

INVESTIGATIONS OF MARINE MAMMALS IN VIETNAM

Brian D. Smith¹, Thomas A. Jefferson², Stephen Leatherwood³,
Dao Tan Ho⁴, Chu Van Thuoc⁵ and Le Hai Quang⁶

1. Aquatic Biodiversity Associates, P.O. Box 283, Arcata, California 95521, USA
2. Ocean Park Conservation Foundation, Aberdeen, Hong Kong
3. Sadly, Dr. Leatherwood died on 25 January 1997
4. Institute of Oceanography, Nha Trang, Vietnam
5. Haiphong Institute of Oceanology, Haiphong, Vietnam
6. Centre for Natural Resources and Environmental Studies, Hanoi, Vietnam.

Abstract

During March, April and October of 1995 and April 1996, we gathered preliminary information on the occurrence and distribution of marine mammals in the South China Sea and Mekong River of Vietnam. We had only four cetacean sightings during 1,121 km (120.1 hours) of at-sea search effort and no sightings during 224 km (22.0 hours) of search effort in the Mekong River. Sixteen species of cetaceans were documented from bones stored at 19 'whale temples,' including one mysticete (humpback whale *Megaptera novaeangliae*), and 15 odontocetes (pygmy sperm whale *Kogia breviceps*, dwarf sperm whale *Kogia simus*, short-finned pilot whale *Globicephala macrorhynchus*, false killer whale *Pseudorca crassidens*, pygmy killer whale *Feresa attenuata*, melon-headed whale *Peponocephala electra*, Risso's dolphin *Grampus griseus*, rough-toothed dolphin *Steno bredanensis*, Indo-Pacific hump-backed dolphin *Sousa chinensis*, bottlenose dolphin *Tursiops truncatus*, pantropical spotted dolphin *Stenella attenuata*, spinner dolphin *Stenella longirostris*, long-beaked common dolphin *Delphinus capensis*, Irrawaddy dolphin *Orcaella brevirostris* and finless porpoise *Neophocaena phocaenoides*), and one species of sirenian, the dugong (*Dugong dugon*). The practice of burying the carcasses of stranded or accidentally caught cetaceans and then taking the bones to be worshipped at village temples appears widespread throughout south and south-central Vietnam. The reason for the paucity of sightings, despite the variety of cetaceans documented from Vietnamese waters, is unknown, but we strongly recommend that research be conducted on levels of cetacean bycatch in fishing nets.

Introduction

There has been little research on marine mammals in Indochina, here defined as consisting of Vietnam, Laos, and Cambodia (for a review and summary of cetacean work in the entire southeast Asia/Indo-Malay region, see Perrin 1994; Perrin *et al.* 1995, 1996). The only directed research conducted in Indochina has been studies of the Irrawaddy dolphin (*Orcaella brevirostris* Gray, 1866) in the Mekong River of Cambodia, Laos, and Vietnam (Lloze 1973; Baird and Mounsouphom 1994, 1997; Baird *et al.* 1994;

Stacy 1996) and a preliminary survey of dolphin distribution in the Mekong Delta and southern coast of Vietnam (V. Yasskin and A. Abramov pers. comm.). In addition to the Irrawaddy dolphin, only three cetacean species have been reported to occur in Vietnamese waters, all opportunistic reports of strandings: the blue whale *Balaenoptera musculus* Linnaeus, 1758 (Gravel 1925), the pygmy sperm whale *Kogia breviceps* de Blainville, 1838 (Serene 1934), and the bottlenose dolphin *Tursiops truncatus* Montagu, 1821 (Zhou and Qian 1985). The finless porpoise *Neophocaena phocaenoides* Cuvier, 1829 is

known from Vietnam, based on photos of skulls published by Kemf (1993). In addition, a single sirenian, the dugong *Dugong dugon* Muller, 1776 has been recorded several times from Vietnamese waters (Tranngocloi 1962; van Bree and Duguay 1977).

There is growing interest in the status of wildlife in southeast Asia, in part due to the rapid economic development and concomitant environmental problems of nations within the region. Wildlife conservation concerns were addressed at the 1993 meeting of the Scientific Council of the Convention on Migratory Species of Wild Animals (Bonn Convention; see Perrin *et al.* 1995) and the marine mammal fauna of this part of the world has been a focus of interest in recent years (International Whaling Commission 1994; Perrin *et al.* 1996).

During March, April, and October 1995 and April 1996, we visited Vietnam to gather preliminary information on the occurrence and distribution of marine mammals. We present our findings here in the form of a species list and attempt to summarize what is currently known about marine mammals in Vietnam.

Study area

Most of the coastline of Indochina belongs to Vietnam (Fig. 1). This large country (329,566 km²) is essentially a narrow strip of land with 3,630 km of tropical coastline extending along the western edge of the South China Sea. The coastline is characterized by a broad continental shelf, narrowest in south-central Vietnam, where it is 30 or 40 km wide, but much wider in the rest of the country. There are several groups of offshore islands, most of them located in shallow waters of the south-central part of the country, near Nha Trang, and in and around Halong Bay in the far north.

Methods

Coastal surveys

At-sea sighting surveys for marine mammals were

conducted during March, April, and October 1995. We surveyed a total of 1,121 km of linear trackline during 120.1 hours of search effort in coastal waters. Effort consisted of 498 km of trackline in south-central Vietnam, between Hon Noi and Vung Ro Bay, from 3–10 March and on 12 April (Fig. 2); 151 km of trackline in and around the Mekong River Delta, from 16–17 March (Fig. 3); 134 km of trackline on the southeast side and offshore of the southern tip of Phu Quoc Island, near the Cambodian border, from 20–21 March (Fig. 4); and 338 km of trackline between Do Son and Hon Gai, including Halong Bay and offshore the southeast side of Cat Ba Island, in the far north, from 2–8 April and 22–25 October (Fig. 5). The surveys covered a variety of continental shelf habitats, including river mouths, shallow bays, inland channels, exposed coasts, waters immediately around offshore islands, and offshore waters to a depth of about 180 m.

Two to three observers searched for marine mammals from 10–15 m vessels, with the aid of 7 X 35 and 10 X 70 binoculars. We followed tracklines designed to cover all coastal habitats and recorded our position, using a Global Positioning System (GPS), every 15–20 minutes, at course changes, and at the locations of cetacean sightings. Sighting conditions, including Beaufort sea state and presence or absence of fog and/or rain, were also recorded each time a position was taken.

River surveys

Sighting surveys in the Mekong River were conducted from 20–23 April 1996, covering the majority of large channels between Can Tho and An Phu, in the Hau Giang distributary, and between Tan Chau and Sa Dec, in the Tien Giang distributary (Fig. 6). Survey methods in the river were roughly the same as surveys in marine waters except that the vessel followed tracklines approximately 100–200 m from the shoreline and arbitrarily alternated between sides.

Examination of specimens

In addition to sighting surveys, we examined marine mammal specimens at the Institute of

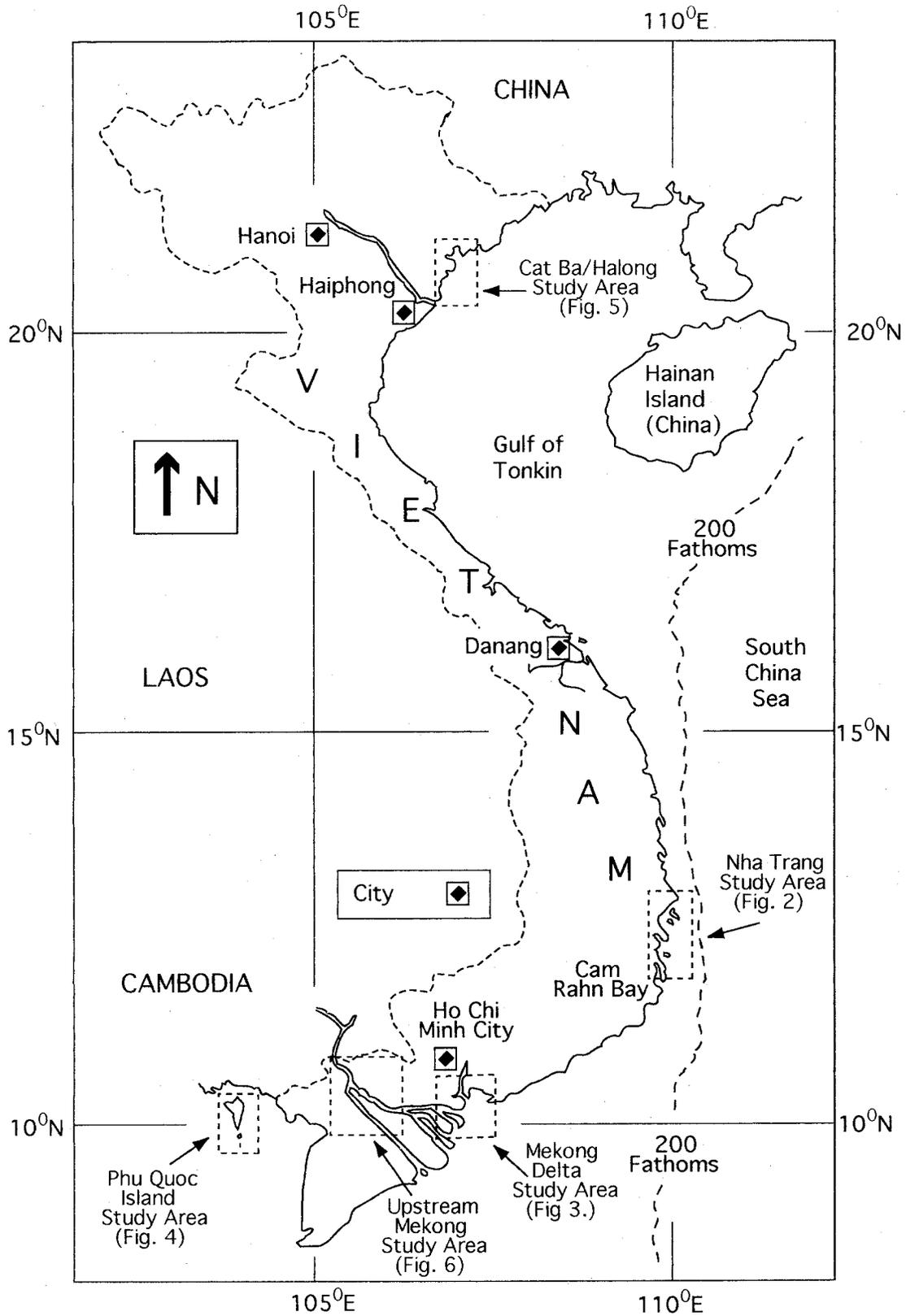


Fig. 1. Vietnam, showing the five study areas where we conducted search effort for marine mammals and visited whale temples and museums.

