BALIKPAPAN BAY IRRAWADDY DOLPHIN PROJECT 2008

Conservation and diversity of cetaceans in and near Balikpapan Bay, East Kalimantan, Indonesia

TECHNICAL FINAL REPORT

FIELDWORK PERIOD: MAY, JULY & NOVEMBER 2008

Orcaella brevirostris near Jenebora village, Balikpapan Bay

Project executed by

RASI CONSERVATION FOUNDATION

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Sponsored by The Whale and Dolphin Conservation Society

PREFACE AND ACKNOWLEDGEMENTS

The results presented in this technical final report are still preliminary and not to be cited without prior approval from the author. This survey was conducted by the local Indonesian NGO, Yayasan Konservasi RASI or the Conservation Foundation for Rare Aquatic Species of Indonesia (YK-RASI). The project is in collaboration with the University of Mulawarman. Field surveys were conducted by Danielle Kreb, Imelda Susanti (YK-RASI) and Firman Abadi. A.T. (BEBSiC). I would like to thank every field observer gratefully and also our boat driver Pak Ronding. Finally, I owe a great deal of gratitude to the sponsor of this project, the Whale and Dolphin Conservation Society.

Samarinda, 14 January 2009

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ABSTRACT

Marine mammal observation surveys were conducted in Balikpapan Bay in East Kalimantan in 2008 in order to obtain information on cetacean diversity, total abundance, distribution patterns and threats. A total of 985 km of line-transects were surveyed in 84.9 hours in 16 days during three surveys in May, June and November 2008. The surveys were compared with the results from two surveys in 2000 and two in 2001, which were conducted during similar seasons to assess changes in abundance and distribution. Three cetacean species, i.e. Irrawaddy dolphin, *Orcaella brevirostris*, Finless porpoise, *Neophocaena phocaenoides*, and Indo-Pacific bottlenose dolphin, *Tursiops aduncus* were encountered during all surveys as well as dugongs *Dugong Dugon*. The finless porpoise and bottlenose dolphins occurred in low densities in the outer coastal bay segment, and dugongs in several bay segments in very low densities. Irrawaddy dolphins were the species most commonly encountered but were almost exclusively sighted in the upper parts of the bay in 2008, whereas during 2000 and 2001 they also significantly occurred in the lower bay segments downstream of Tanjung Batu and near coastal area. Individual dolphins also show a high site-fidelity throughout the seasons. Best estimates of mean abundance in 2008 were between 67 and 140 individuals based on the Burnham & Overton mark-recapture- and line-transect density analysis, respectively. No significant changes in mean abundance were found between 2000, 2001 and 2008. The disappearance of Irrawaddy dolphins in the lower bay segments is likely caused by increasing boat traffic and industrial activities in the lower segments, as well as increased sedimentation impacting on fisheries in these areas due to mangrove conversion. The preservation of mangroves of the upper bay segments, above Tanjung Batu, and prevention of industrial activities in these segments including prevention of bridge construction plans in this segment, is essential for the preservation of the Irrawaddy dolphins and dugongs in the bay. Since the dolphins live in close contact with the human population in the bay, increasing awareness is similarly important.

INTRODUCTION

The Indonesian Archipelago contains some 5 million km^2 of territory (including water and land), of which 62% consists of seas within the 12-mile coastal limit (Polunin, 1983). However, in spite of this extensive water mass only few reports on cetaceans are available. The investigation of the status of cetaceans in the Indonesian archipelago is one of the research projects recommended in the 2002-2010 Action Plan by the IUCN/SSC/Cetacean Specialist Group (Reeves *et al*., 2003). Rudolph *et al.* (1997) reported at least 29 species of cetaceans to occur in the seas of the Indonesian Archipelago but only a few dedicated studies have been conducted on the abundance, distribution and conservation of cetaceans in Indonesia such as long-term research conducted on several cetacean species in Komodo National Park waters and on the Irrawaddy dolphin, *Orcaella brevirostris* in the Mahakam River and coastline in East Kalimantan (Kahn *et al.*, 2000; Kreb, 2004, Kreb & Budiono 2005, Kreb et al. 2008). The Irrawaddy dolphin is a unique freshwater and coastal dolphin species, which is found in shallow, coastal waters of the tropical and subtropical Indo-Pacific and in the Mahakam, Ayeyarwady and Mekong Rivers (Stacey & Arnold, 1999). The species is protected in Indonesia and adopted as symbol of East Kalimantan. The status of most coastal Irrawaddy dolphin populations are still data deficient.

Coastal surveys were conducted in Balikpapan Bay and the Mahakam Delta in several seasons over 40 days between May 2000 and May 2002 (Kreb & Budiono, 2005) to obtain data of coastal Irrawaddy dolphins with regard to densities, social ecology and acoustics for comparison with the freshwater Irrawaddy dolphin population in the Mahakam River (Kreb, 2004; Kreb & Rahadi, 2004). Several areas were then identified as preferred dolphin areas, such as confluence areas with tributaries. Currently, many changes have taken place in the bay such as an increase of boat-traffic activities and logging activities in the mangrove forest, which impacts on local fisheries. Also, concrete plans exist to construct a bridge over-spanning the bay although the precise location is still undetermined.

The research involving three seasonal surveys in 2008 aims to assess the current population size of the Irrawaddy dolphin population in Balikpapan Bay, to conduct a threat assessment analysis based on the dolphin's distribution and density pattern and to hand recommendations for their conservation to the local government and other stakeholders. Recent ongoing research has been undertaken to assess the biodiversity and eco-tourism potential in the mangrove forests surrounding the bay and the impact of bridge and road construction on the environment (Lhota, 2006). The dolphin research results will be a necessary component for inclusion in this evaluation report as well.

