Chapter 3

Results

1. Species found in the Inner Gulf

From August 1995 to December 1996, one species of porpoise and two species of dolphins specimens were studied. They were *Neophocaena phocaenoides* (finless porpoise), *Orcaella brevirostris* (Irrwaddy dolphin) and *Sousa chinensis* (Indo-Pacific humpback dolphin). Some specimens of these three species had newly been collected from bycatch as well as specimens kept in the older days both as skeleton and taxidermy. Another two species of dolphins *Tursiops truncatus* (bottlenose dolphin)and *Stenella longirostris* (spinner dolphin) can only be studied only from the old specimens kept as skeletal and taxidermic specimens. No sample of these two species had been collected recently. (Table 5)

Table 5. Number of specimens in the Inner Gulf of Thailand up to December 1996.

Species	Numbers of specimens		
	New specimens	Old specimens	
		Skeleton	Taxidermy
N. phocaenoides	6	7	3
O. brevirostris	2	1	2
S. chinensis	1	2	2
T. truncatus	0	6	12
S. longirostris	0	2	8
Total	9	18	27

New specimens of bottlenose dolphin was not found although this species was one of the most common dolphin seen by most interviewees in the study area.

On the other hand, both Irrawaddy dolphin and finless porpoise were very commonly reported only in certain areas (see more in distribution part). Spinner dolphin seemed to have very small population if not without population remaining in this area because only two out of five hundreds and twenty seven interviewees reported seeing this species.

2. Distribution and tributaries intrusion

2.1 Distribution

Distribution pattern of the four species found in the study area *N. phocaenoides* (finless porpoise), *O. brevirostris* (Irrawaddy dolphin), *S. chinensis* (Indo-Pacific humpback dolphin) *and T. truncatus* (bottlenose dolphin) was extracted from interview surveys and confirmed by stranded and bycatch specimens, plus sight surveys and photographs. The interview survey composes of two part, the direct interview and the correspondent questionaire by mail.

Correspondent questionaire by mail

From nine hundred and thirty three distributed questionaires, one hundred and thirty two cases were replied.

Direct interview

Seven persons along the Bang Pakong and six persons along the Chao Phraya river reported the observation of Irrawaddy and bottlenose dolphins. Indo-Pacific dolphins were reported to intrude the four major rivers by the people around the river mouths. The number of interviewees in main six provinces along the coast of study area is presented in table 6-11. The number of interviewees reported seeing dolphins

or porpoises in the Inner Gulf of Thailand were calculated as percentage to intepret the distribution as in figures 11-14.

Table 6. Percentage of 149 interviewees reported seeing dolphins and porpoises in Petchburi provinces.

Locations	number of interviewee	Percentage of interviewee reported seeing each species			
		N	O	S	T
Bangtaboon	10	60	70	90	20
Laem laey	12	33	83	100	42
Wat Ton Son	15	13	53	100	20
Bang Kaew	8	50	75	88	38
Laem Pak Bia	13	69	77	90	69
Had Chao	20	55	50	45	70
Puk Tian	10	60	30	20	40
Ban Tha, Klong Tian, Tawee Suk	15	67	53	67	60
Cha am (fish landing)	23	70	39	57	83
Cha am beach	23	74	74	74	35

N, *N. phocaenoides* (finless porpoise)

O, *O. brevirostris* (Irrawaddy dolphin)

S, *S. chinensis* (Indo-Pacific humpback dolphin)

T, *T. truncatus* (bottlenose dolphin)

Table 7. Percentage of 211 interviewees reported seeing dolphins and porpoises in Chon Buri province.

Locations	number of interviewee	Percentage of interviewee reported seeing each species			
		N	O	S	T
Ban Sai	15	13	100	80	27
Maung	11	45	72	72	45
Ang Sila	30	67	50	27	57
Sam muk, Vorn Napa, Bang Saen	15	93	73	60	87
Bang Phra Sri Racha	23	39	0	61	100
Ko Sichang	21	43	10	81	100
Ao Udom	11	27	18	73	100
Lam Chabang	17	12	6	71	82
Pattaya, Na Klau	15	7	0	47	87
Bang Sarhae	19	0	0	100	84
Sattahip	20	0	0	90	100
Samae Sarn	29	0	0	79	100

N, *N. phocaenoides* (finless porpoise)

O, *O. brevirostris* (Irrawaddy dolphin)

S, *S. chinensis* (Indo-Pacific humpback dolphin)

T, *T. truncatus* (bottlenose dolphin)

Table 8. Percentage of 47 interviewees reported seeing dolphins and porpoises in Samut Prakarn province.

Location	number of interviewee	Percentage of interviewee reported seeing each species			
		N	O	S	T
Laem Fa Pa	16	0	100	94	89
Fish landing ,Amara	18	11	44	62	75
Klong KoTo, Bang Pu	31	31	100	77	77
Klong Dan	15	15	100	50	69

N, *N. phocaenoides* (finless porpoise)

O, *O. brevirostris* (Irrawaddy dolphin)

S, *S. chinensis* (Indo-Pacific humpback dolphin)

T, *T. truncatus* (bottlenose dolphin)

Table 9. Percentage of 49 interviewees reported seeing dolphins and porpoises in Samut Sakorn province.

Locations	number of interviewee	Percentage of interviewee reported seeing each species			
		N	O	S	T
Sahakorn	9	44	100	44	66
Kampra	14	79	79	64	86
Fish Landing, Yha Phrake	16	63	81	81	81
Chy Tale Laung	10	60	90	70	90

N, *N. phocaenoides* (finless porpoise)

O, *O. brevirostris* (Irrawaddy dolphin)

S, *S. chinensis* (Indo-Pacific humpback dolphin)

T, *T. truncatus* (bottlenose dolphin)

Table 10. Percentage of 47 interviewees reported seeing dolphins and porpoises in Samut Songkram province.

Location	number of interviewee	Percentage of interviewee reported seeing each species			
		N	O	S	T
Klong Kone	13	0	69	100	62
Bang Jkreng	17	18	35	100	71
Rong Kung, Bang bho	17	35	65	100	59

N, *N. phocaenoides* (finless porpoise)

O, *O. brevirostris* (Irrawaddy dolphin)

S, *S. chinensis* (Indo-Pacific humpback dolphin)

T, *T. truncatus* (bottlenose dolphin)

Table 11. Percentage of 24 interviewees reported seeing dolphins and porpoises in Chachoengsao province.

Location	number of interviewee	Percentage of interviewee reported seeing each species			
		N	O	S	T
Bang Pakong	12	25	100	100	25
Samae Kao	12	33	100	75	60

2.1.1. *Neophocaena phocaenoides*, finless porpoise

Although finless porpoise is the coastal species but it is commonly found at the depth of 10-15 m or even deep. They has wider distribution than Irrawaddy dolphin. In this study, a population of finless porpoise appeared to be the resident of Bang Saen to Vornapa beach throughout the year. They were seen frequently from Sri Racha to Laem Chabang and Patthaya. However they were never been spotted further south from Pattaya to Sattahip in the lower part of the Inner Gulf.(Fig. 11) They were also not frequently seen along the coast of the upper part of the Inner Gulf.

Because of the absence of its dorsal fin, it was very difficult to sight finless porpoise during the field survey. However, at 1450 hrs. of October 8, 1996, three finless porpoise were observed at 13°19'.10'N 100°53'.36'E off the coast of Laem Tan. Unfortunately, the photographs did not well enough. They were surfacing at 50-60 m away from the boat and could not be able to follow them.

Many stranding and bycatch specimens found during the study period firmly support the distribution pattern determined by interviewing survey. Along the east coast, Chon Buri, one dead female juvenile, BIMS16 was collected floating near Bang Phra on August 17, 1995, a male adult, MSCU001 recieved from fishlanding at Kao

Sam Muk on March 15, 1996, a female subadult, BIMS019 was accidentally caught from Vornnapa beach in September, 1996, and a juvenile male MSCU005 was trapped by driftnet off 2 km off Ang-Sila on October 1, 1996. Toward the east of Samut Prakarn province, a juvenile male, CUMZ006 was tangled by driftnet off Klong Dan. On the west coast in Petchaburi province, two specimens and four photographs were recorded from this area. First on July 2, 1996 the deteriorating specimen from Had Chao Samran, slightly north of Cha-am was dug up to clean for skeleton examination. This skeletal sample was without head but it can be identified as finless porpoise according to its size and the 3 fused cervical vertebrae. Local people reported that this porpoise was stranded and died on the beach about 2 months before this recovery. Later on August 29, 1996, a lactating female MSCU003 was accidentally caught by driftnet 1 km off Cha-am.

The two photographs of adult finless porpoise tangled by driftnet off Had Chao Samran on January 20, 1997 and another adult also tangled by driftnet off Cha-am beach on September 21, 1996 were taken.

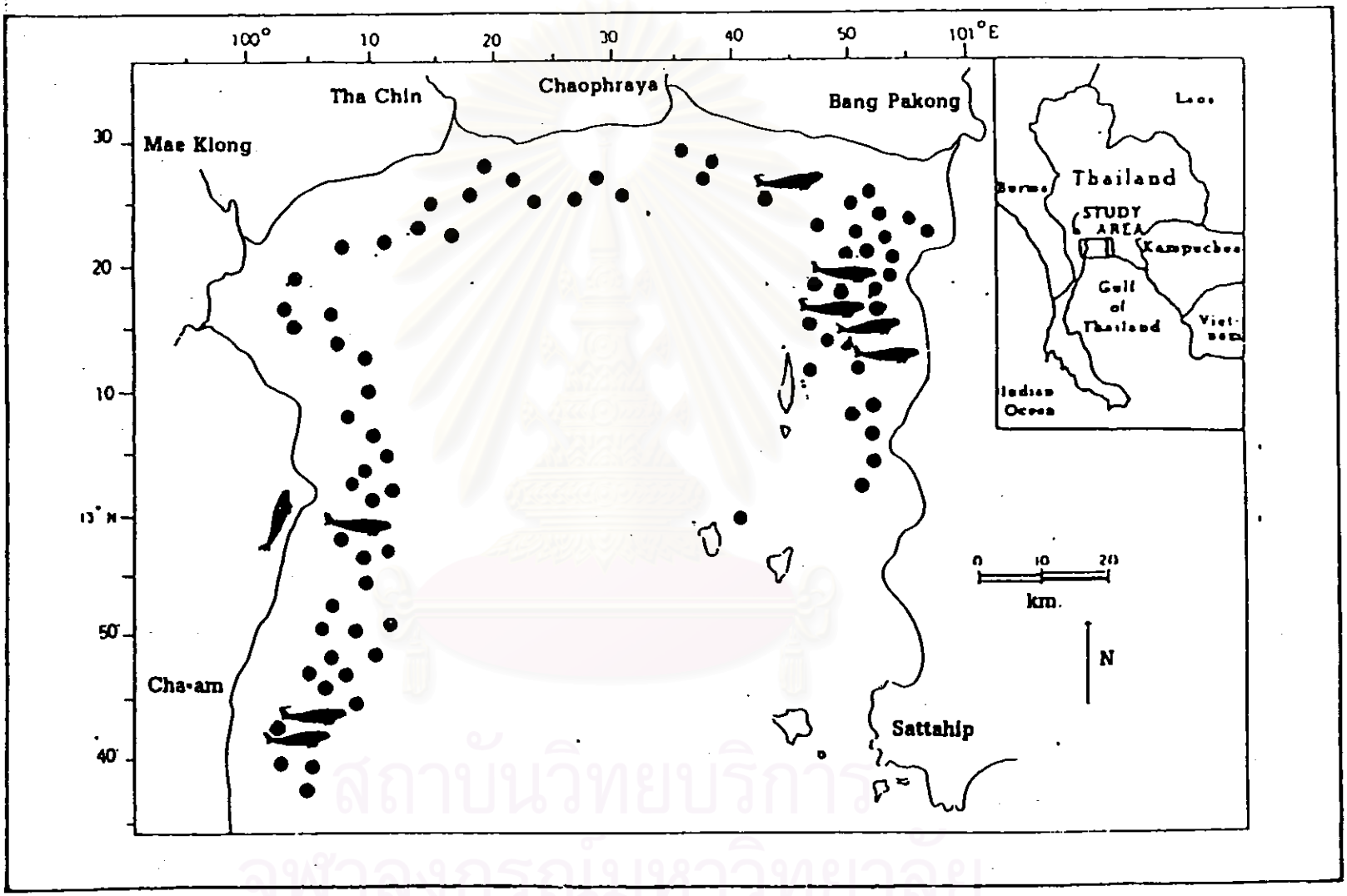

Fig. 11 Distribution of finless porpoise in the Inner Gulf of Thailand

● = 20% of interviewees reported seeing this species = photographs or carcasses of finless porpoises

2.1.2. *Orcaella brevirostris*, Irrawaddy dolphin

The interview records showed that Irrawaddy dolphin had formerly distributed in the riverine, estuarine and coastal habitats near the mouth of Bang Pakong and along the coast of the Inner part of the Gulf including the Chao Phraya, Tha Chin and Mae Klong estuaries. The distribution extended over on the west along the coast of Petchaburi. On the east coast of Chon Buri province, this dolphin was reported to be seen only in Sri Racha It had never been spotted from Patthaya further southward. (Fig. 12) This dolphin was commonly seen in the shallow water at about 1.5 m depth near mudflat. Stranded dolphins were often reported on the mud flat along the Inner part of the Gulf.

