CROCODILE SPECIALIST GROUP NEWSLETTER

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COVER PHOTOGRAPH: Australian Freshwater crocodile (*Crocodylus johnstoni*) photographed at sunset, at Mount Borradaile billabong, Arnhem Land, Australia. Photograph: Tom Dacey.

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Editorial

The 58th meeting of the CITES Standing Committee (SC58) was held in Geneva, Switzerland, on 6-10 July 2009. Items of interest to the CSG, discussed at the meeting, were (a) Illegal trade in *C. niloticus* from Madagascar; (b) Trade in crocodilian specimens (control & marketing); and, (c) Personal & household effects. CSG members in attendance were Christine Lippai, Hank Jenkins and Don Ashley. Summaries of the outcomes of that meeting can be found at: http://www.cites.org/eng/com/SC/58/sum/index.shtml.

The agreements reached at SC58 give Madagascar another opportunity to ensure uses and trade in *C. niloticus* skins are legal, sustainable and verifiable. This will only happen if the industry helps Government derive a strategy that they all know will close the loophole allowing wild skins to be traded as ranched skins. When the CSG provides advice to Government and Industry that is repeatedly ignored, we simply waste resources. Our position now is to encourage Madagascar to solve their problem, as they see fit,. Time will tell whether this gets done effectively.

I wrote to the Japanese Ministry of Economy, Trade and Industry (METI), informing them that CSG was deeply concerned about the conservation status of the wild population of *C. niloticus* in Madagascar, and seeking their support to prevent illegal trade between Japan and Madagascar. This letter was also copied to the CITES Management Authorities in Madagascar, USA, France and all CSG industry members. We understand that exports to France have large ceased.

During July, two significant reintroductions of Philippine crocodiles (*C. mindorensis*) were undertaken in the Philippines: 3 animals in Santo Tomas, Davao del Norte, Mindanao, by J.K. Mercado & Sons, in coordination with the Department of Natural Resources, Protected Areas & Wildlife Bureau and the local communities of Puroks 8,9,10 and 11; and 50 animals in Dicatian Lake, Barangay Dicatian, Municipality of Divilacan, Isabela Province, Luzon Island, by Merlijn van Weerd of the Mabuwaya Foundation, PAWB, and local government officials and community members.

The Executive Officer also visited the Philippines to attend the Mindano reintroduction and also to participate, as an observer, in the Philippine Crocodile National Recovery Team (PCNRT) meeting, where it was agreed to review and revise the National Recovery Plan for the Philippine crocodile.

Following recent reports of Saltwater crocodile (*C. porosus*) issues in East Timor (Timor-Leste) the CSG sent a fact-finding mission to Dili on 14-17 September 2009, to meet with Government and discuss crocodile-related issues, and if applicable, to discuss ways in which the CSG may be able to assist. Tom Dacey (CSG Executive Officer), Phil Steel (CSG member) and Anna Ingles (interpreter, advisor) comprised the team. The Government of East Timor is seeking assistance from CSG with respect to staff training, population surveys and the development of a management program. A follow-up visit is planned to gather further detailed information. A related article is on pages 12-14.

Mexico is proposing the transfer of Morelet's crocodile (*C. moreletii*) from Appendix I to Appendix II with a zero quota for trade on wild-taken specimens. A draft proposal, to be considered at the 15th CITES meeting (Qatar, 13-25 March 2010), was circulated to a number of CSG members and a collated CSG response was provided to the Mexican authorities for their consideration.

Congratulations to Samir Whitaker, who was appointed Executive Officer of the Gharial Conservation Alliance in August, taking over from Janaki Lenin to enable her to focus on the consultation process for the Gharial Species Recovery Plan.

The 2nd CSG West Africa Sub-regional meeting to be held at Nazinga Game Ranch, Burkina Faso, has been postponed until early 2010. For further details contact Samuel Martin (s.martin@lafermeauxcrocodiles.com) or Christine Lippai (lippainomad@gmail.com).

Professor Grahame Webb, *CSG Chairman*

Student Research Assistance Scheme Update

In the third quarter of 2009, one project (Costa Rica) was awarded Student Research Assistance Scheme (SRAS) funding of $US1000.

- Luz Barrantes (University of Florida, USA): Evaluation and management of the American crocodile (*Crocodylus acutus*) population in the Tempisque Basin, Guanacaste, Costa Rica.

Tom Dacey, *CSG Executive Officer, <csg@wmi.com.au>*.

20th CSG Working Meeting

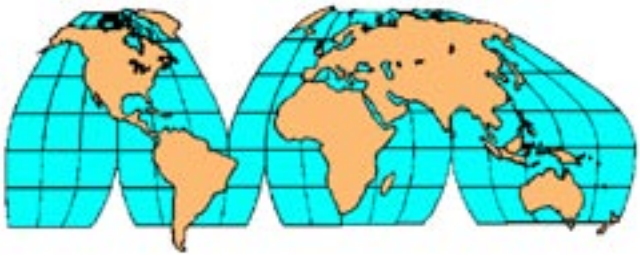
The 20th CSG Working Meeting will be hosted by the Amazonas State Government, and held in the city of Manaus, Brazil, from 13-16 September 2010. The CSG Steering Committee meeting will take place prior to the working meeting, on 12 September, and various "field trips" will be available to participants during and after the meeting.

12 Sept: CSG Steering Committee meeting
13 Sept: Day 1 - CSG working meeting
14 Sept: Day 2 - CSG working meeting
15 Sept: Day 3 - CSG working meeting
16 Sept: Day 4 - CSG working meeting
17 Sept: Field trip (various options available; see website)

The meeting website (**www.csgmeeting.com.br**) is now up and running, and will be regularly updated with details on the agenda, accommodation, etc.

Tom Dacey, *CSG Executive Officer, <csg@wmi.com.au>*.

Regional Reports



South Asia and Iran

Nepal

LATEST GHARIAL CONSERVATION ACTIONS IN NEPAL: MONITORING AND ASSESSMENT OF CONSERVATION INITIAVES IN CHITWAN NATIONAL PARK. The Gharial (*Gavialis gangeticus*) is restricted to a few large river systems in India and Nepal, having gone extinct in Bhutan, Burma and Pakistan, and almost extinct in Bangladesh (Whitaker *et al*. 1974). Despite the concerted conservation efforts of Nepal and India since the mid-20th century, the species is listed as Critically Endangered on the IUCN Red List.

In Nepal, a conservation program has been in place for over 30 years. Two breeding centers have been established, in the Bardia National Park and Chitwan National Park. More than 300 young gharials have been released in different rivers since 1981 (Maskey and Mishra 1982), yet despite this work the gharial population in Nepal remains at a low level (81 gharials were counted in 2008 in the whole country).

On 11 February 2009, 13 captive-raised gharials (5-years-old, 1.5 m long) equipped with radio-transmitters and one without, were released by the Department of Nature Protection and Wildlife Conservation staff in Chitwan NP, in the Rapti River between Kasara and Sauraha. Awely (www.awely.org) staff, Dr. Antoine Cadi and Renan Aufray assisted with the releases.

Regular monitoring of the released gharial has been undertaken each month by DNPWC and Renan Aufray, to determine locations in the river and to detect any threats to these animals. Each gharial was also marked with a yellow, yellow cattle-tag fixed to the vertical tail scutes (Fig. 1). The field study focused on major river systems in central Nepal (Narayani and Rapti Rivers in Chitwan NP), which provide prime habitat for gharial.

Figure 1. Juvenile gharial fitted with radio-transmitter and numbered cattle tag.

Progress to date against the workplan can be summarised as:

1. Training: Antoine Cadi and Renan Aufray trained more than 20 DNPWC staff over a 3-day period in monitoring with telemetry (Fig. 2).

2. Enclosure: Gharials were released into an enclosure built with elephant grass in such a way that small fish could enter it, but if gharial wanted to go out in search of food the enclosure would break with ease. The enclosure was constructed such that the animals had sun and shade, and water and land (sand) areas, to allow them to regulate body temperature.

Figure 2. Training was provided to Government personnel.

3. Release: The release took place in the presence of many institutional personalities and media. The 14 gharials were successfully released into the enclosure. They were expected to escape by themselves after habituating in their new habitat.

4. Monitoring: Since the release, DNPWC staff and Renan Aufrey have carried out monitoring every month. Monitoring started from Khagendramally on the Rapti River up to Tribeni on the Narayani River. Monitoring takes place by boat,and gharial are located using standard radio-receiver and antenna.

Results after 5 months of monitoring can be summarised as:

1. Four single transmitters were located in the water (3) and buried in sand (1). For the three transmitters found in the water, the causes are difficult to ascertain. They may have simply fallen off - they were sewn between the double caudal scales of the tail (Fig. 1) - or the animals may have been poached or accidentally caught in fishing nets. The transmitter that was buried in sand had some fishing net around it, and there seems little doubt that this gharial was caught in a fishing net, and the transmitter hidden in the sand by the people responsible. Whether this animal was intentionally poached or accidentally caught in the fishing net is not known - the fate of all four animals remains unknown. There are many villages around the river, and gharial are sometimes killed for food and skins.

2. The locations of 5 gharial could not be determined. One possibility is that they followed the river through into India and are now resident there. Dams in the river at the border between Nepal and India don't allow gharial to return to Nepalese river systems

3. For 9 gharials, the distribution pattern along the river suggests that individuals spread out from their release site differently, even though they are all the same age and raised under the same conditions. Two gharials stayed at the release site, 4 animals moved upstream (up to 4 km) despite the big effort required to do so, and 3 moved downstream, more than 50 km from the release site for one of them.

Conclusions: Ongoing monitoring will provide information on how the monsoon season will affect the distribution of the tracked gharial. It is important to know whether the great increase in water flow in the rivers will result in the animals being "pushed" into India, or whether they will remain in Nepal.

To date, monitoring has shown that poaching and/or incidental capture are potential problems for gharial. Information needs to be disseminated in villages for people to stop poaching and avoid boating too close to gharial. Gharials are typically very shy animals and go directly into the water when boats approach them. These disturbances may have a negative impact on gharial health and behavior if repeated too many times every day.

DNPWC, WWF Nepal, NTNC and Awely are working to build an ambitious conservation program for gharial in Nepal. If sponsoring and fundraising are confirmed, the program will begin in early 2010.

