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POPULATION BIOLOGY AND ECOLOGY OF THE PACIFIC WHITE-SIDED DOLPHIN, *Lagenorhynchus obliquidens*, IN THE NORTHEASTERN PACIFIC. PART II: BIOLOGY AND GEOGRAPHICAL VARIATION

by

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Part II
Biology And Geographical Variation

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I. INTRODUCTION

The Pacific white-sided dolphin, Lagenorhynchus obliquidens, is a North Pacific endemic reported from Taiwan to the Kurile and Commander Islands on the west (Okada and Hanaoka, 1939; Sleptsov, 1961; Nishiwaki, 1967; Tomilin, 1967; Mitchell, 1975), from 20°-21°N to 61°N on the east, and more-or-less continuously across temperate waters (Leatherwood and Walker, 1982; Leatherwood et al. 1984). The species was originally described by Gill (1865) based on three co-types (U.S. National Museum Nos. 1961, 1962, 1963) reportedly taken "off the California coast." Though the exact locality is unclear, Poole and Shantz (1942:110) list the type specimens, 3 skulls with mandibles, in good condition, as having been taken by W. P. Trowbridge from San Francisco (near), San Mateo County and catalogued 14 October 1885. They attribute these details to True (1889:98). A careful reading of the latter indicates that the specimens were, indeed, obtained "on the coast of California by Lieutenant W. P. Trowbridge" but that for the types and for another specimen (USNM 14329) discussed in the same paragraph "...no particular localities are given in either instance."

In the northeastern Pacific, white-sided dolphins are widely distributed, at least seasonally, between about 23°N and the northern Gulf of Alaska and northern North Pacific. Within that range, seasonal fluctuations in apparent abundance, thought to be related to shifts in population center(s), are reported for northern California, the Southern California Bight and the west coast of Baja California (Leatherwood and Walker, 1982; Leatherwood et al., 1984). Relationships among the dolphins in various areas have not been investigated.

In 1979, under contract from the National Marine Fisheries Service (NMFS), Southwest Fisheries Center (SWFC), we began a study of the population biology and ecology of *Lagenorhynchus obliquidens* in the eastern North Pacific. We have since reported on distribution, seasonal movements and abundance, based on all records available through 1979 (Leatherwood and Walker, 1982; Leatherwood et al., 1984). This paper reports findings on biology and geographic variation in white-sided dolphins in the northeastern Pacific based on examination of literature and specimen materials - external measurements, skulls, skeletons and osteological data, teeth, reproductive organs, photographs, stomach contents and parasites.

II. METHODS AND RESULTS

A. External Morphometrics

Some external measurements, ranging from only total length to a complete suite of measurements, were available for a total of 243 specimens. The entire set has been deposited with the NMFS/SWFC. The largest specimens known to us are a 250 cm male (specimen MVZ 116037, collected 23 July 1950 by Seth Benson at 28°00'N, 114°45'W) and a 236 cm female (specimen 56-68, collected by W. A. Walker 12 April 1968 at 33°30'N, 118°25'-see Harrison et al., 1969). Of all standard measurements taken for odontocetes, total length is that most likely to be taken consistently. Even so, length measurements were screened carefully before being used in any further analysis. We consider that all other measurements are less likely to be consistently reliable. They were taken over a long period (1905-1982) by a variety of workers using various and often unreported techniques. Therefore, we did not use such measurements in any analyses to differentiate populations.

Dorsal fins in Lagenorhynchus obliquidens vary considerably in size and range in shape from falcate and sharply pointed to lobate and more rounded on the tip (Kasuya 1981:15) (Figure 1). We have observed fins of both shapes in the same herds and on both males and females in captivity. As none of the standard measurements taken on odontocetes (Norris, ed., 1961) are adequate to detect such differences in fin shape, we have no data to test the relationship of dorsal fin shape to sex, length, age or state of maturity of specimens. We hypothesize that these differences are age related and that fins begin to become lobate with the onset of physical maturity.

B. Cranial Morphometrics

Cranial measurements were selected and taken following Perrin (1975) (Table 1). As in previous studies of this kind, juvenile specimens were excluded from consideration because of ontogenic growth changes and their effect on the analysis of population differences. Because rostral distal fusion, a feature used to indicate the onset of sexual maturity in Stenella spp. (Dailey and Perrin, 1973) and Tursiops sp. (Walker, 1981), does not occur in even physically mature Lagenorhynchus obliquidens, we determined state of maturity using:

1. reproductive condition, judged by direct analysis of organs or availability of other data indicating sexual maturity, such as notes on lactation or presence of a fetus;
2. evidence of fusion in thoracic vertebral epiphyses;
3. presence of 7 or more growth layer groups in teeth (see section on age/length relationships); or

4. in the absence of other data, evidence from the overall development of cranial sutures that the animal was obviously at least sexually mature.

We were unable to develop a suture grading system to permit elimination of juveniles because we did not have an age-stratified sample.

We measured 152 crania (73 females, 60 males and 19 animals of undetermined sex) collected in the northeastern Pacific between about 24°30'N and 61°N. The sample included some stranded animals and some collected at sea. One hundred and fourteen of these (74%) were from the area of Southern California between 32° and 37°N, 31 (20%) were from north of 37°N, 9 (6%) were from below 32°N. The hiatuses between the sample from Southern California and those from extreme northern and extreme southern portions of the sample's range are useful in separating cranial specimens for analysis.

Data were analyzed using both multivariate and bivariate techniques. Multivariate analysis was performed initially using principal component analysis (PCA) because PCA requires no prior assumptions of differences within the sample. We did not regard the alternative, discriminant analysis, as appropriate because the technique does require predetermined group separation and because we did not have statistically adequate sample sizes for the northern and southern portions of the sample's range. In multivariate analysis, specimens with missing measurements are automatically eliminated from the sample. To counter this problem and maintain the highest possible sample size, we eliminated from the data sets used in the multivariate analysis those measurements which are commonly missing due to damage during collection and preparation of specimens (see Table 1). These variables were, however, later included in the bivariate analysis.

The scores of individual specimens for principal component axes one and two were plotted by latitude (Figures 2 and 3). Similar geographic plots of PCA scores have been used in previous studies of animal populations (Douglas et al., 1984; Kennedy and Schnell, 1978; Menozzi et al., 1978; Schnell et al., 1982). In evaluating the results of PCA, the first principal component is generally thought to represent specimen size, the second specimen shape (Seal, 1964; Cooley and Lohnes, 1962).

Though the sample in the present investigation is small, there appears to be marked separation between animals from the extreme northern (above 37°N) and southern (below 32°N) ranges of the sample with respect to size (Figure 1). Crania of southern animals tend to be larger than those of northern animals. We tentatively interpreted these results as evidence of the existence of two populations in the northeastern Pacific, one in northern temperate and one in southern temperate regions. The distribution of scores for principal component two supports this interpretation, indicating that differences occur between these two putative populations with respect to skull shape as well as to skull size. It is worth noting that in both analyses there is significant variability in scores below about 37°N, with the most dramatic spread in values between 34°30' and 32°30'N. We interpreted this to mean that there were specimens from both populations in the Southern California Bight. That interpretation is supported by age-length and reproductive data discussed below. The dramatic change in character of the sample latitudinally (Figures 2 and 3) corresponds to changes in oceanographic condition near Point

Conception (approx. 34°30'N), changes which result in marked faunal differences north and south of the point (Hubbs, 1960).

Bivariate analyses were undertaken to determine proportional differences in skulls of northern and southern animals. Plots for various pairs of cranial features were prepared and examined. Interpretation of such plots was complicated by the extremely small number of samples geographically attributable to either postulated population and by apparent mixing of the 2 populations in the intermediate area. Results of comparisons involving measurements characterized by significant variation could not be interpreted at all. Only the relationship between total length of the skull and length of the temporal fossa (Figure 4) appeared modally to separate the two populations; the fossae tend to be proportionally smaller in the southern than in the northern form.

C. Age-length Relationships

Teeth were collected from near the middle of the left lower jaw of 147 Lagenorhynchus obliquidens (86 females, 56 males and 5 animals of unknown sex) for which total length and collection location were known. The teeth were prepared at NMFS/SWFC following procedures detailed by Myrick et al., (1983) and were read at SWFC under the direction of Dr. Myrick. Decalcification times ranged from 11.5-20.0 hours, increasing with tooth and pulp cavity size. Staining times ranged from 30-60 minutes.

Dentinal growth layer groups (GLG's) of Lagenorhynchus obliquidens are composed of 4 alternating lightly and darkly stained bands. The first band or boundary layer (beginning with the neonatal line) is thin and either unstained or lightly stained. Within the GLG and advancing toward the pulp cavity, this band is adjacent first to a broad darkly stained band, then a thin unstained mid-GLG band, and finally a broad dark band. Cemental GLG's are composed of two bands, one darkly and one lightly stained.

Each tooth section was independently read twice by each of 2 readers (Goodrich and Myrick). Following a cursory examination of the condition of the section, dentinal readings were made. GLG's were counted in a step-wise fashion, starting with and just above the base of the neonatal line and proceeding towards the pulp cavity. Counts of dentinal layers were supplemented by counts of cemental layers, recognizing that the latter often occur in multiples of the former. Ideally, cemental layers were read near the mid-point of tooth height. However, if cement was missing or damaged, the quality of staining was poor or multiple cemental layers were present, readers looked elsewhere on the section. Whenever the pulp cavity was occluded or dentinal layers were poorly stained, cemental layers were considered the most reliable indicators of GLG's.

Readers logged low, high, and "best" readings, ratings of confidence in readings and clarity for dentinal and cemental GLG's, date read and overall condition of the mount. "Best and final" counts, considering size of the pulp cavity and condition of GLG layers (see protocol, Myrick et al., 1983) were averaged. If any single "best and final" reading(s) were outside a pre-established interval from that mean (± 1 for 0-10 GLG's, ± 2 for 11-15 GLG's, ± 3 for 16-25 GLG's, ± 4 for 26-36 GLG's, and ± 5 for ≥ 37 GLG's) the tooth was reread. Results of all readings ("best" initial and reread values) were used to calculate mean GLG's for each specimen (see Table 2, Figure 5).

