THE IMPORTANCE OF THE INDO-PACIFIC HUMPBACK DOLPHIN (*SOUSA CHINESIS*) POPULATION OF SANNIANG BAY, GUANGXI PROVINCE, PR CHINA: RECOMMENDATIONS FOR HABITAT PROTECTION.

Pan Wenshi[1], Lindsay Porter[2], Wang Yamin[3], Qin Dagong[1], Long Yu[1], Jin Tong[1], Liang Zuhong[1], Wang Dezhi[1], Su Yun[4], Pei Zixing[1], and Koen Van Waerebeek[5]

1 Qinzhou Bay Chinese White Dolphins Research Center of Peking University, PR China. Email: panda@pku.edu.cn
2 WWF, 1 Tramway Path, Central, Hong Kong. Email: lporter@wwf.org.hk
3 Office of Aquatic Fauna and Flora Conservation, Ministry of Agriculture, Beijing 100026, P. R. of China. E-mail: wildlifes66@yahoo.com.cn
4 Director of Tourism, Management Office of Sanniang Bay, Guangxi Tourism Authority, PR China.
5 CEPEC, Museo de Delfines, Pucusana, Lima 20, Peru. E-mail: cepec@speedy.com.pe

Abstract: During the period June 2004 - January 2006, a research team from the Qinzhou Bay Chinese White Dolphins Research Center of Peking University, the Peoples Republic of China, conducted systematic and opportunistic boat surveys of Sanniang Bay, Guangxi Province, in which Indo-Pacific humpback dolphins *Sousa chinensis* were regularly seen. Ninety eight dolphins were photographically identified. The dolphins appear to inhabit a small, shallow area of core habitat within the greater Sanniang Bay area. They do not appear to travel up the two rivers which are located to each side of the bay. Of the five populations known from the coastal area of China, the one that resides in Sanniang Bay is determined as having the least impact from anthropogenic activities. The area itself has been designated as a nature tourism location and considerable effort and money has been spent on developing appropriate tourist facilities. The dolphin watching industry in the area is strictly monitored and controlled by one local authority. The largest estuary adjacent to Sanniang Bay has been allocated for industrial development and a paper pulp mill will be established there. Considering the investment already made in the nature tourism industry, the natural beauty of the bay and the surrounding area and the likelihood that this is the only population of Indo-Pacific humpback dolphins which remain in uncompromised and relatively pristine habitat in all of China, it is urged that all effort be made to maintain the natural integrity of the bay. It is recommended that all development and operational aspects of the paper pulp be thoroughly scrutinized and all efforts made to minimize impact upon the environment and that all current and future industries and activities in this area must not detrimentally impact the dolphin population or compromise the integrity of the bay ecosystem.

Introduction

In early 2004, Sanniang Wan, an isolated bay in Guangxi Province, southern China, was designated as a new tourist destination. Major road construction has connected for the first time, the only fishing village in the bay to several large cities. Due to the area's astounding natural beauty and the regular occurrence of Indo-Pacific humpback dolphin *Sousa chinensis* in the bay, tourism based on nature and the environment was elected, including dolphin watching. The first day of operation, in early 2004, recorded an overwhelming 10,000 visitors to the area. The popularity of the area and the interest in dolphin watching surprised both the village inhabitants and the local authorities. It was decided immediately that these tourist activities must not have a detrimental impact on either the environment or those species which live within it. Restrictions on types of development were put in place, i.e., low rise, non-intrusive buildings that did not impact the foreshore and restrictions on the daily number of boats that conducted dolphin watching. The development in its entirety is strictly controlled by the Tourism Authority. To date, the Authority has spent 30 Million Renminbi (eqv. EUR 3 Million) in establishing appropriate low level tourism facilities and maintaining a pristine environment in which to conduct nature tourism. Further, the local authorities and fishermen wished to ensure that the dolphins were not adversely impacted by dolphin watching and contacted researchers in China and Hong Kong for advise. Since that time, research teams from the Qinzhou Bay Chinese White Dolphins Research Center of Peking University, PR China, and staff and associates of the World Wide Fund for Nature (WWF) in Hong Kong have been conducting visual surveys on the area's dolphin population.

