

A note on the species occurrence, distributional ecology and fisheries interactions of cetaceans in the Mergui (Myeik) Archipelago, Myanmar

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ABSTRACT

A vessel-based line-transect survey for cetaceans conducted during 23 February–6 March 2005 of the nearshore waters (to a depth of 40–60m) of the Mergui (Myeik) Archipelago of southern Myanmar searched along 955km of trackline resulting in 30 cetacean sightings. These included Indo-Pacific bottlenose dolphins *Tursiops aduncus* (n=15), Indo-Pacific humpback dolphins *Sousa chinensis* (n=3), spinner dolphins *Stenella longirostris* (n=4; the largest of these was mixed with pantropical spotted dolphins *Stenella attenuata*), Irrawaddy dolphins *Orcaella brevirostris* (n=1), finless porpoises *Neophocaena phocaenoides* (n=1), Bryde's whales *Balaenoptera edeni/brydei* (identification tentative; n=1), one unidentified baleen whale (probably also a Bryde's whale) and four unidentified delphinid groups. Irrawaddy dolphins and finless porpoises were found in shallow, brackish waters, Indo-Pacific humpback dolphins also in shallow waters but those less affected by freshwater inputs and Bryde's whales and Indo-Pacific bottlenose, spinner and spotted dolphins in deeper and clearer waters. In total 2,565 gill netters/long liners (95% CI=1,228–3,903), 1,301 squid jiggers (95% CI=611–1,992) and 532 stern trawlers (95% CI=154–910) were estimated to be operating in the study area. Concentrations of gill netters/long liners were particularly high in shallow nearshore waters and at least 150 were operating in the bay where the only sightings of Irrawaddy dolphins and finless porpoises were made. There is a need to better assess nearshore cetacean populations, investigate whether or not incidental and intentional catches are sustainable and incorporate a cetacean element into an initiative to establish a marine protected area network in the Mergui Archipelago.

KEYWORDS: SURVEY-VESSEL; HABITAT; FISHERIES; GILLNETS; ASIA; INCIDENTAL CATCHES; DIRECT CAPTURE; TRAWLS; CONSERVATION; DISTRIBUTION; NORTHERN HEMISPHERE; INDO-PACIFIC BOTTLENOSE DOLPHIN; INDO-PACIFIC HUMPBAC DOLPHIN; SPINNER DOLPHIN; PANTROPICAL SPOTTED DOLPHIN; IRRAWADDY DOLPHIN; FINLESS PORPOISE; BRYDE'S WHALE

INTRODUCTION

Little is known about the status of cetaceans in nearshore waters of the Bay of Bengal. However, anecdotal evidence suggests that mortality from fisheries bycatch and deliberate catch is increasing. The paucity of information on the occurrence, distribution and abundance of cetaceans, and the extent and magnitude of factors that threaten their survival make it impossible to advocate conservation measures that balance their survival needs with those of growing local human populations and increasing development.

Surveys in 1996 along the northern (or Rakhine, also formerly Arakan) coast of Myanmar (Smith *et al.*, 1997) recorded sightings of Indo-Pacific bottlenose dolphins (*Tursiops aduncus*), Irrawaddy dolphins (*Orcaella brevirostris*), spinner dolphins (*Stenella longirostris*; probably the *rosieventris* subspecies) and what was identified as the small-form of the Bryde's whale (*Balaenoptera edeni/brydei*). Groups of 1–6 Irrawaddy dolphins were found in the mouths of the Myebone, Kalidan and Kyaukpyu rivers. Dried skins, one each of a spinner dolphin and an Indo-Pacific humpback dolphin (*Sousa chinensis*) were also examined during the 1996 survey. Fishermen said the dolphins were caught accidentally in gillnets and claimed that they would release a live dolphin if found entangled. However, the high reported value of dolphin oil, which is reportedly used for medicinal purposes, provides an economic disincentive for them to do so (Smith *et al.*, 1997). In Myanmar, a 'critically endangered' population of Irrawaddy dolphins (Baillie *et al.*, 2004) occurs more than 1,000km from the sea in the

Ayeyarwady (formerly Irrawaddy) River, and the species has also been recorded in the Ayeyarwady Delta (Smith and Than Tun, 2007).

