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STOMACH CONTENT ANALYSIS OF SHORT-FINNED PILOT WHALES *(Globicephala macrorhynchus)* AND NORTHERN ELEPHANT SEALS *(Mirounga angustirostris)* FROM THE SOUTHERN CALIFORNIA BIGHT

by

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INTRODUCTION

Stomach content analyses of four short-finned pilot whales (Globicephala macrorhynchus) and twenty-one northern elephant seals (Mirounga angustirostris) from the Southern California Bight are presented in this report.

The feeding habits and related movements of Globicephala macrorhynchus in the eastern North Pacific are essentially undescribed. Seagars and Henderson (1985) reported the remains of cephalopods Loligo opalescens, Moroteuthis robusta and Histioteuthis dofleini from the stomach of a pilot whale collected near Santa Catalina Island, California. Hall (1971) mentions squid "beaks" found in "several" of twenty-eight pilot whales stranded on San Clemente Island, California, and Kritzler (1952) reported squid "beaks" from the intestines of two pilot whales that died in captivity. Sergeant (1962) found that Globicephala melaena prey almost exclusively on the short-finned squid (Illex illecebrosus) in Newfoundland waters, taking fish (specifically cod, Gadus morhua L.) in the absence of squid. The range of the short-finned pilot whale in the eastern North Pacific extends from the tropics to the Gulf of Alaska, with greatest abundance south of Point Conception (Reilly, 1978; Fiscus, 1979). Walker (1975) describes a group of 20-30 animals considered resident to the Catalina Channel area inclusive of San Clemente and Santa Barbara Islands. Norris and Prescott (1961) suggested that inshore resident animals may be joined in winter months by an offshore group concomitant with the spawning season of the market squid, Loligo opalescens. The results from this study and the Seagars and Henderson 1985 report lend support to the suspected dietary reliance of the short-finned pilot whale on squid.

Analyses of stomach contents from northern elephant seals have been reviewed and augmented by several authors (Antonelis and Fiscus, 1980; Jones, 1981; Condit and LeBeouf, 1984), and are summarized and expanded in this report. The breeding range of Mirounga angustirostris extends from the islands off the Pacific coast of Baja California, Mexico, north to the Farallon Islands, including a recently established mainland rookery off Año Nuevo Point, California (LeBeouf and Panken, 1977). The non-breeding range continues from the Pacific coast of Baja California, Mexico as far north as the Gulf of Alaska. Sightings are reported seaward of the continental shelf (Kenyon and Scheffer, 1955; Delong, 1978; Antonelis and Fiscus, 1980), and in pelagic waters over seamount areas and submarine canyons (Morejohn et al., 1978). Return to and residence on the rookery sites, where seals "haul out" for up to two months for breeding and molting, varies according to age and sex (Antonelis and Fiscus, 1980). Little or no feeding takes place during this time (Scammon, 1874; Townesend, 1912; Huey, 1924, 1925; Morejohn et al.,1978; Condit and LeBeouf, 1984). The return to sea after these periods represents a departure for feeding areas north of the rookeries (Condit and LeBeouf, 1984), and the resumption of foraging behavior that is poorly understood.

METHODS

Sample Collection

Stomach contents from four pilot whales and twenty-one elephant seals were available for examination. Samples were collected within the Southern California Bight from 33°42'N to 34°26'N over a period of fourteen years (Table I and II). All of the elephant seals and one pilot whale (WAW-790) in the sample were stranded of unknown cause. Pilot whale samples WAW-404, WAW-405, and SBMNH 77-54 stranded as a result of incidental fisheries mortality. Elephant seal samples 72-77S, 73-141S, and 73-133S were stranded alive and maintained in captivity for three, four and six days prior to their death. The animals refused food during this time. Stomach contents from these three animals were retained from meals prior to the date of collection and captivity.