There is some uncertainty as to where the specific divisions lie within the genus *Sousa*. Rice

(1998) nominates three species based on external and cranial morphology although there is still disagreement with regards to species designation (the genus Sousa was discussed in detail at IWC 54, Shimonoseki, Japan, 2002). A recent multivariate analysis of geographic variation in 222 skulls confirmed the same three geographic forms coinciding with *S. teuszii*, *S. plumbea* and *S. chinensis*, without necessarily assigning a definitive taxonomic status (Jefferson and Van Waerebeek, 2004). On-going molecular studies are anticipated to assist in further defining the genus within the near future. Within Southeast Asia, one species occurs, *S. chinensis*, which consists of a number of suspected populations. Apart from the population which dwells within the Pearl River Estuary (Jefferson and Leatherwood, 1997; Parsons, 1997; Porter *et al.*, 1997; Porter, 1998; Jefferson, 2000; Porter, 2002), until very recently, little has been known of distribution within the region (Perrin *et al*, 1996; Wang and Han, 2006). There is considerable concern over the survival of this and other cetacean species within Southeast Asia due to the accumulative impacts from fisheries activities, heavy ship traffic, coastal development and pollution.

The Sanniang Bay population of *S. chinensis* is one of only five known from China's South China Sea coastal area. The other populations reside in Leizhou and the Pearl River Estuary (Guangdong Province), Xiamen Harbour (Fujian Province) and western Taiwan. All of these populations are small and the distance between each is considerable, such that it is likely that each population is isolated from the other. Of all known populations, the one that resides in Sanniang Bay appears least effected by anthropogenic activities. The dolphins which occur in the Pearl River Estuary and Xiamen Harbour are heavily impacted by shipping and coastal development activities and mortality is regularly recorded, e.g., in Hong Kong on average one Indo-Pacific humpback dolphin strands every month. In Xiamen Harbour, comparisons between 1994 and 2004 population abundance estimates indicate that the population has halved in that time (Huang and Liu, 2006; Yang *et al*, 2006). The results from a single survey in Taiwan indicate that the population numbers less than 200 and is critically impacted by industrial activities (Wang, 2005). The population which occurs in Leizhou has only just become the focus of a dedicated study and results from the first survey indicate that the population is small and encounter rate is low (Zhou Kaiya, unpublished data). Added to this, a new port development is underway in the area in which the dolphins are sighted.

The Ministry of Agriculture, the Peoples Republic of China, recently held a workshop which aimed to compile all recent information on the distribution and status of Indo-Pacific humpback dolphins in Chinese waters and to develop a common strategy for the effective conservation of the species within China. It was proposed that the level of conservation concern for the various areas should be 1) Guangdong Province, including the Pearl River and Leizhou Bay. 2) Fujian and Taiwan, specifically the Taiwan channel. 3) Sanniang Bay, Guangxi Province (Wang 2006). That is, it was generally agreed that the dolphin populations which reside in Sanniang Bay was least at risk and those populations in the Pearl River Estuary, Xiamen Harbour and Taiwan were impacted by continued and increasing development of these areas.

Methodology

Sanniang Bay covers an area of approximately 350km^2 (centred at 21°38.3'N, 108°47.7'E) and is located between two estuarine systems, to the west lies the Qinjiang and to the east the Dafengjiang. The bay is very shallow and influenced by freshwater input, however, little is known of the area's physical oceanography and its seasonal fluctuations (Fig. 1). Since May 2004, regular surveys of the entire bay indicate that the dolphins occupy a core area of approximately 120km^2 and rarely occur in water depths greater than 10m (Fig. 2).

