

TSA | Turtle Survival Alliance

AUGUST 2010

TRANSFORMING PASSION FOR TURTLES INTO EFFECTIVE CONSERVATION ACTION
THROUGH A GLOBAL NETWORK OF LIVING COLLECTIONS AND RECOVERY PROGRAMS



FROM THE PRESIDENT'S DESK

Rick Hudson

Taking the good with the bad... its all part of the business.

Living on the front lines of turtle conservation certainly has its ups and downs — from experiencing the excitement and surprise that comes with the all too infrequent good news, to the lows that accompany the everyday tragic news that we have grown so accustomed to. But, you learn to take the bad with the good and if there is one maxim that always holds true in the conservation business its... *two steps forward, one step back.*

So first, some of the good news. Today, June 17, 2010, we received word that the *Rafetus* female at Suzhou Zoo in China laid her first clutch of the season: 63 eggs. We are optimistic again this year, due to an improved diet and hopefully better calcium stores. In Myanmar, despite intensive gold mining activity around the primary nesting beach, we have recovered 115 new hatchlings of the Burmese Roof Turtle for the captive program — a record number and an unexpected surprise. In Belize, Thomas Rainwater's river surveys, though revealing dismal news on the status of *Dermatemys*, have mobilized the local conservation NGO community to action, and we predict that this will have a catalytic affect in

the region. This unique species, the sole member of an entire family of turtles, is disappearing rapidly due to overexploitation and a unified response is urgently needed. We believe the TSA can lead this effort.

The good news is (of course) tempered with the bad. In Malaysia, the government is advancing plans to channelize the Setiu River in Terengganu, connecting it with the South China Sea to allow fishermen quicker access. This decision would prove devastating to populations of both River Terrapins (*Batagur affinis*) and Painted Terrapins (*B. borneoensis*) in what is arguably the most important *Batagur* site in all of Southeast Asia. In Bangladesh, we learned that a pair of long-term captive Northern River Terrapins (*B. baska*) that we had planned to acquire for breeding had been killed and eaten. The female weighed 27 kg! Like the Yangtze Giant Softshell Turtle, this species faces imminent extinction unless urgent conservation action is taken, and is considered the second most endangered turtle in Asia. In Madagascar, we saw firsthand evidence of a massive new trade in Radiated Tortoise meat, one that is clearly unsustainable and that threatens the existence of this once widespread and abundant species.

So, how does the TSA expect to deal with all these emerging threats while at the same time continuing to fund our core programs, like India and Myanmar? I believe the answer lies in our new Board of Directors, a dedicated, resourceful, and caring group of individuals that usually manages to rise to the occasion. This group is not shy about meeting difficult challenges, and is fast becoming a globally recognized force for turtle conservation. In February of 2010, the TSA Board, in just its second year of existence, approved a ramped up budget that nearly doubled the spending of 2009. Growing expectations can only be achieved

with additional staff, and soon we will hire a full-time Animal Management Coordinator to oversee the captive side of our program. This position underscores the importance we place on captive management and the role it plays in ensuring the survival of *on the brink* species. The upcoming *Cuora* workshop is another example of this commitment.

The 2010 annual TSA symposium in Orlando promises to be our best yet!! New Conference Program Chairs Andrew Walde and Beth Walton have done an exceptional job organizing this year's program and we have a packed agenda that includes special sessions on Madagascar and Chinese chelonians, to be followed by strategic planning sessions for both. With generous donor support for both of these sessions, we will be able to bring in key players from those countries and engage them in a strategic planning process. The TSA symposium is becoming increasingly important in providing that *sense of community* that is so crucial to what we do. People in developing countries need to know where to turn for help, and given the challenges before us this opportunity to share experiences and resources helps restore our optimism and fuel our passion. And, despite our myriad backgrounds, what binds us is our shared commitment to protecting turtles and tortoises. Whether you are on the front lines working to save species where they live or maintaining captive assurance colonies, please know how much we appreciate your dedication to turtle conservation and the TSA.

Finally the TSA magazine has a new look and feel this year thanks to Louie Porras and Eagle Mountain Publishing, LC. Louie has years of experience in the publishing business and has been a pleasure to work with, absorbing much of the editorial work that I did previously. With Heather Lowe out on leave with a new baby, he has been a godsend. Saludos, Louie!!



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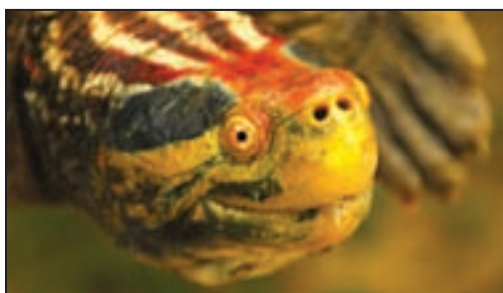
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ABOUT THE COVER: During his first full day in the field on a March 2010 visit to southern Madagascar, Brian Horne made a gruesome discovery. In a trash dump outside the coastal village of Faux Cap, he found the remains of over 200 Radiated Tortoises (*Astrochelys radiata*) that had been slaughtered recently for food. The cover image vividly captures a broken carapace half buried in the wind-swept dunes, a grim harbinger of the carnage that the team would uncover over the following 10 days. For the past 15 years, the number of Radiated Tortoises harvested for food and export has steadily increased, but recent trends are particularly disturbing because they reflect a massive expansion in this trade. Wild populations of these tortoises, especially those close to urban centers, have been decimated and poachers are closing in on protected areas. Formerly numbering in the millions, the Radiated Tortoise now faces a situation similar to that of the American Bison. See story on p. 5.

ABOUT THE PHOTOGRAPHER: Brian D. Horne, Ph.D. currently serves in a dual position, coordinating the development and implementation of the Wildlife Conservation Society's overall turtle conservation strategy as well as directing the Red-crowned Roof Turtle program in India for the San Diego Zoo's Institute for Conservation Research.

Partnerships are Key to the TSAs success

When the TSA was founded in 2001, we described our new organization as a *partnership alliance*. Today that holds truer than ever, and the collaborations listed below represent the realization of our original vision. These partnerships are what sustain us, support us, provide us access to working with foreign governments, and ultimately enable us to grow and exert the impact that we do on turtle conservation; they are the core network that allows us to fulfill

our promise of *zero turtle extinctions*. The challenge of protecting turtle and tortoise species today is far too great for just a handful of organizations. We must be strategic in our development of partnerships in order to be most effective, and to marshal the right resources at the right place and time.

These myriad organizations provide a range of services to our collective mission, including guidance, networking, strategic planning, funding, turtle care

and rescue facilities, animal management, marketing and public relations, field research, logistical and technical support, salaried positions, and a host of other resources. Significantly, some of these partnerships have been with us since the early days, when the TSA was “born,” and all are an integral part of our success. On behalf of the Board of Directors of the TSA, we salute this remarkable group of dedicated partners.



Troubled Times for Radiated Tortoises

Rick Hudson¹ and Brian Horne, Ph.D.²

Borrowing a quote from the late John Behler, these are indeed “troubled times for turtles.” This rings especially true for Madagascar’s Radiated Tortoise, *Astrochelys radiata*, widely considered one of the world’s most strikingly beautiful tortoises. One of four endemic tortoises, *A. radiata* occupies a narrow band of xeric spiny forest along the island’s southwestern coast. Traditionally avoided by indigenous tribes, these tortoises are now routinely harvested for food (Leuteritz, 2005). When John and RH first visited southern Madagascar nearly 20 years ago, Radiated Tortoises were abundant and one could hardly fathom why they were ever classified as an Endangered Species. We drove to the coastal fishing village of Beheloka, and at approximately 4:00 PM it was...in John’s words, “like someone threw the switch.” Radiated Tortoises suddenly began to emerge in numbers and it felt like we were stopping the vehicle every 50 yards to photograph another tortoise. As we gazed down the long, straight, red dirt road, we could see tortoise after tortoise in the distance. Upon arriving in Beheloka several hours later and shortly before dusk, we again found Radiated Tortoises in abundance, as well as numerous

BRIAN HORNE



Not long ago, images such as this were common, with Radiated Tortoises on the road as far as the eye could see.

Spider Tortoises, *Pyxis a. arachnoides* in the coastal dunes around the village. We encountered both species side by side, hunkered under the same *Euphorbia* bush. This day was truly one of those special moments in life that one never forgets.

But those halcyon days are long gone, with populations of Radiated Tortoises having been decimated

in this area during the late 1990s, for human consumption, followed some years later by the mass collection of Spider Tortoises for the international pet trade. Today, only a few scattered individuals of the Spider Tortoise can be found around Beheloka, mere remnants of a once thriving population. Unfortunately, this scenario is now being played



A dump in Faux Cap was littered with the remains of over 200 Radiated Tortoises.



Bonnie Raphael (WCS) trains a Malagasy veterinary student, Tsanta Rakotonana, in tortoise health assessment techniques.



The garbage dump in Beloha contained numerous freshly-killed Radiated Tortoises. Markets here openly sold tortoise meat.

throughout southern Madagascar, and the Radiated Tortoise, once a commonly seen denizen of the spiny forest landscape, has disappeared from vast tracts of its former range. Formerly considered one of the world's most abundant tortoises, with populations conservatively estimated at 12 million (Leuteritz, 2005), the Radiated Tortoise is now ranked as Critically Endangered by the IUCN Red List and unless drastic protective measures are taken, extinction in the wild within the next 20 years is a distinct possibility.

EXTINCTION WITHIN 20 YEARS

After a visit to Madagascar in March of 2010, we predicted extinction for the Radiated Tortoise in the wild within the next two decades, a projection supported in a widely distributed press release by the Wildlife Conservation Society (WCS). The purpose of our joint TSA/WCS expedition was to conduct health assessments on both wild and captive Radiated Tortoises, in preparation for an upcoming release of animals that had been confiscated

from the illegal wildlife trade. On the second day of our trip, one of us (BH) stumbled upon a disturbing site at a garbage dump in the town of Faux Cap. The area was littered with Radiated Tortoise shells (minimally estimated at 200 adults and sub-adults) from animals that were recently slaughtered for food, a grim harbinger of the carnage that we were to discover over the next two weeks.

We also discovered that poaching had heavily impacted populations of the tortoise in areas that just a few years ago supported scores of individuals; we found only a handful of juveniles in these areas, and encountered adults only in close proximity to protected lands. We likened this rate of hunting to what the American Bison faced during the early 19th century when it was nearly hunted to extinction, after numbering in the 10s of millions (Dary, 1974). Although a limited level of subsistence hunting of Radiated Tortoises has existed for decades, generally for holiday celebrations in the city of Tulear, the current rate of poaching is unsustainable. With

this scale of poaching and the rate of decline in this species, which is unlike anything witnessed in modern times, functional extinction of natural populations in 20 years is not an unlikely scenario.

Tortoise extinctions are not new to islands, and certainly not islands in the Indian Ocean. According to the Fritz and Havas (2007) checklist, at least 10 species of gigantic tortoises have been driven to extinction by the actions of humans. Those in Madagascar were the first to go, as two species were lost approximately 750 to 1,050 years ago, shortly after humans arrived. Five species disappeared in the 1700s, from Reunion, Mauritius, and Rodrigues, and in more recent times three more became extinct in the Galapagos Islands.

To date, the work of Sue O'Brien and colleagues (2003) has provided the most scholarly review of the current level of overexploitation of the Radiated Tortoise. These authors presented some startling conclusions, though not all were totally unexpected. They estimated that the annual harvest of Radiated



BRIAN HORNE

Above The team collects samples and data at the Village des Tortues in Ifaty, as part of a pre-release health screening protocol for Radiated Tortoises.

Right: A Radiated Tortoise with prickly-pear (*Opuntia* sp.) in the background. Although the tortoises feed on the cactus fruit, this introduced plant has disrupted the ecology of the region.



RICK HUDSON

Tortoises exceeded 50,000 animals per year, an amount they considered unsustainable based on the following salient points:

- (1) The geographic range of the Radiated Tortoise has contracted by 20% over the last 25 years; tortoise abundance has significantly declined close to centers of high demand; and commercial harvesters are traveling increasingly far to find sufficient densities of tortoises.
- (2) Tortoise density was three times lower and the size of adult tortoises was smaller in harvested populations, compared to an unharvested population.
- (3) Based on several important life-history characteristics, including differential survival rates between adults and juveniles and the female reproductive output, at the current harvest rate their models predicted extinction for a population of 10,000 tortoises within 2–15 years.

- (4) The current harvest is at least 25 times greater than a predicted sustainable harvest, and the authors point out that a juvenile-biased harvest would be much more sustainable.

Unfortunately, the Radiated Tortoise is being impacted by indiscriminate collection at two critical stages of its life history, as both juveniles and adults are being taken. Aside from the slaughter of adults for food, we received reports of thousands of small Radiated Tortoises leaving the Antananarivo airport on direct flights to Bangkok, Thailand, from where they are distributed to markets in Asia, most notably China, Indonesia, Japan, Malaysia, Singapore, and the former Soviet Union. Recent work by TRAFFIC indicates that Radiated Tortoises are being smuggled into Southeast Asia at an alarming rate, through Thailand, and that they are now the most commonly observed chelonian in the trade (Nijman and Shepherd, 2007). This “one-two harvesting punch” will

almost certainly render recovery of unassisted populations of Radiated Tortoises impossible

The paradoxical question remains as to how the Radiated Tortoise has managed to sustain such remarkable population numbers prior to these modern times, when other species have long since undergone catastrophic population declines (e.g., the African Spur-thighed Tortoise and the Burmese Star Tortoise). The answer is *fady*. The dominant tribe in southwestern Madagascar, the Mahafaly, do not eat tortoises and hold on to a long-held belief that harming them is taboo, or *fady*. Unfortunately, these local customs that protected tortoises for centuries are being lost to the rapid westernization of traditional societies. In addition, this particular tradition of *fady* is not being respected by outside tribes, especially those in the highlands of central Madagascar. Members of other tribes are now coming to the area specifically to collect tortoises for sale in major cities, and to meet the demand for bushmeat



BRIAN BORNE



RICK HUDSON

Left: A Radiated Tortoise with telltale evidence of feeding on *Opuntia* fruit. **Center:** Cap St. Marie, the windswept southern tip of Madagascar, supports a robust population of Radiated Tortoises. **Right:** All age classes of Radiated Tortoises can be found at Cap St Marie, a small protected area that supports one of the highest densities of tortoises in the world.

fueled by large-scale international mining operations in southern Madagascar. For instance, tortoise populations have been extirpated in areas surrounding large urban centers in the south (Tulear and Ft Dauphin). Even more disturbing, recent evidence indicates that poachers are searching for tortoises in distant and remote areas that are often extremely difficult to reach, as evidenced by poaching camps discovered with the remains of hundreds of tortoises (C. Castellano, pers. comm.). Local informants are also reporting that trucks loaded with Radiated Tortoises and/or dried tortoise meat have been recently spotted on their way to the Antananarivo. Furthermore, in towns such as Beloha and Tsiombe, fresh tortoise meat is being sold openly without the fear of prosecution. This dire situation is exacerbated by the following factors:

- Several years of extreme drought have led to diminished rice and agricultural production, and poverty, leading people to collect the tortoises for cash so they can purchase rice and corn.
- An arcane law dictating that wildlife laws must be enforced from afar (Antananarivo, or a regional office), and thus local officials have no legal capacity to apprehend poachers. Enforcement action is often several days away, which makes the system easy to circumvent.
- Severe habitat degradation of the xeric spiny forest, now regarded as the most endangered forest type in Madagascar (< 2% remains), and one of the most important for conserving endemic plants. Few intact examples remain, primarily in a limited number

of protected areas. Following the burning and clearing of forests for agriculture (slash and burn), invasive plant species are outcompeting native species, particularly *Opuntia* sp. (prickly pear) and *Agave* sp. (sisal) that now dominate the landscape. The problem is exacerbated by an overabundance of Zebu Cattle that sustain themselves almost entirely on *Opuntia*, which facilitates the plant's dispersal through the spread of its numerous seeds in the dung. Large numbers of goats also share the habitat, and charcoal production consumes any large trees left standing after burning. Fortunately, in this highly disturbed and man-altered habitat, the Radiated Tortoise is still able to "make a living" and survive. The tortoise, however, cannot survive the current threat of wholesale collection for the food market.



RICK HUDSON

- The recent collapse of the central government and political instability. In short, the government is effectively non-operational, international tourism is at a modern low, and any and all natural resources are apparently for sale in marginal efforts to keep the government “running” by funding the payroll of federal employees.

Perhaps the most troubling trend is that poachers are now entering protected areas (Special Reserves, National Parks, World Heritage Sites) to collect tortoises. One of the largest remaining populations is in the Cap Ste. Marie (CSM) Special Reserve, a small (17 km²) protected area with one of the highest densities of tortoises in the world (once estimated from 1,905 to 2,105 individuals/km²; Leuteritz, 2005). But, with only a handful of

guards to protect the reserve and no means of making daily patrols to deter poaching, this near pristine site remains highly vulnerable. The guards lack motorcycles or all-terrain vehicles; rather, they might occasionally hitch a ride in an ox-cart. The only real protection comes from the fact that the park is isolated and difficult to reach. This protection is fleeting, however, as once the population of tortoises outside the park is diminished the poachers will eventually make their way into the park. This situation was confirmed through conversations with the CSM staff, who admit that they are aware of the looming crisis but are poorly prepared to deal with the impending threat. We heard similar stories from the staff at Lac Tsimanampetsotsa, Madagascar’s newest National Park, where poaching has already heavily impacted tortoise populations largely due to the park’s close proximity to the city of Tulear. Here, we observed primarily adult individuals and speculated that collectors had already extracted the juveniles for shipment to Asia.

Given the urgent nature of the present crisis, what can we do to help? How can we engender support for protecting tortoises in the face of such grinding poverty? The solutions will not be easy, because of the number of people and domestic livestock trying to eek out an existence in this harsh, desert environment. Moreover, this situation can only become worse as Madagascar contains one of the fastest-growing populations in the world, with the majority of people under the age of 12.

VITAL PROTECTED AREAS

We believe that at least one solution begins with the Madagascar National Parks (MNP; formerly ANGAP), a private association that manages the protected areas network and operates under the

Ministry of the Environment and Forests (MEF). With only two protected areas that support robust populations of Radiated Tortoises, we must find ways to empower and strengthen them to meet this challenge. Given the importance of the CSM as a major “source” population, might the concept of an Adopt-a-Park relationship prove effective, as it has elsewhere? Could the TSA gear up support to more effectively manage this critical population, given that high dollar items such as vehicles are so desperately needed? Perhaps more importantly, do we really have a choice? If we can not draw a “line in the sand” around the protected areas, we will almost certainly loose this species in the wild.

A second but equally important solution involves the development of community-based protection programs, whereby local villagers assist the MNP staff in patrolling and monitoring tortoise populations within and around the protected areas. In order to encourage such cooperation, we need to find ways for improving the lifestyles of the local people as an incentive to support protective measures. We found an enthusiastic group of locals in the village of Antsakoamasy, located on the outskirts of the Park, who are already doing a good job of protecting the tortoises. We engaged them to find out why, and what they hoped to gain, by protecting the tortoises and challenging the poachers. We learned that they need a water catchment basin (estimated at ca. \$12,000 US), so they no longer have to purchase water; some villagers told us that they spend up to ¾ of their annual income on drinking water. Something this simple, therefore, could prove transformational in their lives and likely forge a lasting relationship with conservation groups trying to save the tortoises. If you put the \$12,000



RICK HUDSON



Left: Most people in Madagascar are under the age of 12. **Right:** Villagers at Antsakoamasy examine brochures and a copy of TSA Magazine. Located just outside the Cap St. Marie Special Reserve, this village could become a model for providing community-based protection for Radiated Tortoises.

amount into perspective, the sale of surplus offspring from Radiated Tortoise captive breeding programs in the United States alone could easily generate this sum in a year.

KEYSTONE SPECIES

If the spiny forest habitat has a keystone species, it is almost certainly the Radiated Tortoise. This species has become an icon for southern Madagascar, one that every tourist expects to see (with lemurs of course), and if conservation groups need a landscape species to rally around, this is it. Surviving in both disturbed and “undisturbed” habitats, the Radiated Tortoise is one of the most highly visible components of this tortured ecosystem, and losing it to provide meat for celebratory meals would be a travesty. But then, travesties of nature are not new to Madagascar!

The ongoing crisis with the Radiated Tortoise should be a call to action for all of us — a rallying cry if you will — because if we lose this durable symbol of longevity and survivorship from the spiny forest, what will be left to save? We hear conservation groups say that “we don’t do single species conservation,” but if we ignore the plight of the

Radiated Tortoise then the question becomes, “at the end of the day, what have we really achieved in southern Madagascar?” We believe this species must become our barometer for success in this ecosystem. *If we lose the tortoise, then everything else will not be far behind.*

The TSAs goal is to develop partnerships with groups already working at the community level in the south, such as WWF Madagascar, which has an extensive education network and is able to impact conservation on a broad scale. At Bernard Devaux’s Village des Tortues, plans are in place to reintroduce Radiated Tortoises into Lac Tsimanampetsotsa National Park, while cultivating community support. Nearby, personnel from Henry Doorly Zoo’s Madagascar Biodiversity and Biogeography Project are working in the Lavavolo Classified Forest to find an alternative fuel source to charcoal, thereby protecting tortoise habitat from burning and agricultural conversion. The TSA supports both of these programs, and hopes to soon forge a closer working relationship with the CSM Special Reserve staff to protect this incredibly important population. Radiated Tortoises will

not survive unless we can encourage community support for their protection, and we are challenged to find innovative solutions that will benefit the local villages. With local support, we should be able to strengthen the infrastructure at protected areas so that tortoise populations can be more closely monitored.

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The TSA Welcomes Two New Board Members

The TSA is pleased to announce that the appointment of two new members to the Board of Directors. Lonnie McCaskill was approved at the February 2010 meeting in

New York, and Russ Mittermeier will come on officially at the August Board meeting in Orlando, just before the annual conference.



RICK HUDSON

in zoo animal management, and for the past 13 years has been employed at Disney's Animal Kingdom.

Lonnie McCaskill has been with the TSA since Day 1, as an active participant in many aspects of our field programs and a central figure in our annual conference. Since the first meeting in 2003, he has worked on our projects in India, Myanmar, and Cambodia, and has served as the TSAs Conference Coordinator. In the winter of 2001–2002, he also played a leading role with logistics and coordinating the Hong Kong turtle rescue event staged in Florida. Lonnie has 26 years of professional experience



CONSERVATION INTERNATIONAL

Russ Mittermeier has also been with the TSA from Day 1 and was instrumental in supporting the group, through Conservation International (CI), during its formative years. Russ is currently the President of CI, a position he has held since 1989;

prior to that he was with WWF for 11 years. A well-known primatologist and herpetologist (specializing in chelonians and specifically South American chelids), he has conducted fieldwork for over 40 years on three continents and more than 20 countries, mainly in such tropical areas as Brazil, Suriname, and Madagascar. Mittermeier's fieldwork has focused on primates, protected areas, and other conservation issues, and he is considered an expert on such topics as biological diversity and its value to humanity, ecosystem conservation, tropical biology, and species conservation. He is active in the IUCN (World Conservation Union), currently serving as one of the Vice Presidents. Russ serves on the Steering Committee of the Species Survival Commission, as Chair of the Primate Specialist Group (since 1977), and on the governing boards of both the Tortoise and Freshwater Specialist Group and the Turtle Conservation Fund. Russ has authored some 600 scientific papers and 19 books.

David Shapiro, founding Board member and long-time TSA supporter, recently stepped down from the Board, citing problems with meeting attendance due to

living in Hong Kong. David has been a dedicated supporter of our efforts to breed the Yangtze Giant Softshell Turtle at the Suzhou Zoo, as well as other TSA initiatives. We will

continue to count on his support, but his input will be missed. Thanks David, for caring about turtles and tortoises, and for helping the TSA.

TSA: Transforming Passion for Turtles into Conservation Action

MEMBER SPOTLIGHTS



Marilyn Connell

HOMETOWN: Gootchie, a rural district in southeastern Queensland, Australia. My property fronts Gutchy Creek, which flows into the Mary River. Gootchie/Gutchy (same pronunciation) is a local aboriginal word for “fat goanna.”

OCCUPATION: Project Officer, Tiaro & District Landcare Group, and Environmental Consultant.

WHAT IS YOUR MOST MEMORABLE ENCOUNTER WITH A TURTLE IN THE WILD?

At the end of each nesting season, I dig up clutches from protected nests and collect the hatching data. While carefully removing the overburden at the end of last season, I uncovered a small dark head. Unbeknownst to me, the incubation period of this clutch was much longer than that for other clutches laid on same day. My first reaction was one of concern as to whether the hatchling was alive or dead. For the next hour, I had the privilege of watching the little turtle gradually dig its way out.

HOW DID YOU FIRST LEARN ABOUT THE TSA? In 2009, the first Australian Biology and Conservation of Freshwater turtle workshop was held in Brisbane. There, I met Chuck Schaffer (another TSA member), who ensured our entanglement in the international turtle community.

HOW WOULD YOU DESCRIBE YOUR PERSONAL CONSERVATION PHILOSOPHY? I have been associated with the Australian Landcare movement for many years, which reflects my values of working toward balancing conservation with agricultural production. Rivers are the lifeblood of our environment, as well as of urban and rural communities; plus, they are great for kayaking.

TELL US ABOUT YOUR JOB. Each year, from late September to January, river turtles seem to rule my life. First, we organize a Landcare fencing working bee before the nesting season. Then, we await the spring rains, wondering if enough rain will “wet up” the nesting banks. On many mornings it means getting up early to reach the nesting banks just after dawn, where we check for nests, follow the tracks up and down the bank, and sometimes discover a freshly laid clutch.

I love learning from other people. Mariana A. de M. Campbell is researching the Mary River Turtle for her Ph.D. dissertation, and we spent many hours on the river, testing water, collecting nesting data, and asking questions. An unforgettable experience happened in 2008 when I sat on the Mary River Turtle nesting banks with John Cann, an Australian turtle expert whom we all admire. Three months later, we hosted such international turtle experts as Dr. Peter and Sybille Pritchard, Dr. Gerald Kuchling, Dr. Peter Paul van Dijk, and Chuck Schaffer, which was beyond my wildest dreams. For a small rural community, it was the highlight of the year. Many local folks can’t believe that people from overseas are that interested in our district.

One never knows where turtles will take you. It’s a great adventure.



Chris Bednarski

HOMETOWN: Houston, Texas.

Occupation: Senior keeper of Herpetology at the Houston Zoo.

DO YOU KEEP TURTLES AT YOUR HOME? I do.

What is your most memorable encounter with a turtle in the wild?

My most memorable encounter with a turtle in the wild was the first time I saw a Spotted Turtle (*Clemmys guttata*). I was about 8 years old and living in Rhode Island, and would frequently (3 or 4 times a day) go to “the swamp,” which was really a cranberry bog behind my house, to look for herps. Then, there he was...a beautiful male Spotted Turtle. I watched him foraging underwater for about five minutes before he disappeared.

HAVE YOU EVER TRIED TO EDUCATE OTHERS ABOUT TURTLES AND TURTLE CONSERVATION?

I conduct many keeper chats at the zoo, about the few turtles we have on exhibit. In addition, this spring a few of the other Herpetology Keepers and I held a TSA fundraiser outside of the Reptile House, where we handed out pamphlets and raised public awareness on turtle conservation. We made posters showing the “Top 25 Species on Death Row,” and had the opportunity to speak to countless

MEMBER SPOTLIGHTS

people. Overall, the fundraiser went very well. I even dressed up in a turtle mascot costume!

TELL US ABOUT YOUR JOB. I am a senior keeper in the Herpetology Department at the Houston Zoo. My main responsibilities are taking care of amphibians and chelonians.



Joshua Mitchell

HOMETOWN: Ames, Iowa.

OCCUPATION: Student (Animal Ecology).

DO YOU HAVE ANY PETS? A bearded dragon (Sandy), six turtles, and a dog named Izzy.

DO YOU KEEP TURTLES AT YOUR HOME? Yes, I have two rescued Three-toed Box Turtles (Spud and Shiela), a Red-eared Slider (Clyde), an African Sideneck Turtle (Enguru), and two Ouachita Map Turtles.

HAVE YOU EVER TRIED TO EDUCATE OTHERS ABOUT TURTLES AND TURTLE CONSERVATION? Yes, I gave a presentation on the TSA for my learning community class at Iowa State University. I also created an interpretation program for naturalists in my natural resources class.

TELL US ANYTHING ABOUT YOURSELF THAT MAKES YOU UNIQUE. One of the unique things about me is that I have ADHD, so sitting around or just relaxing is hard for me to do. When I am not swamped with school or work, you can almost always find me building something to improve my animals' habitats. That may include building a better basking area, filtration, a better hide, or whatever I can imagine. As a college student with a large number of animals, it is safe to say I can't afford expensive setups for them. That is why 90% of the things I have for my animals are things I made for them. To be honest, since these items are custom made with their specific needs in mind, I think they are better than a lot of what I could buy in the store.



Bryan Zaher

HOMETOWN: Harrisville, Pennsylvania.

OCCUPATION: Maintenance and construction at the Alaska Zoo.

WHAT FIRST SPARKED YOUR INTEREST IN TURTLES AND TORTOISES? I grew up running around the creeks and ponds in the woods. When I was five years old, I found two Common Snapping Turtles that I brought home and kept for the next 25 years. During this time, I studied and raised

other turtles and tortoises, including Sri Lankan Star Tortoises, Impressed Tortoises, and North American Wood Turtles.

WHAT IS YOUR MOST MEMORABLE ENCOUNTER WITH A TURTLE IN THE WILD? While fishing at a backwoods pond when I was young, I watched a large water snake swim by when it was snatched from below by a large Common Snapping Turtle that had likely followed my fishing lure toward the shore.

HOW WOULD YOU DESCRIBE YOUR PERSONAL CONSERVATION PHILOSOPHY? Conservation is everyone's responsibility and can range from making donations to volunteering or participating in captive breeding programs. I also encourage pet owners to not allow their pets to roam free or to release animals into the wild. Non-indigenous species are increasingly plaguing ecosystems and having a negative effect on native wildlife.

HAVE YOU EVER TRIED TO EDUCATE OTHERS ABOUT TURTLES AND TURTLE CONSERVATION? Conservation is one of my priorities in conversation. I have also been selling items at craft fairs and businesses around town to raise money for TSA, and educating people on the importance of all species, big and small, in healthy ecosystems. For example, I teach people how certain seeds may only germinate after passing through the stomach of a tortoise, and that these seeds can grow into a tree that is home to many other species. Those other species also propagate in their own way, like small parts of a big machine, and taking away one seemingly small part of the machine will cause it to break down.

MEMBERS MAKE THE DIFFERENCE

Heather Lowe¹

Our members are the driving force behind the success of the TSA, and we are thrilled to announce that our membership has more than doubled in the past year! Word of mouth is our most powerful recruitment tool, so we'd like to take this opportunity to say thanks to all who have helped to spread the word about the TSA and our conservation projects around the globe. Funds generated by membership dues help to offset the operating costs of the TSA, and they also allow access to non-restricted funds that can be used in the event of unexpected costs related

to conservation projects around the world. In essence, your support is essential to our success.

This year, we made an effort to significantly increase communications with our members via the e-mail newsletter, website, and Facebook page. Hopefully, you are enjoying the frequent updates on field projects that inspired you to support the TSA in the first place. If you have any suggestions about other things that you'd like to see on the website or in any of our other communications, let us know!

The TSA is truly a grassroots organization and we hope that each of our members and donors feel

engaged in the work being done for turtles globally on their behalf. As an organization, we believe that **anyone** can contribute to turtle conservation, regardless of their background or experience. Each and every member has the ability to become an advocate for turtle conservation in their local community, increasing the TSA's presence around the world. In this issue, we are highlighting four truly exceptional members. We hope that you enjoy getting to know them.

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TSA Animal Management Update

Dwight Lawson¹, Henk Zwartepoorte², and Scott Davis³

The last year was typically busy for the Animal Management programs of the TSA. Behind the scenes, the TSA focused its captive collection by divesting of species and individuals that were not going to be part of an actively managed program. Reducing the number of tracked individuals through donations frees up some of our most precious resource — time — to focus on species that are in dire need of captive management. This decision was timely, because several high-profile confiscations and transactions have demanded our attention.

