

Population and Conservation Status of Irrawaddy Dolphins (*Orcaella brevirostris*) in Trat Bay, Trat Province, Thailand

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ABSTRACT

Trat Bay is an important area for fishing activities along the Eastern coast of the Gulf of Thailand. The Irrawaddy dolphin (*Orcaella brevirostris*) is the dominant species in this area. They are currently listed as an endangered species in Thailand. The distribution and behavior of Irrawaddy dolphins in Trat Bay, were investigated between 2010-2012. The photo identification technique was used to estimate density of Irrawaddy dolphins. We also conducted interviews with small-scale fishers, and collected information on dolphin stranding. Photo identification results indicated that Irrawaddy dolphins inhabit the coast of Trat Province all year round and could be observed with calves mainly between December and February. Group sizes observed ranged from 5 to 20 individuals. The minimum population was estimated as 171 ± 73.18 individuals. Many dolphins were observed around fishing boats, area closed by used fishing gears and artificial reefs. As the results of fishing gear mapping, the most common fishing gears used by the fishery communities in Trat Bay are gill nets and crab traps (54% and 25% respectively), especially during the spring tide. Five Irrawaddy dolphins were found entangled in fishing gears during this research. The high density of fishing gears is likely the major threat to dolphins in this area. These obtained data could contribute to management and strategies for dolphin conservation based on integration of local community agreement.

KEYWORDS: Irrawaddy dolphins, *Orcaella brevirostris*, conservation, endangered species, Trat Bay, Thailand

INTRODUCTION

Irrawaddy dolphin (*Orcaella brevirostris*), Indo-Pacific humpback dolphin (*Sousa chinensis*) and finless porpoise (*Neophocaena phocaenoides*) are endangered species under the Wildlife Preservation and Protection Act, B.E.2535 (A.D.1992) which prohibits killing, trading, possessing and breeding of these animals. Moreover, they are on the list of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Irrawaddy dolphin is listed on Appendix I as threatened with extinction and on the IUCN Red lists as CR - Critically endangered. (IUCN, 2012)

Irrawaddy dolphins can be found throughout the tropical and subtropical Indo-Pacific region; along the coasts of India, Bangladesh, Myanmar, Thailand, Cambodia, Laos, Vietnam, Malaysia, Singapore, Brunei Darussalam, and Indonesia. (Stacey and Leatherwood, 1997; Stacey and Arnold, 1999). Irrawaddy dolphins usually inhabit coastal, shallow, brackish, or fresh turbid waters at the mouths of rivers in southeastern Asia (Marsh et al. 1989; Jefferson et al. 1993; Rice, 1998; Baird and Mounsouphom, 1997; Smith et al. 1997).

The Irrawaddy dolphin exists in small isolated populations around Southeast Asia. Some populations are close to extinction such as those in the Songkhla lake Thailand and the Mekong river Malampaya sound in the Philippines. (WWF.panda.org/endangered_species/ Irrawaddy dolphin, 2013). The major threats to Irrawaddy dolphins include fisheries bycatch and habitat loss. Some small cetaceans caught by fishing nets, especially in coastal and riverine areas (Jefferson et al. 1993). Bycatch of Irrawaddy dolphins probably occurs in many areas such as Bangladesh, India, and the Gulf of Papua New Guinea (IWC, 2000; Smith et al. 2008). Occasionally, the animals entangled by fishing net can escape by themselves but some are drowned (Reyes, 1991; Jefferson et al. 1993).

Trat Bay is an important area for fishing along the Eastern coast of the Gulf of Thailand. Since fishing is the main occupation in this area which might effect on Irrawaddy dolphin, other marine endangered species and their habitat. The objectives of this study were to understand (1) the population density and habitat use of dolphins along Trat Bay by boat base survey and photo identification techniques and (2) the interactions between

Irrawaddy dolphins and small-scale fisheries along Trat Bay. The information obtained would provide for management the marine protected areas.

MATERIALS AND METHODS

1. The species distribution was investigated by boat based surveys. We conducted boat surveys in 4 areas within Trat Province, including 1) west coast area, 2) Lem Klut, 3) Mai Rut and 4) Klong Yai. (Fig.1).The survey took place between January-February 2010, 2011 and 2012.

