions. Dr. James visited the facility to monitor treatment, and worked on obtaining the CITES permits. Sam, and now Sandy and I, worked to keep the website updated and to respond to contributions both in the Cayman Islands and in the U.S. Enforcement continued their investigation.

From Friday until I left the island on 20 May, the daily routine remained constant. Sandy left for home on the 13th after reaching a point where remaining didn't make sense, and my efforts became divided between assisting Fred, Sam, or John and working on photographic assignments for the Program. Dr. James continued treating Billy and Archie until she left on 14 May, handing the responsibility to Dr. Elisabeth Broussard, who continued the treatment every three days until completion. Billy and Archie have largely recovered and continue to improve. As the days passed, our focus shifted to the nesting females. Nests had to be excavated and eggs gathered.



John Marotta (back), Sarah Agnolin (left), Rachel Hamilton (center), and Kirstyn Werner (right); the latter three naturalists, who work as Ambassadors of the Environment at the Ritz Carlton (by Jean-Michel Cousteau), worked for days looking for Deborah's nest chamber. This was Billy's first successful mating.



John Marotta loading freshly collected eggs into a box for incubation.



While Fred Burton searches for Vegas's nest, Archie looks on inquisitively. Archie had already been receiving treatment for over a week when this photograph was taken, and he was clearly regaining mobility in his severely injured rear left leg.

One act of insanity killed 17.5% of our captive adults. The Program is extremely fortunate that the seven lost iguanas had produced large numbers of offspring and are well represented genetically. One heartbreaking note is that we had already been discussing the release of these individuals. They had served the program well, and were largely responsible for helping to replen-



The name signs for Pedro, Digger, and Sara that once adorned their pens, later moved to the facility shed.

ish the population. It only seemed right, the royalty that they were, that they should live their remaining years free in the kingdom we are working so hard to protect.

This heinous crime and the loss of these animals have scarred the fiber of our souls. None will be forgotten, and each will be cherished and remembered for the special creatures they were. Rest in Peace.

Acknowledgements

Thanks to my wife, Sandy Binns, for her constant support and encouragement. I am grateful and thank those who contributed information for this story: Fred Burton, John Marotta, Samantha Hicks, Dr. Stephanie James, and Sarah Agnolin. Thanks also to Giles Shaxted for his assistance in providing our accommodations, and to the Compass Point Dive Resort and Ocean Frontiers Diving East End, Grand Cayman, which supplied wonderful accommodations during our 11-day stay. I commend and thank Team Blue volunteers: Stu Petch, Gary Redfern, Sheilagh Rickford, Kirstyn Werner, Rachel Hamilton, and all Team Blue volunteers who make this Program possible. Thanks to the doctors who gave their full support during this crisis: Dr. Colin Wakelin, Dr. Elisabeth Broussard, Dr. Caroline McKinney, and Dr. Stephanie James; Shana Chin for her efforts and assistance with the export samples; Island Veterinary Service for radiographs; the organizations that continue to support the efforts of the Blue Iguana Recovery Program: National Trust for the Cayman Islands, The Department of the Environment, The Department of Agriculture for the Cayman Islands, and St. Matthew's Veterinary School, and the Wildlife Conservation Society. Thanks also to AJ Gutman and Bob Powell for their review and comments.

In Memory of the Seven Blues

Samantha Hicks

Blue Iguana Recovery Program



JOHN BINNS

Sara's service to the Program began in 1992. She had been caught in the East End as a youngster several years before and we estimate that she was born in 1985. Sara was the first founder female in the Program and had bred successfully with many males, producing 49 young. She was the Grand Dame of the captive facility. Dignified and self-contained, she was never aggressive yet never overtly friendly, just warily tolerant of our presence. Sara's contribution to the Program and the survival of her species was invaluable. She was digging a nest when she was set upon and beaten to death.



JOHN BINNS

Jessica, born in 1993, was the daughter of Sara and Zadok. Like her brother Pedro, she developed minor eye problems that rendered her a little slower than most iguanas. This factor added to the impression that she was the gentlest and sweetest of creatures. She bred successfully with Daniel and Digger and produced 23 young. She was always ready for attention and very responsive to voices, making her an easy target for her attackers. Jessica somehow managed to survive the initial attack and fought for her life for over 24 hours before she succumbed.



SAMANTHA HICKS

Eldemire was born to Mr. Blue and QE in 1990. He was a big beast, but gentle, easily identifiable by the underbite that showed off his sharp upper teeth, ironic for such a meek soul. With his long dorsal spines and gargoyle-like features, Eldemire looked like a scraggly old man and never failed to attract attention from touring visitors. Although not filled with machismo like his younger brother Digger, Eldemire did sire five young with Sara in 1995. He was dignified despite his peculiarities, and had warmed to humans in recent years, unfortunately making him all the easier to target. Eldemire's remains were mutilated and discarded.



CRAIG FELKE

Digger touched thousands of people's lives. He was naturally friendly and was our greatest ambassador. He was born in 1994, the offspring of Mr. Blue and QE. His first keepers named him Digger because he used to dig into a plant pot in his cage and hide from them. Digger was the most loving and inquisitive iguana; he would do almost anything for anybody, especially if there was a flower or a Noni fruit involved in the bargain. His great love for people likely contributed to his death. Rather than being afraid of strangers with evil intent, he probably welcomed their company.



SAMANTHA HICKS

Pedro was the son of Sara and brother to Jessica and was born in 1993. Pedro was a crowd pleaser. He was capable of flushing up to the most vivid and beautiful shades of blue, so that one of the most common comments made about him was that he didn't look real. Like Jessica, he had minor eye issues. He adored being stroked. He was totally unable to defend himself and completely unprepared for violence from trusted human beings. Pedro was very proudly sponsored by Kenrick Webster and was such a gentle role model for his species that he was chosen to meet The Earl of Wessex on his last visit.



SAMANTHA HICKS

Matthias didn't succumb to his terrible injuries for several days, behavior typical of this proud little Blue. Matthias was larger than life and we would have been interested in seeing if he would have achieved great physical size; born in 2001, at seven years he was a mere youngster and should have had at least 60 more years to grow. Son of Nathaniel and Ruth, Matthias was very handsome, a perfectly formed animal with a row of very neat spines and a bright blue flush. He appeared to know his own worth and cockily taunted much larger iguanas from inside his earlier wire enclosure. He spent many happy hours dangling his legs from his favorite perch on a Smokewood branch.



FRED BURTON

Yellow was our movie star and cover boy. He was born to Dempster and a wild male in 1995. His eager and sometimes rather aggressive style earned him the Botanic Park's southern kingdom, where he dominated 35 acres, intersecting with the territories of six females, until he was deposed by Forrest in 2004–5. His favorite mate, Sapphire, used to walk far from her territory to visit him, but he fell on hard times as a King-in-Exile, and was eventually returned to the captive facility for a chance to recuperate. He was just beginning to look like his former self when his life was violently ended. We like to think that he has joined Sapphire, who was taken from us by dogs in 2006.



SHANNON TOMPKINS, HOUSTON CHRONICLE

Diamondback Terrapins (*Malaclemys terrapin*) in a crab trap.

Terrapins in the Stew

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Imagine for a moment an animal species whose very existence threatened our survival. What would we be willing to do? One consideration would certainly be to control its numbers, possibly even to ponder its extermination. Perhaps we would embark upon a crusade to eliminate every last individual, conceivably starting with females so no more would be created. What kind of animal might fall into this category? Something big and scary with large teeth or claws and a ravenous hunger would do. A creature with a propensity for insensate carnage and destruction might also fit the bill. Perhaps at times in the dim past such creatures may have existed, or at least creatures that were thus perceived. However, humans now determine the destiny of the world, and this niche is rarely occupied. Tigers, sharks, crocodiles, and the like might have fallen into this category, but only rarely and in very specific times and places. One animal that would definitely not be considered threatening is a turtle. Unlike the rest of the reptilian clan, people are almost universally fond of turtles.

Yet a campaign is afoot to eliminate the inoffensive Diamondback Terrapin (*Malaclemys terrapin*). Sure, you wouldn't want to intentionally place a finger in a terrapin's mouth as it could give a nasty bite, but this would be the same with almost any animal. Nevertheless, the terrapin is being subjected to a campaign of systematic extermination. Traps take terrapins along with crabs. The same traps, when lost or discarded, continue to remove adults indiscriminately. Roadways built along or through marshes unequally target reproductive females by mimicking nesting grounds. Unsustainable take for markets and by-catch

severely decimate numbers. Hits by boat propellers, habitat loss, shoreline and coastal development, pollution, and predation also take their toll.

In order to address these concerns, we need to answer two simple questions: (1) Is present legislation for the protection of these turtles based on an adequate knowledge of terrapins' biological needs? (2) Can anything be done by either state or national governments to check the extermination of terrapins? These questions were posed, not in a magazine article, but in a government publication, "The Natural History and Cultivation of the Diamond-back Terrapin" by Coker in 1906. We haven't progressed very far since then.

Carl Hiaasen (2006; reprinted in *IGUANA* 13(2): 154–155) eloquently framed the problem regarding Gopher Tortoises and developers permitted to bury them if willing to pay a price, "If your kids asked to bury a small animal alive, you'd be horrified. You'd tell them that's an awful thing and that they ought to be ashamed. Most children wouldn't dream of doing it, of course, because they know what's wrong and what's right. Unfortunately, they don't make the rules." Although we don't bury terrapins, we might as well.

Diamondback Terrapins are unique. The word terrapin often is used to refer to a variety of North American aquatic turtles, but especially the genus *Malaclemys* — the Diamondback Terrapin. Diamondback refers to the conspicuous ridges on the scutes of the carapace. The etymology of *Malaclemys* has been lost over the years, with possible translations of "Mali" range from bad, to soft, to soft heads, to soft prey, none of which are convincing. The Greek word for chelonian gives rise to "clemmys," and "terrapin" is a derivation of torope, from the Virginia Algonquian tongue. John White first illustrated this turtle in watercolor around 1585 (Lorant 1946). A terrapin also was pictured in "Their Manner of Fishing in Virginia" (Plate XIII, Incolarum Virginiae piscandratio) in de Bry's *India Occidentalis* (1590). The Diamondback Terrapin was formally described for science by Schoepff (1792–1801) as *Testudo terrapin* (in "Tab. XV").

Diamondback Terrapins tolerate a wide range of salinity, although they are most commonly found in brackish environments. Oddly enough, unlike sea turtles, which also are found in saltwater, terrapins are thought to drink only fresh water. Found from Massachusetts to Texas, seven subspecies are currently recognized. Nesting takes place multiple times a year in warmer portions of their range and only once annually near the northern limits. Some variation occurs, with some Georgia terrapins nesting less frequently than their New Jersey brethren.

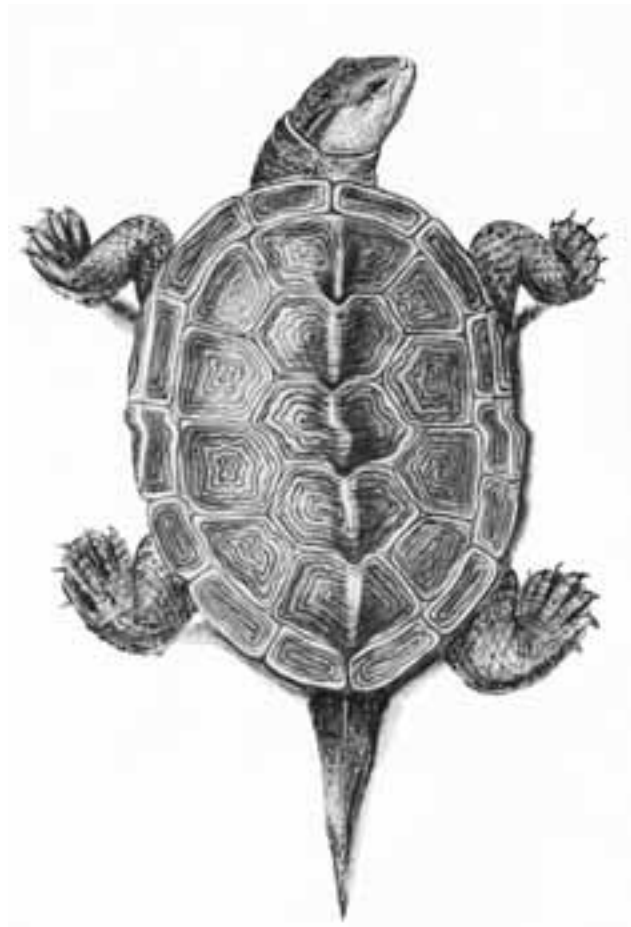


BRIAN K. MEALEY, INSTITUTE OF WILDLIFE SCIENCES

Diamondback Terrapins (*Malaclemys terrapin*) are suffering from overharvesting and inadvertent mortality.



Schoepff's *Testudo terrapin* Tab. XV (1792–1801; above); White's terrapin (~1585; above right), and de Bry's "Their Manner of Fishing in Virginia" (1590; right). Note the terrapin in the water below the canoe in the latter image.



Female *Malaclemys* are larger than males. The species exhibits temperature dependent sex determination (TSD).

The origin of this species is uncertain, but most authorities believe that it evolved from Map Turtles (*Graptemys*) or from a common ancestor shared with *Graptemys* (Dobie 1981, Lamb and Ostentoski 1997, Wood 1977).

Terrapins appear in myriad folktales (usually as a trickster) from pre-contact Native American legends to Uncle Remus's Brer Terrapin (Brer Tarrypin), who beats Brer Bear in a tug of war by diving underwater with the rope and tying it to a branch (Chandler 1881). Much more recently, in "Time of the Turtle," Jack Rudloe (1979) experiences a run of bad luck after capturing a batch of Diamondback Terrapins. He related a myth prevalent among the local fisherman that terrapins, locally known as "wind turtles," bring ill fortune. He traced the story back to local Native American tribes that regarded terrapins as sacred animals.

Tales tell of terrapins in the Chesapeake being so great in number that slaves and indentured servants complained about the frequency of turtles in their diets. A corollary rumor tells of a law passed by the State of Maryland prohibiting excessive meals of terrapin to said complainants. I have never been able to

find evidence other than old news stories (Anonymous 1892), one of which stated, "In some of the old records of the State



JIM HARDING

Diamondback Terrapins tolerate a wide range of salinity, although they are most commonly found in brackish water.



PHIL ALLMAN

Female terrapins, such as this individual, are larger than males; like many turtles, sex is determined by temperature during incubation.

(Maryland) there were clauses that the slaves should not be fed on terrapin more than three times a week.”

Gourmet Delicacy

Undeniably the terrapin was sufficiently tasty that many never complained about eating too much terrapin. True (1884) wrote, “Philadelphia furnishes the best market for this species, but it is also sold in large numbers in Baltimore, Washington, New York, Boston, Chicago, Pittsburg, Cincinnati, Saint Louis, and many other cities.” He went on to quote a price of up to fifty cents each, quite expensive for the time. The price and harvest continued to rise and, within a few years, approximately 400,000 pounds a year were harvested, representing a value of about \$44,000 (True 1887). Cookbooks from the mid-1800s to the early 1900s confirm the popularity of terrapins. The first of these recipes is from *The White House Cookbook ...* (Gillette et al. 1887).

Stewed Water Turtles, or Terrapins

Select the largest, thickest and fattest, the females being the best; they should be alive when brought from market. Wash and put them alive into boiling water, add a little salt, and boil them until thoroughly done, or from ten to fifteen minutes, after which take off the shell, extract the meat, and remove carefully the sand-bag

and gall; also all the entrails; they are unfit to eat, and are no longer used in cooking terrapins for the best tables. Cut the meat into pieces, and put it into a stewpan with its eggs, and sufficient fresh butter to stew it well. Let it stew till quite hot throughout, keeping the pan carefully covered, that none of the flavor may escape, but shake it over the fire while stewing. In another pan make a sauce of beaten yolk of egg, highly flavored with Madeira or sherry, and powdered nutmeg and mace, a gill of currant jelly, a pinch of cayenne pepper, and salt to taste, enriched with a large lump of fresh butter. Stir this sauce well over the fire, and when it has almost come to a boil take it off. Send the terrapins to the table hot in a covered dish, and the sauce separately in a sauce tureen, to be used by those who like it, and omitted by those who prefer the genuine flavor of the terrapins when simply stewed with butter. This is now the usual mode of dressing terrapins in Maryland, Virginia, and many other parts of the South, and will be found superior to any other. If there are no eggs in the terrapin, “egg balls” may be substituted.



Brer Tarrypin (Chandler, 1881), “Terrafin fishing” (Leslie, 1888).

Stewed Terrapin

Plunge the terrapins alive into boiling water, and let them remain until the sides and lower shell begin to crack — this will take less than an hour; then remove them and let them get cold; take off the shell and outer skin, being careful to save all the blood possible in opening them. If there are eggs in them put them aside in a dish; take all the inside out, and be very careful not to break the gall, which must be immediately removed or it will make the rest bitter. It lies within the liver. Then cut up the liver and all the rest of the terrapin into small pieces, adding the blood and juice that have flowed out in cutting up; add half a pint of water; sprinkle a little flour over them as you place them in the stewpan; let them stew slowly ten minutes, adding salt, black and cayenne pepper, and a very small blade of mace; then add a gill of the best brandy and half a pint of the very best sherry wine; let it simmer over a slow fire very gently. About ten minutes or so, before you are ready to dish them, add half a pint of rich cream, and half a pound of sweet butter, with flour, to prevent boiling; two or three minutes before taking them off the fire peel the eggs carefully and throw them in whole. If there should be no eggs use the yolks of hens' eggs, hard boiled. This recipe is for four terrapins.

The *New York Times* (Anonymous 1891) even recommended terrapins as Lenten fare. For some unfathomable reason, terrapins and turtles to this day are considered “fish” by the Roman Catholic Church — but that really isn't all that surprising. In Maryland statutes, the terrapin also was defined as a “fish” and remains classified as such (Whilden, 2007).

For the next course there is still lobster and terrapin, the former as croquettes and the latter a stew; that is what it is, although the dish is put down simply as terrapin. Terrapin is a very embarrassing dish; it may be a good deal veal, and then arises the question whether terrapin made of veal can be eaten in Lent, or it may be a good deal bone that you cannot eat with or without religious scruples. The bones left in are proof positive that some terrapin is present if you do not get it on your plate. If you add wine to this dish do it gently and economically. Terrapin has too subtle a flavor to be drowned in sherry or Madeira.

Advice for the preparation of Lenten dinners (*New York Times* 1891).

Diamondback Terrapins were so popular as gourmet food from the mid-1800s through the 1920s that wild stocks began to diminish early in the 1900s (Babcock 1926, Finneran 1948, McCauley 1945). The terrapin fishery was able to supply markets initially, but the increasing demand and decreasing numbers of wild terrapins necessitated another solution. Terrapins were popular, not only in the United States, but many were exported to locales including London, Paris, Berlin, Guam, and Cuba. A number even found their way to rubber-rich Manaus in Brazil. The new idea was to establish experimental terrapin “pounds,” primarily in Georgia and North Carolina (Barney 1922; Coker 1906, 1920; Gadow 1901; Hatsel and Hildebrand 1926; Hay 1904; Hildebrand 1929, 1932, 1933). Ironically, most of our early knowledge about the biology of *Malaclemys* came from these farms.

Terrapin probably would have been driven to extinction if not for the one-two punch of the great depression and prohibition. The latter rendered access to sherry (a key ingredient in terrapin stew) almost impossible. Two eminent herpetologists, Archie Carr and Roger Conant, suggested that consumers discovering that the Diamondback Terrapin wasn't orders of magnitude tastier than less expensive turtles and the decreasing availability and increasing cost of household help contributed to the survival of the species (Pritchard 1979).

