

Trip Report



Chinese alligator (*Alligator sinensis*). Photograph: Pablo Siroski.

CSG Visit to China, August 2016

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At the 1st East-Southeast Asia Regional Meeting of the IUCN-SSC Crocodile Specialist Group (CSG) in Cambodia (May 2015), Dr. Mark Merchant (McNeese State University, Lake Charles, Louisiana, USA) was approached by Prof. Wu Xiaobing (Anhui Normal University, Wuhu, Anhui Province, China) to co-chair a crocodylian symposium at the 8th World Congress of Herpetology (WCH8), to be held in Hangzhou, China, 15-20 August 2016. Participation at WCH8 was seen as an opportunity for CSG to visit captive breeding facilities and reintroduction sites for the Chinese alligator (*Alligator sinensis*) in Anhui and Zhejiang Provinces, and get an update on progress with the Chinese Alligator Action Plan. A visit would also provide an opportunity to introduce some members of the CSG Future Leaders Working Group (CSG-FLWG) to China and the Chinese alligator program (Webb 2016).

The CSG team comprised Charlie Manolis (Australia), Mark Merchant (USA), Paolo Martelli (Hong Kong), Matthew Shirley (USA/Côte d'Ivoire), Marisa Tellez (USA/Belize), Pablo Siroski (Argentina) and Alexander Meurer (Germany). With the exception of Marisa Tellez, Charlie Manolis and Paolo Martelli, no other members of the team had previously visited China, and only Charlie Manolis had visited Anhui and Zhejiang Provinces (2001, 2005) and had first-hand experience with the Chinese alligator program and the key institutions and personnel involved.

Prof. Wu and some of his staff and postgraduate students accompanied the CSG team in both Anhui and Zhejiang Provinces, and Prof. Fang Shengguo and two of his postgraduate students from Zhejiang University joined the team in Zhejiang Province. Dr. Jiang Hongxing [National Wildlife Research and Development Center, State Forestry Administration (SFA), Beijing] joined the team in Wuhu.

1. Reintroduction Sites

The pre-WCH8 itinerary comprised visits to:

1.1. Anhui Normal University (Wuhu, Anhui Province; 12 August 2016)

The team was introduced to key staff at the College of Life Sciences at Anhui Normal University, including: Vice-President Prof. Zhu Jiachun; Party Secretary Mr. Jiang Xuebo; Director Prof. Wu Xiaobing; Vice-Directors Dr. Zhu Guoping and Dr. Hu Haoyuan; Dean of Academic Committee Dr. Nie Liuwang; Prof. Fang Zhang; and Associate Professors Yan Peng and Zhao Jihong (Wannan Medical College). Matt Shirley, Marisa Tellez, Paolo Martelli, Pablo Siroski and Mark Merchant made brief presentations to Prof. Wu's postgraduate students working on Chinese alligators.

1.2. Dajiang Alligator Farm (Wuhu, Anhui Province; 12 August 2016)

This is one of two privately-owned alligator farms. It was established in 2011 with 200 adults (1M:3F), and now produces around 1300 hatchlings per year. Current stocks comprise around 5000 alligators of different ages. Retired staff from the Anhui Research Centre for Chinese Alligator Reproduction (ARCCAR; see below) have been engaged to provide technical expertise, and the facilities observed (eg breeding enclosures, raising pens, incubator, food preparation areas; Fig. 1) were of

a high standard. Tourism appears to be the main goal for this farm. The owner, Mr. Jiang, professed that his “love” of wildlife was a key motivating factor for the venture.



Figure 1. Breeding enclosure (left) and raising pen (right) at Dajiang Alligator Farm. Photographs: Pablo Siroski.

The second privately-owned farm, Tangshan Alligator Farm, in Nanjing (Jiangsu Province), was not visited, and is reported to hold around 2000 alligators.