2. The photo identification technique were conducted 6 times per year in 2010, 2011 and 2012. Cameras used were a NIKON D90 and D7000 attached with a 70–300 mm telephoto zoom lens. We also collected data on group size, general age composition (adult or calf), behavior and markings on their bodies.

The data from the photo identification technique were analyzed with Mark recapture software base on “Close capture model” and a Chapman-modified Petersen estimator. This model assumes that the population is estimated without birth, death, migration, when the study period is short, such as 1 year (Hammond, 2002). Density of dolphin is estimated by Chapman-modified Petersen estimator (Chapman, 1951) as shown in eq. 1. N is estimate of total population size, n_1 is total number of animals captured and marked on the first visit, n_2 is total number of animals captured on the second visit and m_2 is number of animals captured on the first visit that were then recaptured on the second visit.

$$N = \frac{(n_1 + 1)(n_2 + 1)}{(m_2 + 1)} - 1 \quad (\text{eq. 1})$$

3. The mapping of fishing gears were investigated with rubber boats during May, July and August 2012, speed of 6 kilometers per hour.

4. The stranding data were recorded in year 2010-2012. The stranded animals were necropsied to find the cause of death. The stomach contents of stranded dolphins were analyzed to identify their prey species.

5. Interviews were conducted with local people in villages along the Trat coast during May, July and August 2012. These interviews focused on marine mammals, stranding events, patterns of movement and sightings, and fishing practices that may affect dolphins.

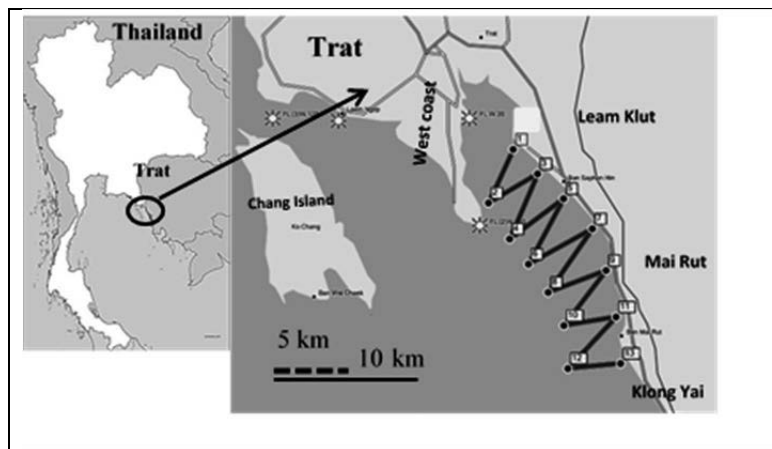


Fig.1. Map of study area, showing the survey routes in Trat Bay, Trat Province, Thailand

RESULTS

Species diversity and distribution

During boat-based surveys in 2010-2012, the three species were observed Irrawaddy dolphins (*Orcaella brevirostris*), Indo-Pacific humpback dolphins (*Sousa chinensis*) and Finless porpoises (*Neophocaena phocaenoides*) (Table 1).

The Irrawaddy dolphins could be found all year round. Ninety five sightings were recorded in three years. The average group size was 4.94 ± 4.9 individual. The calves of Irrawaddy dolphins usually appeared between December and February.

The Indo-Pacific humpback dolphin was observed in January, February and July. The average group size was 3.8 ± 2.6 individual. The Finless porpoise was sighted only once in year 2010 (best estimate was 4 individuals).

Table.1. Number of sightings and average minimum group size of the three cetacean species observed in 2010-2012 along Trat Bay, Trat Province, Thailand.

year	<i>O.brevirostirs</i>		<i>S.chinensis</i>		<i>N.phocaenoides</i>	
	Number of sightings	Average minimum group size	Number of sightings	Average minimum group size	Number of sightings	Average minimum group size
2010	17	4.7±2.4	1	5	1	4
2011	12	4.7±3.1	-	-	-	-
2012	66	3.9±4.3	5	3.6±2.8	-	-
Total	95	4.94±4.9	6	3.8±2.6	1	4

The distribution of dolphins in Trat Bay ranged from Leam Klut to Klong Yai villages, with hot spot areas of Irrawaddy dolphins at Leam Klut and Mai Rut. A common group size was between 1-5 individuals. Groups that were engaged in mating were very active, moving in herds (as noted in Ponnampalam et al. 2013). Larger group sizes could be observed when the animals were engaged in socializing behaviors. The group size during these mating ranged from 10–30 individual dolphins. The distribution of dolphins during the study period in Trat Bay is shown in figure 2.