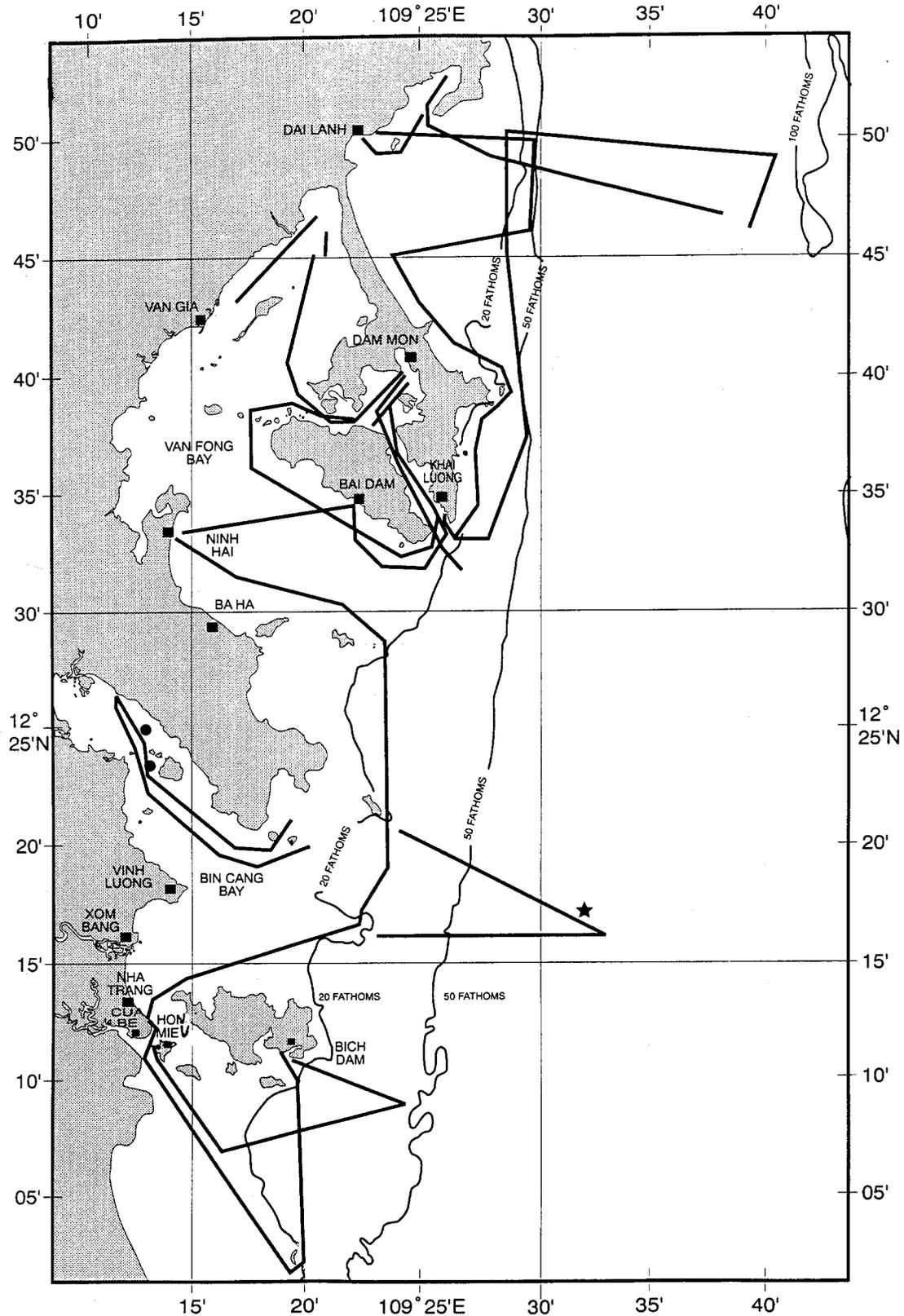


Fig. 2. South-central Vietnam (Nha Trang study area), showing tracklines surveyed, positions of whale temples (squares), sightings of Indo-Pacific hump-backed dolphins (circles), and a sighting of an unidentified small whale (star).

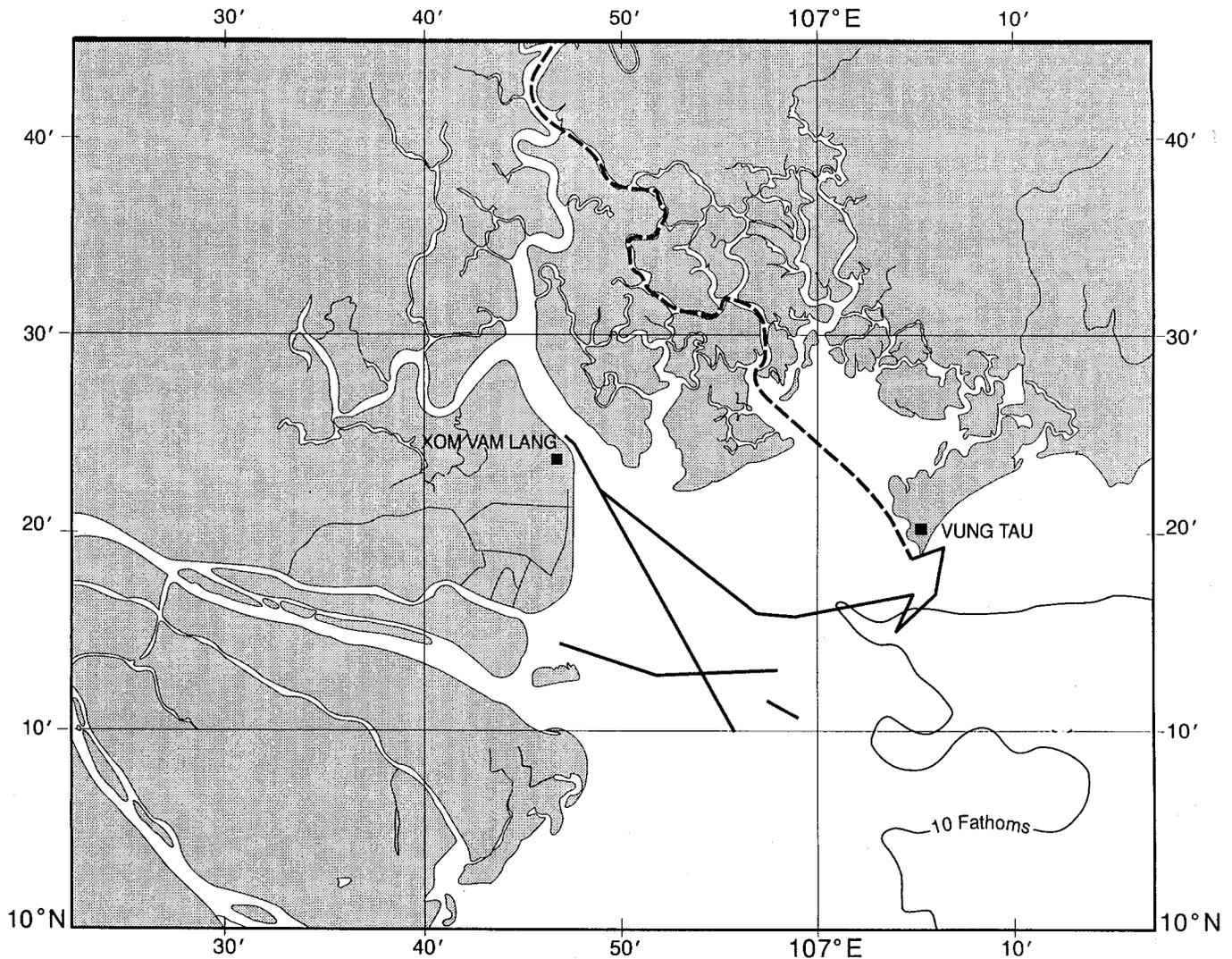


Fig. 3. Mekong River Delta study area, showing tracklines surveyed and positions of whale temples (squares). Dashed line represents trackline covered while in transit on a passenger hydrofoil; this was not included in calculating the total hours or km of search effort because the high speed of the vessel only allowed for casual search coverage.

Oceanography in Nha Trang (ION), Haiphong Institute of Oceanology (HIO), Research Institute of Marine Products in Haiphong (RIMP), Museum of Quang Ninh Province (MQNP), Yen Hung District Museum (YHDM), and at 'whale temples' located in many fishing villages (see Kemf 1993 and Discussion below). We visited 14 temples in south-central Vietnam (Fig 2; temples in Ninh Chu and Hai Chu are not included; these temples are located south of Nha Trang on the mainland near Cam Rahn Bay; Fig. 1), five temples in south Vietnam (Fig. 3; temples in Thoi Thuan, Binh Thang, and My Tho are not included), and one

temple in north Vietnam (Fig. 5; no specimens were stored at this temple)

Skeletal materials at whale temples were examined, measured, and photographed, when time and handling constraints allowed. Although not often, at some temples we were unable to handle specimens because of concerns of temple keepers or the fragility of damaged or decomposed skulls. We measured condylobasal length (CBL) of skulls with a plastic tape measure or along the edge of a field journal (and later converted these measurements to centimetres), as we did not have access to calipers.

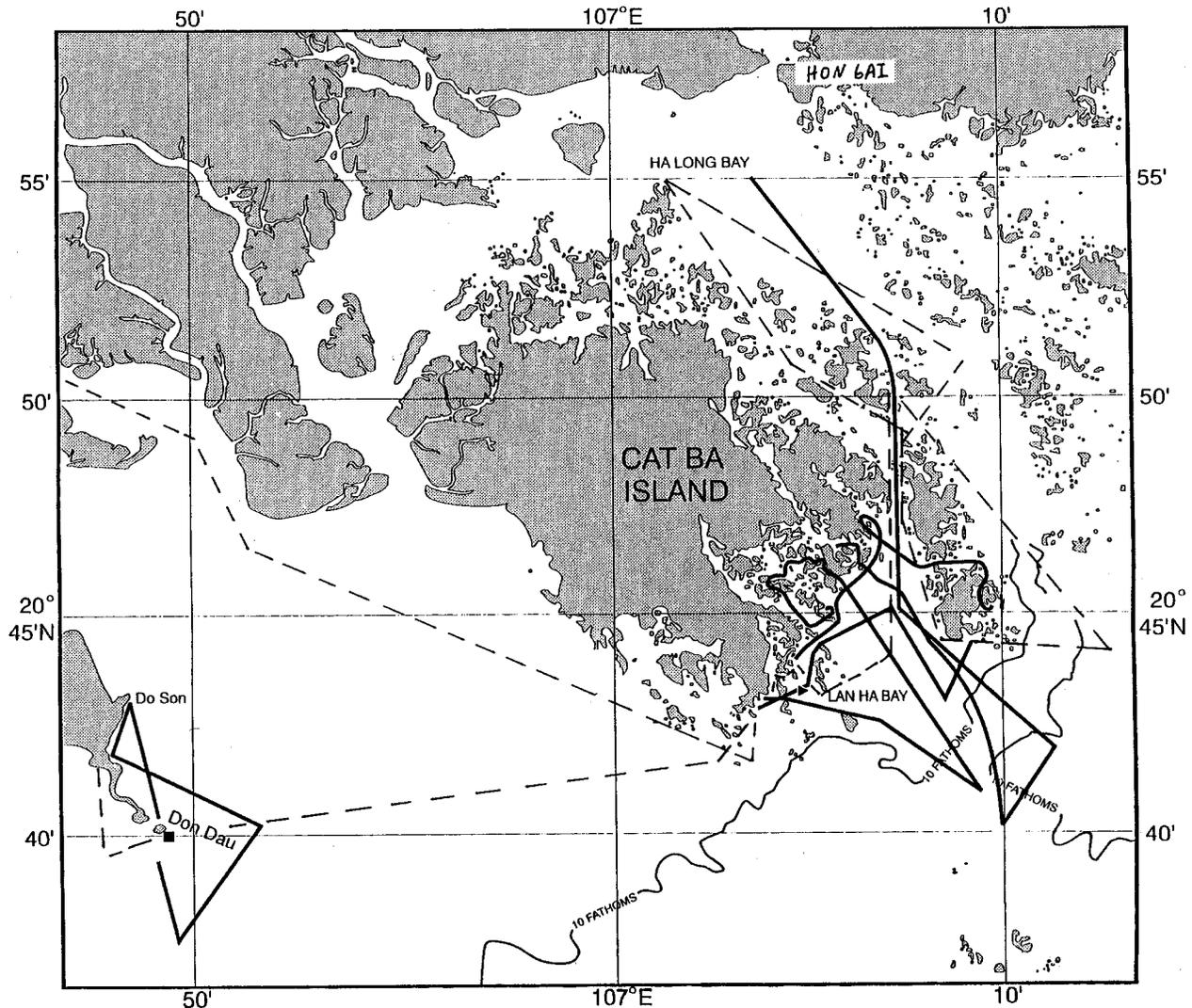


Fig. 5. Halong Bay and Cat Ba Island study area, showing tracklines surveyed, position of whale temple (square), and a sighting of an unidentified delphinid (triangle). Solid and dashed lines represent survey effort conducted from 2–8 April and 22–25 October 1995, respectively.

