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Rapid Ecological Assessment (REA) for Cetaceans in the Savu Sea Marine National Park

By: Benjamin Kahn and Yusuf Fajariyanto

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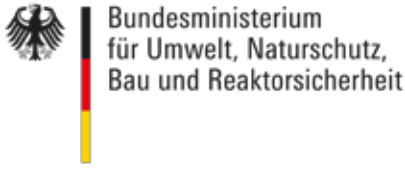

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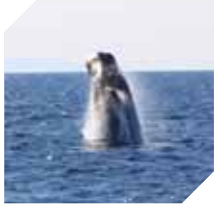
List Of Content

List Of Tables

List Of Figures



List Of Appendices

I. INTRODUCTION

The Savu Sea is positioned in eastern Indonesia at the nexus of the open Indian Ocean and the Indonesian Seas. It boosts an exceptional bio-diversity and abundance of whales and dolphins and includes critical habitat, such as migratory bottlenecks (or marine corridors) for large whales as well as upwelling zones of regional importance within the Indo-Pacific region (Kahn 2011).

The Indonesian government officially stated its intention to declare the Savu Sea Marine National Park (SSMNP) during the World Ocean Congress in 2009 (i.e., Kahn and Subijanto 2009) and was legally declared by Ministerial Decree in 2014 (KEPMEN-KP/2014/Nr 5 and 6). The SSNMP includes numerous coastal and oceanic habitats which are very important for cetaceans (the collective name for all whales and dolphins) as well as the dugong.
Furthermore, it includes migratory bottlenecks for endangered whale species – such as sperm and blue whales – that are of regional conservation importance.

SSMNP has recently drafted the management and zonation plan, which includes as one of its main priorities the management and protection of the 22 cetacean species identified in the Savu Sea to date (Kahn 2013) and their preferred habitats and migratory corridors.

The 2013 Rapid Ecological Assessment on both cetaceans and seabirds was conducted under the leadership of the SSMNP

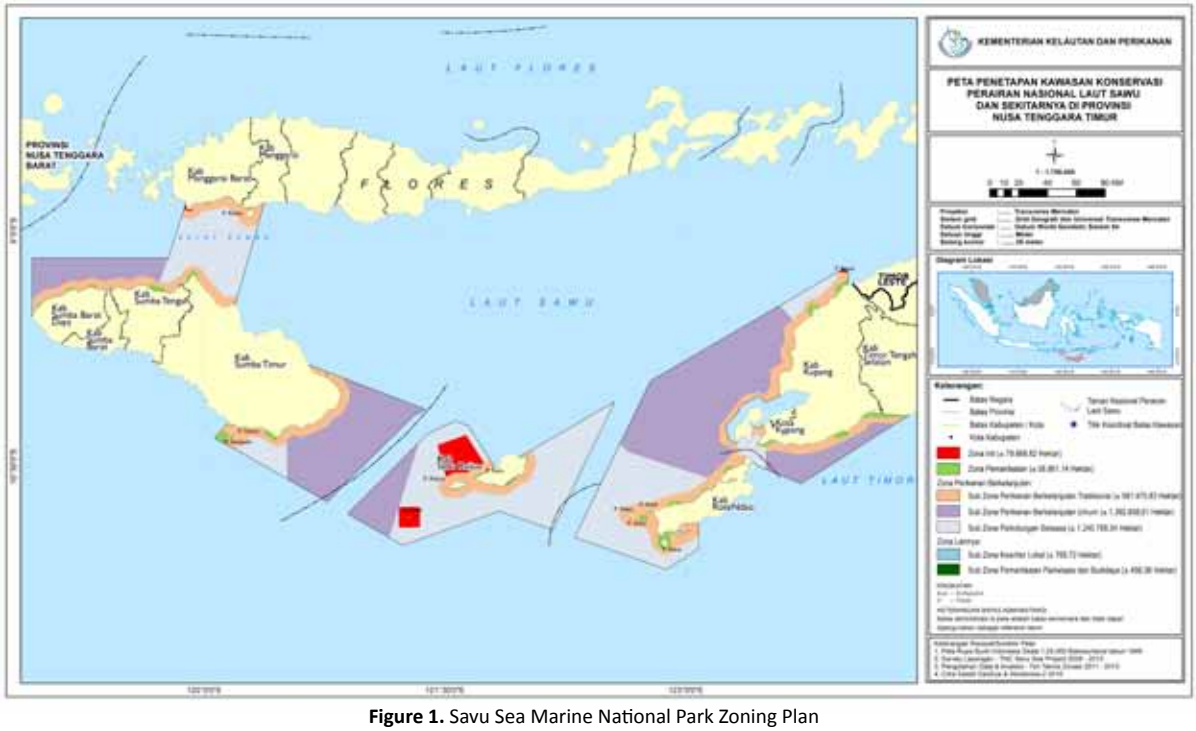


Figure 1. Savu Sea Marine National Park Zoning Plan

authority (locally known as BKKPN) in close collaboration with other government and non-government partners (DKP KKJI, DKP NTT Kupang, BKPPN, Tim P4KKP, TNC, APEX.)

These surveys aim to contribute to our understanding of any particularly sensitive areas within the SSNMP for marine mammals – and provide on-going technical support to:

- Assess if such areas have been adequately included in the proposed zonation plan
- Assess if other management measures are needed to address current or emerging threats that may jeopardize both resident and migratory cetaceans and their habitats.

Such potential threats may include unsustainable fisheries practices and net entangements, plastic waste, ship strikes with migrating whales, underwater noise pollution from shipping lanes, seismic and operational activities from the oil and gas industry, large-scale coastal infrastructure development (ports and mining) and others.

In addition, REA outcomes will provide guidance on how marine mammals can contribute to a tourism development strategy for the SSNMP and the broader Lesser Sunda Seascape (LSS) which includes Bali as its western boundary and Wetar and Timor Leste within its eastern border. Whale and dolphin watching is a rapidly expanding marine industry and currently practiced in over 90 coastal nations. Globally its revenues exceed billion USD. In Indonesia, this activity is relatively new, despite the high potential in certain areas, such as in the Lesser Sundas, Banda Sea and Raja Ampat, Papua. In the last 2-3 years, especially, several live-aboard vessels have added dedicated or opportunistic whale watching activities as part of their dive itineraries. In Bali, which has the most developed wild dolphin watch industry in Indonesia (with different fleets operating in the south and north coasts), the dolphins are estimated to generate USD 5-8 million to the local economy.

However, these activities remain largely unregulated and there have been long-standing concerns that Bali's dolphin-watching is turning into whale and dolphin harassment (i.e., no legal limits to vessel numbers, size combined with minimal compliance to existing regulations or voluntary Codes of Conduct on boat handling as per Kahn 2006). The Savu Sea Cetacean REA is well-aware of these issues and specifically aims to support a management framework that is able to effectively promote (and enforce) responsible whale watching in these waters.

1.1. Rapid Ecological Assessments in the Coral Triangle: The REA concept.

The Rapid Ecological Assessment (REA) is a survey technique designed to cover vast and data poor areas, with limited time and resources, in order to:

1. Identify elements of marine biodiversity
2. Identify important habitats and species assemblages (hotspots)
3. Facilitate field training and capacity building
4. Obtain the initial data for more species or habitat-specific follow up tasks to further investigate (often newly identified) conservation targets.

Once completed the REA can help identify follow up activities:

1. Field work incl. additional REA
2. Conservation and management
3. Site based projects
4. National policy development
5. Various other outcomes and recommendations as per Technical Reports and publications

II. METHODS

2.1. Visual cetacean assessment

During the active survey efforts in daytime hours two dedicated teams of 2 cetacean observers conducted visual surveys of the surrounding waters. Teams were rotated every two hours. The majority of sighting efforts were made from the aft and forward deck areas, with an observer height of approximately 4m above sea level. Regular scanning of the surrounding seas with marine binoculars (7x50 Steiner Commander; 8x40 Nikon) further increased the visual survey range and were frequently used to investigate initial sighting cues. Once cetaceans were sighted or a possible cue observed more than once, the vessel's course and speed was adjusted to allow for a discreet approach and close observations.

For each sighting, a positive species identification (or ID) was made whenever conditions and animal behaviour allowed this to be done safely and with minimal disturbance. If species could not be ascertained with certainty then lesser taxonomic or generic categories were used (i.e. Kogia sp.; unidentified small cetacean). Other standard data recorded for each sighting included:

- Date and time.
- GPS location and area description.
- Species identified.
- Estimated group size and composition – individual counts at surface, presence of newborn calves.
- Any cetacean species associations – mixed species groups.
- Distance from vessel.
- Direction of travel when first sighted.
- Occurrence of 10 behavioural categories – including feeding, resting, bow riding, aerials, avoidance and data on other behaviours observed; surface interval and dive durations whenever possible.
- Photo and video data whenever possible.
- Any natural markings.
- Sighting conditions (a 1-5 ranking of the overall visual conditions for spotting cetaceans, incorporating sea state, ambient light, rain and other weather factors).

A digital SLR camera (Canon EOS 60D) equipped with an optically stabilized telezoom lens (Canon EF 100-400mm f/4.5-5.6 L IS USM) was used to obtain the majority of high quality photo-identifications of individual animals with distinctive colourations, marks or scars. Other digital "compact cameras" were used on deck to complement the digital SLR. Photographs were used to 'mark' (and possibly 'recapture') individuals during most sightings and for the majority of cetacean species encountered. These photographic data are crucial for longer-term ecological focus research including studies on local movements/site fidelity and population/stock assessments. In addition, HD digital video cameras were used to record the diversity of cetacean species and nearby surface behaviours.

Figure 2. Documenting the cetacean species and the surface behavior during visual assessment

2.2. Acoustic cetacean assessment

During off-shore routes the visual surveys were complimented by periodical acoustic listening stations using either omni-directional or directional custom VHLF hydrophones (20Hz-20kHz) connected to a custom-made MAX – Beta amplifier equipped with multi- channel high/low pass filters. Detection range for sperm whales was estimated to be at least 8 nm in good conditions, whereas the detection range for smaller cetaceans was estimated to be 3 nm. In order to minimize any coastal interference, the acoustic assessment was usually conducted once the vessel was located 4 or more nautical miles offshore. Listening stations were conducted at least 8 nautical miles apart, depending on daily schedules and offshore conditions, to minimize acoustic overlap. Each listening station was conducted for at least 10 minutes, after which the following data was recorded:

- Date and time.
- GPS location and area description.
- Position of high and low pass audio filters.
- Any acoustic contact with cetaceans[1].
- Direction of contact (priority species only).
- Species identification (when applicable).
- Abundance estimate (when applicable).
- Listening conditions (a 1-5 ranking of the overall audio quality of listening station incorporating sea state, vessel and ambient noise).
- Any audio recording numbers.

