First human-caused extinction of a cetacean species?

Samuel T. Turvey1, Robert L. Pitman2, Barbara L. Taylor2, Jay Barlow2, Tomonari Akamatsu5, Leigh A. Barrett4, Xiujiang Zhao1,6, Randall R. Reeves7, Brent S. Stewart8, Kexiong Wang9, Zhuo Wei10, Xianfeng Zhang11, L. T. Pusser2, Michael Richlen9,10, John R. Brandon11 and Ding Wang5,6

1 Institute of Zoology, Zoological Society of London, Regent’s Park, London NW1 4RY, UK
2 NOAA Fisheries, Southwest Fisheries Science Center, La Jolla, CA 92037, USA
3 NRIFE, Fisheries Research Agency, Hasaki, Kamisu, Ibaraki 314-0408, Japan
4 Baiji.org Foundation, Kloobachstrasse 106, 8032 Zurich, Switzerland
5 Chinese Academy of Sciences Graduate School Beijing 100039, China
6 Okapi Wildlife Associates, Hudson, Quebec, Canada J0P 1H0
7 Hubbs-SeaWorld Research Institute, 2595 Ingram Street, San Diego, CA 92109, USA
8 PO Box 122, West End, NC 27376, USA
9 Department of Zoology, University of Hawai‘i, Edmondson 152, Honolulu, HI 96822, USA
10 University of Washington, School of Aquatic and Fisheries Sciences, Box 355020, Seattle, WA 98195, USA
11 Author for correspondence (wangd@shh.ac.cn).

1. INTRODUCTION

The Yangtze River dolphin or baiji (Lipotes vexillifer), an obligate freshwater odontocete known only from the middle-lower Yangtze River system and neighbouring Qiantang River in eastern China (figure 1), has long been recognized as one of the world’s rarest and most threatened mammal species (e.g. Chen et al. 1980; Holm & Hua 1989; Lin et al. 1985; Zhou & Li 1989; Zhou et al. 1998; Würsig et al. 2000; Zhang et al. 2003). Baiji have not been seen in the Qiantang River since the 1950s (Smith et al. 2000), and Chinese scientists reported a steady rapid decline in the Yangtze through the 1980s and 1990s from an estimated 400 individuals in 1979–1981 (table 1). Surveys during 1997–1999 provided a minimum estimate of only 13 animals (Zhang et al. 2003). The last authenticated baiji records were of a stranded pregnant female found in 2001 and a live animal photographed in 2002, although a few more recent unverifiable sightings have been reported by fishermen to reserve managers in National and Provincial Baiji Reserves along the Yangtze (see electronic supplementary material).

A range of anthropogenic extinction drivers (e.g. boat collisions, dam construction), which also threaten freshwater cetaceans in other river systems (e.g. Smith et al. 2000), have been implicated in the baiji’s precipitous decline. However, the primary factor was probably unsustainable by-catch in local fisheries, which use rolling hooks, nets (gillnets and fyke nets) and electro-fishing (Zhou & Wang 1994; Zhou et al. 1998); similar by-catch constitutes the principal cause of mortality in many populations of small cetaceans worldwide (Reeves et al. 2003). Although relatively few data are available on baiji mortality, at least half of all known baiji deaths in the 1970s and 1980s were caused by rolling hooks and other fishing gear, and electro-fishing accounted for 40% of baiji deaths recorded during the 1990s (Lin et al. 1985; Chen & Hua 1989; Zhou & Li 1989; Zhou & Wang 1994; Zhou et al. 1998; Zhang et al. 2003). Harmful fishing practices are still widespread and may be increasing in the Yangtze, despite national legislation banning the use of rolling hooks, electro-fishing and fyke nets, and repeated recommendations for more effective regional regulation (Zhou et al. 1998). Establishment of a closely monitored ex situ baiji population in a semi-natural reserve has been consistently advocated by scientists and policy makers as an essential short-term goal for continued survival of the species (Chen & Hua 1989; Zhou et al. 1998; Zhang et al. 2003).

2. MATERIAL AND METHODS

We made a systematic visual and acoustic survey for baiji from Yichang to Shanghai in two independently operating research vessels travelling at average speeds of 15 km/h, covering the in-channel distance of 1669 km twice between 6 November and 13 December 2006 (figure 2; see electronic supplementary material). The survey was designed both to maximize the probability of finding baiji and to estimate the abundance of the Yangtze finless porpoise (Neophocaena phocaenoides asiaeorientalis), the other cetacean present in the river system. The line-transect sampling design was adapted from that of standard marine cetacean surveys (Wade & Gerrodette 1993; Barlow 1995). Methods used for this survey were generally consistent with previous freshwater cetacean survey recommendations (Zhou & Hua 1989; Vidal et al. 1997; Smith & Reeves 2000), although variations from an ideal design (e.g. zigzag transects for mid-channel coverage) were necessary owing to navigational and logistical constraints.
We did not survey Dongting and Poyang Lakes, two large water bodies appended to the main Yangtze channel which were also part of the baiji’s historical range, because they are surveyed by Institute of Hydrobiology staff every three months, and baiji have not been seen in either lake since the 1970s (Chen et al. 1997).