Tooth counts were recorded from both sides of the upper jaw and, when available, the lower jaw. Mandibles were matched for size with the upper jaws to ensure a greater probability that they were from the same specimen. We recorded counts as minimum values when large sections of the jaw were missing, or as estimates when the missing section was small enough to allow such an estimate to be made. If the tip of the rostrum or lower jaw was broken off, we estimated the number of teeth and used a +, followed by the estimated number, to indicate that the number of teeth was not based on a complete count. If the broken off portion was too large to estimate the

number of teeth, we used a + without a number to indicate that there were more teeth than the reported count but too much uncertainty about the number to allow an estimate. Tooth counts were coded UR, UL, LR, and LL for the upper right tooth row, upper left tooth row, lower right tooth row, and lower left tooth row, respectively.

Photographs were taken of the dorsal, ventral, and lateral aspects of most skulls we examined, especially when we were not able to reliably identify the specimen to species during the initial examination. Photographs, tooth counts, and measurements from these specimens were later shown to colleagues specializing in these animal

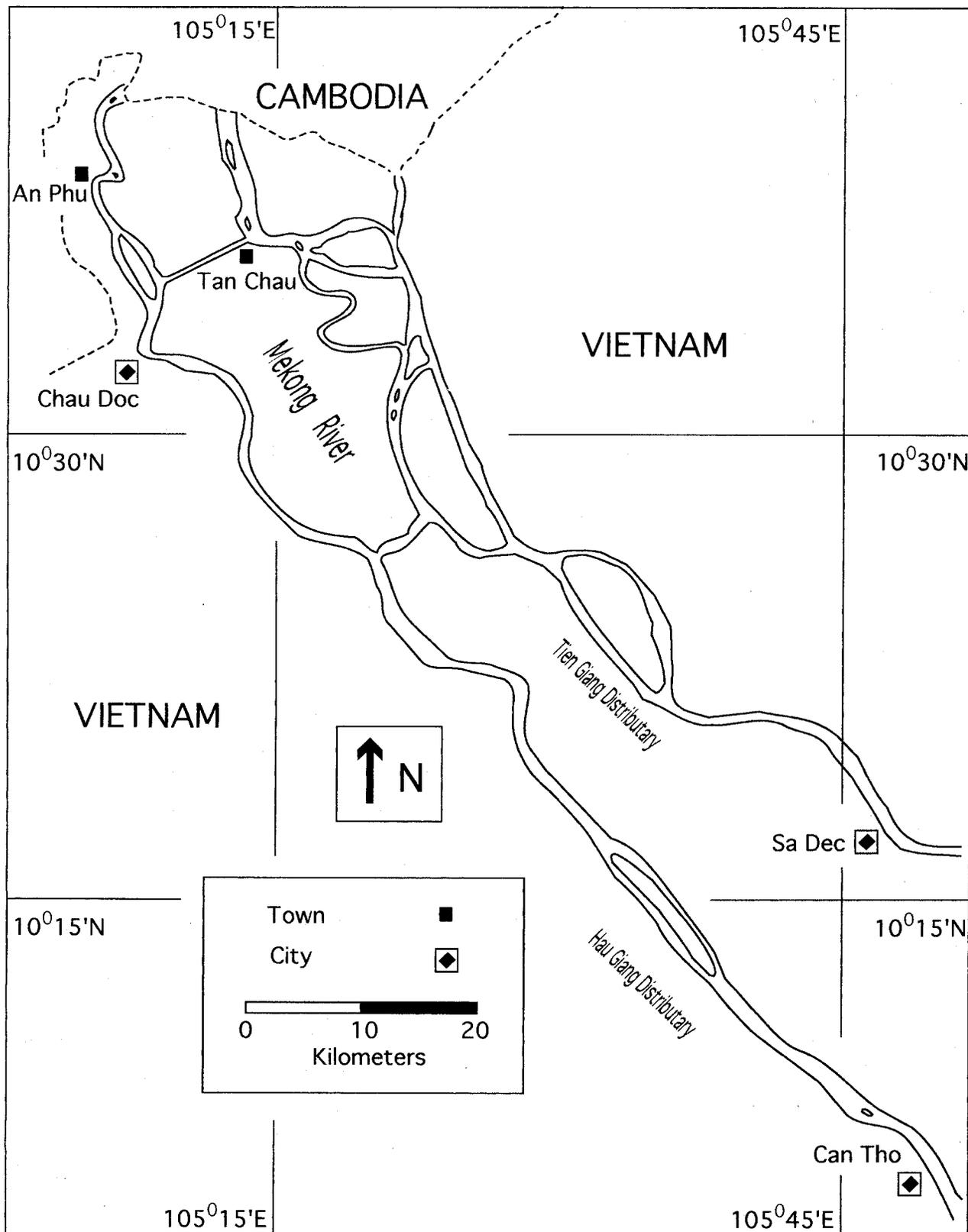


Fig. 6. Upstream study area of Mekong River.

groups to clarify questionable identifications. Even with the help of knowledgeable colleagues, we were unable to identify some specimens to species. These specimens were identified to the lowest taxonomic group possible. Specimen numbers in the species accounts refer to the sequential number we assigned to each skull we examined, e.g., DL4 refers to the fourth skull we examined at the Dai Lanh temple.

Questionable or species-group identifications were generally not included in the species accounts (unless the identification is considered probable and they represent a possible new record for Vietnam). All questionable identifications were labeled with the notation: (?), following the species name.

Species accounts

Blue whale *Balaenoptera musculus* *Linnaeus*, 1758 (?)

Gruvel (1925) mentioned a blue whale stranded at Poulo-Condor (Con Dao Islands; Fig. 1) on 16 September 1907. This must be a misidentification, however, because the length of the specimen is reported as 5.4 m, which is too small, even for a newborn blue whale (see Leatherwood and Reeves 1983, Jefferson *et al.* 1993). The correct identity of the specimen remains unknown.

Bryde's whale *Balaenoptera edeni* *Anderson*, 1878 (?)

One skull from the temple at Dai Lanh (DL4; Plate 1) and two skulls and post-cranial bones from the temple at Thoi Thuan (TT1 and TT2) were probably from Bryde's whales. The skull from the temple in Dai Lanh was reported to have come from a stranding that occurred about 40 years ago (specific location unknown). One skull from the temple in Thoi Tuan was reported to be more than 90 years old (TT1) and the other (TT2) from a stranding that occurred in 1958. It is likely that the Bryde's whale, which is primarily a tropical/subtropical species (Leatherwood and Reeves 1983; Jefferson *et al.* 1993), will prove to be the



Plate 1. Skulls of baleen whales from Vietnam: humpback whale from the north coast (top) and a probable Bryde's whale (DL4) from Dai Lanh whale temple (bottom).

most common species of baleen whale in Vietnamese waters.

Minke whale *Balaenoptera acutorostrata*
Lacepede, 1804 (?)

Bones from the post-cranial skeleton of a baleen whale at the Bich Dam Temple (Hon Lon) (BD1) were extremely small. We feel fairly confident about identifying the skeleton as coming from a minke whale because of the small size of the bones; the only other possibility is that they came from a newborn of a different balaenopterid species, which is unlikely because of the postmortem decomposition that occurs in the uncalcified skeletal material of newborn animals.

Humpback whale *Megaptera novaeangliae*
Borowski, 1781

Two or three records of humpback whales were documented for Vietnam. One was a specimen stored at the HIO. The skeleton was being moved when we visited the institute, so a detailed examination could not be made. We were, however, able to identify the specimen as a humpback whale from the absence of an acromial process on the scapula; this feature is present in all other members of the *Balaenopteridae* (J. E. Heyning pers. comm.).

In addition, we obtained photographs of a humpback whale skull from the northern coast of Vietnam. In the photograph (Plate 1), the whale can be identified as a humpback from the gentle U-shaped curve of the anterior margin of the squamosal; in all other balaenopterids the feature has a sharp V-shaped curve (J. E. Heyning pers. comm.). It is possible that these photographs were from the same specimen stored at the HIO, but we were not able to confirm this.

The other record is based upon photos in a newspaper article entitled, 'Details for Identifying the Big Animal in Hai Hau (Nam Ha)' (Bao Khoa Hoc Va Doi Song — Science and Living Newspaper, 16 February 1995, p. 4). In the article, the whale is identified as a probable fin whale *Balaenoptera physalus* Linnaeus, 1758, with one local scientist identifying it as belonging to the genus *Physeter* (of which the only species is the sperm whale, *P. macrocephalus* Linnaeus, 1758).

However, photos in the article allow the skull to be identified as that of a humpback whale, from the broad rostrum and U-shaped margin of the squamosal.

Pygmy sperm whale *Kogia breviceps* *de Blainville, 1838*

Skulls of pygmy sperm whales were identified at three temples:

1. Van Gia (VG3; Plate 2) — tooth counts 12 (LR) and 10 + (LL), no teeth in upper jaw, CBL 48 cm;
2. Hai Chu (HC 5) — lower jaw unavailable for tooth counts, no teeth in upper jaw, CBL 41 cm;
3. Cua Be (CB12) — lower jaw unavailable for tooth counts, no teeth in upper jaw, CBL 41 + 1 cm.

Serene (1934) reported that a pygmy sperm whale stranded 2 km south of Nha Trang (Fig. 2) on 19 May 1934. However, because the two species of *Kogia* were not properly distinguished until 1966 (Handley 1966), this specimen may have been a dwarf sperm whale (*K. simus*). The reported length of 3.1 m indicates *K. breviceps*, but the number of teeth (7–8 pairs) is more consistent with *K. simus* (Jefferson *et al.* 1993). Because of this conflicting information, we conservatively log this record as only identifiable to the genus *Kogia*.

Dwarf sperm whale *Kogia simus* *Owen, 1866*

Skulls of dwarf sperm whales were identified at two temples; and a damaged skull (CB8) at a third temple was tentatively identified as *K. simus*:

1. Dam Mon (DM4; Plate 2) — lower jaw unavailable for tooth counts, no teeth in upper jaw;
2. Ninh Chu (NC10) — tooth counts 11 (LR) and 11 (LL), no teeth in upper jaw;
3. Cua Be (CB8) — lower jaw unavailable for tooth counts, no teeth in upper jaw, skull too fragile to handle, identification of species tentative.