One decaying carcass was discovered in the mangrove at Bang Pu, Samut Prakarn, on July 18, 1996. It was identified as MSCU 002 and preserved as skeleton at Department of Marine Science, Chulalongkorn University. Another decayed specimen, EN 062, was found floating off Bang Boh coast between Mae Klong and Tha Chin river mouth in March, 1996. Now EN 062 is kept at Phuket Marine Biological Center. These two specimens supported the nearshore distribution pattern as revealed from the interview survey.

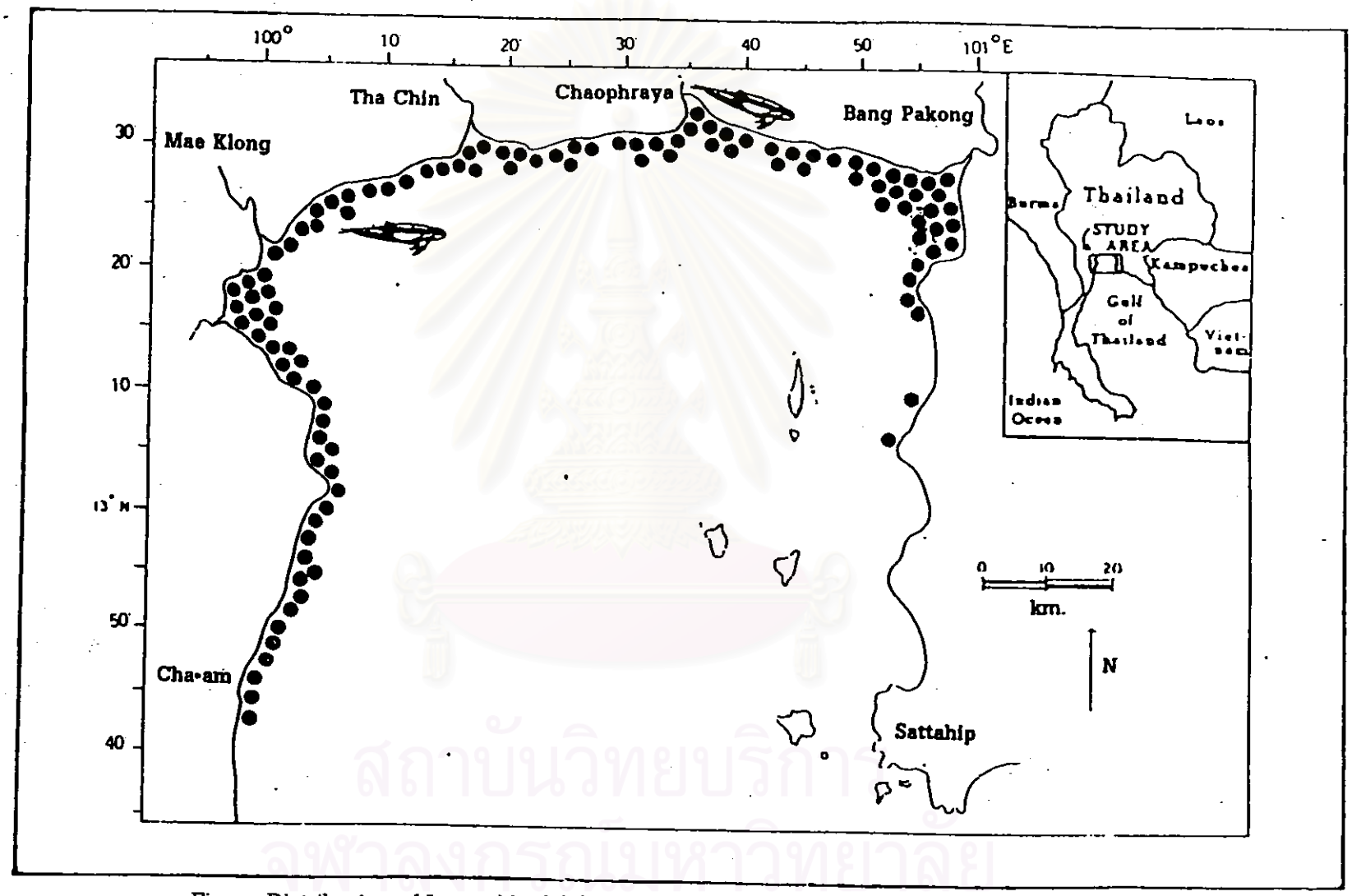

Fig. 12 Distribution of Irrawaddy dolphin in the Inner Gulf of Thailand

● = 20% of interviewees reported seeing this species = carcasses of Irrawaddy dolphins

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

Indo-Pacific humpback dolphin was found to be widely distributed slightly offshore of the Inner Gulf. The distribution was reported to be concentrated more at the rivermouth of all four rivers particularly Bang Pakong and Mae Klong and in the coastal area to about 20 m depth. It was also often seen far from the river mouth in areas such as Ko Sichang, Bang Sarhae and around Sattahip (Fig 15). This population of hump-backed dolphins at the mouth of Bang Pakong appeared to be the resident there throughout the year. Most fishermen could recognized them by their distinctive greyish pink body color.

Only one specimen was available for detail studied in this research. This specimen (MSCU004) was found floating near Ko Pai on September 6, 1996 by the fishermen from Ang-Sila (Fig. 13). This skeleton is now kept at the Department of Marine Science, Chulalongkorn University. Another stranded dead female was found by an officer of Sichang Marine Research Station in the morning of December 22, 1996, on the beach infront of the station.

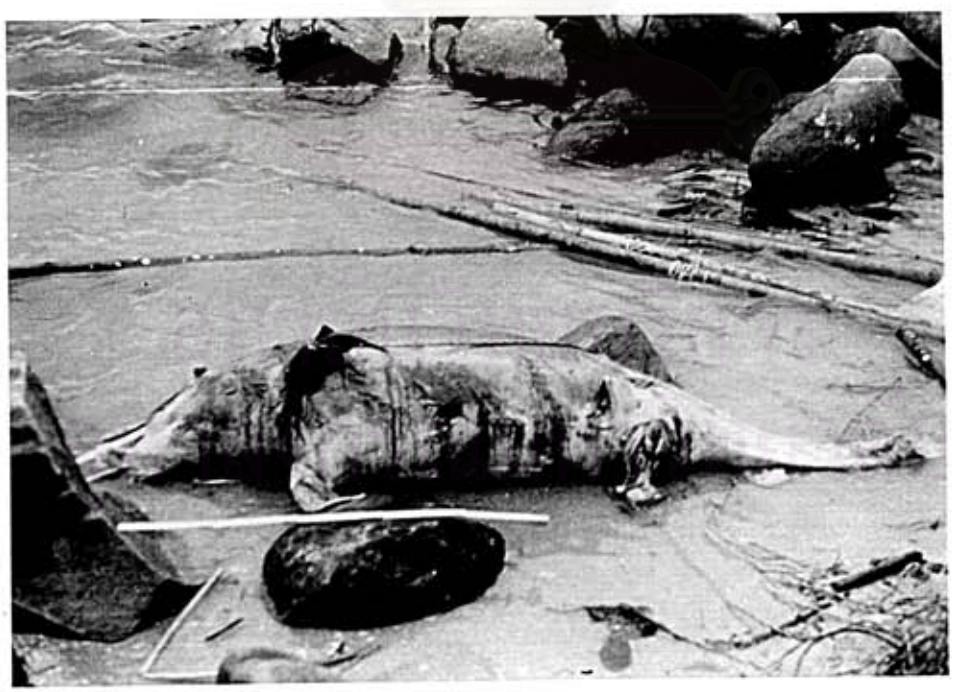

Fig. 13 The half decayed specimen of Indo-Pacific humpback dolphin

Photographs of sightings these humpback dolphin were taken by few observers. One was taken by a reporter of Thai Rath newspaper at Chao Phraya rivermouth on January 7, 1997. The other photo was taken by the village chief of Moo 10, Ban Laem district, Petchaburi province. He observed 3 dolphins around Petchaburi rivermouth in March 1994. (Fig. 14)

Fig. 14 Indo-Pacific humpback dolphin around Bang Taboon

On February 16, 1997, the intensive sighting survey at the Bang Pakong rivermouth encountered approximated ten Indo-Pacific humpbacked dolphins at the position of 13° 24'.250' N 100°56'.118' E at 1304 hrs at the depth of about 10 m. They generally remained at distance of 20-30 m from the boat and approaching at 4-5 m on two occassions. This area was far from the mangrove area of Bang Pakong. It was possible to bring the boat approaching close to them. They let us follow them for about one and a half hours.

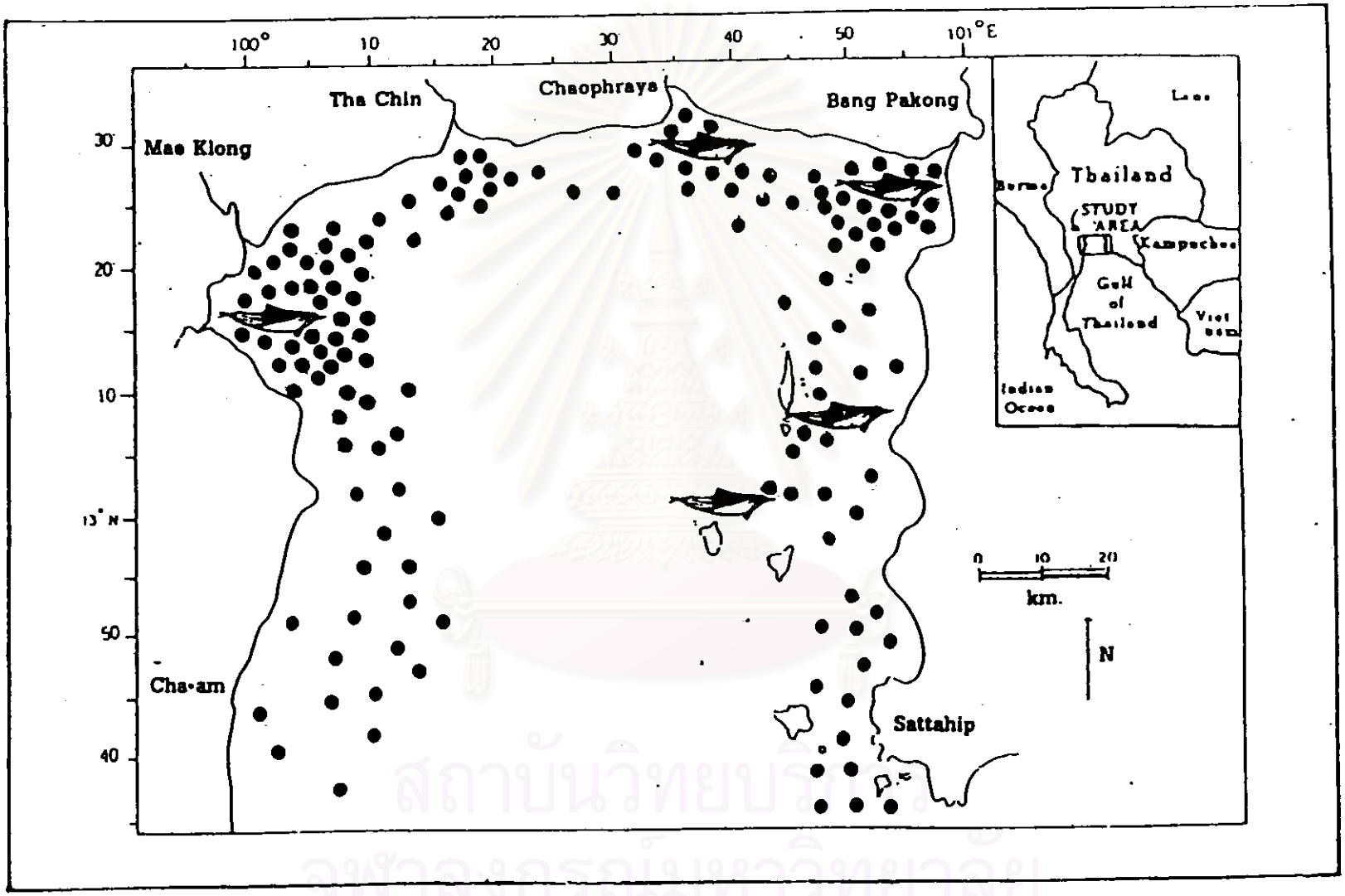

Fig.15 Distribution of Indo-Pacific humpback dolphin in the Inner Gulf of Thailand

● = 20% of interviewees reported seeing this species = photographs or carcasses of Indo-Pacific humpback dolphins

2.1.4. *Tursiops truncatus*, bottlenose dolphin

This dolphin possibly has the wider distribution than other three species. They were commonly encountered by people along the coast of the study area. This species was reported to be common around most of the islands on the east coast of the Inner Gulf from Ko Si chang, Ko Pai, Ko Lan, Ko Kram throughout Sattahip and Samae Sarn (Fig. 16). Although the depth of the water where bottlenose dolphin was found varied greatly, they prefer 20 m or deeper waters and seldom seen visited nearshore. In most areas, eventhough they were not seen as frequent as the other three species but they were well known to most interviewees because of their acrobatic behaviors, such as bowriding and breaching. They were often reported to follow the ferries between Sri Racha to Ko Si Chang and between Pattaya to Ko Lan and Ko Pai.

