USAID SUSTAINABLE ECOSYSTEMS ADVANCED (SEA) PROJECT

TECHNICAL REPORT TA2-16A: A Rapid Ecological Assessment (REA) for Oceanic Cetaceans in the Banda and Ceram Seas, Maluku, Indonesia (FMA 714 and 715), a Critical Habitat for Pygmy Blue Whales (*Balaenoptera musculus brevicauda*)

15-24 October 2017

Prepared by: Benjamin Kahn, APEX Environmental

Field survey by: Coral Triangle Center & APEX Environmental, Benjamin Kahn, Rian Siahuta – BKKPN Kupang, Melannie Bachman, Johannes Hennicke

Additional survey support: Nyoman Suardana (Coral Triangle Center), Marthen Welly (Coral Triangle Center)

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Cover Photo: Benjamin Kahn/APEX Environmental

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ACRONYMS & ABBREVIATIONS

AIS	Automatic Identification System
ALKI	Alur Laut Kapuluan Indonesia (the archipelagic sea lanes of Indonesia)
AOI	Area of Interest
BKKPN	Balai Kawasan Konservasi Perairan Nasional (National Aquatic Conservation Center)
Cat	Category
CTC	Coral Triangle Center
E.U.	European Union
EBSA	ecologically and biologically significant area
FAD	fish aggregating device
FMA	Fisheries Management Area
GPS	global positioning system
HD	high definition
IMMA	Important Marine Mammal Area
IMO	International Maritime Organization
IUCN	International Union for Conservation of Nature
KKP	Kementerian Kelautan dan Perikanan (Ministry of Maritime Affairs and Fisheries)
km	kilometer
km^2	square kilometer
KOARMATIM	Komando Armada Republik Indonesia Kawasan Timur (Fleet Command of Eastern Indonesia)
Lantamal	Pangkalan Utama Tentara Nasional Indonesia Angkatan Laut (Main Naval Base)
LNG	liquefied natural gas
m	meter
MD	marine debris
MMPA	Marine Mammal Protection Act
MPA	marine protected area
MSP	marine spatial planning
n	sample size (number of individuals)
NGO	non-governmental organization
nm	nautical miles
pers. obs.	personal observation
REA	Rapid Ecological Assessment

Satker TWP Laut Banda	Satuan Kerja Taman Wisata Perairan Laut Banda (Banda Sea Aquatic Park Unit)
SEA	Sustainable Ecosystems Advanced Project
TNI-AL	Tentara Nasional Indonesia-Angkatan Laut (Indonesian Navy)
UNCLOS	United Nations Convention on the Law of the Sea
U.S.	United States
USAID	United States Agency for International Development
VHLF	very high/low frequency

EXECUTIVE SUMMARY

The 2017 Rapid Ecological Assessment (REA) for Marine Mammals in the Ceram Sea was led by the non-profit APEX Environmental and Coral Triangle Center (CTC), with field assistance from Indonesia's Ministry of Maritime Affairs and Fisheries (KKP) and funding from the United States Agency for International Development (USAID) Indonesia Sustainable Ecosystems Advanced (SEA) Project.

The five-year (2016-21) USAID SEA Project supports the Government of Indonesia to conserve biological diversity and improve governance of marine resources at local, provincial and national levels. It covers the three provinces of Maluku, North Maluku and West Papua within Fisheries Management Area (FMA) 715.

ASSESSMENT OBJECTIVES

The 2017 REA was specifically designed to address data deficiency for important marine mammal species in remote regions of eastern Indonesia. Its main Area of Interest (AOI) was the southern Ceram Sea (central section of FMA 715), following on a similar assessment conducted in 2016, which covered parts of the Banda Sea (northern section of FMA 714) and established that the area is the endpoint destination for a population of blue whales migrating from the Southern Ocean off Australia to Indonesian waters via the migratory passages of the Lesser Sundas and Timor-Leste.

Three main objectives were set for the 2017 REA, as follows:

1. To support Marine Protected Area (MPA) network design in Maluku and North Maluku
2. To identify, and whenever possible assess, cetacean interactions with coastal and pelagic fisheries and other activities related to ocean usage (e.g., international sea lanes and local shipping routes)
3. To identify opportunities for cetacean conservation at the local, district and provincial levels and provide recommendations on management strategies

METHODS

The 2017 Ceram Sea Marine Mammal REA was conducted without interruption over 10 field days (15-24 October). Daytime active survey involved two dedicated teams of 2 cetacean observers rotated every two hours. During active survey, a team searched for and recorded cetacean sightings. For each sighting, a positive species identification was made when this could be done safely and with minimal disturbance; otherwise, the sighting was recorded under a lesser taxonomic or generic category. Other standard data were also recorded, including, whenever possible, photo and video data.

On offshore routes, the visual assessment was complemented by periodic acoustic listening stations using either omni-directional or directional custom very high/low frequency (VHLF) hydrophones. Each listening station was conducted for at least 10 minutes.

In addition, the survey also documented large non-cetacean marine life, marine debris, fisheries, and shipping activities in the Banda-Ceram Seas region in order to identify management issues. However, given the short time scale of the project relative to the area to be covered, these issues need to be further investigated through additional field work. Although effective in terms of investigating large, virtually unknown areas, the REA method is not designed, by itself, to address species- or habitat-specific conservation and management issues that require fine-scale parameters that can best be estimated through more structured and periodic surveys and monitoring, and long-term ecological research spanning decades.

RESULTS

Starting and ending in Ambon, Maluku, the survey team logged in a total of 1,017.1 kms and 98.5 hours of daytime observation watches, of which 81.25 hours were active, "on-effort" time, and 17.25 hours were "off-effort" time spent in positive species identification, estimation of group size and composition, and close-range behavioral observations of numerous priority species, particularly blue whales.

All 10 field days yielded cetacean sightings, including numerous sightings of blue whales, which were subsequently tracked individually for 2-6 hours per sighting. The high number of blue whale and other sightings combined with unforeseen circumstances (inclement weather, transportation issues, etc.) limited the acoustic survey effort to two listening stations covering an estimated area of 219 km^2 for sperm whales with 0% acoustic contact and 55 km^2 for oceanic dolphins with 100% acoustic contact.

In all, the survey recorded 1,248 individual cetaceans in 48 sightings. The individual count is a known underestimate, as only visual counts of individual cetaceans at the surface at any one time per sighting were used in the calculations. Eleven species were identified, including several species of toothed whales and dolphins (Suborder Odontoceti) and two great whale species (Suborder Mysticeti).

These results bring the total number of confirmed marine mammal species in the Banda-Ceram Seas region to 17, a relatively high number given the limited cetacean research that has been undertaken so far in the region. For comparison, 22 marine mammal species have been confirmed to date in the Savu Sea, a fairly well-studied area with surveys dating back to 2000 (Kahn 2014).

Significantly, the endangered blue whale not only dominated the great whale sightings during the 2017 Ceram Sea Marine Mammal REA, but was also the survey's second most frequently sighted species (after the spinner dolphin).

Equally significant for this survey were two sightings of beaked whales (Family Ziphiidea), which resulted in a positive identification of Cuvier's beaked whales (*Ziphius cavirostris*), and possibly a Longman's beaked whale (*Indopacetus pacificus)*, said to be one of the rarest and least known members of the beaked whale family.

Beaked whale sightings were also recorded in the 2016 REA and in surveys across the Banda Sea on vessels of opportunity. The relatively frequent sightings appear to be related to the complex bathymetric features of the Banda-Ceram Seas and, in particular, the prevalence in this seascape of clusters of seamounts rising from depths of 3,000-5,000m.

In addition to investigating marine mammal biodiversity, distribution, abundance and habitat use, the other important component of the survey was a baseline threat assessment for marine mammals. The major and immediate threat identified was the prevalence of marine debris, particularly plastic pollution, throughout the REA area. There was significantly less marine debris recorded in this survey than in the 2016 REA, but this was likely because lower local rainfall resulted in less runoff from land. The distribution of debris was unchanged, with most of the debris fields recorded in Ambon Bay and surrounding waters.

Other potential threats identified in the 2017 survey were shipping activities, seismic surveys from the oil and gas industry, and fisheries (especially kite fishing for tuna and the use of fish aggregating devices or FADs). These activities were observed to overlap and could interact with and consequently impact marine mammals in the area. With the Banda-Ceram Seas having been identified as a regional stronghold for beaked whales, noise pollution is of particular concern, because this species group is known to be especially vulnerable to extreme ocean noise.

Fishery interactions with cetaceans were identical with those observed in the 2016 REA, with one striking difference: Although the two REAs were conducted less than 12 months apart, there was a striking difference in the number of FADs recorded. Major "clusters" of pelagic FADs were observed during most days of the 2017 survey, many of which were not in place during the 2016 REA. Some areas had such concentrations of FADs as to make vessel navigation at night very hazardous. Blue whales were tracked while swimming through a series of such FADs – whether they could actually detect and avoid such obstacles or only moved safety through by sheer luck could not be ascertained.

CONCLUSIONS

- Overall, the 2016 and 2017 Marine Mammal REAs confirmed exceptional marine mammal species biodiversity, with wide distribution and relatively high abundance, throughout the Banda-Ceram waters surveyed so far.
- The relative abundance of the blue whale for several months of the year in the Banda-Ceram Seas provides an exciting opportunity to study and better protect this endangered species.
- There is solid basis for a comprehensive long-term program on marine mammal conservation in the region, with increased potential for economic opportunities, for example, from responsible whale watch.
- Excessive plastic trash and marine debris as recorded throughout the survey area is the threat that is most urgent to mitigate; dense vessel traffic is a secondary threat directly related to the marine debris problem.

- Through workshops and training activities, the REA has increased awareness and active participation among key stakeholders, as well as promoting the establishment of long-term cetacean survey and research programs.
- Additional surveys and capacity building will be vital for any future marine mammal conservation programs.

SITE-SPECIFIC RECOMMENDATIONS (MALUKU PROVINCE)

- Engage with stakeholders on the main outcomes of the REAs and their relevance to local issues and priorities.
- Conduct marine debris monitoring and assessment.
- Broaden/leverage main outcomes of the assessments to other provinces and national marine conservation initiatives.
- Implement outreach and awareness initiatives for marine conservation.
- Engage local marine-based user groups in volunteer sighting and awareness programs.
- Engage concerned stakeholders in efforts to address marine debris.
- Undertake desktop study to establish an ecological profile of deepwater and oceanic habitats in the Banda and Ceram Seas.
- Conduct technical workshops with emphasis on field training techniques and skills for marine monitoring teams, and conservation and management for decision-makers, and policy development.
- Undertake additional marine mammal REAs and support ecological studies on blue whales.

SPECIES-SPECIFIC RECOMMENDATIONS

- Designate the blue whale as a "flagship species" for Maluku Province.
- Initiate drafting of Provincial/National Conservation Action Plan for Indonesia's Blue Whales.
- Incorporate critical habitats for blue whales and other cetaceans in marine spatial planning and MPA network designs and development.
- Designate core AOIs and integrate with shortlisted candidates for new MPAs.
- Conduct outreach to socialize the special status of the Banda-Ceram Seas for blue whales and other spectacular marine life.
- Conduct additional survey work for other priority cetacean species.