This project also fits within the action plans of the IUCN (i.e. IUCN 2002-2010 Conservation Action Plan for the World's Cetaceans) and UNEP/ CBD Regional Action Plan for SE Asia's Small Cetaceans and its Indonesia Country Report in particular.

OBJECTIVES

The objectives of the present research project are to conduct a series of systematic at-sea surveys during a period of one year to:

- To provide a total population estimate of Irrawaddy dolphins that use the bay and its near coastal area based on photo-identification of mark-recaptured individuals as well as abundance estimates based on line-transect distance sampling.
- To compare current dolphin densities with those collected between 2000-2001 in order to compare relative abundance
- To assess their current distribution pattern based on densities per bay segments and mapping and compare these with the 2000-2001 surveys to see if any changes occurred.

- Assess threats and analyze likely causes for possible fluctuations in relative abundance and dolphin's distribution pattern between 2001 and present surveys.
- Assess all cetacean diversity in the near coastal waters
- Inform local and national authorities, NGO's and local university of the results of the study and draft conservation recommendations to provide input with regards to areas where bridge construction causes least adverse effects on the dolphin population (based on this study) and other wildlife (based on other studies). Furthermore, designate areas where and in which seasons sustainable, regulated ecotourism activities may take place or not, to avoid unlimited, uncontrolled dolphin watching.
- Raise awareness at public places and with schools in Balikpapan as well as in villages surrounding the bay by distributing posters on the dolphin conservation and presentations.

FIELD METHODS AND ANALYSIS

Study area

Balikpapan Bay stretches from 116°42' to 116°50' E and 1° to 1°22' S (Fig. 1). Water surface area of the bay is approximately 120 km^2. Maximum width of the bay is approximately 7 km, and the surrounding shorelines within the bay consisted mainly of mangrove vegetation. Food ecology is regulated seasonally, whereas fish availability is highest between September until April, and lowest from May to August, especially between June – August when southern wind is dominant and fish are spawning in the mangroves. Boat traffic is most frequent in the downstream part of the bay, including oceanic tankers, coal barges tugboats, and ferries and speedboats crossing the bay mostly in one particular lane.

Field methods

In 2000, 2 boat surveys were conducted in Balikpapan Bay between 1 to 6 May and 8 to 14 December, whereas in 2001 another 2 boat surveys were conducted between 31 May to 8 June and 3 October to 14 October, totalling 1350km of transects in 125.8 hours. In 2008, three different boat surveys were conducted between 19 until 24 May 2008, 6 until 10 July and 8 until 12 November 2008 in Balikpapan Bay and nearby coastal area. In 2008 a total of 985 km of transects were surveyed in 84.9 hours while cruising an average speed of 11.9 km/ hr. Transect lines were systematically designed to cover the entire survey area with no prior assumptions regarding dolphin distribution (see Appendix 1). The survey area was divided in four segments, A (outside bay), B down (downstream part of bay), B upper (upstream part of bay), C (upstream part of bay). Transect lines were spaced parallel at 2 km distance and each segment could be finished in one day. Survey effort was suspended when the sighting conditions deteriorated or at Beaufort sea states above 3.

Surveys in 2000 and 2001 were conducted from a wooden boat of 16 m length and 20 hp inboard diesel engine. Surveys in 2008 were conducted using a wooden boat of 7m length and 12 hp diesel engine (Dong Feng). The survey team existed of two front observers, which actively searched for dolphin at 2 to 3 m eye-height above sea level (2008 & 2000/2001, resp.) and one data recorder switching positions every 30 minutes One front observer continuously scanned the sea surface within a 180° angle from the beam by aid of binoculars (7x50 Fujinon) attached to a hand-held wooden stick and the other observer searched with the unaided eye, occasionally using binoculars. All sighting effort data (position in relation to track stations, speed) and environmental conditions (clouds, beaufort, tide and visibility (fog, rain, sun reflection)) were recorded using a GPS every 30 minutes. In addition, each day we also recorded the moon positions referred to as *sorong*, which counts from 1 to 28 after each new moon and influences tidal height, current speed and duration length between low and high tide. The survey track-line and effort data were also directly stored in the Garmin eTrex

Vista CX. Segment A could be surveyed in one day, whereas for the other segments, two segments could be surveyed within one day. Double sightings on the same transect were avoided by means of photo-identification of dorsal fins.

Effort was suspended long enough to photograph as many individuals as possible for mark-recapture analysis and also to identify species (specifically in the coastal area). The total dolphin observation time of the three surveys in 2008 was 15.5 h, and the mean observation time per sighting was 27 min. Upon making a sighting, the radial distance between boat and dolphins was estimated, and compass bearing of the boat and of the dolphins and coordinates of the sighting location were recorded. Distance estimation and 'calibration' among observers was exercised by regularly estimating distance to fixed waypoints (floating buoys, fishing traps etc) and check with the distance estimated by the GPS to this waypoint. Effort is suspended long enough to photograph as many individuals as possible for mark-recapture analysis and also to identify species (specifically in the coastal area) and group size. Minimum, maximum and best estimates of group size and of the number of calves and juveniles were recorded. In addition, video footage was made. Depth at sighting locations was measured using a depth-meter.

