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# OPPORTUNISTIC OBSERVATIONS ON THE DISTRIBUTION OF CETACEANS IN THE MALAYSIAN SOUTH CHINA, SULU AND SULAWESI SEAS AND AN UPDATED CHECKLIST OF MARINE MAMMALS IN MALAYSIA

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***ABSTRACT.*** — Opportunistic observations for cetaceans were conducted during the 2009 Prime Scientific Sailing Expedition, onboard the Royal Malaysian Navy Hydrographic vessel, KD PERANTAU. A total of 21 days was spent conducting observations in the Malaysian waters of the South China, Sulu and Sulawesi Seas. The survey yielded a total of 27 sightings and comprised (in order of frequency) the spinner dolphin (*Stenella longirostris*), bottlenose dolphin (*Tursiops* sp.), pantropical spotted dolphin (*S. attenuata*), unidentified dolphins, and an unidentified species of whale. The depth range for spinner dolphins ranged from shallow continental shelf depths to deep waters beyond the shelf. Similarly, bottlenose dolphins were found both in inshore and offshore waters, and based on external morphology, were likely to be *T. aduncus*. Despite reported high cetacean diversity in neighbouring countries such as the Philippines and Indonesia, the diversity of cetaceans observed during the expedition was low, perhaps owing to seasonal oceanography. Although opportunistic in nature, the survey provided a rare opportunity to study the diversity and distribution of cetaceans in deeper offshore waters that are otherwise difficult to reach by smaller vessels. The results here emphasise the need for further dedicated cetacean research in the pelagic waters of the South China, Sulu and Sulawesi Seas. This paper also uses data from the opportunistic survey and other records collated by the author to construct an updated checklist of marine mammals in Malaysia as a means of providing the most comprehensive overview of confirmed species records in the country and to further assist future research and conservation plans.

***KEY WORDS.*** — cetacean, distribution, diversity, checklist, South China Sea, Sulu-Sulawesi Sea

## INTRODUCTION

Knowledge on the distribution of marine mammals throughout most parts of Malaysia remains basic and poorly documented. Information on species occurrence is provided in published historical literature (Lydekker, 1901; Bank, 1931; Gibson-Hill, 1949, 1950; Fraser, 1956; Lewin, 1958; Harrison & Jamuh, 1958; Harrison, 1960; Berry et al., 1973; Ratnam, 1982; Payne et al., 1985; Abdul, 1986), more recent reports (Beasley & Jefferson, 1997; De Boer, 2000; Jaaman, 2004), and from coastal, inshore surveys in selected areas (Nadarajah, 2000; Bali et al., 2008; Minton et al., 2011). Marine mammal occurrence and distribution in Malaysia has also been reviewed and summarised previously by Beasley & Jefferson (1997; for Borneo), Jaaman et al. (2002; for Peninsular Malaysia), and Jaaman (2004), who reported a total of at least 22 species that either reside in or pass occasionally through Malaysian waters.

In 2009, the National Oceanographic Directorate (NOD) under the Malaysian Ministry of Science, Technology and Innovation (MOSTI), organised the 2009 Prime Scientific Sailing Expedition (EPSP). The core aims of the expedition focused on physical oceanography, however, research proposals from other areas of marine science were also welcomed, and a proposal to conduct marine mammal observations during the survey was accepted, allowing two full-time observers to join the cruise. The expedition was thus seen as an opportunity to collect data on the diversity and distribution of cetaceans in the offshore areas of the Malaysian South China Sea, as well as the Malaysian Sulu-Sulawesi Sea region, which are typically more difficult to survey due to the costs and logistics involved in working long distances from land. Surveys like the one reported here, though opportunistic in nature, are important for adding on to the knowledge base of marine mammals in Malaysia, which at present remains relatively small. Such lack of information can lead to difficulty in developing effective conservation and management plans, and can also lead to cetaceans being left out of consideration during environmental impact assessments in areas targeted for development or human activity. Additionally, with more recent developments in the

field of marine mammal studies in Malaysia, an increased number of species has been recorded in the country, both from live sightings and stranding records. In this paper, an updated checklist of marine mammals in Malaysia using confirmed records collated by the author is also presented, as a reference base for future research efforts in the various parts of the country.

