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GEOGRAPHICAL VARIATION IN MORPHOLOGY AND BIOLOGY OF BOTTLENOSE DOLPHINS (TURSIOPS) IN THE EASTERN NORTH PACIFIC

BY

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INTRODUCTION

Our understanding of systematics of the genus *Tursiops* is presently in a confused state. Since the original generic description, twenty species have been described (Hershkovitz, 1966). To further add to this problem, numerous subspecies have also appeared in the literature, most having been proposed after examination of a meager amount of material. Tomilin (1957) expressed the opinion that *Tursiops* is represented by a single cosmopolitan species with an as yet undetermined number of geographic races. Ross (1977) proposed that the best approach to dealing with the present controversy regarding existing *Tursiops* species is through "more detailed regional studies of the limits of variation within populations." This author considers the latter to be the best approach in research investigations on this subject, and thus the rationale for confining this study to the eastern north Pacific.

To date, two species of bottlenose dolphin have been described from the eastern north Pacific: *Tursiops gillii* (Dall) 1873, type locality Monterey, California; and *Tursiops nuuanu* (Andrews) 1911, type locality 12°N; 120°W. Though examination of additional material presented in this study indicates these two nominal species to be at least modally distinct, this author considers it premature and beyond the scope of this report to attempt to definitively assess the validity of these species or to assign specific or subspecific names to other populations or forms of Tursiops which appear from the data to exist in the study area.

From the data presented here, at least three forms of Tursiops exist in the eastern north Pacific. For purposes of this report, these forms will be referred to as follows:

1) southern California and Mexico coastal form; corresponds to Tursiops gillii (Dall)
2) northern temperate offshore form; closely related to ETP offshore form
3) eastern tropical Pacific offshore form; corresponds to Tursiops nuuanu (Andrews)

THE SAMPLE

Sources of various data and specimens examined are described later in the text. In general, samples were obtained as follows:

1) Southern California and Mexico coastal: Most specimens were obtained as beach pick-ups. Almost all of these were the result of individual beach strandings; however, there is evidence that in some areas, particularly the upper Gulf of California, Mexico and San Diego, California, some of the animals recovered were the result of incidental catches of local gillnet fisheries (Table VII).

2) Northern temperate offshore: With one exception, almost all specimens examined were collected by a local public display fishery (Marineland of the Pacific, Los Angeles, California). These dolphins were all taken in the vicinity of Catalina, Santa Barbara, and San Clemente Islands. Depending on display requirements, these animals were selected for size (Walker, 1975). Generally, selection was for late juvenile to early sexually mature age groups; however, on two occasions, selection for animals of large size was conducted. One specimen was collected at sea off Guadalupe Island, Mexico (Table VIII).

3) Eastern tropical Pacific offshore: Most were obtained through Southwest Fisheries Center tuna/porpoise program as incidental fishery mortality occurring during commercial yellowfin tuna purse-seine fishery activities in the offshore waters of the eastern tropical Pacific. Three were collected during research cruises, and a small number were collected as beach pick-ups on islands in the lower Gulf of California (Table IX).

HISTORICAL BACKGROUND

The type specimen of _Tursiops nuuanu_ (AMNH 35045) was collected December 1906 at approximately 12°N; 120°W by J.T. Nichols. Nichols (1908) had the following comments regarding the specimen: "This animal is quite different from _Tursiops gillii_, and probably different from _T. trun-_

catus of our Atlantic coast, though the material is not sufficient to warrant separating it positively from that species."

On the basis of examination of two similar skulls collected from Santa Catalina Island, Gulf of California, Mexico, and the specimen collected by Nichols in 1906, Andrews (1911) erected a new species: Tursiops nuuanu. The cranial characters were summarized as follows:

> "Skull. - Temporal fossae much smaller than in T. truncatus. Orbits not so curved, due to a shortening of the posterior, downward-projecting spurs of the orbital processes of the frontals. The maxillary and frontal orbital processes, and the plates of the maxillae just postero-external to the maxillary notches, are much thinner than in T. truncatus or T. gillii. The malar along its outer free border is longer and thinner, the vomer visible between the backward prongs of the two pterygoids is wider, and the beak is flatter distally than in T. truncatus."

Tursiops gillii was described from a single mandible (USNM 13022) from Monterey, California (Dall, 1873). On the basis of the type specimen and examination of two additional skulls attributed to this species, True (1889) considered T. gillii to be a valid species and placed particular emphasis on the comparative size of the mandibular condyles.

> "In this mandible the greatest diameter of the condyle is contained twice only in the greatest depth of the ramus. In all the mandibles of T. tursio, on the contrary, the greatest diameter of the condyle is contained two and a half times in the greatest depth of the ramus."

In his subsequent review of the genus, True (1914) considered both Tursiops nuuanu and T. gillii to be valid species. He summarized the key characters separating the two species as follows:

> Tursiops nuuanu: "The free margins of the orbital plates of the maxillae, over the orbits, are not thickened as they are to a greater or less degree in all other species of Tursiops. These plates are unusually broad proximally, and the posterior border is nearly straight. The orbits are flat above. The posterior end of the vomer, where it appears between the pterygoids, is broad and triangular in outline. The mandibular condyles are small."
>
> Tursiops gillii: "This is a robust species, with very thick cranial bones, strong teeth, and heavy mandible. While the skull closely resembles that of T. truncatus in many particulars, it is distinguishable by the large mandibular condyles, whose greatest length is fully one-half the height of the mandible at the coronoid process, and the peculiar shape of the portion of the parietal bones forming the lower part of the wall of the temporal fossae. Instead of occupying the whole of the middle portion of the wall, as in T. truncatus, these bones are greatly narrowed below, owing to a large backward extension of the frontals, and the large size of the squamosal."

Van Gelder (1960) placed particular emphasis on tooth diameter as a means of separating T. nuuanu from T. gillii and presented tooth measurements of one specimen of T. gillii (9.0-11.3 mm) and from four specimens of T. nuuanu (6.7-7.9 mm).

CRANIAL CHARACTERS PRESENTED IN THIS STUDY

Methods:

Cranial measurements utilized in this study were based on a standardized form presented in Perrin (1975) with one addition. (See Tables I, II, and III.) Since morphometric characters are influenced by changes in proportional growth in juveniles, only measurements from those skulls indicating distal fusion of the maxillary and premaxillary bones of the rostrum (criteria of Perrin et al, 1979) were included in this study. Tooth-width measurements were taken from the middle of the tooth row of the left mandible, two mm below the gum line to preclude influence of wear.

Results:

The skulls examined and measured during this study indicate that many of the historically utilized cranial characters related to size of temporal fossa, antorbital process, and shape of the vomer and supra-orbital bones (maxillary and frontals) are too variable for taxonomic use in the study area. From the existing data, tooth width appears to be the best comparative criteria for distinguishing the inshore or coastal population from both the ETP offshore and northern temperate offshore. (See Figure 1.)

Other skull parameters are also useful but less defined in that they demonstrate more subtle, modal differences. The evidence indicates some degree of isolation of populations of Tursiops in the study area, particularly between the coastal and two offshore populations. These are as follows:

1) Relative size of mandibular condyles: As is indicated in a scatter-plot (Figure 2) good separation between the coastal and ETP offshore populations is clearly demonstrated. The northern temperate offshore population, though apparently more closely related to the ETP offshore, demonstrates some degree of overlap in the lower end of the range of the coastal population.

2) Comparative shape of rostrum: In general the rostra in both offshore forms tapers more acutely and is narrower distally than in the coastal. (See Figure 3.) This character is particularly evident in the ETP offshore form.

From the cranial measurements, clear differences between the coastal and two offshore forms is evident. The two offshore forms are apparently closely related; however, there is evidence from cranial measurements that the northern temperate offshore form may reach at sexual maturity a larger size than the ETP offshore form. Ranges in condylobasal length of skulls exhibiting distal fusion of maxillary and premaxillary bones differ between the two populations (ETP offshore 448-492 mm, 473.4 mean; northern temperate offshore 476-570 mm, 507.2 mean). Though the sample size for the northern temperate offshore population is small and potentially influenced by fishery selection, reproductive data also support these findings. (See section on Reproduction.)

EXTERNAL MORPHOMETRICS

Evaluation of external measurements has been hampered by lack of standardization and technique utilized by prior researchers. The problem is compounded by the small sample size in the study area. To date, preliminary analysis has demonstrated no reliable criteria for distinguishing any of the three populations.

AGE DETERMINATION

Analysis of teeth from specimens of known length is planned for the future. At present, techniques for preparation and reading of tooth layers in Tursiops are still under development at SWFC (A. Myrick, personal communication). Attempts at this time to analyze tooth readings would be premature.

COLORATION

Van Gelder (1960) suggested that Tursiops gillii and T. nuuanu may be indistinguishable in the field. From my experience, this will probably prove to be the case. My observations at sea and examination of numerous photographs lead me to believe that the ranges in coloration in Tursiops from the study area will prove too variable to use as a tool for field identification.

Bottlenose dolphins are not vividly marked, but exhibit a very generalized color pattern consisting primarily of the simple cape and cape overlay components (terminology of Perrin, 1972). Perrin (1972) advanced the hypothesis that geographic variation in Tursiops coloration relates primarily to the extent of the dorsal overlay. From my observation to date, a wide variation in intensity of the dorsal overlay exists in single herds observed both in the ETP and temperate offshore southern California waters. These herds were generally very small: 8 - 12 animals. In some, the cape overlay was intense with the components of the cape system almost obscured.

As a result, the dorsal aspect of these animals appeared almost black. In others, the more common lead gray cape overlay with clearly defined cape system was evident.

REPRODUCTION

Reproductive data on the three eastern north Pacific *Tursiops* populations are presented in Appendix 1. The results are summarized as follows:

1) Northern Temperate Offshore Population

Reproductive data on five males and eight females were available as samples and from the literature. The smallest reproductively mature male was 263.0 cm in length. The smallest female known to be reproductively mature was 276.0 cm.

2) Southern California and Mexico Coastal Population

Gonad samples and data from five males and four females were available. The smallest sexually mature male was 296.6 cm in length; the largest immature male was 269.9 cm. No sexually mature females were represented in this sample. The largest immature female was 255.2 cm in length.

3) Offshore Eastern Tropical Pacific Population

Gonad samples and data from twelve males and nine females were available for examination. The smallest sexually mature male from this sample was 244.0 cm in length. The largest immature male was 236.0 cm. For females, the smallest size encountered at sexual maturity was 243.0 cm. The largest immature female was 242.0 cm.

Though the sample size of Tursiops specimens accompanied with reproductive data is small, indications are that the two offshore forms from the ETP and southern California temperate waters may represent separate stocks. It appears from the reproductive data that animals in the northern temperate offshore population may reach reproductive maturity at a much larger size, both males and females, than is evidenced in the ETP offshore population.