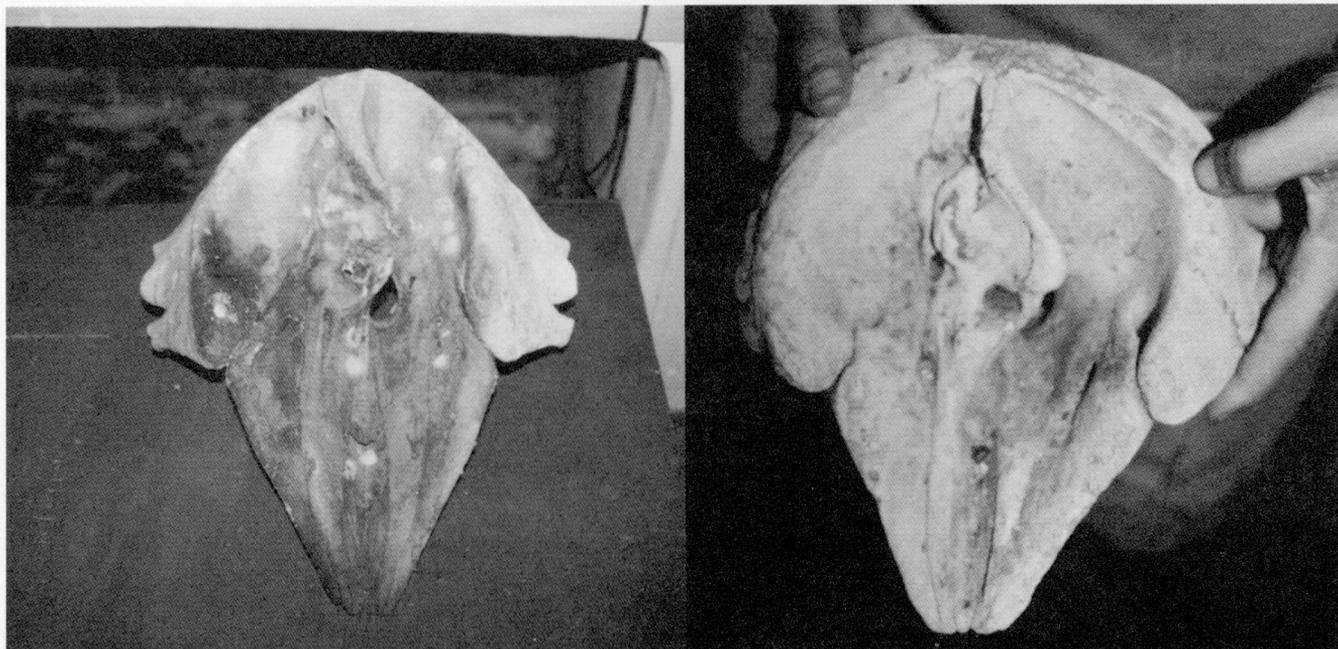


Plate 2. Skulls of *Kogia* spp.: pygmy sperm whale (VG3) from Van Gia temple (left) and a dwarf sperm whale (DM4) from Dam Mon temple (right).

Cuvier's beaked whale *Ziphius cavirostris*
Cuvier, 1823 (?)

A small whale we observed at sea on 3 March 1995 at 12°18' N, 109°33' E (Fig. 2) was tentatively identified as a Cuvier's beaked whale, judging from its size and surfacing profile; however, during the single surfacing that we saw, we were unable to observe the diagnostic characteristics necessary to positively identify the whale to species.

Melon-headed whale *Peponocephala electra*
Gray, 1846

Skulls of melon-headed whales were identified at two temples:

1. Dam Mon (DM1; Plate 3) — upper tooth counts approximately 25, deep antorbital notches, approximate CBL 45 cm (skull damaged);
2. Hai Chu (HC2); tooth counts 22 + 2–3 (UR), 23 + 3–4 (UL), 23 (LR), 22 (LL), deep antorbital notches, CBL 45 cm.

Pygmy killer whale *Feresa attenuata* Gray, 1875

A skull of a pygmy killer whale was identified at the Dam Mon temple: (DM5; Plate 3) — tooth counts 11 (UR), 10 + 1 (UL), 13 (LL), and 12 (LR), teeth restricted to anterior two-thirds of rostrum, CBL 33 cm. A very small, incomplete skull at the Khai Luong (KL13) temple was suspected to be that of a young pygmy killer whale, although this could not be confirmed.

We examined a photograph at the temple in Vung Tau of a dead cetacean which we identified as a pygmy killer whale. We were able to distinguish this species from similar looking cetaceans, such as the false killer whale and melon-headed whale, by the flipper shape and the number and spacing of teeth visible in the lower left jaw (11 widely spaced teeth could be seen). No information was available about the source of the photograph and no skulls of this species were examined at the temple.



Plate 3. Skulls of 'blackfish' from Dam Mon temple: melon-headed whale (DM1) (left), pygmy killer whale (DM5) (centre), and a short-finned pilot whale (DM9) (right).

Short-finned pilot whale *Globicephala macrorhynchus* Gray, 1846

A skull of a short-finned pilot whale was identified at the Dam Mon temple: (DM9; Plate 3) — tooth counts 7 + 2 (UR) and 6 + 3 (UL), CBL 65 cm.

False killer whale *Pseudorca crassidens* Owen, 1846

The ION has the stuffed skin of a false killer whale on display (Plate 4). It is labelled '*Ca Ong Chuong Pseudorca crassidens* (Owen).' The stuffed specimen had a total length of 263 cm, and the tooth counts were: 7 + 2 (UR), 8 + 1 (UL), 9 (LR), and 9 (LL).

Skulls of false killer whales were also identified at five temples:

1. Nha Trang (NT1) — specimen stranded about 1983, tooth counts 9 (UR) and 9 (UL), teeth extensively worn, CBL 70–75 cm;

2. Dam Mon (DM3) — tooth counts 8 (UR) and 8 (UL), CBL 57 cm;
3. Khai Luong (KL5) — tooth counts 9 (UR), 9 (UL), and 9 (LL), CBL 48 cm;
4. Van Gia (VG2) — CBL 55 cm;
5. Vinh Luong (VL6) — tooth counts 8 + 1 (LR) and 9 (LL).

In addition, at the Khai Luong temple, we examined a mandible and partial cranium of a small whale (KL12) that we provisionally identified as a false killer whale. Lower tooth counts were 9–10.

We also examined a photograph in a newspaper article entitled, 'Killing of a Dolphin in Halong Tourist Area' (Lao Dong, 27 July 1993) of a specimen that appears to have been either a false killer whale or a melon-headed whale. If the reported length of 4.2 m is correct, it was certainly a false killer whale.

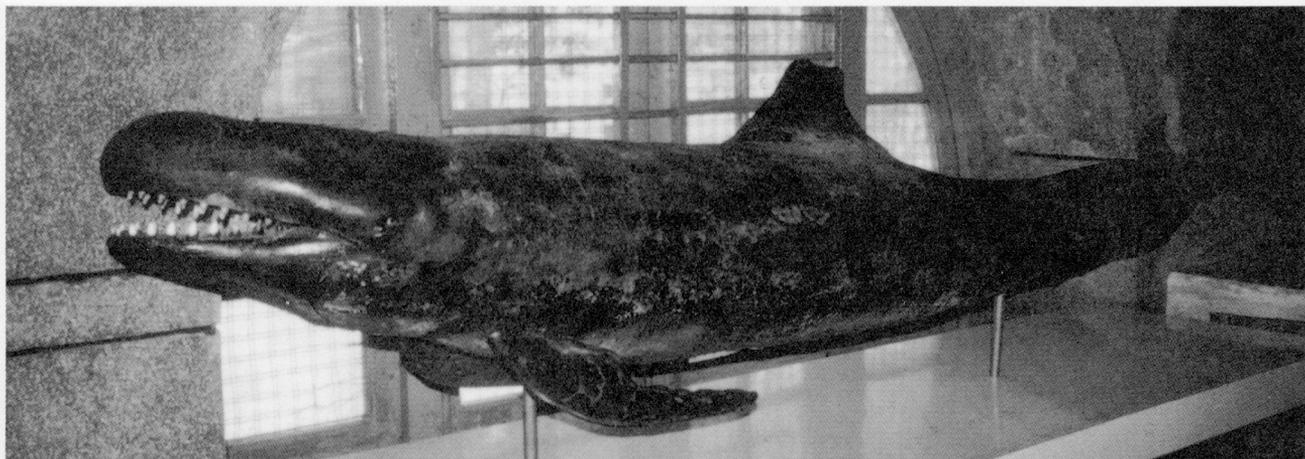


Plate 4. Stuffed specimen of a false killer whale at the Oceanographic Institute in Nha Trang.

Risso's dolphin *Grampus griseus* Cuvier, 1812

Skulls of Risso's dolphins were identified at two temples:

1. Ninh Chu (NC 8; Plate 5) — tooth counts (UR) and (UL) absent, 3 (LR) and 3 (LL), CBL 47.5 cm;
2. Hon Mieu (HM 4) — tooth counts (UR) and (UL) absent, 4 (LR) and 4 (LL).

Bottlenose dolphin *Tursiops truncatus* Montagu, 1821

Zhou and Qian (1985) reported two records (one consisting of three specimens) of bottlenose dolphins (reported as *T. aduncus*) in the central Gulf of Tonkin (Gulf of Beibuwan), between the northern Vietnamese coast and Hainan Island.

The stuffed skin of a bottlenose dolphin specimen displayed at RIMP was reported to be from a stranding in Halong Bay several years before. Tooth counts were 24 (UR), 24 (UL), 23 +1 (LL), and 23 (LR). The total length of the specimen was approximately 180 cm. The beak length was 11.5 cm.

In addition, skulls of bottlenose dolphins were identified at five temples:

1. Dam Mon (DM2; Plate 5) — tooth counts 24 (UR) and 25 (UL), CBL 48 cm;
2. Hai Chu (HC1) — tooth counts 23 + 1–2 (UR) and 20 + 1–3 (UL), CBL 48 cm;
3. Hon Mieu (HM1) — tooth counts 20 + 3–4 (UR) and 23 + 1 (UL), CBL 48 + 1 cm;

4. Xom Bong (XB5) — tooth counts 23 + 1–2 (UR), 22 + 2–3 (UL), 21 + 2–3 (LR) and 21 + 2–3 (LL), CBL 51 + 0.5 cm;
5. Vung Tau (VT2) — tooth counts 20 + 1 (UR) and 19 + 2–3 (UL);
6. Vung Tau (VT6) — tooth counts 25 + 1–2 (UR) and 26 + 1–2 (UL), CBL 44.5 cm;
7. Vung Tau (VT12) — tooth counts 23 + 1–2 (UR) and 20 + 2–3 (UL), CBL 45 + 1 cm;
8. Vung Tau (VT14) — tooth counts 24 + 1–2 (UR) and 22 + 3–4 (UL), CBL 43.5 cm;
9. Vung Tau (VT 15) — tooth counts 24 (UR) and 23 + 1–2 (UL).

Based on their small size, with the exception of XB5, we considered all bottlenose dolphin skulls examined to be from the *aduncus*-type, which is a characteristically coastal form of *Tursiops* in the Indo-Pacific (see Ross 1977; Ross and Cockcroft 1990). Specimen XB5 may be an offshore form of *Tursiops*, judging from its large size and very wide rostrum (Ross and Cockcroft 1990).

Indo-Pacific hump-backed dolphin *Sousa chinensis* Osbeck, 1765

There is a skeleton of a hump-backed dolphin from Tonkin (northern Vietnam) in the Museum National d'Histoire Naturelle, Paris, France. The specimen is cataloged with the number 1897-654 (D. Robineau pers. comm.).

Indo-Pacific hump-backed dolphins were



Plate 5. Skulls of Risso's dolphin (NC8) from Ninh Chu temple (left) and a bottlenose dolphin (DM2) from Dam Mon temple (right).

identified twice during our sighting surveys, both times inside the Bay of Binhcang, north of Nha Trang (Fig. 2). The first sighting occurred on 3 March at 12°24' N, 109°13' E, and consisted of three animals. The second sighting was on 4 March at 12°26' N, 109°12' E, and was of a single animal swimming in the vicinity of a small fishing boat using a gillnet; the fishermen later told us that the dolphin was attempting to take fish from the net.

