Final Research Report for Ocean Park Conservation Foundation

Coastal Marine Mammals along the Eastern Gulf of Thailand (2013)

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Executive Summary

This project was the continuation of research in 2003, 2004, 2005, 2008, 2009 and 2013 to locate coastal marine mammals and assess the numbers of animals and the location of population groups along the eastern Gulf of Thailand. This year, we conducted line transect boat surveys in two different areas within Trat province in Thailand. We first conducted surveys encompassing the waters surrounding the archipelago of islands west of our field site, which included Ko Chang, Ko Mak, and Ko Kut (Ko = Island). The survey around the islands yielded only four sightings in 11 survey days (Figure 1). We then conducted line transect surveys for 13 days between Ban Mai Rut and Khlong Yai along the eastern coast of Trat province within our usual nearshore

survey area (Figure 2). We completed surveys along all transect lines two times and had 45 on-effort sightings of 161 Irrawaddy dolphins (*Orcaella brevirostris*), one on-effort sighting of three Indo-Pacific finless porpoises (*Neophocaena phocaeniodes*) and three on-effort sightings of 14 Indo-Pacific humpback dolphins (*Sousa chinensis*). We also found a total of 17 animals that had stranded, both dead and alive, and carcasses of dead animals that were floating at sea, including three Indo-Pacific finless porpoises and 14 Irrawaddy dolphins. Using DISTANCE software, we combined and analyzed our survey data for 2008, 2009, 2012 and 2013, resulting in an average relative abundance estimate of 431 Irrawaddy dolphins throughout our nearshore study area. Our colleagues from the Eastern Marine and Coastal Resources Center conducted 62 interviews in local villages. In 2014, we will continue this research strategy further west along the eastern Gulf coast. The Thai coast along the eastern Gulf of Thailand is an important opportunity to study coastal marine mammals; local communities and the Thai government are supportive of these efforts. Appendices include reports of A) a report from Dr. Kimura regarding acoustic survey techniques that were employed in 2012 and 2013, B) a report from Ms. Junchumpoo on the series of dead animals, C) progress report from Ms. Jackson-Ricketts on the habitat modeling component, D) progress report from Ms. Whitty on bycatch surveys, E) a report from Ms. Groc on her photography, interviews with scientists and plans for future articles and F) in a separate attachment, photographs from Ms. Groc and other researchers.

Acknowledgements

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- All of our collaborators!
- Our volunteer, Andrea Dransfield
- Our driver Pi Hom and our captains and cooks
- Our respondents

Collaborating Thai Researchers and Institutions

Ms. Chalatip Junchompoo, (Marine Biologist) and her team from the Eastern Marine and Coastal Resources Center (Thai Department of Fisheries) in Rayong province.

Background and Rationale

Little is known about nearshore Irrawaddy dolphins (*Orcaella brevirostris*) in the Gulf of Thailand. The Irrawaddy dolphin is generally found in shallow estuaries and coastal waters throughout Southeast Asia (Reeves *et al*. 2008). For example, in the Philippines, most sightings were made within 6 meters of depth (Dolar *et al*. 2002). Like the dugong, Irrawaddy dolphins are vulnerable to incidental fisheries catch and proximity to coastal development (Dolar *et al*. 2002, Reeves *et al*. 2003). All three of the species we have sighted (*Orcaella brevirostris, Sousa chinensis*, and *Neophocaena phocaenoides*) had not been studied in this area previous to our project's commencement in 2008. We found a relatively large population of *Orcaella*, and have had repeated sightings of the other 2 species, including a group of 10 *Neophocaena* in 2012.

Chantrapornsyl *et al*. (1996), Stacey and Leatherwood (1997), Stacey and Arnold (1999), and Andersen and Kinze (1999) note that while records of occurrence are few, Irrawaddy dolphins have been reported along the Gulf coast, with one report of a skull found in Khlong Yai, in Trat province, in 1914 (Andersen and Kinze 1999). The IUCN classes the Irrawaddy dolphin as a vulnerable species with a decreasing trend on its Red List of Threatened Species (Reeves et al. 2008). In Thailand, the Irrawaddy dolphin is included under the 1992 Wild Animals Preservation and Protection Act. In the IUCN/SSC Cetacean Specialist Groups's 2002-2010 Conservation Action Plan for the World's Cetaceans, one of the recommended research initiatives concerning the status of coastal cetaceans in Thailand addresses a need to identify special areas of "cetacean abundance for special conservation attention", as well as to document fishing intensity in these areas (Reeves *et al.* 2003, pg. 60). These dolphins are a species of concern in Thailand, as is evidenced by Thailand's sponsorship of Irrawaddy dolphins for CITES Appendix I protection in Bangkok, 2004.

The Research Team

The aim of the proposed research is to assess the conservation status of coastal cetaceans in Trat province and to provide recommendations towards their management and conservation in a multi-year interdisciplinary project, overseen by the principal investigators. Since 2000, as a deliberate policy, Dr. Hines has worked in close collaboration with local scientists and to establish strong links with local communities to continue the research and increase our knowledge of these animals, their habitats, and their conservation needs. Our team consists of: Ms. Junchumpoo, a marine biologist for the Eastern Marine and Coastal Resources Center, which is part of the Department of Coastal and Marine Resources (DMCR) of Thailand and a scientist in the their Endangered Marine Species Unit. Ms. Junchumpoo is applying for her doctoral degree, and would like to do her dissertation on the photo-identification of cetaceans from our project. Ms. Junchumpoo brings with her a team of Thai scientists who train in our methods, as part of our project's objective in building capacity. Some of these Thai scientists have worked with us since 2008, and have gained quite a bit of expertise in survey methods. Dr. Ponnampalam and Ms. Ilangakoon have been assisting in the project since 2008, and are both experienced cetacean scientists who have provided inputs for survey design, methodology and analysis. Dr. Kimura is a specialist in acoustic surveys of Asian marine mammals, and is currently also working on finless porpoises in the Yangtze River in China and in Nagoya Bay, Japan. She conducted a pilot study in January 2012 during our

boat survey. Ms. Whitty is a doctoral candidate at Scripps Institute of Oceanography with Drs. Lisa Balance, Ellen Hines, William Perrin, Louella Dolar and Paul Dayton on her committee, and is looking at issues of dolphin conservation and bycatch in small-scale fisheries in Southeast Asia. Ms. Jackson-Ricketts is a doctoral candidate in Dr. Dan Costa's lab at the University of California, Santa Cruz, and will look at two research questions: 1) spatio-temporal modelling of dolphin habitat use using environmental data and oceanographic variables, and 2) to discover which of the potential prey species in the Gulf of Thailand are eaten by resident Irrawaddy dolphins, what general types of habitats (nearshore, offshore, freshwater) they occupy over their lifetimes, and how their feeding habits change over time, using three separate analyses.

Objectives of Research

Our general research goals are as follows:

- Investigate the spatial distribution of coastal cetaceans along the coastal waters of Trat province.
- Estimate the relative abundance of Irrawaddy dolphins in Trat province.
- Determine the habitat use of Irrawaddy dolphins in Trat province.
- Investigate their behavior, group dynamics, and movement patterns.
- Investigate the potential threat local fishing practices pose to coastal cetaceans in Trat province.
- Interview members of surrounding communities to assess their modern and historical relationship and interactions with dolphins
- Train Thai scientists in research methods so that this work can be continued throughout the year.
- Contribute research results as input to educational materials and national conservation planning.

Research Methodology

Our methods are based in part on techniques developed for research on the Irrawaddy dolphin in Australia (now described as the Australian snubfin dolphin *Orcaella heinsohni*, a coastal dolphin of the same genus) by Dr. Guido Parra (2005 and Parra *et al*. 2006) Our zig-zag survey design for boat-based transects is based on Strindberg and Buckland (2004). Research objectives rely upon the principal hypothesis that a practical and repeatable systematic survey can be designed for this north-south oriented area that will allow for quantitative statistical analysis and long-term monitoring of the dolphin population. Nested within the larger hypothesis are three smaller hypotheses: H_1: an abundance estimate for the population can be determined using distance sampling, H_2: the population exhibits spatial distribution patterns within the area and H_3: the population uses the area unevenly and exhibits obvious preferences to certain habitat characteristics or locations. To test these hypotheses we developed a systematic survey design for the near-shore survey using the geographic information system (GIS) software ArcMap 9.3 (ESRI 2007) and the statistical modeling software Distance 6.0 (Thomas et al. 2009) (used to estimate animal abundance) (Figure 1). This design was used in

2008, 2009, 2012 and 2013. The design ensured even coverage across the study area while maximizing on-effort time. Field ground-truthing of each line was conducted to account or adjust for shallow or impassable areas and to ensure the transect lines can be run in perpetuity with minimal difficulty.

Distance sampling surveys along line transects that are widely used to estimate density and abundance of cetacean populations (Buckland *et al.*, 2004), were used for Irrawaddy dolphin dolphins in a stratified study area in the Gulf of Thailand during four field seasons in 2008, 2009, 2012 and 2013. During the survey, boat-based observers moved along zig-zag transect lines in each of the three survey strata: North, Middle, and South (see Figure 1). For each dolphin group observed, the radial distance (r) together with the angle (θ) between the transect line and the line of the detection, as well as the group is recorded. Density of Irrawaddy dolphin groups within the area surveyed is estimated as $\hat{D}_s = \frac{n\hat{f}(0)}{2L}$, where L denotes the aggregate length of the transects, n is the number of groups observed, $f(0)$ is the probability density function of observed perpendicular distances evaluated at zero distance from the line. The density of groups $\hat{D}_s$ is multiplied by the estimated expected group size $\hat{E}(s)$ to obtain density of individuals $\hat{D}$, and this estimate is multiplied by the surface area of each survey stratum to obtain the corresponding abundance estimate of dolphins by stratum ($\hat{N}$). Stratum-specific encounter rates and expected group size $\hat{E}(s)$ by year were used to estimate stratum specific densities of groups and individuals per year. Overall density for the study area per year was obtained by calculating a mean of stratum estimates weighted by stratum area.