The acoustic survey component is especially valuable to locate large cetaceans such as sperm whales, pilot whales and other deep-diving oceanic cetaceans. These animals spend the majority of time underwater, and thus while present in the surveyed area, are not often seen at the surface. However, these 'deep-divers' routinely echolocate and/or communicate underwater during foraging dives and the hydrophones are able to detect (and locate) the clicks and other vocalizations from most odontocete (toothed whales and dolphins) cetacean species. Acoustic detection of baleen whales depends on the species. Blue whales often vocalize outside our hearing range and can thus not be detected, whereas humpback whales "songs" can be readily identified. The detection range for large baleen whale vocalisations is unknown, even when using more sophisticated hydrophone arrays or acoustic data logger devices (as these sounds can be exceptionally loud and can transmit over 100's -1000's of kilometers underwater).

[1] Depending on the species heard, positive identifications can be made and abundance categories estimated from these acoustic assessments of cetacean presence in the proximity of the vessel.

Figure 3. Acoustic cetacean assessment using Hydrophones

2.3. Other REA field activities

1. Large marine life sightings (non-cetacean).

While underway, sighting details for other large (and often migratory) marine life were recorded on a separate 'non-cetacean' data sheet. This included all deck-based observations on marine turtles at sea, manta rays, whale sharks, oceanic sharks, sunfish (mola mola), all billfish and tuna sightings).

2. Marine debris.

Marine debris field such as plastic garbage concentrations along current lines where recorded. Data includes:

- Date and time
- Position
- Estimated length and depth of plastic garbage field
- Category 1-5 assigned as an estimation of threat level, based on overall area size and density of plastic pollution.

3. Shipping activity.

Throughout the REA, local and international shipping activity was recorded on a dedicated data sheet.

4. Community interviews: traditional knowledge and local wisdom on marine mammals.

Extensive community interview were conducted as part of the comprehensive SSNMP socialization strategy with over 120 coastal communities in 10 districts visited in 2011 and 2012. Within each community, stakeholder groups were interviewed. Questions on traditional knowledge, local wisdom and cultural aspects related to marine mammals were specifically included in this project (pers. comms. with Yusuf Fajariyanto).

2.4. Limits of the REA approach

Marine mammals are challenging to study and often require a long-term approach to establish a basic understanding of species diversity and distribution (monsoonal and migratory influences).

Hence, while a rapid ecological assessment such as this survey is most effective to investigate a large, virtually unknown area, it is not designed per se to address species- or habitat-specific conservation and management issues (such as the estimation of relative abundances, population sizes, and stock identities). These fine- scale parameters can best be estimated through more structured and periodic surveys, monitoring and long-term ecological research spanning decades. This is especially so for initial cetacean work in data-deficient regions like the Lesser Sunda Seascape. Another factor limiting species-specific outcomes of the Cetacean REA was the relatively short time scale of the project in relation to the area to be covered. Hence, certain key management issues were identified (i.e. regarding pollution, marine tourism, fisheries interaction and cetacean habitat overlap with oil and gas interests) but need to be further investigated during subsequent field work. The Cetacean and Seabird REA reported on here has provided a solid groundwork to undertake such future steps.

III. SURVEY RESULTS AND DISCUSSION

3.1. Visual Survey Results

The Savu Sea Cetacean REA was conducted over 16 field days from 28 September to 14 October 2013 and covered an estimated 948.6 nautical miles (nm) or 1756.8 km (Table 1, Figure 4).

Table 1. Summary of Survey Effort and Results for the Savu Sea Cetacean REA 2013

No	Activities	Number
A	**Summary of Visual Survey Effort**	
	Survey days (non-stop)	16 days
	Total area surveyed (vessel track, nm)	948.6 nm
	Total area surveyed (vessel track, km)	1756.8 km
	Daily area surveyed (median, vessel track, nm)	60.9 nm
	Daily area surveyed (median, vessel track, km)	112.7 km
	Average vessel speed (kn, SOG)	5.7 knots
	Total daylight survey hours	169.5 hrs
	Active survey hours (on-effort)	148.3 hrs
	Hrs - Oceanic	72.5 hrs
	Hrs - Coastal	65.3 hrs
	Hrs - Straits (Inter island)	10.5 hrs
	Sighting and ecological tracking hours (off-effort)	21.3 hrs
B	**Summary of Visual Survey Results**	
	Cetacean sightings (n)	39
	No. cetacean species (n)	10
	No. great whale species (n)	3
	Total individual count (n)	1595
	Average sighting condition	2.3
C	**Summary of Acoustic Survey Effort and Results**	
	Estimated area covered – sperm whales	455.3 km2
	Estimated area covered – oceanic dolphins	97.0 km2
	Listening stations	8 (100%)
	Acoustic contact - total	5 (62.5 %)
	Acoustic contact - sperm whale (bulls)	1 (12.5 %)
	Average acoustic condition	1.0

The REA route was designed to include maximum habitat diversity within the SSMNP boundaries and covered 3 main habitat zones: coastal, oceanic and straits within each of the REA's 3 sectors (Figure 5) all within the Savu Sea Marine National Park):

- Sector 1 - Flores – Sumba
- Sector 2 – Savu – Rote
- Sector 3 - N and S coasts Timor

The REA started in Labuan Bajo, Flores NTT and ended in Kupang, Timor NTT and covered large tracks of south Flores, Sumba, Sabu and Raijua, Rote and south Timor islands (Figure 4).

The survey effort on-deck included 169.5 daytime observation hours including 148.3 actively "on-effort" and a further 21.3 hours of behavioral observations of numerous species (Table 1).

Figure 4. Vessel track, daily distances and anchorages during the 2013 Cetacean REA, including daily sections.

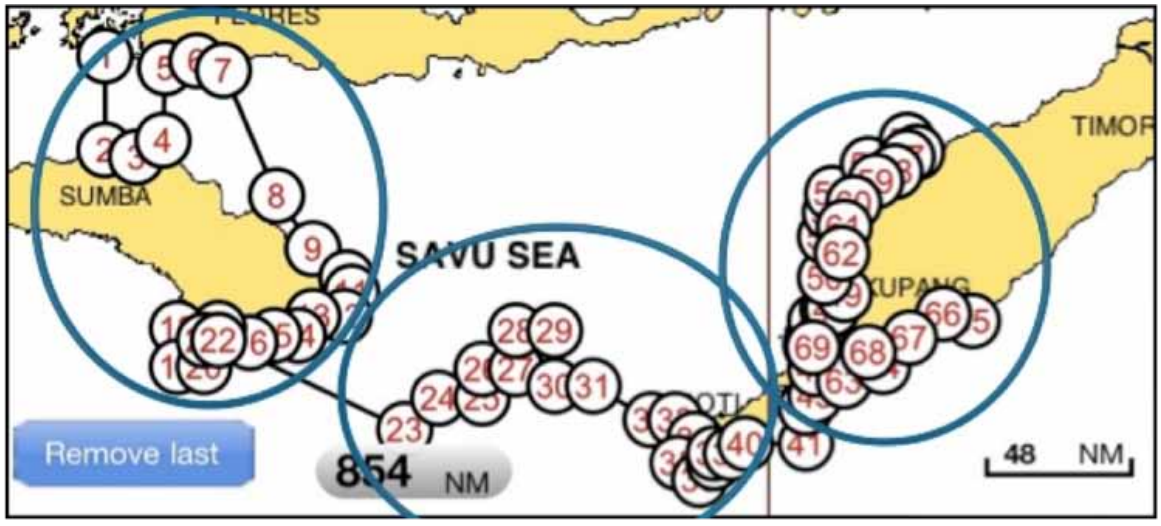


Figure 5. The REA's 3 main areas within the Savu Sea Marine National Park

Cetaceans were sighted on 14 field days. A total of 10 cetacean species were identified visually in 39 sightings. Importantly, three "Great Whale" species where sighted (blue whales, sperm whales and humpback whales - see underlined common names in Table 2. No dugongs (Dugong dugon) were observed during the survey. Species identified included toothed whales and dolphins (Suborder Odontoceti) and baleen whales (Suborder Mysticeti) and belong to 9 genera (Table 2).

Table 2. Cetacean species diversity recorded during the REA

Species number and rank	Species Identification (SI)	Indonesian SI	Scientific SI and sighting frequency	Status[2]	Legal[3]
1	Spinner dolphin	Lumba-lumba pemintal	*Stenella longirostris*; n=14	NE	Yes
2	Spotted dolphin	Lumba-lumba totol	*Stenella attenuata*; n=7	NE	Yes
3	Blue whale	Paus biru	*Balaenoptera musculus*; n=5	EN	Yes
4	Fraser's dolphin	Lumba-lumba Fraser	*Lagenodelphis hosei*; n=4	LC	Yes
5	Risso's dolphin	Lumba-lumba Risso	*Grampus griseus*; n=2	LC	Yes
6	Sperm whale	Paus sperma	*Physeter macrocephalus*; n=1	VU	Yes
7	Humpback whale	Paus bongkok	*Megaptera novaeangliae*; n=1	LC	Yes
8	False killer whale	Paul pembunuh palsu	*Pseudorca crassidens*; n=1	DD	Yes
9	Melonheaded whale	Paul kepala semangka	*Peponocephala electra*; n=1	LC	Yes
10	Common bottlenose dolphin	Lumba-lumba hidung botol	*Tursiops truncatus*; n=1	LC	Yes
11	Small unidentified cetacean		(n=1)		Yes
12	Large unidentified cetacean		(n=1)		Yes

[2] Conservation status according to the www.iucnredlist.org status (last accessed 23 Jan 2014):
NE – Not Evaluated yet; DD – Data Deficient; LC – Least Concern
NT – Near Threatened; VU – Vulnerable; EN – Endangered
CR – Critically Endangered; EW – Extinct in the Wild; EW – Extinct

[3] All marine mammals are fully protected under Indonesian national law.

To date, the marine mammal diversity of the Savu Sea includes 18 species (Kahn 2013, Appendix 1). All cetacean sighting coordinates for the REA were transcribed to a GIS format and assigned species-specific colour-coded data points (Figure 6). Cetaceans were assigned general symbols according to taxonomic classification, or occasionally, broader cetacean categories depen ding on the resolution of the field data.

