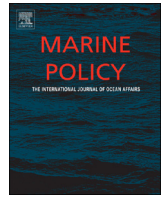




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Strandings, bycatches and injuries of aquatic mammals in China, 2000–2006, as reviewed from official documents: A compelling argument for a nationwide strandings programme

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ABSTRACT

In the present study, the species composition, geographical and seasonal patterns of strandings, bycatches and injuries of aquatic mammals reported in Chinese mainland waters, from 2000 to 2006, were analyzed based on national official documents. A total of 97 strandings, 66 bycatches and 30 injuries, involving at least 18 species (possibly 20) in eight families of Cetacea and two families of Carnivora, were recorded. Finless porpoises (*Neophocaena* spp.), spotted seal (*Phoca largha*) and bottlenose dolphins (*Tursiops* spp.) were the most common species in all three categories, in total comprising 59.8% of strandings, 97.0% of bycatches and 86.7% of injuries. Strandings occurred throughout the year, but records of both bycatches and injuries peaked in spring (March to May), corresponding to the major fishing season and may reflect the negative impacts of fishing activities. The highest species diversity found in Fujian Province may be linked to upwelling and high production in the Strait of Taiwan. Serious difficulties were encountered in overall data interpretation and between-provinces comparability, mainly due to a lack of quantified observer effort and variable expertise levels. Hence the establishment of a coordinated nationwide network is recommended, providing a mechanism for the instant reporting of aquatic mammal events, as well as the adoption of a standardised data recording system including necropsy protocols. Better-quality data should allow quantitative analyses leading to an improved understanding of anthropogenic threats in China's aquatic mammal populations. The need to upgrade reserve management, such as the Dalian protected area in Liaoning, is also stressed.

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1. Introduction

Most cetaceans and some other marine mammals are distributed over large areas and spend the majority of their lives underwater, which makes observations difficult and studies expensive to conduct [63,9]. Many species either migrate great distances between feeding and breeding grounds or are characterized by other large-scale movements, adding to the difficulties of conducting research or monitoring programmes. As a consequence, examination of stranded cetaceans and other aquatic mammals found ashore has long been an invaluable source of information on the morphology, diet, life history, and population structure of these animals, and has helped to identify threats [19,37,5]. Long-term systematically recorded information on the time and location

of stranding events can provide clues regarding spatial distribution and seasonal movements, although caution is needed in the interpretation of such information. The stranding location is highly influenced by physical oceanographic features such as wind and tides [28,19,60,5]. The species composition in the records may be reflective of both distribution and disproportionate fishing efforts.

There are many possible causes for strandings. Injuries (both natural and anthropogenic) and diseases may incapacitate individuals and lead them being carried passively by currents [61,39]. The injury and mortality of many populations of small cetaceans worldwide is primarily due to bycatch [41]. In some species, bycatch has caused or contributed to population-threatening levels of mortality. For example, studies found evidence of bycatch in stranded specimen samples for 63% of harbor porpoises *Phocoena phocoena* (Linnaeus, 1758) on the US East Coast [6] and for 79% of short-beaked common dolphins *Delphinus delphis* Linnaeus, 1758 examined in SW England [30]. Bycatch led even to the functional extinction of the vaquita *Phocoena sinus* Norris

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and McFarland, 1958 [22,44,68] and the baiji *Lipotes vexillifer* Miller, 1918, respectively. Effective mitigation measures require the identification of high-risk areas, the magnitude of threats and the most vulnerable species.

Some populations of aquatic mammals in Chinese waters are expected to decline rapidly, and a few, such as the Yangtze finless porpoise [49,67], could even emulate the extreme example of the baiji, an obligate freshwater odontocete known only from the middle-lower Yangtze River, which became functionally extinct before any effective intervention was carried out [44]. Unsustainable bycatch in fisheries of the Yangtze River is considered the primary cause of the demise of the species [44]. According to a FAO [14] report on the State of World Fisheries and Aquaculture, China remains the leader of global fisheries landings, with production at approximately 15 million tonnes in 2010. In 2007, there was a total of 288,779 marine fishing vessels with a combined power of 14.7 million kW, equipped with mainly drift and set gill nets and trawl nets, gears well-documented to cause high marine mammal bycatch rates worldwide (e.g. [46,65,40]). Studies conducted in the USA showed that, in 1994, 2500 fishing vessels operating gill nets captured approximately 6491 marine mammals and 8030 vessels operating with trawl nets captured 228 marine mammals [40]. In view of the intensive fishing activity in Chinese waters and absence of any bycatch reduction efforts, it is important to determine the level of interactions between fisheries and aquatic mammals. The highest quality of bycatch data is attained through ship-board observer programmes, but these tend to be expensive and require well-trained technicians [32]. In addition, the wide spatial distribution of aquatic mammals and the large number of fishing vessels present serious obstacles to the implementation of effective observer programmes. These factors are especially relevant in China. Consequently, data gleaned from post-mortem and clinical examinations of, respectively, stranded and injured animals are an important supplement to information obtained from ship-board observer programmes. In addition, direct reports from fishermen and information from fishery enforcement personnel in China provide relevant insights.

