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Boat Effects on the Behaviour of Indo-Pacific Humpback (*Sousa chinensis*) and Irrawaddy Dolphins (*Orcaella brevirostris*) in Cowie Bay, Sabah, Malaysia

(Kesan Bot Terhadap Tingkahlaku Lumba-lumba Putih (*Sousa chinensis*) dan Lumba-lumba Empesut (*Orcaella brevirostris*) di Teluk Cowie, Sabah, Malaysia)

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ABSTRACT

A series of boat surveys were conducted from April to September 2008. This work evaluated the effects of boats on Indo-Pacific Humpback and Irrawaddy dolphins. The types of boats, dolphins' interactions towards various types of boat and vessel-dolphin distance under different intensities were measured. The absence of boats sailing in the bay was considered as control situation. There was a highly significant difference in the response of Indo-Pacific Humpback ($x^2 = 97.1$, $df = 8$, $p = 0.000$) and Irrawaddy ($x^2 = 52.4$, $df = 8$, $p = 0.000$) dolphins to different classes of boats. Analyses showed that positive behaviour was the most observed behaviour towards trawlers for both dolphin species. However, Indo-Pacific Humpback ($H = 3.107$, $p = 0.540$) and Irrawaddy ($H = 4.208$, $p= 0.379$) dolphins independently associated with negative behaviour while interacting with all boat classes. Irrawaddy dolphin tend to avoid boats using outboard <40 hp engine compared to Indo-Pacific Humpback dolphin ($Z = -2.023$, $p = 0.043$). In this study, these fast moving vessels often caused immediate stress and behaviour disruption on dolphin's community especially on Irrawaddy dolphin. On the other hand, Indo-Pacific Humpback and Irrawaddy dolphins showed a high rate of neutral response towards trawlers. Even though there was no stress involved in slow moving vessels especially trawlers, there is still concern on how it will affect the animal's feeding behaviour, as dolphins always show approaching behaviour during the presence of trawlers.

Keywords: Behaviour; Cowie Bay; marine mammals; Orcaella brevirostris; Sousa chinensis

ABSTRAK

Satu jaringan kajian tinjauan bot dijalankan dari April hingga September 2008. Kajian dijalankan untuk menentukan kesan bot ke atas tingkah laku lumba-lumba Putih dan Empesut. Jenis bot, interaksi lumba-lumba ke atas jenis-jenis bot dan jarak antara bot dan lumba-lumba dikenal pasti. Ketiadaan bot di kawasan kajian dikenal pasti sebagai situasi terkawal. Interaksi Lumba-lumba Putih ($x^2 = 97.1$, $df = 8$, $p = 0.000$) dan Empesut ($x^2 = 52.4$, $df = 8$, $p = 0.000$) ke atas jenis-jenis bot menunjukkan keputusan yang siknifikan. Analisis menunjukkan bahawa tingkah laku positif merupakan tingkah laku yang sering diperhatikan apabila kedua-dua spesis lumba-lumba berinteraksi dengan bot pukat tunda. Lumba-lumba Putih ($H = 3.107$, $p = 0.540$) dan Lumba-lumba Empesut ($H = 4.208$, $p=0.379$) tidak menunjukkan nilai yang siknifikan apabila berinteraksi dengan jenis-jenis bot. Lumba-lumba Empesut kebiasaannya cuba mengelak bot yang menggunakan enjin <40 hp jika dibandingkan dengan Lumba-lumba Putih ($Z = -2.023$, $p = 0.043$). Dalam kajian ini, telah dikenal pasti bahawa bot-bot yang bergerak laju menyebabkan tekanan kepada komuniti lumba-lumba terutama terhadap lumba-lumba Empesut. Di sebaliknya, lumba-lumba Putih dan lumba-lumba Empesut menunjukkan respon yang neutral terhadap bot-bot yang bergerak perlahan terutama bot pukat tunda, walau bagaimanapun, terdapat beberapa pihak yang prihatin atau mengambil berat terhadap tabiat pemakanan kerana lumba-lumba sentiasa tertarik dan menunjukkan respon yang positif terhadap bot pukat tunda.