In addition to these sightings, we identified skulls of Indo-Pacific hump-backed dolphins at six temples:

1. Van Gia (VG4; Plate 6) — tooth counts 32 + 1 (UR), 29 + 2 (UL), 34 (LR) and 31 (LL);
2. Van Gia (VG5) — tooth counts 30 + 3 (UR), 31 + 3 (UL), 28 + 3 (LR) and 30 (LL), CBL 46 cm;
3. Van Gia (VG7) — tooth count 29 + 3 (UL);
4. Van Gia (VG8) — no data collected;
5. Van Gia (VG9) — no data collected;
6. Van Gia (VG11) — tooth count 36 (UL);
7. Van Gia (VG13) — tooth count 34 + 3 (UL);
8. Van Gia (VG16) — tooth counts 35 (UR) and 34 (UL);
9. Vinh Luong (VL 10) — tooth counts 32 + 3—

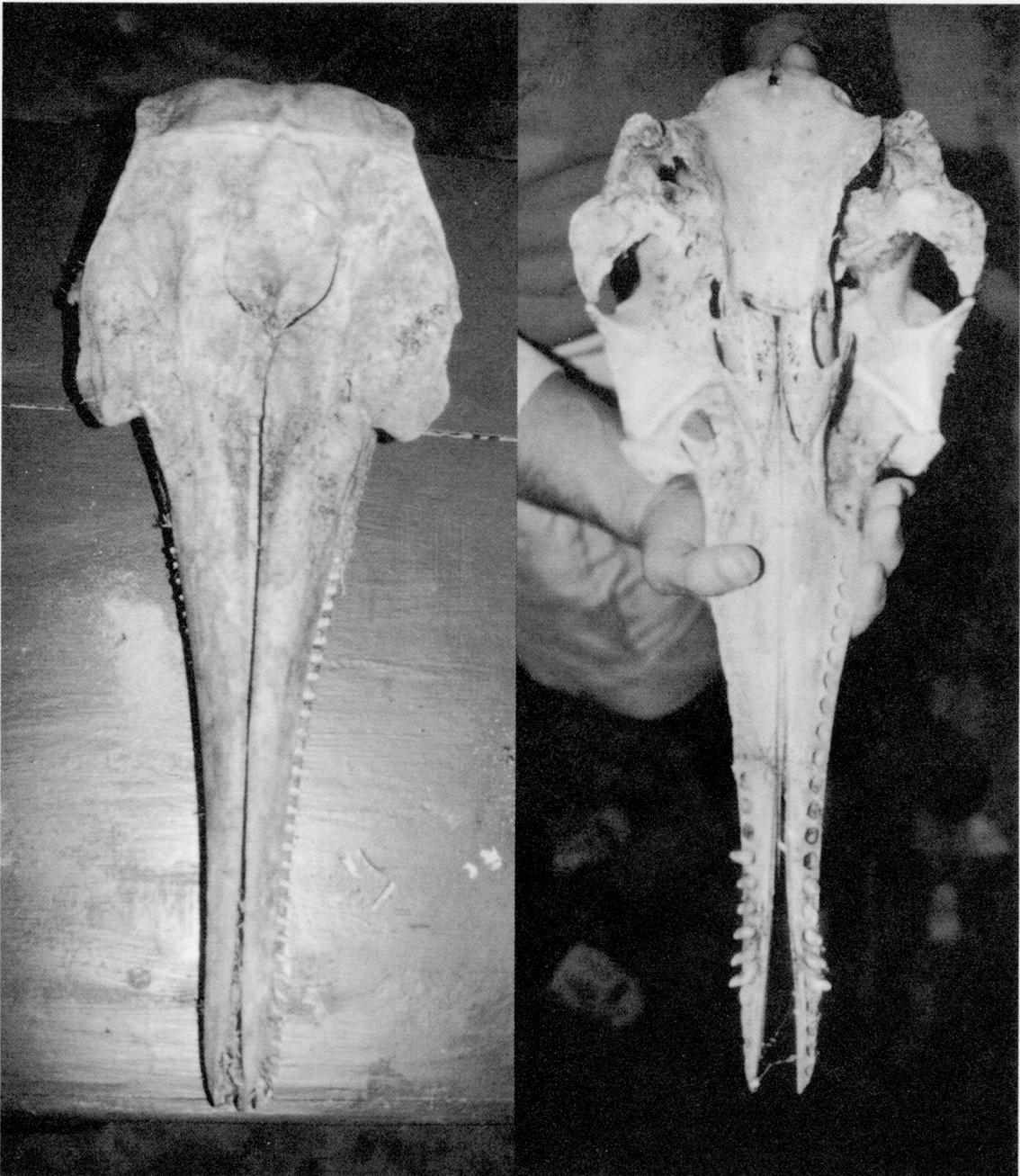


Plate 6. Skulls of an Indo-Pacific hump-backed dolphin (VG4) from Van Gia temple (left) and a rough-toothed dolphin (DM8) from Dam Mon whale temple (right).

- 6 (UR), 33 + (UL), 32 + 1–2 (LR) and 32 + 1–2 (LL), CBL 48 cm;
10. Hai Chu (HC3) — tooth counts 34 + 1 (UR), 34 + 1 (UL), 30 + 2–3 (LR) and 32 + 1 (LL), CBL 49 cm;
11. Cua Be (CB 4) — juvenile specimen, no data collected;
12. Ninh Hai (Hon Koi) (NH1) — tooth counts 35 + 1–3 (UR), 34 + 3–4 (UL) and 33 + 1–3 (LL),

CBL 50 cm;

13. Vung Tau (VT5) — tooth counts 37 + 1–2 (UR) and 36 + 1–2 (UL), CBL 50.5 cm.

We examined two additional skulls at Van Gia and Bai Dam Temples (VG14 and BD2, respectively) that were damaged; these were tentatively identified as Indo-Pacific hump-backed dolphins.



Plate 7. Skulls of *Stenella* spp. from Khai Luong temple: spinner dolphin (KL9) (left) and pantropical spotted dolphin (KL1) (right).

Rough-toothed dolphin *Steno bredanensis*
Lesson, 1828

Skulls of rough toothed dolphins were identified at three temples:

1. Dam Mon (DM8; Plate 6) — tooth counts 22 (UR) and 22 (UL), CBL 49 cm;
2. Dai Lanh (DL3) — tooth counts 27 (UR), 28 (UL), 28 (LR) and 26 (LL);

3. Ninh Chu (Phan Rang) (NC5) — tooth counts 22 + 1 (UR), 22 + 1 (UL), 24 (LR) and 23 (LL), CBL 51 cm.

Spinner dolphin *Stenella longirostris* Gray, 1828

Skulls of spinner dolphins were identified at four temples:

1. Khai Luong (KL9; Plate 7) — tooth counts 43

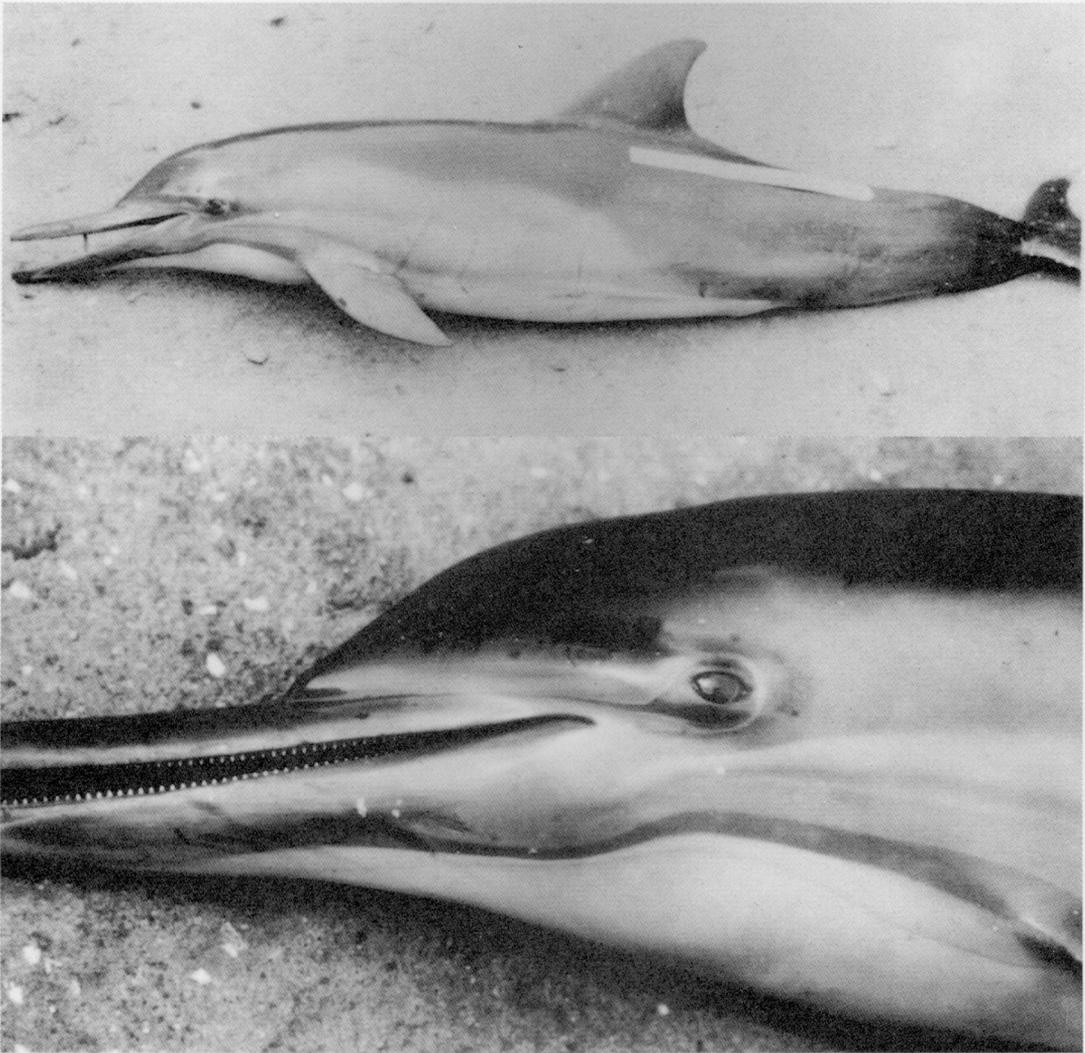


Plate 8. Long-beaked common dolphin stranded in Nha Trang, now a stuffed specimen on display at the Institute of Oceanography, Nha Trang.

- + 8–9 (UR) and 44 + 8 (UL), CBL 42 cm;
- 2. Khai Luong (KL10) — tooth counts 51 + 1 (UR), and 51 (UL), CBL 41 cm;
- 3. Hai Chu (HC6) — tooth counts 38 + 5–6 (UR), 41 + 2–3 (UL), 40 (LR) and 41 (LL), CBL 37 cm;
- 4. Hon Mieu (HM3) — tooth counts 38 + (UR) and 46 (UL), CBL 35 + 1.5 cm;
- 5. Ninh Chu (NC6) — tooth counts 46 + 1–2 (UR), 48 (UL), 45 (LR) and 47 (LL), CBL 39 cm.

Based on the size of several of these skulls (e.g., KL9, KL10, and NC6), the specimens were

not of the dwarf form, described from the Gulf of Thailand by Perrin *et al.* (1989), but rather of the pantropical subspecies, *S. longirostris longirostris* (Perrin 1990). The smaller skulls may have been of the dwarf form or they may have been from young specimens of *S. l. longirostris*. More work with larger sample sizes is needed to confirm whether or not the dwarf form occurs along the coast of Vietnam.