The DISTANCE 6 software (Thomas *et al*., 2010) was used to analyze the data. The on-effort observations of Irrawaddy dolphin groups made from the line transects shown in Figure 1 were used for the distance sampling analysis. Options using a stratified (by stratum or year) or pooled data approach were considered in fitting the detection function. Various combinations of key functions and adjustment term were considered to model the detection function (e.g., uniform + cosine or simple polynomial, half-normal + cosine or simple polynomial, hazard rate + cosine or hermite polynomial). Goodness of fit tests were used to identify violations of assumptions. Exploratory analyses were conducted to examine options for truncation and grouping intervals to improve model fit for the detection function. Akaike's Information Criterion adjusted for small sample size (AICc) was used in final model selection. Encounter rate was estimated within each of the survey strata per year and its variance was estimated empirically using the replicate transect lines as samples. There may be a tendency for smaller dolphin groups to be missed more often than larger groups at large distances from the transect line, which can lead to "size bias" if the average group size is simply used during the estimation process. To test for bias in the estimate of group size, we applied a statistical hypothesis test at the 15% $\alpha-$level to the regression of natural logarithm of group size against the probability of detection at distance *x* from the line within the Distance software. If the regression was statistically significant the expected group size $[E(s)]$ is used, otherwise average group size was used to estimate density and abundance. Group size

estimation was also stratified by survey stratum and year. Individual Irrawaddy dolphin density per stratum for each year and between sequential years was tested for statistically significant difference at the 5% significance level using a two-sided t test (Buckland *et al.*, 2004).

For the island survey, we created a parallel line equal coverage scheme in survey blocks perpendicular to the coastline around the islands (Figure 2) (Dawson et al 2008).

All surveys were conducted in closing mode from a 12-meter fishing boat equipped with inboard engines and boat speed was kept at 10 km hr^{-1}. A team of three observers continuously scanned from the bow to 90 degrees Port and Starboard with the naked eye and 7x50 binoculars while on effort. For each dolphin sighting detected during on effort searching , three variables necessary to estimate abundance were immediately recorded: the distance from the survey boat, the angle of the sighting and number of animals seen. Once the initial data were recorded the dolphin group was approached off effort, to within 10m to record their location using a handheld GPS unit. We also collected data on group size, general age composition (adult or calf), photographs for photo-identification when possible, behavioral data and environmental parameters. Environmental parameters for species distribution modeling were also collected every 30 minutes while on transect.

We conducted interviews with local people, mostly small-scale fishers, in villages along the Trat coast. These interviews focused on marine mammals, their relationship with villagers, stranding events, patterns of movement and sightings, and fishing practices that may affect dolphins. This year, we attended village meetings and gave lectures in local schools in Trat province. At these meetings and presentations, we explained our research and concerns about cetacean bycatch and plastic pollution, our fieldwork and research methods, and distributed posters, stickers and button badges about the “Trat Coastal Dolphin Project” and the new coastal stranding network that our collaborators at the DMCR have created. We had two discussions with local conservation NGOs, and worked with a local conservation group to assess several cases of recently stranded Irrawaddy dolphins.

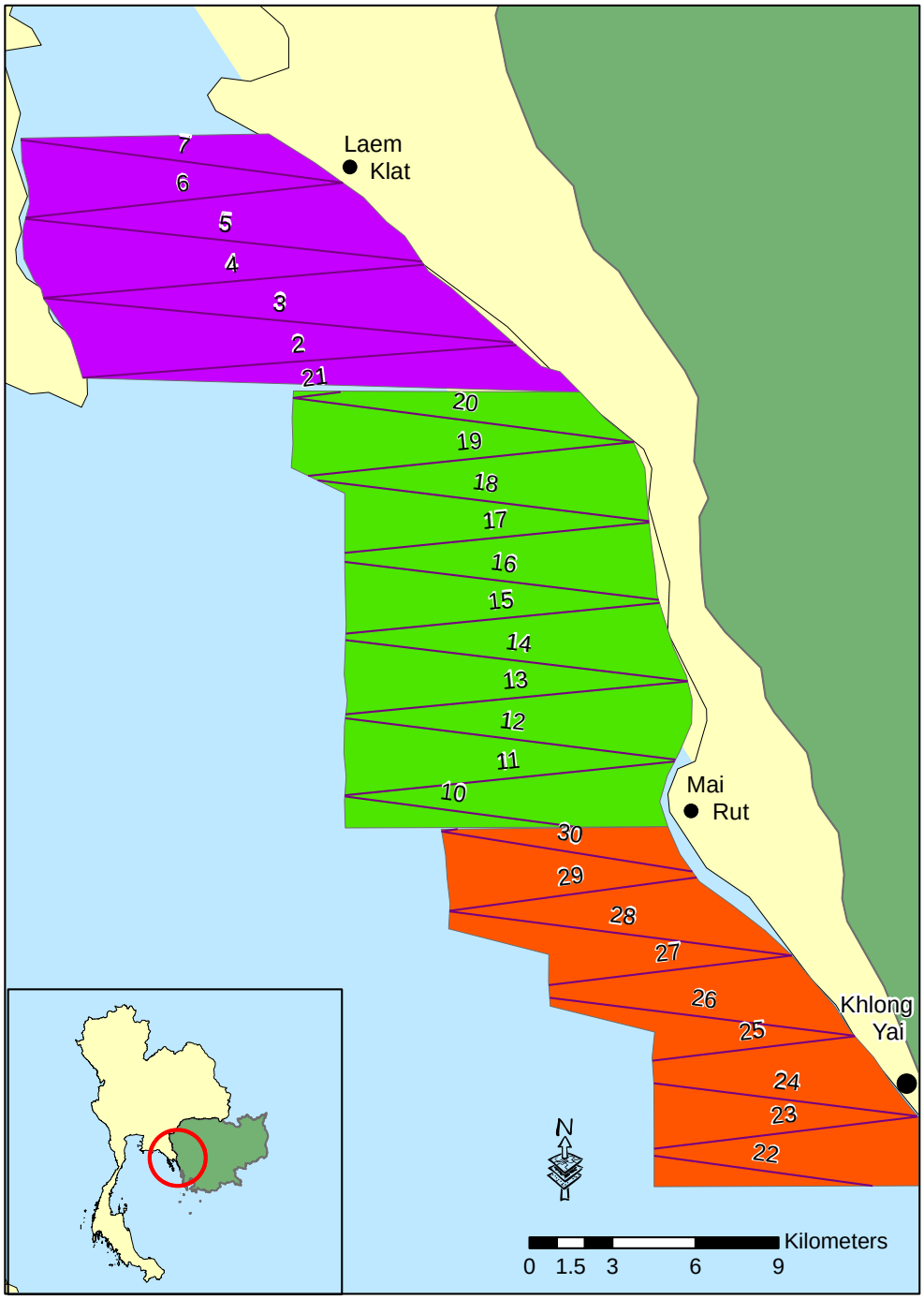

Figure 1. Transects and sampling strata in the nearshore survey area. Purple is the north strata, green is the middle and orange is the south strata.