Kata kunci: Mamalia marin; Orcaella brevirostris; tingkah laku; Sousa chinensis; Teluk Cowie

INTRODUCTION

Indo-Pacific Humpback dolphin (*Sousa chinensis*, Osbeck 1765) is widely distributed in the shallow, coastal water of the western Pacific Ocean and Indian Ocean (Ross et al. 1994), while Irrawaddy dolphin (*Orcaella brevirostris,* Owen in Gray 1866) is a facultative freshwater dolphin, living both in shallow coastal waters and large riverine channel in tropical Southeast Asia and subtropical India (Stacey & Arnold 1999). In Sabah, Indo-Pacific Humpback and Irrawaddy dolphin are protected under the Wildlife Conservation Enactment of 1997 where the enactment made provisions for the conservation and management of wildlife and its habitats in the State of Sabah.

Jaaman (2001) noted that, historically, Malaysian waters sustained rich marine mammal population. Malaysia had started marine mammals research since 1996 but the scientific knowledge, and the status of marine mammals in Malaysia is not adequately documented (Jaaman 2004)

with the exception of a few published reports. There were few early sightings of Indo-Pacific Humpback dolphin in Malaysia that were reported by some researchers (e.g., Beasley & Jefferson 1997; Dolar et al. 1997; Gibson-Hill 1949; Leatherwood et al. 1984), while Jaaman (2010) reported few sightings of Indo-Pacific Humpback dolphins in Datu Bay, Sarawak and Cowie Bay, Sabah. There were 21 records that have been compiled for Irrawaddy dolphin: 15 sightings and six specimens. Records from Peninsular Malaysia include one from Perak (Gibson-Hill 1949), two from Penang (Mŏrzer 1971; Pilleri & Gihr 1974), and five from the Klang River (Mŏrzer 1966, 1971). Furthermore, during a survey done by Beasley (1998) in East Malaysian waters, showed that Irrawaddy dolphin is the most abundant coastal cetacean sighted. There were also several confirmed records of Irrawaddy dolphin sightings and strandings from Peninsular Malaysia (Chasen 1940; Gibson-Hill 1950; Jaaman et al. 2002; Lewin 1958; Nadarajah 2000). Records in Sarawak consist of one from Buntai (Gibson-Hill 1949), one from Baram river (Pilleri & Gihr 1974), three from the Rajang river (Mŏrzer 1966), four from Santubong (Gibson-Hill 1950; Medway 1977), one from Sandakan Bay and Jambongan Bay (Dolar et al. 1997). In addition, sightings were also reported in Labuk and Cowie Bay and Jambongan, Berhala, and Silumpat Islands, close to the shore of eastern Sabah (Jaaman et al. 1999; Jaaman 2000).

Since 2004, some work have been done in Cowie Bay, Tawau, Sabah. The area was first covered by Jaaman (2010). It has one of the major ports in Sabah with a large fishing fleet container services, tanker services and an international passenger terminal with regular ferry connections to Indonesia, which is just across Cowie Bay (DHI Water & Environment 2005). The area is extensively occupied by traditional fishing such as artisanal gillnet, trap and line fisheries along with commercial shrimp trawlers, which also operate in this area and frequently used by motorized boats and container tugboats (Jaaman 2010). According to the data obtained from the Department of Fisheries on the number of fishing, vessels of district and gross tonnage, Sabah 2008, 1126 fishing vessels operated in the Tawau area. From the total, 200 were inboard engine vessels, 293 were non-powered engine and 633 were outboard engine vessels (Number of Fishing, Vessels by Districts and Gross Tonnage, Sabah 2008). The most commonly sighted cetaceans in Sabah were Irrawaddy dolphins and open water dolphins. All sightings of Irrawaddy dolphins and Indo-Pacific humpback dolphins were reported to occur in estuaries, bays or waters close to shore, and fishermen interviewed in the Northeastern and Eastern regions reported that the species often followed trawlers during fishing. In addition, Jaaman (2010) recorded four individual of Indo-Pacific Humpback dolphin near Kalabakan area inside Cowie Bay.