As publicized on the TSA website throughout the year, authorities in Hong Kong have been very active in policing and seizing illegal turtle shipments, including one of 1,300 individuals in February of 2010. Long-time TSA partner Kadoorie Farm and Botanic Garden (KFBG) accepted 317 of these turtles and is holding some, primarily Yellow-headed Temple Turtles (*Heosemys annandalii*), for placement in TSA facilities in the United States. A number of high profile and rare tortoises have been seized as well, of which some are awaiting clearance and permitting before they are shipped to the United States. Others have recently been placed within the TSA Europe network. Henk Zwartepoorte, the TSA Europe Chair, reports that one European placement arrived on March 30th and included a diverse array of 35 individuals of eight species. This group contained some highly endangered species, including Madagascar Radiated Tortoises (*Astrochelys radiata*),

Burmese Star Tortoises (*Geochelone platynota*), and one Arakan Forest Turtle (*Heosemys depressa*), which later was placed at the Muenster Zoo. A second shipment from KFBG, with 39 individuals, arrived in Amsterdam on July 8th and included 11 Flower-back Box Turtles (*Cuora galbinifrons*). All of these turtles were transferred to various privately managed studbooks/breeding programs registered with European Studbook Foundation participants, and they represent welcome new bloodlines for the ESF. Finally, eight Roti Island Snakeneck Turtles (*Chelodina mccordi*) were received by the ESF from the San Diego Zoo, the result of a previous bloodline exchange with Europe. These new individuals improve the management options for this Critically Endangered species in Europe, and provide new bloodlines for increasing genetic diversity within the captive population.

A developing partnership with Wildlife Reserves Singapore/Singapore Zoo resulted in the importation of 36 confiscated Indian Star Tortoises (*Geochelone elegans*) into the United States. The majority of these individuals were placed with TSA members in the western part of the country, where the climate is most amenable for their husbandry and reproduction. We hope that offspring from this group will be available for adoption soon. In the second phase of this new partnership, early this fall the TSA will be sending an adult pair of Giant Softshell Turtles (*Pelochelys cantori*) from Scott Davis' collection to the Singapore Zoo.



Malayan Box Turtles (*Cuora amboinensis*) continue to dominate turtle trade seizures, and consistently show up in large numbers. One of the most heavily exploited turtles in Asia, this species is unlikely to sustain this level of exploitation.

The 2010 Conference will feature a session dedicated to the Chinese box turtle genus *Cuora*, which contains among the most threatened of the Asian turtles, with at least four species already functionally extinct in the wild. The *Cuora* session will be followed by a full-day *Cuora* workshop, during which experts from China, Europe, and the United States will meet to discuss the status of these species in the wild, their husbandry and breeding in captivity, and future plans for their conservation.



KADOORIE FARM & BOTANIC GARDEN



Left: Senior Fauna Conservation Officer Kit Tan Sun marks a large Yellow-headed Temple Turtle (*Heosemys annandali*) as part of the triage process at Kadoorie Farm & Botanic Garden. The staff at KFBG staff are often asked to hold and treat large numbers of confiscated chelonians, and are highly experienced in this regard. **Right:** Adult India Star Tortoises (*Geochelone elegans*) await shipment from Singapore to the United States.

The most exciting news for this and the coming year is the realization of a full-time, paid TSA Animal Management position. Thanks to the generous support of the Beneficia Foundation and the Mohamed bin Zayed Species Conservation Fund, the TSA is

actively recruiting a Coordinator to oversee its assurance colonies, actively acquire important taxa, and develop detailed management plans for the most Critically Endangered holdings. We hope to hire a dynamic, experienced individual soon who will invigorate this important branch of the TSAs activities. The new Director of Animal Management will be intimately involved with the TSAs *Cuora* program, with efforts to repatriate the Vietnamese Pond Turtle (*Mauremys annamensis*) and a host of other conservation activities. With so many wild turtle populations continuing to decline, captive assurance colonies and well-managed breeding programs are more important now than ever.



COURTESY OF HARRY ROTMANS

A Radiated Tortoise (*Astrochelys radiata*) shipped by Kadoorie Farm & Botanic Garden is uncrated in Amsterdam in March of 2010. These confiscated tortoises will be integrated into TSA Europe breeding programs.

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³Turtle Survival Alliance, 1989 Colonial Pkwy, Fort Worth, Texas 76110.

WILDLIFE RESERVES SINGAPORE



Bernard Santhosh confirms the PIT number on a tortoise prior to shipment.

TSA: We're serious about saving turtles.

SINIFICANT BREEDINGS

BRANDON GREAVES



Omaha's Henry Doorly Zoo announced the first captive breeding of the **GIANT NILE SOFT-SHELL TURTLE** (*Trionyx triunguis*). An adult pair maintained in a 48,500 gallon pool in the Zoo's Lied Jungle Exhibit has produced a number of infertile eggs over the past several years. On 17 April 2009, keepers observed the female in the process of laying 10 eggs and were able to collect them early the next morning. Several shells were cracked, but the internal membranes appeared to be intact. All eggs were incubated in 1:1 perlite at 84°F and seven hatchlings emerged after 67 days of incubation. Their average weight was 16 grams. After four additional days in the incubator, they were transferred into simple aquatic set ups with a water temperature of 82°F. The hatchlings have been raised on a diet of gut-loaded crickets and Ziegler Aquatic Turtle Food, and their average weight is now 103 grams.

Ten adult **MALAYSIAN GIANT TURTLES** (*Orlitia borneensis*) have been maintained in the moat and island exhibit that houses Siamangs and Gibbons at the Miami Metrozoo since the massive 2001 Hong Kong confiscation/rescue by the TSA. Although many of the *Orlitia* were in poor physical condition upon arrival, the staff worked diligently to bring them back to health and losses were minimal. In September of 2009, the staff discovered a juvenile (11cm) in with the group of 10 adults. Based upon the size of the offspring, it was estimated that the hatchling was from the 2008. In December of 2009, another hatchling was found in the moat, this one significantly smaller (7 cm). Subsequently, between December of 2009 and May of 2010, six more hatchlings have been discovered, all determined to be this season's offspring based upon their size. This was the first successful reproduction of *Orlitia* at Miami Metrozoo.



NICOLE ATTEBERRY

STEPHAN BÖHM



Stephan Böhm [stephan@unsre-bu.de] reports the captive breeding of the **AMAZON TOAD HEAD TURTLE** (*Mesoclemmys raniceps*). Two clutches of six and seven eggs, respectively, were laid by a mature female, and a first clutch of three eggs came from a young female. All of the eggs were fertile, and the mean measurements were 40.5 × 31.8 mm with an average weight of 26.1 grams. The eggs were incubated in a "Budde-Incubator" (Glass tank filled with 25% heated water, with the eggs incubated in boxes over the water), in a coco-peat substrate that was kept

rather dry throughout the incubation period. The substrate was moistened when the eggs began to hatch, and after this stimulus the small turtles emerged. As with most South American chelids, *Mesoclemmys* hatched lying on their backs. The first three eggs hatched in 133 days, but incubation may require up to 150 days at temperatures between 26.5 and 30.0 °C.

SINIFICANT BREEDINGS

BILL HUGHES



Bill Hughes reports that 2009 was a good year for **ASIAN SPINY TURTLES** (*Heosemys spinosa*) at the Tennessee Aquarium. Four eggs hatched this year, bringing the total number of hatchlings to seven for the past three years (two in 2007, one in 2008). Incubation times ranged from 101–108 days at 81°F. **Left:** A hatchling in its egg. **Below, left to right:** offspring from 2009, 2008, and 2007.



BILL HUGHES

Bill also reports the hatching of two clutches of the **YELLOW-BLOTCHED MAP TURTLE** (*Graptemys flavimaculata*) eggs at the Tennessee Aquarium in 2010, resulting in a total of five hatchlings. One clutch was incubated at 82°F and one at 86°F, in an effort to produce offspring of both sexes.



BILL HUGHES

SINIFICANT BREEDINGS

RICHARD STRUIJK



Richard Struijk reports the hatching of five **KEELED BOX TURTLES** (*Cuora [Pyxidea] mouhotii mouhotii*) at his facility in the Netherlands. Eggs have been produced yearly since 2007, ranging from two to five eggs per clutch. In 2009, a first clutch consisting of two eggs was produced on June 29th. The mean egg sizes were 47 × 29 mm and their mean weight was 19 g. A second clutch, containing five eggs, was produced on July 26th. The mean egg sizes were 37 × 26 mm and their mean weight was 15.6 g. All seven eggs were fertile and five hatched after 102–113 days. All eggs were incubated while buried up to 45% of their height in a damp

mixture of cocopeat and sand, at temperatures of 26–27°C. The mean hatchling weight was 12.2 g and the mean body sizes 41 × 33 × 21 mm (L × W × H).

Richard Struijk also reported the hatching of 13 F₂ **PANCAKE TORTOISES** (*Malacochersus tornieri*) between 2005 and 2009. The male and female parents were F₁ individuals that hatched in 2000 and 1999, respectively, and started producing eggs at five years of age (female). From one to five eggs hatched every year between 2005 and 2009. One egg measured 41 × 24 mm. Only two eggs were hatched in an incubator, in sand, and all of the other eggs hatched within the terrarium housing the parents. The eggs were deliberately left *in situ*, and hatching almost always occurred on the surface at night or during the early morning. The mean hatchling length was 34 mm (N = 6), the mean width was 39 mm (N = 4) and the mean height was 17 mm (N = 2). The mean hatchling weight was 10.7 g (N = 6), and hatchling weights differed by as much as a factor of 2.



RICHARD STRUIJK

JULIE TOUGAS



Julie Tougas reports the hatching of three **FLOWERBACK BOX TURTLES** (*Cuora galbinifrons galbinifrons*). The 2.3 parents were purchased in 2002 and reportedly originated from Hainan Island. Eggs were laid on 26 May, 17 July, and 26 July of 2009, and hatched after 74–79 days of incubation.

Captive Management of *Cuora*: An Alternative to Extinction in the Wild

The genus *Cuora* contains some of the most threatened Asian turtles, with several species already functionally extinct in the wild. As such, captive management is the sole remaining option for the conservation of a number of species. With support from the Mohammed bin Zahed Species Conservation Fund, the TSA is holding a workshop at our Annual Meeting in Orlando in order to make an initial assessment of captive populations of *Cuora* in China, Europe, and North America, and to lay the foundation for a long-term captive breeding efforts. Leading *Cuora* experts from around the world will meet to share information and ideas, with the goals of determining the viability of remaining wild populations, identifying the founder animals being held in captivity, and setting out the basic requirements for the captive husbandry and breeding of each species. All 12 of the *Cuora* species have been bred in captivity and this photo montage illustrates the amazing diversity seen in the hatchlings.

TING ZHOU



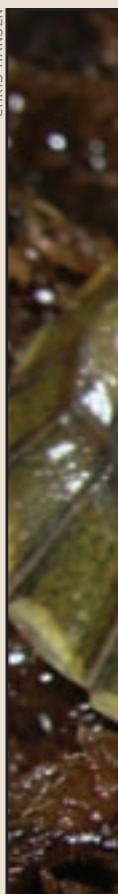
Cuora yunnanensis

CHRIS HANSEN



Cuora mccordi

CHRIS HANSEN



TORSTEN BLANCK



Cuora zhoui

SABINE SCHOPPE



Cuora amboinensis

SINIFICANT BREEDINGS — CUORA



Cuora aurocapitata



Cuora mouhotii



Cuora picturata



Cuora cyclornata



Cuora trifasciata



Cuora galbinifrons



Cuora flavormarginata evelynae



Cuora bourreti



Cuora flavomarginata (twins)



Cuora pani

Turtle Conservancy and Behler Chelonian Center Annual Report 2009–2010

Ross Kiester¹, Eric Goode², and Max Maurer³

In the last year, the Turtle Conservancy and Behler Chelonian Center (TC/BCC) focused on the coordinated interaction of *in situ* and *ex situ* conservation: *in situ* conservation implementing local

efforts to preserve species in their native habitats and ranges, and *ex situ* conservation directed at off-site efforts to protect species outside their natural habitats. Our understanding of the optimum interaction and combination of *in situ* and *ex situ* conservation has led the TC to focus on a few long-term projects. These include working with the Malagasy government for the preservation of *Astrochelys yniphora*, achieving a breakthrough in our land purchase in Mexico for the preservation of *Gopherus flavomarginatus*, signing a formal cooperation agreement with the Taipei Zoo in an effort to better protect *Geochelone platynota*, and bringing critical knowledge of the captive husbandry of *Siebenrockiella leytenensis* to the Philippine Islands.

Personnel at the TC/BCC have been involved with *Astrochelys yniphora* (Ploughshare Tortoise or Angonoka) for many decades, and last year we began a major new effort with this most Critically Endangered tortoise. Jim Juvik, a scientist at TC, originally rediscovered this species in 1971, when there was concern that it was already extinct. In the 1990s, Juvik and Ross Kiester worked with Lee Durrell and Don Reid of the Jersey Wildlife Preservation Trust, who had begun a captive breeding and field research program. In 2007, Eric Goode visited Richard Lewis of Durrell Wildlife Conservation Trust (DWCT) in Madagascar to begin discussions of collaboration, and in January of 2008, Goode and Maurice Rodrigues participated in the Red-

listing meeting in Madagascar. From that time, we have worked actively with the Malagasy government, the DWCT, the TSA, the TCF, and many other organizations and individuals in crafting the Action Plan for this species. This Action Plan is now being reviewed by the government of Madagascar and likely will become official policy.

We began our work on the implementation of this plan by forming a partnership with the DWCT. Together, we wrote a grant proposal to the U. S. Fish and Wildlife Service that was funded in the amount of \$30,000. The TC/BCC matched that amount, as did the DWPT, resulting in a total of \$90,000. This money is being used for *in situ* work to enhance protection of the Angonoka in Baly Bay National Park, where it is under extreme threat from poaching. Although completely protected by law, the recent political instability in Madagascar has made it all too easy for poachers to remove a significant portion of the remaining wild population, estimated at only between 200 and 600 individuals. We hope that these new resources for guards in the park will help stop this exodus.

Coordinated with this work, the TC/BCC is committed to *ex situ* work enhancing the captive breeding facility that DWCT operates at Ampijoroa. In a separate *ex situ* effort, we are working with the TSA, the Association of Zoos and Aquariums, the European Association of Zoos and Aquariums, and other partners to create additional captive breeding colonies using animals confiscated from the illegal trade. This effort is complex and difficult and involves the governments of Madagascar, the country in which the animals were confiscated, and the host country



Gerald Kuchling with an *Astrochelys yniphora* in Madagascar.

A *Geochelone platynota* at the Behler Chelonian Center.



that will maintain the colony, as well as CITES and TRAFFIC. The number of known confiscated Angonoka in Taiwan and Hong Kong alone is over 28, with many more animals held illegally. We hope that these confiscated animals can become a key resource in the overall strategy to save this tortoise from extinction.

During September of 2009, the TC/BCC co-director and scientific staff were guests of the Taipei Zoo in Taiwan and attended a regional, Asia-focused symposium on "Conservation Activities for Endangered Chelonian Species." A significant motivation for this zoo visit was to forge a working relationship between the TC/BCC and the zoo's Center for Research and Conservation. The center holds a large inventory of endangered turtles and tortoises confiscated from the illegal animal trade in Asia. These include several Angonoka, and we discussed their husbandry and the possibility that they could become part of an assurance colony.

After several years of effort in the field and at understanding the complexities of acquiring land in Mexico, the TC together with the Andrew Sabin Family Foundation and assisted by Josiah T. Austin and the Desert Tortoise Council, is now in the process of purchasing 12,000 acres of prime *Gopherus flavomarginatus* (Bolson Tortoise) habitat in the middle of the Mapimí Biosphere Reserve. José Amate Perez leads our effort in Mexico, with much help from Myles Traphagen, Mercy Vaughn, and the TC staff. This land will be managed for the long-term protection of the Bolson Tortoise population and is critical to its conservation. A substantial population is present on this land, so protecting it from degradation due

to cattle and off-road vehicle use will likely result in the largest population of this species anywhere. This land is also home to a wide variety of other animals and plants. It lies adjacent to the Desert Laboratory, operated by Mexico's Institute of Ecology (INECOL), and has been the site of many studies on the Chihuahuan Desert.

We do not maintain this species at the BCC, but collaborate with the Turner Endangered Species Fund, under which Bolson Tortoises are being bred in New Mexico. We have shared expertise in captive breeding, set up parallel climate monitoring at the Turner site and in the Bolson de Mapimí, and are providing on-board tortoise cams for a study of foraging in both localities. This *ex situ* work is part of a long-term plan to reintroduce this species in areas of its former range where it has gone extinct.

The BCC and the Taipei Zoo hold the two largest collections of *Geochelone platynota* (Burmese Star Tortoise) in captivity outside of Myanmar. Our mutual interest in the *ex situ* conservation of this species led the TC/BCC and the Taipei Zoo to sign a formal cooperation agreement on September 16, 2009. The agreement integrates the

TC/BCC MIYE MCCULLOUGH



Signing of partnership between the TC and the Taipei Zoo. **From left:** Jim Juvik, Eric Goode, Jason Yeh (Director of the Taipei Zoo), and Kuo-Yun Fang (Deputy Director Counsel of Agriculture).



PHOTO BY ANDREW TERRY

Eric Goode and Ross Kiester presenting checks to Lee Durrell of the Durrell Wildlife Conservation Trust.

A *Gopherus flavomarginatus* in Mexico.



TC/BCC MAURICE RODRIGUES



The TC and the TSA at the Katala Foundation in the Philippines. **From left:** Eric Goode, Miye McCullough, Peter Praschag, Diverlie Acosta, Bill Zeigler, Sabine Schoppe, and Rick Hudson.



A *Siebenrockiella leytensis* in the Philippines.



Gerald Kuchling examines a *Cuora trifasciata* at the Behler Chelonian Center.

management of these two significant assurance populations into a single genetic resource. We also hosted personnel from the Taipei Zoo on two separate occasions at the BCC in California to further the partnership, exchange management ideas, and to collect genetic material to determine the paternity of our individuals.

We have had great success in breeding this species, so we are now working with these institutions and

with the TSA on the long-term goal of repatriating some of these captive-bred animals to Myanmar.

We have maintained a small group of *Siebenrockiella leytensis* (Philippine Forest Turtle) at the BCC since 2008, and have learned about its husbandry requirements. This turtle is highly unusual, being crepuscular and nocturnal, and spends its days on land in deep burrows and its nights in streams. This unique natural history, and a high degree of intraspecific aggression in this species, create significant management problems for both *in situ* and *ex situ* conservation. The TC is supporting the TSA and Sabine Schoppe and the Katala Foundation's efforts in the Philippines to manage animals confiscated from the illegal pet trade. In 2009, we became a partner in this work by committing financial support and by visiting the site in the Philippines. Because understanding the natural history of this species is critical to their husbandry, the knowledge that the TC has gained from maintaining *S. leytensis* will help this field project greatly.

In the past year, the Behler Chelonian Center continued to have success in breeding, producing a total of 145 hatchlings of 11 species. We hatched 32 *Astrochelys radiata*, 37 *Geochelone platynota*, 20 *Geoclemys hamiltonii*, 62 *Manouria emys phayrei*, and five *Pyxis arachnoides*, as well as *Chersina angulata*, *Homopus signatus*, *Indotestudo forstenii*, and *Malacochersus tornieri*. As we continue to transform breeding success into *in situ* conservation action, we sometimes have surplus animals available. All proceeds from these sales go directly into conservation work in range countries. Our website (turtleconservancy.org) shows the current details.

A major advance in the work of the BCC came when Gerald Kuchling visited to determine the sexes of our offspring via endoscopy. Gerald sexed over 120 juvenile animals at the center. Knowing the sex of hatchlings as soon as possible is extremely important to captive breeding, because it tells us if we are incubating eggs at the correct temperature to produce the mix of males and females we desire. With the numbers of *Astrochelys radiata* and *Geochelone platynota* that we breed, we will be able undertake experiments on Temperature Dependent Sex Determination on these species. Early sexing also makes studbook management much easier, because it means that we can meet studbook goals years sooner than if we had to wait for the hatchlings to mature in order to be sexed.

In addition to the trips to Taiwan and the Philippines mentioned above, we undertook an extended



Above: A group of juvenile *Astrochelys radiata* at the BCC.

Right top: *Geoemyda japonica*, a species found in Okinawa, Japan.

Right botom: *Psammobates tentorius trimeni*, a species found in South Africa.

trip to Namibia and South Africa to learn about the habitats of the many species of tortoises that can be encountered between Windhoek, Namibia, and Cape Town, South Africa. We were especially interested to see *Chersina angulata*, *Homopus areolatus*, and *H. signatus* in their native habitats, as they are species we maintain at the BCC. We documented our trip in a video, which we will present at the TSA meeting.

The TC also traveled to the Ryukyu Islands of southern Japan in search of *Geoemyda japonica*, to study its ecology, status, and distribution. Again, we maintain this species at the BCC and seeing it in the wild increased our understanding of its husbandry requirements. To our surprise, we found that this species lives on steep hillsides and takes refuge in deep burrows among rocks. The video documenting this trip is available for viewing at <www.turtleconservancy.org>.



TC/BCC ERIC GOODE

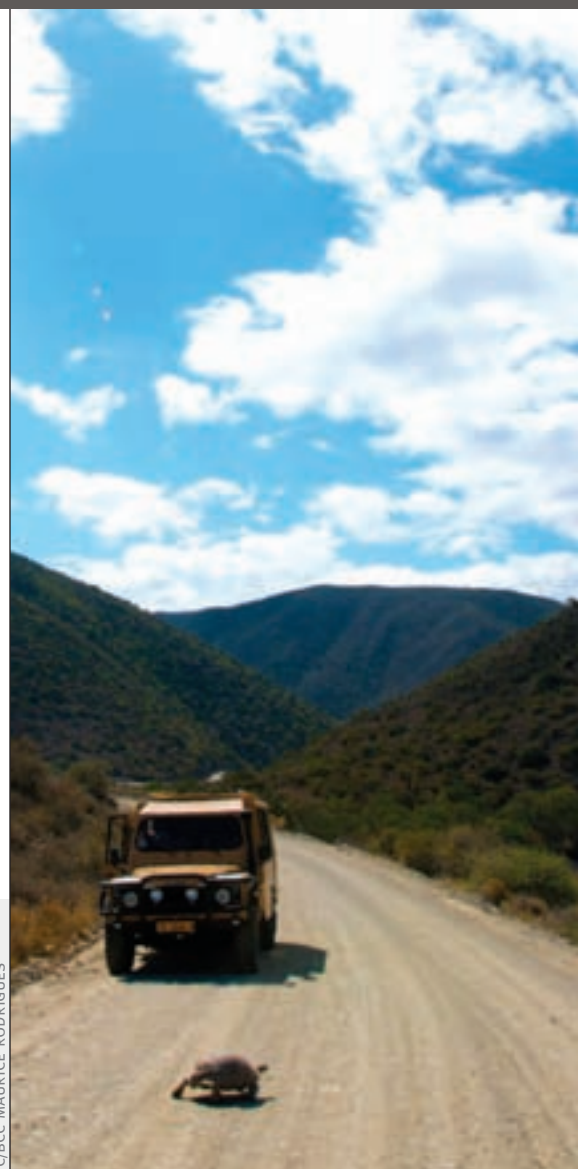


TC/BCC ERIC GOODE

A short trip to Oaxaca, Mexico, again led us to visit the National Mexican Turtle Center (Centro Mexicano de la Tortuga) and gave us the opportunity to retrieve weather data loggers we had previously left in the habitat of *Rhinoclemys rubida rubida* (Oaxaca Wood Turtle), a species we breed at the BCC. Placing these data loggers in the actual habitats of the tortoises and terrestrial turtles that we study and keep gives us a much better picture of their actual annual microclimate requirements. Data derived from conventional weather stations often does not provide an accurate representation of this microclimate, because the stations are too far away and are not inside a specific habitat. We now routinely use these data loggers as we travel, and have placed them at several locations in Madagascar, Argentina, Namibia, the Philippines, and Mexico.

The TC/BCC is delighted to announce that we have hired Dr. Paul Gibbons (DVM, MS) to be the new Director of the Behler Chelonian Center. Paul is the President-elect of the Association of Reptile and Amphibian Veterinarians, and is held in high esteem by the herpetological community. We are looking forward to even better care of our living collection and to helping Paul shape the direction of reptile veterinary medicine. Look for him at the TSA meeting. At the same time, The Behler Center in California will be expanding as we complete the purchase of neighboring land that will more than double the area of the center, giving us the opportunity to improve our infrastructure.

In the next year, the TC will continue along, slow and steady, supporting *in situ* and *ex situ* projects, seeing to it that current projects come to fruition, and engaging in collaborations that lead



TC/BCC MAURICE RODRIGUES

Stigmochelys pardalis: Q: Why did the tortoise cross the road? A: To show the opossum it could be done.

to coordinated projects. Our greatest challenge now is to make this whole endeavor sustainable, to help ensure that turtle and tortoise populations are sustainable.

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The Turtle Conservation Fund: Providing Strategic Action Planning and Funding Support for Conservation of the World's Most Endangered Tortoises and Freshwater Turtles

Anders G. J. Rhodin¹ and Hugh R. Quinn²

Over the last several years, the Turtle Conservation Fund (TCF) has gained notoriety as one of the world's leading turtle conservation support organizations. The TCF has been successful in helping to identify, prioritize, promote, support, and provide a leadership role in collaborative global turtle conservation efforts and opportunities focused on the world's most endangered tortoises and freshwater turtles. The TCF has been highly successful with its grants program, by supporting needed turtle conservation projects and programs worldwide.

Since the founding of the TCF in 2002, 268 grant proposals have been received, of which 97 (36%) have been funded. Total requests have been received for \$1,442,317 in funding, with a total TCF disbursement of \$446,159 (31%) in awards granted. The average award was for \$4,600, with support ranging from \$1,000 to \$10,000. Of the TCFs "Turtles in Trouble: The World's Top 25 Most Endangered Tortoises and Freshwater Turtles – 2007," projects representing 21 (84%) have been funded. Of the TCFs 42 Target Species (2008 list), projects representing 28 (67%) have been supported. Of the 68 taxa listed by the IUCN as Critically Endangered (CR) or Endangered (EN), the TCF has supported projects for 43 (63%). These Top 25, CR, EN, and Target Species figures do not include calculation of support provided

for facilities or broad projects that impact additional species. In the first of two funding cycles of 2010, the TCF received an additional 31 grant support proposals totaling about \$175,000.

With the TCFs global perspective, grants were awarded to projects conducted in 37 countries. Awards were given to projects in Australia, Bangladesh, Belize, Benin, Bolivia, Brazil, Cambodia, Cayman Islands, China, Colombia, Cuba, Dominican Republic, Ecuador, Egypt, Germany, Ghana, Guatemala, Haiti, India, Indonesia, Iran, Jamaica, Madagascar, Malaysia, Mexico, Myanmar, Nigeria, Pakistan, Papua New Guinea, Peru, Philippines, Puerto Rico, South Africa, Tanzania, Togo, Turkey, and Vietnam. Such a broad geographic distribution of funds reflects the TCFs mounting impact on international turtle conservation.

Of the 37 countries where the TCF has provided support, projects in 10 countries have received funding, from five to 10 grants in each. These countries, and the Critically Endangered turtle species in them, have especially needed this extra focus and support and have benefited the most from directed TCF funding efforts. These focus countries are: China (10 funded projects), Madagascar, Myanmar, and Vietnam (nine each), Indonesia and Colombia (eight each), Cambodia (seven), India (six), and Mexico and the Philippines (five each). Several other countries have received

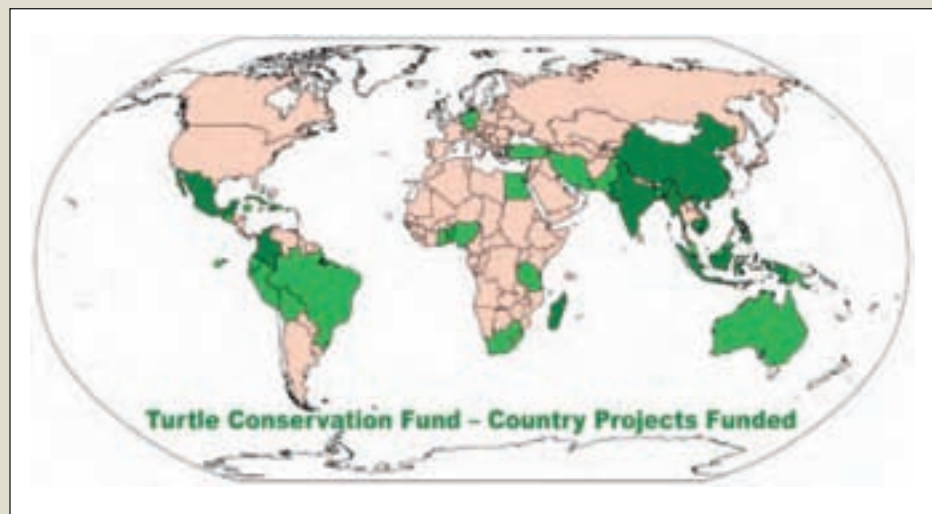
funding for one or two projects. The TCF continues to strive to meet the urgent conservation challenges and opportunities for all of the world's endangered tortoises and freshwater turtles, and is gradually expanding a portfolio of assisted species, countries, and projects.

An example of a country where the TCF has focused its efforts is China. This country is home to nine of the TCFs 42 target species, more than any other nation. These species are represented by seven Asian box turtle species and two giant softshells, all categorized as Critically Endangered. One of the softshells, *Rafetus swinhoei*, is precariously teetering on the brink of extinction, as it is known from only four living individuals. The softshells and box turtles were driven to near extinction because they were relentlessly hunted for food and use in traditional medicine. Collecting animals for the pet trade has also been a factor contributing to the decline of the remaining box turtles. Overall, the TCF has supported projects on the ecology, status, conservation genetics, and other measures needed to conserve China's Critically Endangered turtles. Additionally, work by the TCF's partner organization, the Turtle Survival Alliance, has been funded partially by the TCF, in an attempt to breed the two remaining *Rafetus swinhoei* in captivity, both held at the Suzhou Zoo in China. The future of this species truly hinges on this effort. Should it not succeed, this species may be lost forever. In all, 10 projects have been funded for China's Critically Endangered turtles since 2007, totaling over \$46,000 and involving 17 investigators.

In Madagascar, the TCF began its efforts in 2007 by supporting the IUCN/SSC Tortoise and Freshwater

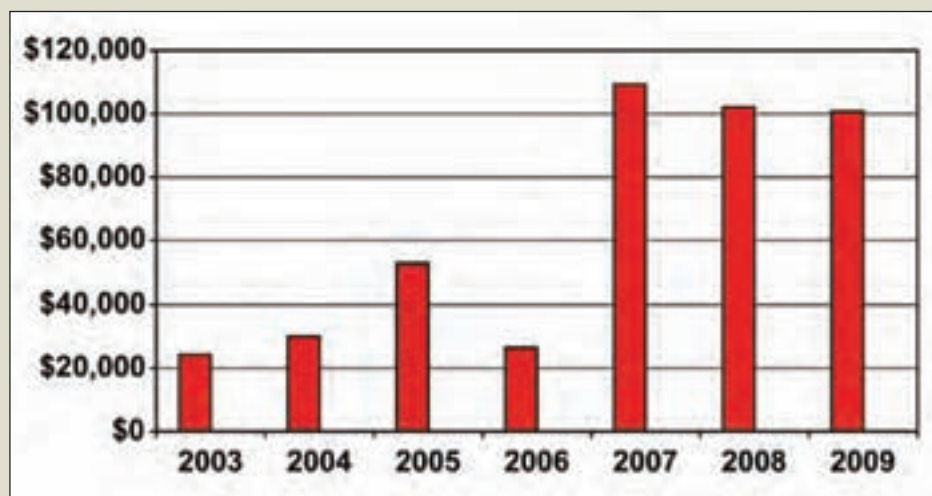
Turtle Specialist Group workshop that examined the current IUCN Red List status of all Madagascan tortoises and freshwater turtles. All five endemic species were uplisted to Critically Endangered, as a result of widespread population declines and habitat destruction. Additional key outcomes of this workshop were conservation prioritization and strategic action planning. Implementing the plan developed at the workshop, and focusing on the endemic species, the TCF has since supported several projects on the ecology, status, critical areas, and measures needed to conserve Madagascan turtles and tortoises, notably the Spider Tortoise (*Pyxis arachnoides*) and the Flat-tailed Tortoise (*P. planicauda*). Additionally, work has been funded to examine the effectiveness of a repatriation release program for the Madagascan Big-headed Turtle (*Erymnochelys madagascariensis*). In all, the TCF has funded nine projects in Madagascar since 2007, totaling over \$41,000 and involving 10 investigators. Not only are these projects working effectively to conserve Critically Endangered turtles in Madagascar, but they are also providing valuable training for Malagasy conservationists.