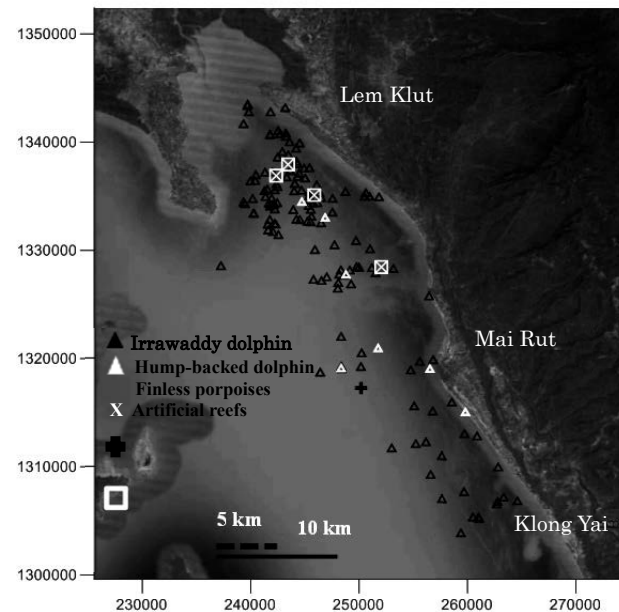


Fig.2. The sightings of Irrawaddy dolphin, Indo-Pacific humpback dolphin and Finless porpoises in 2010-2012 (The black triangle = Irrawaddy dolphin, white triangle = Indo-Pacific humpback dolphin, black cross = Finless porpoises and white square = artificial reefs)

Photo identification

We focused on markings at dorsal fins and scars on their bodies (Fig.3). Some of photographs were unclear because Irrawaddy dolphins had a small dorsal fin and less body markings. According to our result, 46 Irrawaddy dolphins and 8 Indo-Pacific hump backed dolphins were identified. There is no photograph of finless porpoises.

The values of capture history from photo identification were calculated with Mark-recapture software and used the Chapman modified Peterson's estimator. Estimation of minimal number of Irrawaddy dolphin in this area was 171 ± 73.18 individual with approximate 95% confidence interval 88 to 404 individuals. The data from photo identification confirmed that the Irrawaddy dolphins were foraging in Trat Bay during the period of survey and it appeared that the dolphins were at times seen engaged in hunting and foraging for prey.

The population estimate of Indo-Pacific humpback dolphin was 8 ± 1.43 individuals with approximate 95% confidence interval 8 to 17 individuals. Groups of Indo-Pacific Hump-backed dolphins recorded in year 2010-2012, were observed in January, February and July of the each year.



Photos of Irrawaddy dolphin (*Orcaella brevirostris*)



Photos of Indo-Pacific Hump-backed dolphin (*Sousa chinensis*)

Fig.3. Dorsal fin characteristics of Irrawaddy dolphin and were used for individual identification

Fishing gear map and human activities

According to the interviews from 346 local fishermen, fishing gears used in the area can be classified into 8 types: gill nets, traps, purse seine, trawls, set traps, hooks, push nets and luring purse seine (Fig.4).

The most commonly used gears were gill nets, traps and purse seine (54%, 25% and 8% respectively). 90% of the interviewees went fishing on a daily basis, while the rest 10% fished only when target species were in season. Interestingly, our results also show that gillnets were more frequently used during spring tide than neap tide. The currents during the spring tide are usually stronger because of the greater range between higher and lower tides, thus, increase the chance of fish being caught in fishing nets.

Fifteen types of fishing gears were observed in 254 locations. The fishing gears were stationed around 0.5- 12 km from the coastline, especially in the areas offshore of Leam Klut and Mai Rut villages, where dolphins had also been sighted frequently (Fig.5). Over 20% of dolphins sighted during our surveys (both Irrawaddy dolphins and Indo-Pacific humpback dolphins) were observed swimming and feeding around fishing gears and fishing boats as well as foraging in proximity of artificial reefs.