No experimentally calibrated teeth were available for *Lagenorhynchus obliquidens*. We have assumed that 1 GLG = 1 year. With that assumption, animals we examined ranged in age from 0.4 to 46.0 years with significant variability in length at any given age. Animals examined from above 37°N and below 32°N ranged from 1.5 to 37 years. In this latter sample, the relative lengths of northern vs southern animals of comparable size (Figure 5) support the contention based on skull morphometrics that the southern form is larger than the northern form.

D. Reproduction

Literature and data on reproduction in Lagenorhynchus obliquidens from the northeastern Pacific were summarized by Harrison et al. (1972). This study updates that review with data from the single relevant publication since 1972 (Sawyer and Walker, 1977) and data from 97 previously unpublished specimens (49 females and 38 males) (Tables 3 and 4). As in previous studies, sexual maturity in the present sample was judged from presence of at least one corpus luteum or corpus albicans or presence of sperm in a section of testes, supplemented by other data available.

Harrison et al. (1972), based on 33 specimens of this species (18 females and 15 males) from the Southern California Bight and a single male from Punta Abreojos, Baja California, noted but were unable to explain considerable variability in the length at sexual maturity of either sex or in the lengths and number of corpora of females. Data from the present sample contain comparable variability. For example, a 197 cm female estimated to be 6.9 years old had no corpora while a 172 cm female estimated to be 24.5 years old had 23 corpora (Table 3) and a 179 cm male of undetermined age was sexually mature while a 213 cm male of undetermined age was sexually immature (Table 4). We hypothesize that such disparities relate, at least in part, to an overlap in distribution at least between 32° and 37°N, of the two populations which differ markedly in overall size. Unfortunately, reproductive information available from below 32°N is insufficient to permit us to test this hypthosesis.

E. Coloration

Pacific white-sided dolphins are strikingly marked, with a black dorsal surface, light gray sides and a white belly (see Figure 1). The black cape is interrupted on each side of the dorsal fin by a light stripe, originating in the light color of the forehead and face, curving over the top of the melon, continuing along the side to below the dorsal fin, then turning downward and widening to form a prominent light gray patch on the flank. The beak is dark and a narrow stripe extending forward from the flipper is continuous with the black of the lips. The sides of the body in front of the dorsal fin and the forehead are gray. A thin dark band separates the gray and black zones of the side from the white ventrum. The dorsal fin is dark on the anterior third and light on the posterior two-thirds. The flippers are often similarly bi-colored. The flukes are all dark.

Our impressions from numerous observations of free-ranging and captive individuals are that fetuses (Figure 6a) and newborn contain essential elements of adult color patterns but in muted expression, that the various components appear, in general, to intensify with age, and that there is wide variability in intensity even within a given herd. We were unable to undertake a quantitative assessment of coloration by sex and length. We did, however, examine photographs of 13 known length individuals (7 males and 6 females) and were unable to define any consistent patterns.

Anomalous color patterns have been observed. Brownell (1965) described and illustrated an animal with a black thoracic patch surrounded by exceptionally extensive and bright regions of white. A specimen so colored was collected from 37°46'N, 124°30'W, 25 February 1966, (Figure 6). Others have been seen in herds off Washington in April 1971 and off Southern California in February 1974 and 1976 (Leatherwood, unpublished). Brown and Norris (1956) noted observations of three instances of what they interpreted as albinism in the species, 2 off Southern California and 1 off western Baja California. Hain and Leatherwood (1982) added a report of an encounter with a nearly all white, white-sided dolphin off Pedro Point, Santa Cruz Island in September 1968.

F. Food Habits

Kajimura et al., (1980) and Stroud et al., (1981) summarized food items identified in stomachs of Pacific white-sided dolphins from Japan, the northwestern Pacific and western Bering Sea, and the west coast of North America, 1919-1969, and reported contents of stomachs of 44 new specimens they collected off California and Washington 1958-1972. Jones (1981) summarized published accounts of stomach contents of 16 specimens from California 1958-1973 and added details of 7 specimens he collected from beaches off northern California 1968-1973. By all accounts, in the eastern North Pacific above Point Conception (about 34°30'N) these dolphins feed primarily on small schooling fishes and cephalopods from the epipelagic and mesopelagic zones. Northern anchovies and hake and the squid *Loligo opalescens* appear to be most consistently important in the species' diet.

Stomach contents have been reported from 7 specimens collected south of Point Conception (Table 5); contents of stomachs of 23 additional specimens off Southern California from the present investigation are summarized in Table 6. In terms of frequency of occurrence, volume and number of specimens found, anchovy, hake and squid appear most important, in that order.

There is little information available on daily feeding cycles of Lagenorhynchus obliquidens. Based on their observations that large stomach volumes were most often observed in animals collected before 1000 hours, Kajimura et al., (1980) and Stroud et al., (1981) surmised that most feeding is done at night or in the morning. Data from Jones (1981) and the present investigation, based as they are primarily on samples from stranded specimens, shed little light on this question. Other observations, however, suggest feeding may occur at other times as well. For example, Leatherwood and Reeves (1983) reported that white-sided dolphins have been "often seen feeding near dawn and dusk on small surfacing balls of unidentified bait." Brown and Norris (1956), without indicating time of day, reported having many times seen these dolphins, scattered in small groups, milling among anchovy schools. The numerous anchovy scales in the water on many of these occasions were taken as evidence the dolphins were feeding on anchovies. Data from a 184 cm female Lagenorhynchus obliquidens radio-tagged 15 December 1972 and tracked sporadically from aircraft during daylight hours 19 December 1972 and 26 January 1973 indicate feeding dives during early and mid morning (0730-1015) (Leatherwood and Evans, 1979; Leatherwood, unpub. data). In the Southern California Bight, white-sided dolphins are sometimes caught incidentally in anchovy purse seine operations, set in daylight and in darkness. Presumably dolphins caught were feeding on anchovies.

A single white-sided dolphin captured near dawn on 9 December 1970 in an anchovy purse-seine off Point Fermin, California was transported to Marineland of the Pacific, where it lived until 17 December 1970. Although the dolphin was fed herring during its 8 day internment, the stomach, when examined as part of routine post-mortum examination, was found to contain otoliths of anchovies though none were fed in captivity (William A. Walker, unpublished data). This observation cautions against assuming that the contents of a dolphin's stomach represent the last feeding before death.

G. Parasitism and Disease

The occurrence of parasites in *Lagenorhynchus obliquidens* is summarized in Dailey and Brownell (1972) and Dailey and Walker (1978). Of the eight genera of parasites documented from this species, only the two air sinus parasites, *Nasitrema* spp. (Trematoda) and *Crassicauda* sp(p). (Nematoda) have been implicated in natural mortality of small cetaceans in the eastern North Pacific (Dailey and Perrin, 1973; Dailey and Walker, 1978; Walker et al., 1984).

In the present sample, specimens of *Nasitrema* spp. were found in dolphins collected at sea from 25°22'N to 37°46'N and specimens of *Crassicauda* sp(p). in free-ranging animals from 33°40'N to 46°14'N. Evidence for the incidence and distribution of *Crassicauda* is primarily the presence of intact parasites recovered during necropsy. Incidence of such infection was small, occurring in only 10% (four of 39) of the animals examined.

During the course of this study, we examined 197 skulls for evidence of *Crassicauda* bone lesions of the kind described by Dailey and Perrin

(1973). Only one specimen (WAW 122) a 160 cm juvenile female collected by W. A. Walker 26 July 1971 at 33°53'N, 118°25'W, had such lesions. The animal's left periotic bone was almost completely eroded (illustrated in Cowen et al., in press). The low rate of Crassicauda infection implied by the low incidence (0.5%) of bone lesions in the skull sample examined should be intepreted cautiously, as the sample was biased toward specimens of older age classes.

A total of 63 post-cranial skeletons was examined for disease. Of these, 34 (54%) demonstrated some degree of vertebral bone disease (osteonecrosis) (Figure 7). The extent of damage from this disease varied from necrosies and fusion of 2-3 adjacent vertebrae to extreme cases in which the entire lumbar region was fused and the associated vertebral centra were considerably distorted. In four instances, vertebral osteonecrosis was encountered during dissection of whole specimens. In none of the four cases was there tissue pathology of adjacent muscles or integument. Examination of the data revealed no association between locality, sex, length or age and this disease. The incidence of osteonecrosis in Lagenorhynchus obliquidens was equal in the sample of stranded animals (21 of 39 or 53.8%) and animals collected at sea (13 of 24 or 54.2%). We surmise, therefore, that this vertebral bone disease does not play a significant role in individual stranding. To date, we are unable to postulate a cause for this disease.

III. CONCLUSIONS

1. There appear to be two populations of Lagenorhynchus obliquidens in the temperate northeastern Pacific, one in northern temperate the other in southern temperate waters. From age, length and reproductive data and

cranial size we conclude that the two populations differ in overall size, the southern form tending to be markedly larger than the northern.

2. Attempts to investigate proportional cranial differences between the two populations have been hampered by small sample sizes in the northern and southern extremes and by apparent combination of the two populations in the Southern California Bight sample. One cranial feature demonstrates modal differences. Members of the southern population have proportionally shorter temporal fossae.

3. In the northeastern Pacific, white-sided dolphins feed primarily on small schooling fishes and cephalopods from the epipelagic and, to a lesser extent, mesopelagic zones. Feeding apparently takes place primarily between dusk and dawn.

4. The parasites Nasitrema and Crassicauda were detected in low incidence. Incidence of vertebral osteonecrosis was high and was found in equal proportions (54%) of animals stranded and collected at sea. This disease does appear to be a factor in individual stranding of Lagenorhynchus obliquidens in the study area.