Stomach volumes were obtained on three of the pilot whales and one elephant seal. Excess liquid was drained from the stomach contents and the amount of water then displaced by the material was measured by graduated cylinder. In all cases, stomachs were rinsed and the contents were rough sorted by a general flotation-decanting technique (as described in Jones, 1981) and stored in alcohol.

Sample Identification

Cephalopod beaks, otoliths (sagittae), elasmobranch egg cases, and fleshy remains from fish and cephalopods were used to identify prey species. Cephalopod beaks were identified by comparison with the reference collections of the Santa Barbara Museum of Natural History, Santa Barbara, California, of the William A. Walker private collection, Los Angeles, California, and of the National Marine Mammal Laboratory, Seattle, Washington. Descriptive references included Iverson and Pinkas (1971) and Voss (1969). Otolith identification was made by the late John E. Fitch, California Department of Fish and Game. The otolith reference collection of the National Marine Mammal Laboratory, was also used for comparative purposes. Elasmobranch egg cases were identified to species based on Cox (1963). Voucher specimens for otoliths and cephalopod beaks are archived at Santa Barbara Museum of Natural History.

The highest number of either upper or lower cephalopod beaks was recorded as the maximum count for each species present (Table 3 and 4). Because deterioration of the otoliths obscured any distinction between left and right, otoliths from each representative species were totaled and halved, resulting in a minimum estimate of the number of fish present. This should be taken into account in Figure 4. Egg cases were recorded individually and included in the total count of fishes.

Sample Analysis

The number, frequency of occurrence and length estimates of ingested prey were recorded (Tables 3 & 4 ; Figure 1). Available volumetric data is presented in the results section. Beaks and otoliths were used to determine body lengths of two of the dominant prey species (the market squid, *Loligo opalescens*, and pacific hake, *Merluccius productus*).

Upper hood length was measured to the nearest .01mm. on 676 *Loligo opalescens* beaks. Beak length frequency histograms are presented in Figure 1. Kashiwada et al., (1979) determined that upper hood length (UHL) correlated most highly with mantle length among a series of beak measurements on *Loligo opalescens* from southern California. An approximation of mantle length using the findings of Kashiwada et al. (1979) from a combined sample of males and females is discussed. *Loligo opalescens* beaks from this sample were in good condition, showing little or no wear.

Hake ages were estimated from a known age-length series of 31 otoliths from hake collected off the California coast in 1979. The approximate ages and body lengths were then compared with findings from Dark (1975) for hake collected off California, Oregon and Washington, 1965-1969. The age categories assigned to the hake otoliths are illustrated in Figure 2. Due to erosion of otoliths in the stomachs, the size of hake were underestimated by this method.

RESULTS

Globicephala macrorhynchus

The 647 prey items recovered from the pilot whales consisted entirely of cephalopod beaks and fleshy remains (Table 3). *Loligo opalescens* was present in each of the four stomachs comprising 617 (95%) of the individual food items present. The onychoteuthid, *Moroteuthis robustus*, occurred in three stomachs totaling seven individuals. A total of nine *Histioteuthis dofleini* were present in two stomachs. In the only other report of identified remains from the stomach contents of the short-finned pilot whale, Seagars and Henderson (1985) counted an approximate one hundred fourteen L. opalescens, one M. robustus, and one H. dofleini from an animal collected near Santa Catalina Island, California.

Two lower beaks of an unidentified gonatid (probably Berryteuthis magister or Gonatopsis borealis) were present in one stomach. The beaks were compared to the Clarke and Macleod (1980) voucher specimen for Berryteuthis magister (identified from the stomachs of sperm whales taken in western Canadian waters) and found to be very similar in structure. Berryteuthis magister is subarctic in distribution with Oregon as the known southern range extreme (Young, 1972). Gonatopsis borealis, also a subarctic inhabitant, is common to southern California waters (Young, 1972). To date, the two are considered indistinguishable by comparison of beak structure alone (C.H. Fiscus, pers. comm.). The beak specimen from this sample is illustrated in Figure 3.