Previous research has focused primarily on the biology and ecology of these animals, so there is still a great deal to understand about the possible impacts of human activities, such as boating on dolphin's behaviour. Impacts of boat activity on marine mammals are of particular concern in coastal areas because of the large number of boats, their widespread use, high noise level, speed, and mobility (Richardson et al. 1995). Boats pose both direct and indirect threats to dolphins where they can cause dolphins to change movement patterns, alter behavior, or can even collide with each other (Gubbins 2002). For example, humpback dolphins demonstrated a strong tendency to chase fishing vessels for food (Jefferson 2000; Parsons 1998; Torey 2001). Indirect effects of boat traffic include influencing prey movement, degrading habitat quality, or causing avoidance of critical feeding or breeding areas (Richardson et al. 1995). Concerning on the cetaceans itself, the study was done in inner Cowie Bay (Figure 2) where the abundance of the cetaceans is known (Jaaman, 2010) thus it is essential to understand the dolphins' behaviour towards vessel traffic for proper management and conservation of the cetacean community. With this in mind a series of boat surveys were conducted at selected point in inner Cowie Bay of known dolphin abundance. The study was conducted to determine the dolphin's behaviours towards boats.

Material and Methods

Study site

The project took place at a location off Cowie Bay, Tawau, Sabah. Cowie Bay is located at 4°10'-4°28'N, 1117°30'-117°53'E, extending from Kalimantan border in the south to Tawau in the north, south-eastern Sabah. The bay is described as an oblong-shaped approximately 50 km long and 10 km wide aligned with its mouth facing southeast. Its surface area covers about 500 km^2, excluding estuaries. The depth ranges from 0.5 m to 35 m near the opening of the bay of Kalabakan Estuary. It is known for the mangrove swamps and twelve rivers, (Figure 1) which flow into the bay from upload areas to the north and west plus three rivers that directly discharge to Wallace Bay (Payne 1986; Phillips 1984). In the bay, the research covered only Sector II (Figure 2) (refer Jaaman 2010) which includes the North Rivers; Kalabakan (17 km), Brantian (20.4 km), Batumapun (34 km), Mangkalitan (41 km), Umas-umas (48.7 km) and Merotai, while Marumar (38.8 km) river is in the west side of the bay or it is known as the inner Cowie Bay. It was a relatively smaller area of marine water approximately 168 km^2 with many estuaries, depths between 0.5 and 18 m. As for Simandalan, Serudong (38.8 km) and Sino Solan rivers, they flow into Wallace Bay, a channel that allow waters to flow into the outer part of Cowie Bay and direct it to Celebes Sea.

Survey methods

Surveys were conducted at a fixed speed range of 12-15 km/h from a sturdy six metres in length fibreglass boat, which can a fit maximum of ten individuals including the helmsman, powered by 60 hp outboard engine. A standard