Gone Fishing

Some (Coker 1951, Hurd et al. 1979) suggested that populations gradually recovered after the heavy exploitation of the terrapin stew boom, and that terrapins were out of the woods — but the reprieve, if indeed it existed, seems to have been fleeting. Once again, wild populations are under intense pressure, this time due to demand from Asian communities in the United States and abroad. This threat is every bit as real as it was around the turn of the 20th century. As demand continues to increase, commercial harvesters are increasing efforts to supply the market. Recent years have seen harvests increase five-fold, while wild populations have dropped to as little as a quarter of their former size. The total take in Maryland for 2006 was reportedly over 10,000 terrapins — a twenty-fold increase over the previous year (Whilden 2007). One Maryland waterman has turned himself into the “terrapin king.” He converted his property into a turtle farm, “breeding tens of thousands of hatchlings for sale as food or pets. We are sending the babies to China — thousands and thousands and thousands,” Lewis said (Pelton 2006). The U.S. Census Bureau even has an industry title for “Terrapin Catching” (NAICS Code 114119; Census Industry Code 0280).

An Order of Crab with a Side of Terrapin

Many of us enjoy a dinner of crabs, but most of us don't realize the price for that meal is paid in terrapins. The primary cause of terrapin mortality throughout a large portion of the species' range is incidental capture and drowning in commercial crab traps, with deaths estimated in the tens of thousands (Seigel and Gibbons 1995). An early estimate in South Carolina alone was 2,835 terrapin captures per day in April and May (Bishop 1983). A single trap in Maryland was found with 49 entire and



Ghost traps continue to kill terrapins.



ROGER WOOD

Roads are sought by migrating turtles because they mimic the high ground that females use for nesting,

many partial turtle shells (Roosenberg 1991). Up to 78% of a population could be captured in a single year (Roosenberg 1997). Since the distribution of the Blue Crab (*Callinectes sapidus*), for which the two million commercial crab traps annually deployed were designed, coincides closely with that of the terrapin, Diamondbacks are especially at risk (Watters and Wood 2003). Although these traps were never intended to capture terrapins, they do.

These figures do not take into account recreational traps. In one small Maryland community, over half of the waterfront properties are weekend homes, and most of the docks have traps in the water all week long. While many full-time residents check their traps often enough to preclude terrapin drowning, that would be impossible for the weekenders.

Ghost Story

“Ghost traps” are abandoned or lost crab traps that continue to execute their function. They not only continue to deplete the downward spiraling population of crabs, but also take many terrapins. Ghost traps have been found with over 50 dead terrapins (Roosenberg 1991). Of the two million commercial crab traps placed in U.S. waters each year, as many as 25% become ghost traps, and these devices take a long time to rust away. Consequently, tens (or even hundreds) of thousands of traps work tirelessly to catch terrapins and other creatures — without any purpose. The results can be staggering (Watters and Wood 2003).

Our fish dinners also are paid for in terrapins. By-catch in several fisheries can be substantive. One that is getting considerable attention is the eel-pot fishery, which has great potential for harm and has been relatively understudied (Radzio and Roosenburg 2005).

Why Did the Terrapin Cross the Road?

The same roads we take to reach vacation destinations on barrier islands or the beach kill turtles. Road mortality inadvertently targets reproductively mature females because the roads mimic the high ground that female terrapins use for nesting. Each year, thousands of gravid terrapins are killed by vehicular traffic. In a six-year period, a single seven-mile stretch of road accounted for over 4,000 terrapin deaths (Wood and Herlands 1997).

Habitat loss continues to be a problem for terrapins. The two main culprits are waterfront development (Roosenberg 1991) and pollution (Ford et al. 2008). Many waterfront properties are bulk-headed or rip-rapped, denying access to terrapins. Several spill incidents in the last few years have affected prime terrapin habitat. Without access to nesting sites or unpolluted water, Diamondbacks cannot survive.

Due to the elimination of their natural predators, Raccoons (*Procyon lotor*) have increased in number and densities and are considered the major nest predators of terrapins (Butler 2000, Burger 1977, Seigel 1980). They are, after all, a human-subsidized predator, with great fondness for handouts from our trashcans. In some areas, the problem is so great that they destroy 100% of terrapin nests (Feinberg 2004). Consequently, many previously thriving populations have become sinks (Ner 2003).



TOMAS DIEBNE



ROGER WOOD

Thousands of gravid terrapins are killed each year by vehicular traffic.



PETER KING

Mortality attributable directly or indirectly to human activities appears to be exceeding the species' reproductive capacity.

Even boat traffic takes a toll, with 20% of turtles in some populations, predominantly females, showing propeller scars (Roosenberg 1991).

Jay Leno, in a potato chip advertisement, said, "Eat 'em, we'll make more." Unfortunately that doesn't apply to Diamondback Terrapins.

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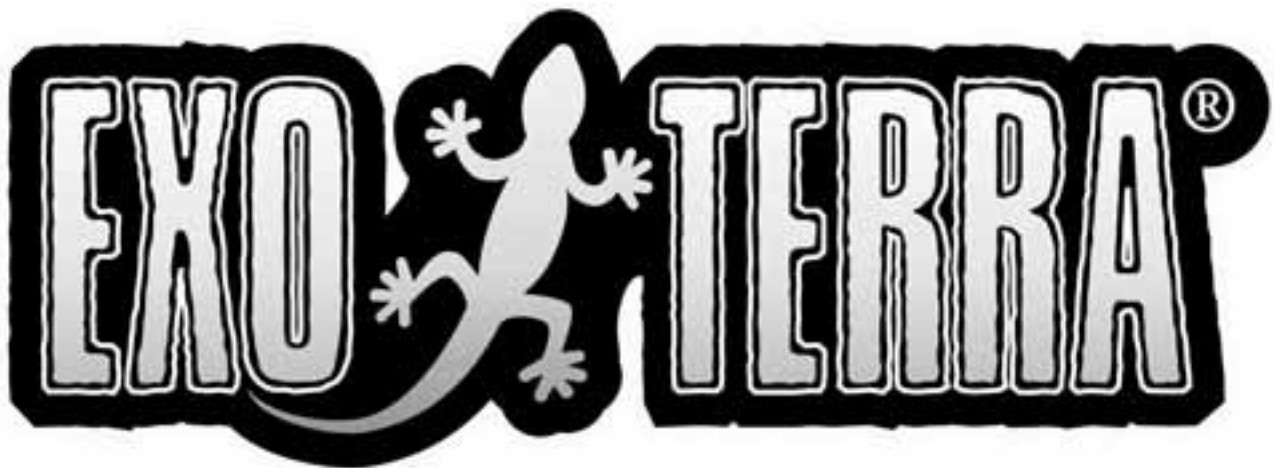
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MARK HAZEL

Most *Lampropeltis pyromelana* activity occurred under cloud cover or topographic shade. For such a strikingly colored animal, *L. pyromelana* can be surprisingly cryptic.

The Sonoran Mountain Kingsnake (*Lampropeltis pyromelana*) in the Great Basin

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The Great Basin is North America's largest desert, spanning an area of 190,000 square miles. Located in the rain shadow of the Sierra Nevada, the region is arid, mountainous, and cold, with most precipitation falling as snow. Climate varies dramatically, and higher elevations are cooler and wetter than lower elevations. Such climactic variability produces vegetative complexity. Plant communities from valley floor to mountain peak include salt desert, sagebrush, piñon and juniper, mountain mahogany, mixed conifer, riparian, and alpine vegetation. As the most remote region of the contiguous United States, only three cities in the Great Basin have populations over 100,000. These cities, Salt Lake, Reno, and Provo are located on the region's eastern and western fringes. Due to the vast area, vegetative and topographic complexity, and extreme remoteness, Great Basin reptilian communities have historically received little attention (but see Linsdale 1940, Tanner 1941, Hirth et al. 1969, Parker and Brown 1974a, 1974b, Brown and Parker 1982, Setser et al. 2002).

Voucher specimens are sparsely distributed throughout the Great Basin and entire mountain ranges and valleys lack collection data. As a consequence, reptilian distributions, natural history and ecology are poorly understood. This is especially true

of secretive species such as the Sonoran Mountain Kingsnake (*Lampropeltis pyromelana*).

First documented from the central Great Basin in eastern Nevada in 1932 (Linsdale 1940), *L. pyromelana* has since been considered rare due to the low frequency of observations, isolated populations, and the location of Nevada on the extreme northwestern limit of the species' distribution (see Stebbins 2003 and Hubbs 2004 for distribution information). Fewer than ten museum specimens are known from Nevada, and relatively little ecological information on its status has accrued since its first documentation in the state.

Great Basin populations are isolated on mesic mountain ranges separated by xeric valleys. These montane habitats are relicts of cooler and wetter Pleistocene climates, which allowed the expansion of woodlands and forests across Great Basin valleys. Populations expanded under these favorable conditions. As climates became warmer and drier during the Holocene, suitable habitat contracted, isolating *L. pyromelana* to its present mountain chain distribution (Grayson 1993; Tanner and Cox 1981).

Research needs for *L. pyromelana* in Nevada include basic natural history information such as distribution, abundance, and habitat requirements. The Nevada Department of Wildlife and Great Basin National Park surveyed cooperatively to address these data gaps. The primary objectives of these surveys were to document the natural history and ecology of Great Basin reptilian communities, with a particular focus on *L. pyromelana*.

Methods

Study Site

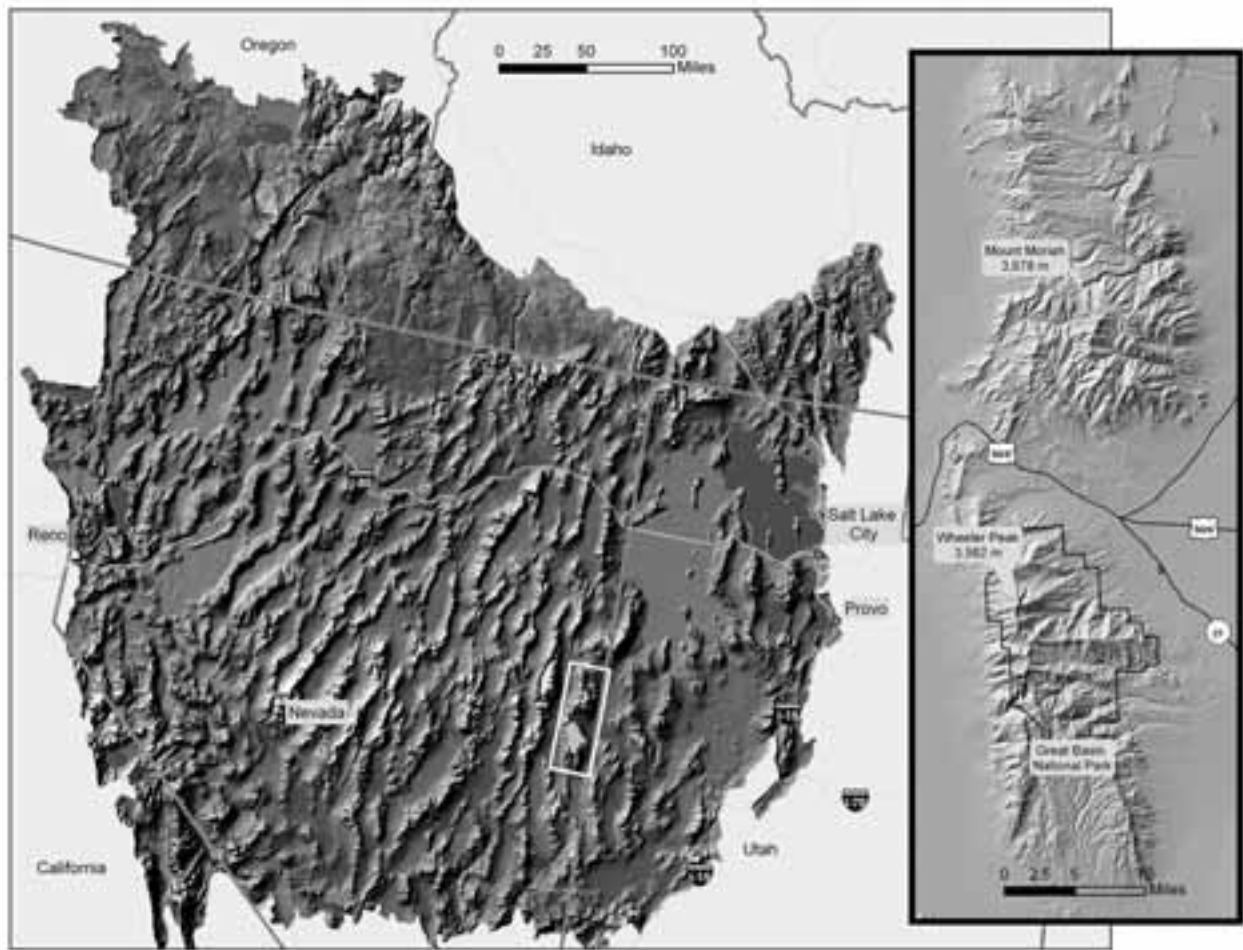
The Snake Range is the largest mountain range in the central Great Basin. Located in eastern Nevada, the southern portion of the range is encompassed by Great Basin National Park (GRBA). Elevations range from 1,585 m in Snake Valley to 3,982 m at the summit of Wheeler Peak. The park is mountainous and dissected by multiple deep canyons. Snowmelt-fed perennial streams support a diverse assemblage of plant and animal communities, resulting in ideal habitat for *L. pyromelana*.

Surveys

Surveys occurred in May of 2006 and 2007. Surveyors included a diverse mix of professional biologists and volunteers, includ-



Reptilian distributions, natural history, and ecology are poorly understood for many species in the Great Basin. This is especially true of secretive species such as the Sonoran Mountain Kingsnake (*Lampropeltis pyromelana*).



The Great Basin, Snake Range, and Great Basin National Park. The study site encompassed the entire Snake Range and included Great Basin National Park. The boundary of the Great Basin is defined biologically by contiguous sagebrush plant communities (Grayson 1993).

ing personnel from the National Park Service, Nevada Department of Wildlife, Southern Nevada Water Authority, Brigham Young University, Utah State University, Utah Herpetological Society, and U.S. Geological Survey.

To maximize reptilian encounters and increase the probability of encountering *L. pyromelana*, we used nonrandom, targeted surveys, which are superior to randomized methods in documenting secretive or rare species and maximizing species richness (Campbell and Christman 1982, Persons and Nowak 2007). Survey protocols followed the Visual Encounter Surveys of Scott (1994), and survey sites were exhaustively searched on the surface and under cover objects. To further maximize the likelihood of *L. pyromelana* encounters, survey locations were chosen based on historic localities, anecdotal reports, and sight records. Habitats surveyed included canyons, riparian areas, rocky uplands, and talus.

Reptilian Diversity

Search effort, weather conditions, survey location, and reptilian observations were documented. To permanently document reptilian diversity, a single physical voucher specimen of each reptilian species per location was collected and preserved according to Simmons (2002). For *L. pyromelana*, photographs and tissues rather than physical specimens were collected.

Lampropeltis pyromelana

Activity

To document the seasonal activity pattern of *L. pyromelana* in the Great Basin, we compiled vouchers, observations, and anecdotal reports from the range of the subspecies *L. p. infralabialis* (Tanner 1953), an area that includes Nevada, Utah, and northern Arizona. Data were taken from museum searches, anecdotal reports, and sight records from the period of 1932–2007 and included observations from these surveys.

Natural History

Each *Lampropeltis pyromelana* was photographed, measured, weighed, sexed via probing, and uniquely marked by ventral scale clipping (Brown and Parker 1976). Location, ambient temperature, and substrate temperature were recorded and a tissue sample collected. Habitat characteristics such as geomorphology, surface water, vegetation, elevation, and substrate were recorded at capture sites. All *L. pyromelana* were subsequently released at their exact capture site.

Results

Reptilian Diversity

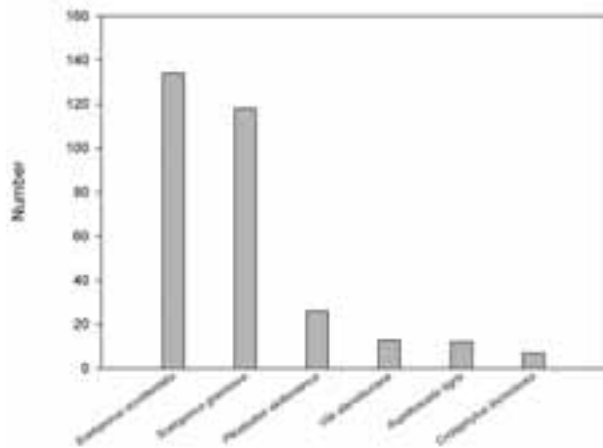
We surveyed six localities during May of 2006 and 2007. Search effort over both years totaled 424 person hours. A total of 366

individuals of 12 species were observed in the course of the surveys and 59 voucher specimens were collected.

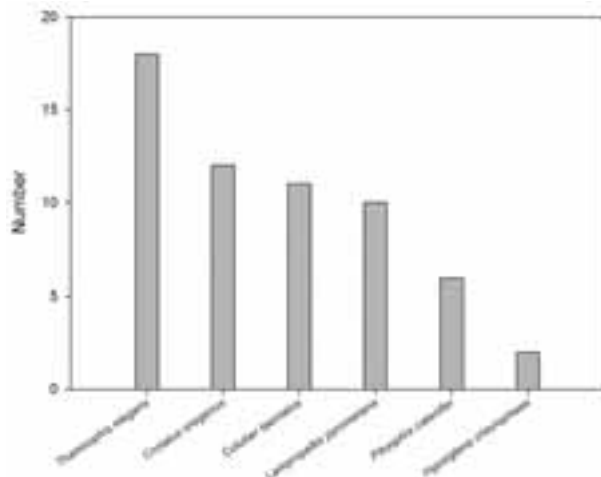


JOHN E. FREE

Most *Lampropeltis pyromelana* surface activity occurred at relatively low ambient temperatures, high humidity, and under cloud cover.



Lizard diversity for Visual Encounter Surveys in the Snake Range during 2006 and 2007.



Snake diversity for Visual Encounter Surveys in the Snake Range during 2006 and 2007.

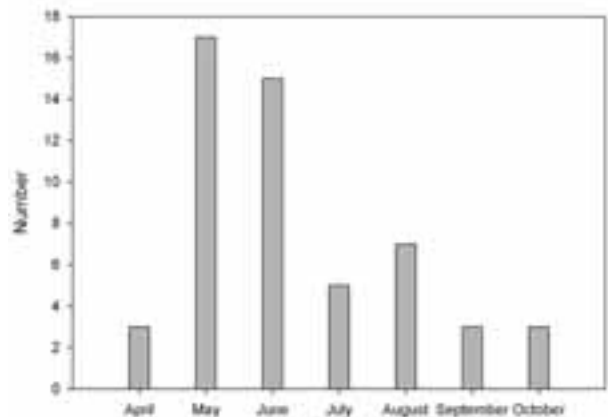
Lizard diversity exhibited a typical right-skewed pattern with two abundant species (*Sceloporus occidentalis* and *S. graciosus*), an intermediately abundant species (*Plestiodon skiltonianus*), and three rare species (*Uta stansburiana*, *Aspidoscelis tigris*, *Crotophytus bicinctores*).

Snake diversity was more uniform. One species (*Thamnophis elegans*) was abundant, four (*Crotalus oregonus*, *Coluber taeniatus*, *Lampropeltis pyromelana*, *Pituophis catenifer*) were of intermediate abundance, and one (*Hypsiglena chlorophaea*) was rare.