A long-beaked dolphin that stranded about 50 years ago near Nha Trang is on display as a stuffed specimen at the Oceanographic Museum in Nha Trang. It is labelled '*Prodelphinus malayanus* Lesson,' and is either a specimen of *Stenella*

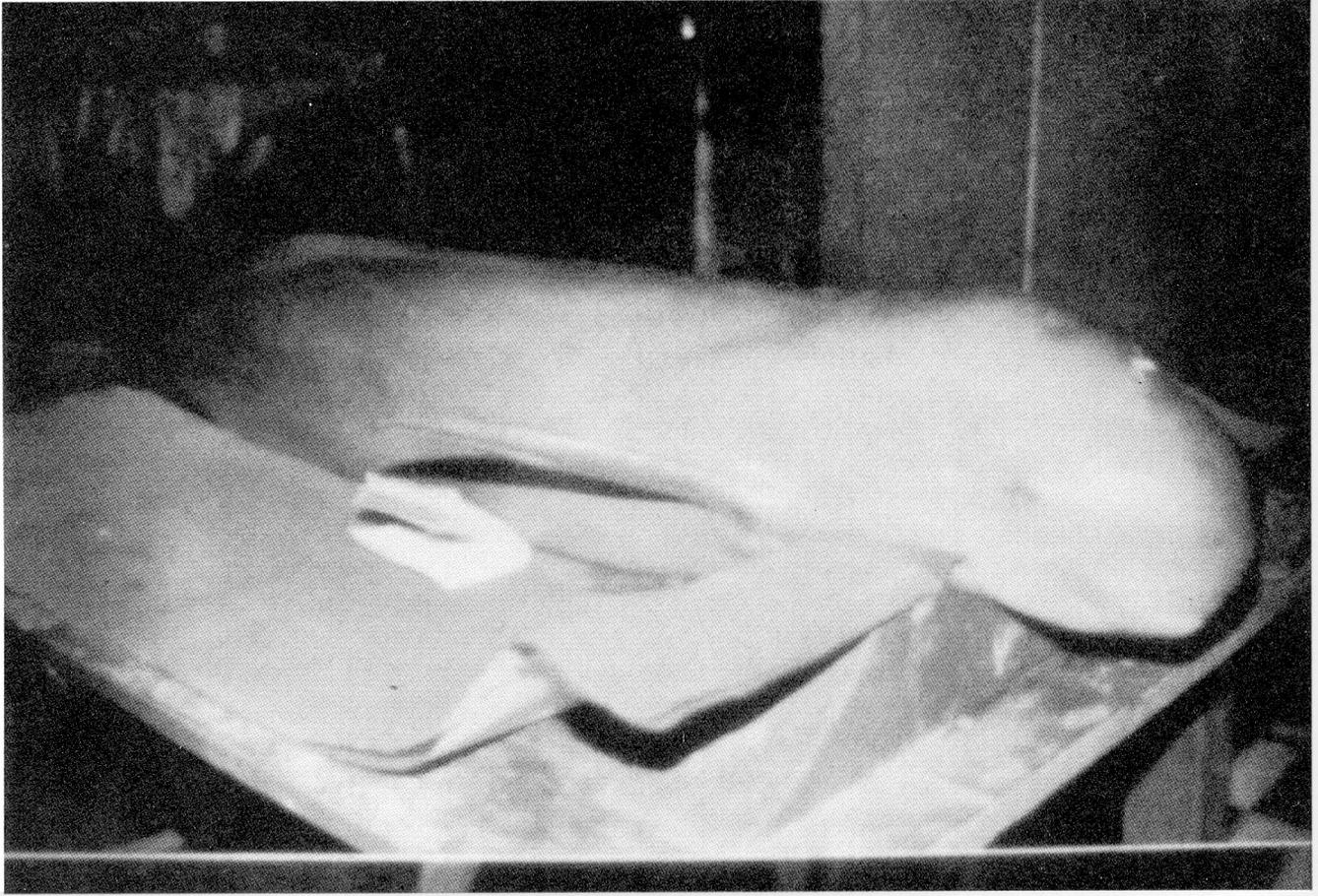


Plate 9. Finless porpoise that was caught in a fishing net in the Mekong River Delta.

longirostris Gray, 1828 or *Delphinus capensis* Gray, 1828. Because of the closed position of the mouth, it was impossible to tell if this specimen possessed the deep palatal grooves characteristic of *Delphinus* spp. Measurements of the stuffed skin are as follows: total length 132 cm, beak length 16.8 cm, dorsal fin height 9.3 cm, and anterior flipper length 20.3 cm.

Pantropical spotted dolphin *Stenella attenuata*
Gray, 1846

Skulls of pantropical spotted dolphins were identified at three temples:

1. Khai Luong (KL1; Plate 7) — tooth counts 35 (UR), 35 (UL), 31 + (LR) and 34 + (LL), CBL 43 cm;
2. Khai Luong (KL8) — tooth count 34 + 1–2 (UR);
3. Khai Luong (KL6) — no data collected;

4. Dai Lahn (DL6) — tooth counts 35 (UR) and 34 (UL);
5. Vinh Luong (VL5) — tooth counts 35 + 2 (UR), 35 + 2 (UL), 37 + 1–2 (LR) and 34 + 2–3 (LL), CBL 39.4 cm.

Long-beaked common dolphin *Delphinus capensis* Gray, 1828

Skulls of common dolphins were identified at nine temples:

1. Khai Luong (KL2) — tooth counts 63 (UR) and 60 + (UL), CBL 52 cm;
2. Khai Luong (KL3) — skull damaged, no data collected;
3. Khai Luong (KL4) — skull damaged, no data collected;
4. Khai Luong (KL11) — skull damaged, no data collected;
5. Van Gia (VG10) — tooth count 53 + 4 (UL),

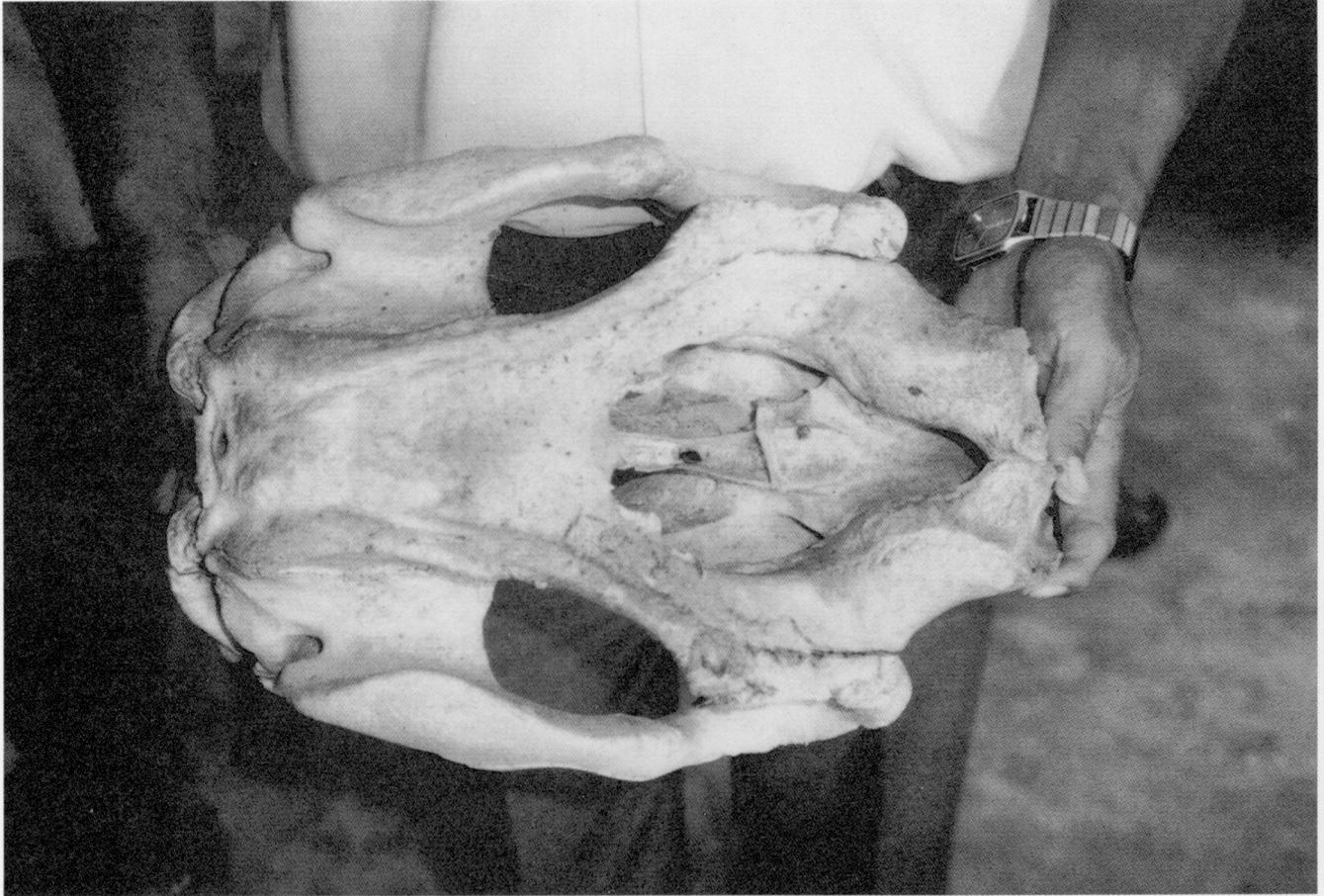


Plate 10. Skull of a dugong (NH2) from Ninh Hai (Hon Koi) temple.

- skull damaged;
6. Dai Lanh (DL7) — tooth counts 53 + 3 (UR), 57 + 2 (UL), 56 (LR) and 56 (LL);
 7. Hai Chu (HC4) — tooth counts 53 (UR) and 54 (UL), CBL 50 cm;
 8. Bich Dam (Hon Tre) (BD2) — tooth counts 56 + 2–3 (UR) and 52 + (UL), CBL 49 + 0.5 cm;
 9. Bich Dam (BD3) — skull damaged, no data collected;
 10. Bich Dam (BD4) — tooth counts 61 + 1–3 (UR) and 62 + 2–3 (UL), CBL 51 + 1 cm;
 11. Bich Dam (BD6) — skull damaged, no data collected;
 12. Hon Mieu (HM2) — no data collected;
 13. Xom Bong (XB2) — no data collected;
 14. Xom Bong (XB7) — no data collected;
 15. Cua Be (CB13) — tooth counts 52 + 5–7 (UR), 54 + 2–3 (UL), 51 + 2–4 (LR) and 51 + 2–4 (LL), CBL 50 + 1 cm;

16. Cua Be (CB14) — skull damaged, tooth counts 51 + (UR), 51 + (UL), 60 + (LR) and 60 + (LL), CBL 49 + 1;
17. Vung Tau (VT16) — tooth counts 54 + 1–2 (UR) and 54 + 1–2 (UL), CBL 49 cm.

Another specimen of this species stranded near Nha Trang about 3 years ago. The stuffed and painted skin is now on display at the ION, where it is labelled '*Prodelphinus malayanus* Lesson.' It is not recognizable as a *Delphinus* from the stuffed carcass, but was identified from photographs of the fresh carcass (Plate 8). We took the following measurements from the stuffed display specimen: total length, 125.0 cm; rostrum length, 14.2 cm; dorsal fin height, 10.4 cm; and anterior flipper length, 20.6 cm.

In addition, another stuffed specimen at the ION (described in spinner dolphin account) may be of this species. It was not possible to

Table 1. Species of marine mammals known or expected to occur in Vietnam.

