

Chapter 2

Methodology

To gather information on species, distribution and status of dolphins, three methods were used. First, interview surveys were used to indicate the general status and distribution of dolphins in the area. Secondly, specimens were used for the study of dolphin morphology in details. Finally, the sighting surveys had been carried out to confirm the results of the above two methods.

Interview survey

1. Correspondent questionnaire by mail

Nine hundred and thirty three replied mail questionnaires were distributed to various temples along four major rivers and the coastline. The questions have placed focus on the specimens collected at those temples and on the occurrence of dolphin along the coastline in the Inner Gulf and its tributaries.

2. Direct interview survey

Fishermen at all fishlanding sites and villagers along the coastline in the study area were interviewed. Records were made on the occurrence of dolphins, the details about dolphins caught and stranded (species, sex, size), frequency of dolphins accidentally caught by fishing gears and the type of those fishing gears caught and the fishing areas.

The elderly local people along the tributaries of the target rivers, Mae Klong, Tha Chin, Chao Phraya and Bang Pakong, were interviewed concerning the occurrence of dolphins in fresh water. The boundary of the study area was limited to

the last district where no dolphin had ever been seen. The evidences of tributary intrusion by dolphins were based on information gathered from field interviews as well as secondary sources such as published books, newspapers and articles.

Specimen study

1. Bycatch dolphins

Dolphin carcasses used in this research were collected from fishermen at all fishlandings and the stranded ones along the coast. Details of capture such as type of fishing gear and fishing area were gathered by interviewing the fishermen possessing the specimens. Specimens were examined as followed :

1.1. Species identification and condition

Identification was based on external characters, colour pattern and numbers of teeth. Detailed records were made on shape, pigmentation patterns, lesions, and net mark. Sex determination was made at either the mammary slits or the urogenital area. Age was determined from the measurement of body length and weight. Specimens were photographed, measured and dissected for morphological study.

1.2. Morphological study

Thirty four morphometric characters (table 1, fig. 8) were selected for morphological analysis, based on Law (1994). Morphometric characters were measured with measuring tape and calipers to the nearest mm.. Measurements in parallel to the body axis are taken from the tip of the upper jaw to the center of

apertures (genital, anal, eye, etc.). The carcasses were dissected for inspection of some internal organs.