The length-frequency distribution for upper hood length of Loligo opalescens beaks ranged from 4.4 to 11.5 mm. (Figure 2). The corresponding approximation of mantle lengths from Kashiwada et al. (1979) range from 90 to over 200 mm. Specimen SBMNH 77-54 contained fleshy remains of L. opalescens including intact mantles with egg masses, gladii and beaks. Mantle length measurements on fifteen of these specimens ranged from 110-170 mm. with a mean of 138 mm. Seagars and Henderson (1985) estimated a range of 112-142 mm. with a mean of 128 mm. for mantle length measurements on eleven intact or nearly intact L. opalescens from their sample. The average diameter for individual eggs present in gravid specimens from sample SBMNH 77-54 was 2.0 mm.

Stomach content volumes were recorded on three of the four samples: WAW 405 = 1.2 liters; WAW 790 = 0.6 liters; SBMNH 77-54 = 2.2 liters.

Mirounga angustirostris

Fishes, including egg cases and egg case remains, were the dominant prey in the 21 elephant seal stomachs examined. Cephalopods were second in abundance and percent occurrence (Table 4).

Fishes occurred in 100% of the stomachs representing 54% of the 307 prey items recovered. The most highly represented fishes in both number and percent occurrence, were the cusk eel (Chilara taylori), Pacific hake (Merluccius productus), ratfish (Hydrolagus colliei), and plainfin midshipman (Porichthys notatus). Nineteen percent of the fish were represented by egg cases from pacific hagfish (Eptatretus stoutii), ratfish, and the

Rajidae. Egg cases were present in the same stomach with the fleshy remains of 'adults' of the same species in only one instance (E. stoutii, Table 4). Egg cases and egg case fragments recovered from the stomach contents were hardened and dark in color.

Seventy-three percent of the 63 hake otoliths examined from this sample were from fish of age groups one through three based on otoliths from the known age-length stratified sample of hake (Fig. 2). Forty-four percent of these were between two and three years old and approximately 25-31 cm. in length. This projected length range correlates well with the average body lengths of 26.93 cm. and 28.03 cm. found by Dark (1975) for male and female hake within this age range, although some variation in age and length between different year classes and geographic locale should be expected (Dark, 1975).

Eleven species of cephalopods were present in 17 of the 21 elephant seal stomachs examined (Table 4). Loligo opalescens was the most frequently represented prey. It was identified from 13 (62%) stomachs representing 29% of the total prey and 67% of the cephalopod sample. Octopus bimaculoides was identified from 33% of the stomachs examined. Two lower beaks from the unidentified gonatid (probably Berryteuthis magister or Gonatopsis borealis) similar to those in the pilot whale sample were found in two stomachs (Figure 3).

The range in UHL for L. opalescens beaks from the elephant seal sample was 3.2-10.2 mm. with associated mantle lengths (Kashiwada et al., 1979) of 80-160 mm., and 80-200 mm. for males and females respectively (Figure 1).

The crustacean, Hemisquilla californiensis, family Squillidae, was found in five stomachs. Remains of Tunicates and the red crab (Pleuronocodes planipes) were not included in the prey totals due to the difficulty of obtaining an accurate count, however, volumes are given in Table 4 .

Prey species previously unidentified in M. angustirostris stomach contents (Table 4 & 5) included the following fishes: the angel shark (Squatina californica), body parts and egg cases of the horn shark (Heterodontus francisci), whole specimens and body parts of the thornback (Platyrhinoides triseriata), egg cases of the big skate, Raja binoculata (egg cases of Raja sp. were identified by Huey in 1930), the northern anchovy (Engraulis mordax), the black eelpout (Lycodes diapterus), the sablefish (Anoplopoma fimbria) and the pileperch (Damalichthys vacca). Newly described cephalopods included the gonatid Berryteuthis magister or Gonatopsis borealis (probably identified in prior studies as *Gonatopsis borealis*), *Ocythoe tuberculata*, *Octopus bimaculoides*, and *Vampyroteuthis infernalis*. Previously undescribed crustaceans and tunicates included *Hemisquilla californiensis*, *Pleuronocodes planipes*, *Pyrosoma atlanticum*, and *Thetys vagina*.