FOOD HABITS

Methods:

Stomach contents from nine coastal and seventeen ETP offshore Tursiops were available for study. No samples from the northern temperate offshore population were available. All samples from the coastal population were from the southern California region (San Diego and Orange Counties).

Volumetric data are presented only for the ETP offshore samples. The sample from the southern California coastal stock was obtained from individual beach strandings (of presumably ill animals); few fleshy remains were present.

Numbers for individual prey species presented (Tables IV and V) represent the minimum number of individuals that could be represented by the remains (otoliths, cephalopod beaks, crab claws, etc.).

Results:

As would be expected, marked differences in feeding habits are indicated for the ETP offshore and coastal populations.

Data presented for the coastal stock (Table IV) are similar to those from Norris and Prescott (1961) for one animal from San Diego Bay, California. It is evident that the primary prey species of coastal Tursiops of southern California are fishes and invertebrates inhabiting littoral and sublittoral zones. Most of the species encountered are year-round inhabitants of the near-shore environment and not known to undergo pronounced seasonal changes in distribution. This is particularly evident in the occurrence of the fish families, Sciaenidae (croakers) and Embiotocidae (perches) which make up 62 percent of the species ingested.

Data indicate the preferred prey species of the ETP offshore population to be epipelagic fish (86.7 percent by volume) and cephalopods (13.3 percent by volume). Otoliths of mesopelagic fishes representing four families are represented in trace amounts (Table V). Perrin et al (1973) suggested the possibility that remains of small fish and cephalopods may be introduced into stomach samples secondarily as prey of larger prey ingested. Evidence substantiating this opinion was present in these samples. In one stomach sample, one intact frigate mackerel, Auxis thazard, and one squid, Dosidicus gigas, were available for dissection. Stomach contents of these specimens revealed otoliths from two species of mesopelagic fish. The frigate mackerel contained fifteen otoliths from Scopelogadus sp. (Melamphaidae). The squid contained five otoliths from Myctophum aurolaternatum (Myctophidae). In this author's opinion, most, if not all, mesopelagic fish remains evident in the ETP offshore samples were introduced secondarily.

PARASITISM

A systematic examination of intact carcasses for evidence of parasitism was conducted on five ETP offshore, seven northern temperate offshore, and nine coastal Tursiops. All coastal animals examined were recovered from the southern California area (San Diego and Orange Counties). With the exception of the air-sinus nematode, Crassicauda sp., all parasites included in this report were encountered in the viscera. The incidence of Crassicauda sp. was based entirely on examination of prepared skulls for evidence of typical bone lesions, as described for Stenella attenuata in the eastern tropical Pacific (Dailey and Perrin, 1973).

The use of parasites as natural biological tags in stock identification and migration patterns has been successful in fishes (Arthur and Arai, 1978). Comparison of the incidence of five common marine mammal parasites recovered in this study clearly demonstrates stock differences between the coastal and offshore populations (Table VI). Though natural immunity to parasitic organisms cannot be discounted, the reason for these differences in parasite load are more likely to be related to differences in food habits.

DISTRIBUTION

With the exception of the northern range the general pattern of distribution of *Tursiops* in the eastern tropical Pacific demonstrates considerable similarity to that described by Perrin (1975b) for *Stenella attenuata*. Differences in cranial characteristics evident for coastal and offshore *Stenella attenuata* are also paralleled in the coastal and offshore *Tursiops*; the cranial characters distinguishing the two forms are primarily those features related to feeding, particularly the relative tooth size.

A summary of National Marine Fisheries Service (SWFC) ship and aerial survey data is presented for the years 1972-1979 (Figure 4). Background information on both shipboard and aerial surveys conducted in the study area south of San Diego is summarized in Leatherwood et al (1979). A detailed account of the ranges of the three forms based on examined specimens is as follows:

1) Southern California and Mexico Coastal (Table VII, Figure 5):

The present day range is from the northern border of Orange County, California (approximate lat. 33°45'N) south along the Pacific coast to Baja California, Mexico and throughout the Gulf of California. On the mainland side of Mexico specimens identified as coastal have been examined from as far south as San Blas, Nayarit (approximate lat. 21°30'N). The coastal form probably extends much further south along the coast of Central America; however, to date, no specimens collected from the coastal area south of latitude 21°30'N have been located for examination.

Specimens collected during the late 1800's indicate the coastal form ranged further north than it does today. The type specimen of *Tursiops gilli* Dall (coastal form) was collected in Monterey Bay, California (approximate lat. 37°N) by C.M. Scammon in 1871 (Dall, 1873; Scammon, 1874). Another specimen reportedly from the same locality (True, 1889) is retained at the Museum National D'Histoire Naturelle, Paris, France. The date of collection for this skull is unknown. The specimen was received at the Museum in 1879 (D. Robineau, personal communication). Orr (1963) reported on a partial cranium dredged from San Francisco Bay (approximate lat. 37°40'N). This cranium (CAS 12738) was estimated to have been in the water 50-100 years. The condition of this San Francisco Bay cranium precludes the use of meristic analysis to determine positive stock identification; however, the robust nature of the intact bony elements, particularly the premaxillaries, indicates to me that this cranium is probably of the coastal form. These three specimens (two coastal, one probably coastal) from the same approximate time frame and location indicate a more northern distribution on the California coast at one time. During the 1850's the nearshore central California waters were inhabited by a number of tropical animals (Hubbs, 1948). Leatherwood et al (1979) document the common occurrence of *Grampus griseus* in the Monterey Bay area during the 1870-1880 period, a locality where this species is now uncommon.

2) Northern Temperate Offshore (Table VIII, Figure 5):

Extensive ship and aerial surveys have been conducted off the southern California borderland and southern and central California (Leatherwood et al, 1979). Data reveal no sightings of *Tursiops* north of Point Conception (approximate lat. 34°30'N). During the Naval Ocean Systems Center's aerial and ship surveys conducted during the 1968-1975 period the northernmost *Tursiops* sighting occurred just off the northwest end of Santa Rosa Island (approximate lat. 34°10'N) (S. Leatherwood, personal communication). Recently (July 1980) a cranium identifiable as northern temperate offshore form was dredged from San Francisco Bay (approximate lat. 37°40'N). From the condition of the cranial remains, this specimen appears to be much more recent than the specimen published by Orr (1963) and may represent a recent anomalous stranding; however, the possibility that this find represents a historically more northward range similar to that discussed for the coastal population cannot be ruled out.

Due to the nature of the sample the southern distributional range of the northern temperate offshore form is less defined as only one specimen taken south of latitude 33°N is available for examination. The southernmost specimen collected from the northern temperate offshore population was taken off Guadalupe Island, Mexico (approximate lat. 29°N).

3) Eastern Tropical Pacific Offshore (Table IX, Figure 6):

Distributional data collected from specimens reveal that this population occurs offshore off the west coast of Baja California, Mexico north to at least Magdalena Bay (approximate lat. 24°30'N) and into the lower Gulf of California as far north as Isla Santa Catalina (approximate lat. 25°40'N). From specimens examined it is evident that the eastern tropical Pacific offshore population extends south along the offshore waters of Central America, Columbia, and Ecuador, including the Galapagos Islands (approximate lat. 02°S). Based on samples examined from the tuna fishery the eastern tropical Pacific offshore form extends to at least longitude 120°W. No samples south of latitude 02°S have been examined.

The number of sightings in the offshore waters south of the Galapagos Islands is considerable (Figure 4); however, based on well-known oceanographic features (Au et al, 1979) and documented stock differences (Perrin et al, 1979) I consider even the tentative inclusion of the southern *Tursiops* sightings as part of the range of the eastern tropical Pacific offshore population to be premature.

CONCLUSION

Data presented in this report indicates that at least three populations of bottlenose dolphin exist in the eastern north Pacific. Criteria for separation are based on skull measurements, size at sexual maturity, and differences in parasite load. The main points are summarized as follows:

1) A clear separation of the coastal and offshore populations is indicated by comparative tooth size. Other skull measurements demonstrate modal differences.

2) Skull measurements indicate the eastern tropical Pacific and northern temperate offshore populations are closely related. Skull length and reproduction data indicate that the northern temperate offshore animals reach sexual maturity at a larger size than in the eastern tropical Pacific offshore population.

3) Differences in parasite load clearly separate the coastal from the two offshore populations.

4) New information on feeding habits demonstrates marked differences between southern California coastal and eastern tropical Pacific offshore populations. Secondary introduction of mesopelagic fish remains is confirmed in the sample from the eastern tropical Pacific offshore population.

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TABLE I

Skull measurements (in mm) and meristics of the eastern tropical Pacific offshore form of *Tursiops sp.* *

Variable	Sample	Range	Mean	Standard Deviation
1. Condylobasal length	20	448-492	473.4	
2. Rostrum length	20	248-278	262.7	
3. Rostrum width at base	20	111-128	119.2	
4. Rostrum width at 60 mm	20	83-101	93.3	
5. Rostrum width at midlength	20	65-82	74.8	
6. Premaxillary width at rostrum midlength	20	35-49	42.3	
7. Rostrum width at 3/4 length	20	48-61	54.8	
8. Rostrum tip to external nares	20	285-325	308.2	
9. Rostrum tip to internal nares	18	289-354	318.6	
10. Preorbital width	20	195-230	212.7	
11. Postorbital width	20	214-257	237.5	
13. External nares width	20	48-76	54.3	
14. Zygomatic width	20	216-256	238.2	
15. Greatest width of premaxillaries	19	75-91	84.1	
16. Parietal width	20	171-198	181.5	
17. Braincase height	18	129-151	139.2	
18. Braincase length	17	50-96	79.5	
19. Posttemporal fossa length	20	96-118	103.8	
20. Posttemporal fossa width	20	65-82	75.6	
25. Orbit length	20	60-67	62.6	
26. Antorbital process length	20	42-64	54.8	
27. Internal nares width	20	64-84	76.6	
28. Pterygoid length	18	59-74	65.4	
32. Upper tooth row length	20	210-243	226.2	
33-36. Teeth (no.) U.L. | U.R. / L.L. | L.R.	28 | 29 / 26 | 26	20-25 | 21-25 / 18-24 | 18-24	22.7 | 22.6 / 21.4 | 21.2	1.19 | 1.66 / 1.42 | 1.42
37. Lower tooth row length	20	205-237	224.2	
38. Ramus length	20	387-420	403.1	
39. Ramus height	20	80-91	83.9	
40. Tooth width	20	6.1-7.7	7.0	
120. Mandibular condyle width**	19	30-39	34.3	

* Numbering system follows Perrin (1975a). Sample for measurements includes only those indicating distal fusion of the maxillaries and premaxillaries.