The objectives of the survey in Myanmar were to investigate cetacean populations in the Mergui Archipelago and provide training opportunities and field experience for regional scientists. This study and a parallel one conducted during the preceding year in coastal waters of Bangladesh (see Smith *et al.*, 2008) were part of a marine mammal initiative sponsored by the Conservation of Migratory Species of Wild Animals (CMS), Wildlife Conservation Society (WCS) and Whale and Dolphin Conservation Society (WDCS).

STUDY SITE

The Mergui (locally called Myeik) Archipelago is located in southern Myanmar (Fig. 1). It is composed of about 800 limestone and granite islands with steep and rugged topography. The shorelines of these islands and along the mainland are generally made up of coral sand beaches and rocky headlands interspersed among mangrove forests. There are numerous tidal creeks, but major sources of freshwater are limited to the Pakchan River, which constitutes the Myanmar-Thailand border (and was the southern starting point of the survey), and the Tenasserim and Kyaukpya rivers, whose mouths are located near the head of a semi-enclosed bay just below the northern extent of our survey area. The Mergui Archipelago has special conservation significance due to its rich coral reef and island biogeographic diversity that spans the Indochina and

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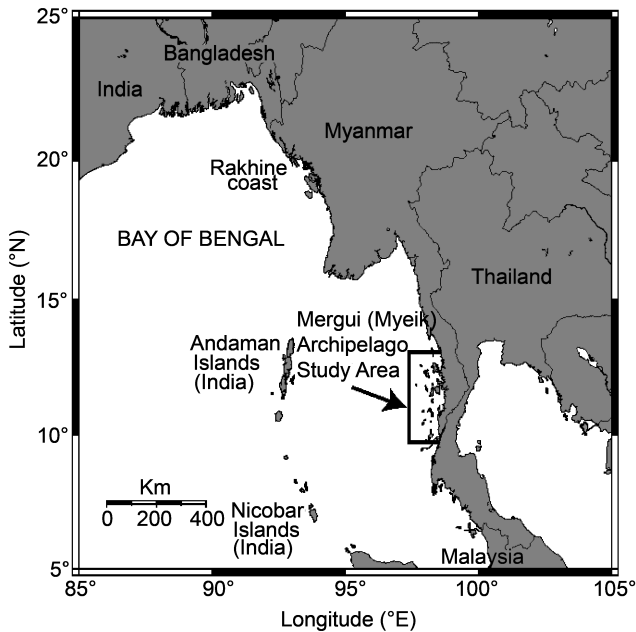


Fig. 1. Map showing the study area in Mergui (Myeik) Archipelago, Myanmar.

Sundaic realms. The Archipelago includes Lampi National Park and a recently declared protected area for sharks in the southern portion. Little is known about the ecology of the Archipelago and it has only been open to foreigners since 1997.

METHODS

During 23 February-6 March 2005, a team of 12 scientists from Myanmar, Bangladesh, Sri Lanka, India, Thailand and the USA conducted a vessel-based line-transect survey for cetaceans in the nearshore waters of the Mergui Archipelago. A one-day training course was convened before the survey. Seven team members had participated in a similar survey conducted in the nearshore waters of Bangladesh during February 2004 (see Smith *et al.*, 2008) and four had participated in surveys for Irrawaddy dolphins in the Ayeyarwady River (see Smith and Than Tun, 2007). The survey was conducted from a motorised Chinese junk converted for tourism purposes (length=22m, height above the waterline to the centre and bow observation platforms=4.8m and 5.0m, respectively).

A standardised searching, sighting and environmental sampling procedure was followed with five observers standing watch at all times using 7×50 and 18×50 binoculars and naked eye while following pre-designed, saw-tooth transect-lines. The same field methods were employed during the survey of nearshore waters in Bangladesh mentioned above (see Smith *et al.*, 2008). The trackline extended out to the edge of the Archipelago to a depth of 40-60m. Similar to the survey in Bangladesh, significant deviations were made in the field from the pre-designed transect-lines due to weather and logistical considerations. While searching for dolphins a separate observer maintained watch and recorded sighting data on active fishing vessels (i.e. those with their gear deployed and not just underway or drifting) including the geographic position, number and type and the estimated distance to the vessel when it was positioned perpendicular to the beam of our vessel. The total number of fishing gears was then estimated according to type using a strip-transect technique

and coefficients of variation (CVs) were calculated from the variance in the number of sightings of each fishing gear type recorded each day.