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India

MOVEMENTS OF AN INDIVIDUAL MUGGER INTO URBAN AREAS OF VADODARA CITY, GUJARAT STATE, INDIA. Over the last two decades, the Gujarat Society for the Prevention of Cruelty to Animals (GSPCA) and its volunteers have rescued wild animals from urban areas of the state. Mugger crocodiles (*Crocodylus palustris*) have often been rescued in and around Vadodara City (Bhatt 2000: Vyas and Bhatt 2004; Vyas 2005). Interestingly, one female Mugger has been rescued 7 times since 2001. A brief history of its captures is:

1. 1 July 2001: Initially captured at Akota Police line (Figs. 1 and 2). Measured 79.2 cm (2.6'), and marked by scute-clipping (56). Rreleased at Sayaji Sarovar (= Ajwa Lake) (Fig. 1), a 1200 ha reservoir that provides potable water

for the city. The reservoir is around 22 km from the city, on the Vishwamitri River, and a small population of *C. palustris* has existed there since early independence (Oza 1975). The Vishwamitri River is one of the closest Mugger habitats to Vadodara City, and is only a few kilometres away.

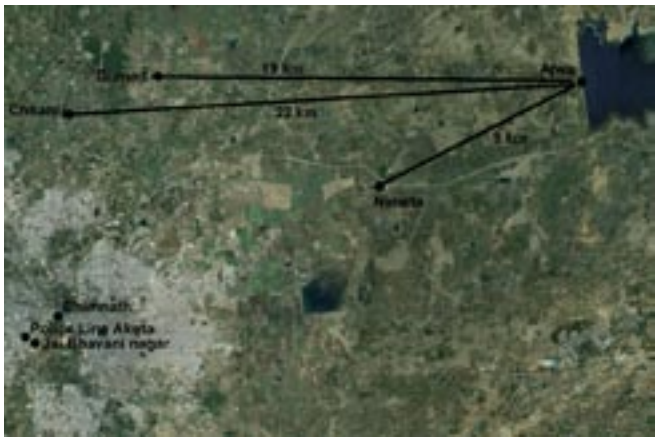

Figure 1. Locations of capture/rescue and release sites.

Figure 2. Locations of initial capture (Police Line Akota; July 2001), final release (Bhimnath Bridge; 9 April 2007) and "rescue" (Jai Bhavani nagar; 27 April 2007).

2. 27 August 2002: Rescued from Nimeta Village pond (Fig. 1), around 9 km from the July 2001 release site. Total length was 137.2 cm, indicating average growth rate of 50.5 cm/y. Released back into Ajwa Lake.

3. 5 May 2007: Rescued from Chhani Village pond (Fig. 1), 4.7 years since the previous capture. The Chhani Village pond is situated on the outskirts of the city, about 22 km straight distance from the release site, and has an area of 8 ha. Total length was 198.1 cm (6.5'), indicating average growth rate of 13.0 cm/y. Released back into Ajwa.

4. 16 July 2007: Rescued from Dumad roadside puddle (Fig. 1), approximately 19 km straight distance from Ajwa, and released back into Ajwa.

5. 18 August 2007: Rescued from Chhani Village pond, and released back into Ajwa.

6. 11 April 2008: Rescued from Chhani Village pond, and released back into Ajwa. Total length was 228.6 cm (7.5'), indicating average growth rate of 32.6 cm/y since May 2007.

7. 9 April 2009: Caught by Chhani villagers in fishing net in the village pond. The animal was in a poor condition by the time it was received from the villagers, having been tied tightly with wire, the jaws were closed, and the head covered completely with jute bags. The animal was released near Bhimnath Bridge on the Vishwamitri River (Figs.1 and 2), as local authorities were not in favour of its release into Ajwa. Total length was 234.7 cm (7.7'), indicating growth rate of 6.1 cm/y.

8. 27 April 2009: At 1900 h a badly injured mugger without a tail (Fig. 3) was reported on the railway track near Jai Bhavani nagar, Akota (Fig. 2). An approximately 90 cm long portion of tail was found nearby, the examination of which indicated that it was the same female *C. palustris* (56) (Fig. 3). It appears that the animal emerged from the river at night, and was hit by a train as it crossed the railway tracks. The injured Mugger and the severed tail were taken to the Government veterinary hospital, where local veterinarian Dr. Snehal Patel examined the animal and attempted to sew the detached portion of tail back on. However, despite the 3-hour long treatment, the crocodile died due to loss of blood.

Figure 3. The tail of the Mugger had been completely severed by the train as it crossed the railway tracks at Jai Bhavani nagar (see Fig. 2). Photograph: Rajesh Bhavsar.

That the animal was able to leave the river and walk over land at the railway tracks suggests that its ability to walk was not severely impaired followings its capture on 9 April 2009 by Chhani villagers (see 8.). Nonetheless the possibility exists that its limbs were damaged by being so tightly tied, and that it was unable to avoid the approaching train. However, there

are reports of other crocodilian species being hit by trains or vehicular traffic (eg Anon 2009), including Muggers in Iran (Mobaraki 2007), and so it equally possible that it was simply in the wrong place at the wrong time!

The origin of this female Mugger is unknown. Given its size in July 2001 (79 cm), growth rate achieved between the first and second captures (50.5 cm/y), and timing of nesting of *C. palustris,* the animal is likely to have been around 1 year of age. On 6 occasions it had moved from the site of release (Ajwa Lake) to urban areas of Nimeta Village (1), Dumad roadside (1) and Chhani Village (4); 9 km, 19 km and 22 km straight-line distance from Ajwa Lake respectively. Distance between the Bhimnath Bridge (Vishwamitri River) and site of collision with the train was 2 km. Interestingly, 3 of 8 captures occurred in May-August 2007, indicating movement of at least 63 km in that period.

All 8 captures occurred between the months of April and August, and 4 of them occurred during the monsoon season. During the monsoon season the waterbodies at Nimeta, Dumad and Chhani are interconnected with the Vishwamitri River, and movement at this time would have been easier for the animal. Reasons for the movement of this individual out of Ajwa and into urban areas may involve:

1. Social interaction with other Muggers in Ajwa.

2. Seeking nesting habitat. The animal was located at Chhani Village on four occasions after it had reached size at maturity, perhaps reflecting better "breeding" conditions at this location.

3. Some type of "homing" mechanism, as has been reported for other crocodilians (eg *C. porosus*, *C. johnstoni, C. acutus*).

Acknowledgements

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East and Southeast Asia

Philippines

DO CROCODILES HAVE RABIES? INITIATING A DIALOGUE ON *IN-SITU* PHILIPPINE CROCODILE CONSERVATION. In 2008 the Mabuwaya Foundation (MF) organized community dialogues in 15 villages in the northern Sierra Madre. These meetings took two days and included: lectures on the Philippine crocodile, wetland conservation and environmental legislation; film showing; a puppet show; and, a planning workshop on community-based wetland conservation action. More than 750 people attended these meetings and asked questions, raised issues and proposed solutions. Here we present four short dialogues (translated from Ilocano) that are illustrative of local peoples' perceptions of protecting Philippine crocodiles (*Crocodylus mindorensis*) in the wild. The questions of people and the answers of our team show the importance (and also the difficulties) of engaging rural communities in crocodile conservation.

Why do we have to protect crocodiles?

On 24 May we organized a community consultation in Cadsalan, a remote village in the municipality of San Mariano and one of the key Philippine crocodile conservation sites in the northern Sierra Madre.

- Boy Robles (farmer): "Why do we have to protect crocodiles? It seems that crocodiles are more important than people. The government made a law to protect crocodiles, but they don't help the people."
- Jessie Guerrero (MF): "Of course crocodiles are not more important than people. We conserve the Philippine crocodiles for the benefit of people. The Philippine crocodile occurs only in the Philippines and is almost extinct, that's why we have to protect it. It is part of our cultural heritage. In other countries people earn money with crocodiles, for example through tourism."

- Elymar Appaccag (barangay councilor): "If you want to protect your crocodile you should place a fence around the creek, or transfer the crocodiles to a safe place."
- Jessie Guerrero: "Our goal is to protect the Philippine crocodile in the wild. We don't want to create a zoo. And if we place a fence the crocodiles cannot move out and people can no longer fish in the creek."
- Sofia Manuel (barangay health worker): "Does a crocodile bite contain rabies?"
- Jessie Guerrero: "Only mammals can have rabies. Crocodiles are reptiles. I have been bitten many times by the crocodile hatchlings and never got sick."

In all villages, people asked why crocodiles should be protected. Most people in the project area now know that the Philippine crocodile is protected by law. But people question the motivation of preserving crocodiles. In most cases people really don't understand why a potentially dangerous animal should be preserved. Some people fear crocodile conservation is a political ploy for more regulatory control by the central government that will lead to the expropriation of farmland. Others see crocodile conservation as a distraction from more pressing developmental needs, such as the provision of basic infrastructure, education and healthcare.

Our team formulated 6 reasons why it is important to conserve crocodiles in the wild:

1. the national law (obviously begging the question but people often accept this as an excellent reason);
2. ecological values (crocodiles are a flagship species for sustainable wetland management);
3. cultural values (crocodiles are an important part of Philippine culture and history);
4. economic benefits (increased fish catches from wetland conservation);
5. intrinsic or religious values (crocodiles have the right to live); and,
6. immaterial benefits (it's interesting, exciting and fun to conserve crocodiles). Particularly the fact that this endemic species has been exterminated throughout the country but survives in their village appeals to people.

Are crocodiles dangerous?

On 8 February we held a meeting in Disulap to discuss the management of the municipal Philippine crocodile sanctuary in the Disulap River. We have worked 10 years with this community, but people still have many questions.

- Marites Balbas (MF): "There are several zones in the crocodile sanctuary. In the nesting season from April to July all activities are prohibited in the strict protection zone, because crocodiles can be aggressive when they guard their nest. In other areas fishing, bathing and washing clothes are allowed."
- Johnny de Gollo (farmer): "There is no problem with the sanctuary. But a crocodile attacked my pig far from the sanctuary. And the crocodile did not even finish everything: it just ate the intestines of the pig. That's not good. The crocodile is greedy. I'm afraid that one day it will attack a child"
- Marites Balbas: "But did you ever hear of a Philippine crocodile attack on people?"
- Aizah Nojadera (teacher): "No, but what will happen if the crocodile population will grow? We will experience ecological imbalance. The crocodile will have to eat more."
- Marites Balbas: "fifty years ago there were many crocodiles in San Mariano. Now there are only very few. If the population will grow they will find a place. There is enough food in the river for the crocodile: fish, rats, insects, snails…"
- Aizah Nojadera: "I'm not against the crocodile, but I thought that large crocodiles ate people."
- Marites Balbas: "You have seen too many movies! The Philippine crocodile grows up to 3 meter. We never heard a story of a Philippine crocodile attacking people. But be careful: when the crocodile has a nest, she can be aggressive. That's why there is a strict protection zone in the sanctuary."
- Johnny de Gollo: "But what about my pig?"
- Paul de Gollo (barangay captain): "Your pig should not wander around: it should be tied near the house."

