Title	The Population Sizes of Indo-Pacific Humpback Dolphins (Sousa chinensis) Around Sukon and Sarai Islands, Thailand Estimated Using Photo-Identification Technique
Author(s)	CHERDSUKJAI, PHAOTHEP; KITTIWATTANAWONG, KONGKIAT
Citation	PROCEEDINGS of the Design Symposium on Conservation of Ecosystem (2013) (The 12th SEASTAR2000 workshop) (2013): 51-54
Issue Date	2013-03
URL	http://dx.doi.org/10.14989/176190
Right	
Type	Conference Paper
Textversion	publisher

The Population Sizes of Indo-Pacific Humpback Dolphins (*Sousa chinensis*) Around Sukon and Sarai Islands, Thailand Estimated Using Photo-Identification Technique

PHAOTHEP CHERDSUKJAI[1]*,
KONGKIAT KITTIWATTANAWONG[2]
[1]*Marine and Coastal Resources Research and development Center (Upper Gulf of Thailand), 120/1 Moo 6 Bangyaprak, Samut Sakhon 74000, Thailand*
Email: Phaothep1313@hotmail.com
[2]*Phuket Marine Biological Center, P.O.Box 60, Phuket 83000, Thailand*

ABSTRACT
The population sizes of Indo-Pacific humpback dolphins (*Sousa chinensis*) around Sukon Island, Trang Province and Sarai Island, Satun Province on the Andaman coast of Thailand, were estimated using photo-identification technique. The field survey was conducted during November, 2010 – December, 2011. The survey effort at Sukon Island amounted to 11 days, totaling 59.09 hours of observation, while at Sarai Island the survey effort amounted to 15 days and totaled 57.11 hours. A total of 23 dolphins were identified at Sukon Island and a further 24 identified at Sarai Island via photo-identification. Estimation of dolphin population sizes with the Chapman- modified Peterson's mark and recapture model, showed that there were 56±21.5 and 29±4.2 individuals around Sukon and Sarai Islands respectively. Combining the results of photo-identification from the previous and present surveys, the total number of animals was found to be very similar to the estimated population's size predicted using Chapman's equation.

KEYWORDS: Indo-Pacific humpback dolphin, photo-identification, population size

INTRODUCTION

The Indo-Pacific humpback dolphin (*Sousa chinensis,* Osbeck, 1765) is a coastal species which is found in the Indian Ocean and western Pacific Ocean (Jefferson et al., 2008). In Thailand, this dolphin has been managed under the Protected Animals Act of Thailand since 1992. Although sighting information and stranding records of Indo-Pacific humpback dolphins from both sides of Thai coastal waters has been gathered by the Phuket Marine Biological Center (PMBC) (Adulyanukosol., 1999; Chantrapornsyl et al., 1996) since 1993, there is no available population size estimate of this species taken from along the Andaman coast of Thailand. However, Jaroensutasinee et al., (2010) researched this species using photo identification (Photo-ID) technique at Khanom Bay, Nakhon Sri Thammarat Province in the Gulf of Thailand and estimated the dolphin population's size.

Photo-ID technique has the great advantage of avoiding physical capture or the application of a mark. Instead, the natural markings of each individual are captured in photographs (Hammond et al., 2002). This technique is therefore commonly used for estimating the population size of cetaceans with mark-recapture methods, by using the data of the number of marked animals and the proportion of marked animals in samples of recaptured animals (Hammond., 1995).

Mark-recapture analyses of photo-identification data were therefore chosen for this study in order to monitor and estimate the population size of Indo-Pacific humpback dolphins in the study areas of Sukon and Sarai Islands and to propose additional standard methods to check and monitor dolphin's status, improving survey methods used to record dolphins in Thai waters.