SECTION 1. INTRODUCTION

The Rapid Ecological Assessment (REA) for Marine Mammals in the Ceram Sea was specifically designed to address the data deficiency for important marine mammal species in remote regions of eastern Indonesia. This REA's main area of interest was the southern Ceram Sea in the central section of Fisheries Management Area (FMA) 715, to build on the outcomes of a 2016 REA survey that covered parts of the Banda Sea (northern section of FMA 714).

The REA had three main objectives, as follows:

1. To support Marine Protected Area (MPA) network design in Maluku and North Maluku, in particular to:
    - Assess the biodiversity of marine mammals in the Ceram Sea, and when possible identify their preferred or critical habitats (species-specific).
    - Assess, and where possible identify, new migratory corridors of regional importance, as well as possible breeding grounds, particularly for oceanic and migratory species such as blue and sperm whales.
    - Better understand the ecological connectivity between FMA 714 and FMA 715.
2. To identify, and whenever possible assess, cetacean interactions with coastal and pelagic fisheries (small- and large-scale) and other activities related to ocean usage (e.g., international sea lanes and local shipping routes).
3. To identify opportunities for cetacean conservation at the local, district and provincial levels and provide recommendations on management strategies.

Other REA activities included hands-on training of the survey team in all facets of the survey and additional data collection on:

- Large non-cetacean marine life – surface observations at sea on marine turtles, billfishes, mantas/mobulas, oceanic sharks, whale sharks, large tuna aggregations
- Seabird biodiversity
- Ocean usage by maritime industries and initial threat assessment
- Commercial shipping activities on domestic and international sea lanes
- Fisheries interactions with cetaceans, e.g., ranging by tuna kite fishers, fish aggregating devices (FADs, or "rumpon" in the Indonesian language), coastal gillnets, and floating fishing platforms locally called "bagan"
- Marine debris fields, categorized based on a scale of 1 to 5 according to estimated area of plastic trash

The survey was led by the non-profit APEX Environmental and Coral Triangle Center (CTC), with field assistance from the Ministry of Maritime Affairs and Fisheries (KKP, including a REA team member) and funding from the USAID Sustainable Ecosystems Advanced (SEA) Project.

The five-year (March 2016-March 2021) USAID SEA helps to preserve marine biodiversity and fisheries in Indonesia through support to the Government of Indonesia at both local and

national levels. It covers the three provinces of Maluku, North Maluku and West Papua within FMA 715.

The 2016 REA survey confirmed that the Banda Sea is the endpoint destination for a population of blue whales migrating from the Southern Ocean off Australia to Indonesian waters via the migratory passages of the Lesser Sundas and Timor-Leste. In 2017, the Ceram Sea was confirmed as an important extension of this critical habitat, and the Manipa Strait (between Ceram and Buru Island) has also been identified as a migration corridor of regional importance to marine conservation.

To follow up on both surveys, CTC and APEX Environmental will conduct several technical workshops and capacity building activities in 2018. These workshops will focus on marine mammal species identification at sea, ecology, conservation and management, and are planned for Bali and Maluku. Training emphasis will be on hands-on field techniques and skill sets for marine monitoring teams, conservation and management for decision makers, and policy development (including tourism opportunities such as responsible whale watch).

This survey report builds upon the technical report of the 2016 Marine Mammal REA conducted in the northern Banda Sea (Kahn 2017). The Marine Mammal REA outcomes, recommendations and capacity building conducted from 2016-2018 onwards will assist the Maluku government with the integration of important oceanic habitats within a provincial network of MPAs.

SECTION 2. METHODS

The REA is a survey technique designed to cover vast and data poor-areas, with limited time and resources, in order to (adapted from Kahn 2014):

- Identify elements of marine mammal biodiversity
- Identify important habitats and species assemblages (hotspots)
- Facilitate field training and capacity building for local teams
- Obtain 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, such as:

- Additional field work including further REAs and other surveys, such as ecological focus studies on priority species or critical habitats.
- Capacity building for marine mammal conservation and management
- Site-based projects, including marine spatial planning (MSP) initiatives, development of MPA networks, and defining zonations within MPAs
- National policy development, e.g., endangered species plans, best practice guidelines for ocean industries
- Various other activities based on the REA outcomes and recommendations of technical reports and other pertinent publications

1.1. 2.1. VISUAL CETACEAN ASSESSMENT

During daytime active survey, two dedicated teams of two cetacean observers conducted visual surveys of the surrounding waters. The 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 was frequently done to investigate initial sighting cues. Once cetaceans were sighted or a possible cue observed more than once, the vessel's course and speed were adjusted to allow for a discreet approach and close observations.

For each sighting, a positive species identification was made whenever conditions and animal behavior allowed this to be done safely and with minimal disturbance. If the species could not be identified with certainty then lesser taxonomic or generic categories were used (e.g. Kogia sp.; unidentified small cetacean). 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 behavioral categories, including feeding, resting, bow riding, aerials, avoidance, and surface interval and dive durations whenever possible
- Photo and video data whenever possible
- Any natural markings
- Sighting conditions ranked on a scale of 1 to 5 based on 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 colorations, 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 behaviors.

1.2. 2.2. ACOUSTIC CETACEAN ASSESSMENT

On offshore routes, the visual surveys were complemented by periodic acoustic listening stations using either omni-directional or directional custom very high/low frequency (20Hz-20kHz) hydrophones connected to a matching amplifier equipped with multi-channel high/low pass filters. Detection range for sperm whales was estimated to be at least 8nm in good conditions, whereas the detection range for smaller cetaceans was estimated to be 3nm. In order to minimize any coastal interference, the acoustic assessment was usually conducted once the vessel was located 4nm offshore at the minimum. To minimize acoustic overlap, listening stations were conducted at least 8nm apart depending on daily schedules and offshore conditions. 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 (1-5 ranking of overall audio quality of listening station incorporating sea state, vessel and ambient noise)
- Any audio recording numbers

[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.

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

In addition to data on presence/absence of vocalizing cetaceans within the estimated listening range, the acoustic assessment can also provide more detailed data for each listening station, including, species identification; group size estimates; indications of foraging and/or social behaviors; and determination of local (underwater) movement patterns through acoustic tracking activities. The acoustic survey results are especially important for comparative analysis between and within sites over time.

After the visual and acoustic data collection was completed for each cetacean encounter and listening station, the vessel would depart from the area slowly and return to the predetermined REA route. Routes were occasionally adjusted to allow for maximum habitat coverage and environmental factors such as unfavorable currents and/or strong winds.

A more extensive description of methodologies and data analysis has been provided by several authors (Whitehead and Kahn 1992; Kahn et al. 1993; Kahn et al. 2000; Kahn and Pet 2003, Kahn 2008).

1.3. 2.3. OTHER REA FIELD ACTIVITIES

2.3.1. LARGE MARINE LIFE SIGHTINGS (NON-CETACEAN)

While the survey was underway, sighting details for other large (and often migratory) marine life were recorded on a separate "non-cetacean" data sheet. These included all deck-based observations on marine turtles at sea, manta rays, whale sharks, oceanic sharks, sunfish (mola mola), billfishes and tunas.

2.3.2. MARINE DEBRIS

Marine debris (MD) fields such as plastic garbage concentrations along current lines were also recorded throughout the daytime survey. Data included:

- Date and time
- Position
- Estimated length and depth of plastic garbage field
- Category (Cat) 1-5 assigned as an estimation of threat level, based on overall area size and density of plastic pollution from Cat1 (minor field) to Cat4 (vast,

expansive field with trash also distributed in the water column 5-10m deep) (Table 2-1)

In addition to their negative impact on marine biodiversity, Cat3 and Cat4 MD fields are a shipping hazard. Cat4 fields in particular are a challenge for sea vessels to avoid while navigating. These fields routinely result in plastic trash uptake into the cooling water filters of the survey vessel main engine, risking overheating and engine failure. The risk of engine damage from marine debris intake is substantial, even on cut-through courses with minimal exposure of the survey vessel to the trash (as opposed to running on a parallel course along or inside the trash field direction). Throughout the survey, the cooling water intake was specifically monitored for this risk and any trash was removed.

Table 2-1. Relative scale used to categorize marine debris fields (Ceram Sea Marine Mammal REA, 2017)

Marine debris category (MD - Cat)	Description
0	No trash
1	Patchy, dispersed and local area (<500m trackline)
2	Medium density, local area (<1000m trackline)
3	Medium density, widespread throughout area (<2000m trackline); medium hazard to shipping (cooling water intake blockage).
4	Extremely dense, widespread, distributed vertical in water column 5-10m deep, widespread (<4000m trackline); major hazard to shipping (cooling water intake blockage).
5	Asian megacity plastic trash pollution. Not yet observed at sea during all MD monitoring surveys (2012-2017)

2.3.3. SHIPPING ACTIVITIES

Throughout the REA, local and international shipping activities were photographed with date, time and location data.

1.4. 2.4. LIMITS OF THE REA APPROACH

Marine mammals are a challenge to study and often require a long-term approach to establish a basic understanding of species diversity and distribution, which are influenced by monsoonal and migratory patterns. While the REA method is 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 and monitoring, and long-term ecological research spanning decades. This is especially so for initial cetacean work in data-deficient regions.

Specifically for this particular Ceram Sea Marine Mammal REA, another factor limiting species-specific outcomes was the relatively short time scale of the project in relation to the area to be covered. The assessment was designed to identify some key management issues regarding pollution, marine tourism, fisheries interactions and cetacean habitat overlap with oil and gas interests, but these issues need to be further investigated through subsequent field work. What this work has provided is a solid foundation from which to launch future steps.