Fear of crocodiles was another recurrent theme during the consultations. People are concerned about the safety of their children and livestock. In our communication, education and public awareness campaign we've stressed that the Philippine crocodile is extremely wary of people, and that there are no recorded fatal attacks on humans. In fact most people know from their own experience that Philippine crocodiles do not pose an imminent threat to humans. But the teacher in the dialogue above expressed a common concern: what will happen if the Philippine crocodile population will recover? Crocodiles might not be dangerous today; but how about tomorrow? We had actually never thought about this issue. There is an urgent need to integrate these local concerns and questions in the design of our communication materials.

How can we benefit from crocodile conservation?

We held a community consultation in Buyasan on 26 May. Buyasan lies on the bank of the Ilaguen River and fishing is an important livelihood strategy for the community. Philippine crocodiles are occasionally caught in nets or fish traps.

- Elvis Sales (fisherman): "The fishermen complain that crocodiles destroy their fishnets. The fishermen are afraid to fish because of the crocodiles. Sometimes they see crocodiles underwater. What can you do about that?"
- Visitacion Aglugub (housewife): "Why are your afraid? We wash our clothes in the creek. Often the crocodile is very near, but it never attacked us. Sometimes the crocodile wants to play with us. When I was washing clothes the crocodile once took the shirt. As long as you don't harm the crocodile, the crocodile will not harm you."
- Juan Telan (farmer): "How can we benefit from the conservation of crocodiles?"
- Jerome Miranda (municipal councilor): "It is simple: if we protect the Philippine crocodile, we protect the fish that we

eat. We have to stop the use of electricity fishing, because it depletes the fish stocks on which we depend. Let us join hands to protect our environment!"

- Bonbon Aglugub (fisherman): "Yes, there used to be many fish in Buyasan. The problem is that people from other villages come here and fish with electricity. There is no ludong [Bluespot mullet] anymore in the river."
- Marites Balbas (MF): "It is the responsibility of the barangay officials to protect the environment. The officials can declare a fish sanctuary or enact a barangay ordinance prohibiting destructive fishing methods. It protects the Philippine crocodile and benefits people."
- Melchor Marrallag (fisherman): "But in most cases the army and the police are the ones doing illegal fishing!"
- Elmer Tales (barangay tanod):"Can we apprehend offenders?"
- Jerome Miranda: "Yes, based on the Local Government Code, the barangay officials can arrest people who violate the barangay ordinances. The barangay officials should make a decision on this. You are the ones who can decide what is best for the people and for the crocodiles."
- Rogelio Macapia (barangay captain): "We would like to declare Bulawan Cave and Dilatngan Creek as our fish sanctuary. If we see people fishing with electricity we will confiscate the battery."

In the remote rural areas of the Philippines, such as Buyasan, most people earn less than $US1 per day. There is a clear need to link crocodile conservation with people's well-being. But a sustainable harvesting or ranching program is obviously not a possibility with this critically endangered species. And the economic returns of a community-based crocodile-tourism enterprise in this remote corner of the Philippines are highly uncertain. We have therefore adopted a broader ecosystem approach to conserve wetlands. Rural communities in the Philippines rely heavily on freshwater ecosystems. Fishing is an important livelihood activity, especially for the poor. People are directly confronted with the effects of overfishing and erosion as a result of logging and unsustainable land use practices. There is broad public support to conserve critical wetlands and ban destructive fishing methods. In this view the Philippine crocodile becomes the flagship species of community-based wetland conservation. The participation and consent of rural communities assures that environmental legislation is actually enforced. Representatives from the municipal government, in this case the municipal councilor Jerome Miranda, attend the dialogues and provide feedback. The views, ideas, suggestions and critique of respected local politicians, village leaders, elders, friends and neighbors are obviously taken more seriously than the remarks of conservationists: when Vistacion said that the Philippine crocodile does not pose a threat, nobody questioned it anymore.

How many eggs do crocodiles lay?

On 18 June we talked with the community of Dibuluan, a small Kalinga settlement on the forest frontier. The Kalinga are the indigenous people of the northern Sierra Madre. A population of Philippine crocodile survives in this area.

- Margie Collado (daycare worker): "How many eggs can a crocodile lay?"
- Jessie: "There can be up to 23 eggs in a Philippine crocodile nest. The incubation period is 60 to 90 days. The crocodiles lay their eggs in April and the nest will hatch in July. You can easily recognize a crocodile nest: it is a large mound made of leafs."
- Rudy Revilla (member of the farmer's cooperative): "What if my carabao is eaten by a crocodile? Do I have the right to kill the crocodile in return?"
- Dominic Rodriguez (Mabuwaya Foundation): "No. According to the Wildlife Act you can only kill a crocodile if there is an imminent danger to humans. Anyway, did you ever see a Philippine crocodile attacking a buffalo?"
- Rudy Revilla: "No."
- Dominic Rodriguez: "The Wildlife Act specifies a penalty of 100,000 pesos or 6 years in jail for killing a Philippine crocodile."
- Onofre Daniel (village councilor): "It's good that we know the laws and the penalties now. It is up to us if we want to violate the law. For me, I will not try. It's hard to be in prison"
- Bernalie Coca (daycare worker): "I attended this meeting because I wanted to know the importance of the Philippine crocodile. First, I found the bukarot [Philippine crocodile] useless. But during the lectures I learned many new things and now I am interested in crocodile conservation."
- Myla Tagaoan (village councilor): "Yes, the lectures were as clear as the blue sky. It was not boring."

What should we do if a crocodile attacks livestock? What is the penalty if someone kills a crocodile? What to do if you accidentally catch a crocodile? During the village meetings people often pose practical questions. It provides an opportunity for our team to disseminate information on Philippine crocodile conservation, and better understand and respond to people's concerns. In fact people raise relatively few problems with crocodiles during the community consultations: in general people tolerate the species.

To our surprise most questions of communities deal with Philippine crocodile ecology and behavior: How big is an adult crocodile? What do crocodiles eat? How long can a crocodile stay underwater? What does a nest look like? People are often fascinated by crocodiles and have a genuine interest in the species. This is an important motivation for people to preserve crocodiles, also for poor rural households in the northern Sierra Madre.

Initiating a dialogue on crocodile conservation

During the village meetings in the northern Sierra Madre we engaged rural communities in a dialogue on Philippine crocodile conservation. It enabled us to contextualize the fears and concerns of local people, and directly address these issues. It provided an opportunity to share information, find common ground to solve specific problems, and integrate crocodile conservation in broader discussions on rural development and environmental management. As a result rural communities feel that their voice is heard and their concerns are taken into account.

We think that such a participatory approach is instrumental to mobilize local support for the conservation of endangered crocodilians in the developing world. Much can be gained by documenting local experiences with community-based approaches and drawing global lessons. Here lays, in our view, an important role for the Crocodile Specialist Group. The CSG website is a valuable tool for extension workers in the field (particularly the "crocodilian biology for beginners" section). This can be further developed into an interactive platform that provides conservation education tools for schools and communities, and facilitates information sharing among crocodile conservationists and local communities across the globe.

Figure 1. The Philippine crocodile mascot 'Krokey' dances with a village councilor in Tappa. Photograph: Marites Balbas.

Figure 2. Community consultation in barangay Disulap. Photograph: Merlijn van Weerd.

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Cambodia

CAUGHT ON CAMERA! THE SIAMESE CROCODILE RETURNS TO EASTERN CAMBODIA. Populations of the critically endangered Siamese crocodile (*Crocodylus siamensis*) appear to be recovering in the Mondulkiri Protected Forest region of eastern Cambodia. Camera traps set up on small "beaches" alongside the Tonle Srepok River in the protected region caught some excellent photographs within one month of being established (Figs. 1 and 2).

Figure 1. Siamese crocodile captured by camera trap during the day.

Figure 2. Siamese crocodile captured by camera trap at night.

The cameras, which are triggered by movement, were set up as part of a joint conservation project by the International Institute for Environment and Development (IIED) and WWF Greater Mekong. They have been a great source of evidence

on the species that live within the protected area, including the Siamese crocodile.

Limited surveys during the 2009 dry season also estimated 10-15 individual Siamese crocodiles were present, based on the distribution of tracks and other signs. This compares to no confirmed signs when the area was first surveyed in 2003.

The potential increase in numbers of Siamese crocodiles directly reflects upon the conservation activities of the project's dedicated ranger and management team and the local community. Enforcement patrols along the river, together with community extension work in fishing villages, have reduced disturbance and illegal fishing and hunting along key stretches of the Srepok River. This has created the conditions for the populations of this species to recover after years of war, colonial mismanagement of wildlife, and civil strife.

The area supports one of the largest and least disturbed lowland dry forest ecosystems in Southeast Asia. Wetland habitats form a key component of the conservation value of Mondulkiri Protected Forest, with the Tonle Srepok, a major tributary of the Mekong, flowing through the region, along with numerous seasonal wetlands and pools. These habitats support one of the most intact assemblages of riverine biodiversity in Asia, including: the enigmatic Masked Finfoot, one of the least known and most threatened bird species in Asia; the critically endangered White-shouldered Ibis; the recently discovered endemic Mekong Wagtail; an important, though poorly studied fish community, including the endangered Seven-striped Barb; and the Siamese crocodile.

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Thailand

MODAPLAS®: THE FIRST FDA APPROVED CROCODILE BLOOD CAPSULE. Numerous studies have shown the efficacy of crocodile blood in killing various pathogens (eg Merchant *et al*. 2003, 2004, 2005; Preecharam *et al*. 2008, 2009; Siruntawineti *et al*. 2004). A crocodile blood capsule produced by Sriracha Moda Company Limited, and marketed as MODAPLAS®, has now been approved by the FDA (Thai-FDA registeration number 20-2-04548-1-0001).