DISCUSSION

The feeding habits of a predator can be determined from stomach contents only if the sample is representative of the natural population and of statistically adequate size. Since an efficient predator's selectivity of prey is likely to shift with the varying availability of that prey (Emlen, 1966; Morse, 1980), sample collection should range over an extended period of time under varying environmental conditions. The restrictions inherent to the collection of marine mammal samples more often than not preclude fulfillment of these criteria in any one study. However, as baseline data is accumulated, predator-prey relationships may begin to emerge.

The *Mirounga angustirostris* sample was composed entirely of stranded, undersized juveniles (Table 2). These factors could bias the nature of the stomach contents, however, collections were made over a fourteen year period under a variety of oceanic conditions, including several warming periods influenced by El Niño (McLain and Thomas, 1983). It is likely that potential bias from either source is tempered by the time period involved. In addition, the predominance of the represented fish species in the sample as well as the high number of elasmobranch egg cases is consistent with accounts from previous stranded and live capture studies (Table 5).

Results from this study suggest that egg cases and whole animals represent two different prey and that egg cases may be directly targeted as a food source by the elephant seals. Little distinction has been made between the identification of elasmobranch fleshy remains and egg cases in previous studies (Table 5). It seems to have been generally assumed that egg cases present in gut contents are introduced with the consumption of a gravid female of that species. Egg cases of oviparous species are pliable upon extrusion, hardening with exposure to the environment (Dean, 1906; Wourms, 1977). Egg cases introduced coincidentally with a gravid female would be expected to digest rapidly. Only hardened and darkened egg cases were identified from each of the oviparous species encountered in this study. Egg cases were found together with fleshy remains from the same species in only one instance. Sample WAW-795 contained four egg cases and two nearly intact specimens of *Eptatretus stoutii*. No egg cases were found from the stomach containing the ovoviviparous Platyrhinoides triseriata. Egg cases are typically laid in rocky crevices around plant growth in shallower (20 m.) inshore waters, but occur in deeper water as well (Dean, 1906; Feder, et al., 1974). Hydrolagus colliei spawns year-round with peaks in the late summer and early fall. Both egg cases and adults are found in as little as five meters of water in Puget Sound, but are more common from 37-140 meters in the Monterey area (Dean, 1906). Cephaloscyllium ventriosum, is common to kelp bed areas in depths of 5-47 meters from the Gulf of California to Monterey Bay. Individuals are nocturnal, dwelling in crevices during the day. Egg cases are found in the same areas as adults (Feder, et al., 1974).

At least six of the prey species identified from the elephant seal stomachs may be attributed to the influences of warm water insurgence or secondary introduction. Sample SBMNH 83-34 appears to have been influenced by both factors. Stomach contents yielded a volumetric measurement of .31 liters, .23 liters of which were attributable to Pleuronocodes planipes, a pelagic warm water crustacean. Pyrosoma atlanticum, Thetys vagina, and a small beak (3.3 mm. UHL) from Ocythoe tuberculata were also found in the stomach of this individual. Ocythoe tuberculata males are small (up to 20 mm. mantle length) and known to occur in the body cavity of Thetys vagina, an epipelagic salp (Hardwick, 1970). Thetys vagina is generally restricted to warm temperate waters, but, can be carried to northerly latitudes under certain conditions (Yount, 1958). Sample SBMNH 83-34 was collected in 1983 - a year heavily influenced by El Niño. Secondary introduction may be a causal factor in the presence of some smaller less highly represented organisms in the sample. Sanddabs (Citharichthys spp.) and northern anchovy (Engraulis mordax) for example, are both known prey of Pacific hake (Best, 1963). Hake occurred in each of the samples associated with these two groups (Table 4).