SECTION 3. SURVEY RESULTS & DISCUSSION

1.5. 3.1. VISUAL SURVEY EFFORT & RESULTS

The Ceram Sea Marine Mammal REA was conducted without interruption over 10 field days (15-24 October 2017). The major islands covered in the visual survey route included west Ambon, west-northwest Ceram, Kelang, Boano, Manipa Strait, north Buru, two oceanic crossings traversing the archipelagic sea lanes (part of ALKI-III,[2] connecting Australia and Asia), and the remote Sanana and Mangoli Islands (part of the Sula Island group). (Figure 3-1)

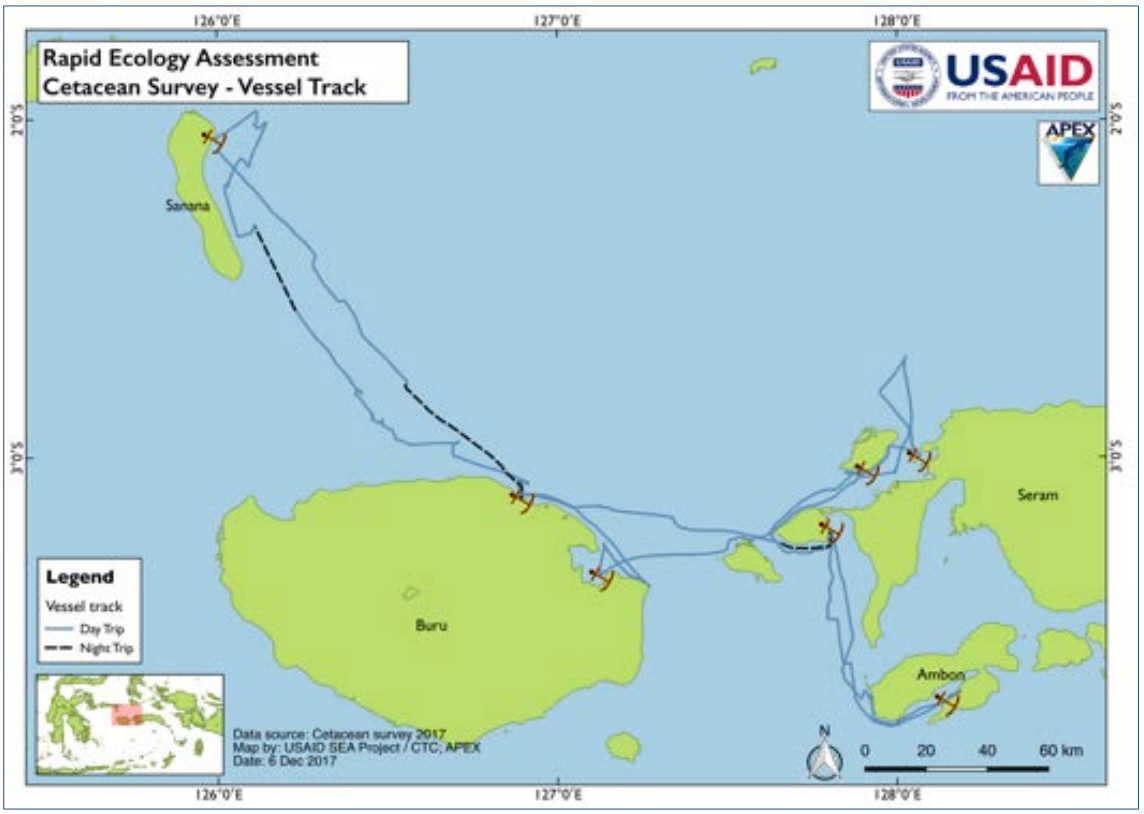


Figure 3-1. Survey vessel trackline (Ceram Sea Cetacean REA, 2017)

As shown in Figure 3-1, the visual survey started and ended in Ambon, Maluku, covering 1,017.1 kms of trackline and a total 98.5 hours of daytime observation watches. The survey route was designed to include maximum habitat diversity within the southern Ceram Sea, including the boundary region of FMA 714 and FMA 715. The total on-deck daytime effort of 98.5 hours included 81.25 hours of active, "on-effort" observations, and a further 17.25 hours "off-effort" observations for positive species identification, estimation of group size and composition, and close-range behavioral observations of numerous priority species, particularly blue whales.

The visual survey details are summarized in Table 3-1.

[2] Based on the United Nations Convention on the Law of The Sea (UNCLOS), Indonesia has established Alur Laut Kapuluan Indonesia (ALKI), or the archipelagic sea lanes of Indonesia. ALKI III branches into the ALKI III A (Sawu Sea, Kupang), ALKI III B, ALKI III C (East Timor Leste), and ALKI III D (around Aru waters).

Table 3-1. Summary of visual survey effort and results (Ceram Sea Marine Mammal REA, 2017)

A. Survey effort	
Survey period (non-stop)	15 – 24 October 2017
Start-Finish	Ambon, Maluku, Indonesia
Survey duration Area surveyed (daytime trackline)	10 days 1,017.1 kms (549.2 nm)
Total time surveyed	98.5 hrs
Total time "on-effort"	81.25 hrs
Total time "off-effort," including training on species identification, abundance estimates, behaviors, data recording, boat handling	17.25 hrs
Overnight passages (n)	2 (relocation - no data)
Total nighttime trackline	134.3 kms (72 nm)
Total night time effort	19.75 hrs
B. Results *(+1 for sperm whales - via acoustic contact)*	
Total marine mammal sightings (n)	48
Cetaceans (n)	48
Dugong (n)	0
Marine mammal species (n)	11
Great whale species (n)	2
Total individual count	1,248

Cetaceans were sighted on all 10 field days. Sightings were assigned general symbols (Table 3-2) according to taxonomic classification or, occasionally, broader categories depending on the resolution of the field data.

Table 3-2. Symbols used to represent cetaceans based on taxonomic classification or broader categories (Ceram Sea Marine Mammal REA, 2017)

Cetacean species category	Symbol
Sub-order Mysticeti – baleen whales	●
Family Ziphiidae - beaked whales	◈
Globicephalinae, a Delphinidae subfamily[3] similar to the historical 'blackfish' grouping	✚
Unidentified large cetacean – toothed whale (> 6m)	□
Unidentified beaked whale (Family Ziphiidae)	◇
Families Physeteridea and Kogiidae - sperm whales	■
Family Delphinidae – dolphins (mostly oceanic species)	▲
Unidentified small cetacean (< 6m)	△
Unidentified large cetacean – baleen whale (> 6m)	○

[3] The Globicephalinae subfamily is based on a systematic revision of Delphinidae and includes 6 species: *Feresa attenuata*, *Peponocephala electra*, *Globicephala macrorhynchus* and *G. melas*, *Pseudorca crassidens* and *Griseus grampus* (LeDuc et al. 1999). It replaces the historical 'blackfish' category that includes the majority of these species. Globicephalinae sightings are recorded when sightings of members of the subfamily cannot be identified to species. This occurs infrequently and is mostly due to the similarities of *P. electra*, *F. attenuata* and juvenile or sub-adult *G. griseus*, particularly during unfavorable sighting conditions.

Detailed data on position, depth, nearest distance to land, group composition, local movements, species associations were recorded for each sighting together with photo and video documentation of numerous behaviors[4] (Figure 3-2).


A. Blue whale swims along coral reef and beach


B. Melonheaded whales approach survey vessel


C. Blue whale swims along coral reef and beach


D. Spotted dolphin group, including juvenile


E. Tuna fishers often interact with spotted and spinner dolphins


F. Spotted dolphin with a recent cookie cutter shark bite


G. Spotted dolphin leaping as high as 6m


H. Blue whale surfaces, showing two blowholes


I. Blue whale fluke-up prior to a deep dive


J. Blue whale surfaces close to a local boat


K. Risso's dolphins "head-standing"


L. Spinner dolphin exhales upon surfacing

Figure 3-2. Examples of cetacean species diversity and behaviors recorded during the 2017 Ceram Sea Cetacean REA (all photos © Benjamin Kahn/APEX Environmental)

[4] Because new survey routes were used and significant distances covered each day, the likelihood of 'double counts' (observing and recording the same dolphins or pods more than once) was considered a low likelihood. Nonetheless, double counts may have occurred for some species (i.e. the pilot whales off west Ceram and Manipa Island that were encountered on two subsequent days). The photographic identification efforts supports this overall assumption, as apart from this species, no individuals were matched thus far between encounters within or between survey days.

1.6. 3.2. ACOUSTIC SURVEY EFFORT & RESULTS

The acoustic survey effort was limited to n=2 for 3 main reasons:

1. During the survey period, the coastal and oceanic survey routes included numerous sightings of blue whales, which were subsequently tracked individually for 2-6 hours per sighting. This, and the high number of other sightings each day, left little time for setting up listening stations, which need to be done 4-6nm from the shore to avoid coastal interference.

2. Inclement weather (sea state conditions 4+) for most of the first week (30 or more knot winds, numerous rain squalls, rough seas) meant no listening stations could be conducted. Listening stations are best conducted from a stationary vessel with all systems stopped (no acoustic interference from the vessel's engine, generator, depth sounder, etc) and in calm seas. Stations were planned for all deepwater survey days but, in the first week of the REA, these were routinely cancelled because of above Cat3 choppy seas.

3. For the last leg of the survey, while at the remote Sanana Island, the vessel's crew conducted running repairs on the main engine and fixed the problem (replaced the cooling water pump). As a precaution, the team decided not to stop the vessel offshore to conduct listening stations for the remaining two survey days, and instead opted to prioritize the visual survey component for blue whales and other cetaceans. These last survey days (east Buru, west Ceram, west Ambon) included some of the most productive sighting days of the whole REA, and thus acoustic survey time would have been limited anyway.

The details of the acoustic survey component for this REA are summarized in Table 3-3.

Table 3-3. Summary of acoustic survey effort and results (Ceram Sea Marine Mammal REA, 2017)

A. Survey effort	
Estimated area covered – sperm whales (6nm range)	219.3 km²
Estimated area covered – oceanic dolphins (1.5 nm range)	54.9 km²
Listening stations (n)	2
B. Survey results	
Total acoustic contact (n)	2 (100%)
Acoustic contact with sperm whales (n)	0 (0 %)

1.7. 3.3. MARINE MAMMAL BIODIVERSITY & RELATIVE ABUNDANCE

To aid analysis, all cetacean sighting coordinates for the REA were later transcribed to GIS format and assigned species-specific color-coded data points (Figure 3-3).