## MATERIAL AND METHODS

***Opportunistic survey sites and survey period.*** — Marine mammal observations were conducted during the EPSP organised by the NOD. The four-leg expedition was multidisciplinary in nature, covering physical, chemical, and biological oceanography, and was conducted onboard the 68-meter long Royal Malaysian Navy Hydrographic vessel, KD PERANTAU. The vessel departed from Port Klang, on the western Peninsular Malaysian seaboard and travelled to the South China Sea (SCS), and Sulu and Sulawesi Seas (SSS) (Fig. 1). The expedition lasted 45 days, beginning on 18 Jun.2009 and ending on 1 Aug.2009, however, marine mammal observations were conducted for 21 days in Jun. and Jul.2009 only (Table 1). The first leg in the South China Sea followed a series of parallel line transects. These transects started within 20 nautical miles of the Sarawak coast and extended well offshore, however, remaining within the 200-nautical mile limit of the Malaysian Exclusive Economic Zone (EEZ). Each of these transects had multiple oceanographic sampling stations in which the vessel stopped for researchers to collect data. The vessel travelled non-stop during both daylight hours and night, in its mission to complete all sampling stations. During the second leg of the expedition, survey tracks were centred around the Spratly Islands, while in the third leg, the vessel moved from Kota Kinabalu south to Sipadan Island following a series of pre-determined sampling stations. Due to exceptionally rough weather, marine mammal observations could not be conducted on the fourth leg in which the research vessel travelled the reciprocal route of the third leg.

***Cetacean observations.*** — Observations were made during daylight hours while the vessel was in transit, either from port to a sampling station, or between sampling stations. These observations were made when the research vessel was cruising at speeds no greater than 12 knots and weather conditions were fair. Observations were terminated at sunset, when darkness fell, or when it rained heavily and/or the sea state was greater than 3 on the Beaufort scale. Two observers were placed on the bridge of the research vessel, at 12.9 m above the sea surface. Both observers used Nikon 7x50 CF WP binoculars to search for cetaceans. Each observer searched for the presence of cetaceans in a 90° arc from the bow of the vessel to the starboard and port sides respectively, rotating between using both naked eyes and binoculars every 10 minutes.

When a cue (e.g. splash, blow, birds) was sighted, a GPS waypoint was recorded and efforts made to identify the species, its group size and composition, behaviour, distance,

Table 1. Summary of observations conducted during Legs 1–3 of the 2009 Prime Scientific Sailing Expedition, as well as search effort (hours and distance) in sea states 0 – 3 on the Beaufort Scale.

| Leg | Survey area | Survey period | No. of days | Search effort (hours) | Search effort (km) | No. of sightings | Encounter rate (groups/hour) | Encounter rate (groups/km) |
|---|---|---|---|---|---|---|---|---|
| 1 | South China Sea | 20 Jun. – 2 Jul.2009 | 10 | 78.67 | 1506.17 | 21 | 0.27 | 0.014 |
| 2 | Spratly Islands | 3 Jul. – 8 Aug.2009 | 6 | 33.85 | 684.46 | 2 | 0.06 | 0.003 |
| 3 | Sulu-Sulawesi Sea | 15 Jul. – 22 Jul.2009 | 5 | 15.15 | 314.64 | 4 | 0.26 | 0.013 |
| **TOTAL** | | | **21** | **127.67** | **2505.27** | **27** | | |

and angle from the research vessel. The observers worked mainly in 'passing mode' (i.e. observers made the best effort to identify the species and determine group size while the research vessel continued along its course) and occasionally in 'closing mode' (i.e. observers stopped searching for cetaceans and the vessel approached the group to confirm species identity and group size, and to take photographs) when possible (i.e. when the research vessel could afford the time to break away from the transect line).

***Data collection.*** — A log of activity and effort during each survey was kept in order to be able to distinguish between the times spent 'on effort' searching for cetaceans and times spent 'off effort' during other activities such as sampling stations or other breaks, moving in transit above search speed or observing and photographing a group of cetaceans. The weather and sea conditions during surveys were taken at hourly intervals or when the conditions changed. Information recorded during a sighting included initial sighting cue, species name, behaviour, group size (minimum, maximum, and best estimate), group composition, direction of travel, quantified human activity in the area, notes on appearance (especially if there were unusual characteristics), and associated species. The bottom depth at a sighting location was derived from the depth sounder that was fixed on the research vessel. Where depth readings were not available from the depth sounder, the charted depth of the sighting location derived from Malaysian Admiralty Charts was recorded instead.

***Checklist of marine mammals.*** — Three geographical regions of Malaysian waters were designated in order to arrange species records in the updated checklist. These were Peninsular Malaysia, Sarawak, and Sabah. Within each region, two subcategories of 'live sighting' and 'stranding' were created, in order to indicate the type of record for each species occurring in each region. As the checklist is an update of previously published checklists on marine mammals in Malaysia (i.e. Beasley & Jefferson, 1997; Jaaman et al., 2002; Jaaman, 2004), only published literature and more recent unpublished reports and observations with confirmed species identification were reviewed to expand and revise these previously published checklists. These records also include all media reports of sightings and strandings from 2007 onwards. When possible, the author visited the stranding site to confirm species identification. When it was not possible to do so, the author used photographs, including those in newspaper reports and videos provided by third parties to confirm species identification, and when necessary, consulted external cetacean experts. New species records for Peninsular Malaysia, obtained from more recent surveys conducted by the author were also included in the review and updating of this checklist.

