Short Communication

Evidence for the massive scale of turtle farming in China

Shi Haitao, James F. Parham, Fan Zhiyong, Hong Meiling and Yin Feng

Abstract One of the main threats to the survival of Asian turtles is the demand in China for turtles for use as food and medicine products. As the demand for turtle products escalated over the past 20 years entrepreneurs initiated commercial breeding facilities for profit. To gain a better understanding of the scale of the captive turtle trade we conducted a survey of the 1,499 large turtle farms known by branch offices of the Endangered Species Import and Export Management Office and the Provincial Forestry Bureaus. The results from the 684 respondent farms (46%) indicated that a total of >300 million turtles are sold per year and are worth *c*. USD 750 million. Although the bulk of these figures comprise the common Chinese softshell turtle *Pelodiscus sinensis* many other species are also farmed, including Critically Endangered species and even species native to North America. As 54% of known farms did not respond to our survey we suggest that the trade in captive turtles is probably a multi-billion dollar industry. This is likely considering that many Chinese turtle farms operate covertly and are thus impossible to survey. The large scale of turtle farming in China raises questions about the impact of so many threatened turtles being bred and sold for profit. Because the commercial breeding of these species is so well developed and large in scale, the deleterious impact is serious and difficult to control.

Keywords Aquaculture, Asia, captive breeding, China, freshwater turtle, trade.

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Asia has a diverse and imperiled turtle fauna (van Dijk *et al*., 2000), the main threat to which is the high demand in China for turtles as food and medicine (Li & Li, 1998; van Dijk *et al*., 2000). Although the Chinese have used turtle products for thousands of years, economic reforms in the last 25 years have dramatically increased the demand for luxury items such as turtles. A corollary of this increased demand is that turtles command a high price, and this has encouraged entrepreneurs to develop farms in China. Some large-scale freshwater turtle and tortoise farms in Guangxi, Guangdong and Hainan Provinces were established in the 1980s (Shi & Parham, 2001), and the number of new freshwater turtle farms increased steadily from 1990 onwards. Some companies have invested large sums of money to establish large-scale commercial turtle farms. Although early efforts focused almost exclusively on the Chinese softshell *Pelodiscus sinensis* (Chen *et al*., 2000), the farm output of this species has now satiated demand. Consequently, farms have started to rear more valuable hard-shelled turtles, especially the three-line box turtle *Cuora trifasciata* and species of Chinese stripe-necked turtles *Mauremys* (*M. mutica*, *M. reevesii* and *M. sinensis*).

The captive breeding of freshwater turtles and tortoises in China is different from that in western countries, where turtle breeders raise small numbers of many species, primarily for pets, and the techniques of captive breeding are exchanged freely (Artner & Loehr, 2006). In China most turtle farmers raise large quantities of a few species, primarily for food and medicine, and seldom exchange information because of intense competition. The farmers are also reluctant to make their practices known because they are concerned about revealing

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Table 1 Summary of respondents' claims in a survey of 684 of the 1,499 officially recognized turtle farms in China for the 11 most commonly reared and easily identified species (for complete survey results see Appendices), with their IUCN global Red List status (IUCN, 2007).

Species (by Family)	Captive population size[1]	Individuals for sale (yr^{-1})	Weight for sale yr^{-1} (kg)	Estimated value of individuals for sale yr^{-1} (USD)	Red List status[2]
Softshell species (Trionychidae)					
Pelodiscus sinensis	303,076,700	124,849,800	91,382,300	685,367,300	VU
Palea steindachneri	252,600	80,700	52,300	784,500	EN
Aquatic hard-shelled species (Geoemydidae)					
Mauremys reevesii	2,796,000	565,800	320,300	6,406,000	EN
Mauremys sinensis	1,487,400	1,804,400	885,700	13,285,500	EN
Mauremys mutica	229,500	45,700	25,800	2,580,000	EN
Cuora trifasciata	115,900	20,600	21,100	36,925,000	CR
Terrestrial species (Geoemydidae)					
Cuora mouhotii[3]	140,100	50,000		1,600,000	EN
Geoemyda spengleri[3]	26,100	10,000		100,000	EN
Non-native species (Emydidae and Chelydridae)					
Trachemys scripta elegans	941,400	500,100	205,300	2,053,000	LR/nt
Chelydra serpentina	32,000	4,100	2,300	103,500	VU
Macrochelys temminckii	4,700	1,600	2,800	105,000	VU

[1]Includes individuals for sale per year plus the breeders and reared individuals
[2]CR, Critically Endangered; EN, Endangered; VU, Vulnerable; LR/nt, Lower Risk: near threatened
[3]Terrestrial species that are sold by the individual, and therefore weight is irrelevant

commercial secrets or having their turtles stolen. A consequence of this secrecy is that the existence of Chinese turtle farms is not fully appreciated, and it is therefore often assumed that most turtles in food markets and the pet trade come from the wild (Salzberg, 1998; Barzyk, 1999). As recently as 2002, when the data presented here were gathered, many western herpetologists still doubted the existence of large-scale turtle farms in China (H. Shi & J.F. Parham, pers. obs.). A deeper knowledge of the scale and scope of Chinese turtle farms is an important step towards understanding China's role in the Asian turtle crisis.