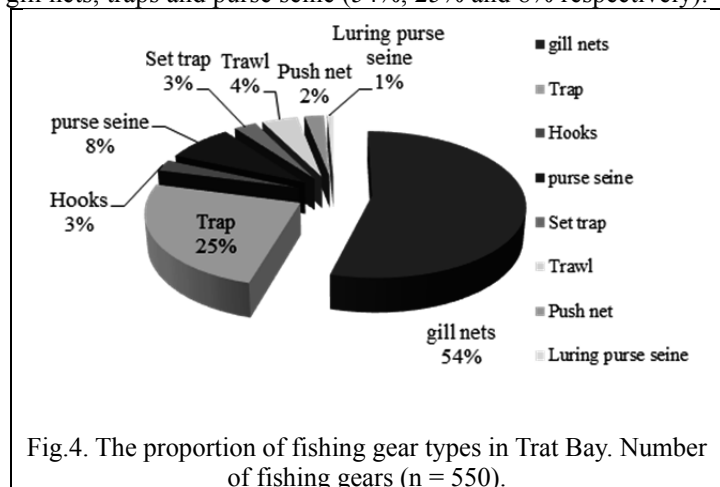


Fig.4. The proportion of fishing gear types in Trat Bay. Number of fishing gears (n = 550).

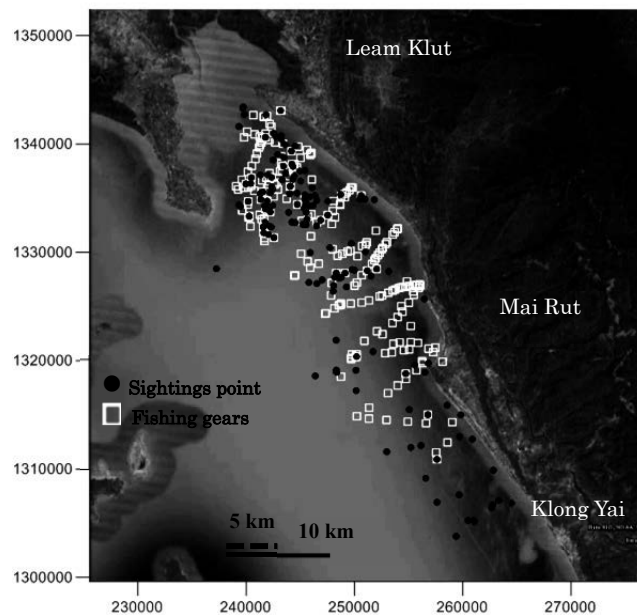


Fig.5 The map showing locations of fishing gears and dolphin sightings in Trat Bay. (Black circles = sightings point, white squares = fishing gears location)

Stranding data

Stranding record during 2010-2012, covering the east and west coast of Trat Bay and Kho Chang, were collected. The stranded animals were necropsied. Unfortunately, most of the animal bodies and internal organs (>90% of the cases) were already decomposed, thus the cause of death could not be identified.

In total, 44 stranding cases were recorded, including 31 Irrawaddy dolphins, 11 finless porpoises, 1 Indo-Pacific humpback dolphin and 1 Indo-Pacific bottlenose dolphin (*Tursiops aduncus*). 16 cases were reported in Mairut, 12 in Leam Klut, 9 Klong Yai, 6 along the west coast and 1 from Koh Chang. The Irrawaddy dolphin was the only species found stranded in nearly all of our study areas but Koh Chang (Fig.6).

The stomach contents of stranded dolphins were analyzed to identify their prey species. The stomach conditions from this study can be classified into 2 classes: 1) Empty stomachs and 2) Full stomachs. The prey species were observed from this study such as shrimp, tiger prawn, cuttlefish, octopus, soft cuttlefish, croaker, yellow-stripe scad, anchovy and mackerel.

Nevertheless, in almost all of our stranding cases, there was no evidence to confirm the cause of death. Only 6 dolphins were actually found entangled with part of fishing gears such as ropes, trawls and surrounding nets. Additionally, in cases of 2 females stranded in Mai Rut village in January 2010 and February 2012, we found that they were pregnant with the embryos measured 60 cm in length.