## RESULTS

***Opportunistic survey effort.*** — In total, survey effort amounted to 21 days for all three legs of the expedition. A total of 2505.27 km over a period of 127.67 hours were spent actively searching for cetaceans in the South China Sea, around the Spratly Islands, and the Sulu-Sulawesi Sea (Fig. 1; Table 1). Of the total search effort, 55% (1375.37 km) was spent searching for cetaceans over continental shelf waters (0–200 m), 4% (98.36 km) in intermediate depths (200–500 m) and 41% (1031.54 km) in deep offshore waters (>500 m). However, the 55% of search effort over continental shelf waters did not include searching for cetaceans in coastal, nearshore habitats (<20 km from shore; Fig. 1).

***Species composition and encounter rates.*** — A total of 27 sightings were recorded during this survey including at least three species of dolphins in two genera, and one species of unidentified whale (Table 2). Cetaceans were encountered in continental shelf waters, intermediate depths and deep offshore waters (Fig. 1; Table 2). The spinner dolphin was the most frequently encountered species, with an encounter rate of 0.07 groups $h^{-1}$ and 0.36 groups 100 $km^{-1}$ respectively. Pantropical spotted dolphins were the least frequently encountered species, with an encounter rate of 0.02 groups $h^{-1}$ and 0.12 groups 100 $km^{-1}$. There were a total of 10 sightings of cetaceans that could not be identified to species level, including one unidentified whale that was sighted over the continental shelf of the South China Sea (Table 2). The whale could not be identified to species level as its blow was sighted near the horizon at sunset. A total of two sightings comprised mixed-groups of spinner and pantropical spotted dolphins.

***Observations on dolphin behaviour during opportunistic survey.*** — Highly evasive behaviour of the dolphins was observed during three of the nine spinner dolphin sightings and two of the seven bottlenose dolphin sightings. During these sightings, the dolphin group generally kept moving away as the vessel attempted to approach alongside the group, some darting away without even breaking the water's surface. Social and herd mating behaviours were observed in spinner dolphins on two occasions, whereby the dolphin group was very active and most individuals appeared to be harassing and in constant close body contact with a single individual that was in the middle of the group. Similar descriptions of

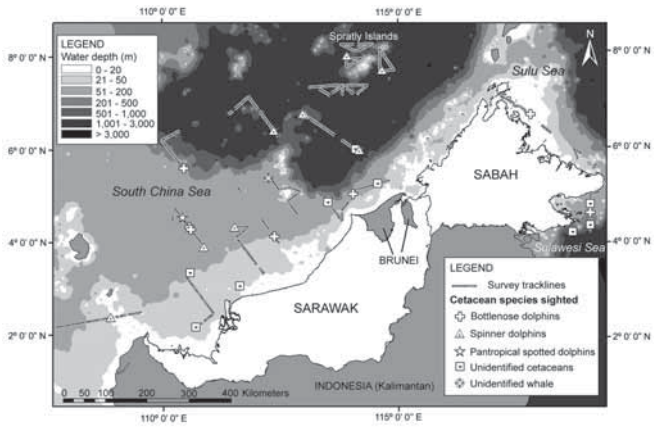


Fig. 1. Map showing the transect lines on which cetacean observations were conducted as well as the sightings of cetaceans that were encountered during the 2009 Prime Scientific Sailing Expedition.

Table 2. Summary of sightings recorded during the survey, including encounter rates, group sizes and depth distributions. EG/h = groups sighted per hour of search effort; EG/100 km = groups sighted per 100 km of search effort. n = sample size.

| Species | No. of sightings | Encounter rate | | Group size | | | Depth (m) | | |
|---|---|---|---|---|---|---|---|---|---|
| | | EG/h | EG/100 km | Range | Mean (n) | Std. Dev. | Range | Mean (n) | Std. Dev. |
| Spinner dolphin (*Stenella longirostris*) | 9[a] | 0.07 | 0.36 | 10–55 | 27.0 (9) | 12.6 | 30–1250 | 563.3 (9) | 586.7 |
| Bottlenose dolphin (*Tursiops* c.f. *aduncus*) | 7 | 0.05 | 0.28 | 1–75 | 29.3 (7) | 29.0 | 32–142 | 83.1 (7) | 35.4 |
| Pantropical spotted dolphin (*Stenella attenuata*) | 3[a] | 0.02 | 0.12 | 35–250 | 111.7 (3) | 120.0 | 108–1250 | 852.7 (3) | 645.4 |
| Unidentified cetaceans (excluding large whales) | 9 | 0.07 | 0.36 | 2–50 | 11.9 (9) | 16.0 | 42–1250 | 232.5 (9) | 392.1 |
| Unidentified whale | 1 | 0.008 | 0.04 | 1 | 1.0 (1) | — | 110 | 110.0 (1) | — |
| **TOTAL** | **27[a]** | | | | | | | | |

[a] Two sightings were of mixed spinner-spotted dolphin group sightings, hence total sightings is 27 and not 29.

such social behaviour in cetaceans have been described in Filatova et al. (2009), Ponnampalam et al. (2009), and Minton et al. (2011). A lone bottlenose dolphin was once observed following behind a fishing trawler in the shallow coastal waters of northeastern Sabah, while spinner dolphins were observed chasing fish on the surface on three occasions.

