Zigzag transect survey by towed passive acoustic method for finless porpoise in the Yangtze River

SATOKO KIMURA[1], TOMONARI AKAMATSU[2], LIJUN DONG[3], SHIYONG WANG[3], KEXIONG WANG[3], DING WANG[3] AND NOBUAKI ARAI[1]

[1] *Graduate School of Informatics, Kyoto University, Kyoto 606-8501, Japan*
Email: sk0130@bre.soc.i.kyoto-u.ac.jp

[2] *National Research Institute of Fisheries Engineering, Fisheries Research Agency, Hasaki, Kamisu, Ibaraki 314-0408, Japan*

[3] *The Key Laboratory of Aquatic Biodiversity and Conservation of Chinese Academy of Sciences, Institute of Hydrobiology, Chinese Academy of Sciences, Wuhan 430072, China.*

ABSTRACT

Accurate estimation of abundance is one of the most important tasks for conservation and management of the endangered species. However, the population estimation of cetaceans in riverine systems is difficult due to the limited cruise course restricted by shallow water and ship lanes. In the present study, we conducted a zigzag survey trial with towed acoustic system in the main stem of the Yangtze River and appended Poyang Lake on the Yangtze finless porpoise (*Neophocaena asiaeorientalis asiaeorientalis*), which has been decreasing rapidly in the last couple of decades. The porpoise detected were 4 and 28 individuals per 14 km (by straight-line distance) of the river and lake respectively on the same day. This corresponded to the seasonal site preference of the porpoises reported previously. Eighty-four percent of the porpoises were detected between 100 and 400 m from the bank. We also counted the number of navigating ships, which was 52 and 29 in the same sections of the river and lake respectively. Most of the ships were cargo vessel and navigated in the middle of the river and lake. Although the survey boat had to carefully across the channel, the zigzag transect seemed to be feasible. In the future work, we will examine the persistence to the bank of the porpoises with a bigger data set and should be able to estimate the accurate abundance of the local population.

Keywords: acoustic data loggers, A-tag, echolocation, dolphin, abundance estimation

INTRODUCTION

The Yangtze finless porpoise (*Neophocaena asiaeorientalis asiaeorientalis*) is a freshwater subspecies of finless porpoise unique to the Yangtze River basin. In the early 1990s, the population size was estimated at approximately 2700 individuals (Zhang et al. 1993). By 2006, it decreased to as low as 1800 over the porpoise's entire distribution range (Zhao et al. 2008). This subspecies has been classified as Endangered by IUCN (The World Conservation Union) since 1996, and its isolation from contiguous marine populations has been confirmed by recent genetic studies (Zheng et al. 2005). Without conservation measures, the animal could soon become extinct, just as the Yangtze River dolphin (baiji, *Lipotes vexillifer*) has likely been driven to extinction directly by human activity (Turvey et al. 2007). Immediate and extreme conservation measures are necessary (Wang et al. 2006, Turvey et al. 2007).

Yangtze finless porpoises produce high frequency sonar signals frequently, on average one click train every 5.1 s (Akamatsu et al., 2005a) or 6.4 s (Akamatsu et al., 2007). Due to the low visibility of the water (< 1 m), it is assumed that the porpoise produce the echolocation signals not only when they are foraging but also navigating. They rarely travel more than 20 m without vocalizing (Akamatsu et al. 2005a), suggesting that the porpoises do not usually travel far without producing detectable sounds. Using this characteristic, passive acoustical monitoring methods have been applied to monitor this species for these several years (Kimura et al., 2009; Li et al., 2010; Kimura et al., in press).

Towed acoustic platform for monitoring the porpoise had higher detection probabilities than visual methods (Akamatsu et al., 2008). Strip or line transects with this monitoring system is considered to be suitable to estimate abundance or population size, which is one of the most important keys for the conservation or management of the animals. Dawson et al. (2008) suggested that a zigzag survey at 45 degree to a line down the centre of the inlet was ideal for the survey in the river region. However, no zigzag transect survey was carried out for this species because of the difficulty of the zigzag boat operation in the Yangtze River due to heavy ship traffic and shallow river bed nearby the bank.

In the present study we report the preliminary results of a zigzag survey trial at 45 degree. The acoustic detection probability of porpoises within a strip width was already

confirmed, which was about twice that of visual surveys (Kimura et al., 2009). We also counted the number of navigating ships in the survey area.