The above are only a couple of examples of how and where the TCF has been providing strategic assistance and conservation funds for threatened tortoises and freshwater turtles. Such work cannot be done in a vacuum. The TCF is a true partnership coalition of leading turtle conservation organizations and individuals. Partner organizations include Conservation International, International Union for the Conservation of Nature/Species Survival Commission/Tortoise and Freshwater Turtle Specialist Group,



Countries where the TCF has provided funding for turtle conservation projects are shown in green (37 countries); countries in dark green (10) are focus countries with 5–10 projects funded each. Countries in beige contain native turtle populations that have not received funding from the TCF; countries and regions or islands in white contain no native turtle populations.

Total annual grant disbursements by the TCF since its inception (two funding cycles per year).



Turtle Survival Alliance, European Association of Zoos and Aquaria Shellshock Campaign, Chelonian Research Foundation, Chester Zoo, Fort Worth Zoo, Asian Turtle Program, Wildlife Conservation Society, Behler Chelonian Center/Turtle Conservancy, Chelonian Research Institute, and Humane Society International – Australia.

Individuals on the TCF Executive Board span the globe and are

among the world's foremost turtle biologists and conservationists. Included in this leadership group are Gary Ades, Chris B. Banks, Kurt A. Buhlmann, Kevin R. Buley, Antoine Cadi, Bernard Devaux, Eric Goode, Douglas B. Hendrie, Brian D. Horne, Rick Hudson, Gerald Kuchling, Richard Lewis, Susan Lieberman, Luca Luiselli, George A. Meyer, Russell A. Mittermeier, Vivian Páez, Hans-Dieter Philippen, Colin Poole,

Peter C. H. Pritchard, Hugh R. Quinn (Co-Chair), Martina Raffel, Anders G. J. Rhodin (Co-Chair), Walter C. Sedgwick, Peter Paul van Dijk, and Henk Zwartepoorte.

To date, the TCF has received nearly \$850,00 in total funding or committed support over the next few years, primarily from private foundations and individual private donors, in addition to various in-kind donations from several organizations. Among many others, we most gratefully acknowledge the very welcome and substantial support over the years from the following wonderfully generous and committed individuals and organizations: the European Association of Zoos and Aquaria (EAZA) Shellshock Campaign, George A. Meyer and Maria Semple, Conservation International, Frankel Family Foundation, Matthew Frankel, Humane Society International – Australia, A Taste of Thai, Chuck Landrey, Behler Chelonian Center/Turtle Conservancy, The Maritime Hotel, Eric Goode, Walde Research and Environmental Consulting, Island Foundation, Wildlife Conservation Society, Fort Worth Zoo, Chester Zoo, Savannah River Ecology Laboratory, Nando Peretti Foundation, Chelonian Research Foundation, and Panaphil Foundation. We thank them all, as do all the endangered turtles and tortoises of the world.

To learn more about the TCF and its many programs, to apply for grants, or to consider a donation to the TCF, please visit our website at: www.TurtleConservationFund.org

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GERALD KUCHLING



RICHARD LEWIS



Top: Collecting eggs laid by the last captive pair of *Rafetus swinhoei* at the Suzhou Zoo, China, as part of a TCF-supported project co-directed by the Turtle Survival Alliance.

Middle: Measuring wild *Erymnochelys madagascariensis* for a TCF-supported repatriation project for the species in Madagascar.

Bottom: The TCF Executive Board (partial) at a funding-cycle review meeting in New York at The Maritime Hotel, March of 2009. **Front to back, left to right; seated:** Colin Poole; **1st row:** Peter Paul van Dijk, Brian Horne, Hugh Quinn, Rick Hudson; **2nd row:** Russ Mittermeier, Walter Sedgwick, Hans-Dieter Philippen; **last row:** Peter Pritchard, Anders Rhodin, Kurt Buhlmann, and Eric Goode (meeting host).

Exciting New Partnership Launched for Turtle Conservation

Recently, the Institute for Conservation Research at the San Diego Zoo, the Turtle Survival Alliance (TSA), and the Wildlife Conservation Society (WCS) signed a two year Memorandum of Understanding (MOU) detailing the creation of a global conservation program on freshwater turtles and tortoises. Under the supervision of Dr. Brian D. Horne (Conservation Research Postdoctoral Fellow), this agreement allows Brian to divide his time between projects on the Red-crowned Roof Turtle (*Batagur kachuga*) in India and other crucial turtle conservation projects in

Madagascar and Southeast Asia. Both of these areas are well known for containing highly diverse and/or endemic species of chelonians. Sadly, these two areas also have the majority of the most Critically Endangered turtle species in the world. Dr. Horne is currently helping to guide multiple conservation programs for Giant River Turtle in places such as Myanmar, Cambodia, and Malaysia. He also recently returned from southwestern Madagascar, where he and a team from the TSA and WCS helped prioritize conservation projects for the island's Radiated Tortoises,

now facing extinction due to over-collection on a massive scale. New initiatives for Dr. Horne may include fieldwork on Critically Endangered turtles endemic to Indonesia.

This exciting alliance creates the first-ever joint program between three major conservation organizations in the United States devoted specifically to freshwater turtle and tortoise conservation. In particular, the TSA has been an integral partner with Brian's postdoctoral research on the Red-crowned Roof Turtle, since 2005. This new agreement will act as a catalyst for strategic turtle conservation projects that are crucially needed in Asia.

Dr. Brian D. Horne, photographing a Radiated Tortoise (*Astrochelys radiata*).



RICK HUDSON

Project EMI: Breeding and Rearing the Impressed Tortoise, *Manouria impressa* (GÜNTHER, 1882)

Gabriela Eberling¹ and Viktor Mislin¹

The Impressed Tortoise (*Manouria impressa*) is notoriously challenging to maintain in captivity, and thus in Europe very few adult individuals are available for captive reproduction. Because of its specialized diet, which includes a preference for certain types of mushrooms that often are expensive or hard to locate, the nutritional demands of this species are

sometimes difficult to meet. The behavior of the Impressed Tortoise is also rather interesting, as in nature females will construct large nesting mounds in which they deposit soft-shelled eggs, an unusual condition in tortoises, and for several weeks will aggressively guard the nest against any intruders.

In the year 2000, one of us (VM) began assembling a group of *M. impressa* for the purpose of captive propagation. In 2007, a female constructed a nesting mound into which she deposited 47 eggs. With the help of Dwight Lawson (Zoo

Atlanta), who provided information on incubation temperatures and methods for hatching the eggs, 14 eggs hatched, a first for this species in Europe. Because of the moderately low hatching rate, however, it was obvious that additional work was necessary to improve future results.

A lack of available information on the nutritional requirements of *M. impressa* and techniques for incubating their eggs led to the idea of initiating a research project. In time and with the cooperation of Basel University in Switzerland, we established Project EMI, which we called: "Research on optimal husbandry and breeding conditions as a contribution to species conservation of the endangered *Manouria impressa*."

To gather information and obtain additional experience to help us with this project, we began assembling various types of data on *M. impressa* from keepers both in zoos and at private locations. As these developments unfolded, VM decided to contribute his offspring of *M. impressa* to the project.

The EMI project is coordinated by Viktor Mislin (Switzerland) and Gabriela Eberling (Germany), includes other individuals with long-term experience in keeping and breeding *M. e. emys*, and is being conducted in cooperation with the Department of Evolutionary Biology at Basel University. Veterinary support is being provided by Dr. med. vet. Piero Godenzi (in Switzerland) and by Dr. med. vet. Frank Mutschmann (in Germany). The dates for the project extend from 2008 to 2013, a time span when we plan to rear the young tortoises to sexual maturity under standardized, controlled conditions.

The husbandry of *M. impressa* and the conditions for egg incubation

Top: An adult female *Manouria impressa*.

Bottom: Reproductive behavior in *Manouria impressa*.

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Left: A box (top) and enclosure (bottom) used for rearing Impressed Tortoises at Project EMI.



Right, from top to bottom: Viktor Mislin with a protégé.

A nesting mound constructed by a female *Manouria impressa*.

An egg clutch within the nesting mound.

Eggs of *Manouria impressa* hatching.

Hatchling Impressed Tortoises.



will be studied for the duration of the project not only to gather information applicable to the study animals, but also to other captive individuals. Accordingly, we researched the climate data available for the natural habitat of this species and applied these conditions to the activity and aestivation periods reported for *M. impressa* in nature. By using this information, our goal is to establish a controlled population of captive born individuals.

HUSBANDRY

The size of the enclosure for maintaining *M. impressa* is based on the “minimum conditions for the husbandry of reptiles” listed in the regulations established in Germany on 10 January 1997. These regulations indicate that the minimum size of an enclosure must be six times the carapace length of the largest tortoise.

According to these regulations, the enclosure size applies to two tortoises. If one or two more tortoises are added to the enclosure, the surface area must be increased by a factor of 10%, and by a factor of 20% if a fifth is added. With the EMI project, we increased the enclosure size for two tortoises by 10%, based on the experiences of VK

in maintaining captive *M. impressa*. The additional space includes places for the tortoises to hide, for food and water bowls, as well as areas for basking and egg deposition. We adjusted the surface area for juvenile tortoises based on the parameters used for adults. We maintain one to three tortoises to an enclosure, as additional animals kept in enclosures that are too small, or that do not contain enough hiding places, could stress the tortoises and lead to health problems.

For lighting and humidity, we are using HQI spots and a UV A/B lighting source, in addition to a humidifier. Our preferred UV light source is a new product called Bright Sun Desert. The young tortoises appear to be rather active under this type of lighting, and this product is indicated to approximate the conditions experienced under natural conditions.

We measured the light intensity and UV B output of the Bright Sun Desert lights at a distance of 30 cm from the floor of the enclosure. Through the use of using solar meters, we attained a UV B value of 79 mW (Micro Watt) and the light a value of 110,800 Lux, which corresponds to the light intensity values measured outdoors on sunny

days in Germany and Switzerland. Importantly, the light intensity should be measured on a regular basis, since the values could decrease by as much as 50% within six months to a year, depending on the number of hours the lights are in use. To prevent overheating the tortoises, however, the lights must be placed at a proper height in the enclosure. For example, a temperature of 60°C can be reached when the lights are placed at a height of 20 cm from the floor of the enclosure.

An enclosure should be fully furnished before any young tortoises are introduced. Any rearrangement of the furnishings in the enclosure, however, might stress the tortoises and cause them to refuse food.

As the project moved along, we began to distribute young tortoises

among new participants. In one case, where their transportation involved crossing country borders and several checkpoints by customs authorities, the tortoises were stressed to such a degree that upon arrival at their destination they were foaming from their mouths and noses. Furthermore, after they were released into their new housing they showed signs of stress by attempting to climb the walls of the enclosure, and once they found hiding places, they retreated for weeks and during this time refused any food.

In certain cases, starting in 2008, yearling tortoises were maintained outdoors from June until early September. In each of two seasons when they were maintained outdoors, once they were brought back indoors their activity and food

intake decreased for some time. After they became re-acclimated, however, they appeared to recognize their enclosures and at times were observed feeding on snails and earthworms.

The outdoor enclosures were planted heavily in order to offer appropriate hiding places. The tortoises showed a preference for lying under the plants by half-burying themselves in the soil, and in these places appeared to seek a cool retreat during hot days. In addition, we installed a sprinkling system along the edges of the enclosures to provide better humidity.

NUTRITION

The rearing of juvenile *M. impressa* can not be considered without addressing certain problems. With respect to nutrition, these dietary specialists can become very demanding subjects for their keepers.

In order to not rely on oyster mushrooms, a favorite food item of these tortoises, we offered them a variety of other mushroom species. The cultivation of various mushrooms has proven to be a valuable addition to the project, because now we do not depend on the relatively expensive types of mushrooms available at supermarkets. Different kinds of mushrooms, however, are not always eaten by the tortoises. If a proper microclimate is provided within the enclosure, the types of mushrooms preferred by the tortoises can be grown.

We also offer the tortoises white mushrooms, pumpkins, zucchini, chopped cherries, seasonal vegetables, and hay flowers (chopped meadow hay). We provide them a fiber-rich diet at all times, and occasionally powder their food with a mineral supplement (Korvimin ZVT) that contains important vitamins,

Top, left to right: An Illumination Meter used for measuring light intensity; the Bright Sun UV Lamp; and, a digital Solarmeter used for measuring UV B rays.

Bottom: Chickweed planted in an enclosure for rearing Impressed Tortoises.





Left: Juvenile *Manouria impressa* at 6 months. **Middle:** Juvenile *Manouria impressa* at two years of age. **Right:** Portrait of a hatchling *Manouria impressa*. Note the protruding egg-tooth, used to slit the eggshell.

amino acids, and spore elements. We also offer the young tortoises cuttlebone (*Sepia* sp.), which is eagerly ingested. To avoid digestive problems, we occasionally provide the tortoises with a vegetable substitute (Diarovet-N). At times during the spring but not in other seasons, the tortoises appeared to prefer feeding on the leaves of such green vegetation as chickweed, field lettuce, dandelions, pointy plantain, and the fresh shoots of ivy (*Epipremnum pinnatum*) that we planted in the enclosure. The young

tortoises did not accept animal matter, but at the age of about two years, when maintained outdoors, we observed them feeding on snails, as well as *Daphnia* that we sprinkled on their food.

The coloration of hatchling *M. impressa* is predominantly brown, and at this stage of life the tortoises lack significant markings. At one and one-half to two years of age, however, the juveniles begin taking on the appearance of the adults. At this point, the carapace rim is strongly serrated, a feature that

becomes reduced with age.

Breeding Results

Between September of 2007 and April of 2010, 23 additional tortoises hatched. Interestingly, during the summer of 2008 the temperatures were significantly lower than in 2007 and 2009 and the tortoises experiencing problems with egg-laying, and thus no offspring were produced.

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Top, left to right: Mushrooms growing in the enclosure; mushroom cultivation provides a ready food source for Impressed Tortoises; and, a variety of mushroom species favored by *Manouria impressa*.

Bottom, left to right: Ivy (*Epipremnum pinnatum*) is another food item of *Manouria impressa* that we planted in the enclosures; and, a young *Manouria impressa* feeds on chickweed planted in the enclosure.



Research Project EHAP: Advances in the Husbandry of the Madagascar Flat-tailed Tortoise, *Pyxis planicauda*

Viktor Mislin¹, Lydia Reck¹, and Marcel Reck¹



One of the enclosures used in Project EHAP.

In an effort to improve the husbandry of the endangered Madagascar Flat-tailed Tortoise, we made advances to Project EHAP (a German acronym that translates to “Exchanging experiences in keeping and breeding the Madagascar Flat-tailed Tortoise [*Pyxis planicauda*]”) with respect to the application of lighting and humidity to this species under captive conditions.

LIGHTING

Lighting is an important consideration, as the light intensity and ultraviolet exposure the animals receive in their natural habitat can not be exactly replicated in captivity. By using state-of-the-art lighting equipment, however, we can now approach these conditions. For standard lighting, we use Sylvania FL54 Watt T5/865 Daylight tubes, which we turn on for 12 hours per day. To approximate the natural daylight intensity, we use a Bright Sun Desert light that contains good UV B values; these lights are turned on for two periods of three hours each per day. As substitute during the midday hours, when in nature the UV radiation reaches its peak, a Ultra Vitalux 300 Watt bulb is turned on for three to four hours. The UV B output of this bulb is

300/350 mW/12000 Lux. The output intensity of this bulb, however, should be measured on a regular basis.

Importantly, we take periodic readings with a Solarmeter Model 6.2 UVB to measure the intensity and output of these lights, as their UV radiation output is reduced by about 50% after using them for six months to one year. Another important consideration is to avoid overheating the enclosure, and the tortoises. When the bulbs are operating at full capacity the enclosure temperatures can reach 40°C, so the tortoises must have the option of retreating to hiding areas where the temperatures are 50% lower. For this reason, our enclosures are open on top and are equipped with a glass strip (only 12 cm tall) on the front.

HUMIDITY

We use ultrasound humidifiers to create proper climatic and microclimatic conditions in the enclosure. By using these humidifiers, less fungal and bacterial growth is developed in the substrate of the enclosure. A wet substrate can lead to bacterial infections and protozoan infestations in the tortoises, in addition to shell rot.

To avoid bacterial growth, micro dust particles, or the intrusion of small insects into the humidifier chamber, a humidifier must be cleaned after being used for a certain number of hours.

For our purposes, we made instruments that we connect to a water reservoir or directly to an ion



Top left: An ion exchange feeder for the ultrasound humidifier. **Top right:** An ultrasound humidifier in use. **Bottom:** A newly-hatched Madagascar Flat-tailed Tortoise.

exchange apparatus. Fifteen minutes after we turn on the standard lighting, we connect the humidifiers for 15 minutes/hour during each hour of the day, for a total of six or seven times per day. We use the humidifiers on all the tortoises...from hatchlings to adults.

We adapt or improve our supporting apparatus according to the latest information and techniques available. The use of proper lighting and humidity is crucial for the optimal husbandry of *P. planicauda*, as these will directly affect the health and rearing of the hatchlings. To date, 26 hatchlings of *P. planicauda* have been transferred to project participants, and all the animals have remained healthy and are thriving at all locations. From 2005 to 2010, not a single hatchling has died, and we attribute this to the high standards set for this project and the use of proper technical equipment.

We support and encourage keepers of *P. planicauda* in their efforts to assure the survival of this endangered tortoise in private collections by means of captive propagation.

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European Studbooks: *Cuora bourreti*, *Cuora galbinifrons*, and *Cuora picturata*

Richard Struijk¹

The European Studbook Foundation (ESF; www.studbooks.eu) is a nonprofit, volunteer-driven organization that was formed for the conservation of reptiles and amphibians in captivity, with an emphasis on endangered species. One of the main goals of the foundation is to create sustainable and genetically-healthy *ex situ* populations through the use of studbooks. Due to the dramatic decrease of population numbers *in situ*, species of *Cuora* are well represented within the ESF. Three of the 11 current *Cuora* studbooks are for *Cuora bourreti*, *Cuora galbinifrons*, and *Cuora picturata*. The first studbook, for *C. galbinifrons*, was initiated in the late 1990s. Despite its downfall a few years later, it was revived in 2005 and divided into the three above-mentioned studbooks of the (former) *galbinifrons*-complex. In 2006, registrations started taking place.

STUDBOOK PARTICIPANTS

Participants from eight European countries (Austria, Belgium, Czech Republic, Germany, Netherlands, Poland, Spain, and Switzerland) are currently participating in the three studbooks. Most are private turtle keepers, but one Turtle Center has also registered their turtles. The number of participants for each of the studbooks has increased since 2006, especially for *C. galbinifrons* and *C. picturata*. Growth has been due largely to breeding successes and the entry of several new participants. In 2009, the total number of participants ranged from seven (*C.*

bourreti) to 17 (*C. galbinifrons*). The collection sizes for the participants ranged from one to 14 turtles.

STUDBOOK POPULATIONS

The total number of registered live turtles are 22, 78, and 57 for *C. bourreti*, *C. galbinifrons*, and *C. picturata*, respectively. Since re-starting the studbooks five years ago, the number of registered live turtles has increased by a factor of 5.5% for *C. bourreti*, 4.6% for *C. galbinifrons*, and 5.2% for *C. picturata*. The sex ratios for all three species are biased toward females, which is most obvious in *C. bourreti* (live studbook

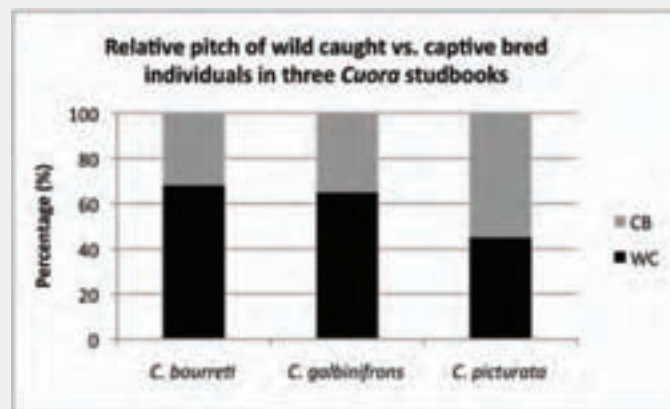
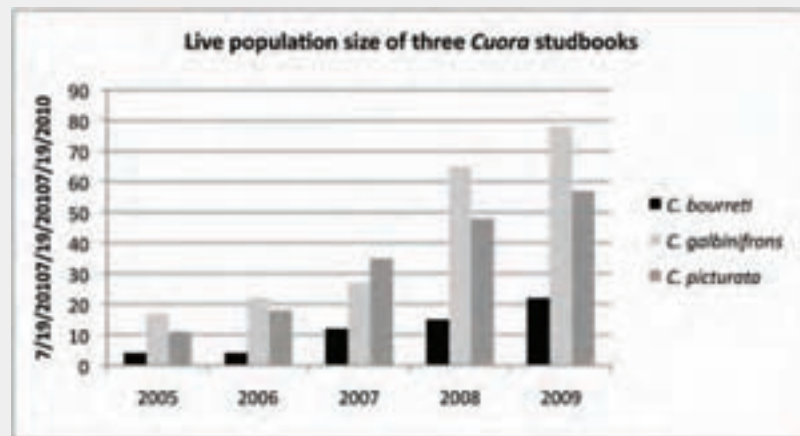
population = 4.9.9). A substantial part of the studbook populations is of captive-bred origin, ranging from 32 to 55%.

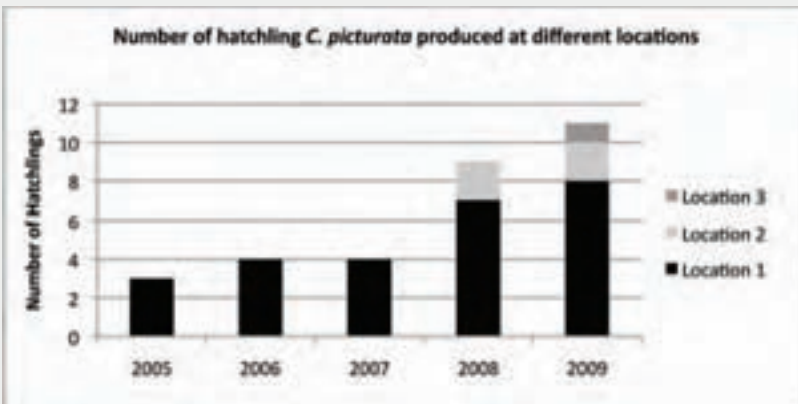
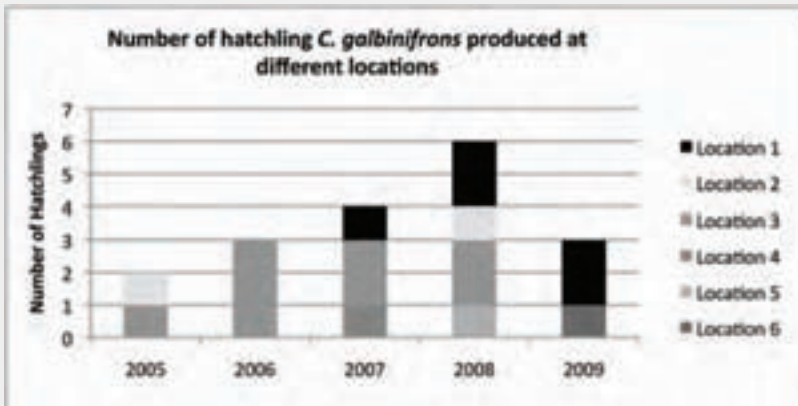
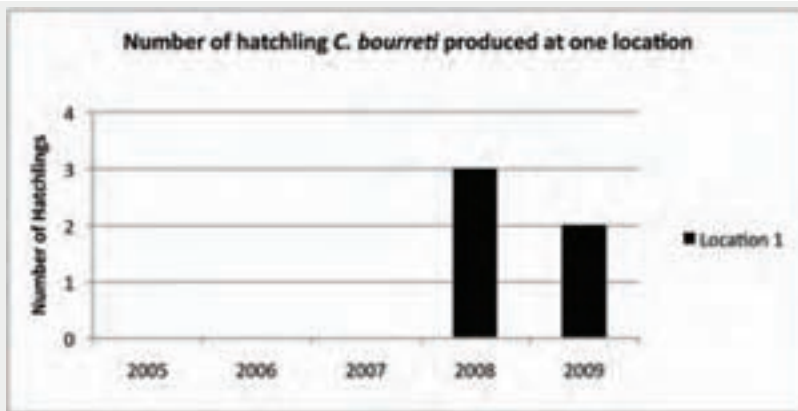
STUDBOOK BREEDING

All three of the species in the studbooks are being reproduced in captivity. Until now, *C. bourreti* has been bred the least, with offspring being produced at only one location on a yearly basis since 2008, resulting in a total of five hatchlings. Outside of the studbook, five captive bred individuals have also been registered.

Cuora galbinifrons has been bred at six locations, although offspring have been produced on a regular basis (> 2 years within a four-year period) at two locations. In total, 18 turtles have hatched since 2005.

Three breeders are available for *C. picturata*, which is a





unique situation. One of the first (if not the first) captive breedings of *C. picturata* worldwide was registered by one of the studbook participants in 2001. Today, *C. picturata* is being bred on a yearly basis, and males have been produced. In total, 31 turtles have hatched since 2005.

CONCLUSIONS

A positive trend can be seen in the increasing number of studbook participants and the sizes of populations in the studbooks. In addition, breeding success has also increased. All three studbooks, however, require a broader genetic base to achieve future sustainability. The number of wild caught *C. bourreti* and *C. picturata* remains small, and thus new participants for the studbooks are needed.

The sex of captive bred individuals remains uncertain. Although male *C. picturata* have been produced, sex ratios likely will be female biased, just as in almost all captive bred *Cuora* species. Accurate data regarding incubation methods and the sex of offspring are necessary, as well as an important consideration.

Furthermore, only unrelated pairs of individuals should be introduced to prevent inbreeding. We expect that the number of people breeding these species of *Cuora* will increase in the future. The owners of captive bred individuals should house related turtles of the opposite sex separately, and make an attempt to acquire unrelated animals. Maintaining good records are the key, especially for the long term.

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Dorsal (left) and ventral (right) views of captive bred studbook individuals of *Cuora bourreti* (upper, in photo), *C. galbinifrons* (lower left), and *C. picturata* (lower right), respectively.

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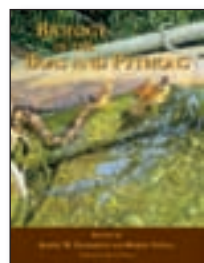
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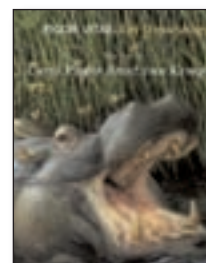
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Tortoise and Terrapin Survey in Benin, West Africa

Tomas Diagne¹



An adult *Pelusios niger* basks at the Rembo Koto Lagoon, Benin.

LUCY KEITH

W edged between Nigeria and Togo, the small country of Benin is 750 km long and 300 km wide, with a surface area of 112,622 km². Formerly called Dahomey, in November of 1975 the country became known as the “Republic of Benin.” Because of my interest in the turtles of this region, my plans were to attend a Biodiversity Congress in Cotonou, as well as to meet the TSA Africa network’s national representative for Benin, Josea Dossou Bodjrenou.

The landscape and environment of Benin shows a high degree of contrast between the southern and northern parts of the country. The lagoon environment along the coast quickly rises to an area of crystalline plateaus, which then gradually

rise to an elevation of 800 m at the Massif of Atakora, the highest point in the country. The climate in the different regions of the country is also variable. During my stay, heavy rainfall fell at Cotonou Ouidah, in the south, while at Djougou and in Pendjari Park, in the north, it was the dry season. South of the 10th parallel the climate is considered south-equatorial, with the temperature ranging from 23 to 32°C during the four seasons of the year, while in the north, the thermal fluctuations increase along with a drought, more of a Sahelian regime that encompasses two seasons.

I began my journey with a three day stay in the capital city of Cotonou, where I attended the Regional Biodiversity meeting. Many of the neighboring countries were represented, including Burkina Faso, Ghana, Nigeria, Sierra Leone, and Togo. In a pond at the Benin government office of Water and Forestry I saw several live freshwater turtles (*Pelusios castaneus* and *Pelomedusa subrufa subrufa*), an adult female *Centrochelys sulcata* (a species a ranger indicated exists in this country, around Parakou, in the reserve of Alama) and many *Kinixys belliana* and *K. homeana*. Other reptiles, such as Savanna Lizards and a Royal Python were held in cages, as well as small mammals such as a Spotted Genet and Hedgehogs. Regrettably, this “biodiversity salon” was offering the captive wildlife for sale!

Later, I accompanied Severin Tchibofo, a biologist at the University of Abomey Calavi, to the Dantokpa market on the banks of the Oueme River, which flows through the capital city. There, amidst alleys strewn with garbage and waste, I found an assortment of bones and dead animals, including the skulls

of monkeys and vultures, as well as crocodiles, mutilated sea turtle shells, terrestrial and aquatic turtles, and so on. Most of these species are protected by national laws, but they are still used widely in pharmacopeias and animist rites. In the narrow streets of this disturbing scene, I asked where one could buy live turtles. "Sure," replied a seller, as he pulled a dehydrated freshwater turtle from a tin box. By its dark shell and accompanying pectoral, it appeared to be a *Pelomedusa subrufa nigra*. Until then, I was not aware that this subspecies was still found in Benin! I negotiated to buy it — something I normally would not do — for 1,500 FCFA (approximately \$3 US) in order to photograph and release it.

Severin showed me some posters that described the traditional uses of certain species of turtles. Although the content of the posters made me shudder, their text was informative and reflective of traditional customs. The first was of *Kinixys belliana*, with a vernacular name Logozo (Fon), and indicated that for medicinal use one must, "Kill the turtle and take its entire head, plus the excrement of a horse and a cow's hoof. Dry all of these elements in the sun and crush them into powder. The powder should then be mixed with red palm oil. A person suffering from hemorrhoids should first wash his anus after using the toilet and then pass the mixture. This preparation is made without any incantation." A second poster listed the Leatherback turtle, Agbossègué, or Hou (Mina), and showed that for medicinal use, "The turtle is killed and its flesh is consumed to fight against various malaria fevers, vomiting, and indigestion. Its shell is recovered and exposed to sunlight to facilitate the flow of oil into a container. The recovered oil is used to massage people suffering from tetanus convulsions."

After a few days, I was happy to leave Cotonou and its barbaric manners. Accompanied by Severin, Pascal Dupont, and Martin, we drove north into the wilder regions of the country. Our destination was the small village of Toffo, not far from the city of Bohicon in the province of Zou. Pascal, who is an avid entomologist, picked up one of his colleagues, a snail farmer named Daniel Gnanvo, on the roadside at Attogon. Subsequently, we left the paved road and went through a large teak plantation managed by the National Office of Wood (ONAB). At Toffo, we briefly surveyed the neighborhood, but Pascal and I were disappointed by the paucity of animals in the vicinity of the village. From their huts, however, people brought about 10 turtle shells; the turtles had been eaten in old feasts and I easily recognized *Kinixys belliana* and *Pelusios castaneus*, common species in the country.

The landscape along our journey was deep green and hypnotic. Pineapple vendors sold their fruit on the roadsides, especially at the beautiful village of Séhoué. During our return, we stopped at a research station devoted to coffee and cocoa and I discovered a beautiful and relatively untouched primary forest, with ponds in the spongy soils invaded by large ferns. Although this appeared like good habitat for *Pelusios*, Daniel indicated that the main species in this area was *Kinixys*, a turtle widely consumed by the local populace. The flesh of the turtle is used to prepare a sauce as an accompaniment to white rice or maize paste. Often, the head of the turtle is kept and used at official "voodoo" ceremonies during mysterious night meetings, but I did not learn more about these practices. Back home, Daniel handed me two large shells of *Kinixys*, and it was the first time I had seen such large individuals; the carapace length of

one was 35 cm long. I asked Daniel where the shells had come from, and he replied, "I won them near Kumasi in Ghana. We find many over there. They are very popular because there is a lot of meat inside." Based on the lack of nuchal and prominent marginal shape, I immediately deduced that this was *K. erosa*, a species widely consumed in Ghana. I was beginning to understand the plight of turtles in this part of West Africa.

After a brief return to Cotonou, we prepared for a longer expedition to Pendjari National Park in the northern part of the country. This time I hoped to find some wilderness, and a larger number of live turtles. We left the capital city on April 9th, after experiencing numerous technical and regulatory difficulties. Our team consisted of members of the NGO Nature Tropicale, and some winners of



Top: *Kinixys homeana*, a species that resides in wet forest environments and spends most of its time amongst the decaying vegetation.
Bottom: What is known today as *Pelusios castaneus* in Benin occurs in two forms. The dark one is likely an undescribed species.