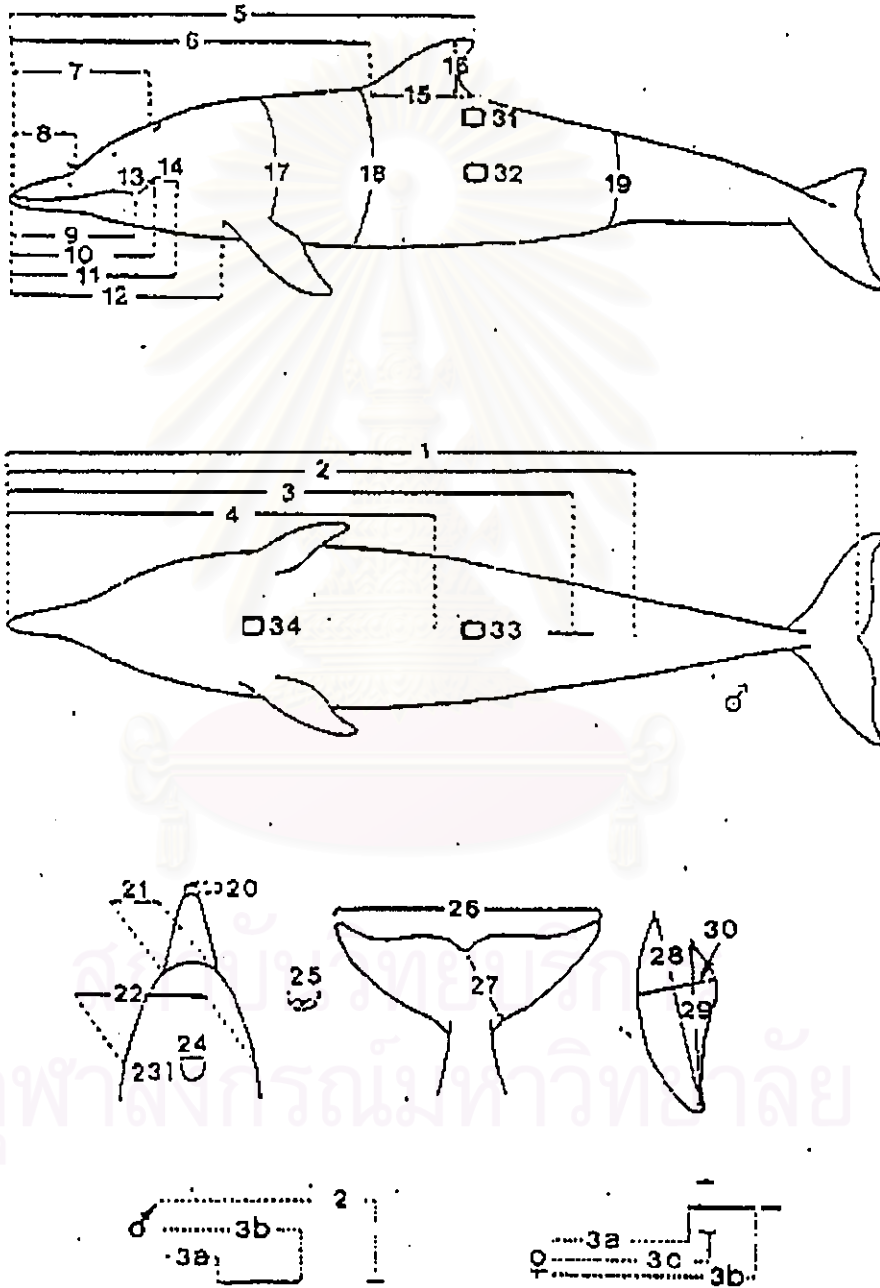


Fig. 8. Morphometric measurement of dolphin and porpoise

Table 1. Morphometric measurements of dolphin and porpoise

All measurements parallel to the body axis were taken from the tip of the upper jaw to the center of apertures (genital, anal, eye, and so on).

1. total length from snout to tail notch
2. Snout to anus
3. Snout to genital slit
 - 3a. Snout to anterior end of genital slit
 - 3b. Snout to posterior end of genital slit
 - 3c. Snout to mammal grand slit
4. Snout to umbilicus
5. Snout to posterior base of dorsal fin
6. Snout to anterior base of dorsal fin
7. Snout to blowhole
8. Snout to melon
9. Snout to the angle of mouth
10. Snout to eye
11. Snout to ear
12. Snout to anterior base of flipper
13. Angle of mouth to anterior base of eye
14. Posterior base of eye to ear
15. Basal length of dorsal fin
16. Height of dorsal fin
17. Body girth at posterior base of flipper
18. Body girth at anterior base of flipper
19. Body girth at anal slit
20. Tip of upper jaw to tip of lower jaw
21. Maximum breadth of beak

22. Breadth of head at eyes
23. Length of blow hole
24. Breadth of blow hole
25. Eye length
26. Breadth of the fluke
27. Fluke notch across fluke to lateral base
28. Anterior edge of flipper to flipper tip
29. Posterior edge of flipper to flipper tip
30. Greatest breadth of the flipper
31. Area of blubber thickness
32. Area of blubber thickness
33. Area of blubber thickness
34. Area of blubber thickness



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1.3. Selected internal characteristics study

1.3.1. Stomach contents

Three dolphins' stomachs were dissected for identification of the food contents inside. The numbers of prey eaten were counted and weighed.

1.3.2. Internal organs

Internal organs were weighed and observed for the condition and internal parasites.

After dissection, the flesh was removed from the five carcasses as much as possible and left in water for decomposed within six to seven weeks. After that, skeletons were cleaned by water and left in 10% hydrogen per oxide (H_2O_2) for an hour, 5% H_2O_2 for preparing the skeleton of juvenile dolphin. Then they were washed in water three times and left in water over night. Finally, skeletons were brushed with a tooth brush to remove small pieces of flesh and all bones left to be dried away from sun light. The skeletons were stored for further osteological study.

