Chinese Alligator *Alligator sinensis*

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Common Names: Chinese alligator, Yangtze alligator, tulong, yow lung

Range: Formerly widespread in Lower Yangtze River drainage, now wild Chinese alligators are limited to southeastern Anhui Province of China and a small reintroduced population in Shanghai Province.

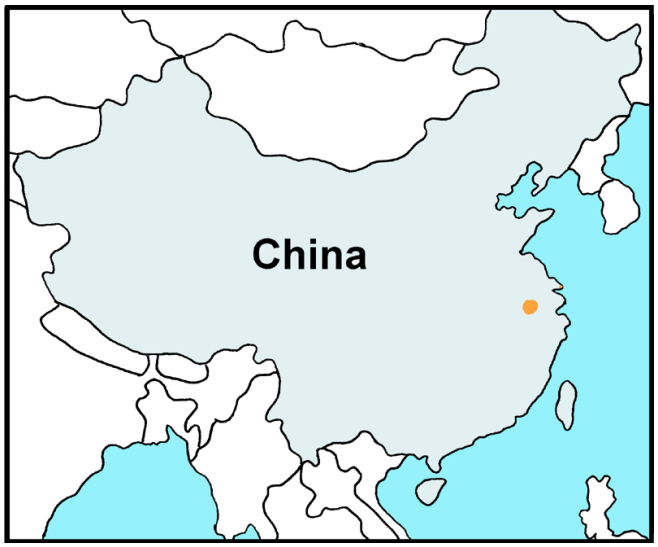

Figure 1. Current distribution of *Alligator sinensis*. Population in Shanghai Province was reintroduced.

Conservation Overview

CITES: Appendix I

2018 IUCN Red List: Critically Endangered (Criteria A1c - a decline of >80% in 3 generations in area of occupancy, D - possibly fewer than 50 wild adults) (last assessed in July 2017; Jiang and Wu 2018).

CSG Action Plan:
- Availability of survey data: Adequate
- Need for wild population recovery: Highest
- Potential for sustainable management: Moderate

Principal threats: Habitat fragmentation and degradation, natural disasters (floods and drought), limited distribution, low productivity and pollution

Ecology and Natural History

The Chinese alligator is a relatively small crocodilian with a maximum length of approximately 2 m (Brazaitis 1973). Historically more widely distributed in the lower Changjiang (also known as Yangtze) River system in southeastern China (Huang 1982; Chen *et al*. 2003), *Alligator sinensis* is currently only known from a small region in southeastern Anhui Province, and a small reintroduced population in Shanghai Province (Platt *et al*. 2016). Breeding occurs in both provinces.

Figure 2. Figure 2. Captive *Alligator sinensis*. Photograph: Wu Xiao Bing.

There are three principal habitat types in which wild *A. sinensis* are found, the classifications of which are similar to those of Watanabe *et al*. (1982).

- remnant wetlands in low, broad, fertile valleys along main river courses, dominated by paddy fields;
- intermediate ponds in low hill valleys (<100 m) but with significant agriculture in the valley above the pond; and,
- ponds situated in low hill valleys (<100 m) at the upper edge of rice cultivation and the low edge of tree plantations (Ding *et al*. 2001; Thorbjarnarson *et al*. 2002).

Because Chinese alligators occur at relatively high northern latitude, they spend a large portion of the year aestivating in subterranean burrows (Huang 1982; Huang and Watanabe 1986). The burrows can be complex, with above- and below-ground pools, and numerous air holes (Chen *et al*. 2003). The extensive use of these burrows and their very secretive behavior has allowed *A. sinensis* to inhabit wetland habitats in areas with dense human populations.

Chinese alligators usually begin to emerge from their dens to bask in May. In June, with warming temperatures, they will begin to make nocturnal sorties. Nesting occurs from early July to late August (Huang 1982), with 10-40 eggs being laid

Jiang, H., Peng, Y., Fang, Z. and Wu, X. (2019). Chinese Alligator *Alligator sinensis*. *In* Crocodiles. Status Survey and Conservation Action Plan. Fourth Edition, ed. by S.C. Manolis and C. Stevenson. Crocodile Specialist Group: Darwin. 6pp.

in a mound nest of decaying vegetation (Chen *et al*. 2003; Thorbjarnarson and Wang 2010).

Analysis of habitat characteristics of wild alligators indicates that the most significant impact on their survival is the condition of the bank (Wu *et al*. 2008). Banks with vertical slopes and which have vegetative cover provide alligators some advantage for prey ambush and digging of burrows (Wu *et al*. 2005). In addition, the position of islands is an important aspect of suitable habitat for wild alligators.