***Checklist of marine mammals.*** — A total of 27 species of marine mammals from 21 genera and seven families have been recorded in Malaysia. These comprise species that are known solely from stranding records, live sightings, or both. New species records for Peninsular Malaysia since the last published checklist (i.e. Jaaman, 2004) are the Omura's whale (*Balaenoptera omurai*), pygmy sperm whale (*Kogia breviceps*), pantropical spotted dolphin (*Stenella attenuata*), striped dolphin (*S. coeruleoalba*), and the pygmy killer whale (*Feresa attenuata*) (Table 3). The Omura's whale record was based on half a carcass that washed ashore in Pahang in 2008, and was identified as an Omura's whale based on the morphology of its skull (Wada et al., 2003; T. Yamada, pers. comm.). The pygmy sperm whale record was based on newspaper reports with clearly identifiable photos of an adult female whale stranded in Terengganu in 2009. The pantropical spotted dolphin record was based on a stranding on Langkawi Island in 2007, while the record of the striped dolphin was based on a stranding in Kedah in 2010. The last two incidents were communicated to the author, with photographs provided by third parties. The pygmy killer whale identification is based on a skull that was found at a beach bar in Tioman Island, and which, according to locals, was from a stranded juvenile individual several years ago.


Fig. 2. Map showing the locations of live sightings and strandings of various cetacean species in Peninsular Malaysia as listed in the updated checklist in Table 3. Each species' code on the map is according to the two-letter abbreviations listed in Table 3.

Table 3. Checklist of marine mammal species known to occur/have occurred in Malaysian waters based on sighting and stranding records. Two-letter abbreviations at the end of each species name denote species codes in Figs. 2 and 3. LS = live sighting record; ST = stranding record.

| Species | Peninsular Malaysia | | Sarawak | | Sabah | | Reference(s) |
|---|---|---|---|---|---|---|---|
| | LS | ST | LS | ST | LS | ST | |
| **Family Dugongidae** | | | | | | | |
| Dugong (*Dugong dugon*) - Dd | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | 1, 16, 21, 23, 25, 27, 28, 29 |
| **Family Balaenopteridae** | | | | | | | |
| Omura's whale (*Balaenoptera omurai*) - Bo | | ✓ | | | | | 29 |
| Bryde's whale (*Balaenoptera edeni*) - Be | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | 9, 6, 16, 24, 27, 28, 29 |
| Blue whale (*Balaenoptera musculus*) - Bm | | | | | | ✓ | 28 |
| Fin whale (*Balaenoptera physalus*) - Bp | | | | | ✓ | | 18 |
| Humpback whale (*Megaptera novaeangliae*) - Mn | | | ✓ | | | | 25 |
| **Family Ziphiidae** | | | | | | | |
| Cuvier's beaked whale (*Ziphius cavirostris*) - Zc | | | | | | ✓ | 20 |
| Ginkgo-toothed whale (*Mesoplodon ginkgodens*) - Mg | | ✓ | | | | | 13 |
| **Family Physeteridae** | | | | | | | |
| Sperm whale (*Physeter macrocephalus*) - Pm | | | | ✓ | ✓ | ✓ | 16, 18, 24 |
| **Family Kogiidae** | | | | | | | |
| Pygmy sperm whale (*Kogia breviceps*) - Kb | | ✓ | | ✓ | | | 6, 28 |
| **Family Delphinidae** | | | | | | | |
| Indo-Pacific humpback dolphin (*Sousa chinensis*) - Sch | ✓ | ✓ | ✓ | ✓ | ✓ | | 4, 5, 8, 9, 16, 17, 22, 25, 26, 27, 28, 29 |
| Irrawaddy dolphin (*Orcaella brevirostris*) - Ob | ✓ | ✓ | ✓ | ✓ | ✓ | | 1, 2, 3, 4, 7, 11, 16, 17, 22, 24, 25, 26, 27, 28, 29 |
| Indo-Pacific bottlenose dolphin (*Tursiops aduncus*) - Ta | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | 20, 22, 24, 25, 27, 28, 29 |
| Common bottlenose dolphin (*Tursiops truncatus*) - Tt | | | | | ✓ | | 24 |
| Long-beaked common dolphin (*Delphinus capensis*) - Dc | ✓ | ✓ | | | | | 3, 12, 27, 29 |
| Spinner dolphin (*Stenella longirostris*) - Sl | ✓ | | ✓ | | ✓ | ✓ | 18, 22, 24, 25, 29 |
| Pantropical spotted dolphin (*Stenella attenuata*) - Sa | | ✓ | ✓ | | ✓ | | 18, 20, 24, 27, 29 |
| Striped dolphin (*Stenella coeruleoalba*) - Sc | | ✓ | | | | | 27 |
| Fraser's dolphins (*Lagenodelphis hosei*) - Lh | | | ✓ | ✓ | | | 5, 24 |
| False killer whale (*Pseudorca crassidens*) - Pc | ✓ | ✓ | | | ✓ | ✓ | 18, 22, 24, 27, 29 |
| Pygmy killer whale (*Feresa attenuata*) - Fa | | ✓ | ✓ | | ✓ | | 18, 28, 29 |
| Melon-headed whale (*Peponocephala electra*) - Pe | | ✓ | ✓ | | ✓ | | 18, 24 |
| Rough-toothed dolphin (*Steno bredanensis*) - Sb | | | | ✓ | ✓ | | 24, 27 |
| Killer whale (*Orcinus orca*) - Oo | | | | ✓ | ✓ | | 4, 24 |
| Risso's dolphin (*Grampus griseus*) - Gg | | | | ✓ | | | 16, 24 |
| Short-finned pilot whale (*Globicephala macrorhynchus*) - Gm | | ✓ | | | ✓ | ✓ | 2, 3, 24 |
| **Family Phocoenidae** | | | | | | | |
| Indo-Pacific finless porpoise (*Neophocaena phocaenoides*) - Np | ✓ | ✓ | ✓ | ✓ | ✓ | | 1, 2, 3, 14, 15, 16, 20, 22, 24, 25, 26, 27, 28, 29 |