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VI. FIGURES

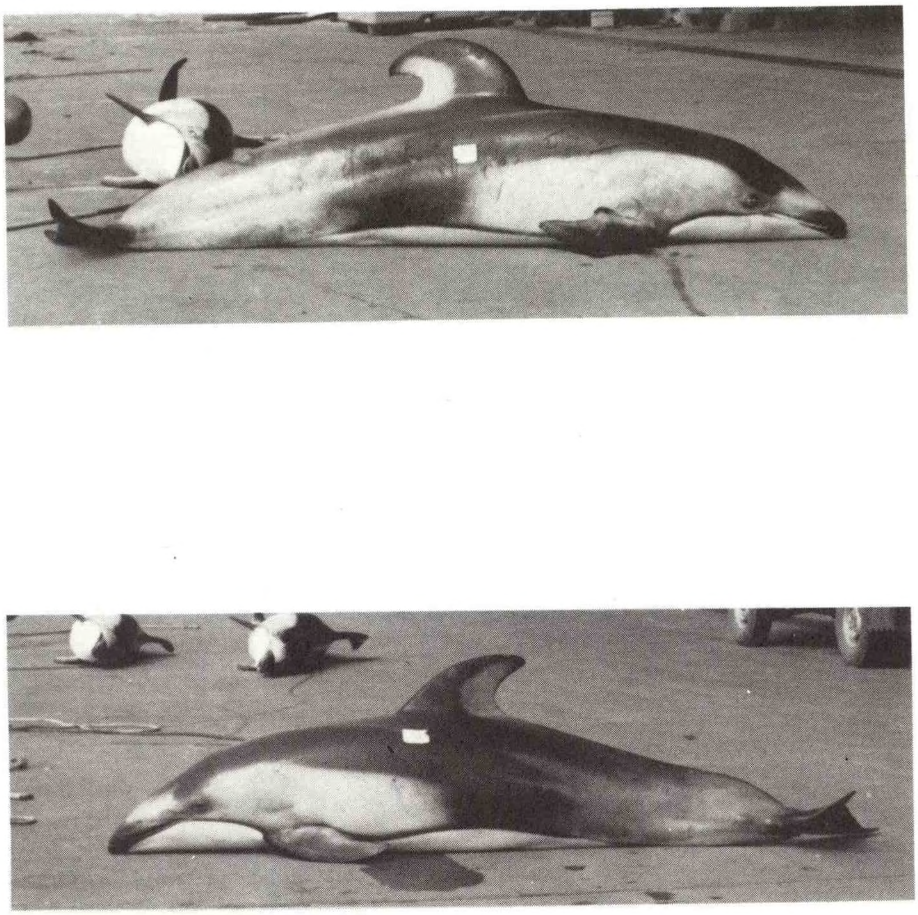

Figure 1. Pacific white-sided dolphins from Iki Island, Japan, showing normal coloration and variability in dorsal fin size and shape also observed in the northeastern Pacific; Top - 225 cm adult male. Bottom - 205 cm immature male (from Kasuya 1981:15, by permission of author).

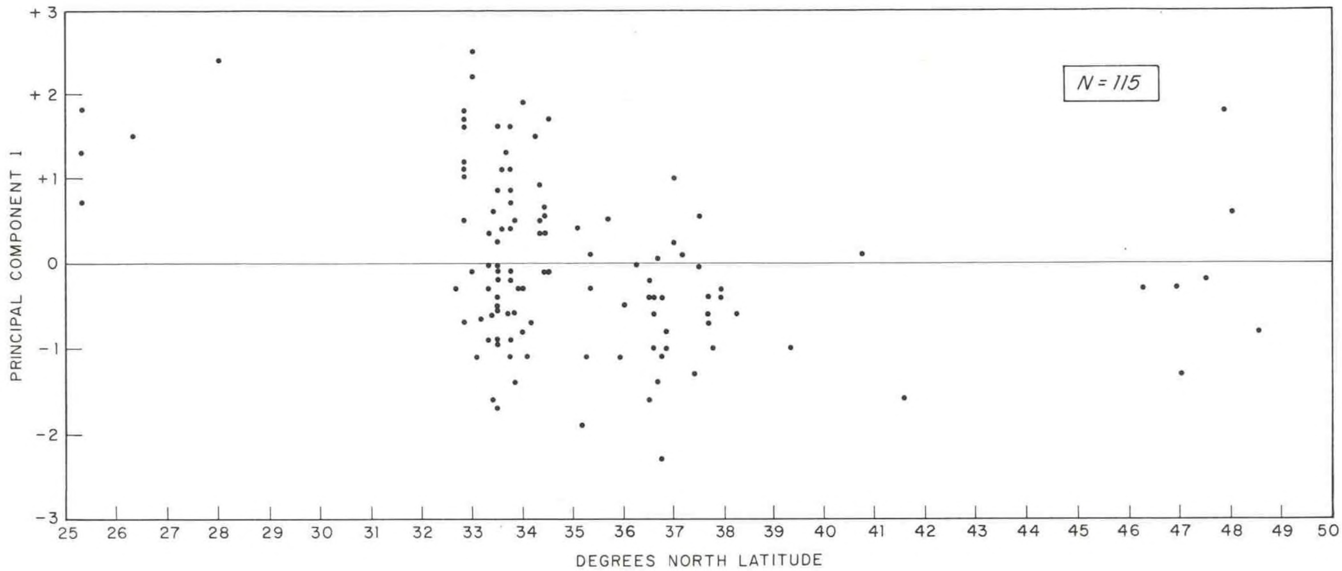

Figure 2. Scores of individual cranial specimens for principal component one, by latitude.

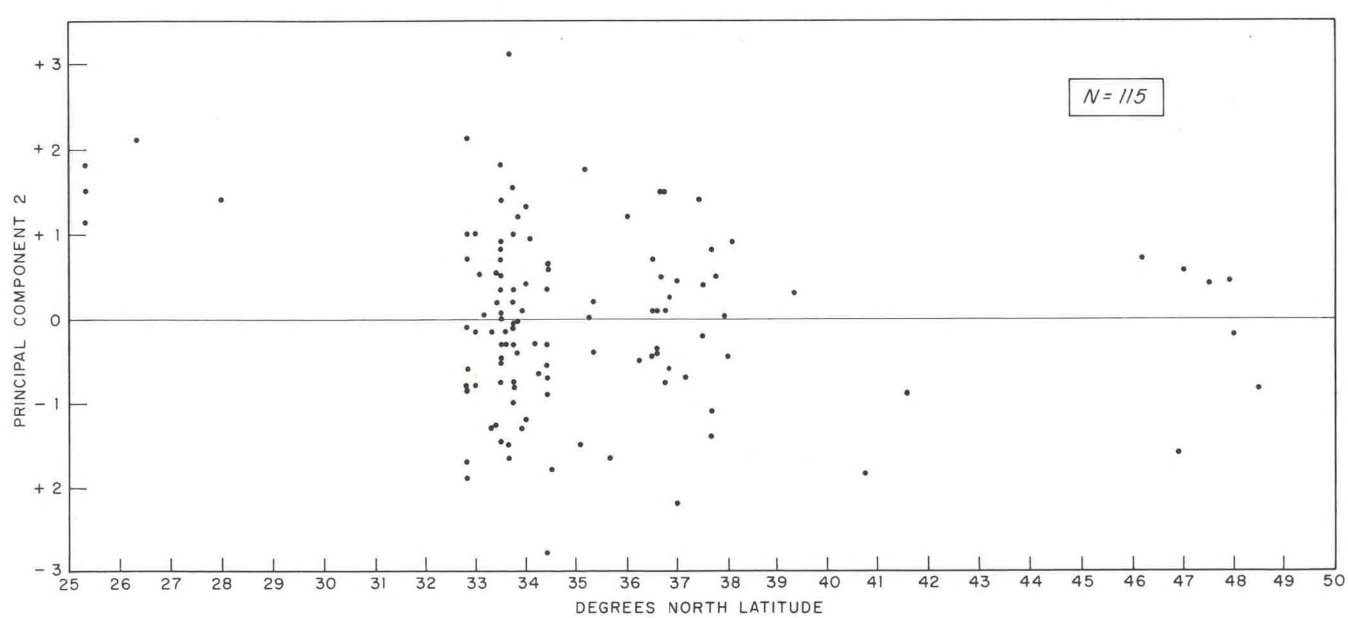

Figure 3. Scores of individual cranial specimens for principal component two, by latitude.