Conservation and Status

The Chinese alligator is considered one of the world's most endangered crocodilians. In 1972 the Government of China listed *A. sinensis* as a Class I endangered species, providing it with the highest degree of legal protection (Wan *et al*. 1998). Enforcement of regulations prohibiting the capture or killing of wild alligators, however, was not entirely effective, particularly during the 1970s and early 1980s (Watanabe 1982). Since 1979, Chinese alligator management has focused on captive breeding, and centers were initially established in Anhui and Zhejiang Provinces (Wan *et al*. 1998).

The Chinese alligator is a good candidate for reintroduction because wild populations are at dangerously low levels and a large captive population exists. The release of captive-reared crocodilians has been successfully used as a means of restocking or reintroducing wild populations of crocodilians (eg India, Venezuela, Argentina, Philippines), but were made possible by the existence of protected areas containing suitable habitat.

The factors most responsible for the *A. sinensis* population decline have varied over the last 50 years, but have included habitat fragmentation and degradation, hunting, natural disasters (floods and drought), geographic separation, low productivity and pollution. From the 1950s to 1990s, habitat loss and the killing of alligators were the most significant factors. Presently, killing of alligators is less of an issue, but the loss of natural habitat has been virtually complete. Therefore, the highest priority for the conservation of *A. sinensis* is habitat restoration as the first step towards reintroduction of captive-bred individuals. In addition, the potential consequences of environmental pollution and reduced genetic diversity of the wild population must be addressed (Ding *et al*. 2004).

After the International Workshop on Conservation and Reintroduction of Chinese Alligator (SFA 2002), the State Forestry Administration (SFA) issued the "China Action Plan for Conservation and Introduction of Chinese Alligator" in 2002. The species was also listed as the one of 15 prior species of National Wildlife Conservation Project in the Tenth-Five Year Plan. Since then, the Chinese Government has paid more attention to the protection and management of wild populations and their habitats, as well as speed up release projects.

To strengthen captive breeding and commerce management of crocodilians in China, the Guangzhou Advocation was issued at the International Workshop on Captive Breeding and Commerce Management in Crocodylia (Guangzhou, Guandong Province, China; 30 August-3 September 2001). This workshop also considered the deliberations of the International Workshop on Conservation and Reintroduction of Chinese Alligator (Hefei City, Anhui Province, China; 25-28 August 2001) (SFA 2002).

- Anhui Province

  By the late 1980s, wild *A. sinensis* remained only in Anhui Province, principally in small ponds in agricultural valleys and hills in 5 counties (Nanling, Jingxian, Guangde, Langxi, Xuancheng), which together comprise the 43,300-ha Anhui National Nature Reserve for Chinese Alligator (ANNRCA). Established in 1982 and promoted as the national nature reserve in 1986, the ANNRCA includes 13 protected sites that contained virtually all the remaining areas with wild Chinese alligators.

  The Anhui Research Center for Chinese Alligator Reproduction (ARCCAR), established in 1979, is the oldest and largest facility, and serves as the administrative center for alligator management in Anhui Province (Zhou *et al*. 2012). ARCCAR was stocked in 1981-82 with 212 wild individuals. Of these, 160-170 were still alive in 1990. Wild eggs (787 in total) were also collected between 1982 and 1985. Captive breeding has been very successful, with the first F2 generation produced in 1988 and the first F3 produced in 1998. By 2012, some 15,000 alligators were held, and 1000-1500 hatchlings were being produced annually (Zhou *et al*. 2012). Stocks in 2016 were reported to be around 15,000 alligators (Manolis *et al*. 2016).

  In 1992 the ARCCAR facility was registered with CITES as a captive breeding operation (see Webb and Vernon 1992). The primary intentions expressed at the time of registration were to provide alligators for local meat consumption and live animals for the European pet market. Income from the trade of captive-bred alligators was mainly used to maintain and continue captive breeding and conservation activities.

  To mitigate the pressure of the large captive population, the SFA provided $US1.2 million and the Anhui Provincial Government co-financed about $US0.74 million in 2003, for ARCCAR to construct two new breeding areas with the area of 1.6 ha, and reinforce the existing fence (length of 3500 m to be more than 3 m high). To effectively protect and manage the current wild Chinese alligators and their habitats in Anhui Province, the State Council of China approved the range adjustment of the current ANNRCA to 18,565 ha, to benefit control of habitat destruction/alteration, reinforce the wild population, create habitat corridors for isolated sites, and mitigation of conflicts between natural protection and community development.