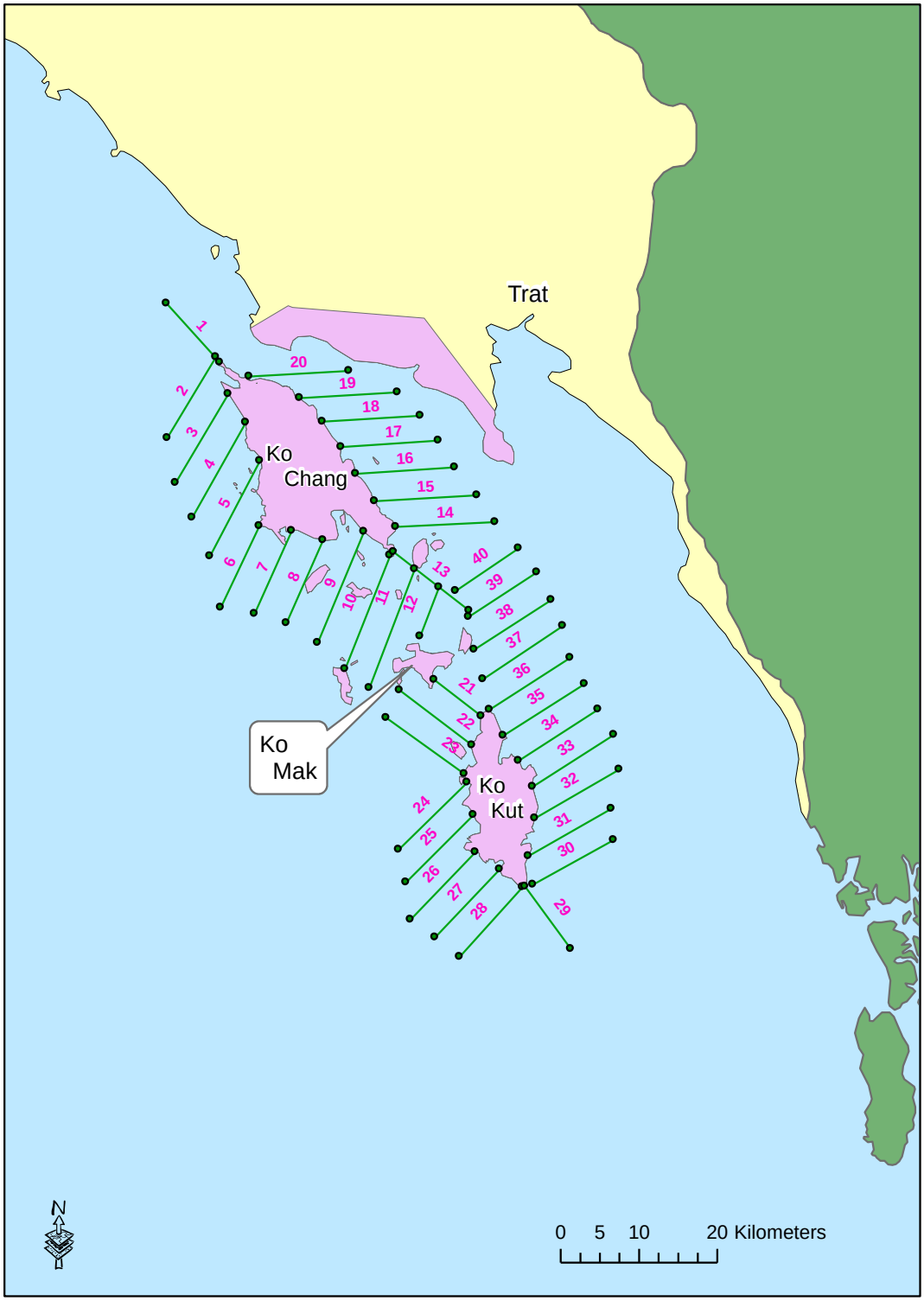

Figure 2. Transects in the island survey area. Transect lines, and beginning and end points are labeled.

Research Results

Boat surveys

In the island surveys, we surveyed around the islands for 11 days, but only had four on effort sightings, two of a total of seven Indo-Pacific finless porpoises (*Neophocaena phocaenoides*), and two of a total of three

Irrawaddy dolphin dolphins (*Orcaella brevirostris*) (Figure 3). We then continued our surveys in the nearshore survey area and conducted line transect surveys for 13 days between Ban Mai Rut and Khlong Yai along the eastern coast of Trat province (Figure 1). We completed surveys along all transect lines twice. Throughout the survey, we had 45 on-effort sightings of 161 Irrawaddy dolphins, including three mating herds, two on-effort sightings of a single Irrawaddy dolphin and a group of 10-15 Indo-Pacific finless porpoises and three on-effort sightings of 14 Indo-Pacific humpback dolphins (*Sousa chinensis*) (Figure 4).

Table 1. Sightings and numbers of the three cetacean species seen in four years along the eastern Gulf Coast of Thailand.

Year	**Species**	**No. of on-effort sightings**	**Numbers of animals seen**
2008	*Orcaella brevirostris*	62	248
2008	*Sousa chinensis*	3	12
2008	*Neophocaena phocaenoides*	5	15
2009	*Orcaella brevirostris*	83	341
2009	*Sousa chinensis*	2	7
2009	*Neophocaena phocaenoides*	1	4
2012	*Orcaella brevirostris*	52	266
2012	*Sousa chinensis*	6	25
2012	*Neophocaena phocaenoides*	2	11-16
2013	*Orcaella brevirostris*	45	161
2013	*Sousa chinensis*	3	14
2013	*Neophocaena phocaenoides*	1	3

Even with all years combined, we did not have enough sightings of Indo-Pacific humpback dolphins or Indo-Pacific finless porpoises for an accurate abundance estimate. The encounter rate for Indo-Pacific humpback dolphins for example, was 0.06 sightings km^{-1} of effort.

The total effort per stratum and year for Irrawaddy dolphins are detailed in Table 2. In the final models, data were pooled across survey strata and years and grouped into 5 equal-spaced intervals with right truncation at 450 m (10% of the data). Pooling provided a more robust detection function (see Figure 5) due to some

sample size issues when stratifying per year or survey stratum, and also due to some issues with the data measurements. In the early years there was heaping at zero and indications that particularly small angle sizes were not being measured accurately. In the later years it seemed that observers may have been overcompensating as there were more observations than expected some distance from the line (with no movement of dolphins away from the observers before measurements were taken). The final model was a half-normal with cosine adjustment terms, which gave a detection probability of about 38% and an effective half strip width of 171.26m (see Figure 5). Estimates of encounter rate and expected group size for each species and survey stratum are also detailed in Table 2. There is some indication of "size bias" in the North and Middle stratum in 2009 and in the South in 2012, so the expected group size was used in those cases and the average group size for the remainder of the stratum-year combinations. The final estimates of Irrawaddy dolphin group and individual density, and abundance for each survey stratum per year and overall per year is shown in Table 3. Although there were differences between the strata per year and overall by sequential survey years, given the fairly high variance associated with the estimates, individual Irrawaddy dolphin densities overall were only significantly lower in 2012 compared to 2009. Only when considering one-tailed t- test results was the South stratum significantly lower than the Middle stratum in 2009, and the South stratum was also significantly lower than the North stratum in 2013.

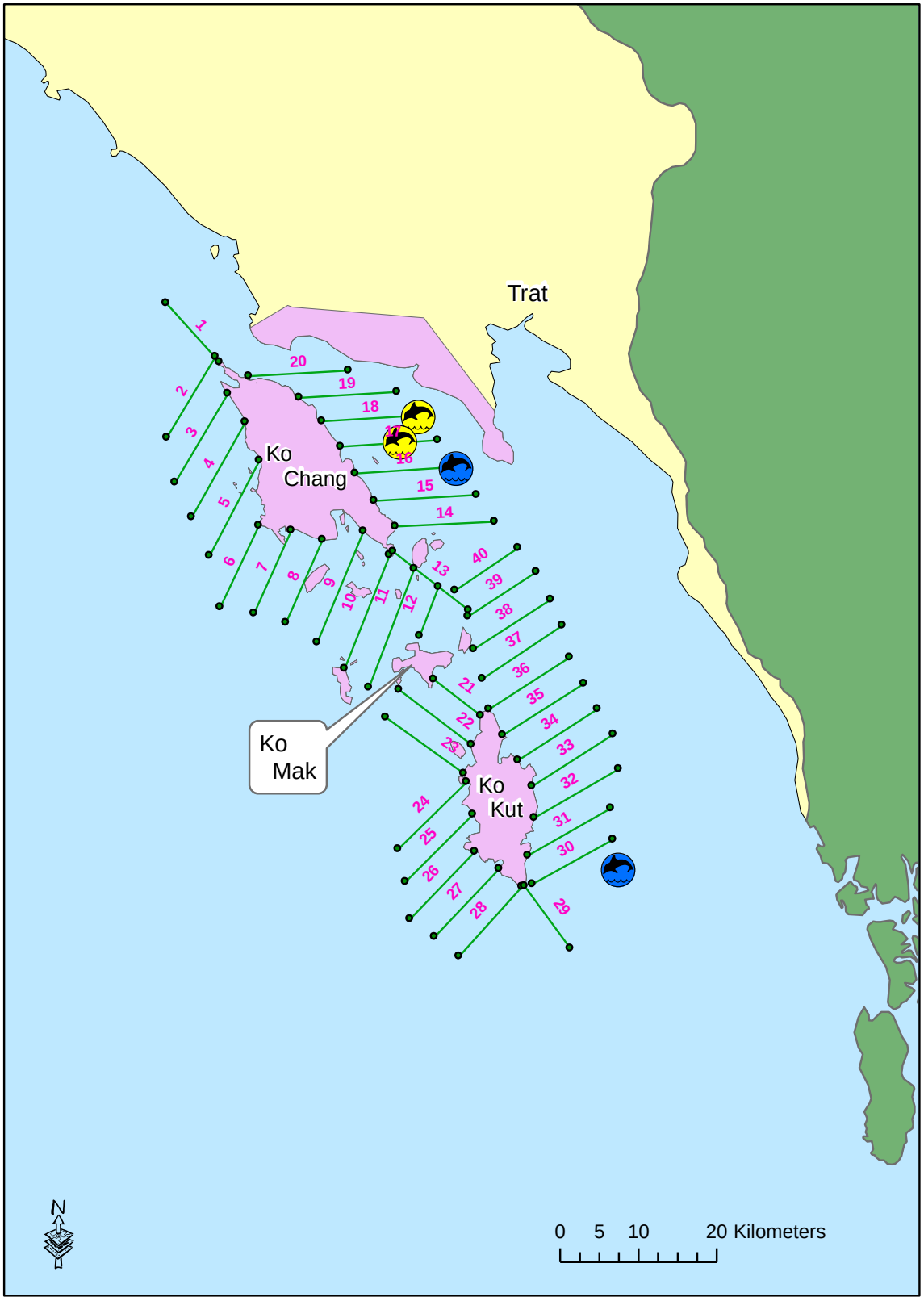

Figure 3. All sightings in 2013 for the island survey. Blue points: Irrawaddy dolphin sightings, yellow: Indo-Pacific finless porpoises.