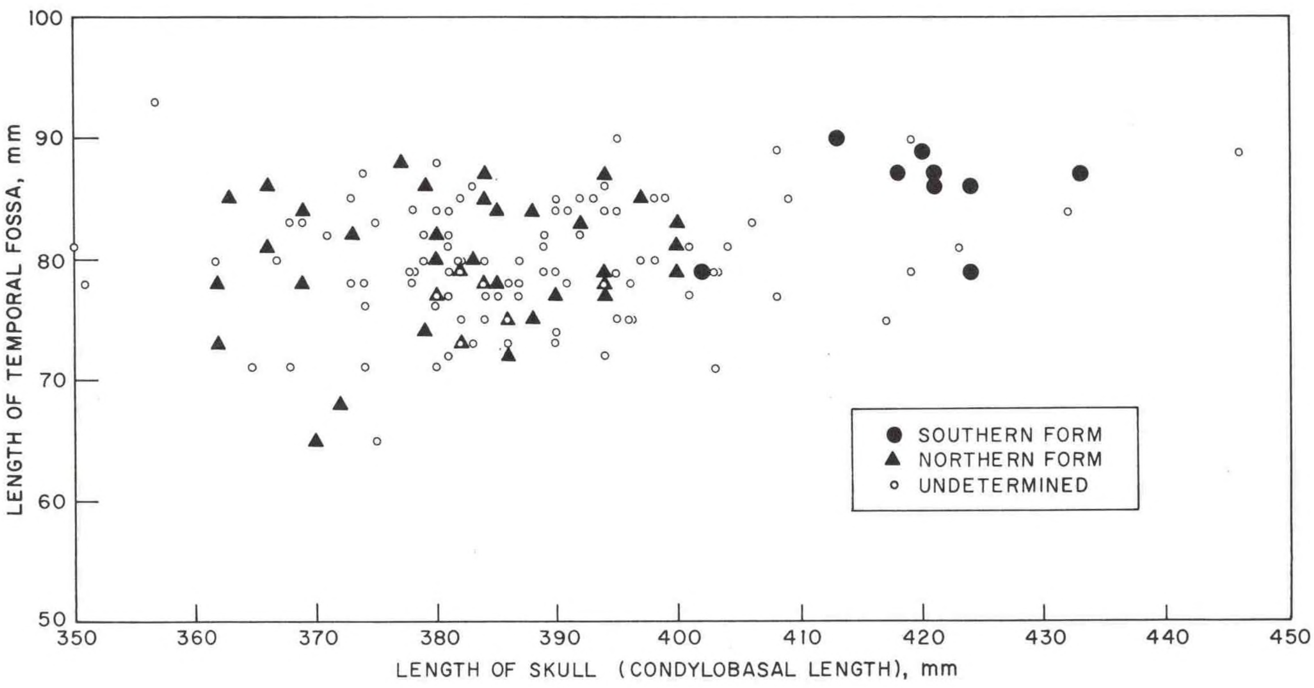

Figure 4. Relationship between length of the skull (condylobasal length) and length of the temporal fossa.

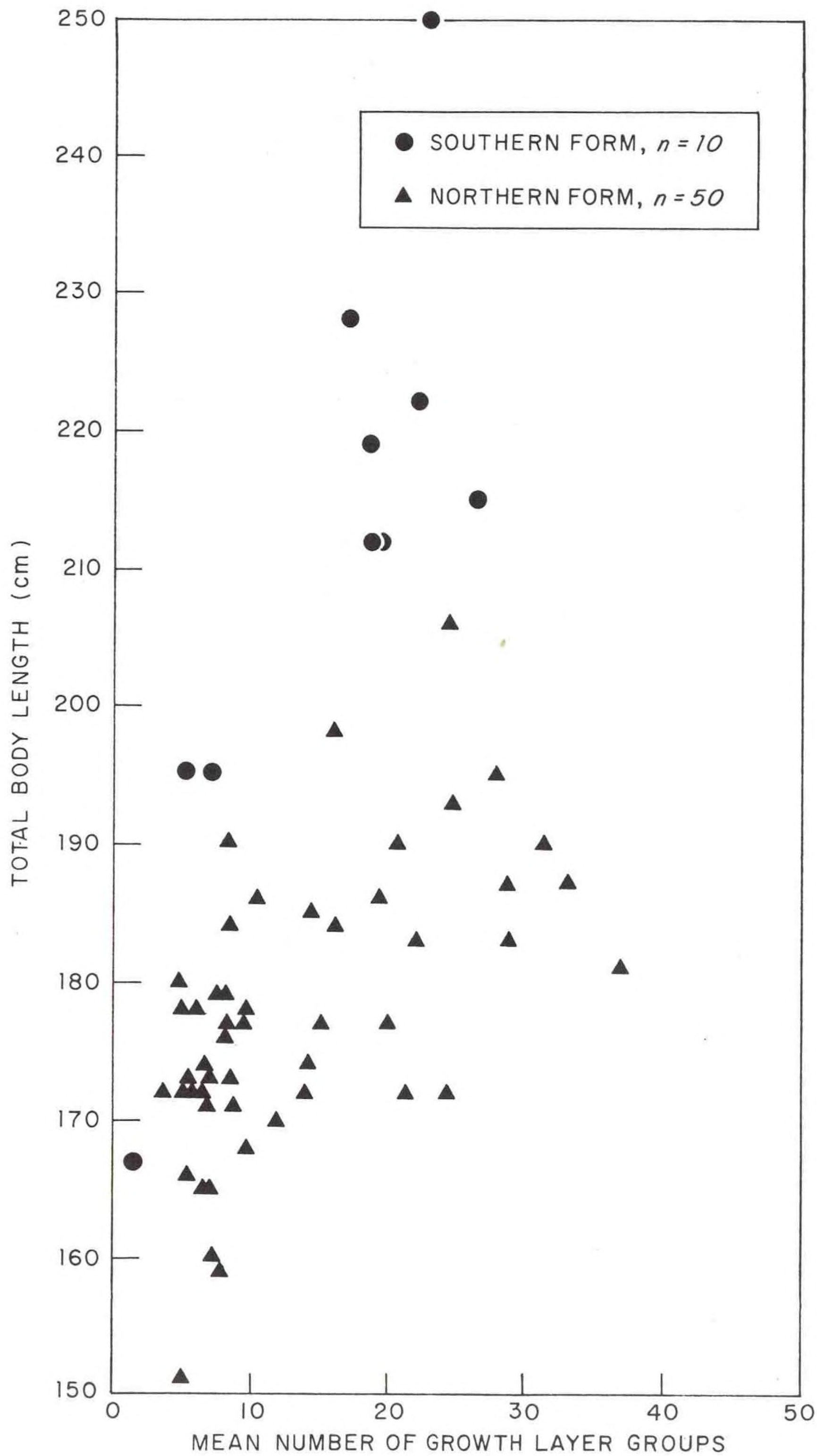

Figure 5. Relationship between total body length and mean number of growth layer groups (CLG's).

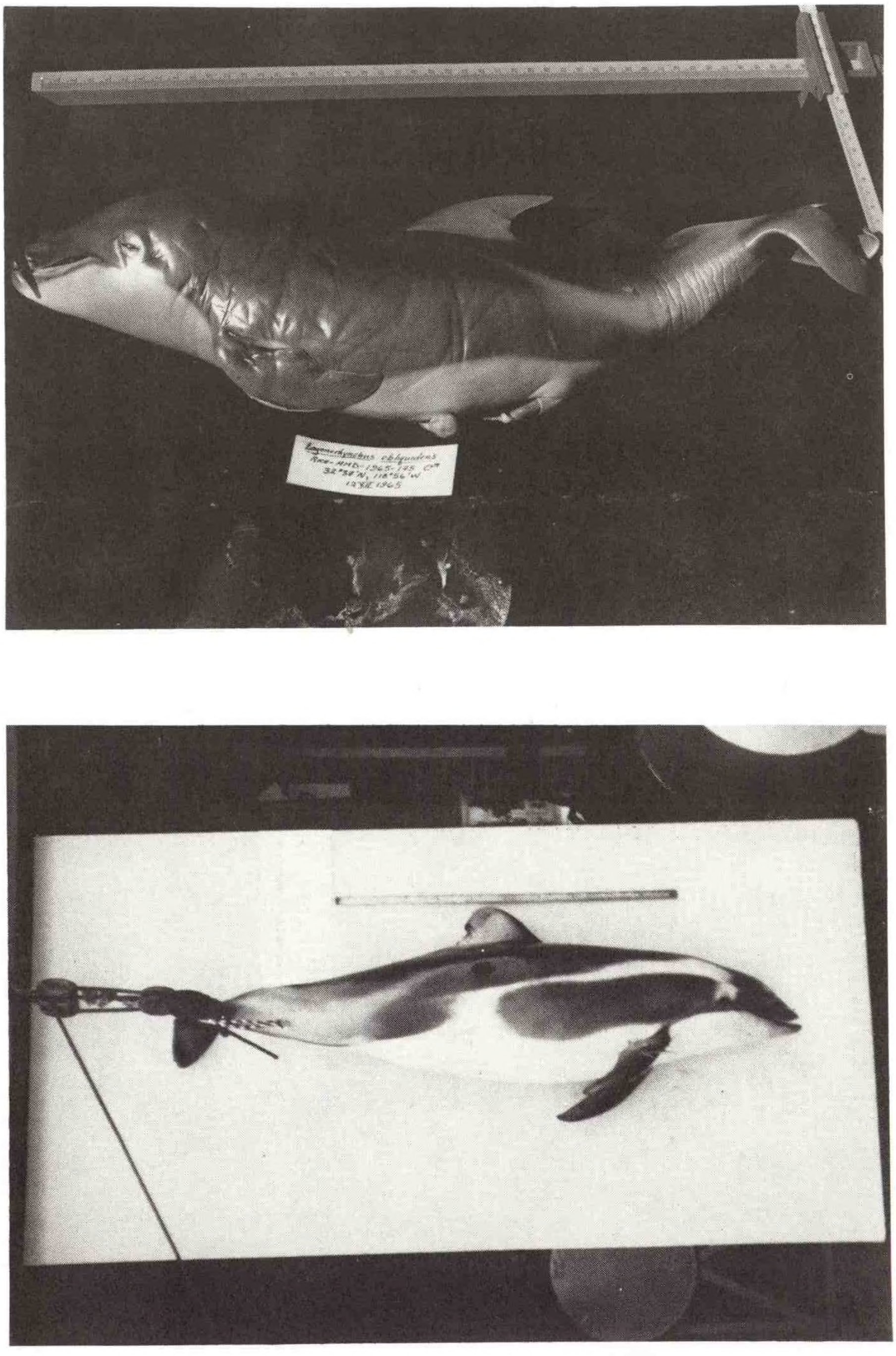

Figure 6. Top - A normally colored fetus (Specimen MMD-1965-175, a male collected by D. W. Rice, 12 December 1965 at 32°37'N, 118°56'W); Bottom - An anomously colored male, Specimen NMML 3766, collected by R. K. Stroud, 25 February 1966 at 37°46'N, 124° 30'W. (Photos by S. Leatherwood [top] and R. K. Stroud [bottom])