RESULTS

Search effort

During 70.2hr of surveying 955km of trackline were searched (mean vessel speed=13.6km hr⁻¹; Fig. 2). Survey conditions were generally good, except during the last two days, with Beaufort sea states 0-6 recorded during 4.9%, 23.3%, 25.3%, 24.5%, 6.5%, 9.1% and 6.1% of the total distance covered, respectively.

Species occurrence

A total of 30 cetacean groups were detected while 'on-effort' (actively searching along the trackline – 36.7%, 40.0%, 20.0% and 3.3% during Beaufort 1-4 sea state conditions, respectively), including Indo-Pacific bottlenose dolphins ($n=15$, mean group size=14.9, median=10.0, range=5-70; the largest group was a single detection but spread out in numerous subgroups), Indo-Pacific humpback dolphins ($n=3$, mean group size=10.8, median=15, range=8-20); spinner dolphins ($n=4$, mean group size=105.8, median=97.5, range=60-168; the largest of these groups was mixed with pantropical spotted dolphins *Stenella attenuata* that composed about 30% of the entire group or an additional 72 individuals), Irrawaddy dolphins ($n=1$, 12 individuals), finless porpoises *Neophocaena phocaenoides* ($n=1$, five individuals), Bryde's whales ($n=1$, three individuals including a small calf), one unidentified baleen whale (probably also a Bryde's whale) and four unidentified delphinid groups (Fig. 2).

During observations of humpback dolphins, adult animals were focused on because juveniles do not exhibit the exaggerated dorsal hump generally associated with the *plumbea* form of the species and used to differentiate it from the *chinensis* form. Colouration in the *chinensis* form of the species also progresses with age from all dark to pinkish white, starting from the dorsal fin and gape, so the pattern in juveniles can appear similar to an adult of the *plumbea* form (Jefferson and van Waerebeek, 2004; Reeves *et al.*, 2002; Ross *et al.*, 1994). The colouration of all observed large adults (including mothers with calves) resembled the *plumbea* form: uniformly gray on the dorsal half of the body but with small white to pinkish blotches on the rostrum, edge of the dorsal fin and tips of the flukes (Fig. 3). The distinct hump noted for the *plumbea* form in the western Indian Ocean, however, appeared weakly developed and was only slightly more distinct than typically observed in the *chinensis* form.

Bottlenose dolphins were identified as *T. aduncus* (versus *T. truncatus*) due to their relatively long rostrums, slender appearance, less convex melon and lighter colouration particularly on the ventral surface. Spotting on the throat and belly typical of Indo-Pacific bottlenose dolphins was not observed, but the animals did not expose the ventral half of their body during most sightings.

Spinner dolphins may have been of the *roseiventris* subspecies (see Perrin *et al.*, 1999; 1989) according to their relatively small size (adults appeared to be <1.5m) and disproportionately long flippers (28% and 29% of the dorsal fin tip to beak tip length in photographs of two individuals, Fig. 4) relative to the larger pelagic subspecies *S.l. longirostris* – a single individual of the pelagic form from the eastern Indian Ocean¹ was measured as 23% in this

¹ See Errata in *Mar. Mammal Sci.* 23(3):730.