1.3.3. Osteological study

Osteological study was carried out with all eight skeletons of bycatch and stranded dolphins. Fifty morphometric characters (Table 2, Fig. 9) were selected for morphological analysis, following Yoshida (1994), Perrin (1975) and Kinze (1985). Morphometric characters were measured with calipers or rulers to the nearest mm.. The complete fusion between the vertebral centrum and the epiphysis was determined by the closure of the epiphyseal suture.

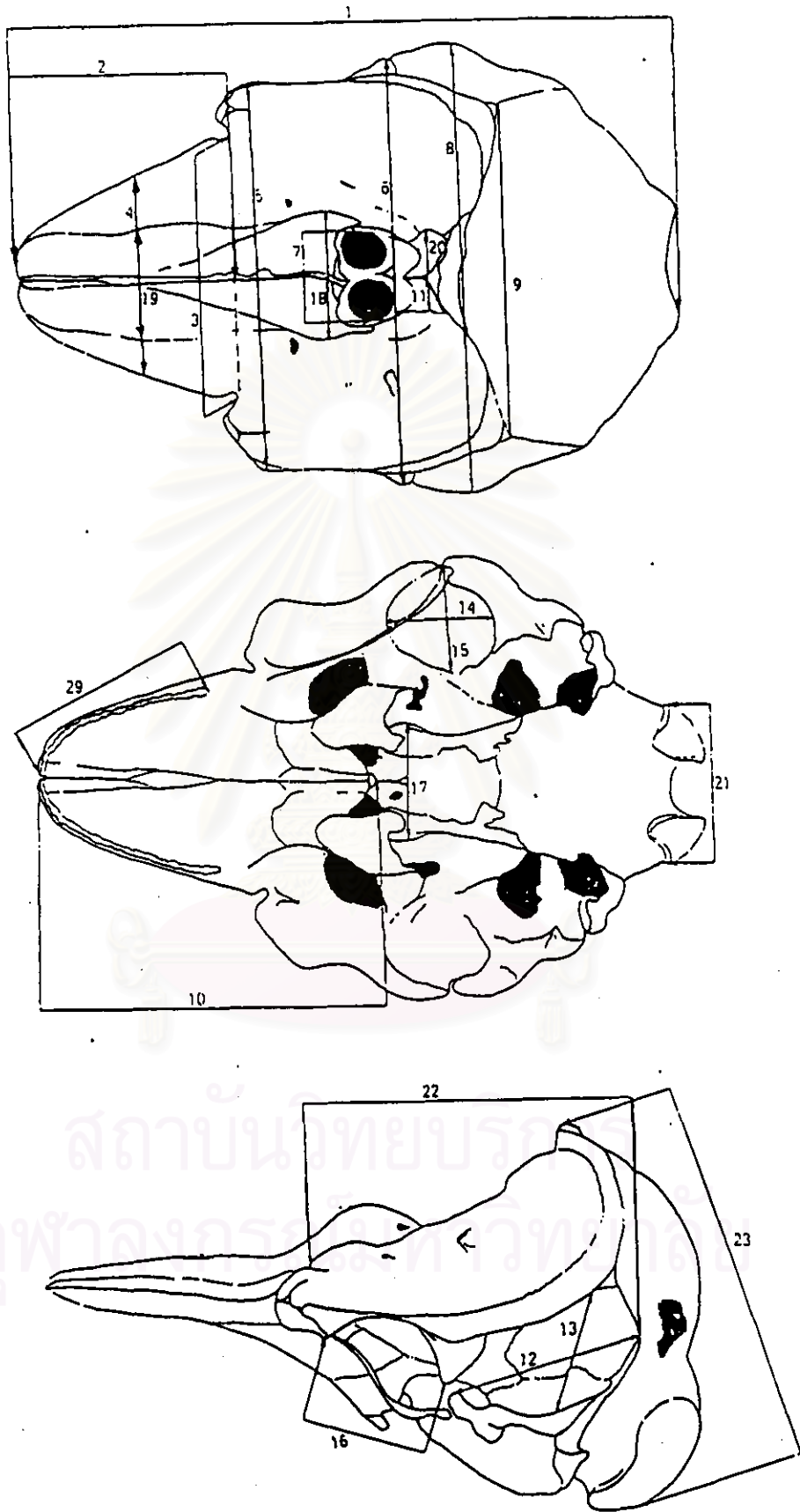


Fig. 9. Morphometric measurement of skeleton

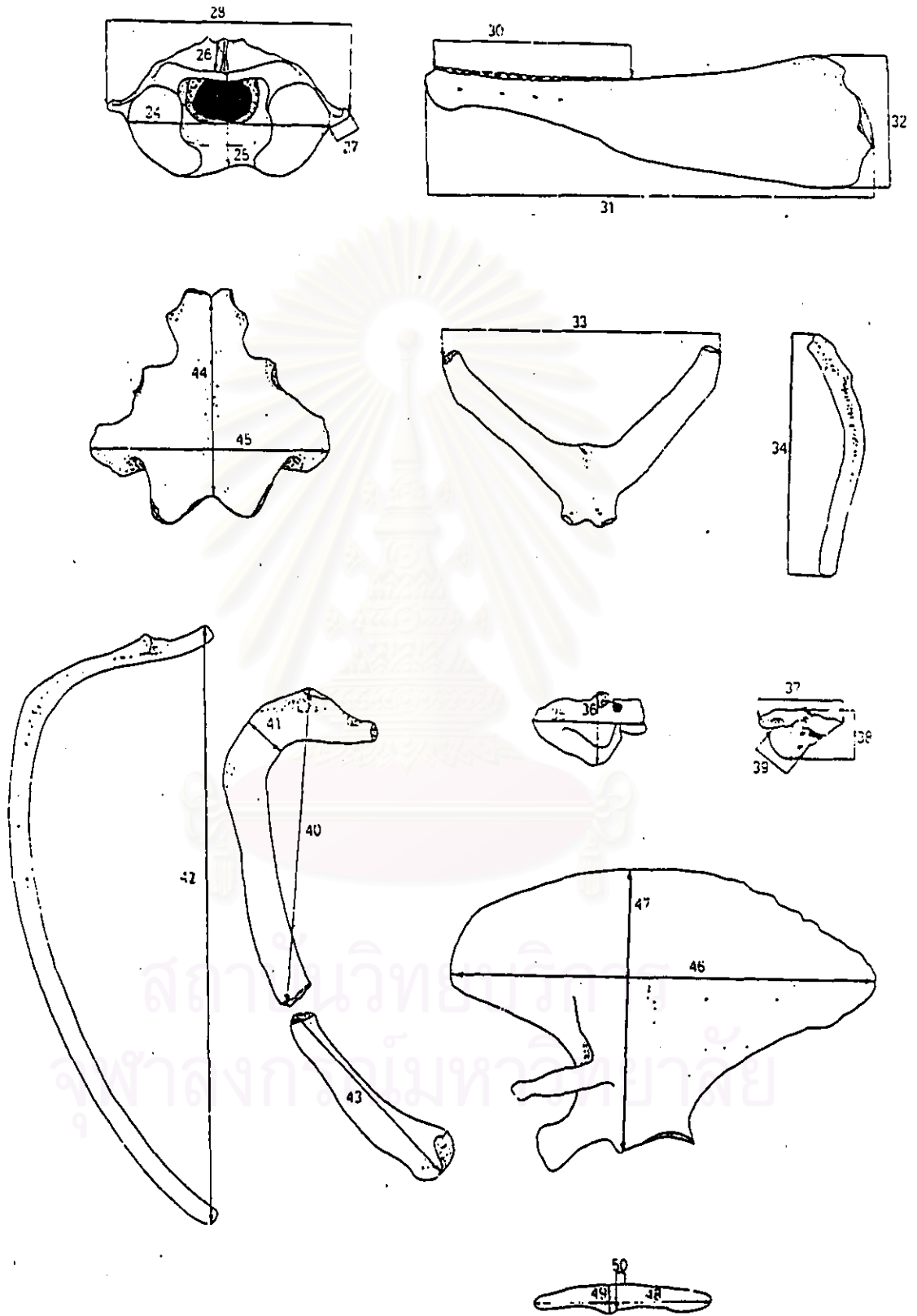


Fig. 9. Morphometric measurement of skeleton (continued)