MATERIALS AND MEDTHODS

PMBC has been working to create a database of fishing communities, from which two areas of study were chosen. The first site was Sukon Island (N 7.09834 E 99.58321), located in Trang Province and the second was Sarai Island (N 6.66351 E 99.85043), located in Satun Province. Both areas are situated along the Andaman coast of southern Thailand (Fig.1). The distance between the two areas is 60 kilometers. While working at the fishing communities, fishermen were given sighting calendars and GPS data-loggers to record the dolphin's sighting locations. The collected information, the dolphins' distribution and their hot-spots were used as a basis to conduct the dolphins' Photo-ID survey.

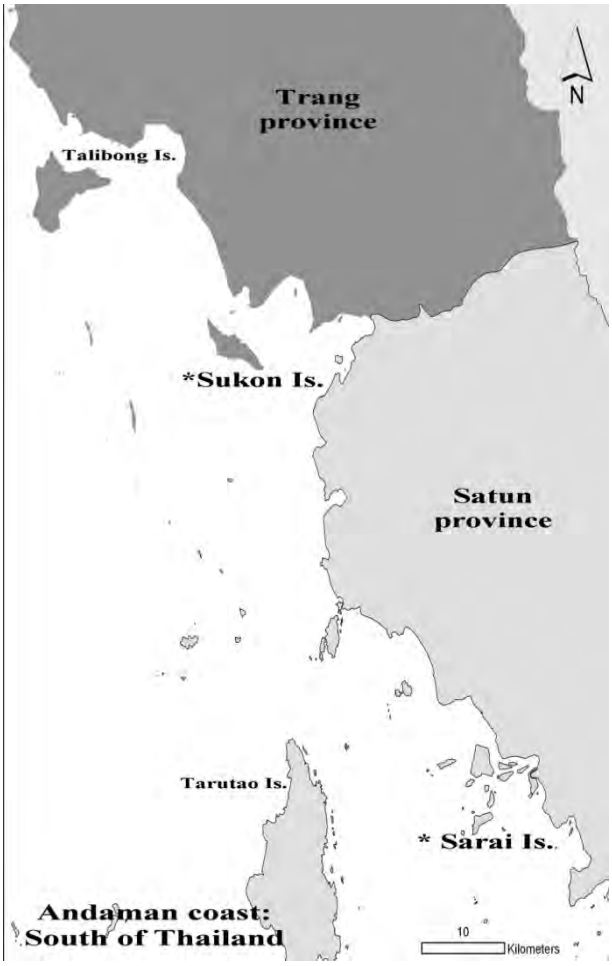

Fig. 1: Map showing the two study areas, Sukon Island in Trang Province and Sarai Island in Satun Province. Both study sites were located along the Andaman coast of Southern Thailand.

Each study area was surveyed four times, with each survey lasting 1-5 days and taking 6-8 hours per day, depending on weather conditions. The surveys were conducted from a long-tail fishing boat. When dolphins were sighted, pictures of the lateral view of their dorsal fins were taken using the Nikon D7000 and Canon 40D digital single-lens reflex cameras, each fixed with a 70-300mm telephoto zoom lens. The position of the animals, the environmental conditions, dolphins' behavior and the group size were also recorded during each sighting. The dolphins were followed for a maximum duration of an hour and at a distance of more than 50 meters.

The software, Discovery, was used to categorize the photographs obtained and to identify each individual within each group. Subsequently, the capture history for each identified individual was set. A capture history is defined as a string of 1's and 0's representing whether an animal was found (1) or not found (0) in a series of sampling occasions. The dolphin population sizes were estimated using the program MARK and based on the "Close capture model", due to the surveys being completed within one year. This model assumes that the population is estimated without including births, deaths, immigration and emigration when the study period is brief, such as one year (Hammond, 2002). In addition, one common estimator, the Chapman's modified Peterson estimator (Fig.2), was used for the analyses in this study.

At Sukon Island, the survey was conducted in November 2010, January 2011, April 2011 and July 2011. The number of animals that were found in November and January are represented as n_1 and a number of animals that were found in April and July are represented as n_2. A number of animals that were re-sighted in both periods are represented as m_2.

$$\hat{N} = \frac{(n_1 + 1)(n_2 + 1)}{(m_2 + 1)} - 1$$

Fig.2: Chapman's modified Peterson estimator (referred to in abbreviated form throughout this paper as 'Chapman's equation'), population size estimate is $\hat{N}$; the total number of individuals captured, marked and released for the first time is n_1, for the second time is n_2, and the total number of animals already marked or re-sighted, is m_2.