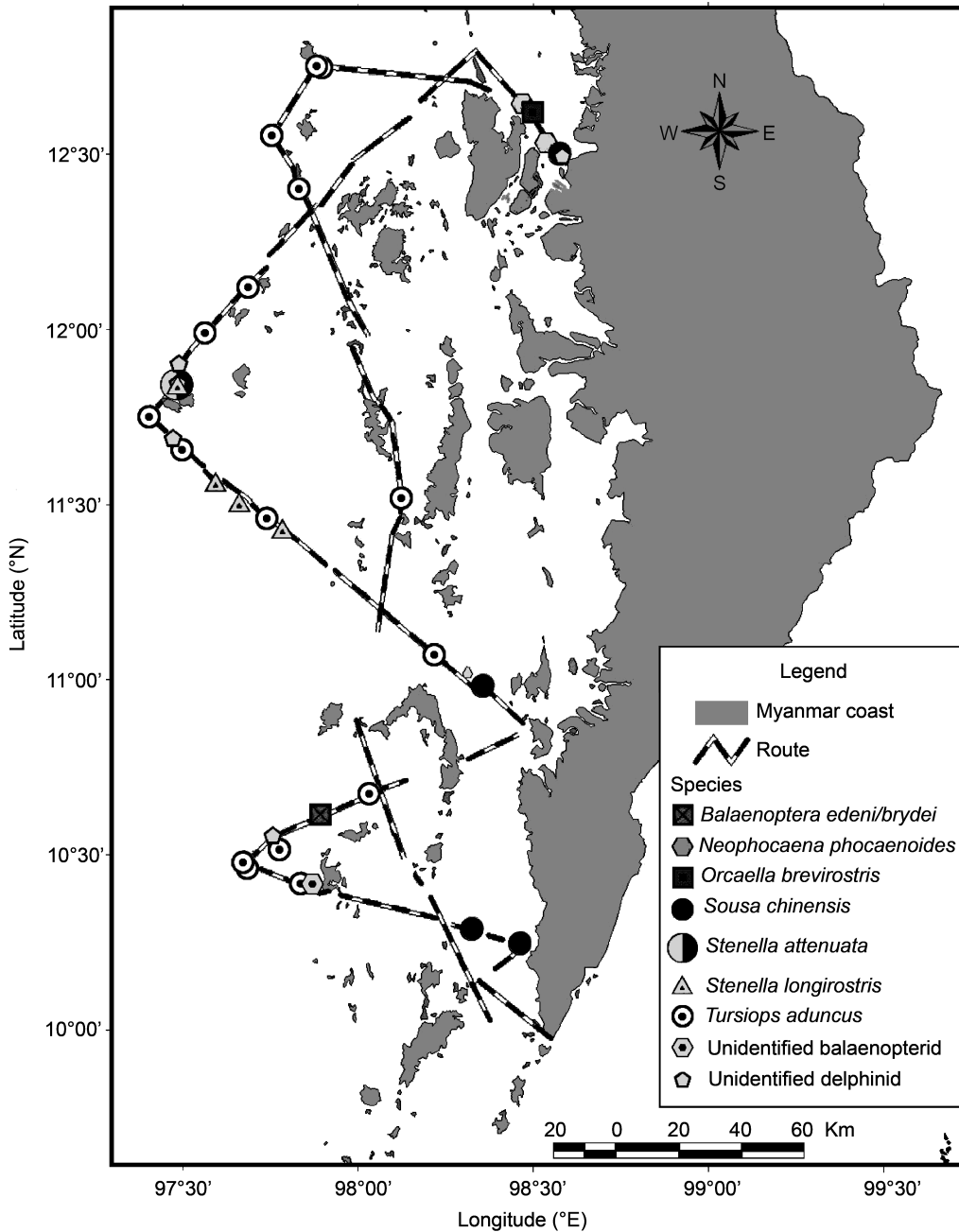


Fig. 2. Map of the tracklines followed and cetacean sightings made during a survey of the Mergui Archipelago, Myanmar, in February and March 2005.



Fig. 3. A mother-young pair of Indo-Pacific humpback dolphins resembling the *plumbea*-form in the Mergui Archipelago.

proportion, whereas a single dwarf spinner dolphin from the Philippines near northern Borneo was measured as 28% (Perrin *et al.*, 2007). Photographs of spinner dolphins in the Mergui Archipelago also showed the distinctive pink

coloration on the ventral field consistent with their subspecific name. This feature, however, is probably not diagnostic but instead a physiological response for dumping heat in the relatively warm waters where the dwarf subspecies typically occurs (Perrin *et al.*, 2007).

Bryde's whales (small form) were tentatively identified by their tall, erect and extremely falcate dorsal fins, two auxiliary ridges on the rostrum (Fig. 5), estimated length of approximately 10m for an adult female with an accompanying calf and symmetrical cream-coloured appearance of the lower jaw on at least one adult animal (although the creamy colouration appeared in a blotchy pattern rather than uniformly). There is a small chance that these whales could have been the recently described Omura's whale (*B. omurai*; Sasaki *et al.*, 2006; Wada *et al.*, 2003) due to their small size and unconfirmed reports that some Omura's whales may also exhibit auxiliary head ridges (Jefferson *et al.*, 2008). However, this was considered



Fig. 4. Spinner dolphin possibly of the *roseiventris* subspecies in the Mergui Archipelago. Notice the extraordinarily long flippers. Also in the original colour photograph there was a distinct pinkish hue to the belly.



Fig. 5. Probably small form of Bryde's whale from the Mergui Archipelago. Note the auxiliary head ridge, a key diagnostic feature of the species.

doubtful due to the lack of asymmetrical colouration on the throat, which has been described as a feature characterising the Omura's whale and the original description of the species which specifically states that it does not have auxiliary head ridges (Wada *et al.*, 2003).

