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RESEARCH

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First record of the Indo-Pacific humpback dolphins (*Sousa chinensis*) southwest of Hainan Island, China

Songhai Li^{1*}, Mingli Lin¹, Xiao Xu^{1,2}, Luru Xing¹, Peijun Zhang¹, Rodolphe E. Gozlan³, Shiang-Lin Huang¹ and Ding Wang⁴

Abstract

Background: Populations of Indo-Pacific humpback dolphins (*Sousa chinensis*) in China were known to be distributed from the Beibu Gulf near the border with Vietnam to the mouth of the Yangtze River. According to existing studies, the waters around Hainan Island, China, were not considered to be part of the humpback dolphins' distribution.

Results: In 2014, for the first time, we recorded humpback dolphins in waters southwest of Hainan Island.

Conclusions: This record expands the known southern distribution range of this dolphin in Chinese waters by more than 300 km.

Keywords: Chinese white dolphin, Marine mammals, Conservation, Distribution

Background

Stranding and whaling records indicate the presence of more than 40 marine mammal species in Chinese waters (Wang, 2012), some of which are of high conservation value and listed by the Chinese State Council as Grade 1 National Key Protected Animals since 1988. This is, for example, the case for both the Yangtze River dolphin (*Lipotes vexillifer*), or baiji, and the Indo-Pacific humpback dolphin (locally called Chinese white dolphin, *Sousa chinensis*, Osbeck, 1765), which was classified as Near Threatened by the International Union for Conservation of Nature in 2001 (IUCN, 2001) as a single species, and evaluated as Vulnerable by a recent assessment of the species. Humpback dolphins (genus *Sousa*) are small odontocetes that occur in coastal waters of the eastern Atlantic, Indian and western Pacific Oceans (Ross et al. 1994; Jefferson and Karczmarski, 2001; Parra and Ross, 2009). Evidence from skeletal and external morphology, coloring, genetics and distribution support the recognition of three species of humpback dolphins in India-Pacific waters, which are *S. plumbea*, *S. sahalensis*, and *S. chinensis* (Jefferson and

Rosenbaum, 2014). Specifically, *S. chinensis* has a relatively larger dorsal fin with no prominent hump and largely white adult coloring. It ranges from coastal waters of Southeast Asia to central China (Jefferson and Rosenbaum 2014). If assessed separately, in light of likely taxonomic distinctness (Jefferson and Rosenbaum, 2014; Reeves et al. 2008), *S. chinensis* would qualify as Vulnerable (Reeves et al. 2008). The Yangtze River dolphin is now functionally extinct (Turvey et al. 2007; Guo, 2006) and, as such, conservation efforts have been concentrated on *S. chinensis* populations, which could still benefit from a targeted conservation strategy (Jefferson and Hung, 2004). However, the current rapid economic growth in China that can be seen through its recent increase in coastal economic activities (e.g. fishing, tourist boating, island construction) has directly impacted its marine environment. Such rapid changes have resulted in habitat degradation including noise pollution, harassment and overfishing of prey species with knock-on effects on marine mammal populations (Jefferson and Hung, 2004) throughout Chinese waters.