Varying rates of digestion, secondary introduction (Perrin, et al., 1973; Walker, 1981; Mead, et al., 1982), and the presence of a large number of small organisms relative to larger, potentially more calorically valuable prey, are the primary sources of bias in obtaining volume, number and frequency of occurrence values in marine mammal stomach content analysis. In addition, the presence of prey hard parts, such as otoliths and cephalopod beaks, may represent an accumulation of meals spanning over a period of days or even weeks. Examples of retention have been cited by Kritzler (1952), and Condit & LeBeouf (1984), and were noted in this study as well. Biomass estimates may be influenced by seasonal and geographic factors. Length projections, on the other hand, provide a less variable measure of bulk than weight.

In addition, many species of fishes and cephalopods are stratified in the water column according to age or size classes (Fitch and Brownell, 1968; Dark, 1975; Roper and Young, 1975) in which case, length estimates may also provide insight into predator feeding depth and seasonal shifts in food preference. Berg (1979) and Hyslop (1980) have made thorough and critical reveiws of methods typically used in quantitative analyses of stomach contents. The validity and reliability of the various methods discussed are examined in reference to fish feeding habits, but are applicable to marine mammals as well. Traditional methods for quantitative assessment of prey items include volume, number and frequency of occurrence, and biomass or weight estimates. None of the methods provides a satisfactory measure of prey preference and selection when viewed independently. As a result, numerous researchers have applied single formulas that mathematically combine the independent measures of volume, number and frequency of occurrence. Pinkas et al. (1971) developed an "Index of Relative Importance" (IRI) in an attempt to describe the relationship between prey items in a sample. The IRI represents the sum of number and volumetric percentage values multiplied by the frequency of occurrence percentage values. Other researchers have since utilized the IRI or a modified version of it (Hureau, 1969; Karpov and Cailliet, 1978). Each of these attempts are of value in presenting a composite picture of prey selection by a given predator if the individual components are listed separately as well for cross-comparison between studies. However, the bias introduced by each of the independent variables into any mathematical equation of this type could potentially compound the error in the final numerical measure derived.

Prey availability and selection, and related movements by both predators under examination in this study are likely influenced by the unique physical characteristics of the study area itself. Point Conception marks the northernmost boundary of the Southern California Bight. The California Current arcs south to southeast and north again along the California coastline as the Southern California eddy where prevailing north-northwest winds influence seasonal periods of upwelling (Reid, et al., 1958; Emery, 1960; Ebeling, et al., 1972; Littler, 1980). The strongest periods of upwelling begin off Baja California in April and May, and become most marked off southern and central California in May and June. This seasonal pattern is coincident with the northward and inshore movement of prey important to elephant seals and pilot whales, particularly Loligo opalescens and Merluccius productus.

Loligo opalescens is primarily neritic and especially prevelant in the waters of the California Current. Schools are segregated by size during the spawning season and probably throughout their pelagic non-breeding existence as well. Spawning takes place in southern California December through March and July at depths of 25-35 meters. Spawning activity in Monterey Bay extends from April through December with major peaks in May and June at 20-55 meter depths. Population movements between spawning seasons are unknown (Fields, 1965; Hochberg and Fields, 1980; Roper, et al., 1984).

Merluccius productus displays both latitudinal and diel vertical migration. Within its range, the pacific hake shows greatest abundance in the coastal region of the California Current system. In late spring, summer and early fall, adult feeding schools are most abundant in the inshore northerly waters of Oregon and Washington in depths less than 100 meters. Local concentrations of hake are also present off northern and central California in spring and fall. Individuals migrate diurnally during periods of feeding activity and can be found dispersed from the surface to 20 meters at night. They descend to form schools during the day. Spawning takes place offshore November through March at intermediate (275-299 fathoms) levels in the water column. No diel migration or feeding takes place during this time (Best, 1963; Gotshall, 1969; Grinols and Tillman, 1970; Nelson and Larkins, 1970; Bailey, et al., 1982).