** This measurement not included in Perrin (1975a).

TABLE II

Skull measurements (in mm) and meristics of the northern temperate offshore form of <u>Tursiops</u> sp. *

Variable	Sample	Range	Mean
1. Condylobasal length	12	476-570	507.2
2. Rostrum length	12	251-297	274.8
3. Rostrum width at base	12	117-145	128.1
4. Rostrum width at 60 mm	12	94-118	101.7
5. Rostrum width at midlength	12	73-89	78.7
6. Premaxillary width at rostrum midlength	12	37-49	44.7
7. Rostrum width at 3/4 length	12	50-63	56.3
8. Rostrum tip to external nares	12	301-376	327.7
9. Rostrum tip to internal nares	11	302-383	332.3
10. Preorbital width	12	216-272	230.2
11. Postorbital width	11	240-292	255.4
13. External nares width	12	51-66	56.8
14. Zygomatic width	12	240-304	256.8
15. Greatest width of premaxillaries	12	86-107	94.1
16. Parietal width	12	168-194	182.9
17. Braincase height	11	132-172	156.2
18. Braincase length	11	68-98	82.7
19. Posttemporal fossa length	12	107-130	117.7
20. Posttemporal fossa width	12	73-91	81.5
25. Orbit length	12	60-73	65.3
26. Antorbital process length	12	50-71	55.0
27. Internal nares width	12	77-95	84.6
28. Pterygoid length	12	63-86	76.7
32. Upper tooth row length	11	218-273	240.5
33-36. Teeth (no.) U.L. | U.R. / L.L. | L.R.	12 | 12 / 12 | 12	22-25 | 22-25 / 21-24 | 21-24	23.7 | 23.6 / 22.5 | 22.4
37. Lower tooth row length	12	215-264	231.5
38. Ramus length	12	401-494	467.8
39. Ramus height	12	85-110	94.6
40. Tooth width	11	6.6-7.6	7.2
120. Mandibular condyle width**	12	31-45	36.2

* Numbering system follows Perrin (1975a). Sample for measurements includes only those indicating distal fusion of the maxillaries and premaxillaries.

** This measurement not included in Perrin (1975a).

TABLE III

Skull measurements (in mm) and meristics of the coastal form of eastern Pacific bottlenose dolphin, Tursiops sp.*

Variable	Sample	Range	Mean	Standard Deviation
1. Condylobasal length	28	497-556	520.9	15.29
2. Rostrum length	28	266-309	283.1	12.15
3. Rostrum width at base	28	126-151	136.6	5.96
4. Rostrum width at 60 mm	28	97-125	108.0	5.86
5. Rostrum width at midlength	28	83-103	92.2	5.39
6. Premaxillary width at rostrum midlength	28	42-58	51.4	4.17
7. Rostrum width at 3/4 length	26	64-80	72.8	4.81
8. Rostrum tip to external nares	27	323-373	339.9	13.67
9. Rostrum tip to internal nares	23	318-361	335.3	—
10. Preorbital width	28	220-262	236.4	10.13
11. Postorbital width	28	245-294	266.2	11.96
13. External nares width	28	58-88	63.6	5.50
14. Zygomatic width	28	248-295	270.3	12.54
15. Greatest width of premaxillaries	28	92-108	99.5	3.85
16. Parietal width	28	192-211	190.2	6.88
17. Braincase height	27	150-180	163.2	6.75
18. Braincase length	25	55-99	76.2	13.07
19. Posttemporal fossa length	28	107-142	123.4	9.18
20. Posttemporal fossa width	28	69-96	83.7	7.27
25. Orbit length	28	60-73	68.4	3.31
26. Antorbital process length	28	47-64	55.6	4.25
27. Internal nares width	28	62-95	80.8	6.96
28. Pterygoid length	24	62-81	69.7	—
32. Upper tooth row length	28	230-275	249.5	11.15
33-36. Teeth (no.) U.L. | U.R. / L.L. | L.R.	32 | 34 / 22 | 22	19-25 | 20-24 / 19-24 | 19-23	22.0 | 21.8 / 21.8 | 21.6	1.39 | 1.32 / — | —
37. Lower tooth row length	22	229-272	245.9	—
38. Ramus length	22	422-469	440.1	—
39. Ramus height	22	92-107	100.5	—
40. Tooth width	21	8.9-11.3	9.9	—
120. Mandibular condyle width**	22	38-55	47.1	—

* Numbering system follows Perrin (1975a). Sample for measurements includes only those indicating distal fusion of the maxillaries and premaxillaries.

** This measurement not included in Perrin (1975a).

TABLE IV

SUMMARY OF STOMACH CONTENTS

OF NINE SOUTHERN CALIFORNIA

COASTAL BOTTLENOSE DOLPHIN

Food Item	Number		Occurrence	
	No.	% of total	No.	% (N=9)
Total	260	100.0	-	-
FISH	228	87.7	9	100.0
Synodontidae				
Synodus lucioceps	2	0.8	1	11.1
Batrachoididae				
Porichthys myriaster	10	3.9	2	22.2
Porichthys notatus	25	9.6	1	11.1
Ophidiidae				
Otophidium taylori	3	1.2	2	22.2
Atherinidae				
Atherinopsis californiensis	1	0.4	1	11.1
Serranidae				
Paralabrax clathratus	6	2.3	1	11.1
Paralabrax sp.	1	0.4	1	11.1
Carangidae				
Trachurus symmetrichus	2	0.8	1	11.1
Sciaenidae				
Seriphus politus	40	15.4	2	22.2
Cynoscion nobilus	1	0.4	1	11.1
Umbrina roncador	4	1.5	3	33.3
Menticirrhus undulatus	13	5.0	3	33.3
Genyonemus lineatus	23	8.8	6	66.7
Roncador stearnsi	6	2.3	3	33.3
Embiotocidae				
Rhacochilus toxotes	2	0.8	1	11.1
Embiotoca jacksoni	1	0.4	1	11.1
Hyperprosopon argenteum	40	15.4	2	22.2
Damalichthys vacca	3	1.2	1	11.1
Phanerodon furcatus	12	4.6	2	22.2
Unident. Embiotocids	16	6.2	4	44.4
Pomacentridae				
Chromis punctipinnis	8	3.1	1	11.1
Labridae				
Oxyjulis californica	1	0.4	1	11.1
Bothidae				
Paralichthys californicus	5	1.9	1	11.1
Pleuronectidae				
Pleuronichthys coenosus	2	0.8	1	11.1
Pleuronichthys sp.	1	0.4	1	11.1
INVERTEBRATES	32	12.3	9	100.0
Arthropoda				
Callianassidae				
Callianassa californiensis	8	3.1	2	22.2
Crancridae				
Cancer antennarius	2	0.8	2	22.2
Mollusca				
Pelecypoda				
Unident. Bivalve Siphons	9	3.5	1	11.1
Cephalopoda				
Loliginidae				
Loligo opalescens	5	1.9	4	44.4
Ommastrephidae				
Dosidicus gigas	1	0.4	1	11.1
Octopodidae (Octopoda)				
Octopus bimaculatus	7	2.7	2	22.2

TABLE V

SUMMARY OF STOMACH CONTENTS FROM SEVENTEEN BOTTLENOSE DOLPHIN TAKEN IN THE EASTERN TROPICAL PACIFIC

Food Item	Volume ml	Volume % of total	Number No.	Number % of total	Occurrence No.	Occurrence % (N=17)
Total	16,907	100.0	911	100.0	-	-
FISH	14,652	86.7	324	35.6	17	100.0
Bathylagidae						
Bathylagus sp.	tr.	-	1	0.1	1	5.9
Scopelarchidae						
Unident. Scopelarchid	tr.	-	6	0.7	2	11.8
Myctophidae						
Lampanyctus parvicauda	tr.	-	2	0.2	1	5.9
Lampanyctus sp.	tr.	-	1	0.1	1	5.9
Diogenichthys sp.	tr.	-	1	0.1	1	5.9
Benthosema panamense	tr.	-	2	0.2	1	5.9
Myctophum aurolaternatum	tr.	-	3	0.3	1	5.9
Myctophum sp.	tr.	-	1	0.1	1	5.9
Symbolophorus sp.	tr.	-	4	0.4	1	5.9
Hygophum sp.	tr.	-	3	0.3	1	5.9
Unident. Myctophids	tr.	-	7	0.8	2	11.8
Gonostomatidae						
Vinciguerria sp.	tr.	-	1	0.1	1	5.9
Exocoetidae						
Exocoetus sp.			6	0.7	2	11.8
Oxyporhamphus micropterus	280	1.7	3	0.3	1	5.9
Cypselurus sp.			1	0.1	2	11.8
Unident. Exocoetid			13	1.4	3	17.7
Bregmacerotidae						
Bregmaceros sp.	tr.	-	1	0.1	1	5.9
Melamphaidae						
Scopelogadus bispinosus	tr.	-	202	22.2	2	11.8
Stomateidae						
Cubiceps pauciradiatus	tr.	-	4	0.4	2	11.8
Carangidae						
Unident. Carangid	tr.	-	2	0.2	1	5.9
Coryphaenidae						
Coryphaena sp.	87	0.5	3	0.3	1	5.9
Scombridae						
Auxis thazard	14,285	84.5	57	6.3	7	41.2
CEPHALOPODS	2,255	13.3	587	64.4	17	100.0
Enoploteuthidae						
Abraliopsis affinis			97	10.7	8	47.1
Ommastrephidae						
Dosidicus gigas			383	42.0	12	70.6
Symplectoteuthis oualaniensis	2,158	12.8	56	6.2	5	29.4
Unident. Ommastrephid			11	1.2	1	5.9
Thysannoteuthidae						
Thysanoteuthis rhombus			13	1.4	2	11.8
Histioteuthidae						
Histioteuthis sp.	tr.	-	3	0.3	2	11.8
Octopoteuthidae						
Octopoteuthis sp.	tr.	-	6	0.7	2	11.8
Chiroteuthidae						
Chiroteuthis sp.	tr.	-	1	0.1	1	5.9
Cranchiidae						
Unident. Cranchiid	tr.	-	5	0.6	3	17.7
Ocythoidae (Octapoda)						
Ocythoe tuberculata	97	0.6	12	1.3	5	29.4

TABLE VI

PARASITES IN NORTH PACIFIC BOTTLENOSE DOLPHINS

Parasite Species	Infection Site	Southern California and Baja California Coastal			Northern Temperate Offshore			Eastern Tropical Pacific Offshore		
		(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Phyllobothrium delphini (Cestoda)	Blubber layer, primarily in urogenital slit area	10	0	0	10	10	100.0	5	5	100.0
Monorygma grimaldii (Cestoda)	Serosa; primarily in posterior aspect of abdominal cavity	10	0	0	8	8	100.0	5	5	100.0
Crassicauda sp. (Nematoda)	Air sinuses	82	0	0	16	7	43.8	34	12	35.3
Halocercus sp. (Nematoda)	Lungs	10	3	30.0	7	4	57.1	4	2	50.0
Nasitrema sp. (Trematoda)	Air sinuses	10	2	20.0	7	3	42.9	5	2	40.0