Table 2. Morphometric measurement of Skeleton

1. Condylbasal length - from tip of rostrum to hindmost margin of occipitalcondyles.
2. Length of rostrum - from tip to line across hindmost limits of antorbital notches.
3. Width of rostrum at base - along line across hindmost limits of antorbital notches.
4. Width of rostrum at midlength.
5. Greatest preorbital width.
6. Greatest postorbital width.
7. Greatest width of external nares.
8. Greatest width across Zygomatic process of Squamosal.
9. Greatest parietal width, within posttemporal fossae.
10. Distance from tip of rostrum to internal nares (to mesial end of posterior margin of right pterygoid / to ventral median spine of vomer (in finless porpoise))
11. Greatest width of left nasal.
12. Greatest length of left posttemporal fossa, measured to external margin of raised suture.
13. Greatest width of left posttemporal fossa at right angles to greatest length.
14. Major diameter of left temporal fossa proper
15. Minor diameter of left temporal fossa proper
16. Length of left orbit - from apex of preorbital procees of frontal to apex of postorbital process.
17. Greatest width of internal nares.
18. Maximum width of premaxillary
19. Width of premaxilla at midlength of rostrum
20. Maximum width of nasals
21. Maximum width of occipital condyls
22. Rostrum junction to posterior base of parietal
23. Frontal crest to occipital condyle base
24. Greatest width of articulating surface of atlas
25. Height of atlas - from internal anterodorsal margin of neural canal to bottom of anterior face of body
26. Greatest length of neural spine of atlas

27. Length of lateral process of atlas - from margin of anterior articulating surface to farthest point at end of process
28. Greatest width of atlas
29. Length of upper left tooth row - from hind most margin of hind hindmost alveolus to tip of rostrum.
30. Length of lower left tooth row - from hind most margin of hind hindmost alveolus to tip of mandible.
31. Left mandible length.
32. Maximum height of left mandible.
33. Greatest width between tip of thyrohyals.
34. Greatest length of left stylohyal.
35. Greatest length of left tympanic bulla.
36. Greatest width of left tympanic bulla
37. Greatest length of left periotic.
38. Greatest width of left periotic.
39. Diameter of cochlear portion of left periotic.
40. Greatest length of 1st left vertebral rib.
41. Width of first left vertebral rib at apex of proximal curvature
42. Greatest length of longest left vertebral rib.
43. Greatest length of 1st left sternal rib.
44. Greatest length of sternum along midline.
45. Greatest width of sternum.
46. Greatest length of left scapula.
47. Greatest width of left scapula.
48. Greatest length of left pelvic bone.
49. Greatest width of left pelvic bone.
50. Greatest thickness of left pelvic bone.

2. Old specimens

Taxidermic specimens and skeletal specimens obtained from ten institutions were examined as follows :

Table 3. Examined specimen collections

Institutions	Number of specimens	
	Taxidermic	Skeleton
Faculty of Fishery, Kasetsart University (FKU)	3 (+1)*	3
Department of Zoolgy, Kasetsart University (KUMZ)	6	-
Thailand Inst. of Scientific and Technological Res.(TISTR)	-	1(+1)**
Science Center for Education (SCCE)	-	1
Bangkaen Institute of Marine Science, (BIMST/BIMS)	7 (+1)***	11 (+2)****
Phuket Marine Biological Center (EN)	-	1
Natural History Museum, Chulalongkorn Univ. (CUMZ)	2	4
Oceanic Fishery Division, Samut Prakarn (OCFD)	2	-
Crocodile Farm, Samut Prakarn (CRDF)	3	-
Swankaniwas Fish Farm, Samut Prakarn (SWNF)	3	-
Faculty of Veterinary, Chulalongkorn University (VETCU)	1	-
Dept. of Marine Science, Chulalongkorn University(MSCU)	-	5
Total	27	26

* Body broken specimens of *Neophocaena phonoides*.