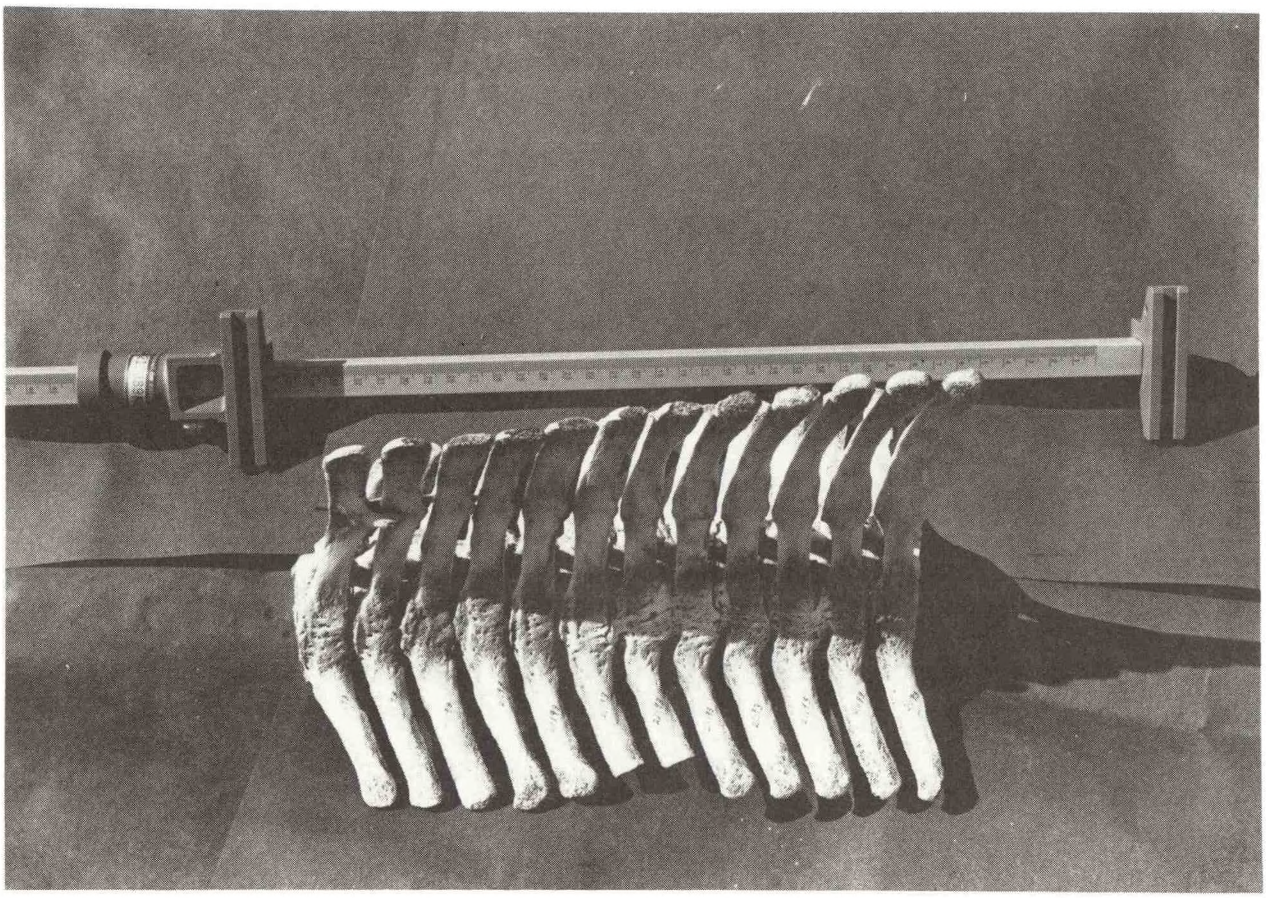

Figure 7. A section of lumbar vertebrae showing osteonecrosis found in the postcranial skeletons examined (photo by S. Leatherwood).

VII. TABLES

Table 1. Skull measurements (in mm) and meristics of *Lagenorhynchus obliquidens* from the northeastern Pacific. * indicates measurements used in principal components analysis.

Table 2. Age-length data for 145 specimens of *Lagenorhynchus obliquidens*.

Table 3. Summary of reproductive data on female northeastern Pacific *Lagenorhynchus obliquidens*.

Table 4. Summary of reproductive data on male northeastern Pacific *Lagenorhynchus obliquidens*.

Table 5. Published summaries of stomach contents of 7 *Lagenorhynchus obliquidens* collected south of Point Conception, California (ca 34° 30'N), 1952-1968.

Table 6. Summary of stomach contents from 23 *Lagenorhynchus obliquidens* from Southern California and the west coast of Baja California, Mexico.

Table 1. Skull measurements (in mm) and meristics of Lagenorhynchus obliquidens from the northeastern Pacific.
* indicates measurements in principal components analysis.

Variable	Sample	Range (mm)	Mean	Stand. Dev.
* 1 Condylobasal length	144	350-446	388.0	16.2
* 2 Rostrum length	144	171-228	195.6	10.3
* 3 Rostrum width at base	146	91-123	105.6	6.6
* 4 Rostrum width at 60 mm	145	66-95	78.6	6.2
* 5 Rostrum width at midlength	142	60-86	70.9	5.5
* 6 Premaxillary width at rostrum midlength	144	36-56	43.8	3.9
* 7 Rostrum width at 3/4 length	142	43-70	54.6	5.2
* 8 Rostrum tip to external nares	144	208-273	237.9	11.3
* 9 Rostrum tip to internal nares	123	206-277	243.8	12.9
* 10 Preorbital width	139	164-198	178.0	7.6
* 11 Postorbital width	141	181-214	194.5	7.2
* 13 External nares width	146	44-90	56.9	4.8
* 14 Zygomatic width	144	178-218	195.1	8.3
* 15 Greatest width of premaxillaries	147	80-103	89.9	3.6
* 16 Parietal width	144	148-184	168.8	6.2
* 19 Temporal fossa length	147	65-93	79.7	5.8
* 20 Temporal fossa width	148	50-78	60.8	4.9
* 25 Orbit length	141	47-65	53.9	3.0
* 26 Antorbital process length	142	25-47	36.1	3.6
* 27 Internal nares width	144	48-75	61.7	4.7
28 Pterygoid length	142	53-74	62.8	4.6
30 Bulla length	89	29-38	35.2	1.6
31 Periotic length	81	28-37	30.5	1.4
32 Upper tooth row length	142	154-213	179.1	9.9
33-36 Teeth (no.)	140|138	24-36|25-35	30.3|30.5	2.1|2.2
	145|144	23-34|25-35	30.1|30.1	2.0|2.0
37 Lower tooth row length	140	165-214	180.6	9.0
38 Ramus length	137	231-366	320.2	15.6
39 Ramus height	139	60-81	68.6	3.9
40 Tooth width	127	3.2-6.5	4.6	0.5

NOTE: Data from both populations are pooled. These calculations are presented solely to characterize cranial features of Lagenorhynchus obliquidens and to facilitate comparisons with other species of Lagenorhynchus.

Table 2. Age-length data for 145 specimens of *Lagenorhynchus obliquidens*

Specimen Number	Date Yr, Mo	Location Lat (°N), Long (°W)	Length (cm)	Sex	Mean Age (GLG's)
USNM 274627	44,11	4700,12409	183	-	22.0
SLO M1114	70,09	3422,11942	185	-	11.6
JRH 078	80,09	3315,11726	188	-	15.8
USNM 143140	05,09	5950,14800	190	-	08.1
CAS 13687	63,12	3924,12001	193	-	24.8
SDMNH 21226	57,08	3355,11715	---	M	24.5
USNM 274922	45,07	4800,12500	124	M	00.4
NMML 3215	66,03	3629,12230	151	M	05.0
TAC 21142	68,02	4613,12436	165	M	07.0
REJ 69-42	69,07	3645,12148	166	M	05.6
LACM 54719	71,08	3355,11830	167	M	07.1
USNM 286862	52,02	3400,11925	167	M	04.8
SDMNH 2333	80,05	3408,11918	168	M	09.7
LBV 11	70,06	3330,11822	170	M	07.7
CAS 16159	72,09	3702,12230	170	M	11.8
SDMNH 21217	55,04	3325,11825	172	M	07.8
LACM 54717	71,05	3405,11840	172	M	08.4
NMML 3791	65,06	3625,12231	172	M	05.8
REJ 872	75,07	3637,12157	172	M	14.1
CAS 13683	65,08	3754,12235	172	M	21.5
NMML 3766	66,02	3746,12430	172	M	03.6
LACM 54710	69,12	3325,11840	174	M	18.0
SBMNH 2346	81,04	3428,12007	174	M	16.3
NMML 3214	66,03	3629,12230	174	M	14.2
CAS 13948	63,12	3345,11825	175	M	10.1
NMML 3211	66,03	3629,12230	177	M	15.2
CAS 21378	72,05	3646,12149	177	M	09.5
SLO M1341	75,05	3513,12048	180	M	34.8
NMML 3206	66,02	3623,12214	180	M	04.8
USNM 270980	42,05	4614,12403	180	M	04.8
UCSB 11692	81,05	3425,11943	181	M	25.0
SLO M1321	71,10	3520,12050	181	M	30.3
NMML 3213	66,03	3629,12230	184	M	16.2
NMML 3224	66,03	3745,12313	186	M	10.5
WFP 82	71,05	3252,11715	187	M	14.0
LJH 012	82,02	3307,11820	187	M	25.0
MVZ 134415	66,06	3920,12255	187	M	32.8
WAW 114	71,05	3349,11824	190	M	15.8
SBMNH 917	73,03	3425,11940	190	M	28.2
CAS 16593	72,09	3730,12230	190	M	20.8
LACM 54721	73,07	3345,11825	191	M	18.8
LACM 54716	71,04	3345,11830	192	M	23.5
LACM 54714	70,12	3335,11812	193	M	11.2
SDMNH 21219	56,01	3251,11716	194	M	25.4
WAW 146	71,11	3315,11815	195	M	09.6
JEH 1051	81,05	3344,11805	195	M	08.4