Boat surveys: two types of boat surveys were conducted; systematic and opportunistic. Several routes were plotted that covered the entire bay area defined. These routes were surveyed systematically between June 2004 and January 2006. Fishing vessels were used as platforms of opportunity and the route they took was not influenced by the survey team onboard. The exact route of these surveys was recorded using GPS.

During both types of surveys, the time and location of every encounter with dolphins was recorded using a GPS. Detailed information on condition, age category and behaviour was also noted. When possible, high resolution images of the dorsal fin area and individual colouration patterns were taken. This resulted in the collection of more than 10,000 images and a variety of features were used to clearly identify individuals (Fig. 3). The minimum size of the population is estimated as 98, from counting the absolute number of individuals through photo-identification techniques. These 98 individuals comprise 52 juveniles (calves and adolescents), 46 adults and sub-adults (using the criteria outlined below). The proportion of non-identifiable individuals is still being assessed. An estimate of population size using

mark-recapture analysis is being conducted but is currently not completed.

Distinguishing age categories: using the images of only the 98 identified dolphins, individuals were divided into four different age categories depending on size, behavioural traits and pigmentation patterns. Calves were classified as being less than 1m long, having dark grey skin and being closely associated with the same adult individual, presumably the mother. Adolescents were classified as being 1m in length, having grey skin but seen to be swimming individually for extended periods of time. Sub-adults were classified as being greater than 1.2m, having light grey to pink skin with dense dark grey spotting. Sub-adults were never associated with calves. Adults were classified as having predominantly pink skin with a few areas of dark pigmentation and may be closely associated with calves or adolescents. Two large adults were identified that were entirely white in colour. Using this criteria, there are to 15 - 16 calves, 34 - 35 adolescents, 7 sub-adults and 41 adults, two of which are presumably aged (Fig. 4).

Mortality: No strandings of Indo-Pacific humpback dolphins were reported during the survey period and fishermen report that strandings prior to this time were rare. One dolphin was photographed with a net caught around its neck in August 2004. This dolphin has been regularly sighted and was last seen in March 2006.

Discussion

As appears usual for this species, the population of dolphins that reside in Sanniang Bay is small and inhabits a core area of shallow habitat that is influenced by freshwater input from nearby two rivers. Unlike other populations of *Sousa chinensis* in Southeast Asia, the dolphins of Sanniang Bay appear to be healthy, with a large proportion of young individuals (>50%) and apparent low mortality. There is little evidence that fishing gear significantly impacts the dolphins, e.g., only one incidence of net entanglement has been reported. Similarly, vessel collisions are unknown in this area of southern China, in contrast with other populations (Van Waerebeek *et al.*, 2006).

To date, Guangxi, China's most southern Province, has been relatively un-developed. The area's unique natural beauty, limestone karsts and fertile flood plains remain largely intact and coastal development has been minimal. It would appear that the Sanniang Bay dolphin population is unique as it is minimally impacted by fisheries, either interactions or competition, and development activities. In addition, it is not currently subjected to pollution from industry or large municipalities. The Bay has been designated as a local level marine protected area and is going through the process of establishing higher status. In the meantime, Central Government authorities are encouraging Guangxi Province to increase coastal development so as this Province might benefit from the same financial gain that all other coastal provinces have experienced in the last decade of booming industry. As such, the estuary adjacent to Sanniang Bay has been allocated for industrial development. Although outside the Sanniang Bay area itself, there is concern that the proposed development of a paper pulp mill will detrimentally impact the bay area. It has been suggested that this particular development should not take water from the estuary itself and that all effluent should be discharged offshore via a 15km pipeline. Effluent from such industries historically has been extremely detrimental to the aquatic environment and it is feared that without stringent controls, the shallow Sanniang Bay area is at risk of becoming contaminated.