** A skull specimen of *Pseudorca crassidens* from Prachuab Kirikan.

*** A preserved calf of *N. phocaenoides* in unopenable bottle.

**** Two skull of *Phocaena phocaena* and *Delphinapterus leucus* from Denmark.

2.1. Taxidermic specimens

Taxidermic specimens were measured the same as morphological study in 1.2 except the character numbers 2, 3, 4, 11, 19, 30, 31, 32 and 34 which could not be measured. Twenty five morphometric characters were measured as complete as possible and were selected for morphological analyses by separating from the external morphology of new bycatch dolphins.

2.2. Skeletal specimens

Old skeleton specimens collected at various locations kept at many institutes were measured according to the osteological study in 1.3.3. Morphometric characters were measured as complete as possible and were selected for morphological analysis with the skeleton from the bycatch dolphins.

Sighting survey

Two specific surveys were conducted in the area where dolphins occurrences were frequently reported by the interviewee. The first study area was around Bang Sa Rae and Ko Kram. The second was around the Bangpakong river mouth. Both were conducted by the pseudotranssect method with the binoculars. The appearance of the sighted dolphins was photographed and positioned by a GPS. The numbers of dolphins were determined immediately.

Other surveys were spot-checked at anytime when space was available on the ships belonging to 4 institutions (Table 4). The observation was carried out by using the 7 x 35 binoculars. The appearance of dolphins were photographed and positioned with a GPS.

Table 4. Route of sighting survey.

Institutions	Vehicles	Route
1. Aquatic Resources Research Chulalongkorn Univ.	Chula - Research ship	1.1. along the coast of the Inner gulf
2. Dept. of Aquatic Science, Burapha University	rental research ship	2.1. Ang sila - Bangpakong - Ang sila 2.2. Ang sila - Ko sichang - Ang sila
3. S. V. Marine Co., ltd.	commercial ship	Chao praya - Prachuab
4. Dept. of Marine Science, Chulalongkorn Univ.	rental boat	4.1. Bang Sahrae - Ko Kram
	rental boat	4.2. Around Bang Pakong estuary

Study area

The Gulf of Thailand is semi - enclosed shallow water body. Its northern boundary is almost a straight line extending from about 100 E to 101 E at latitude 13° 30' N. From the northeast corner the eastern boundary runs straight south to approximately 12° 40' N, the southern most boundary of the Inner Gulf of Thailand.

Piyakarnchana, et al,1990 referred to Robinson(1974) that the general shape of the Gulf's bottom topography can be considered as elliptic paraboloid. The maximum depth of the Inner Gulf is approximately 20 metres (Menasveta, 1990).