**References:** (1) Bank, 1931; (2) Chasen, 1940; (3) Gibson-Hill, 1949; (4) Gibson-Hill, 1950; (5) Fraser, 1956; (6) Harrison & Jamuh, 1958; (7) Lewin, 1958; (8) Harrison, 1960; (9) Mörzer-Bruyns, 1971; (10) Berry et al., 1973; (11) Ratnam, 1982; (12) Abdul, 1986; (13) Mead, 1989; (14) Duckworth, 1995; (15) Durville & Taylor, 1996; (16) Beasley & Jefferson, 1997; (17) Dolar et al., 1997; (18) De Boer, 2000; (19) Jaaman et al., 2000; (20) Jaaman et al., 2001; (21) Jaaman & Lah-Anyi, 2003; (22) Nadarajah, 2000; (23) Mansor et al., 2000; (24) Jaaman, 2004; (25) Bali et al., 2008; (26) Minton et al., 2011; (27) Confirmed third party report; (28) Newspaper report; (29) Recent survey by LSP.

The Bryde's whale (*B. edeni*) and ginkgo-toothed whale (*Mesoplodon ginkgodens*) were not included for Peninsular Malaysia in earlier checklists presented in Jaaman et al. (2002) and Jaaman (2004), but were already mentioned in Berry et al. (1973) and Mead (1989) respectively, and thus included in this updated checklist. Bryde's whales have also been sighted in more recent times in coastal Peninsular Malaysian waters, based on confirmed third party reports and recent surveys by the author (Ponnampalam & Jamal Hisne, 2011). Bali et al. (2008) reported a new species record for Sarawak, that is the humpback whale (*Megaptera novaeangliae*), which was sighted off the coast of Miri during an aerial survey in 2007. In Sabah, new species records are the blue whale (*B. musculus*), which, based on newspaper reports with clearly identifiable photos and online videos, had stranded in Kota Kinabalu in 2006, and rough-toothed dolphins (*Steno bredanensis*), which were photographed by divers off Layang-Layang Island in 2010 (G. Minton, pers. comm.). The complete updated checklist of species, along with its source of references, is listed in Table 3. The locations where live sightings and strandings have been recorded in Peninsular and East Malaysia according to the updated checklist are shown in Figs. 2 and 3 respectively.