Distributional ecology

Environmental data collected every 30min along the trackline indicated relatively warm, clear and mostly shallow and saline waters in the survey area (Table 1). Insufficient data were available to statistically compare environmental parameters among species, but the general pattern appeared similar to the results of the February 2004 survey in Bangladesh mentioned above (see Smith *et al.*, 2008), with Irrawaddy dolphins and finless porpoises occurring in relatively shallow waters affected by freshwater inputs, Indo-Pacific humpback dolphins also occurring in shallow waters, but those less affected by freshwater and Bryde's whales and Indo-Pacific bottlenose, spinner and pantropical spotted dolphins occupying deeper and clearer waters close to the edge of the continental shelf (Fig. 6). Although in Myanmar the latter species were located close to numerous islands and reef habitat absent in the offshore waters of Bangladesh.

Fisheries

During the survey a total of 1,068 fishing vessels and gears were recorded, including 537 gill netters/long liners (the two different types could not always be reliably differentiated so were grouped together; however, most appeared to be gill netters), 307 squid jiggers, 170 stern trawlers, 20 set bag nets, 12 purse seiners and 22 unidentified (Fig. 7). Using a 1,000m strip on both sides of the vessel, a total of 2,565 gill netters/long liners (95% CI=1,228-3,903), 1,301 squid jiggers (95% CI=611-1,992) and 532 stern trawlers (95% CI=154-910) were estimated to be operating in the survey area. Concentrations of gill netters/long liners were particularly high in shallow nearshore waters and at least 150 were operating in the bay where the only sightings of Irrawaddy dolphins and finless porpoises were made.

Table 1

Descriptive statistics for environmental parameters recorded every 30 minutes along the trackline and at the location of cetacean sightings. NTU=nephelometric turbidity units.

Trackline/Species	Temperature (°C)	Depth (m)	Salinity (ppt)	Turbidity (NTU)
Every 5 km along the trackline (n=304-310)*	Mean=29.3 SD=0.7 Range=27.5-32.0	Mean=46.4 SD=23.1 Range=2.8-93.2	Mean=32.2 SD=0.6 Range=29.9-33.5	Mean=0.9 SD=1.8 Range=0.0-16.0
Indo-Pacific bottlenose dolphin (n=15)	Mean=29.8 SD=1.1 Range=28.6-31.2	Mean=61.2 SD=25.2 Range=23.9-78.4	Mean=32.0 SD=0.3 Range=31.7-32.4	Mean=0.0 SD=0.0 Range=0.0
Indo-Pacific hump-backed dolphin (n=4)	Mean=29.8 SD=0.9 Range=28.4-30.4	Mean=13.0 SD=7.2 Range=5.5-19.3	Mean=32.4 SD=0.8 Range=31.4-33.2	Mean= 2.8 SD=2.3 Range=0.5-6.0
Spinner dolphins (n=4)	Mean=29.6 SD=1.2 Range=28.3-31.2	Mean=80.3 SD=8.3 Range=72.0-89.3	Mean=31.4 SD=0.6 Range=31.0-32.2	Mean=0.1 SD=0.1 Range=0.0-0.3
Finless porpoise (n=2)	30.8, 29.7	26.6, 17.3	31.8, 32.1	3.2, 3.6
Pantropicalspotted dolphin ⁺ (n=1)	29.4	86.4	31.0	0.0
Bryde's whale (n=1)	29.7	47.5	32.4	0.8
Irrawaddy dolphin (n=1)	32.2	18.8	31.8	4

*A few data entries were missed for some parameters. ⁺Environmental data for pantropical spotted dolphins are also included in the statistics reported for spinner dolphins since they were observed in the same mixed school.