  The ANNRCA initiated reintroductions in 2001. In 2003, three captive-reared alligators were released at one of the

protected sites - Hongxing Reservoir. Monitoring results indicated successful breeding in 2004 and 2005 (Jiang *et al*. 2006). An additional reintroduction site, Gaojingmiao Forest Farm (GFF), was evaluated and identified as a reintroduction site by international and national crocodile experts in 2001 (Matsuda and Jenkins 2002). Between 2005 and 2015, a total of 313.9 ha of habitat (50 ponds) had been constructed and restored in ANNRCA, together with 16 artificial breeding pens housing alligators for future release. From 2003 to 2017, the ANNRCA had carried out 13 releases, with 102 captive-bred alligators being released into the wild. Released alligators started to breed at GFF in 2008, and by 2015 a total of 8 nests containing 158 eggs had been found at the site. However, thick vegetation makes locating nests difficult, and the full extent of nesting to date is unknown.

Figure 3. Reintroduction site at Gaojingmiao Forest Farm. Photograph: Yan Peng.

Dajiang Alligator Farm, a privately-owned facility in Wuhu, was established in 2011 with 200 adults (1M:3F) from ARCCAR. By 2016 it was producing around 1300 hatchlings per year, and Manolis *et al*. (2016) reported stocks of around 5000 alligators of different ages. Tourism is the main goal for this farm.

Outside the ANNRCA, including all sites where alligators were previously found bordering the Yangtze River (Wuhu, Ningguo and Dangtu counties), ARCCAR staff report alligators were extirpated over the last 20 years. Despite establishment of the ANNRCA, the wild population has continued to decline, and current population estimates are <25% of 1980s levels. Results of population surveys over time can be summarized as:

- In the early 1980s, surveys in Anhui Province estimated the wild *A. sinensis* population to be at least 300 individuals, comprised mostly of juveniles or sub-adults [Watanabe, cited in Groombridge (1982)].
- In 1985 and 1987, a more extensive survey of 129 villages (423 bodies of water) in the ANNRCA was organized by ARCCAR, and the population was estimated as 735 individuals. Based on this estimate, and that between 1979 and 1983, 212 wild *A sinensis* were collected to stock the ARCCAR, it is likely that around 1000 wild *A sinensis* were in Anhui Province during the late 1970s.
- In 1994, the total population was estimated to be 667-740 individuals, based on the assumption that only one-third of the sites within the ANNRCA were surveyed (Li *et al*. 1996). But because the key locations actually known to have Chinese alligators were visited, the validity of this extrapolation is questionable and the population figure is most likely an overestimate.
- In 1997 the population was estimated to have been reduced to approximately 400 animals (Wan *et al*. 1998), but no details were provided.
- Thorbjarnarson *et al*. (2002) provided data indicating the total wild population had declined from approximately 1000 alligators in the late 1970s to the current estimate of ≥130.
- The population appeared to have stabilized between 1998 and 2003 (Ding *et al*. 2004).
- Counts of 23, 22, 20, 32, 58 and 63 wild Chinese alligators were recorded during spotlight surveys in the ANNRCA in 1999, 2002, 2003, 2005, 2011 and 2015, respectively (Thorbjarnarson *et al*. 2002; Ding *et al*. 2004; Wu *et al*. 2008; ANNRCA 2015). The most recent survey in July-August 2015 indicated the total number to be around 136-173 individuals (ANNRCA 2015), distributed among 18 fragmented habitats (ponds), and that the wild population was stable in most sites and increasing in the protection site of Changle.

Of 9 potential reintroduction sites assessed by Lu *et al*. (2015), only two were considered suitable - a 200-ha portion of Long Gan Lake for a small population of alligators, and Wuchang Lake. 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. 2016).

- Zhejiang Province

Yingjiabian Village Farm Reserve was established as a breeding/rearing centre in 1984 at Yingjiabian, and operated by the local cooperative until 2001, when management was taken over by the Changxing Forestry Bureau. In 2003 the SFA provided $US0.6 million and the Changxing Government co-financed $US0.9 million to facilitate infrastructure and wetland restoration, and the "Construction Programme for Releasing Chinese Alligators in Zhejiang Province" was approved by the SFA in October 2006.

Renamed as the Changxing Chinese Alligator Nature Reserve (CCANR), it currently comprises the original breeding/rearing operation (10.5 ha; 5000 alligators in 2016) and open semi-natural wetland area into which alligators were first introduced in 2012 (22.9 ha; >500 alligators in 2016). An additional 50-60 ha of wetland

are proposed to be developed over the next 10-20 years. Alligators in the wetland area are not fed, and sustain themselves, and nesting was first recorded in 2014. Tourism is an integral part of the CCANR, and includes a museum that provides information on the alligator conservation program.

A small breeding centre at the National Forest Park of Oiandaohu (Thousand Island Lake) was established with 10 alligators from CCANR (Webb and Vernon 1992).