(1) = Number Examined

(2) = Number Infected

(3) = Percent Occurrence

TABLE VII

Skeletal Specimens of Southern California and Mexico Coastal Form of Bottlenose Dolphin Included in Analysis of Geographical Variation

Field No.	Institution	Date of Collection	Locality	Circumstances
	AMNH 32015	Unknown	Bahia San Bartolme, Baja California Sur, Mexico	Beach pick-up
RB-286	Raymond Bandar private collection	Aug 1962	4 miles north of Puertocitos, Baja California Norte, Mexico	Beach pick-up
RB-309	Raymond Bandar private collection	Aug 1962	5 miles south of Puerto Penasco, Sonora, Mexico	Beach pick-up
RB-310	Raymond Bandar private collection	Aug 1962	22 miles south of Puertocitos, Baja California Norte, Mexico	Beach pick-up
RB-311	Raymond Bandar private collection	1962	21 miles south of Puertocitos, Baja California Norte, Mexico	Beach pick-up
RB-312	Raymond Bandar private collection	1962	Bahia San Luis Gonzaga, Baja Calif-ornia Norte, Mexico	Beach pick-up
RB-625	Raymond Bandar private collection	Aug 1964	2 miles north of Kino Bay, Sonora, Mexico	Beach pick-up
RB-626	Raymond Bandar private collection	Aug 1964	3 miles SE of San Blas, Nayarit, Mexico	Beach pick-up
RB-913	Raymond Bandar private collection	July 1966	Bahia Conception, Baja California Sur, Mexico	Beach pick-up
RB-914	Raymond Bandar private collection	Aug 1966	5 miles south of Bahia San Luis Gonzaga, Baja California Norte, Mexico	Beach pick-up

TABLE VII (cont'd)

Field No.	Institution	Date of Collection	Locality	Circumstances
RB-915	Raymond Bandar private collection	Aug 1966	Santa Rosalia, Baja California Sur, Mexico	Beach pick-up
RB-1854	Raymond Bandar private collection	Aug 1970	3.5 miles south of Puertocitos, Baja California Norte, Mexico	Beach pick-up
RB-2059	Raymond Bandar private collection	July 1972	10 miles south of Puertocitos, Baja California Norte, Mexico	Beach pick-up
RB-2060	Raymond Bandar private collection	July 1972	1.5 miles north of Bahia San Luis Gonzaga, Baja California Norte, Mexico	Beach pick-up
GDH-232	CAS 10464	4- 3-53	Bahia San Pedro, Sonora, Mexico	Found floating in bay
	CAS 10465	6-12-53	Coyote Bay, Bahia Conception, Baja California Sur, Mexico	Beach pick-up
	CAS 10474	9- 1-53	Desemboque, Sonora, Mexico	Beach pick-up
	CAS 13937	Aug 1966	Santa Rosalia, Baja California Sur, Mexico	Beach pick-up
	CAS 14935	Aug 1972	4 miles south of Puertocitos, Baja California Norte, Mexico	Beach pick-up
	CAS 15683	Aug 1970	6.5 miles south of Puertocitos, Baja California Norte, Mexico	Beach pick-up
	CAS 15685	Aug 1970	2 miles south of Huerfanito, Baja California Norte, Mexico	Beach pick-up
RB-13	CAS 15686	Aug 1970	3.5 miles south of Puertocitos, Baja California Norte, Mexico	Beach pick-up

TABLE VII (cont'd)

Field No.	Institution	Date of Collection	Locality	Circumstances
	CAS 15687	Aug 1970	3.5 miles south of Puertocitos, Baja California Norte, Mexico	Beach pick-up
	CAS 16282	July 1972	4.5 miles south of Puertocitos, Baja California Norte, Mexico	Beach pick-up
	CAS 16283	July 1972	8 miles south of Puertocitos, Baja California Norte, Mexico	Beach pick-up
	CAS 16286	July 1972	South shore Bahia Conception, Baja California Sur, Mexico	Beach pick-up
	CAS 16821	Unknown	20 miles north of San Felipe, Baja California Norte, Mexico	Beach pick-up
	CAS 106689	4- 5-47	San Felipe, Baja California Norte, Mexico	Beach pick-up
	CBM 80.8.1	March 1978	Bahia San Bartolme, Baja California Sur, Mexico	Beach pick-up
	LACM 1800	11-12-54	San Felipe, Baja California Norte, Mexico	Beach pick-up
	LACM 8589	1-22-50	Bahia Cholla, Sonora, Mexico	Beach pick-up
RLB-217	LACM 27097	4-23-66	15 km north of San Felipe, Baja California Norte, Mexico	Beach pick-up
RLB-219	LACM 27098	4-23-66	15 km north of San Felipe, Baja California Norte, Mexico	Beach pick-up
RLB-277	LACM 27405	9-23-66	12 miles south of San Felipe, Baja California Norte, Mexico	Beach pick-up

TABLE VII (cont'd)

Field No.	Institution	Date of Collection	Locality	Circumstances
RLB-278	LACM 27406	9-23-66	8 miles north of San Felipe, Baja California Norte, Mexico	Beach pick-up
	LACM 31334	Unknown	Punta Penasco, Sonora, Mexico	Beach pick-up
	LACM 31442	Unknown	San Felipe, Baja California Norte, Mexico	Beach pick-up
RLB-001	LACM 54014	4- 9-63	Bahia de Los Angeles, Baja California Norte, Mexico	Beach pick-up
RLB-002	LACM 54015	4- 9-63	Bahia de Los Angeles, Baja California Norte, Mexico	Beach pick-up
RLB-187	LACM 54020	6-18-65	8 miles south of Puertocitos, Baja California Norte, Mexico	Beach pick-up
RLB-191	LACM 54023	6-18-65	10 miles south of Puertocitos, Baja California Norte, Mexico	Beach pick-up
RLB-192	LACM 54024	6-18-65	10 miles south of Puertocitos, Baja California Norte, Mexico	Beach pick-up
RLB-215	LACM 54025	4-23-66	15 km north of San Felipe, Baja California Norte, Mexico	Beach pick-up
EDM-163	LACM 54029	1-12-57	San Diego Bay, San Diego County, California, U.S.A.	Live capture display fishery (Norris and Prescott, 1961)
	LACM 54133	1-19-79	San Ignacio Lagoon, Baja California Sur, Mexico	Beach pick-up

TABLE VII (cont'd)

Field No.	Institution	Date of Collection	Locality	Circumstances
	LACM 54181	12-21-72	Gulf of California, Mexico	Beach pick-up
JEH-1006	LACM 54577	1-19-79	Half way between Cabo San Lazaro and Boca Soledad, Baja California Sur, Mexico	Beach pick-up
DRM-1016	LACM 54586	2-20-79	Isla Magdalena, Baja California Sur, Mexico	Beach pick-up
RLB-003		4- 8-63	Gulfo de Santa Clara, Sonora, Mexico	Beach pick-up
EDM-160		Unknown	Torrey Pines, San Diego County, California, U.S.A.	Beach pick-up
RLB-050		8- 7-63	Scripps Pier, La Jolla, San Diego County, California, U.S.A.	Beach pick-up
WAW-141		12-26-71	Bolsa Chica State Beach, Orange County, California, U.S.A.	Beach pick-up
UCLA 51.201		4-27-49	Bahia Cholla, Sonora, Mexico	Beach pick-up
	MCZ 49082	1957	San Diego Bay, San Diego County, California, U.S.A.	Live capture display fishery (Norris and Prescott, 1961)
	MCZ 49083	1957	San Diego Bay, San Diego County, California, U.S.A.	Live capture display fishery (Norris and Prescott, 1961)
	MVZ 106689	4- 5-57	San Felipe, Baja California Norte, Mexico	Beach pick-up
	SBMNH 1554	3-28-78	Baja de los Angeles, Baja California Norte, Mexico	Beach pick-up

TABLE VII (cont'd)

Field No.	Institution	Date of Collection	Locality	Circumstances
	SDMNH 10991	May 1933	50 miles south of San Felipe, Baja California Norte, Mexico	Beach pick-up
	SDMNH 11102	1- 7-35	Pacific Beach, San Diego, San Diego County, California, U.S.A.	Beach pick-up
BKS-192	SDMNH 20143	8- 7-63	3/4 mile north of Scripps Pier, La Jolla, San Diego County, California, U.S.A.	Beach pick-up
BKS-193	SDMNH 20144	8- 7-63	3/4 mile north of Scripps Pier, La Jolla, San Diego County, California, U.S.A.	Beach pick-up
BKS-200	SDMNH 20145	9-22-63	Sunset Cliffs, San Diego County, California, U.S.A.	Beach pick-up
RMG-4701	SDMNH 21212	Oct 1957	La Jolla Shores, La Jolla, San Diego County, California, U.S.A.	Beach pick-up
RMG-4702	SDMNH 21213	12- 2-57	San Diego Bay, San Diego County, California, U.S.A.	Live capture display fishery (Norris and Prescott, 1961)
	SDMNH 23334	March 1974	La Jolla, San Diego County, California, U.S.A.	Beach pick-up
WFP-029	SWFC	1969	Bahia Magdalena, Baja California Norte, Mexico	Beach pick-up
WFP-520	SWFC	6-28-76	San Elijo State Beach, San Diego County, California, U.S.A.	Beach pick-up
WFP-522	SWFC	7-27-76	Torrey Pines State Beach, San Diego, San Diego County, California, U.S.A.	Beach pick-up

TABLE VII (cont'd)

Field No.	Institution	Date of Collection	Locality	Circumstances
WFP-523	SWFC	8- 2-76	Borderline State Beach, San Diego County, California, U.S.A.	Beach pick-up
WFP-535	SWFC	8- 9-76	Torrey Pines State Beach, San Diego County, California, U.S.A.	Beach pick-up
WFP-537	SWFC	8-31-76	Encinitas State Beach, San Diego County, California, U.S.A.	Beach pick-up
WFP-559	SWFC	2- 5-77	Black's Beach, San Diego County, California, U.S.A.	Beach pick-up
WFP-563	SWFC	5-16-77	Black's Beach, San Diego County, California, U.S.A.	Beach pick-up
WFP-565	SWFC	6-27-77	Foot of 8th Street, Del Mar, San Diego County, California, U.S.A.	Beach pick-up
	USNM 12054	Dec 1871	Baja California, Mexico	Type of *Tursiops gillii*
	USNM 13022	1871	Monterey, California, U.S.A.	Beach pick-up
	USNM 25181	May 1889	Puerto San Bartolme, Baja California Sur, Mexico	Beach pick-up
	USNM 174687	1-13-17	Bahia Santa Maria, Baja California Sur, Mexico	Beach pick-up
	USNM 261317	5-22-37	Isla Tiburon, Sonora, Mexico	Beach pick-up
	USNM 277170	6-19-44	Pearl Islands, Gulf of Panama, Panama	Beach pick-up

TABLE VII (cont'd)