Lampropeltis pyromelana

Activity

Fifty-three *L. pyromelana* voucher specimens and observations were tallied, which included 10 from this project. Activity occurred from April through October, peaked during May and June, and rose again slightly in August. These results suggest that the optimal survey window for *L. pyromelana* surface activity in the Great Basin is during May and June, a typical activity pattern for reptiles in the Great Basin (Fautin 1946, Shelford 1963), and a pattern partially explained by regional climate. In the Great Basin, most precipitation falls during the winter as snow (Trimble 1989). Spring snowmelt increases available soil moisture and plant production peaks in the spring, concurrent with weather conditions favorable for reptilian surface activity. As available soil moisture is depleted in the early summer, plant production ceases and little precipitation is available to replenish soil moisture. During the summer, diurnal weather conditions are also generally too hot and dry for reptilian surface activity until the arrival of monsoonal moisture, which brings cooler temperatures in August. We suggest the August activity spike is due to the influence of a summer monsoon rain regime.



Monthly observations of *Lampropeltis pyromelana infralabialis*. Data are from voucher specimens and sight records from Nevada, Utah, and Northern Arizona from 1932 to 2007 and include data from the present surveys.

Natural History

Ten *L. pyromelana* were documented during our surveys, nine males and one female, which suggested a male-biased sex ratio; ($\chi^2 = 3.8$, d.f. = 1, $p = 0.051$). Male-biased sex ratios are commonly observed in snake populations due to sampling bias, detectability differences, differential sex ratios at birth, and differential survival (Burger and Zappalorti 1988, Iverson 1990,

Madsen and Shine 1992, Shine and Bull 1977). Male *L. pyromelana* may be more detectable than females due to more frequent movements and surface activity while searching for mates or due to earlier emergence from hibernation than females. Alternatively, survival of *L. pyromelana* may be higher in males than females due to higher costs associated with reproduction in females.

Mean SVL was 64.8 cm and mean mass was 96.6 grams (N = 10), sizes within the range reported by Stebbins (2003) and Hubbs (2004).

Our surveys confirmed a relationship between *L. pyromelana* surface activity and weather (Hubbs 2004). Activity was observed at relatively low ambient temperatures (mean = 22.4 °C, N = 10), high humidity (mean = 19.4%), and high cloud cover (mean = 39%). Cloud cover seemed to be a key variable associated with surface activity. Cloud cover filters direct sunlight, lowers substrate temperatures, and is associated with higher humidity. Although four *L. pyromelana* were observed under conditions of zero cloud cover, all snakes were shielded from direct sunlight by topographic shade. Searching for *L. pyromelana* in shaded canyons in the morning or evening is a search strategy often employed successfully in Arizona (R. Legere, pers. comm.). Topographic shade mimics cloud cover by lowering substrate temperature and providing favorable thermal conditions for surface activity.



Lampropeltis pyromelana habitat in the Snake Range varied from open sagebrush shrubland to piñon/juniper woodland. Habitats were generally close to perennial riparian vegetation and had high cover in the form of rocks or vegetation.

Lampropeltis pyromelana was observed at intermediate elevations (mean = 6,354 ft), in the lower reaches of canyons, and utilized three major habitat types: piñon/juniper woodland, riparian, and mixed sagebrush shrubland. No specific plant species or combination of species was noted that would serve as an indicator of suitable *L. pyromelana* habitat.

Although not measured, the availability of cover, either in the form of vegetation, litter, or rocks appeared to be an important habitat component. *Lampropeltis pyromelana* is only occasionally active on the surface due to its elongate body shape, high surface-to-volume ratio, and thin, porous skin. High cover and abundant refugia facilitate the semi-fossorial habits of *L. pyromelana* and provide suitable subsurface environmental conditions.

Lampropeltis pyromelana was generally found close to perennial water (mean distance = 186 m) in association with riparian vegetation. One locality lacked surface water and riparian vegetation, but was characterized by more mesic upland vegetation such as Skunkbrush (*Rhus trilobata*) and Squaw Apple (*Peraphyllum ramosissimum*). Surface water often is considered an important component of the *L. pyromelana* habitat template (Ernst and Ernst 2003). However, many ectotherms are capable of completing their life cycle with minimal access to surface water provided that enough cover is present to provide access to suitable subsurface environmental conditions and food is relatively high in water content (Congdon et al. 1982, Gans 1979, Greene 1997, Karasov and Martinez del Rio 2007, Meyer 1966, Pianka and Vitt 2003, Pough 1980, Rubio 1998, Schmidt-Nielsen 1991). Our observations of two *L. pyromelana* at a location lacking surface water suggest that, while surface water is not a requirement for Nevada *L. pyromelana*, it is an important component of their habitat, as the other eight individuals were observed in close proximity to streams. We suggest that riparian vegetation provides the link between *L. pyromelana* and water. *Lampropeltis pyromelana* was generally found in close proximity to riparian vegetation. Riparian vegetation provides cover, moderates microclimate, and is more productive than uplands in providing a greater prey base (lizards and small mammals). Although the exact details of the relationship between *L. pyromelana* and riparian areas remain unclear, a combination or interaction between factors such as surface water, prey base, cover, and microclimate are almost certainly responsible.

Conclusion

Prior to these surveys, fewer than ten *L. pyromelana* were documented from Nevada. These surveys doubled that number, documented natural history and ecology of the species, and further documented reptilian diversity through collection of voucher specimens. Partnerships facilitated these results. The partnership between Nevada Department of Wildlife and Great Basin National Park was critical in this effort, as were the efforts of the academic, professional, and amateur herpetologists who provided the bulk of the observations and data.

Although this is the largest dataset on Nevada *L. pyromelana*, it is quite limited (10 observations over a two-year period). *Lampropeltis pyromelana* is a sensitive species in Great Basin National Park, a species of conservation priority in Nevada's Wildlife Actions Plan, and is protected from collection in



Cooperative surveys by Great Basin National Park and NDOW brought together a diverse mix of surveyors from volunteers to academic and agency biologists. These cooperative efforts doubled the available information on *Lampropeltis pyromelana* in Nevada.

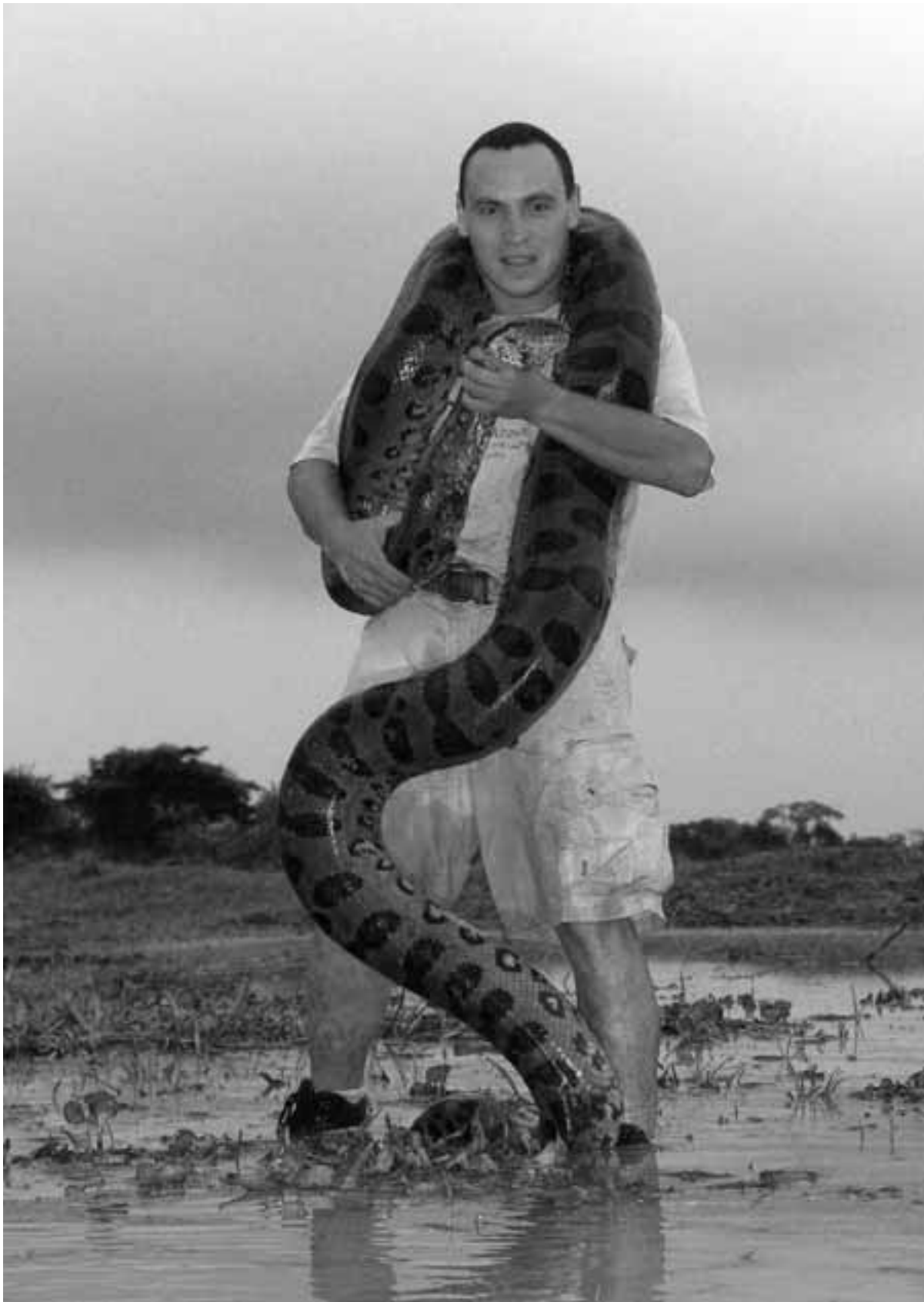
Nevada. Further surveys will be conducted. With continued data and voucher collection, the resolution of our understanding of reptilian communities in the Great Basin continues to improve. For more information on surveying, please contact the authors.

Acknowledgements

Surveyors who provided much of the data for this work: Aaron Ambrose, Gretchen Baker, JoAnn Blalack, Rosaleen Conrad, Neal Darby, Alan De Quieroz, Brian Eagar, Jenny Hamilton, Mandy Harmon, Stephanie Harris, Mark Hazel, Meg Horner, John Hurst, RayJean Layland, Neil Marchington, Nichole Marchington, Dan Mulcahy, Erika Nowak, Ryan O'Donnell, Ben Roberts, Travis Smith, Harry Sweet, Dave Syzdek, Shawn Thomas, Ryan Thomas, Fran Thompson, Jen Ward, Becky Williams, and Jason Williams.

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The senior author with a Green Anaconda (*Eunectes murinus*).

Observations on the Natural History of the Green Anaconda (*Eunectes murinus* Linnaeus, 1758) in the Venezuelan Llanos: An Ecotourism Perspective

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Photographs by the authors unless otherwise indicated.

“It is of unsightly body, the size of a pine beam. It can be as long as eight *varas* [6.4 m; each vara is 0.8 m]. Just seeing it is frightening. Knowing the range of its pestilent breath spurs one to flight. In response to a noise, the snake lifts its head one or two *varas* and fires a breath at tiger, lion, calf, deer, or man that stops cold, stuns, and turns immobile the animal that was poisoned. It then approaches and swallows it. I said that it swallows because it lacks teeth. It can open its mouth widely and may spend days consuming its prey...”

Father José Gumilla
El Orinoco Ilustrado. 1741

During the past seven and 12 years respectively, we have been accumulating data on the natural history of the Green Anaconda (*Eunectes murinus*) in the Venezuelan Llanos. We are wildlife guides who lead tours to this remarkable area called Los Llanos (flat lands), an extensive region of Venezuela and Colombia consisting of savannas north of the Orinoco River. Some of the most impressive rivers of South America flow through Los Llanos, leaving the plains flooded for half of the year. The landscape is mainly grassland with scattered trees and palms (more forested areas to the northwest are called *Llanos*

altos), but also dry gallery forest along rivers, many lagoons, and palm forests (*morichales*). We base our activity in the small village of San Vicente, on the shore of the Apure River, although both of us have had experience in other areas as well. Our tour groups are taken into the field in search of the typical fauna of the zone: Capybaras, Giant Anteaters, Giant Amazon Otters, Pink River Dolphins, hundreds of species of birds (raptors, egrets, herons, screamers, terns, skimmers, parrots, toucans, woodpeckers, ducks, storks, etc.), piranhas, Spectacled Caimans, Green Iguanas, Mata-Mata Turtles, and, of course, the indisputable star of Los Llanos, the giant serpent, the Green Anaconda. A tour in the dry season is not complete if we are unable to find at least one of these snakes.

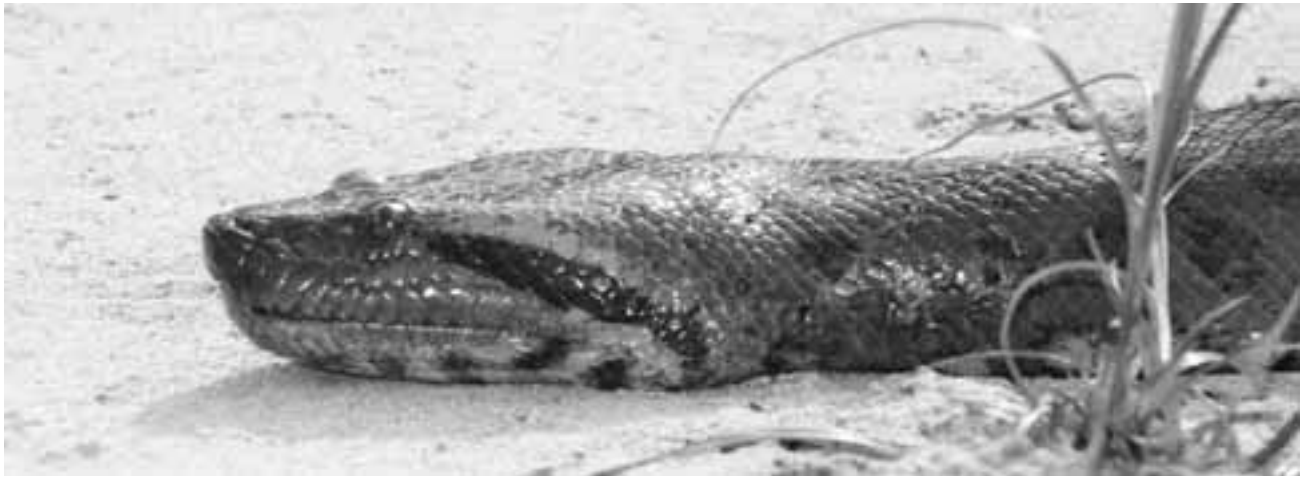
Among the stunning wildlife and the impressive landscapes of the region, anacondas are perhaps the most emblematic natural element and the most intriguing to foreign visitors. The reactions of tourists to this star of myriad tales range from fascination to fear. Herein we address the myth, the fantasy, the scientific reality, the natural history, interactions with humans, folklore within the local culture (indigenous people and descendants of Europeans), and the economic importance of this giant serpent.

The Family Boidae

The family Boidae includes some of the most beautiful and well-known of all snake species. The colorful Rainbow Boa (*Epicratis cenchria*), the elegant Emerald Boa (*Corallus caninus*), the slender tree boa (*Corallus rufescens*), the Red-tailed Boa (*Boa constrictor*), and the impressive Green Anaconda (*Eunectes murinus*) are all members of this family of non-venomous snakes. All boas (subfamily Boinae) are known for killing their prey by constriction. The subfamily is widely distributed in the Americas (where pythons are absent), ranging from the southern United States to the lowlands of Bolivia and northern Argentina. Real boas also occur in Madagascar and New Guinea, and the South Pacific. Boas are a complex family of snakes that includes terrestrial, aquatic, burrowing, and arboreal species and which consume a wide variety of prey. All boas are live-bearers. Most boas



A large female Green Anaconda with a total length of 5.6 m.



The Green Anaconda is the largest boa (Family Boidae, Subfamily Boinae) and the heaviest snake in the world.

are nocturnal, but some Neotropical species, including the Boa Constrictor and the famous anacondas, may hunt by day as well as during the night.

In addition to the Green Anaconda, three other anaconda species are currently recognized. Both are similar, albeit much smaller. The Yellow Anaconda (*Eunectes notaeus* Cope) reaches a maximum size of 4 m and lives in the Paraguay-Paraná River Basin (northern Argentina, Paraguay, Bolivia, southwestern Brazil). The Brazilian Anaconda (*Eunectes deschaunseei* Dunn and Conant) reaches a maximum length of only 2.5 m and is known from the mouth of the Amazon to French Guiana, where it is sympatric with *E. murinus*. Recently, a third species has been described from Bolivia as *E. beniensis* (Dirksen 2002; Dirksen and Böhme 2005). It also is small (maximum length 4 m). Another name applied to an anaconda, *E. barbouri*, was proven to be a synonym of *E. murinus* by Strimple et al. (1997) and Dirksen and Böhme (1998).

The Green Anaconda

Eunectes murinus, the Green Anaconda, is known as *serpiente de agua*, *culebra de agua*, *caribita*, *madre de agua*, *güio*, *petaca*, *mata-toro*, *sucurí*, *yacu mama*, *camudi*, and by many more names throughout its range, which extends from Trinidad and Venezuela to Bolivia. The species is the largest of the anacondas, and the heaviest serpent in the world, its weight surpassing that of other giants like the Reticulated Python. Green Anacondas can reach 200 kg (227 kg is the record taken from the *Guinness Book of World Records 2004*).

Which species of snake is the longest is a question that engenders an ongoing debate — but the Green Anaconda is indisputably in the mix. A maximum length of 8.3 m is widely accepted (Murphy 1997), and no documented voucher specimen of greater size is available (although the *Guinness Book of World Records 2004* lists a total length of 8.45 m, but fails to cite a source). People, especially in Los Llanos, commonly speak of anacondas measuring dozens of meters, but like many fishing stories, sizes tend to be exaggerated. A skin that was allegedly 12 m long proved to be only 6 m in length when accurately measured; most surprised (and disappointed!) was the owner of the skin, who had been quite certain that it was longer (Murphy and

Henderson 1997). Many of the historical cases (Murphy and Henderson 1997) of “scientists” reporting animals as long as 14 m and even 50–60 ft are considered unreliable as the claimants had been unable to measure the animals in question and estimates were entirely subjective. The most prominent case is that of Emmett Dunn, an important herpetologist in Colombia, who believed the seemingly accurate report from an oil geologist of an anaconda captured in the Río Meta that reportedly measured 11.5 m (35.5 ft). In any event, the Zoological Society of New York is still offering a prize of \$50,000 for an anaconda longer than 30 ft! Only females can reach the largest size; the longest males do not surpass 4 m (pers. obs.). Of interest, however, are reports of enormous anaconda skins, such as one allegedly 29 ft in length (Robertson 1998) or those reported in Murphy and Henderson (1997). Snakeskins, once separated from the flesh, salted, and stretched, can increase in length by as much as 30%, giving the impression that the snake was considerably longer than it actually was when alive.

The ground color of Green Anacondas typically is olive-green, with round black spots and yellow ocelli surrounded by black on the flanks. The belly is yellow with black checks. One red and one black stripe immediately behind the eyes are distinguishing features that help differentiate species of anacondas.

Taxonomy

The Northern Green Anaconda was long known as *Eunectes murinus gigas* (Latreille), the largest of all anacondas. Differences



The ground color of Green Anacondas typically is olive-green, with round black spots and yellow ocelli bordered by black on the flanks.

distinguishing this race included a lighter postocular region and slight differences in scale counts. However, as Dirksen and Böhme (1998) indicated, this color pattern is widespread throughout the range of *E. murinus*, and scale counts do not differ consistently. Consequently, *Eunectes murinus* (Linnaeus 1758) is now recognized as a single monotypic species.

Distribution

The Green Anaconda has a continuous distribution from northeastern Venezuela and Trinidad to Bolivia, through the Orinoco and Amazon basins. It is currently unknown west of the Andes (but see below). In Venezuela, it is found throughout the lowlands in the states of Sucre, Monagas, Anzoátegui, Bolívar, Amazonas, Apure, Barinas, Guárico, Cojedes, Portuguesa, and probably the southern parts of Aragua and Carabobo.

