Chapter 1

Introduction

Dolphin is a marvelous animal. Its splendid body, its miracle intelligence and its acrobatic behavior interest every observers including the author. Although it can not be easily found in the sea as most marine animals, marine mammologist still want to divulge its mysterious life.

Cetacean watching in the sea has been promoted as commercial tourism in many parts of the world such as New Zealand, Australia, Canada and the United States of America. This creates the best avenue for public to appreciate the real life of cetaceans in nature. Careful watching will not disturb the animals but will introduce the cooperative life of both man and dolphin peacefully.

On the other hand, their normal behavior and quick-learning abilities, dolphins and porpoise have been taken from their normal habitat for many aquaria world-wide, including a few dolphinaria in Thailand. Condition in some dolphinaria or aquaria are unacceptable. They usually are reluctant to provide information for researchers and reporters. The number of dolphins died in these dolphinaria remains unknown.

Furthermore, the incidental catch may now be a bigger problem for cetaceans worldwide than directed catch even though cetacean flesh consumption is still common in some countries such as Japan and Vietnam. A particular concern in recent years is large scale monofilament pelagic driftnetting which are still being used by some countries. This driftnet is causing many dolphin incidentally entangled. This fishing methods has been employed in coastal waters, and cetaceans become more accidentally caught. Other types of gears, particularly set net of various types, are more dangerous than others. Researchers have now been trying to find some means to deter cetaceans from such gears, without affecting the fishing effiency. Due to the little known status of dolphins in Thailand causes extreme difficulty to protect or conserve them effectively.

The Gulf of Thailand, where the four major rivers, Chao Phraya, Ta Chin, Mae Klong and Bangpakong drained into, is the most productive area of Thai waters. This area has been considered as one of the rich fishery resources in the world together with a rich diversity of dolphins. However, the fisheries development in the Gulf had grown unsystematically and unmanagably. Overfishing condition had severely affected marine wildlife and dolphins as well. Furthermore, habitat degradation, incidental catch, pollution and dolphinaria supply can effect dolphin population. All these factors are now prevalented in many countries around the world.

So far, knowledge of cetaceans in Thai waters is still very preliminary. Reports of small cetaceans in Thai waters from Pilleri & Gihr (1974), Lekagul & McNeely (1977), Humphrey & Bain (1990), Sudara (1990), Andersen & Kinze (1991), Kowitwatee (1991) and Chantrapornsil, et al. (in press), are not supportive and contradicted to one another.

Up to present, very few studies on the numbers of small cetacean species and their distributions had been carried out in Thai waters. Irrawaddy dolphins had been reported in many great rivers of Asia. Lekagul & McNeely (1977) reported that the Irrawaddy dolphin was previously known to enter the Chao Phraya river. This compels the author to search for more evidence to confirm the presence of Irrawaddy dolphin and the others in the four major rivers open to the Inner Gulf of Thailand.

The interview data is needed to scan the basic information of dolphin in the area. Study on old specimens may indicate the status of dolphin in the past. The morphological and biological study on the new specimens will help to evaluate the present status of dolphin. Therefore this integrated study is carried out and expected to gather some information on the ecological and biological aspects of dolphins and porpoises. It is intended in providing more information as the basis to find ways to conserve them in our waters.

Objectives

1. To study species composition and external morphology of dolphins and porpoises in the Inner Gulf of Thailand.

2. To study the distribution of dolphins and porpoises in the Inner Gulf of Thailand, including the four major tributaries.

3. To study some biological aspects and determine the status of dolphins and porpoises in the current environment of Inner Gulf of Thailand.

Expected Results

1. Gather additional information and knowledge of dolphins and porpoises in the Inner Gulf of Thailand.

2. Estimate the changes of status of dolphins and porpoises from the past to present.

3. The study on morphology in details would aid in the identification to species in dolphins and porpoises. This may lead to the discovery new species.

Literature review

Cetaceans are mammals which spend their lives in water, and have evolved many adaptations to this way of life. The body is streamlined, with no hindlimbs, reduced forelimbs to form flippers and a powerful horizontal tail for propulsion. The nostrils have become blow holes at the top of the head to facilitate respiration while travelling through the water. The marine mammal order Cetacea includes 2 Suborders : The Mysticeti or moustached whales, including 11 living species of baleen or whalebone whales; and the Odontoceti or toothed whales, including

dolphins, porpoises and whales with teeth but no baleen. Delphinidae is one family of the suborder Odontoceti. They are the group of oceanic dolphins, including the biggest, 10 m., Killer whales and the smallest, 1.5 m., Heaviside's dolphin. The Phocoenidae is the another family of Odontoceti which consists of 6 species of porpoises which seperated from delphinids by the difference of their teeth. Phocoenids have teeth blunt with expanded crowns, and all have extremely short or non existent beak. On the other hand, Delphinids have conical and sharply pointed teeth; only some of them have no beak. Member in smalll size of both families are called " Pla loma " in Thai.