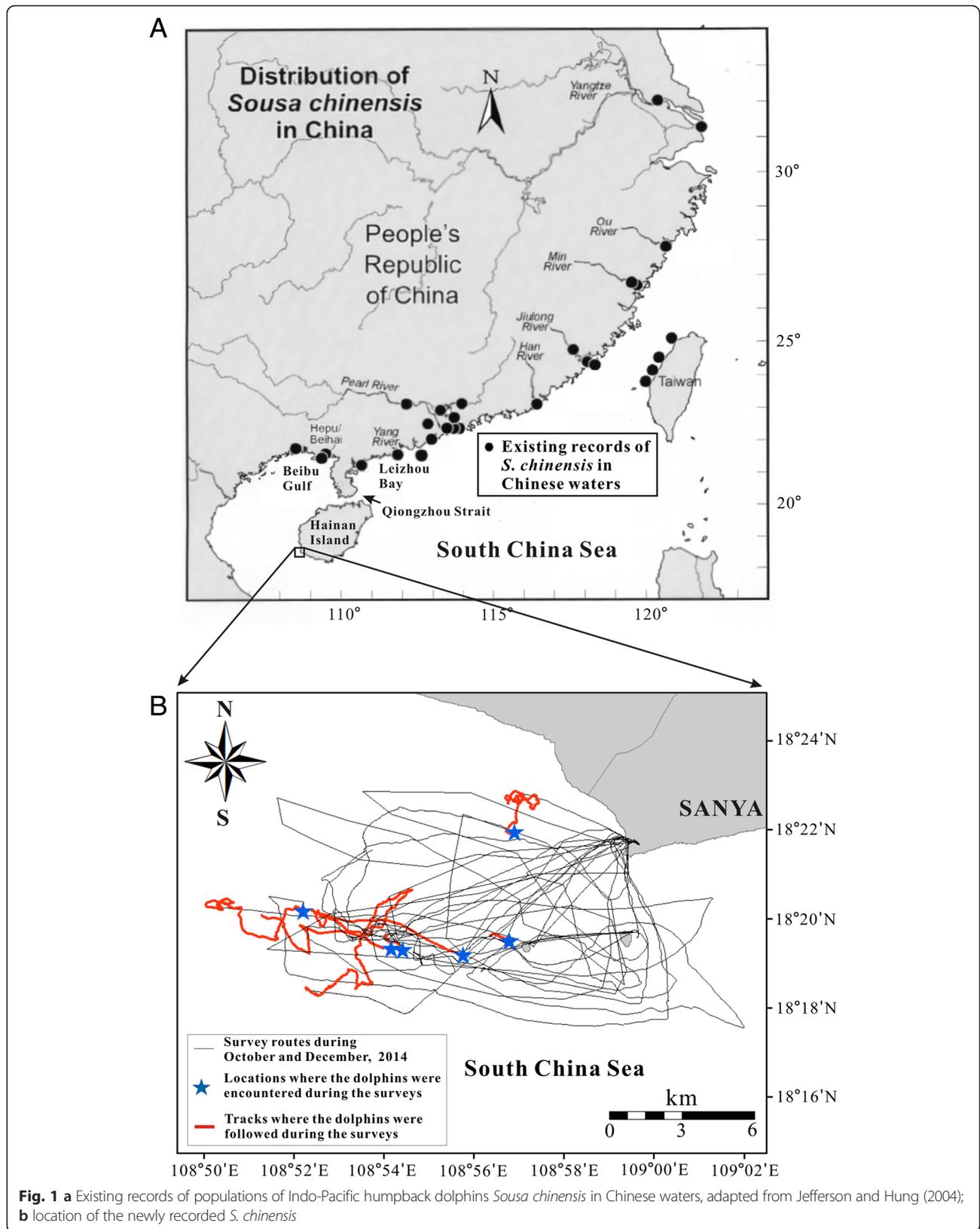
The current census of *S. Chinensis* identified a few populations in Chinese waters, albeit with a sparse distribution (Fig. 1a; Jefferson, 2000; Jefferson and Hung, 2004; Chen et al. 2009). It was assumed that *S. chinensis* was sporadically distributed along the coast, from the

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Beibu Gulf near the Vietnamese border to the mouth of the Yangtze River (Fig. 1a; Corkeron et al. 1997; Jefferson and Leatherwood, 1997; Jefferson and Karczmarski, 2001), with the southernmost records being in the Beibu Gulf (Wang and Sun, 1982).

On the basis of the best available information about *S. chinensis* and its habitat along the coast of mainland China (Jefferson and Rosenbaum 2014), waters around Hainan Island which are isolated from mainland China by the Qiongzhou Strait, where water is deep and appears to be a barrier for movement of this species (Chen et al. 2009), did not include distribution records of *S. chinensis* (Jefferson and Hung 2004, Chen et al. 2009). However, targeted marine mammal surveys are too few and only carried out in certain waters along the coast of mainland China despite a need for a comprehensive understanding of *S. chinensis*' distribution in Chinese waters to underpin a robust and sound conservation plan.

Here we aimed to carry out further *S. chinensis*' population surveys in Chinese waters. Specifically, in waters where, despite possible sightings by local fishermen, this species has not yet been officially recorded.