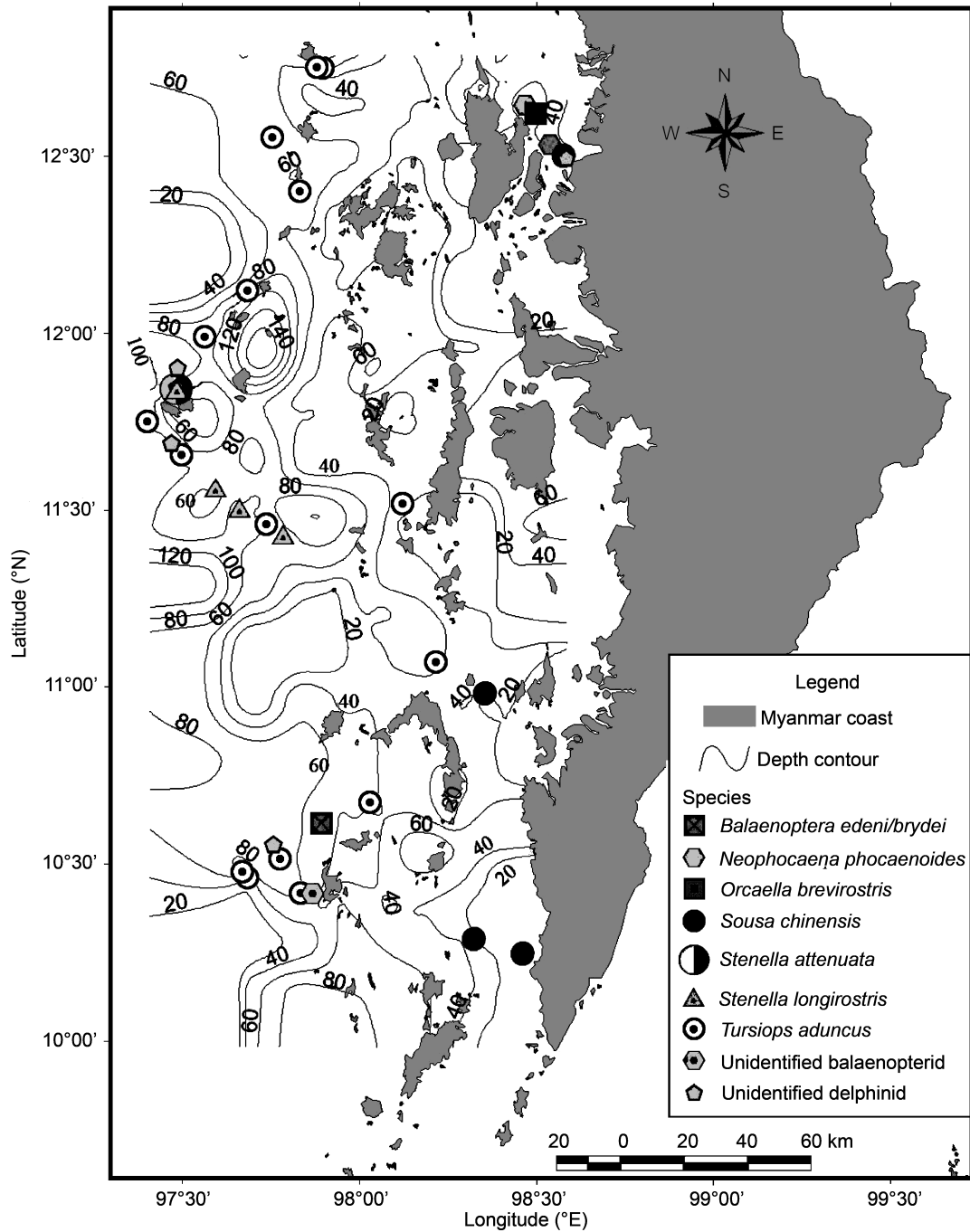


Fig. 6. Map of the Mergui Archipelago showing cetacean sighting locations in relation to depth contours.

DISCUSSION

The species recorded in the Mergui Archipelago were those to be expected, based on records from the adjoining waters of Thailand (Andersen and Kinze, 1999; Chantrapornsyl *et al.*, 1996) and those recorded in the northern coastal waters of Myanmar (Smith *et al.*, 1997).

The Indo-Pacific humpback dolphins observed had a colour pattern more closely resembling the *plumbea* form, suggesting discordant geographical variation in the species. Dolphins resembling the *chinensis* form, whose range is generally described as extending east from at least the Gulf of Thailand to central China and south to northern Australia (Jefferson and van Waerebeek, 2004), have been reported to

also occur farther west in Bangladesh (Smith *et al.*, 2008) and along the east coast of India in Orissa (Sutaria and Jefferson, 2004).