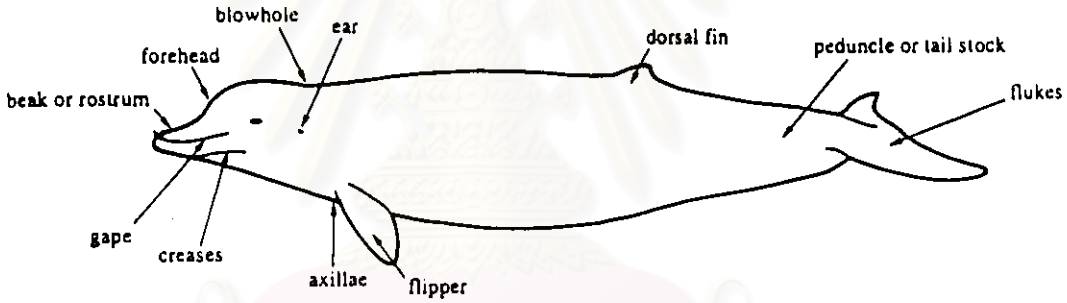

Fig.1 External morphology of dolphin (from Jefferson, et al., 1993)

Pilleri & Gihr (1974) reported on seven species of cetacean in Thai waters. Lekagul & McNelly (1977), reported eight species of dolphins, *Sotalia plumbea*, *S. borneensis*, *S. chinensis*, *Steno bredanensis*, *Stellnella malayana*, *Delphinus delphis*, *Tursiops aduncus* and *Orcaella brevirostris* and 1 species of porpoise, *Neophocaena phocaenoides*. Some of the species reported are now concidered as synnonyms of others. Sudara (1990), reviewed the above paper and recognized one more species of dolphin, *Stenella longirostris*. Humphrey and Bain (1990) reported 9 small cetacean in

Thai waters. Kowitwatee (1991) reported 10 species of tooth whales and dolphins on the east and west coast of the Gulf of Thailand.

Sixteen species of small cetaceans, *Kogia breviceps* (de blainville 1838), *Kogia simus* Owen 1866, *Mesoplodon gingodens* Nishiwaki and Kamiya 1958, *Peponocephala electra* (Gray 1846), *Pseudorca crassidens* (Owen 1846), *Globicephala macrorhynchus* Gray 1846, *Orcinus orca* (Linnaeus 1758), *Orcaella brevirostris* (Gray 1866), *Steno bredanensis* (Lesson 1828), *Sousa chinensis* (Osbeck 1765), *Tursiops aduncus* (Ehrenberg 1833), *Delphinus delphis* Linnaeus 1758, *Stenella attenuata* (Gray 1846), *Stenella coeruleoalba* (Meyen 1833), *Stenella longirostris* (Gray 1829) and *Neophocaena phocaenoides* (Cuvier 1829) had been reported in Thai waters (Andersen & Kinze, 1995 and Chantrapornsil et al., 1996). Recently, the two more species *Ferasa attenuata* Gray 1375 and *Lagenodelphis hosei* Fraser 1956, are to be reported further from the Andaman Sea (Chantrapornsil , personal communication).

***Neophocaena phocaenoides*, finless porpoise**

Neophocaena phocaenoides (Cuvier, 1829), finless porpoise, is found in warm rivers and coastal waters from the Persian Gulf, through the Indian subcontinent to southeast Asia and north to China, the Korean peninsula and Japan. They are found in the middle and lower reaches of the Yangze (Changjianj) river in China, as far as Yichang, and in the adjacent lakes, such as Dongtinghu and Boyanghu. Elsewhere they are reported from mangrove areas, estuaries, deltas and fresh water lakes connected to rivers. They are found in all major rivers is this area (Klinowska, 1991).