## DISCUSSION

***Diversity and distribution.*** — Despite travelling through several different marine habitat types, the diversity of cetaceans throughout the opportunistic survey appeared to be low, with only three confirmed species of dolphins and one unidentified species of whale sighted. This was somewhat surprising, as deep-diving species such as sperm whales and short-finned pilot whales have been reported in several previous sources to occur around the Spratly Islands and surrounding waters (De Boer, 2000; Jaaman, 2004). The Spratly Islands lie north of the deep Palawan Trough and are relatively close to the Philippines, which has a high reported diversity of cetaceans (Dolar et al., 2006; Aragones et al., 2010). A combination of factors could have contributed to the surprisingly low cetacean diversity during the EPSP survey. The South China Sea has been reported to be low in productivity during the summer months (Liu et al., 2002). Low productivity could have meant that the amount of food resources available was not adequate to support a higher diversity of cetaceans. Several studies have shown that observed seasonal shifts in the distributions of certain cetacean populations are probably linked to the movement of their prey that is responding to seasonal oceanographic changes, and these prey are generally found in areas where chlorophyll levels are elevated (Davis et al., 2002; Tynan et al., 2005; Ballance et al., 2006). However, the absence of certain species within the study area may have also been attributed to seasonality in reproduction and migration patterns, of which data is limited. Another possible contributing factor to the low diversity could lie in the underwater noise emission from the large hydrographic survey vessel from which observations were conducted. As previously mentioned, several cetacean groups that were sighted showed evasive responses to the vessel. Evasive behaviour in the presence of large ships has been reported in certain species of marine mammals (Bryant et al., 1984; Finley et al., 1990; Cosens & Dueck, 1993). It is thus possible that cetacean species expected to occur in the survey areas, particularly more cryptic species such as beaked whales and species of the family Kogiidae, moved out of the area before detection by the observers. Finally, the low encounter rate and low diversity of cetaceans observed during this survey may be partially attributed to a bias in sighting ability resulting from having only two observers with limited or no opportunity to rest and rotate duties.

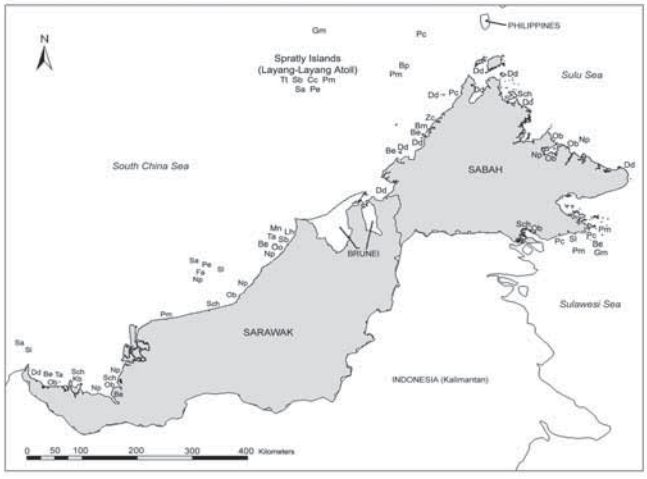


Fig. 3. Map showing the locations of live sightings and strandings of various cetacean species in East Malaysia as listed in the updated checklist in Table 3 (excludes sightings in Fig. 1). Each species' code on the map is according to the two-letter abbreviations listed in Table 3.

During the EPSP survey described here, spinner dolphins were found in both shallow and deep water in the South China Sea. While the majority of sightings were in open water, several were sighted around the Spratly Islands, suggesting that these animals may utilise reef areas for a certain portion of the day, as in locations like Hawaii and Fernando de Noronha (Norris & Dohl, 1980; Lodi, 1998). In neighbouring Philippines, spinner dolphins were also reported in both coastal and oceanic, shallow and deep water habitats in the Sulu Sea and Tanõn Strait (Dolar et al., 2006). Pantropical spotted dolphins were sighted only in the South China Sea and appeared to inhabit mainly deep water beyond the continental slope. The species was sighted twice in mixed groups with spinner dolphins, an association found commonly in the Eastern Tropical Pacific (Reilly, 1990) and that has also been observed in the Gulf of Tonkin, Vietnam (Smith et al., 2003), East Kalimantan, Indonesia (Kreb & Budiono, 2005), and the Gulf of Thailand, Cambodia (Beasley & Davidson, 2007). Similarly, spotted-spinner groups were sighted during past surveys in Sarawak waters, albeit in nearshore, shallow waters (Beasley, 1998). At present there remains scant information on these two stenellid species of dolphins in the South China Sea, aside from basic distribution data, perhaps due to their pelagic nature and the lack of research effort in pelagic waters. However, the pelagic waters of the South China Sea appears to be an area fit for future detailed studies on these species.