Information regarding the bycatch of this species was rare and no new specimen was able to obtain for this study. Most fishermen believed that their fast swimming behavior abale them to avoid being caught.

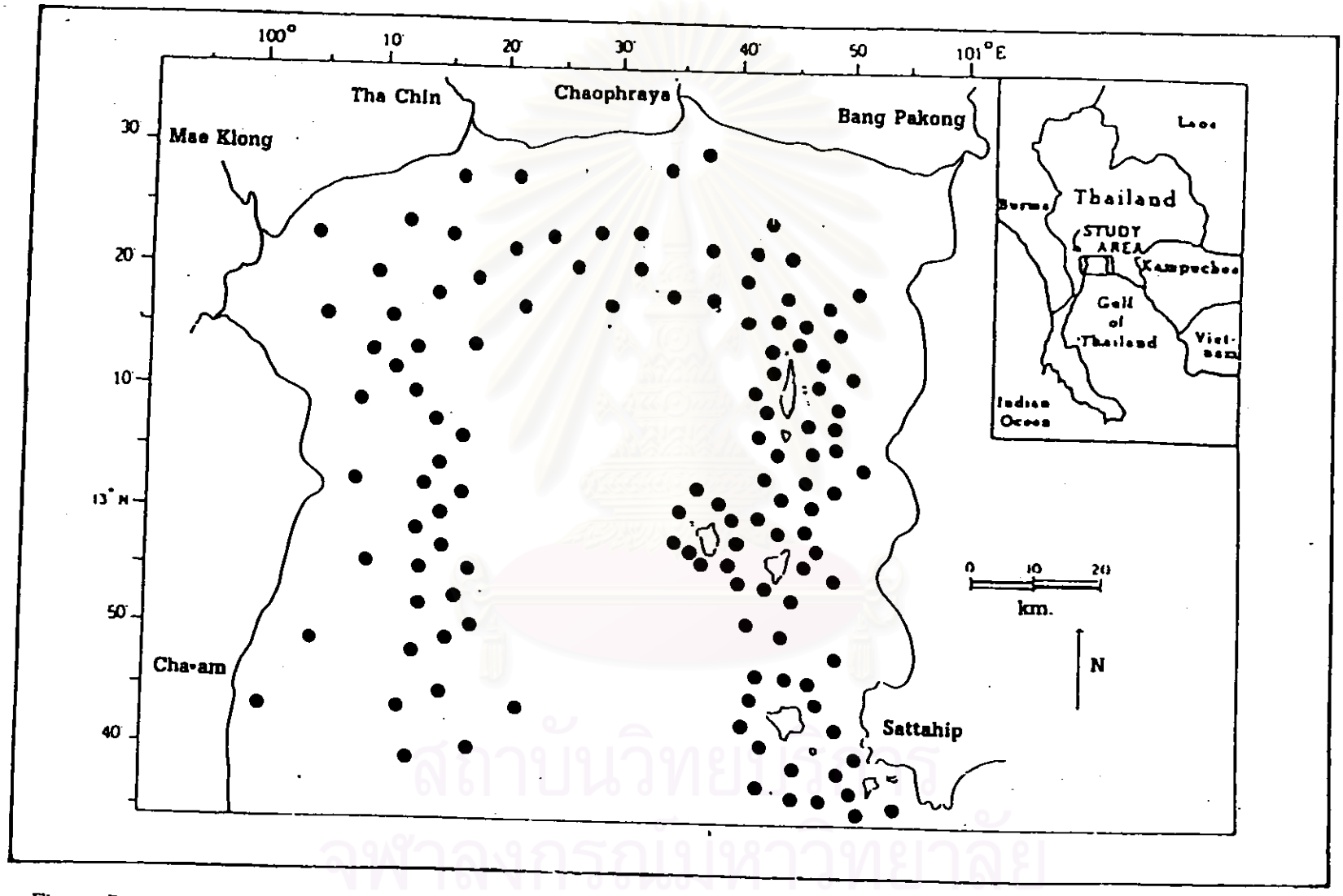

Fig.16 Distribution of bottlenose dolphin in the Inner Gulf of Thailand ● = 20% of interviewees reported seeing this species

2.2. Tributaries intrusion

From the intensive interviews of the elderly people who live along the tributaries of the Inner Gulf, Bang Pakong, Chao Phraya, Ta Chin and Mae Klong three species from five inhabited in the Inner Gulf of Thailand, Irrawaddy dolphin, Indo-Pacific humpback dolphin and bottlenose dolphin had been claimed to intrude freshwater into the tributaries in the past decades. The other two species, finless porpoise and spinner dolphin never been seen to swim through freshwater. Recently, only humpback dolphin are sometimes observed to intrude approximately two km of every river mouth (Fig. 17).

Among all dolphins known to the fishermen, Irrawaddy dolphin had been confirmed to be the most common fresh water intrusion species during the past 30 years or over. It had been known to intrude far from the river mouth of Chao Phraya and Bang Pakong. In Chao Phraya river, many people reported seeing Irrawaddy dolphin at Ko Kret, Nonthaburi, about 85 km from the river mouth in 1958. It was also reported by one old man that he had seen the dolphin as far as 60 km from the river mouth in 1962. He saw the dolphin at night and thought that it was a crocodile. This Irrawaddy dolphin was reported to be killed and consumed by local people. In Bang Pakong, the occurrence of Irrawaddy dolphin had been confirmed by many elderly local people. They were seen about 30 years ago to intrude about 60 km from the river mouth. At present, Irrawaddy dolphin is also occasionally found only few kilometers from the Bang Pakong river mouth.

Recently, Indo-Pacific humpback dolphin had sometimes been observed to intrude approximately two km of every river mouths.

Bottlenose dolphin are not as good at freshwater intrusion. Surprisingly, a young man reported that he observed seeing this species at Klong Jek, Bangkok 30 km from the river mouth in 1983. That bottlenose dolphin was shot by local people mistaking that it was an invader crocodile. This specimen had been cleaned for skull study and still kept at Science Museum, SCMS001.

For the other two rivers, Ta Chin and Mae Klong, more than 200 elderly local people were intensively interviewed but nobody reported to have seen any dolphins intruded further into these two rivers except recent reports at the river mouths.

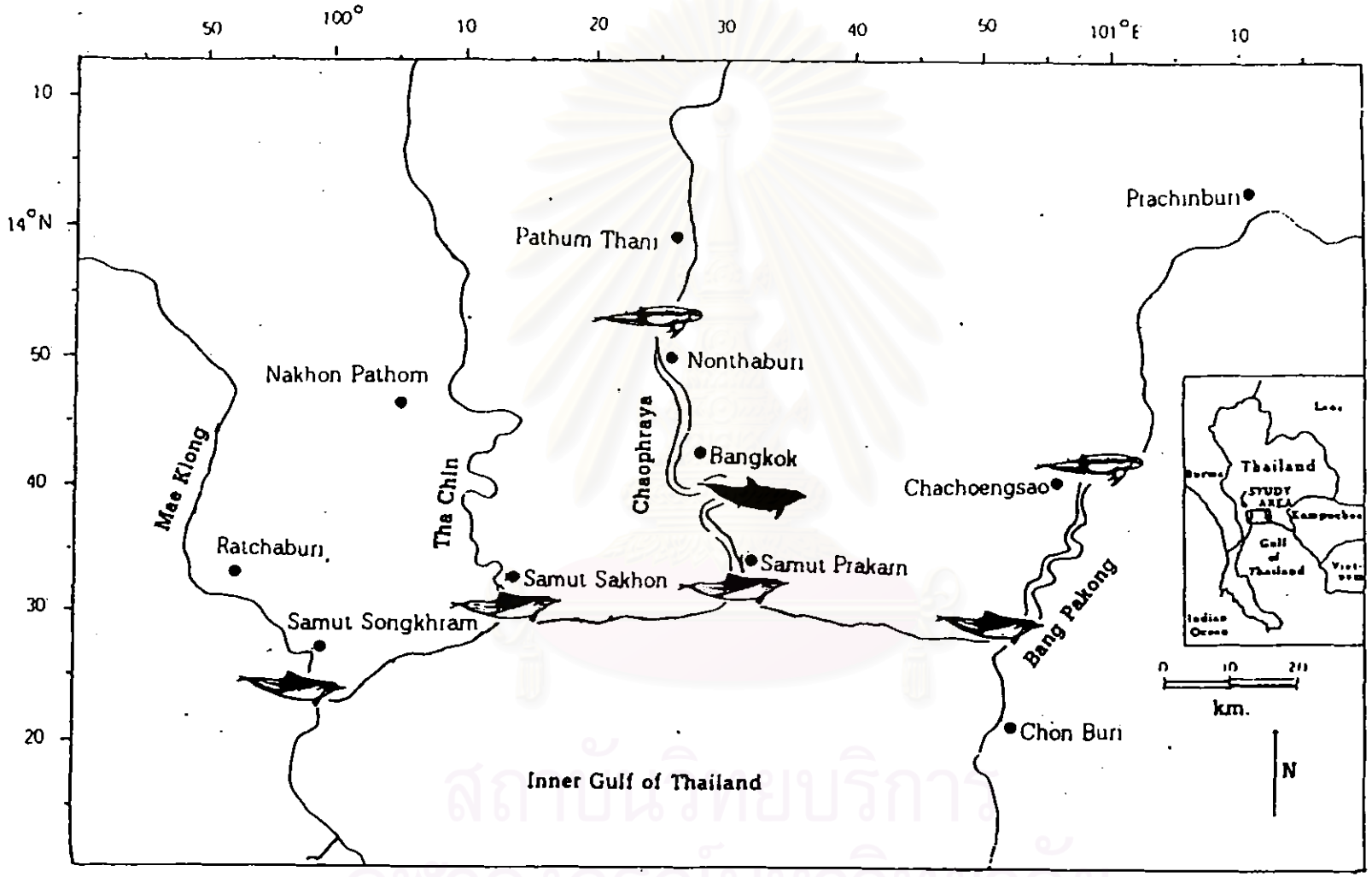

Fig. 17 Tributaries intrusion of dolphins in Bang Pakong, Chao Phraya, Mae Klong and Ta Chin River

= Irrawaddy dolphin = Indo-Pacific humpback dolphin = bottlenose dolphin

3. Specimens studied

A total of fifty four specimens of dolphins and porpoises were studied in detail. Nine new specimens obtained during this study were recorded in table 12. Twenty seven taxidermies and eighteen skeletons were also checked and recorded in table 13 and 14.

Table 12. New specimens of dolphins and porpoises collected between 1995 and 1996.

Code	Species	Date	Sex	TL**	TW**	Locality
BIMS016	*Neophocaena phocaenoides*	Aus17, 95	F	80	9.00	Bang Phra, CB.
MSCU001	*N. phocaenoides*	Mar15, 96	M	141	31.50	Khao Sam Muk, CB.
MSCU002	*Orcaella brevirostris*	July18,96	*	*	*	Bang Poo, SP
MSCU003	*N. phocaenoides*	Aus29, 96	F	133	24.50	Cha Am, PB.
MSCU004	*Sousa chinensis*	Sep6, 96	F	225	*	Kao Pai, CB.
MSCU005	*N. phocaenoides*	Oct1, 96	M	74.50	9.00	Angsila, CB.
CUMZ006	*N. phocaenoides*	Mar5, 96	M	84	*	Klong Dan, SP
BIMS019	*N. phocaenoides*	Nov13,96	F	122	16	Angsila,CB.
EN062	*O. brevirostris*	Mar,96	*	*	*	Samut Sakorn

* specimens incompleted, unable to determined sex, TL(total length) and TW (total weigth)

** Total length and total weight, unit in cm

Abrreviation : CB ; Chonburi, SP ; Samut Prakarn, PB ; Petchburi

Table 13 Taxidermic specimens of dolphins and porpoises.