WAW 137	71,09	3400,11830	196	M	27.0
LACM 54713	70,12	3335,11812	198	M	26.5
SBMNH 981	75,06	3422,11942	199	M	24.5
SDMNH 21223	57,01	3330,11820	200	M	24.6
LACM M-10-67	66,12	3325,11943	201	M	10.9
SBMNH 980	75,05	3416,11919	201	M	26.7
JRH 210	81,04	3247,11715	206	M	18.0
BURKE 30181	78,05	4755,12440	206	M	24.4
SBMNH 916	73,05	3422,11942	210	M	26.6
SBMNH 2380	80,07	3425,11940	210	M	27.6
WFP 239	60,04	3252,11715	217	M	24.0
MWD 207	79,08	2620,11365	219	M	18.4
JEH 1042	81,02	3340,11801	220	M	37.4
USNM 504413	76,02	2522,11252	228	M	17.2
MVZ 116037	50,07	2800,11445	250	M	23.2
SDMNH 21225	56,00	3325,11715	---	F	08.2
USNM 504234	57,01	3357,11716	153	F	02.8
NMML 3223	66,03	3742,12308	159	F	07.8
WAW 122	71,07	3353,11825	160	F	07.1
MVZ 115618	52,05	3800,12300	160	F	07.3
WAW 182	73,04	3352,11824	162	F	02.0
NMML 3208	66,03	3504,12133	162	F	04.0
SDMNH 20691	65,09	3330,11825	165	F	07.4
NMML 3277	68,02	4614,12440	165	F	06.8
USNM 504414	76,02	2522,11252	167	F	01.5
LACM 54718	71,08	3355,11830	168	F	10.0
NMML 3790	65,06	3625,12231	168	F	07.2
NMML 3765	66,02	3746,12326	168	F	09.8
NMML 3212	66,03	3629,12230	171	F	06.8
HSU 2418	58,09	4103,12409	171	F	08.7
JEH 1047	81,04	3400,11830	172	F	26.4
NMML 3221	66,03	3737,12307	172	F	24.5
NMML 3761	66,02	3746,12326	172	F	05.4
NMML 3763	66,02	3746,12326	172	F	06.6
NMML 3209	66,03	3629,12230	173	F	07.0
NMML 3222	66,03	3740,12308	173	F	08.5
NMML 3762	66,02	3746,12326	173	F	05.6
SDMNH 20146	62,06	3251,11716	174	F	30.2
SDMNH 21216	55,02	3330,11820	174	F	08.0
NMML 3218	66,03	3508,12125	174	F	05.5
NMML 3768	66,02	3746,12326	174	F	06.8
TAC 21143	68,02	4614,12440	174	F	06.5
SDMNH 21220	56,09	3330,11815	175	F	09.0
USNM 395870	66,08	3353,11826	175	F	05.6
SBMNH 2347	81,05	3506,12040	175	F	25.0
LACM 54722	72,09	3347,11810	176	F	03.6
NMML 3767	66,02	3746,12326	176	F	08.1
SDMNH 21215	54,10	---------	177	F	06.8
NMML 3207	66,03	3720,12338	177	F	08.2
NMML 3270	68,02	4614,12434	177	F	20.0
NMML 3760	66,02	3746,12326	178	F	05.9
NMML 3764	66,02	3746,12326	178	F	05.0
NMML 3275	68,02	4614,12433	178	F	09.4

SDMNH 21214	54,07	3320,11820	179	F	08.4
NMML 3210	66,03	3629,12230	179	F	08.0
NMML 3220	66,03	3641,12224	179	F	07.6
NMML 1965-175	65,07	3237,11856	180	F	08.7
LACM 54078	99,99	3340,11818	180	F	08.6
USNM 395871	67,08	3346,11810	180	F	14.2
LACM 54720	72,05	3357,11825	181	F	26.5
NMML 3217	66,03	3508,12125	181	F	09.0
MVZ 140845	70,02	3805,12255	181	F	37.2
LACM 54715	70,10	3320,11830	182	F	11.6
REJ 237	70,05	3645,12148	182	F	28.8
SBMNH 1205	75,07	3424,11931	183	F	20.0
USNM 276395	48,12	3745,12310	183	F	08.6
LACM 54712	70,10	3300,11800	185	F	21.5
CAS 16632	66,11	3345,11825	185	F	12.5
GDF 064	70,07	3405,11855	185	F	18.2
CAS 21431	79,11	3755,12240	185	F	14.5
USNM 504851	77,11	3819,12305	185	F	19.2
NMML 1968-103	6802	3348,11943	186	F	19.5
NMML 985	64,01	3407,12046	186	F	14.2
JRH 054	80,03	3305,11718	187	F	21.8
CAS 21379	73,04	3646,12149	187	F	28.8
WAW 192	73,07	3357,11927	188	F	26.2
NMML 3219	66,03	3602,12155	188	F	09.8
NMML 1969-54	69,06	4800,12240	190	F	31.4
SDMNH 21221	56,09	3345,11820	191	F	29.4
CAS 16748	66,11	3345,11825	191	F	16.6
NMML 3216	66,03	3508,12125	191	F	07.2
WAW 110	99,99	3330,11922	194	F	27.6
MVZ 095088	39,10	2658,11306	195	F	05.2
LACM 54077	70,06	3250,11705	195	F	24.8
CAS 16623	74,12	3805,12025	195	F	28.0
USNM 504416	76,02	2522,11252	196	F	06.9
LACM 54711	70,02	3320,11830	197	F	11.8
USNM 290512	49,07	4830,12845	198	F	16.0
WAW 150	72,03	3402,11846	199	F	18.7
LACM 54076	70,05	3248,11717	201	F	29.2
WFP 591	79,04	3252,11715	208	F	26.4
SDMNH 21224	57,01	3330,11825	210	F	16.0
LACM 27410	66,04	3345,11808	210	F	36.0
MWD 183	79,05	2620,11343	212	F	19.5
USNM 504412	76,02	2522,11252	212	F	18.8
USNM 504415	76,02	2522,11252	215	F	26.6
MVZ 116038	50,07	2615,11445	222	F	21.8
WFP 472	74,07	3251,11715	233	F	46.0
CRL M-56-68	68,04	3330,11825	236	F	31.2

Table 3. Summary of reproductive data on female northeastern Pacific Lagenohynchus obliquidens.

Specimen No.	Location Lat(N)	Location Long(W)	Collection Date YMD	Mean GLG No.	Weight (kg)	Total Length (cm)	Gonad Weights Left	Gonad Weights Right	No. of Corpora Left	No. of Corpora Right	Source of Data or Reproductive Specimens	Reproductive Comments
NMML 3223	37°42'	123°08'	66-03-25	7.8	65	159	3.3	2.7	0	0	NMML	Follicle diameter: 35-40 microns.
NMC L-02-19	34°07'	119°06'	67-07-13	—	—	162	5.5	5.5	—	—	NUC	———
NMML 3208	35°04'	121°33'	66-03-09	4.0	66	162	1.2	1.2	0	0	NMML	Immature, follicle diameter: 0.5 mm.
NMML 3277	46°14'	124°40'	68-02-26	6.8	67	165	1.3	1.1	0	0	NMML	Immature, follicle diameter: 0.9 mm.
NMML 3273	46°14'	124°40'	68-02-26	—	71	167	2.2	3.1	0	0	NMML	Follicle diameter: left 1.7 mm.; right 2.9 mm.
NMML 3790	36°25'	122°31'	65-06-19	7.2	73	168	6.3	3.8	0	0	NMML	Follicle diameter: left 6.7 mm.; right 3.1 mm.
18-68	33°30'	118°25'	68-02-28	—	—	168	1.0	0.9	0	0	Harrison et al., 1969	No follicles over 100 microns.
NMML 3765	37°46'	123°26'	66-02-25	9.8	73	168	4.8	2.3	0	0	NMML	Follicle diameter: left 5.1 mm.; right 1.9 mm.
06-63	33°45'	118°25'	63-05-04	—	68	169	—	—	0	0	Harrison et al., 1969	Few small follicles 350 microns in both ovaries.
TAC-59-3	35°42'	121°41'	59-02-27	—	85	170	—	—	0	0	Fiscus & Niggol, 1965	Barely visible follicles on left ovary.
NMML 3212	36°29'	122°30'	66-03-05	6.8	69	171	3.0	2.6	0	0	NMML	Follicle diameter: left 2.4 mm.; right 2.6 mm.
HSU 2418	41°03'	124°09'	58-09-11	8.7	62	171	—	—	0	0	Houck, 1961	no corpora present.
NMML 3221	37°37'	123°07'	66-03-25	24.5	83	172	4.0	2.0	17	6	NMML	Follicle diameter: left 1.6 mm.; right 2.0 mm.
NMML 3761	37°46'	123°26	66-02-25	5.4	75	172	0.7	1.4	0	0	NMML	Follicle diameter: left 1.6 mm.; right 4.3 mm.
NMC L-02-12	33°50'	119°10'	64-06-02	—	80	173	—	—	0	0	NUC	Lab report indicates no corpora present.
38-63	33°45'	118°25'	63-10-20	—	81	173	—	7.5	—	4	Harrison et al., 1969	Few follicles up to 500 microns in diameter.
NMML 3209	36°29'	122°30'	66-03-05	7.0	78	173	3.8	3.2	0	0	NMML	Follicle diameter: left 1.7 mm.; right 1.1 mm.
NMML 3222	37°40'	123°08'	66-03-25	8.5	72	173	3.1	2.3	0	0	NMML	Follicle diameter: left 2.7 mm.; right 2.5 mm.
NMML 3762	37°46'	123°26'	66-02-25	5.6	75	173	1.8	1.6	0	0	NMML	Follicle diameter: left 1.4 mm.; right 1.7 mm.
NMML 3218	35°08'	121°25'	66-03-10	5.5	83	174	5.5	2.4	1	0	NMML	Follicle diameter: left 4.0 mm.; right 1.8 mm.
SJSU C-195	36°48'	121°47'	77-05-04	—	—	174	—	—	—	—	SJSU	Pregnant, 84 cm fetus.
NMML 3768	37°46'	123°26'	66-02-25	6.8	77	174	5.0	4.3	0	0	NMML	Follicle diameter: left 3.7 mm.; right 1.9 mm.
NMML 3269	46°14'	124°34'	68-02-25	—	75	174	2.6	1.8	0	0	NMML	Follicle diameter: left 4.1 mm.; right 2.9 mm.
TAC 21143	46°14'	124°40'	68-02-25	6.5	75	174	1.3	1.1	0	0	NMML	Follicle diameter: left 0.5 mm.; right 0.4 mm.
07-63	33°45'	118°25'	63-05-05	—	69	174	2.6	2.6	0	0	Harrison et al., 1969	No follicles over 120 microns in either ovary.
SBMNH 2347	35°06'	121°40'	81-05-03	25.0	—	175	7.2	7.1	—	—	SBMNH	Ovaries not examined: animal not pregnant or lactating.
NMML 3271	46°14'	124°34'	68-02-25	—	84	175	6.1	2.1	6	0	NMML	Follicle diameter: left 2.6 mm.; right 1.8 mm.