CYPRIEN EDIAH

Thomas Diagne, the TSA African Chair, during a field survey of the Lokoli Forest in Benin.

the Marathon of Biodiversity. We drove to the north, passing through several towns and villages that included Bohicon Savalou, Pira, Bassila, Djougou Natitingou, and finally Tanguieta, where we spent the night after having crossed the mountainous massif of Atakora and its breathtaking scenery. The temperature at Tanguieta was hot and the air was much drier, a Sudanese climate. In the morning, we visited an ostrich farm near Tanguieta, and then entered the national park at Porga, near the border with Togo.

Undoubtedly, this park had rich fauna, a change from the rest of the country. After a few kilometers, we saw a raptor that had just captured a snake and was holding it tightly in its talons. We saw red monkeys, baboons, an elephant, and various species of antelope, including the famous Roan. I imagined what this region must have been like before the presence of humans. We then stopped at the Pendjari River, from which the park received its name. I asked the guards about the occurrence of turtles in the park, and they assured me that people often see two “kinds” of tortoises, one a “soft tortoise” and the other a “tortoise.” I presumed that they were referring to *Kinixys* and *Cyclanorbis*, but I wanted to be sure.

We could not afford any delays,

because we were headed for the outpost of Arli, where our driver, Chabi, had recommended that we spend the night. Arbi is located in the north, near the border with Burkina Faso. We saw more wonderful animals, including bustards, hartebeest, warthogs, and hippopotamus in a large pond where we observed them from the top of a tower. Unbelievable! How talkative and noisy they are! Just before nightfall they gave us a thundering concert in the style of “Out of Africa.” The outpost of Arli was well equipped with a large, permanent building and attractive outdoor facilities. The instructions provided by the rangers were clear: do not travel alone at night, and do not make much noise early in the morning and be sure to look around because animals are often out; even lions cross the encampment. These instructions were enough to keep us on our guard, and to sleep lightly.

The next morning, my intuition led me to search the kitchen waste left by the guards, and I found several bones and some of the plastron of *Cyclanorbis* sp. Unfortunately, this proved that the guards consume some of the animals in the park, an observation that is not very comforting. Later, we all traveled to the Bali pool, an area where animals such as primates, ungulates, and birds gather to quench their thirst. Of course, we did the same by rushing to the hotel bar at Pendjari to enjoy a cold beer, after several hours under the beating sun.

After 12 days, we returned to Cotonou following a route that took us to the Tanougou waterfall. A nice bath in the icy water made me nostalgic for the conditions of Senegal, as traveling abroad can sometimes make you feel better about your own country. When I returned to the capital, Pascal Dupont suggested that I spend the night so that in the morning we

could travel to the Lokoli swamp forest. The forest is located 8 km from the main road between Cotonou and Bohicon, and extends for over 500 hectares among three villages: Lokoli, Koussoukpa, and Démé. The population of this area consists of about 1,500 people, all farmers from the Fon ethnic group. The climate is Guinean, with an annual rainfall of about 1,100 mm. The relative humidity is high, even in the dry season, which explains the lush, dense forest, which consists primarily of Guinean species. The fauna is also diverse, and you can find many types of birds and insects (some-endemic), mammals such as the extremely rare Sitatunga, fishes, and tortoises. This time I hoped to observe turtles active in their environment.

When I arrived, I met with Cyprian Edah, a young forester who works on the forest conservation project implemented by Nature Tropicale. He was aware of my visit, and promised to facilitate my meeting with Adrian, a hunter and fisherman who often catches turtles, here called “logozo.” After taking a canoe with Cyprian across the marsh and to the edge of a swampy forest, he explained the issues of conservation in this region and the purpose for his work; he is involved in the preservation of the endemic Red-bellied Monkey of Benin. I observed and photographed the rich aquatic vegetation that surrounded me, and Cyprian surprised me with his knowledge of the scientific names of most plants, which reminded me of previous courses in botany.

Once I returned from the field, I met the famous hunter and fisherman Adrian Salame, who handed me a beautiful *Pelusios castaneus* as if it was a rare treasure. Adrian is a stocky man, austere and a bit wild, who does not understand French very well and who smelled of raffia alcohol. That day he had



Young villagers hold a *Pelomedusa subrufa*, an abundant turtle in Benin.



A turtle seller shows a juvenile *Trionyx triunguis*.

already visited his traps, and I suggested going with him the following day to see what we would find. Of course, I told him I would release any animals after observing them. Back in the village of Démé, I left my friend Pascal Dupont and his family, with whom I spent many pleasant moments.

Adrian had two kinds of traps. The first, which were very sophisticated, were long, 50 cm high corridors made from palm leaves. They included 30 to 50 m of trap with a slip knot. Once an animal, a bird, rodent, or even a python enters this device, it follows it, loses its way through the maze, and ends up trapped with no apparent exit, which inevitably leads to its capture. The second trap was made of a net that was half submerged in the current of a small stream flowing between two marshlands. Adrian was proud to show me his traps, and to explain the subtlety of their operation. I realized that he had placed much thought into the behavior of animals, and had adapted his traps to the different prey. A professional hunter that lives only from what he catches, he appears respected by other villagers in the region. At the edge of a stream he explained to Cyprian, who then translated to me that “in about January, in the good season, he sometimes trapped two bags full of turtles as they go upstream.”

Two bags could hold about 100 lbs. I knew these turtles would end up in a soup, and did not like it.

We moved around in a swampy area that was particularly difficult to traverse, and felt like I was walking with suction cups. In one of the traps, we found a beautiful *Kinixys homeana*. The habitat was suitable for this species, consisting of woody vegetation and a low water level, the same habitat in which the Sitatunga Antelope is found. By then the turtle had curled into its shell. This species is well represented in almost all the countries bordering the Gulf of Guinea, and it prefers wet forest environments where it spends most of its time in decaying vegetation. It feeds primarily on earthworms, insects, and snails, but also has a real passion for wild mushrooms. Its long legs enable it to walk easily on a wet and spongy substrate.

Once back in the village, the children learned of my interest in turtles and brought me an abundance of shells and pieces of bone. I quickly identified them as belonging to the three main species: *Cyclanorbis* sp., *Kinixys homeana*, and *Pelusios castaneus*. I sat in the shade of a huge Ironwood Tree and I shared a glass of palm wine with Adrian, which he placed in a gourd full of dust. He told a dark story about the local turtles in the Fon language, which Cyprien then translated. The

palm wine, however, prevented me from understanding everything that was said.

I returned to Cotonou with a head full of images and memories of an authentic forest, not destroyed by humans, where there still appear to be many living turtles. We can only hope that Adrian will eventually reduce his catch and that no other hunter will take his place. The situation of tortoises and terrapins, of course, is not ideal, and most species are widely hunted and consumed. We can expect to see more chelonians only in a few isolated parks, and in a restricted part of the country. Luckily, the main species are elusive and small, or hide in the mud, which somewhat reduces their risk of capture.

My only ambition for writing this story is to provide some information about a relatively little-known country not yet described in this magazine.

I thank Severin Tchibozo, Josea Dossou Bojirenou, Adrian Salame, Cyprian Edha, and all the trackers and villagers I met during my stay, who certainly helped me to better understand this country and the situation regarding its turtles. I also thank Rick Hudson and the TSA for helping to finance my work.

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Efforts to Conserve the Myanmar Roof Turtle (*Batagur trivittata*) Reach a Milestone: Record Number of Hatchlings Recovered on the Chindwin River

Win Ko Ko¹, Kyaw Moe², Khin Myo Myo³,
Brian D. Horne⁴, and Rick Hudson⁵

In terms of extinction risk, the Myanmar Roof Turtle (*Batagur trivittata*) is assured a spot in the top five chelonians considered *close to the brink*. Hence, it is imperative that we safeguard the last natural population, no matter how small it is, as it might represent our only chance to save this species in the wild.

A rather resilient species, *B. trivittata* is tenaciously clinging to existence in the wild. Despite decades of chronic and intensive exploitation of both eggs and adult

turtles, this species continues to survive, albeit now only on the upper Chindwin River. We may never be able to return *B. trivittata* populations to their historic numbers, but our goal is to establish at least three new nesting populations across the species' historic range.

The Wildlife Conservation Society (WCS) turtle team began protecting this last known breeding population of *B. trivittata* in 2005. Of approximately 600 miles of habitat

along the Chindwin River, only a small section (10–25 km) of the river, near the village of Linpha, still supports this turtle. We estimate that as few as 10 adult turtles remain in the wild. Further exacerbating the problems of this small population is that the sex ratio is female biased, and each year at least 100 eggs fail to show any signs of embryonic development. Perhaps, too few males are available to properly inseminate the remaining wild females. Our hope is, however, that in 2011 a number of the 5-year-old males currently being headstarted at the Yadanabon Zoo can be released into this population, to increase the number of hatchlings produced each year.

We approached the 2010 nesting season with a sense of dread and foreboding, knowing that in late 2009 the Myanmar government had granted leases for large scale gold extraction on the Chindwin River, including on the main nesting beach used by for this species. We had every reason to believe the mining activity would prove highly disruptive to the females' nesting attempts, not to mention the associated environmental ills, and thus we expected very little nesting to occur. Yet, incredibly, a record number of hatchlings (118) were produced from the nest site protection program.

To date, 376 hatchlings (2006–2010) have been transferred from riverine hatcheries and *in situ* protected nests to the Yadanabon Zoo for headstarting, as well as integration into the zoo's assurance colony. Remarkably, the adult females in the assurance colony started to breed just two years after being introduced into the new facility, in December of 2006. The first four hatchlings were produced

Extensive gold mining activity on the upper Chindwin River, near the beaches used by *Batagur trivittata* for nesting, was expected to have devastating consequences on nesting success. An unexpected record number of hatchlings, however, were produced in 2010.



KYAW MOE AND WIN KO KO



KYAW MOE AND WIN KO KO



KYAW MOE AND WIN KO KO

Left: The WCS Turtle Team searches for eggs laid recently by a *Batagur trivittata* on the upper Chindwin River. **Right:** Each of the depressions or “body pits” represents a trial dig by a nesting female *Batagur trivittata*. Here, the team measures the distance between pits.

in late 2008, 17 more hatchlings in 2009, and an additional 16 in 2010, thereby bringing the total number of juvenile turtles headstarted at the zoo to nearly 400 animals.

The *B. trivittata* assurance colony at the Yadanabon Zoo has grown rapidly, and the headstarting facility is now at full capacity. Additional housing, however, will be built in 2010 (see adjacent article). The next critical step in our recovery program will be to find suitable release sites that offer some measure of protection from illegal hunting and accidental drowning in fishing nets. Expanding on the surveys conducted by Brian D. Horne and Win Ko Ko for suitable reintroduction habitat for *B. trivittata* in the Hukaung Tiger Reserve in 2009, the WCS turtle team is now conducting additional surveys in the Chatthin Wildlife Sanctuary and the Alaungdaw Kathapa Wildlife Sanctuary.

Many pieces are in place to launch a monitored reintroduction program for *B. trivittata*. Nevertheless, to advance to the next phase of the recovery program we must devote more resources and experienced personnel to the field research effort. With this in mind, we hope that Gerald Kuchling will be able to guide the recovery process in 2011. We have reached a crucial juncture where good science could likely

prove pivotal in our recovery efforts for *B. trivittata*, and have come too far not to devote our best resources to this program. Although much can be celebrated, as we have reached some historic milestones, history tells us that celebrating too soon can lead to catastrophic results.

The *B. trivittata* recovery program has been a model for collaboration, capitalizing on the strengths of both the WCS (in managing *in situ* field programs) and the TSA (in establishing captive programs). The wild population has, from the start, supported the assurance colony; now the time has come for the assurance colonies to play an integral role in

the survival of *B. trivittata*, as well as to support the recovery of wild populations.

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A juvenile Burmese Roof Turtle captured by fishermen and turned over to the WCS Turtle Team, a positive sign that at least some eggs are surviving in nature.



KYAW MOE AND WIN KO KO

MYANMAR

The TSA Gears Up for New Construction Projects in Myanmar

Rick Hudson¹

The TSA will soon embark on a major construction phase in Myanmar, with new facilities planned for turtles and tortoises at three locations. The culmination of many months of planning and

fund-raising, these new facilities will provide greatly enhanced breeding and management conditions for three Critically Endangered endemic species: the Burmese Roof Turtle (*Batagur trivittata*), the Burmese Star Tortoise (*Geochelone platynota*), and the Arakan Forest Turtle (*Heosemys depressa*). New enclosures are also planned at three locations for groups of Asian Mountain Tortoises (*Manouria emys phayrei*). In August of 2009, a TSA team led by Rick Hudson that included Lonnie McCaskill, Dave Manser, Kalyar Platt and her father Nyunt Thein — a retired Burmese civil engineer with years of experience in the construction industry. Over a period of two weeks, the team visited numerous sites with an eye on building a turtle and tortoise rescue center, while expanding existing facilities at the Yadanabon Zoo in Mandalay and the Lawkananda Wildlife Sanctuary in Bagan. The TSA will partner with another conservation group to build facilities for *H. depressa* and *M. e. phayrei* in the Rakhine region.

THE YADANABON ZOO

Mandalay's Yadanabon Zoo is set for the most intensive construction activity, with a vastly expanded breeding enclosure for Asian Mountain Tortoises, new grow-out ponds for Burmese Roof Turtles, and new rearing ponds for endemic softshell turtles, starting with a group of Peacock Softshells (*Nilssonina formosa*).



Rick Hudson inspects a juvenile *Batagur trivittata*. This species grows so rapidly in captivity, that individuals soon outgrow their enclosures and new ones must be built.



Above: Kalyar Platt (center) and her father Nyunt Thein review design plans for a proposed rescue facility near Myitkyina, the capital of the Kachin State.

Below: The Arakan Forest Turtle (*Heosemys depressa*) is one of seven chelonian species endemic to Myanmar, and is the target of new captive facilities at several sites.



Currently over 240 rapidly growing *B. trivittata*, hatched from 2006 to 2009, are maintained here, with another 115 from a record hatch on the Upper Chindwin River soon on the way. *Batagur* grow at an astounding rate and they have quickly outgrown their ponds, and one group of 2006 hatched "juveniles" has already been moved to the adult breeding pond to free up space. To accommodate the 2010 hatchlings, another group will have to be moved to the adjacent water hyacinth filled filtration-pond for grow out. Plans call for two new ponds, each 6' × 18', and a third pond that is circular and measures 10' × 12'. Each pond is three feet deep in the center, gently sloping or stair-stepping up to the edge.

With plans to expand our captive work with the two endemic softshell turtles, *Chitra vandijki* and *N. formosa*, we are building a series of four 10' × 20' ponds. This new area will allow the zoo staff to provide optimal growing conditions for the small group of *N. formosa*, and to have space for a pilot program for *C. vandijki* when the opportunity arises.

The Yadanabon Zoo's group of 65 adult *Manouria e. phayrei* (see the 2008 TSA magazine for a full story) have been living in crowded and temporary quarters since



RICK HUDSON



RICK HUDSON



RICK HUDSON

Left: Burmese Roof Turtles exhibit extreme differences in sexual dimorphism, which become prominent in their third year. These individuals hatched in 2006 and were photographed in 2009; the male is on the right. **Center:** Yadanabon Zoo veterinarian Dr. Tint Lwin holds a 3½ year old *Batagur trivittata*, displaying its impressive growth. **Right:** The sexes in *Batagur trivittata* are diagnosable not only by coloration, but also by tail length. The female is on the left.

being confiscated from traders in September of 2007 — but that is about to change. A new facility will triple the size of the existing enclosure, and will improve husbandry and management by allowing smaller breeding groups to be maintained. Permanent ponds with drains, earthen mounds for climbing, and shade retreats with planted bamboo will also be featured. This group will soon be divided among multiple locations to avoid risk, and one group has already been placed at the Yangon Zoo. In August of 2009 we found the Yadanabon Zoo group to be remarkably healthy, as evidenced by their good weight and state of hydration. The estimated costs for all of the construction at the Yadanabon Zoo are approximately \$41,000.

LAWKANANDA PARK

Of the four government-run Burmese Star Tortoise breeding facilities, Lawkananda is the most successful and maintains the largest population. Lawkananda is currently overcrowded, however, because they receive the government's 20% share of captive-hatched tortoises from the nearby foreign-run commercial facility known as Griffin Enterprises. The staff here is concerned about potential theft, so

besides a major expansion we are including provisions for beefed-up security measures. The new facility will include a 60' × 88' expansion of the old facility, with new and secure grow out enclosures for juveniles and new breeding areas for adults, with elevated nesting areas (to avoid

flooding, star tortoises seek high ground for nesting). In addition, we will build an adjacent 28' × 88' divided enclosure for *Manouria e. phayrei*. The security features include predator-proof, heavy mesh wire, a 10' high perimeter fence with razor wire, a guard tower, and

The staff at the Lawkananda Wildlife Sanctuary were surprised to see captive Burmese Star Tortoises (*Geochelone platynota*) feeding on spineless *Opuntia*, or prickly pear cactus. This plant is readily available in the central dry zone of the country, and could be cultivated to provide an inexpensive and nutritious food source.

RICK HUDSON





RICK HUDSON

This juvenile Peacock Softshell Turtle (*Nilssonia formosa*) was hatched from a protected nest on the upper Chindwin River and brought to the Yadanabon Zoo for headstarting. New facilities will soon be built to manage both of Myanmar's endemic softshell turtle species.



RICK HUDSON

These Asian Mountain Tortoises (*Manouria emys phayrei*) were part of a confiscation in 2007 in which 70 individuals were taken to the Yadanabon Zoo. New facilities are being constructed to better manage the 65 remaining tortoises.



RICK HUDSON

motion detectors with automatic lights. The estimated costs for this facility are \$23,000.

LASHIO

Located in northeastern Myanmar on the border with China, Lashio is a common trade route into that country and the site of multiple wildlife confiscations. Consequently, Lashio was designated as a priority for a first-response rescue center for turtles and tortoises seized from the trade. A Forestry Department base station just outside the town, Kho San Tan Park, provides a perfect setting for the Center: the land is adjacent to a hillside of moist tropical forest, has plenty of relief, and a stream that runs through it. We designed a broad range of terrestrial enclosures (14 in total) to support the diversity of species seen in the trade, including areas for *Indotestudo elongata*, *Manouria emys*, and *M. impressa*. A series of three stream-fed ponds are designed that should be suitable for any number of aquatic turtles, including large softshells. The staff here is enthusiastic about having an area to stage turtle confiscations, and just the past week handled a large seizure of *Indotestudo* and *Lissemys*.



RICK HUDSON

Top: Members of the TSA team inspect the land at Kho San Tan Park near Lashio, the site of a planned turtle and tortoise rescue center. Lashio, near the border with China, lies along a major trade route for illegal wildlife.

Bottom: Yellow Tortoises (*Indotestudo elongata*) from a large trade seizure near Lashio are packed into the bed of a pickup truck and hauled away for release. Without adequate holding and treatment facilities, mortality among confiscated turtles and tortoises is generally high. Survivors may not fare much better without better release protocols.

Lacking adequate facilities, and with turtles packed tightly, the mortality was high. After being stored in a warehouse, the surviving tortoises were packed in the bed of a pick-up and taken to a release site. The Forestry Department wants to do a better job and welcomes the TSAs offer for assistance. The estimated costs for this facility are about \$32,000.

Though the team designed two additional facilities, those described above are our top priorities; others will be completed as funds permit. The total costs are \$96,000. To meet this challenge, the TSA has been aggressively fund-raising, and we have reached about ⅔ of our goal. For their generous support, we thank the following organizations: Pat Koval/WWF Canada, the Los Angeles Zoo, the British Chelonia Group, the Taipei Zoo, Woodland Park Zoo, Kenneth Tang and the HATZH Donation Fund, the Detroit Zoological Society, the Toronto Zoo, Nature's Own, and Andrew Walde.

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A Promising Start for Turtle Conservation in Bangladesh, with an Emphasis on the Flagship Species *Batagur baska*, the Northern River Terrapin

Peter Praschag¹ and Rupali Ghosh²



PETER PRASCHAG



PETER PRASCHAG



PETER PRASCHAG

Bangladesh is characterized by a dense network of over 700 rivers, which produce the third highest outflow of water of all the countries in the world. The widest rivers are the Brahmaputra, Ganges, and the lower Meghna, with the latter expanding to around eight kilometers during the wet season and even more during floods. Together with slow moving channels, flooded areas, lakes, and countless smaller bodies of water, these heterogeneous aquatic habitats support a high diversity of freshwater turtles.

A total of 28 species (including 15 subspecies) of turtles and tortoises occur in Bangladesh, which includes five marine turtles, 14 geoemyds (hard-shelled freshwater or estuarine turtles), two testudinids (tortoises), and seven trionychids (softshell turtles) (Khan 1982; Sarker and Sarker, 1988; Das, 1991; Rashid and Swingland, 1997; P. Praschag and R. Ghosh, pers. observ.). None of the species, however, is endemic to the country.

Local trade in freshwater turtles

Top: An adult male *Batagur baska* in breeding coloration.

Middle: One male and two female *Batagur baska* kept in a village pond. The owner consumes their eggs every year.

Bottom: Rupali Ghosh with an old male *Batagur baska* from a village pond. The owner had the terrapin for more than 50 years.

increased dramatically in Bangladesh after the country's independence in 1971, which opened the door for commercial exploitation on a large scale. During the 1980s and 90s, commercial harvesting and the export of turtles reached a peak (Rashid and Khan, 2000), with annual sales of about US \$ 600,000 resulting from turtle exports mainly to China, Japan, and a few other countries. Fortunately, these exports have been banned by the government, but local consumption and trade still occur, especially in remote areas. The harvesting of turtles and their eggs occurred to such a degree, however, that the large, hard-shelled turtles (*Batagur baska*, *B. donghoka*, and *Hardella thurjii*) are on the brink of extinction or perhaps already extirpated (*Batagur kachuga*). The collapse of populations of these highly specialized riverine species came in the mid-to-late 90s, due to a change in fishing techniques. Small rowboats were then replaced by motorized fishing trolleys, and fishermen were able to set extensive nets in rich fishing grounds along the rivers. These nets were so large that they sometimes extended across the width of the rivers.

Today, the turtle market revolves around relatively abundant species like the Anderson's Flapshell Turtle (*Lissemys punctata andersoni*), the Indian Roof Turtle (*Pangshura tecta*), the Indian Eyed Turtle (*Morenia petersi*), and the two of the larger soft-shell turtle species, the Indian Peacock Softshell (*Nilssonina hurum*) and the Ganges Softshell (*N. gangetica*). In recent years, a new and profitable market originating in Bangladesh is causing the mass harvesting of softshell turtles throughout southern Asia. Large softshells are being harvested in alarming quantities all over the country to collect their



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Top: The Friday market in Old Dhaka, where turtles are slaughtered and sold openly on the street. Pictured here are the bodies of *Lissemys punctata andersoni*, *Nilssoniana hurum*, and *Pangshura tecta*. **Bottom:** The slaughtering of *Morenia petersi* in Old Dhaka.

cartilaginous posterior rim of the carapace and some smaller parts of the plastron, a product called calipee. We saw drying calipee on fishing lines in fishermen's houses throughout most of the country. All of the target species are listed on CITES I (*N. gangetica* and *N. hurum*) or CITES II (*Chitra indica* and *Pelochelys cantorii*). Unfortunately, the dried calipee, which are often cut into small pieces, are difficult to identify as part of a softshell turtle and thus are transported without difficulty across international borders on their way to Hong Kong and mainland China. A few shipments containing several hundred kilograms of calipee, from thousands of softshell turtles, have been confiscated, but the risk for traders remains very low and the demand and profit are very high. In Dhaka, 1 kilogram of a living *Nilsson-*

nia sp. is sold for 400 to 600 Tk (\$6 to \$9 US), a fresh kilogram of calipee for 2000 Tk (\$30 US), and 1 kilogram of dried calipee for over 6000 Tk (\$90 US).

All attempts to find one of the most Critically Endangered turtle species, the Northern River Terrapin (*Batagur baska*) in the Indian states of West Bengal and Orissa have failed, so Bangladesh appears to be the last stronghold for *B. baska*. To our knowledge, only 12 individuals are being maintained in India (two at the Madras Crocodile Bank and 10 at the interpretation center in Sanjakhali, West Bengal) and a few more in a private collection in Austria. Only one female remains at Sanjakhali, and no male has been transferred to the Crocodile Bank for an attempted breeding with its two females.

Presently, we are not aware of any reproducing populations of *B. baska* in the wild, so our primary objective was to locate individuals of this species in the turtle trade or in village ponds. After three years of investigation, with fieldwork accomplished primarily by Rupali Ghosh, a few individuals were spotted in fish breeding ponds in disparate areas of southern Bangladesh. All of the individuals identified have been held in captivity for at least 15 years. As a result, we now have a remarkable opportunity to assemble a breeding group for a species that is functionally and ecologically extinct in the wild due to overexploitation for human consumption.

In collaboration with CARINAM (Center of Advanced Research in Natural Resources and Management, S.M.A. Rashid) and the Forest Department, the TSA is supporting the establishment of a breeding facility for the Northern River Terrapin. We are attempting to obtain several individuals from different fish ponds to establish a breeding group. The permitting process is finished, but financial hurdles must

now be overcome. The facility will have the capacity to house and breed other endangered freshwater turtle species found in Bangladesh, such as the Indian Narrow-head Softshell Turtle (*C. indica*), the Black Softshell Turtle (*Nilssoniana nigricans*), the Giant Softshell Turtle (*P. cantorii*), and also a few hard-shelled species of the genera *Batagur* and *Hardella*.

Next to the Yangtze Giant Softshell Turtle, *Rafetus swinhoei*, no freshwater turtle is likely in more danger of rapid extinction than *Batagur baska*. The next few years will be critical for this species, as we rush to build holding and breeding ponds in Bangladesh and secure long-term captive specimens. This endeavor promises to be costly, but the TSA is committed to securing the funds. We thank the Beneficia Foundation for supporting some of our field work, and Pat Koval and WWF Canada for generously providing the funds for pond construction.

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TSAs Indian Turtle Conservation Program: A Ray of Hope for an Imperiled Turtle Fauna

Shailendra Singh^{1,2}, Brian D. Horne³, and Rick Hudson²

Since its inception in 2005, the Indian Turtle Conservation Program, a joint endeavor of the Turtle Survival Alliance, the Madras Crocodile Bank Trust, and the San Diego Zoo's Institute for

Conservation Research has expanded greatly to better aid in the recovery of India's imperiled turtles. Originally a single species conservation project, it has grown to become a larger, multi-species program. Through

this project, we are currently conducting natural history research, *in-situ* headstarting, community-based education programming, and poacher rehabilitation activities for five of India's most endangered turtles. By addressing various social and economic issues in the communities associated with India's diverse turtle fauna, we have made great strides in halting the downward spiral of many turtle populations throughout the region. Our turtle conservation program is now considered one of the most socially integrated of its kind in Asia.

Many of our activities in 2009 included educating and training various groups on issues of turtle conservation, which created dialogue with government and non-government organizations, and policy makers, in an effort to build sustained advocacy for freshwater turtles and their associated habitats in India. These activities will help us continue our current efforts in the Chambal River and Upper Ganges River System (central India), and expand our program in four additional turtle priority areas: the Terai Region (northern India), the state of Assam (northeastern India), the Sunderbans of West Bengal and the state of Orissa (eastern India), and the Western Ghats and the state of Tamilnadu (southern India). Our goals are to conserve as many remaining wild populations of chelonians as possible, and to establish multiple assurance colonies of the regions' Critically Endangered turtle species within the next five to 10 years. We are optimistic that we can achieve these benchmarks by garnering help and support from regional partners, international donors, and local stakeholders and communities.

A male Red-crowned Roof Turtle (*Batagur kachuga*) in full breeding coloration. Ranked as Critically Endangered by the IUCN Red List, this species is emblematic of the Turtle Conservation Program and serves as its flagship species.



BRIAN D. HORNE

Herein, we are presenting a few of our key achievements from 2009, which we hope will be the building blocks for long-term chelonian conservation in India.

THE INDIAN NARROW-HEADED SOFTSHELL TURTLE CONSERVATION INITIATIVE

The Indian Narrow-headed Softshell Turtle (*Chitra indica*) is hunted extensively throughout its wide distribution in India. The outer cartilaginous rim of its carapace is used as delicacy in Southeast Asian cuisine, as well as an aphrodisiac in traditional Chinese medicine.

In 2006, we began to assess the population status of this turtle. Our surveys revealed steep population declines, and that less than 20% of the habitat reported for this species 20 years ago continued to support populations. These declines were mainly due to unsustainable harvesting, along with habitat degradation and fragmentation.

We had limited success during our initial nesting surveys and it was not until 2008, when we engaged former turtle poachers as field assistants, that we identified a few surviving but isolated breeding populations. One population along the upper Ganges River (herein referred to by the Indian name “Ganga”) near the confluence of the Ganga and Ramganga rivers, in the state of Uttar Pradesh, is of particular interest. Here, we studied the nesting biology of *C. indica* via an *in-situ* nest protection program.

Encouraged by these results, we expanded our surveys to include the middle and lower stretches of the Yamuna and Chambal rivers. In September, we found two *C. indica* nests (351 eggs) along the Ganga River nesting site, and two more in October (195 eggs) near the village of Kundpura. Only one of the four clutches produced hatchlings, however, and only at a 12% hatching

rate. We believe the poor hatching rate was caused by a sudden decrease in nest temperatures in early November. After collecting standard morphological measurements and injecting a small decimal coded wire under the skin of a hind limb of the hatchlings for future identification, we released them all at the original nesting site.

During the surveys along the Ramganga River, we found four nests destroyed by predators (presumably jackals) and two more in which the eggs had been poached by locals for human consumption. This year the low water level in the river rendered historically favorable nesting habitat along the hatchery unsuitable. Previously, we observed *C. indica* nesting on high and steep riverbanks, yet this year we found all 10 nests on low and flat sandbanks.

Since the main channel of the Ganga River along the project site is under intense fishing pressure, we assume that this nesting population of *C. indica* originated either from upstream or from other tributaries of the Ganga (e.g., the Ramganga River, which flows through the Corbett Tiger Reserve). Within the next year, we hope to use radio-telemetry to determine whether female *C. indica* exhibit nest site fidelity. Additionally, we hope to initiate a survivorship study of post-release headstarted individuals, but this project will have to be postponed because of last year’s disappointing headstarting results. Despite efforts at intensive care, no hatchlings survived the cool winter months at our soft-release site or outdoor captive facilities. This year, we released all of the *C. indica* hatchlings after taking the standard morphological measurements, and retained none of them for headstarting. Our new goal is to build an indoor rearing facility specifically for *C. indica*, which will allow for better control the environmental temperatures. We



ASHUTOSH TRIPATHI



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Top to Bottom: We collected the eggs of *Chitra indica* mostly from unprotected stretches of the Yamuna River and incubated them naturally through hatchery programs.

Hatchling *Chitra indica* before being processed and released at one of the *in situ* hatcheries.

A hatchling *Chitra indica* stretches its neck in front of our green headstarting facility.

Ashutosh Tripathi, Project Officer with the India Program, processes a hatchling *Chitra indica* for a rearing program at the Garhaita Turtle Centre.



Left, top to bottom: Individuals of *Chitra indica* sometimes wander outside of the limits of the National Chambal Sanctuary and are vulnerable to accidental or intentional killing.

Dr. Gowri Mallapur, a veterinarian for the Crocodile Bank Trust, inspects Decimal Coded Wire tags placed in newly hatched *Chitra indica* at one of the *in situ* hatcheries.

Chitra indica juveniles sampled from the Yamuna River as part of a species migration and dispersal study.

Fishermen are given an incentive to rescue and release individuals of *Chitra indica* that they accidentally capture in unprotected stretches of the Yamuna River.



plan to build this facility at our turtle center in the village of Garhaita, once we raise the necessary funds.

We initiated a mark-recapture study on the Yamuna River, just outside of the National Chambal Sanctuary, to quantify the *C. indica* population at the sanctuary. The primary results show that *C. indica* moves in and out of the sanctuary, and especially during the monsoon floods (July to September). We also expanded the nesting surveys on the Yamuna and Chambal rivers, along our *B. kachuga* project lines in the Etawah district of Uttar Pradesh (UP). Here, we found one clutch (141 eggs) along the Yamuna and two clutches (257) on the Chambal, near the Garhaita Turtle Centre. We translocated these eggs to another *in-situ* hatchery established near the village of Garhaita. Of these, only two nests from the Chambal River hatched, with an 85% success rate, while the clutch from Yamuna River failed to develop. In addition, we recorded observations on three natural nests on the Chambal River near Garhaita; the eggs from these nests hatched in October and November, with a 96% success rate. Protecting the *C. indica* nests *in situ* would seem to be a preferable option over translocating them to remote hatcheries, although this option might not always be feasible due to

manpower issues.