These initial proposals to mitigate damage to the environment are a good first step. It would be beneficial if the Central Government of the Peoples Republic of China would formalise and support these proposals. It is hoped that a clear conservation initiative for the paper pulp mill be developed and it is recommended that this include that:

(i) the effluent from the proposed paper pulp mill adjacent to Sanniang Bay be treated before emission into the aquatic environment;

(ii) models that accurately calculate water circulation in the estuary, Sanniang Bay and adjacent waters be devised so that effluent can be harmlessly dispersed into the aquatic environment;

(iii) a stringent monitoring system be established that allows early warning of any possible environmental damage;

(iv) an emergency procedure be established and initiated timely to minimise damage to the environment in the event of a contamination incident.

Considering the investment of some 30 Million RMB in the development of the tourism industry, that tourists are attracted by the currently pristine condition of the environment, and the likelihood that it supports the only uncompromised population of Indo-Pacific humpback dolphins in all of China, it is urged that the Central Government of the Peoples Republic of China recognise the very special value of

this area and support and participate in a broad scale conservation strategy.

It is recommended that all future and proposed developments in coastal and catchment areas of Guangxi Province are thoroughly scrutinised and only approved when all measures have been put in place to prevent the environment and the species which dwell within it from being detrimentally impacted. Further, that the Indo-Pacific humpback dolphin be promoted as a flagship species for the conservation efforts of the Sanniang Bay habitat.

Acknowledgements

Many thanks to the Guangxi Aquatic Product and Pasturage Bureau and the Hong Kong Ocean Park Conservation Foundation for supporting and funding the research work conducted in Sanniang Bay. KVW thanks IFAW for travel support to PR China. KVW attends the IWC annual meeting for the Federal Public Service; Public Health, Food Chain Security & Environment (Brussels) as head of Belgium's scientific delegation. LJP wishes to thank WWF for travel support to IWC58

References

Huang, Z.G. and Liu, W. 2006. Chinese white dolphin (*Sousa chinensis*) in Xiamen Bay. In *The Proceedings of The Xiamen International Workshop on Conservation of Sousa chinensis, Xiamen*, Peoples Republic of China, March 2006. p13

Jefferson, T. and Leatherwood, S. 1997. Distribution and abundance of Indo-pacific hump-backed dolphins (*Sousa chinensis* Osbeck, 1765) in Hong Kong. *Asian Marine Biology* 14:93-110.

Jefferson, T. 2000. Population Biology of the Indo-Pacific humpback dolphin (*Sousa chinensis*) in Hong Kong waters. *Wildlife Monographs* 144: 1-65

Jefferson, T.A. and Van Waerebeek, K. 2004. Geographic variation in skull morphology of humpback dolphins (*Sousa* spp.). *Aquatic Mammals* 30(1): 3-17.

Parsons, E.C.M. 1997. Hong Kong's cetaceans: the biology, socioecology and behaviour of *Sousa chinensis* and *Neophocaena phocaenoides*. PhD thesis. The University of Hong Kong.

Perrin, W.F., Dolar, M.L. and Alava, M. N. R. 1996. *Report of the Workshop on the Biology and Conservation of Small Cetaceans and Dugongs of Southeast Asia*, Dumaguete, June 1995. UNEP (W)/EAS WG.1/2. Bangkok: United Nations Environment Programme.

Porter, L., Parsons, E., and Morton, B. 1997. The Status and Biology of the Chinese White dolphin (Indo-Pacific Hump-backed dolphin), *Sousa chinensis*, in Hong Kong: Recommendations for Conservation and Management. *A Final Report to The Director of the Agriculture and Fisheries Department of the Hong Kong Special Administrative Region.* Hong Kong: The Swire Institute of Marine Science. 148pp.

Porter, L. 1998. *The Taxonomy, Ecology and Conservation of Sousa chinensis (Osbeck, 1765) (Cetacea: Delphinidae) in Hong Kong waters.* PhD. thesis, The University of Hong Kong, Hong Kong.

Porter, L., 2002. A re-description of *Sousa chinensis* (Osbeck, 1765) (Mammalia: Delphinidae) and designation of a neotype. *The Bulletin of the Natural History Museum* 271-80.