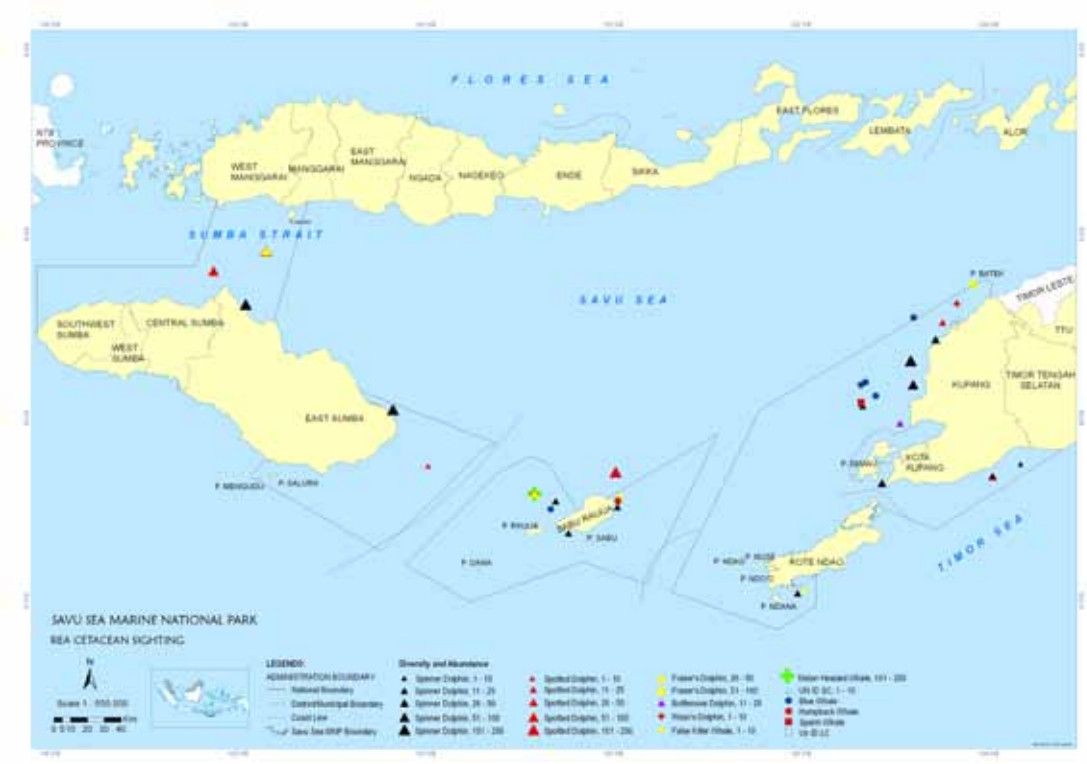


Figure 6. Whale and dolphin sighting distribution and abundance categories recorded during the Cetacean REA

An estimated total of 1595 individual cetaceans were counted during the 39 sightings (Table 1). This cetacean count is a known underestimate, as only conservative counts of individual cetaceans at *the surface at any one time* per sighting were used in the calculations. Because of the new survey routes each day and significant distances covered each day, the likelihood of 'double counts' (observing and recording the same dolphins or pods more than once) was considered negligible. The photographic identification efforts supported this assumption, as no individuals were matched between encounters, within or between survey days.

Sightings frequencies were dominated by three species: spinner and spotted dolphins, and remarkably, the blue whale (Figure 7). Over 66% of all whale and dolphin sightings consist of these 3 species:

1. Spinner dolphin (*Stenella longirostris*; 35.9%)
2. Spotted dolphin (*Stenella attenuata*; 18.0%)
3. Blue whale (*Balaenoptera musculus*; 12.8%)

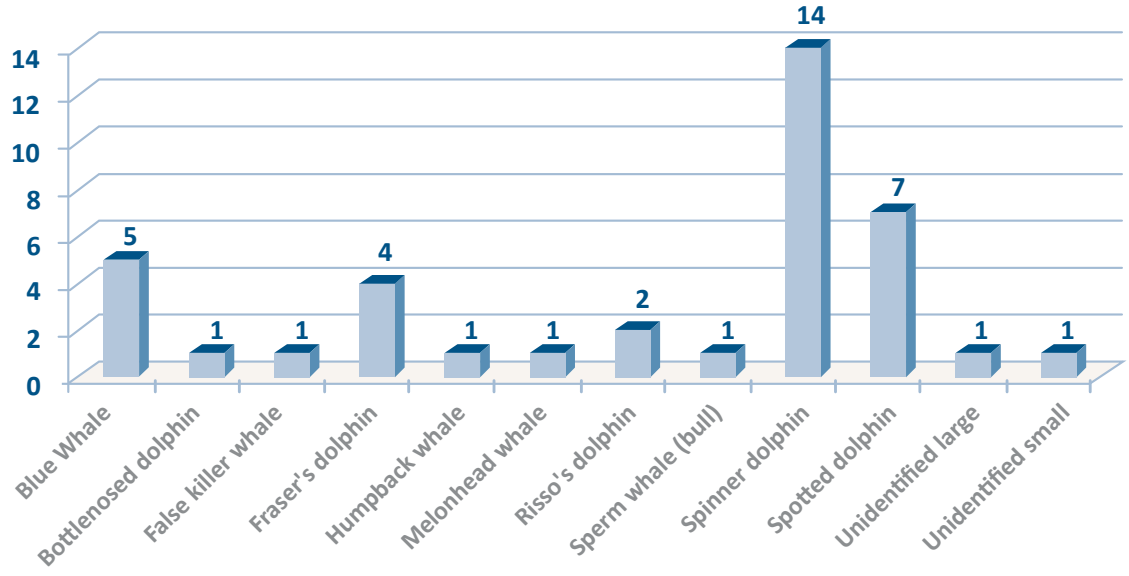


Figure 7. Sightings frequency per species (n=39) during the Cetacean REA

A different pattern is evident for total individual counts (Figure 8) – a measure of relative abundance - where over 84% of all counts are due to 3 dolphin species:

1. Spinner dolphin (*Stenella longirostris*; 39.0%)
2. Spotted dolphin (*Stenella attenuata*; 31.4%)
3. Fraser's dolphin (*Lagenodelphis hosei*; 14.4)

These differences between species-specific sightings and counts of individuals are to be expected due to the high sociality of the oceanic dolphin species. In particular members of the genus Stenella, which includes the spinner and spotted dolphins, are routinely sighted in relatively large groups. Overall, these results imply a relatively high species diversity and abundance in the SSNMP waters during the REA period.

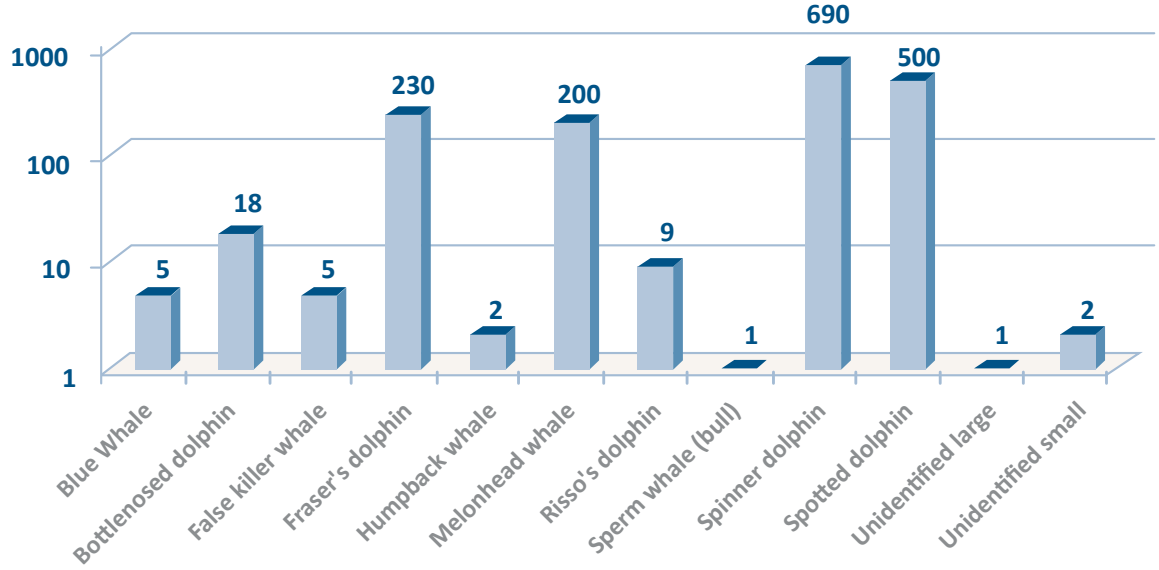


Figure 8. Individual animal counts per species (n=1595) recording during the Cetacean REA. Note logarithmic scale on Y-axis

3.1.1. Cetacean Species Associations – Multi-Species or Mixed Groups

During the REA, cetacean species associations were defined as the simultaneous observation of two or more cetacean species occurring in mixed groups or in close proximity (<10 body lengths) to one another (Kahn 2008). Overall, 5 occurrences of mixed-species groups were recorded (12.8 % of all sightings). Cetacean species associations involved interactions between spinner dolphins, common bottlenose dolphins, spotted dolphins and pilot whales.

The ecological significance and possible function(s) of cetacean species associations is still poorly understood (e.g. Mann et al. 2000).
However, such associations may be a strong indication of preferred cetacean habitat, especially if cetacean species associations in the Savu Sea

a) Remain stable and coordinated over a period of hours or days.
b) Are consistently observed in the same areas during different field sesons.

The logistical constraints of the REA did not allow for long observation times (i.e. days). Ideally, periodic dedicated surveys should be conducted to determine the duration of each association and conduct studies on (joint) habitat use.

3.1.2. The Blue Whales of the Savu Sea

Of particular interest are the sightings of blue whales during the REA. These baleen whales have been rarely encountered during other surveys in East Indonesia - including North Sulawesi and Sangihe-Talaud; Komodo, Solor-Alor, Derawan, Bali-Lombok and the Solomon Islands (Kahn 1999, 2001, 2003b, 2004, 2005, 2006, Kahn and Pet 2003)5 yet were recorded from 5 separate sightings from the Savu Islands to NW Timor. This means that blue whales are listed as the 3rd most sighted cetacean in a highly diverse area. Such relative high abundance is a strong confirmation of the Savu Seas critical role as a migratory corridor (Kahn 2005, 2008, 2011). Importantly the abundance of blue's whales in SSNMP waters provides an exciting opportunity to study and better protect one of the least known and endangered marine mammals in the Asia-Pacific region, and the largest creature that ever lived on Earth.

3.2. Acoustic Cetacean Survey Results

A total of 8 listening stations were conducted during the survey. The listening stations were limited due to the large swell (height 2-3m), which is routinely present in the southern waters of the Savu Sea with open access to the Indian Ocean. Acoustic contacts with cetaceans were analysed in situ for vocalization characteristics and assigned a particular 'acoustic cetacean category'.[6] Acoustic contact with cetaceans was recorded during 5 (62.5 %) of all the listening stations. Acoustic detection range was estimated in the field at 6.5 nautical miles (nm) for sperm whales and 3.0 nm for small odontocetes.[7] Total acoustic coverage was calculated to be 455.3 km^2 for sperm whales and 97.0 km^2 for small odontocetes respectively.

3.2.1. Savu Sea sperm whales

Sperm whales were heard on 12.5 % of all listening stations, and 20.0 % of stations with acoustic contact. Furthermore, the highly distinctive vocalizations or 'clangs' of sperm whale bulls were heard on 1 listening station. The high-pitched metallic clangs are thought to function as mating calls of sexually and socially mature sperm whale males (Weilgart 1988). These are the so-called *bulls*, which grow to 18m compared to the 10-11m females). Sperm whale bulls are highly migratory and prefer cold, high latitude waters, and only infrequently venture into tropical seas in order to breed (Rice 1989).