Bottlenose dolphins, although not the most frequently encountered species during the survey, were found in both the South China Sea and Sulu-Sulawesi Seas. Due to the nature of the survey and the difficulty in approaching cetacean groups, it was impossible to confidently determine whether sightings were of *T. truncatus* or *T. aduncus*. The latter species' distribution is considered as "widespread along the coastal waters of East Malaysia" (Jaaman, 2004: 10) and most sightings of bottlenose dolphins during this survey were over shelf waters at intermediate depths. Similar findings were reported for *T. truncatus* in the Philippines by Dolar et al. (2006). Photographs taken during bottlenose dolphin sightings show that the dolphins resembled *T. aduncus*. The animals that were photographed had slender rostrums, and comparatively smaller body sizes than that of *T. truncatus* (Wang et al., 2000). However, the animals were photographed from quite a distance, thus even when enlarged to maximum size, the photographs could not show clearly the presence of ventral spotting, which is common in *T. aduncus* (Wang et al., 2000). On several occasions during the survey, bottlenose dolphins were sighted in the vicinity of oilrigs, and as was also observed in the Philippines (Dolar et al., 2006), were observed once following fishing trawlers in the Malawali Channel, northeastern Sabah.

***Overview of new records in the updated checklist.*** — The knowledge base of marine mammals in Malaysia remains limited, with most of the current information obtained from more recent dedicated surveys in various areas of the country's coastlines. However, these surveys, along with reviews of the literature and existing newspaper and confirmed third party reports, indicate that the diversity of marine mammals that either reside or are transient in Malaysian waters is higher than previously documented. The Omura's whale, previously unrecorded in Malaysia, is now known to occur in the country's waters. As one of the newer species of whales to be classified by science in modern times (Wada et al., 2003), this new record of a species that remains poorly studied and is difficult to identify in the field is significant for Malaysia. Omura's whale had already been recorded previously in neighbouring Thailand, Indonesia, and the Philippines (Yamada et al., 2006, 2008; Aragones et al., 2010). It is possible that some previous records of Bryde's whales from Malaysia also represent misidentifications of this species, which at the time had not yet been described.

The stranding of the blue whale in Sabah, as well as the sighting of the humpback whale in Sarawak, indicate that Malaysian waters may occasionally host the passing through of large migratory whale species. Humpback whales are known to winter in northern Philippines, around the Babuyan Islands (Acebes et al., 2007), have been reported in the South China Sea (Slijper et al., 1964; Tan, 1997), from Vietnam (Smith et al., 1997), in East Kalimantan (Kreb, 2010) and even further south in Bali (Mustika et al., 2009). The blue whale has been sighted in the Philippines' Bohol Sea (Sabater, 2005), which is adjacent to the Sulu Sea, further south in Indonesian waters around the Komodo National Park and Flores Sea (Rudolph et al., 1997; Kahn et al., 2000) and has also been recorded from southern China (Rudolph & Smeenk, 2008).

It is likely that the ginkgo-toothed whale, which had stranded in 1954 in Melaka, along the Straits of Malacca, might have died elsewhere and drifted to shore. The Straits of Malacca is a relatively shallow body of water (17–55 m; Chua et al., 2000), with water depths that are not suited for deep-water dwelling beaked whales. The species probably occurs further north, in the deeper waters of the Andaman Sea, as a stranding of this species has been recorded in Thailand (Andersen & Kinze, 1999).

The more cryptic pygmy sperm whale, formerly recorded only from East Malaysia but now also recorded from Peninsular Malaysia, is also a species that is likely to be more common in Malaysian waters than previously thought, especially since it has also been recorded in Thailand (Chantrapornsyl et al., 1996), Vietnam (Smith et al., 1997) and the Chinese South China Sea (Zhou et al., 1995; Perrin et al., 1996). The lack of research effort in this species' deeper water habitat, along with its inconspicuous behaviour makes this species difficult to detect and observe. Recent confirmed sightings, strandings, and anecdotal accounts of 'blackfish' species such as the false killer whale and pygmy killer whale off the east coast islands of Peninsular Malaysia, along with previous known records from Sarawak and Sabah, indicate that these gregarious species are likely to be occasional transients in Malaysia's pelagic waters, and may occasionally approach the country's coasts and offshore islands. False killer whales have been sighted in neighbouring Thailand (Chantrapornsyl et al., 1996; Adulyanukosol et al., 2009) and Cambodia (Beasley & Davidson, 2007), while pygmy killer whales have been recorded in Thailand (Chantrapornsyl et al., 1996; Adulyanukosol et al., 2009), Vietnam (Smith et al., 1997) and from the Philippines' Sulu Sea (Dolar et al, 2006).

New records of the pantropical spotted dolphin and striped dolphin from the northwestern coast of Peninsular Malaysia show that these pelagic species are likely to occur further offshore, perhaps in the Andaman Sea area, and may occasionally stray into the said coastal waters of Malaysia. These two species are already recorded from strandings along the Andaman Sea coast of Thailand (Chantrapornsyl et al., 1996; Andersen & Kinze, 1999; Adulyanukosol et al., 2009), while the pantropical spotted dolphin has also been sighted further north in the Andaman Sea of Myanmar (Smith & Than Tun, 2008). Rough-toothed dolphins, now recorded from Sabah waters, are possibly more common in Malaysian waters than they are observed, as the species has also been recorded in the Gulf of Thailand (Adulyanukosol et al., 2009), Vietnam (Smith et al., 1997) the Philippines' Sulu Sea (Dolar et al., 2006), and the Chinese South China Sea (Zhou et al., 1995).