Ingredients comprise 100% freeze-dried, farmed Siamese crocodile (*Crocodylus siamensis*) blood (250 mg/capsule), and the product is available in 30 and 100 capsule bottles. MODAPLAS® is rich in protein and natural iron, and is thus beneficial as an iron supplement. Protein is purported to "repair body damage, reduce stress, and maintain good body condition". Potential benefits that are under study include an antimicrobial peptide "Crocosin VI" which promotes faster wound recovery, and which has been shown to have efficiency in killing *Salmonella typhi* and *Staphylococcus aureus*. With a shelf life of 2 years, intake of 1-2 capsules with a meal twice per day is recommended. Nutritional information is:

Nutrients	per 1000 mg
Calories (kcal)	3.58
Protein (g)	0.86
Total fat (g)	0.01
Saturated fat (g)	0.00
Cholesterol (mg)	2.08
Minerals (g)	0.05
Iron (mg)	1.47
Vitamin C (mg)	0.11
Vitamin A (μg RE)	2.37
Sodium (mg)	11.1
Calcium (mg)	0.91

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Australia and Oceania

Australia

The Federal Government's Department of Environment, Heritage, Water and the Arts (DEHWA) recently approved a Code of Practice for the Humane Treatment of Wild and Farmed Australian Crocodiles. The Code, which outlines minimum standards for humane treatment of farmed and wild crocodiles, was endorsed by the Natural Resource Management Ministerial Council on 21 May 2009. The Code does not apply to crocodiles held for display purposes in wildlife parks and zoos.

Compliance with the Code is a requirement of Wildlife Trade Management Plans approved under the Environment Protection and Biodiversity Conservation Act 1999, for the export of crocodiles and/or products. The Code can be downloaded at: http://www.environment.gov.au/biodiversity/trade-use/publications/crocodile-code-of-practice.html.

Papua New Guinea

INCREASING NUMBERS OF CROCODILE ATTACKS WITH INCREASING CROCODILE POPULATION. The Saltwater crocodile (*Crocodylus porosus*) population in East New Britain Province has grown to a level that it is now causing serious concerns among local people. Livestock and people have attacked in recent times (eg 12 people in the Pomio area over the last 8 years).

Ania River (Melkoi), Baraman River (West Mamusi) and Lark River (Open Bay) have each reported one death as a result of crocodile attack, the latest occurring in mid-August. A large crocodile populations is reported from a lake at the base of Mt. Vulcan at Karavia village, Gazelle District - several people have reported their domestic dogs and pigs missing.

People are being advised to be careful when out fishing or collecting shells and sago fronds in areas such as Malaguna, Raluana. It is estimated that there are about 22 breeding grounds for *C. porosus* in the province, including Pomio, Sulphur Creek at Matupit, Keravat River, and the swampy surroundings areas of Doy, Ganai and Warangoi Rivers.

Source: *PNG National Newspaper, 28 August 2009. Submitted by Godfrid Solmu, Mainland Holdings Limited, P.O. Box 196, Lae, Papua New Guinea, <crocresearch@mainland.com.pg>.*

East Timor

STATUS REPORT ON *CROCODYLUS POROSUS* AND HUMAN-CROCODILE INTERACTIONS IN TIMOR-LESTE. East Timor (also known as Timor-Leste) is a former Portuguese colony that gained its independence in 2002 after a UN-sponsored referendum and the withdrawal of Indonesian occupying forces. The young country is in the process of implementing a variety of wildlife management, research, and conservation policies, and accounting for the presence and the activities of the largest predator in the country is, of course, a topic of considerable interest. The dearth of information regarding the natural history and interactions of crocodilians in the country is something that must be quickly remedied for policies to be crafted effectively and to ensure public safety.

Although some recent publications (Trainor *et al*. 2007a,b) feature photographs of Saltwater crocodiles (*Crocodylus porosus*), there have been no efforts to systematically census the population, map distribution, or document human-crocodile interactions. Unconfirmed verbal accounts of the presence of *Tomistoma schlegelii* in East Timor may reflect misidentifications by people familiar with that species from western Indonesia.

In general, accounts of crocodile activity are sporadic, and invariably popular as opposed to scientific in their nature. In 2000 there was a well-publicized intervention by International Crocodile Rescue (Irwin 2000; Scientific American 2001) to relocate two captive crocodiles in Dili, the country's capital, to secure enclosures (a video of these enclosures is available on YouTube.com, search for "East Timor Crocodiles"). Further assistance was provided by: Hartley's Creek Crocodile Farm (Palm Cove, Queensland, Australia), who sent two staff to Dili to assist with capture and relocation of captive crocodiles; and, Wildlife Management International, who provided advice on crocodile husbandry and handling to Australian Army personnel stationed in the country (Manolis, pers. comm.).

In 2003, the profile of crocodiles in the country was raised again when the East Timorese army adopted *C. porosus* as its mascot (Associated Press 2003). In recognition of the danger from crocodile attack, the United Nations issued a circular to its troops (unavailable to the public according to Gowan 2008).

It is therefore certain that there is a keen awareness among the local population that crocodiles live among them, and traditions rooted in local animist beliefs hold that the island of Timor is the body of a giant crocodile (eg Sylvan 1988). The crocodile has been described as a local "totem" (Irwin 2000). Indeed the Saltwater crocodile is East Timor's national animal (see Anon 2008).

However, beyond folklore and road signs (Fig. 1), there is very little actual knowledge of the habits of crocodiles, the dangers they pose, and how to best handle safety concerns. This misinformation even extends to the usually quite accurate Lonely Planet travel guide, which plays down the dangers of crocodile encounters in the country (see Ver Berkmoes and Skolnick 2008).

Figure 1. A. An example of widely available wooden crocodile carvings. B. Another common motif depicts the legend of the boy riding the crocodile that becomes the island of Timor. C. Crocodile warning sign along the coastal highway west of Manatuto, Manatuto District. The sign is bilingual in Portuguese (cuidado = caution) and the national language Tetum (nani iha ne'e = swim here), combined with a crocodile image. Since there is no word to express "danger" in Tetum, the Portuguese is integrated into the official language. D. Mural on an elementary school near Lospalos, Lautém District. Photographs: A, C, D - Paul Freed; B - Mark O'Shea.

Reports of crocodile attacks are relatively infrequent and may not reach the authorities for reasons of logistics or culture, but those that do surface inevitably report fatalities. In early 2007, a 16-year-old boy was attacked and killed by a crocodile at a beach near Com, a coastal city in the country's eastern Lautém District. Nearly at the opposite end of the country, a 10-year-old boy was killed in 2009 in the Nutur River estuary near Betano, a coastal city in Manufahi District. Near that same location, a crocodile attacked and killed a horse. Medical personnel stationed in East Timor in the early to mid-2000s reported "a few crocodile attacks each year" (see CSG 2006).

During a herpetological survey in July 2009, we sighted crocodiles several times while driving along the northern coast road. These sightings were of crocodiles in waterways and lagoons close to the coast. One particular sighting was of an adult (estimated total length around 4 m) under a bridge crossing the Malailada River just west of Lautém, Lautém District. We photographed the crocodile, which slowly moved upstream and showed no recognizable avoidance behavior. When one of us simulated the splashing of potential prey at the river's edge by slapping the water with the palm of a hand, the crocodile immediately and rapidly changed direction to approach the splashing. The boldness of the crocodile in its approach is unlike crocodile behaviors some of us have observed in Papua New Guinea and Australia, and caused us to stop our luring activity immediately. It appears that the general reverence in which crocodiles are held in East Timor does not cause them to fear humans, as is the case in many other countries where crocodiles hunted for food (eg Papua New Guinea, Indonesia). As a consequence, the potential danger to humans from crocodile interactions is magnified.

We encountered two captive crocodiles in the town of Aileu, Aileu District. One of these had been captured in the coastal area of Samé Subdistrict, Manufahi District, to the south. This crocodile looked healthy, and its enclosure was of a size not uncommonly seen in western zoos. It was explained to us that a person of high social standing had transported the crocodile to this enclosure from the coast in what we surmise is a sign of elevated social status (similar to displaying captive monkeys or deer in the front of the homes of important citizens). The second, smaller individual was relegated to an old gasoline barrel (Fig. 2) - the treatment of this animal is inconsistent with the Timorese belief system of *C. porosus* as a totem.

Figure 2. Captive, juvenile *C. porosus* (A) held a gasoline barrel (B). Photographs: Paul Freed.

We believe that our encounters with crocodiles in East Timor are a typical display of high-risk human behavior in a situation where the supernatural and reality converge. One indication of this is the use of the animal as a status symbol, akin to the use of animal teeth and furs in royal regalia. However, given that there is a lot of subsistence fishing in East Timor and that significant distances often have to be covered on foot, especially by school-age children and those helping their parents with fishing or washing, there is a serious and persistent danger, primarily to children, from crocodile attack. The imagery of the friendly crocodile (eg Fig. 1B) can be considered misleading, and may be a symptom of handling crocodiles too cavalierly.

We feel that a detailed population and habitat survey for *C. porosus* in East Timor is an essential first step in better

understanding the needs of both the animal and the human population and their interactions in order to provide a common basis for their coexistence.

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Latin America and the Caribbean

Mexico

DISTRIBUTION OF PESTICIDES IN *CROCODYLUS MORELETII* HABITAT: CENTLA SWAMPS, MEXICO. There is a diverse range of anthropogenic activities that have significant impacts on the environment. These impacts are mainly from agriculture practices and cattle rearing. The pesticides used in these activities are applied to fight plant plagues, however these have an effect on other organisms. This is an important consideration when pesticides are sprayed in areas of interest for conservation of biodiversity, such as the Biosphere Preserve of Centla Swamps (RBPC) in the State of Tabasco, Mexico. The RBPC is one of the most important wetlands in Mexico due to its biological productivity and ecosystem diversity, but unfortunately significant concentrations of some pesticides frequently used by residents may threaten the swamp crocodile habitat.