Methods

According to a recent survey of fishermen carried out around the coast of Hainan Island, China, it was expected that humpback dolphins were appearing in waters southwest of Hainan Island. Boat-based visual surveys were thus set up to confirm the presence of these dolphins in these waters. The field surveys were conducted under China's Wildlife Protection Act, 1989, Implementation By-law on Aquatic Wildlife Conservation, and marine mammal research permit No. SIDSSE-SYLL-MMMBL-01 from Institute of Deep-sea Science and Engineering of the Chinese Academy of Sciences. The surveyed waters are located about 40 km west of the city of Sanya, which is the most famous tropical tourist resort in China. The area is characterized by sandy and muddy bottom structure with water depth between approximately 5 and 30 m. There is no large estuary close to the investigated waters.

Monthly boat-based visual surveys of 4 to 5 days were carried out between August and December 2014. The surveys were conducted using a 9-m-long fishing boat, traveling at about 10 km/h. The survey team consisted of a boat skipper who was an experienced local fisherman and a minimum of three observers. To increase the chance of sighting dolphins, survey transects were not previously designed but more or less followed the suggestion of the boat skipper with a prior assumption to encounter dolphins during each survey. A minimum of two observers searched the waters using unaided eyes or binoculars (FUJINON, 7 × 50 FMT-SX) from an eye height of about 3 m above sea level. Two observers searched a quadrant covering 90° of arc from the center line to the sides of the

boat on each side of the boat. Information about date, time, GPS position, water depth, species and number of animals was recorded on a standardized effort log by the third observer at 30 min intervals or whenever the survey boat made a major course change or dolphins were observed. Once the dolphins were observed, as many high-quality photographs and videos as possible were taken of the animals by slowly following the animal groups.

Results

All survey efforts were conducted in Beaufort Sea states of 1–3. The survey effort generally lasted for 5 to 9 h (mean ± SD = 6.7 ± 1.4 h) along an approximately 40 to 80-km route (mean ± SD = 55.4 ± 15.6 km) each day depending on weather condition. The first sighting of *S. chinensis* with more than 20 individuals was made on 20 October 2014. The second sighting was made the following day, 21 October 2014 with more than 30 individuals. In subsequent survey efforts during November and December 2014, the dolphins were sighted about once every other day in the surveyed area. In total, there were six dolphin sightings recorded over a 13-day survey from October to December 2014. Water depth at sighting points was shallower than 20 m (mean ± SD = 15.2 ± 1.5 m). Survey details are presented in Table 1. Routes of surveys (grey lines), locations (blue stars) and tracks (thick pink lines) where *S. chinensis* were sighted and slowly followed between October and December 2014 are shown in Fig. 1b. Each sighting consisted of approximately 10 to 40 individuals with several fission/fusion societies of 3 to 6 dolphins with white, pink, or gray skin color. Dolphins with gray skin color generally have relatively shorter body length compared to those with white or pink skin color. Occasionally, newborns with gray skin color and body length shorter than half of that of the adults with white or pink color were observed. Pictures of the observed dolphins are presented in Fig. 2 as examples.

Discussion and conclusions

Observed dolphins possessed the typical external morphology and coloring of *S. chinensis* (Fig. 2; Jefferson and Leatherwood, 1997). Thus, these sightings consist of the first record of *S. chinensis* in the coastal waters southwest of Hainan Island, as until now the waters were considered void of *S. chinensis* (Fig. 1a; Jefferson and Hung, 2004; Zhang and Tang, 2008; Chen et al. 2009) despite previous records along the coastal waters of Vietnam within the Beibu Gulf (Smith et al. 2003). This new record expands the currently known Chinese distribution range of this lion-sized mammalian predator by more than 300 km south. However, its population status, size, age class composition, habitat range, annual or seasonal present pattern, possible prey, threatening factors (such as by-catch, vessel

Table 1 Survey effort (time duration, length), sighting location, sighting number and number of animals estimated in each sight between August and December 2014