The potential occurrence of the *roseiventris* subspecies of spinner dolphins in the far 'offshore' extent of the study area, which in other areas of its range occurs in shallow-waters (Perrin *et al.*, 1999), may reflect the close proximity of shallow-reef habitat surrounding the numerous islands that defined the offshore boundary of the study area. Although the four sightings of spinner dolphins ranged from 99-120km from the mainland, they were only 1-14km away from the nearest island. There is still a great deal to be learnt regarding the subspecific/population structure of spinner dolphins and it is important to note that members

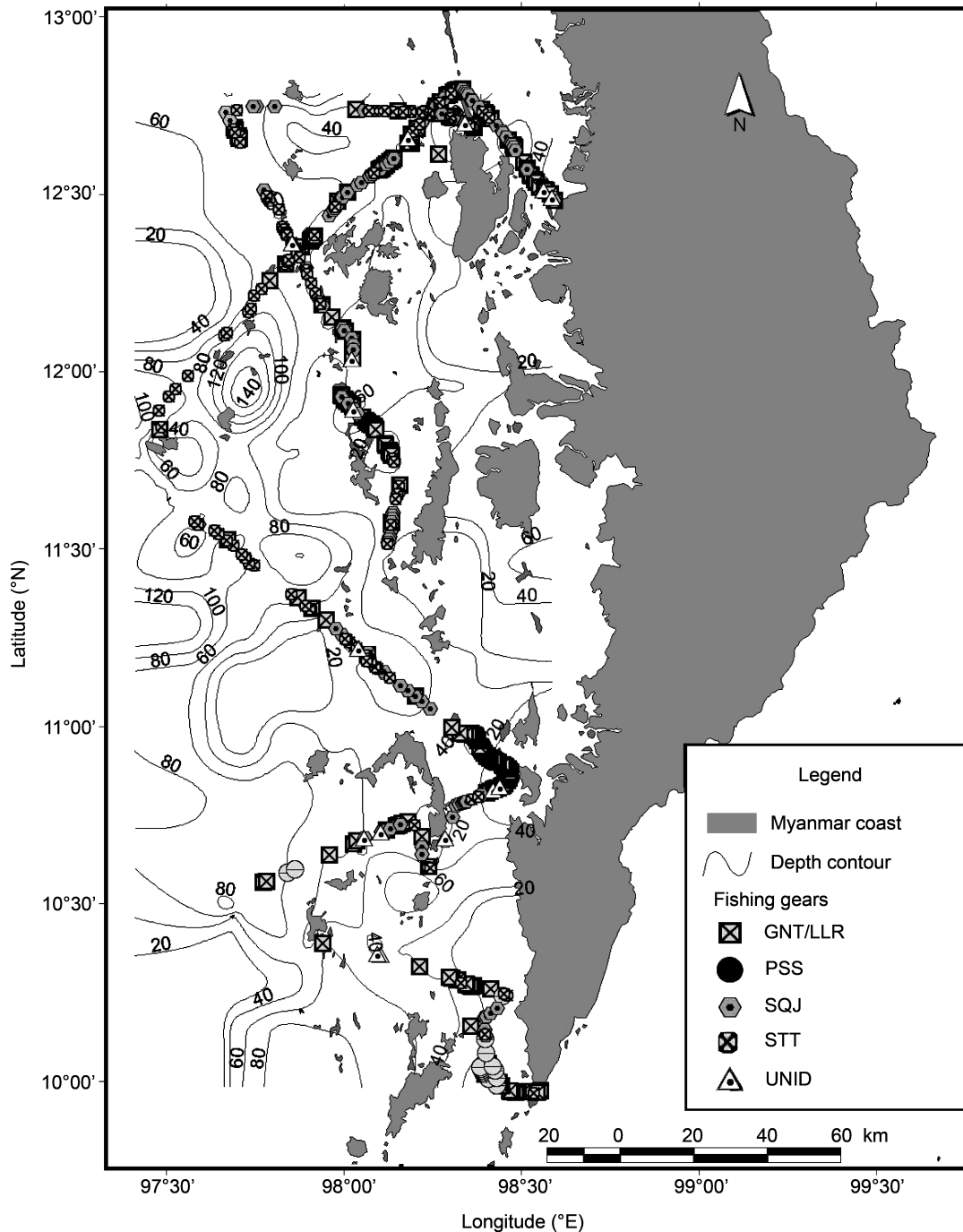


Fig. 7. Map of the Mergui Archipelago showing the locations of fishing vessel sightings observed along the trackline. GNT/LLR=gill netter/long liners, PSS=purse seiners, SQJ=squid jiggers, STT=stern trawlers and UNID=unidentified.

considered to belong to the *longirostris* subspecies in the western Indian Ocean are also quite small with body-length measurements of 154-178cm in four physically mature individuals (Van Waerebeek *et al.*, 1999) versus 180-190cm reported elsewhere for the nominate subspecies (Perrin, 1990) and 129-137cm for four adult animals of the *roseiventris* subspecies in Thailand (Perrin *et al.*, 1989).