Finally, we developed a modest turtle incubation chamber (3.3 × 3.3 m) at the Garhaita Turtle Centre, under the water tower of the green rearing facility for *Batagur kachuga*. This chamber will be insulated and used for artificially incubating *C. indica* clutches from the Chambal River, which will avoid the loss of developing eggs during unexpected cold spells.

This year we collected significant data on the ecology and biology of *C. indica*, and this information could be important for the conservation management of this species as we expand this initiative in other priority areas. The preliminary studies indicate our need to enhance research efforts to better understand the ecology and reproductive biology of this species — one that is constantly forced to adapt to the myriad of habitat fluctuations and unpredictable climatic conditions imposed by this harsh region.

This project was supported, in part, by a grant from Cleveland Zoological Society.

THE BATAGUR CONSERVATION PROGRAM ON THE CHAMBAL RIVER

In 2006, the project team started implementing the Conservation Action Plan recommendations for the Endangered Red-crowned



Roof Turtle (*Batagur kachuga*) and the Three-striped Roof Turtle (*B. dhongoka*) in the National Chambal (River) Sanctuary, located in the states of UP and Madhya Pradesh (MP). The Red-crowned Roof Turtle conservation program was chosen as the flagship project for this region, as well as for the country, because this turtle is charismatic and shows a high probability for quickly securing a viable population of the turtles while serving as a model for other turtle conservation programs throughout India and abroad. With fewer than 400 adult females remaining in the wild (based on yearly nesting surveys), decisive conservation actions were clearly warranted.

We completed the fifth field season (2006–2010) by conducting a recovery program in Chambal for the above two sympatric turtle species. During this time, more than 380 nests of *B. kachuga* and over 2,150 nests *B. dhongoka* have been protected through the establishment of 14 *in-situ* riverside hatcheries (3 or 4 per year) along the Chambal River.

Last winter, we started various conservation and research activities in the middle and lower stretches of the Chambal River. Again, we established three *in-situ* turtle hatcheries, two in the state of UP and one in the state of MP. We protected 77 nests (1,330 eggs) of *B. kachuga* and 436 nests (9,120) *B. dhongoka*. The eggs began hatching in early May of 2010, a process that continued throughout the month. We released most of the hatchlings within 24 hours, once they were permanently marked. This procedure entails the injection of a decimal coded wire tag under the dermis of a hind limb and/or a colored plastic cable tie attached to the trailing edge of the rear shell. By surveying for marked turtles, we hope to estimate hatchling survivorship and dispersal distances

in this population. This crucial part of the project is a standard means of gauging the success of a hatch-and-release program in augmenting the wild population.

We surveyed the entire lower course (ca. 400 km) of the Chambal River and determined the abundance of chelonians, habitat conditions, and suitable nesting habitats from January through March. We also collected data on various habitat parameters and anthropogenic disturbances, to develop a nesting habitat suitability index. A comparison among the previous years' data showed continued marginalization of the nesting areas due to the various anthropogenic disturbances, especially riverside agriculture and cattle intrusion along the riverbanks. Historically, the low water levels in the river have been regarded as one of the major threats to the nests, since most of the previous turtle nesting islands became accessible to terrestrial predators. For example, in the lower 100 km of the Chambal, 34 major nesting islands that historically were isolated from the riverbanks became continuously connected to them.

At present, we are rearing over 1,500 *B. kachuga* of various age groups (from 0 to 5 years of age) in two headstarting facilities along the Chambal River. In early 2011, we will initiate movement and survivorship studies by using sonic-telemetry with headstarted *B. kachuga*.

In the spring of 2010, the state forest department released about 400 turtles of various age groups (2006–2008) from our Deori facility in MP, at various locations near the middle Chambal River. To expand this effort, we have been searching for suitable habitats to release headstarted *B. kachuga* and *B. dhongoka*. We identified the Son, Ken, Betwa, and Ghaghara rivers as possible reintroduction sites. The Son River, in the Son Gharial

Below, top to bottom: A riverside hatchery for *Batagur dhongoka* and *B. kachuga* along the Chambal River.

A group photo of the turtle project team at the Uttar Pradesh riverside hatchery.

Turtle team members collect eggs from a *Batagur* nest for relocation to a riverside hatchery.

A clutch of *Batagur kachuga* eggs is ready for transport to a riverside hatchery.



SHAILENDRA SINGH



ANASUA ROY



KHEM B. BHADARIA



ASHUTOSH TRIPATHI

Sanctuary, might be the next possible reintroduction site for *B. kachuga*, whereas in our surveys we are encountering moderate populations of *B. dhongoka* along the middle stretch of the Ghaghara River, 200 km downriver from the Katarniaghat Wildlife Sanctuary.

We completed the *green* headstarting enclosure to rear endangered turtles (especially *B. kachuga*) at the Garhaita Turtle Conservation Centre, on the lower



Above, top to bottom: A female *Batagur dhongoka* found early on the morning, shortly after nesting.

The hatchery staff releases tagged turtles along the Chambal River.

A bucket of tagged hatchling *Batagur dhongoka* about to be released at the *in situ* hatchery.

Renovations to the original headstarting facility are now complete, with the construction of deeper pools and basking ramps.

Chambal River, with partial support from the Turtle Conservation Fund. This (51 × 16 m) enclosure is close to 2 m deep and contains floating and stationary basking platforms, and the entire structure is covered with predator-proof iron mesh. We also added a four-chambered biofiltration unit powered by a solar water pump.

The rearing enclosure currently houses over 200 juveniles (three or four years old) of *B. kachuga*. Additionally, we renovated the original hatchling facility at the Garhaita Turtle Conservation Centre by creating four deeper pools with wider ramps, to hold turtles of various age classes separately for growth and temperature related studies.

EDUCATION AND SOCIO-ECONOMICS

This year's greatest accomplishment was the construction of a Conservation Education Centre. We upgraded our humble education facility, aptly named the "Makeshift Hut" at the Garhaita Turtle Centre into a modest (15 × 10 m), permanent structure. The center was named after the late Dr. John Thorbjarnarson, a well-respected herpetologist who made lasting contributions to crocodile and turtle conservation.

This education and interpretation facility was built with the generous support of the Disney Worldwide Conservation Fund and the Beneficia Foundation. We can now accommodate over 100 children/community members for educational events. In the near future, the building will be equipped with four internal display panels dedicated to the region's endangered freshwater turtles, threatened aquatic biodiversity, freshwater ecosystems, and socio-cultural features. In addition, a live animal aquatic exhibit will be added, along with interactive animal models. Though the prime objective of this facility is to cater

to the turtle conservation awareness needs of the local/riparian community, it will also facilitate the conservation (education, awareness, and training) initiatives involving other regional threatened aquatic animals, ecosystems and protected areas, issues, and target groups.

Mrs. Patricia Koval, of the TSA Board of Directors and Chair of WWF Canada, inaugurated the center on World Earth Day (22 May 2010), with over 200 villagers and government officials in attendance. To mark the occasion, the villagers of Garhaita sang traditional songs invoking the Chambal River as a deity, and the local children performed a short play enacting the depletion of the sanctuary's flora and fauna.

We began to utilize a mobile education exhibit featuring the region's biodiversity. The exhibit was based on the area's traditional camel-drawn cart and inaugurated by Mr. Neeraj Kumar, a Divisional Forest Officer of the Chambal, and it traveled throughout the sanctuary during National Wildlife Week (1–7 October 2009). Various color posters depicting the sanctuary's wildlife were displayed, along with conservation slogans in Hindi. Additionally, a puppet team was hired to perform shows atop the cart. The theme centered around the greater conservation of natural resources and the plight of aquatic wildlife. This mobile exhibit now travels from village to village along the Chambal River, creating awareness of freshwater turtles and other aquatic wildlife in riparian communities.

We also assembled over 50 outreach educational programs for over 2,000 villagers and primary school children living within the Chambal National Sanctuary. We organized these programs using such education tools as lectures, ecological based games, drawing competitions, and live demonstrations and

skits on the relevant dates of the environmental calendar (e.g., Water Day, World Wetland Day, Earth Day, World Biodiversity Day, World Turtle Day, World Environment Day, and National Wildlife Week). We also distributed turtle calendars and posters portraying wildlife and associated laws to the various schools within the sanctuary. We are now planning to hold a series of teachers training workshops in association with the nationally recognized Centre for Environmental Education.

The school education and awareness programs made us realize that many of the participants lacked a general knowledge of the flora in the protected area. Perhaps, this lack of knowledge is due to the fact that most native plants in the region have been outcompeted by the exotic and invasive *Prosopis juliflora* (a Mexican mesquite tree). In order to raise awareness of the region's floral diversity, we developed a small plant nursery (13 × 7 m) in the campus of the turtle center to demonstrate native plants to the local children, as well as to encourage their use.

This year, on World Wetland Day, we conducted two major trainings sessions for the MP frontline forestry department staff. The topics included aquatic wildlife survey methodology, turtle diversity and nest protection, and wildlife laws regarding freshwater turtles. In November, we conducted another training workshop, at the Kukrail Gharial Centre, for turtle/crocodile keepers and fishermen. The objective of this workshop was to train these people to safely capture and handle aquatic reptiles. We also accepted two student research trainees from the state of West Bengal, who were trained in all aspects of turtle conservation and research in the Chambal and Terai regions.

We continued to conduct socio-economic surveys in the

villages along the Chambal River. We evaluated approximately 200 villages along the lower section of the river and the accompanying buffer zone, near the confluence of the Chambal and Yamuna rivers, and assessed their interaction with the sanctuary's threatened biota. This information was critical because it could help us develop additional livelihood and social/civic programs. To sustain the momentum of this initiative, we hired several students that previously had volunteered as part-time educators. We also employed fishermen from various fishing hamlets to assist with the turtle surveys and guard the *in-situ* riverside turtle hatcheries around-the-clock. In addition, we contracted local village masons and laborers to build the education center described above. Paying the local people for their involvement with the project has garnered great community support.

We are currently expanding our goals and aim to conduct our social/education programs in over 600 villages along the entire length of the sanctuary. The information collected from the present education and awareness initiatives will help us design educational and social development programs for the various

Right, top to bottom: Pat Koval introduces a juvenile *Batagur kachuga* into the new green headstarting facility.

Brian D. Horne, Pat Koval, and Shailendra Singh (**middle front row, left to right**) at the inauguration of the new education center.

Pat Koval reveals the commemorative name plaque on the new education center on the Chambal.

A camel-powered mobile education cart. The cart traveled across rough terrain to reach rural villages along the Chambal River, to broadcast the turtle conservation message.

Shailendra Singh demonstrates the proper techniques for capturing turtles to zoo keepers and the forestry department staff at the Kukrail Gharial and Turtle Centre in Lucknow.



BRIAN D. HORNE



ASHUTOSH TRIPATHI



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SHAILENDRA SINGH



GOWRI MALLAPUR



Far left: *Batagur kachuga* yearlings at the Deori EcoCentre headstarting facility. These turtles will be studied to examine the dispersal capabilities and threats to headstarted individuals.



Left: Construction of the new green headstarting facility at the Garhaita Turtle Conservation Centre is complete, and includes a solar powered biological filtration system.

target groups (e.g., fishermen, sand miners, riverside agriculturists, and turtle poachers) that are adversely impacting the biota of the sanctuary. Ideally, the implementation of these specialized programs can convert our conservation philosophy into action, so that wildlife and traditional societies can survive alongside one another!

ASSAM IN NORTHEASTERN INDIA

Located at the junction of the Himalaya and Indo-Burma biodiversity hotspot, northeastern India is regarded as a major turtle conservation priority area. This region supports a remarkable 23 species of chelonians, making it the world's greatest area for turtle diversity. In 2008, a group of students from Guwahati University started an awareness project for the various threatened species inhabiting the Brahmaputra River basin, with financial support provided by the Rufford Small Grant Foundation and technical support by the TSA India Program. In 2010, the TSA became an active participant in the program, and initiated conservation projects for safeguarding the region's turtles. Presently, we are targeting four turtle species for conservation efforts: the Assam Roof Turtle (*Pangshura sylhetensis*), the Black Softshell Turtle (*Nilssonina nigricans*), the Elongated Tortoise (*Indotestudo elongata*), and the Asian Brown Tortoise (*Manouria emys*).

An elusive species, *P. sylhetensis* is now found only in a few protected

areas, including the Kaziranga, Nagawan, and Nameri national parks in the Brahmaputra River basin. We began our preliminary surveys and community awareness programs for *P. sylhetensis* along the chars (islands) of the Brahmaputra River, near the Nameri and Nagawan national parks. We also established a hatchery on an island in the district of Morigawan in order to protect a few clutches of *P. sylhetensis* eggs, as people in these river communities often poach turtle eggs for human consumption. Although we did not locate any *P. sylhetensis* nests, we protected over 50 nests of *P. tentoria* and multiple clutches of *N. nigricans*. Many of the rescued *P. tentoria* clutches failed to hatch, however, perhaps due to previous mishandling of the eggs by poachers, but the *N. nigricans* clutches are still incubating in the hatchery.

Although this year we used the hatchery as an experiment, it helped to create awareness among the river communities on the diversity of turtles using this island as a nesting area. Additionally, it helped impart egg translocation methodology, hatchery construction techniques, and management ideas to our new field assistants. The decision to use the hatchery will likely prove to be of vital importance in the future protection of *P. sylhetensis* eggs.

In late March of 2010, we visited various locations along the Brahmaputra to determine the current status of *P. sylhetensis*. During our surveys, we interviewed a wide range of fishermen and riparian

community members as to the occurrence of the species at Vishwanath (opposite bank of Kaziranga National Park) and Ghahigaon, in the Sonitpur district. According to the fishermen and previous unpublished research accounts, these locations were known to support robust populations of *P. sylhetensis*, but after the weeklong surveys it was obvious that a population of *P. sylhetensis* remains only in reduced numbers along the upper stretch of the river. We plan to return to these locations this fall in hopes of finding our first *P. sylhetensis* nests.

We also identified a project site, Chandavi, along the Assam and Meghalaya state border. This area consists of a complex of *bheels* (lakes) along the Kulsi River, in the Kamrup district, and holds high numbers of softshell turtles (i.e., *C. indica* and *Nilssonina hurum*) with the possibility that *N. nigricans* is found there as well. We conducted several education programs for the local villages and the Rabha tribal communities, to create awareness regarding the area's turtle diversity and how unsustainable turtle harvesting will negatively impact the aquatic ecosystem that many local livelihoods depend on.

The other regional target species, the Black Softshell Turtle (*N. nigricans*), has only recently been reported in the wild; previously, it was only known to survive in a few Hindu temple ponds. The majority of these ponds in Assam are governed by the *Mandir Pujo Samiti* (Temple Worship Committees), and in the

past it has been difficult to convince the temple worship committees that improvements to the ponds are necessary for the long-term survival of these “sacred” turtles. Consequently, we are planning a meeting to generate dialogue among the temple authorities, the district administration, conservation organizations, and the forestry departments. We aim to create a construction blueprint for the needed improvements to the temple ponds, in an effort to improve their husbandry and survival. Our goal is for these populations to reproduce and become self-sustaining assurance colonies.

We visited the temples of Hazo and Kamakhya and a few other smaller temples in the region, searching for more captive *N. nigricans*. At Hazo, we saw a moribund female on a masonry bank of the temple pond, which died shortly after our arrival possibly from a severe infection on a front leg. We also saw several other individuals that showed signs of a severe fungal infection on their shells. Surprisingly, we found a few *N. nigricans* nests under ornamental bushes bordering the masonry banks of the pond.

Although the death of the female *N. nigricans* was disheartening, it proved to be the needed motivational factor for the temple authorities to grant us permission to improve the basking and nesting areas. We added sand to a large nesting area, and built basking platforms and shade structures in two corners of the pond. What we lack, however, is financial assistance from the regional turtle program to assist the temple committee in hiring a full-time staff member to monitor the turtles. The responsibility of this staff member would be to prevent the future loss of valuable adult *N. nigricans*, and to protect their nests from predators. An additional juvenile grow-out facility is also needed, as the pond

currently contains numerous large predatory catfish that could easily consume the younger turtles.

Our plans are to initiate a captive conservation program with the Assam State Zoo and Botanic Garden to develop assurance colonies of regional target species, and toward this end we had several lengthy discussions with the zoo’s director, Mr. Narayan Mahanta. We agreed to work together to design and construct enclosures for holding endangered turtle species, which include *Indotestudo elongata*, *Manouria emys*, and *P. sylhetensis*. These enclosures are scheduled for construction under their new master plan. We also created dialogue with such regional conservation organizations as Aranyak and the Centre for Environmental Education, as well as with local researchers, in an effort to build strong partnerships and networks for a wider turtle conservation program in the region.

ORISSA

In April of 2010, we completed a rapid survey along the Mahanadi River to gather preliminary information on turtle diversity and abundance in the state, as previous reports indicated that the river was a major area for trapping turtles. We visited Binka,

Chaurpur, and Durgapalli (near the town of Sambalpur) to inquire about the softshell turtle trade, and gathered a large amount of information regarding the composition, location of trade routes, modes of transportation, location of the collection centers, and final destination of the catch. During interviews with the local fishermen, we confirmed the occurrence of the Asian Giant Softshell Turtle (*Pelochelys cantorii*) and the high abundance of *C. indica* in the area.

We also surveyed the mouths of various rivers along the eastern coast of Orissa, to gather information on the past and present status the River Terrapin (*Batagur baska*). We interviewed over 50 fishermen along the Devi and Kathjodi rivers, but found no evidence of recent sightings or nests of *B. baska* in the area. Furthermore, we arranged meetings with several local conservation organizations, forestry department biologists, researchers, and interest groups to discern the feasibility of future collaborative projects with TSA India.

We concluded our surveys and meetings with a positive outlook for initiating a turtle conservation project in the state. Partners like the Wildlife Society of Orissa, Utkal State University at Cuttuck, and the state



Above: The *Nilssonina nigricans* facility improvement project for creating nesting beaches is underway. The project is being conducted in association with Guwahati University and Temple committees in the state of Assam.

Right: A trained turtle guard collects *Nilssonina nigricans* eggs at the Hazo Temple pond. The eggs are incubated in a safe environment.



CHITTARANJAN BARUAH

SHALENDRA SINGH



A boy at a fisherman's home along the Mahanadi River, near the town of Sambalpur in the state of Orissa, shows the bony carapace of a recently eaten Giant Softshell Turtle (*Pelochelys cantorii*).

forestry departments appear willing to collaborate on turtle conservation projects.

Although this year the *B. baska* project progressed slowly due to a lack of required permits from the state forestry department, we completed the first phase of the statewide survey on the present and historical status of *B. baska*. We presented our findings and future conservation plans to various high-level research advisory committees, in an effort to obtain permission to launch nesting population surveys deeper into the Sunderbans. Hopefully, permission will be granted to improve the breeding facility at the Sajnekhali field station, in the Sunderbans Tiger Reserve. As reported in 2009, eight males, three females, and one juvenile were in the pond, but, sadly, two females were lost during a recent “Aila” (sea storm) when floodwaters inundated the facility.

Acknowledgments. — We graciously acknowledge the Turtle Survival Alliance for spearheading conservation programs on India's

endangered turtle fauna. We thank the Madras Crocodile Bank Trust for their logistic and administrative support for this nationwide conservation program, the San Diego Zoo's Institute for Conservation Research for technical assistance for various projects and critical financial support for the Central India project, and the Beneficia Foundation for backing our work since 2007. We acknowledge the generosity of the Disney Worldwide Conservation Funds for supporting the Turtle Conservation Education and Awareness Initiative. For various critical components of the program, we are especially grateful to the Cleveland Zoological Society, Pat Koval/WWF Canada, the Detroit Zoological Institute, Sedgwick County Zoo, Nature's Own, the Turtle Conservation Fund, British Chelonia Group, and Andrew and Angela Walde of Walde Research & Environmental Consulting. For aiding with various logistical problems and permits, we thank the Ministry of Environment and Forests, the

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We are grateful to various partner organizations, including the Centre for Environmental Education, the Zoology Department of Guwahati University, the Terai Environmental Foundation, the Katarniaghat Foundation, and the Gharial Conservation Alliance, for joining hands with us in taking the turtle conservation mission forward. Finally, we appreciate the help provided by the conservation team members, Ashutosh Tripathi, Khem B. Bhadauria (Chambal), Nikhil Whitaker (MCBT/South India), Pradeep Saxena and Bhasker Dixit, Anasua Roy (Terai region), Chittaranjan Baruah (Assam), Rupali Ghosh (Eastern India), and all of the students and volunteers; without their tireless efforts, this program would not have been possible.

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Strategic Planning Workshop for Endangered Indian Turtles

Shailendra Singh¹ and Rick Hudson²

The joint TSA/MCBT/San Diego Zoo Indian Turtle Conservation Program (ITCP), in association with the Uttar Pradesh (UP) Forest Department, is organizing a national level workshop dedicated to turtle conservation entitled “**Indian Freshwater Turtle and Tortoises Conservation Priority Areas Initiatives.**” The workshop will be held from the 22nd to the 24th of October 2010 in Lucknow, the capital city of Uttar Pradesh. The main objectives of the workshop will be to:

- Review the implementation of the 2005 “Conservation Action Plan for Indian Endangered Turtles and Tortoises” developed at the Kukrail Gharial Rehab Centre in Lucknow by the MCBT and TSA.
- Discuss and prioritize important turtle areas for conservation action across India, and review their potential to support new programs.
- Identify competent local partners and collaborators for key turtle conservation initiatives.

After five years of executing the 2005 *Conservation Action Plan for Endangered Freshwater Turtles and Tortoises of India*, there is a need for a rigorous review of ongoing turtle conservation projects. Based on the success of the Chambal River-based program, and given the rapidly increasing level of threats that Indian’s turtle face, we believe that it is time to expand our program to other regions in India that support endangered or endemic species in need of conservation attention. India is a large country with a diversity of habitats, cultures, and chelonian species. In order to

focus our efforts and develop an organizational strategy, we mapped out a system (see map) that will provide extensive coverage to as many key species and critical habitats as possible.

Five priority turtle areas in India have been identified: the Chambal River and Upper Ganges River System (central India), the Terai Region (northern India), the state of Assam (northeastern India), the Sunderbans of West Bengal and the state of Orissa (eastern India), and the Western Ghats and the state of Tamilnadu (southern India). When combined, these five regions support India’s most highly endangered and charismatic turtles. Priority areas were selected on the basis of species richness, endemism, proportion of endangered turtles, and our ability to initiate conservation programs. This alignment encompasses much of the Ganges-Brahmaputra river basin drainages (excluding Bangladesh), an area that supports the world’s greatest diversity of turtle species. Containing 18 species, including 12 of the 14 Indian species in need of conservation, the Lower Gangetic Plain was designated as a global Turtle Priority Area (Buhlmann et al., 2009).

The workshop aims to synchronize as well as capitalize on the efforts of the various organizations and individuals working to conserve chelonians in India. By bringing together over fifty national and international frontline biologists, conservationists, educators, socio-economists, managers, and policy makers, the workshop seeks to develop regional conserva-



India Turtle Priority Regions.

tion action plans and identify immediate needs for the five Turtle Priority Areas. Participants will evaluate past priorities with respect to changes in national and international conservation priorities. The ITCP and other regional partners will implement these action plans through mobilizing and facilitating conservation teams. The workshop and action plan will also seek enhanced participation of the central and state governments in the turtle conservation effort as part of next year’s activities associated with the “International Biodiversity Year.”

The program’s vision is to conserve as many of the remaining wild populations of turtles as possible and to establish multiple assurance colonies of Critically Endangered turtle species within the next five to 10 years. Funding for this workshop is being provided by the Turtle Survival Alliance.

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World Turtle Day in India Commemorated with a Poacher Conversion Workshop

Shailendra Singh¹

World Turtle Day in India was again a success, when a cadre of 35 turtle poachers, *prima-facie*, gave-up on the commercial



Most participants of the Terai poacher conversion workshop agreed to work with the project team for the next three years, and signed a pledge to give up the commercial harvesting of freshwater turtles.

Shailendra Singh (white hat) collects data for a recently launched study on the population dynamics and reproduction of *Hardella thurjii*, conducted with the help of ex-poachers and fishing communities.



harvesting of turtles along the Ghaghra-Sarju river system in the Terai (foothills of the Himalaya's along Indo-Nepal border). They reached a decision after long hours of discussion regarding the losses and benefits of poaching and killing turtles, as well as after weighing the possibilities of eco-friendly livelihood options available through a turtle project. The turtle poachers and fishermen involved in non-commercial turtle harvesting took a week of convincing to gather at a conversion workshop in Ghaghraghat, along the Ghaghra River, to discuss these issues and find ways of working together for the benefit of turtle conservation in the area.

The Ghaghra-Sarju river system along the Terai supports one of the few healthy populations of the Crowned River Turtle (*Hardella thurjii*), the Indian Narrow-headed Softshell Turtle (*Chitra indica*), the Indian Eyed Turtle (*Morenia petersii*), and the Spotted Pond Turtle (*Geoclemys hamiltoni*), in addition to two other softshell turtles, *Nilssonia gangeticus* and *N. hurum*. On both rivers, softshells are hunted extensively for the commercial trade of calipee (the outer cartilaginous rim) and meat, while hard-shelled turtle species like *Hardella* and *Geoclemys* are killed for local consumption. Furthermore, each year a significant number of turtles throughout the region drowns accidentally in nets and traps used for community fishing. Besides involvement in species

status and trade assessments, the TSA-MCBT India Program has been working through such meetings to convert regional turtle poachers by finding ways to provide them with alternative livelihood training by setting-up various eco-friendly micro-enterprises.

Thirty-five people participated at the last meeting. After hours of long discussion and the presentation of opposing views, most (80%) of the participants agreed to work with the project team for at least next three years. During this time they would be involved with protecting turtles and other aquatic wildlife in the region, along with other converted poachers and conservation teams. In addition, these people signed a pledge that prohibits them from commercially harvesting freshwater turtles in the area.

A series of follow-up meetings are planned in near future, in an effort to form several "River Conservation Committees" along critical stretches of the entire river system. Under the auspices of the TSA-MCBT program, such committees will include ex-turtle poachers, fishermen who use eco-friendly fishing methods, local but influential community members, and regional conservation NGOs. These committees will advise the regional turtle project on turtles and habitat protective measures, the feasibility of creating livelihood options for poachers, the availability and need for candidates for a rehabilitation program, and the long-term costs associated with turtle protection and habitat conservation in the area.

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Red-crowned Roof Turtle (*Batagur kachuga*) Breeding at the Centre for Herpetology/Madras Crocodile Bank, an Update on the 2010 Breeding Season

Nikhil Whitaker¹

The Madras Crocodile Bank Trust (MCBT) has maintained an Assurance Colony of the Red-crowned Roof Turtle (*Batagur kachuga*), with 2: 4 adults arriving in 2001 and successful breeding (i.e., the production of viable eggs) beginning in 2004. The details of previous reproductive success, husbandry and management, and enclosure design for this species have been described by Basu et al. (2006) and Whitaker (2009). Here, I present captive breeding observations for the 2010 season, and report on the growth rates of hatchlings produced in 2009.

Six clutches of *B. kachuga* eggs were deposited in 2010, and since six others were deposited in 2009, this information again implies that females produced multiple clutches. Egg laying in 2010 occurred between 25th January to 4th March. The clutch size ranged from one to 30 eggs, for a total of 89 eggs. The same method of sweeping the banks clean of

turtle tracks every evening was employed in 2010, ensuring that for the most part (5/6 nests) the eggs were collected the night after laying. The time of oviposition appeared to be unrelated to the ambient temperatures (average temperature = 26.5° C), but deviations from the average were high at this time and there was a large difference between minimum and maximum temperatures. Interestingly, all six clutches were laid within a circle with a diameter of ca. 2 m, but the temperatures at the time of egg collection varied considerably, as well as the depth of the nests (from 15 to 23 cm). The overall viability of the eggs was 56 %, with the hatch rate of the viable ones at 62 %. The viable eggs that did not hatch were subjected to the same medium (vermiculite) and approximately the same humidity, so the reasons why they failed to hatch remain unclear.

The low hatching rates in the clutches are confusing, given the high proportion of viable eggs that

were produced. Clutch 3/Box 1, with a range from 25 to 31° C (average = 27.54° C), did not produce any live hatchlings; however, this clutch did not deviate significantly from those that produced a large number of hatchlings. For example, the temperature in Clutch 4 ranged from 27 to 32° C (average = 29.3° C) and in Clutch 6 from 24 to 32.5° C (average = 29.9° C). Some eggs showed no calcification, particularly at or near the poles, and they had low hatching success; others showed punctures into the shell membrane, and these were repaired with surgical tape but failed to hatch.

The growth rates for 29 hatchlings produced in 2009 were higher than expected. The hatchlings gained an impressive amount of weight from the time of hatching until they reached one year of age (total = 238 g, an increase of 83%). The hatchlings were maintained in glass aquaria measuring 4' × 1' 18" × 1' 18", with a square land area and fish bio filters (Body Guard™ AP2200F). The aquaria were equipped with logs for the animals to climb onto, and with half broken clay pots that they could use for shelter.

The juveniles were transferred to a much larger enclosure with a gravel bed filtration system on 5th August 2009 (at six months of age), and implanted with PIT tags on their

Left: A clutch of Red-crowned Roof Turtle eggs deposited the previous evening. **Middle:** Clutch 4 of *Batagur kachuga* hatched en masse. **Right:** At six months of age, the juvenile *Batagur kachuga* were transferred to a much larger enclosure.



right hind limbs on 15 January 2010 (at 10 months of age).

Work at the MCBT is presently underway to collaborate with the TSA in obtaining an endoscope, so the animals that hatched with known incubation temperatures can be sexed; this information would provide Temperature Sex Determination patterns in this species. Also of interest is that the turtles produced at the MCBT in 2005 now show the cephalic and neck pigmentation of adult males,

suggesting that sexual maturity is reached at around five years of age.

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PAINTING AUCTION



This original painting by noted wildlife artist Carel Brest van Kempen, entitled *Radiated Tortoise Browsing*, will be auctioned at the 2010 TSA Annual Conference in Orlando, Florida. Proceeds will directly benefit conservation efforts for the Radiated Tortoise in Madagascar.

Distribution of the Madagascar Spider Tortoise, *Pyxis arachnoides*

Ryan C. J. Walker^{1,2} and Tsilavo H. Rafeliarisoa^{3,4}

The dry-spiny ecoregion of southern coastal Madagascar supports the highest rates of endemism in this island country and is an important environment for many locally-endemic reptiles (Gardner et al., 2009), including the Madagascar Spider Tortoise (*Pyxis arachnoides*). This tortoise, one of the world's smallest, is so-called because the intricate pattern of its carapace resembles a spider's web. From 1970 to 2000, the habitat of the Madagascar Spider Tortoise has undergone levels of forest loss averaging 1.2%/yr. (Harper et al., 2007) as a result of subsistence agriculture, especially from charcoal production (Örjan et al., 2006) and livestock herding (Harper et al., 2007; Walker, 2009). Coupled with suspected illegal poaching activities for the pet trade (Walker et al., 2004) and the local food market, the pressures exerted on this species threaten its long-term survival. Not surprisingly, the Madagascar Spider Tortoise has become one of the TSAs focal species.

