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Unsustainable human-induced injuries to the Critically Endangered Taiwanese humpback dolphins (*Sousa chinensis taiwanensis*)

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ABSTRACT

The Critically Endangered Taiwanese humpback dolphin (*Sousa chinensis taiwanensis*) is endemic to inshore and estuarine waters of central western Taiwan. It numbers fewer than 75 individuals, is declining and faces a myriad of human threats. Data from a long-term photo-identification program on these dolphins allowed major injuries to be examined quantitatively. A large proportion (57.7%) of individuals had suffered major human-induced injuries that likely compromised their health, survivorship or reproductive potential and thus, the future of this subspecies. Considering major injuries as “takes”, the injury rate (1.13 dolphins/year) for the population was 8–8.5 times higher than its Potential Biological Removal rate. Observations of new injuries and fishing gear entanglements on several dolphins showed that fisheries continue to be the predominant cause of these major injuries. Unless immediate action is taken to reduce harmful fisheries, extinction is imminent for Taiwan's only endemic dolphin.

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1. Introduction

The Taiwanese humpback dolphin (*Sousa chinensis taiwanensis*) was first recognized as a distinct and isolated population (Wang et al., 2008) with a highly restricted distribution (Wang et al., 2007, 2016). However, using more data and quantitative criteria, it was later described as a subspecies (Wang et al., 2015) that is endemic to and a year-round resident (Wang and Yang, 2011) of the waters off western Taiwan (= eastern Taiwan Strait). The subspecies is recognized by the Committee on Taxonomy of the Society for Marine Mammalogy (Committee on Taxonomy, 2016) and comprises fewer than about 75 individuals (Wang et al., 2012). Due to numerous threats, it was suspected to be declining (e.g., Ross et al., 2010, Dungan et al., 2011). In 2008, it was listed as Critically Endangered by the IUCN Red List of Threatened species (Reeves et al., 2008). Although the Taiwanese humpback dolphin was only discovered scientifically in 2002 (see Wang et al., 2004a) and described as a subspecies in 2015, it is facing imminent extinction.

Fisheries are the most direct and immediate threat to this subspecies. In the waters inhabited by the Taiwanese humpback dolphins, there are several thousand motorized fishing crafts that are capable of

deploying gillnets, with trammel nets being the primary kind of gillnets used (see Slooten et al. (2013) for more details). Due to the small size of the population and the oceanographic and coastal features along western Taiwan, few fresh carcasses are available to be examined for understanding the impacts of threats. In >20 years, only four Taiwanese humpback dolphin carcasses have been recovered along western Taiwan, of which only two were fresh enough to allow individual identification and determination of cause of death. Both showed clear signs of being entangled in gillnets prior to death. These observed mortalities may be few but the impact on such a small population is very concerning because the Potential Biological Removal rate was calculated to be <1 individual per 7 years (Slooten et al., 2013). Furthermore, Araújo et al. (2014) showed that threats (such as fisheries) which removed additional dolphins increased the rate of decline and the likelihood of extinction, with removals of females showing very dramatic results.

Analysis of injuries incurred by living dolphins using photo-identification (photo-ID) data collected during long-term monitoring offers another way to examine the impacts of such threats directly (e.g., Baird et al., 2015, Bradford et al., 2009, Bechdel et al., 2009, Wells et al., 2008). A preliminary analysis of photo-ID data revealed that a large proportion of the Taiwanese humpback dolphins suffered injuries caused by human activities, with fisheries accounting for 31.2% of the injured dolphins (Slooten et al., 2013). Several individuals have been observed entangled in fishing gear including one well-known dolphin that was severely

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mutilated as a result of, and almost certainly experienced extreme pain and suffering during and after, the entanglement (Wang and Araújo-Wang, 2017). In this study, we expand the study of Slooten et al. (2013) to better quantify and understand the impacts of human activities (particularly fisheries) on the Taiwanese humpback dolphins by looking at the prevalence of injuries over time, rates of injury, and the propensity of different age classes and body sections of dolphins to get injured.