The impact of pesticides on wetlands is not only important because of biological damage, but also to ecological and economic damage in terms of lost biodiversity and reduction of goods and services (Howard 1999). The recorded effect of pesticides on organisms is related to the decrease of physiological functions, neurotoxic and reproductive disorders, congenital deformation, among others (Rock 2002). In crocodilians, the effect can be severe, as described for *Alligator mississippiensis* by Guillette *et al*. (1995), where the population decreased significantly, egg mortality increased, and a high proportion of offspring died within 10 days. Rivas (2004) describes that females presented abnormalities in the ovaries and low blood estrogens levels, and males were strongly feminized, with small abnormal penises and high levels of estrogens in the blood. Other studies describe changes in steroid concentrations in plasma of *A. mississippiensis* in relation to the size of genitals, age and body size (Milnes *et al*. 2002; Gunderson *et al*. 2004; Rooney *et al*. 2004).

Through the Moreletii RBPC Project, a study was carried out to identify and determine the frequency of use of pesticides, and potential areas where pesticide pollution may represent a risk for *Crocodylus moreletii* in the RBPC. The study was

carried out through a survey based on the methodology of rapid rural appraisal (RRA), and a questionnaire was randomly applied to RBPC residents. To determine the potential effect of pesticides, the physicochemical properties were identified for each of the identified substances through the RRA. Information available through the National Institute of Statistics, Geography and Informatics (INEGI), the National Institute of Ecology (INE), and the Conservation Management Program of RBPC, was consulted for verifying information related to pesticides. Characteristics of restricted or prohibited pesticides were identified and average volumes used in areas near waterbodies calculated.

Results indicated that the residents of the RBPC use 8 types of pesticide, the uses of which vary according to the active ingredient and purpose. The most used was methylic parathion, followed by lindano, DDT and paraquat. However, the reasons given by interviewees for the use of methylic parathion, lindano and DDT awere for fumigation of houses (insecticides) and as herbicides. Dilution rates and frequency of use varied greatly.

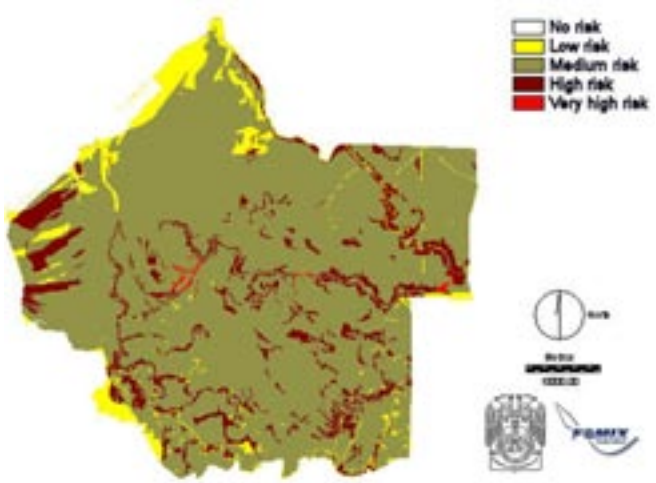

Figure 1. Distribution of highly persistent pesticides in the Biosphere Preserve of Centla Swamps, Tabasco, México.

Based on this information, conceptual maps were developed to determine possible routes of exposure of *C. moreletii* to pesticides. This allowed the identification of potential routes for which the pollutant can be in contact with the organisms using the properties of the pesticides and characteristics of the habitat of the species. This information was used to develop a geographical information system (GIS) model: the first model shows the distribution of towns and pesticide type used in the RBPC, the second model shows the distribution of pesticides that produce low risk for *C. moreletii* populations, and the last model shows the distribution of highly persistent pesticides (Fig. 1).

A progressive increase in agricultural activities within the RBPC has been taking place over time, and although the volumes of reported pesticides are relatively low, this could increase considerably over next few years. The use of these substances is important in the control of plagues that affect the productive activities in the RBPC, but it must be pointed out they should preferably be substituted by short-life chemical substances or those with minimum residuals. Therefore, the requirement to implement strategies to communicate the danger of these substances is essential, particularly in areas where pesticide application frequency represents a high risk for crocodiles. The conceptual models turned out to be a good tool in the identification of the exhibition routes from pesticides to crocodiles, since they allowed pondering the potential risk in each analysis.

In site verification is required to determine pesticides source points and levels in water, soils and organisms, in order to record the pollutant dynamics. In this way, the models could be updated and the analysis extended to determine potential risk for other species in the Swamps of Centla. Equally it is necessary to support dissemination of the environmental legislation in Mexico, since the use of persistent pesticides registered in very remote communities within the RBPC indicates a lack of knowledge and control of these substances. This work has shown to be useful as a prospective analysis tool of the risk *C. moreletii* could be by exposure to persistent pesticides in a quick, not very expensive and reliable way.

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Brazil

CAIMAN HARVEST AFTER 18 YEARS. Two decades ago, caimans were hunted intensively for theirs skins throughout the Pantanal, and illegally traded via Paraguay and Bolivia. Mourão *et al*. (1996) measured 1358 skulls found in 20 hunting camps surrounding Nhumirim Farm, Central Pantanal. Since 1991, no additional camps were located in this area, and the Forest Police of Mato Grosso do Sul have not confiscated any salted flanks in the Pantanal. However, in 2006, caimans were killed for their tail meat, and tourists offered up to $US50/caiman to fishermen and river-dwellers in the region of Pantanal (Campos and Mourão 2006). We have since recorded this practice in different areas of the Pantanal, with dead caimans without tails being encountered in rivers, lakes and ponds beside roads (Fig. 1).

Figure 1. Dead caimans with tails removed (2007).

We have studied caimans for more than 20 years in the area of Nhumirim Farm and surroundings (50 km^2), and have marked 6000 animals (Campos *et al*. 2006). The area is subject to a strong dry season (August to November) and rainy season (December to March). Caimans congregate in the few sites containing water of a suitable depth during the dry season, and this results in extremely high densities (Coutinho and Campos 1996). However, the rainy season in 2009 was short, and rivers started drying in February. In June 2009 we recorded 40 dead caimans without tails (Fig. 2) in remnant pools of an intermittent river on Dom Valdir Farm, surrounding Nhumirim Farm. These animals were probably harvested for commercial trade because the 40 tails would have provided a large quantity of meat.

Figure 2. Dead caimans without tails (foreground) in study area surrounding Nhumirim Farm, Pantanal, 2009.

In August, another extensive kill was documented in a in three nearby dams. These dams were made for cattle (Fig. 3), and caimans normally congregate in high densities there in the dry season. The 48 caimans had been shot in the head, and the tails were not removed (Fig. 4). In one dam we encountered 23 skulls and counted 5 live caimans, in the second dam there were 21 skulls and 10 live caimans, and in the third dam there were 4 skulls and 7 live caimans. Using morphometric relationships (Mourão *et al*. 1996), the majority of the dead caimans were estimated to be >90 cm SVL (mean= 98.5 $\pm$ 10.9 cm). Strong dry seasons normally induce high mortality of small caimans, especially hatchlings. The additional mortality caused by hunting for meat or control actions in farm dams that we documented are likely to severely affect the caimans populations in the Pantanal.

Figure 3. Farm dam on surrounding Nhumirim Farm, constructed to provide water for cattle, in which caimans congregate in high densities during the dry season.

Figure 4. Complete skeletons of caimans killed from farm dams, in order to control numbers.

Acknowledgments

Special thanks to Denis Tilcara, Vandir Silva and Henrique de Jesus for helping locate the dead caimans and Guilherme Mourão and William Magnusson for corrections to the text.

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Europe

DWARF AFRICAN CROCODILE STUDBOOK. The second edition of the studbook for the African Dwarf Crocodile (*Osteolaemus tetraspis*) is now available. It should be noted that there is neither a full historical report nor a full genetic analysis in this edition. However they were published last year in the first edition.

The chapter on Taxonomic Status (page 22) contains considerable changes in light of the recent paper by Eaton *et al*. (2008), which has consequences for captive population of the species.

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Science

Recent Publications

Elsey, R.M. and Trosclair III, P.L. (2008). Effect of timing of egg collection on growth in hatchling and juvenile American alligators. Herpetological Bulletin 105: 13-18.

Abstract: Many crocodilians are raised commercially for their valuable hides and meat. Stock is often obtained by collecting eggs from the wild, a practice known as egg ranching. Hatchlings are then obtained after incubating these eggs in a controlled setting. Alligators are raised in commercial facilities in Louisiana, and growth rates of hatchlings and juveniles can be an important economic factor for the producer. In this study we demonstrate that alligator eggs collected soon after deposition, and incubated at optimum temperatures for the majority of the incubation period produce hatchlings that are heavier (p= 0.029) and longer (p= 0.0072) than clutch mates collected later, and subjected to fluctuating diurnal temperatures in the wild. This accelerated growth associated with early egg collection can be an economic benefit to the alligator producer, and may reduce the impact of potential natural mortality factors (such as flooding, predation, and lightning fires) that eggs would otherwise be exposed to if not collected.

Firth, B.T., Christian, K.A., Belan, I. and Kennaway, D.J. (2009). Melatonin rhythms in the Australian freshwater crocodile (*Crocodylus johnstoni*): a reptile lacking a pineal complex? J. Comp. Physiol. B.

Abstract: The vertebrate pineal gland is the primary source of melatonin, the rhythmic secretion of which is influenced by environmental light and temperature, thereby providing animals with information about seasonally changing photoperiod and thermoperiod. Although pineal glands are present in the majority of vertebrate species, a discrete organ is reported to be absent in the Crocodilia. However, if the melatonin rhythm is crucial to the survival of the organism, it would be expected that the rhythm would be present in crocodiles. In the present study, we measured blood plasma

melatonin over a 30-h period in aestivating Australian freshwater crocodiles (*Crocodylus johnstoni*) in their natural habitat at the end of the dry season (November) and found no discernible melatonin rhythm. However, another group of captive-reared *C. johnstoni*, maintained under natural light and temperature cycles and sampled in the early dry season (June) showed a clear melatonin rhythm. These results suggest that there is either an extrapineal source of melatonin in this crocodile species or that there is melatonin producing tissue elsewhere which heretofore has not been discovered. Further studies are needed to determine why the melatonin rhythm is intermittently expressed and whether this may be related to seasonal changes in the expression of the rhythm linked to tropical environments.

Subalusky, A.L., Smith, L.L. and Fitzgerald, L.A. (2009). Detection of American alligators in isolated, seasonal wetlands. Applied Herpetology 6: 199-210.