Lake Maracaibo is a large brackish Venezuelan lake connected to the Gulf of Venezuela by a 55-km strait. The presence of Green Anacondas in Lake Maracaibo has not been confirmed, although local people are familiar with a “Madre de Agua” living in the deep pools of associated rivers and lagoons. They fear the animal, but respect it because they believe that these giants protect the rivers. Two guides who have worked with us report

road-killed anacondas. Although these men are not trained herpetologists, they lead wildlife tours to Los Llanos and are capable of identifying the species. No vouchers exist, however, and so we cannot confirm the presence of these snakes until we have more solid evidence.

Habitat

Anacondas are aquatic snakes. They prefer to keep the entire body under water, with only the eyes and nares above the water line. When basking, they rarely range more than one meter from water. Anacondas living in rivers have continuous water access, but those living in swamps are subjected to the risk of drought during the dry season. They sometimes remain burrowed in mud for months until the swamp refills in the rainy season. However, we have observed dead anacondas in dried swamps far from any permanent water.

Coiled anacondas are commonly seen basking in the sun on riverbanks or even in the shadow of overhanging vegetation. They may seek refuge in burrows and natural holes, where they are easy to find along rivers during the dry season. In the rainy season, they move throughout the flooded savannas, and are almost impossible to find.



Green Anacondas have a continuous distribution from northeastern Venezuela and Trinidad to Bolivia, through the Orinoco and Amazon basins. In Venezuela, the species is known from throughout the llanos.



Despite their large size, Green Anacondas may be hard to locate. For example, the presence of the species in Lake Maracaibo has not been confirmed despite reports from reliable sources, and no voucher specimens have been taken.



Anacondas are aquatic. Typically, the entire body is under water, with only the eyes and nares emergent.

Anacondas are not arboreal, but we have on occasion found individuals resting in trees as high as 4 m above the ground. These are likely to be subadult females or adult males rather than heavy adult females.

Abundance

Although snakes in the tropics are never as common as they are depicted in the movies, given the proper conditions and habitat, anacondas can be quite numerous. In the rainy season, when the plains are flooded, anacondas, like many animals, are widely distributed throughout the savannas and difficult to locate. In the dry season, however, when the water evaporates from the lagoons and the rivers are at minimal flow, animals cluster around the remaining rivers and lagoons. At this time, Los Llanos provides spectacular views of thousands of Spectacled Caimans, birds, turtles, and Capybaras together on the shore of a single body of water. In these conditions, anacondas, although not as visible as other animals, can be extraordinarily abundant. Along one five-km stretch of the Apure River, our record is 16 anaconda sightings in three days. The average is always lower, from one to four. In swampy areas, they can be even more concentrated. The summer dry season also coincides with the breeding season, and females may be accompanied by several males.

Reproduction

One legendary aspect of anacondas is their size... No *llanero* will admit that anacondas can only reach 8, perhaps 9 m in length. All of them have seen at least once in their lives anacondas of 15, 20, or even 40 m. And it is impossible to claim otherwise! They are right, and you are a “gringo” who does not know anything! On one occasion, a *llanero* came to us, and said that he had seen



Coiled anacondas are commonly seen basking in the sun on riverbanks or even in the shadow of overhanging vegetation. They may seek refuge in burrows and natural holes, where they are easy to find along rivers during the dry season. In the rainy season, they move throughout the flooded savannas, and are almost impossible to find.



A Green Anaconda resting by day in vegetation along a riverbank.



Anacondas are not arboreal, but smaller, lighter individuals may bask in trees to heights of 4 m.



CEGAR L. BARRIO AMOROS

The Green Anaconda (*Eunectes murinus*) is one of the longest and certainly the heaviest snake in the world.



CEGAR L. BARRIO AMOROS



CEGAR L. BARRIO AMOROS



CEGAR L. BARRIO AMOROS

As one of the remaining top predators of the Venezuelan Llanos, effective conservation of Green Anacondas may depend on education and the benefits provided through ecotourism. See article on p. 92.



GERALD KUCHLING

Last Chance for the Yangtze Giant Softshell Turtle? The world's rarest and most endangered turtle, *Rafetus swinhoei*, may be getting a reprieve from impending extinction. With only four known living individuals (two in China, two in Vietnam) and only one of these a female, the odds couldn't be much worse. In early May 2006, the Turtle Survival Alliance (TSA), in conjunction with the Wildlife Conservation Society, coordinated the successful transport of the lone female from the Changsha Zoo to the single male (estimated to be 100 years old) at Suzhou Zoo, for a desperation captive breeding attempt. "Team Rafetus" breathed a collective sigh of relief when the pair first met and gently began a courtship process that culminated with breeding attempts. The female, affectionately known as China Girl, is shown here basking with the male watching her from the water. Fingers are crossed that she will lay fertile eggs in June. For more information on this historic event, go to the TSA web site at <www.turtlesurvival.org>. See also the Newsbrief on p. 124.



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JOHN BINNS

The Grand Cayman Blue Iguana (*Cyclura lewisi*) remains one of the world's most endangered lizards. A brutal attack at the breeding facility on Grand Cayman resulted in the death of seven captive adults. Local and international efforts continue to support the Blue Iguana Recovery Program. See article on p. 66 and Travelogue on p. 106.



ROBERT POWELL



JOHN BINNS

Ground lizards, such as the Dominican Ground Lizard (*Ameiva fuscata*, left), and anoles, such as the Grand Cayman Blue Anole (*Anolis conspersus*), are among the most abundant and visible species on West Indian islands. However, ground lizards have become rare or extirpated on islands where introduced mongooses (*Herpestes javanicus*) are established, and the native anole on Grand Cayman shifted its structural niche when it came into competition with introduced Cuban Brown Anoles (*A. sagrei*). See Commentary about an appreciation of “common” species on p. 105.

a huge anaconda of at least 20 m, and that he knew where it was. So we ran to the site and, after some hours in the swamps, we actually saw an amazing ball of anacondas — probably 20 m long — but not one, instead 14 anacondas — 13 males trying to mate with one huge female!

This is representative of anaconda mating. In the dry season, large females release pheromones that attract males from many kilometers. The first male to find the female is likely to remain for days (or even weeks) coiled around her. Inevitably, other males are attracted as well, all of them surrounding the female and competing to introduce one of their hemipenes into the female's cloaca. This orgy is essentially a patient battle among the males who are not aggressive toward each other (Rivas et al. 2007).

An interesting feature of anacondas, and many other boids, is the presence of small "spurs" adjacent to the cloaca, with those of males larger than those of females. The spurs are mobile, and may assist in mating by stimulating the female's cloaca for reception (Rivas et al. 2007).

After 6–7 months of pregnancy, the female gives birth to 8–82 baby anacondas (usually 20–40). Newborn anacondas usually are 60–80 cm in length, lighter in color (bright yellow) than the adults, and very aggressive.

Prey

One of the most fascinating aspects of large serpents is their feeding habits. What do huge snakes eat? A Green Anaconda may wait for hours, sometimes days or weeks, hidden underwater, with only nostrils and eyes above the surface. When prey approaches, it will attack at close quarters with lightning speed, wrapping its coils around the prey animal and killing it.

Prey items vary according to the size of the snake. Juveniles prey on small mammals, frogs, and large invertebrates, gradually taking larger items as they grow. A giant female of 6 m can swallow a Capybara or a pig. Although stories abound of anacondas swallowing cows and bulls, no such instances have been documented in Venezuela.

Enemies

Adult anacondas are at the top of the feeding pyramid, but the young are eaten by many birds (e.g., storks, raptors, herons), Spectacled Caimans (*Caiman crocodilus*), and a wide variety of carnivorous mammals. The notion of a fight between a giant anaconda and a jaguar is purely a Hollywood fantasy. We can-



After 6–8 months of pregnancy, females give birth to 8–82 (usually 20–40) baby anacondas.



Newborn anacondas are 60–80 cm long, lighter in color than adults, and very aggressive.

not imagine that any jaguar would be stupid enough to attack a giant serpent, but smaller anacondas make easy prey for experienced big cats.

One of the most striking features of many anacondas of all sizes is the number of wounds, old and recent, on their bodies. Many are attributable to piranhas (*Serrasalmus* sp. or *Pygocentron* sp.), which apparently bite and release, leaving a nasty wound. Others are from Spectacled Caimans, powerful predators that can put up a good fight when the tables are turned. Anacondas usually heal well, and most show old scars in the form of a half-moon or a complete circle from piranha bites or parallel linear wounds from caimans. Some snakes, however, can die of such bites. Other common injuries include incomplete tails. Some of these short-tailed anacondas are easy to recognize even when recaptured years later. One unusual wound observed in an adult female was the absence of the left eye, with the area almost completely covered with scales.

Anacondas can be cannibalistic. Rivas and Owens (2000) documented three cases, two of them females eating smaller males at the end of the breeding season. They speculated that the females ate the males immediately after mating.

The primary enemy of anacondas is humans. In almost any encounter between the two, snakes are systematically killed. We see them dead on the road (cars never stop or go around), killed by *campesinos* when encountered in the field, and, on one sad occasion when it was too late to intervene, we saw a fisherman pouring fuel and setting fire to a complete ball of breeding anacondas. Attitudes, at least in areas with a strong tourist presence,



ALAN HIGHTON

Green Anacondas select prey according to size. Juveniles prey on small mammals, frogs, and large invertebrates, gradually taking larger items as they grow. A giant female 6 m in length can swallow a Capybara or a pig. This juvenile killed a small Common Caiman (*Caiman crocodilus*); note the wounds inflicted during an earlier battle with another prospective meal.

show signs of change, but fear of snakes is very deep-rooted in the human psyche and rational appeals proceed at a limited pace.

Do Anacondas Attack Humans?

Like any other animal in the world, anacondas do not like to be bothered by annoying guides who want to show them to tourists. Predictably enough, anacondas will defend themselves energetically, biting and voiding their bowels when handled. An anaconda bite is not venomous, and, depending on the size of the snake, can be like a cat scratch or a Rottweiler bite. Since the snakes are aquatic, their mouths contain bacteria that can infect a wound. In some cases, anaconda teeth can break off and become embedded in a wound, only to surface months later.

Anacondas longer than 5 m can cause severe injuries, and the long teeth can penetrate to the bones of a hand, for example. An infected bite can also be quite serious and require hospital care. A few cases reported in the literature describe appar-



One of the most striking features of many anacondas of all sizes is the number of wounds, old and recent, on their bodies. Many are attributable to piranhas (*Serrasalmus* sp. or *Pygocentron* sp.).



The principal enemy of anacondas is humans. In almost any encounter between the two, snakes are systematically killed. We see them dead on the road (cars never stop or go around) and killed by *campesinos* when encountered in the field.

ent attacks by anacondas. One in Murphy (1997) involved a young girl caught by her bathing suit and saved by her sisters. The size of the snake is not mentioned. Rivas (1998) mentioned two attacks on his helpers during field surveys in swamps. One of the anacondas measured 5.04 m and the other 4.45 m, and Rivas indicated that both attacks appeared to be predation attempts. An anaconda of 6 m could easily swallow a child or a small adult, and an animal of 8 m could swallow an adult of any size. To be caught, a person would have to be exceedingly careless, asleep, or drunk. As with prey of a similar size, the snake would take several hours to swallow its meal and weeks or even months to digest it.

Sensational stories of anacondas attacking humans have cropped up in popular literature for centuries. Some of these epic and not very realistic accounts were addressed by Murphy and Henderson (1997). Fortunately, no reports of such incidents exist from Venezuela, although rumors of missing persons suspected of having run afoul of anacondas can be heard from local *llaneros*.

Capturing Anacondas:

Defensive Behavior, Bites, and Other Annoyances

When observed along the river during the day, anacondas usually are resting, basking in the sun on the shore completely exposed, or, more commonly, concealed to some extent in tall grass, in *paleras* (floating mats of logs and branches), or submerged with only the nares and eyes exposed. They are more active at night, when they move along shorelines or swim in the shallow water near the riverbank. Capturing an anaconda is never easy. We first try to catch a glimpse of the neck. If the animal is resting and the neck exposed, our task is much simpler.



When handled, anacondas will defend themselves energetically, biting and voiding their bowels. An anaconda bite is not venomous; however, the snakes are aquatic and their mouths contain bacteria that can infect a wound. In some cases, anaconda teeth can break off and become embedded in a wound, only to surface months later. Note also the round “hole,” the opening of the glottis, which can be extended between the lower jaws, allowing the snake to breathe when swallowing large food.

The snake will allow a close approach, and usually the catch is successful. If the head is hidden, we must touch the animal until it starts to move. Once we see the head, we can catch it. If the animal is in the water and the head submerged, we usually grasp the body, and risk being bitten. Especially the smaller, more agile, and aggressive males will turn quickly and strike — but generally we manage to restrain the animal. Some guides use gloves, which are useful to avoid bites, but we tend to be somewhat masochistic and always try to capture the animals by hand. Anacondas can bite underwater, and, on occasion, we have been surprised by an angry male biting our feet.

We have received dozens of bites, some severe. A bite is inevitably painful and bloody. Teeth of large individuals can penetrate to the bone. Only rarely have we decided to leave the anaconda catching for another day due to the severity of injuries. Females are bigger but also calmer and quieter than males, and easier to catch. Once one of us has the neck, we can move or lift the animal depending on its weight. Males are lighter, and we can deal with adults to 3 m in length without too much difficulty. An adult male of 3 m can weigh 5–7 kg. Females are a different question. A subadult female of the same size can weigh twice as much, depending on its girth and whether it has prey in the stomach. Usually females of more than 4 m are difficult or impossible for a single person to lift. The senior author recently captured an impressive female of 5.5 m, so thick that it was impossible for three people to move it! We estimate that it weighed more than 100 kg! An animal of more than 6 m requires at least four people to move it out of the water, and at least 10 people are necessary to lift it.

Other than striking, an anaconda, when secured by the neck, releases a horribly offensive musk from its cloaca. If it splatters skin or clothing, the odor can persist for hours! The stench is truly vile. We quickly wash the cloacal region of any recently captured anaconda, until it releases all the musk into the water.

Once an individual has been shown and photographed by all interested parties, it is released in the same spot where it was captured. After handling, some anacondas become very calm and will remain for a while in the same position in which we leave them. Others disappear quickly. A few adopt a balling defensive posture (Dirksen et al. 1998), in which the snake coils into a ball to protect the head.

Myths

Anacondas are said to produce a powerful and poisonous vapor (Gumilla 1741) capable of stunning victims. Similar beliefs are common to several cultures throughout the world, and especially strongly ingrained in Spain and all of Latin America. Many *llaneros* are particularly fervent believers.

Another common legend tells of a giant anaconda (invariably much more than 6 m in length) coiled in a tree overhanging a pool of water with its tail securely wrapped around a branch, waiting patiently until a cow or bull arrives to drink at the pool. Once the snake catches the snout of the ruminant, the anaconda will firmly grip it while stretching out elastically to an incredible length. When the prey is exhausted, it is killed and the snake will release its tail and proceed to swallow the animal.

Another myth refers to finding an immense anaconda resting and digesting with the horns of a prey animal (either a White-tailed Deer or a cow) sticking out of its mouth. According to *llaneros*, the anaconda will wait until the horns drop naturally as the rest of the animal is digested. Murphy and Henderson (1997) gave little credence to these tales (although horns of prey are known to have survived digestion by pythons in Africa).

Conservation

Little is known about the roles of the top predators in Los Llanos. In addition to the anacondas, top predators include Jaguars, Pumas, Orinoco Crocodiles (*Crocodylus intermedius*),



Capturing large anacondas is a risky proposition.

Spectacled Caimans, Pink River Dolphins, and Giant Amazon Otters. The two biggest predators, the Jaguar and the Orinoco Crocodile, have almost totally disappeared, and Pumas and Giant Otters have become very rare, leaving anacondas and Spectacled Caimans as the principal top predators. The vast llanos ecosystem depends mostly on these two predators and the scavengers (piranhas, vultures, and other raptors) to keep the environment clean and healthy. Of course, alterations by humans have changed the natural interactions between prey and predators by introducing cattle, hunting deer and Capybaras, and over-fishing. Some almost untouched llanos ecosystems remain in national parks, but most private preserves have been substantially altered, although no hunting is allowed. To protect cattle, large predators are exterminated, and then natural prey, such as Capybaras and deer, increase in numbers well beyond the natural carrying capacity. Anacondas thus fulfill a very important role — if they are not killed.

Advocating protection for snakes is always difficult, but attitudes show signs of changing. We see fewer anacondas killed now than we did years ago. People use them less for natural medicine (although some still believe that the fat is miraculous for rheumatism). On one occasion, we rescued a huge anaconda of 4.5 m that was kept by a local fisherman who wanted to extract the fat and sell it for a high price.

Anacondas remain quite common in some areas. Endless swamps are not amenable to humans, yet provide ideal habitat for giant serpents. Also, big rivers and small tributaries offer many opportunities for anacondas to live and hide with little disturbance. The most important aspect of conservation is to convince *llaneros* to value and protect their natural heritage. Educational campaigns, posters, lectures in local schools, and demonstrations show that anacondas are not dangerous and can be economically important as an attraction for tourists.

Can Ecotourism Protect Anacondas?

In the past ten years, we have shown hundreds of anacondas to tourists from all over the world. We believe that personal contact with anacondas is necessary to convey the conservation message. We generally capture one specimen per group (and usually show many more), and make everyone feel the power of its muscles, feel its skin, see the colors, and even experience the terrible smell. When a tourist is faced with an anaconda, even if held by one of us, reactions are diverse, ranging from excitement, fascination, and admiration to abject fear. Even many who are scared at first will eventually agree to touch or even to hold one of these animals and, in the process, perhaps reconsider the idea that all serpents are evil. Having at hand one of nature's most powerful predators and seeing it in its own habitat is a unique experience, which we hope will give visitors an idea of the importance of preservation. When these people return to their cold homes in Sweden, England, or Canada, and tell incredible stories to their friends, some of them in turn want to see the show live! This as much as any other single factor has led to an increase in ecotourism in Los Llanos — with the primary objective of seeing, among the other spectacular animals, anacondas. Eco- or bio-tourism operators (at least the most serious) offer work to many people in Los Llanos, boatmen, local guides, cooks, etc. They and the people around them



The two largest predators of the Venezuelan Llanos, the Jaguar and the Orinoco Crocodile, have almost totally disappeared, and Pumas and Giant Otters have become very rare, leaving anacondas and Spectacled Caimans as the principal top predators.

(family, friends, neighbors), all fishermen, and other potential enemies of anacondas and other animals in time will see the value of protecting these animals, recognizing that they attract tourists and thus, money for the village.

What are the Negatives?

During the rainy season, when Los Llanos are flooded, the huge concentrations of birds and caimans, turtles and piranhas disperse into the flooded savannas and become difficult to see. In Venezuela, the rainy season extends from mid-May to mid-November. Anacondas also are much harder to locate and, although we advertise this fact, tourists may be disappointed. Inevitably, entrepreneurial *llaneros* will capture any anaconda they can find (and keep it in a bag for weeks or until it dies or is too weak or thin to be interesting) and offer to show it for a price. Others tie a rope around the neck of a big snake and keep the animal in a swamp until the tourists arrive with a local guide, at which time the giant suddenly appears (always with neck injuries) to the delight of tourists unaware of the fraud. Such dishonest practices can penalize “honest” guides, but is this truly negative? The impact is not pronounced; only a few anacondas serve as bait, and the educational aspect for the tourists can be more positive than if they do not see any snakes. Nevertheless, it presents a false image of nature, and we do not engage in or approve of such dishonesty.



We believe that personal contact with anacondas is necessary to convey the conservation message. We generally capture one specimen per group and let everyone feel the power of its muscles, feel its skin, see the colors, and even experience the terrible smell.