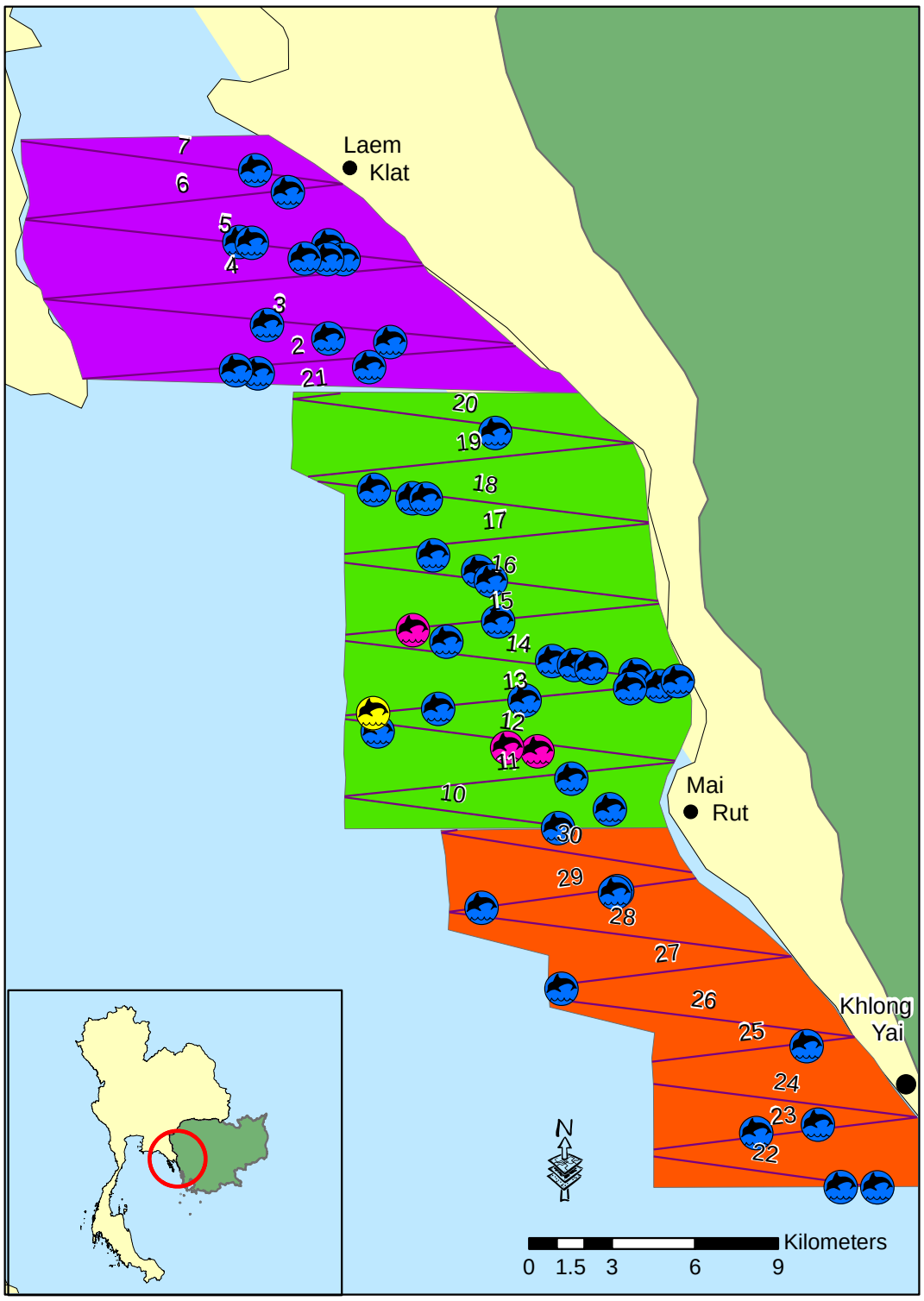

Figure 4. All on-effort sightings in 2013 for the nearshore survey. The transect numbers are noted on the transect lines. The blue area is the Top strata closer to the shallow bay. The green area is the shallow Middle strata near several river mouths. The orange area is the Bottom strata, a deeper area closer to the major fishing port of Khlong Yai. Blue points: Irrawaddy dolphin sightings, yellow: Indo-Pacific finless porpoises and pink: Indo-Pacific humpback dolphins.

Table 2. Details of the total effort (*L*) per year in the North (140.37 km^2 with 6 transects), Middle (179.02 km^2 with 12 transects) and South (118.06 km^2 with 10 transects) survey stratum. The number of observed of Irrawaddy dolphin groups (*n*) post right truncation, the estimate of group encounter rate (*n*/*L*), and the expected group size ($E(\hat{S})$) for each survey stratum per year with the corresponding 95% confidence interval (95% CI).

Year	Stratum	*L* (km)	*n*	*n*/*L* (km^{-1})	95% CI	$E(\hat{S})$	95% CI
2008	North	125.89	10	0.079	(0.042 – 0.151)	3.7	(2.19 - 6.25)
	Middle	363.77	36	0.099	(0.057 – 0.171)	3.53	(2.91- 4.27)
	South	240.36	11	0.046	(0.022 – 0.096)	4.64	(3.01 - 7.14)
2009	North	125.89	17	0.135	(0.079 – 0.230)	3.10	(2.09 - 4.61)
	Middle	363.77	50	0.137	(0.094 – 0.201)	3.74	(2.91 - 4.81)
	South	240.36	16	0.066	(0.038 – 0.116)	3.81	(2.71 - 5.36)
2012	North	125.88	20	0.159	(0.061 – 0.415)	2.90	(2.00 - 4.20)
	Middle	241.14	13	0.054	(0.021 – 0.138)	2.85	(2.07 - 3.92)
	South	160.24	10	0.062	(0.037 – 0.106)	5.67	(2.16 -14.89)
2013	North	83.92	12	0.143	(0.061 – 0.333)	3.67	(2.40 – 5.60)
	Middle	241.14	22	0.091	(0.049 – 0.171)	3.64	(2.57 - 5.14)
	South	160.24	8	0.050	(0.022 – 0.114)	2.38	(1.51 - 3.74)

Table 3. Estimates of density ($\hat{D}$) in number/km^2 (group density $\hat{D}_s$ in parentheses) and abundance ($\hat{N}$) of Irrawaddy dolphins for each survey stratum per year and overall per year with their corresponding 95% confidence intervals (95% CI), and the percent coefficient of variation (%CV).

Year	Stratum	$\hat{D}$ ($\hat{D}_s$)	95% CI	$\hat{N}$	95% CI	(%CV)
2008	North	0.858 (0.232)	(0.410 - 1.795)	120	(58 - 252)	35.27
	Middle	1.019 (0.289)	(0.571 - 1.821)	182	(102 - 326)	27.92
	South	0.619 (0.134)	(0.277 - 1.388)	73	(33 - 164)	39.39
	Total	0.860 (0.229)	(0.577 - 1.281)	376	(252 - 561)	20.02
2009	North	1.222 (0.394)	(0.667 - 2.237)	172	(94 - 314)	28.97
	Middle	1.501 (0.401)	(0.953 - 2.362)	269	(171 - 423)	22.48
	South	0.741 (0.194)	(0.396 - 1.388)	87	(47 - 164)	30.57
	Total	1.206 (0.343)	(0.868 - 1.676)	528	(380 - 733)	16.6
2012	North	1.345 (0.464)	(0.514 - 3.520)	189	(72 - 494)	43.23
	Middle	0.448 (0.157)	(0.170 - 1.183)	80	(30 - 212)	47.71
	South	1.032 (0.182)	(0.369 - 2.885)	122	(44 - 341)	50.38
	Total	0.894 (0.262)	(0.501 - 1.595)	391	(219 - 698)	28.46
2013	North	1.531 (0.417)	(0.645 - 3.636)	215	(90 - 510)	39.65
	Middle	0.969 (0.266)	(0.483 - 1.943)	173	(86 - 348)	34.34
	South	0.346 (0.146)	(0.143 - 0.839)	41	(17 - 99)	43.08
	Total	0.981 (0.282)	(0.586 - 1.642)	429	(256 - 718)	25.14