Analysis

Densities were seasonally calculated per transect and bay segment using the following formula below for line-transects with only two perpendicular sighting distance zones, one within distance *r* and one beyond that distance. The distance was selected so that about half the records were in each belt (Jarvinen & Vaisenen, 1975). Mean seasonal densities per segment were multiplied by available dolphin habitat for each segment (km^2) to obtain abundance. The sum of abundance estimates per segment per season is the total abundance estimate. The coefficient of variation (CV) was calculated for each segment and season, whereas the associated CV for the total seasonal estimate was derived from the average of each segment CV.

$$D = (n_1+n_2/2rl).\log_e(n_1+n_2/n_2).1.000.000$$

Where: D = density (dolphins/ km_2)

r = perpendicular sighting distance (m) from transect to boundary between two zones (the second extending to infinity), in which about 50% of sightings were recorded each.

n_1= number of animals counted within r

n_2= number of animals counted beyond r

l = transect length (m)

The distance from transect to boundary of two zones was calculated by sorting the combined perpendicular distances in increasing order from all surveys in 2000 and 2001 and from all surveys in 2008, after which the distance was selected so that about half the records were in each belt. The boundary distance for 2000 and 2001 was 86 m and r for 2008 was 61 m. The distances for the 2000 and 2001 surveys were combined because of the low number of available perpendicular distances per survey and because similar observation teams were used during similar weather conditions using a similar boat and observation platform. In 2008 the same reasons applied for combining the seasonal distances. For the density calculation in 2008, transect length for segment A was excluded because no sightings were made here in any of the three surveys in spite of similar survey efforts and seasons as in 2000/2001. On effort search effort excluded transects, which were less than 50% finished due to environmental constraints, because density in transects, of which less than 50% of transect length was surveyed, may not properly reflect density in this section, either over- or underestimate.

The density method described above was chosen because perpendicular sighting distances were not recorded for all sightings (55% and 93% for 2000/2001 and 2008 surveys respectively) and because their number was below the requirement of 60 observations for calculation of detectability functions (43 and 28 observations respectively).

When calculating mean densities and abundance estimates for 2008, July 2008 was excluded because this represented the southern wind season, which was not represented by surveys in previous years (i.e. 2000 and 2001).

In addition, for the 2008 surveys, a population estimate was calculated by means of the Jolly Seber method for 'open populations' that includes all three survey periods in the calculation. Because of low precision and high site fidelity (see results) an additional estimate was generated using Petersen mark-recapture analysis for 'closed populations'. Because of a recorded heterogeneity of capture probability, the Burnham & Overton mark recapture analysis was also performed for 'closed populations'. For the 2000 and 2001 surveys no photo-identification data was available and hence no mark-recapture analysis could be performed.

For the other species encountered only simple encounter rates were calculated because of the low number of sightings.

RESULTS

In Balikpapan Bay during three surveys conducted in 2008, three species of cetaceans were observed: 1) Irrawaddy dolphin, which was the most common and only distributed inside the bay, 2) Finless porpoise, *Neophocaena phocaenoides* and 3) Indo-Pacific bottlenose dolphins (*Tursiops aduncus*, which last two species were both encountered in low density in near coastal habitat outside the bay.

Irrawaddy dolphin - *Orcaella brevirostris*

Density and abundance estimates

Abundance estimates based on distance sampling of the Irrawaddy dolphin population in Balikpapan Bay in 2008 varied between 70 (CV=32%) and 157 (CV=14%) individuals (Table 1). Lowest mean density in 2008 was found during the onset of the southern wind season in July, when dolphins were more scattered in smaller group sizes (Table 2), which increased the chance of missed sightings. Second lowest densities were recorded in May, which may also be caused to the fact that more search effort was performed in May under Beaufort 3 as compared to July and November (20%, 5% and 5% of survey effort time, respectively), which decreased sighting abilities during the first survey. Because wave action was lowest in November when the highest estimate was made, this estimate is considered most reliable. The May and November estimates in 2008 had relatively low coefficients of variation indicating relatively high levels of precision.

Table 1. Sightings, densities and abundance of Irrawaddy dolphins per segment in Balikpapan Bay 2008.

Segment	Total n			N sighted			Total km transect line km			No. of transects			Density N/km2			N estimated			dolphin distribution area km2
Months	May	June	Nov	May	June	Nov	May	June	Nov	May	June	Nov	May	June	Nov	May	June	Nov	
A	0	0	0	0	0	0	83	52	105	2	1	2	0	0	0	0	0	0	0
B down	2	1	0	3	3	0	114	71	59	3	2	2	0,014	0,243	0	0,4	7,8	0	32
B upper	4	4	7	36	9	32	138	108	103	3	3	3	1,790	0,624	1,859	89,5	31,2	92,97	50
C	3	3	6	12	10	24	57	40	55	2	2	2	1,287	1,210	2,482	33,47	31,45	64,5	26
Total/ mean	9	8	13	51	22	56	392	271	322	10	8	9	1,03	0,692	1,447	123,4	70	157,5	**108**

Density in different segments in 2008 was consistently lowest in the area outside the bay (A), where no sightings at all were made and downstream part of the bay (B down) (see map of sightings Appendix 2).