Specimens	Species	Date	Locality	Remarks (kept at)
CRODF001	*Orcaella brevirostris*	U	Samut Prakarn	Crocodile Farm, SP
BIMST004	*O. brevirostris*	U	Chonburi	Bangsaen Inst. of Marine Science
BIMST007	*Sousa chinensis*	U	Chonburi	Bangsaen Inst. of Marine Science
BIMST005	*S. chinensis*	U	Chonburi	Bangsaen Inst. of Marine Science
OCFSH002	*Tursiops truncatus*	U	Samut Prakarn	Oceanic Fishery Division, SP
BIMST002	*T. truncatus*	U	Chonburi	Bangsaen Inst. of Marine Science
BIMST006	*T. truncatus*	U	Chonburi	Bangsaen Inst. of Marine Science
SWKN001	*T. truncatus*	1977	Ban Pae, Rayong	Swankaniwas Fish Farm, SP
SWKN002	*T. truncatus*	1977	Ban Pae, Rayong	Swankaniwas Fish Farm, SP
SWKN003	*T. truncatus*	1977	Ban Pae, Rayong	Swankaniwas Fish Farm, SP
VETCU001	*T. truncatus*	1974	Death at Sarom Palace Bangkok	Fac. of Veterinary, Cu has recieved from Florida Dolphin Show
ZMUKU001	*T. truncatus*	U	Samut Sakorn	Zoological Mus., KU
ZMUKU002	*T. truncatus*	U	Samut Sakorn	Zoological Mus., KU
FSHKU004	*T. truncatus*	U	U	Mus. of Fac. of Fishery, KU
FSHKU005	*T. truncatus*	U	U	Mus. of Fac. of Fishery, KU
SCCE001	*T. truncatus*	1983	Klong Jek, Chaopraya river Bangkok	Science Center for Education, Bangkok
OCFSH001	*Stenella longirostris*	1977	Samut Prakarn	Oceanic Fishery Division
NHMUS005	*S. longirostris*	U	U	Natural History Museum, CU
CRODF002	*Stenella spp.*	U	Samut Prakarn	Crocodile Farm, SP
CRODF003	*S. longirostris*	U	Samut Prakarn	Crocodile Farm, SP
BIMST001	*S. longirostris*	U	Chonburi	Bangsaen Inst. of Marine Science
ZMUKU003	*S. longirostris*	U	Samut Sakorn	Dept of Zoology , KU
ZMUKU004	*S. longirostris*	U	Samut Sakorn	Dept. of Zoology , KU
FSHKU006	*S. longirostris*	U	U	Old Mus. of Fac. of Fishery, KU
ZMUKU005	*Neophocaena phocaenoides*	U	Samut Sakorn	Dept. of Zoology, KU
ZMUKU006	*N. phocaenoides*	1991	Bangkok fish landing	Dept. of Zoology, KU
BIMST003	*N. phocaenoides*	U	Chonburi	Bangsaen Inst. of Marine Science

U, Data unavailable ; SP, Samut Prakarn province ; KU, Kasetsart University ; CU, Chulalongkorn University

Table 14 Skeletal specimens of dolphins and porpoises

Specimens	Species	Date	Locality	Remark (kept at)
FSHKU001	*Tursiops truncatus*	1965	Hua hin, Prachuab.	Mus. of Fac. of Fishery, KU
FSHKU002	*T. truncatus*	U	U	Mus. of Fac. of Fishery, KU
TISTR001	*T.truncatus*	1982	Pratew, Prachuab.	Th. Inst. of Sc. & Tech. Res.
BIMS015	*T. truncatus*	U	Bangsaen, Chon.	Bangsaen Inst. of Marine Science
SCCE001	*T.truncatus*	1983	Klong Jek, Chaopraya river, Bangkok	Science Center for Education
CUMZ001	*T. truncatus*	U	U	Natural History Museum, CU
CUMZ002	*Orcaella brevirostris*	1992	Mae Kong river, Lao	Natural History Museum, CU
EN0062	*O. brevirostris*	1996	Samut Sakorn	Phuket Marine Biological center
MSCU002	*O. brevirostris*	1996	Bang Poo, SP	Dept. of Marine Science, CU
BIMS003	*Sousa chinensis*	1993	Bang Lamung, Chon.	Bangsaen Inst. of Marine Science
FSHKU003	*S. chinensis*	U	U	Mus. of Fac. of Fishery, KU
MSCU004	*S. chinensis*	1996	Ko Pai, Chon.	Dept. of Marine Science, CU
BIMS013	*Stenella longirostris*	U	Bangsaen, Chon.	Bangsaen Inst. of Marine Science
BIMS014	*S. longirostris*	U	Bangsaen, Chon.	Bangsaen Inst. of Marine Science
CUMZ003	*Neophocaena phocaenoides*	U	U	Natural History Museum, CU
CUMZ004	*N. phocaenoides*	1989	U	Natural History Museum, CU
BIMS012	*N. phocaenoides*	U	Bangsaen, Chon.	Bangsaen Inst. of Marine Science
BIMS010	*N. phocaenoides*	U	Bangsaen, Chon.	Bangsaen Inst. of Marine Science
BIMS007	*N. phocaenoides*	1994	Bangsaen, Chon.	Bangsaen Inst. of Marine Science
BIMS016	*N. phocaenoides*	1995	Bangsaen, Chon.	Bangsaen Inst. of Marine Science
BIMS008	*N. phocaenoides*	1994	Bangsaen, Chon.	Bangsaen Inst. of Marine Science
BIMS011	*N. phocaenoides*	U	Bangsaen, Chon.	Bangsaen Inst. of Marine Science
BIMS019	*N. phocaenoides*	1996	Chon.	Bangsaen Inst. of Marine Science
MSCU001	*N. phocaenoides*	1996	Kao Sam Muk	Dept. of Marine Science, CU
MSCU003	*N. phocaenoides*	1996	Cha am, Petchburi	Dept. of Marine Science, CU
MSCU005	*N. phocaenoides*	1996	Ang sila, Chon.	Dept. of Marine Science, CU

Abbreviations are the same as table 13 .

4. External and internal morphological data

Specimens of each species of dolphins and porpoises encountered in the Inner Gulf of Thailand had been carefully measured. Their external morphological characteristics had been recorded whenever possible and the new specimens had been dissected to record the data on the internal morphological characteristics.

4.1. *Neophocaena phocaenoides*, finless porpoise

4.1.1. External morphological characteristics

Two most distinctive characteristics of finless porpoise are the lack of dorsal fin and beak. Replacing the dorsal fin is the dorsal ridge characterized by thick denticulated epidermis along the back. This ridge would rise slightly higher in juvenile. The body is streamline in shape and dark grey in color but the ventral side is paler with light reddish color. Body color would turn darken during the postmortem time within about 24 hours. The round head has steep forehead. Mouthline runs gradually upward. (Fig. 18 - 20).

Fig. 18. Lateral view of finless porpoise

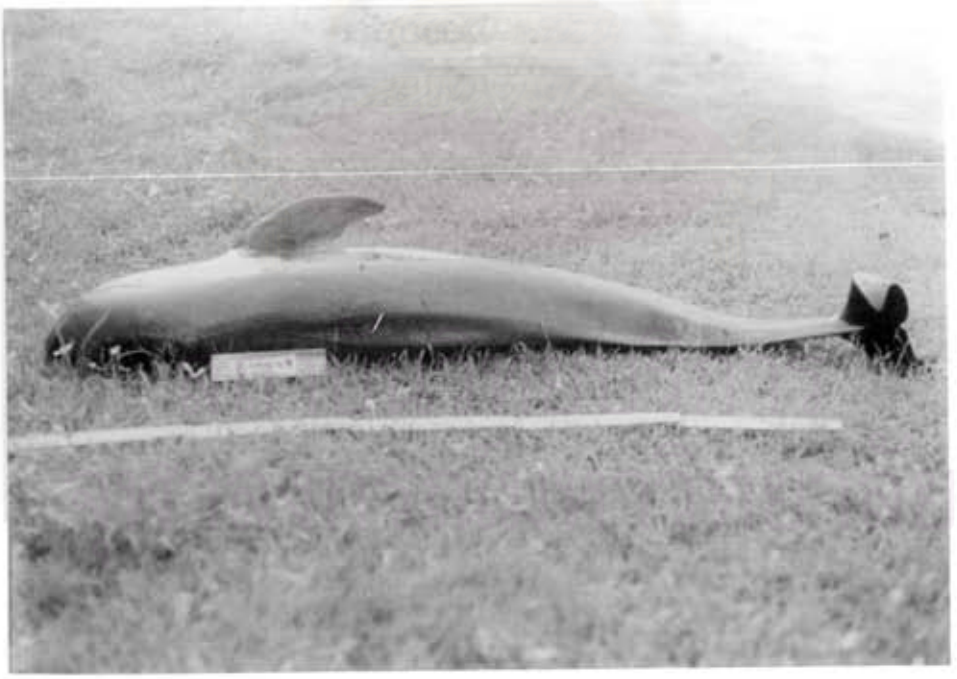

Fig. 19 Dorsal view of finless porpoise

Fig. 20. Head shape of finless porpoise

Six new specimens and three old taxidermies were studied for external morphology. The teeth are spatulate. The ranges of upper/lower tooth counts are 15 - 21/14 - 21 in each tooth row with the mode of 16/18,19 (n=10). In juvenile, the numbers of eruptive teeth are higher in the upper jaw.

Finless porpoise is the smallest cetacean in Thai waters. The biggest male, MSCU001 of this study is 141 cm long with 31.5 kg weight. The biggest female , MSCU003 is 133 cm long and 24.5 kg weight. The taxidermic smallest one, KUMZ006 is 62.5 cm long. The smallest new female carcass, MSCU005 is 74.5 cm long with 9 kg weight. The smallest male, BIMS016 is 80 cm long and 9 kg weight. Breadth of the fluke is 29.24% of body length. This is broader than flukes of other four dolphins. Flippers have pointed tip with the length (measurement no. 28) of 18.38% of body length. This is similar to Irrawaddy's flippers but they are longer than those of Indo-Pacific humpback, bottlenose and spinner dolphin.

Table 15. Percentage of morphometric measurement/total length in finless porpoise

Measurement characters	Mean	Range	n
Snout to blowhole	7.96	7.09-9.42	4
Snout ot eye	7.95	7.38-8.72	4
Snout to ear	20.00	19.15-21.72	4
Anterior edge of flipper to flipper tip	18.38	17.39-19.17	4
Posterior edge of flipper to flipper tip	13.80	12.32-15.16	4
Greatest breadth of the flipper	6.18	5.43-6.70	4
Breadth of the fluke	29.24	27.82-30.14	4
Fluke notch across fluke lateral base	7.04	6.52-7.54	4

4.1.2 Comparision on some selected morphometric between adult and juvenile porpoises

Porportions of head, flipper, body girdle and blubber thickness to body length were different. When compared the mean length of head measurements nos. 7, 10, 11 and 12, girdle measurement nos. 17 and 19, flipper measurement nos. 28, 29 and 30, blubber thickness measurement nos. 31, 32, 33 and 34, they revealed that juveniles showed the higher numbers of these ratios. (Table 16)

Table 16 Percentage of morphological measurements/total length between adult and juvenile finless porpoise

Measurement characters	Adult			Juvenile		
	Mean	Range	n	Mean	Range	n
Snout to blowhole	7.88	7.09 - 9.42	3	8.70	8.05 - 9.92	3
Snout to eye	4.63	3.55 - 5.64	3	6.27	4.97 - 7.20	3
Snout to ear	10.49	9.62 - 11.35	2	15.88	15.88	1
Snout to ant. base of flipper	19.42	19.15 - 19.57	3	22.58	21.72 - 24 13	3
Body girth at post. base of flipper	48.84	49.97 - 49.65	3	60.45	58.75 - 62.15	2
Body girth at anal slit	33.62	32.48 - 34.75	3	41.61	40 - 43.22	2
Ant. edge of flipper to flipper tip	18.22	17.39 - 19.17	3	21	20.40 - 21.60	3
Post. edge of flipper to flipper tip	13.34	12.32 - 14.18	3	16.69	15.44 - 17.50	3
Greatest breadth of the flipper	6.05	5.43 - 6.70	3	7.68	7.38 - 8.00	3
Bubbler thickness (31)	0.40	0.30 - 0.50	2	1.375	1.37 - 1.38	2
Bubbler thickness (32)	0.55	0.45 - 0.64	2	1.24	1.13 - 1.35	2
Bubbler thickness (33)	0.40	0.30 - 0.50	2	1.115	1.11 - 1.12	2
Bubbler thickness (34)	0.69	0.60 - 0.78	2	1.26	1.12 - 1.39	2

4.1.3. Internal anatomical characteristics

4.1.3.1. Organs

Data on the internal organs of dolphin and porpoise are very rare because it is difficult to get the specimen for examination. Five samples of this species were availabled during the time of the study.