Some tourists do not want to touch snakes, only observe them, not out of fear, but because they claim that we stress the animals. Yes, this is likely true. However, reptiles do not stress like birds or mammals, due to their slower metabolism. Usually, big snakes like anacondas, but also smaller boids, iguanas, and caimans, fight for a short period when captured and then cease to move, as if in a trance... This is the perfect moment to show them to people, to take pictures, and in a few minutes, the animal is free again, at the same location. Only a few animals are caught and used as live teaching material, always with concern for the well-being of both captor and captive. They always are released quickly, and often become wary of being captured again (minimizing any potential stress). Some anacondas, however, have been recaptured several times, and they always seem to be in perfect shape.

Future Perspectives

Much remains to be learned about the natural history of anacondas and we would like to do our part. We have the ability to follow populations of anacondas at little cost. We can mark, photograph, measure, and release anacondas whenever we take tourists to Los Llanos. Attaching radio transmitters to some of these animals and tracking them, especially during the rainy season when the savanna is flooded and the anacondas disappear from the river shores, would surely provide much insight into the lives of these intriguing serpents.

Acknowledgements

We are indebted to Arassari Trek (www.arassari.com), the company for which we have been working for many years. They have made it possible for us to develop our interest in nature directly in Los Llanos. We also are grateful to the many *llaneros* who have worked with us for more than 10 years: Azael, Carlos Andrés, Dixon Güiza, Luisson, Asdrúbal, and many others. Robert Henderson and Lutz Dirksen provided valuable information and helped correct our English, improving the manuscript dramatically.

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When a tourist is faced with an anaconda, even if held by one of us, reactions are diverse, ranging from excitement, fascination, and admiration to abject fear.



Biotope of *Davewakeum miriamae* at Sakaerat Experimental Research Station, showing the rocks on which lizards were found.

The Thai endemic, Miriam's Legless Skink, *Davewakeum miriamae* Heyer, 1972

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Photographs by the author.

Although discovered nearly four decades ago, Miriam's Legless Skink (*Davewakeum miriamae*) is still one of the least known Thai skinks. We "rediscovered" it and provide the first picture of a live specimen with illustrations of its biotope.

In 1972, Dr. William Ronald Heyer described a new genus and species of skink from dry evergreen forest in northeastern Thailand, *Davewakeum miriamae*. The new taxa were dedicated respectively to Dr. David B. Wake (University of California, Berkeley) and to Miriam Harriet Muedeking, Ron Heyer's wife, the latter having collected the very first specimen of the type series. The holotype was collected by the late Sukhum Pongsapipatana, a promising Thai herpetologist who tragically died too young, hit by a car in 1974.

As mentioned in the original description, the 17 types were originally deposited at the Field Museum of Natural History (FMNH, Chicago); however, four paratypes were later sent on exchange to other institutions (FMNH 18542–545, sent respectively to the Museum of Comparative Zoology, Harvard; Los Angeles County Museum of Natural History, Los Angeles; the British Museum, London; and the Thailand Institute of

Scientific and Technological Research, Bangkok) (A. Resetar, pers. comm., January 2008).

The distinctiveness of the taxon at the generic level, mainly justified on cranial and scalation features, has always been accepted. Brandley et al. (2005) and Greer (2002) stressed the morphological similarities between *Davewakeum* and the other Southeast Asian genus *Brachymeles*, but recognized these genera as clearly distinct from each other. The genus *Davewakeum* remains monotypic.

The Thai common name of *Davewakeum* is *ching-laenduang Pakthongchai* (Nabhitabhata et al. 2004, Thirakhupt 2000). Its English name is *Miriam's Legless Skink*. We suggest the French name *scinque apode de Miriam* and the Dutch/Flemish name *Miriam's pootloze skink*.

The holotype of Miriam's Legless Skink was collected at "Khao Saton, 300 m. above the Kasetsart University Forestry Station, 60 km. S of Nakhon Ratchasima on Highway 304, Amphoe [= District] Pak Thong Chai, Changwat [= Province] Nakhon Ratchasima, Thailand"; the paratypes all came from this locality with the exception of one that was collected at "Sakaerat Experiment Station, Amphoe Pak Thong Chai, Changwat Nakhon Ratchasima." Nabhitabhata et al. (2004) listed the species from Sakaerat and Wang Nam Khiao (Subdistrict), both in Pak Thong Chai District in Nakhon Ratchasima Province, the only district and province from which the species is known.

Ron Heyer's team found specimens in dry evergreen forest (partially cleared in the case of the Sakaerat paratype). They were found by daytime underground (1–15 cm deep), often along tree buttresses or under rocks (Heyer 1972, Heyer and Berven 1973, Inger and Colwell 1977). In contrast, one specimen (Sakaerat's paratype) was found active at 2140 h on the forest floor less than a meter from a stream. Whether the species is diurnal or active at night remains unknown, although the latter observation alone suggests a nocturnal cycle. At one site in Khao Saton, as many as ten individuals were found in a 4-m² area, in syntopy with the semi-fossorial skink *Riopa bowringi* (Günther, 1864) (Heyer 1972). The diet of *Davewakeum* is totally unknown, but most probably includes various small leaf litter invertebrates. Its reproductive biology is also unknown.

During an afternoon in November 2004, in dry evergreen forest at Tham Jong Ang ("King Cobra Cave"; altitude ca. 400 m asl), Sakaerat Experimental Research Station (SERS), we dug



Live adult *Davewakeum miriamae* from Sakaerat Experimental Research Station.

a large hole in a boulder filled with humus, and found two adult *Davewakeum miriamae* a few centimeters from each other. As soon as they were exhumed, they became extremely excited and crawled surprisingly quickly; one even managed to escape by letting itself fall from the boulder and disappearing into a rock crevice, the other was caught but immediately lost its tail (voucher IRSNB 17009). The species is very common at SERS, where it is encountered frequently when gardening and digging (T. Artchawakom, pers. comm., November 2004). The biotope of *Davewakeum miriamae*, the dry evergreen forest of Sakaerat, was described in detail by Lamotte et al. (1997).

Despite an apparently localized distribution, the species does not appear to be threatened. Thirakhupt (2000: 163) briefly reviewed its conservation status, qualified its commercial value as low, and its biology and ecology as unknown and thus not sufficient to clearly establish its status ("data deficient"). The species is listed as "near-threatened" in the Thailand Red Data list by Nabhitabhata and Chan-ard (2005), who forgot to indicate its endemicity to Thailand; however, no information was provided to justify this near-threatened status. The species is not included in the 2007 IUCN Red List of Threatened Species (IUCN 2007). We have not seen or heard about the species in the Thai or international reptile pet trade. Its fossorial habits, small size, and dull coloration make it unappealing for hobbyists. At the time of its discovery, the species appeared to be locally common (Heyer 1972) in dry evergreen forest, and it remains common at least in Sakaerat. The Sakaerat site was nominated as a UNESCO-MAB Biosphere Reserve and hence benefits from some protective status. Investigators may yet be able to document the presence of the species in Thap Lan National Park (Nakhon Ratchasima Province), just south of the known localities, and in adjacent Khao Yai National Park to the west and part of the same low mountain range (the southern part of the Phetchabun Mountain Range) that separates the Khorat Basin from the Central Valley of Thailand.

Acknowledgements

We are grateful to Taksin Artchawakom, Director of SERS, for his kind hospitality and support, to Chucheep Teak



Overview of the dry evergreen forest at Sakaerat Experimental Research Station.



Miriam and Ron Heyer at the Smithsonian Institution (Washington, D.C.) in December 2007.

Chimsunchart (Phetchaburi) for her help with the translation of Thai herpetological literature, to Dr. Lawan Chanhome (Thai Red Cross Society), Kirati Kunya (Korat Zoo), and Montri Sumontha (Ranong Fisheries Station) for companionship in the field, and to Dr. Ron Heyer (Smithsonian Institution, Washington, D.C.), Pascal A.R. Pauwels (Brussels), Alan Resetar (FMNH), and Dr. Surachit Waengsothorn (Thailand Institute of Scientific and Technological Research, Bangkok) for useful information.

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COMMENTARY

Let's Not Be Complacent About The Obvious¹

J. Whitfield Gibbons

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Last week in Alabama, I took my friend Andrew on a field trip. He wanted to catch a snake and other reptiles and amphibians, so we turned over logs in the forest, waded up streams, and slogged along the shorelines of lakes. Among our captures were Slimy Salamanders, Green Anoles, fence lizards, and cricket frogs. We even caught a large Yellow-bellied Watersnake. Anyone who spends time looking for these creatures in the Southeast would eventually find them also, as all are relatively common in many areas.

But I do not take these species for granted. Just because they are prevalent today gives no guarantee for the future. Now-extinct plants and animals have included some that were once very abundant. Revisiting the Passenger Pigeon saga is always a good way to make us realize we should appreciate and protect what we have.

Early in the 20th century the last surviving Passenger Pigeon — a species claimed by some to have occurred in greater numbers than any other bird or mammal for which we have records — died in captivity. Numbers offered little protection from extinction, and environmental protection laws came too late to help.

Passenger Pigeons looked similar to Mourning Doves, but one distinction, communal nesting, ultimately led to their downfall as a result of uncontrolled hunting by humans. The abundance of Passenger Pigeons was documented in many ways. John James Audubon reported an enormous migrating flock in Kentucky that was more than a mile wide, closely compact, and passed overhead during the daylight hours for three full days. He estimated that more than a billion birds were in the flock.

The largest known nesting site for Passenger Pigeons was Petoskey, Michigan, where almost every tree limb had at least one nest. Campsites were set up each year by hundreds of people who exploited the communal nesting area. In 1878, the nesting colony was 28 miles long and 4 miles wide. Thousands, maybe millions, of pigeons were sold during the late 1800s.

Most Passenger Pigeons were used for food, but people also found other uses for them. More than 20,000 of the docile and cooperative birds were used as shooting gallery targets on the Coney Island midway. Passenger Pigeons, despite their millions, dwindled away over the years as the onslaught continued. Everyone took the abundant and commonly seen birds for granted.

One way to capture pigeons was to lure them to a would-be feeding spot with a decoy, a tame pigeon sitting on a stool. Upon seeing the “stool pigeon,” passing flocks would land, only to be captured in a net trap. According to one authority, approx-



imately 10 nettings of about 1,200 Passenger Pigeons each were made in a day, more than 80,000 being captured in some weeks. The actual toll was even greater when trapping occurred during the nesting season, because countless nestlings lost their parents and starved in the nest as a result.

The extinction of the Passenger Pigeon is a commentary on a persistent and dangerous attitude of that era, the belief that we could exploit any natural system to the fullest, without regard for long-term sustainability. Unfortunately, the attitude exists even today. The approach of squeezing everything we can out of natural areas for fast financial gain may be the most costly feature of free enterprise. The final payment may be far more costly than anyone anticipated.

By the late 1800s, some people, including a few legislators, realized that Americans had overextended their exploitation of the Passenger Pigeon. By the 1900s, laws were being passed to prevent wholesale killing and trapping of the once most common of birds. But as is true with many of today's environmental laws, the rulings were passed too late, were not stringently enforced, and left too many loopholes. No one can be sure when and where the last Passenger Pigeon died in the wild. But the last known lonely Passenger Pigeon died in captivity on September 1, 1914, in the Cincinnati Zoo.

The next time you hear a Bullfrog, smell a Wax Myrtle, or see a Tiger Swallowtail Butterfly, stop and appreciate it. Although they are common today, let's not let them become the Passenger Pigeons of tomorrow. Let's support protection of natural habitats.

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Once it began to rain daily, Grand Cayman Anoles (*Anolis conspersus*) were visible everywhere in the branches and rummaging through leaf litter on the ground.

TRAVELOGUE

Tales of a Blue Dragon Tracker: Grand Cayman Blue Iguana Fieldwork 2007

Craig Pelke

Milwaukee County Zoo

Photographs by the author unless otherwise indicated.

3 May 2007

I left Milwaukee on an early morning flight to Georgetown, Grand Cayman. Despite a half-hour delay leaving Charlotte, I arrived and slipped through customs with ease, primarily due to a special letter from the National Trust detailing the electronic “toys” I was bringing for use in our fieldwork. Fred Burton, Director of the Blue Iguana Recovery Program (BIRP), and Doug Bell, my partner in the field, met me at the airport. After a quick trip to West Bay for some business, we were off to Fred’s home in Newlands.



GG, a handsome adult male Grand Cayman Blue Iguana (*Cyclura lewisi*) strikes a pose.

After unloading the “toys” at Fred’s house, Doug and I were off to Boddentown to set up house for the next 13 days. We made a quick trip to the grocery store for two weeks worth of “creative” cooking (cost of groceries and lack of energy at the end of the day make me a less-than-vigorous chef), followed by a stop at a local spirits store to stock up on Red Stripe and rum. These went down well over good conversation while Doug and I got to know each other.

4 May 2007

Fred had prior commitments at the Blue Iguana Recovery Program (BIRP) captive facility in the Queen Elizabeth II Botanic Park (QEIBP) as a large group of volunteers were due to arrive to assist with some “gardening” tasks in the adult iguana pens. The volunteers included employees from the Governor’s office escaping the grind of the office for a day, and Mariko Jack, the Governor’s wife. The main task was to remove unwanted vegetation, mainly grasses, from the pens, where they choke out other desirable (i.e., edible) species of plants. Removing the largely dried grasses now would allow the coming rains to reach the remaining food plants more easily.

The enthusiastic group vigorously cleared the pens, and an added bonus was the donation of numerous new and incredibly useful tools, such as garden forks, shovels, pruners, loppers, and rawhide gloves. BIRP staff greatly appreciates such tools to assist



The completed nest mound constructed by Chris Carr, Doug Bell, and the author.

with regular enclosure maintenance as well as other tasks necessary for the husbandry of the Blue Iguanas.

Another important task on our list was the construction of a nesting site for one of the Park's free-ranging females. In 2006, her eggs had been spoiled by rainwater pooling in the spot where she had chosen to lay her clutch. The nest-building crew was made up of Chris Carr (BIRP warden), Doug, and me, and involved relocating (shoveling!) 1.5 pick-up beds full of soil into this female iguana's preferred nesting area. This upgrade should improve the chances for survival of her next clutch.

After lunch, Fred and Doug started preparations for the first day of fieldwork in the Salina Reserve. Aside from the normal planning, Fred and Doug introduced themselves to some of the new electronic equipment I had brought for the numerous research endeavors. That evening, we attended a ribbon-cutting ceremony in Boddentown to commemorate the rebuilding of the Boddentown Mission House. After decades of decay, this culturally significant early 20th Century historic building had

been destroyed by Hurricane Ivan in 2004. Although the evening was typically warm by Grand Cayman standards and I was required to wear pants instead of shorts (in Wisconsin, I start wearing shorts once it hits 45 °F), witnessing some of the cultural history of the island and touring the rebuilt house was a great experience.

5 May 2007

After an early rise, we were off to the Salina Reserve. As eager as I was to begin our fieldwork, I still felt some hesitation approaching the treacherous beauty of the Salina. The thought of seeing individuals of one of the world's rarest iguanas roaming through the bush as they should is quite the incentive. On a more personal note, seeing some of the "children" growing up and doing well is also very rewarding. This is my fifth tour of duty on Grand Cayman to assist with the recovery of the species, and besides watching the many released iguanas grow and mature, the fieldwork provides me with a bit of professional sanity.



RYB, a four-year-old female Blue Iguana was our first and easiest capture.



RYB felt quite comfortable alongside members of Team Blue '07 in the Central Zone base camp.



RYB modeling her newly attached antenna accessories.

Our goal was to collect tracking data for a group of 20 Grand Cayman Blue Iguanas of varying demographics (males and females, two to five-year-old age classes) to add to the data bank Fred has been building over three years of tracking in the Salina's Central Zone (CZ). First, we needed to catch iguanas to which we would attach the radio antennas. Our first capture was almost expected and would have been a very safe bet. RYB, or "Rib," as we like to call her (officially she is known as red-yellow-blue, which are her bead colors read from outside in), a four-year-old female with a history of being a "trap magnet," was trapped almost immediately after she was seen. She very casually sidestepped a lizard noose, and actually oversaw the setting of her own trap from two meters away! The traps used were the common metal live animal traps in three sizes.

Overall, we had a very successful first day, with six iguanas trapped and "processed." Processing consists of verifying identity (beads, PIT, and sex), checking/noting physical condition (sheds, injuries/scars, missing toes or tail tips, etc.), measuring snout-vent length and tail length, weighing, and applying a radio antenna. Fred diligently takes all notes for his data stores on the population. When females are captured, we also palpate for early signs of egg production. Finally, we release the iguana where we trapped it, and reset the trap in a spot where another iguana was seen or "rumored" to be traveling.

The process of trapping can be very challenging. If you check the trap too soon, you could inadvertently chase away an interested iguana, but if you do not check soon enough, the iguana could perish in the severe tropical sun/heat (it was in the mid-90s with matching humidity). Traps are baited with a tasty



The author baiting a trap with pieces of banana that are hard to resist (if you're an iguana).

iguana treat, incredibly overripe banana. Very disgusting! I have a fairly strong stomach due to the great variety of animal feces I have cleaned up in my zoo career, but this was a tough one. However, to an iguana searching for food, this is intoxicating, and almost 100% irresistible. Some iguanas were caught multiple times.

While checking the circuit of traps, I took the time to reacquaint myself with the system of paths we had hacked out of the bush in previous sessions. I find it interesting how quickly the terrain and vegetation types can change from visit to visit while



Geckos known locally as Woodslaves (*Aristelliger praesignis praesignis*) were frequent guests at our lodging in Boddentown.

hiking through the network of paths. The paths also take on a different look as shadows change through the day. The Grand Cayman Banana Orchid (*Schomburgkia thomsoniana* var. *thomsoniana*) was sending up new flower spikes, and many of the paths were in need of trimming.

Aside from looking for more iguanas to trap, I also look for other indigenous wildlife, especially reptiles. On one round, I spotted a large gecko (*Aristelliger praesignis praesignis*), sometimes called a “Woodslave,” and a large male Grand Cayman Anole (*Anolis conspersus lewisi*). This subspecies differs from the more



A male Grand Cayman Anole (*Anolis conspersus*).

common nominate species as it tends to have a whiter ground color with a paler pattern. Fred mentioned that they are rather tough to find and, of course, I had chosen not to tote my cumbersome camera on that particular round. My “tough find” proceeded to position himself head down and perform his territorial ritual, complete with extensive head bobbing and dewlap extension. Must carry the camera at all times!

We exited the Salina after 6 pm, exhausted, extremely warm, sweaty, quite smelly (!), and in need of cool drinks and a functioning shower. However, we were quite satisfied with our catch for the day, which would allow us to begin radio-tracking the next day.

6 May 2007

Once again we were off to the Salina. We try to begin radio-tracking at 8 am, so we needed to be at the roadside entrance no later than 7:30 am to begin our hike to the CZ “base camp.” Fred began tracking the six iguanas that we had trapped the previous day while Doug and I began setting up traps. Doug devised a plan for trap placement based on some of his observations the previous afternoon and they paid off immediately. By 10:30 am, we had three iguanas caught and processed, including a two-year old (all iguana ages used in this writing were based on how old they would be as of August 2007). At that point, Fred began training Doug in the fine art of tracking Blues through the Salina. I continued trapping.



Essential equipment (minus the trap) to be hauled through the bush on every tracking round.