Table 2. Sightings, densities and abundance of Irrawaddy dolphins compared per survey in 2000, 2001 and 2008 in Balikpapan Bay 2008

Month	n sightings	mean G	N sighted	PSD (km)	L (km)	Mean density N/km2)	N estimate	CV
May-00	12	4	48	0.086	228	0.727	157	32%
Dec-00	8	5.8	46	0.086	285	0.706	135	31%
May-01	21	3	64	0.086	311	0.738	122	17%
Oct-01	26	4.0	103	0.086	491	0.947	170	30%
May-08	9	5.7	51	0.061	299	1.030	123	21%
Jul-08	8	2.3	22	0.061	220	0.692	70	32%
Nov-08	13	4.3	56	0.061	216	1.447	157	14%

***** = transect line in 2008 excluded segment A for density analysis.

No significant difference was found between the mean abundance estimates in 2000, 2001 and 2008 when July 2008 was excluded (X^2=2.5; df=2). However, density distribution among the segments was markedly different where densities in segment A (bay near coastal area) was zero and nearly zero in the downstream segment in the 2008 surveys (Table 3, 4 & Fig 1) except for the sightings made in segment B down in July 2008, which nevertheless were all sighted near the border with segment B upper (Appendix 3).

Table 3. Mean densities of Irrawady dolphins per segment per season and year in Balikpapan Bay

Segments	May 2000 density (N/km2)	Dec 2000 density (N/km2)	May 2001 density (N/km2)	Oct 2001 density (N/km2)	May 2008 density (N/km2)	July 2008 density (N/km2)	Nov 2008 density (N/km2)
A	0.618	0.369	0.041	0.142	0	0.000	0.000
B down	1.477	0.198	0.527	2.066	0.014	0.243	0.000
B upper	0.076	0.782	1.567	0.696	1.790	0.624	1.859
C	0.738	1.473	0.817	0.885	1.287	1.210	2.482
Mean density	0.727	0.706	0.738	0.947	1.030	0.692	1.447
N estimate	157	135	122	170	123	70	157
CV	32%	31%	17%	30%	21%	32%	14%

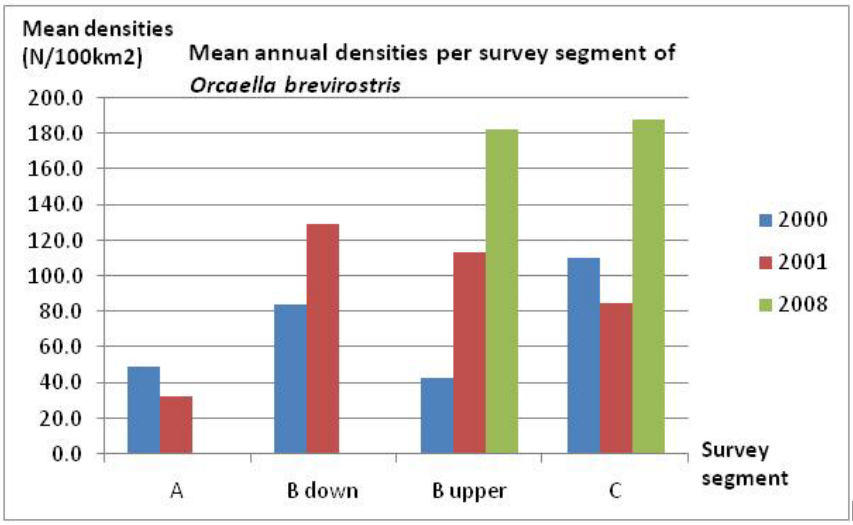

Fig 1.

The annual mean abundance estimate in 2008 (N_{2008} = 140, excluding July 08) in the upper bay segments (combining B upper and C) was significantly higher in comparison to the estimates of 2000 (annual mean of N_{2000} = 50; X^2 = 17; df = 1; $p<0.01$ and 2001 (annual mean of N_{2001} =79; X^2 = 42; df = 1, $p<0.01$)

Preferred dolphin locations in 2008 are in the B upper and C segments including: Sungai Riko, Pantai Lango, Pulau Balang, Pulau Benawa Besar/ Kecil and the entire stretch between these islands and the confluence of Semuntai and Sepaku (Appendix 2).

Most frequent and intensive group socializing behaviors were observed in November, whereas during the first two surveys, behaviors mostly involved feeding activities. Because fish abundance was higher in November after fish had spawn in the mangroves in July-September and southern wind had lay down, dolphins probably could spend more time socializing.

Table 4. Mean annual densities and abundance estimates of Irrawaddy dolphins per segment in Balikpapan Bay in 2000, 2001 & 2008.

Segment	Total n sightings			N sighted			Mean G			Total km transect line km			Mean density N/km2			Orcaella bay distribution area km2		Mean N estimate (CV)		
Months	2000	2001	2008	2000	2001	2008	2000	2001	2008	2000	2001	2008	2000	2001	2008*	2000-2001	2008	2000	2001	2008
A	9	3	0	29	6	0	3,2	2,0	0,0	235	186	188	0,493	0,327	0,000	140	0	69 (24%)	46 (13%)	0
B down	7	9	2	23	42	3	3,3	4,7	1,5	75	123	173	0,838	1,296	0,007	32	32	27 (63%)	41 (30%)	0.2 (1%)
B upper	6	19	11	16	69	68	3,5	3,1	6,2	112	288	241	0,429	1,132	1,825	50	41	21 (27%)	57 (36%)	91 (40%)
C	8	16	9	26	49	36	3,3	3,1	4,0	92	204	112	1,106	0,851	1,884	26	26	29 (22%)	22 (14%)	49 (12%)
Total/ mean	30	47	22	94	166	107	3,3	3,2	2,9	513	802	714	0,716	0,902	1,239	248	108	146 (31%)	166 (23%)	140 (17%)

* Transect A was excluded in 2008 density analysis; N.B. All data in this table excludes July 2008 survey. 2008 data was based on the May and November surveys only.