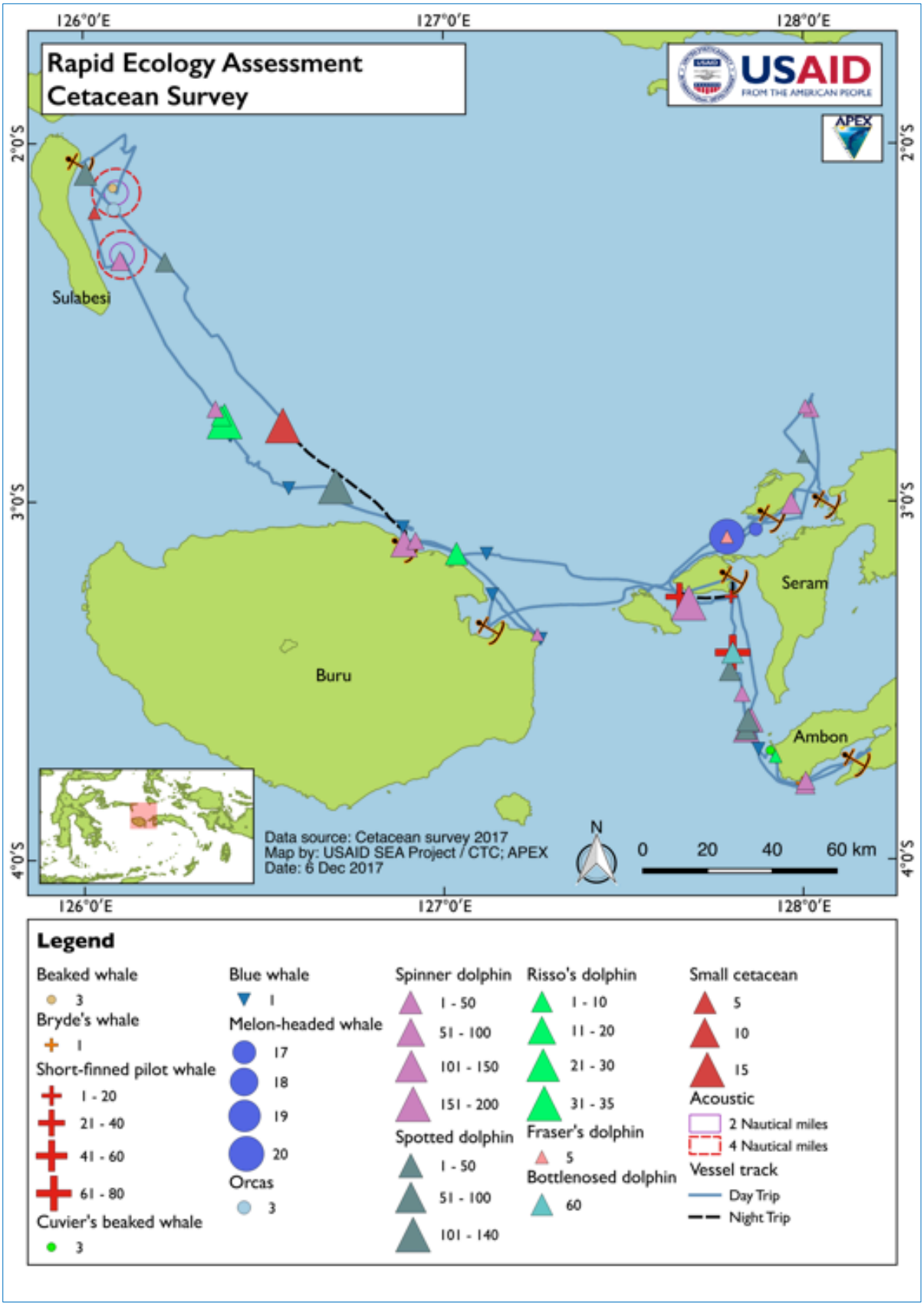


Figure 3-3. Species-specific sighting distribution (n=48), abundance categories and acoustic listening stations (n=2) recorded during the 2017 Ceram Sea Marine Mammal REA

A total of 11 cetacean species were positively identified during 48 separate group sightings (Table 3-4). These included several species of toothed whales and dolphins (Suborder Odontoceti) and two baleen whales (Suborder Mysticeti). No dugongs (*Dugong dugon*) were sighted.

The two "great whale" species recorded during the REA were the blue whale and Bryde's whale. Significantly, blue whales not only dominated the great whale sightings, but were also one of the most frequently sighted species throughout the REA, second only to the spinner dolphins (Figure 3-4; see also further below separate section on blue whales).

Table 3-4. Cetacean species diversity recorded (Ceram Sea Cetacean REA, 2017) – Whale and dolphin species (n=11); identified with common, local and scientific names, their conservation and legal status. Species identified included toothed whales and dolphins (Suborder Odontoceti) and baleen whales (Suborder Mysticeti). The so-called "great whale" species are bolded.

Species (n=11)		Sighting frequencies (n=48)
Common name	**Scientific name**	
Blue whales	***Balaenoptera musculus brevicauda* (pygmy subspecies)**	9
Bryde's whales	***Balaenoptera brydei***	1
Cuvier's beaked whales	*Ziphius cavirostris*	1
Short-finned Pilot whales	*Globicephala macrorhynchus*	3
Orcas or Killer whales	*Orcinus orca*	1
Melon-headed whales	*Peponocephala electra*	2
Fraser's dolphins	*Lagenodelphis hosei*	1
Risso's dolphins	*Grampus griseus*	4
Oceanic bottle-nosed dolphins	*Tursiops truncatus*	1
Spotted dolphins	*Stenella attenuata*	7
Spinner dolphins	*Stenella longirostris*	14
Unidentified beaked whales		1
Unidentified small cetacean		3

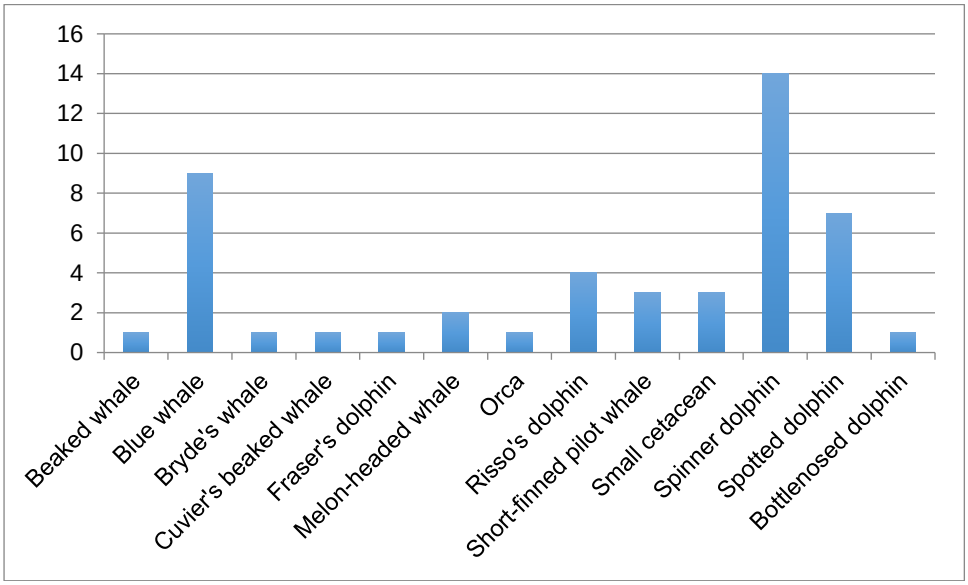


Figure 3-4. Sighting frequency per species (n=48) during the 2017 Ceram Sea Marine Mammal REA

As of this reporting, the Banda and Ceram Seas have recorded 17 species (Kahn 2017). This species list illustrates the relatively high marine mammal biodiversity in the area, especially given the minimal survey efforts to date in this vast marine region. By comparison, the Savu Sea, where surveys have been conducted since 2000, has a total of 22 marine mammal species confirmed to date (Kahn 2014).

An estimated total of 1,248 individual cetaceans was recorded during the survey (Figure 3-5). Based on a conservative field method, this count is a known underestimate, as only visual counts of individual cetaceans at the surface at any one time per sighting were used in the calculations. On average for all 10 REA days, 4.8 separate sightings and 2.9 different species were recorded per survey day with an average daily survey on-effort of 8.2 hrs. [5]

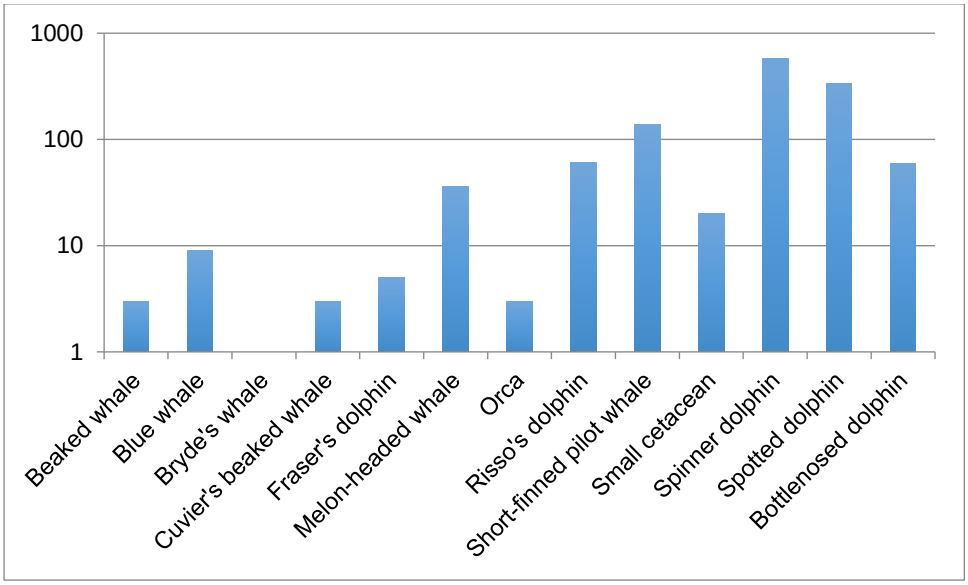


Figure 3-5. Individual animal counts per species (n=1248) recording during the 2017 Ceram Sea Marine Mammal REA (Note logarithmic scale on Y-axis)

1.8. 3.2. SPECIES-SPECIFIC OVERVIEW

3.2.1. BLUE WHALES – A PRIORITY MARINE SPECIES FOR MALUKU, & INDONESIA.

As noted above and shown in Table 3-4 and Figure 3-4, blue whales were the most frequently sighted (n=9) large cetacean and also had the 2nd highest sighting frequency (after the common spinner dolphins) for all 48 sightings and 11 species encountered during the 2017 REA (Table 2, Figure 4). These blue whale sightings, as well as the boat-based ecological tracking of blue whales conducted during the survey, confirmed that Banda and Ceram Seas are an important part of the migratory destination area for this endangered species (see Kahn 2007, 2009 and 2017 for more detailed background on Indonesia's blue whales). This is an exceptional outcome for the 2017 REA, as blue whales are rarely

[5] Cetaceans are highly mobile marine mammals with complex movement patterns that are driven by ecological requirements (e.g., day-to-day locating/tracking of certain oceanic conditions favorable for abundant local prey, seasonal relocations within a seascape, long-range migrations to/from high latitudes). These challenging ecological requirements also apply to each of the 11 species (both residential and migratory) recorded during the 2017 REA. For this reason, these small-scale results in a data-deficient area, as briefly summarized in this section, must be viewed with caution.

encountered in other regions in Indonesia besides the Savu and Banda Seas, which are in the same whale migration route and destination area, respectively. Indeed, throughout the Coral Triangle blue whales are rarely seen.

The blue whales' extraordinary sighting frequency was also evident during the 2016 REA and from other observations in the years prior (Kahn 2017). The 2016 REA confirmed the Banda Sea as the destination for a (sub)population of blue whales, which migrate from the Southern Ocean off Australia to Indonesian waters via the migratory passages of the Lesser Sundas and Timor Leste (Kahn 2007, 2009, 2014, Double et al. 2014).

In 2017, the Ceram Sea REA recorded an important extension of this migratory destination area, increasing this critical habitat to well beyond the northern part of Banda Sea (FMA 714). In particular, the waters off east and north Buru (FMA 715) had numerous blue whale sightings during the REA. Furthermore, the Manipa Strait, which is a major oceanographic feature in its own right, has been identified as a migration corridor of regional importance to blue whales.

3.2.2. BANDA-CERAM SEAS – A CONFIRMED BEAKED WHALE HOTSPOT

Beaked whales (Family Ziphiidea) are rarely observed in the Indo-Pacific waters because of their preferred oceanic habitat near seamounts, short surface intervals between long dives, and their shy surfacing behaviors in the vicinity of boats. It is therefore important to note that these deep-diving and mysterious toothed whales seem relatively abundant in both the Banda Sea and Ceram Sea.