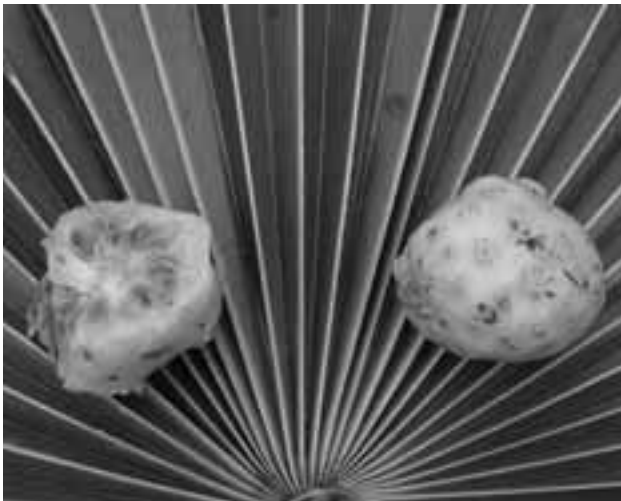
One particular iguana managed to continuously elude my attempts to nab her. At one point, she was actually in the trap eating the banana bait while I watched. When she finished the banana, she casually walked out of the trap, and then, with a quick burst, vanished behind an agave. Another iguana that had been “playing” with me for the last two days was “Wiggly Worm,” more officially known as WGW (white-green-white). Once again, he had the last laugh of the day. He was analyzing the large trap specifically set for him by the large Manchineel Tree (*Hippomane mancinella*) while I went on my final round to check and close traps. He then casually inspected another trap I had just shut down. The only thing that made me feel better is that he probably would not have fit into that one, as he is growing into quite a hulking specimen. I believe tomorrow he will be in our hands.

Throughout these exercises, I had noticed that I did not seem to be handling the tropical temperatures and humidity as well as I have on past trips. At noon, I took a reading of a palm frond that was elevated about 4 in off the ground, and had been in shade all morning beneath our newly constructed white-sheet canopy. Now I know why I felt so poorly. My TempGun informed me that it was 96.4 °F; the ground in the shade was 98.4 °F. At 4:30 pm, the same palm frond was down to 88.4 °F. That was a far cry from the mid-50s with a lake wind that my wife had reported that day for Milwaukee, Wisconsin. Spring in Wisconsin this year was actually more like prolonged winter, so my body was not used to anything approaching tropical temperatures.

7 May 2007

Once again we were on our way into the Salina. Doug and Fred really set a pace this morning. Fred believes it's like riding a bike, the faster you go, the easier it is to balance. Doug concurred. I prefer to set my own pace to avoid premature crucifixion on the dreaded razor-sharp karst rock.

Today I was trapping more iguanas while Fred and Doug shared radio-tracking responsibilities. Trapping started off pretty



The author found the Noni fruit (*Morinda citrifolia*), with its rotten cheese smell, incredibly repulsive, but the Blue Iguanas found it to be an irresistible bait.



Tracking data sheets, zone map, and data code descriptions.

slow, and my confidence was on the brink until Fred called with good news. After some mild tweaking of my trap placement, OGO had been apprehended. After processing him, I moved the trap to the southwestern part of the CZ where a small iguana hovered while I set and baited the trap — and started moving in as I walked away. I decided to wait on this one, and was not disappointed. Not more than five minutes later the trap was sprung and iguana #2 was caught. By the end of the day, two more were caught, including a valuable two-year old. Iguanas in this age class, the youngest presently in the Salina, are so far underrepresented in our data. The only disappointment was my continuing inability to nab “Wiggly Worm.” I believe I would have had the big male if he hadn't been trying to get some Noni fruit (*Morinda citrifolia*) from a trap that was too small for him. He apparently triggered the trap, but backed himself out, and was spooked for the day. We'll get him tomorrow.

Noni fruit really stinks! Rotting blue cheese comes to mind, yet the iguanas flock to it, and other animals enjoy it as well. Fred said that a juice made out of it is supposed to cure all that ails you, and is thought to enhance sexual prowess. I can't help but think, based on the smell, that it would have the opposite effect on me.

Hard to believe, but it actually was hotter today. My 12:30 pm reading was 97.4 °F in the shade. I am handling the tropical weather better today, having drunk water like a camel this morning. My real nemesis now appears to be the dreaded Maiden Plum (*Comocladia dentata*). I feel I have been doing quite well in avoiding it, yet I have the tell-tale red itchy blotches all over my forearms. After an incredibly refreshing shower, I realize I must have rubbed some Maiden Plum sap inadvertently around my right eye. This is only my third day in the Salina with many more to go, and I already have a serious case of plant poisoning and a bit of heat rash as well.



During one of PRP's many advances, RYB exhibits the "no" posture.



PRP catching the early morning sun.



PRP, a five-year-old male, introduces RYB to the rough and tumble world of *Cyclura* courtship with a nuchal bite.

8 May 2007

A new task for me in the Salina today; aside from trapping, I was going to begin some rounds of iguana tracking. While this is rigorous, I was eagerly anticipating it, as the busy pace makes the day go faster. Because of my trapping duties, I was only respon-



RYB (foreground) guarded by her mate PRP (background).



PRP, a five-year-old dominant male.

sible for tracking three iguanas, while noting any other iguanas seen, antenna or not.

Most of the excitement occurred right in the base camp as PRP (pale blue-red-pale blue), a five-year-old dominant male, made his first advances on RYB (red-yellow-blue), who is large enough to breed for the first time. PRP's advances were typical of male rock iguanas. He bobbed his head, jaws gaping, and colored as bright blue as he could get. RYB was not receptive, but this did not thwart PRP as he continued to chase, bite, and appear very threatening as we observed the spectacle from front row seats.



PRP courting RYB just outside the Central Zone's base camp. This pair was completely unconcerned by human presence.



PRP patrolling his territory.

Dark clouds had begun accumulating and thickening, by 11 am we heard thunder in the distance. By 11:30 am, the Salina and its inhabitants were receiving a much-needed soaking as the sky poured forth, leaving us scrambling to cover non-waterproof items and equipment. I hastily cut numerous fan palm fronds to use as mini-umbrellas for backpacks and gear. When the rain let up, Fred placed a call to get a weather report for the rest of the day — bad news for tracking. Aside from cooling temperatures, which caused iguanas to seek shelters, carrying large metal antennae during a storm is rather risky. We packed our gear, and beat a soggy retreat from the Salina.

9 May 2007

The Salina was absolutely beautiful today. The vegetation was still beaded with rain drops. The temperature was a pleasant 81.1 °F, but the humidity had to have been 100%. After the long stretch of dry weather, you could almost hear the Salina sucking it up.

The real beauty of the morning was from the sounds that were heard, and the sounds that were not. With no wind rustling dry palm fronds, we could hear the birds so much more clearly. The most prominent was the call and response of

Northern Flickers (*Colaptes auratus*). The stillness of the air also improved our ability to hear iguanas for tracking. The rains brought out the anoles, which could be heard as they bounced from plant to plant, sometimes fooling us into thinking they were passing iguanas (yes, they can sound that loud). I witnessed a pair of male Grand Cayman Anoles (*A. conspersus*), one brown, the other gray, act out a territorial ritual of headbobbing and full extension of their bright blue dewlaps. I frequently have seen Black Crabs (*Gecarcinus ruricola*), but today was the first time I saw the Land Crab (*Cardisoma guanhumii*), which is considerably bigger and more menacing. I don't startle easily, but this crab got me good as it sidestepped across the path where I was not expecting anything but an iguana. Everything was coming alive after a refreshing drink of water.

Tracking was fairly uneventful due to the previous day's storm, with cooler temperatures and only partly sunny skies. Many of the iguanas spent the night where they were caught in the rain yesterday, instead of returning to their normal retreats. Then the rains came again. As the skies opened up, we were discussing our exit plan after another half-day of data collecting. As I closed traps for the day, I did see "Wiggly Worm" duck into the rocks where he had been hanging out. I followed his trail and at last discovered the location of his retreat, a large fissure in a mound of karst rock. This will be priceless knowledge as we continue our attempts to trap him for the radio-tracking study. The day was not a total loss!

Another great discovery was the sight of "Egypt" (GYP, green-yellow-pale blue) as we slogged our way from the CZ to the North Zone (NZ) on our way to the Queen's Highway. Fred had been wondering where this male had been. Was he displaced by "Wiggly Worm" or did he just not make it? Now we know. He casually crossed the trail in front of us during the downpour, barely acknowledging us, but providing us ample chance to visu-



A spectacular Cuban Tree Frog (*Osteopilus septentrionalis*) that inhabited the garden outside the Boddentown residence.

ally check his proportions and to breathe a sigh of relief on seeing this guy alive and clearly doing well.

10 May 2007

Today was not a banner day. Equipment shortages and losses slowed us down. I was the designated trapper today, and came up with a goose egg. The only other days during which I was skunked could be attributed to the weather (and were not my fault!). A ten-hour day in the Salina seems never-ending when you are hot, sweaty, and feel like you are not contributing.

We had a “guest” in the Salina today, a Master’s degree student from Exeter University who was shadowing us to learn some of the basics of radio-tracking animals. His project will involve the introduced Monk Parakeet (*Myiopsitta monachus*) on Grand Cayman. He handled the terrain fairly well for his first time, but I think he managed to develop a healthy respect for what we do.

One of the few positives of the day was the return of other forms of wildlife to the Salina after the recent rains. The anoles came out in force, with many large adult males displaying to their rivals. The bush seemed alive with birds, and for the first time I heard Grand Cayman Parrots (*Amazona leucocephala caymanensis*) chattering in large numbers. They inhabit the thicker forests in the Salina, but today they were heard throughout the xerophytic scrub. I also heard one of my favorites, the croaking of the Cuban Tree Frog (*Osteopilus septentrionalis*), which reminds me of some of the carbonation-generated noises produced by my son.



grW displaying the beadwork that helps trackers with binoculars to easily identify individual iguanas.



DOUG BELL

A racer (*Alsophis cantherigerus*) captured by the author at QEII Botanic Park.



The “engineered” trap created to catch Wiggly Worm (WGW), a very large and cunning male Blue Iguana.

11 May 2007

I was going to be tracking all day along with my trapping duties. Things were not looking good in the morning, when a large gray cloud seemed to literally cover the Salina Reserve. I went to rebait my traps around 11:30 am to give them something fresh during the “dead hours” of the day. While I was engineering a “chute” for a young iguana, grW (small green-small red-white), to go directly from its retreat to a trap, I received a call from Fred that I had an iguana in another trap. It was YBY (yellow-blue-yellow), a male we had yet to see during our jaunts through the Salina, and a needed candidate for the study. I carefully (more for my health than the iguana’s) removed him from the trap and carried him back to the processing center at base camp when I received another call from Fred that I had yet another iguana! It was the trap I had just baited with the engineered chute! Things were rolling now. Fred and I rapidly processed the pair of iguanas so we could get back to our tracking rounds, but all were pleased with the trapped pair, especially another much-needed two-year old.

Another interesting result of recent rains seemed to be the hatching of anoles. Very small hatchlings were everywhere, leap-

ing from branch to branch like monkeys. Sightings of racers (*Alsophis cantberigerus*) also began to increase. These are beautiful snakes that are opportunistic feeders, which unfortunately includes young iguanas. Interestingly, if you are fast enough to catch one of these snakes, they never bite, unlike their cousins in North America in the genus *Coluber*. However, you will be generously coated with some nasty smelling musk.

Tracking was fairly uneventful today due to the large gray cloud that continued to hover over us. The exception was Doug's iguanas, which continued to have him running madly through the bush. We actually had a cool ocean breeze hitting us in the afternoon, which is wonderful for us endothermic bipeds, but not so good for iguanas. Temperatures in the mid-80s make them want to head for shelter.

We continued to track Wiggly Worm, the big old male we had yet to trap, monitoring him visually as well as we could. He seemed more interested in cruising his territory than eating the "treats" we left for him. We also believe he may be trap-shy as he may have triggered a smaller trap, wiggling his way out unharmed but full of newfound wisdom. Fred decided that we needed to engineer a chute that would give him no option but to be funneled into a trap when he heads out in the morning.

We were optimistic for tomorrow as we started our long trek out of the Salina. To cap our day, Fred found the GPS unit we had lost the day before.

12 May 2007

Saturday morning, and Doug and I feel as though we have been hit by a truck (possibly the same one). This would be our eighth straight day in the Salina. Other than two days cut short by storms, we had no time off to lick our wounds. Even on the half days, we had to hike in and out of the Salina, which is half the battle. However, we are eager to see if we caught ourselves a Wiggly Worm.

We did our first round of tracking at 8 am. Afterwards, I set some traps and checked Wiggly Worm's status. No iguana in the overnight trap — but, while I was nearby setting a mid-sized trap, I heard the distinct sound of claws on metal coming from his retreat. We set out again for our 9 am round, and, when I returned, there he was looking quite sedate in his metal trap. I



Whitewood flowers, a natural food source and bait item for Blue Iguanas.



The author and Wiggly Worm (WGW) just before his post-processing release.

immediately phoned Fred so that he could meet me at base camp after his current round and help process the big male — and big he was, measuring in at almost 1.5 kilos. He was the biggest iguana we had processed, and I actually put on a leather glove to remove him from the trap for fear of having my hands and wrists shredded by powerful claws as he struggled to free himself.

Meanwhile, in the west end, Doug continued to observe fascinating inter-iguana social dynamics among the several resident males and females. Imagine Blue Iguanas playing the parts on the "Bold and the Beautiful." One of the iguanas on my circuit, OGO (orange-green-orange), decided to explore a new "frontier," which left me doing a lot of bush-whacking to find him. I traversed a specific route so many times that in the process I inadvertently started a new trail, breaking numerous branches to get to him.

I heard a new bird call today, which sounded quite bizarre. It was the Mangrove Cuckoo (*Coccyzus minor*), which sounded more like a frog call than a bird. Fred said that they are often called "rain birds," since many Caymanians believe that you hear them before it rains, but he believes that they are more likely to call after the rain. Today, however, they called before the rain, although we received only a light sprinkle at midday. Nevertheless, storm clouds were within sight (and sound).

A major thunderstorm north of us brought clouds and cooler weather in the afternoon, leading to an early bedtime for most iguanas, so we called it quits an hour early to avoid the collection of unimportant data points. We decided that the next day

would be a day of rest, as both Doug and I needed to give our aching feet and ankles a break from the razor-sharp karst rock.

13 May 2007

A day of rest in Boddentown gave me a chance to relax and enjoy some of the local wildlife not found in the Salina. The beach is well-populated with Curly-tailed Lizards (*Leiocephalus carinatus varius*) or “Lion Lizards,” which offer a great deal of entertainment during daylight hours. Last year when I stayed in Boddentown, a pair inhabited a large concrete structure in the middle of the beach. Sure enough, another pair (possibly the same pair?) was residing in the same location. This time, however, many neighboring curly-tails caused the dominant male to be constantly on the alert to defend his territory. Once he took a break to breed the female, who, judging by her reaction, was quite receptive to his advances.

Another distraction came from a horde of hatchling Black Crabs. They are everywhere, crawling on the floors and walls of structures, and likely in the dried grass outside. I even found some in my clothes and hair! I couldn't help but think of the enjoyment my son would have with all of these baby crabs.

A major storm moved through in the afternoon, extinguishing any pangs of guilt at not being in the Salina. Unfortunately, it put a damper on our plans to take an afternoon snorkeling trip to Smith's Cove, because the rough water persisted for the rest of the day. By the end of the afternoon, I noticed that the swelling in my feet and ankles had subsided, and my numerous Maiden Plum spots were starting to fade. This day off was just what I needed to build up some vigor for my last two days of fieldwork.

14 May 2007

Back to the Salina, where the number of iguanas in the study now stood at 18, so we decided to divide them into groups of six based on their apparent territories. Of course, some of the dominant breeding males travel all over the CZ, so the divisions didn't always help a tracker's hourly rounds as much as one might hope. Doug especially can attest to this unfortunate reality.

The clouds stayed away for the most part, allowing the iguanas to toast up for the day's activities. For the trackers, it was another story. The humidity was higher than normal, especially



A nesting test hole at QEII Botanic Park.



The author releasing YOY after the iguana was trapped and processed.

after the rain the day before. The strong breeze that occasionally blew cool air off the ocean was bitter-sweet, as it felt refreshing but also stirred our stench. Regardless, we all collected a great deal of data for Fred's research.

One of my four-year-old females, GOP (green-orange-pale blue, “the Republican”), was out and about, which was nice, as she seems always to be hunkered down in her rocky retreat. Unfortunately, her adventures were interrupted by a hormone-driven Wiggly Worm, who was intent on either breeding or mate-guarding her. The nervous GOP quickly made for another hole, and didn't reappear for the rest of the day.

Amazingly, I caught my first anole as we began our last round of the day. On all of my previous visits, I could never catch one, but I caught a large male as he was displaying to another. I think I was more shocked than he was, but he quickly answered with a loud squeak and surprisingly strong bite to the palm of my hand. Luckily, Doug was there to capture the moment with his camera.

15 May 2007

Today is my last day in the Salina, so I am trying to soak it all in as I hike into the CZ. Fred has a bruised knee, so for once we get there before him. The leaves have finally dried from Sunday's heavy rain, but the humidity is still much higher than normal, and the continuous stream of sweat has my shirt completely soaked by the time I get to base camp. Because we are early, I am able to set a trap before my 8 am round of tracking.

Today turns out to be a very odd day of tracking, as we all get many peculiar readings. A lot of this is expected and attributable to signals bouncing off the large blades of karst rock, but some new problems are cropping up. The antennae and the worn cords on the receivers are starting to show some wear and tear. At one point, Fred is getting a 99% reading, which would indicate that the iguana is just under your nose, but instead I see the iguana around 10 m away in the opposite direction. Similar conflicting signals have me going the wrong way quite frequently, which proved very frustrating.



Can you see the iguana?

Doug calls us with good news. He has BYB (blue-yellow-blue), a five-year-old male who has joined the already interesting behavior dynamics of 2.2 iguanas in the western part of the CZ. He was originally released in the NZ and has migrated south, putting our study group at 19, one shy of the goal of 20. Interestingly, Doug did not trap the large male, but instead, simply grabbed him. Apparently, BYB was so focused on breeding OPY (orange-pale blue-yellow) that he did not even notice Doug moving in. Very impressive on Doug's part (nice grab, mate!), but this set Fred and me back as we had to take the time to process BYB, and then do our own round of tracking. Because the middle of the day is when iguanas are most active, this had us running straight for about two hours in the tropical steam of the Salina.

Our clear blue skies turned to storm clouds in mid-afternoon, which sent the iguanas into their retreats for the day. We finished our last round at 3:30 pm as it started to sprinkle, so we cut our day short and began what would be my last hike out of the Salina during this tour of duty. I couldn't help but have mixed feelings of relief and sadness as we trekked out.

I spent my last night at Sunset House, a dive resort in southern Georgetown on the edge of the sea. Doug, Fred, and I enjoyed a great meal while watching the sea swallow the sun.

16 May 2007

I am now sitting at Owen Roberts International Airport, awaiting my departure from Grand Cayman and left to contemplate the past two weeks. I'm always excited about escaping my job at the zoo to take in some fieldwork. I like to think of it as great therapy for my "professional sanity reclamation project." Playing a role in a field project such as that run by BIRP is also very rewarding. I'm proud to have been part of a great team that is

working to save an endangered species, especially one as beautiful and charismatic as the Grand Cayman Blue Iguana, the Blue Dragon of the Caribbean.

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CONSERVATION RESEARCH REPORTS

Herpetofaunal Use of Riparian Buffer Zones in South Africa

Habitat transformation is a growing threat to global biodiversity. Many species in South Africa, including reptiles and amphibians, are threatened by broad-scale habitat transformation as habitats are converted to agricultural uses. Understanding how wildlife uses these landscapes is critical for effective land management and for predicting how populations might react to changes in habitat quality. MARITZ AND ALEXANDER (2007. *African Journal of Herpetology* 56:163–169) surveyed herpetofaunal species richness and abundance in riparian and non-riparian habi-



BRYAN MARITZ



GRAHAM ALEXANDER



GRAHAM ALEXANDER



GRAHAM ALEXANDER

Amblyodipsas polylepis, *Lycodonormorphus rufus*, and *Philothamnus hoplogaster* (from top) were captured in riparian areas only, whereas *Mehelya nyassae* (bottom) was detected in both habitat types.

tats to determine how these animals utilize different habitats within agricultural landscapes near Mtunzini, KwaZulu-Natal, South Africa. Riparian areas had a higher mean species richness and abundance than adjacent agricultural areas, and hosted 80% of all herpetofaunal species detected. Ten species were unique to riparian areas, including snakes, lizards, and frogs. In contrast, non-riparian areas hosted only four unique species. These results indicate that conversion to agriculture is not desirable from a herpetological conservation perspective, and that preserved riparian areas can serve as corridors for herpetofaunal species to survive and migrate through otherwise less hospitable terrain.