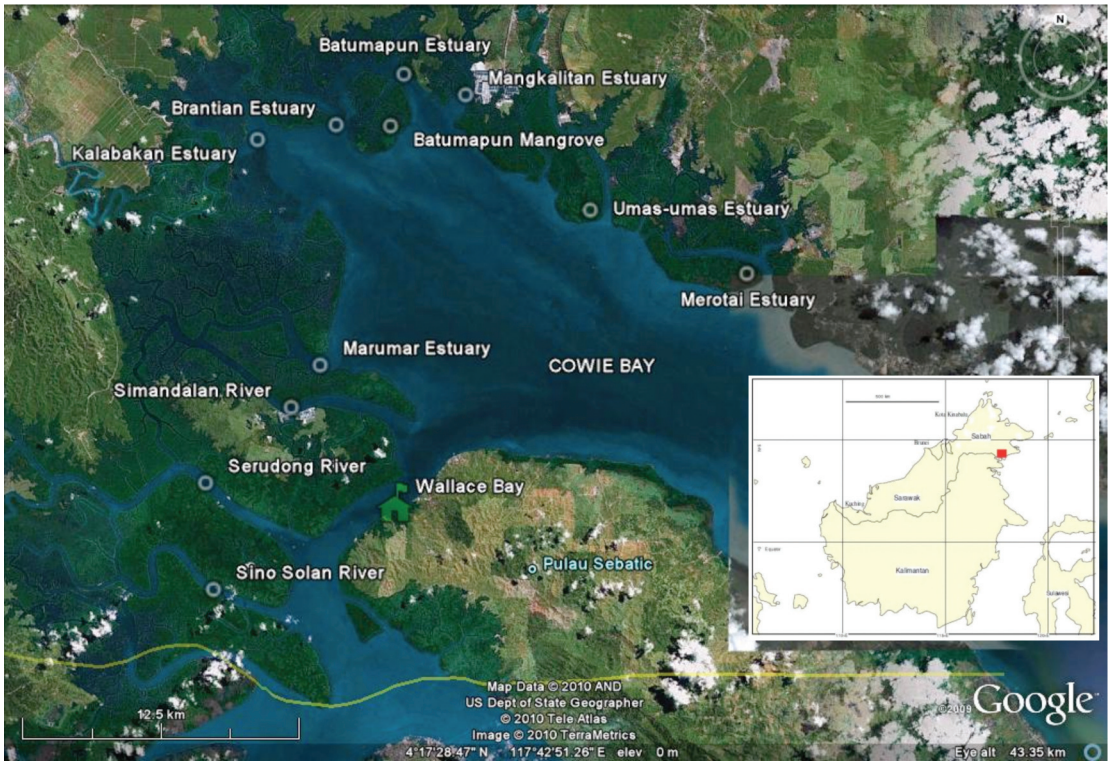

FIGURE 1. Map of Cowie Bay, Tawau, Sabah

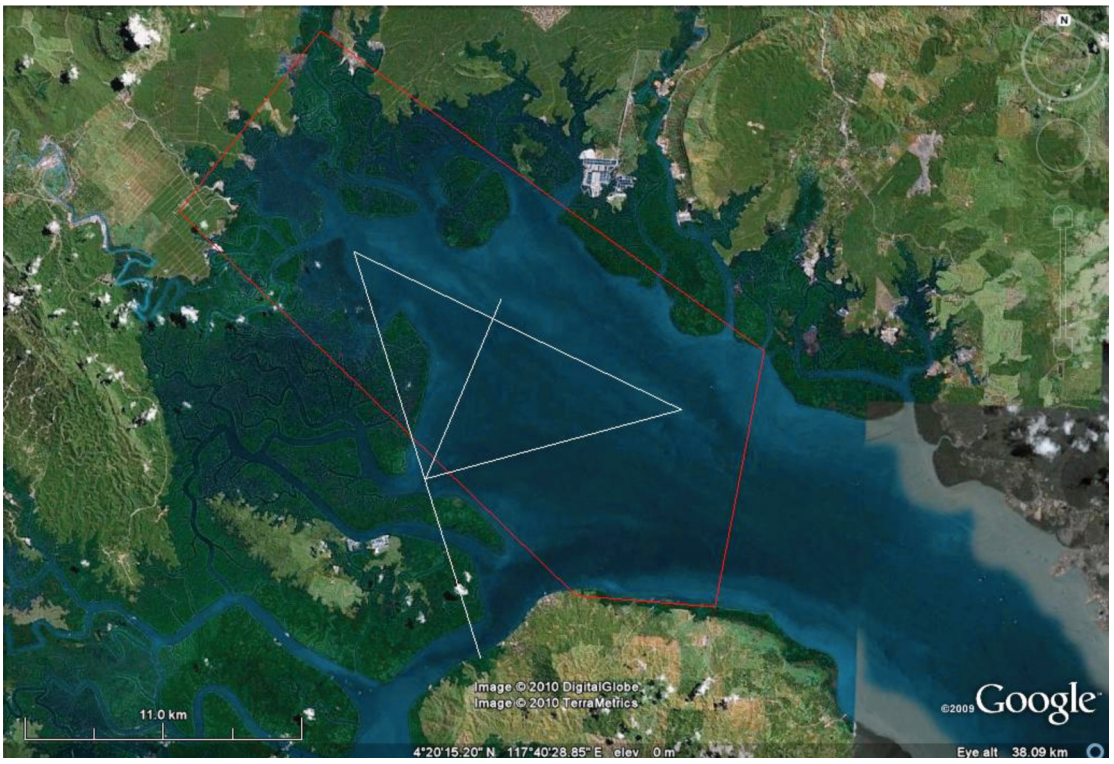

FIGURE 2. Sector II (Red Line): The study area with standard route used during dolphin searching effort (White Line)

route (white line) (Figure 2) was established by using the hand-held global positioning system (GPS 60scx) to standardize dolphins' search effort. All surveys took place between 0600 and 1800 hours each day depending on weather condition preferably during calm sea condition (Beaufort ≤ 3). While on search effort three observers located on board, scanned the area for dolphins, with observer one using hand-held binocular 7×50 magnifier

(FUJINON) binocular, observer two using digital camera (NIKON D300 SLR with 70-200 mm zoom lens), whilst the other using naked eye, alternatively searched for dolphins. The observer's position switched every half an hour, to prevent fatigue due to prolonged searching and observation. When a group or individual of dolphin was sighted, it was approached slowly within 10 m range, and detailed account of its behaviour was recorded every 15 min interval. At this point of time, the standard route was abandoned, and group were followed until it disappeared from sight. Other than dolphin observation, the sighting numbers of vessels and types of vessels passing through the area were also recorded. The vessels were classified into five types (Table 1). The location of dolphins and vessels were recorded using the GPS and plotted onto a map in GARMIN (Mapsource) software.