These limited data must be interpreted with caution. Clangs were detected together with, and mixed with regular clicks from the nursery schools – adult females and immature whales of both genders. Although the social structure of female sperm whales exhibits temporal and geographical variations (Whitehead and Kahn 1992, Kahn et al. 1993), these schools are considered relatively stable and may be residential in tropical waters (Rice 1989). Such acoustic or visual contact with sperm whale bulls in low latitudes strongly indicate that the deep waters of the Savu Sea functions as a tropical breeding ground for this species.

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[5] Regional comparisons must be viewed as preliminary as seasonal and environmental differences between survey areas and years must be taken into account. In addition, even though observers and methods are identical, several other factors are not (i.e., different vessels, average vessel speed and unexpected logistical constraints due to working in remote areas).

6 Acoustic cetacean categories include several single species which can be clearly distinguished in the field (such as sperm whales, humpback whales, orcas) to broader species assemblages (i.e. small oceanic dolphins from the Fam. Delphinidae, such as spotted, spinner and bottlenose dolphins). These species have similar vocalizations when heard in real time and may also group together (see Species associations).

7 Detection of most baleen whale and beaked whale vocalisations was not possible, as most of these sounds are not audible to the human ear in real time.

3.3. Environmental Conditions

3.3.1. Sighting Conditions

All cetacean sightings were allocated a visual condition on a 1-5 scale, ranging from perfectly calm and clear weather (1) to extremely unfavourable conditions (5).[8] In the absence of any cetacean observations for long periods, sighting conditions were recorded every 2 hours. All recorded sighting conditions were then averaged for each survey day.
The visual surveys were halted in sighting conditions greater than 4.5.

During the REA conditions varied widely and ranged from 1.0 to 4.5, which were then averaged per day. Ideal conditions (average sighting condition of 1.0-1.5) were recorded for a total of 5 survey days only (31.3%), due to the frequent windy or high swell days in the area. Mediocre conditions (2.0-3.0) were recorded for a total of 8 survey days (50.0%). Poor conditions (3.5-4.5) were recorded for a total of 3 survey days (18.8%). Hence, the majority of surveying was done in less than ideal open-ocean conditions (68.8% of survey days)[9].

This may have negatively affected the sighting rate and is also a key consideration in both survey vessel and REA Team selection.

3.3.2. Acoustic Listening Conditions

Listening stations were similarly ranked according a 1-5 scale, depending on subsurface noise from sea-state, nearby coastlines and reefs, as well as any interference from the ship and tenders. For the REA, all listening stations (100%) were either conducted in near perfect acoustic conditions of 1.0-1.5 or not conducted at all (that is, acoustic activities were cancelled on days with windy and/or swelly conditions).

3.4. Additional sightings of blue and sperm whales in eastern NTT waters in Sept-Oct 2013.

The following sightings were reported during the REA period:

- 26 September 2014. 0930. A blue whale was sighted just to the N of Selat Linta from a plane as it was coming in for landing at Labuan Bajo airport (Benjamin Kahn, APEX Environmental).
- 3 October 2014. Four sperm whales sighted, N of Flores. Three adults and one sperm whale calf (pers.comm. Johannes Hennicke, Pindito).
- 8th October 2013. Three blue whales sighted, 20 miles west of Riung heading W, 500 meters from shore. (pers. comm. Mark Heighes, The Seven Seas).
- 11 October 2013. 0700. Two blue whales sighted, E coast of Pantar towards the Pura- Pantar passage. Heading S, 500 meters from shore. (pers.comm. Mark Heighes, The Seven Seas).
- 14 October 2013. 0600. A blue whale sighted at Gili Lawa Laut, Komodo NP, surfaced several times swimming past Castle Rock (a popular dive site) then headed S, possibly into Linta Strait (pers-comm. Lida Pet-Soede, WWF Indonesia).

THE SAVU SEA CETACEAN REA WAS CONDUCTED OVER 16 FIELD DAYS FROM 28 SEPTEMBER TO 14 OCTOBER 2013 AND COVERED AN ESTIMATED 948.6 NAUTICAL MILES (NM) OR 1756.8 KM .

[8] This scale is a modified version of the Beaufort scale on windspeed and sea state. A full point gets added to the Beaufort scale if other unfavourable conditions prevail in addition to wind (such as high seas due to strong currents, heavy rainfall, low light conditions).

[9] The seaworthy vessel (even up to conditions 4) and the high position of the sighting platform ensured that the effect of these less than ideal survey conditions on detection rates was kept to a minimum. The more noticeable cues of cetacean behaviour during windy days also indicate that sighting conditions may not substantially affect sighting rates.

3.5. Cetacean Priority Areas of Savu Sea Marine National Park

There are 5 priority areas from the Savu Sea Marine National Park Cetacean REA findings that can see on the table 3.

Table 3. Priority area descriptions

Priority area nr.	Area	Description	Conservation focus
1	Nanglele Bay, SW Flores	High abundance of seabirds, productive waters, exceptionally scenic landscapes (rice terraces, rainforest mountains along the coast with white sandy beaches, Pulau Mules or Toren Isl).	Seabirds, high tourism potential, coastal productivity (baitfish)
2	Tanjung Batu Ata, E Sumba	High abundance of seabirds, multiple tern species resting on sand spits, extensive mangroves and white beaches, productive waters, exceptionally scenic landscapes incl. traditional houses and coastal villages.	Seabirds, high tourism potential
3	Sabu and Raijua Isl.	High cetacean diversity and abundance, incl. blue and humpback whales, oceanic dolphins and billfish relatively abundant, local traditional coastal communities with marine mammal usage (dugong),	Cetaceans, including blue and humpback whales, highly productive coastal waters (baitfish fishery)
4	SW Rote	High cetacean diversity, high diversity and abundance of seabirds, including foraging areas for multiple tern, booby and frigate bird species, productive waters, relatively abundant billsfish, seasnakes and seaturtles, scenic complex of coastal bays and rocky islands, white sandy beaches.	Cetaceans, seabirds, high tourism potential, coastal productivity (baitfish)
5	N Semau – SW Timor (Kupang Corridor)	Offshore area with high abundance of blue and sperm whales (incl highy migratory bulls and residential female groups), high diversity and abundance of seabirds, coastal and oceanic dolphins and scenic bays of Barate and Naiklui	Cetaceans, seabirds, high tourism potential.

IV. POTENTIAL FOR CETACEAN WATCHING IN THE INDONESIAN SEAS

Whale- and dolphin watching in the wild is a fast-growing industry with world-wide revenues of over 1.5 billion US dollars each year (Hoyt 2001). Over 90 coastal nations have benefited from the development of well-managed whale watching operations (Hoyt 2004). In Indonesia, this industry is still in its infancy. The Indonesian Seas harbour exceptional cetacean species (31+ species identified thus far and counting) and habitat diversity - ranging from rivers to mangroves to reefs to oceanic islands and habitats (upwellings, oceanic fronts, seamounts, canyons). Most of these deep-water habitats are close to shore due to the extreme depth drop-offs, which translates into relatively easy access for whale watchers. Hence, cetacean watching may become a valuable new marine tourism industry to developing archipelagic nations such as Indonesia. The NTT Province and Savu Sea in particular is well-positioned to partake in this development.

Interestingly, various case studies of similar challenging regions (like Tonga and Iceland, as well as Bali) indicate that this potential can be realised fairly quickly (< 5 years) – especially if conditions are right and the activities are regulated properly (Hoyt 2001; see also Kahn 2002b for a review on whale watch development options for Indonesia). In Bali, dolphin day trips alone are generating up to USD 2 million per year in direct revenues (2000 was the latest year included in this study, Hoyt 2001). Since then this industry has been growing rapidly and work is underway with operators to improve boat handling skills and provide better educational materials to clients for more effective interpretation and client satisfaction (i.e. identification of species at sea; on-the-spot interpretation of dolphin behaviours; Kahn 2004).

However, any whale watch development in Indonesian waters should be conducted within a strict management framework (multi-use Marine Protected Area or marine management area). Without adequate guidelines, regulations and efficient enforcement in place from the very beginning, whale watching is likely to turn into whale harassment.

4.1. Cetacean tourism potential in NTT – Savu Sea Marine National Park

Consistent sightings of cetaceans in NTT waters may provide coastal communities with a valuable opportunity to establish new eco-ventures such as responsible whale and dolphin watching. The local and provincial governments, NGOs, as well as marine tourism operators, have already expressed keen interest in developing responsible (sperm) whale watching in NTT, as part of a provincial marine tourism strategy. The Cetacean REA's outcomes to date have increased the potential for local cetacean watching, especially for sperm whales, blue whales and coastal or near-shore dolphins.

In particular,

- The Savu Islands;
- The waters off N Semau Kupang - in open waters best described as the Kupang Corridor and the
- Coastal waters off Barate, NW Timor

may hold significant potential for whale watching. The initial survey results indicate that the both the Savu Islands and Kupang Corridor function as a migratory corridor of regional significance and also includes a diverse cetacean habitat for residential species. Barate Bay included a residential spinner dolphin population that can be relatively easily located in the surrounding waters

Preliminary results from the REA suggest that these habitats are not commercially exploited and remain relatively undisturbed. These areas also provide beautiful land scenery and have protected anchorages nearby (which were rare throughout the Savu Sea REA route). Kupang, with its well-developed provincial airport is nearby and provides relatively easy access (but also potential threats – see below). Savu has a local airport with regular flights from Kupang, adding to its marine mammal tourism potential. Based on the geography, nearby infrastructure and outcomes of the Cetacean REA, responsible wild cetacean watching may be possible here, either community-based or with live-aboard vessels (i.e. sea safari/ocean wilderness expeditions in combination with surfing or cultural interests).

These initial recommendations on potential whale and dolphin watch sites in NTT waters needs to be further verified and confirmed during subsequent surveys. The Solor-Alor islands in the northern Savu Sea is another high potential area for cetacean watching.
Furthermore, large sections of the Sumba and S Flores coastlines remain to be surveyed. As more base-line data is obtained from such regions it is possible that new areas may be added to this list.

4.2. MPAs - An essential component for Responsible Cetacean Tourism in Indonesia

Importantly, these activities can be supported and managed according to best practices and integrated with the management plans for the MPA Network in the Lesser Sunda Seascape (LSS), and the Savu Sea National Marine Park in particular. Any developments in cetacean watching should be coupled with operator-endorsed codes of conduct and appropriate regulatory frameworks, including the establishment of Marine Protected Areas or MPAs (Kahn 2002ab, Kahn et al. 2001 and Kahn and Pet 2003, Hoyt 2004). Otherwise, as noted above, whale watching can easily turn into whale harassment. Numerous case studies have been published which have identified that intense whale and dolphin watching activities are a serious conservation risk for these vulnerable (and fully protected) marine species (Hoyt 2001, 2004; Lusseau 2004, Lusseau et al. 2007).