MATERIALS AND METHODS

For acoustic detection of the target animals, we used an acoustic data logger, A-tag manufactured by Marine Micro Technology, Saitama, Japan (Akamatsu et al., 2005b). It consisted of two ultrasonic hydrophones approximately 170 mm apart. This system is a pulse event recorder, recording the time, sound pressure level and time difference in sound arrival between the two hydrophones. The band-pass filter of 55–235 kHz was used to eliminate background noise. Detail specification of A-tag is available at, http://cse.fra.affrc.go.jp/akamatsu/A-tag/index.html

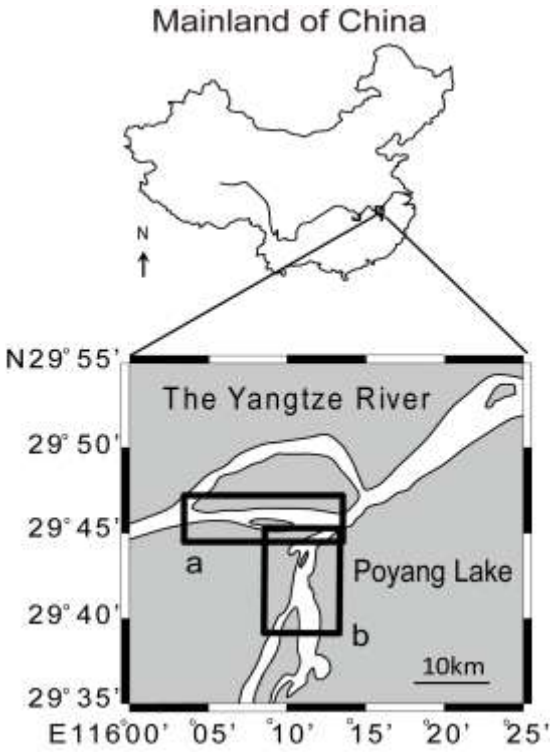

Figure 1. Map of the survey area: the convergent area of Poyang Lake and the middle reaches of the Yangtze River. Black box a and b correspond to those in Figure 2 (a) and (b).

We conducted the survey in about 14 km of both the main stem of the Yangtze River and appended Poyang Lake by straight-line distance (Fig. 1). The A-tag was towed approximately 40 m behind the survey boat, which navigated on the zigzag line we fixed on GPS (GPSmap 76S; Garmin, Olathe, KS, USA) using MapSource software (Garmin, Olathe, KS, USA). The survey boat was 12 m long and had a 12 horse power diesel engine at the top deck of the stern which directly rotated the shaft of the screw. The 6 mm diameter floating rope used for towing the A-tag rode at a depth of <1m given the speed of the boat. To prevent the A-tag from jumping out of the water, a small weight was added in front of the data logger. A 5 m tail was added to stabilize the position to prevent swaying. The zigzag survey was conducted along the current (to downstream). To prevent double-counting of animals, the boat speed was kept faster than the swimming speed of finless porpoises, which is about 4.5 km/h with no current (Akamatsu et al. 2002).

The number of animals was counted based on the method of Akamatsu et al. (2008). The signal processing and acoustical separation of individuals was the same as reported in Kimura et al. (in press).

We counted the number of ships navigating at the same time, 11:00 - 15:00, one day before the zigzag trial. The type of the ship (Cargo ship, Fishery boat or high speed boat), navigation direction (upstream or downstream) and the relative course (middle or bank side) and distance (approximate meters) from the survey boat were recorded. The stopping ships were excluded except for fishing boats. This survey was conducted from the upstream to downstream by straight-line distance to maintain appropriate speed otherwise counter current reduced the boat speed below the swimming speed of the porpoises..

RESULTS AND DISCUSSION

We conducted a zigzag transect survey on February 23rd 2011 and counted the number of the navigating ships on February 22nd. The shoal ground occasionally prevented the boat from approaching the bank (Fig. 2). Due to heavy ship traffic, sometimes we had to wait on or navigate out of the zigzag line (Fig. 2).

A-tag detected 4 and 28 porpoises in the Yangtze River and Poyang Lake. Kimura et al. (in press) reported that the porpoise aggregates in the lake and less in the river in February. Our result corresponded with this seasonal site preference.

Zhao et al. (2008) suggested that the density of the porpoise was higher at closer to the bank and less in the middle of the river. This study confirmed that 84% of the porpoises were detected between 100 and 400 m from the bank (Fig. 3). Note that the river and lake width varied 1 to 2 km according to the location, which means the middle of the river or lake was 500 to 1000 m.