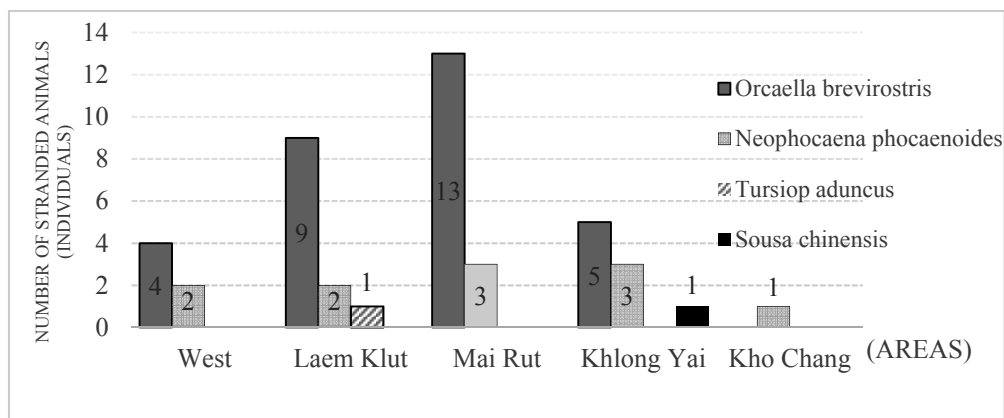


Fig.6 Details of the dolphins stranding cases in Trat Bay from 2010-2012

DISCUSSION

According to previous research and our studies, Trat Bay (Thailand) is the most important foraging and nursing area of Irrawaddy dolphins, where they are dominant species. The population size based on minimal estimate was 171 ± 73.18 individuals which is higher than the best estimate of the population in Mekong River, Ayeyarwady River and Malampaya Sound of the Philippines (40, 59 and 77 individuals, respectively: Baird and Beasley, 2005; Smith, 2004; Smith and Beasley, 2004; Stacey and Hvenegaard, 2002). Groups with up to 6 individuals are most common, but sometimes, up to 15 dolphins can be seen together (Marsh et al. 1989; Jefferson et al. 1993). In Chilika Lake, Orissa, India, which is the largest brackish water lagoon in Asia, there are about 80-90 Irrawaddy dolphins (Sarkar, 2007). And the largest population occurs in the near shore waters of Bangladesh with estimate of 5,383 individuals (Smith et al. 2008).

Additionally, in cases of 2 females were pregnant in January 2010 and February 2012. The record could be used to predict the mating season and nursery period of Irrawaddy dolphin in Trat Bay. According to the herd mating behavior has also been observed in Trat bay and calves have been sighted usually between December and February (Ponnampalam et al 2013). The calving season is not well documented so far. According to Jefferson et al (1993), a female in captivity gave birth in December, while in the wild, calves-sighting have been reported between June and August. In the Northern Hemisphere, mating season is apparently from December to June (Arnold, 2002). The mating behavior has also been reported in Kuching, Sarawak, large aggregations of dolphins up to 20 individuals were observed engaging in what appears to be herd mating, which usually occurs during the summer months (Minton et al. 2011).

The feeding areas of Irrawaddy dolphins in Trat bay appeared to be coincident with the fishing areas. Additionally, the prey species found in their stomachs were similar to the fishery target species (anchovy, shrimp and octopus). One of the most concerning issues is the increase in use of gillnets in Trat Bay. Occasionally reported by fishermen, the animals entangled by fishing net can escape by themselves, some are rescued and released by the net owners, but in many cases they are drowned. According to the major threats to dolphins worldwide are from fisheries by-catch and habitat loss. The subpopulation from Kreb and Budiono's (2005) study was undoubtedly under the threat of gillnet entanglement. Dolphins in the Mahakam are often observed feeding in close proximity to gillnets.

In cases of stomach content, empty stomachs were observed in a finless porpoise and an Irrawaddy dolphin could have been attributed to parasite infection. Numbers of nematode cysts were inspected inside their stomachs while no food had been found in both their stomachs and intestines. The infection could have been the cause of malnutrition, and consequently, death. Full stomachs usually indicate healthy animals under normal condition. In these cases, the stomach were either stuffed with several kinds of prey or with only 1-2 dominant prey species (shrimp and anchovy). From 6 cases, we can assume that the dolphins were sudden death by selective fishing gears such as shrimp gill nets, pair trawl boats, mackerel nets and octopus trap.

The information from our study on dolphin hot spots and interaction between dolphins and human activities had been presented to the local community in order to assign the marine mammal protected area based on communities' agreement, especially in the mating season and nursery period of Irrawaddy dolphin from November to March.

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