First human-caused extinction of a cetacean species?

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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; Chen & 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.

Keywords: baiji; China; extinct; Lipotes vexillifer; river dolphin; Yangtze
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,
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