Abstract: Although the American alligator has been well-studied in coastal marshes and large reservoirs, very few studies have taken place in the isolated, seasonal wetlands that occur within the inland portion of the alligator's range. Understanding alligator populations in these systems is important because, although they are subject to the same management strategies and regulations as their more well-studied counterparts, they may have markedly different population dynamics and densities. Additionally, understanding patterns of alligator presence in isolated, seasonal wetlands is important to understanding how alligators may affect these critical habitats as ecosystem engineers. However, survey methods designed for large, open water systems may not work in these small, vegetated wetlands, and their efficacy in this habitat has yet to be documented. We conducted eyeshine surveys for alligators along walking transects through isolated, seasonal wetlands in southwest Georgia. We used a double-observer method with a Huggins closed capture analysis to determine the detection probability of this method, to model the effects of observer and wetland type on that parameter and to estimate abundance. We found that detection probability for eyeshine surveys under the best-supported model was 57%, between 2 and 5 times higher than documented in other habitats. We then compared eyeshine surveys with systematic trapping to ascertain which components of the population were more likely to be detected by each method. Both methods were effective in detecting a range of size classes in the wetlands; however, the two methods were most effective when used in concert. Wildlife biologists studying population trends and establishing harvest quotas can use this information to design surveys in the inland portion of the alligator's range.

Gruen, R.L. (2009). Crocodile attacks in Australia: challenges for injury prevention and trauma care. World J. Surg. 33(8): 1554-1561.

Abstract: Saltwater crocodiles are formidable predators in northern Australia, and crocodile attacks on humans are not rare. With recent deaths highlighting this as a public health issue, an evidence-based discourse about effective methods of minimizing the danger to humans is needed. Using the Haddon Matrix for injury prevention, approaches to minimizing crocodile associated death and injury were sought. Possibilities for harm minimization before, during and after a crocodile attack are identified, and their merits appriased. The importance of excellent prehospital and surgical and critical care is emphasized. A combination of behavior adaptation, mutual respect, and minimizing contact will be the key to minimizing the harm from attacks, and excellent medical and surgical care will always be necessary for those unfortunate to be victims but fortunate to survive.

Nichols, T. and Letnic, M. (2009). Problem crocodiles: reducing the risk of attacks by *Crocodylus porosus* in Darwin Harbour, Northern Territory, Australia. Pp. 503-511 *in* Urban Herpetology, ed. by J.C. Mitchell, R.E. Jung Brown and B. Bartholomew. Herpetological Conservation 3: 503-511.

Abstract: There are numerous records of fatal attacks on humans by *Crocodylus porosus*. Since the Northern Territory population of *C. porosus* was declared a protected species in 1971, their populations have risen markedly, increasing the potential for conflict between people and crocodiles, particularly near the major population center of Darwin. To reduce the likelihood of crocodile attacks, the Parks and Wildlife Service of the Northern Territory operates a program to remove crocodiles from Darwin Harbour. Between 1999 and 2004, 926 *C. porosus* were captured, mostly in permanently set traps. Of the crocodiles captured, 62% were 1.5-2.5 m total length (TL), 12% were less than 1.5 m TL, and 2.5% were greater than 3.5 m TL. Males comprised 74% of captures. Capture rates were highest in March, April, and May and monthly capture rates in the late-wet and build-up seasons increased over the duration of the study. The increase in problem crocodile captures suggests that future crocodile removal efforts will need to be increased to reduce the risk of crocodile attacks on humans in the Darwin area.

Bishop, J.M., Leslie, A.J., Bourquin, S.L. and O'Ryan, C. (2009). Reduced effective population size in an overexploited population of the Nile crocodile (*Crocodylus niloticus*). Biological Conservation 142(10): 2335-2341.

Abstract: Unchecked exploitation of wildlife resources is one of the major factors influencing species persistence throughout the world today. A significant consequence of exploitation is the increasing rate at which genetic diversity is lost as populations decline. Recent studies suggest that life history traits affecting population growth, particularly in long-lived species, may act to moderate the impact of population decline on genetic variation and lead to remnant populations that appear genetically diverse despite having passed through substantial demographic bottlenecks. In this study we show that the retention of genetic variation in a partially recovered population of Nile crocodile is deceptive, as it masks the reality of a significant decline in the population's effective size (N_e). Repeated episodes of unchecked hunting in the mid

to late 20th century have today led to a five-fold decrease in the population's N_e. Using current census data we estimate the contemporary N_e/N ratio as 0.05 and, in light of quotas that permit the ongoing removal of adults, simulated the likely effects of genetic drift on extant levels of variation. Results indicate that even if the current effective size is maintained, both allelic diversity and heterozygosity will decline. Our findings have complex implications for long-lived species; an emphasis on the retention of genetic variation alone, whilst disregarding the effects of population decline on effective size, may ultimately obscure the continued decline and extinction of exploited populations.

Merchant, M., McFatter, J., Mead, S., McAdon, C. and Wasilewski, J. (2009). Identification and characterization of serum complement activity in the American crocodile (*Crocodylus acutus*). Vet. Immunol. Immunopathol.

Abstract: Incubation of unsensitized sheep red blood cells with serum from the American crocodile (*Crocodylus acutus*) resulted in a concentration-dependent hemolysis. The hemolytic activity was heat-sensitive, and inhibited by EDTA in a concentration-dependent manner. The EDTA-inhibited SRBC hemolysis could be restored by the addition of excess Ca(2+) or Mg(2+), but not Ba(2+) or Cu(2+), revealing the specificity of this activity for these two divalent cations. The hemolytic activity of crocodile serum was titer-dependent, with 329muL producing 50% of maximal SRBC hemolysis. The complement activity was also temperature-dependent, with decreased activity at lower temperatures (5-15°C) and maximal activity occurred at 30-40°C. The hemolysis occurred relatively slowly, with near zero activity after 10 min, 40% of activity observed within 15 min of exposure to SRBCs, and maximal activity at 30 min.

Pierce, S.E., Angielczyk, K.D. and Rayfield, E.J. (2009). Shape and mechanics in thalattosuchian (Crocodylomorpha) skulls: implications for feeding behaviour and niche partitioning. J. Anat.

Abstract: Variation in modern crocodilian and extinct thalattosuchian crocodylomorph skull morphology is only weakly correlated with phylogeny, implying that factors other than evolutionary proximity play important roles in determining crocodile skull shape. To further explore factors potentially influencing morphological differentiation within the Thalattosuchia, we examine teleosaurid and metriorhynchid skull shape variation within a mechanical and dietary context using a combination of finite element modelling and multivariate statistics. Patterns of stress distribution through the skull were found to be very similar in teleosaurid and metriorhynchid species, with stress peaking at the posterior constriction of the snout and around the enlarged supratemporal fenestrae. However, the magnitudes of stresses differ, with metriorhynchids having generally stronger skulls. As with modern crocodilians, a strong linear relationship between skull length and skull strength exists, with short-snouted morphotypes experiencing less stress through the skull than long-snouted morphotypes under equivalent loads. Selection on snout shape related to dietary preference was found to work in orthogonal directions in the two families: diet is associated with snout length in teleosaurids and with snout width in metriorhynchids, suggesting that teleosaurid skulls were adapted for speed of attack and metriorhynchid skulls for force production. Evidence also indicates that morphological and functional differentiation of the skull occurred as a result of dietary preference, allowing closely related sympatric species to exploit a limited environment. Comparisons of the mechanical performance of the thalattosuchian skull with extant crocodilians show that teleosaurids and long-snouted metriorhynchids exhibit stress magnitudes similar to or greater than those of long-snouted modern forms, whereas short-snouted metriorhynchids display stress magnitudes converging on those found in short-snouted modern species. As a result, teleosaurids and long-snouted metriorhynchids were probably restricted to lateral attacks of the head and neck, but short-snouted metriorhynchids may have been able to employ the grasp and shake and/or 'death roll' feeding and foraging behaviours.

Meganathan, P.R., Dubey, B. and Haque, I. (2009). Molecular identification of Indian crocodile species: PCR-RFLP method for forensic authentication. J. Forensic Sci.

Abstract: South East Asian countries are known for illegal poaching and trade of crocodiles clandestinely, to be used in skin, medicinal, and cosmetic industries. Besides crocodiles being listed in the Convention on International Trade in Endangered Species of Wild Fauna and Flora, India has its Wildlife Protection Act, 1972 for conservation of crocodile species. Hitherto, lack of any rapid and reliable technique for examinations of crocodile-based crime exhibits such as skin, bones, etc. has been a major problem for an effective promulgation of law on illegal trade. DNA-based identification of species using PCR-RFLP technique for an apt identification of all the three Indian crocodile species namely, *Crocodylus porosus*, *Crocodylus palustris* and *Gavialis gangeticus* is presented here. A 628 bp segment of cytochrome b gene was amplified using novel primers followed by restriction digestion with three enzymes i.e., HaeIII, MboI, and MwoI, separately and in combination. The technique has produced a species-specific pattern for identifying the three crocodile species individually, which fulfills the requirement for its forensic application. It is expected that the technique will prove handy in identification of all the three Indian crocodile species and strengthen conservation efforts.

Magnino, S., Colin, P., Dei-Cas, E., Madsen, M., McLauchlin, J., Nöckler, K., Prieto Maradona, M., Tsigarida, E., Vanopdenbosch, E. and Van Peteghem, C. (2009). Biological risks associated with consumption of reptile products. Int. J. Food Microbiol.

Abstract: The consumption of a wide variety of species of reptiles caught from the wild has been an important source of protein for humans world-wide for millennia. Terrapins,

snakes, lizards, crocodiles and iguanas are now farmed and the consumption and trade of their meat and other edible products have recently increased in some areas of the world. Biological risks associated with the consumption of products from both farmed and wild reptile meat and eggs include infections caused by bacteria (*Salmonella* spp., *Vibrio* spp.), parasites (*Spirometra*, *Trichinella*, *Gnathostoma*, pentastomids), as well as intoxications by biotoxins. For crocodiles, *Salmonella* spp. constitute a significant public health risk due to the high intestinal carrier rate which is reflected in an equally high contamination rate in their fresh and frozen meat. There is a lack of information about the presence of *Salmonella* spp. in meat from other edible reptilians, though captive reptiles used as pets (lizards or turtles) are frequently carriers of these bacteria in Europe. Parasitic protozoa in reptiles represent a negligible risk for public health compared to parasitic metazoans, of which trichinellosis, pentastomiasis, gnathostomiasis and sparganosis can be acquired through consumption of contaminated crocodile, monitor lizard, turtle and snake meat, respectively. Other reptiles, although found to harbour the above parasites, have not been implicated with their transmission to humans. Freezing treatment inactivates *Spirometra* and *Trichinella* in crocodile meat, while the effectiveness of freezing of other reptilian meat is unknown. Biotoxins that accumulate in the flesh of sea turtles may cause chelonitoxism, a type of food poisoning with a high mortality rate in humans. Infections by fungi, including yeasts, and viruses widely occur in reptiles but have not been linked to a human health risk through the contamination of their meat. Currently there are no indications that natural transmissible spongiform encephalopathies (TSEs) occur in reptilians. The feeding of farmed reptiles with non-processed and recycled animal products is likely to increase the occurrence of biological hazards in reptile meat. Application of GHP, GMP and HACCP procedures, respectively at farm and slaughterhouse level, is crucial for controlling the hazards.