Field No.	Institution	Date of Collection	Locality	Circumstances
WFP-036	USNM 395924	4-27-70	Torrey Pines, San Diego County, California, U.S.A.	Beach pick-up
RLB-442	USNM 396165	6- 5-65	San Felipe, Baja California Norte, Mexico	Live capture display fishery
WFP-294	USNM 484983	Oct 1968	San Felipe, Baja California Norte, Mexico	Beach pick-up
WFP-278	USNM 500851	2-14-74	Borderland State Beach, San Diego County, California, U.S.A.	Beach pick-up
WFP-243	USNM 504236	March 1956	San Felipe, Baja California Norte, Mexico	Beach pick-up
WFP-509	USNM 504353	10-22-75	Northern San Diego County, California, U.S.A.	Beach pick-up
	UWBM 19898	12-27-50	San Diego, California, U.S.A.	Beach pick-up
WAW-069	W.A. Walker private collection	May 1969	Estero de Punta Banda, Ensenada, Baja California Norte, Mexico	Beach pick-up
WAW-553	W.A. Walker private collection	9- 2-78	Huntington Beach, Orange County, California, U.S.A.	Beach pick-up

AMNH = American Museum of Natural History, New York, New York; CAS = California Academy of Sciences, San Grancisco, Calif.; CBM = Cabrillo Beach Museum, San Pedro, Calif.; LACM = Los Angeles (Calif.) Museum of Natural History; MCZ = Museum of Comparative Zoology, Harvard, Cambridge, Mass.; MVZ = Museum of Vertebrate Zoology, Univ. of Calif., Berdeley; SBMNH = Santa Brabara (Calif.) Museum of Natural History; SDMNH = San Diego (Calif.) Museum of Natural History; SWFC = Southwest Fisheries Center, La Jolla, Calif.; USNM = U.S. National Museum, Washington, D.C.; UWBM = University of Washington Burke Museum, Seattle, Wash.

TABLE VIII

Skeletal Specimens of Northern Temperate Offshore Population

of Bottlenose Dolphins Included in Analysis of Geographical Variation

Field No.	Institution	Date of Collection	Locality	Circumstances
EDM-301	LACM 1775	9-28-66	3-1/2 mi SSW Point Vicente, Rancho Palos Verdes, CA	Live display fishery
RLB-222	LACM 27401	12-15-65	Catalina Channel	Live display fishery
	SDMNH 21403	5-03-67	N.E. Embayment, Guadalupe Island, Mexico	Shot at sea
	Private Collection W. A. Walker			
WAW-064		10-20-69	Off West End Catalina Island, Los Angeles County, CA	Live display fishery
WAW-065		12-08-64	1/2 mi SE Catalina Harbor, Catalina Island, Los Angeles County, CA	Live display fishery
WAW-078		10-21-69	16 mi S Point Vicente, Rancho Palos Verdes, CA	Live display fishery
WAW-100		2-09-71	1 mi S Silver Canyon, Catalina Island, Los Angeles County, CA	Live display fishery
WAW-105		2-11-71	1-1/2 mi off West End Catalina Island, Los Angeles County, CA	Live display fishery
WAW-125		5-19-71	Off Catalina Island, Los Angeles County, CA	Live display fishery

TABLE VIII (cont'd)

Field No.	Institution	Date of Collection	Locality	Circumstances
WAW-138		11-17-66	1 mi off West End Catalina Island, Los Angeles County, CA	Live display fishery
WAW-140		5-20-71	6 mi SW East End Catalina Island, Los Angeles County, CA	Live display fishery
WAW-145		11-08-66	3 mi SE East End Catalina Island, Los Angeles County, CA	Live display fishery
WAW-159		2-02-72	1-1/2 mi S Silver Canyon, Catalina Island, Los Angeles County, CA	Live display fishery
WAW-175		11-09-72	3 mi S Silver Canyon, Catalina Island, Los Angeles County, CA	Live display fishery
WAW 212		4-20-71	Catalina Channel, Los Angeles County, CA	Live display fishery
MLP-71-6		6-28-71	Catalina Channel, Los Angeles County, CA	Live display fishery

LACM = Los Angeles (Calif.) County Museum of Natural History; SDMNH = San Diego (Calif.) Museum of Natural History

TABLE IX

Skeletal Specimens of Eastern Tropical Pacific Offshore Population

of Bottlenose Dolphins Included in Analysis of Geographical Variation

Field No.	Institution	Date of Collection	Locality	Circumstances
	AMNH 31830	April 1911	Isla Catalina; Baja California, Mexico	Beach pick-up (Andrews 1911)
	AMNH 31831	April 1911	Isla Catalina; Baja California, Mexico	Beach pick-up (Andrews 1911)
	AMHN 35045	12-06-06	Approx 12°N; 120°W	Collected at sea; type *Tursiops nuuanu* (Andrews 1911)
	AMNH 180611	4-28-57	Isla San Francisco; Baja California, Mexico	Beach pick-up (Van Gelder 1960)
	AMNH 180808	3-27-57	off Isla San Juanito, Tres Marias, Nyarit, Mexico	Collected at sea (Van Gelder 1960)
	LACM 51394	1964	Isla Cerralvo, Baja California, Mexico	Beack pick-up
	MVZ 125479	10-19-57	Chatham Island, Galapagos Islands, Ecuador	Beach pick-up
66-KB-1	NMML 66-1	2-03-66	24°24'N; 112°22'W	Collected at sea
	NMML 1193	2-16-65	21°39'N; 106°42'W	Collected at sea
	SDMNH 19146	4-9-62	Isla Catalina; Baja California, Mexico	Beach pick-up
FMR-081	SWFC	10-14-75	07°53'N; 107°07'W	Incidental mortality Y/F tuna seine
DAV-50	SWFC	6-27-77	14°28'N; 98°33'W	Incidental mortality Y/F tuna seine
MEH-019	SWFC	8-06-77	09°41.5'N; 95°19.4'W	Incidental mortality Y/F tuna seine

TABLE IX (cont'd)

Field No.	Institution	Date of Collection	Locality	Circumstances
DOB-198	SWFC	10-14-77	12°46'N; 90°44'W	Incidental mortality Y/F tuna seine
	USNM 254634	6-11-29	Cocos Island, 500 mi West of Panama	Collected at sea
	USNM 254910	8-15-29	70 mi South of Cape Mala, Panama	Collected at sea
	USNM 258642	1-30-34	Post Office Bay, Isla Santa Maria, Galapagos, Ecuador	Beach pick-up
WFP-002	USNM 395774	10-30-69	14°45'N; 100°00'W	Incidental mortality Y/F tuna seine
JMC-367	USNM 484930	10-14-72	11°23'N; 108°10'W	Incidental mortality Y/F tuna seine
JWP-137	USNM 484931	3-22-73	12°02'N; 96°58'W	Incidental mortality Y/F tuna seine
JMC-368	USNM 500118	10-14-72	11°23'N; 108°10'W	Incidental mortality Y/F tuna seine
JMC-489	USNM 500119	10-18-72	10°00'N; 104°14'W	Incidental mortality Y/F tuna seine
JMC-490	USNM 500120	10-18-72	10°00'N; 104°14'W	Incidental mortality Y/F tuna seine
JMC-491	USNM 500121	10-18-72	10°00'N; 104°14'W	Incidental mortality Y/F tuna seine
WAW-103	USNM 500861	1-21-71	14°38'N; 101°00'W	Incidental mortality Y/F tuna seine
WAW-102	USNM 500862	1-21-71	14°38'N; 101°00'W	Incidental mortality Y/F tuna seine
WAW-099	USNM 500863	1-05-71	13°05'N; 104°51'W	Incidental mortality Y/F tuna seine
AP-041	USNM 504730	1-01-72	10°47'N; 101°32'W	Incidental mortality Y/F tuna seine
CBP-080	USNM 504770	1-30-75	11°00'N; 97°19'W	Incidental mortality Y/F tuna seine
CBP-029	USNM 504771	2-09-75	12°50'N; 92°38'W	Incidental mortality Y/F tuna seine

TABLE IX (cont'd)

Field No.	Institution	Date of Collection	Locality	Circumstances
FMR-077	USNM 504783	10-17-75	$07^{o}53'N$; $107^{o}07'W$	Incidental mortality Y/F tuna seine
JAH-212	USNM 504793	3-18-75	$12^{o}38'N$; $093^{o}40'W$	Incidental mortality Y/F tuna seine
JMC-641	USNM 504796	11-02-76	$11^{o}27'N$; $109^{o}50'W$	Incidental mortality Y/F tuna seine
JS-005	USNM 504797	1-19-76	$15^{o}20'N$; $105^{o}17'W$	Incidental mortality Y/F tuna seine
MJJ-189	USNM 504807	2-25-75	$08^{o}23'N$; $101^{o}06'W$	Incidental mortality Y/F tuna seine
RFK-047	USNM 504813	2-16-75	$12^{o}26'N$; $096^{o}27'W$	Incidental mortality Y/F tuna seine
RFK-048	USNM 504814	2-16-75	$12^{o}26'N$; $96^{o}27'W$	Incidental mortality Y/F tuna seine

AMNH = American Museum of Natural History, New York, New York; LACM = Los Angeles (Calif.) County Museum of Natural History; MVZ = Museum of Vertebrate Zoology, Univ. of Calif., Berkeley; NMML = National Marine Mammal Laboratory, Northwest and Alaska Fisheries Center, Seattle, Wash.; SDMNH = San Diego (Calif.) Museum of Natural History; SWFC = Southwest Fisheries Center, La Jolla, Calif.; USNM = U.S. National Museum, Washington, D.C.