1.3. Gaojinmiao Forestry Farm (Anhui Province; 13 August 2016)

GFF was chosen as the main site for reintroduction of alligators due to: historical occurrence of wild alligators; it is Government-owned, and so land-use can be controlled (some fishing occurs, but no agriculture); there is very low human involvement; and, so no human-crocodile conflict. Sixteen (16) artificial breeding pens, holding around 455 adult alligators, have been constructed within GFF (Fig. 2). This stock is available on-site for future reintroduction into restored wetlands in the future.



Figure 2. Restored natural pond (left) and captive breeding enclosure (right) at Gaojinmiao Forestry Farm. Photographs: Pablo Siroski.

Since 2006, 50 ponds (30 ha total water area; largest pond is around 1 ha in area; Fig. 2) have been constructed within GFF. The team was only able to visit one the largest of the ponds at GFF (119°12.132'E, 31°00.978'N). Attempts to reach a second pond were unsuccessful, as the thick vegetation made access difficult.

Planning at GFF has involved considerable scientific input to ensure that the wetlands have the highest probability of sustaining released alligators. Ponds were established with terrestrial (eg bamboo; = nesting material) and aquatic vegetation, and “seeded” with fish, amphibians, snails, etc., to ensure a food source for the alligators. Each pond generally includes an island, into which the alligators can burrow and on which they sometimes nest. Ponds are located within “valleys” and creek channels, which limits the maximum size of ponds, but which allows a natural water supply to them. From start to finish, it takes 2-3 years to get a pond ready for alligators, and costs around \$US10,000 to construct and prepare the average-sized pond. Another 30 ponds are to be constructed in GFF in the near future.

Prior to release, adult alligators are isolated for 3-4 months, micro-chipped, DNA-screened for relatedness, and their health-screened (cloacal bacteria, blood, body size/condition). Between 2006 and 2016 there have been 11 releases (usually in May-June), involving a total of 93 animals, with a sex ratio of 1M:2F. Some released alligators were tracked in 2006 (Dacey 2006) and 2012 using radio-telemetry, and movement between ponds is known to occur. The latest release was 18 alligators in May 2016.

The first successful nesting was recorded in 2008, and since then 8 nests have been identified (total of 158 eggs, producing 80 hatchlings). Thick vegetation makes locating nests difficult, and the full extent of nesting to date is unknown.

Population monitoring is carried out by spotlight survey. The latest survey, carried out in 2015, confirmed alligators were distributed among 28 of the 50 ponds, and that recruitment (ie hatchlings were sighted). Survivorship of released alligators is thought to be >85%, but no specific recapture or re-sight efforts have been carried out to verify this rate.

A wild population of 120-150 adult alligators by 2020 is the target for GFF.

1.4. Anhui Research Centre for Chinese Alligator Reproduction (Xuancheng, Anhui Province; 13 August 2016)

ARCCAR is the largest alligator facility in China, and serves as the administrative centre for alligator management in Anhui Province. Established in 1979, ARCCAR began a captive breeding program in 1980-81 with 212 wild alligators and wild nests (778 eggs) collected in 1982-1985. The captive alligator population has increased from around 10,000 individuals in 2006 to around 15,000 in 2016. Raising facilities are currently being upgraded (Fig. 3), and a museum is integrated into the new building currently under construction.



Figure 3. Breeding enclosure (left) and “old” raising pen (right) at the Alligator Research Centre for Chinese Alligator Reproduction. Photographs: Pablo Siroski.

ARCCAR was registered with CITES as a captive breeding operation in October 1993. It relies on tourism as the main source of income, and receives around 100,000 visitors per year (Fig. 3). The minimal signage is mostly in Chinese, Korean and English - reflecting the demographics of visitation to the facility.

1.5. Changxing (Yingjiabian) Chinese Alligator Nature Reserve (Changxing, Zhejiang Province; 15 August 2016)

The CCANR (119.7284°N, 30.9222°E) comprises the original breeding and rearing centre that was established in 1979, with 11 wild alligators, and the new wetland area that was constructed in 2007-2012.