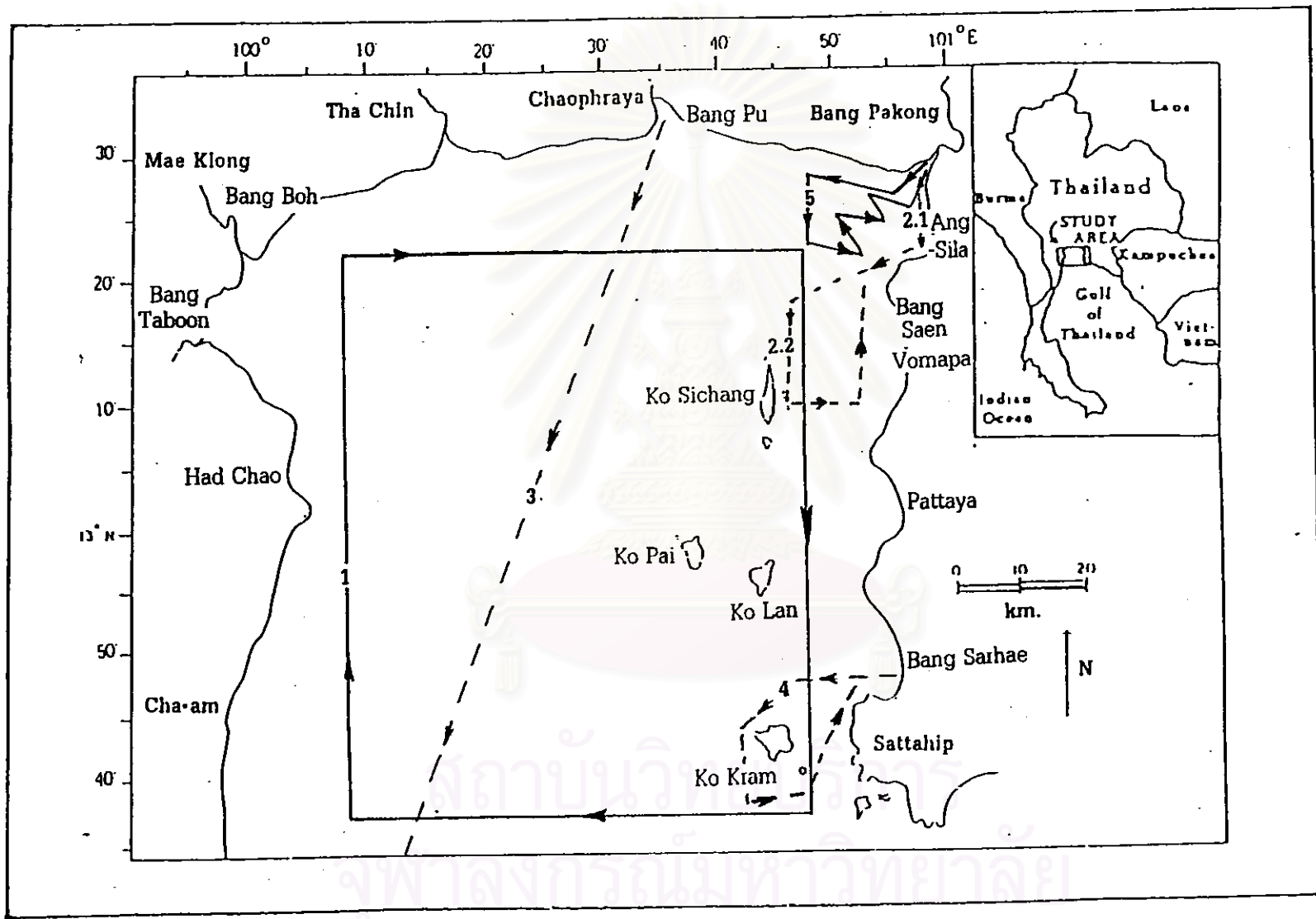


Fig. 10 The study area and routes of sighting survey

Oceanographic characteristics of the Gulf of Thailand

There are four major rivers, Bang Pakong, Chao Phraya, Ta Chin and Mae Klong that discharge fresh water into the northern part of the Gulf of Thailand . The average annual discharge from these rivers is approximately $1.5 * 10^{10}$ cubicmetres (Bunpamong, 1987). There is also some evidence that high salinity water from the south China sea enters the Gulf near the bottom (Pongsapipat and Sapsomwong, 1973; Robinson, 1974). In view of these two factors, the Gulf of Thailand can be considered a two layered system.

On the average, temperature of seawater at the surface level is higher than any of the other levels. The average temperature of every level is 29.66 °C. The average salinity of seawater is 29.29% with the highest at 32.70% and the lowest at 12.85%. on the offshore area, sunlight can penetrate around 30 cm up to 13 meters at the most. The highest amount of nutrients accumulated around the river mouth especially at the mouth of Chao Phraya River. The amount of nutrients decreases in direct proportion to the distance of the coastal area. (NRCT,1977)

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