Habitat Disturbances Affect Growth Rates in Turtles

Disturbances often help structure ecological communities, and their effects may have consequences on population dynamics and long-term species persistence. Should disturbances affect resources, a trade-off may result between reproduction and individual growth, which could affect the timing of sexual maturity in animals dependent on reaching a requisite size for the onset of maturation. DODD AND DRESLIK (2008. *Journal of Zoology* 275:18–25) used a 14-year mark-recapture dataset to determine the effects of catastrophic storms and the removal of nonindigenous vegetation on individual growth rates of a long-lived turtle, *Terrapene carolina bauri*. Adult male growth rates increased 19% after the disturbances, whereas female growth rates decreased by a similar percentage. Juvenile growth rates briefly increased, but as these animals became subadults, their growth rates slowed after disturbance, a change more pronounced in females than males. After the disturbances, the onset of male sexual maturity decreased by about 1 year (from 10.8 to 9.5 years), female maturity was delayed by 2.5 years (from 8.5 to 11.0 years), and the subadult life stage was extended from 2 to 3.5 years. With resources and habitats similarly available to adults, the authors suggested that adult females diverted resources from growth to repro-



C. KENNETH DODD, JR.

duction, whereas males allocated available resources to growth. Subadult growth rates decreased regardless of sex, implying that fewer or lower quality prey were available to smaller turtles in the years following disturbance. The results of this study suggest that habitat disturbances affected individual growth rates differently according to sex and life stage, which affected the timing of maturation. In long-lived vertebrates, such perturbations on life-history traits such as growth rates likely affect population recovery, and may help to explain why turtle populations recover slowly following catastrophic disturbance, even when adult survivability is high.

Alligator Snapping Turtles in Oklahoma and Kansas

Alligator Snapping Turtles (*Macrochelys temminckii*) historically occurred in the Arkansas, Caney, Verdigris, Neosho, and Spring river drainages of northern Oklahoma and southern Kansas. High harvest rates in Oklahoma and river impoundments in both states have greatly reduced turtle numbers by decimating populations and impeding dispersal routes. Populations of *M. temminckii* are poorly studied in both states, but particularly so in Kansas. Management efforts for *M. temminckii* were initiated in Oklahoma in 1997 with the collection of information on distribution, habitat use, and population structure, and establishment of a captive breeding/headstart program. Management efforts in Oklahoma



SUZANNE L. COLLINS, CMAA

Management efforts for Alligator Snapping Turtles (*Macrochelys temminckii*) in Oklahoma could have positive repercussions for the species in Kansas.

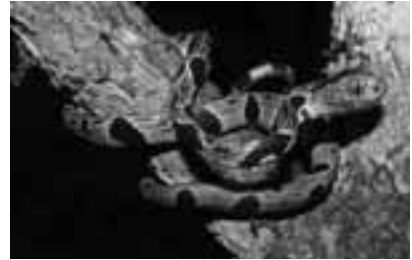
could have positive repercussions for the species in Kansas. RIEDLE ET AL. (2008. *Transactions of the Kansas Academy of Science* 111:21–28) outlined current knowledge of the species in both states, provided information on management efforts for the species in Oklahoma, and

made recommendations for interstate collaboration for managing the species in Kansas.

Ranching to Conserve Horsfield's Tortoises

According to CITES, ranching is a method based on the collection of eggs, incubation, and artificial hatching. Since 1997, associates of Zoocomplex (Tashkent, Uzbekistan) have studied hatching of Horsfield's Tortoises (*Agrionemys horsfieldii*) on farms at commercial levels. BYKOVA ET AL. (2007. *Russian Journal of Herpetology* 14: 232–236) obtained 20,000 eggs from tortoises kept in captivity, those temporarily kept in the nursery, and collected in the wild. Egg lengths varied from 36.1–56.5 mm. Survival rate of eggs was

75%. Body sizes of hatched tortoises were positively correlated with egg sizes. The size of hatched tortoises was 25.2–48.6 mm and about 20 g. During seven months of rearing, 5% of hatched tortoises died (versus 70–90% in the wild). Of 15,000 hatched tortoises, 29 twins (13 normal and 16 pairs asymmetrical) and four terato-twin abnormalities with varying levels of terato-duplication were recorded.



H. MAURICIO ORTEGA-ANDRADE



CÉDRIC COUTARD, WWW.CHELOIOPHILE.COM

Ranching Horsfield's Tortoises (*Agrionemys horsfieldii*) in Russia has been successful and may provide a hedge against extinction in nature.

Dipsas andiana, a little-known dipsadid snake endemic to Ecuador, is associated with seasonal forests of the West Ecuadorian zone.

Conservation Status of the Ecuadorian Snake *Dipsas andiana*

While studying the distribution and natural history of *Dipsas andiana*, a little-known snake endemic to Ecuador, CISNEROS-HEREDIA (2007. *Russian Journal of Herpetology* 14:199–202) determined that the conservation status of *D. andiana* would classify for the IUCN category "Near Threatened" (NT). The ecological distribution of the species is apparently related with seasonal forests of the West Ecuadorian zone, a recently recognized biogeographic region between the very humid Choco and the dry Tumbesian zone.

Serpents and Dragons: Finding the Beauty in the Beast

Limited Edition Press — Now Available!

The photo book, *Serpents and Dragons: Finding the Beauty in the Beast* has just been released by Michael Kern, an officer of the IRCF. Photographing in the field and studio, Michael has been recognized worldwide for his ability to capture the beauty and personality of his natural subjects. The book contains striking images of many rare, exotic, and endangered creatures including two IRCF-sponsored species, the Guatemalan Beaded Lizard (*Heloderma horridum charlesbogerti*) and the Grand Cayman Blue Iguana (*Cyclura lewisi*). More information about the book and how to purchase it can be found on Michael's website <<http://www.thegardensofeden.org/>>.



NATURAL HISTORY RESEARCH REPORTS

Foraging Mode and Locomotion

Foraging mode has molded the evolution of many aspects of lizard biology. From a basic sit-and-wait feeding strategy, several lizard groups have evolved a wide foraging strategy, slowly moving through the environment using their highly developed chemosensory systems to locate prey. MCELROY ET AL. (2008. *Journal of Experimental Biology* 211:1029–1040) studied locomotor performance, whole-body mechanics, and gaits in a phylogenetic array of lizards that use sit-and-wait and wide-foraging strategies to contrast the functional differences associated with



ROBERT POWELL

Anoles, such as this *Anolis stratulus* (top) from the British Virgin Islands, are classic sit-and-wait predators that use elevated perches to scan the area below for prey. In contrast, Dominican Ground Lizards, *Ameiva fuscata* (bottom), employ a wide-foraging strategy, slowly moving through the environment using their highly developed chemosensory systems to locate food.



AMANDA LAINE

Melanism in Black-banded Sea Kraits (*Laticauda laticaudata*) is not linked with thermoregulatory efficiency, protective coloration, or protection against solar radiation.

the need for speed versus slow continuous movement during foraging. Sit-and-wait species used only fast speeds and trotting gaits coupled with running (bouncing) mechanics. Different wide-foraging species independently evolved slower locomotion with walking (vaulting) mechanics coupled with several different walking gaits, some of which have evolved several times. Most wide foragers retain the running mechanics with trotting gaits observed in sit-and-wait lizards, but some wide foragers have evolved very slow running mechanics. In addition, three evolutionary reversals back to sit-and-wait foraging are coupled with the loss of walking mechanics. These findings provide strong evidence that foraging mode drives the evolution of biomechanics and gaits in lizards and that several means of evolving slower locomotion exist. In addition, the different gaits used to walk slowly appear to match the ecological and behavioral challenges of the species that use them.

Is Melanism Adaptive in Sea Kraits?

Ontogenetic melanism (progressive darkening of the skin) has been documented in snakes. Black coloration of the skin often compromises the cryptic effects associated with other patterns (e.g., zigzags) and exposes individuals to predation; however, the mortality risk presumably can be balanced, for example, by a thermoregulatory advantage during basking. Such adaptive context has been proposed to explain the appearance and the mainte-

nance of melanism in snake populations. Based on a very large capture/recapture sample (>8000 observations) gathered on two species of Sea Kraits (*Laticauda saintgironsi* and *L. laticaudata* in New Caledonia), LORIOUX ET AL. (2008. *Amphibia-Reptilia* 29:1–5) observed that melanism occurred in only one species (*L. laticaudata*), was infrequent, and affected only adult snakes. None of three adaptive hypotheses respectively linked to thermoregulation, predation, or protection against sun radiation, provided a satisfactory account for the occurrence of melanism in the study populations. Therefore, the authors suggest that melanism was a fortuitous phenomenon.

Signal for Mating Success and Survival

Many species of lizards have colored spots on the flanks that may function as ornaments. SALVADOR AND VEIGA (2008. *Amphibia-Reptilia* 29:117–120) investigated the between-years stability of the blue patch color saturation and the relationships between color saturation, mating success, and survival in males of the lizard *Psammodromus algirus*. Saturation values of the anterior blue patch of males were significantly repeatable across years. Survivors had more saturated patches than non-survivors among paired males but not among non-paired males. The positive relationship between blue patch saturation and survival suggests that this morphological trait acts as a reliable signal of male quality measured by adult survival.



Color saturation of the anterior blue patch of male *Psammomodromus algirus* was an “honest” signal of a male’s quality.

Courtship Behavior in Four-eyed Spotted Turtles

LIU ET AL. (2008. *Amphibia-Reptilia* 29:185–195) recorded 168 courtship sequences from 12 male and 18 female adult captive Four-eyed Spotted Turtles (*Sacalia quadriocellata*) and described 30 male and four female discrete motor patterns. Male display patterns involved tactile and visual signals to induce female receptivity to mating. In response, females may emit olfactory signals for gender recognition. Female rejection of male suitors resulted in a male success rate of 4.17%. Only seven copulations were observed. Copulation occurred only when a female became quiescent and relaxed her tail for coition.



Courtship of male Four-eyed Spotted Turtles (*Sacalia quadriocellata*) involves tactile and visual signals. In response, females may emit olfactory signals.

Reproduction and Sexual Dimorphism in a Night Lizard

RAMÍREZ-BAUTISTA ET AL. (2008. *Amphibia-Reptilia* 29:207–216) studied reproductive characteristics of the night lizard, *Lepidophyma sylvaticum* (Xantusiidae) from cloud forest in Tlanchinol, Hidalgo, Mexico. Males reached sexual maturity at a snout-vent length (SVL) of 55 mm, and females

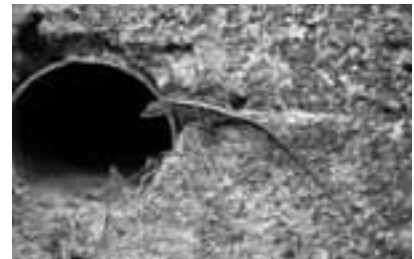
reached sexual maturity at a SVL of 56 mm. Males and females were not sexually dimorphic in SVL, but males had significantly larger heads and limbs than females. Reproduction in males and females was seasonal. Testicular mass increased in July and August, reaching maximum size in September. Minimum testes size occurred in March. Follicles of females began to increase in size in September when vitellogenesis was observed. Follicles in some females increased in mass during January–March, whereas other females ovulated during that period. Late embryonic stages (35–40) were observed in July with parturition likely occurring in July and August, coincident with maximum rainfall. Litter size averaged 4.7 ± 0.4 neonates, and was not correlated with female size. Similarities in reproductive characteristics between *L. sylvaticum* and other xantusiids (viviparity, long gestation period) suggest that some reproductive characteristics have a historical origin.



Reproduction in the tropical night lizard *Lepidophyma sylvaticum* is seasonal, with young born during periods of maximum rainfall.

Predation by Brown Anoles on Spiders in Taiwan

NORVAL ET AL. (2007. *Russian Journal of Herpetology* 14:191–198) analyzed stomach contents in 502 Brown Anoles (*Anolis [Norops] sagrei*) from an area surrounding a plant nursery in Santzepu, Taiwan. The stomachs of 166 lizards contained spiders, which were removed for identification to establish a basis upon which future studies on spider predation by *N. sagrei* in Taiwan can be based. These spiders comprised 298 individuals



Brown Anoles (*Anolis sagrei*) in Taiwan often are highly terrestrial and feed heavily on ground-dwelling spiders.

from 13 families. Unlike other studies, which found that these lizards prey mainly on web spiders, the majority of the spiders in this study are ground-dwelling species. The results from this study suggest that this exotic invasive species is predominantly terrestrial at this locality.

Microhabitat Characteristics for Reptiles in Latvia

CEIRANS (2007. *Russian Journal of Herpetology* 14:172–176) examined vegetation characteristics of reptilian microhabitats using 280 circular plots throughout Latvia. The lizard *Lacerta agilis* preferred xeric sites, and, at the other end of the gradient, both snake species (*Natrix natrix* and *Vipera berus*) preferred mesic sites with a tall herbaceous layer and shrubs. The legless lizard *Anguis fragilis* often was associated with relatively intact pine forest, whereas the other reptiles were associated mainly with disturbed sites and grass cover.



The Slow Worm (*Anguis fragilis*) was more frequently associated with intact pine forest than other Latvian reptiles.

NEWSBRIEFS

Ray Ashton Receives Award

Ray E. Ashton, Jr., President of the Ashton Biodiversity Research & Preservation Institute, Inc., in Newberry, Florida, and one of the founders of the activist group, The Gopher Tortoise Conservation Initiative, was awarded the 2008 Citizen's Award at the 14th Annual Public Interest Environmental Conference held at the University of Florida Law School on 28 February 2008.

The award was presented for his outstanding contributions on behalf of Florida environmental and land use policy. Some of the contributions that Ashton has made include work with local county governments in developing policies that support local conservation of Gopher Tortoises and their habitats. Over the past two years, he has worked with 17 counties to establish programs that will help protect tortoises. Meanwhile, over the past ten years, he has been a strong voice attempting to change the old policies of the Florida Fish & Wildlife Conservation Commission from incidental take to one of long-term management and protection through uplisting the tortoise to threatened status in Florida and to encourage relocation of tortoises to well-managed and protected lands. He has proposed reasonable financing of tortoise management that would insure perpetual monitoring and management for generations to come. He and members of The Gopher Tortoise Conservation Initiative proposed a tax exemption to landowners that maintain natural lands. Today, farmers cannot maintain their agricultural exemptions on these lands and pay the highest taxes on them. Thanks to the Florida Wildlife Federation and other stakeholders, this tax bill and many changes have been brought forward to create an entirely different way of conserving a species.

Although Ashton is not totally pleased with the current rules being presented to the Florida Fish & Wildlife Conservation Commission in April 2007, he supports the direction in which they are going and hopes that the Commission will follow-up on promises to strengthen what is being presented in the near future. If they do not, we will

see a continued decline of Gopher Tortoises and the need for them to be federally listed.

Petition to End Commercial Harvest of Freshwater Turtles in Four Southern States

Conservation and health groups are seeking to end unsustainable commercial harvests of freshwater turtles in four southern states and to stop the exportation of contaminated turtles to international food markets. The Center for Biological Diversity filed emergency petitions with the states of Florida, Georgia, Oklahoma, and Texas to ban commercial turtle harvesting in public and private waters, to prevent further population declines of native southern turtle populations, and to protect public health. Turtles collected in these states and sold as food are often contaminated with mercury, PCBs, and pesticides.

Wildlife exporters and dealers are commercially harvesting massive and unsustainable numbers of wild freshwater turtles from Oklahoma, Florida, and Georgia, the few southern states that continue to allow unlimited and unregulated take of turtles. Herpetologists have reported drastic reductions in numbers and even the disappearance of many southern species of Map Turtles (genus *Graptemys*) in Georgia and Florida, especially in the panhandle. Recent surveys by Oklahoma State University show depletions and extinction of freshwater turtles in many Oklahoma streams, and commercial turtle buyers in Oklahoma reported purchasing almost 750,000 wild-caught turtles from 1994 to 1999. Over a quarter million wild-caught adult turtles captured in Texas were exported from the Dallas-Fort Worth Airport to Asia for human consumption from 2002 to 2005.

"Unregulated commercial trappers are capturing appalling numbers of freshwater turtles in southern states, including rare map turtle species that are so depleted they may need protection under the Endangered Species Act," said Jeff Miller, conservation advocate with the Center for Biological Diversity. "Collectors could legally harvest every

non-protected turtle that exists in the wild under the inadequate regulations that currently exist in Florida, Georgia, and Oklahoma. These turtles are an important part of aquatic ecosystems and should not be allowed to be wiped out."

Most wild turtles harvested in the southern United States are exported to supply food markets in Asia, primarily China, which has depleted or driven most of its native freshwater turtles to extinction in the wild. Numerous southeastern turtles are sold to Asian seafood markets in the United States as well. Many of these turtles are harvested from streams under state and federal fish advisories and bans that caution against and prohibit human consumption due to aquatic contaminants that are carcinogenic or harmful to humans such as DDT, PCBs, pesticides, mercury, and other heavy metals. Turtles live longer and bioaccumulate considerably greater amounts of aquatic contaminants than fish, particularly Common Snapping Turtles (*Chelydra serpentina*) and softshells (*Apalone* spp.) that burrow in contaminated sediments. "Hundreds of thousands of wild-caught turtles are sold locally as food or exported to international food markets from southern states each year, many contaminated with dangerous levels of mercury, PCBs, and pesticides," said Miller. "The potential health implications are staggering."

Because freshwater turtles are long-lived (some may reach 150 years of age), breed late in life, and have low reproductive and survival rates, they are highly sensitive to over-harvesting. Stable turtle populations are dependent on sufficient numbers of long-lived breeding adults to offset natural mortality and human



SUZANNE L. COLLINS, CINAH

Drastic reductions in numbers of Map Turtles (genus *Graptemys*) have been reported in Georgia and Florida. *Graptemys barbouri* is confined to the Apalachicola River system of Florida, Georgia, and Alabama.

impacts. Removal of just two adult turtles from a wild population could halve that population in as few as 50 years, since for each adult turtle removed, the reproductive potential of that animal is eliminated over a breeding life that may exceed 50 years. Commercial collecting of wild turtles intensifies the effects of water pollution, road mortality, incidental take from fishery devices, and habitat loss, which are already contributing to turtle declines. Scientists warn that freshwater turtles cannot sustain any significant level of harvest from the wild without leading to population crashes.

Adult turtles also are harvested from the wild to breed hatchlings in captivity for the international pet trade. Turtle dealers solicit huge numbers of wild turtles from American sources on the internet. A single dealer can employ a virtual army of hundreds of interstate turtle collectors to conduct unlimited turtle harvests in states where commercial harvest is still legal.

Oklahoma, Florida, and Georgia continue to allow unlimited commercial take of all sizes and ages of most species of turtles, using an unlimited quantity of hoopnets and box traps in public and private waters. In these states, many state and federally protected freshwater turtles are incidentally harvested and sold since turtle traps do not distinguish the species captured. Collectors often capture and misidentify protected species that appear similar to non-protected turtles. Hoopnets and box traps also capture, maim, kill, and drown protected turtle species, non-target fish, mammals, migratory birds, and sensitive species such as the federally threatened American Alligator (*Alligator mississippiensis*).