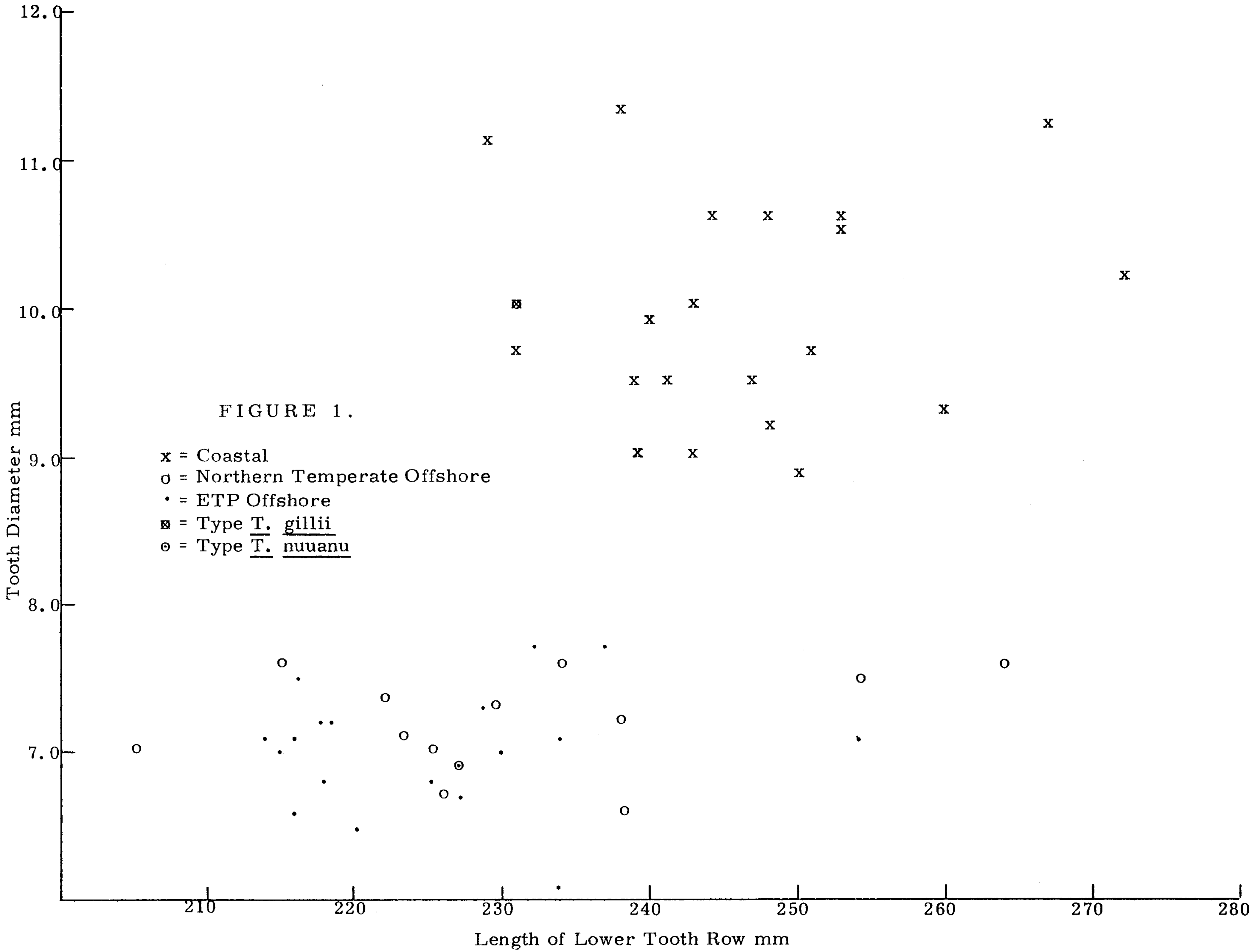
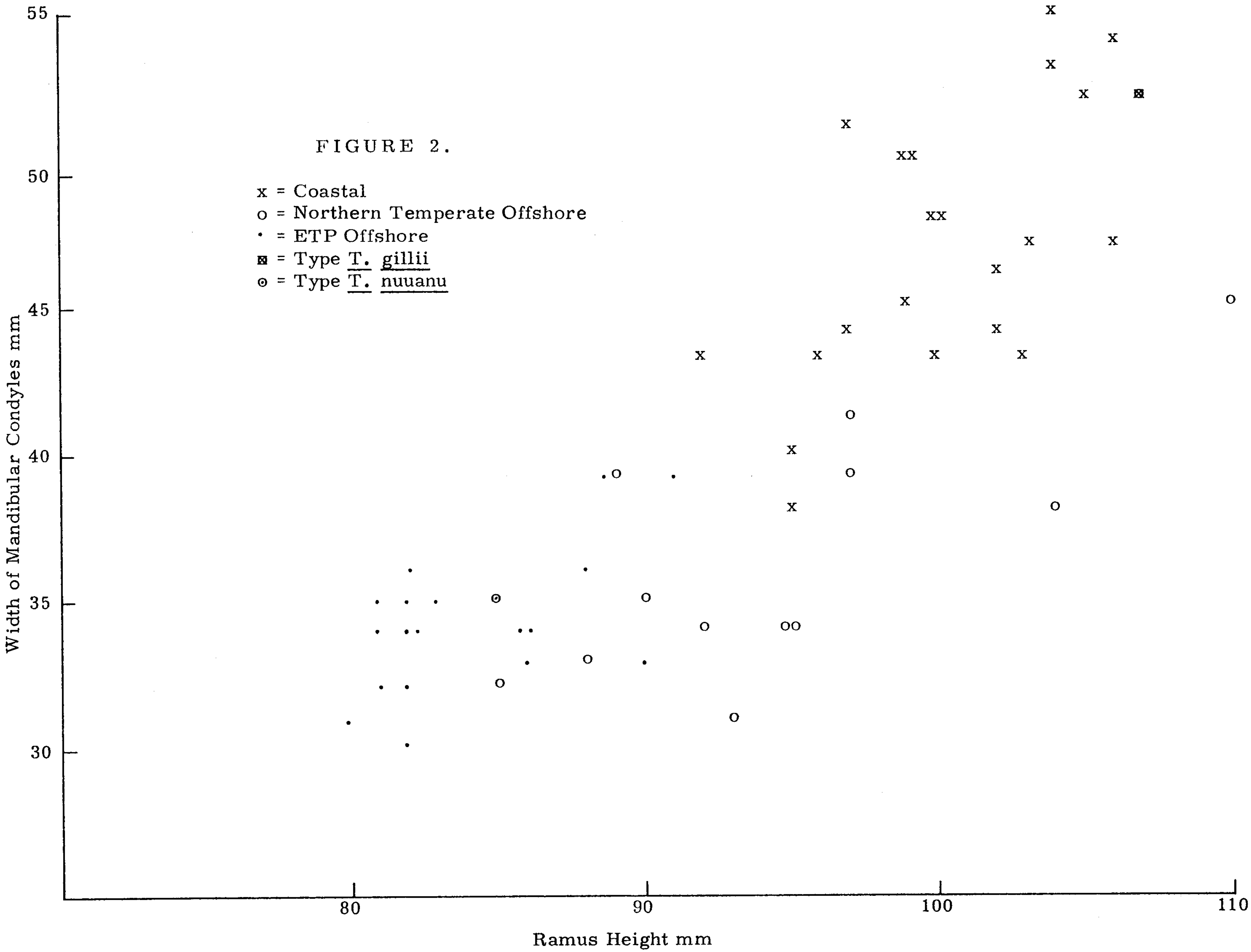


FIGURE 1.
x = Coastal
o = Northern Temperate Offshore
• = ETP Offshore
⊠ = Type T. gillii
⊙ = Type T. nuuanu
Tooth Diameter mm
12.0
11.0
10.0
9.0
8.0
7.0
210
220
230
240
250
260
270
280
Length of Lower Tooth Row mm

FIGURE 2.


x = Coastal
o = Northern Temperate Offshore
· = ETP Offshore
⊠ = Type T. gillii
⊙ = Type T. nuuanu
55
50
45
40
35
30
Width of Mandibular Condyles mm
80
90
100
110
Ramus Height mm

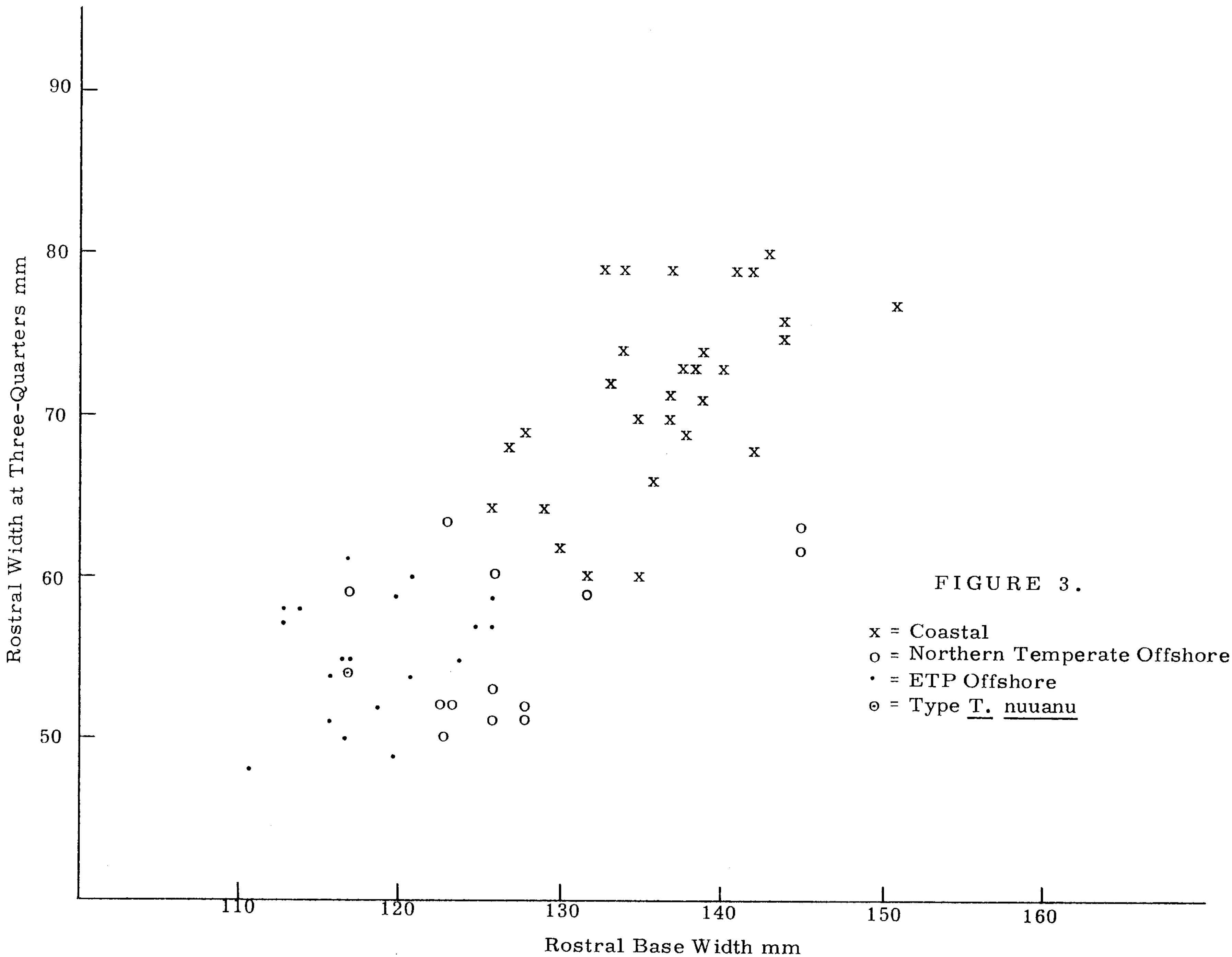

90
80
70
60
50
110
120
130
140
150
160
Rostral Width at Three-Quarters mm
Rostral Base Width mm
x = Coastal
o = Northern Temperate Offshore
• = ETP Offshore
⊙ = Type *T. nuuanu*

FIGURE 3.