Diel vertical migrators are known to disperse in their ascent in the water column (Fitch and Brownell, 1968). If this is the case for schooling prey such as hake and loligo, then deep diving by elephant seals during daylight hours may allow access to a more concentrated food source. In this sense, deep diving could also eliminate potential competition from other predators comparatively less adapted for deep dives. However, the direct targeting of diel migrators and schooling species during their seasonal nearshore activity would eliminate the energetic costs of deep diving. In addition, nocturnally active prey that tend to burrow in the daytime are not only more available but, in some cases, more highly concentrated at night (W.A. Walker, pers. comm.).

Standard sampling techniques and fisheries observations do not fully characterize the locality of lower trophic level organisms (Jones, 1981). It may be that prey are being taken by elephant seals in offshore areas north of the rookeries as sighting and tagging data suggest (Condit and LeBeouf, 1984). Elephant seals are adapted for deep diving (Elsner, et al., 1964; Simpson, et al., 1970) and have been recorded at depths of 183 meters (Scheffer, 1964). However, the primary prey species consistently represented in elephant seal stomachs are present in shallow coastal waters, at least on a seasonal or diurnal basis. Many are nocturnally active, burrowing in the substrate or hiding in crevices by day. Onychoteuthis borealijaponicus is most commonly observed in shallow waters of the epipelagic and nearshore zones, day or night (Young, 1972; Anderson, 1978; Roper et al., 1984). Octopus bimaculoides typically inhabits the mid to low intertidal zone or sub-tidal to 20 meters depth in protected crevices, rocky areas, and kelp beds (Hochberg and Fields, 1980). Depth distribution records indicate the upper daytime limit for Octopoteuthis deletron in Monterey and southern California to be 190 and 200 meters. However, individuals are spread throughout the water column at night and are highly represented in the upper 100 meters (Young, 1972; Roper and Young, 1975; Anderson, 1978). Chilara taylori, is nocturnally active. It is commonly found nearshore burrowed tail first in sand and muddy substrate in depths of less than 18 meters, but has been found as deep as 244 meters (Miller and Lea, 1972; Fitch and Lavenberg, 1975). The plainfin midshipman, Porichthys notatus, burrows or rests in sand, mud or rocky areas nearshore to 305 meters, spawning in the intertidal zone in late spring and summer (Miller and Lea, 1972; Feder, et al., 1974; Fitch and Lavenberg, 1975; Gotshall, 1981).

Elephant seals may be searching for prey in both deep and nearshore waters depending perhaps upon sex and age, oceanic conditions, and season. The primary prey represented in stomach contents of Mirounga angustirostris suggest that it is an opportunist with feeding habits likely related to seasonal availability and abundance of prey. Elephant seals are capable of diving to great depths. They are selecting prey that are available both at depth and in the shallows on a diurnal or seasonal basis.

The small sample size, limited collection period and limited comparative data prevent definitive conclusions regarding prey preferences among Globicephala macrorhynchus. However, the 100% occurrence of cephalopods, and predominance of Loligo opalescens in the sample strongly suggests selection for this particular prey in the study area - at least during the fall and winter when the samples were obtained.

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REFERENCES

Ahlstrom, E.H. 1965. Kinds and Abundance of Fishes in the California Current Region Based on Egg and Larval Surveys. CalCOFI, rep. 10, p.31-52.

Anderson, M.E. 1978. Notes on the Cephalopods of Monterey Bay, California, with New Records for the Area. The Veliger 21(2):255-262.

Anthony, A.W. 1924. Notes on the Present Status of the Northern Elephant Seal, Mirounga angustirostris. J. Mamm. 5:145-152.

Anthony, A.W. 1925. Expedition to Guadalupe Island, Mexico, in 1922:The Birds and Mammals. Proc. Cal. Acad. Sci., 4th Series, 4(13):277-320.