1.5.1. Original Breeding/Rearing Centre

The original breeding/rearing centre has increased in size from 0.67 ha in 1979 to 10.47 ha, of which 5.34 ha is water area. The facility was registered with CITES as a captive breeding operation in December 2002.

Stocks comprised 121 individuals in 1992 (Webb and Vernon 1992), 366 individuals in 2001 (Manolis 2002), 600 individuals in 2006 (Dacey 2006), and it now holds around 5000 animals.

1.5.2. Wetland Area

The original breeding/rearing centre was expanded in 2007 with the purchase of adjacent land (Liu 2013), following approval of the “Construction Programme for Releasing Chinese Alligators in Zhejiang Province” by SFA in October 2006 (Jiang 2010).

The new additional area comprises a total area of 22.88 ha, of which 9.38 ha is water area (Fig. 4). It is proposed to increase the area of the wetland by an additional 50-60 ha of Government-approved land over the next 10-20 years.



Figure 4. Restored wetlands at Changxing Chinese Alligator Nature Reserve. Photographs: (left) Pablo Siroski; (right) Lin Jian Qing.

The first release of alligators was in April 2012, and it currently holds more than 500 adult alligators, which are not fed and sustain themselves within this restored wetland. Nesting was first recorded in 2014.

Tourism is an integral part of the new facility, and it receives around 80,000 visitors per year. A museum provides information on the history of the CCANR, the conservation program, and biology of Chinese alligators. The facility is important for public education on the species. During the visit the CSG team assisted in the release of 10 alligators into the wetland (Fig. 5).



Figure 5. Museum (top left) and releasing alligators into restored wetlands at Changxing Chinese Alligator Nature Reserve. Photographs: (top left) Pablo Siroski; (top right, bottom right) Charlie Manolis; (bottom left) Lin Jian Qing.

2. Captive Stocks

According to Jiang (2010), additional alligator breeding centres have been established at Qiongsan City (Hainan Island), National Forest Park of Qiandaohu (Thousand Island Lake, Zhejiang Province), Doumen County (Guangdong Province) and Jiangying City (Jiangsu Province). Some safari parks and museums also rear *A. sinensis*.

There are currently around 28,000 *A. sinensis* in captivity in China (Wu Xiaobing, pers. comm.).

3. Wild Alligator Populations

3.1. Anhui Province

The team did not visit any of the wild alligator sites within the Anhui National Nature Reserve for Chinese Alligator (ANNRCA). However, authorities reported that the situation with alligator habitats in ANNRCA remains effectively unchanged over the last 10 years. Ponds containing alligators are small and fragmented, and adjacent to human habitation. Three types of wetland have been identified: plains (agriculture); summer pools at base of hills; and, valleys (low food abundance). All sites are threatened by pollution, agriculture and conflict with domestic animals (eg ducks) and artisanal fisheries. Overall habitat quality is low.

In 2005, a survey by John Thorbjarnarson in 7 of 13 designated sites in the ANNRCA reported 32 alligator sightings. Surveys in 2011 and 2015 reported sightings of 58 and 63 alligators respectively. The wild population is estimated to be stable and comprise 120-150 individuals.

3.2. Zhejiang and Jiangsu Provinces

For all intents and purposes the species is considered to be extinct in Zhejiang and Jiangsu Provinces.

3.3. Shanghai Province

As part of a collaborative program with the Wildlife Conservation Society (WCS), adult alligators were introduced into Dongtan Wetland Park in 2007 (N= 6; 3 dead in 2007-2009) and 2015-16 (N= 6). Nesting was recorded in 2008, 2012, 2014 and 2015, and surveys undertaken in July 2016 indicate that the population comprises 9 reintroduced adults, at least 4 adult progeny from the 3 alligators released in 2007, and up to 5 juveniles/sub-adults from nesting in 2012-2015 (Platt *et al.* 2016).