For all intents and purposes the species is considered to be extinct in the wild in Zhejiang Province. None of the potential release sites examined in 2001 (Manolis 2002) were considered suitable for the establishment of wild alligator populations, leading to the focus on restoring wetlands at CCANR.

- Jiangsu Province

  Chinese alligators are considered to be extinct in the wild in Jiangsu Province. Tangshan Alligator Farm, a privately-owned facility in Nanjing, was reported to hold around 2000 alligators in 2016 (Manolis *et al*. 2016).

- Shanghai Province

  The Wildlife Conservation Society (WCS) has collaborated with the Shanghai Forestry Bureau to release 6 captive-reared alligators into Dontang Wetland Park in 2007, and 6 alligators in 2015-16. Nesting has been recorded in 2008, 2012, 2014 and 2015. Surveys undertaken in July 2016 indicate that the population comprised 9 reintroduced adults, at least 4 adult progeny from the 3 surviving alligators released in 2007, and up to 5 juveniles/sub-adults from nesting in 2012-2015 (Platt *et al*. 2016).

- Sichuan Province

  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. 2016).

- Other

  Additional breeding centers have been established at Hainan Island (Qiongshan City), Guandong Province (Doumen County) and Jiangsu Province (Jiangying City). In addition, some small-scale safari parks, museums and captive-breeding farms also rear *A. sinensis* (eg Chongqing and Shanghai Municipalities).

  Captive breeding of Chinese alligators has also been achieved at the Bronx Zoo (New York), St. Augustine Alligator Farm (Florida), and Rockefeller Refuge (Louisiana) in the USA. Specimens are held in zoos and private holdings outside of China, and studbooks are maintained for the USA and Europe (Jensch 2008).

Figure 3. Captive-bred *Alligator sinensis* hatchlings. Photograph: Wu Xiao Bing.

All of these cases indicate that captive-reared *A. sinensis* can adapt to restored habitats quickly and recover breeding capacity in the wild.

Priority Projects

High priority

1. **Conservation and restoration of natural habitats**: In the current distribution of *A. sinensis* in Anhui Province, measures are needed to improve and maintain ecosystem integrity. Through the State policy of returning farmland to wetlands, ANNRCA should have ownership of the core protection areas. In the historical range, at least 4-5 potential habitats owned by official forestry organizations should be considered as the highest priority for restoration for future release of alligators.

2. **Wild population monitoring**: Regular, systematic monitoring (eg surveys and nest counts) for the known wild populations is required to determine population trends and assess the success of conservation efforts.

3. **Evaluation of current release projects**: To date, captive-bred Chinese alligators have been released at three different habitats in Hongxing Reservoir, Gaojingmiao Forest Farm (Anhui), Chongming Island (Shanghai), Changxing (Zhejiang). At Gaojingmiao Forest Farm, monitoring of released alligators using radio-telemetry is still ongoing, but at the other sites it was discontinued due to lack of funding. Based on the evaluation of these experimental releasing projects, the technical specification of reintroduction for Chinese alligator should be defined as far as possible, which can provide a good understanding of the ecological requirements for future release projects.

4. **Identification and assessment of potential future release sites**: With a captive population of around 28,000 alligators in 2016, the availability of animals for release is not a limiting factor. However, the availability of suitable natural habitats is limited. Potential reintroduction sites identified to date should be assessed and included in release programs, and other future reintroduction sites identified.

Moderate priority

5. **Maintenance and management of captive populations**: Captive *A. sinensis* populations, both within and outside China, are the current repository of most of the individuals and most of the genetic diversity of this species. These populations should be managed in a manner that ensures maximum genetic diversity and the maintenance of an adequate founder base for the future. To this end the managers of the various captive collections should communicate and cooperate in matters of information and studbook maintenance, exchange of captive specimens and husbandry technology, etc. It is suggested that a comprehensive pedigree system covering the whole state should be established in the future.

6. **Diet**: Understanding the diet of wild Chinese alligators can assist in the design and establishment of restored habitats, and allow the status of nutrition and growth in wild alligators to be quantified in a more meaningful manner.

7. **Public education and community co-management**: With many of the surviving wild Chinese alligators located in human-made habitats in close proximity to dense human populations, the role of public education is an important one. Efforts are needed, perhaps through a formal public education program (Manolis *et al*. 2016) and community co-management, to emphasize the protected status of the alligator and enforce existing protective legislation. Emphasis on how to live in perfect harmony with alligators is vital to this program, and developing a respect for the alligators. By establishing the eco-compensation system, it is supposed to reduce the conflicts between ecological conservation and living of local villagers.

Acknowledgements

J. Perran Ross and Charlie Manolis provided valuable input into this plan.

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