NMML US-61-P1	51°45'	128°00'	61-01-26	--	89	175	2.2	--	0	—	NMML	Left ovary only diameter 0.7 mm.
36-68 USNM 395870	33°53'	118°26'	66-08-15	5.6	66	175	2.0	2.5	0	0	Harrison et al., 1969	No follicles over 120 microns in either ovary.
NMML 3767	37°46'	123°26'	66-02-25	8.1	78	176	2.7	3.7	0	0	NMML	Follicle diameter: left 1.6 mm.; right 1.7 mm.
WAW 174	33°36'	118°09'	71-09-21	—	—	176	10.6	2.0	9	0	Sawyer & Walker, 1977	------
NMML 3207	37°20'	123°38'	66-03-03	8.2	83	177	3.1	4.4	0	0	NMML	Follicle diameter: left 1.8 mm.; right 3.2 mm.
NMML 3270	46°14'	124°34'	68-02-25	20.0	86	177	7.8	4.1	15	0	NMML	Lactating; follicle diameter: left 1.3 mm.; right 1.8 mm.
NMML 3760	37°46'	123°26'	66-02-25	5.9	76	178	2.2	2.7	0	0	NMML	Follicle diameter: left 1.7 mm.; right 3.0 mm.
NMML 3764	37°46'	123°26'	66-02-25	5.0	78	178	5.5	4.2	0	0	NMML	Follicle diameter: left 2.7 mm.; right 1.9 mm.
NMML 3275	46°14'	124°33'	68-02-26	9.4	82	178	4.4	2.3	1	0	NMML	Follicle diameter: left 4.8 mm.; right 2.0 mm.
69-7-4	33°30'	118°25'	69-02-01	—	—	178	7.3	4.2	5	0	Harrison et al., 1969	Follicle diameter: right ovary 2.0 mm.
NMML 3210	36°29'	122°30'	66-03-05	8.0	89	179	3.0	6.3	0	4	NMML	Follicle diameter: left 2.3 mm.; right 3.8 mm.
NMML 1965-175	32°37'	118°56'	65-07-12	8.7	97	180	—	—	—	—	NMML	Animal pregnant, 45 cm fetus; not lactating.
USNM 395871	33°46'	118°10'	67-08-21	14.2	55	180	6.5	3.0	9	0	Harrison et al., 1969	No follicles over 120 microns.
NMML 3217	35°08'	121°25'	66-03-10	9.0	81	181	5.5	3.2	2	0	NMML	Follicle diameter: left 2.9 mm.; right 2.5 mm.
MVZ 140845	38°05'	122°55'	70-02-09	37.2	—	181	—	—	—	—	MVZ	Field records report numerous corpora albicantia on both ovaries.
MLP 70-19-1	33°45'	118°25'	70-09-22	—	—	182	—	—	—	—	MLP	Captive animal; gave birth to 95 cm, 25 lb. male calf; calf lived 1/2 hr.
TAC 59-4	36°58'	122°53'	59-03-05	—	88	182	—	—	—	—	Fiscus & Niggol, 1959	Authors reported "numerous follicles" and considered the animal nulliparous.
69-06-2	33°35'	118°25'	69-06-01	—	84	183	10.1	5.1	5	0	Harrison et al., 1969	Animal aborted a near term fetus on 06-03-01.
TAC 59-1	35°16'	121°35'	59-02-14	—	84	183	—	—	—	—	Fiscus & Niggol, 1959	Reported numerous follicles; apparently nulliparous.
02-63	33°30'	118°35'	62-10-00	—	74	183	—	4.1	—	0	Harrison et al., 1969	No follicles over 120 microns in right ovary.
USNM 276395	37°45'	123°10'	48-12-12	8.6	95	183	—	—	—	—	USNM	Data state the animal was pregnant.
21-68	33°45'	118°25'	68-01-14	—	—	185	9.5	5.5	4	21	Harrison et al., 1969	Follicle diameter: ranged from 3-15 mm.
16-62	33°30'	118°25'	62-10-00	—	77	185	4.2	4.1	0	0	Harrison et al., 1969	No follicles over 120 microns.
13-62	33°57'	118°25'	62-08-24	—	65	185	8.3	13.3	0	4	Harrison et al., 1969	Numerous cystic follicles ranging from 1-2 cm diameter.
LACM 54712	33°45'	118°20'	70-10-26	21.5	86	185	—	—	11	—	LACM	Necropsy records reported 11 CA's on left ovary.
NMML 1968-103	33°48'	119°43'	68-02-08	19.5	88	186	—	—	—	—	NMML	Necropsy records report "many CA's" on left ovary.
NMML 985	34°07'	120°46'	64-01-08	14.2	91	186	6.8	1.9	4	0	NMML	Not lactating; mammary thickness 10 mm.
SJSU 2158	36°37'	121°54'	78-04-04	—	85	186	7.4	5.6	23	12	SJSU	Follicle diameter: left 2.2 mm.; right 4.3 mm.
15-62	33°30'	118°25'	52-10-00	—	76	186	4.4	6.1	—	—	Harrison et al., 1969	No follicles over 120 microns in either ovary.

"DEBBIE"	33°30'	118°25'	69-07-05	--	--	186	3.2	2.6	—	—	Harrison et al., 1969	No follicles over 120 microns in either ovary.
83-66	34°25'	118°30'	66-11-30	--	66	187	14.0	5.0	18	0	Harrison et al., 1969	Aborted fetus two weeks prior to death.
NMML 3219	36°02'	121°58'	66-03-22	9.8	93	188	5.5	2.5	3	0	NMML	Follicle diameter: left 3.1 mm.; right 2.5 mm.
HSU 2689	41°35'	124°06'	78-06-08	--	80	188	5.6	--	23	—	HSU	Lactating; only left ovary examined; follicle diameter: 3.1 mm.
NMC L-13-64	34°20'	119°25'	65-05-17	--	76	190	9.0	4.0	--	--	NUC	Ovarian tissue not examined.
NMML 3216	35°08'	121°25'	66-03-10	7.2	101	191	16.8	3.0	1	0	NMML	Pregnant, 72 cm male fetus; follicle diameter: left 2.4 mm.; right 1.6 mm.
RB 2118	37°24'	122°27'	73-04-14	—	—	193	—	—	—	—	Ray Bandar priv. coll.	Pregnant, records indicate "full term fetus".
USNM 504416	25°22'	112°52'	76-02-11	6.9	--	197	5.3	4.7	0	0	USNM	Immature.
LACM 54711	33°20'	118°25'	70-10-20	11.8	--	197	--	--	0	9	LACM	Captive animal; aborted 29 cm fetus.
WAW 150	34°00'	118°48'	72-03-04	—	—	199	8.8	4.2	7	0	Sawyer & Walker, 1977	———
LACM 54076	32°48'	117°17'	70-05-07	29.2	—	201	—	—	—	—	LACM	Pregnant, 81.0 male fetus.
WFP 591	32°52'	117°15'	79-04-16	26.4	—	208	--	—	—	—	SWFC	Lab reports about 10 CA's; lactating; uterin condition postpartum.
USNM 504412	25°22'	112°52'	76-02-11	18.8	142	212	28.6	4.2	4	2	USNM	Pregnant, 52 cm fetus; follicle diameter: 2.0 mm.; not lactating.
MWD 183	26°20'	113°43'	79-08-25	19.5	145	212	15.5	5.8	14	1	USNM	Follicle diameter: left 2.6 mm.; right 3.8 mm.
USNM 504415	25°22'	112°52'	76-02-11	26.6	140	215	12.0	3.2	10	0	USNM	Lactating; follicle diameter: left 1.4 mm.; right 1.6 mm.
56-68	33°30'	118°25'	68-04-12	31.2	--	236	12.5	4.5	23	0	Harrison et al., 1969	Few follicles 2.0 mm. diameter.

Table 4. Summary of reproductive data on male northeastern Pacific *Lagenohynchus obliquidens*.