Finless porpoises have no dorsal fin, and this is their most distinctive characteristic. In some way, they resemble small, slender white whales. The head is beakless; the rounded forehead rises steeply from the snout tip. The body shape, in general, is more slender than in other porpoises. The finless porpoise is soft and mushy, and the neck is very flexible. Instead of dorsal fin, the finless porpoise has an area of small bumps or tubercles on its back, running from just forward of midback to

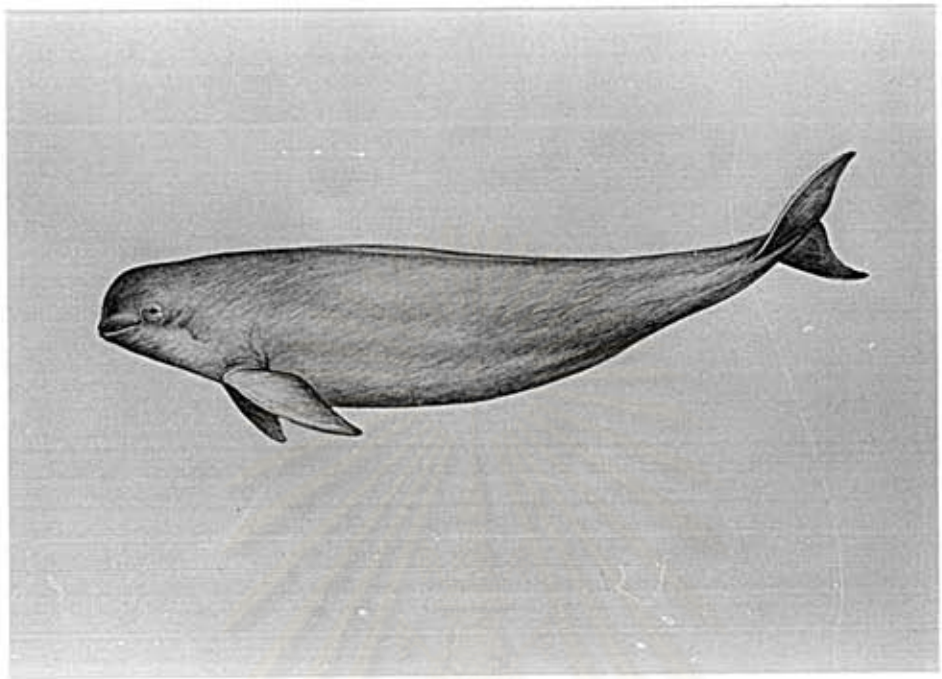

Fig. 2 *Neophocaena phocaenoides*, finless porpoise

the tail stock. The trailing edge of the flukes is concave and the flippers are large, ending in rounded tips. Regional differences in body size and morphology have been documented, with Yangze River animals apparently representing a separate stock. In most areas, finless porpoises are grey in color, with lighter areas on the throat and around the genitals. Older animals are gennerally lighter grey than juveniles. In the Yangze river population, they are very dark grey, nearly black. Tooth counts ranges from 13 to 22 in each tooth row. Finless porpoises are apparently about 70 to 80 cm. at birth (Jefferson, et al., 1993). The geographical differences and available information on distribution implies that the finless porpoises in western Kyushu constitute a local population (Shirakihra et al., 1993)

In the Changjiang River, body lengths of the smallest neonate and the largest fetus ranged between 60.0 cm. and 73.35 cm. (Kasuya, in press, quoted in Howell, 1927 and Chen et.al., 1982). Adults of this species have a significant geographical variation in their growth. A male finless porpoise increases from the smallest in the Indian Ocean (150 cm.) to the largest in the Yellow Sea/Bohai area (201 cm.). The maximum body length of females changes from the smallest in the Indian Ocean (155 cm.) to the largest in the Yellow Sea/Bohai area (200 cm.) (Kasuya, in press).

The information on the season of mating and parturition suggests that peaks of mating and parturition of finless porpoises are more diffused and problably later in the southern habitat. The northern populations are problably adapted for calves to switch their major source of nutrition from milk to solid food during the most productive summer months by clustering births, as the newborn calves can endure the cold climate in the spring. The weaning and calving interval, including a 11 month's gestation and a uniformly short nursing period, suggests that a two year cycle will be usual (Kasuya and Kureha, 1979) but further study is needed to arrive at a firm conclusion because the sample composition reflects mortality which may be dependent on age and reproductive status (Kasuya, in press).