Table 17 Percentage of weight of organs(g.)/total weight

organ	BIMS016	MSCU001	MSCU003	MSCU005	BIMS019
liver	1.73	2.37	3.27	2.44	3.49
lung	3.40	-	3.27	-	3.46
heart	0.47	-	0.72	0.44	0.69
kidney	-	-	1.10	0.89	1.38
pancrease	-	-	0.29	0.11	0.19
testis L/R	-	290/330	-	-	-

From all specimens examined, the liver weight is in the range 1.73 - 3.49 % of body weight, kidney 0.89 - 1.38 % , pancrease 0.11 -0.29 %, heart 0.44 - 0.72%. and lung 3.27 - 3.46% of body weight. The pneumortic tract of this species composed of double tracheas. The trachrea on the left is bigger. The one on the right branched into smaller tubes to supply the upper part of the right lung (Fig.21). Main trachea on the left is similar to other mammals in dividing into two bronchus upon entering the thorax to supply the left lung.

Fig. 21. The respiratory tract of finless porpoise

4.1.3.2. Stomach content

The main food content of three finless porpoise composed of cephalopods, crustaceans and fishes (Table 18). The dominant prey is cephalopods. Two small stones and one remaining valve of bivalves mollusk were also found in the stomach.

Table 18 Stomach contents of 3 finless porpoise

Contents	Weight (g)		
	MSCU001	MSCU003	BIMS019
Cephalopods (Loligo sp.)	43.96*	2.09**	0.02
Crustaceans	14.22	-	-
Fishes	18.84	4.25	-
Bivalves	-	0.02	-
Stones	0.07 (1 piece)	0.26 (2 pieces)	-
Unidentified	27.37	1.95	-
Total	104.46	8.57	0.02

*including 70 beaks and 51 eyeballs

** including 71 beaks and 15 eyeballs

4.1.3.3. Internal parasite

Numerous worm cysts were found in the lungs of juvenile finless porpoises, BIMS016 and MSCU005. They were nematodes of the family Pseudalliidae. In an adult porpoise MSCU003, the encapsulated (calcified) parasites were found in the lung but no living worm was found. No parasite could be recorded in other organs.

4.1.3.4. Skeleton

Cranium

The skull of finless porpoise is quite small. The rounded tip rostrum is very short with 33.43% of the condylobasal length,CBL. The margins of rostrum are almost parallel. The mandible is 72.42% of CBL long and 21.17% of CBL broad. The bony bosses of premaxilla are located in front of the nares. This is one of the characters used in recognition between dolphin and porpoise.

Fig. 22 Dorsal view of finless porpoise's skull

Fig. 23 Ventral view of finless's porpoise skull

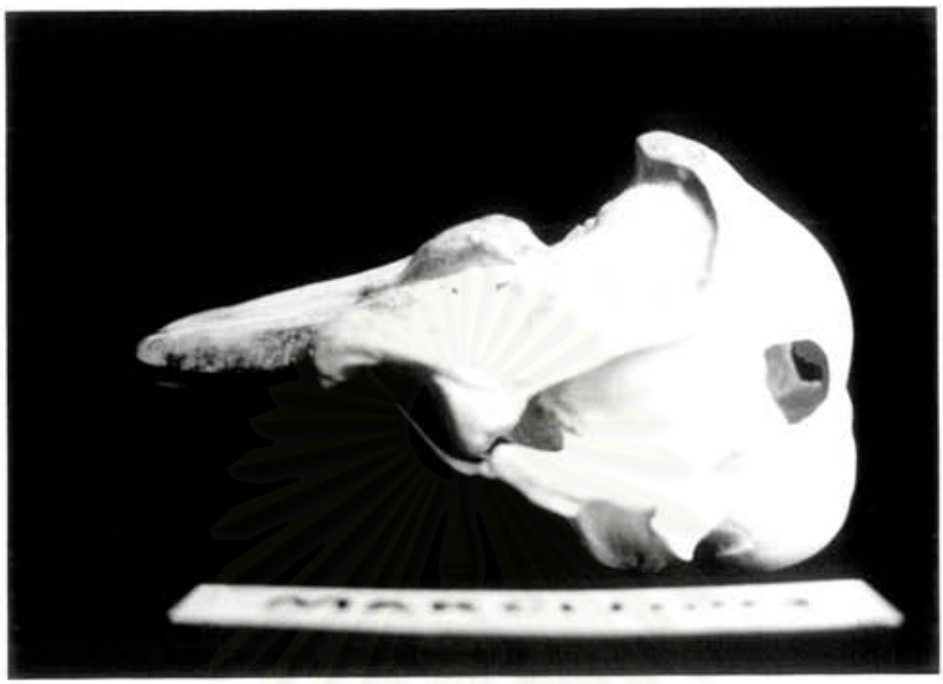

Fig. 24 Lateral view of finless porpoise's skull

Fig.25 Posterior view of finless porpoise's skull

The size of the tympanic bulla and periotic bones of adult and juvenile are not obviously difference, Table 19, Fig. 26 .

Table 19 Percentage of tympanic bulla (TB) and periotic (PR)/ condylobasal length between adult and juvenile finless porpoise.

Measurement nos.	Adult			Juvenile		
	mean	range	n	mean	range	n
Greatest length of TB	3.70	3.60 - 3.80	3	3.62	3.52 - 3.70	4
Greatest width of TB	2.27	2.10 - 2.34	4	2.33	2.30 - 2.40	4
Greatest length of PR	2.76	2.70 - 2.87	3	2.66	2.59 - 2.80	4
Greatest width of PR	1.71	1.67 - 1.75	4	1.78	1.74 - 1.86	4
Diameter of cochlear portion of PR	1.29	1.24 - 1.35	4	1.28	1.24 - 1.30	4

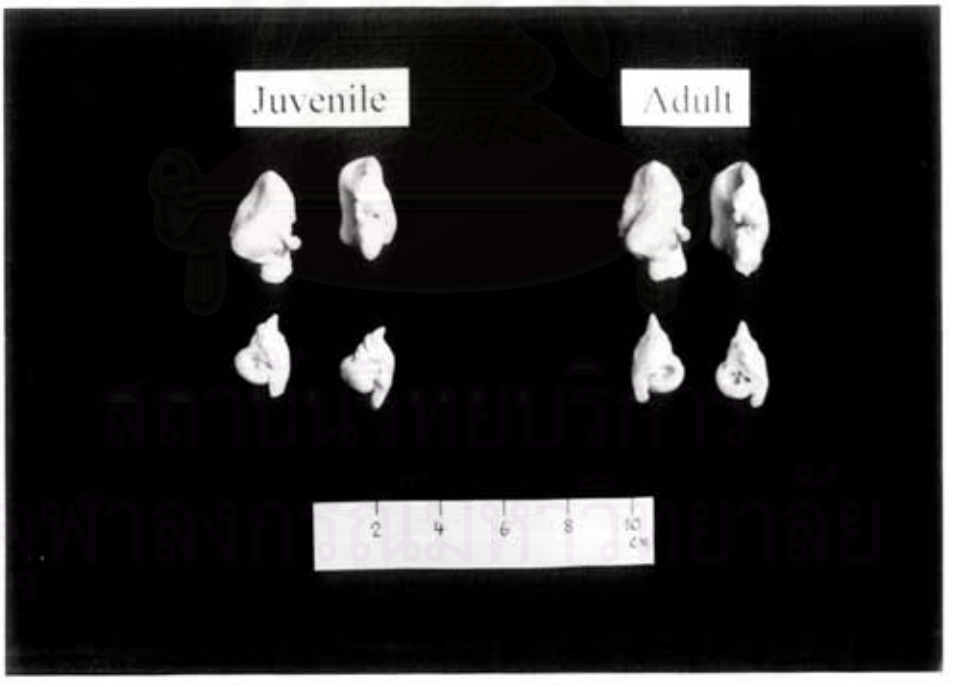

Fig. 26. Tympanic and periotic bone of adult and juvenile finless porpoise

Postcranial skeleton

Most postcranial skeletons of old skeletal specimens were lost or broken. Therefore, most informations were gathered from three new skeletons examined.

Scapula

When divide the width of scapula by its length (measurement no. 47/46), the higher ratio was shown in scapula of juvenile. (Table 20)

Table 20 Comparision on percentage of scapula (47/46) and sternum (45/44) width/length between adult and juvenile finless porpoise.

Measurement nos.	Adult			Juvenile		
	mean	range	n	mean	range	n
47/46	66	64 - 71	5	74	73 - 77	4
45/44	10.6	9.1 - 11.6	4	12.9	12.5 - 13.4	3

Sternum

Sternum ratio between width/length (45/44) is also reflected the growth as in the ratio of sternum width/length (45/44). The shape and size of sternum is obviously different between male and female (Fig. 27)

Pelvic

The shape and size of pelvic bone is distinctively different between male and female. The male pelvic, MSCU001 was 6.75 cm long, 1.04 cm broad and 0.56 cm thick with rough surface and twisted, while female, MSCU003, was only 6.18 cm long , 0.79 cm broad and 0.31 cm thick with smooth surface and untwisted (Fig. 28).

Fig. 27 Sternum of male and female finless porpoise

Fig. 28 Pelvic bone of male and female finless porpoises

Vertebrae

Finless porpoise has the first three fused cervical vertebrae. This fusion of vertebrae occured since the porpoise was young, MSCU005. The last fusion between the centrum of a vertebra and its epiphysis occurs in the thoracic vertebrae. This phenomenon could be observed in lactating MSCU003, whose milk was still flowing from mammary gland even when dead. This can be concluded that the sexual maturity occur before physical maturity. The common vertebral formula of both male, MSCU001, and female, MSCU003, is C7+Th13+L11+Ca30.

Ribs

Ribs are bilatteral symetry. Finless porpoise has thirteen vetebral ribs and eight sternal ribs on each side. Vertebral ribs compose of seven two-headed ribs, five single-headed ribs and one floating rib (n=3).

4.1.4. First record on life history of finless porpoise in Thailand

A lactating female, MSCU003 taken in August 29, 1996 was 133 cm long and weight 24.50 kg. Although MSCU003 was sexually mature, she was not physically mature because some of her thoracic vertebrae and their epiphyses were still not fused together yet. The physically mature male, MSCU001 was taken in March 15, 1996. He was 141 cm long and weight 31.5 kg with the right testis of 290 g and the left of 330g. Although the smallest 9 kg new specimen, MSCU005 is 74.5 cm long and was taken in october 1, 1996 and the old smallest specimen ZMKU006 is 62.5 cm long.

4.2. *Orcaella brevirostris*, Irrawaddy dolphin

Only two available old taxidermies and two new skeletons had been examined. Hence, detail of internal organs and life history of this species could not be studied and are still unknown. The total length of the two taxidermic specimens, CRDF001 and BIMST004, are 160 cm and 171 cm. Morphometric measurements are also based on these two specimens.

4.2.1. External morphology

A falcately tiny dorsal fin of Irrawaddy dolphin sets behind midback or about 52.9% of body length from the head tip. Among four species dolphins found in the study area, Irrawaddy dolphin has smallest dorsal fin. The base of dorsal fin is 7.6% and the height is 2.7% of body length. The flipper is quite large with rounded tip. The length of anterior part is 17.7% and 13.8% of the posterior part. The breadth of the flipper is 6.7% of body length. The fluke is broad and concave but propotion of the size is not different from other four dolphins.

Tooth count of upper/lower jaws ranged from 14 - 17/12-14 on each side with the mode of 15/13 (n=4).

Table 21 Percentage of morphometric measurement/total length in Irrwaddy dolphin

Measurement characters	Mean	Range	n
Snout to blowhole	6.05	5.85-6.25	2
Snout to eye	10.00	9.36-10.63	2
Snout to posterior base of dorsal fin	59.98	57.89-61.88	2
Snout to anterior base of dorsal fin	52.90	52.05-53.75	2
Basal length of dorsal fin	7.62	5.85-9.38	2
Height of dorsal fin	2.72	2.34-3.10	2
Snout to anterior base of flipper	21.01	20.76-21.25	2
Anterior edge of flipper to flipper tip	17.74	15.79-19.69	2
Posterior edge of flipper to flipper tip	13.80	12.28-15.31	2
Greatest breadth of the flipper	6.67	5.84-7.50	2
Breadth of the fluke	26.27	25.63-26.90	2
Fluke notch across fluke lateral base	7.26	7.02-7.50	2

4.2.2. Internal anatomy

4.2.2.1. Skeleton

Cranium

The condylobasal lengths were 27.2 cm.(EN062) and 29.8 cm.(MSCU002). The intensive skull measurement are shown in Table 22. Rostrum was moderately short with pointed tip. Length of rostrum is 40.71% of CBL. Width of rostrum at base is closed to length or about 39.62% of CBL but width at midlength is much shorter than length or 23.40%.