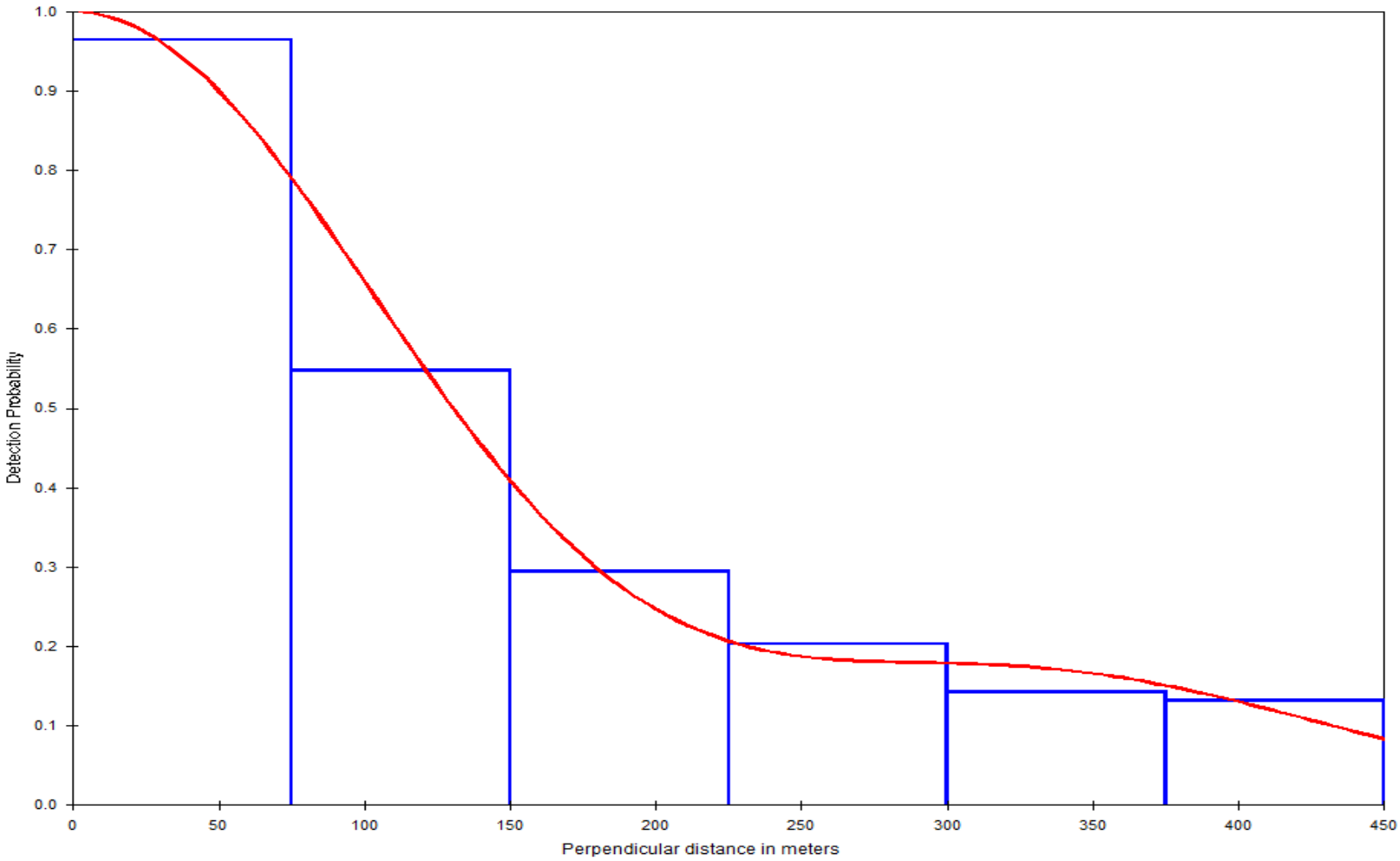

Figure 5: Detection functions fitted to the perpendicular distances of observations of groups of Irrawaddy dolphins. On-effort sightings are pooled across survey strata and survey years. Data were grouped for final analysis using 6 equal-spaced intervals with right truncation at 450 m.

Interview surveys

Our colleagues from the Eastern Marine and Coastal Resources Center conducted 67 interviews in local villages. Respondents comprised 61 men and 6 women, with an average age of 44, minimum of 16 and maximum of 66 years. Table 4 shows the village, profession, boat size and fishing gear of respondents. Figure 6 shows interview locations.

Table 4. The villages, type of employment, fishing gear and boat size of interview respondents.

Village address/Profession Pivot

	Profession			
Village address	**Fisher's helper**	**Ferry Boat driver**	**Fisher**	**Total**
Ao Yai			8	8
Jek Rak			4	4
Khlong Yai		1	17	18
Kloa Meow			7	7
Klong Kud			7	7
Klong Manao			7	7
Klong Son	1		6	7
Laem Klut			30	30
Laem Ngob			16	16
Mai Rut	1		20	21
Namchieo			5	5
Nong Kansong			11	11
Total	**2**	**1**	**138**	**141**

Fishing gear/Boat size

	Boat size(S=<10 m, M=10-20 m, L=>20 m)			
Fishing gear	**L**	**M**	**S**	**Total**
Bamboo stake trap		1		1
Crab Gill Net		3	19	22
Crab Trap		2	23	25
Crab Trap, Crab Gill Net			2	2
Fish Gill Net		4	32	36
Fish Trap			1	1
Long line for Octopus			5	5
Long line hook		2	7	9
Purse seine		1		1

Push net		2		2
Shrimp gill net		2	25	27
Shrimp Trawler	1	7		8
Squid Trap		1		1
(Blank)		1		1
Total	**1**	**26**	**114**	**141**

Figure 6. Interview locations along the coast of Trat province in 2013.

Out of 67 responses, no respondents had hunted dolphins in the past or present. Table 5 shows the reporting of sightings of cetaceans and turtles from each village. Forty-one respondents see more dolphins in the dry season, between October and April, 25 believe they can be seen all year, one respondent sees dolphins in the wet season, between May and September.

When asked the number of dolphins seen in groups, 56 respondents reported seeing only small groups of animals (<5), 11 had no response. No respondent mentioned having seen calves. Only two respondents said they had found stranded dolphins, both Irrawaddy dolphins. One person left the carcass at sea where they found it, the other informed local authorities. These same people were the only two that had heard about strandings.

Nineteen respondents believe that the local dolphin population is increasing. Thirty-two people believe the population is decreasing, and five respondents say that the population is not changing (Table 6 for comments). All respondents do not feel that dolphins interfere with fishing. No respondents mentioned catching animals in nets. Table 7 shows respondent opinions on conservation issues. Table 8 summarizes respondent comments on dolphin conservation.

Table 5. Sightings of cetaceans and turtles in each village.

Location	Species 1	Species 2	Species 3
Ko Chang	Bottlenose dolphin	Indo-Pacific humpbacked	Irrawaddy dolphin
Ko Chang	Bottlenose dolphin	Irrawaddy dolphin	Indo-pacific humpbacked
Ko Chang	Indo-Pacific humpbacked dolphin		
Ko Chang	Irrawaddy dolphin	Bottlenose dolphin	Indo-pacific humpbacked
Ko Chang	Indo-Pacific humpbacked dolphin		
Ko Chang	Irrawaddy	Indo-Pacific humpback	

	dolphin		
Ko Chang	Irrawaddy dolphin	Indo-Pacific humpback	
Ko Chang	Indo-Pacific humpback dolphin	Irrawaddy dolphin	
Ko Chang	bottlenose dolphin		
Ko Chang	bottlenose dolphin		
Ko Chang	Bottlenose dolphin	Indo-Pacific humpback	
Ko Chang	Indo-Pacific humpbacked dolphin	Irrawaddy dolphin	Indo-pacific humpback
Ko Chang	Bottlenose dolphin	Indo-Pacific humpback	
Ko Chang	Irrawaddy dolphin	Bottlenose dolphin	
Ko Chang	Irrawaddy dolphin		
Ko Chang	Irrawaddy dolphin	Indo-Pacific humpback	
Ko Chang	Irrawaddy dolphin		
Ko Kut	bottlenose dolphin	Irrawaddy dolphin	
Ko Kut	Bottlenose dolphin	Irrawaddy dolphin	
Ko Kut	bottlenose dolphin	Irrawaddy dolphin	
Ko Kut	Bottlenose dolphin	Irrawaddy dolphin	
Ko Kut	Irrawaddy dolphin	Bottlenose dolphin	
Ko Kut	Irrawaddy dolphin	Bottlenose dolphin	
Ko Kut	Irrawaddy dolphin		
Ko Kut	Indo-Pacific humpbacked		
Ko Kut	Bottlenose dolphin	Irrawaddy dolphin	
Laem Ngop	Bottlenose dolphin		
Laem	Bottlenose	Indo-Pacific	

Ngop	dolphin	humpback	
Laem	Irrawaddy		
Ngop	dolphin		
Laem	Irrawaddy		
Ngop	dolphin	Indo-Pacific humpback	
Laem	Irrawaddy		
Ngop	dolphin		
Laem	Irrawaddy		
Ngop	dolphin	Indo-Pacific humpback	
Laem	Irrawaddy	Indo-Pacific	
Ngop	dolphin	humpback	
Laem	Irrawaddy		
Ngop	dolphin	Bottlenose dolphin	
Laem	Irrawaddy		
Ngop	dolphin	Indo-Pacific humpback	
Laem	Irrawaddy	Indo-Pacific	
Ngop	dolphin	humpback	Bottlenose dolphin
Laem	Irrawaddy	Indo-pacific	
Klut	dolphin	humpback	
Laem	Irrawaddy	Bottlenose	
Klut	dolphin	dolphin	Finless porpoise
Laem	Irrawaddy	Indo-pacific	
Klut	dolphin	humpback	Finless porpoise
Laem	Irrawaddy	Indo-pacific	
Klut	dolphin	humpback	
Laem	Irrawaddy	Indo-pacific	
Klut	dolphin	humpback	
Laem	Irrawaddy		
Klut	dolphin	Indo-pacific humpback	
Laem	Irrawaddy		
Klut	dolphin		
Laem	Irrawaddy		
Klut	dolphin	Indo-pacific humpback	
Laem	Irrawaddy	Indo-pacific	
Klut	dolphin	humpback	
Laem	Irrawaddy		
Klut	dolphin		
Laem	Irrawaddy		
Klut	dolphin	Indo-pacific humpback	
Laem	Irrawaddy	Indo-pacific	
Klut	dolphin	humpback	
Laem	Irrawaddy		
Klut	dolphin	Indo-pacific humpback	
Mai Rut	Irrawaddy dolphin	Indo-pacific humpback	
Khlong	Irrawaddy	Indo-pacific humpback	

Yai	dolphin		
Khlong	Bottlenose	Irrawaddy	
Yai	dolphin	dolphin	
Khlong	Irrawaddy		
Yai	dolphin		
Khlong	Irrawaddy		
Yai	dolphin		
Khlong Yai	Finless porpoise		
Khlong	Irrawaddy	Indo-pacific	
Yai	dolphin	humpback	finless porpoise
Khlong	Irrawaddy		
Yai	dolphin	Indo-pacific humpback	
Khlong	Irrawaddy		
Yai	dolphin	Indo-pacific humpback	
Khlong	Irrawaddy		
Yai	dolphin	Indo-pacific humpback	
Khlong	Irrawaddy		
Yai	dolphin	Indo-pacific humpback	
Khlong	Irrawaddy		
Yai	dolphin	Indo-pacific humpback	
Khlong	Irrawaddy		
Yai	dolphin		
Khlong	Irrawaddy		
Yai	dolphin	Indo-pacific humpback	
Khlong	Irrawaddy		
Yai	dolphin		

Table 6. Reasons for Irrawaddy dolphin populations increasing, decreasing, or staying the same.