Shirakihra et al. (1993) studied finless porpoises in the coastal waters of western Kyushu, Japan. They reported that both males and females grew to around 140 cm. by 5 yr. of age. Females probably attain sexual maturity at ages of 6-9 yr and at body lengths of 135-145 cm.. Males probably mature sexually at ages of 4-6 yr and at body lengths of 135-140 cm. and at weight of testis of 40-150 g.. The weight of testis increased with body length as well. Spermatozoa in the epididymis were abuntdant for 11 mature males taken in autumn to winter (September-January) and less abundant for 3 males taken in summer (June-July), inspite of the presence of spermatozoa in the seminiferous tubules. However, a seasonal change in testis weight and diameter of seminiferous tubules was inconclusive because of the small sample size. Parturition in western Kyushu was estimated to be prolonged from autumn to

spring, whereas in the Inland Sea and Pacific waters it was restricted from spring to summer with a peak in April.

The skeleton of finless porpoises in coastal water of western Kyushu, Japan, have been well studied by Yoshida, et al. (1994) Skulls ceased growing by the fourth year. Postcranial skeletons ceased increasing in size at an age older than 11years. Fusion between vertebral centra and the epiphyses progressed gradually with age (Fig. 3). Neonates have no epiphyses fused with centra. Fusion was observed first in the cervical vertebrae. Fusion progressed in a posterior direction in the cervical vertebrae and in anterior direction in the caudal vertebrae. An individual age 14 yr showed fusion in all the vertebrae, but epiphysial sutures were still visible in the thoracic and lumbar vertebrae.

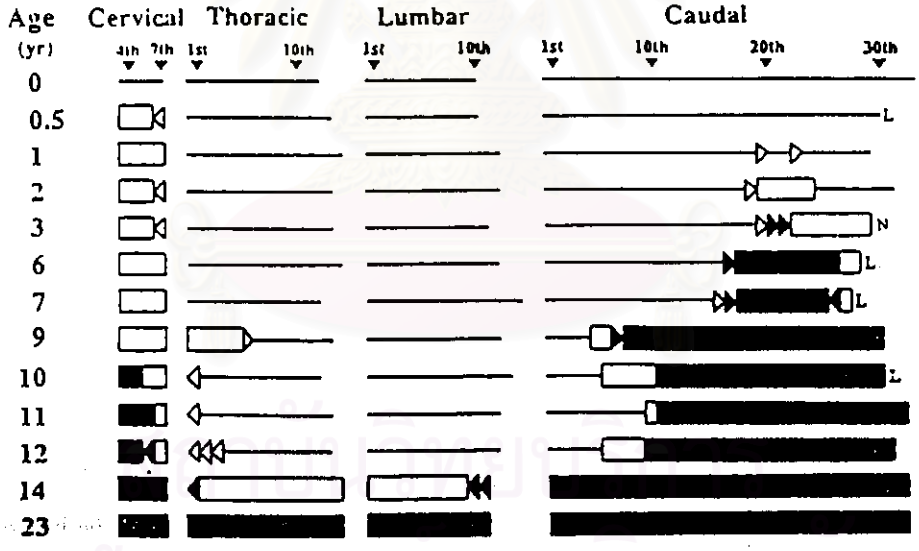

Figure 3 A typical pattern of fusion between vertebral centra and epiphyses. —, Both sides free; ◁, anterior side fused but suture visible; ▷, posterior side fused but suture visible; □, both sides fused but suture visible; ◀, anterior suture invisible but posterior visible; ▶, posterior suture invisible but anterior visible; ■, both sutures invisible; L, posterior caudals were lost; N, posterior caudals were too small to be examined. For animals aged 0 and 0.5 yr, in which lumbar and caudal vertebrae were combined, the first 10 lumbar + caudal vertebrae are shown as lumbars for simplicity.

From Yoshida (1994)

Sexual dimorphism was not detectable in most of the cranial characters but detected in more than half of the postcranium characters. Females tended to show larger values of poscranial characters. The shape of pelvic bone was obviously difference between male and female. Thus, a discriminant function was proposed to determine sex using measurements of this bone.