Rice, D. 1998. *Marine Mammals of the World: Systematics and Distribution.* Soc. Mar. Mammal. Spec. Publ. No. 4. 231pp

Van Waerebeek, K., Baker, A.N., Félix, F., Iñiguez, M., Sanino, G.P., Secchi, E., Slocum, G., Sutaria, D., van Helden, A., Wang, Y. 2006. Vessel collisions with small cetaceans worldwide and with large whales in the Southern Hemisphere, building a standardized database. SC/58/BC6, presented to 58th Meeting of IWC, St Kitts, May-June 2006.

Wang, J. 2005. The Distribution of Indo-Pacific humpback dolphins (*Sousa chinensis*) in Taiwan. Presented at *The 57th International Whaling Commission Meeting, Scientific Committee Annual Meeting*, Ulsan, Korea, May – June 2005.

Wang, P. and Han, J. 2006. The Present Status of the Distribution of Chinese white dolphin (*Sousa chinensis*) population in Chinese waters. In *The Proceedings of The Xiamen International Workshop on Conservation of Sousa chinensis, Xiamen*, Peoples Republic of China, March 2006.

Wang Yamin. 2006. The Conservation of *Sousa chinensis* in China. *In the proceeding of the Xiamen International Workshop on conservation of Sousa chinensis* ,Xiamen, China, March 2006.

Yang, G., Chen, B., Xi, X., Zhai, F, Sun, P. and Wang, Q. 2006. Abundance and distribution of Chinese white dolphin (*Sousa chinensis*) in Xiamen waters. In *The Proceedings of The Xiamen International Workshop on Conservation of Sousa chinensis, Xiamen*, Peoples Republic of China, March 2006. p25