Mark recapture abundance estimates

During the surveys of May, July and November 2008 a total of 23, 16 and 38 individual Irrawaddy dolphins were identified, respectively based on dorsal fin identification. When combining the surveys a total of 46 individuals were identified of which 55% were indentified during more than one survey, whereas of the total of 43 individuals identified in the surveys most separated in time from each other, i.e. May and November, an overlap of 42% in individuals existed, indicating relatively high levels of site fidelity.

For 23 out of the 31 Irrawaddy dolphin sightings of all 2008 surveys combined photo-id pictures were obtained, and on average 99% of the individuals per group was photo-identified. During 8 sightings, no pictures could be obtained because the group was only observed too short for taking pictures. These groups all involved single individuals or small groups of 2 individuals maximal. For eight of 23 photo-id sightings the number of photo-identified individuals was higher than the directly estimated group size, especially bias existed for group sizes larger than 10 individuals, which were under-estimated during field observation.

Total abundance estimate based on Jolly Seber mark-recapture analysis generated an estimate for the second survey period of N = 36. Because of the low confidence limits (95%CL= 17-210) and the fact that this estimate is lower than the total identified dolphins together (N = 46), this estimate is not considered representative for the mean bay population.

The Burnham & Overton method was also used because of the heterogeneity in capture probability and because of the high overlap of individuals in the May and November survey assuming a more or less closed population model. Best estimate was 67 individuals (95%CL = 59 – 74). An additional estimate was made using Petersen's mark recapture analysis using these two survey periods. Best 'Peterson' estimate was 48 individuals (95% CL=40-62).

Other marine mammal species occurrence

Three sightings of dugongs were made in 2008 of which two in similar locations as in 2000-2001 (Appendix 2 & 3), namely Kariangau and Muara Beranga. Finless porpoise and Indo-Pacific bottlenose dolphins were also sighted in similar near coastal bay habitat (A) in 2008 as in 2000-2001.

Table 5. Encounter rates and habitat of *D. Dugong,N. Phocaenoides* and *T. Aduncus* in Balikpapan Bay area in 2008.

	n			mean G			N sighted			L		Encounter rate (N/km)			Habitat		
Month	D. dug	N. phoc	T. adun	D. dug	N. phoc	T. adun	D. dug	N. phoc	T. adun	D. Dug*	N. phoc T. adu**	D. dug	N. phoc	T. adun	D. dug	N. phoc	T. adun
Mei-08	1	2	1	1	5	38	1	10	38	335	83	0,003	0,120	0,458	A	A	A
Jul-08	0	1	1	0	1	14	0	1	14	231	52	0,000	0,019	0,269	-	A	A
Nop-08	2	0	0	1	0	0	2	0	0	267	105	0,007	0,000	0,000	B	-	-

***** Transect C was excluded in encounter rate calculation due to lack of sighting
** Only transect A was included in encounter rate calculation

DISCUSSION

Population abundance

Population estimates generated according to line-transect and density analysis in 2008 were between 2-3 times higher (N = between 70 and 157, $N_{mean\ 2008}$ = 140) than the estimates generated following the most suitable photo-identification and mark-recapture analysis methods, i.e. Petersen and Burnham & Overton (Petersen: N = 48, 95% CL =40 – 62, & Burnham & Overton: N = 67, 95% 59 - 74). All methods had their short-comings: The density sampling may overestimate numbers in the bay because it assumes a homogenous distribution of dolphins in the bay, whereas their actual distribution is more confined to specific areas and very often near shorelines. In our surveys, we anticipated on that by always travelling within c. 250m distance that enabled a clear sight of the shores. Because most dolphins were observed at c. 100-200 m from the shore, perpendicular sighting distances were quite small (50% were recorded within 61 m sighting distance). This, in combination with the extrapolation of densities with available dolphin habitat, which may effectively be less large as dolphins more often occur near shores instead of the middle segments of the bay, may cause an overestimation of population abundance.

On the other hand, the Petersen photo-identification estimates may be underestimated since for 8 out of 31 sightings no pictures could be obtained. These 8 sightings involved group sightings of one or two individuals. Also, at least 46 individuals were identified, which in addition to groups that may never have been photographed should at least be higher than the minimum estimate of 40 generated by Petersen.

The Burnham & Overton analysis method had a relatively narrow range of confidence limits for the estimate, but is likely biased as well because the mean catchability was not constant over time ($G=110$; $df=2$, $P<0.01$), whereas differences in proportion photo-identified individuals between surveys have no effect on the Petersen estimate. However, considering the fact that at least 46 individuals were identified and that a number of groups were never photographed the estimates of Burnham & Overton seem to present a more realistic population estimate. Therefore, I hypothesize that the true population estimate may be somewhere between 67 and 140 individuals.

Conservation

During the 2008 survey, the near disappearance of Irrawaddy dolphins in the lower bay segment and complete lack of sightings in near coastal waters of the bay became apparent. A plausible reason seems that the dolphins in the downstream segments have moved upstream, implying a shift in habitat use and decrease of available habitat, which is demonstrated by the significant increases in mean densities in 2008 in the upper bay segments. The chances may be linked to the increase of industrial activities and intensification of boat traffic in the lower bay segment such as oceanic carrier ships, tankers, coal barges, which mean numbers at any given moment during the day moving or stationary were c. 4-6 times higher in 2008 (c. 20-30 ships) than in 2000-2001 (c. 5 ships). Underwater noise pollution as well as a decrease in fish resources in the lower bay segment may have contributed to the reduced use of this area by the Irrawaddy dolphins. Fish resources may possibly be reduced as a result of increased sedimentation due to mangrove conversion in upper parts of the bay (B upper) that is deposited in the lower and outer parts of the bay. The confinement of the dolphins in the upper segments in the bay makes them very vulnerable to the threats that would result from plans to construct a bridge crossing Pulau Balang and Tempadung, which would create tremendous underwater noise during the construction process and open mangrove, which is still intact, and provide easy access because of the

road to open more mangrove forest for industry or illegal shrimp farms, which besides habitat loss for several species, would also cause sedimentation that will impact on dolphin prey resources and local fisheries. An alternative bridge plan is proposed linking Penajam and Melawai in the downstream bay segments.