Many countries have established reporting schemes, stranding collection networks or national databases run by various organizations (e.g. [2,70,24,25,45]) and make information available through periodic publications or in other formats. However, recording efforts are dismal in Chinese waters, which support approximately 50 aquatic mammal species along 18,400 km of coastline and in the Yangtze River. Reports of strandings in historical literature are scarce. There are published records of 1 female rough-toothed dolphin *Steno bredanensis* (G. Cuvier in Lesson, 1828) in 1973 [21]; 1 female ginkgo-toothed beaked whale *Mesoplodon ginkgodens* Nishiwaki & Kamiya, 1958, in 1980 [43,56]; 1 short-finned pilot whale *Globicephala macrorhynchus* Gray, 1846, in 1991 [54]; 1 Blainville's beaked whale *Mesoplodon densirostris* (de Blainville, 1817) in 1994 [69], and 4 gray whales *Eschrichtius robustus* (Lilljeborg, 1861) strandings between 1949 and 1996 [70]. The government has made little attempt to establish a standard reporting scheme or network and the status of most populations of aquatic mammals is poorly known. This lack of information hampers a proper understanding of threats and conservation needs and obstructs attempts to determine whether existing conservation measures are being effective.

The authors organized the collection of official documents related to strandings, bycatches and injuries of aquatic mammals in the waters of mainland China from provincial fishery administrations for the years 2000 to 2006. The objectives of this paper are: (i) to provide an initial analysis of the species composition and the spatial and monthly patterns of aquatic mammals that were stranded, captured or injured in China based on existing official records; (ii) to encourage the standardized reporting of such

events and to promote the establishment of a national reporting network for aquatic mammal strandings, bycatches and injuries; and (iii) to provide suggestions for improved future conservation and management policies of aquatic mammals in China.

2. Material and methods

In response to an official letter from the Aquatic Fauna and Flora Conservation Office, Fishery Administration Center, Ministry of Agriculture, China, provincial and municipal fishery administrations in mainland China analyzed historical records of strandings, bycatches and injuries of aquatic mammals. Because there was no specific recording scheme targeting aquatic mammals, all the relevant data were retrieved from records within the overall category of wildlife protection.

Strandings in the present paper refer to the beaching or washing ashore of live or dead aquatic mammals, as well as dead animals found floating in the water. A mass stranding was treated in this article as a single event [4]. Injuries refer to injured but live animals found floating in the water. Bycatches are animals that were reported directly by fishermen and those found entangled by fishery enforcement officers during patrols. Using reports by fishermen inevitably results in a serious underestimation of the real magnitude of bycatch because they are not obliged to report bycatch, and certainly avoid such reporting in the event of illegal fishing. However, fishermen often report to other institutions rather than fishery enforcement, which was how most bycatch information was obtained. For example, some fishermen in Weihai, Shandong, sent finless porpoise carcasses to a local university for research each time there was a bycatch. Reporting to fishery enforcement usually occurs when the fishermen are unfamiliar with an animal or for opportunistic reasons. Although they may overlap, strandings, bycatches and cases of injury were separated into distinct categories for the discussion of spatial and temporal distribution.

The reports were from 8 coastal provinces (minus Jiangsu), 2 coastal municipalities and 4 provinces across which the Yangtze River flows. The period covered from 2000 to 2006, before which time there were few official records. The information supplied in each of the cases varied, but included a description of the numbers, species, reporting dates and locations, handling organizations and any treatments. Some provinces provided more detailed information, such as sex, body length, weight and body condition (alive, dead, state of injury or decomposed). However, most records included no information on the types of injuries or causes of death, nor explanations for each stranding event. Due to non-quantified and unstandardized observer effort, apparently highly variable between provinces, as well as low sample sizes per province, any comparative statistical analysis would be meaningless.

Observers did not distinguish between common bottlenose dolphin *Tursiops truncatus* (Montagu, 1821) and Indo-Pacific bottlenose dolphin *Tursiops aduncus* (Ehrenberg, 1833) while both species are distributed in Chinese waters [50]. Therefore this paper refers to generic bottlenose dolphins (*Tursiops* spp.). Similarly, the two main morphotypes of finless porpoise [16] were not specified. The taxonomy of finless porpoises has recently been revised [23,49,51,57] with two species recognized in Chinese waters. In cooler waters predominates the narrow-ridged form *Neophocaena asiaorientalis* (Pilleri and Gühr, 1972), with one subspecies Yangtze finless porpoise *N. asiaorientalis asiaorientalis* occupying the middle and lower reaches of the Yangtze River, and another subspecies, the East Asian finless porpoise *N. asiaorientalis sunameri* distributed in coastal waters from the Taiwan Strait, including the western coast of Taiwan, through the East China Sea

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