To gather data on the scale of captive breeding of turtles in China we surveyed Chinese turtle farms with questionnaires in 2002. The surveys included questions about the number of species and individuals bred, as well as their estimated annual yield. The survey was distributed to branch offices of the Endangered Species Import and Export Management Office of China and local Provincial Forestry Bureaus. These offices forwarded our survey to each of the 1,499 large breeding facilities on record (excluding numerous smaller breeding operations), compiled the results, and sent a final summary report to us.

We received 684 reports from 15 Chinese provinces, mainly from central and southern China (especially Guangdong, Guangxi, Hunan and Hainan provinces). SH then surveyed 12 farms in Hainan, Guangxi and Zhejiang to verify the scale of farming and species bred through personal observations and interviews.

The questionnaire survey indicated that most native species of freshwater turtles and tortoises are bred in some Chinese turtle farms. However, it became clear from the follow-up surveys that it is difficult for turtle farmers to correctly identify every species they maintain, especially the rarer taxa. For this reason we list only the 11 most commonly reared and easily identified species in Table 1 (for full data, see Appendices). The total number of commercial individuals reared of these 11 species, all of which are on the IUCN Red List (IUCN, 2007), is >300 million, with an estimated sale value of *c.* USD 750 million. Most species (especially *M. reevesii*, *M. mutica*, *C. trifasciata* and *Palea steindachneri*) are farmed for ingredients for food and medicine, whereas terrestrial species (e.g. *Cuora mouhotii* and *Geoemyda spengleri*) are bred at smaller scales to supply the pet trade. Some exotic species are also bred. The North American red-eared slider *Trachemys scripta elegans* has been introduced since 1986 and is now bred in large numbers (Shi, 2002). Recently, the North American alligator snapping turtle *Macrochelys temminckii* has become popular because of its high meat yield, quick growth and high reproductive output but the reported numbers in 2002 were still low (Table 1).

Our results represent evidence for the massive scale of turtle farming in China. Prior to this study the only values known for the captive turtle industry in this region were restricted to a report on the utilization of chelonian products in Taiwan that included some data on the annual production of the Chinese softshell turtle

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P. sinensis during 1966-1997 (Chen *et al*., 2000), which reported annual numbers ranging from 6,000 kg (in 1966) to a maximum of >2 million kg (in 1997). In 2002 the 684 turtle farms we surveyed sold over 91 million kg of *P. sinensis* to internal wholesale markets. Clearly, the scale of the turtle farming within China is massive and far surpasses that reported in any other part of Asia. While the massive scale of this industry is possibly surprising, the reason it exists is obvious: China is by far the largest consumer of turtle products (van Dijk *et al*., 2000).

Because of the black market turtle trade and the secrecy of many Chinese turtle farmers the figures we have reported are almost certainly lower than the real figures (54% of farmers did not respond to our survey). A direct extrapolation of the 684 respondent values to all 1,499 farms gives an estimate that captive turtles in China in 2002 generated revenue >USD 1.3 billion. The full value of turtle farms, including non-commercial individuals (i.e. also including breeding individuals and those being reared) must be several billion USD. Even these extrapolations should be considered conservative estimates because most farms operate illegally and are therefore not known by the Provincial Forestry Bureau for Endangered Species Import and Export Management Office (Shi *et al*., 2004).

Whatever the exact value of the trade, our estimate of the number and value of turtles in captivity in China is extremely high. Although these data were collected in 2002 our ongoing contact with turtle farmers has not indicated any decrease in the scale of the industry. The captive breeding of turtles in China could deflect unsustainable trade pressures away from wild populations of turtles (van Dijk, 2000), especially those imported from other countries. However, turtle farms are a confounding problem for the conservation of Chinese turtle populations. In addition to the problems highlighted by Shi *et al*. (2007), the massive scale of turtle farming in China means that we can no longer take market surveys as direct evidence for the scale of harvesting for some species (Shi, 2002; Shi *et al*., 2004).