Date	Time duration (hrs)	Length (km)	Sighting location		Sighting number	Number of animals sighted
			Longitude	Latitude		
10/08/2014	6.5	52	N/A	N/A	0	0
11/08/2014	6	41	N/A	N/A	0	0
14/08/2014	7.5	71	N/A	N/A	0	0
16/08/2014	9	79	N/A	N/A	0	0
21/09/2014	2	12	N/A	N/A	0	0
22/09/2014	6	55	N/A	N/A	0	0
24/09/2014	7.5	69	N/A	N/A	0	0
26/09/2014	8.5	76	N/A	N/A	0	0
27/09/2014	7	68	N/A	N/A	0	0
19/10/2014	6	50	N/A	N/A	0	0
20/10/2014	7.5	57	108°52.219'	18°20.194'	1	20–30
21/10/2014	7.5	55	108°55.772'	18°19.198'	1	30–40
23/10/2014	8	70	N/A	N/A	0	0
11/11/2014	5	38	109°54.720'	18°19.657'	1	8
12/11/2014	6.5	60	N/A	N/A	0	0
15/11/2014	7.5	50	N/A	N/A	0	0
16/11/2014	6	38	108°56.919'	18°21.956'	1	15–20
13/12/2014	7	60	108°56.794'	18°19.523'	1	15–20
14/12/2014	6	44	N/A	N/A	0	0
15/12/2014	8	72	N/A	N/A	0	0
18/12/2014	6	56	N/A	N/A	0	0
20/12/2014	6	45	108°54.170'	18°19.339'	1	12

collisions and overfishing of prey) and connections to other known populations remain to be investigated.

Most information on ecology of *S. chinensis* comes from studies conducted in Hong Kong and surrounding waters, and in recent years in Taiwan and some areas of the mainland coast of China. Published studies showed that *S. chinensis* movements tend to be over relatively small areas

with an average of 135 km² (Hung 2008). The present new sightings are located nearly more than 300 km away from previously known habitat of *S. chinensis*. This coast is a prime tourist destination and hosts dense human populations, especially during the winter tourist season. However, although these waters are generally subject to high economic pressure and coastal development, the Beibu

**Fig. 2** Pictures of *S. chinensis* taken during the present boat surveys

Gulf is shallow (i.e. mean of 38 m) and is an important fishing ground with abundant fishery resources (Qiao and Lin 2007) and thus potentially consists of an ecologically important habitat for small dolphins. Previous studies indicated that habitat of *S. chinensis* consists of shallow, coastal marine waters and especially waters in and around large estuaries (Jefferson and Karczmarski 2001). In Hong Kong waters, it appears to occur anywhere where there is a riverine influence, but does not occur in a strictly-marine environment (Jefferson 2000). There is no large estuary around the sighting area, however, with these new sightings in an area generally shallower than 20 m, which is similar to those previously recorded in Hong Kong and surrounding waters (Jefferson and Karczmarski 2001; Chen et al. 2011), it confirms a preference of these dolphins in shallow waters. Although fish catch and species components in the present surveyed area were not yet quantitatively investigated, shoals of small fish were frequently observed during the surveys.

The previous lack of records for *S. chinensis* in waters southwest of Hainan island may be due to limited past marine mammals survey efforts most likely arising from a low understanding by local societies of the need for dolphin conservation. National and local government management agencies would be partly accountable if some *S. chinensis*' populations were facing a risk of extinction before they could even be studied and protected. In effect, conservation action is vulnerable to a knowledge gap and researchers must consider the intrinsic characteristics of their species to raise public perception effectively (Gozlan et al. 2013). However, communication to the wider scientific community is the first stepping-stone to ignite a policy change. In addition, we will appeal to the regional government to take action and support extensive and substantive national and international collaboration with scientists and conservationists to put in place a set of conservation actions and effectively protect *S. chinensis* populations in the border area against extinction.

Competing interests

The authors declare that they have no competing interests.

Authors' contribution

LS and LM designed and carried out the field surveys. XX participated in the field surveys. XL and ZP provided logistics supports during the study. LS analyzed the data and drafted the manuscript. LM participated in the data analysis. GRE helped to draft the manuscript. HSL participated in the survey design. WD participated in the study design and coordination. All authors read and approved the final manuscript.

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