Fig. 29 Dorsal view of Irrawaddy dolphin's skull

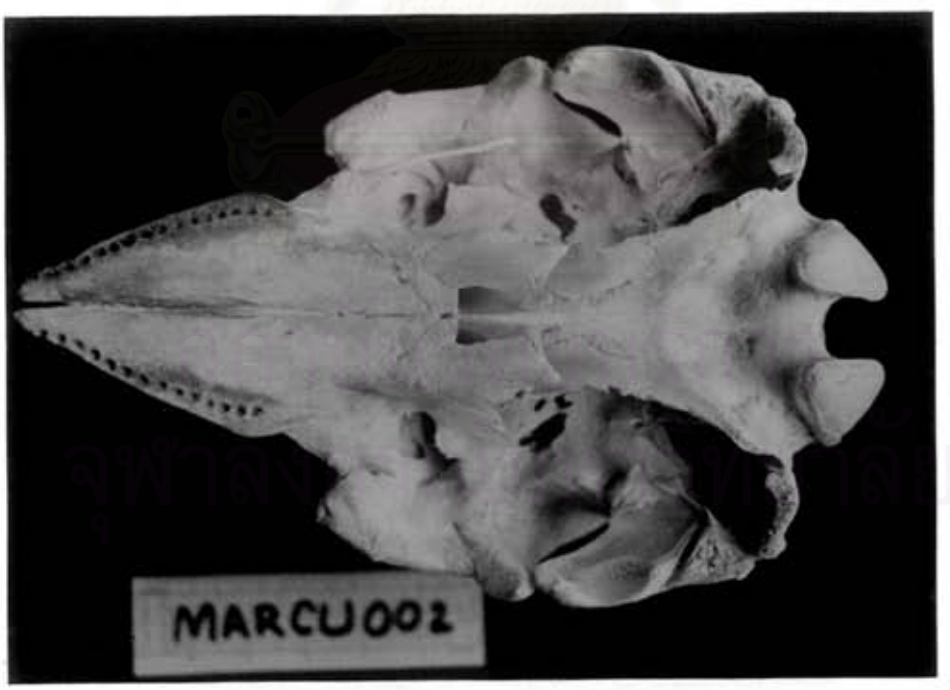

Fig. 30 Ventral view of Irrawaddy dolphin's skull

Fig. 31 Lateral view of Irrawaddy dolphin's skull

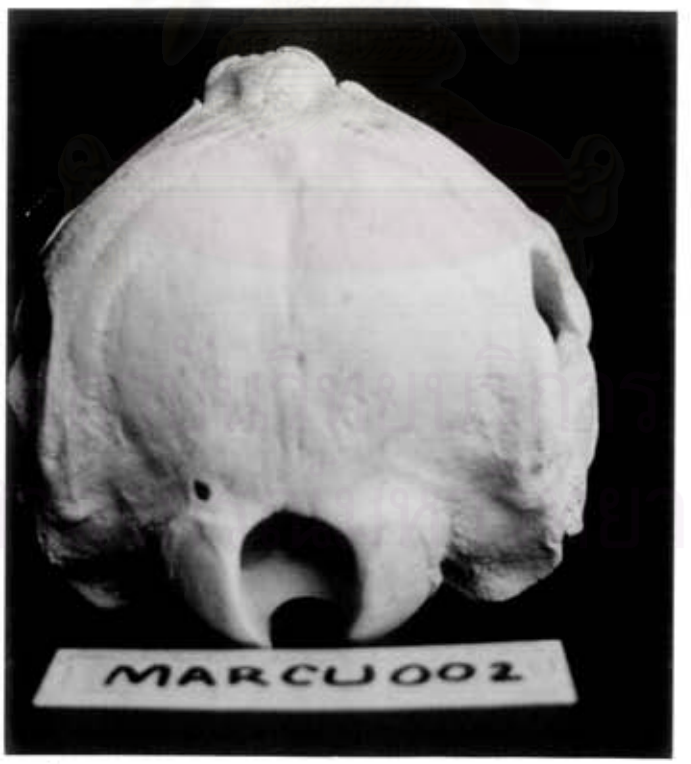

Fig. 32 Posterior view of Irrawaddy dolphin's skull

Postcranial skeleton

In MSCU002 the first two cervical vertebrae are fused. In EN062 the atlas and axis were lost and the four cervicals are free. The important point feature is the acromion on scapula. The shape of acromion is thin and slender.

Table 22 Percentage of skull measurement/CBL between finless porpoise and Irrawaddy dolphin

Measurement characters	N. phocaenoides			O. brevirostris		
	mean	range	n	mean	range	n
LR	33.43	29.23-36.34	6	40.71	39.34-42.08	2
WRB	34.21	31.41-36.91	6	39.62	38.86-40.37	2
WRH	23.40	13.89-27.55	6	23.99	21.14-26.84	2
PRO	65.62	59.90-68.04	6	73.26	71.14-75.31	2
LPF	26.58	22.22-29.90	6	29.96	28.94-30.97	2
WPF	16.04	13.62-19.48	6	15.57	14.85-16.28	2
LUTR	31.35	30.29-33.14	5	35.64	35.64	1
LLTR	32.05	30.17-35.67	5	33.27	31.38-35.15	2
LRA	72.49	70.85-73.47	5	82.85	81.88-83.82	2
HRA	21.17	20.45-22.28	5	26.95	26.68-27.21	2
WEN	14.13	11.88-15.62	6	16.87	16.76-16.98	2
WLN	5.52	4.83-6.86	6	6.79	4.87-8.71	2
WIN	19.33	17.00-22.17	6	18.81	18.16-19.46	2
PRO	55.48	50.24-60.41	6	62.71	61.07-64.34	2
LO	21.62	20.36-23.71	6	19.81	19.40-20.22	2
PRW	58.33	53.86-62.63	6	53.12	50.54-55.70	2

Abbreviation : LR, length of rostrum ; WRB, width of rostrum at base ; WRH, width of rostrum at midlength ; PRO, preorbital width ; LPF, length of post temporal fossa ; WPF, width of post temporal fossa ; LUTR, length of upper left toothrow ; LLTR, length of lower left toothrow ; LRA, length of left mandible ; HRA, height of left manible ; WEN, width of external nares ; WLN, width of left nasal ; WIN, width of internal nares; PRO, preorbital width ; LO, length of left orbit ; PRW, preorbital width

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

Only one already half-decayed specimen was dissected. Most of its internal characteristics could not be studied. This sample and two taxidermic specimens were examined for external morphological informations. The largest, BIMST005 is 224.5 cm long. One new and two old skeletons were also examined for osteological study.

4.3.1. External morphology

Most humpback dolphin share the pale greyish pink background with various grey spots or patches. Some with wider grey patches while some with very few grey spots.

The beak length is 8.97% of body length. This is longer than that of bottlenose dolphin but shorter than that of spinner dolphin. Indo-Pacific humpback has the smallest proportion of flipper among all species found in the study area. The length of anterior part of flipper (measurement no. 28) is 14.47% of body length and 10.88% in posterior part. A small dorsal fin has wide base and the prominent crease between dorsal fin and back is hardly distinct or absent. Dorsal fin appears to run smoothly on the back of the animal. However it can not be concluded that this dolphin has no hump or ridge on the back at all. When surfacing dolphin archs its back to begin diving, the hump or ridge on the back will be present with a small dorsal fin on top.

The range of upper/lower tooth counts are 33-39/34-38 on each side with the mode of 36/35 (n=5).

Table 23 Percentage of morphometric measurement/total length in *S. chinensis*

Measurement nos.	Mean	Range	n
Snout to melon	8.97	8.46-9.33	2
Snout to the angle of mouth	13.70	12.44-15.75	2
Snout to blowhole	16.62	14.92-18.51	2
Snout to eye	16.57	14.70-19.89	2
Snout to pos.-base of dorsal fin	63.73	60.13-67.96	2
Snout to ant. base of dorsal fin	43.87	41.65-48.89	2
Basal length of dorsal fin	18.68	17.37-20.44	2
Height of dorsal fin	7.87	4.01-5.80	2
Snout to ant. base of flipper	25.74	24.00-28.73	2
Ant. edge of flipper to flipper tip	14.47	13.80-15.11	2
Post. edge of flipper to flipper tip	10.88	10.39-11.56	2
Greatest breadth of the left flipper	5.20	4.89-5.80	2
Breadth of the fluke	25.65	24.50-26.80	2
Fluke notch across to fluke latteral base	7.10	6.46-7.73	2

4.3.2. Internal anatomy

4.3.2.1. Skeleton

Cranium

The CBL of three skulls examined are 54 cm, 51 cm and 57.75 cm. *S. chinensis* has long and very narrow rostrum. Length of rostrum is 58.88% of CBL (n=3). Width of rostrum at base is 20.64% of CBL but it is only 7.28% at midlength.

Postcranial skeleton

The vertebral formula examined of this species is C7,Th12,L11,Ca21. The first two cervicals are fused. A 225 cm female (MSCU004) is physically immature because of her free epiphysis. Twelve vertebral ribs composed of five two-headed ribs and other seven single-headed ribs. Seven sternal ribs are present. There is no floating rib on both sides.