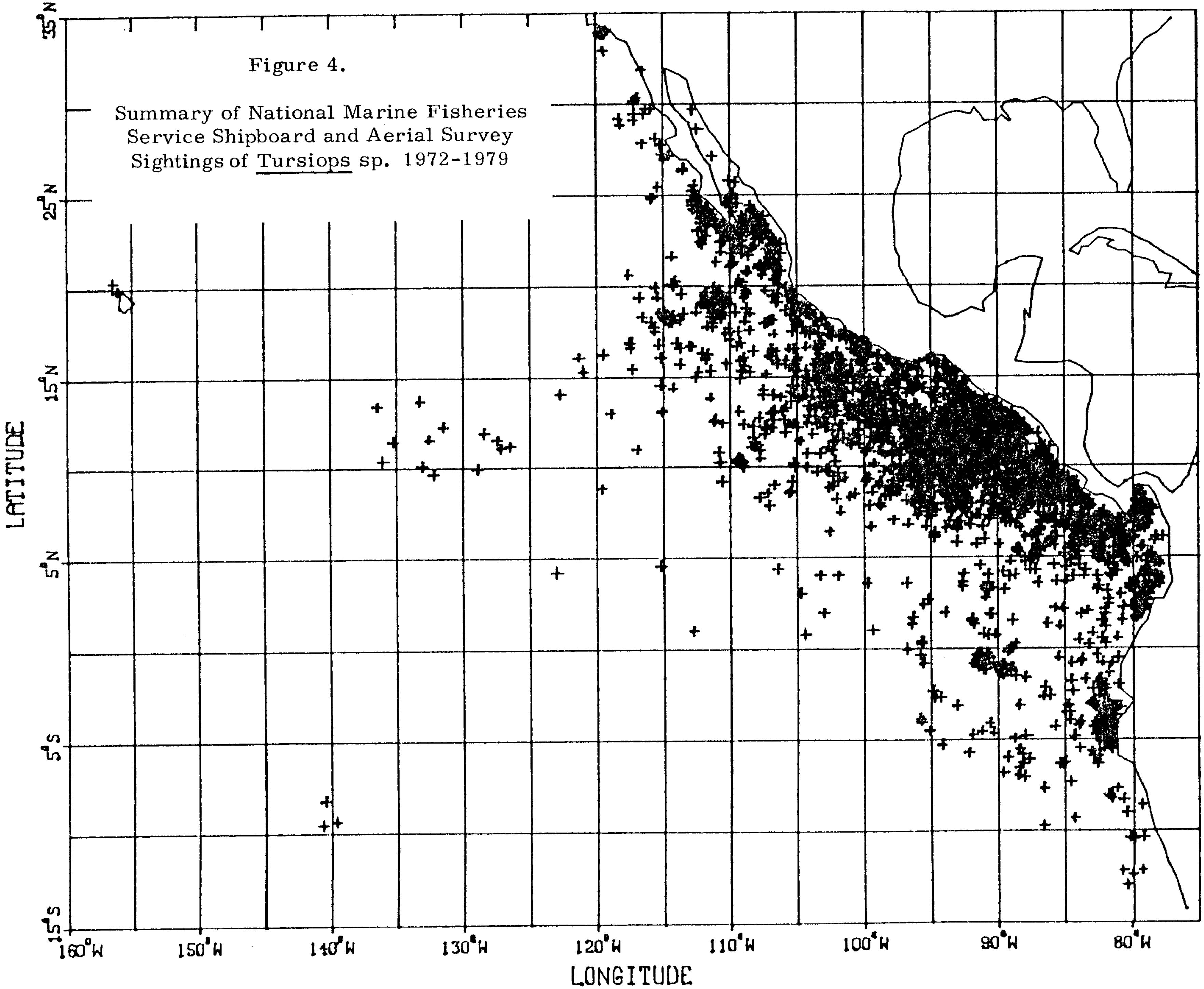


Figure 4.

Summary of National Marine Fisheries Service Shipboard and Aerial Survey Sightings of <u>Tursiops</u> sp. 1972-1979

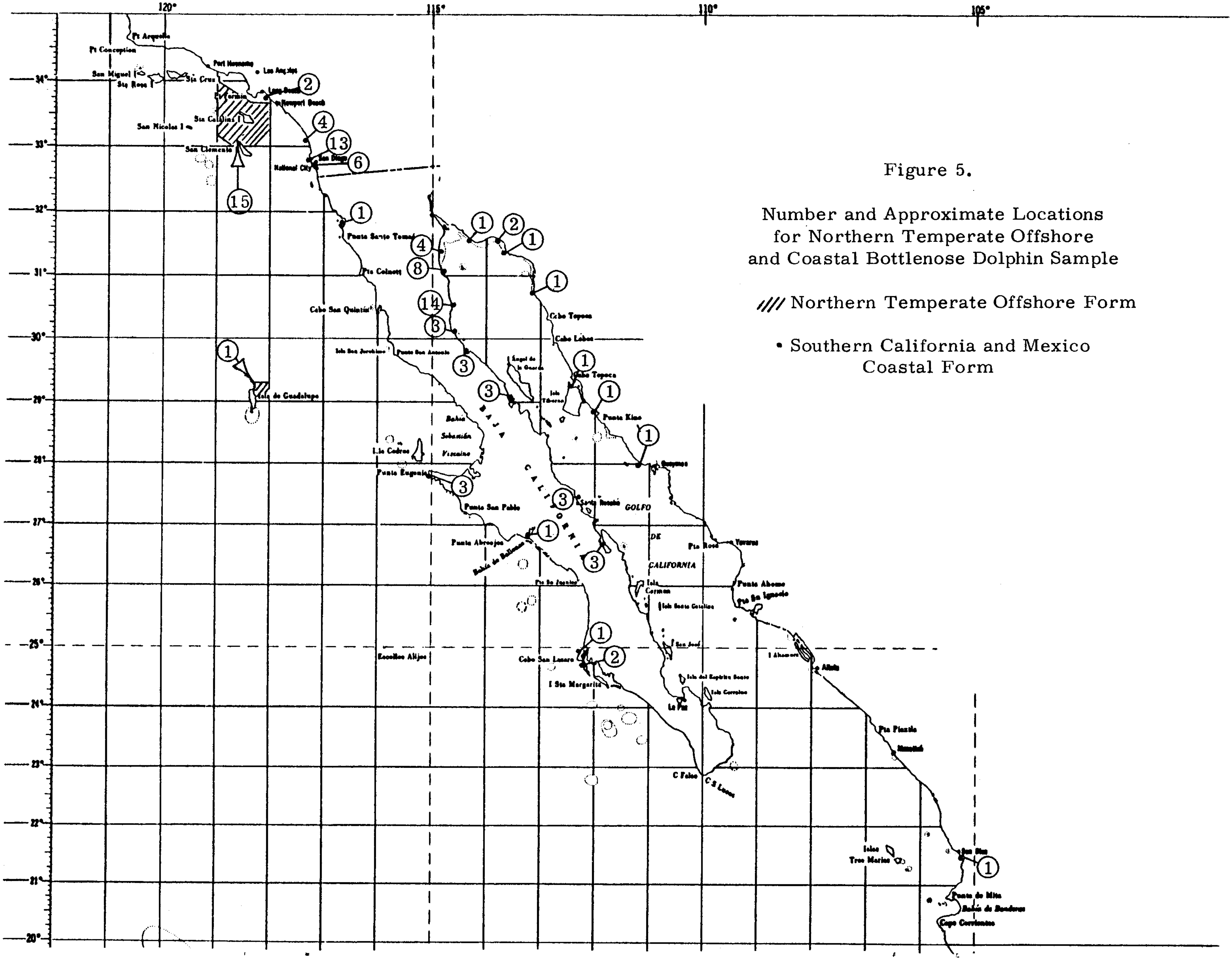


Figure 5.

Number and Approximate Locations for Northern Temperate Offshore and Coastal Bottlenose Dolphin Sample

//// Northern Temperate Offshore Form

• Southern California and Mexico Coastal Form

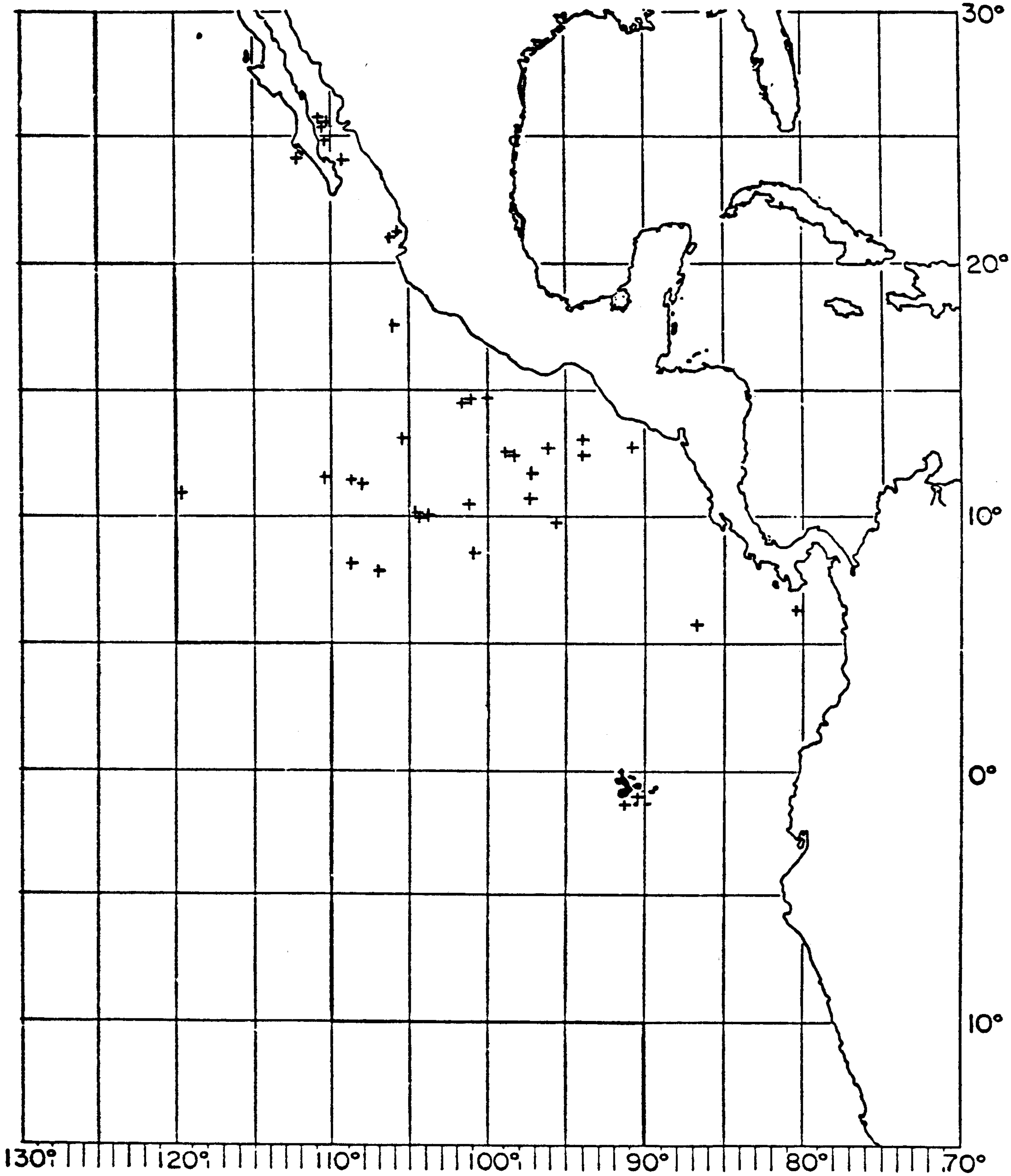


Figure 6.