Beaked whales were sighted on two separate occasions during the 2017 REA. In the first sighting, the Cuvier's beaked whales (*Ziphius cavirostris*) were positively identified off west Ceram. No positive species identification could be made at sea for the second sighting, but the observed animal's large size, dorsal fin position and size, coloration and surfacing sequences indicated it was either a Cuvier's beaked whale or a Longman's beaked whale (*Indopacetus pacificus)*. The latter is reported to be "one of the rarest and least known members of the beaked whale family". [6]

Beaked whales were also sighted in the 2016 REA (Kahn 2017) and surveys across the Banda Sea on vessels of opportunity (pers. obs. B. Kahn in 2012, 2013, 2015). The relatively frequent sightings of beaked whales in the Banda and Ceram Seas compared to other regions already surveyed seem to be related to the complex bathymetric features of this seascape and, in particular, the prevalence in the area of clusters of seamounts rising from depths of 3,000-5,000m (Figure 3-6). Like other pelagic predators such as billfishes, tunas and oceanic sharks (Worm et al. 2003, 2005), beaked whales are often associated with such deep seamounts (Pitcher et al. 2007).

[6] NOAA Fisheries – Protected Resources website. *http://www.nmfs.noaa.gov/pr/species/mammals/whales/longmans-beaked-whale.html*

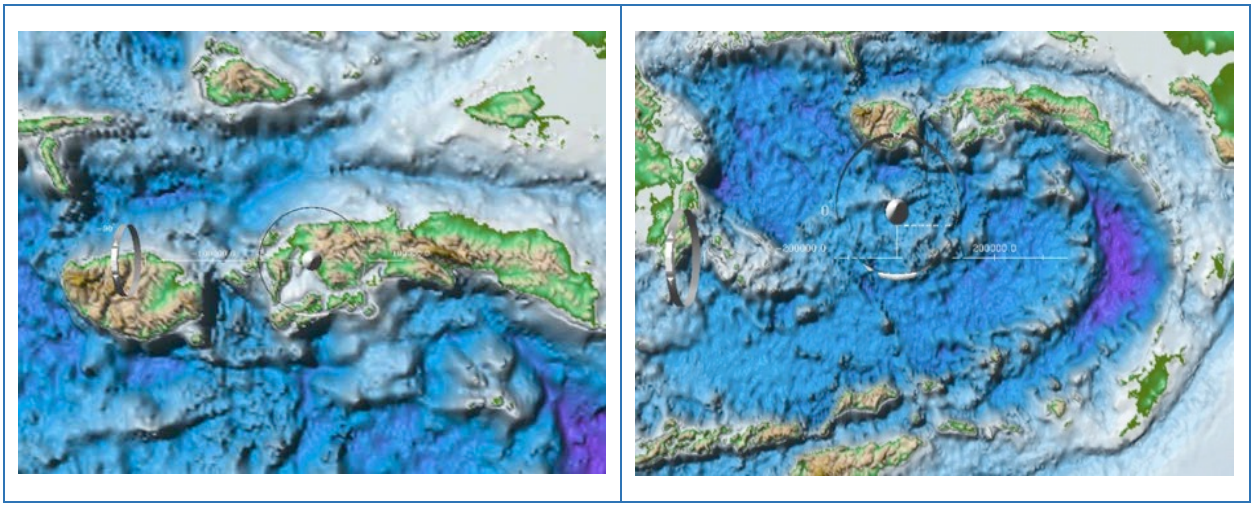


Figure 3-6. Deep-sea habitats and MPA Networks in Maluku Province – A bathymetric map of the northern Banda and Ceram Seas, illustrating (i) exceptional oceanic habitat diversity, including clusters of seamounts, migratory corridors, a 5,000m deep basin, and the 7,000m deep Banda arc (in purple), and (ii) the oceanic habitat's proximity to coastal ecosystems including coral reefs and mangroves (map by Fledermaus software)

For both the 2016 and 2017 Marine Mammal REAs to consistently observe beaked whales and natural features known to be preferred habitats for these species strongly indicates that:

1. At least some parts of the Banda-Ceram Seas area are important habitats for this mysterious and specialized cetacean species group.
2. The area seems to be a stronghold for beaked whale populations in east Indonesia.
3. The conduct of additional oceanic cetacean surveys around clusters of seamounts is important in order to establish a comprehensive beaked whale species list of the area and gather information about their fine-scale habitat preferences. The focus on beaked whales in Banda-Ceram Seas will help address regional data deficiency and lack of adequate management for this important species.
4. The Banda-Ceram Seas may be especially vulnerable to impacts from extreme ocean noise emanating from various human activities, such as:
    - Seismic surveys being undertaken by the oil and gas industry as an essential part of their exploratory activities, e.g. the 2015 BandaSeis 2D survey (Figure 3-7)
    - Naval exercises using specialized sonar (often deployed during so-called "submarine wargames") – Nearby Ambon Bay hosts the home port for the Indonesian Navy (TNI-AL), the Main Naval Base IX (Lantamal IX) under the Eastern Indonesia Fleet Command (KOARMATIM), which oversees the naval bases in Ambon, Ternate, Saumlaki, Morotai and Tual. Indeed, navy patrol vessels and cruisers were observed at sea on two occasions during the 2017 REA.
        (i) It is important to note that the US Navy is generally required to comply with the U.S. Marine Mammal Protection Act of 1972 (MMPA), whether it is operating in the U.S. or in non-U.S. waters (e.g. as part of a joint military exercise). (https://www.nrdc.org/media/2016/160718)

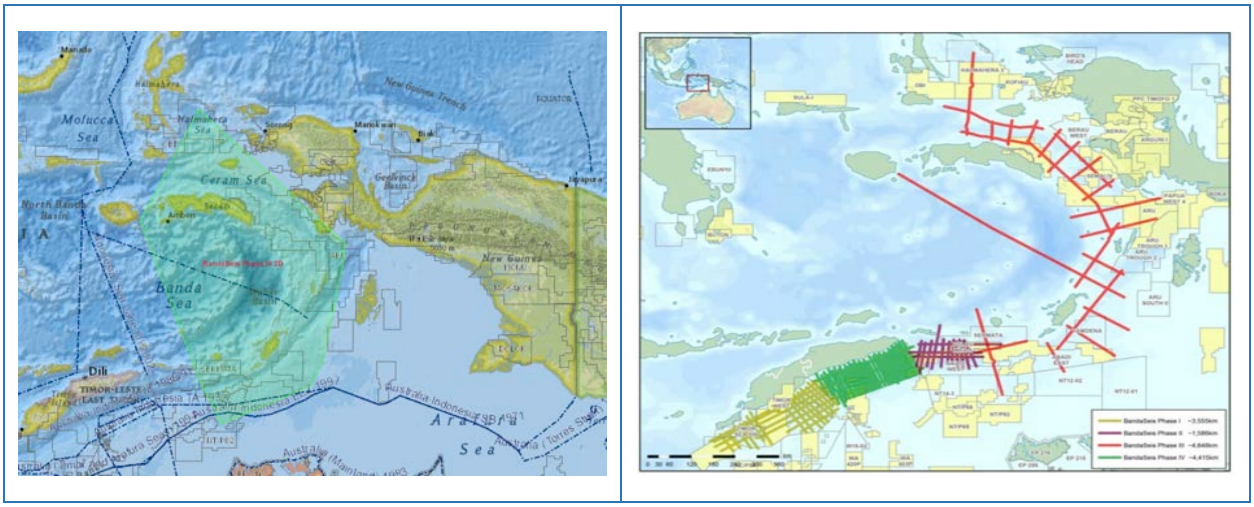


Figure 3-7. Map of the BandaSeis seismic survey (2D) conducted in 2015 showing a) major spatial scope and b) offshore leases that may be obtained by the oil and gas industry. More details can be found at https://www.cgg.com/en/What-We-Do/Multi-Client-Data/Seismic/Asia-Pacific/BandaSeis and the interactive map at https://geostore.cgg.com/?id=15049&type=2&region=apac

Current regulations for seismic surveys in Indonesia are lagging behind regional standards (see Kahn 2010 for a review and recommended best practices for operating in sensitive high biodiversity regions like east Indonesia). In the past, seismic surveys have caused major conflicts between the ocean industry and local communities, fisheries and recreational dive industry (e.g., the Raja Ampat conflict, detailed by Kahn in 2010).

A recent (2017) and groundbreaking scientific study has proven the substantial impact of seismic survey activities to the oceanic habitat (McCauley *et al.* 2017). In addition to potentially lethal impacts to deep-diving mammals such as beaked whales, the study clearly shows the major ramifications for pelagic fisheries management, as zooplankton and fish larvae within a 1km radius of the array are routinely wiped out (including tuna larvae, negatively impacting on recruitment potential). McCauley *et al.* (2017) states that widely used seismic survey air gun operations create "death zones" along the seismic survey grid. This impact zone was previously estimated to be only a few meters away from the array.

For these and other reasons, seismic survey activities are of relevance not only to marine mammal species managers but also to large-scale pelagic fisheries management initiatives for tropical tuna, billfishes and other commercially important pelagic target species. FMAs may be an appropriate management unit to address these concerns and mitigate potentially conflicting uses by ocean industries.

3.2.3. MARINE MAMMAL HABITATS & MALUKU'S PROVINCIAL MPA NETWORK

The importance of this region to blue whales and other marine mammal elements is evidenced by the consistently high species diversity and high relative abundance and large-group sizes found there, which makes the Banda and Ceram Seas a priority for marine mammal conservation and management for Indonesia, and indeed a priority for the Coral Triangle. Blue whales in the Banda-Ceram Seas are observed for several months of the year

(with July-November as the main 'season'), providing 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. This makes the Banda-Ceram Seas region an exceptional and new cetacean hotspot for both Maluku Province and for Indonesia.

The Ceram Sea also includes preferred habitats for other large and residential cetaceans such as pilot whales, false killer whales, sperm whales and numerous species of oceanic dolphins that all use these productive deep waters to forage, mate, calve and nurse their young.

Regional marine mammal species lists have been compiled for the Savu Sea to the south of the current area (22 species confirmed, (Kahn 2014) and Raja Ampat to the north (18 species confirmed Kahn 2007, 2015). These lists are based on over a decade of dedicated marine mammal field work. In comparison, the Banda Sea has already shown exceptional marine mammal biodiversity without any long-term survey effort, with 17 species identified there after just two REAs in previously uncharted and data-deficient waters (Kahn 2017). Such consistent cetacean habitats and migratory passages are prime candidates for:

- Better integration in large-scape MSP initiatives (i.e. Agardy 1997, Hyrenback 2000, Hoyt 2004, Palacios et al. 2006); and
- Inclusion in the ongoing development of MPA Networks in east Indonesia (PHPA 1984, Fortes, Djohani and Kahn 2003, Kahn 2009, 2014, 2015, 2016, 2017)

Furthermore, the whales and dolphins were often sighted close to shore (in part because of the extreme depth gradients from reefs to seamounts, Figure 3-6), so there is a need for the local community to be fully engaged in protecting these sea mammals and their habitats.