Comment	#
Fishers see less often	30 (45%)
Fishers see more often	18
Fishers see the same number	5
Too many boats	1
Need more conservation	1
Don’t know	11
Total	**66**

Table 7. Interview respondent opinions on the importance of dolphin conservation, endangered species, seagrass, mangroves, coral reefs (5=very important, 4= important, 3=neutral, 2=moderately negative,1=very negative) and conservation in general (5=extremely positive, 4=moderately positive, 3=neutral, 2=negative, 1=extremely negative).

	Dolphin conservation (%)	Endangered species (%)	Seagrass (%)	Mangroves (%)	Coral reefs (%)	Conservation (%)	Totals (%)
5	22 (33)	13 (20)	17 (26)	21 (32)	19 (29)	37 (56)	129 (33)
4	40 (61)	49 (74)	49 (74)	45 (68)	47 (71)	25 (38)	255 (64)
3	4 (1)	4 (1)	0	0	0	4 (1)	12 (1)
Totals	66	66	66	66	66	66	396

Table 8. Respondent comments on dolphin conservation.

Comment summaries	Number of respondents
When dolphins are here, tourists will come and people will benefit	3
When dolphins are here, tourists will come and people will stop hurting dolphins	1
Dolphins are an indicator of diversity, we need to conserve them, but this area still has a problem with trawlers and push net	4
Dolphins are lovely and friendly, they are not aggressive to people so we should save them	5
Dolphins are important for diversity , no one needs to hurt them, we should save them for the next generation	1
Dolphins make more abundance of resources	2
Mangrove forest replantation can be helpful to increase the number of resources	2

including dolphins	
Need to save sea grass bed from trawlers and push net	4
Need to create more fishery networking for dolphin conservation in this area, protect the dolphins from trawlers	4
Need to save the dolphin for next generation, the water pollution from the community should be reduced.	1
Government officers should give more knowledge to fishermen about the sustainable use of marine resources	1
Support to do conservation in this area for dolphin watch	4
Need to have artificial reefs, it is a tool to conserve resources, then the dolphin will come more	2
Proud that dolphins are here, they need to be saved	1
Agrees with all efforts to save dolphins	1
Don't know	10

Conclusions and Recommendations

We have shown over four years of research that we were successful in creating a practical and repeatable systematic survey for this north-south oriented area that allows for quantitative statistical analysis and long-term monitoring of the Irrawaddy dolphin population. Enough Irrawaddy dolphins were seen in the combined years for robust statistical analysis, with a low coefficient of variation, which shows the increasing skills of the international and Thai scientists trained in these methods. Also critical, each year the visibility of the scientists and our research increases conservation awareness in local

villages. We stayed in local hotels run by villagers for all four years, hired a driver who is an active community member and ran our research on local fishing boats. As mentioned earlier, as part of our commitment to local education, we have given presentations and lectures at elementary schools in Trat province, attended village council meetings and explained our research and concerns about cetacean bycatch and plastic pollution, had local teachers and students on our boats and explained our fieldwork and research methods to them, and worked with a local conservation group to take samples and teach about incidental bycatch in a local village after bycaught animals were was found both on several beaches and floating in the water during our surveys (see Appendix B for a report).

During the island survey, we heard scattered reports from local people of groups of Indo-Pacific bottlenose dolphins (*Tursiops aduncus*) in the ocean west of our survey area, and a few stories about small groups of Irrawaddy dolphins in sheltered bays during the rainy season. However, we believe that our low number of sightings reflect the use of more coastal habitat by our focal species, where there is a higher level of nutrients and production from coastal runoff. As we collected environmental data in both the island and nearshore field-sites, Ms. Jackson-Ricketts will map out and compare the salinity, temperature, depth, turbidity and chlorophyll levels in both areas.

The average relative abundance estimate of 431 Irrawaddy dolphins along the nearshore survey area reflects the estimate of animals in our survey area based on the number of sightings averaged over the four years (Table 3). Averaged over these four years, based on our sighting patterns, the top and middle strata had slightly more sightings and groups of animals, and the bottom strata the least, with the exception of 2012 (Table 3). My colleagues believe this is because of the increased fishing activity

near the port of Khlong Yai. These abundance results will be written up and submitted as a journal article. The number of animals caught in nets is high as compared to the abundance estimate, as evidenced by the bycatch we encountered this year in the field and as stated in past reports (Hines et al. 2003,2004, 2008, 2009 and 2012). This reflects the important global threat of marine mammal bycatch. Tara Whitty, one of the PhD students in the project, is working on bycatch issues for our study, as well as comparing our results to Irrawaddy dolphin populations in Indonesia and the Philippines. The 2013 field season will be her last before writing her dissertation. Justine Jackson-Ricketts is busy analyzing the species distribution/environmental parameters modeling, and has submitted a request for permits to be able to export Irrawaddy dolphin teeth and stomach samples from Thailand for her isotope analysis. Ms. Jackson-Ricketts is planning on using sightings and environmental data from 2008, 2009, 2012, 2013 and 2014 to model species distribution of the Irrawaddy dolphins as correlated to physical and environmental variables, as well as fishing boat size and distribution. She has received a National Geographic Society Young Explorers grant. Please also see the report from Dr. Satoko Kimura, a postdoctoral scientist from Nagoya University, Japan who joined us in 2012 to test the use of acoustical signals in detecting small cetaceans.

Both Justine and Tara have had their abstracts accepted for presentation at the New Zealand Society for Marine Mammalogy Biennial in December of 2013. See Appendix C, #2 for Justine's abstract. Also accepted is an abstract led by Dr. Hines on changing conservation values along the eastern Gulf coast of Thailand based on interviews since 2003. The abstract is pasted below, and a journal article on these results is in progress.

Coastal marine mammals, small-scale fishers and bycatch: changing conservation values in Thailand

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As part of a long-term project to document abundance, distribution and conservation issues of marine mammals along the eastern Gulf coast of Thailand, we conducted interviews over the course of a decade with small-scale coastal fishers about the perceived importance of marine species and systems conservation in local fishing villages. Between 2003 and 2013, we interviewed 673 fishers in this region between the ages of 13 and 80. We used a standardized semi-structured questionnaire including both closed and open-ended questions, administered by representatives from the Thai Department of Marine and Coastal Resources. Villagers were asked to rank the importance of conservation on a Likert scale of increasing importance (1-5). Responses about the importance of conservation did not differ significantly between age groups. However, results indicate that respondents' perceptions of the importance of coastal conservation have increased significantly in later years as compared to earlier years. For example, the average importance of coastal conservation in 2009 was 4.29 vs. 3.89 in 2003 ($p < 0.05$). The results suggest that, as direct resource users, small-scale fishers are increasingly aware of the importance of the conservation of resources for their livelihoods. These interviews document changing perceptions and values and point towards education needs and enforceable economic and management solutions that address local conservation practices. Values can change as the result of various factors, such as the perception of threats and scarcity, political and economic circumstances, community cohesion and pressures, generational memories and exposure to media.

We also were again able to document Irrawaddy dolphin mating herd behavior that has not been seen before in a coastal population (this has been seen in the Bang PaKong River, (Adulyanukosol, pers. comm.). This topic was presented as a poster at the 2009 Society of Marine Mammalogy Conference in Quebec, Canada and a paper written collaboratively by our research team and headed by Dr. Louisa Ponnampalam has been accepted by the journal *Aquatic Mammals* and is likely to be published by the end of 2013.

As in past years, the majority of respondents are small-scale fishers with small to medium-sized boats. Based on the interviews from all years, we believe that the local people in this area are growing more aware of the significance of conservation. However, as compared to our interview results of 2012, more people believe that the numbers of Irrawaddy dolphins are decreasing. For example, in 2012, 44% of respondents thought the numbers of dolphins was increasing. In 2013, that percentage was 34%. Those who thought the number of dolphins was decreasing grew from 31% in 2012 to 57% in 2013. In 2012, 22% of respondents mentioned that they saw less dolphins while fishing; this percentage grew to 45% in 2013. The comments about dolphin conservation are varied, showing various concerns about dolphin and marine conservation in general, as well as an awareness of the dolphin's role in nearshore ecosystems and ecotourism. All of our respondents believe conservation is of importance. However, no respondents mentioned either bycaught animals or stranded animals being found this year, while last year's responses showed that 14 animals were found incidentally caught in fishing nets and drowned by the fishers we interviewed. This is a vital issue that should be explored in more detail in future community surveys, and the numbers compared with DMCR records of stranded animals. Strandings and

bycatch should be made one of the foci of educational programs; the other being coastal pollution, as we saw quite a substantial amount of plastic marine debris on our surveys.

There are still questions that we would like to continue to explore while doing more transects and interviews in coming years about the ecology, foraging and habitat use of Irrawaddy dolphins and other coastal cetaceans in this area. One of our biggest questions is still the possible change of foraging and habitat patterns in various seasons. To begin to address this question, Ms. Junchompoo and her team are continuing bi-monthly photo-identification surveys.

In 2014, we will commence surveys for cetaceans further west between Chonburi and Trat provinces in the eastern Gulf of Thailand (funded by the Indo-Pacific Cetacean Fund). We will do surveys both along the coast and further into several estuaries. For 2013, we distributed t-shirts, buttons, badges and posters in the villages when we did presentations as well as for school and village council visits, and have created a Facebook page for the Trat Coastal Dolphin Project (https://www.facebook.com/groups/580820581934377/).