As behaviour of dolphins was usually fluid (Shane 1990) and might perform different reactions when approached by categorized vessels, a standard measurement of dolphin response towards oncoming vessels was established (Table 2) (following Ng et al. 2003). The presence of oncoming vessel was defined when the distance between vessel and dolphin was less than 1 km (<1 km) (Parsons & Scarpaci 2009, 2010), (Lusseau et al. 2009) and (Ng et al. 2003), Furthermore, four more distances (<500 m, <300 m, <100 m, <50 m) were established to determined which behaviour (Positive, Negative, Neutral) associated with which distance category. Distance between dolphin and vessel was determined by using a rangefinder or from the experienced of helmsman's judgement. Recording were done every 15 min, because shorter period would yield too few observations. Dolphins sightings sample were taken during absence and presence of vessels. The observers determined whether there were present or absent of vessels during this 15 min interval. Once dolphin sense the presence of vessels (<1 km), data on behaviour were recorded. On the other hand, during the absence of dolphins, vessels sightings and types of vessels (>1 km distance) were recorded. This way it was possible to obtain an instantaneous sample of dolphins' behavioural data.

STATISTICAL ANALYSES

Chi square test (x^2) was used to test the relationship between different types of boat effects on the behaviour of dolphins and dolphins association with distance of vessels. Kruskal-Wallis test was used to determine the association between each behaviours and types of vessels, in both species. Wilcoxon test was then used to test the association of behaviour between both species.

RESULTS

A total of 250 responses of dolphins toward vessels were recorded in this study, where 133 responses were recorded for Indo-Pacific Humpback dolphin while 117 responses were of Irrawaddy dolphins. The interactions observed were significantly differ between Indo-Pacific Humpback ($x^2 = 97.1$, df = 8, p = 0.000) and Irrawaddy ($x^2 = 52.4$, df = 8, p = 0.000) dolphins toward different types of vessels. There were significant difference in Positive (H = 25.762, df = 4, p = 0.000) and Neutral (H = 18.521, df = 4, p = 0.001) behaviours of Indo-Pacific Humpback dolphins toward different types of vessels. Similarly, Irrawaddy dolphin also showed significant value in Positive (H = 25.869, df = 4, p = 0.000) where both species showed a high rate of Positive behaviour towards Trawlers (Figure 3 and Figure 4). In addition, both dolphins' Neutral

TABLE 1. Vessels classification

Type	Description
Trawler boat	Fishing vessels
Outboard engine < 40 hp	Primarily used by the villagers for fishing, private transportation, gill netters,
Outboard engine > 40 hp	High speed vessels, travelled in a high speed, including pleasure boat, passenger boat, police patrol
Inboard engine > 40 hp	Passenger boat for villagers to travel from their village to mainland, ferries travelled from Indonesia to Malaysia
Tugboat	Cargo vessel, tug and tows, sand barges, large and bulky in size when comparing to other vessels.

TABLE 2. Dolphin response to oncoming vessel

Response	Description
Positive (+)	Boat-chasing behaviour, actively approaching vessel
Negative (-)	Actively moving away from boat, boat avoiding behaviour
Neutral (N)	Dolphin continue perform ongoing activity or no changes in behaviour observed

behaviour significantly associated with different types of vessels (H = 13.763, df = 4, p = 0.008). On the other hand, Indo-Pacific Humpback (H = 3.904, df = 4, p = 0.419) and Irrawaddy (H = 4.208, df = 4, p = 0.379) dolphins' Negative behaviours independently associated with different types of vessels, however, Wilcoxon test present a significant value when comparing both dolphins' Negative behaviour toward different types of vessels (Z = -2.023, p = 0.043). Indo-Pacific Humpback dolphin were observed to show a high rate of neutral and positive responses to boat using outboard <40 hp engine compared to Irrawaddy dolphin. Furthermore, there were no positive response observed to high-speed vessels (boat with >40 hp engine).