To date, range estimates for the Madagascar Spider Tortoise have been made using dated information and limited field records. Historically, *P. arachnoides* was thought to inhabit a continuous strip of coastal dry forest that covered approximately 560 linear kilometers along the southwestern coast of Madagascar (Fig. 1; Bour, 1981); this range, however, might be contracting (Pedrono, 2008). Three subspecies of this tortoise are recognized: (1) *P. a.*

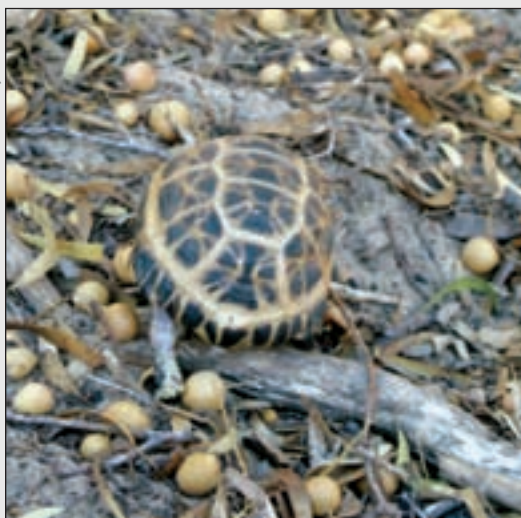
brygooi inhabits the northern extent of the range between Morombe and the Manombo River (Pedrono, 2008); (2) *P. a. arachnoides* is found to the south as far as the Menarandra River; and (3) *P. a. oblonga* inhabits the extreme southern reaches of the range (Pedrono, 2009). The three subspecies are characterized by the presence of a plastral lobe that shows clinal variation in mobility (Prichard, 1979), with the mobility increasing from north to south. Establishing the population density and range of any threatened species is essential if effective and well-directed conservation efforts are to be implemented. Therefore, during 2008, a three-year survey program was initiated by a team of British, North American, and Malagasy field biologists, aimed at establishing

where the last remaining strongholds of the Madagascar Spider Tortoise occur. With two out of the three field seasons (January–March 2009; January–March 2010) completed, 106 km of transects have been traversed using a Distance Sampling methodology (Buckland et al., 2004; Walker, 2009a) across approximately 87% of what is thought to be the species' coastal range (Fig. 1). The results of the 2009 field season, which documented the extent of the range of *P. a. brygooi* within the Mikea forests (Fig. 1) were reported in the 2009 TSA Magazine (Walker, 2009b). Three population centers are thought to exist for this northern subspecies, with sparse numbers found north of the Manombo River, a concentrated population north of the Baie de Fanamotra, and a small population around the forests east of Morombe at the northern extremity of the range (Fig. 1). The resulting data from the 2010 field work suggests that *P. a. arachnoides* is likely to be extirpated between the Onilahy and the Fiherenana rivers, probably due to habitat



An adult *Pyxis a. arachnoides* forages in Tsimanampetsotse National Park.

RYAN C. J. WALKER



Top: A survey vehicle in the Anakoa region. **Middle:** An adult female *Pyxis a. arachnoides*. Note the worn carapace scutes, possibly caused by the hooves of livestock. **Bottom:** A *Pyxis a. arachnoides* rests under a tree to escape the midday sun in the Cap Sainte Marie region of southwestern, coastal Madagascar.

removal to the north and east of Toliara and the ease of collection for poachers from Toliara to the south. A reasonably unfragmented population of *P. a. arachnoides*, however, still inhabits the coastal dry forests south of the Onilahy

River, within the narrow coastal strip west of the Mahafaly Plateau to the Linta River (Fig. 1). An area of approximately 72 km along the coast, south of Ampalaza and through the Marolinta and Menarandra regions, appears to be devoid of tortoises; this situation is similar to the large expanses of habitat within the range of *P. a. brygooi* where the tortoises are apparently absent. A small, isolated population of the Southern Spider Tortoise (*P. a. oblonga*) was discovered approximately 40 km north of Cap Sainte Marie, and moderate numbers were found in the Cap Sainte Marie Special Reserve (Fig. 1).

Among the subspecies of *P. arachnoides*, the plastron morphology of the populations within the transitional zones is interesting. The population occurring between the Fiherenana and Manombo Rivers supports a mixture of individuals displaying a plastron hinge consistent with the morphological traits of *P. a. brygooi*, *P. a. arachnoides*, and also examples of individuals showing a combination of the two (Fig. 1). This mixture of characters suggests intergradation between the two subspecies. A zone of intergradation was also recorded during 2010 around the Linta River area, stretching south for approximately 26 km along the coast, where tortoises displaying morphological characteristics consistent with intergradation between *P. a. arachnoides* and *P. a. oblonga* were found (Fig. 1). Overall, the current range of *P. arachnoides* has been reduced as much as 68% of the historic range reported in the literature.

Pyxis a. arachnoides and *P. a. oblonga* occur in moderate numbers in each of the regions' protected areas, Tsimanampetsotsa National Park and Cap Sainte Marie Special Reserve respectively. The protected areas, however, fail to encompass

the healthiest population for each respective region. For example, populations of tortoises inhabiting the dunes 5 km to the west of Tsimanampetsotsa National Park occur at levels of approximately 2–3 times the densities of populations within the park. Also, the historic range of *P. a. brygooi* lies outside of any formally recognized protected area. Two new protected areas, Ranobe PK32 and Northern Mikea, however, have been proposed for the region. Unfortunately, because of the fragmented nature of the range between the subspecies, none of the remaining populations fall within the boundaries of those newly proposed protected areas.

The above data will be incorporated into the TSAs GIS database. This database provides a “real time” map of the current distribution of the remaining Madagascar Spider Tortoise populations. Our recent work represents the only comprehensive survey of the distribution and population size of *P. arachnoides*. One more field season of data collection remains, which will provide a better understanding of the current range and distribution of this Critically Endangered species.

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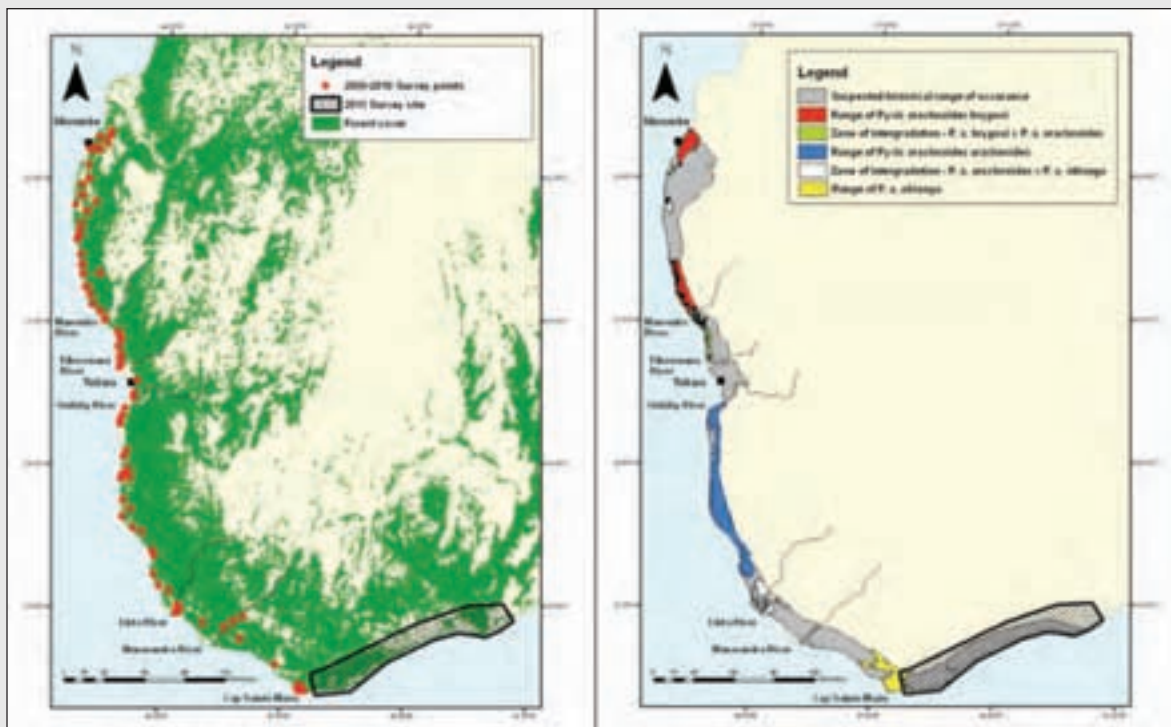


Fig. 1. Left: Forest cover in southwestern Madagascar deduced from shapefiles derived from LandsatTM data, with locations of the 106 km of tortoise survey transects undertaken in phases 1 and 2 of the project (January–March, 2009 and January–March, 2010). Right: Suspected historical area of occurrence of *Pyxis arachnoides* as described by Bour (1981) and later by Pedrono (2008), with current range of the three subspecies overlaid.

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The survey team in February of 2010, two months into the range wide population survey of *Pyxis a. arachnoides* in the Anakoia region.

Tsilavo Rafelarisoa, Richard Razatimanatsoa, and Ryan Walker (left to right) collect morphometric data to better understand population variation in the subspecies of *P. arachnoides*.



Innovative Solutions to Conservation Challenges for the Radiated Tortoise (*Astrochelys radiata*) Project at Lavavolo Classified Forest, Madagascar

Tsilavo H. Rafeliasoa¹, Gary D. Shore²,
Susie M. McGuire³, and Edward E. Louis, Jr.⁴

The Radiated Tortoise Project (RTP), part of Omaha's Henry Doorly Zoo (HDZ) and the Madagascar Biodiversity Partnership (MBP), was initiated in 2000 to facilitate the

conservation of the Radiated Tortoise (*Astrochelys radiata*), a flagship species emblematic of the dry spiny forests of southern Madagascar. Categorized as Critically Endangered,

several factors have contributed to the vast decline of this species, including the loss and alteration of natural habitat and the lack of enforcement against illegal harvesting that has intensified due to current political instability in Madagascar. Based in Lavavolo, Madagascar, the RTP is a multifaceted program that addresses both environmental and anthropogenic threats to the Radiated Tortoise (see August 2009 Rafeliasoa, Pp. 76–77).

The results of a recent survey reveal several conservation challenges in Lavavolo. Radiated Tortoise declines are associated with the loss of habitat from slash and burn activity, fuel wood and charcoal production, and the subsequent overgrowth by an invasive *Opuntia* cactus. Four years of extreme drought have led to a severe lack of water in the region affects both the tortoise and human populations. Additionally, the lack of a strong educational foundation in the region magnifies these issues. Many children stop attending school because they do not want to continue to endure the daily 20+ kilometer walk in such extreme heat. Furthermore, due to limited educational tools, students are not engaged or motivated to continue their schooling past the first few years.

Therefore, in addition to the RTPs research programs of habitat



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Top left: Tsilavo Rafeliasoa documenting a Radiated Tortoise (*Astrochelys radiata*) in Madagascar.

Far left: Tsilavo Rafeliasoa, Richard Razatimanatsoa, and Ryan Walker collecting morphometric data on tortoises during a range-wide survey.

Left: Jean Claude Rakotoniaina, a Madagascar Biodiversity Partnership field assistant, notches an identification pattern on the marginals of a Radiated Tortoise.



Top: Susie McGuire demonstrates the use of puppets at a primary school in Madagascar. **Bottom:** Malagasy primary school students learn about tortoise conservation.

Ventral and dorsal views of the new Radiated Tortoise Project mascot.

evaluation and restoration, tortoise diets in pristine versus impacted habitats and population genetic monitoring, community based pilot programs have been initiated to empower the local people. Conservation education plays a vital role in changing attitudes toward the intrinsic nature of wildlife. The first task completed and already transferred to Madagascar involves use of the Radiated Tortoise as a conservation tool. The MBP purchased Gopher Tortoise puppets, which were painted to resemble Radiated Tortoise shell patterns. These puppets are ambassadors and mascots to the project, and will aid in the introduction of all RTP programs. Through the use of presentation equipment provided through a 2010 TSA grant, environmental education workshops are held in schools that incorporate new environmental lessons into their curriculum. In addition to conservation education as a means to address community based challenges, the HDZ and MBP have also developed several pilot programs that provide solutions to the conservation challenges of the Lavavolo region. These

prototype initiatives include evaluating the effectiveness of desalination technologies, potential for cash and food crops, and biofuel methodology using local resources.

First, a prototype solar desalination unit has been constructed at the HDZ and is being evaluated for its efficiency to produce potable water from saltwater. Substantial rainfall has not occurred in Lavavolo for the past four years, and the water currently utilized for drinking or watering the local cattle herds by the community is "brackish." Moreover, the community well is located over 500 meters from the village, requiring the local residents to invest a significant amount of their time to water collection. Therefore, a program to involve Hippo Rollers to transport water and create community crops will be implemented, solving the problem of the water accessibility, which should also improve inconsistent agricultural productivity.

With the introduction in the 1800s of *Opuntia* cactus, *raketa* in Malagasy, the landscape of the original spiny forest has been dramatically altered. One of four species

of *raketa* in Lavavolo, *raketa mena*, is a highly invasive species that impedes the growth of agricultural gardens. Furthermore, during the dry season the people of Lavavolo only use the fruit portion of the *raketa* as a source of food and water, for themselves and their cattle. The MBP is evaluating the utility of this invasive species as a key component in biofuel briquettes. To aid in the drying of the biofuel material, a working prototype solar desiccator has been developed using supplies readily available in Madagascar. Two approaches for making the briquettes from the *Opuntia* cactus pads are being tested as part of a preliminary pilot study in Omaha prior to transferring the results and information to Lavavolo, Madagascar. The first method involves drying the *Opuntia* before the cactus is processed with other biofuel material (sawdust and cattle dung). The second method involves the direct grinding of fresh *Opuntia* cactus prior to briquette production. To facilitate this process, a prototype grinder built from lawnmower blades that chopped the *Opuntia* pads will be further “field” tested by a local high school mentoring program. Using non-dried pads straight from the *Opuntia* plant, as in method two, would allow the solar desiccator unit to be used solely for drying the briquettes.

Both approaches will be tested in rocket stoves here in Omaha, with the biofuel briquettes evaluated for their use and efficiency depending on the percentage of cactus, sawdust, and cattle dung. Other alternatives to sawdust such as ground leaves will also be tested. When combined with other activities, such as research, access to alternative food resources increases the standard of living, which ultimately reinforces behavioral changes needed to effectively protect endangered species.

This project was funded, in part, through grants from the Turtle Survival Alliance.

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Right: A prototype water desalination unit.

Far right, top to bottom: A solar desiccator unit; racks of *Opuntia* pads drying in a solar desiccator; a grinder prototype; and, briquettes of sawdust, cattle dung, and freshly ground *Opuntia* are set out to dry.



Slaughtered: Scenes from a Radiated Tortoise Poaching Camp

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Riana Rakotondrainy³, William Ronto³,
Tantely Mahamasina³, Julio Duchene⁴, and Zigzag Randria⁵

Our 4-wheel drive rocks side to side in the sun as we lumber over the rugged, white ground beneath us. We are lost in delighted memory of the previous evening's celebration — a feast of roasted goat, hearty rum, and traditional song with the gracious and vibrant community at Ankirikirika. They opened their home to us while we searched for tortoises, and now the smiling Prince is guiding us away from their sacred forest to our next destination. The road quickly narrows; we are just meters from the muddied waters of the Menarandra when a camp comes into view through the barbed and prickly trees of the forest. As we inch closer the staggering details become crystal-clear. Bloodied tortoise shells, tangles of entrails, disjointed limbs. Grinding halt, doors tear open, hearts racing, shouts heard; now we are in hot pursuit of fleeing poachers, breathless they vanish into thin air.

The sacred forest of Ankirikirika is located less than 300 km west of the port-city Ft. Dauphin in southern Madagascar. Known for its splendid and pristine gallery forest, it is also legendary for supporting a huge population of Radiated Tortoises (*Astrochelys radiata*). Leuteritz

(2002) estimated that *A. radiata* occurred at a density of more than 1,000 individuals per km². Nearly a decade later, we visited Ankirikirika to obtain a current estimate of *A. radiata* density, assess the population's trend, and compare it to other locations across this species range.

What we encountered at Ankirikirika was not what we expected. We uncovered few tortoises despite long days spent searching. The trees in the forest had been illegally harvested, and we discovered fire pits at old harvesters' camps that contained burned tortoise shells. Most shells had been hacked open from the top of the carapaces and the plastrons were ripped-off with visible hatchet marks on their bridges. The villagers told us that strangers enter the forest to harvest the timber and live off tortoise meat during their stay. Dried tortoise limbs are a delicacy among outside tribes that do not respect the taboo, or *fady* that prevents the local people from harming them. Indeed, the local tribes consider the tortoises dirty and prefer not even to touch them. From our surveys, we estimated the mean density of Radiated Tortoises at Ankirikirika to be 465 individuals per km², which is a significant decrease from earlier estimates.

The local community, including the King and his extended family are the traditional stewards of the forest at Ankirikirika. We interviewed the brother of the King, a 70-year old goat herder, and his son aged 35 to determine the causes of the local habitat destruction and the mass disappearance of tortoises. They agreed that in the past outside people were unafraid to collect tortoises from the forest, but now they run from the police. Those that still collect them have been suffering through a prolonged

Radiated Tortoise limbs are considered to be a delicacy by outside tribes. Here, they dry in the sun in preparation for transport to markets.

CHRISTINA CASTELLANO



drought and have had little success with their crops. The two men were sympathetic, because the tortoise hunters are apparently in need of food for their families and have very little else to sustain them. Having both been born in the forest, the men have witnessed the decline in tortoises over the years. Consequently, they have imposed a law to punish collectors, which stipulates that if someone is seen slaughtering a tortoise they must purchase a six-year-old zebu for about 200,000 Ariary (\$90 US), spread its blood at the site where it was killed, and present the meat to the villagers. Moreover, the event is documented and the poachers' names are sent to the police.

Despite the disappointment of locating few tortoises, we completed our stay at Ankirikirika with a celebration to thank the community for graciously hosting us. We left the next morning for our next survey location, which was just east of the fishing village of Itampolo. About 11 km south of Ankirikirika, we inadvertently entered a functioning tortoise poaching camp. The poachers were just as startled as we were and fled anxiously into the surrounding forest. On the road were old, tattered blankets covered with

cooked tortoise limbs. They were being dried in the sun for transport to market for sale. We estimated that each blanket had over 150 limbs, or the meat of about 40 tortoises. Together, the meat on all of the blankets represented more than 250 individuals.

When we arrived the poachers were in the process of slaughtering tortoises, cleaning shells, and removing entrails. There were dozens of small, charcoal pits that were being used for cooking. Cast iron pots filled with diced vegetables sat in the sand along with pieces of burned shell. Primitive metal hatchets used for the slaughter were also lying beside tall, plastic bottles filled with liver oil. One living tortoise was hanging in a tree — a rope sewn through a hole in its shell — we swiftly cut it loose. Three sacks filled with dried tortoise meat were also discovered, each sack containing the meat of about 100 tortoises. The sacks were tied to timber poles, or carry sticks, used for transport. Twenty-eight carry sticks were left in the camp, suggesting that about thirty poachers had been present.

At the urging of our accompanying Malagasy environmental officer we destroyed the camp before leaving by tossing

the meat, weapons, and cooking utensils into the Menarandra River. Our drive out of the site was at a snail's pace due to the rocky road, and we were filled with fear and anxiety at the thought of enraged poachers returning to their camp and discovering the losses to their livelihood. Once clear of any danger our moods turned somber as we traveled to Itampolo. There we submitted a police report and provided several hatchets and bottles of liver oil to the police as evidence of this crime. The long drive and silence among our group forced reflection and the images of dismembered turtles are now forever burned in our minds.

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We located tens of fire pits with burned tortoise shells throughout the poaching camps.

Primitive hatchets are used to slaughter tortoises and oil is collected in old, plastic bottles and later used for cooking



First “Turtle Cup” Soccer Match Held for Dong Mo Lake in Vietnam

Timothy McCormack¹

On March 28th of 2010, the Asian Turtle Program (ATP) of the Cleveland Metroparks Zoo organized the first Turtle Football (Soccer) Cup in the village of Nghia Son, in the Son Tay district of Hanoi. The matches involved teams from four villages, and were organized to promote awareness and conservation of the Critically Endangered Swinhoe’s Softshell Turtle (*Rafetus swinhoei*), a species known to occur in Dong Mo Lake but recognized as one of the world’s most Endangered Species. Presently, only four animals are known to exist globally.

Swinhoe’s Soft-shell, also known as the Hoan Kiem Turtle in Vietnam, is important to Vietnamese culture

and history due to a 15th century legend about a mystical turtle living in a lake at Hanoi.

Presentations were made between the matches to highlight the need for community support in protecting the Dong Mo Turtle, and the lake it lives in, for future generations.

Following some closely played matches, one of which went to penalty kicks, the Youth Union team of the village of Ngia Son II emerged as the champions of the day. Because of the success of the first Turtle Football Cup, Mr. Pham Van Thong, the *Rafetus* project coordinator, intends to expand the games in 2011 to include additional communities.

The first Turtle Football Cup for *Rafetus swinhoei* was supported by the Columbus Zoo, Critical Ecosystem Partnership Fund (CEPF), as well as the Cleveland Metroparks Zoo (CMZ).

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Below: T-shirts: “Turtle Cup” T-shirts carried the awareness message, “Let’s protect the legend of Vietnam. Protect the Hoan Kiem Turtle.”

Right: The winning team: the youth team of Ngia Son II received sports equipment for their village.



TIMOTHY MCCORMACK



Training Detection Dogs for Research and Conservation of Tortoises and Freshwater Turtles in Southeast Asia

Timothy McCormack¹

Historically, dogs (*Canis lupus familiaris*) have been used to hunt many taxa, from elephants and lions to birds and, yes — turtles. The well evolved olfactory system in dogs allows for much

greater sensitivity in detecting and distinguishing a wide variety of odors than our own (MacKay et al., 2008). This fact means that in the hands of a proficient hunter, man's best friend could be considered the

worst enemy of many turtle species, especially terrestrial ones that are most vulnerable to detection by hunting dogs. In Southeast Asia, dogs have long been used for hunting. For example, in Vietnam, dogs will often follow their owners into the forest, individually or in packs. With a natural hunting instinct, they follow a lead dog and chase wild pigs, deer, squirrels, civets, or almost anything they see. They either catch, corner, or chase their prey until it is exhausted, which allows the hunters to pick off the animals with a stick, knife, gun, or crossbow. If they encounter turtles, their barking, scratching, and biting quickly alerts the hunters to an easy catch.

During interviews with Vietnamese hunters, they often reminisce about the hunting heyday. In the 1980's, when turtles and other wildlife were abundant in the forests and the Asian Turtle Crisis was just emerging, they would take their dogs into the forest with three or four friends. The turtles were so common and the dogs would find so many that additional friends were brought along to carry out rice sacs full of turtles that they collected in a matter of days. Today, some terrestrial species (the ones most vulnerable to dogs) have all but disappeared, especially those with a high commercial value such as the Chinese Three-striped Box Turtle (*Cuora trifasciata*) and the Indochinese Box Turtle (*C. galbinifrons*) (Spinks and Shaffer, 2007). Because of this decline, the number of dedicated turtle hunters has dwindled and, instead, hunters take dogs into the forest to catch anything they can. If they find a single turtle per day, they are doing

A local hunting dog in northern Vietnam, with an Indochinese Box Turtle.



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well; some weeks they find none. Such reduced turtle populations pose a serious challenge for researchers, as surveys are sometimes exhausting and demoralizing. Increasingly, graduates from the university, who have studied forestry or a biological science, are interested in the conservation and research of the 25 species of native chelonians. More turtle-focused fieldwork is being conducted in Vietnam each year, which is helping to increase our knowledge of these animals and is promoting conservation. For aquatic species, non-lethal trapping is possible and requires little effort other than setting, baiting, and checking traps. For terrestrial turtles, pit-fall traps and drift fences can work, but they require time for construction and a placement in good locations to be successful. Time search, walking line transects, or covering grid squares has proved successful, but these require extensive man hours. One example is the survey work performed on the Keeled Box Turtle (*Cuora mouhotii*) at Cuc Phuong National Park, in Ninh Binh Province. During a two year study, in 2008 and 2009, time search was conducted in an area where radio-tracking studies on this cryptic species had already identified

a sizable population in good habitat. Despite selecting the best seasons of the year for encountering active turtles, the capture rate was only 0.029 turtles per man hour (H. Van Ha and T. McCormack, unpublished). Because such efforts are required, it's not surprising that some researchers have opted to use hunters and local dogs to form a more efficient team, and to lower the costs. But the risks associated with this method are often overlooked, as local dogs are difficult to control, especially if they run in packs, and then there's the risk they might kill other wildlife. Hunters finding valuable species of turtles, pangolins (*Manis* sp.), or other species could potentially choose those animals over payment for work. Also, if good populations are identified, the hunters will come back when the research team or Forest Protection Department (FPD) is not present.

Because of the need for greater efficiency in surveying Critically Endangered species such as the Indochinese Box Turtles (*Cuora bourreti*, *C. galbinifrons*, and *C. picturata*; see Stuart and Parham, 2004), for which their distribution and occurrence in many protected areas remains unclear, we decided to utilize the incredible olfactory sense of dogs. Their sense can be trained

to detect a wide variety of items, from finding drugs and explosives to invasive ant species, and even whale scat or mobile phones in private schools (Smith et al., 2003; Rolland et al., 2007; Parker and Hurt, 2010). With a detection accuracy greater than experienced by humans, dogs have been used in wildlife conservation for over 100 years (Smith et al., 2003; Parker and Hurt, 2010). The Asian Turtle Program (ATP) at the Cleveland Metroparks Zoo, in cooperation with the Centre for Resources and Environmental Studies (CRES), organized training with the Barking Mad Dog Training School (BMDTS) to professionally train the dogs to allow for a safer, more efficiently controlled, and the use of a scientific approach in conducting turtle surveys. Surveys on Desert Tortoises (*Gopherus agassizii*) have shown much greater efficiency when performed by teams using dogs, especially in thick undergrowth (Nussear et al., 2008).

Rather than importing popular breeds, such as Labradors, or pre-trained dogs, however, we selected six local dogs, all without prior training. Two were a special breed known as Phu Quoc dogs, from a small island in southern Vietnam, renowned for their hunting capabilities and agility. Some came

Left: A *Cuora mouhotii* at Cuc Phuong National Park, Vietnam. **Right:** Searching for turtles without dogs requires large teams, long hours, and hard work. Pictured here is the team assembled to search for *Cuora mouhotii*.



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from local villages where they were destined for the dinner table, since dog meat is considered a speciality dish in Vietnam and eaten at the end of the lunar month. Local dogs were selected, as these were already acclimatised and adapted to life in a tropical environment, as well as a local diet that some imported dogs have struggled with. Using local dogs also reduced the significant cost of purchasing and transporting animals and, from a welfare standpoint, this decision rescued these animals and presented an opportunity to show that all dogs have an ability to be trained.

In May of 2010, we held a two week intensive training course for the dogs and their six handlers. The course was conducted by Richard Clarke, the director of training for BMDTS, and four qualified volunteer trainers from the United Kingdom with decades of combined experience in training drug, explosive, and security dogs, as well as tiger scat detection dogs. Training was held in Cuc Phuong National Park, where animals from the Turtle Conservation Center (TCC) were used to introduce turtles scents to the dogs. For some of the dogs that were raised in the urban sprawl of

Hanoi, it was their first experience in forest.

Training started with basic handling, care, and grooming, and rapidly progressed to basic obedience and encouragement in their search for turtle scents, which was accomplished by using cloth bags scented with the desired turtle species, with meat treats inside the bags. Gradually, over the weeks, the treats were removed and eventually we used live turtles in small cages, and harnessed the dogs so they could work on long lines. As the dog training progressed the harnesses were removed, which allowed them greater movement through the thick undergrowth.

Indications of success varied with each dog, as some would bark and bite at the turtles but others were more passive, sniffing or showing excitement when they detected them. Although the dogs displayed different strengths and weaknesses, after only two weeks each was able to locate and indicate the presence of four concealed animals within a 25m² grid square.

Following the course, additional training will focus on the dogs' fitness and scent-building capacity, to prepare the them for summer surveys in northern and central Vietnam. Field testing the team to gain practical experience for both the handlers and hounds will be important for their development through 2010. By 2011, therefore, a more experienced team will be conducting fieldwork in Vietnam, which will greatly reduce the risk to wild turtles and the duties will be performed with more scientific methodology. We also would like to diversify our agenda by using the dogs in enforcement activities. The dogs can be used by the FPD and the environmental police to check buses and trains along major trade routes in Vietnam and China for

illegal wildlife, since shipments often contain turtles.

The training was conducted with the support of the Critical Ecosystems Partnership Fund (CEPF), The Mohamed bin Zayed Species Conservation Fund, and the Cleveland Metroparks Zoo. The Ocean Park Conservation Foundation, Hong Kong, supported the radio-tracking and time search. We would also like to thank the personnel at Cuc Phuong National Park and the Turtle Conservation Center (TCC) for hosting the training program.

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Local dogs trained to hunt for turtles.



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A Third Attempt at Breeding *Rafetus swinhoei* in China

Gerald Kuchling¹, Lu Shunquing², and Emily H. King³



A female *Rafetus* basks at the Suzhou Zoo.

After moving the last Chinese female Yangtze Giant Softshell Turtle (*Rafetus swinhoei*) from the Changsha Zoo to be with the last Chinese male at the Suzhou Zoo, the female laid over 100 eggs in 2008 (two clutches) and over 200 in 2009 (four clutches; see TSA Newsletter 2008, 2009). Unfortunately, none of the eggs hatched. Egg candling in July of 2009 indicated that about 25% of the eggs showed early embryonic development, with the terminal sinus of the vitelline circulation visible after one week of incubation; none of the eggs, however, showed further development. As suggested in the TSA Newsletter of 2009, nutritional deficiencies in the long-term captive female (over 70 years in captivity) were the most likely cause for this setback.

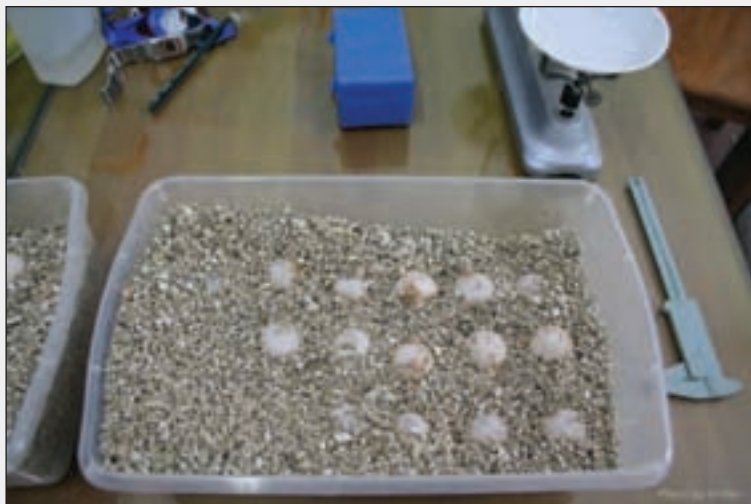
Although nutrition in these turtles has been discussed extensively with the Chinese stakeholders since 2007, drastic improvements to the previously mainly meat-based diet (chicken and pork) were only implemented since July of 2009, when it became apparent, like in 2008, that the eggs deposited in 2009 again would not hatch. In the summer of 2009, however, the female *Rafetus* began filling up on “junk food” (e.g., bread, crackers, and chips) thrown into her pond by zoo visitors, a situation that seriously jeopardized the attempts to improve her diet. To address this problem, immediately after last year’s TSA meeting in St Louis TSA Board members Chuck Landrey, Pat Koval, Walter Sedgwick, and Anders Rhodin generously made funds available

for a glass barrier to better separate the public from the breeding pond. The barrier was built in late August of 2009. To follow suit, the Chinese government is presently funding a similar glass barrier for the second, larger *Rafetus* pond.

The male and female *Rafetus* were maintained together during August and early September of 2009, but due to bites from the male during mating attempts the female received skin abrasions and scarring on her neck and front feet. Because of an unsuccessful attempt by veterinarians to catch and restrain the female for examination and treatment in mid-September of 2009, the female became shy and wary of people, a situation that continued into the spring of 2010. The female still will not accept food from hand feedings as readily as before, which has made the monitoring of her supplement intake more difficult. The improved diet is now mainly based on whole shrimp, freshwater crayfish, fishes, freshwater snails, frogs, quail, pigeons, and occasionally chicken heads and wings that contain vitamin and calcium supplements. An additional food item is Mazuri Croc Chow, donated by Disney’s Animal Kingdom.

On 6 June 2008, the female laid her first clutch of eggs. After an unusually hot spring in Suzhou in 2009, she nested for the first time on the 31st of May. In 2010, however, the spring and early summer were unusually cool and rainy, and the female did not nest for the first time until the 16st of June. Due to the late nesting date, it was not possible for us to report on the development of the eggs.

The *Rafetus swinhoei* breeding program still has hurdles to overcome, and those problems might increase if hatchlings are produced.



EMILY KING



EMILY KING



GERALD KUCHLING



GERALD KUCHLING

Top left: Several mediums for incubating *Rafetus* eggs are being tried this year, including vermiculite, pearlite, and sand. The eggs are divided among three incubators with varying temperature regimes. **Bottom left:** A mating attempt by the pair of *Rafetus* occurred on May 3rd of this year, shortly after they were introduced.