Specimen Number	Location of Collection Lat(N)	Location of Collection Long(W)	Date of Collection Y/M/D	Length (cm)	Weight (kg)	Mean Number GLG's	Testis Weights (gr) Left	Testis Weights (gr) Right	Testis Length (cm) Left	Testis Length (cm) Right	Tubule diameter (m)	Sperm Present Tubules	Sperm Present Epidymus	Source of Data or Specimens	Reproductive Comments
CPSLO ----	35°06'	120°38'	67-03-22	148	—	—	23.5	24.0	15.0	15.0	—	—	—	CPSLO	
NMML 3215	36°29'	122°30'	66-03-05	151	58	5.0	15.0	12.0	—	9.0	40	No	No	NMML	
NMML 3272	46°13'	124°36'	68-02-26	152	59	—	5.1	5.2	—	7.5	40	No	No	NMML	
NMC L-01-6	34°10'	119°15'	64-01-27	152	46	—	25-35.0	25-35.0	8-10.0	8-10.0	—	Undet.	Undet.	Ridgway & Green, 1967	Teste weights and lengths are approximate
NMC L-12-55	34°20'	119°16'	67-02-24	155	—	—	—	7.5	—	7.0	—	Undet.	No	NMC	
19-67	33°52'	118°25'	67-05-10	164	64	—	14.7	18.0	8.0	8.0	90	Undet.	No	Harrison et al., 1972	Teste weight w
NMML 3276	46°13'	124°36'	68-02-26	165	75	7.0	13.7	13.7	—	8.6	40	No	No	NMML	
29-64	33°53'	118°27'	64-10-16	170	56	—	—	—	—	—	110	Undet.	No	Harrison et al., 1972	
14-24	34°02'	118°50'	64-04-21	170	74	—	305.0	340.0	21.0	22.0	160	Undet.	No	Harrison et al., 1972	
NMML 3766	37°46'	124°30'	66-02-25	172	79	3.6	15.0	16.0	—	9.5	50	No	No	NMML	
NMML 3214	36°29'	122°30'	66-03-05	174	82	14.2	130.0	140.0	—	19.0	—	Undet.	Undet.	NMML	
NMML 3211	36°29'	122°30'	66-03-05	177	84	15.2	130.0	150.0	—	21.0	—	Undet.	Undet.	NMML	
17-63	33°52'	118°23'	63-12-17	178	63	—	25.0	25.0	7.3	8.5	70	Undet.	No	Harrison et al., 1972	
82-66	33°25'	119°43'	66-12-21	178	55	—	14.0	22.5	8.5	8.0	70	Undet.	No	Harrison et al., 1972	Teste weight w
NMML 3274	46°14'	124°33'	68-02-26	179	97	—	121.0	133.3	219.0	235.0	80	Yes	Undet.	NMML	
17-62	38°17'	122°28'	62-12-17	180	61	—	21.0	22.1	50.0	90.0	70	Undet.	No	Harrison et al., 1972	
NMML 3206	36°23'	122°14'	66-02-17	180	78	4.8	18.0	25.0	—	120.0	70	No	No	NMML	
SBMNH 11692	34°25'	119°43'	81-05-18	181	—	25.0	345.0	—	—	—	—	Undet.	Undet.	SBMNH	
TAC 59-2	35°28'	121°38'	59-02-22	181	90	—	—	—	—	40.0	135	Undet.	Undet.	NMML	
28-64	33°45'	118°25'	64-09-19	183	78	—	107.0	100.0	—	—	—	Undet.	No	Harrison et al., 1972	
L-2	33°30'	118°22'	64-11-27	183	76	—	17.8	17.2	8.6	8.8	70	Undet.	No	Harrison et al., 1972	
NMML 3213	36°29'	122°30'	66-03-05	184	99	16.2	155.0	170.0	215.0	22.0	—	Undet.	Undet.	NMML	
27-65	34°02'	118°29'	66-07-17	184	—	—	15.0	15.5	9.5	9.5	75	Undet.	No	Harrison et al., 1972	
NMML 3224	37°45'	123°13'	66-03-25	186	91	10.5	175.0	165.0	225.0	230.0	110	Yes	No	NMML	
WFP 082	32°52'	117°15'	71-05-16	187	77	14.0	455.0	454.0	—	—	—	—	—	SWFC	
NMC 68-L-17	34°10'	119°45'	64-10-27	188	72	—	35.0	35.0	—	—	—	Undet.	Undet.	NMC	
SDMNH 21219	32°51'	117°16'	56-01-08	194	99	25.4	150.0	150.0	30.0	30.0	75	Undet.	No	SDMNH	
JEH 1051	33°44'	118°05'	81-05-16	195	79	8.4	17.0	20.0	8.2	9.0	75	No	No	LACM	
RMG 4605	25°30'	113°35'	69-04-23	198	—	—	52.0	59.0	14.0	14.0	—	Undet.	No	Harrison et al., 1972	
SDNMH 21223	33°30'	118°20'	57-01-24	191	125	24.6	250.0	—	30.0	—	—	Undet.	Undet.	SDNMH	
RMG 4-68	33°30'	118°20'	57-01-24	191	—	—	250.0	—	30.0	30.0	—	Undet.	No	Harrison et al., 1972	
LACM 54714	33°35'	118°12'	70-12-09	193	90	11.2	162.0	154.0	32.0	30.0	—	Undet.	Undet.	LACM	
04-68	33°30'	118°25'	68-02-16	194	—	—	34.5	35.0	12.0	11.5	75	Undet.	No	Harrison et al., 1972	
SDNMH 981	34°22'	199°42'	75-06-16	199	133	24.5	900.0	900.0	37.0	37.5	—	Undet.	Yes	SDNMH	
CPSLO M-1218	35°06'	120°38'	72-08-20	200	—	—	—	—	45.0	45.0	—	Undet.	Yes	CPSU	
R&G	34°04'	119°30'	65-08-15	200	102	—	548.0	559.0	24.0	24.5	200	Undet.	Yes	Harrison et al., 1972	
10-67	33°25'	119°43'	66-11	201	73	10.9	104.0	106.0	19.0	17.0	100	Undet.	No	Harrison et al., 1972	
NMC 104-L-20	34°30'	119°40'	67-08-02	213	100	—	540.0	510.0	35.0	35.0	—	Undet.	No	NMC	
MWD 182	26°20'	113°43'	79-08-25	219	157	18.4	—	580.0	—	—	180	Yes	No	SWFC	
JEH 1042	33°40'	118°01'	81-02-16	220	124	37.4	634.0	—	30.0	—	164	Yes	No	LACM	
USNM 504413	25°22'	112°52'	76-02-11	228	198	17.2	316.5	326.5	31.0	31.0	205	Yes	No	USNM	

Table 5. Published summaries of stomach contents of 7 Lagenorhynchus obliquidens collected south of Point Conception, California (ca 34 30'N), 1952-1968.

Date	Location of Collection	Source of Information	Types of Stomach Contents
27 Feb 52	10 nm S.E. Anacapa lighthouse	Scheffer (1953)	squid beaks and eyes; jellyfish;
06 Jun 54	San Pedro Lighthouse Los Angeles, County, CA	Brown and Norris (1956)	anchovies; misc. fish bones, otoliths scales and eyes, and squid
22 Aug 63	near Santa Monica pier	Fitch and Brownell (1968)	anchovy; hake
08 Jan 64	34 07'N, 120 46'W	Kajimura et al. (1980), Stroud et al. (1981)	squid; unidentified fish
12 Dec 65	32 37'N, 118 56'W	Kajimura et al. (1980)	mackerel; sand dab. squid; misc. other cephalopods
12 Aug 67	Long Beach, CA	Fitch and Brownell (1968)	Pacific hake; anchovies; queen fish.
08 Feb 68	33 48'N, 119 43'N	Kajimura et al. (1980), Stroud et al. (1981)	squid, (principally Loligo)

Table 6. Summary of stomach contents from 23 Lagenorhynchus obliquidens from Southern California and the west coast of Baja California, Mexico.

Food Item	Volume ml.	Volume % of Total	Number No.	Number % of Total	Occurrence No.	Occurrence % (N=23)
TOTAL	23800	100	5469	100	-	-
FISH	23490	98.70	5184	94.90	20	86.90
Clupeidae						
Sardinops sagax	243	1.00	9	0.20	3	13.00
Engraulidae	17936	75.40	4212	77.00	18	78.30
Engraulis mordax						
Bathylagidae						
Leuroglossus stilbius	tr.	-	1	0.02	1	4.30
Myctophidae						
Diaphus theta	tr.	-	1	0.02	1	4.30
Triphoturus mexicanus	tr.	-	9	0.02	2	8.70
Batrachoididae						
Porichthys notatus	tr.	-	21	0.40	3	13.00
Porichthys myriaster	tr.	-	16	0.30	2	8.70
Ophidiidae						
Chilara taylori	tr.	-	3	0.05	2	8.70
Merlucciidae						
Merluccius productus	507	2.10	778	14.00	14	60.90
Scorpaenidae						
Sebastes sp.	tr.	-	40	0.70	3	13.00
Anoplopomatidae						
Anoplopoma fimbria	tr.	-	2	0.04	1	4.30
Carangidae						
Trachurus symmetricus	1063	4.50	55	1.00	8	34.80
Sciaenidae						
Genyonemus lineatus	tr.	-	8	0.10	1	4.30
Seriphus politus	tr.	-	2	0.04	1	4.30
Scombridae						
Pneumatophorus japonicus	3741	15.70	20	0.40	1	4.30

Stromateidae						
Peprilus simillus	tr.	-	5	0.10	2	8.70
Cynoglossidae						
Symphurus atricauda	tr.	-	1	0.02	1	4.30
Pleuronectidae						
Hypsosetta guttata	tr.	-	1	0.02	1	4.30
CEPHALOPODS	310	1.30	285	5.10	14	60.90
Loliginidae						
Loligo opalescens	310	1.30	220	4.00	13	56.50
Gonatidae						
Gonatus spp.	tr.	-	28	0.50	1	4.30
Octopoteuthidae						
Octopoteuthis sp.	tr.	-	8	0.10	3	13.00
Onychoteuthidae						
Onychoteuthis sp.	tr.	-	23	0.40	3	13.00
Octopodidae						
Octopus sp.	tr.	-	6	0.10	2	8.70