The survey at Sarai Island was conducted in February 2011, May 2011, August 2011 and December 2011. The values n_1 and n_2 represent the number of animals that were found between the period of February and May and the period of August and December respectively. A number of animals that were re-sighted in both periods are represented as m_2 as well.

RESULTS

The number of dolphins that were marked (identified) at Sukon and Sarai Islands were recorded at 23 and 24 individuals respectively. The values n_1 and n_2 of Sukon Island, which represent the number of dolphins that were found in November and January and in April and July, were 16 and 10 respectively. The values n_1 and n_2 of Sarai Island, which represent the number of dolphins that were found in February and May and in August and

December, were 10 and 21 respectively. The number of previously marked dolphins with the value of m_2, was 2 at Sukon Island and 7 at Sarai Island.

Values from each capture history were placed in MARK's Close capture model and used the Chapman modified Peterson's estimator to estimate the dolphin population sizes.

The estimated dolphin population size at Sukon Island was 67 ± 37.93 (S.E.) based on MARK's Close capture model and 56 ± 21.5 (S.E.) based on Chapman's equation. The estimated dolphin population size at Sarai Island was 29 ± 4.37 (S.E.) based on MARK's Close capture model and 29 ± 4.2 (S.E.) based on Chapman's equation (Table1)

Table 1 Estimated dolphin population sizes of Sukon Island and Sarai Island using Program MARK and Chapman's equation

Locations	n_1	n_2	m_2	MARK (±S.E.)	Chapman's equation (±S.E.)
Sukon Is.	16	10	2	67±37.93	56±21.5
Sarai Is.	10	21	7	29±4.37	29±4.2

DISCUSSIONS

Although the numbers of animals estimated in both areas were very similar, the m_2 value recorded at Sarai Island showed a higher rate of sightings than the m_2 value recorded at Sukon Island. The standard error of the population estimates from Sarai Island was much lower than that of those from Sukon Island, which means that the higher the number of re-sighted animals, the more accurate the estimates should be. Additionally, in both study areas, the Chapman's equation results show a narrower standard error, compared with the standard error from the results of MARK. Therefore, the Chapman's equation provided better results for this study.

Not only in the years 2010 and 2011 when Photo-ID survey s at Sukon Island and Sarai Island were conducted but Photo-ID surveys were also conducted occasionally, in the years 2007-2008 at Sukon Island and in 2009 at Sarai Island. During these surveys, the dolphins that could be identified were counted at 11 and 4 individuals from Sukon Island and Sarai Island respectively. There were no previously marked animals recorded in the prior surveys found existing during the present survey of both study area. So, at Sarai Island, the total number of individuals from the 2009 survey and the 2010-2011 survey was very similar to the estimated population's size using the results of Chapman's equation (Table 2).

Table 2 Total number of dolphins that were identified in 2007-2009 and 2010-2011, and their population size estimatesusing Chapman's equation

Location	No. of animals (2007-2009)	No. of animals (2010-2011)	Total	Chapman's equation
Sukon Is.	11	23	34	56
Sarai Is.	4	24	28	29

Additionally, no individuals were sighted at both sites. If the populations at both study sites are completely separated from each other and have low population sizes, each group could become extinct because of low genetic variability (Caughley et al., 1996). However, further detailed research for an extended duration will provide more insight into the population ecology of this species at both islands.

Though the closed model was suitable for simply estimating population size within short study duration, Jaroensutasinee et al. (2010) used the open model to estimate the population size of Indo-Pacific humpback dolphins at Khanom Bay, Nakhon Si Thammarat Province in the Gulf of Thailand. The study was conducted between July, 2008 – June, 2009, and the population's size taken from the open model at 49 was similar to the number of individuals from the Photo-ID survey at 49 however the survival rate and dilution rate of the dolphins were also estimated as being 0.94 and 1.01 respectively. Our study appeared to show that the population size estimated by open model was an underestimate or had lower numbers compared with the number of dolphins recorded using the Photo-ID survey (Table 3). With these findings the open model could be used in some specific cases for closed population, such as the birth or death of animals in study areas which were occurring during the period of reported study.