Threats to dugongs in the bay include increased sedimentation reducing available grazing areas and occasional entanglements in fishing nets after which the dugongs is killed if still alive to take oil for traditional medicine and bones, to which magical powers are attributed. Based on informal interviews, dugongs are increasingly rarely observed by local fishermen. In order to reduce threats from occasionally reported by-catch and killing of dugongs, raising awareness about their protected and rare status is necessary. One report was obtained of an Irrawaddy dolphin, which was found dead nearshore in 2003, but put afloat again. In order to solve the systematic status of the coastal Irrawaddy dolphins in East Kalimantan in relation to the freshwater Irrawaddy dolphins in the Mahakam it is important to obtain samples from stranded individuals and therefore cooperation should be sought with local communities and authorities. A first step has been taken to increase awareness in important dolphin areas in East Kalimantan, such as the Berau archipelago, Bontang, Mahakam delta and Balikpapan Bay by giving presentations on marine mammals and their habitat at both elementary and high schools as well as distributing posters with marine mammals that occur in East Kalimantan, their protected status and how to safe them when stranded but still alive and how to collect samples if they are dead.

In Balikpapan Bay and near coast, at least seven different fishing gears can be distinguished all of which more or less traditional. Trawling with 24 wide nets is regulated in the form of a limited number of fishermen and set locations. However, some illegal trawling outside these areas also occurs and should be prevented. Fisheries most suffer from seasonal chances in fish resources and wind conditions as well as increased sedimentation that impact on fish resources.

In terms of ecotourism, the upstream segments of the bay including several rivers offer a high potential for a responsible and controlled form of dolphin watching using instructed and responsible boats drivers and other wildlife sightseeing of easily observable animals such as proboscis monkeys, long-tailed macaques, silvered langurs and various birds including eagles, hornbils, storks and several species of egrets.

Future project planning

Continue investigating cetaceans in Balikpapan Bay to understand long-term, local distribution patterns, trends in abundance and obtain samples from stranded marine mammals. Finally, we aim to conduct local education/ awareness campaigns to increase the knowledge and sense of belonging/ care of the local communities for natural resources and marine mammals in particular.