Miles, L.G., Isbergm, S.R., Glenn, T.C., Lance, S.L., Dalzell, P., Thomson, P.C. and Moran, C. (2009). A genetic linkage map for the saltwater crocodile (*Crocodylus porosus*). BMC Genomics 10(1): 339.

Abstract: Genome elucidation is now in high gear for many organisms, and whilst genetic maps have been developed for a broad array of species, surprisingly, no such maps exist for a crocodilian, or indeed any other non-avian member of the Class Reptilia. Genetic linkage maps are essential tools for the mapping and dissection of complex quantitative trait loci (QTL), and in order to permit systematic genome scans for the identification of genes affecting economically important traits in farmed crocodilians, a comprehensive genetic linage map will be necessary. A first-generation genetic linkage map for the saltwater crocodile (*Crocodylus porosus*) was constructed using 203 microsatellite markers amplified across a two-generation pedigree comprising ten full-sib families from a commercial population at Darwin Crocodile Farm, Northern Territory, Australia. Linkage analyses identified fourteen linkage groups comprising a total of 180 loci, with 23 loci remaining unlinked. Markers were ordered within linkage groups employing a heuristic approach using CRIMAP v3.0 software. The estimated female and male recombination map lengths were 1824.1 and 319.0 cM respectively, revealing an uncommonly large disparity in recombination map lengths between sexes (ratio of 5.7:1). We have generated the first genetic linkage map for a crocodilian, or indeed any other non-avian reptile. The uncommonly large disparity in recombination map lengths confirms previous preliminary evidence of major differences in sex-specific recombination rates in a species that exhibits temperature-dependent sex determination (TSD). However, at this point the reason for this disparity in saltwater crocodiles remains unclear. This map will be a valuable resource for crocodilian researchers, facilitating the systematic genome scans necessary for identifying genes affecting complex traits of economic importance in the crocodile industry. In addition, since many of the markers placed on this genetic map have been evaluated in up to 18 other extant species of crocodilian, this map will be of intrinsic value to comparative mapping efforts aimed at understanding genome content and organization among crocodilians, as well as the molecular evolution of reptilian and other amniote genomes. As researchers continue to work towards elucidation of the crocodilian genome, this first generation map lays the groundwork for more detailed mapping investigations, as well as providing a valuable scaffold for future genome sequence assembly.

Shan, X., Ray, D.A., Bunge, J.A. and Peterson, D.G. (2009). A bacterial artificial chromosome library for the Australian saltwater crocodile (*Crocodylus porosus*) and its utilization in gene isolation and genome characterization. BMC Genomics 2009: S9.

Abstract: Crocodilians (Order Crocodylia) are an ancient vertebrate group of tremendous ecological, social, and evolutionary importance. They are the only extant reptilian members of Archosauria, a monophyletic group that also includes birds, dinosaurs, and pterosaurs. Consequently, crocodilian genomes represent a gateway through which the molecular evolution of avian lineages can be explored. To facilitate comparative genomics within Crocodylia and between crocodilians and other archosaurs, we have constructed a bacterial artificial chromosome (BAC) library for the Australian saltwater crocodile, *Crocodylus porosus*. This is the first BAC library for a crocodile and only the second BAC resource for a crocodilian. The *C. porosus* BAC library consists of 101,760 individually archived clones stored in 384-well microtiter plates. NotI digestion of random clones indicates an average insert size of 102 kb. Based on a genome size estimate of 2778 Mb, the library affords 3.7 fold (3.7x) coverage of the *C. porosus* genome. To investigate the utility of the library in studying sequence distribution, probes derived from CR1a and CR1b, two crocodilian CR1-like retrotransposon subfamilies, were hybridized to *C. porosus* macroarrays. The results indicate that there are a minimum of 20,000 CR1a/b elements in *C. porosus* and that their distribution throughout the genome is decidedly non-random. To demonstrate the utility of the library in gene isolation, we probed the *C. porosus* macroarrays with an overgo designed

from a C-mos (oocyte maturation factor) partial cDNA. A BAC containing C-mos was identified and the C-mos locus was sequenced. Nucleotide and amino acid sequence alignment of the *C. porosus* C-mos coding sequence with avian and reptilian C-mos orthologs reveals greater sequence similarity between *C. porosus* and birds (specifically chicken and zebra finch) than between *C. porosus* and squamates (green anole). We have demonstrated the utility of the *Crocodylus porosus* BAC library as a tool in genomics research. The BAC library should expedite complete genome sequencing of *C. porosus* and facilitate detailed analysis of genome evolution within Crocodylia and between crocodilians and diverse amniote lineages including birds, mammals, and other non-avian reptiles.

Chiu, C.H., Kuo, Y.W., Hsu, H.T., Chu, K.S. and Shieh, C.F. (2009). Continuous infraclavicular block for forearm amputation after being bitten by a saltwater crocodile (*Crocodylus porosus*): a case report. Kaohsiung J. Med. Sci. 25(8): 455-459.

Abstract: Two important issues after a complete right forearm amputation are replantation and ongoing pain management. There are no reports of successful forearm replantation as a consequence of a crocodile bite. Here, we discuss our pain management in a case of complete forearm amputation after a bite from a saltwater crocodile (*Crocodylus porosus*), which necessitated six further operations to achieve successful replantation. Continuous infraclavicular brachial plexus block was effective for acute pain control in this case. We strongly recommend performing the block with an indwelling catheter under ultrasound guidance for higher accuracy and safety.

Chapus, C. and Edwards, S.V. (2009). Genome evolution in Reptilia: in silico chicken mapping of 12,000 BAC-end sequences from two reptiles and a basal bird. BMC Genomics. 10 Suppl 2: S8.

Abstract: With the publication of the draft chicken genome and the recent production of several BAC clone libraries from non-avian reptiles and birds, it is now possible to undertake more detailed comparative genomic studies in Reptilia. Of interest in particular are the genomic events that transformed the large, repeat-rich genomes of mammals and non-avian reptiles into the minimalist chicken genome. We have used paired BAC end sequences (BESs) from the American alligator (*Alligator mississippiensis*), painted turtle (*Chrysemys picta*) and emu (*Dromaius novaehollandiae*) to investigate patterns of sequence divergence, gene and retroelement content, and microsynteny between these species and chicken. From a total of 11,967 curated BESs, we successfully mapped 725, 773 and 2597 sequences in alligator, turtle, and emu, respectively, to sites in the draft chicken genome using a stringent BLAST protocol. Most commonly, sequences mapped to a single site in the chicken genome. Of 1675, 1828 and 2936 paired BESs obtained for alligator, turtle, and emu, respectively, a total of 34 (alligator, 2%), 24 (turtle, 1.3%) and 479 (emu, 16.3%) pairs were found to map with high confidence and in the correct orientation and with BAC-sized intermarker distances to single chicken chromosomes, including 25 such paired hits in emu mapping to the chicken Z chromosome. By determining the insert sizes of a subset of BAC clones from these three species, we also found a significant correlation between the intermarker distance in alligator and turtle and in chicken, with slopes as expected on the basis of the ratio of the genome sizes. Our results suggest that a large number of small-scale chromosomal rearrangements and deletions in the lineage leading to chicken have drastically reduced the number of detected syntenies observed between the chicken and alligator, turtle, and emu genomes and imply that small deletions occurring widely throughout the genomes of reptilian and avian ancestors led to the ~50% reduction in genome size observed in birds compared to reptiles. We have also mapped and identified likely gene regions in hundreds of new BAC clones from these species.

Agrawal, R., Wessely, O., Anand, A., Singh, L. and Aggarwal, R.K. (2009). Male-specific expression of Sox9 during gonad development of crocodile and mouse is mediated by alternative splicing of its proline-glutamine-alanine rich domain. 276(15): 4184-4196.

Abstract: The initial trigger for sexual differentiation is regulated by multiple ways during embryonic development. In vertebrates, chromosome-based mechanisms generally known as genetic sex determination are prevalent; however, some species, such as many reptilians, display temperature-dependent sex determination. The Sry-related transcription factor, Sox9, which is expressed by an evolutionary conserved gene, has been shown to be a key player in the process of sex determination. In the present study, we report the identification and expression of crocodile homolog of Sox9 (cpSox9) from the Indian Mugger, *Crocodylus palustris*. We show that cpSox9 undergoes extensive alternative splicing around the proline-glutamine-alanine rich transactivation domain that results in cpSox9 variants with presumably impaired or reduced transactivation potential. The multiple isoforms were also detected in various embryonic tissues, with some of them displaying a differential expression profile. With respect to sex differentiation, a putative unspliced full-length cpSox9 could be detected only in the genital ridge-adrenal-mesonephros complex of male, but not female embryos during the temperature-sensitive period. Importantly, we further show that this phenomenon was not restricted to the temperature-dependent sex determination species *C. palustris*, but was also observed in the mouse, a species exhibiting genetic sex determination. Thus, the present study describes, for the first time, a complete coding locus of Sox9 homolog from a temperature-dependent sex determination species. More importantly, we demonstrate an evolutionarily conserved role of alternative splicing resulting in transcriptional diversity and male-sex specific expression of Sox9 during testis development in vertebrates (i.e. irrespective of their underlying sex-determination mechanisms).

Carr, C.E., Soares, D., Smolders, J. and Simon, J.Z. (2009).

Detection of interaural time differences in the alligator. J. Neurosci. 29(25): 7978-7990.