Table 3 Comparison between the number of dolphin sightings that were gained from use of photo-ID, the Close model and the Open model. The population estimate from the open model was lower than the number of animals from the Photo-ID. So, the results from use of the open model led to an underestimation.

Locations	No. of animals (photo-ID)	Close model (±S.E.)	Open model (±S.E.)
Sukon Is.	23	56±21.5	22±2.76
Sarai Is.	24	29±4.2	11±0.81

While Buckland et al. (2001) suggested that at least 60 sightings are needed to obtain more precise population estimates, our sightings in each study area totaled only four sightings because these studies were part of a pilot project and long term studied were due to occur already. Determining the survival rate and the dilution or increasing rate were our purposed.

Irrawaddy dolphins (*Orcaellabrevirostris*, Owen in Gray, 1866) were also found in both areas and the Finless porpoise (*Neophocaenaphocaenoides*, Cuvier, 1829) was found in Sarai Island. These two species have different characteristics which identify them. Because of the very small dorsal fin of the Irrawaddy dolphin we could only identify some of them. Due to this, using a high performance camera and lens is needed for working on a photo ID or changing the survey method to use the Line transect survey. As for the Finless porpoise which is lacking a dorsal fin, the Line transect survey method or Acoustic methods can be used to survey them more effectively. However, because the Indo-Pacific humpback dolphin has a distinctly shaped dorsal fin and color patterns on their body, the photo-ID technique with mark-recapture method were appropriate for use in studying their population size.

ACKNOWLEDGMENTS
Special thanks are given to Prof. Phillip Hammond for suggestions on our analysis. Thank you also to our survey members,Mr.SumanParnpuum, Ms.NisaratTawisuwan, Mr.ShinnakornThongchai and Mr.PiyawutSukthong - the staff from the Marine Endangered Species Unit, Phuket Marine Biological Center.

REFERENCES

Adulyanukosol, K. (1999) Dugong, dolphin and whale in Thai waters. In: *Proceeding of the first Korea-Thailand Joint Workshop on Comparison of Coastal Environment*: Korea-Thailand, Seoul.; 5-15

Buckland, ST., Andersin, DR., Burnham,KP.,Laake, JL., Borchers, DL. & Thomas L.(2001)*Introduction to Distance Sampling*: *estimating abundance of biological populations*. Oxford University Press, Oxford.

Caughley, G.& Gunn, A. (1996)*Conservation Biology in Theory and Practice*. Blackwell Science, Oxford.
Chantrapornsyl, S., Adulyanukosol, K.&Kittiwatanawong, K. (1996) Records of cetaceans in Thailand.*Phuket Marine Biological Center Research Bulletin*.; 61: 39-63

Jaroensutasinee, M., Jutapruet,S. &Jaroensutasinee, K. (2010) Population Size of Indo-Pacific Humpback Dolphins (Sousa chinensis) at Khanom, Thailand. *Walailak Journal Science and Techhnology*.; 7(2): 115-125
Jefferson,TA., Webber, MA. & Pitman, RL. (2008) *Marine Mammals of the World: A Comprehensive Guide to their Identification*. Elsevier, Canada.

Hammond, PS. (1995) Estimating the abundance of marine mammals: a North Atlantic perspective. In:Blix, AS., WallØe&Ultang, Ü. *Whale, seals, fish and man*. Developments in Marine Biology. Elsevier Science B.V., Amsterdum.; 4. 3-12

Hammond, PS. (2002) Mark-Recapture. In: Perrin, WF, WÜrsig., B&Thewissen, JGM (eds). *Encyclopedia of Marine Mammals*. Academic Press, California.; 705-709