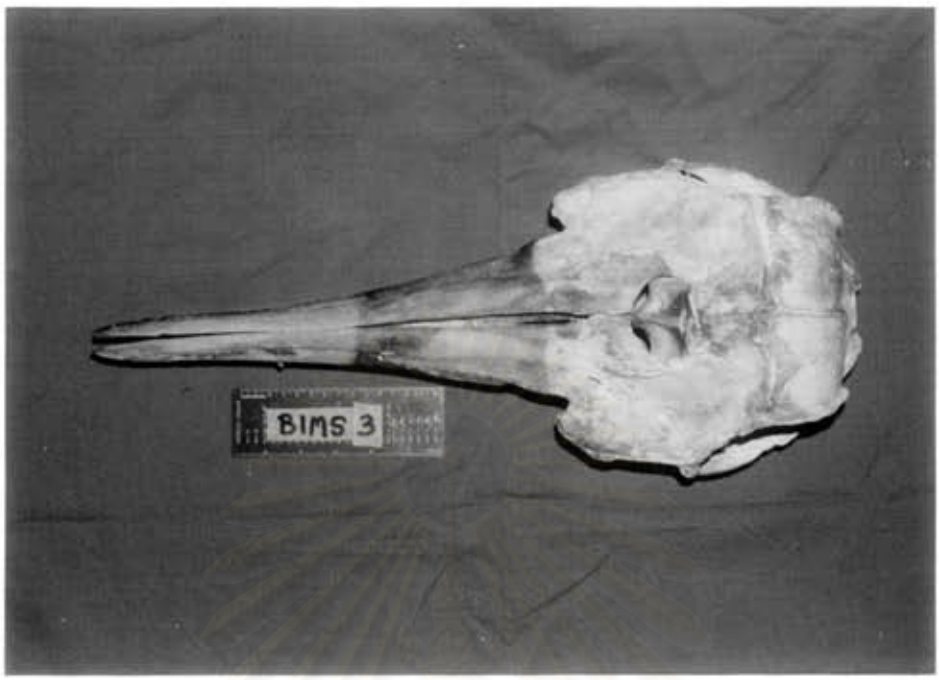

Fig. 33 Dorsal view of Indo-Pacific humpback dolphin's skull

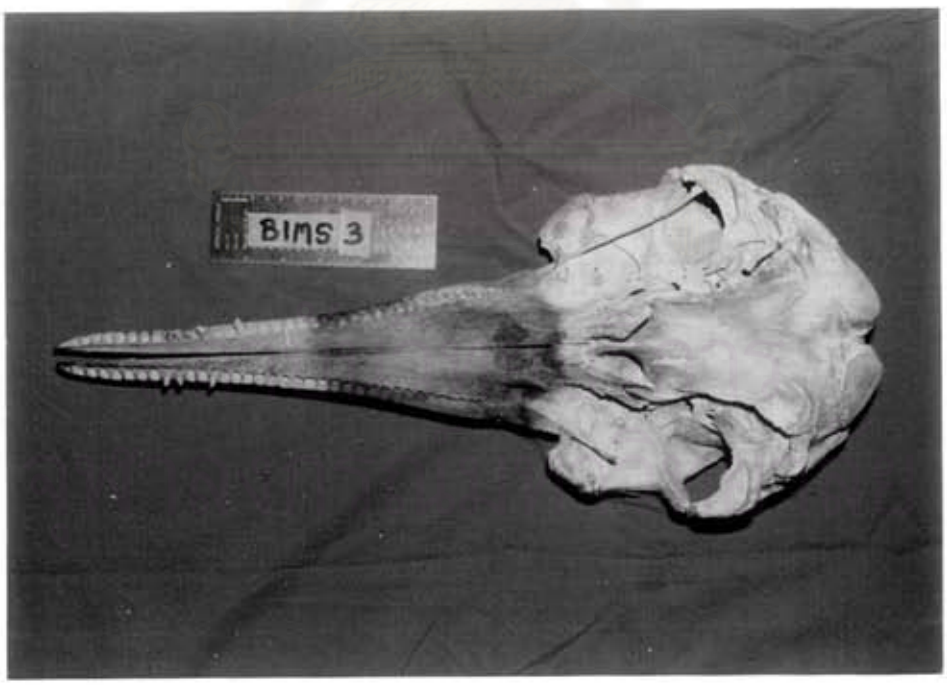

Fig. 34 Ventral view of Indo Pacific humpback dolphin's skull

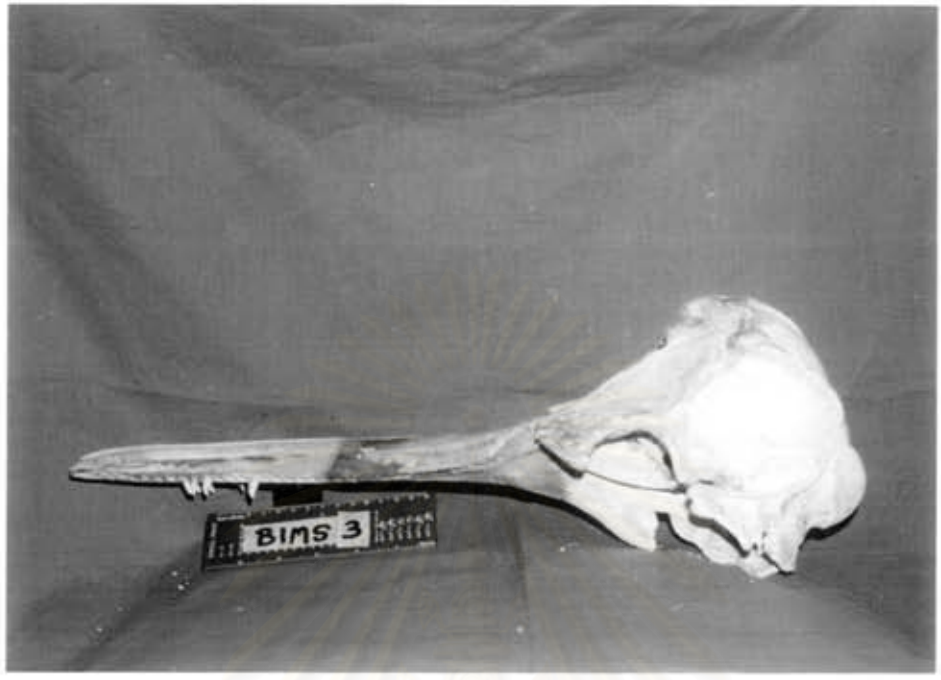

Fig. 35 Lateral view of Indo-Pacific humpback dolphin's skull

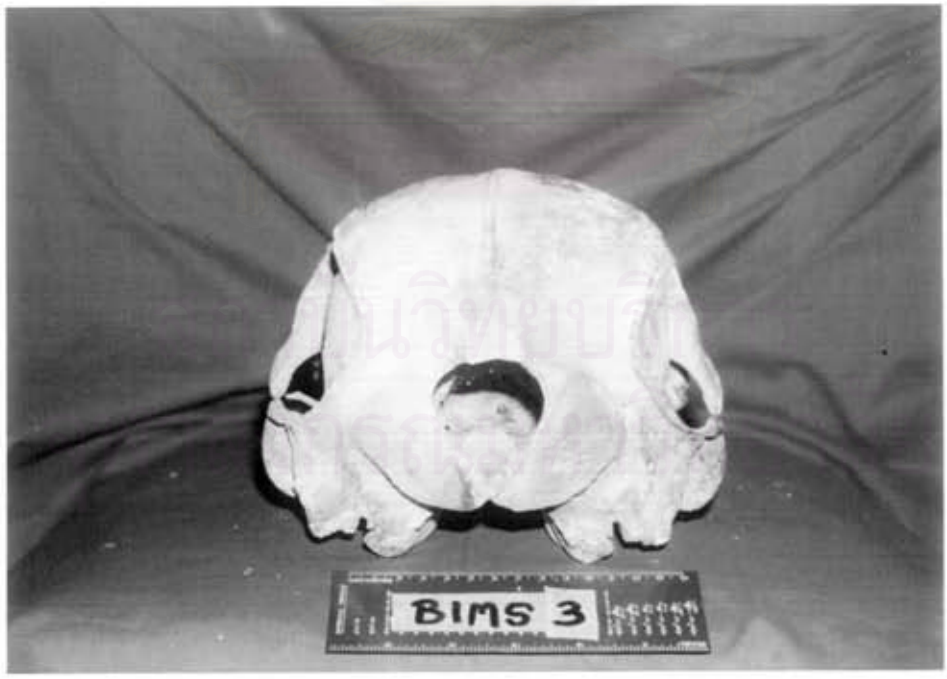

Fig. 36 Posterior view of Indo-Pacific humpback dolphin's skull

4.4. *Tursiops truncatus*, bottlenose dolphin

4.4.1. External morphology

All external characters were studied from old taxidermic specimens. The body color therefore could not be described. This species, however, is one of the most typical dolphin whose body color was said to be bluish grey to dark grey. Furthermore, one bycatch male bottlenose dolphin from Rayong landed at Samut Prakarn fish landing but only part of the animal could be collected. Its available skin shows bluish grey color on side and pale pink belly. A prominently large beak is well defined but rather short about 7% of the body length. A fulcate dorsal fin is tall and sits on midback. The biggest sample examined is 190 cm in total length. A dorsal fin is erectly falcated.

Tooth count on upper/lower jaws ranged from 22-26/21-25 on each side with the mode of 24/23 (n=16).

Table 24 Percentage of morphometric measurement/total length in bottlenose dolphin.

Measurement characters	Mean	Range	n
Snout to melon	7.00	5.06-7.74	6
Snout to the angle of mouth	13.82	12.11-11.84	6
Snout to blowhole	17.55	15.79-19.06	6
Snout to eye	17.22	16.05-18.18	6
Snout to pos. base of dorsal fin	58.82	57.83-61.50	6
Snout to ant. base of dorsal fin	46.07	43.95-48.09	6
Basal length of dorsal fin	16.07	14.13-19.03	6
Height of dorsal fin	10.62	8.29-11.41	6
Snout to ant. base of flipper	25.77	23.67-29.03	6
Ant. edge of flipper to flipper tip	15.81	13.23-17.65	6
Post. edge of flipper to flipper tip	11.38	8.71-12.77	6
Greatest breadth of the left flipper	6.64	5.44-7.33	6
Breadth of the fluke	24.49	22.01-28.42	6
Fluke notch across to fluke latteral base	7.27	6.45-8.21	6

4.4.2. Internal anatomy

4.4.2.1. Skeleton

The 6 skulls have the CBL of 40.80, 47, 45.50, 44.50, 49 and 45 cm. Length of rostrum is only 37% of CBL. The first two cervicals are fused (n=6). An acromion is paddle shape.

Fig. 37 Dorsal view of bottlenose dolphin's skull

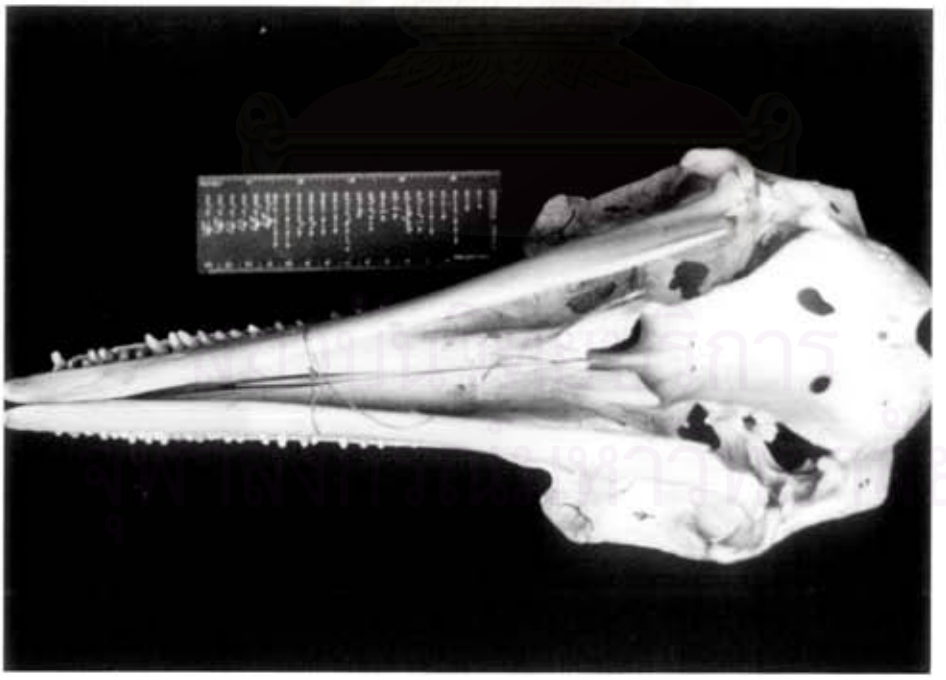

Fig. 38 Ventral view of bottlenose dolphin's skull

Fig. 39 Side view of bottlenose dolphin's skull

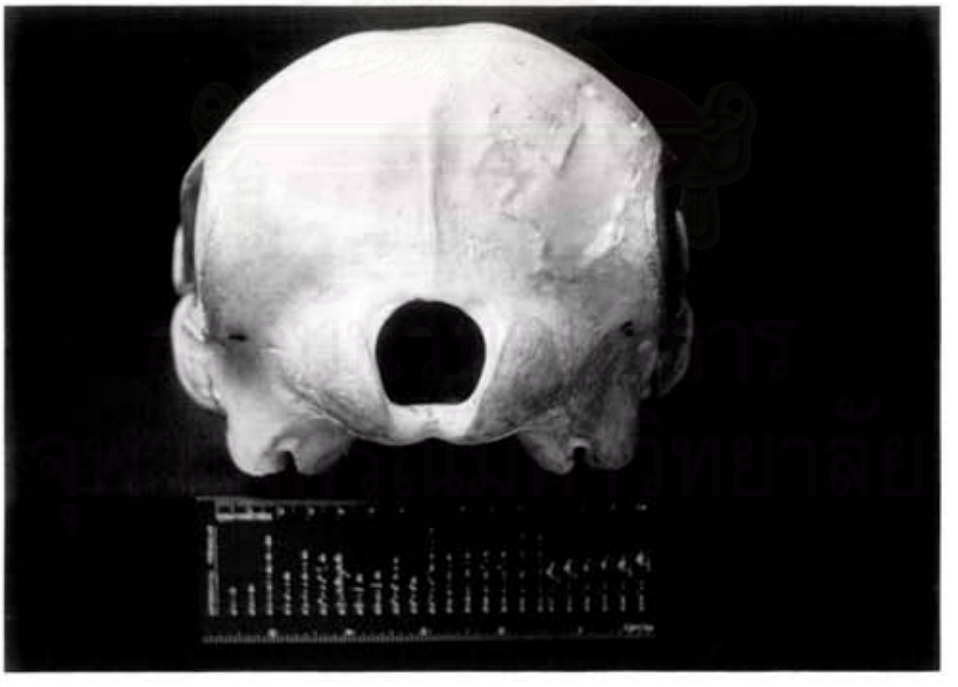

Fig. 40 Posterior view of bottlenose dolphin's skull

4.5. *Stenella longirostris*, spinner dolphin

New specimen of these species could not be obtained. The body color can not be described from the taxidermy. Only two skeletons were available for this study. This species seemed to have problem in maintaining population in the study area. All of the specimens are very old and undated.

4.5.1. External morphology

In this region, spinner dolphin is the smallest dolphin with the total length ranged from 88-129.5 cm (n=7).

External morphological characteristics gather from seven taxidermies show that their dorsal fin is erectly falcate. Hight of dorsal fin is as tall as bottlenose dolphin or 10.33% of total length (n=5). Prominent beak is moderately streamlined and much longer than others, 10.83% of body length.