Antonelis, G.A. Jr. and C.H. Fiscus 1980. The Pinnipeds of the California Current. CalCOFI, rep. 21, p.68-77.

Antonelis, G.A. Jr., C.H. Fiscus and R.L. DeLong 1984. Spring and Summer Prey of California Sea Lions at San Miguel Island, California, 1978-1979. (In press) Fish. Bull. 82(1).

Bailey, K.M., R.C. Francis and P.R. Stevens 1982. The Life History and Fishery of Pacific Whiting, Merluccius productus. CalCOFI, rep. 23, p.81-98.

Berg, J. 1979. Discussion of Methods of Investigating the Food of Fishes, with Reference to a Preliminary Study of the Prey of Gobiusculus flavescens (Gobiidae). Mar. Bio. 50:263-273.

Best, E.A. 1963. Contribution to the Biology of the Pacific Hake, Merluccius productus (Ayres). CalCOFI, rep. 9, p.51-56.

Clarke, M.R. 1966. A Review of the Systematics and Ecology of Oceanic Squids. Adv. Mar. Biol. 4:91-300.

Clarke, M.R. 1983. Cephalopod Biomass - Estimation from Predation. IN: Memoirs of the National Museum of Victoria, no. 44, Melbourne Austrailia, 30 June, 1983. (Proc. of the Workshop on the Biology and Resource Potential of Cephalopods. Melbourne, Austrailia, March 1981), p.95-107

Clarke, M.R. and N. MacLeod 1980. Cephalopod Remains from Sperm Whales Caught off Western Canada. Mar. Bio. 59:241-246.

Condit, R. and B.J. LeBoeuf 1984. Feeding Habits and Feeding grounds of the Northern Elephant Seal. J. Mamm. 65(2): 281-290.

Cox, K.W. 1963. Egg-Cases of Some Elasmobranchs and a Cyclostome from Californian Waters. Cal. Fish and Game 49(4):271-289.

Croxall, J.P. and P.A. Prince 1982. Calorific Content of Squid (Mollusca: Cephalopoda) Br. Antarct. Surv. Bull., no. 55: 27-31.

Dark, T.A. 1975. Age and Growth of Pacific Hake, Merluccius productus. Fish. Bull. 73(2):336-355.

Dean, B. 1906. Chimaeroid Fishes and Their Development. Publ. Carn. Inst. of Wash., pub. 32, 195p.

DeLacy, A.C. and W.M. Chapman 1935. Notes on Some Elasmobranchs of Puget Sound with Descriptions of their Egg Cases. Copeia, no. 2, p.63-67.

DeLong, R.L. 1978. Northern Elephant Seal. IN: Marine Mammals, Delphine Haley (ed), Pacific Search Press, WA., p.206-211.

Ebeling, A.W., G.M. Cailliet, R.M. Ibara and F.A. DeWitt, Jr. 1972. Pelagic Communities and Sound Scattering of Santa Barbara, California. In: Farquhar, C.B. (ed), Proc. Intnl. Symp. on Biol. Sound Scattering in the Ocean. U.S. Navy, Wash. D.C., p.1-19.

Elsner, R.W., P.F. Scholander, A.B. Craig, E.G. Dimond, L. Irving, M. Pilson, K. Johansen and E. Bradstreet 1964. A Venous Blood Oxygen Reservoir in the Diving Elephant Seal. The Physiologist, no. 7:124.

Emery, K.O. 1960. The Sea off Southern California. John Wiley, New York, 366p.

Emlen, J.M. 1966. The Role of Time and Energy in Food Preference. The Am. Nat. 100(916):611-617.

Feder, H.M., C.H. Turner and C. Limbaugh 1974. Observation on Fishes Associated with Kelp Beds in Southern California. Cal. Dept. Fish and Game, Fish. Bull. 160, 144p.