The impact of widespread turtle farming on wild populations of Chinese turtles is poorly understood. Issues such as the replenishment of breeding stock from the wild (true farming vs ranching), the impact on the availability of and demand for turtle products, the increased use of non-native species, and the likelihood of genetic pollution (Parham & Shi, 2001; Parham *et al*., 2001) all diminish the effectiveness of turtle farms as a potential conservation resource (Shi *et al*., 2007). Given the scale of the captive turtle trade in China, the deleterious effect on the conservation of wild species must be proportionately large. Instead of attempting to co-opt the captive breeding of threatened turtles for profit to conservation, we agree with Gong *et al*. (2006) who strongly advocate the establishment of protected natural areas to preserve the few remaining populations of wild Chinese turtles.

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References

Artner, H. & Loehr, V. (eds) (2006) *Proceedings of the Turtle and Tortoise Symposium, Vienna 2002*. Chimaira Verlag, Frankfurt am Main, Germany.

Barzyk, J. (1999) *Turtles in Crisis: The Asian Food Markets*. Http://www.tortoisetrust.org/articles/asia.html [accessed 26 June 2006].

Chen, T.H., Lin, H.-C. & Chang, H.-C. (2000) Current status and utilization of chelonians in Taiwan. In *Asian Turtle Trade: Proceedings of a Workshop on Conservation and Trade of Freshwater Turtles and Tortoises in Asia* (eds P.P. van Dijk, B.L. Stuart & A.G.J. Rhodin), pp. 45–51. Chelonian Research Foundation, Lunenberg, USA.

Gong, S., Wang, J., Shi, H., Song, R. & Xu, R. (2006) Illegal trade and conservation requirements of freshwater turtles in Nanmao, Hainan province, China. *Oryx*, **40**, 331–336.

IUCN (2007) *2007 IUCN Red List of Threatened Species*. IUCN, Gland, Switzerland & Cambridge, UK [http://www.iucnredlist.org, accessed 6 November 2007].

Li, Y. & Li, D. (1998) The dynamics of trade in live wildlife across the Guangxi border between China and Vietnam during 1993-1996 and its control strategies. *Biodiversity and Conservation*, **7**, 1–20.

Parham, J.F., Simison, W.B., Kozak, K.H., Feldman, C.R. & Shi, H. (2001) New Chinese turtles: endangered or invalid? A reassessment of two species using mitochondrial DNA, allozyme electrophoresis, and known locality specimens. *Animal Conservation*, **4**, 357–367.

Parham, J.F. & Shi, H. (2001) The discovery of *Mauremys iversoni*-like turtles at a turtle farm in Hainan Province, China: the counterfeit golden coin. *Asiatic Herpetological Research*, **9**, 71–77.

Salzberg, A. (1998) The Chinese turtle problem. *Reptilia*, **22**, 14–17.

Shi, H. (2002) Results of turtle market surveys in Chengdu and Kunming. *Turtle and Tortoise Newsletter*, **6**, 15–16.

Shi, H., Fan, Z., Yin, F. & Yuan, Z. (2004) New data on the trade and captive breeding of turtles in Guangxi Province, South China. *Asiatic Herpetological Research*, **10**, 126–128.

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Shi, H. & Parham, J.F. (2001) Preliminary observations of a large turtle farm in Hainan Province, People's Republic of China. *Turtle and Tortoise Newsletter*, **3**, 4–6.

Shi, H., Parham, J.F., Lau, M. & Chen, T.-H. (2007) Farming endangered turtles to extinction in China. *Conservation Biology*, **1**, 5–6.

van Dijk, P.P. (2000) The status of turtles in Asia. *Chelonian Research Monographs*, **2**, 15–23.

van Dijk, P.P., Stuart, B.L. & Rhodin, A.G.J. (eds) (2000) *Asian Turtle Trade: Proceedings of a Workshop on Conservation and Trade of Freshwater Turtles and Tortoises in Asia*. Chelonian Research Foundation, Lunenberg, USA.

Appendices

The appendices for this article are available online at http://journals.cambridge.org

Biographical sketches

Shi Haitao has researched aspects of the ecology, status, conservation and trade of Chinese turtles for 15 years. James F. Parham has been working in China since 1999, mainly investigating anthropogenic impact on the systematics and distribution of endangered turtles. Fan Zhiyong has studied and worked in wildlife management and conservation for 25 years and has carried out research on the protection of threatened species, nature reserves, wildlife trade, international laws and wildlife farming. For the last 5 years Hong Meiling has studied several aspects of the nutrition and captive breeding of Chinese turtles. Yin Feng directs wildlife conservation programmes, focusing on the domestic trade of turtles, snakes, wild birds, the Chinese pangolin, and other wildlife along the heavily trafficked border between China and Vietnam.

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