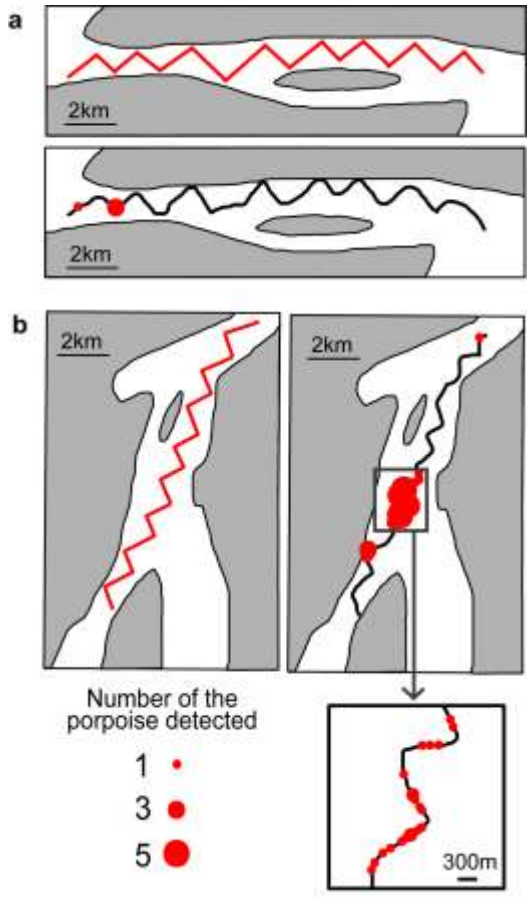

Figure 2. Zigzag transect lines designed in advance with MapSource software (upper and left of a and b, respectively) and actual lines surveyed. Number of the porpoises detected (lower and right of a and b) are depicted in the lower inset. (a) and (b) correspond to those in Figure 1 a and b.

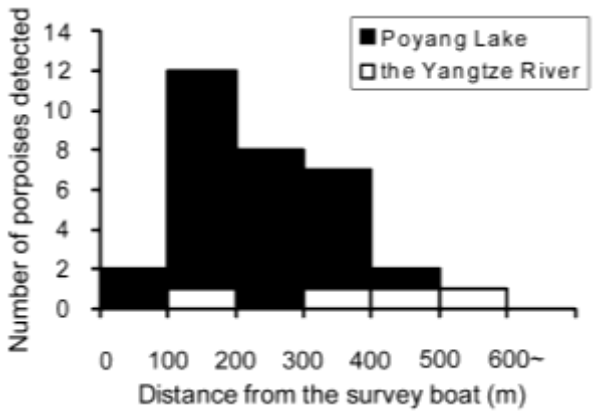

Figure 3. Distance of porpoises detected from the bank.

The number of the navigating ships counted was 52 and 29 in the Yangtze River and Poyang Lake (Table 1). This means there was a ship every 270 m and 500 m in the river and lake, respectively. Most of the ships were not fishery but cargo ships (Table 1). The cargo ships need to be operated in the middle of the river due to their deep-draft. Thus, 98 and 79 % of the ships navigated in the middle side of the river and lake (Fig. 4). The survey boat sailed 300 m and 3-500 m from the bank in the river and lake, respectively. Because of the shoal, we could not keep the same distance from the bank.

CONCLUSION

The present study showed the preliminary results of the zigzag transect with towed acoustic system. Although the survey boat had to carefully across the channel because ship traffic is heavy in the middle of the river and lake, the zigzag transect seemed to be feasible. In the future work, we also have to examine the persistence to the bank of the porpoises and should be able to estimate the accurate abundance of the local population.

Table 1. Ships and boats counted on February 22nd.

Area	Yangtze River	Poyang Lake
Start time	12:03:47	10:37:35
End time	13:18:02	12:13:47
Duration (Start time to End time)	1:14:15	1:36:12
Number of cargo ships	51	20
Number of fishery boats	0	7
Number of speed boats	1	2
Number of upriver ships	49	24
Number of downriver ships	3	3
Number of ship fishing	0	2

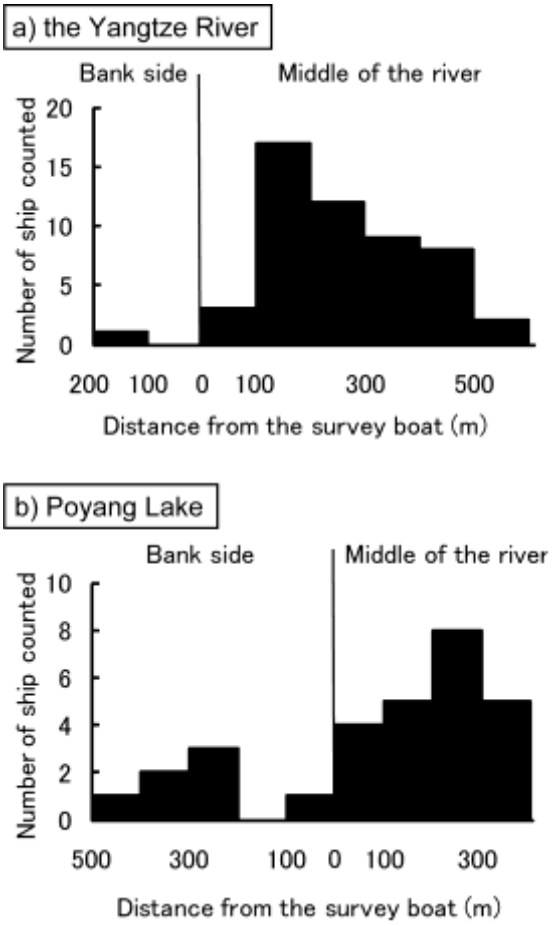

Figure 4. Distance of the ship counted from the survey boat. About 98 and 79 % of the ships navigated in the middle side of the river and lake. The survey boat sailed approximately 300 m and 3-500 m from the bank in the river and lake, respectively.

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