To help define smaller-scale critical habitats for multiple species, additional surveys are recommended for the following areas and other AOIs located in FMA 714 and FMA 715, as detailed in Kahn 2017 (Figure 3-8):

- Piru Bay-Saparua-Nusa Laut-Banda Neira – to confirm consistent habitats and expand upon the 2016 REA, including capacity building and local community stakeholders workshops
- West Ambon-West Ceram-Manipa Strait region-NE Buru – to confirm consistent habitats and expand upon the 2017 REA, including capacity building and local community stakeholders workshop
- South Halmahera: Ternate-Bacan-Obi – an ecological extension of the 2016 and 2017 REAs; currently extremely data-deficient
- North Halmahera, Northeast Sulawesi, Saumlaki-Wetar

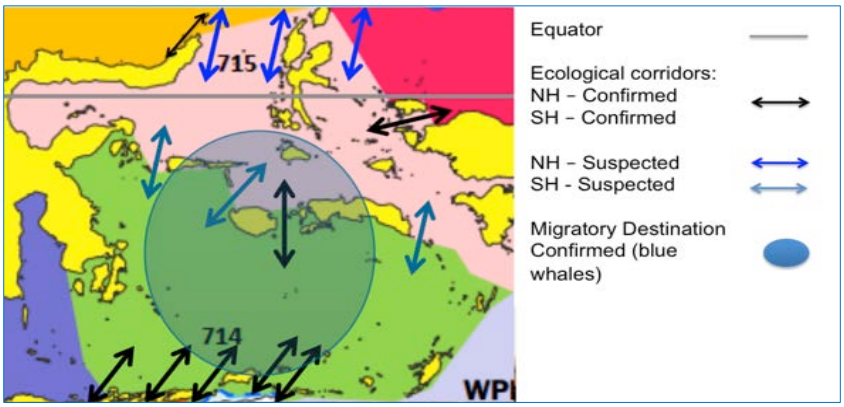


Figure 3-8. Ecological corridors for large cetaceans in FMA 714 and FMA 715 – This region remains data-deficient, a major management gap (from Kahn 2017)

These surveys would build upon existing cetacean program activities and provide important outcomes for the following initiatives:

- MSP and conservation planning including:
  - On-going assistance to the Maluku government to develop a provincial MPA network
  - Assistance with the shortlisting of the Banda-Ceram region as a large-scale/seascape AOI and candidate Important Marine Mammal Area (IMMA) at the Asia Regional Workshop to be held in March 2018[7] -- The region appears to meet the requirements of the International Union for Conservation of Nature (IUCN) for a new IMMA under the species-specific and habitat-use categories. The REAs' outcomes will help confirm this.
- Protected species management for marine mammals – FMAs are large-scale by definition and may become appropriate management units for east Indonesia's wide-ranging and migratory marine species such as cetaceans (Figure 3-9). The REAs' outcomes and recommendations for FMA 714 and FMA 715 may assist with the management of these species on a wide range of issues, as follows:
  - Fisheries interactions with marine mammals – close association between oceanic dolphins and tuna (kite) fishers and FADs or rumpons
  - Net entanglements and discarded fishing gear
  - Large-scale gear restrictions in FMAs with extensive blue whale habitats (i.e. FMA 714)
- Raising awareness about marine mammals within coastal and pelagic fisheries groups and ocean industry stakeholders – The blue whale "story" in particular provides a major opportunity to highlight many important conservation and sustainability issues

[7] The author is a member of the IUCN Marine Mammal Protected Areas Task Force that is responsible for the development and implementation of the global IMMA initiative (for more details see https://www.marinemammalhabitat.org/activities/immas/imma-criteria/)

of relevance to both fishing communities and maritime businesses operating in the Banda-Ceram Seas.

- Identification of major conflicts between ocean user groups, such as:
  - Offshore energy versus pelagic fisheries/marine resource management, e.g., the potentially devastating impact of seismic surveys for oil and gas exploration on fish larvae and zooplankton, as detailed in this report based on McCauley *et al.* 2017)
  - Marine debris versus marine tourism potential (including whale watch potential)
- Ensuring compliance with various international bycatch reduction initiatives that may block or restrict access for Banda-Ceram Seas tuna and other commercially important pelagics to major markets, including the U.S., E.U., and others. In January 2017, the U.S., the world's largest seafood importer, put in place new import restrictions under the MMPA (see also Williams et al, 2017).

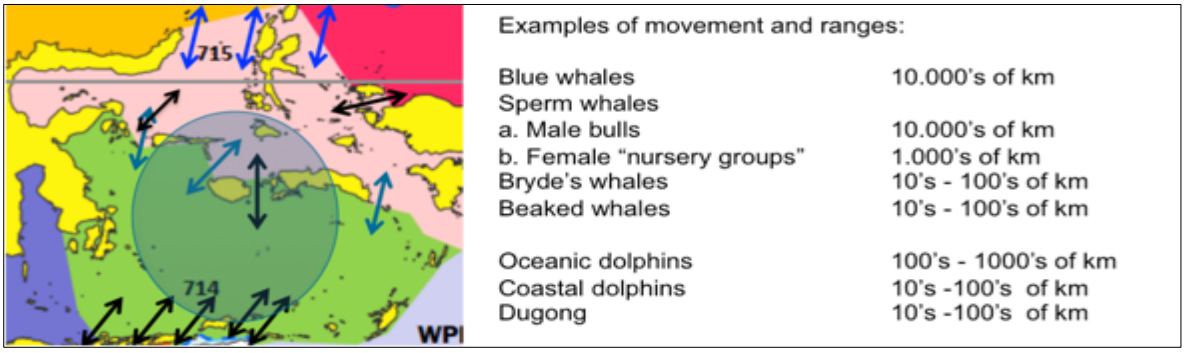


Figure 3-9. Movement ranges for migratory and residential marine mammals in FMA 714 and FMA 715 (from Kahn 2017) – For highly mobile migratory and wide-ranging yet residential marine mammals, critical habitat-based/MSP initiatives and MPA networks can be highly effective management tools, providing ecological corridors and migratory bottlenecks; feeding, calving and mating grounds; critical inter-island passages for local movements; and FMA approaches to reduce any cetacean-fisheries interactions and prey depletion for marine mammals

1.9. 3.3. INITIAL THREAT ASSESSMENT FOR CETACEANS IN THE BANDA-CERAM SEAS[8]

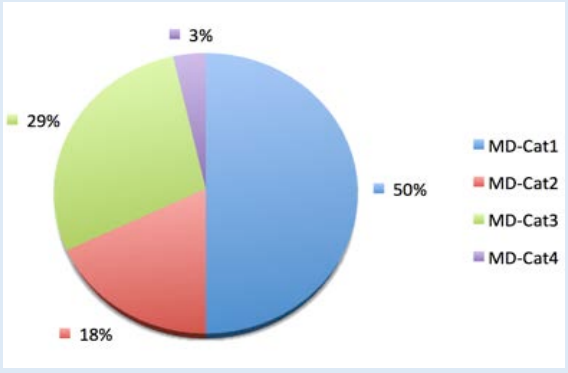
3.3.1. MARINE DEBRIS IN THE CERAM SEA

In addition to investigating marine mammal biodiversity, distribution, abundance and habitat use of this region, the other important component of the survey was a baseline threat assessment for marine mammals. The major and immediate threat identified was the prevalence of marine debris, particularly plastic pollution, throughout the REA area (see Kahn 2017).

The 2017 Ceram Cetacean REA recorded much less marine debris than in November 2016. The MD fields often included other types of debris in addition to plastic litter, such as floating logs, clothing, wood, shoes, bags, and all sorts of household wastes. Both the total number of MD fields (n=28) and the number of the more extensive MD Cat3-Cat4 were

[8] Threats to marine mammals in the Banda and Ceram Seas are further identified and described in Kahn 2017.

substantially reduced (Figure 10 and 11, Kahn 2017). However, this apparent improvement over the devastating plastic trash densities recorded in 2016 may be attributed to local rainfall patterns (and subsequent run-off from land). While there was a notable difference in the density of plastic trash, the same patterns of marine debris distribution were evident. Most of the trash fields were recorded in Ambon Bay and surrounding waters (Figure 3-11).



A relative scale was used from Category (Cat) 1 (minor field) to Cat4 (a vast, expansive field with trash also distributed in the water column 5-10m depth). In addition to their negative impact on marine biodiversity, Cat3 and Cat4 fields are a shipping hazard. Cat4 fields in particular are a challenge to avoid while navigating, routinely resulting in plastic trash uptake into the cooling water filters for the survey vessel main engine, risking overheating and engine failure. The risk of engine damage from marine debris intake is substantial, even on cut-trough courses with minimal exposure of the survey vessel to the trash (as opposed to running on a parallel course along or inside the trash field direction). Throughout the survey, the cooling water intake was specifically monitored for this risk and any trash was removed.

Figure 3-10. Marine debris (MD) fields recorded throughout the daytime survey effort during the 2017 Ceram Sea Marine Mammal REA – Cat5 fields were not observed during the 2017 REA. Overall, the marine debris was much reduced compared to the 2016 REA, possibly due to seasonal variations in rainfall and subsequent run-off. The majority of MD sightings was recorded near urban centers and appeared to be the result of local point-source pollution. Kahn (2017) has further details on local management measures on local waste management for the Banda and Ceram Seas.