The technicalities of whale watch development are largely dependent on the site and species involved. However, it is important to note that some of the basic requirements for responsible whale watching have been met in Savu Sea and parts of the Lesser Sunda Seascape:

- There is an initial MPA-based management framework for these waters, with plans to include specific marine mammal regulations.
- The current REA has provided the initial data, guidance and specialized training tools to support any interest in whale watching.
- Strict guidelines have been proposed for responsible cetacean watching in Indonesian waters (APEX Environmental 2001) during the training workshops. These guidelines for Indonesia have been endorsed by an increasing number of government agencies, NGOs and adopted by marine tourism industry associations and individual operators.

The development of such a marine tourism industry will be hard to reconcile with any large-scale industrial resource extraction such as mining and forestry, or substantially

expanded commercial fisheries. These industries would all impact negatively on marine
mammal habitat and deplete the natural attributes and 'wilderness values' on which marine mammal tourism depends. It is telling that at most, if not all, highly successful and responsible cetacean watch areas worldwide, benign research and monitoring of living whales and dolphins have been incorporated as an essential part of industry management (Hoyt 2001, 2004). Outcomes of these programs are vital to:

1. Establish a legal framework to manage cetacean tourism in the area of interest. To have commercial viability such areas must have highly consistent sightings (year- round or seasonal) and thus are important cetacean habitats. Multi-purpose MPAs are one tool to achieve such a legal framework, as are dedicated Marine Mammal Management Areas (M3As, see Kahn 2002b for a national approach).
2. Help evaluate the potential impacts of increasing tourism activities targeting cetaceans.
3. Assess sustainability based on precautionary principle
4. Adopt a proactive management approach regarding 'entry to market' requirements– initially to set limits on total number allowed and maximum capacity of vessels working in the target area/season.
5. Develop voluntary guidelines, permit system and regulations in collaboration with industry and government.
6. Ensure compliance with points 4-5 and implement enforcement whenever called for (often at the request of industry operators to manage issues such as crowding or boat handling).
7. Monitor compliance by operators and fine-tune regulations to reflect (evolving) best practices which are grounded in marine mammal science.

4.3. What can cetaceans do for MPAs (and MPA networks)?

MPAs themselves can benefit from incorporating marine mammals in their management plans as well. For example, as high-profile 'flag-ship' species Savu Sea's whales and dolphins can assist in site promotions, regional marketing and branding, and may add significant value to MPA sustainable financing in Indonesia through any user-pays visitation schemes (see Hoyt 2004 and Kahn 2002b for more details). Other benefits are:

1. Broaden the marine conservation perspective for local and large-scale initiatives (MPA design and planning incl. site selections, MPA boundary considerations.
2. Broaden the management scope for Marine Spatial Planning (MSP) and Integrated Ocean Management (IOM) and Ecosystem-Based Management (EBM) approaches.
3. Increase the knowledge of marine bio-diversity (including in deep sea habitats - prey items) and ecological significance of the area.
4. Assist in efforts to establish expanded MPA boundaries through additional offshore buffer zones - protective measures designed to benefit migration corridors and deep-sea habitats.
5. Improved MPA media 'exposure' and profile raising, using cetacean encounters for divers and other visitors
   - Area promotion.
   - Enhanced visitor satisfaction.
6. Increased potential for marine tourism, visitation (and thus boost any park user fees).
7. Focus on long-lived species vulnerabilities for current and emerging threats that may not be a priority for other species groups – i.e. acoustic habitat degradation and chemical pollution and bio-accumulation of toxins.
8. Capacity building opportunities.
9. Outcomes for marine mammals are also beneficial for a myriad of other ocean wanderers.
10. As high-profile species, marine mammals can assist with outreach programs to local communities and the public on the need for marine conservation in general.

4.4. Responsible well-regulated cetacean tourism – what next?

The Cetacean REA has increased the potential for responsible wild cetacean watching in the Savu Sea National Marine Park. However, no dedicated work has been conducted yet to properly guide the development of such marine mammal tourism ventures in any of Indonesian MPAs, let alone in NTT waters. From this socio-economic perspective, it would be useful to conduct a feasibility study which evaluates:

- The ecological significance of NTT waters for the 22 cetacean species
- The habitat use for species of interest in priority areas with consistent sightings.
- The basic infrastructure requirements for establishing such a venture.
- The interest of current marine operators in promoting marine mammal tourism.

In particular, an assessment of the role cetaceans can play in regional eco-tourism[10] development and economic diversification in remote regions of NTT is an important follow- up recommendation.

[10] Eco-tourism is broadly defined here as: responsible nature-based tourism which causes minimal environmental impacts, as guided and/or regulated by best industry practices which are periodically reviewed.

It is a noteworthy trend that increased protective measures for cetaceans have often 'kick started' or accelerated the development of a whale and/or dolphin watching industry in new locales and nations. Hence the newly declared MPA in NTT may provide a good opportunity to start on such feasibility studies for responsible cetacean tourism, in conjunction with socialisation of the REA's outcomes and recommendations.

4.5. Cetacean tourism - Engage the marine tourism community

NTT's and Savu Sea's increasing popularity for divers means that the majority of Indonesia's live-aboard dive boats now spend several months per year in the area, although mostly in Komodo NP and Solor-Alor in the northern waters of the Savu Sea. Land-based dive and surf resorts are also steadily increasing in number and quality. This presents a clear opportunity to engage the dive fleet and resorts as volunteer observers during their voyages to the various far-flung dive sites.

Whale and dolphin encounters are consistently ranked as the highlight of dive holidays in diver magazine surveys and questionnaires. To make the most of even opportunistic encounters with cetaceans will make a big impression on dive clientele – and substantially increase overall satisfaction of a dive trip. Many people from leading dive / resort operations have expressed an interest in keeping records on whales, dolphins and dugong. But in reality, well-willing and motivated observers often lack the know-how to recognize different species at sea.

Awareness and practical knowledge on behaviour are also often lacking (e.g. which species are deep-divers that may be under the surface for long periods, and thus may not be worth waiting for). Boat handling skills to approach marine mammals with minimal disturbance are often not known or can be improved upon through training and awareness.

When combined properly, these skills will increase the chances of operators to approach with minimal disturbance and show their clients natural, wild behaviours of these spectacular animals. Quality interpretation of what these whales and/or dolphins are doing around the vessel, will increase client satisfaction of such an experience.

While this optimal scenario will take some effort to achieve, it should be noted that marine tourists are well traveled and often expect a duty of care around wildlife. Often they have taken organized whale tours before and are familiar with codes of conduct. Any brazen approach to marine mammals will often be frowned upon, and there are incidences when tourists have been horrified with the aggressive style of whale and dolphin watching in Indonesian waters – and told others and occasionally dive magazines of their bad experiences.

From a cetacean management perspective, periodic support and follow-up training activities for the dive industry are crucial to obtain high quality data as part of a broader Savu Sea Cetacean Program. Over the years, such a volunteer component to the program will be invaluable to obtain initial sighting data for this vast and largely unexplored region of Indonesia and will assist in the identification of seasonal trends in diversity, abundance, distribution and habitat use of NTT's whales, dolphins and dugongs.

FROM A CETACEAN MANAGEMENT PERSPECTIVE, PERIODIC SUPPORT AND FOLLOW-UP TRAINING ACTIVITIES FOR THE DIVE INDUSTRY ARE CRUCIAL TO OBTAIN HIGH QUALITY DATA AS PART OF A BROADER SAVU SEA CETACEAN PROGRAM.

V. THREATS TO SAVU SEA MARINE MAMMALS - OVERVIEW

Cetaceans in the Asia-Pacific are thought to be vulnerable to the region's ever-increasing coastal and marine resource usage (IUCN 2003). To date, the waters of the remote Savu Sea provide an opportunity to observe cetaceans in a relatively undisturbed environment.

However, in many of the NTT islands there is a rapid increase in coastal development include large-scale industrial activity such as coastal mining and ports, as well as forestry, fisheries, shipping and offshore exploration for oil and gas.

Residential whale and dolphin populations, as well as migratory species which include the NTT corridors passages in their long-range movements, may be increasingly vulnerable to numerous regional and local environmental impacts such as habitat destruction, subsurface noise disturbances, net entanglement, marine pollution and over-fishing of marine resources (Hofman 1995, Fair and Becker 2000, Gordon and Moscrop 1998, Simmonds et al. 2003, Reeves et al. 2003, Hoyt 2004). At least some of these impacts on cetaceans are known to occur in NTT waters.

The major threats to marine mammals in the Savu Sea thus far identified by the Cetacean REA are:

Habitat degradation - overview

- Kupang, Kalabahi, Ende, Labuan Bajo and other major Savu Sea cities - urban, industrial and liquid wastes are dumped at sea
- Impacts of deforestation on coastal cetacean habitats
- Underwater noise pollution (acoustic habitat degradation) from
  - seismic oil and gas exploration and production
  - military/navy activities involving extremely loud sonar for submarine warfare exercises
  - shipping
  - destructive fishing practices such as reef blasting
- Shipping – discarded bilge and wastes, direct whale-ship strikes especially due to the increasing international and regional traffic passing through confined inter-island sea lanes, which also function as migratory corridors for large marine life).
- More details given below.

Pollution

- The rapidly increasing waste disposal in and around Kupang Bay and other Savu Sea cities is of major concern (see Figure 11). For marine mammals the threats are significant and often fatal:
  - Long-term chemical loading; Bio-accumulation and magnification of man-made toxins
  - Ingestion of plastics and subsequent stomach blockage and starvation
  - Entanglement in discarded nets and/or debris
  - Fisheries – these potential threats need to be further quantified.
- Net entanglement in discarded or lost nets (drift, gill and ghost fishing)
- Reef bombing or blasting
  - Direct impacts
  - Pressure wave causes bodily damage to internal organs and hearing (likely to be fatal)

- Indirect impacts
- Acoustic habitat degradation
- Local exclusion and displacement of marine mammals from original habitats
- Acoustic closure of migratory corridors with frequent bombing practices in the area.

➤ Accidental catch (especially for gill and drift nets; some long-lines). By- catch of marine mammals is likely to occur in most types of fisheries: coastal and pelagic; commercial and artisanal

➤ Targeted catch
- In some areas cetaceans are caught for their meat, which is then used as bait for shark long-line fisheries.
- Dugong fishery or meat and ornaments – tusks as ornaments such as cigarette holders; bones for medicinal use.

➤ Resource depletion
- Overfishing of prey items, especially overharvesting of local fish (incl. bait fish) and squid stocks.

Shipping

➤ Direct strikes / collisions with large whales
- Increasing commercial ship traffic passes through narrow sea lanes which also function as migratory corridors of regional conservation importance
- In other areas where shipping overlaps with cetacean and dugong habitats

➤ Discarded wastes; solid and liquid waters dumped along sea lanes and in ports

➤ Noise pollution – Masking of environmental cues in heavy traffic areas.
- Local trade and industry support vessels
- Engines can have excessive noise levels underwater when poorly maintained.