***Limitations of the opportunistic survey.*** — The expedition provided a rare opportunity for data collection on Malaysian cetaceans over a vast previously unsurveyed area that would otherwise be difficult to survey on a smaller vessel. However, many logistical circumstances limited the work scope for cetacean observations. The most significant limitation to this cetacean survey was the inability to survey during portions of the transects travelled at night, leaving awkward gaps in

coverage (see Fig. 1). In the Sulu-Sulawesi Sea area, survey effort coverage was even poorer due to the many stations that required the vessel to stop for long periods of time for sediment coring. In addition, due to the multidisciplinary nature of the expedition, it was often not possible to work in 'closing mode' and not feasible for the ship to change its course to approach the animals for species identification on the many occasions when cetaceans were sighted. This constraint was due mainly to time limitations as the oceanographic sampling stations had to be completed within a certain time frame. The inability to approach cetacean groups resulted in nearly 40% of sightings that could not be identified to the species level (see Table 2) and the behaviour and sizes of these groups could not be determined and estimated respectively with confidence. The survey was also limited by having only two observers throughout the cruise, therefore rotations to avoid observer fatigue were not possible and the use of binoculars was limited.

***Recommendations for future research.*** — There is much potential and need for more research on marine mammals in Malaysia. Marine mammals in Malaysia continue to face various anthropogenic threats, which include depleted prey resources due to intensive fishing activities, habitat degradation resulting from destructive fishing methods (e.g. dynamite fishing, trawling), coastal and offshore developments, and pollution from various industries, shipping activities, and incidental capture in fishing gear (Jaaman, 2004; Jaaman et al., 2009). At the same time, our knowledge base of these cetaceans and their conservation and management needs are barely known and understood. Future research should be extended to cover areas not surveyed previously, and areas where cetaceans co-exist with dense human population and development. Studies on cetacean population abundance, population genomics, seasonal movement and marine mammal-human interactions should be pursued, where funds and manpower permit. Given that dolphins were sighted in the vicinity of oilrigs, it would be valuable for researchers to undertake observations from these facilities, and in addition, to study the interactions between the animals and the human activities in the area.

Despite high levels of seismic exploration in Malaysian waters, particularly in the South China Sea since the 1950's (Ramli, 1985; Mohamad Razali, 2005), there is currently no legal requirement for seismic survey vessels operating in Malaysian waters to place marine mammal observers onboard. This is standard practice in many countries around the world where Joint Nature Conservation Committee (JNCC) or other national guidelines require trained observers and stipulate procedures for seismic exploration in the presence of marine mammals (JNCC, 2004; Compton et al., 2008). Following such practice in Malaysia not only takes into account the welfare of cetacean populations in areas of seismic exploration, but would also allow these seismic exploration vessels to serve as platforms of opportunity for marine mammal research in areas that are not easily accessible offshore, and also help to minimise cost in a field of study that can be rather costly to execute.

Recent research conducted by Yamada et al. (2008) revealed that there may be yet another species of so-called Bryde's whale in existence, but yet unclassified taxonomically, pending further analyses. Skeletal remains of this potentially new species, tentatively referred to as the "Indo-Pacific Bryde's whale" by Yamada et al. (2008), have been found in the Philippines and Indonesia. Thus, it would be worth reviewing the various baleen whale specimens that are curated in various places around Malaysia to obtain updated species identifications based on the relatively recent discovery of the Omura's whale and the "Indo-Pacific Bryde's whale". In doing so, not only do we improve our understanding of marine mammal diversity within the country, we can also contribute to the understanding of the taxonomy and distribution of these balaenopterid whales at the regional and global level, which at present, are still in need of review (Yoshida & Kato, 1999; LeDuc & Dizon, 2002; Yamada et al., 2006, 2008).

In summary, while some recent progress has been made on more fine-scale studies of cetacean distribution and habitat use in specific coastal areas in Malaysia, such as in Sarawak (Minton et al., 2011), Cowie Bay, Sabah (Jaaman, 2006), Langkawi (Ponnampalam & Jamal Hisne, 2011) and Tioman Islands (pers. obs.), knowledge outside these areas is extremely limited. It is recommended that various stakeholders, both within and outside the academic and government research communities, engage in more active collaboration and information sharing to better synergise research, conservation, and management efforts throughout the country. Efforts are already underway to establish a multi-organisation national marine mammal stranding response network, which, if successful, should better coordinate the handling of stranding events and facilitate valuable data collection through examination and sampling of stranded carcasses. Only through such collaboration can adequate research, conservation, and management take place.

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