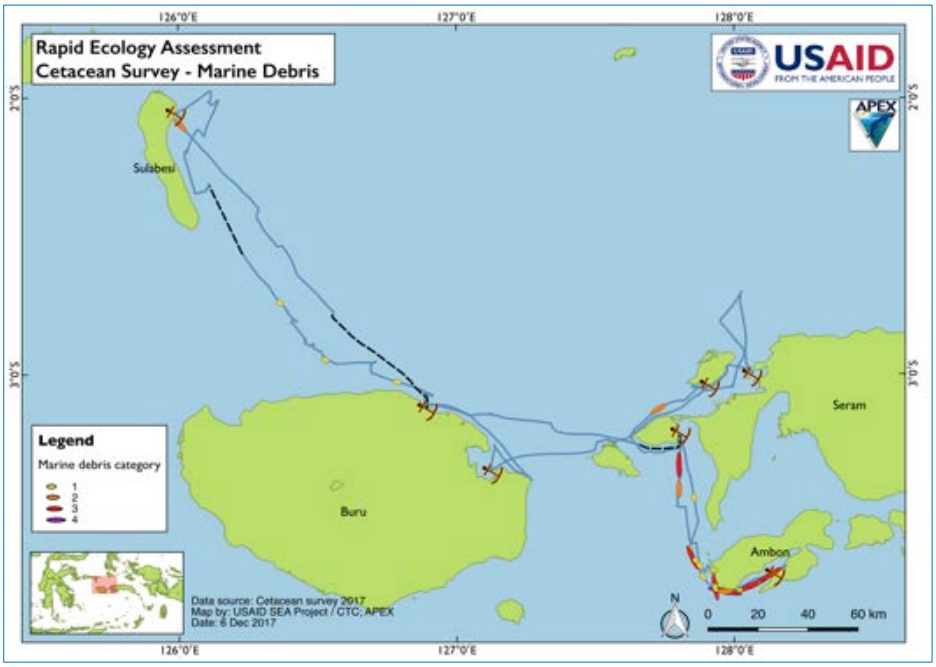


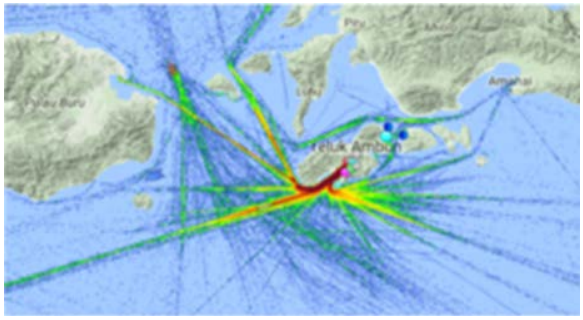
Figure 3-11. Marine debris trash fields (n=28) according to size (and impact) categories as recorded during the 2017 Ceram Sea Marine Mammal REA

The impact of marine debris on cetaceans, which as a group are especially vulnerable to accidental ingestion of plastic trash as well as long-term chemical loading of pollutants, and the marine ecosystem as a whole is a major priority from both conservation and food security perspectives. In December 2017, the annual United Nations Environment Assembly prioritized the issue as an "existential threat." More than 200 nations passed a resolution to

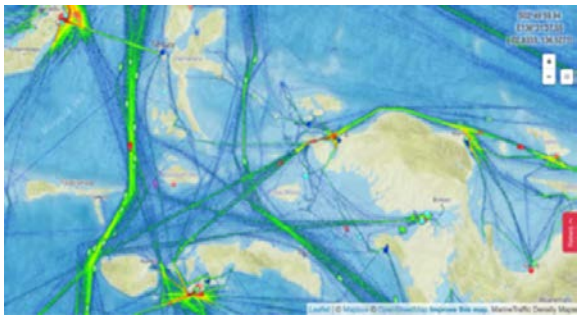
eliminate plastic pollution in the ocean. Indonesia, being one of the worst contributors globally to marine debris, has a special responsibility to address this problem, also with a regional perspective. It is important to note that urban centers in relatively remote settings such as Ambon have experienced rapid growth in both population and industrial activities, without adequate advances in waste management (see Kahn 2017 for a more detailed account of the marine debris issue in the northern Banda Sea and recommendations on waste management).

3.3.2. DOMESTIC & INTERNATIONAL SHIPPING ACTIVITIES IN THE BANDA-CERAM SEAS (FMA 714-715)

The key attibutes of maritime transportation in the Banda-Ceram have been detailed by Kahn (2017). The Ambon-Ceram-Buru region is one of the busiest maritime transport regions in remote east Indonesia (Figure 3-12), and shipping activities there overlap substantially with marine mammal habitats,[9] making potential negative impacts from shipping (e.g., whale-ship strikes, pollution from busy local vessel routes and international sea lanes) of utmost concern. The REA recorded a diverse array of vessel types, ranging from local canoes to speed-boat tuna fishers, mini purse seiners, interisland ferries, local cargo vessels and navy frigates, to ocean industries' oil and gas support vessels, tow boats and barges, Panamax (300m x 50m) bulk carries, conventional oil tankers and LNG gas tankers. All these vessel types were photo-documented during the REAs (Figure 3-13).



Domestic shipping: Ambon is clearly visible *as the major shipping hub for domestic shipping* in northeastern Indonesian waters (bottom of figure: red, yellow and green thin lines, variable heading but strong east-west component,). Bitung, North Sulawesi is another major port. The main difference from Ambon is that Bitung has a mix of international and domestic vessel traffic (red area top left of figure).



International shipping: This is mostly concentrated along the western side of Buru Island, as part of Indonesia's archipelagic sea lane network. There is a secondary shipping passage through Manipa Strait (between east Buru and west Ceram). International vessel traffic has a strong north-south heading component, and consists for a substantial part of 'Panamax' bulk carriers and liquefied natural gas (LNG) tankers from/to Australia-China/Korea. The international traffic of large cargo vessels and LNG tankers is estimated to expand many fold in the next years with China's economic growth and shift from coal to gas as its main energy source.

Figure 3-12. Vessel density heat map and major shipping lanes within FMA 714 and FMA 715 (Map source: www.marinetraffic.com, summary graph of all vessel movements for 2016 based on Automatic Identification System (AIS), accessed 14 November 2017)

[9] See Kahn and Vance-Borland (2013) and Kahn et al. (2015) Kahn, Djohani and Vance-Borland (2016) for a regional overview of overlap between EBSAs – ecologically and biologically significant areas – and ocean industries. and recommendations to move "Towards an responsible ocean industries in the Coral Triangle". Kahn's report on the Banda Sea Marine Mammal REA (2017) includes a detailed account of shipping, local ports and the linkage of these stakeholders to waste management.

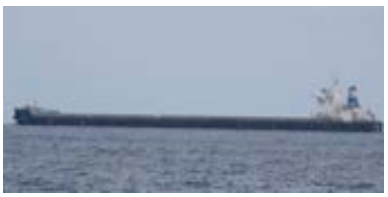
A. LNG Tanker – International sea-lane off Sanana Island

B. Bulk carrier – Manipa Strait

C. Tanker – Manipa Strait

D. Local fishing boats – Sanana harbor

E. Panamax bulk carrier – International sea lane, Buru-Sanana



F. Tanker - International sea lane, Buru-Sanana

G. Long tow (200m) – N Buru

H. Cargo vessel – Manipa Strait

I. Fast ferry passing oil and gas support vessel – west Ambon

J. Local tanker – Boano Strait

K. Navy vessel – west Ambon

L. Oil and gas support vessel – west Ambon

M. Coastal gillnet fisher – Sanana

N. Tuna (kite) fisher – north Buru

O. Coastal hand line fisher – Sanana

Figure 3-13. Vessel categories encountered during the 2017 Ceram Sea Marine Mammal REA

3.3.3. SEISMIC SURVEYS IN THE BANDA-CERAM SEAS (FMA 714-715)

Another potential threat to marine mammals is the increasing number of seismic surveys from the oil and gas industry being conducted in east Indonesia. These activities (e.g., the BandaSeis 2D survey, Figure 3-7) generate extremely loud noise levels underwater that cover a vast area and may injure deep diving marine mammals. Recent studies off Tasmania, Australia using industry-conformant equipment and settings (McCauley et al., 2017) have established that seismic surveys affect many species of marine life and, importantly, kill plankton as well as fish larvae within several kilometers of the air gun array ("ocean death zones").

The Banda-Ceram Seas have been identified as a regional stronghold for beaked whales, a species group that is especially vulnerable to extreme ocean noise (see Section 0 above). The ramifications of this groundbreaking study go well beyond cetacean conservation and have direct bearing on recruitment of fish (including tuna) and fisheries management for the productive tropical tuna fisheries of the Banda and Ceram Seas.

3.3.4. FISHERIES INTERACTIONS WITH CETACEANS IN THE BANDA-CERAM SEAS (FMA 714-715)

The main fisheries interaction with cetaceans that was observed during the survey relate to the close association of tuna (kite) fisheries with large pods of oceanic dolphins that seem to be residential or at least have high seasonal site fidelity.

The tuna fishing "fleet" routinely numbers 10-15 boats, working in close proximity to each other. Fishing activities are conducted well offshore and have not yet been observed near the FADs or rumpons, which are rapidly expanding throughout the region (see Section 0 below). Instead, on a regular basis, tuna fishers seem to rely on cues from dolphins and seabirds to find their preferred fishing grounds.

These observations (and at times actual areas) are identical to the 2016 REA. The typical tuna hand-line speedboats used in this region are almost always working in overlap with large dolphin pods, especially spotted and spinner dolphins. The boats routinely crisscross through the pods at full speed to position their lures in front of the perceived travel direction of the dolphins and the tunas that swim underneath the dolphins (Figure 3-2E). While the risk of entanglement seems minimal, the risk of a propeller strike and the chronic noise pollution in this blue water habitat are two potential threats to these dolphins. Outboard noise may mask prey sounds and socialization calls, although long-term impacts on the population level may be minor, as the dolphins are likely to get habituated to fishers' activities and would have periods of respite during the night and during bad weather.

3.3.5. RAPID EXPANSION OF COMMERCIAL FADS IN THE BANDA-CERAM SEAS

The two REAs were conducted less than 12 months apart but there was a striking difference between the two assessments in the number of FADs or rumpons recorded, due primarily to the rapid expansion of pelagic FADs anchored offshore in the surveyed areas (Kahn 2017). Both the west Ceram, Manipa, Boano and Buru regions have such concentrations of FADs that vessel navigation through these areas at night has become very hazardous. A similar situation has been documented off wouth Ambon to Nusa Laut and off the Banda Neira Island group (Kahn 2017), as well as other regions of east Indonesia such as along the entire coast of North Flores. Off east Buru and west Ceram, blue whales were tracked while swimming through a series of such FADs. Whether the blue whales could actually detect and avoid such obstacles (poly-ropes to the seafloor at charted depths of 3000m or more) or only moved safety through this area by sheer luck, could not be determined.

Major "clusters" of pelagic FADs were observed during most days of the REA (Figure 3-14), many of which were not in place during the 2016 REA, for example, along the west Ambon-west Ceram-Manipa survey route. Many FADs observed through the current REA included new white floats/buoys and new bamboo structures (i.e. Kahn 2017) that appear to be non-

compliant with current Food and Agriculture Organization (FAO) guidelines and national fisheries regulations by the KKP.

The REA observations may be useful for stakeholder discussions among KKP and various pelagic fisheries experts on the seemingly out-of-control expansion of FADs in the waters so far surveyed in the Banda-Ceram Seas. [10]

Figure 3-14. Map showing major clusters of FADs or "rumpon" (red boxes) as often seen during the Ceram REA; photo at right shows an example of a pelagic FAD off Manipa Island

[10] See overview and discussion on FAD management options at *https://news.mongabay.com/2017/02/fish-magnet-boom-creates-headaches-in-indonesias-war-on-overfishing/*

SECTION 4. CONCLUSIONS

Overall, the combined 2016 and 2017 Marine Mammal REAs visual and acoustic results confirm exceptional marine mammal species biodiversity, with wide distribution and relatively high abundance, throughout the Banda-Ceram waters covered so far. In addition, the oceanic habitat diversity is equally exceptional with several outstanding features that are of regional and indeed global significance.

The relative abundance of blue whales in the Banda-Ceram Seas for several months of the year (with July-November being the main 'season') 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. This further confirms the REA's main finding that the Banda-Ceram region is indeed an exceptional and new cetacean hotspot both for Maluku Province and for Indonesia.