Oil and gas industry

➤ Project development in Indonesia is routinely without any marine mammal component in the project's legally required Environmental Impact Assessment (AMDAL). As such the most basic environmental industry standards and 'best practices' for all phases of these projects are often not required by law – this is especially lacking for the marine environment. For marine mammals, in most Indonesian projects no standard mitigation measures relating to high impact activities are considered; such as exploratory seismic surveys or pile driving (David 2006). There are numerous 'ready-to-implement' mitigation measures which can be used as *minimal* requirements (Kahn et al 2006, Kahn 2008):
  i. Standardized and practical mitigation options for marine- based activities are legally required for oil and gas activities in many coastal nations
  ii. Voluntary industry-based 'best practices" and "operational guidelines" for environmental 'duty of care" are often adopted as worldwide policy by the major industry stakeholders

➤ Underwater noise generators include activities such as
- Exploratory seismic surveys (air-gun arrays)

- Pile driving for jetty's and offshore platforms (i.e. use of noise blocking "bubble nets" are regarded as best practice in many situations)
- Increased noise in local area stemming from project support including supply vessels
- Potential for major increases in pollution through urbanization (increased work force) and industrial processes

➤ Construction phase of infrastructure near shore and offshore facilities (i.e. use of silt nets are regarded as best practice in many situations)

➤ Operation phase – often for a period of decades. Thus small incremental changes over time may cause a significant impact on long-lived marine mammals. Fixed maintenance includes seismic surveys, pipe inspections and offshore repairs.

➤ Decommissioning and rehabilitation of the site

Kahn (2008) provided a comprehensive review of global best practices and lists key requirements for the activities in sensitive marine areas such as the Indonesian Seas.

Marine mammal tourism

➤ Whale and dolphin watching can easily turn into harassment Marine mammal tourism may become a significant disturbance to residential populations if developed without adequate regulation and compliance in place beforehand (see Section IV of this report).

5.1. Pollution of NTT waters – "The silent killer"

5.1.1. Improve municipal waste management

Pollution is regarded as the 'Achilles heel' for many cetacean species. Solid and liquid waste disposal at sea is a major threat to cetaceans worldwide and NTT waters are no exception. Although still relatively pristine; increased industrial activities, shipping and the growth of Kupang and other local cities (Kalabahi, Larantuka, Maumere, Ende, Labuan Bajo, Waingapu) have generated record levels of waste. These fairly recent developments have strained the municipal waste management system well beyond capacity, and all too often these wastes end up in the sea. For marine mammals these effects of chemical and plastic pollution can be deadly, yet are often incremental over long time periods, or hard to detect. Hence they are called the 'silent killers'. This includes bio-accumulation of toxins in internal organs, ingestion of plastics leading to stomach blockages and a suite of other ailments.

A proper assessment of the waste management situation in Kupang is urgently needed. However, it seems obvious from the limited observations during the REA that a large portion of these discarded wastes will eventually make their way into open waters – to be flushed away with the tides or at the onset of the rainy season. The only two observation of plastic debris along the REA track field were recorded in Kupang Bay. Liquid waste from residential and industrial sources is less visible but an equally challenging problem for municipal waste management. Throughout coastal cities in Indonesia this is a recurrent problem and often it is a major challenge to mobilize and motivate local decision makers to act. The survey's results and recommendations to safeguard NTTs whales and dolphins from pollution could help to spearhead any improved waste management program in Kupang and other Savu Sea cities.

SOLID AND LIQUID WASTE DISPOSAL AT SEA IS A MAJOR THREAT TO CETACEANS WORLDWIDE AND NTT WATERS ARE NO EXCEPTION. ALTHOUGH STILL RELATIVELY PRISTINE; INCREASED INDUSTRIAL ACTIVITIES, SHIPPING AND THE GROWTH OF KUPANG AND OTHER LOCAL CITIES (KALABAHI, LARANTUKA, MAUMERE, ENDE, LABUAN BAJO, WAINGAPU) HAVE GENERATED RECORD LEVELS OF WASTE.

VI. CONCLUSION

In addition to the significant bio-diversity and ecological results on whales, dolphins and the dugong, the Cetacean Rapid Ecological Assessment has provided a solid basis for a comprehensive long-term program on marine mammal conservation in this remote yet important marine region of eastern Indonesia.

In addition, the REA has provided substantial support for the establishment of the Savu Sea Marine National Park and supplied information that was useful for its zonation and management plans. The potential for economic opportunities such as responsible whale watching has increased substantially due to the REA's outcomes. Several local threats to Savu Sea marine mammals have been identified.

Importantly, the REA has increased awareness and active participation amongst key government and non-government stakeholders through its workshops and training activities, promoted the establishment of long-term cetacean survey and research programs, and improved the skills of local environmental staff through intensive field- training. Additional capacity building will be vital for any marine mammal projects in the future. Overall, the current Cetacean REA provides a solid foundation to build upon towards the integration of their preferred habitats in the Marine Protected Area Networks of the Lesser Sunda Seascape.

OVERALL, THE CURRENT CETACEAN REA PROVIDES A SOLID FOUNDATION TO BUILD UPON TOWARDS THE INTEGRATION OF THEIR PREFERRED HABITATS IN THE MARINE PROTECTED AREA NETWORKS OF THE LESSER SUNDA SEASCAPE.

VII. REFERENCES

Agardy, T.S. 1997. Marine protected areas and ocean conservation. Academic Press Limited, London UK. 244pp.

APEX Environmental. 2001. Watching wild whales and dolphins with minimal disturbance in Indonesian waters. Indonesia Oceanic Cetacean Program - Information Sheet No.5. 2pp.

Aragones, L., Lawler, I., Foley, W. and H. Marsh. 2006. Dugong grazing and turtle cropping: grazing optimization in tropical seagrass systems? Oecologia 149:635–647.

Bannister, J. L, Kemper, C.M. and R. M Warneke. 1996. The Action Plan for Australian Cetaceans. Australian Nature Conservation Agency, Canberra, Australia.

BP. 2005. Summary Environmental Impact Assessment. Tangguh LNG Project in Indonesia.

BP. 2002. Tangguh LNG Volume 1: Executive Summary – Integrated ANDAL activities gas exploitation, gas transmission, LNG plant, sea port, airfield and resettlement Tangguh LNG Project Manokwari, Rorong and Fak-Fak Regencies, Papua Province, Indonesia.

Beasley, I., Robertson, K. and P. Arnold. 2005. Description of a new dolphin, the Australian Snubfin Dolphin Orcaella Heinsohni sp. n. (Cetacea, Delphinidae). Marine Mammal Science: Vol. 21, No. 3, pp. 365-400.

Browman, H. I. and K. I. Stergiou (eds). 2004. Perspectives on ecosystem-based approaches to the management of marine resources. Marine Ecology Progress Series 274:269–303.

Corkeron, P. Opposing Views of the "Ecosystem Approach" to fisheries management. Conservation Biology. Volume 20, No. 3, June 2006

Corkeron, P.J., Morissette, N.M., Porter, L.J. and H. Marsh. 1997. Distribution and status of hump- backed dolphins, Sousa chinensis, in Australian waters. Asian Marine Biology 14: 49–59.

Culik, B. 2004. Review of small cetaceans. Distribution, Behaviour Migration and Threats. Published by the United Nations Environment Program and Convention of Migratory Species of Wild Animals (UNEP/CMS) Secretariat, Bonn, Germany. 343 p.

David, J.A. 2006. Likely sensitivity of bottlenose dolphins to pile-driving noise. Water and Environment Journal Vol. 20 (1): 48.

Etnoyer, P., Canny, D., Mate, B. and L. Morgan. 2004. Persistent Pelagic Habitats in the Baja California to Bering Sea (B2B) Ecoregion. Oceanography. Vol. 17(1)

Fair, P.A. and P.R. Becker. 2000. Review of stress in marine mammals. Journal of Aquatic Ecosystem Stress and Recovery 7: 335-354.

Fortes, M., Djohani, R. and B. Kahn (eds). 2003. Introducing the Regional Action Plan (RAP) to Strengthen a Resilient Network of Effective Marine Protected Areas in Southeast Asia 2002- 2012: Technical Background and RAP Description. Final Report to the IUCN World Commission for Protected Areas (WCPA), Gland, Switzerland. 128pp.

Gordon, J. and A. Moscrop. 1998. Underwater noise pollution and its significance for whales and dolphins. In: The conservation of whales and dolphins: Science and practice. By M. Simmonds and J. Hutchington (eds). Wiley and Sons. England. pp 281-320.

Heinsohn, R., Lacy, Lindenmayer, D., Marsh, H., Kwan, D. and I. Lawler. 2004. Unsustainable harvest of dugongs in Torres Strait and Cape York (Australia) waters: two case studies using population viability analysis. Animal Conservation, 7: 417-425.

Hodgson, A.J. and H. Marsh. 2006 Response of dugongs to boat traffic: The risk of disturbance and displacement. Journal of Experimental Marine Biology and Ecology. Volume 340, Issue 1, 2. 60-61.

Hofman. R.J. 1995. The changing focus of marine mammal conservation. Trends. Ecol. & Evol. Vol.10. No. 11: 462-465.

Hoyt, E. 2001. Whale Watching 2001: Worldwide Tourism Numbers, Expenditures, and Expanding Socioeconomic Benefits. The International Fund for Animal Welfare (IFAW). 175pp.
Available at www.ifaw.org.

Hoyt, Erich. 2004. Marine Protected Areas for Whales, Dolphins and Porpoises: A World Handbook for Cetacean Habitat Conservation. Whale and Dolphin Conservation Society and Earthscan Publishers. London, UK. 512 pp, including bibliographical references and index. ISBN: 1844070638 (hardback) and 1844070646.

Hyrenbach, D.K.,Forney, K. and P. Dayton, 2000: Marine Protected Areas and Ocean Basin Management. Aquatic Conser : Mar. Freshw. Ecosyst. (10) 437-458.

IUCN. 2004. The 2004 IUCN Red List of Threatened Species. Available at www.redlist.org. IUCN. 2007. The IUCN Red List of Threatened Species. www.iucnredlist.org. Accessed on 20 September 2007.

Kahn, B. In prep. Cetaceans, corridors, canyons and seamounts: The near-shore yet deep water habitats of the tropical archipelagic waters of Indonesia, Papau New Guinea and the Solomon Islands.

Kahn, B. 2006. Oceanic Cetaceans and Associated Habitats in the Western Solomon Islands. In: Green, A., P. Lokani, W. Atu, P. Ramohia, P. Thomas and J. Almany (eds.) 2006. Solomon Islands Marine Assessment: Technical Report of Marine Survey - May 13 to June 17, 2004. The Nature Conservancy - Pacific Island Countries Report No. 1/06. pp 445-515.
http://conserveonline.org/workspaces/pacific.island.countries.publications/SIMAReport

Kahn, B. 2005. Indonesia Oceanic Cetacean Program Activity Report - January – February 2005: The rapid ecological assessment (REA) of oceanic cetaceans and associated habitats in the Bali-Lombok Strait region; Capacity building workshop: 'Indonesia's Whales and Dolphins - A Tourism Perspective'; Indonesian Marine Protected Areas (MPA) and cetaceans – the Solor Alor MPA development. 21pp.