4. New Release Sites

4.1. In Anhui Province, 9 potential reintroduction sites were assessed by Lu *et al.* (2015) in April 2015. Only two sites were considered suitable - a 200 ha portion of Long Gan Lake (116.2715°E, 29.9760°N) for a small population of alligators - and Wuchang Lake (116.7846°E, 30.2621°N).

Wuchang Lake has a total area of around 10,000 ha, and parts of it (eg Saikou-Hongqi Zha, 1500 ha) would be amenable to the release of alligators, and could potentially support a sizeable population of around 800-1000 alligators (Lu *et al.* 2015). Lu *et al.* (2015) outlined a proposed plan for reintroduction of alligators into Saikou-Hongqi Zha by May-June 2017, which has been well-received by local authorities (Jiang 2016). However, final approval for the plan from SFA has not yet been received (Steve Platt, pers. comm.).

4.2. A 2000-ha wetland in Sichuan Province has yet to be assessed in detail, but is considered a potential release site. Alligators occurred in this area around 300 years ago (Fang Shengguo, pers. comm.).

4.3. None of the potential release sites examined in Zhejiang Province in 2001 (Manolis 2002) were considered suitable for the establishment of wild alligator populations, which is why wetlands were restored at Changxing (see 1.5.2. above).

5. Action Plan

At the Second IUCN World Conservation Congress in 2000, Resolution 2.62 on the Chinese alligator was passed (Annex 1). This resolution provided the impetus for China to draft the “China Action Plan for Conservation and Introduction of Chinese Alligator” and to convene an “International Workshop on Conservation and Reintroduction of Chinese Alligator” in Hefei City in 2001, which included visits to potential reintroduction sites by CSG members (eg Jenkins and Matsuda 2002; Manolis 2002; Webb 2002). The “International Workshop on Captive Breeding and Commerce Management in Crocodylia”, held in Guangzhou immediately after the workshop, provided a forum for additional input from the CSG into the draft Action Plan. The finalized Action Plan was launched by SFA in 2002.

On 14 August 2016, at Xuancheng, the Chinese delegation, including Mr. Wu (Director, GFF), presented an overview on progress with the reintroduction program in Anhui and the Chinese Alligator Action Plan generally, to the CSG team, which provided the basis for significant discussion and recommendations for future activities (see 7. below). The team was informed that a revised Action Plan was submitted to SFA about two years ago, but it has not yet been reviewed (Jiang Hongxing, pers. comm.).

6. World Congress of Herpetology (15-20 August 2016)

The location of WCH8 was changed from Hangzhou to Tonglu, about 75 km from Hangzhou, 2-3 days before the Congress was due to begin. Despite this sudden directive from the central Chinese Government, the organisers did a remarkable job of changing the venue and re-organising accommodation for participants, and the meeting went smoothly.

The Conservation Biology of Crocodylians Symposium was held on the afternoon of 17 August 2016, and comprised the following presentations:

- Zhao Lan (China): The effect of incubation temperature on sex ratio of the Chinese alligator (*Alligator sinensis*).
- Zhao Jinhong (China): Analysis on diversity of the intestinal parasites in captive Chinese alligator *Alligator sinensis* and the biological research of the new nematode *Ortleppascaris sinensis*.
- Wu Xiaobing (China): Fortune of the Chinese alligator: protecting a species on the edge of extinction for 40 years.
- Wang Huan (China): The influence of sex steroid receptors on follicular development of the Chinese alligator *Alligator sinensis*. [won a student prize].
- Ji Huang Mazák (China): A new paleolithic ecomorph of Chinese alligator (*Alligator sinensis* ssp) from Songjiang, Shanghai.
- Yan Peng (China): Phylogeny of the Order Crocodylia based on the mitochondrial genomes.
- Zhang Fang (China): Relationship between nest defence behaviours and reproductive benefits in Chinese alligators.
- Mark Merchant (USA): Crocodiles can alter skin color in response to environmental light conditions.
- Marisa Tellez (USA/Belize): Caye Crocin': population management and parasitism of *Crocodylus acutus* in Caye Caulker, Belize.
- Charlie Manolis (Australia): Sustainable use of crocodylians as a conservation tool.
- Matthew Shirley (USA/Côte d'Ivoire): Cave isolation sparks ecological and evolutionary divergence in the African dwarf crocodile (*Osteolaemus tetraspis*).
- Ruhana Hassan (Malaysia): Research notes on the wild *Tomistoma* populations in Western Sarawak, Malaysian Borneo.
- R.J. Rao (India): Long-term studies on reintroduction of Indian Gharial (*Gavialis gangeticus*) in India.
- Pablo Siroski (Argentina): Crocodylian management programs and the Argentinean experience.
- Paolo Martelli (Hong Kong): Crocodylian physiology and biology and how it relates practically to aspects of crocodylian medicine.

Hank Jenkins (CSG Vice Chair for CITES) co-chaired a symposium on Captive Breeding and Conservation Strategies for Amphibians and Reptiles, which touched on crocodylian programs. Engkamat Lading (Sarawak, Malaysia) delivered a presentation on “Roles of mythologies in crocodile conservation in Sarawak” in a session on Ethnoherpetology.

7. Conclusions and Recommendations

The number of captive alligators in China has increased significantly since the last CSG visit in 2001, with some 28,000 alligators currently held, mainly in government facilities (20,000) and privately-owned farms (7000). However, the status of the only natural wild population in the Anhui National Nature Reserve for Chinese Alligator has not improved over the last 5 years, and is currently estimated to comprise a population of 120-150 individuals (see also Jiang 2016).

The availability and quality of existing habitat appears to be a major constraint to establishing “new” wild populations through the reintroduction program. Wetland habitats continue to be restored/created at Gaojinmiao Forestry Farm (Anhui Province), where monitoring suggests a relatively high rate of survival of released animals, and

successful nesting and some recruitment. However, no attempts have been made to capture any of the released alligators or recruits in order to: assess growth rates, body condition and diet; confirm survivorship; and, quantify the proportion of alligators in the population that are sighted during surveys. The CSG team strongly recommends that serious consideration be given to quantifying these additional indices of the reintroduced population (and habitat) that are critical to assessing the success of the reintroduction program.

The program has involved considerable input from research scientists, with around 14 postgraduate students from Anhui Normal University and Zhejiang University currently involved with studies on the Chinese alligator. However, there appears to be limited experience with working with alligators in the wild (natural or introduced), particularly on ecological research. The highest (Class 1) level of protection afforded to *A. sinensis* at a national level has perhaps resulted in a somewhat precautionary approach to hands-on studies of wild (and captive) alligators. Indices to assess the success of the reintroduction program (see above) could also be applied to the natural wild alligator population in ARCCAR.

The team discussed options through which the CSG could assist China with the Chinese alligator program, including:

- a. Support and help organize training workshops in crocodylian survey, capture and other techniques (eg stomach flushing, sampling for genetic and isotope analysis) for university, forestry and farm personnel. Matt Shirley has offered to assist in this initiative.
- b. Workshop on crocodylian health assessment. Paolo Martelli has offered to assist in this initiative.
- c. The ability of Chinese students to publish their work is often more difficult due to the language barrier. The CSG-FLWG offered to assist by reviewing draft manuscripts prior to submission to journals, to ensure that English expression does not become a negative factor in the review process. Other CSG members could also be involved in this initiative. [At the time of writing one manuscript had been submitted to Matt Shirley for review].
- d. Participation at international meetings, including CSG working meetings, would expose Chinese students and other researchers working on *A. sinensis* to crocodylian researchers from around the world and encourage collaboration. We encourage our Chinese colleagues to not let this barrier impede their progress. CSG, through its Executive and Steering Committees, as well as the CSG-FLWG, could facilitate communication by acting as conduits.
- e. Communication with researchers outside China could assist Chinese researchers to understand and explore new avenues of research, etc. Again, perhaps due to the language barrier, students appear reticent to contact people outside China for advice, information exchange, internships, etc.
- f. The team discussed whether the reintroduction program could be a little “bolder” with regard to the numbers of alligators being released. Reintroductions to date have