There are still questions that we would like to continue to explore while doing more transects in coming years about the ecology, foraging and habitat use of Irrawaddy dolphins and other coastal cetaceans in this area. Now that we have an abundance estimate, the next step is to continue to monitor the population for trends; to see whether the numbers and increase or decrease or remain the same over the next five years. Getting the estimate now is just a first step – but knowing the trends gives us a clearer idea of status. One of our biggest questions is the possible change of foraging and habitat patterns in various seasons, and increased gathering of environmental data to use as covariates for further distribution analysis. Another question is how education and

environmental change are shifting, how local fishers see and value their environment and the role of these top predators, and how their ideas of conservation are changing.

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Appendix A: Report from Satoko Kimura, PhD

MATERIALS AND METHODS

We used A-tag acoustic data loggers manufactured by Marine Micro Technology, Saitama, Japan to record high frequency echolocation sonar. The A-tag was deployed vertically from the side of the survey boat during visual sightings. The click train, series of echolocation signals were detected using a custom-made program in IGOR PRO 5.03 (WaveMetrics, Lake Oswego, OR) developed by Tomonari Akamatsu. As shown in

Figure 1, smoothly changing patterns of sound pressure level (SPL) and inter-click intervals (PI) helps to extract echolocation signals of dolphins and porpoises from background noise. The number of click trains were counted except in the case that some of click trains overlapped. The number of animals was counted using the difference in time arrival of the same signals between the two hydrophones (time difference in Fig. 1) based on the method of Kimura et al. (2009).

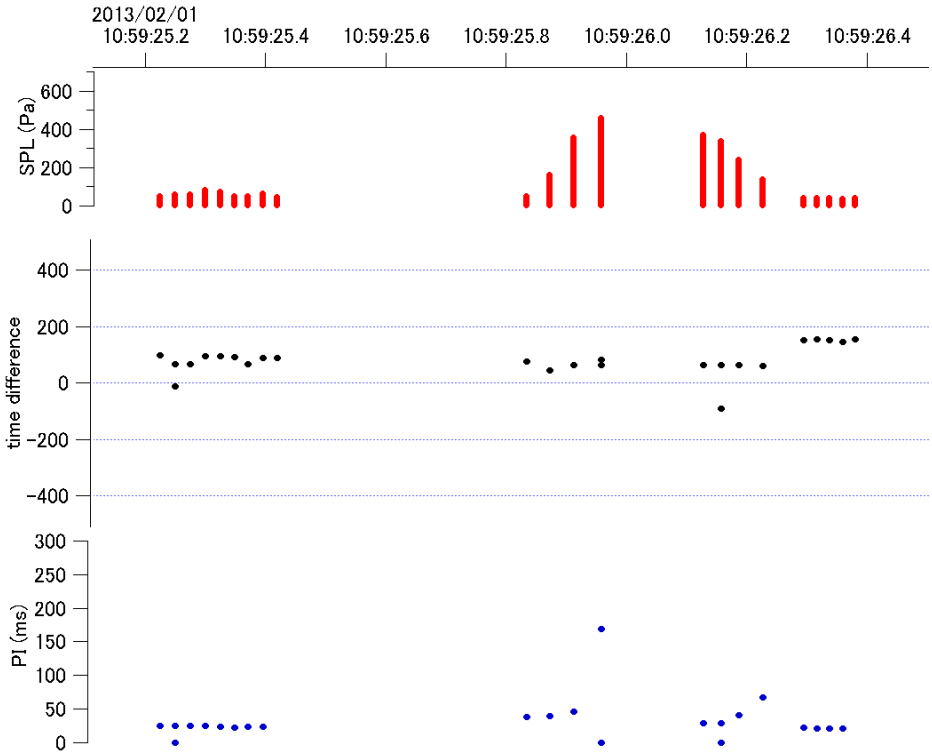

Figure 1. An example of echolocation signals from a Irrawaddy dolphin recorded in A-tag on Feb 1st 2013.

RESULTS

In total, 33 groups were detected acoustically (Table 1: in the last page). Possible snapping shrimp noise was recorded during most of the recording time.

- Finless porpoises; no group was acoustically detected among two effective enounters. Ship avoidance or lower source level could be reasons. Small numbers of encounters prevented us from reaching conclusions. *effective encounter means simultaneous recording by visual and acoustical means
- Humpback dolphins; two group were acoustically detected among two effective encounters. In one case, the group sizes of acoustical and visual methods were matched. But in another case, visually estimated group size was 6. Acoustically estimated group size was at least 2. The upper limit to estimate the acoustic group

size is 5. Irrawaddy dolphins; Among 33 effective encounters, 22 encounters were detected acoustically. The number of dolphins detected did not correlate well (Figure 2 and Table 2).

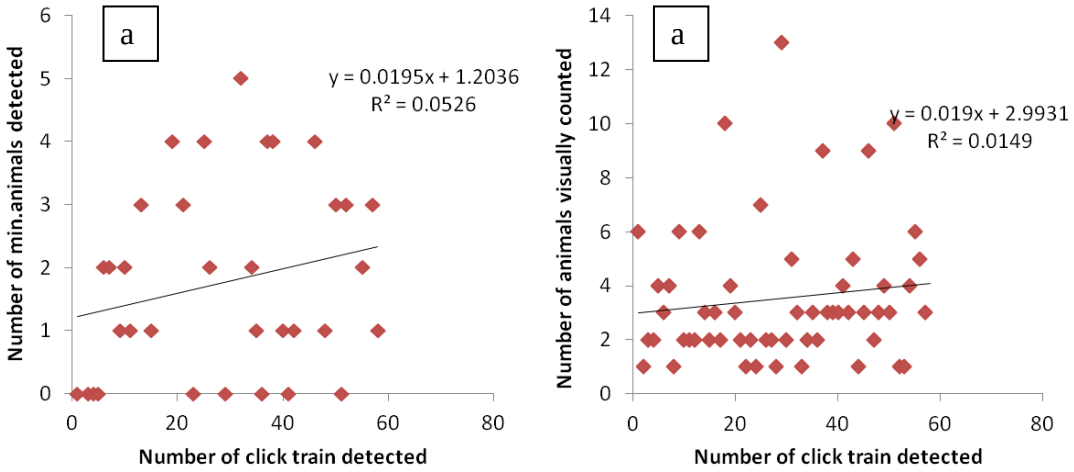

Figure 2. Comparison between number of click trains (series of echolocation signals) and number of minimum animals detected (a) or number of animals visually detected (b). All dots indicates Irrawaddy dolphins (N=34).

Table 2. Comparison of Irrawaddy dolphin group size between acoustic (raw, red cell) and visual (line, blue cell) method.

	0	1	2	3	4	5	6	7	8	9	10	11	12	13
0			4		2		1				1			1
1			2	4			1							
2			3	1	1		1							
3		1	1	3			1							
4				1	1			1		2				
5				1										

DISCUSSION

The number of echolocation signals and acoustical group size did not correlate with the visually-estimated group size. Double counts cannot be avoided using fixed monitoring stations. In addition, the group size of humpback and Irrawaddy dolphins are sometimes bigger than 5 animals. This is close to the upper limit of present acoustical counting at the same moment (Kimura et al., 2009). For the case of Irrawaddy dolphins, small

group size such as single animal could be missed acoustically. Rather the distance to the group was considered to be dominant factor of detection performance.
Occasional acoustic observation using closing mode showed limitations. The application of towing method (Akamatsu et al., 2008) can solve this problem namely acoustic distance sampling. However, this method needs to hire one more boat and estimating abundance would be almost the same as that of visual observation (Akamatsu et al., in press). The snapping shrimp noise, which masks echolocation signals, also could be the cause to underestimate the acoustical group size.

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Appendix B. Chalatip Junchumpoo, DMCR Scientist

Case study: Stranding of dolphins along Trat Bay

During boat based surveys between January, 27 – February, 15, 2013, cooperative research with San Francisco State University, 17 dead dolphins were observed. Those dolphins were handled by Department of Marine and Coastal Resources. They included 14 Irrawaddy dolphins and 3 finless porpoises. The average size of the Irrawaddy dolphins and finless porpoises were 2 meters and 1 meters respectively (11 males, 6 females). One of the Irrawaddy dolphins female was pregnant. Tissue samples and teeth were collected for DNA, heavy metal and age analysis.

Almost all of the dead dolphins were decomposed, with peeling skin. They were all found dead within the same period. We assumed that they were more than 2 weeks dead. So we could not find the causes of death from external bodies, no have the fishing gear evident on their body. But we classified the stomachs into 2 conditions, based on stomach content.

1) The empty stomachs

We thought that 1 finless porpoise and 1 Irrawaddy dolphin might have died because of disease, a lot of nematode cysts were found inside their stomachs. No food was found inside stomachs and intestines. There could be malnutrition.

2) The full stomachs

Full stomach could be used to show the health of these dolphins. We found 2 types of stomach contents:

1) Several kinds of fish, shrimp and squid.

2) Compacted with dominant kind of fish or shrimp. We assumed that, they are feeding from selective gear as shrimp nets; pair trawl boats or mackerel nets.

We assumed that the dolphins were healthy before death but entangled in fishing gears by accident. We did not find any other dead animals or invertebrates in this area.

Moreover, we should consider animal disease, infection and histopathology. But almost all of the dead dolphins were over stage 2 (decomposed and smelly). Therefore the tissue samples were damaged.

This event was reported to the governor of Trat Province. They put together a forum with stakeholders, fisherman and government officers who have responsibility in this area to disentangle the problem.