***Orcaella brevirostris*, Irrawaddy dolphin**

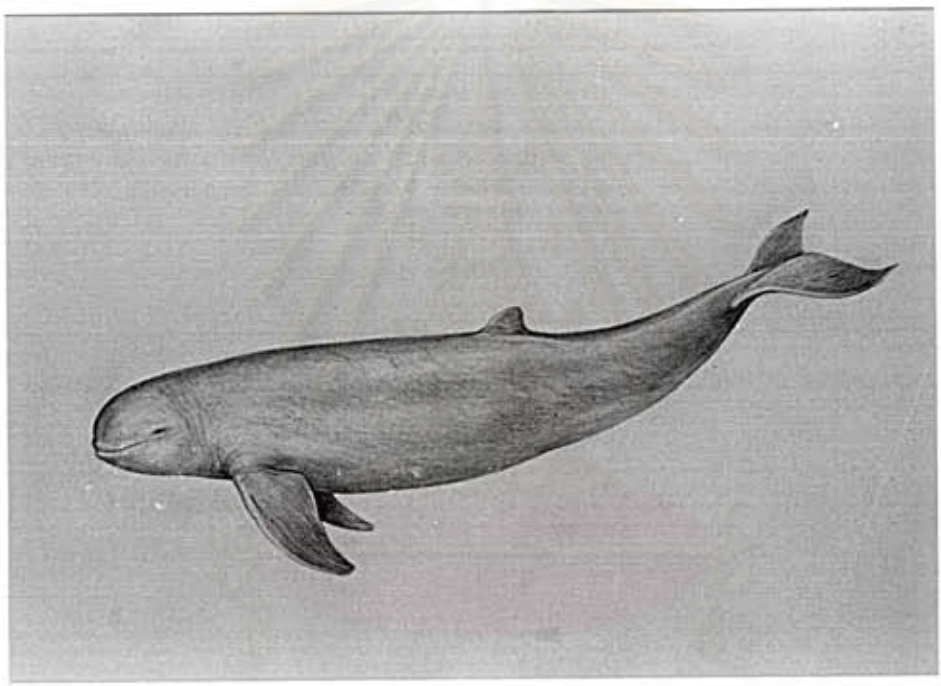

Fig. 4 *Orcaella brevirostris*, Irrawaddy dolphin

Orcaella brevirostris (Gray, 1866), the Irrawaddy dolphin, resembles the finless porpoise, *Neophocaena phocaenoides*, but unlike that species, it has dorsal fin. The fin is small and triangular, with abluntly rounded tip, and is set just behind midback. The large flipper have curved leadind edge and rounded tips. The head is blunt, with no beak; the mouthline is straight, and there may be a visible neck crease. The U-

shaped blowhole is open toward the front, the reverse of the situation in most dolphin species. The back and sides of Irrawaddy dolphins are grey to bluish grey; the belly is somewhat lighter. Tooth counts are 17 to 20 (upper) and 15 to 18 (lower) in each row. The teeth have slightly expanded crowns. Adults range from 2 to 2.75 m.. Scant evidence indicates that the length at birth is about 1 m.(Jefferson, et al.,1993).

Irrawaddy dolphin is found in the Bay of Bengal and throughout the Indo-Malay Archipelago to northern Australia, particularly in the major rivers, such as the Ganges, Mekong and Irrawaddy, and frequently in warm shallow water. (Klinowska, 1991). Freshwater intrusion of Irrawaddy dolphins have been reported in many areas. They are apparently riverrine, estuarine, and coastal inhabitants. There are some populations which are restricted to freshwater, and it is doubtful whether they venture very far offshore. Animals are found long distance from the sea in some of the great rivers of Asia, including the Irrawaddy and Mekong (Marsh et al.,1989). They also refer to records of Anderson (1879) and U Tin Thein (1977) reporting the presence of the dolphins at Bhamo (Burma) about 1300 km. up the Irrawaddy River. Furthermore Baird and Mounsouphom, (1994) reported that Irrawaddy dolphins were sighted by them in the Mekong River. Sightings during the survey and reports from villagers indicate that there are two main areas in Lao PDR inhabited by Irrawaddy dolphins. The first is in the southern-most section of the Mekong River in Champasak Province, along the Cambodian border. The other is in the Sekong River, a tributary of Mekong, and some of its larger tributaries in the provinces of Sekong and Attapeu. Lao and Cambodian villagers have also reported that dolphins inhabited the Cambodian part of the Sekong River and the Sesan River in Cambodia.

In Thailand, the species was previously known to enter large rivers, including the Chao Phraya (Lekagul & Mcneely, 1977) and Chanthaburi River, as reported by Chantaburi residents living along the river. It is possible that pollution and heavy river traffic on the Chao Phraya River and dams on the Chantaburi River have resulted in the dolphins' disappearance from these rivers in recent years. Irrawaddy dolphins are also found in brackish estuaries and saltwater coastal waters in many Asian

countries, including Thailand, where they are often refered to as "pla loma hooa baht" because their snouts are rounded like monk' s bowl ("hooa baht") (Baird et.al., 1994). In Songkhla Lake, Irrawaddy dolphins are often reported by villagers. Dolphins were also incidentally caught in 1990 and 1991, and two incidental catches were reported in 1995 (Sirimontraporn & Sritakon, 1996). They also dissected a male Irrawaddy dolphin with a lengths of 188 cm., a weight of 64 kg and found 3 tails of Ciprinids fish in the stomach.