Species	Recorded			Not Recorded, But Expected ²
	Confirmed ¹	Tentative ¹	Source(s)	
<i>Balaenoptera musculus</i>			Gruvel (1925) ³	X
<i>Balaenoptera physalus</i>				X
<i>Balaenoptera borealis</i>				X
<i>Balaenoptera edeni</i>		S	This paper	
<i>Balaenoptera acutorstrata</i>		S	This paper	
<i>Megaptera novaeangliae</i>	S		This paper	
<i>Physeter macrocephalus</i>				X
<i>Kogia breviceps</i>	L, S		Serene (1934) ⁴ ; this paper	
<i>Kogia simus</i>	S		This paper	
<i>Ziphius cavirostris</i>		O	This paper	
<i>Hyperoodon</i> sp.				X
<i>Mesoplodon densirostris</i>				X
<i>Mesoplodon ginkgodens</i>				X
<i>Orcinus orca</i>				X
<i>Globicephala macrorhynchus</i>	S		This paper	
<i>Pseudorca crassidens</i>	S		This paper	
<i>Feresa attenuata</i>	S		This paper	
<i>Peponocephala electra</i>	S		This paper	
<i>Grampus griseus</i>	S		This paper	
<i>Steno bredanensis</i>	S		This paper	
<i>Sousa chinensis</i>	S, O		This paper	
<i>Tursiops truncatus</i>	L, S		Zhou and Qian (1985); this paper	
<i>Stenella attenuata</i>	S		This paper	
<i>Stenella longirostris</i>	S		This paper	
<i>Stenella coeruleoalba</i>				X
<i>Delphinus delphis</i>				X
<i>Delphinus capensis</i>	S		This paper	
<i>Lagenodelphis hosei</i>				X
<i>Orcaella brevirostris</i>	L, S		Lloze (1973); this paper	
<i>Neophocaena phocaenoides</i>	L, S		Kempf (1993); this paper	
<i>Dugong dugon</i>	L, S		Tranngocloi (1962); van Bree and Duguy (1977); this paper	

¹ L = literature record, S = previously-unpublished specimen record, and O = previously-unpublished sighting record.

² Species not recorded but expected to occur in Vietnam are based on species known to occur in the Southeast Asia/Indo-Malay region (see Perrin *et al.* 1995, 1996).

³ The literature report of the blue whale in Vietnam is apparently erroneous.

⁴ The literature report of the pygmy sperm whale in Vietnam is questionable.

Table 2. Summary of the number of hours of survey effort conducted in different areas in good and poor conditions.

Area	Sighting conditions		Total
	Good ¹	Poor ²	
South-central coast (Nha Trang area)	25:36	23:25	49:01
Mekong River Delta	0	13:18	13:18
Around Phu Quoc Island	1:34	11:56	13:30
Cat Ba Island/Halong Bay area	33:01	11:18	18:19
Total	60:11	59:57	120:08

1 Good sighting conditions are defined as clear weather, with Beaufort sea conditions of 0–2.

2 Poor sighting conditions are defined as significant fog or rain, or Beaufort 3+ (or both).

distinguish it from *Stenella longirostris* Gray, 1828, because the color pattern has been completely lost, and the presence or absence of palatal grooves could not be confirmed.

Based on their relatively high tooth counts and long condylobasal lengths, all of the *Delphinus* skulls that we examined appeared to be of the long-beaked species (*D. capensis* Gray, 1828; see Heyning and Perrin 1994) or the extremely long-beaked variety (*tropicalis*-type) described by van Bree and Gallager (1978). According to Heyning and Perrin (1994), this type is likely to be either a geographical form of *D. capensis* Gray, 1828, or a valid species (*Delphinus tropicalis* van Bree, 1971), but this decision must await further taxonomic study.

Irrawaddy dolphin *Orcaella brevirostris* Gray, 1866

Lloze (1973) reported at least four records of Irrawaddy dolphins from near the mouth of the Mekong River of Vietnam, and from the Isles de Pirates, off southwest Vietnam. On the basis of interviews with local people, V. Yasskin and A. Abramov (pers. comm.) reported that Irrawaddy dolphins reside primarily in the main channel of the Mekong river. No dolphins were observed during our surveys of the Mekong River in April 1996.

We identified skulls of Irrawaddy dolphins at two temples:

1. Binh Thang (BT4) — tooth count 12 + 0–2 (LR), skull inaccessible;
2. Vung Tau (VT4) — tooth count 11 + 2–4 (UL), CBL 32 + 2–4 cm, skull damaged;
3. Vung Tau (VT7) — tooth counts 18 + 1 (UR) and 14 + (UL), CBL 31 + 2–4 cm;
4. Vung Tau (VT8) — skull damaged, no data collected;
5. Vung Tau (VT13) — tooth counts 13 + 1 (UR) and 12 + 1–2 (UL), CBL 29 + 1.

The absence of this species from the skulls we examined at whale temples in south-central Vietnam may indicate that the estuarine region of the Mekong and Dong rivers (The Dong River runs past Ho Chi Minh City and enters the sea near Vung Tau) represents the northernmost range of Irrawaddy dolphins in the South China Sea. A recent review of records of small cetaceans in Chinese waters (Zhou *et al.* 1995) determined that previous reports of Irrawaddy dolphins in coastal waters of Taiwan (Chou 1994) and Hong Kong (Viney 1993) were unreliable. It should be noted that Irrawaddy dolphins are present in the Mekong river as far upstream as southern Lao PDR, just below the Khone waterfalls (Baird and Mounsouphom 1994, 1997; Baird *et al.* 1994).

Finless porpoise *Neophocaena phocaenoides*
Cuvier, 1829

Photographs published in the article by Kemf (1993) show two skulls of finless porpoises being prepared for deposit into the temple in Vung Tau (Fig. 3). This is the only published indication that this species occurs in Vietnam; however, we identified more than 47 skulls of finless porpoises at eight temples:

1. Nha Trang (NT2) — collected from stranding in about 1985;
2. Nha Trang (NT3) — collected from stranding in about 1985;
3. Van Gia (VG6) — CBL 24 cm;
4. Van Gia (VG12) — no data collected;
5. Van Gia (VG15) — no data collected;
6. Dai Lanh (DL1) — no data collected;
7. Dai Lanh (DL2) — no data collected;
8. Dai Lanh (DL5) — no data collected;
9. Bai Dam (BD1) — no data collected;
10. Bai Dam (BD3) — no data collected;
11. Vinh Luong (VL2) — no data collected;
12. Vinh Luong (VL3) — no data collected;
13. Vinh Luong (VL7) — no data collected;
14. Vinh Luong (VL8) — no data collected;
15. Vinh Luong (VL9) — no data collected;
16. Cua Be (CB5) — no data collected;
17. Binh Thang (BT2) — no data collected.

In addition, over 30 *Neophocaena* skulls were observed in a glass case at the temple in Vung Tau. The skulls were not available for handling, but were easily identified as finless porpoises, by their small size and prominent bosses located just anterior to the nares; this feature is a defining characteristic of the family Phocoenidae, of which *N. phocaenoides* Cuvier, 1829 is the only member occurring in Indo-Pacific waters (Jefferson *et al.* 1993).

We also examined photographs of a finless porpoise (Plate 9) at the Xom Vam Lang Temple near the mouth of the Mekong River (Fig. 3). The photographs were of a fresh specimen that was reportedly caught in a fisherman's net several months before our visit in mid-March 1995.

Dugong *Dugong dugon* Muller, 1776

A dugong was caught in a fishing net about 20 km south of Nha Trang (Fig. 2) in July 1960 (Tranngocloi 1962). Van Bree and Duguay (1977) published information on seven dugong specimens from the Con Dao Islands (Fig. 1), housed in the Museum of Bordeaux, France. An additional dugong specimen (#1907–303) from Tonkin (Ha Coi) is housed at the Museum National d'Histoire Naturelle (D. Robineau pers. comm.).

We identified dugong skulls at five temples:

1. Ninh Hai (Hon Koi) (NH2; Plate 10) — no data collected;
2. Khai Luong (KL7) — no data collected;
3. Ba Ha (Ninh Thuy) (BH3) — no data collected;
4. Cua Be (CB15) — no data collected;
5. Van Gia (VG1) — no data collected.

Discussion

Species diversity

Of the 30 species of cetaceans previously recorded in the Southeast Asia/Indo-Malay region (Perrin 1994; Perrin *et al.* 1995, 1996), 16 have now been confirmed in Vietnam, most for the first time as a result of this study (Table 1). Examination of two mysticete specimens and a sighting of an odontocete suggest that three additional species can be added. This study indicates that, at least historically, the coastal and offshore waters of Vietnam have provided habitat for a wide diversity of cetaceans, as well as for dugongs.

Cetacean abundance

During a total of 1,126 linear km (120.1 hours) of at-sea survey effort (Table 2), we made only four cetacean sightings, two of hump-backed dolphins (Fig. 2), one of an unidentified small whale (probably Cuvier's beaked whale; Fig. 2), and one of an unidentified delphinid (Fig 5.). During 224 linear km (22.0 hours) of survey effort in the

Mekong River we sighted no cetaceans. We are unable to account for the apparent virtual absence of cetaceans, despite extensive search effort in a variety of different locations and representative habitats. The results of our surveys are consistent with reports of a similar paucity of cetaceans during at-sea surveys conducted from Vung Tau to Cam Ranh Bay (Fig. 1) in February - April of 1989 by researchers from Moscow University and the A.N. Severtsov Institute of Ecology and Evolution in Russia; only two dolphins were observed, probably belonging to the genus *Stenella* (V. Yasskin and A. Abramov per. comm.), and four days of casual search effort, conducted as part of an ecotourism cruise from Ho Chi Minh City to Haiphong (Fig. 1) during June 1993 on the passenger ship *Caladonia Star*; no dolphins were observed (W.T. Everett pers. comm.).

The paucity of sightings may be partially accounted for by the offshore distribution and migratory habits of some species. Many of the species we recorded at whale temples are typically found offshore of the continental shelf (e.g., false killer, pygmy killer, melon-headed, short-finned pilot, dwarf sperm, and pygmy sperm whales and long-beaked common, Risso's, spinner, and pantropical spotted dolphins; Leatherwood and Reeves 1983; Jefferson *et al.* 1993). Fishermen frequently also suggested that we come back in the summer when dolphins were more abundant. These explanations would not, however, account for the absence of species which are typically found inshore and are known from other areas of their distribution to be more sedentary (e.g., bottlenose, hump-backed, and Irrawaddy dolphins, and finless porpoise; Wells *et al.* 1980, but see exceptions in Durham 1994; Wells *et al.* 1990). Although it is possible that these species were never common, they must have occurred in sufficient numbers for the species to persist within the range of Vietnamese waters (as evidenced by whale temple specimens, interviews with fishermen, and newspaper accounts of strandings and hunting). We have no basis for making a quantitative judgement on the minimum population density necessary for persistence of these species, but suspect that it is greater than virtually zero. Other explanations for the low

number of sightings may be that dolphins living along the coast and in the Mekong River have not recovered from possible war-related mortality, have been subjected to high levels of mortality from accidental entanglement in fishing nets, or that a depletion in their food base has reduced dolphin survival or reproduction. We suggest that the actual explanation for the absence of sightings may be a combination of all of the above.

Interactions with fisheries

Fishermen reported that they sometimes accidentally catch dolphins in gillnets, although not often. They consistently reported releasing animals that were alive when found. In practice, dolphins probably die fairly quickly from suffocation when they are caught in gillnets and prevented from reaching the surface for air. Considering the large number of gillnets we observed being used along the coast of Vietnam, even a low bycatch rate of dolphins could result in a significant conservation problem. One Vietnamese fisherman reported that while working as a translator for a large Chinese gillnetter, he witnessed 14–15 dolphins come up dead in the net during a single two-week trip off the coast of the Thanhhoa Province. From photographs we showed him in a cetacean guidebook, he identified the dolphins as Risso's dolphins and pygmy killer or melon-headed whales. He stated that the Chinese fishermen sold the meat of Risso's dolphins in the market at Cat Ba for US\$5 per dolphin but ate the meat of pygmy killer/melon-headed whales themselves; apparently, this meat had a strong taste and would not bring a good price. A local hotel manager also reported occasionally seeing dolphin meat in the market at Cat Ba, but stated that it is generally not popular and sells for a low price.