Appendix C. Report from Justine Jackson-Ricketts

1. Modeling the Habitat of Irrawaddy Dolphins in the Gulf of Thailand

The Irrawaddy dolphin, *Orcaella brevirostris,* an imperiled Asian cetacean, is one of three cetaceans (with the finless porpoise, *Neophocaena phocaenoides,* and the tucuxi, *Sotalia fluviatilis*) able to inhabit marine and freshwater. Until 2008, the IUCN listed *O. brevirostris* as Data Deficient. Now, it is Vulnerable over its range with five Critically Endangered subpopulations. Little is known about Irrawaddy dolphin habitat requirements. Most studies focus on freshwater subpopulations. In an effort to expand scientific knowledge about this at-risk species and help inform management decisions, I am assessing the habitat of Irrawaddy dolphins in the Gulf of Thailand, a subpopulation on which there have been no formal studies to date. I am further comparing dolphin habitat with human use of the Gulf of Thailand. My collaborators and I spent twenty-seven days collecting data in two field sites in the Gulf of Thailand in January and February of 2013. We recorded sightings of dolphins, boats, and fixed fishing gear, and collected various environmental variables, including temperature, salinity, and chlorophyll-*a*. Preliminarily, we learned that the offshore waters surrounding three small islands in the Gulf of Thailand are little used by both humans and dolphins compared to coastal waters along the eastern shoreline of the Gulf. The offshore waters also appear to be less productive, based upon chlorophyll-*a* readings. I cannot, however, draw any specific conclusions until I have statistically analyzed the data and constructed habitat and human use models.

2. Status of Knowledge on Irrawaddy Dolphins, *Orcaella brevirostris*, in Southeast Asia

Justine Jackson-Ricketts, poster abstract submitted for the Society of Marine Mammalogy 20th Biennial Conference on the Biology of Marine Mammals

The Irrawaddy dolphin, *Orcaella brevirostris,* is an imperiled Southeast Asian coastal and freshwater mammal species. It is only one of three cetaceans (with the finless porpoise, *Neophocaena phocaenoides,* and the tucuxi, *Sotalia fluviatilis*) able to inhabit both marine and freshwater. Until 2008, the IUCN listed *O. brevirostris* as Data Deficient. Now, it is considered Vulnerable over its range with five Critically Endangered subpopulations. However, some subpopulations still have not been evaluated, including the Gulf of Thailand subpopulation and a new subpopulation found in the Philippines. Some other gaps in research and conservation, however, remain undiscovered. I believe this is due to the patchy nature of published research on this species. I performed an exhaustive literature review and spoke to experts in the field to unite all *O. brevirostris* research into one comprehensive meta-analysis. Research gaps include diet, habitat, physiology, life history, and marine populations. There have been no formal studies focused on diet. Diet knowledge is limited to three stomach contents from the Mekong River. Very little has been published on *O. brevirostris* habitat. As with diet data, most work has been on freshwater populations and is preliminary in nature. There is a strong need for more detailed diet and habitat information. There are no published reports on *O. brevirostris* physiology and none of the experts in the field could report having heard of such a study. There have been some patchy life history studies, most notably on the cooperative fishing practice between *O. brevirostris* and small-scale fishermen in the Ayeyarwady River of Myanmar. Further research is needed on marine populations, of which only one has been formally evaluated by the IUCN and

is Critically Endangered (Malampaya Sound, Philippines). This work highlights critical areas in which research is needed if we are to conserve this at-risk species.

Appendix D. Report from Tara Whitty

Trat Research Summary for January-February 2013

Tara S. Whitty

As part of the line-transect surveys for cetaceans, human activities on the water were also categorized and recorded. The aim of the human activity survey is to document all observed fishing and boating activity along the survey track lines, in an effort to characterize potential human impact on dolphin habitat. Observed anthropogenic activities included fishing boats, fishing gear, passenger boats, and cargo boats. Recording such activities during these surveys will provide information on how human activity overlaps with dolphin habitat, including the density and diversity of human activitities that might potentially impact dolphins. These data were collected systematically for all transect lines along the mainland coastline.

Information from these human activity surveys will be used as part of Tara Whitty's doctoral dissertation on "Conservation-scapes of Irrawaddy dolphins at four sites in Southeast Asia". Part of this dissertation involves characterizing the ecological and anthropogenic aspects of Irrawaddy dolphin conservation, including social, cultural, economic, and political dimensions of management. These human activity surveys will supplement interviews conducted in 2012 in Trat Province as methods for characterizing the human dimension of Irrawaddy dolphin conservation and small-scale fisheries management.

Appendix E. Report from Isabelle Groc, photojournalist

Trat 2013 Report

In January 2013, I joined a field research project which aimed to locate coastal cetaceans and estimate their abundance along the eastern Gulf of Thailand. The research project was led by Ellen Hines, a Professor in the Department of Geography and Human Environmental Studies at San Francisco State University, and also involved a team of international researchers including Chalatip Junchumpoo who is a marine biologist for the Eastern Marine and Coastal Resources Center of Thailand, Sri-Lanka based marine biologist Anouk Illangakoon, Louisa Ponnampalam, a marine biologist with the University of Malaysia, and Justine Jackson-Ricketts, a doctoral candidate at the University of California, Santa Cruz. Both Ponnampalam and Illangakoon are members of the IUCN Cetacean Specialist Group.

As a freelance writer and photographer, I spent a few days documenting line transect boat surveys in the Gulf of Thailand around an archipelago of islands that included Ko Chang, Ko Mak, and Ko Kut. The researchers specifically looked for Irrawaddy dolphins (*Orcaella brevirostris*), finless porpoises (*Neophocaena phocaeniodes*), and Indo-Pacific humpbacked dolphins (*Sousa chinensis*).

I also documented the team's visit to an elementary school in Trat province to educate children about Irrawaddy dolphin conservation. I also photographed interviews with local fishermen in the village of Ko Kut that focused on dolphin sightings, fishing practices, and views on conservation.

I conducted interviews with team members Ellen Hines, Chalatip Junchumpoo, Anouk Illangakoon, and Justine Jackson-Ricketts to learn about research goals, challenges, and methods to study Irrawaddy dolphins in Thailand. We also discussed threats to the species and conservation approaches to protecting the dolphins.

I hope to return next year and join the January 2014 field season for a longer period of time to build on the foundation work that I accomplished during the 2013 field season. Specifically I hope to obtain high-quality photographs of the species, critical habitat, and local villagers, and complete more in-depth interviews with members of the team. Even though I did not see dolphins during my time with the team in Thailand, I learned a lot about the research project, the field methods, the biology of the species, threats faced by the dolphins, and the conservation challenges and strategies for protecting the long-term future of these animals in this region. I have also started building a collection of photographs of the science process, the researchers, and the local fishermen and communities that are involved in dolphin conservation.

I envision this documentation work to be disseminated in at least two ways:

1. Development of a science story on the Irrawaddy dolphins.
Little is known about Irrawaddy dolphins in the Gulf of Thailand, and no formal surveys have been conducted. Hines' research is the first project that gathers data on this vulnerable (IUCN Red list) species in this location.

This research is particularly important to understand the status of the population and the dolphin's critical habitat, as this species is highly vulnerable to incidental fisheries catch, habitat loss, and proximity to coastal development. The eastern Gulf coast in Trat province is becoming more popular with tourists and is being overfished over time. Research documenting Thai coastal cetacean populations and fisheries bycatch has been identified as a priority by the IUCN/SSC Cetacean Specialist Group in its 2002-2010 Conservation Action Plan for the World's Cetaceans.

The feature story will discuss the ground-breaking work that Ellen Hines and her team have been conducting since 2003. Since the work began, the team has produced the first population abundance estimate of this population. The researchers also confirmed interesting behaviors that had not been documented before for the rarely seen and hardly studied Irrawaddy dolphins. These include mating herd behavior, squid foraging, and mothering behavior. These important findings will be published soon in a scientific paper. Additionally, researchers have interviewed local fishermen on dolphins and conservation values for several years, and will publish a paper soon on the topic of changing conservation values.

The story will report on these recently discovered behaviors and will discuss threats faced by this rare species, as well as conservation strategies. One interesting angle is how the cultural and social relationships that exist between the local coastal villagers and the dolphins can be used as a foundation to build effective conservation solutions for the Irrawaddy dolphins.

This story also has broader significance, as unique dolphins are really in trouble around the world wherever one looks. For example, in 2006 a team of scientists went on an expedition on China's Yangtze River to look for the baiji, the world's rarest and more threatened cetacean. They could not find any. The Yangtze River dolphin had gone extinct after a dramatic decline due to accidental fisheries bycatch and other factors associated with the industrialization of the Yangtze river. Samuel Turvey of the Zoological Institute of London and author of the book *Witness to Extinction: How We Failed to Save the Yangtze River Dolphin* conducted surveys among local fishing communities about what they knew of the Baiji and what the river used to be like. He found the knowledge was disappearing fast and that people were quickly forgetting about these animals.

Given this context, the story on the Irrawaddy dolphins will have broader implications for other rare, vulnerable dolphin species, as it will discuss conservation challenges and ways to involve local communities to better protect these animals. Further, as these species are declining and are more rare, it is increasingly difficult for researchers to study them and gather the information that is needed to develop adequate conservation strategies. The story will examine such challenges in the context of Irrawaddy dolphins, and how they are addressed. The story will include a photo essay with images of the habitat, the dolphins, the researchers at work, and the local communities involved in the conservation of the species.

2. A series of blogs reporting on the research project in Thailand to be published in the Georgia Straight.
The blogs will examine the conservation issues and will also report on observations of the scientific work conducted to learn more about a species that had never been studied before, what it takes to conduct scientific studies on marine mammals in this region of the world, and how local scientists are trained to carry on long-term monitoring of the species.