Number and Approximate Collection Locations
for Eastern Tropical Pacific Offshore Sample

APPENDIX 1

EASTERN PACIFIC *Tursiops sp.* REPRODUCTIVE DATA

Tables From Preliminary Report

Prepared December 20, 1977

by

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Submitted to Southwest National Marine Fisheries Center

TABLE I

LIFE HISTORY DATA OF MALE *Tursiops sp.*

SOUTHERN CALIFORNIA OFFSHORE ECOTYPE

Field No.	Date of Collection Date of Death	Location	Length (cm)	Average Testes Weight (grams)	Average Tubule Diameter (microns)	Reproductive Comments
WAW-105	5 Feb 1971 7 Apr 1971	1-1/2 mi off West End Catalina Island, Los Angeles County, Calif.	231.0	36.0	45.0	Immature; no spermatogenesis.
M-14-66*	15 Dec 1965 29 May 1966	near Catalina Island, Los Angeles County, Calif.	234.0	-	-	Immature.
WAW-145	8 Nov 1966 29 Nov 1971	3 mi SE East End Catalina Island, Los Angeles County, Calif.	263.0	248.0	164.7	Mature; spermatogenesis evident. Sperm in epididymis. This animal sired 114.0 cm female calf. (See WAW-138.)
WAW-078	21 Oct 1969 7 Aug 1970	16 mi S Point Vincente, Rancho Palos Verdes, Los Angeles County, Calif.	277.0	486.0	172.0	Mature; spermatogenesis evident. Sperm in epididymis.
WAW-159	9 Feb 1972 11 May 1972	1-1/2 mi S Silver Canyon, Catalina Island, Los Angeles County, Calif.	310.0	530.6	186.9	Mature; spermatogenesis evident. Sperm in epididymis.

*Harrison, R.J., R.L. Brownell Jr. and R.C. Boice. 1972. Reproduction and gonadal appearances in some odontocetes, p. 361-429. In R.J. Harrison (ed.) Functional anatomy of marine mammals. Vol. 1. Academic Press Inc., London and New York.

TABLE II

LIFE HISTORY DATA OF FEMALE Tursiops sp.

SOUTHERN CALIFORNIA OFFSHORE ECOTYPE

Field No.	Date of Collection Date of Death	Location	Length (cm)	Gonad Weights (grams) Right Left	No. of Corpora Right Left	Reproductive Comments
WAW-125	19 May 1971 13 Jul 1971	Near Catalina Island, Los Angeles County, Calif.	218.0	-	None	Immature.**
WAW-140	20 May 1971 16 Nov 1971	6 mi SW East End Catalina Island, Los Angeles County, Calif.	255.0	2.2 2.4	None	Immature.
WAW-064* 69-37	20 Oct 1969 12 Mar 1970	Off West End, Catalina Island, Los Angeles County, Calif.	256.0	2.4 2.5	None	Immature; few follicles 0.5 mm - 1.0 mm diameter.
WAW-065* "Windy"	8 Dec 1964 13 Dec 1969	1/2 mi SE Catalina Harbor, Catalina Island, Los Angeles County, Calif.	263.5	1.7 1.7	None	Immature; few follicles 0.5 mm diameter.
WAW-212	20 Apr 1972 4 Jan 1974	Near Catalina Island, Los Angeles County, Calif.	264.0	2.1 1.9	None	Immature.
WAW-138	17 Nov 1966 20 Oct 1971	1 mi off West End Catalina Island, Los Angeles County, Calif.	276.0	10.8 21.2	2 1; 1 corpus luteum	Mature; animal calved 22 Jul 1971 114.0 cm female calf. (See WAW-145.)
MLP 69-31	5 Aug 1969 17 Mar 1977	Near Catalina Island, Los Angeles County, Calif.	279.4	- -	0 1	Mature.**
WAW-100	9 Feb 1971 26 Feb 1971	1 mi S Silver Canyon, Catalina Island, Los Angeles County, Calif.	290.0	4.5 4.2	0 1	Mature; follicle diameter 15.0 mm - 17.0 mm.

*Harrison, Brownell, and Boice (1972) **Based on external examination only.

TABLE III

LIFE HISTORY DATA OF MALE *Tursiops* *sp.*

NEAR SHORE WATERS OF CALIFORNIA AND MEXICO

Field No.	Date of Collection Date of Death	Location	Length (cm)	Average Testes Weight (grams)	Average Tubule Diameter (microns)	Reproductive Comments
WFP-565	27 Jun 1977	Foot of 8th Street, Del Mar, San Diego County, Calif.	269.9	180.0	83.1	Immature; no spermatogenesis.
WFP-520	28 Jun 1976	San Elijo State Beach, San Diego County, Calif.	296.6	957.0	Not Examined	Mature.**
WFP-559	5 Feb 1977	1/2 mi N Southwest National Marine Fisheries, San Diego County, Calif.	302.8	878.0	197.0	Mature; spermatogenesis evident. Sperm in epididymis.
WFP-535	9 Aug 1976	200 yards S. Mussel Rock, San Diego County, Calif.	313.0	983.5	Not Examined	Mature.**
RMG-4701*	Oct 1957	La Jolla, San Diego County, Calif.	333.0	-	-	Mature.

*Harrison, Brownell, and Boice (1972)
**Reproductive maturity based on testes weight; tissue not examined.

TABLE IV

LIFE HISTORY DATA OF FEMALE *Tursiops* *sp.*

NEAR SHORE WATERS OF CALIFORNIA AND MEXICO

Field No.	Date of Collection Date of Death	Location	Length (cm)	Gonad Weights (grams) Right Left	No. of Corpora Right Left	Reproductive Comments
WAW-141	26 Dec 1971	Bolsa Chica State Beach, Orange County, Calif.	207.0	1.3 1.1	None	Immature; no follicles.
WFP-522	27 Jul 1976	Torrey Pines State Beach, San Diego County, Calif.	210.8	1.1 1.3	None	Immature; follicle diameter 2.0 mm.
WFP-563	16 May 1977	Black's Beach, San Diego County, Calif.	234.3	2.4 2.2	None	Immature; follicle diameter 1.0 mm - 5.0 mm.
WFP-523	2 Aug 1976	Borderline State Park, San Diego County, Calif.	255.2	4.0 4.4	None	Immature; follicle diameter 10.0 mm.

TABLE V

LIFE HISTORY DATA OF MALE *Tursiops sp.*

OFFSHORE WATERS OF EASTERN TROPICAL PACIFIC

Field No.	Date of Collection Date of Death	Location	Length (cm)	Average Testes Weight (grams)	Average Tubule Diameter (microns)	Reproductive Comments
WAW-102	21 Jan 1971	14°38'N; 101°00'W	195.0	-	35.6	Immature; no spermatogenesis.
WFP-196(a)	12 Jan 1972	10°00'N; 140°00'W	197.0	22.6	-	Immature. Tissue not examined.
DAV-050	27 Jun 1977	14°28'N; 098°33'W	203.0	20.0	46.2	Immature; no spermatogenesis.
DOB-198	14 Oct 1977	12°46'N; 090°44'W	207.7	20.0	43.0	Immature; no spermatogenesis.
LES-015	10 Jun 1977	10°51'N; 096°15'W	236.0	52.0	80.6	Immature; no spermatogenesis.
FMR-081	17 Oct 1975	07°53'N; 107°07'W	244.0	540.0	170.6	Mature; spermatogenesis evident. Sperm in epididymis.
FMR-077	17 Oct 1975	07°53'N; 107°07'W	249.0	498.0	138.0	Mature; spermatogenesis evident. Sperm in epididymis.
MEH-019	6 Aug 1977	09°41.5'N; 095°19.4'W	251.7	500.0	153.0	Mature; spermatogenesis evident. Sperm in epididymis.
RWM-341	22 Jan 1976	15°00'N; 102°00'W	256.0	492.0	146.2	Mature; spermatogenesis evident. No sperm in epididymis.
WAW-099	5 Jan 1971	13°05'N; 104°51'W	261.0	-	163.0	Mature; spermatogenesis evident. No sperm in epididymis.
RWM-340	22 Jan 1976	15°00'N; 102°00'W	263.0	264.0	206.8	Mature; spermatogenesis evident. No sperm in epididymis.
JAH-212	18 Mar 1975	12°38'N; 093°40'W	266.0	548.0	186.9	Mature; spermatogenesis evident. No sperm in epididymis.

TABLE VI

LIFE HISTORY DATA OF FEMALE *Tursiops sp.*

OFFSHORE WATERS OF EASTERN TROPICAL PACIFIC

Field No.	Date of Collection Date of Death	Location	Length (cm)	Gonad Weights (grams) Right Left	No. of Corpora Right Left	Reproductive Comments
RSGT-002 WAW-103	21 Jan 1971	14°38'N; 101°00'W	214.0	1.8 1.4	None	Immature
JMC-641	2 Nov 1976	11°27'N; 109°50'W	214.0	2.1 2.0	None	Immature; follicle diameter 5.0 mm - 8.0 mm.
AP-041	15 Jan 1972	10°47'N; 100°32'W	222.0	1.8 1.9	None	Immature.
RCD-243	1 Mar 1974	14°58'N; 103°45'W	233.0	1.8 1.9	None	Immature; follicle diameter 11.0 mm.
MJJ-189	25 Feb 1975	08°23'N; 101°06'W	235.0	3.0 3.9	None	Immature; follicle diameter 33.0 mm - 45.0 mm.
JMC-368	14 Oct 1972	11°23'N; 108°10'W	239.0	2.5 3.0	None	Immature.
TMD-461	31 Jan 1975	12°56'N; 099°54'W	242.0	3.1 3.2	None	Immature; follicle diameter 17.0 mm - 20.0 mm.
JS-005	19 Jan 1976	15°20'N; 105°17'W	243.0	5.2 20.0	2 12	Mature. Pregnant; fetus 880 mm female. Not lactating.
JMC-491	18 Oct 1972	10°00'N; 104°14'W	256.0	2.2 3.7	0 8	Mature; follicle diameter 30.0 mm - 33.0 mm. Lactating.