Top right: Veterinarian Dr. Gu (left) and *Rafetus* keeper Di Min (right) excavate the first nest of the 2010 season. A total of 63 eggs were recovered on June 17th. **Bottom right:** Sponsored by the TSA, the glass barrier pictured here was installed to prevent zoo visitors from throwing trash or junk food into the pool. The video surveillance camera used to monitor nesting activity, mounted on the house wall, was donated by David Shapiro. The female *Rafetus* is seen basking on the shoreline.

The water quality is a concern, since in the spring of 2010 the eyes of the male became infected and the female developed skin lesions. The *Rafetus* ponds are connected to a lake and channel system in Suzhou in which the water quality is dubious. Due to the chemicals used to treat the water, the water in Suzhou might not be suitable for raising baby softshell turtles. Currently, we are planning to install reed bed filters in both

ponds to improve the water quality and its clarity, and to use this filtered pond water for the future rearing of hatchlings.

We thank the Suzhou Zoo, the Changsha Zoo, and the China Zoo Society for facilitating the breeding program and for their collaboration. The 2010 breeding attempt was again funded by the Turtle Survival Alliance, with generous financial support from the Turtle

Conservation Fund/Shellshock campaign, the Cleveland Zoo/Wade Foundation, and Pat Koval/WWF Canada.

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Southern River Terrapin Research and Conservation in Terengganu

Eng-Heng Chan¹ and Pelf-Nyok Chen¹

The second half of 2009 through May of 2010 has been an eventful time for Chan and Pelf of the Turtle Conservation Centre (TCC) in Terengganu, Malaysia. Initially named the Turtle Institute with tentative operations under the Sultan Mizan Foundation, the TCC will likely be established as an independent body that seeks patronage from the Sultan of Terengganu, the current King of Malaysia. The location of the center will also change, in view of pending developments in the Setiu area.

In September of 2009, a TSA team comprising of Rick Hudson, Bill Zeigler, and Lonnie McCaskill arrived in Malaysia to brainstorm on the physical facility requirements for the TCC. Designs were also made for breeding and headstarting ponds for the government-run Terrapin Conservation Centre at Bukit Paloh, in Terengganu, and these were

submitted to the State Department of Wildlife and National Parks for evaluation.

In the interim, the TCC rented a house in the village of Mangkuk to use as a base for the ongoing Southern River Terrapin (*Batagur affinis*) research and recovery project at the Setiu River. A mini turtle museum is being assembled in the house, featuring shells and skeletons of various species of freshwater and marine turtles, stuffed hatchlings emerging from sand-nests, preserved specimens, and posters depicting the current projects at the TCC and showing the various species of freshwater, marine, and terrestrial turtle species found in Malaysia. Life exhibits of Southern River Terrapin hatchlings will also be displayed, with a program for adopting one-year old terrapins for the purpose of release. The objective of the TCC is to draw tourists returning from the

resort islands of Terengganu to the museum, where they can learn about the conservation of local turtles. A small grant is being requested from the TSA to further develop the exhibits and produce outdoor posters for display in the compounds of the house.

Since the inception of the TCCs Southern River Terrapin project at the Setiu River in 2004, 1,814 eggs have been incubated and 1,181 hatchlings produced. A total of 920 Southern River Terrapins have been headstarted and released into the Setiu River, ranging from newly-emerged hatchlings to three-year old individuals. The growth and survival of these terrapins is being monitored through a fortnightly sampling program that includes help from local fishermen. Recapture rates of about 18.7% have been attained, and the information gathered on capture locations is providing a better understanding on the distribution of terrapins after their release. The simultaneous capture of Painted Terrapins (*Batagur borneoensis*) that share the same habitat with the Southern River Terrapins will enable a determination of the

Left: Pelf and Chan putting up the TCC logo outside of their base in Mangkuk Village, Setiu. **Right:** The centerpiece of the mini turtle museum.



K. F. CHANG



E. H. CHAN



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E. H. CHAN



E. H. CHAN



E. H. CHAN

Top left: Measuring, weighing, and preparing our first clutch of Southern River Terrapin eggs in 2010 for incubation. **Top right:** Local children are ready observers as we weigh and measure the terrapins. **Bottom left:** Gerald using laparoscopy to determine the sex of a 10-month old terrapin. **Bottom right:** Malek Yunus, a villager who has assisted in head-starting terrapins.

population size and structure of this species, by use of the mark and recapture technique. To date, a total of 172 Southern River Terrapins and 256 Painted Terrapins have been captured and monitored. Collaborative work on Temperature Sex Determination (TSD) with Gerald Kuchling continues, and in May of 2010, 66 one-year-old Southern River Terrapins were sexed. These terrapins hatched in outdoor sand nests where incubation temperatures had been monitored. Subsequently, the terrapins were head-started with the help of Malek Yunus, a local villager.

In 2010, additional work on the population status of the Southern River Terrapin will be extended to all other river systems in Terengganu where the status remains unknown. A grant of \$30,000 (USD) secured from the project from the U. S. Fish and Wildlife Service will allow us to conduct in-depth interviews

with local fishermen in seven river systems in Terengganu, assess the threats to the turtles, determine the feasibility of initiating egg protection programs, and provide a turtle awareness camp in selected schools along the rivers. A strategy for the conservation of the Southern River Terrapins in Terengganu is the goal of this project.

A website for the TCC has been established (<http://www.turtleconservationcentre.org>), in addition to a Facebook Fan page. Our objective is to make the website a one-stop portal for information on Malaysian turtles, and it presently contains write-ups on research and conservation projects at the TCC, as well as educational materials, fact sheets, a bibliography, and a directory of turtle volunteer programs in Malaysia. The website also features a frequently-updated blog that is used as a means of communicating with the public. On

October 25th of 2009, the website was visited intensely (863 visits and 45,000 hits) when we organized a 24-hour Turtle Blogathon to raise awareness and funds for the TCC. Turtle-related blog posts appeared on the website every hour, and these have been archived on the website for future reference (<http://www.turtleconservationcentre.org/category/turtle-blogathon-2009>).

Future research activities on the turtles of this region will likely intensify, as Pelf has expressed an interest in pursuing a Ph.D. degree, focusing his studies on the Southern River Terrapins and Painted Terrapins in the Setiu River. Outreach activities will also continue, as we understand the need to educate the local people so we can recruit as many ambassadors as possible in our effort to save the terrapins from extinction. We will be seeking funding, the most critical factor in the development of the TCC and the organization's crucial conservation work on the terrapins.

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Turtle Conservancy and Behler Chelonian Center Annual Report 2009–2010

The Sre Ambel project is working to conserve Indochina's last known population of the Critically Endangered River Terrapin, or Batagur (*Batagur affinis*), in the Sre Ambel and Kaong rivers of southwestern Cambodia. The project activities are designed to protect wild populations of the Batagur, through guarding nesting beaches and implementing law enforcement patrols in the two rivers, as well as rearing a captive population in a conservation hatchling center. This program is administered by the Wildlife Conservation Society's (WCS) Cambodia program, with technical and financial support provided by the TSA.

The hatchling center focuses on rearing turtles to a size where the likelihood of mortality is lowered, and it has received significant support from the TSA since its construction in 2006. Hatchlings are raised from eggs collected on nesting beaches by the patrol staff, and these are grouped in a number of tanks according to age and size class. Support from the TSA in 2009 funded infrastructure improvements at the hatchling center, including improved water and electricity supply and the construction of an

additional kitchen building. The water supply was improved with the construction of a new and deeper well, and the installation of a solar pump and water tank. The water tank has a capacity of 3,000 liters, and has been installed on a tower that allows the water to flow freely through a system of pipes above the holding tanks. Water flows into the tanks continuously, with overflow pipes allowing excess water to drain from the tanks. The solar pump is powered by two 87 watt solar panels, and the well has been dug to a depth of 12 meters to ensure that water is available throughout the year, including during the dry season.

Further improvements to the hatchling center, however, will soon be necessary, as the population of animals continues to increase. Two nests were located and protected by project rangers during the 2010



MARK GATELY

Far left: New water tanks at the Sre Ambel Hatchling Center. **Left:** Hatchlings at the center, from the 2010 nesting season.

Bottom: Two additional holding tanks installed at the center.



MARK GATELY



MARK GATELY



BRIAN D. HORNE



BRIAN D. HORNE



BRIAN D. HORNE

Left: The nesting beach on the Sre Ambel River is guarded 24 hours per day during the nesting and hatching seasons. Pictured here is the guard coming to shore to transport biologists to the nesting beach. **Middle:** New solar panels will serve to power pumps for moving water from the well to water storage tanks, where the water will be gravity fed into the headstarting facility. **Right:** Three wild caught River Terrapins (*Batagur affinis*), some of the last of their kind in Indochina, held in captivity for over 10 years at a facility in Koh Kong. These turtles represent valuable genetic additions to the captive program. Major improvements at the Sre Ambel facility are required before these turtles can be moved.

nesting season; one nest contained a total of 11 eggs, of which 10 individuals hatched in early May, and the second a total of five eggs, although only one individual hatched, in early June. Thus, there are 11 new arrivals at the center, in addition to the 118 animals that were already held (47 hatchlings from 2006, 47 hatchlings from 2007, one animal estimated at four years of age captured by a fisherman and handed to the conservation team in early 2008, and 23 hatchlings from 2009). Two new plastic tanks have been purchased to increase the capacity of the center in the short term, but a new and larger facility will likely have to be constructed over the next 12 to 18 months, if a suitable site can be located in the vicinity of the Sre Ambel River.

This program represents another outstanding example of the WCS/ TSA partnership that is working



BRIAN D. HORNE

Protecting a *Batagur* nest on the Sre Ambel River, the only known nesting site for this species in Cambodia, through the use of chicken wire. Ten turtles hatched from this nest in 2010.

throughout Southeast Asia to protect populations of Critically Endangered chelonians. Additional financial support has been provided by the Turtle Conservation Fund and the Critical Ecosystems Partnership Fund.

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Catalyzing Conservation Action in Belize for Central America's Imperiled River Turtle

Thomas Rainwater¹, Tom Pop², Octavio Cal³,
Steve Platt⁴, and Rick Hudson⁵

The Central American River Turtle (*Dermatemys mawii*) is found along the coastal lowlands of southern Mexico, northern Guatemala, and Belize (Alvarez del Toro, 1979; Iverson and Mittermeier, 1980; Iverson, 1986; Ernst and Barbour, 1989; Lee, 1996) and is the lone surviving representative of the family Dermatemydidae (Iverson and Mittermeier, 1980). Throughout its restricted range, *Dermatemys* has been intensely harvested for its meat and, to a lesser extent, for its eggs and shell (Moll, 1986; Polisar, 1994, 1995). As a result, *Dermatemys* has been virtually eliminated from much of its former range in southern Mexico, while its status in Guatemala remains unclear (Polisar, 1994). Currently, *Dermatemys* is considered one of the world's most heavily exploited turtles and is classified as Critically Endangered by the IUCN, listed as Endangered under the U. S. Endangered Species Act, and listed on Appendix II of CITES (CITES, 2009; IUCN, 2009; USFWS, 2009).

In Belize, a countrywide survey of *Dermatemys* (locally known as "hickatee") conducted in 1983 and 1984 found that the species was still common to abundant in areas sparsely populated by humans, but declining in more developed areas where the turtles were more accessible to hunters (Moll, 1986). Additional research conducted in north-central Belize from 1989 through 1991 indicated that the exploitation of *Dermatemys* persisted in more populated areas,

and that the level of harvesting was not sustainable (Polisar, 1992, 1994, 1995, 1996, 1997; Polisar and Horwich, 1994). As a result, in 1993 the Belize Fisheries Department drafted nationwide comprehensive legislation for the protection and management of *Dermatemys* that included year-round possession limits, a brief closed (non-hunting) season, a complete prohibition on selling and purchasing *Dermatemys*, and a series of protected zones in the major waterways of northern Belize (Polisar, 1994, 1995, 1997; Polisar and Horwich, 1994). Surveys conducted in north-central Belize in 1998 and 1999 suggested that *Dermatemys* was still common to abundant in some remote localities, but that the species was still declining in more developed areas (T. Garel and D. Collins, unpublished).

Since that time, the status of *Dermatemys* in Belize remained unexamined until April of 2010, when the TSA initiated a countrywide survey to assess the species' current status in what is believed to be its last stronghold. The core survey team included Thomas Rainwater (TSA) and two Belizean researchers, Tom Pop (Belize Foundation for Research and Environmental Education; BFREE) and Octavio Cal (Ya'axché Conservation Trust). The primary objectives of the survey were to: (1) re-survey localities previously surveyed in the early 1980s so that general comparisons of turtle abundance could be made,

(2) survey other areas not included in previous surveys, particularly in southern Belize, (3) train Belizean team members in basic survey and data collection techniques so they could return and conduct more intensive surveys, and (4) work with the Belizean government and non-governmental organizations (NGOs) to stimulate a countrywide interest in *Dermatemys* conservation.

Top: Belizean team member Tom Pop holds an adult *Dermatemys* captured in the Temash River, southern Belize.

Bottom: Thomas Rainwater displays two *Dermatemys* shells. The turtles were harvested from the Belize River around Easter of 2010.



THOMAS ISHIM



THOMAS RAINWATER



Survey team members Tom Pop and Octavio Cal (from left) and local fisherman display adult *Dermatemys* captured in the Belize River.

Surveys were conducted during April and May, which in Belize is generally the peak of the dry season. During this period, turtles are easier to locate because the water levels are low, water bodies are relatively clear due to reduced turbidity from rain and high flow, and turtles are more concentrated in smaller areas (Polisar, 1995). Consistent with previous surveys (Moll, 1986; Polisar, 1995; T. Garel and D. Collins, unpublished), the team employed multiple survey methods, including nocturnal spotlight searches, trammel netting, and diving (free and scuba). When possible, the team also interviewed hunters, fishermen, and other knowledgeable individuals regarding the natural history and local occurrence of *Dermatemys*, the hunting methods employed, and the levels of exploitation (Platt et al., 2004). Each turtle captured was measured, permanently marked, and its location was noted before being released at the point of capture.

From 12 April through 31 May, the team traversed more than 6,200 km of Belize, surveying localities from the deep south to the extreme

north of the country. As in the mid-1980s, a wide range of habitats was surveyed, including estuarine rivers (brackish to fresh water sections); brackish rivers, creeks, and lagoons; inland (fresh water) rivers, creeks, lagoons, and ponds; a mountain (foothills) river, and a coastal bay (Moll, 1986). The associated topography and vegetation varied widely among these habitats, from coastal mangrove swamps to evergreen broadleaf forest along the lower slopes of the Maya Mountains (Stafford and Meyer, 2000).

The team surveyed approximately 30 localities, including 18 areas previously surveyed during the early 1980s (Moll, 1986). Overall, the results of the survey indicate that *Dermatemys* is heavily depleted in most of Belize, but healthy populations remain in a few remote areas, especially those receiving some level of protection. While this mirrors the trend observed in surveys conducted during the 1980s and 90s, the current findings are particularly alarming in that the number of localities where turtles were seen, and the number of turtles

at these localities, were both much reduced compared to previous surveys. In addition, interviews with fisherman and hunters indicate that the laws and regulations enacted in 1993 for the protection and management of *Dermatemys* are largely ignored by locals, as broad-scale enforcement is difficult to impossible. For example, multiple individuals contend that hundreds of adult *Dermatemys* are still taken from relatively small sections of the Belize River each year, and that hickatee continues to be served in rural village restaurants around the time of Easter.

On a more positive note, the occurrence of *Dermatemys* at multiple, previously unsurveyed localities in southern Belize is encouraging. More comprehensive surveys of these and other areas where *Dermatemys* populations appeared to be secure during the 2010 survey will be vital in developing new conservation strategies, potentially including prioritization of areas for more intensive (and enforceable) protection. In addition, the interest and support the survey team received from the Belizean government, as well as several NGOs, villages, and individual conservationists, guides, and fishermen, was outstanding and ensured the success of the project. The level of local knowledge, concern, and enthusiasm regarding *Dermatemys* conservation in Belize is promising, and plans to bring these interested parties together to discuss an updated national conservation plan are currently underway.

VISION FOR A LONG-TERM CONSERVATION STRATEGY

Since 2004, the TSA had prioritized *Dermatemys* for immediate conservation action and tried to launch a program in Mexico, first in Tabasco and then in Veracruz.

Unable to sustain momentum there, a decision was reached to shift focus to Belize, one of the species' strongholds. Recently, one of us (RH) traveled to Belize and met with Mr. Jacob Marlin, the co-founder and director of the Belize Foundation for Research and Environmental Education (www.bfreebz.org), to discuss the possibility of establishing a pilot program to test the feasibility of breeding and rearing *Dermatemys* in outdoor ponds. Mr. Marlin is very interested in the project and pledged his support. The pilot study would be conducted on BFREE property, which encompasses 1,200 acres of forest at the base of the Maya Mountains in central Belize and is surrounded by two protected areas. This pilot study would be a low maintenance operation focused on generating *Dermatemys* food plants (Moll, 1989), while working out such husbandry details as egg laying and incubation (Polisar, 1996). Currently, various pond designs are being discussed so as to provide multiple management options. Filtration will likely be passive and biological, utilizing plants that can be fed back to the turtles. Aeration will require solar power. Start up funds for this phase of the operation are available

from a Batchelor Foundation grant to the TSA.

The program would generate hatchlings that can be headstarted and released to help restore depleted wild populations. Once the husbandry techniques are worked out, and the species can be reliably reproduced in good numbers in captivity, the project could then be expanded. The ultimate goal is to take pressures off local populations. The conservation potential of this initiative, if implemented over the long-term, is exciting and provides a vision that this can develop into a model program and, ultimately, a sustainable future for *Dermatemys*. Not surprisingly, the Belize Fisheries Department, under which the purview of *Dermatemys* resides, has endorsed this concept and offered encouraging support (G. Myvett, pers. comm.). Indeed, the idea to build the TSA captive management component upon wild survey results — just completed by Thomas Rainwater and his local team — was first advanced by Fisheries.

This initiative is exciting for the TSA, and we are encouraged by the outpouring of support and interest by the conservation NGO community in Belize. Looking forward, we

believe that this survey work will prove to be catalytic, not only in Belize but for the region, and we look forward to bringing together the various groups interested in *Dermatemys* to begin discussing an overall recovery strategy for this highly threatened and unique turtle.

Acknowledgments. — This project would not have been possible without the support of George Myvett and James Azueta of the Belize Fisheries Department. We also thank the following groups and individuals in Belize for their support during this project: Alton Jeffords and Oceanic Society Expeditions; Benjamin Cruz; Bill Hasse; Bruce and Carolyn Miller; Bruce Cullerton (Rainforest Mechanic); Karl Tillett; Celia Mahung, Elmar Requena, Santiago Cucul, Luis Ishim, Chris Hamley, and the Toledo Institute for Development and Environment (TIDE); Chrissie and Anita Tupper; Clifton and Nancy Bailey (Manatee Lodge); Derrick Hendy and the Belize Audubon Society; Dion Andrews; Doyle Forman, Egbert Valencio, Thomas Ishim, Narco Nakin, and the Sarstoon Temash Institute for Indigenous Management (SATIIM); Eddie

Adult male (**left**) *Dermatemys* from the Belize River, and an adult female (**right**) from Irish Creek in north-central Belize. Male *Dermatemys* characteristically display yellow (although sometimes cream or reddish-brown) coloration on the dorsal surface of the head, whereas the heads of females are typically uniform brown, olive, or gray.

THOMAS RAINWATER



THOMAS RAINWATER





THOMAS RAINWATER



THOMAS RAINWATER



THOMAS RAINWATER

Top: A sign posted along the Río Grande, in southern Belize, indicating the legal size limits and hunting season for *Dermatemys*.

Middle: Survey team members Octavio Cal (left) and Tom Pop (right) weigh a *Dermatemys* (in bag) captured in the Río Bravo, northwestern Belize.

Bottom: Octavio Cal (left) and Tom Pop (right) collect shell measurements from an adult *Dermatemys* captured in the Río Bravo, northwestern Belize.

Romero (Programme for Belize); Elma Kay (University of Belize); Frank Mazzotti; Geraldine and Lionel Fermin (Community Baboon Sanctuary); Giovanni Fernandez and Black Rock Lodge; Graham Sampson; Isabelle Paquet-Durand (Galen University); Jacob Marlin and BFREE; Jan Meerman; Jerry Larder and Nikki Buxton (Belize Bird Rescue); Kevin Andrewin; Lloyd and Walter Cassosola; Leonard Myers; Marcelo Windsor; Andre Lopez, Rasheeda Sampson, and the Belize Forest Department; Marga Miller, Anna Zabrowski, and Monkey Bay Wildlife Sanctuary; Mark Howells, Ruben Arevalo, and Lamanai Outpost Lodge; Nick Wicks, Ginny Fuhs, Lee McLoughlin, and Ya'axché Conservation Trust; Paul Walker (Wildtracks), Percy Flowers, Jr.; Reynaldo and Sergio Gorosica; Richard and Carol Foster; Robin Brockett; Sharon Matola and the Belize Zoo; Steve Usrey; Tamara Sniffin (San Pedro Sun); Tony Garel (Belize Herpetarium and Aquarium Park); Udell Forman; and Vince and Cherie Rose (American Crocodile Education Sanctuary [ACES]). Finally, we are grateful to the Turtle Conservation Fund (TCF), the Mohammed bin Zayed Species Conservation Fund, and the Delta Foundation for generously providing financial support for this project.

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Field Methods for Studying Freshwater Turtles: Research, Management, and Conservation in the Brazilian Amazon

Richard C. Vogt, Ph.D.¹



The Enigma, a 24 m boat, is used as a base of operations.

In 1988, the Instituto Nacional de Pesquisas da Amazônia (INPA; National Institute of Amazonian Research) extended me an invitation to spend my sabbatical year in the jungles of the Amazon. The purpose for my visit was to provide guidance to Master's students with an interest in turtle ecology, and to teach a course on field methods used to study aquatic turtles. Back then few professionals in Brazil, and particularly in the Amazon region, were interested in turtle ecology, and the researchers who had published the most about Amazonian turtles lived in São Paulo (Paulo Vanzolini) or Brasília (Cleber Alho).

For centuries, freshwater turtles in the Amazon have played an important role in the economy of the region, and their demand eventually caused many populations to become extirpated from many areas and placed others on the verge of extinction. Thus, in 1975, the Instituto Brasileiro do Meio Ambiente (IBAMA: the Brazilian equivalent of the United States Fish and Wildlife Service)

initiated efforts to protect and manage some of the most important nesting beaches used by turtles of the genus *Podocnemis*. This project has grown to become the largest for freshwater turtles in the world, and each year from two to four million hatchlings are released. Because most of the people initially involved with this project were forest engineers and few biologists were on the staff, another purpose for my involvement was to provide these people with training.

The following year, I began working as an outside advisor to this project. In time, however, I became more of an inside advisor due to my understanding and management of conservation practices on a shoestring budget. Today, a few people from IBAMA participate in the courses, as well as graduate students from INPA and other Brazilian universities, and from other South American countries. A few graduate students from Australia, Canada, and the United States have also participated.

I taught the first course, in 1989, with financial assistance provided by the World Wildlife Fund (WWF), and two of my students completed their Master's theses on the topic of turtles. Some students continued their careers by studying turtles, but those that did not gained an understanding of the techniques needed to conduct basic ecological research with aquatic turtles, where to find the literature, and what could be done with a little perseverance. Later, many of these students dispersed to other universities, government

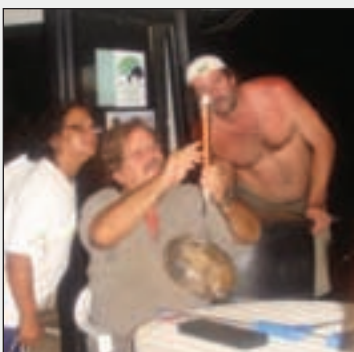
offices, field stations, or NGOs, equipped with the necessary information to advise their own students, write grant proposals, review permit requests, and edit papers dealing with turtles. One of these people, Tibisay Esculenta, became a post-doctoral student with Nicole Valenzuela; Olga Castano became the director of Federico Medem's lab in Colombia; and, Ronis de Silveira went on to become one of the leading *Melanosuchus* experts of the world and a Professor at the Universidade Federal do Amazonas (Federal University of Amazonas) in Manaus. In total, over 350 students have attended the course since its inception.

I taught the course annually, migrating back and forth from Mexico, until I moved to Manaus permanently in 2000 and became the curator of the amphibian and reptile collection at INPA. I have taught the course at the following field sites: Trombetas Biological Reserve (6 years), São Luís Maranhão, Rio Doce in Minas Gerais (where Glaucia Moreria [of *Phrynosoma hogeni* fame] was captured), Rio Negro, Rio Tapajós, Mamirauá Sustainable Development Reserve (8 years), Reserva Ducke, and Balbinas Hydroelectric Dam Project.

We now have a boat for teaching the course, the Enigma, and a permanent base at the biological station of the Rio Trombetas. Although from time to time I offer the course in other areas, the Rio Trombetas station has proven to be optimal because of the amount of turtle diversity in the region, which includes the Pleurodires (Podocnemididae) *Peltocephalus dumerilianus*, *Podocnemis expansa*, *P. sextuberculata*, and *P. unifilis*, and just outside of the reserve, on the way back to Manaus, we can also observe *P. erythrocephala*. Additionally, two Cryptodires, *Kinosternon scorpioides* (Kinosternidae) and *Rhinoclemmys punctulata* (Geoemydidae), occur in the area. The course, however, revolves



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Left: Rosana, a Master's student at INPA, checks the trammel nets for a long-term study on the demography of *Podocnemis unifilis* at Lago Erepecu on the Trombetas Reserve. **Center:** Dick Vogt shows technicians from INPA and IBAMA how to calibrate Pesola scales to weigh turtles. **Right:** Hatchling *Podocnemis expansa* are released with the help of local school children and other people along the river as part of a hand's-on environmental education program.

around the podocnemids because of their abundance and time of nesting, and the ongoing research on these species at this site for over two decades. The infrastructure at the reserve includes a lecture room, a laboratory, wireless internet, dormitories, a dining room, and a location opposite one of the nesting beaches on the Rio Trombetas. A smaller field station also near nesting beaches, at Lago do Erepecu (Erepecu Lake), contains a laboratory, dormitory, dining room, and kitchen. In addition, IBAMA has another large (30 m) regional boat, aluminum boats with outboard motors and canoes, and experienced regional turtle technicians available to assist with the course.

Over the years, funding for the course has been provided by the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq; The National Council for Scientific and

Technological Development), IBAMA, INPA, Mineração do Rio Norte (MRN; a mining company in Brazil), the TSA, the Turtle Conservation Fund, Conservation International, the Chelonian Research Institute, the Chelonian Research Foundation, the Wildlife Conservation Society, Mamirauá, Maurice Rodriguez, Brett Stearns, and the first year from the WWF. The TSA, through the enthusiasm of Rick Hudson, has been a strong supporter of the course for the last six years, and Conservation International, through the generous support of Russ Mittermeier, has also helped out annually. Brian Horne has attempted to run a similar field course in Southeast Asia, but he explained that it is a difficult challenge to accomplish because enough turtles cannot be located in a couple of weeks to demonstrate the various trapping methods or marking techniques. Thus, he suggested that

students from Southeast Asia should come to Brazil to work with turtles, and return to their home countries and apply what they have learned. The course, however, would not be able to exist without the financial support provided by the TSA and other foundations.

The course is registered for four graduate credit hours in the departments of Ecology and Aquatic Biology at INPA. Its purpose is to focus the general biology and ecology of freshwater turtles and the methods used to conduct field and laboratory research, so students will be able to design and implement field or laboratory projects to determine management plans, conservation strategies, and basic research. The idea is for students to learn first-hand the use of techniques and equipment in the field, rather than from books. The course consists of two days of lectures on board the Enigma, a 24 m boat with

Left: A female *Podocnemis expansa*, equipped with a transmitter and data logger, is about to be released along with the hatchlings to record their migration patterns and temperature preferences. **Center:** Camila Ferrara, on board The Enigma, just after collecting data on a *Podocnemis erythrocephala* in 2009. **Right:** Juvenile *Podocnemis expansa* exhibit two color phases, depending on their age. Paler individuals blend in with the lighter sand on the beach and in shallow water, but darken after about a week in captivity. In nature, the darker color allows them to blend in with the rotting leaves on the flooded forest floor. This rapid ontogenetic color shift is a good reason for releasing the hatchlings immediately.



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Left: Graduate Student Paulo Andrade lectures on the advantages and disadvantages of transplanting nests of *Podocnemis sextuberculata*. **Right:** Hatchling *Podocnemis expansa*, equipped with transmitters, are about to be released.

air-conditioned cabins for sleeping, a lecture room, and lab facilities, which travels downstream from Manaus to the Rio Trombetas. In addition to the two field stations in the reserve, we use the boat as a base of operations.

Topics covered in the lectures and discussions include taxonomy and evolution, distribution, economic and cultural importance, biology (physiology, anatomy, and embryology), and ecology (life tables, reproduction, feeding, predation, growth, movements, and predation,). Laboratory techniques include egg incubation, ethology, anatomy, stomach content analysis, digestive efficiency, and blood extraction. Field techniques include collecting methods (traps, trammel nets, basking traps, baited traps, and fyke nets), marking methods (notching, drilling holes, toe clipping, numbered tags, painted numbers, photos, and pit tags), the use of radio-transmitters, data loggers for recording nest temperatures and adult core temperatures, oviposition induction with Oxytocin, the incubation of eggs in the laboratory and in nature, underwater sound recordings of turtle vocalization, and blood collection.

For turtle conservation, the main benefit of the course is in training students and project managers to conduct field research and to analyze the various conservation and management measures being used. The course also makes students aware of the problems associated with turtle conservation, introduces them to the current literature,

and provides information on conservation-related research projects throughout the world. Currently, two former students are working for Conservation International and five for IBAMA.

In 2009, students had an opportunity to participate in the course both during the nesting season in October and the hatching season in December. During October, students collected the three species of *Podocnemis* common to the area (*expansa*, *sextuberculata*, and *unifilis*), using trammel nets or capturing the females while nesting. We used these turtles to practice different measuring and marking techniques, stomach flushing, blood extraction, and the induction of oviposition with Oxytocin.

We placed temperature data loggers in nests, and transferred some of the nests to protected areas. Students had the opportunity to see, first hand, the recapture of *P. expansa* through the use of satellite transmitters (after four years) and a VHF transmitter (after one year). Photographs show that after the transmitters had been placed for four years, no erosion or damage was evident on the carapace of the turtles. Transmitters can be easily removed by sliding the blade of a Swiss Army knife between the hardened *Turbolit* (a bonding material that can dry underwater and is used to fix holes in ocean-going ships) and the carapace. Students also attached VHF and temperature data loggers on adult female *P. expansa*, and followed them. In December, students were able to follow hatchlings equipped

with miniature VHF transmitters, and along with people from local communities, also participated in the release of thousands of hatchling turtles. Finally, students accompanied graduate student Camila Ferrara as she recorded underwater vocalization in *P. expansa*.

THE 21ST YEAR OF THE COURSE

This year, the course will be taught at the Trombetas Biological Reserve, Para, Brazil, from 27 September to 6 October. Although the course is designed primarily for graduate students at INPA, it is open to anyone who wishes to participate. Students wishing to obtain official graduate school credits from INPA must register as a special student. More space is available for the course in December than in October, and the dates are more flexible in December. A total of 18 people can participate in the course, which starts on the boat leaving from Manaus. With regard to fees, INPA covers the cost of its registered graduate students; the fee for students from Latin America and other parts of the third world is \$500US; that for students from Australia, Europe, and the United States is \$1,000 US; and, professional participants are charged \$1,500 US. The fees help offset the costs associated with operating the boat, including salaries for the crew, food and lodging, and boat repairs. Groups interested in specific turtle courses are welcome to contact me. Rental of the boat is also available for any course or excursion in the Amazon Basin, but times must not conflict with courses or research expeditions.

To date, the TSAs support for the course is its only conservation project in South America. Because the course reaches so many students, however, it is an excellent way to broadly impact turtle conservation in the region.

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Husbandry Guidelines for the Philippine Forest Turtle, *Siebenrockiella leytensis* (Taylor, 1920)

Sabine Schoppe¹



Hatchling (left) and juvenile (right) Forest River Turtles. This species has not been reproduced in captivity. ALL PHOTOS © KATALA FOUNDATION, INC.