Kahn, B. 2004. Indonesia Oceanic Cetacean Program Activity Report October-December 2003: Solor-Alor Visual and Acoustic Cetacean Survey and Applied Ecological Research;
Indonesia Marine Mammal Management Area (IM3A) and Solor-Alor Marine Protected Area Development. APEX Environmental/TNC Indonesia Program Technical Report. 29pp.

Kahn, B. 2003a. The Indo-Pacific Marine Corridors of Eastern Indonesia: Ecological Significance for Oceanic Cetaceans and other Large Migratory Marine Life and Implications for MPA networks in Southeast Asia. Proceedings of the Vth World Parks Congress (WPC). WPC Marine Stream workshop 'Scaling Up to Build MPA Networks: Benefits for Fisheries and Endangered Species'. Durban, South Africa, 8-17 September 2003.

Kahn, B. 2003b. Derawan Archipelago Rapid Ecological Assessment - Visual and Acoustic Cetacean Survey and Training Program. Technical Report - AE0301. The Nature Conservancy - East Kalimantan Marine Program. 34pp.

Kahn, B. 2002a. Discussion paper on the establishment of a Protected Marine Mammal Fisheries Area in Indonesia's national and EEZ waters. APEX Environmental/TNC Indonesia Program Technical Report prepared for the Government of the Republic of Indonesia - the Ministry of Marine Affairs and Fisheries. 55pp.

Kahn, B. 2002b. Indonesia's migratory corridors for large marine life: Scientific and management perspectives. In: Proceedings of the 1st Regional Session of the Global Biodiversity Forum for the Pacific (GBF): 'Global Forces and their Impacts on the Pacific's Biodiversity: Towards Local and Regional Response Strategies. Rarotonga, Cook Islands July 5-8, July 2002.

Kahn, B. 2001. Rapid ecological assessment in the Sangihe-Talaud Archipelago, North Sulawesi, Indonesia: Visual and acoustic cetacean survey component. Technical Report - TNC Coastal and Marine Program/Indonesia. 16pp. Kahn, B. 1999. Oceanic cetacean surveys and sperm whale (Physeter macrocephalus) research of Northern Sulawesi, Indonesia. In: Proceedings of the 13th Biennial Conference on the Biology of Marine Mammals, Hawaii Nov.28 - Dec. 3 1999. 226pp.

Kahn, B. 1999. Oceanic cetacean surveys and sperm whale (Physeter macrocephalus) research of Northern Sulawesi, Indonesia. In: Proceedings of the 13th Biennial Conference on the Biology of Marine Mammals, Hawaii Nov.28 - Dec. 3 1999. 226p.

Kahn, B., Gearheart, G. and Ricardo Tapilatu. 2006. Bintuni-Berau Bay Rapid Ecological Assessment (REA) for Marine Mammals and Marine Reptiles: Initial evaluation of risk mitigation measures for Tangguh LNG Project, Papua Indonesia. Technical Report AE- BP0601. 124pp.

Kahn, B. and J. Pet. 2003. Long-term visual and acoustic cetacean surveys in Komodo National Park, Indonesia 1999-2001: Management implications for large migratory marine life. In: Proceedings and publications of the World Congress on Aquatic Protected Areas 2002. Australian Society for Fish Biology. 28pp.

Kahn, B., James-Kahn, Y. and J. Pet. 2000. Komodo National Park cetacean surveys - A rapid ecological assessment of cetacean diversity, distribution and abundance. Indonesian Journal of Coastal and Marine Resources 3(2). 41-59.

Kahn, B. Whitehead, H. and M. Dillon. 1993. Indications of density-dependent effects from comparisons of sperm whale populations. Marine Ecology Progress Series 93, 1-7.

Kanda, N., Goto, M., Kato, H., McPhee M., and L. Pastene. 2007. Population genetic structure of Bryde's whales (Balaenoptera brydei) at the inter-oceanic and trans-equatorial levels. Conservation Genetics 8, 853–864.

Ketten, D. 1998. Marine mammal auditory systems: a summary of audiometric and anatomical data and its implications for underwater acoustic impacts. NOAA-TM-NMFS-SWFSC-256. 74p.

LeDuc, R.G., Perrin, W.F. and Dizon, A.E. 1999. Phylogenetic relationships among the delphinid cetaceans based on full cytochrome b sequences. Marine Mammal Science 15, 619-48.

Lehodey, P. 2001. The pelagic ecosystem in the tropical Pacific Ocean: dynamic spatial modelling and biological consequences of ENSO. Progress in Oceanography 49: 439-468.

Lusseau, D. 2004. The hidden cost of tourism: Detecting long-term effects of tourism using behavioral information. Ecology and Society 9(1)2.

Lusseau, D., L. Slooten and R. Currey. 2007. Unsustainable dolphin-watching tourism in Fiordland, New Zealand. Tourism in Marine Environments, Vol. 3, No. 2, pp. 173–178.

Malakoff, D. 2004. New tools reveal treasures at ocean hot spots. Science 304: 1104-1105.

Mann, J. Connor, R.C., Tyack, P.L. and H. Whitehead. 2000. Cetacean societies - Field studies of dolphin and whales. 433pp.

Marsh, H., C. Eros, H. Penrose and J. Hugues. 2001. The dugong (Dugong dugon) status reports and action plans for countries and territories in its range. IUCN, Gland Switzerland. 160pp.

Norman, M.D, Hochberg, F.G. and C.C. Lu. 1997. Mollusca Cephalopoda: Mid-depth octopuses (200-100m) of the Banda and Arafura Seas (Octopodidae and Alloposidae). In: A. Crosnier and P. Bouchet (eds). Resultats des Campagnes Murorstom, Vol.17. Mem. Mus. Natn. Hist. Nat 172: 357-383. Paris ISBN: 2-85653-506-2

Norman, M. and A. Reid. 2000. A Guide to squid, cuttlefish and octopuses of Australasia. CSIRO Publishing Australia. 96pp.

Nowacek, D., Thorne*, L., Johnston, D. and P.Tyack. 2007. Responses of cetaceans to anthropogenic noise. Mammal Rev. Vol. 37(2) 81–115.O'Shea, S. 2004. The giant octopus Haliphron atlanticus. New Zealand Journal of Zoology. Vol. 31: 7–13.

Palacios, D., Bograd, S., Foley, D. and F. Schwing. 2006. Oceanographic characteristics of biological hot spots in the North Pacific: A remote sensing perspective. Deep-Sea Research II 53: 250–269.

Parra, G., Corkeron, P. and H. Marsh. 2006. Population sizes, site fidelity and residence patterns of Australian snubfin and Indo-Pacific humpback dolphins: Implications for conservation.
Biological Conservation 129: 167-180.

Pauly, D., R.Watson, and J. Alder. 2005. Global trends in world fisheries: impacts on marine ecosystems and food security. Phil. Trans. Roy. Soc. London 360:5–12.

Perrin, W.F, Reeves, R.R, Dolar, M.L.L, Jefferson, T.A, H. Marsh, Wang, J.Y and J. Estacion. 2002. Report of the 2nd Workshop on the biology and conservation of small cetaceans and dugong
of South-east Asia. CMS Technical Series Publication No. 9. published by UNEP/CMS Secretariat, Germany.

PHPA. 1984. Marine Conservation Data Atlas. Dit. Jen. PHPA Dep. Kehutanan. Jakarta, Indonesia.

Polovina, J.J., Howell, E., Kobayashi, D.R., and M. Seki. 2001. The transition zone chlorophyll front, a dynamic global feature defining migration and forage habitat for marine resources. Progress in Oceanography (49) 469–483.

Reeves, R.R., Smith, B.D., Crespo, E.A. and di Sciara, G.N. (compilers). 2003. Dolphins, Whales and Porpoises: 2002-2010 Conservation Action Plan for the World's Cetaceans. IUCN/SSC Cetacean Specialist Group. IUCN, Gland, Switzerland and Cambridge, UK.

Rendell, L., Whitehead, H. and R. Escribano. 2004. Sperm whale habitat use and foraging success off northern Chile: evidence of ecological links between coastal and pelagic systems. Mar.
Ecol. Prog. Ser. Vol. 275: 289–295.

Rice, D. 1998. Indo-Pacific humpback dolphin Sousa chinensis. In handbook of marine mammals, Ed. S.H. Ridgeway and R Harrison. London, Academic Press.

Rudolph, P., C. Smeenk and S. Leatherwood. 1997. Preliminary checklist of cetacea in the Indonesian Archipelago and adjacent waters. Zoologische Verhandelingen 312: 1-48.

Satria, A. and Y. Matsuda. 2004. Decentralization of fisheries management in Indonesia. Marine Policy 28(5):437-450.

Simmonds, M., Dolman, S. and L. Weilgart (Eds). 2003. Oceans of noise - A Whale and Dolphin Conservation Society Science Report. WDCS, Chippenham, Wiltshire, UK.

Simmonds , MP and Hutchinson, JD (eds). 1996. The Conservation of Whales and Dolphins: Science and Practice.J. Wiley and Sons, Chichester (UK).

Tomascik, T., Mah, A.J., Nontji, A. and M.K. Moosa. 1997. The Ecology of the Indonesian Seas (Part 1). Periplus Publishers, Singapore. 642 pp.

Tynan, T., Ainley, D., Barth, J., Cowles, T., Pierce, S. and L. Spear. 2005. Cetacean distributions relative to ocean processes in the northern California Current System. Deep-Sea Research II 52: (2005) 145–167.

Van Parijs S.M., and P.J. Corkeron. 2001. Boat traffic affects the acoustic behaviour of Pacific humpback dolphins, Sousa chinensis. Journal of the Marine Biological Association of the United Kingdom 81 (3): 533-538.

Weilgart, L. 1988. Distinctive vocalizations from mature sperm whales (Physeter macrocephalus). Can . J. Zool. 66: 1931-37.

Whitehead, H. and B. Kahn. 1992. Temporal and geographical variation in the social structure of female sperm whale. Can. J. Zool. 70: 2145-49.

Wolanski E. and W.H. Hamner. 1988. Topographically controlled fronts in the ocean and their biological importance. Science (241) 177-181

Worm B., H. Lotze, and R. Myers, 2003: Predator diversity hotspots in the blue ocean. In: Proc..Nat.Acad.Sci. ences. The National Academy of Science, Washington, D.C.

Worm, B., Sandow, M., Oschlies, A., Lotze, H.K. and R. Myers. 2005. Global patterns of predator diversity in the open oceans. Science 309, 1365–1369.