An insufficient number of sightings were made to estimate absolute abundance for any species. Encounter rates were highest for Indo-Pacific bottlenose dolphins at 0.016 groups km^{-1} or 0.230 dolphins km^{-1} . This group encounter rate was similar to the rate reported for Indo-Pacific bottlenose dolphins in the northern coastal waters of Myanmar (0.011 sightings km^{-1} , $n=6$); however, group sizes

were larger in Mergui (14.9 versus 6.3; calculated from data in Smith *et al.* 1997). However, the apparent difference was not statistically significant (Mann Whitney test $p>0.05$), possibly due to low sample sizes.

There are no published data on the abundance or encounter rates of Indo-Pacific bottlenose dolphins in the adjacent waters of Thailand. However, the species was rarely seen during aerial surveys for dugongs in the Andaman Sea (Ellen Hines, pers. comm.) and never seen during a three-day, vessel-based survey of the outer waters of Phang Nga Bay about 250km south of the Thailand/Myanmar border (Smith, unpublished). The relatively high encounter rate recorded for the species in southern Myanmar may be explained by the high

productivity of these waters due to stratification and upwelling induced by the ca. 800 islands that comprise the Archipelago and possibly the greater likelihood of fatal interactions with the more highly developed fisheries in Thailand.

Other cetaceans documented in the Mergui Archipelago occurred much less frequently; however, it is possible that Irrawaddy dolphins, finless porpoises and Indo-Pacific humpback dolphins were under-represented due to an inability to search shallow waters because of the danger of becoming grounded on rocky coral shoals. The mean school size of >100 for the three spinner dolphin sightings was encouraging and the apparently low encounter rate recorded for the species (together with pantropical spotted dolphins, which were detected only once in a mixed school with spinner dolphins) may be explained by the fact that they were only observed in the far offshore extent of the study area, which formed only a minor proportion of overall searching coverage.

Although searching coverage was limited, the large number of gillnets deployed in nearshore waters may also partially explain the low number of sightings of finless porpoises and Irrawaddy and humpback dolphins. Wherever gillnets occur in high densities in small cetacean habitat it can be anticipated that some animals will be become entangled and die (see Perrin *et al.*, 1994). The large number of stern trawlers operating in the Mergui Archipelago may also be reason for concern. Mortality of small cetaceans in trawl nets can threaten local populations (Crespo *et al.*, 2000; Tregenza and Collet, 1998), but there appear to be differences in bycatch levels among fisheries. Some are quite high (e.g. in a now closed pair-trawl fishery in the USA bycatch averaged about one dolphin for every five net tows; Fertl and Leatherwood, 1997) and others are low to zero. The reasons may have to do with net dimensions, towing speed, duration, locations where the vessels operate and whether the dolphins deplete the fish catch (Northridge, 2002).

An additional conservation concern is a directed harpoon fishery for small cetaceans in the waters near Myeik and to the north near Dawei (located about 180km north) revealed during a follow-up project to investigate cetacean bycatch in southern Myanmar (Tun, 2006). During 11 days in March 2006, 13 Indo-Pacific bottlenose, one Indo-Pacific humpback and three spinner dolphin carcasses (whole or already chopped into pieces) were found available for sale at a fish market in Maungmagan, located about 20km north of Dawei. Fish sellers and a local scientist reported the appearance of Irrawaddy dolphins and finless porpoises at the same market. It is unknown how many of these animals were caught intentionally rather than incidentally, but one spinner and two Indo-Pacific bottlenose dolphin carcasses at the Maungmagan fish market were reported to have large puncture wounds indicating that they were harpooned.

There is a need to better assess populations of nearshore cetaceans (i.e. estimate abundance through rigorous surveys using line-transect and photo-identification techniques conducted from a small boat which can safely transit shallow waters) and to investigate whether or not bycatch and intentional catches are sustainable in the Mergui Archipelago. Incorporation of a cetacean element into an initiative to establish a marine protected area network in the Archipelago (a planned subcomponent of the FAO Bay of Bengal Large Marine Ecosystems Project) would be an important step on balancing the needs of local fishermen with protecting species that are at risk in many other areas of their range (Perrin *et al.*, 2005; Reeves *et al.*, 2003).

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