In addition to the significant biodiversity and ecological results on blue whales, dolphins and the dugong, the REA has provided 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 information that will assist with the ongoing MSP in Maluku Province and its development of new MPA networks. The relevance of such information to the large-scale management of FMA 714 and FMA 715 has also been an important outcome. Furthermore, the potential for economic opportunities, such as, for example, from responsible whale watch, has increased substantially due to the REA's outcomes (see Kahn and Hennicke 2017 for an overview of whale watch development from an operator's perspective).

Several local threats to Maluku's marine mammals have been identified. The excessive plastic trash and marine debris as recorded throughout the survey area is the threat that is most urgent to mitigate. Dense vessel traffic in both domestic and international shipping routes was identified as a secondary threat. For domestic vessels, shipping is directly related to marine debris (discards at sea, lack of sufficient waste management for Ambon's two ports).

Importantly, the REA has increased awareness and active participation among 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 surveys and capacity building will be vital for any marine mammal conservation programs in the future.

SECTION 5. RECOMMENDATIONS

The 2017 REA has further underlined the recommendations of the 2016 Marine Mammal REA (Kahn 2017, see Appendix 1) that are also highly relevant to this report.

1.10. 5.1. SITE-SPECIFIC RECOMMENDATIONS FOR MALUKU PROVINCE

- Conduct outreach to and engage with local, provincial and national stakeholders on the main outcomes of both REAs to date and their relevance to:
  - Endangered megafauna species management, including responsibilities for sustainable fisheries programs and marine mammals
  - MSP and oceanic habitat conservation, including MPA network design
  - Review and evaluation of existing coastal MPAs in FMA 714 and FMA 715 that may have nearshore yet deep-sea features and established boundaries nearby
  - Best practices for ocean industries
  - Pelagic fishing, including FADs
  - Shipping (local routes and international sealanes)
  - Oil and gas (seismic exploration, nearshore and offshore operations, supply activities)
  - Marine and adventure tourism potential (e.g., responsible whale watching).
- Conduct marine debris monitoring and assessment – mapping of accumulations of plastic litter (often in productive current lines and oceanic fronts), assessing impact on marine life including cetaceans, educational programs.
- Broaden/leverage main outcomes to other provinces and national marine conservation initiatives.
- Establish outreach and environmental awareness initiatives for marine conservation.
- Engage local marine-based user groups in volunteer sighting programs (training on data collection) and awareness programs for Ambon, Ceram, Buru and Sanana (main urban centers and regional ports).
- Engage local, provincial and national stakeholders with an interest in marine debris in efforts to address major threats to cetaceans and other marine life in the Banda and Ceram Seas from the excessive plastic trash that gets dumped in local waters. Waste management actions may be centered on Ambon's two harbors, Kayeli Bay in Buru, and Banda Besar.
  - Provincial and national government:
    - (i) Governor's and Mayors' Offices
    - (ii) Ministry of Fisheries, Ministry of Tourism, Coordination Ministry of Maritime Affairs – for marine debris policy and national action plan
    - (iii) Military – TNI-AL (Ambon Bay naval base)
  - Ocean industries
    - (i) Ferry and local shipping routes

(ii) Regional ports, International Maritime Organization (IMO), offshore energy

- Universities and local non-governmental organizations (NGOs)

- Conduct desktop study to establish an ecological profile of deepwater and oceanic habitats in the Banda and Ceram Seas (FMA 715-714), with emphasis on those habitats associated with oceanic cetaceans and other large marine life – This approach was used for another large-scale marine region, the Lesser Sunda Seascape including Indonesia and Timor Leste (Kahn 2008) and proved very valuable for subsequent MSP initiatives.
- Organize several 2-day technical workshops throughout the region, with emphasis on (i) field training techniques and building skills of marine monitoring teams, (ii) conservation and management for decision-makers, and (iii) policy development – Ideally these capacity building activities should include a modest field component such as a 1-2 day hands-on training at sea on species identification and data recording.
- Undertake additional Marine Mammal REAs, especially in highly data-deficient areas in FMA 715 (Halmahera), and support ecological studies on blue whales.
  - Further REAs may have an expanded training component and may be combined with workshops (if planned to coincide with proper field seasons).
  - Cetacean REAs will be crucial to further support MPA development and responsible whale watch development for east Indonesia.
  - The Cetacean REAs for FMA 714 and FMA 715 can be separated under two main goals: (i) To expand on existing knowledge gaimed from previous "first-pass" surveys (e.g. West Ambon-West Ceram-Buru and Nusa Laut-Banda Neira), and (ii) to explore new and highly data-deficient AOIs (e.g., South Halmahera)
  - Cetacean REAs can also be restructured to include other field work priorities for USAID ranging from marine debris monitoring and assessment (e.g., conduct nano plastic tows in proximity to blue whale sightings; establish a 'base-line" for plastic litter impact on oceanic hotspots) to fine-scale FAD mapping in AOIs and fine-scale cetacean studies, such as on fisheries interactions, including local tuna fishers' interactions with large dolphin pods (mixed spinner-spotted dolphins)

1.11. 5.2. SPECIES-SPECIFIC RECOMMENDATIONS

- Assign the blue whale as a "flagship species" for Maluku Province and initiate a draft Provincial/National Conservation Action Plan for Indonesia's Blue Whales.
- Include critical habitats for blue whales and other cetaceans (including the dugong) in MSP and MPA network designs and development.
- Assign core AOIs and integrate these with potential candidates for new MPAs that have been shortlisted. These areas may be further developed in stakeholder meetings and workshops.
- Develop and implement education and awareness (outreach) programs to socialize the special status of the waters of the Banda-Ceram Seas for blue whales and other

spectacular marine life (i.e. sperm whales, seasonal aggregations of schooling hammerheads). These exceptional natural assets need to be adequately valued and protected if their substantial tourism potential is to be fully realized.

- Conduct additional survey work for other priority species such as sperm whales, beaked whales, orcas, pilot whales, false killer whales (some species may have seasonal patterns in distribution and abundance) and their role in the marine ecosystem of the Banda-Ceram Seas.

ANNEX: RECOMMENDATIONS FROM THE 2016 MARINE MAMMAL REA

A1.1. RECOMMENDED NEXT STEPS

The recommended next steps for this project include the following (Kahn 2017):

- Socialize main outcomes and recommendations of the REA Technical Report.
- Work towards integration within ongoing MSP projects – and especially support for the development of a provincial network of MPAs for Banda and Ceram Seas.
- Follow up from REA's main outcomes and recommendations:
  - Capacity building: Additional workshops and intensive training courses (as detailed below).
  - Additional Maluku Province Marine Mammal REAs and surveys, especially in FMA 715, specifically:
    (i) AOI 4: Ceram – Buru – Obi (as detailed below)
    (ii) AOI 5: Halmahera
    (iii) All waters, 2 REAs
    (iv) AOI 6: S Banda Sea (FMA 714)
- Technical support for marine mammal management and threat mitigation in Maluku Province, including:
  - Threat assessment (work with national plastic debris initiatives; ferry waste management; oil and gas exploration; sea-lanes)
  - Species- and habitat-specific conservation projects

A1.2. PROPOSED WORKSHOPS

- **The Banda Sea Cetacean Workshops: Intensive training courses on deep-sea ecology and cetaceans of the Banda - Ceram Seas and their associated oceanic habitats**

  Overview: The 2-day workshops held in conjunction with the Banda - Ceram Seas Marine Mammal REA will be conducted as 'intensive training courses" on cetacean ecology and habitat use, treats and economic opportunities, as well as conservation issues, with emphasis on locally abundant species.

  Workshops will also be a platform to invite feedback from local communities and integrate community-based knowledge into habitat and human resource use maps.

- **Capacity Building: Maluku Cetacean Management Workshops**

  The IUCN's Action Plan for whales and dolphins specifically mentions "Intensive training courses" as a priority activity for Southeast Asia, and for good reason: The lack of marine mammal capacity in Indonesia - including highly skilled observers, ecological specialists and managers throughout – is a key reason why many whale

and dolphin species and populations within the region are so poorly known and classified as data deficient.

In conjunction with the Banda-Ceram Seas Marine Mammal REA, capacity building workshops are recommended at three key training sites in Maluku. Participants will obtain a thorough understanding and hands-on skills to be involved in marine (mammal) conservation initiatives in the future. These 2-day "intensive training courses" will include several components:

- Major oceanographic features that make the waters of Maluku a unique and highly productive part of east Indonesia, and indeed in the Coral Triangle
- Introduction to the deep-sea and pelagic ecosystems of Maluku waters
- Cetaceans of the Banda-Ceram Seas and their associated oceanic habitats, including local knowledge of whale and dolphin species, their distribution, ecology and habitat use
- Species identification and monitoring of cetaceans in Maluku waters: Hands-on training to improve identification skills of cetaceans at sea.
- Current and emerging threats to marine mammals in Maluku, including fisheries interactions, offshore industries, shipping, local marine resource overexploitation, ocean noise
- Socioeconomic opportunities with whale hotspots and key operational and management challenges for whale watching (Hoyd 2001, Kahn and Hennicke 2017).
- Conservation and management opportunities and challenges: Potential for expansion of the cetacean and/or deep-sea habitat component of the Maluku MPA Network

All workshop components will include an emphasis on locally abundant species and conservation options for priority species such as the Banda Sea blue whales. Stakeholders targeted for this training include local and provincial government officials, staff of local NGOs (i.e., the marine monitoring teams, education and community liaison officers), provincial universities, local fishing communities and marine tourism (especially dive operators, both local resorts and live-aboard)

The workshops are also designed to:

- Share the latest outcomes of the Banda Sea Marine Mammal REA
- Record recent whale and dolphin sightings by community members
- Encourage stakeholder feedback on their long-term sightings and perceptions of whale and dolphin diversity, distribution, abundance, movements
- Assess the cultural importance of marine mammals in local folklore and heritage
- Build long-term partnerships and active collaborations with local stakeholders

A1.3. THE CERAM-HALMAHERA SEAS MARINE MAMMAL REA

Title: A Rapid Ecological Assessment of Whales and Dolphins and their Associated Oceanic Habitats in the Banda Sea - Visual and Acoustic Cetacean Surveys & Boat-based Field Training

Overview: The Ceram-Halmahera Sea Marine Mammal REA will build upon the success and outcomes of the current REA. The 10-day REA will survey hitherto largely unknown waters to the north of Ambon (southwest-northwest Ceram, Buru, Obi and nearby islands). Thus this REA make a significant contribution to the marine mammal survey efforts in Maluku Province to date, specifically by:

- Addressing a major data gap in current knowledge on this region's marine mammal biodiversity, distribution and relative abundance
- Starting to identify preferred and critical deep-sea habitats for oceanic cetaceans, with emphasis on priority species such as the blue whale (*Balaenoptera musculus*)

In addition to making a significant contribution to scientific understanding of this remote part of Maluku Province, REA activities will:

- Provide an invaluable field training opportunity for the marine monitoring teams of stakeholders. On-board training will be conducted for environmental government agencies, NGO monitoring teams and community members.
- Provide site- and species-specific outcomes which will be highly useful for ongoing MSP initiatives, including MPA design for the ecoregion and best practices for offshore industries (oil and gas, shipping)

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