Yen, P.W., Sydeman, W.J., Hyrenbach, K.D., 2004. Marine bird and cetacean associations with bathymetric habitats and shallow-water topographies: implications for trophic transfer and conservation. Journal of Marine Systems (50) 79–99.

Zhou, K., Xu,X. and C.Tian. 2007. Distribution and abundance of Indo-Pacific humpback dolphins in Leizhou Bay, China. New Zealand Journal of Zoology, 2007, Vol. (34) 35-42

VIII. APPENDICES

Appendix 1: Marine mammal species positively identified in the Lesser Sunda Ecoregion[11]

Species Identification (ID)	Scientific ID	Status [1]	Indonesian ID	Flores ID [2]
Cetacea: Toothed whales and dolphins				
1. Sperm whale	*Physeter macrocephalus*	VU	Paus sperma	Kote kelema
2. Dwarf sperm whale	*Kogia sima*	DD	Paus sperma cebol	Fefa kumu
3. Pygmy sperm whale	*Kogia breviceps*	DD	Paus sperma kerdil	n/a
4. Short-finned pilot whale	*Globicephala macrorhynchus*	NE	Paus pemandu sirip pendek	Temu bélã
5. Orca (Killer whale)	*Orcinus orca*	DD	Paus pembunuh	Seguni
6. False killer whale	*Pseudorca crassidens*	DD	Paus pembunuh palsu	Temu blã
7. Pygmy killer whale	*Feresa attenuata*	NE	Paus pembunuh kerdil	Temu kebung
8. Melon-headed whale	*Peponocephala electra*	LC	Paus kepala semngka	Temu kebong
9. Risso's dolphin	*Grampus griseus*	LC	Lumba-lumba abu-abu	Temu bura
10. Fraser's dolphin	*Lagenodelphis hosei*	LC	Lumba-lumba Fraser	Temu notong
11. Spinner dolphin	*Stenella longirostris*	NE	Lumba-lumba paruh panjang	Temu kirã
12. Pan-tropical spotted dolphin	Stenella attenuata	NE	Lumba-lumba totol	Temu kirã
13. Rough-toothed dolphin	*Steno bredanensis*	LC	Lumba-lumba gigi kasar	n/a
14. Bottlenose dolphin	*Tursiops truncatus*	LC	Lumba-lumba hidung botol	n/a
15. Indo-Pacific bottlenose dolphin	*Tursiops aduncus*	NE	n/a	n/a

[11] Kahn, 2012. Marine mammal species positively identified in the Lesser Sunda Ecoregion. APEX Environmental.

Continuation of Appendix 1

Species Identification (ID)	Scientific ID	Status [1]	Indonesian ID	Flores ID [2]
Cetacea: Beaked whales				
16. Cuvier's beaked whale	*Ziphius cavirostris*	LC	Paus paruh Cuvier	Ika mea
17. Mesoplodon spp.	*Mesoplodon spp.*	NE	Ika mea	n/a
Cetacea: Baleen whales				
18. Blue whale	*Balaenoptera musculus*	EN	Paus biru	Lelanggaji
19. Bryde's whale	*Balaenoptera brydei*	NE	Paus Bryde	n/a
20. Pygmy Bryde's whale	*Balaenoptera edeni*	NE	Paus Bryde kerdil	n/a
21. Humpback whale	*Megaptera novaeangliae*	LC	Paus bongkok	n/a
Sirenia: Sea cows				
22. Dugong	*Dugong dugon*	V	Dugong	Dugong

At least three additional species of beaked whales are likely to inhabit the Indonesian Seas:
Longman's Beaked Whale (*Indopacetus pacificus*), Blainville's beaked whale (*Mesoplodon densirostris*), Ginkgo-toothed beaked whale (*Mesoplodon ginkgodens*).

1. As per WWW.IUCNREDLIST.ORG (accessed 11 Nov 2013) status categories of threat. (NE – Not Evauated yet; DD – Data Deficient; LC – Least Concern; NT – Near Threatened; VU – Vulnerable; EN – Endangered: CR – Critically Endangered; EW – Extinct in the Wild; EX - Extinct
2. Flores ID - As reported by Rudolph et al. (1997) and Kahn (2002, 2005).

Appendix 2: Meeting and training workshop introduction to the REA [12]

Training outline:

1. REA Concept
2. Species and Habitats
3. REA Schedule
4. REA Route
5. REA Field Activities
6. Priority marine mammal species
7. Observational data collected during the REA
8. Expected outcomes
9. Questions and Discussion

REA Coordination Meetings, Training, Debriefing activities:

- April 2013: Jakarta (briefing and input DKP KKJI, DKP NTT Kupang, BKPPN, Tim P4KKP, TNC, APEX)
- Julu-Sept 2013: Kupang; Numerous meetings and workshops with all REA partners and Provincial Government stakeholders.
- Sept 2013: Labuan Bajo, Training for REA Field Team
- Oct 2013: Rapat Koordinasi meeting with all stakeholders and NTT Governor's Office, REA Outcomes debriefing during Gala Dinner, press events Indonesian media.
- Nov-Dec 2013: Additional press releases for international media, follow-up with partners on REA outcomes

Overview

1) REA Survey techniques
2) Identifying cetaceans at sea
3) Observational data recording
4) Basic personal sea safety for open ocean conditions
5) Team member's daily tasks and responsibilities on-board

1. Rapid Ecological Assessments in the Coral Triangle: The REA concept

The Rapid Ecological Assessment (REA) is a survey technique designed to cover vast and data poor areas, with limited time and resources, in order to:

1. Identify elements of marine biodiversity
2. Identify important habitats and species assemblages (hotspots)
3. Facilitate field training and capacity building
4. Obtain the initial data for more species or habitat-specific follow up tasks to further investigate (often newly identified) conservation targets.

Once completed the REA can help identify follow up activities:

1. Field work incl. additional REA
2. Conservation and Management
3. Site based projects
4. National policy development
5. Other as per the REA's Technical Report

2. Species and Habitats: Boat-based Observations

Note: In-water activities or SCUBA diving are not scheduled for this REA MarMam.

A. All marine mammals in 3 habitat zones:

1. Coastal
2. Corridor
3. Open ocean

[12] Kahn. 2013. Introduction to the Rapid Ecological Assessment for Marine Mammals (REA MarMam) in the Savu Sea National Park.

To date there have been 18 marine mammal species identified in the Savu Sea (Kahn 2012).

B. Priority marine mammal species for the Savu Sea REA:

1. Blue whale (*Balaenoptera musculus*)
2. Sperm whale (*Physeter macrocephalus*)
3. Orca or killer whale (*Orcinus orca*)
4. Bryde's whale (*Balaenoptera brydei*)
5. Beaked whales (*Fam. Ziphiidae*)
6. Dugong (*Dugong dugon*)

C. Large Migratory Marine Life (LMML) Non-cetacean:

1. All marine turtles (sightings at sea, no nesting beaches)
2. Oceanic Sharks incl. whale sharks
3. Billfish and tuna (sea surface activity)

3. REA Schedule

- The total time scheduled is 18 days
- 3 MPA sectors x 5-6 days each
- A REA team of 5 trained observers, from various agencies and organisations
- Start Labuan Bajo - 20 April (to be confirmed).
- End the REA in Kupang - 2nd week May
- 1st REA of a series of four, obtain baseline data between seasons and within years
  - April/May
  - Sept/Oct

4. REA Route

The Route is based on REA design principles:

1. REAs are done non-stop during a certain time period (no major interludes in field activites) and covers a new section the priority area each day (no back tracking).
2. The REA will focus on waters inside the Savu Sea National Park boundary.
3. REAs in the Coral Triangle are designed to include as many different habitat types as possible, to ensure broad exposure to the potential diversity of the priority species group(s).
4. The non-random survey approach due to this habitat focus:
   a. Coastal/nearshore
   b. Migration corridors
   c. Open ocean
   d. Sea floor features. 200-2000m shelf drop, seamounts, sills and ridges, upwelling areas, etc.

The REA's 3 sectors within the Savu Sea National Park are:

1. Area 1 - Flores - Sumba
2. Area 2 - Sumba - Savu - Rote
3. Area 3 - N and S coasts Timor

All initial REA routes are planned within the National Park. Anchorages will depend on the REA's progress each day, which depends largely on the number of marine mammals sighted each day and local weather conditions. The REA sectors 1-3, combined with the time frames of 6 days in each sector will ensure the general location of the vessel is known (on board sat phone means we can report our exact position every 3 days). A detailed map with the expected route will be presented.

5. REA Field activities

On-board activities (no in-water activities are scheduled for this REA MarMam)

A. Daytime

1) Visual survey for all REA species groups (rotating shifts of 2 hours on/off for each team member).
   a. Detect, approach, identify species, abundance, group composition, behaviours
   b. Group follows of priority species

2) Hydrophone listening stations – acoustic contact with cetaceans.
   a. Passive Acoustic Monitoring (PAM) every 3 hours
   b. Range 3-10nm depending on species.
3) Record keeping on Environmental Variables (sea state and sighting conditions) every 3 hours.
4) Occasional community interviews

B. Nighttime

1) Expected to be at anchor most nights by 1730.
2) 2 hours data transcription by team members (rotating shifts, once per 3 days)
3) Occasional community interviews
4) Occasional overnight passages at sea.
5) Relocation between areas.
6) Occasional listening stations depending on survey area and weather conditions.

6. Priority marine mammal species

1. Blue whale (*Balaenoptera musculus*)
2. Sperm whale (*Physeter macrocephalus*)
3. Orca or killer whale (*Orcinus orca*)
4. Bryde's whale (*Balaenoptera brydei*)
5. Beaked whales (*Fam. Ziphidae*)
6. Dugong (*Dugong dugon*)
7. Large aggregations of oceanic dolphins (estimated abundance over 200 animals)

Additional effort will be spend when these are sighted incl. visual tracking / group follows.

7. Observational data collected during the REA

Dedicated Data sheets for:

1. Marine mammal sightings
2. Non-cetacean LMML and seabirds
3. Acoustic contacts - Listening stations
4. Baleen whale tracking - ecological
5. Community interview questionnaire
6. Environmental data
7. Plastic debris - emphasis on current lines - priority foraging habitats
8. Daily summary logs
9. Biological samples - non intrusive collection (floating skin, regurgitated deep-sea squid)

8. REA outcomes

1) Comprehensive species list for Savu Sea marine mammals
2) Ranking of relative sighting frequencies and abundance
3) Distribution maps
4) Species-specific outcomes including habitats preference
5) Acoustic contact maps incl. species and species groups
6) Seabird species list and Areas of Interest – possible identification of Important Bird Areas (marine IBAs)
7) Initial assessment of threats incl.
   a) International shipping - sea lanes
   b) Fishing activity - emphasis on large scale commercial vessels
   c) Plastic debris
   d) Oil and gas – offshore industry activities
   e) Other threats
8) Interim Field Activity Report
9) Annual Technical Reports

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