generally involved low numbers of alligators being released at any one time, which may be appropriate in areas where habitat is limited or being restored over time (eg GFF), but other areas with considerable habitat have been identified, and there is an opportunity to potentially increase the wild population substantially over a much shorter timeframe.

Wuchang Lake is an area that is amenable to a larger-scale release, and it is currently the subject of a proposal involving WCS. The area is considered to have the potential to support a large population of alligators, and SFA is urged to consider the release of a large number of adult alligators in the first stage. Monitoring would provide valuable data that can be applied to other large reintroduction sites, including Long Gan Lake (Anhui) and Dongtan Wetland Park (Shanghai). With the captive population now comprising some 28,000 alligators, the availability of animals for release is not a limiting factor. In addition, data from other release sites (eg Dongtan Wetland Park, Hongxing Reservoir, Gaojinmiao Forestry Farm) indicate that released alligators can become established and successfully breed in the wild.

- g. ARCCAR and CCANR provide forums for public education. However, it was unclear how public education was being applied in ANNRCA, which contains the natural wild alligator population. Jiang (2016) reported that in 2015 funding was raised to enhance community co-management for three ponds in village surroundings in Jin County (Xuancheng Municipality). The CSG team suggested that a more formal public education campaign could be implemented, with specific goals to change public perceptions and strengthen community involvement (goals of the Action Plan). The CSG's Public Education and Community Participation group may be able to assist Chinese authorities with efforts to improve public education and increase community participation in the conservation of the remaining wild population in ANNRCA, but also in those areas where alligators have been reintroduced.
- h. ARCCAR and CCANR hold over 70% of the alligators held in captivity, and both are supported financially through tourism. The maintenance of large numbers of alligators in captivity requires ongoing financial support, and was one of the reasons why ARCCAR was registered as a CITES captive breeding operation in 1993, and CCANR in 2002, to provide options for producing income to support their conservation activities.

Although neither facility has really pursued the export of live animals (pets) or other products (ARCCAR is able to cull up to 20 alligators per year for food, with permission from SFA), the option is nonetheless still available. The skin of *A. sinensis* is not commercially valuable, due to the extensive bony deposits within it (Fuchs 2006), but the manufacture and marketing of a small number of products each year, specifically to raise funds for conservation of the Chinese alligator, may be worth considering in the future.

In overview, the CSG formally acknowledge the progress made with the Chinese alligator reintroduction program, urge authorities to “fast-track” the inclusion of potential release sites at Wuchang Lake (see f. above) and Long Gan Lake in Anhui Province, and a potential site in Sichuan Province, into the program. Authorities are also urged to consider larger numbers of alligators for release at sites with substantial habitat,

especially in view of the status of the wild alligator population in ARCCAR being stable.

The visit was an important learning experience for CSG-FLWG members, and is expected to lead to long-term working relationships with Chinese students and researchers. Participation at WCH8 also provided the team with an opportunity to present their work in an international forum, and to meet with other researchers and managers working with reptiles and amphibians around the world.



Figure 6. Team at Changxing Chinese Alligator Nature Reserve, prior to departure to the 8th World Congress of Herpetology. From left, Matt Shirley, Paolo Martelli, Prof. Fang Shengguo (Zhejiang University), Charlie Manolis, Mark Merchant, Marisa Tellez, Alexander Meurer and Pablo Siroski. Photograph: Lin Jian Qing.

8. Acknowledgements

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