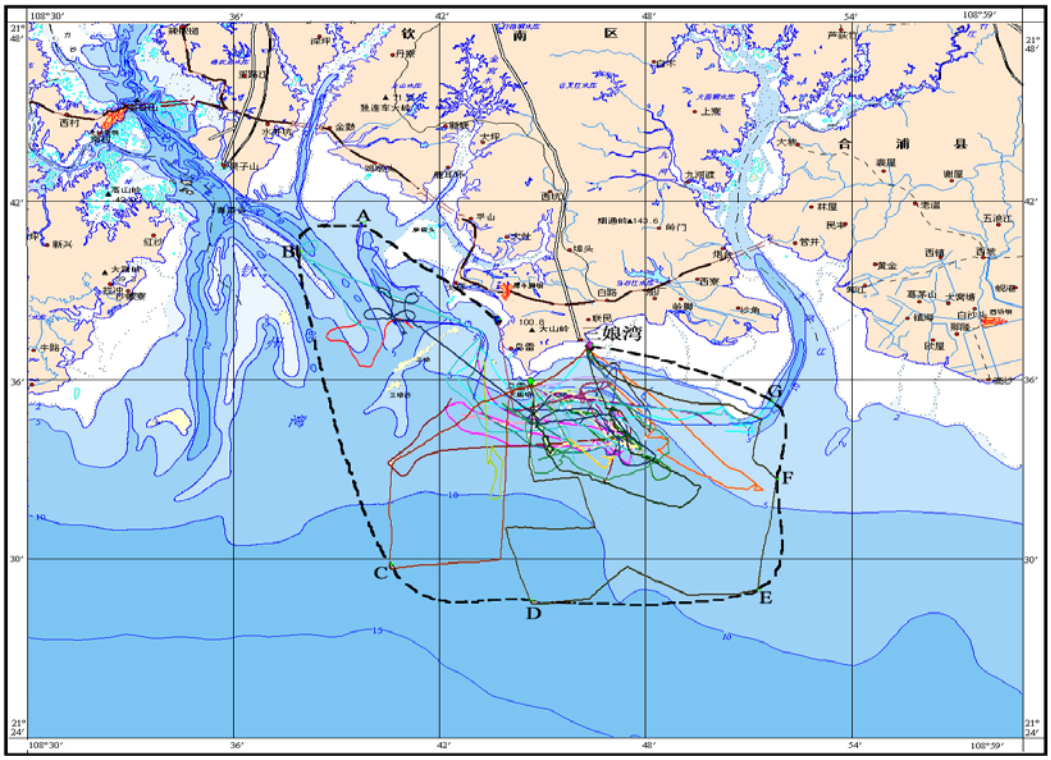

Figure 1. Sanniang Bay, Gunagxi, Peoples Republic of China. The survey area is indicated by the dashed line and the actual survey routes are denoted by coloured, solid lines.

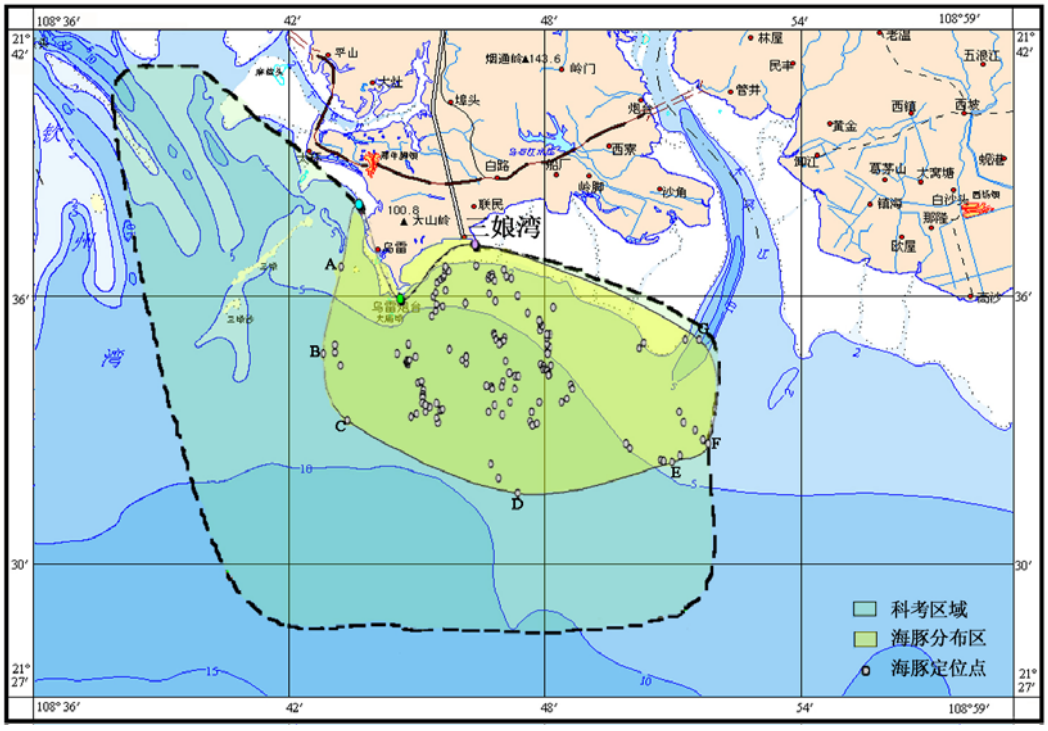

Figure 2. The location of encounters with Indo-Pacific humpback dolphins (*Sousa chinensis*) in Sanniang Bay, Guangxi, Peoples Republic of China. The survey area is indicated by the dashed line and the shaded area where dolphins were encountered.

Figure 3. Age categories of Indo-Pacific humpback dolphin (*Sousa chinensis*) in Sanniang Bay; A, calf; B; adolescent, C; sub-adult and D; adult.

Figure 4. Examples of some of the features used to individually identify Indo-Pacific humpback dolphins (*Sousa chinensis*) in Sanniang Bay, Guangxi, Peoples Republic of China.