State wildlife agencies in Tennessee, Mississippi, North Carolina, and Alabama have prohibited commercial take of freshwater turtles from the wild. Wildlife biologists from states with bans have advised neighboring states to ban harvests, since wildlife traffickers illegally collect turtles in states where they are protected and claim they were collected in states where harvesting is still legal. Texas, Oklahoma, Florida, and Georgia do not survey to determine densities of turtle populations nor do they require commercial collectors to report the quantity and species of turtles harvested from the wild.

In 2007, the Texas Parks and Wildlife Commission voted to end commercial harvests of turtles in public waters but continued to allow unlimited harvests of some native turtle species from streams and lakes on private lands. An emergency petition was submitted today to the Texas Department of Health to ban all commercial turtle harvests in Texas, due to significant public health risk from consumption of contaminated turtles.

Because of their brilliant topographical patterns and colorations, all 12 species of map turtles from the southeastern United States are highly sought by the international pet trade, despite being protected under the Convention on International Trade in Endangered Species. Some species of map turtles fetch more than \$150 per adult on commercial internet websites. Map turtles are drainage specific; each watershed that drains into the Gulf of Mexico produces a brilliant, unique geophysical pattern and striking coloration on the shell and skin. Many map turtles in Texas, Alabama, Mississippi, Florida, and Georgia warrant federal protection under the Endangered Species Act, and two species, the Yellow-blotched Map Turtle (*Graptemys flavimaculata*) and Ringed Map Turtle (*G. oculifera*), that occur in Mississippi are already listed under the Act due to overcollection for the pet trade.

Also signing onto the petition are the St. John's Riverkeeper (Florida), Satilla Riverkeeper (Georgia), Altamaha Riverkeeper (Georgia), Oklahoma Chapter of the Sierra Club, Lone Star Chapter of the Sierra Club (Texas), Pinewoods Group of the Sierra Club (Texas), and the Center for Food Safety. The petitions and background information on the commercial harvest of freshwater turtles can be found on the Center for Biological Diversity Web site at:

http://www.biologicaldiversity.org/campaigns/southern_freshwater_turtles/index.html

The Center for Biological Diversity is a nonprofit conservation organization with more than 40,000 members dedicated to the protection of endangered species and wild places.

Jeff Miller

Center for Biological Diversity

Rudy Komarek, Rattlesnake Poacher

In early March 2008, Rudy Komarek (aka "Cobra King"), a notorious Timber Rattlesnake poacher and sometime showman, suffered a fatal heart attack at the age of 79. Apart from several well-known bounty hunters who took thousands of Timber Rattlesnakes (*Crotalus horridus*) at taxpayers' expense in three northeastern New York counties and one western Vermont county (see Jon Furman's *Timber Rattlesnakes in Vermont and New York*, University of New England Press, 2007), no single individual had a detrimental impact on northeastern populations of this species as great as that of Komarek.

During the second half of the 20th century, Komarek's extensive commercial collecting of reptiles in New York, Massachusetts, Connecticut, New Jersey, Pennsylvania, and West Virginia flourished in a career that spanned four decades. In 1994, Brown, Jones, and Stechert (*Bulletin of the Chicago Herpetological Society* 29:74-79) detailed Komarek's federal felony conviction for interstate trafficking, describing him as a "nefarious hominid" who single-handedly caused severe depletion or extirpation of many populations of Timber Rattlesnakes in the Northeast.

Using Stechert's long-term monitoring data of many of the same rattlesnake dens that Komarek is known to have exploited, Brown et al. (1994) estimated that Komarek accounted for over 2,900 Timber Rattlesnakes taken from 27 dens in eight counties in New York. We now believe that this estimate is overly conservative. Since our report was published, Stechert has continued to conduct detailed status surveys in New York, the results of which — in conjunction with the poacher's own admissions in recent



Rudy Komarek single-handedly caused severe depletion or extirpation of many populations of Timber Rattlesnakes (*Crotalus horridus*) in the northeastern United States.

BARNEY GOLDFELD

years — now allow us to provide an improved estimate of Komarek's take. Our revised estimate suggests that, over a lifetime of collecting, Komarek took or killed approximately 4,000–6,000 (best median estimate 5,000) Timber Rattlesnakes in New York, as well as hundreds in adjoining states.

Over the past 25 years, the Timber Rattlesnake has been legally protected as a threatened species in New York. Before Komarek fled the state (settling for several years in Pennsylvania and finally retreating to semi-retirement in Florida), he is believed to have had about a fourteen-year period of taking the species following its listing and protection in New York. Although an era of outright depletion of Timber Rattlesnakes may have slowed considerably due to Komarek's demise, we must take note of a variety of new and continuing threats to this snake's habitats and populations caused by greatly expanded urban sprawl in the form of housing and commercial developments.

Randy Stechert
Narrowsburg, New York 12764

and

William S. Brown
Department of Biology
Skidmore College
Saratoga Springs, New York

Last Chance for the Yangtze Giant Softshell Turtle?

With only four individuals of *Rafetus swinhoei* known to exist worldwide (two in China and two in Vietnam), and only one of these a female, the stakes could not be much higher. A historic effort is now underway in China to move the lone female, currently at the Changsha Zoo, to the Suzhou Zoo for breeding with their captive male.

A collaborative effort between the Turtle Survival Alliance (TSA) and Wildlife Conservation Society (WCS), the team responsible for the move arrived in China on 1 May. Led by Dr. Gerald Kuchling (University of Western Australia), the world's leading chelonian reproductive physiologist, the team consists of Paul Calle, DVM (Bronx Zoo), Scott Davis (manager of the largest collection of Giant Softshell Turtles outside of

Asia), Nimal Fernando (Ocean Park Hong Kong veterinarian), Alex Grioni (Kadoorie Farm and Botanic Garden veterinarian), and Mitch Kalmanson, who was contracted by the TSA to insure the female during transport and to handle transportation logistics. A PBS Nature film crew will be on hand to document this incredible event for an upcoming special on efforts to breed critically endangered species in captivity. Chinese media attention promises to be intense as well.

The plan is for Dr. Kuchling and Lu Shunqing (WCS China) to inspect the recently modified breeding facilities at Suzhou Zoo; then, if approved, the female will undergo an ultrasound exam to determine her reproductive status. A 2007 exam indicated that she would likely ovulate in mid-May, so the plan is to have her with the male before then. The female will tentatively be driven to Suzhou, a 620-mile trip, on 5 May. The breeding pond at Suzhou Zoo has been subdivided to allow the pair to see and smell each other and gauge their reaction before the introduction occurs. If mating is successful, the male will be removed and the female left alone to nest.

"I hate to call this a desperation move, but it really is," Rick Hudson, Co-Chair of the TSA said. "The risks are certainly there, but doing nothing is much riskier." The TSA is growing accustomed to high-pressure situations — such is the case when working with critically endangered species — but nothing of this magnitude. The planning that has been

involved to get us to this point has been intensive and has produced a remarkable partnership based on the strengths of both the TSA global network and WCS China. This move has required major financial support (at least \$25,000 and the total could increase) and the following organizations are recognized for their contributions: Turtle Conservation Fund, Batchelor Foundation, Kadoorie Farm and Botanic Garden, Ocean Park Conservation Foundation, and Walter Sedgwick.

Should this move go through as planned look for a media storm to follow. And keep your fingers crossed that this goes well. We may not get a second chance.

Turtle Survival Alliance

5 May 2008.—History is being made today — and TSA is leading the way. The last known female Yangtze Giant Softshell Turtle (*Rafetus swinhoei*) is on her way to join the last captive male at the Suzhou Zoo in China. The team transporting the turtle left Changsha this morning about 2 AM CST, a 3-van caravan (including a PBS Nature film crew) starting an 1,100-km trip. Dr. Gerald Kuchling has inspected the modified breeding pond at Suzhou and recommended some last-minute changes before returning to Changsha, where he performed a reproductive ultrasound exam on the female. The good news is that she has not yet ovulated and has 11 pre-ovu-



GERALD KUCHLING

With only four known individuals, the Yangtze Giant Softshell Turtle (*Rafetus swinhoei*) is likely the most endangered species on earth.



TOMMY OWENS, SAN DIEGO ZOO

Hatchling Roti Island Snakeneck Turtle (*Chelodina mccordi*), one of two rare turtles successfully bred at the Fort Worth Zoo.

latory follicles and good fat deposits. The move appears to be right on time.

6 May 2008.—A call last night from “Team Rafetus” announced that, amid great fanfare, they had just put the female in the breeding pond at Suzhou Zoo. She headed down the ramp into the pool, and surfaced a few seconds later and began looking around. The pond is divided with fencing into three sections. Today, the male will be allowed into that adjacent to the female to allow and assess interaction. Phase 1 of this historic operation is complete, and the team is upbeat about the chances of a successful introduction.

Fort Worth Zoo Announces Significant Hatchings

A Forsten's Tortoise (*Indotestudo forsteni*) hatched on 2 April 2008, and four eggs from other clutches are still incubating. The Zoo's group of 4.2 was assembled in late 2005 for inclusion in the conservation-based collection at the Animal Outreach and Conservation Center (ARCC) that opened in March 2006.

The Zoo also reported the hatching of 13 Roti Island Snakeneck Turtles



RICK HUDSON

Hatchling Forsten's Tortoise (*Indotestudo forsteni*), the other rare turtle bred at the Fort Worth Zoo.

(*Chelodina mccordi*) with another 30 eggs still incubating. This species also is included in the ARCC collection.

Turtle Survival Alliance

Death-Dealing Frogs

Are Bullfrogs a four-legged version of Typhoid Mary, spreading a lethal plague among their fellows but remaining unaffected themselves? That's one of the newer hypotheses for a global die-off of frogs and other amphibians, which may already have led to the extinction of more than 100 species since the 1980s. Other hypotheses include increased ultraviolet-B radiation, pesticides, habitat loss, and a mystery parasite.



S. PRICE, BETHSWATERCHUB(VICTORIA.GOV.BC.CA)

Introduced Bullfrogs (*Rana catesbeiana*) have displaced native amphibians from large areas of southeastern Vancouver Island in Canada — and may be carriers of a deadly fungus.

“It's never going to be one single cause,” cautions Purnima Govindarajulu, a biologist who has been tracking the exploding Bullfrog (*Rana catesbeiana*) population on Vancouver Island for the past decade. A fungus known as Bd may be a major reason that Bullfrogs are supplanting common island denizens such as the Western Toad (*Bufo boreas*) and the Red-legged Frog (*Rana aurora*). Bd is short for *Batrachochytrium dendrobatidis*, a fresh-water mold identified in 1998 as responsible for a disease that's deadly to many amphibians, but not to Bullfrogs, which all carry Bd. Govindarajulu began investigating the island's Bullfrog explosion in 1997 for her Ph.D. at the University of Victoria, supervised by evolutionary ecologist Brad Anholt. Now a herpetofaunal specialist with the B.C. environmental ministry, she is coordinating amphibian collections across the province, but keeping an eye on Bd and Bullfrogs as an adjunct professor at UVic.

“We've found Bd in places here where there are no Bullfrogs. For instance, Rough-skinned Newts (*Taricha granulosa*) also carry it, and they are native to Vancouver Island,” she says. The province is now appealing to all biologists to report dead frogs to get a better handle on the extent of the problem. Meanwhile Anholt's lab is preparing molecular family histories of both Bullfrogs and the Bd fungus. “If the two family histories are congruent then there's a good chance that Bullfrogs are the carriers,” says Anholt.

Peter Calamai
Toronto Star

2008 Gopher Tortoise Council Meeting

The annual meeting of the Gopher Tortoise Council will be held at the Oceanside Inn and Suites, Jekyll Island, Georgia on 3–4 October 2008. The meeting will feature a special session on Friday of presentations on Wildlife and Ecosystem Health, with confirmed presentations by Elliot Jacobson, Sonya Hernandez Divers, Charles Innis, Steven H. Divers, Terry Norton, John Maerz, Scott Connelly, Nancy Stedman, Lori Wendland, Matt Aresco, Kimberly Andrews, and Greg Lewbart. On Saturday, the scientific program continues with contributed presentations and posters on any topic relating to the Gopher Tortoise and the Longleaf Pine ecosystem. A tour of the Georgia Sea Turtle Center will be offered Friday evening. For more information and registration information, please visit the Gopher Tortoise Council's website at www.gophertortoisecouncil.org/events.php.



SUZANNE L. COLLINS, CMNH

The scientific program of the Gopher Tortoise Council will focus on the Gopher Tortoise (*Gopherus polyphemus*) and the Longleaf Pine (*Pinus palustris*) ecosystem.

O B I T U A R Y

Robert F. Clarke (1919–2008)

Dr. Robert F. Clarke, Emporia, Kansas, passed away on 2 April 2008. He was born 18 October 1919 in Portsmouth, Virginia. He married Elaine McNabb of Melvern, Kansas, in 1947. In 1948, he and Elaine moved to Emporia, Kansas, where he was a stationary engineer for the Santa Fe Railroad and a freelance illustrator. Dr. Clarke always had a passion for reptiles and amphibians, and had amassed a large collection. After a rain, one of the biology professors from Kansas State Teachers College (now Emporia State University) found him collecting frogs in a ditch and encouraged him to begin college to pursue his passion, which he did in 1952 at the age of 33. He completed his Bachelors Degree in 1955 and Masters Degree in Biology in 1957 at Emporia State University. He received a prestigious National Academy of Science Fellowship to complete his Doctorate in Zoology at the University of Oklahoma in 1963. The family returned to Emporia and he taught at Roosevelt High School on the Emporia State University campus, then became a Biology Department faculty member at Emporia State University in 1968. He was Chairman of the Department of Biology at Emporia State University from 1972 to 1979. As Assistant to the Vice-President of Academic Affairs from 1969 to 1970, he helped initiate sabbatical leave and tenure policies. He retired from Emporia State University in 1985.

As a naturalist/educator, Robert Clarke taught several areas of biology for more than 30 years, published over 50 works on herpetology, established CPR training programs in Emporia, was instrumental in starting the Chickadee Check-Off Program to assist non-game research in Kansas, was a frequent speaker at colleges and universities as part of the American Institute of Biological Scientists, and was the editor, editor emeritus, and one of the creators of the *Kansas School Naturalist*. As an artist/naturalist, he was ranked in the top ten of Kansas wildlife artists. He designed and illustrated numerous association conference covers and illustrated several covers of the *Kansas School Naturalist*. He developed and illustrated over 100 cartoon-like panels entitled "Something Wild" that appeared in over 25 Kansas newspapers.

Dr. Clarke held the office of President for the following organizations: Southwest Association of Naturalists (1971), Kansas Herpetological Society (1972), and Kansas Academy of Science (1981). He was co-founder of the Kansas Conservation Forum and held over 20 professional memberships. Dr. Clarke received the following awards: The Robert L. Packard



LARRY L. MILLER

Outstanding Educator Award by the Southwestern Association of Naturalists (1989), Kansas Wildlife Federation Conservation Communicator Award (1991), The Governor's Kansas Conservationist of the Year Award (1982). He was a Distinguished Alumnus in 1991 from Emporia State University, Emeritus Professor (1986), and Xi Phi Outstanding Graduate Student in Biology from the University of Oklahoma (1961). In his primary profession of herpetology, the pinnacle of his long and productive career was being invested as a Distinguished Life Member of the Kansas Herpetological Society.

Robert is survived by a daughter, Linda Clarke (Emporia), son, John Clarke (Wichita), and four granddaughters, Jessica, Lacy, Tara, and Kristi Clarke (Wichita). His wife, Elaine preceded him in death. He loved his family, lizards and nature, his art and friends, his Model A, making jokes, and laughter. His smile and Virginia accent will be missed.

Modified from an obituary published in the *Topeka Capital-Journal* on 4 April 2008

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Editors' Remarks

All of us who have had the privilege of working for and with the Grand Cayman Blue Iguanas as members of the various Team Blue crews and in other roles know that caring for these animals has the capacity to bring out the best in us: Compassion, generosity, and devotion to a cause greater than ourselves. The individuals that were murdered were beloved by people around the world. They each had their own histories, habits, and endearing quirks. Sara, Jessica, Eldemire, Yellow, Digger, Pedro, and Matthias had learned to trust their caretakers and were unprepared to expect anything from humans other than kindness. Acts as wanton and merciless as these murders are beyond comprehension, and I find that I feel pity for the people who committed them. How small must be their hearts and how closed their minds that they could not recognize the nature of the creatures they were brutalizing, that they could not appreciate them and be enriched by that experience as many of us have.

AJ Gutman

ERRATUM: In *IGUANA* 15(1): 20–23, Brad Lock stated that he hoped that this breeding season would result in the first fertile eggs of the Guatemalan Beaded Lizard (*Heloderma horridum charlesbogerti*) produced “in captivity” instead of at Zoo Atlanta. Guatemalan Beaded Lizards have been bred successfully on two occasions at the San Diego Zoo (see *IGUANA* 13(3): 212–215).

Statement of Purpose

The International Reptile Conservation Foundation works to conserve reptiles and the natural habitats and ecosystems that support them.

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IGUANA, the Journal of The International Reptile Conservation Foundation, is distributed quarterly.

Annual Rates:

Individual U.S. Membership	\$25.00
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New Respect for the Snakes of Swaziland

Devon Massyn

The Kingdom of Swaziland is a small southern African country with an extremely rich reptilian biodiversity. A new revolution in herpetology has begun in Swaziland with the opening of a new reptile park to serve as the home base for new and exciting work. Genetic work on many species is already under way and a new telemetry study on Black Mambas (*Dendroaspis polylepis*) is slated to begin in the near future.

Many residents of Swaziland, who previously knew very little about their indigenous herpetofauna, have developed a newfound respect for local snakes. One new initiative is to educate people in identification and, in some circumstances, even handling of venomous snakes. Some individuals around the country have been trained to handle calls and efficiently manage residential reptile removals. Snakes are killed less frequently than they were in the near past. Locals are even collecting dead snakes found on roads and bringing them in for their scientific value.

This movement started just two years ago when a local woman developed a strong interest in snakes. With the help of her husband, Clifford Koen, Thea Litschka's new passion grew at an amazing rate. In response, residents are now identifying the snakes they once feared, differentiating between those that are harmless and those that are potentially dangerous. Although most still stay clear of reptiles, they will call an expert instead of just killing a snake. One result is that many lives are saved, as many human bites occurred when snakes were confronted.

This new initiative recently opened its doors to international internships. A select few individuals with some experience will have an opportunity to experience the many African species in Swaziland. Interns will work with the captive collection in the reptile park, assisting with breeding efforts and studies of indigenous species. They also will conduct extensive field research and provide educational outreach to local communities.

The country is alive with reptiles! Range extensions and new species records for the country are reported with some regularity, and ongoing genetic work may reveal new discoveries leading to taxonomic changes. The geographic diversity of the nation has isolated many populations, and Swaziland still harbors many locations that have yet to be explored.

For further information please contact Donald Schultz at don@mfezi.com.



DEVON MASSYN

Thea Litschka shows rangers at a Swazi game reserve a Black Mamba (*Dendroaspis polylepis*) just before release. Now, instead of killing them, many mambas found in residential areas are captured and relocated into protected areas.



DONALD SCHULTZ

Philani and Linda, seen here with a Black Mamba, have been working with snakes for about two years and now regularly conduct venomous snake captures and relocations. Blood is taken from snakes prior to release to support genetic research.



CÉSAR L. BARRIO AMOROS

Top predators in the Venezuelan Llanos are increasingly threatened, emphasizing the need to conserve remaining populations of Green Anacondas (*Eunectes murinus*). See article on p. 92.



BRYAN HAMILTON

Annual surveys are attempting to shed light on the natural history and conservation status of Sonoran Mountain Kingsnakes (*Lampropeltis pyromelana*) in the Great Basin. See article on p. 86.