Fisheries in Vietnam are extensive and appear to be expanding. In recent years, the catch of fish and shellfish along the south-central coast of Vietnam (Phuyen Province to Binhthuan Province) has been about 160,000 to 200,000 tonnes·year⁻¹ (Nguyen Huu Phung *et al.* 1994). While surveying offshore of Dai Lanh (Fig. 2), we counted 80–100 active fishing boats in view during a single scan. On another occasion, as we entered the Mekong

River Delta (Fig. 3), we observed several dozen stow nets, each one stretching 200–400 m. Further into the delta, we observed over 10 rows of gillnets, laid out so that they stretched across nearly the entire channel, with only small openings to permit vessel traffic. At one point, we counted 60 gillnet vessels tending 4–5 nets each.

We speculate that a loss of the dolphins' food base from overfishing could prevent the animals from obtaining sufficient nutrition for survival or successful reproduction. This problem would presumably most seriously affect the more sedentary coastal species, which may not be able to migrate to more productive waters.

Direct exploitation

We found no evidence of direct exploitation of cetaceans by Vietnamese fishermen. Small cetacean fisheries are known to occur in other parts of Asia, including the Philippines (Dolar *et al.* 1994), Sri Lanka (Leatherwood and Reeves 1989), and Indonesia (Barnes 1991). In fact, several older fishermen expressed concern and revulsion about stories of fishermen from other countries hunting and eating the meat of whales and dolphins. We are concerned, however, about reports of dolphin meat occasionally being sold in the market in Cat Ba, and of the exploitation of small cetaceans by Vietnamese hunters from inland areas. A newspaper article entitled, 'Killing of a dolphin in Halong Tourist Area' (Lao Dong, 27 July 1993) reported that a dolphin weighing 300 kg with a length of 4.2 m was shot and brought to the beach by a hunter, who stated that the meat from this animal could be sold for 200,000 VND (approximately US\$20). The article also stated that local fishermen never catch dolphins, because the animals sometimes help boats when there is an accident and that seamen like to watch them as they frolic alongside their vessel.

Whale temples and worship

Whale temples have proven to be a highly valuable source of information on marine mammals in Vietnam. In fact, the concept of a marine mammal stranding network may have been

invented by those who first conceived and developed such temples; whale worship was reported by Kemf (1993) to have been practiced since at least the 1700s, although temple keepers in Vung Tau reported that their temple was the first in Vietnam and was built in 1890 (confirmed on a sign at the temple entrance).

Two temples on Cheung Chau and Sha Chau islands in Hong Kong have whale bones incorporated into their altar displays (Leatherwood and Jefferson pers. obs.) and a system of whale temple building and burial exists in some areas of Southern Japan, based on 'making the graves of animals which died for human utilization such as consumption for food, obtaining knowledge and so on' (Uchida 1986). A superficial examination and investigation of the whale temple phenomenon reveals that the practice of saving and 'worshipping' the remains of whales, dolphins, large sharks, rays, and other large sea creatures occurs frequently in Buddhist-based regions of Southeast Asia.

Serene (1934) mentioned that he was not able to acquire the *Kogia* specimen that he reported on because it was being prepared for worship. Museums and research institutions in Vietnam have also found it difficult, if not impossible, to acquire cetacean skeletons for display, as stranded specimens are zealously guarded by local fishermen and temple keepers (Nguyen Tac An pers. comm.) A newspaper article entitled, 'Dolphin Found on the Beach of Quang Tri Province' (Lao Dong, 16 March 1995) told how local fishermen refused to sell the meat of a large dolphin (or whale ?) found on the beach, and, instead, buried it at the village whale temple according to their local tradition.

Vietnamese fishermen told us that they worship cetaceans because they believe the animals will aid them when in distress at sea. In nearly every village we visited, we heard stories of cetaceans pushing people and vessels ashore after boats had sunk or been blown out to sea in a storm. Kemf (1993) reported that the tradition of whale worship began after Chinese invaders sank a Vietnamese naval boat in the 1700s and the sailors were rescued by a group of dolphins.

When Vietnamese fishermen find the body of a dead cetacean, they generally bury the animal

near the temple of their home village if it is small enough to transport. If it is too large to transport, they bury it in the location where it stranded. Cetaceans that are incidentally caught during fishing operations and bones that come up in the net while bottom trawling are also taken to whale temples. After the carcass has been buried for three years and the flesh cleaned from the bones by insects and microorganisms, the fishermen dig up the skeleton in a special ceremony and deposit the bones at the local whale temple for worship (see description of a 'whale wake' in Kemf 1993).

Skeletal materials at whale temples were generally found in cement crypts and wooden coffins, and occasionally in clay urns and glass display cases. The number of specimens stored at each temple varied from three skulls stored in glass cases in Nha Trang (Fig. 2) to more than 200 skeletons stored in individual coffins and urns in Vam Lang (Fig. 3). Some of the skeletal materials we examined were decomposing and appeared to be quite old; we were told by temple keepers that some were more than one hundred years old, while other materials were in good shape and appeared to be quite new. Temple keepers told us that old specimens were never discarded, but some were destroyed in the war.

At the temple in My Tho, we were shown a single wooden coffin on top of the altar display and told that it contained the ashes of a whale skeleton; from the small size of the box, the ashes were probably from a small cetacean or only a few bones from a large whale; these were the only remains stored at the temple. The box was sealed, so we were not able to examine inside. The temple keeper told us that cremation was their traditional way of preparing whale remains for worship. This is the only occasion we have heard about whale bones being cremated as part of the practice of whale worship. It may be significant that the temple in My Tho is located approximately 40 km upstream of the mouth of the Mekong River and, therefore, not as closely connected to the sea as the other temples we visited.

At the temple in Thoi Thuan, we were told that during their yearly 'whale festival,' held in July, the entire village goes to sea in fishing boats to search for whales for the purpose of offering them their prayers. This is the only report that we

have heard of 'whale watching' being a part of the whale worship phenomenon.

In addition to the skeletal materials of cetaceans, we also found bones of dugongs and leatherback turtles (*Dermochelys coriacea* Linnaeus, 1758) and bills of sawfish (*Pristis* sp.) at whale temples. Temple keepers and fishermen told us that in the past they worshipped all large sea creatures, but now at most temples, people only worship animals they consider to be whales, i.e., cetaceans without a beak. Some fishermen include in this category cetaceans with beaks, but only those that do not travel in large groups and swim with characteristic 'sine-wave' leaps. In practice, the definition of what is considered a whale or dolphin varies among temples and is not always clear. In some cases, we were told by fishermen that they did not worship dolphins, only 'whales,' but when we examined specimens at the whale temple, we found mostly long-beaked delphinids (we were generally told that these were old specimens). One man explained that fishermen in his village included dolphins, not because they worshipped them, but only to be respectful of their intelligence and their families. Other fishermen said that, although they worshipped whales, they did not like dolphins, because of their habit of stealing fish from their nets (they said they sometimes beat, but never kill, the dolphins).

During our second sighting of Indo-Pacific hump-backed dolphins (Fig. 2), we observed a single animal surfacing near a gillnet tended by local fishermen. The boat was circling around the net, and a fisherman was beating the water with a long bamboo pole, in part to drive fish into the net, but also (as he later explained) to scare the dolphin away from the net. We watched him pull up the net and reset it approximately one km away; the dolphin followed the boat to the new location. The fishermen later complained that it was difficult to feed his family when dolphins frequently took a large portion of his catch. Our general impression was that dolphins, however they are defined, no longer receive the same reverential treatment from fishermen which they may have enjoyed in the past.

Although it is difficult to determine exactly when dolphins began to fall out of favor with Vietnamese fishermen, the timing seems to

correspond roughly with the introduction of nylon monofilament gillnets in the early 1960s; one fisherman told us that before the Americans arrived during the war they worshipped dolphins but not after they left; other younger fishermen said that although their fathers worshipped dolphins, they did not. We speculate that until this time there was little direct competition between Vietnamese fishermen and dolphins for food. Gillnet fisheries, however, may have provided an easily accessible, although potentially deadly, source of food for dolphins that put them in direct competition with local fishermen. A decreasing food base, resulting in reduced foraging opportunities, could have led dolphins to become more dependent on easily accessible fish from gillnets. In addition, the probable increase in the bycatch rate of dolphins, once gillnets came into common use, may have resulted in a conflict with the traditional venerated status of dolphins.

Some fishermen told us that they worship dugongs and never hunt the animals. Other fishermen readily admitted that on the rare occasions they encounter dugongs, they will attempt to kill the animal, because the meat fetches a high price in local markets. Bones of dugongs that we examined at some of the temples were sometimes mistaken by fishermen as coming from cetaceans.

Dolphins in captivity

According to the report of L. Mukhametov (pers. comm.) from the Severtsov Institute of Ecology and Evolution, three bottlenose dolphins were transported from the Black Sea (one female, approximate age 10 years, and two males, approximate ages 5–6 years) to Nha Trang, Vietnam, on 4–5 February 1991. The original intention was to construct a dolphinarium for scientific research. The dolphinarium was never built and the animals remained in a small pontoon enclosure (size: 10m by 8m by 3m) located in a small inlet near the Oceanographic Institute of Nha Trang. Although the level of dolphin training was low, because of great local interest, an exhibition programme was prepared and presented. The female dolphin died on 21 August 1991 from a rare intestinal disease. One of the

males died on 11 November 1991 and the other on 12 December 1991. An autopsy of both male dolphins found that their stomachs were full of foreign objects and seaweed. One of the animals had an ulcer in the first chamber of the stomach and both had gastritis. It was concluded that both animals died due to stomach diseases caused by the ingestion of foreign objects. Local people in Nha Trang told us that the dolphins occasionally escaped from their pens, and had to be recaptured.

The director of the Ho Ky Hoa Park Aquarium in Ho Chi Minh City, Le Huu Dung (per. comm.), expressed great interest in capturing and maintaining dolphins for display at his aquarium. He had no doubts about the enthusiasm of Vietnamese people for such an exhibit.

Future research

We hope that our initial attempt to assess the distribution of marine mammals in Vietnam will encourage other, more extensive, research projects to fill-in the gaps of our knowledge that we have identified in this preliminary checklist. We especially recommend that studies focus on the problem of incidental catch in fishing nets.

Acknowledgements

Funding for this study was provided by the Ocean Park Conservation Foundation/Ocean Park Corporation, IUCN Species Survival Commission Cetacean Specialist Group, and Whale and Dolphin Conservation Society. The assistance of Dr. Nguyen Tac An and Do Minh Thu from the Institute of Oceanography in Nha Trang and Dr. Nguyen Chu Hoi and Dr. Nguyen Duc Cu from the Haiphong Institute of Oceanology was invaluable in conducting the surveys. Dr. Nguyen Nhat Thi of the Marine Natural Museum of the Haiphong Institute of Oceanology, Tran Trong Ha of the Museum of Quang Ninh Province, and Dr. Bui Dinh Chung of the Research Institute of Marine Products provided important information on museum specimens. We thank Vinh An for assistance in arranging permission to conduct the surveys and for help with searching for animals. D. Robineau provided information on specimens

in French museums, and W. F. Perrin and J. E. Heyning assisted with species identifications. We also thank the crews of our numerous survey vessels for their unfailing hard work and assistance in conducting the surveys. We appreciate the cooperation of fishermen and whale

temple keepers of Vietnam with our requests to exhume the skeletons of marine mammals stored at the whale temples and are grateful for their practice of whale worship, which is an inspiration to all marine mammal enthusiasts.

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