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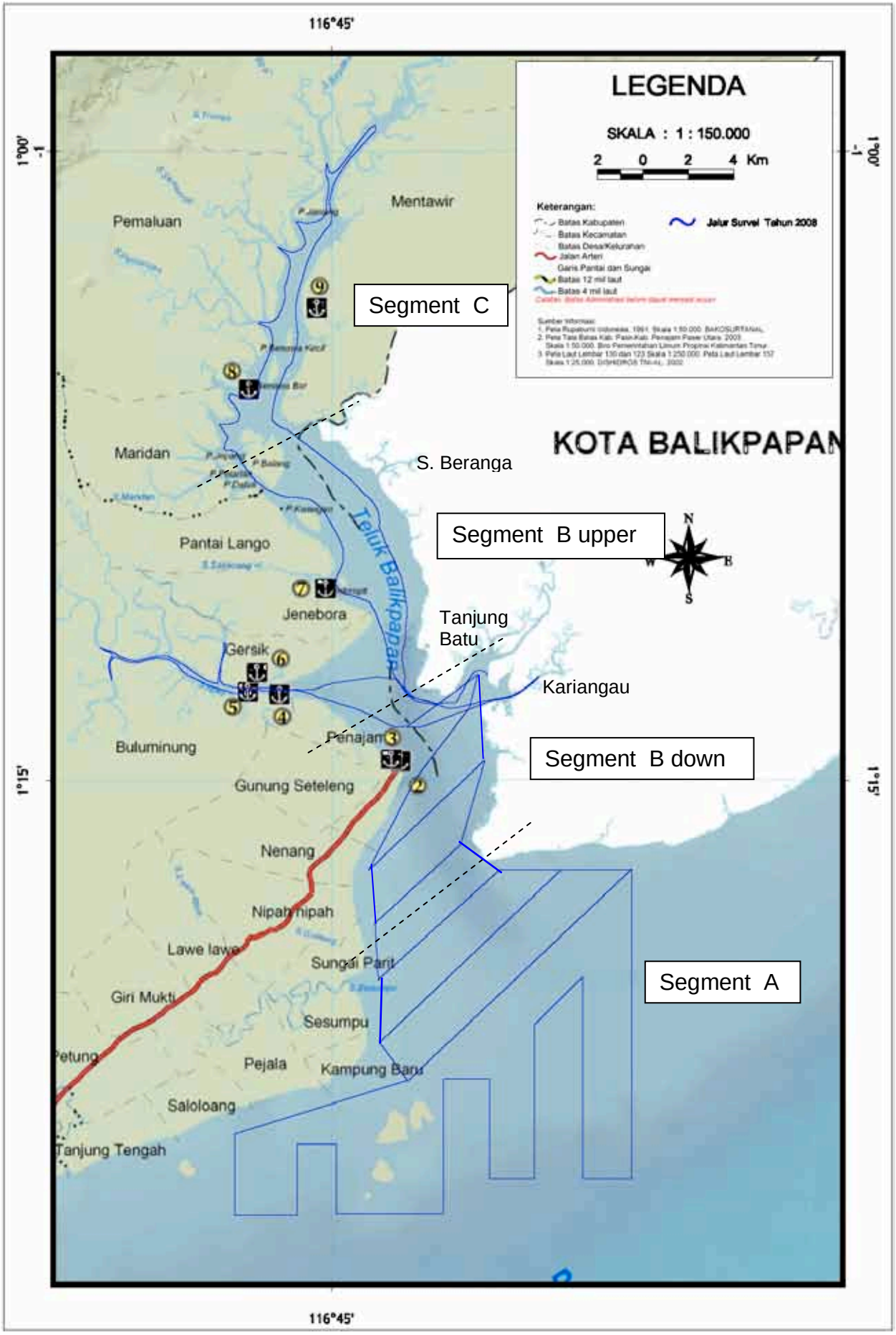
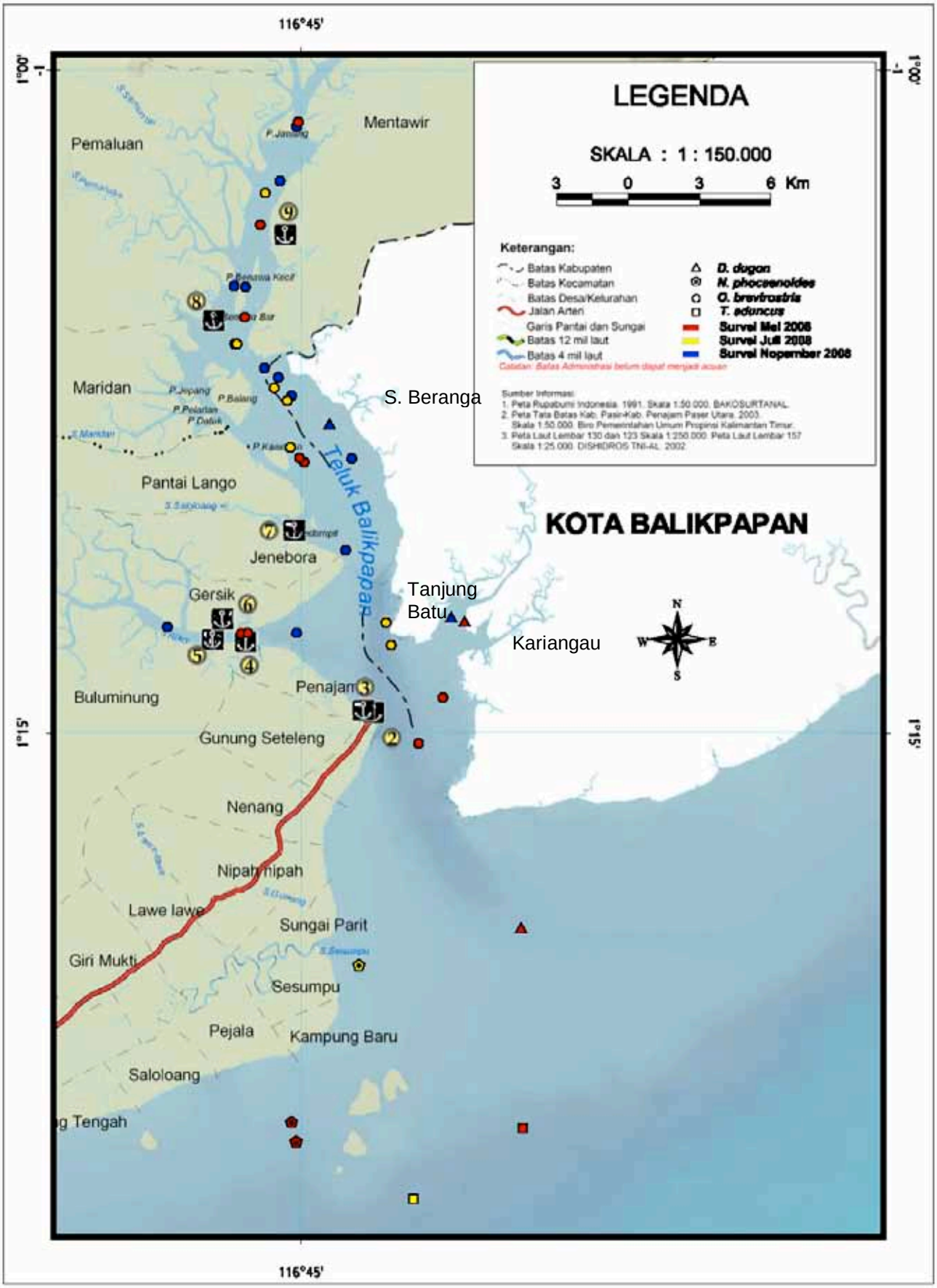
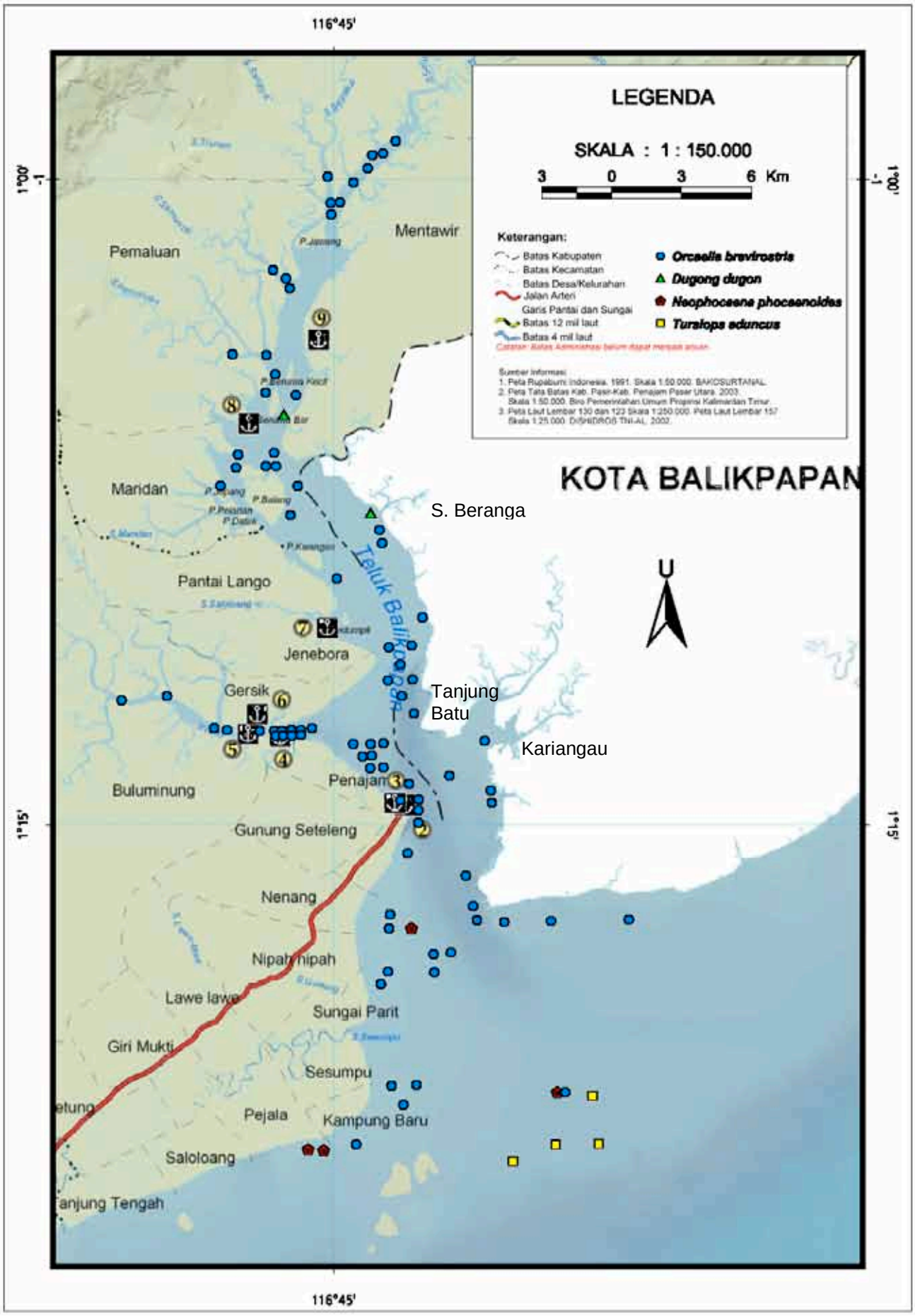
LAMPIRAN 1. Peta Segmen dan Jalur Survei