Since 2009, the TSA has supported work by the Katala Foundation, Inc. (KFI), toward the conservation of the Critically Endangered Philippine Forest Turtle, *Siebenrockiella leytensis*. In 2007, the KFI established the only range-country assurance colony of this species in Narra, Palawan. The captive husbandry of this species has proved challenging, and the TSA is working with the KFI to improve its captive facilities. In February of 2010, the TSA granted the KFI financial support to construct a water treatment/filter system to improve its water quality, and, in March of 2009, the project received counter financing from the Turtle Conservation Fund (TCF). A report on the progress of this project is scheduled to be made as it reaches a more advanced stage, so in this paper I intend to focus on the general husbandry of *S. leytensis*.

INTRODUCTION

Siebenrockiella leytensis (Taylor, 1920), formerly known as *Heosemys*

leytensis, is one of the least known freshwater turtles in the world (Diesmos et al., 2005). This species is listed as Critically Endangered by IUCN (2010), and its international trade is regulated under Appendix II of CITES (CITES, 2009). The Philippine Forest Turtle has never been bred in captivity, and as early as 1994 the Philippine CITES Management Authority had banned the export of wild caught individuals. Then, in 2001, the collection of this species other than for research purposes was prohibited under the Philippine Wildlife Act (Anonymous, 2001). Accordingly, all captive individuals that appeared in the commercial market and in zoos soon after its rediscovery in 2004 were collected illegally. In fact, the illegal collection of *S. leytensis* for the international pet market constitutes the main threat to most populations. The Philippine Forest Turtle is widely maintained by hobbyists, herpetoculturists, and zoos inside and outside of the country. As a

result of a number of confiscations in the Philippines, several rescue centers in the country now house this species.

Due to the limited distribution of *S. leytensis*, its rarity, and the fact that it was only recently rediscovered, very little is known about its biology, ecology, and husbandry. I obtained individuals of this species before the Wildlife Act was implemented; these are now registered with the authorities, and for the past eight years I have maintained them in outdoor enclosures in Palawan. Furthermore, the KFI maintains an assurance colony consisting of individuals confiscated since 2007. Herein, I provide some of the information known for this species, in an effort to improve husbandry conditions in places where it is already maintained; however, I discourage the acquisition of new individuals, since no legal source is available where they can be obtained.

SYNONYMS

Heosemys leytensis (Taylor 1920),
Geoemyda leytensis (Mertens 1934).

TAXONOMY

Heosemys leytensis was described by E. H. Taylor in 1920. A morphological and molecular phylogenetic

An adult male *Siebenrockiella leytensis*.



study showed that *leytensis* is the sister lineage to the previously monotypic Sundaic turtle genus *Siebenrockiella* (Diesmos et al., 2005). Nonetheless, high genetic divergence exists between *S. leytensis* and *S. crassicollis*, hence Diesmos et al. (2005) erected the subgenus *Pany-aenemys* to accommodate the distinct Philippine lineage. No subspecies of *S. leytensis* are currently recognized.

CONSERVATION STATUS

IUCN 2010 Red List: Critically Endangered (A2d, B1+2c); CITES Appendix II (CITES 2009); Philippine Republic Act 9147 or Wildlife Act (Anonymous, 2001).

DISTRIBUTION

Siebenrockiella leytensis is endemic to the Philippines and is restricted to the Palawan group of islands in the western region of the archipelago.

NATURAL HABITAT AND CAPTIVE HOUSING

Siebenrockiella leytensis inhabits lowland forest at elevations from near sea level to about 300 m (Diesmos et al., 2004 a, b). Although the primary habitat of this species is pristine lowland forest, it also thrives in disturbed and fragmented forests. This species is nocturnal, secretive, and does not bask (Schoppe, 2006). Adults are semi-aquatic and spend

the day on land and the night in water, whereas hatchlings and juveniles may be fully aquatic (Schoppe, 2006). Philippine Forest Turtles hide in retreats and do not bask during the day, but they eventually expose themselves on logs at night (D. Acosta, pers. comm.). In its habitat, this species occurs in streams that contain water temperatures ranging from 23.3 to 26.7°C, with the lower water temperatures preferred (S. Schoppe et al., unpublished). Stream water pH ranges from 7.4 to 9.1, alkalinity (as CaCO₃) from 40 to 220 mg/l, and hardness (as CaCO₃) from 17 to 154 mg/l.

High intra-specific aggression occurs in the Philippine Forest Turtle, especially among the males (Schoppe and Fernando, 2009), and no more than one male and one to three females should be housed in an enclosure with a size of about 2 × 2 m. For proper housing, adults must be provided with areas of land and water (see Yuyek, 2004). The water area (or pond) should measure about 1 × 2 m, with a minimum depth of 0.5 m, and contain a slope on at least one side. Rough surfaces must be avoided, since the plastron and nails of the turtles can easily get abrasions that may result in infections and shell rot. Keeping the pH at 8 or lower appears to be crucial. A substantial amount of driftwood or

other objects for the turtles to hide under should be placed in the water. On land, a dark tunnel or den-like structure should be placed for the turtles to use as a retreat during the day. The land area should be densely vegetated to provide shade and darker areas. The entire enclosure, however, should be shaded to avoid direct sunlight. Male Philippine Forest Turtles are sexually aggressive and continuously pursue females, so plenty of furnishings and hiding spaces (logs and a den) in the water are necessary to allow females places to escape.

Juveniles can be maintained in aquaria. An aquarium of about 0.5 × 1.2 m with a water depth of about 15–20 cm can house, depending on their size, a maximum of four to six individuals. No land area is necessary, just some driftwood for the turtles to hide. The substrate can be sand or small gravel; they prefer mud, but it produces turbid waters. The water in the aquaria and ponds should be filtered or completely changed on a weekly basis.

Individuals larger than 12 cm in carapace length should be maintained in outdoor enclosures. Intra-specific aggression develops in larger juveniles or young sub-adults, at which time males should be separated from each other and kept only with females.

Left: *Siebenrockiella leytensis* inhabits streams in lowland forest. **Center:** The distribution of *Siebenrockiella leytensis* is restricted to southern Leyte and Palawan Province in the Philippines. **Right:** A tunnel or den-like structure should be made available for the turtles to hide during the day.





Left: Captive *Siebenrockiella leytensis* should be provided with plenty of hiding space. **Center:** *Siebenrockiella leytensis* is especially fond of snails. Pictured here are snails passed in their feces. **Right:** Philippine Forest Turtles feed on a variety of fruits.

DIET

The Philippine Forest Turtle is an omnivorous, but predominantly herbivorous species. Juveniles, however, appear to be more carnivorous in nature. In the wild, *S. leytensis* preys upon fish, crabs, shrimp (genus *Macrobrachium*), and freshwater gastropods of the family Thiaridae (Schoppe, 2006). It also feeds on algae and wild fruit, especially on ripe figs (Diesmos et al., 2008). This turtle may also feed on Golden Apple Snails (*Pomacea canaliculata*), an invasive alien pest species found in rice fields, as well as on saprophytes and decomposing wood.

In captivity, hatchlings and small juveniles can be easily raised on a diet of turtle pellets and/or small slices of fish, shrimp, meat, and shellfish. Adults accept various fruits (e.g., apples, bananas, papaya, and watermelon), vegetables (e.g., kangkong and cucumber), gastropods, fish, shrimp, meat, dry dog food, and hard boiled eggs (Schoppe, 2006). They also feed on avocados, cashews, guava, earthworms, crabs, and they are especially fond of freshwater or land snails. The latter should be crushed slightly to allow small individuals to also have a bite. Additional calcium should be supplied by providing cuttlebone or a commercial calcium supplement. The Philippine Forest Turtle prefers to feed in the water,

but individuals can get used to feeding from a plate placed along the water's edge, which will prevent contamination of the water. Food should be provided at dusk, since the animals will not feed during daylight hours, and leftover food items should be discarded the following morning. I recommend feeding the turtles animal protein only once a week, the day before the water is changed. In addition, fruit should be offered once a week and leafy vegetables once or twice a week. No food should be provided on the remaining days.

REPRODUCTION

The reproductive biology and natural history of *S. leytensis* remains poorly understood, and this species has never been reproduced in captivity. The eggs of *S. leytensis* are brittle-shelled, oblong, and pale pink in color (Diesmos et al., 2004b). Nineteen eggs laid in captivity had a mean length of 49.6 mm, a mean width of 26.5 mm, and they weighed an average 24.0 g (A. C. Diesmos et al., in progress). Hatchlings and juveniles have been encountered in the wild during the dry months (Widmann et al., 2004; Schoppe 2006, 2008). The growth rate decreases with increasing body size (Schoppe, 2006, 2008). The age at maturity is unknown, but it is estimated to be at least eight years when the animals are ≥ 200 mm in carapace length (S. Schoppe et al., unpublished).

Sub-adult individuals (150–170 mm CL) start to develop external sexually dimorphic characteristics. Males develop a slightly concave plastron and a longer and thicker tail, and are generally larger than females.

HEALTH ISSUES

Under stressful conditions, such as poor water quality (like a high pH), the overstocking of male individuals, high temperatures, and a lack of hiding spaces, *S. leytensis* is prone to bacterial and fungal infections that can lead to shell rot or respiratory infections. To avoid nematode infestations or other internal parasites, the turtles should be de-wormed twice a year with Fenbendazole (Panacur®).

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Left: A Philippine Forest Turtle feeding on banana. **Right:** Placement of the food dish along the bank of a pond will prevent the water from becoming contaminated.

Freshwater Turtle Specialist Group, Kadoorie Farm and Botanic Garden Hong Kong, and Ocean Park in Aberdeen, Hong Kong. The KFI also wants to acknowledge the support of local partners like the Department of Environment and Natural Resources, especially its Protected Area and Wildlife Bureau and the Environment Management Bureau, the Palawan Wildlife Rescue and Conservation Center, the Palawan Council for Sustainable Development Staff, the Provincial Government of Palawan, the local government of Narra and Antipuluan, and the Philippine Associate of Wildlife Veterinarians, Inc.

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A pair of *Siebenrockiella leytenensis* copulating in the water.



Nesting Behavior of the Red-necked Pond Turtle (*Mauremys* [*Chinemys*] *nigricans*) in Captivity

Andrew M. Grosse¹, Kurt A. Buhlmann¹, and Cris Hagen¹

The Red-necked Pond Turtle (*Mauremys* [*Chinemys*] *nigricans*) is a small, semi-aquatic turtle known to occur in southern China (Guangdong Province) and perhaps in extreme northern Vietnam (Bonin et al., 2006; Fig. 1). This species is found in a variety of habitats, including “watercourses in hills and mountains, up to 1,200 m altitude, as well as in calm, mud-bottomed waters and sometimes fast-flowing, clear torrents” (Bonin et al., 2006). Despite being featured in the pet trade and Asian food markets for many years, little natural history information has been documented for *M. nigricans*. As a result of its relatively restricted range, ongoing exploitation, and a lack of natural history data, *M. nigricans* is listed as Endangered on the IUCN Redlist of threatened species (IUCN 2009). *Mauremys nigricans* and its sister species, *M. reevesi*, were originally placed in the genus *Chinemys* but hereby are

referred to in the genus *Mauremys*, based on the work of Honda et al. (2002) and Spinks et al. (2004).

A breeding population of 15 adult *M. nigricans* has been maintained at the Savannah River Ecology Lab (SREL), located on the Upper Coastal Plain of South Carolina, where for several years the turtles were housed in an outdoor pond system. The pond is plastic-lined, rectangular (30 × 15 m), and with water depths ranging from 0.1–2.2 m. The edges of the pond contained emergent vegetation, with the bottom sediment deep with muck and log and stick debris. We used well water to maintain a constant water level. The pond was fenced and the turtles had access to a terrestrial perimeter area that ranged from 4.5 to 7.5 m in width. The substrate of the terrestrial area was predominately red clay, with sparse ground cover consisting of grass clumps and pine straw.

The male and female *M. nigricans* differed in size and coloration. The adult male (N = 9) mean carapace length (CL) was 150 mm (range = 133–172 mm), and the mean plastron length (PL) was 122 mm (range = 110–139 mm). The adult female (N = 6) mean CL was 195 mm (range = 187–200 mm), and the mean PL was 163 mm (range = 154–170 mm). The female mean weight was 955 g (range = 828–1091 g), while males averaged 452 g (range = 363–594 g). The head coloration for males and females differed. Females tend to have a pale yellow stripe down the side of their heads, and males tend to have bright red or orange beaks, heads, and legs, in

conjunction with a yellow head stripe (Fig. 2). The females nested naturally in their enclosure. Here, we discuss observations on the captive nesting behavior, nest characteristics, and the results of egg incubation in *M. nigricans*.

The female *M. nigricans* constructed their nests at night, during rain events from 22 May to 4 August 2006 (Fig. 3). During mornings following nocturnal rain events, we found partially constructed and abandoned nesting attempts, as well as completed nests. We observed one female digging a nest at night on 25 June 2006. We discovered and excavated several completed and covered nests, measured the nest chamber characteristics, and transported the eggs to indoor incubators.

Female *M. nigricans* apparently search for suitable nesting sites after emerging from their aquatic habitat during nocturnal rains. They preferred the north-facing slope (< 20%) of the pond, and used areas of red clay soil surrounding the pond for digging. On 25 June 2006, we observed a female removing the surrounding vegetation with her hind limbs, and she began digging with her hind feet. The nesting female a two egg chambers simultaneously. She used her left hind limb to remove dirt from what would be the left nesting chamber, and then alternated to use the right hind limb to dig the right nesting chamber. This pattern continued until she created two adjacent egg chambers.

For each of five nests discovered the day subsequent to night-time nesting, female *M. nigricans* had distributed the clutch among both egg chambers (Fig. 4c–e). On 4 August 2006, however, one female deposited four eggs in just one of the two available chambers (Fig. 4f). The separation between the adjacent nest chambers averaged a distance of 77 mm (range = 60–110 mm, N = 7 nests; see Fig. 4). The nest chamber depth was 80 mm and 100 mm,

Range of the Red-Necked Pond Turtle (*Mauremys nigricans*) (Buhlmann et al., 2009).



respectively, for two chambers we measured.

The mean clutch size of these five nests was 4.4 eggs. The mean egg length measured 39.1 mm (range = 37.4–40.6 mm), the mean egg width 22.6 mm (range = 20.1–23.9), and the mean egg mass was 11.9 g (range = 10.0–13.6 g). The female camouflaged the nest site after egg deposition was completed, although an oval pattern was still visible on the ground. Following the completion of the nest by the female, we excavated the known nests and incubated the eggs indoors; however, we also found two hatchlings in the pond the following autumn, indicating that some nests escaped our observations and that the eggs had hatched outdoors.

We artificially incubated all of the eggs collected in Styrofoam incubators set at a temperature of 82°F (28°C), using a medium of vermiculite. Although we could not find any data in the literature for egg incubation temperatures in *M. nigricans*, Du et al. (2006) incubated *M. reevesii* (a known TSD species) at temperatures from 24 to 33°C and found that more females were produced at higher and more males at the lower temperatures, but that temperatures of 27–28° C produced equal sex ratios. The incubation times varied, but they averaged 69 days (range = 62–75; N = 4). We measured the midline carapace and plastron lengths (mm) and weighed (g) the hatchling turtles once they

emerged. At the SREL, we hatched 48 *M. nigricans* that measured an average of 31.7 mm PL (range = 26.3–36.5 mm; SD = 2.04 mm), 37.9 mm CL (range = 32.2–43.2 mm; SD = 2.34 mm), and weighed 10.4 g (range = 7–14 g; SD = 1.93). As hatchlings, *M. nigricans* have uniquely-colored red plastrons that remain vibrant for approximately one year, after which they begin to darken to a drab black color (Fig. 2).

Nesting strategies in which more than one nest chamber is excavated have been observed in other turtle species. The Suwannee Cooter (*Pseudemys concinna suwanniensis*), Florida Cooter (*P. f. floridana*), and Peninsular Cooter (*P. f. peninsularis*) have all been documented digging multi-chambered nests (Carr, 1952; Franz, 1986; Jackson, 1988; Aresco, 2004; Ernst and Lovich, 2009). Two aspects of the two-hole nests of *M. nigricans*, however, set them apart from the three *Pseudemys* taxa. First, although *Pseudemys* spp. will dig multiple nests, the main nest chamber is much deeper and more distinct than the side chambers or satellite nests (Carr, 1952; Franz, 1986). Additionally, although it is not uncommon for *Pseudemys* spp. to lay one or two eggs in the side chambers or satellite nests, the majority of each clutch is typically found in the primary nest chamber (Carr, 1952; Franz, 1986; Ernst and Lovich, 2009), whereas *M. nigricans* generally deposits the eggs equally between the two

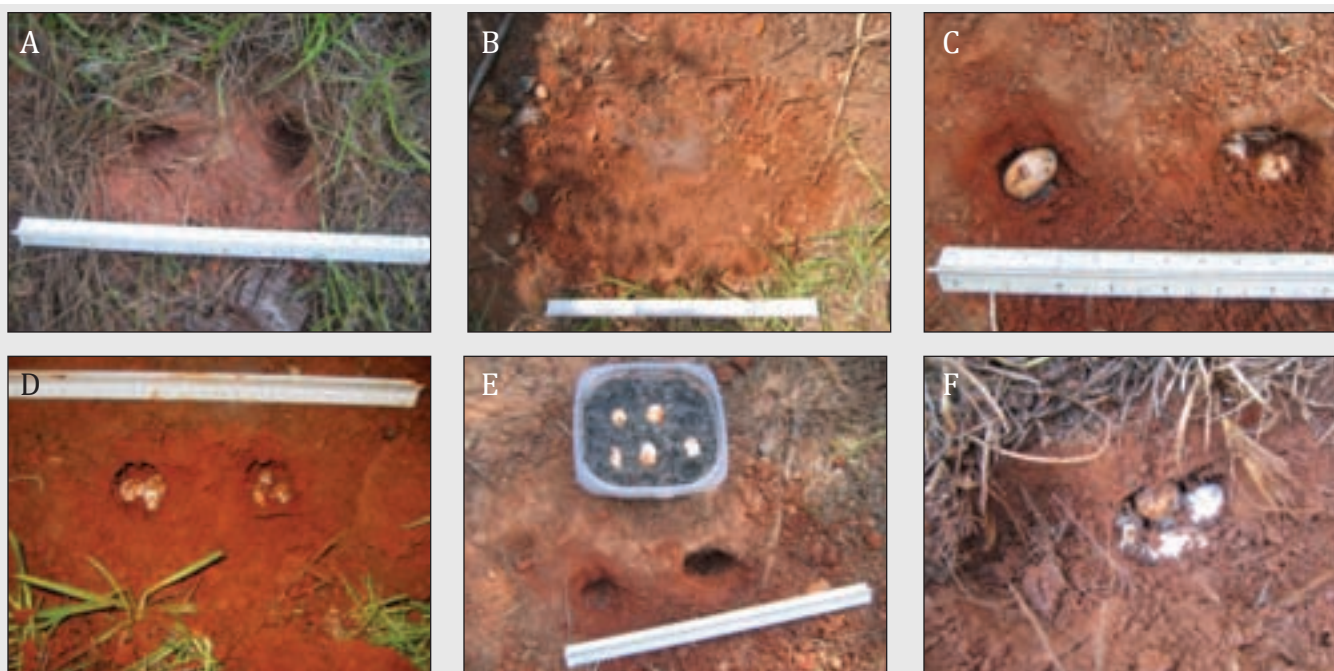
chambers. Secondly, *M. nigricans* will dig both nest chambers simultaneously, while *Pseudemys* spp. will dig each nest chamber separately (Ernst and Lovich, 2009). Although *M. nigricans* is not the only turtle species known to dig multi-chambered nests, to our knowledge, it is the first to be documented digging two equivalent nest chambers simultaneously, one with each hind limb.

The evolutionary reasons for using satellite nests are currently unknown, although it was initially thought that these nests acted as predator “decoys” to keep the main nest chamber from being depredated (Carr, 1952). Cople and Pilgrim (1993) suggest, however, that the satellite chambers provide little protection for eggs in the primary nest chamber. For *M. nigricans*, their construction of adjacent two-holed nests may simply represent a unique digging methodology, rather than for evolved predator deterrence. The width between the chambers is likely correlated with the size of the nesting female. Further studies of these unusual turtles are warranted, and captive populations can shed light on ecological behaviors that are difficult to observe in the wild for many Asian turtle species.

Acknowledgments. — The animals used in this study were provided by the Tewksbury Turtle Institute and are part of Turtle Survival Alliance (TSA) Assurance Colony Programs. The SREL

Vibrant red plastron of hatchling Red-necked Pond Turtles (*M. nigricans*; **left**) and differences in male (**center**) and female (**right**) head markings.





(a) An unfinished two-holed nest (4 June 2006) with chambers 60 mm apart; (b) a covered two-holed nest (4 June 2006); (c) excavating a two-holed nest (4 June 2006) with chambers 90 mm apart, one egg in left chamber and three eggs in right chamber; (d) excavating a two-holed nest (10 June 2006) with chambers 110 mm apart, two eggs in left chamber and three eggs in right chamber; (e) an excavated 2-hole nest (4 June 2006) with chambers 60 mm apart, two eggs in left chamber and three eggs in right chamber; and (f) a two-holed nest (4 August 2006) with all four eggs in the right chamber.

allowed us to use their facilities for this project. Tracey D. Tuberville provided helpful comments on the manuscript. Other funding support was provided by the U. S. Department of Energy's Financial Assistance Award DE-FC09-96SR18546 to the University of Georgia's Savannah River Ecology Laboratory.

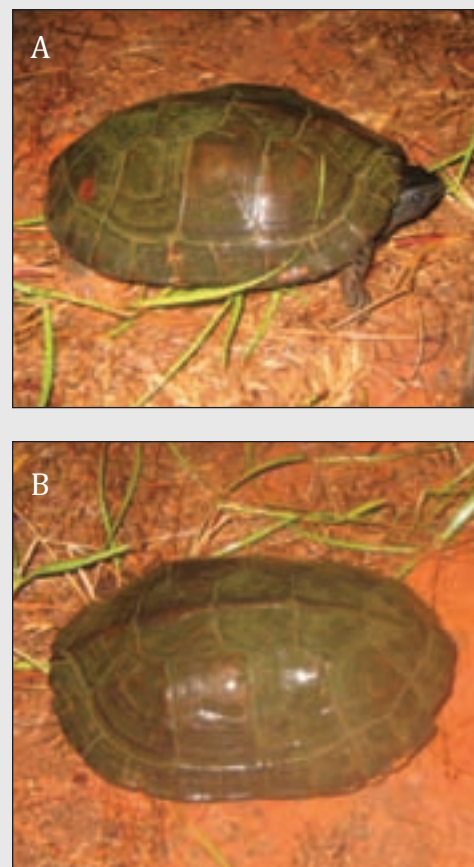
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(a) Female *Mauremys nigricans* on nesting foray, and (b) finishing covering a two-holed nest, 25 June 2006.



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Thank you for your support!

The TSA gratefully acknowledges the following donors and organizations for their generous support over the past year (July 2009–July 2010):

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A special thanks to Sheena Koeth for selling merchandise on behalf of the TSA, which resulted in more than \$5,000 in funds raised for turtle conservation.

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Bernard Devaux Receives the 5th Annual 2010 Behler Turtle Conservation Award

The IUCN/SSC Tortoise and Freshwater Turtle Specialist Group and the Turtle Survival Alliance are pleased to announce that the 2010 Behler Turtle Conservation Award will be presented to Bernard Devaux from SOPTOM, Gonfaron, France.

Bernard is a leading turtle conservationist whose work in France and around the world has been inspirational for many, as he has created a series of educational “turtle villages” around the world and worked tirelessly for the conservation of wild populations of turtles and tortoises. He is essentially a self-taught naturalist, as well as a traveler, writer, and film director. He believes that a new way of thinking is needed to better protect the world’s turtles and tortoises, by disseminating information and raising awareness among children and the general public, starting with the premise that tortoises are not creatures to be kept in a garden or an aquarium, they are not toys for children to play with, nor are they trophies for collectors — they are wild animals that should be protected in their natural habitats.

In 1986, Bernard created the SOPTOM association (*Station d’Observation et de Protection des Tortues et de leurs Milieux*; Station for the Observation and Protection of Turtles and their Habitats) in order

to study and protect the Hermann’s Tortoise (*Testudo hermanni*). He then created the *Village des Tortues* (Turtle Village) in Gonfaron in southern France in 1988, with the idea to finance conservation by opening a visitor center that was not only scientific but also accessible to the public. Spurred on by the success of the concept, he opened the first Turtle Clinic in Europe (1989) followed by other Turtle Villages in Corsica (at Moltifao in 1992), Senegal (at Noflaye in 1995), and Madagascar (at Ifaty in 2003).

Through making films about reptiles, as well as holding conferences and meeting other tortoise and nature enthusiasts such as David Stubbs, Ian Swingland, Gerald and Lee Durrell, and Peter Pritchard, Bernard became a fierce protector of Europe’s tortoises, then of tortoises in other French-speaking countries, and finally all over the world. He uses a variety of media in France and abroad (television, radio and films, as well as specialized and general press) to raise as much public awareness as possible regarding the fate of our planet’s turtles and tortoises. He has written over 10 books on tortoises, both specialized and generalized, as well as an *Encyclopedia of Turtles of the World* (1996), in four languages, in conjunction with two other naturalist photographers, Alain Dupré and Franck Bonin. He is a specialist on the African Tortoise, *Centrochelys sulcata*, and the Aldabra Tortoise, *Dipsochelys dussumieri* (= *Aldabrachelys gigantea*), and wrote two monographs in French and English on these species in 2000 and

2007. A bilingual monograph on the Madagascan Tortoise (*Astrochelys radiata*) is about to be published, a species that he studies and protects on the south of the island.

Bernard is a great believer in globalizing conservation. By developing a worldwide network of specialists, enthusiasts, and those who work tirelessly to protect turtles, we can combat trafficking, collecting, and the removal of turtles and tortoises from their natural habitats. With this aim, he has organized and sponsored several international chelonian conferences and symposia on conservation (1995 in Gonfaron and 2003 in Senegal), pathology (1992), the European turtle *Emys orbicularis* (1999), and the palearctic tortoises of the genus *Testudo* (2002). In October 2010, he will co-sponsor the fifth European Symposium on *Emys orbicularis* (in conjunction with the Swiss association, P.R.T.).

To encourage the creation of a worldwide chelonian conservation network, he visits and assists centers and programs around the world (Australia, China, Costa Rica, Italy, Malaysia, Spain, and South Africa) and keeps specialists informed via his *La Tortue* magazine, which is distributed in 25 countries (three issues a year, in French but with a small English supplement). He firmly believes that globalizing skills and consciences is the only way (thanks to the internet, and powerful organizations such as the IUCN, CI, WWF, and TSA) to act quickly in order to prevent major turtle and tortoise sites from being destroyed, such as in Aldabra in 2005 and in the Mary River in eastern Australia in 2009.

His ambition is to put an end to the turtle and tortoise trade, and to see every country restore its territory’s biotopes and

TSA: Working to secure a future for turtles.

chelonian populations. He also hopes that other information and conservation centers similar to the Turtle Villages will be opened in several countries, encouraging the desire to protect local chelonian populations efficiently. In addition, he hopes that young herpetologists, environmentalists, and biologists will fiercely devote themselves to much-needed chelonian conservation on our planet. He often reminds us (as P. Pritchard and J. Behler said): *tortoises have been on our planet for 230 million years, but we have a responsibility now, in the 21st century, to make sure they do not disappear!*

The IUCN/SSC Tortoise and Freshwater Turtle Specialist Group and Turtle Survival Alliance established the Behler Turtle Conservation Award in 2006, a major annual award presented jointly by these groups to honor leadership and excellence in the field of tortoise and freshwater turtle conservation. The award honors the memory of John L. Behler, previous Chair of the Tortoise and Freshwater Turtle Specialist Group and Curator of Herpetology at the Bronx Zoo, Wildlife Conservation Society. The Award includes an honorarium of \$3,000, and co-sponsors this year are Chelonian Research Foundation, Conservation International, Chelonian Research Institute, Behler Chelonian Center, World Chelonian Trust, Wildlife Conservation Society, Deborah Behler, and Brett and Nancy Stearns.

Previous Behler Award honorees have been Ed Moll, Whit Gibbons, Peter Pritchard, and Gerald Kuchling. In addition to honoring the lifetime achievements of senior turtle and tortoise conservationists, the Award also honors conservation efforts by younger individuals who make major contributions to the field. Recognizing and valuing the

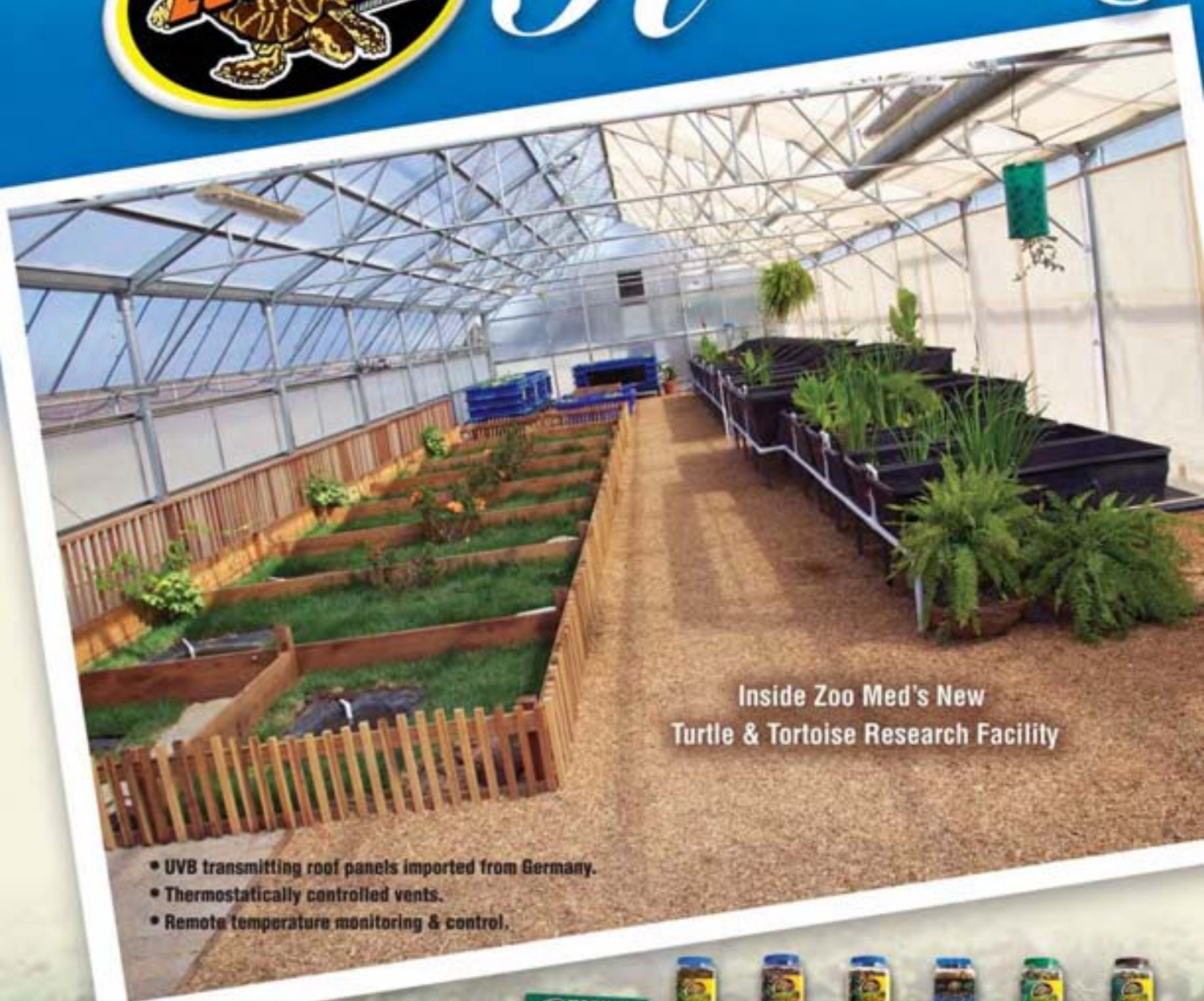


often tireless and dedicated efforts made by all these individuals is important, and the Behler Award hopes to provide some inspiration and reward for those who have demonstrated excellence and leadership on the front lines of global turtle conservation efforts.

Bernard Devaux with a Radiated Tortoise (*Astrochelys radiata*).



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The burgeoning illegal trade in Radiated Tortoises (*Astrochelys radiata*) is leaving many individuals as refugees in their own country. Those lucky enough to be intercepted by the wildlife authorities might end up in the Village des Tortues rescue facility at Ifaty, in southwestern Madagascar. Although these tortoises are released into protected areas, they still face an uncertain future.

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