***Sousa chinensis*, Indo-Pacific humpback dolphin**

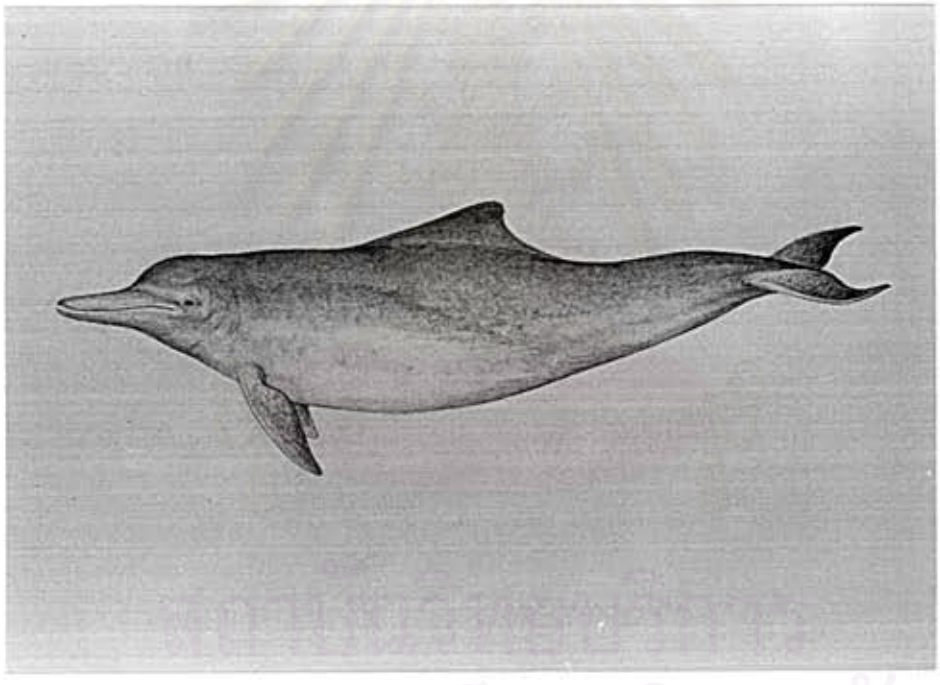

Fig. 5 *Sousa chinensis*, Indo-Pacific humpback dolphin

Sousa chinensis (Osbeck, 1765), the Indo-Pacific humpback dolphin, this highly variable species are characterized by a robust body with a long, well-defined beak. In most population especially those off southern Africa, the dorsal fin sits on a hump, or ridge, in the middle of animal's back. In others, the ridge appear to be

absent, or less well-developed. In most areas, there also appear to have developed ridge on the tail stock. Males are larger and have more exaggerated ridges on the back and tail stock. The color pattern varies with age and area. In most regions, light colored calves darken with age to become dark lead grey above and light grey below. However, off Malaysia and Northern Australia, calves and adults are nearly white. In the western Indian ocean and off China, dark calves lighten with age. In the latter case, adults are pinkish white with spots and blotches. There are 29 to 38 teeth in each tooth row. Maximum known body sizes are 3.2 m., male, and 2.5 m., female. Weight of up to 284 kg. has been recorded. Newborn appear to be around 1 m. in length.

The Indo-Pacific humpback dolphin is widely distributed in coastal and inshore waters of the Indian and western Pacific Oceans. It can also be found in estuaries and sometimes in the lower reaches of rivers, although the latter may be vagrants. Its presence has been confirmed from the southern tip of Africa, northward along the east coast of the continent to the Suez canal, in the Arabian sea and Persian Gulf, along the Indian sub-continent, throughout much of Indonesia, in Australian coastal water from the middle of the west coast northward, eastward and southward to Sydney on the eastcoast, in New Guinea, and from Borneo northward along the Indochinese coast to the northern east coast to the northern East Sea (Leatherwood et al., 1993).