APPENDIX 2. Map with 2008 sightings of different species and seasons



APPENDIX 3. Map with 2000 and 2001 sightings for different species



APPENDIX 4. Pictures

Orcaella brevirostris (pictures by Danielle Kreb)

Common surfacing pattern

A few dolphins were just like Ob 5 heavily scarred

Left: Ob 2 was one of the 46 individuals that were identified based on unique dorsal fin shape
Right: PM 36, which was both identified on dorsal fin and awkward fluke shape.

Conservation

Undisturbed habitat with intact mangroves

The dolphins close presence to humans requires raising local awareness

Dolphins in the area of Tanjung Batu, viewing the lower bay segment with in the distance coal barges and container ships.

Opening of mangroves and industrial activities form a threat for the dolphins and fisheries through increased sedimentation, loss of spawning areas and pollution

Net fishing with small fishing boats near Pulau Balang. Nets (rengge unjil) are attached to a pole at one end at a certain distance from the boat and the boat moves in a circle around the pole. This is an example of sustainable fisheries. Plans to construct a bridge in this section are a threat to wildlife including dolphins, dugongs and fisheries.

A scenic view in Riko River at Lutut Mountain. Riko River also includes one the dolphin core areas

Coastal Species

Tursiops aduncus

Indo-Pacific bottlenose dolphin calf surfacing. The dolphins were all encountered outside the bay

A typical surfacing pattern for T. Aduncus showing the markedly longer beak in comparison to Tursiops truncatus

Distinctive darker cape and lighter lateral body colour patterns

Neophocaena phocaenoides

Finless porpoises were encountered both as single individuals as well as in groups of 10 individuals outside the bay in near shore waters.

Finless porpoises most often surfaced very inconspicuously but we also observed them leaping out of water when socializing

Survey team

F.l.t.r. Imelda Susanti recording on effort data; Danielle Kreb taking pictures during sighting

F.l.t.r. Front observers Danielle Kreb and Firman Abadi; Taking a depth sample at each dolphin location

Left: Coastal survey area outside the bay with view on Balikpapan City (A);
Right: Downstream Bay segment (B down);

Left: Jenebora village in upper bay segment of B. Right: Riko River, part of upper bay segment (B upper)

Most upstream bay segment (C), view on Benawa Kecil Island