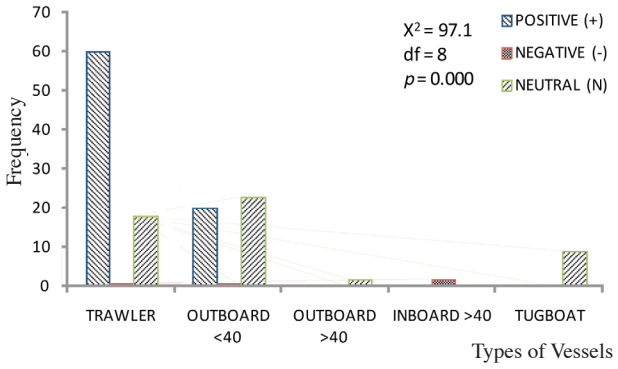

FIGURE 3. Indo-Pacific Humpback dolphins' responses toward different types of vessels

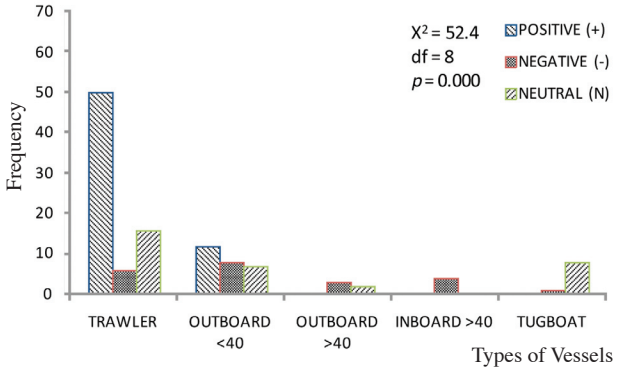

FIGURE 4. Irrawaddy dolphins' responses toward different types of vessels

At considerable distances cetaceans detect and react to the auditory stimuli produced by vessels (Richarson et al. 1995), thus in this study, Indo-Pacific (x^2 = 67.5, df = 8, p = 0.000) (Table 3) and Irrawaddy (x^2 = 52.6, df = 8, p = 0.000) (Table 4) dolphins behaviours were slightly influenced by distance between dolphins and vessels. Both dolphin species tend to perform high rate of positive responses only when the distance between the vessels and dolphins was less than 500 m, indicating that approaching or boat-chasing behaviour is possible at a close range. In this study, when the distance between the vessel and dolphins was larger than 500 m, Indo-Pacific Humpback dolphin would rather show other behaviour or continue their ongoing activity depending upon the type of the vessel. However, Irrawaddy dolphin started performing Negative behaviour even at 1 km distance (Table 4). Both dolphins tend to show neutral responses when encountered with tugboats.

DISCUSSION

DOLPHIN BEHAVIOUR AND VESSEL TRAFFIC

The findings reported in this study provide knowledge on how vessels affect the behaviour of Indo-Pacific Humpback and Irrawaddy dolphins in Cowie Bay. The study area (Sector II) is in the bay. Situated along the bay are villages (Kampung Mentadak Baru, Kampung Wallace Bay), which have a population of approximately 5000 people (Helman & Handoyo 2009; Daily Express 2004). The area is utilized for by traditional fishing such as artisanal gillnet, trap and line fisheries along with commercial shrimp trawlers, and frequently used by motorized boats and container tugboats (Jaaman 2010), where in 2008 itself, 1126 fishing vessels operated in the Tawau area (Number of Fishing Vessels by Districts & Gross Tonnage, Sabah 2008).

In the present study, Indo-Pacific Humpback and Irrawaddy dolphins in the area tend to avoid high speed vessels (boat using outboard and inboard >40 hp engine). This indicates that these vessels caused greatest disturbance to these species population. High-speed vessel might scare off the dolphins with all the noise made by them. There are two possible reasons that might cause disruption behaviour of dolphins; travelling speed and noise of the vessels itself (Richardson et al. 1995). Although Schevill (1968) suggested that cetacean behavioural responses generally are caused by vessel noise, and that for some species, such as humpback dolphins, their acoustic behaviour is affected by transiting boat traffic (Van Parijs & Corkeron 2001). In addition, noise produced by fast-moving vessel can possibly disrupt certain ongoing activity made by dolphins. Possibly, dolphins use acoustic cues to gauge the distance to the approaching boat and, based on that knowledge, plan their dives accordingly. Although acoustic measures were not a part of this project, these could be important in further elucidating the impact of boat traffic on dolphins. Commerson´s dolphins generally present a positive reaction towards moving vessels, within few meters of their bands, bow and stern (Leatherwood et al. 1988; Goodall et al. 1988; Iñiguez 1988, 1991; Iñiguez & Tossenberger 1995). In contrast to Chilean dolphin (Ribeiro et al. 2005) and common striped dolphin (Aguilar & Nadal 1984; IWC 1991), Humpback dolphin were never observed riding the bow or stern wave boats, never approached the research vessel and, on numerous occasions were seen actively avoiding moving vessels (Karczmarski & Cockroft, in press; Ng 2003). Somehow, humpback dolphins in Cowie Bay were more daring, as they tend to show high rate of