Ross, et al. (1994) reported that humpback dolphins occur in shallow water less than 20 m. deep through out their distribution. The saline and often turbid channels off mangroves and between sandbanks so typical of tropical deltas form a prime habitat for humpback dolphins, and appear to support considerable populations. In southern China individuals may swim up rivers for several kilometers. In Moreton Bay, southern Queensland, 80% of sighting were over depth of less than 10 m. and up to 6 km. offshore, but occured deeper in association with bottlenose dolphin while feeding on discards from trawlers. Klinowska (1991) supported that studies in the Moreton Bay region in northeastern Australia has demonstrated that the Hump-

backed dolphins have a more inshore distribution than the Bottlenose dolphins inhabiting in this area. There is some overlap of range between the two species.

***Tursiops truncatus*, bottlenose dolphin**

Fig. 6 *Tursiops truncatus*, bottlenose dolphin

Tursiops truncatus (Montagu, 1821), the bottlenose dolphin, is a large, relatively robust dolphin, with a short to moderately stocky snout that is distinctly set off from the melon by a crease. The dorsal fin is tall and falcate, and set near the middle of the back. Color varies from light grey to nearly black on the back and sides, fading to white (sometimes with a pinkish hue) on the belly. The belly and lower side are sometimes spotted. There is a darkstripe from eye to flipper, and a faint dorsal cape on the back (and sometimes an indistinct spinal blaze), generally

visible at close range. Often, there is a brushing of grey on the body especially on the face, and from the apex of the melon to the blowhole. Bottlenose dolphins have 18 to 26 pairs of robust teeth in each jaw. Adults from would have a length from 1.9 to 3.8 m., with male somewhat larger than female. There is extreme variation between different populations. Maximum weight is at about 650 kg., although most animals are much smaller. Length at birth is about 1 - 1.3 m. (Jefferson, et al., 1993).

The bottlenose dolphin is found worldwide in temperate and tropical waters, both offshore and inshore. Outside tropical waters they are encountered principally in the coastal zone, less frequently on the edge of the continental shelf and beyond. Bottlenose dolphins exploit an impressive range of habitats. The inshore form is occasionally reported in freshwater rivers, although these are most likely to be vagrants or temporary visitors. The usual inshore range includes river mouths, bays, lagoons, estuarine complexes and virtually any shallow water marine region (0.5 - 20 m. deep). Passes between open ocean and enclosed bays or lagoons are often centres of abundance, and the dolphins use intracoastal waterways and other deep channels to gain access to productive shallows. The offshore ecotype is well known to the margin of some coastal and oceanic islands and atolls. It is also encountered in the open ocean (Klinowska, 1991).

The arguement on taxonomic status of bottlenose dolphin, genus Tursiops, has been long discussed. Pilleri & Gihr (1974) differentiated *T. aduncus* from *T. truncatus* by the shape of the fin, the slenderness of the body and the pointed snout. They described more differences between *T. truncatus* and *T. aduncus* in body measurements. The maximum body length measured in *T. aduncus* to date is 2.40 m., as against 3.50 m. in *truncatus*. Differences also exist in the body ratios of the two species. A large numbers of quantitative differences were found between the skulls of *T. truncatus* and those of *T. aduncus*. Generally speaking, the skull of the truncatus specimens is longer. The tip of rostrum-vertex, tip of rostrum- pterygoids, tip of rostrum to median spine of palate sections, the mandible and neurocranium, they all are significantly longer in *T. t.runcatus* than in *T. aduncus*. The *T. truncatus*

specimens also differ from *T. aduncus* specimens in that they posses a significantly wider rostrum and premaxilla, a higher and wider skull, but a shorter mandibular symphysis. The skull of *T. truncatus* is more compact that of *T. aduncus*. The inner ear of *T. aduncus* is smaller and narrower than that of *T. truncatus*. For the configuration of atlas and axis, the vertabral body of *T. aduncus* ends on both sides in a thick, pointed transverse process. The shape of the articular surfaces for the occiput is roughly that of a rounded isosceles triangle. The surface do not touch each other along the midline. In *T. aduncus*, the arch of the atlas is convex and terminates in anabifid spinous process. The medial edge of the scapula of *T. aduncus* is highly convex and its lateral edge is concave. Unlike in *T. aduncus*, the acromion of *T. truncatus* does not narrow at the base. However, these characters should be confirmed by the examination of a large number of specimens.