3. RESULTS

The lack of any baiji sightings or acoustic recordings in the Yangtze during this survey forces us to conclude that the species is now likely to be extinct. While it is conceivable that a couple of surviving individuals were missed by the survey teams, our inability to detect any baiji in the main channel of the river despite this intensive search effort indicates that the prospect of finding and translocating them to an ex situ reserve has all but vanished. The continued deterioration of the Yangtze ecosystem means that the species has no hope of even short-term survival as a viable population in the river, if it has not already disappeared.

4. DISCUSSION

The baiji is the only recent representative of the Lipotidae, a clade that diverged from other cetacean lineages more than 20 Myr ago (Nikaido et al. 2001). Its extinction represents the loss of a disproportionately large amount of mammalian evolutionary history (Isaac et al. 2007), and only the fourth disappearance of an entire mammal family since AD 1500 (MacPhee & Flemming 1999). It also represents the first documented global extinction of a ‘mega-faunal’ (greater than 100 kg) vertebrate for over 50 years, since the disappearance of the Caribbean monk seal (Monachus tropicalis) in the 1950s (MacPhee & Flemming 1999), and the first such species extinction since the emergence of an international network of conservation organisations that have tended to prioritise conservation efforts on charismatic vertebrates.

Indeed, despite intensive historical persecution of marine mammals, very few cetacean populations have been extirpated (e.g. Atlantic population of gray whale Eschrichtius robustus), and the baiji is the first cetacean species known to have been driven to extinction by human activity. The vaquita or Gulf of California porpoise (Phocoena sinus) is now the world’s most Critically Endangered cetacean species; incidental mortality in fishing gear is again the major threat, and the future of this species is uncertain (Rojas-Bracho et al. 2006).

Unlike most historical-era extinctions of large-bodied animals, the baiji was the victim not of active persecution but of incidental mortality resulting from massive-scale human environmental impacts,

Table 1. Baiji population counts and estimates based on surveys carried out from 1979 to 1999 (after Zhang et al. 2003). (S, single vessel survey; M, multi-vessel survey; B, observation from riverbank; P, opportunistic photo-identification of individual animals was possible.)

<table>
<thead>
<tr>
<th>year</th>
<th>survey area</th>
<th>survey method</th>
<th>no. of boats</th>
<th>no. of km surveyed</th>
<th>no. of surveys</th>
<th>no. of baiji sighted</th>
<th>estimated baiji population</th>
<th>reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1979</td>
<td>Wuhan–Chenglingji</td>
<td>S</td>
<td>1</td>
<td>230</td>
<td>1</td>
<td>19</td>
<td>—</td>
<td>Chen et al. (1980)</td>
</tr>
<tr>
<td>1979</td>
<td>Nanjing–Taiyangzhou</td>
<td>S</td>
<td>1</td>
<td>170</td>
<td>2</td>
<td>10</td>
<td>—</td>
<td>Zhou et al. (1980)</td>
</tr>
<tr>
<td>1978–1985</td>
<td>Yichang–Nantong</td>
<td>S</td>
<td>1</td>
<td>1600</td>
<td>9</td>
<td>&gt;20 groups</td>
<td>156</td>
<td>Lin et al. (1985)</td>
</tr>
<tr>
<td>1979–1986</td>
<td>Fujiangsha–Hukou</td>
<td>S</td>
<td>1</td>
<td>630</td>
<td>18</td>
<td>78–79</td>
<td>100b</td>
<td>Zhou &amp; Li (1989)</td>
</tr>
</tbody>
</table>

a one large vessel plus four to six small boats.

b lower reaches only.
primarily uncontrolled and unselective fishing. Its extinction merely reflects the latest stage in the progressive ecological deterioration of the Yangtze region, home to approximately 10% of the world’s human population (Zhou et al. 1998). During the survey, we counted a minimum of 19,830 large shipping vessels (more than one vessel per 100 m of river surveyed) and 1175 fishing vessels as minimum estimates of boat traffic between Yichang and Shanghai, and also observed illegal fishing activities daily along the river. Many other endemic species (e.g. the 7 m Chinese paddlefish *Psephurus gladius*, not reported since 2003) are similarly on the verge of extinction or may be extinct, and the sympatric Yangtze finless porpoise is also experiencing a rapid decline (Zhang et al. 2003); this subspecies has been classified as Endangered by IUCN (The World Conservation Union) since 1996, and its isolation was confirmed as Critically Endangered by IUCN since 2003). This subspecies has been classified as Critically Endangered by IUCN (The World Conservation Union) since 1996, and its isolation was confirmed as Critically Endangered by IUCN since 2003). Furthermore, despite extensive debate and a series of international workshops over more than two decades, little effort was ever made to implement the ex situ recovery programme. The baiji’s probable extinction serves as a potent reminder to conservationists that even large charismatic and nominally protected animals are still in grave danger of being lost; species cannot be expected to save themselves, and intervention may need to be swift and decisive.

The Yangtze Freshwater Dolphin Expedition 2006 was co-organized by the Institute of Hydrobiology, Chinese Academy of Sciences, the Administrative Committee of Changjiang Fisheries Resource of the Ministry of Agriculture of China, and the baiji.org Foundation. Sponsorship was provided by SeaWorld-Busch Conservation Fund, Budweiser Wuhan, Amheuser-Busch, Inc., SGS, DEZA, BAFU, Manfred Hermsen Stiftung Foundation, Hubbs-SeaWorld Research Institute, the Hubbs Society and Ocean Park Conservation Foundation Hong Kong.


---

**Figure 2.** November–December 2006 survey route, covering entire historical distribution of baiji in the main Yangtze channel.