TABLE 3. Indo-Pacific Humpback dolphin frequency responses between types of boats and different distance

	TRAWLER			OUTBOARD < 40 hp			OUTBOARD > 40 hp			INBOARD > 40 hp			TUGBOAT		
	(+)	(-)	N	(+)	(-)	N	(+)	(-)	N	(+)	(-)	N	(+)	(-)	N
< 1 km	0	0	3	0	0	4	0	0	0	0	0	0	0	0	1
< 500 m	0	0	6	0	1	2	0	0	0	0	0	0	0	0	3
< 300 m	3	0	5	0	0	5	0	0	0	0	0	0	0	0	5
< 100 m	20	0	3	15	0	3	0	0	1	0	2	0	0	0	0
< 50 m	37	1	1	5	0	6	0	0	1	0	0	0	0	0	0

TABLE 4. Irrawaddy dolphin frequency responses between types of boats and different distance

	TRAWLER			OUTBOARD < 40 hp			OUTBOARD > 40 hp			INBOARD > 40 hp			TUGBOAT		
	(+)	(-)	N	(+)	(-)	N	(+)	(-)	N	(+)	(-)	N	(+)	(-)	N
< 1 km	0	1	2	0	0	0	0	0	0	0	0	0	0	1	0
< 500 m	2	1	7	1	0	1	0	0	0	0	0	0	0	0	4
< 300 m	5	0	4	0	3	4	0	2	2	0	3	0	0	0	3
< 100 m	25	3	2	1	2	1	0	1	0	0	1	0	0	0	1
< 50 m	18	1	1	10	3	1	0	0	0	0	0	0	0	0	0

neutral behaviours when approached by high-speed or bigger vessels (tugboat). Since there were no collision or injury reported during this study on dolphins caused by vessels or accidentally catches, it might explained why the Indo-Pacific humpback dolphins in Cowie Bay, became fearless. Dolphins are mammals where mammals learn from experience as pointed out by Blane and Jaakson (1994), the apparent tolerance of marine mammals towards disturbance in some areas does not imply that negative impacts do not exist but, rather, that animals continue frequenting these sites for their critical importance in animal's biological and social activities development.

Trawling is an active fishing process; therefore, cetaceans are probably aware of the net and the boat's activity. Engines on trawlers produce a distinguished sound, particularly when changing stages of operation. It has been suggested that some odontocetes are able to acoustically distinguish between stages of trawl operation (Fertl & Leatherwood 1997). Residents' dolphins of Cowie Bay were usually seen fed together (Kamaruzzan & Jaaman 2009) in the area, and most of the time following trawlers and fed behind them. Huang et al. (1978) noted that humpback dolphin primarily fed on estuary fishes, squids and shrimps. Similar studies were also showed by Dolar et al. (1996); Jefferson (2000); Jia et al. (1999); Ng (2003); Parsons (1998); Torey (2001). Patty Tse (2010) recorded that there were occasions when Humpback dolphins were observed following fishing boat In Tai O waters of Hong Kong. The situation applied on other cetaceans as well (Bearzi et al. 1999; Corkeron 1990). Cetaceans and other animals such as opportunistic seabirds (Montevecchi 2001) are sometimes attracted to trawlers, in some cases bottlenose dolphins (*Tursiops truncatus*) are attracted when nets are deployed (Gunter 1954) and have been seen approaching shrimp boats to wait for by-catch to be picked (Delgado-Estrella 1991; Leatherwood 1975; Norris & Prescott 1961), whereas, on different occasion, Killer whales (*Orcinus orca*) have been observed to do the same with trawlers in the Bering Sea (Heimlich-Boran 1988). In Texas, Fertl (1994a) found bottlenose dolphins closely associated with shrimp trawlers and similar findings were made by Corkeron (1990) in Australia. These activities appear to be of benefit to the dolphins who feed off the discarded fish and fish stirred up by net during trawler's fishing operations. These circumstances concern many scientists because it could alter resident cetaceans' feeding behaviour where the circumstance had demonstrated by humpback dolphins which had a strong tendency to chase fishing vessels for food (Jefferson 2000; Parsons 1998; Torey 2001) which also happened in the study area.