Ross & Cockroft (1990) studied 103 specimens of *Tursiops* from Australian water. They discussed the taxonomy of the genus which is poorly understood, and opinions vary on the status of nominal species. They refered to many species, *T. truncatus, T. aduncus, T. gilli, T. gephyreus, T. t. truncatus and T. t.aduncus*, but the two most distinct forms of *Tursiops* are *T. truncatus and T. aduncus*. The presence of this genus from north to south on both sides of Australian continent is of considerable interest taxonomically, particularly as there was no morphological differentiation of taxonomic entities at the species level within the samples. Comparison of skull measurment, tooth count, and other skull features with data for two species of *Tursiops* off southern Africa showed that the data ranges for the latter occupied opposite ends of Australian specimens. These southern African forms have been treated previously as two species, *T. truncatus* and *T. aduncus*. In the present perspective, however, there is little doubt that they all should be treated as a single species, *T. truncatus*, and that Australian bottlenose dolphins should be assigned to this species as well.

***Stenella longirostris*, spinner dolphin**

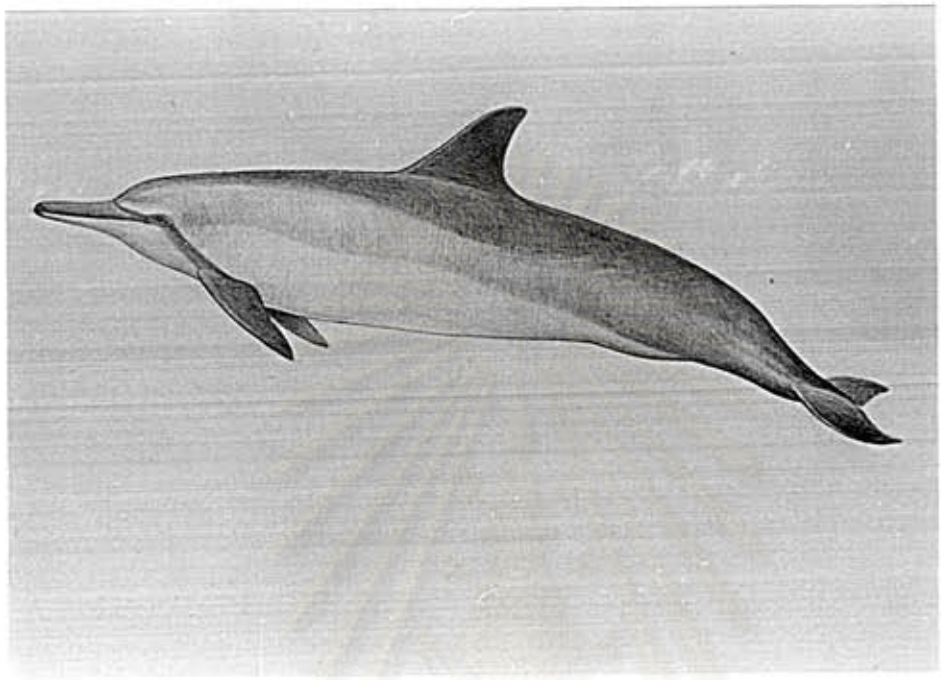

Fig. 7 *Stenella longirostris*, spinner dolphin

Stenella longirostris (Gray, 1828), the spinner dolphin, is a slender dolphin, with an extremely long, thin beak. The head is very slender at the apex of the melon. The dorsal fin ranges from slightly falcate to erect and triangular. Spinner dolphin generally has a dark stripe from eye to flipper on both sides, dark lips and beak tip. The individuals of most spinner dolphin stocks in the world have a three part colour pattern (dark grey cape, light grey side and white belly) and only minor differences in the appearance of male and female. It has 45 to 62 pairs of very fine, pointed teeth in each jaw. Newborn spinner dolphins are about 75 to 80 cm. long; adults reach 2 m. (female) and 2.4 m. (male). They can reach weight of at least 77 kg. (Jefferson, et al., 1993).

The spinner dolphin is found in the Atlantic, Indian and Pacific oceans, where they are mainly restricted to tropical and subtropical waters, although they can be found in some warm temperate areas. The primary distribution is pelagic, but they can be found in continental shelf waters off Central America and the south eastern United State (Klinowska, 1991).

A very small form of the spinner dolphin has been found to inhabit the Gulf of Thailand. Ten specimens from Samut Sakhon differ from specimens of this species collected elsewhere in body size and shape, number of teeth and numbers of thoracic and lumbar vertebrae. The skull of four adult males were 129 - 137 cm. long, well below the ranges for the Indian Ocean, Western Pacific, Central Pacific and Antarctic. Tooth counts and vertebral counts average lower than in series from other part of the range. The cclor pattern is not significantly different from that of spinner dolphins in the central and western Pacific, Atlantic, and Indian Oceans but differ from that of the small eastern spinner of the eastern Pacific (Perrin et al., 1989).