Abstract: The auditory systems of birds and mammals use timing information from each ear to detect interaural time difference (ITD). To determine whether the Jeffress-type algorithms that underlie sensitivity to ITD in birds are an evolutionarily stable strategy, we recorded from the auditory nuclei of crocodilians, who are the sister group to the birds. In alligators, precisely timed spikes in the first-order nucleus magnocellularis (NM) encode the timing of sounds, and NM neurons project to neurons in the nucleus laminaris (NL) that detect interaural time differences. In vivo recordings from NL neurons show that the arrival time of phase-locked spikes differs between the ipsilateral and contralateral inputs. When this disparity is nullified by their best ITD, the neurons respond maximally. Thus NL neurons act as coincidence detectors. A biologically detailed model of NL with alligator parameters discriminated ITDs up to 1 kHz. The range of best ITDs represented in NL was much larger than in birds, however, and extended from 0 to 1000 micros contralateral, with a median ITD of 450 micros. Thus, crocodilians and birds employ similar algorithms for ITD detection, although crocodilians have larger heads.

Aust, P., Boyle, B., Fergusson, R. and Coulson, T. (2009). The impact of Nile crocodiles on rural Livelihoods in northeastern Namibia. S. Afr. J. Wildl. Res. 39(1): 57-69.

Abstract: Nile crocodiles (*Crocodylus niloticus*) are one of the few dangerous predators regularly found outside protected wildlife areas. This is particularly so in northeastern Namibia where an extensive network of rivers and wetlands coupled with successful conservation measures has allowed crocodile populations to flourish since uncontrolled exploitation ended over three decades ago. This area is predominantly communal land characterized by numerous subsistence communities dependent on river and wetland resources. In recent years, the combination of a growing human population and resurgent crocodile populations has resulted in considerable conflict between humans and crocodiles. The principle objective of this study was to quantify the impact of crocodiles on rural livelihoods. Data were obtained from existing records and through community surveys on the lower Kavango, Chobe and Kwando rivers and upper Zambezi River. Existing estimates suggest an annual loss of 255 domestic cattle per year for northeastern Namibia whilst community survey estimates suggest a substantially greater annual loss of 6864 cattle per year. Community surveys also revealed conflict between crocodiles and artisinal fishermen, with an estimated 71,500 fishing nets damaged by crocodiles per year. Human-crocodile conflict in Namibia may have greater impacts than previously assumed, and may undermine conservation and development objectives.

Machkour-M'Rabet, S., Hénaut, Y., Charruau, P., Gevrey, M., Winterton, P. and Legal, L. (2009). Between introgression events and fragmentation, islands are the last refuge for the American crocodile in Caribbean Mexico. Marine Biology 156(6): 1321-1333.

Abstract: Habitat loss and degradation in the Mexican Caribbean, caused by the development of tourism, have decreased the potential nesting area for the American crocodile (*Crocodylus acutus*) and have fragmented the populations of the Yucatan peninsula. Our study investigated five populations (three continental: North, South, Sian Ka'an, and two insular: Cozumel, Banco Chinchorro) of *C. acutus* in the Mexican Caribbean using seven different inter simple sequence repeat (ISSR) markers as tools for genetic variability and population differentiation. Three classification methods were tested and compared: distance analysis, self-organizing map, and Bayesian methods, to evaluate the resolution of each method with ISSR markers. The 77 loci selected revealed a high variability between populations (polymorphism from 17% for Sian Ka'an to 75% for Banco Chinchorro) with a total polymorphism of 84% and a global coefficient of gene differentiation (G ST) of 0.296, but low values of Nei's Gene diversity (from 0.065 for Sian Ka'an to 0.233 for Banco Chinchorro). Our results suggest elevated inbreeding in all local populations with higher indices for Banco Chinchorro and lower indices for Sian Ka'an. Three independent classification methods gave similar results, and suggested that most continental individuals are admixtures, with different levels of introgression, with the sympatric species *Crocodylus moreletii*. We propose that the islands/atolls remain the sole areas with genetically "pure" American crocodiles and we discuss these results for future conservation of this endangered crocodile species.

Meganathan, P.R., Dubey, B. and Haque, I. (2009). Molecular identification of crocodile species using novel primers for forensic analysis. Journal of Conservation Genetics 10(3): 767-770.

Abstract: All crocodilians are under varying degrees of threat due to over exploitation and these species have been listed in Appendix I or II of CITES. The lack of molecular techniques for the identification of confiscated samples makes it difficult to enforce the law. Conclusive forensic identification of species requires a complete gene sequence which is difficult in case of degraded samples. We have developed two novel sets of primers to amplify two partial cytochrome b gene sequences of 6 crocodile species i.e. *Crocodylus palustris*, *Crocodylus porosus*, *Crocodylus siamensis*, *Crocodylus niloticus*, *Gavialis gangeticus* and *Caiman crocodilus*. These partial sequences were edited to give a complete cyt b gene sequence, which can be used as an effective tool for forensic authentication of crocodile species. A phylogeny of crocodile species was reconstructed using these sequences. The described primers hold great promise in forensic identification of crocodile species, which can aid in the effective enforcement of law and conservation of these ancient species.

Jaratlerdsiri, W., Rodríguez-Zárate, C.J., Isberg, S.R., Damayanti, C.S., Miles, L.G., Chansue, N., Moran, C.,

Melville, L. and Gongora, J. (2009). Distribution of endogenous retroviruses in crocodilians. J. Virol.

Abstract: Knowledge of ERVs in crocodilians (Crocodylia) is limited and their distribution among extant species is unclear. Here we analyze the phylogenetic relationships of these retroelements in 20 species of crocodilians by studying the pro-pol gene. Results showed that crocodilian ERVs cluster into two major clades (CERV 1 and CERV 2). CERV 1 clustered as a sister group of Gammaretroviruses, while CERV 2 clustered distantly with respect to all known ERVs. Interestingly, CERV 1 was found only in crocodiles (Crocodylidae). The data generated here could assist future studies aimed at identifying orthologous and paralogous ERVs among crocodilians.

Rivera-Sylva, H.E., Frey, E. and Guzmán-Gutiérrez, J.R. (2009). Evidence of predation on the vertebra of a hadrosaurid dinosaur from the Upper Cretaceous (Campanian) of Coahuila, Mexico. Carnets de Géologie/Notebooks on Geology, Brest, Letter 2009/02 (CG2009_L02).

Abstract: In sediments of the Aguja Formation (Late Cretaceous: Campanian) at La Salada in northern part of the state of Coahuila, Mexico, numerous fossils of vertebrates have been discovered including Hadrosauridae. One hadrosaur vertebra provides evidence of predation probably by a giant alligator *Deinosuchus riograndensis*.

Lance, V.A. (2009). Is regulation of aromatase expression in reptiles the key to understanding temperature-dependent sex determination? J. Exp. Zool. 311A: 314-322. (Special Section: Evolution and Biology of Vertebrate Aromatases, edited by Alan J. Conley and J. Joseph Ford).

Abstract: A brief review of our current understanding (or lack of understanding) of the molecular basis of temperature-dependent sex determination (TSD) in reptiles is presented. Current theories are discussed: yolk steroids as sex determinants, the brain as the driver for TSD and the enzyme aromatase and estrogen production as the possible determinants of sex. There is little evidence to support the first two theories, but enough evidence to keep the third theory in play. As yet, however, we have no molecular understanding of how a two-degree difference in temperature during the temperature-sensitive phase of egg incubation can initiate the molecular cascade that determines whether the indifferent gonad develops as an ovary or a testis.

Gopi, G.V. and Pandav, B. (2009). Humans sharing space with *Crocodylus porosus* in Bhitarkanika Wildlife Sanctuary: conflicts and options. Current Science 96(4): 459-460.

Rainwater, T.R. and Platt, S.G. (2009). Possible decline of an American crocodile (*Crocodylus acutus*) population on Turneffe Atoll, Belize. Herpetological Bulletin 107: 3-11.

Abstract: Surveys of the American Crocodile (*Crocodylus acutus*) in Turneffe Atoll, Belize over the last decade have suggested that populations remain stable but are increasingly threatened by habitat loss, particularly human development of critical nesting beaches. In May, June and July 2008 we used a combination of spotlight surveys and nest counts to evaluate the current status of *C. acutus* populations in Turneffe Atoll. A total of 23 *C. acutus* was observed along 46.6 km of survey route (0.49 crocodiles/km) during spotlight surveys in May, and 8 crocodiles were observed along 45.3 km of survey route (0.18 crocodiles/km) during late June-early July, yielding an overall 2008 encounter rate of 0.34 crocodiles/km. This encounter rate was significantly lower than that reported for surveys conducted in 2002. Two recently hatched nests, both on the same beach, were found during nest counts; no nests were found on other beaches known to have routinely yielded nests in the past. The number of nests found in this study is 4- to 10-fold lower than those reported from 1994 to 2004, suggesting a reduction in breeding females in the Turneffe Atoll crocodile population. Development of two important nesting beaches on Blackbird Cay since 2004 has likely rendered these habitats unsuitable for future nesting. The combination of low crocodile encounter rates, reduced nesting activity and human alteration of known nesting beaches observed in this study suggests a possible decline in the *C. acutus* population in Turneffe Atoll. Continued population assessments will be essential in monitoring the status of *C. acutus* in Turneffe Atoll, and immediate management and conservation efforts should be made to protect beaches on Blackbird, Calabash, and Northern Cays to provide critical nesting habitat for crocodiles.

Submitted Publications

YACARE CAIMAN EATING THE EGGS OF A CONSPECIFIC DURING OVIPOSITION. The St. Augustine Alligator Farm Zoological Park in Florida has reported many interesting crocodilian behaviors, including young alligators eating vegetables, others swallowing their food underwater and crocodiles feeding their young. Now we can report on Yacare caiman (*Caiman yacare*) eating the eggs of a conspecific as the latter was in the process of oviposition.

The enclosure is occupied by 5 female *C. yacare*, which were fed a diet of Mazuri crocodilian pellets earlier that day (4 July 2009). At around 1900 h one female was observed intently watching another female depositing her eggs. She then proceeded to grab an egg from the nest. After swallowing that egg, she grabbed a second egg and entered the pool to eat it. A third female was observed watching the event, but did not appear interested in the activity. However, this behavior was captured on video which can be seen via a link on YouTube (http://www.youtube.com/watch?v=k3q24ZgjN0A).

Jen Walkowich, Reptile Keeper, St. Augustine Alligator Farm Zoological Park.

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