2. Materials and methods

2.1. Surveys and photographic catalogue

A long-term, photo-ID project to monitor the Taiwanese humpback dolphins was started in 2007. Annual photo-ID surveys were conducted using a 4.5 m long inflatable boat during about two months primarily between June and September, the period when weather and marine conditions were most conducive for field work. When dolphins were encountered, attempts were made to obtain good quality photographs of the dorsal fin and adjacent area of the back for each individual (and both sides whenever possible). Often during photography, images of other parts of the dolphins were also obtained especially during burst shooting. The field methods followed those described by Wang et al. (2012) but since 2011, the area surveyed and the amount of survey effort were increasingly expanded southward. By 2014, the annual surveys covered a linear distance of about 170 km from north of Tongshiao, Miaoli County ($\sim 24^{\circ}30'N$) to Jiangjiyun Harbour, Tainan

City ($\sim 23^{\circ}10'N$), encompassing $\sim 90\%$ of the entire known distribution of this subspecies (see Wang et al., 2016; Fig. 1). [Note: Wang et al. (2016) stated incorrectly that the length of the core distribution between Tongshiao and Taixi, Yunlin County ($\sim 23^{\circ}40'N$) was ~ 170 km; it should have been ~ 110 km].

Annual photographic catalogues of individuals were created from the best quality photographs of each individual (both sides when available). All photographs that were included in annual catalogues were amassed into a cumulative catalogue of each individual dolphin. Although, the primary purpose of the catalogues is to aid in the identification of individual dolphins using images of the dorsal fin and adjacent areas of the back, these catalogues also included images of other parts of the dolphins, whenever available, for a more complete record of each individual so that identifications may also be possible when the primary character (dorsal fin and adjacent back area) cannot be seen in photographs. Therefore, it was also possible to examine other body sections of most dolphins.

In this small population, all dolphins (except young calves) possess individually-distinctive spotting patterns (i.e., they are “marked”) (see Wang et al., 2012). Since 2010, no new marked individuals have been photographed, with the exception of young dolphins that were newly recruited into the marked population after developing unique spotting patterns. This indicates that all dolphins in this subspecies (excluding young calves) have been documented.

Because there is little confidence in identifying the gender of most individuals in this population at this time and the photo-ID data were predominantly obtained from about 2 months during the summer

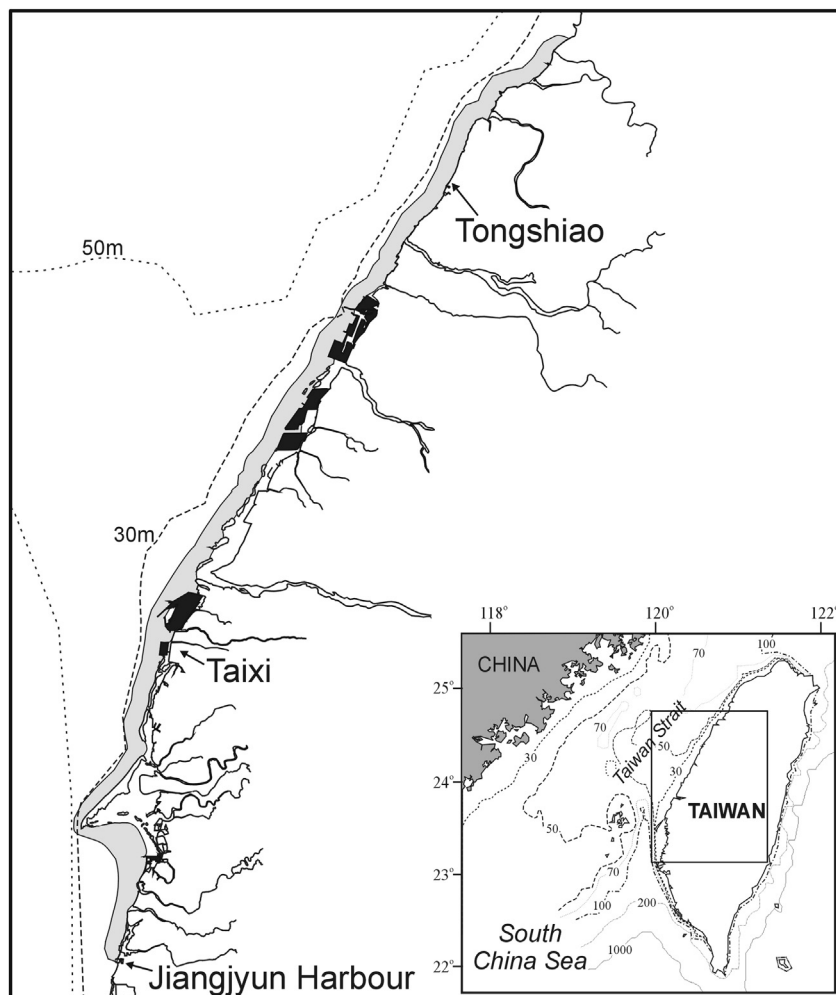


Fig. 1. The known distribution of Taiwanese humpback dolphins is shown in the larger map, which is represented by the box in the inset showing the general location.

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