Teeth are very tiny, sharp and pointed. The range of teeth on upper/lower jaws are 37-46/36-45 on each side with the mode of 41/41 (n=9).

Table 30 Percentage of morphometric measurement/total length in *S. longirostris*

Measurement characters	Mean	Range	n
Snout to melon	10.83	8.33-12.50	5
Snout to the angle of mouth	18.28	15.83-20.00	5
Snout to blowhole	21.66	18.53-24.00	5
Snout to eye	21.53	19.31-23.26	5
Snout to pos. base of dorsal fin	60.36	59.46-61.00	5
Snout to ant. base of dorsal fin	45.48	44.40-46.50	5
Basal length of dorsal fin	17.04	14.92-19.53	3
Height of dorsal fin	10.33	7.50-13.51	5
Snout to ant. base of flipper	28.00	24.17-31.05	5
Ant. edge of flipper to flipper tip	15.96	14.67-17.02	5
Post. edge of flipper to flipper tip	11.71	11.20-12.10	5
Greatest breadth of the left flipper	6.26	5.41-7.00	5
Breadth of the fluke	24.51	22.58-26.67	5
Fluke notch across to fluke latteral base	6.65	5.80-7.50	5

4.5.2. Internal anatomy

4.5.2.1. Skeleton

Cranium

Only two old skeletons could be obtained for this study. The CBL are 35 and 33.5 cm.. The skull of this species is rather small but rostrum are extremely long. Length of rostrum is 63.22% of CBL. The first two cervical vertebrae are fused.

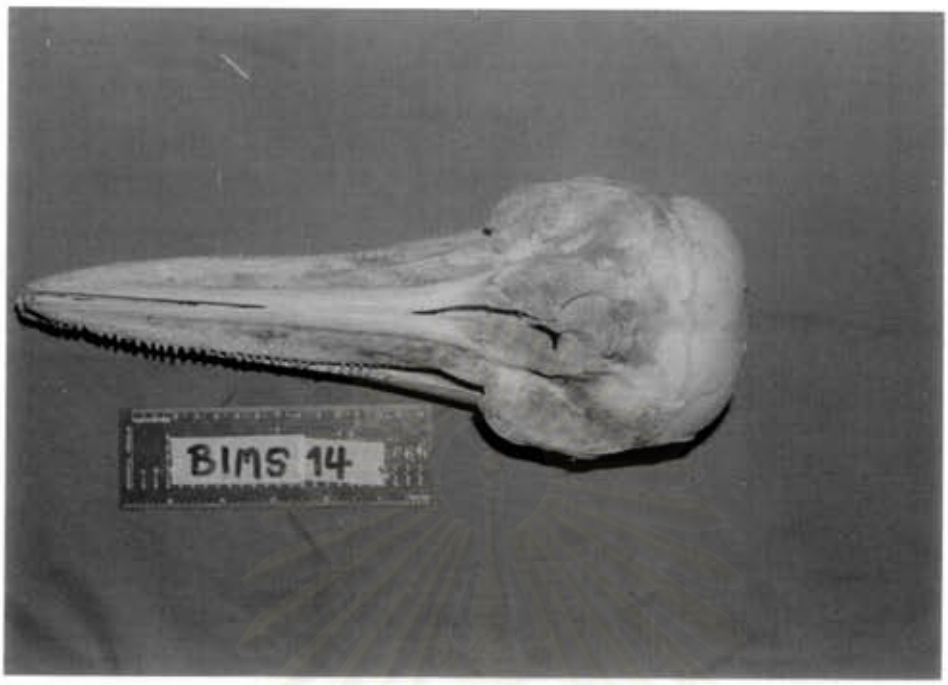

Fig. 41 Dorsal view of spinner dolphin's skull

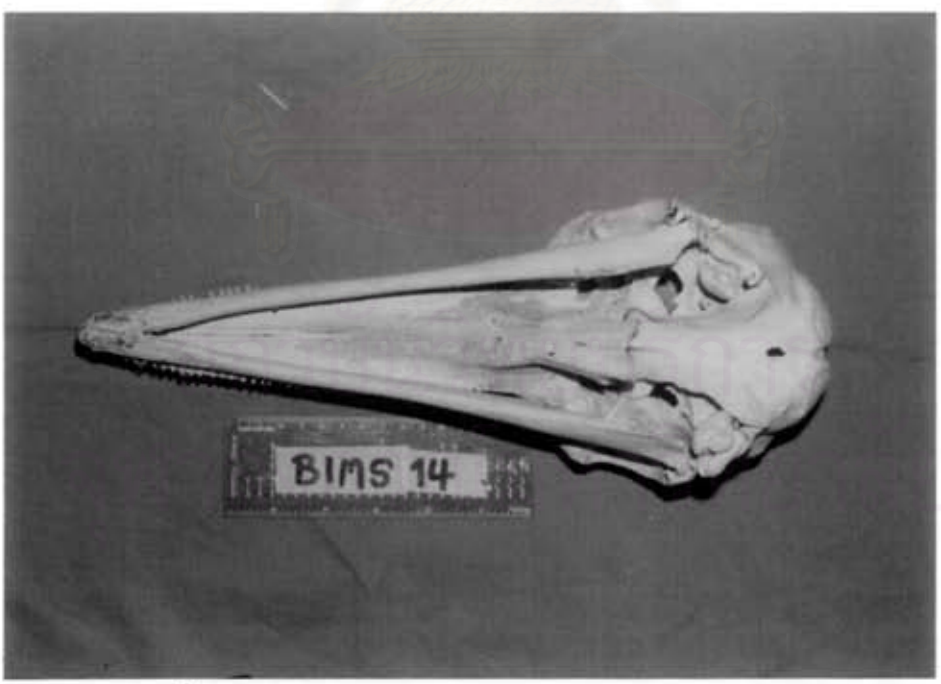

Fig. 42 Ventral view of spinner dolphin's skull

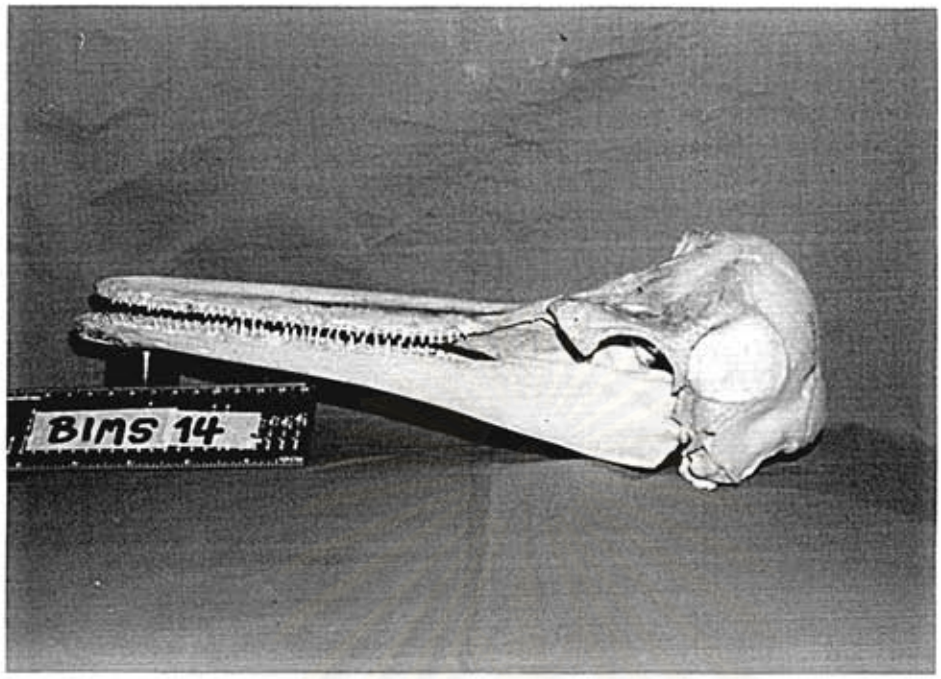

Fig. 43 Lateral view of spinner dolphin's skull

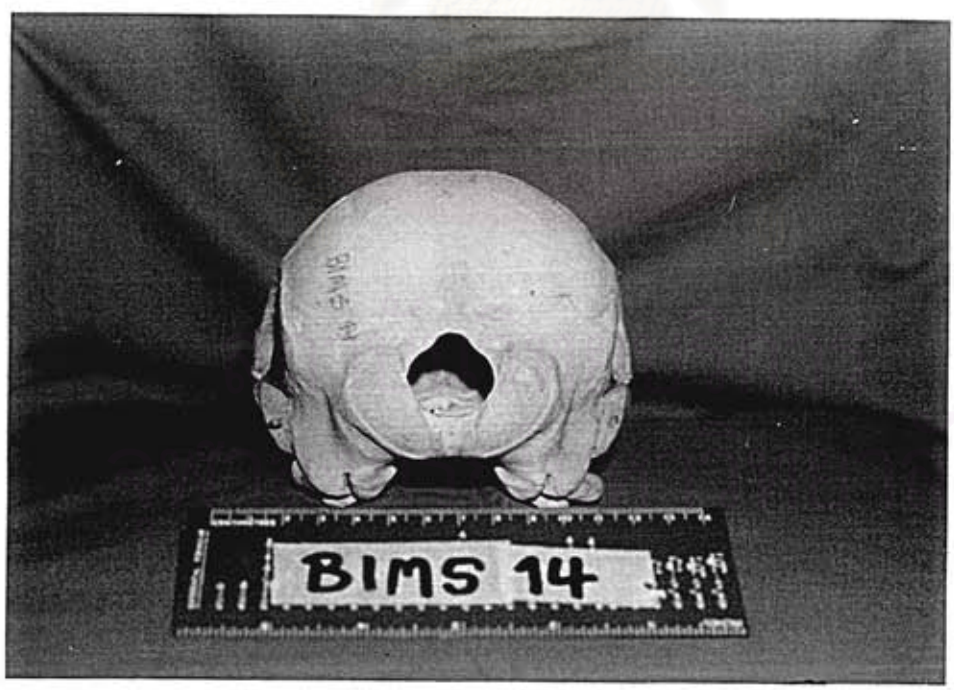

Fig. 44 Posterior view of spinner dolphin's skull

Table 26 Comparision on percentage of skull measurement/CBL between *S. chinensis*, *T. truncatus* and *S. longirostris*

meas.	*S. chinensis*			*T. truncatus*			*S. longirostris*		
char.	mean	range	n	mean	range	n	mean	range	n
LR	58.88	57.06-60.56	3	57.00	54.26-58.82	6	63.22	62.86-63.58	2
WRB	20.64	20.14-21.04	3	22.27	21.43-22.95	5	19.14	18.40-19.88	2
WRH	7.28	5.15-8.80	3	14.51	12.25-20.45	6	11.94	10.27-13.58	2
PRO	39.25	37.75-40.74	2	45.05	42.86-48.57	5	38.07	36.97-39.16	2
LPF	20.02	19.12-20.65	3	19.55	16.89-20.90	6	13.44	13.14-13.73	2
WPF	15.91	15.20-16.29	3	12.33	12.70-17.14	6	11.34	11.13-11.54	2
LUTR	53.53	52.64-54.63	3	48.39	47.66-49.51	3	53.73	53.43-54.03	2
LLTR	52.80	50.21-54.26	3	47.65	45.74-48.67	3	52.55	52.24-52.86	2
LRA	81.89	48.79-83.73	3	83.03	79.79-85.29	3	82.39	80.00-84.78	2
HRA	16.07	15.36-16.86	3	16.86	16.60-17.07	3	13.24	13.14-13.34	2
WEN	9.86	9.06-10.27	3	12.01	10.70-14.94	6	9.40	9.34-9.46	2
WLN	3.95	3.64-4.25	2	5.56	4.40-6.25	4	4.31	3.55-5.06	2
WIN	10.56	9.26-11.75	3	12.89	11.03-16.36	4	9.90	9.77-10.03	2
PRO	34.67	33.59-35.47	2	40.93	38.97-44.40	5	34.63.	33.74-35.52	2
LO	10.50	10.22-11.02	3	14.06	12.87-16.74	5	11.56	11.17-11.94	2
PRW	23.22	19.57-26.87	3	32.66	27.74-36.89	5	33.28	33.25-33.31	2

Abbreviation : LR, length of rostrum ; WRB, width of rostrum at base ; WRH, width of rostrum at midlength ; PRO, preorbital width ; LPF, length of post temporal fossa ; WPF, width of post temporal fossa ; LUTR, length of upper left toothrow ; LLTR, length of lower left toothrow ; LRA, length of left mandible ; HRA, height of left mandible ; WEN, width of external nares ; WLN, width of left nasal ; WIN, width of internal nares; PRO, preorbital width ; LO, length of left orbit ; PRW, preorbital width