THE INFLUENCE OF THE DISTANCE BETWEEN THE DOLPHINS AND BOATS

Underwater noise is known to alter cetacean behaviour at least in the short term period (Reeves 1992; Richardson & Wursig 1996). Vessels that travelled slowly appear to cause less acoustic disturbance to dolphins because slower turning engine and propeller produce primarily low frequency noise of < 300 Hz (Ng 2003). In contrast, high-speed vessels and their auxiliary machinery such as pumps can produce high frequency noise from 300 Hz to 100 kHz (Ng 2003). Ketten (1991) reported that, although high frequency noise dissipates quickly in the water, it is believed to be very disruptive to dolphins when the distance between dolphin and vessel is small, because of their own channels of hearing.

Boats within 100 m had a clear effect on behaviour states especially in approaching behaviour towards trawlers indicating that a positive response such as boat-chasing is possible only at a short distance. Irrawaddy dolphin tend to show negative response at larger distance (<1 km), whereas, Indo-Pacific Humpback dolphins appeared to demontrate neutral responses at a close distance in several occasions, even when confronted by larger vessel (outboard >40 hp and tugboat). The study of Lundquist and Markowitz (2009) revealed that the behaviour of dolphins was significantly affected by the number of boats within 300 m.

Marine mammals were displaced by the presence of vessels within 1 km range (Lusseau et al. 2009) where interaction between vessels and dolphins was possible within the range or less. Although the presence of oncoming vessel was defined when the distance between vessel and dolphin was less than 1 km (<1 km) (Parsons & Scarpaci 2009, 2010; Lusseau et al. 2009; Ng et al. 2003), it is probable that dolphins detect the presence of boats at greater distances as observed, for example, in Hector's dolphins (*C. hectori*), which can detect boats at distance of at least 3 km (Bejder et al. 1999).

IMPLICATIONS FOR DOLPHIN CONSERVATION

From the perspective of conservation, apart from death and injury, high speed vessels are of the most concern, because they can often cause can seriously deflect and distort the behaviours of resident cetaceans. The circumstance was demonstrated by humpback dolphins which had a strong tendency to chase fishing vessels for food (Jefferson 2000; Parsons 1998; Torey 2001). Even though we do not know much how this disruption can really affect the dolphins' behaviour, as present study had not recorded any injury or death, they are still believed to be harmful to the social order and the behaviour of the animals (Richardson et al. 1995). Rules and regulations on controlling boat speed should be implemented in the study area. So far there has been no control of boat speed or traffic implemented in East Malaysia waters except in harbours for safety concerns (Jaaman 2010). Although implementing full coverage of speed control is not relevant in the study area, this study suggests limiting the navigation of high-speed vessels in the study area to prevent disturbance caused by traffic.

Designation of area with high dolphin abundance as a marine park or reserve is the best available solution for dolphin conservation. In addition, an action plan

for the conservation of freshwater dolphins should be implemented, similar to the action plan and conservation of Irrawaddy dolphins in India, Indonesia, Thailand and Cambodia. Although a marine park by themselves cannot ensure the protection of resident dolphins, such places at least can provide some basic needs such as food, rest and shelter for their survival (Liu & Hills 1997).

Conclusion

In the present study, the frequency of types of boats and their interactions with the dolphins in Cowie Bay, Sabah were observed. General situation of the boats' operation in the study area was reviewed and it was found that behaviours of dolphins were affected depending on different types of vessels, and might have already demonstrated a complex association with vessels. They might move away, perform neutral behaviour or even approach the boat, depending upon the types of vessel and the relative distance. While several vessels appeared not to cause immediate stress on the dolphins' community, high-speed vessels are the main concern from the perspective of conservation because they often cause disruption of behaviour and cetaceans' social life.

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