Fields, G.W. 1965. The Structure, Development, Food Relation Reproduction and Life History of the Squid Loligo opalescens Berry. Cal. Dept. Fish and Game, Fish. Bull. 131., 108p.

Fiscus, C.H. 1979. Interactions of Marine Mammals and Pacific Hake. Mar. Fish. Rev. 41(10):1-9.

Fiscus, C.H. 1982. Predation by Marine Mammals on Squids of the Eastern North Pacific Ocean and the Bering Sea. Mar. Fish. Rev. 44(2):1-10.

Fitch, J.E. and R.L. Brownell Jr 1968. Fish Otoliths in Cetacean Stomachs and their Importance in Interpreting Feeding Habits. J. Fish. Res. Bd. Can. 25(12):2561-2574.

Fitch, J.E. and R.J. Lavenberg 1975. Tidepool and Nearshore Fishes of California. Univ. of Cal. Press, 156p.

Frost, K.J. and L.F. Lowry 1981. Trophic Importance of Some Marine Gadids in Alaska and Their Body - Otolith Size Relationships. Fish. Bull. 79(1):187-192.

Gotshall, D.W. 1969. The Use of Predator Food Habits in Estimating Relative Abundance of the Ocean Shrimp, Pandalus jordani Rathbun. FAO Fish. Reps. 57(3):667-685.

Gotshall, D.W. 1981. Pacific Coast Inshore Fishes; Sea Challengers, Los Osos, Ca. 96p.

Grinols, R.B. and M.F. Tillman 1970. Importance of the Worldwide Hake, Merluccius, resource. U.S. Fish Wildl. Serv., circ. 332, p.1-21.

Grover, C.A. 1972. Population Differences in the Swell Shark Cephaloscyllium ventriosum. Cal. Fish. & Game 58(3):191-197.

Hall, J.D., W.G. Gilmartin and J.L. Mattson 1971. Investigation of a Pilot Whale Stranding on San Clemente Island. J. Wildl. Diseases 7:324-327.

Hardwick, J.E. 1970. A Note on the Behaviour of the Octopod Ocythoe tuberculata. Cal. Fish and Game 56(1):68-69.

Hawes, S.D. 1983. An Evaluation of California Sea Lion Scat Samples as Indicators of Prey Importance. M.S. Thesis, San Francisco State University, 50p.

Hochberg, F.G. 1974. Southern California Records of the Giant Squid, Moroteuthis robusta. Tabulata 7:83-85.

Hochberg, F.G. Jr. and G.W. Fields 1980. Cephalopoda: the Squids and Octopuses. IN: Morris, R.J., D.P. Abbott and E.C. Haderlie (eds), Intertidal Invertebrates of California. Stanford Univ. Press, Stanford, Ca., p.429-444.

Hubbs, C.L., W.I. Follett and L.J. Dempster 1979. List of the Fishes of California. Occas. Pap. CAS, no. 133, 51p.

Huey, L.M. 1924. Recent Observations on the Northern Elephant Seal. J. Mamm. 5(4):237-242.

Huey, L.M. 1925. Late Information on the Guadalupe Island Elephant Seal Herd. J. Mamm. 6(2):126-127.

Huey, L.M. 1930. Capture of an Elephant Seal off San Diego, California, with Notes on Stomach Contents. J. Mamm. 51: 173-174.

Hureau, J.C. 1969. Biologie Comparee de Quelques Poissons Antarctiques (Nothotheniidae). Bull. Inst. Oceanogr. Monaco, no. 68, p.1-44.

Hyslop, E.J. 1980. Stomach Contents Analysis - a Review of Methods and their Application. J. Fish Biol. 17:411-429.

Iverson, I.L.K. and L. Pinkas 1971. A Pictorial Guide of Certain Eastern Pacific Cephalopods. Cal. Dept. Fish and Game, Fish. Bull. 152, p.83-105.

Jones, R.E. 1981. Food Habits of Smaller Marine Mammals from Northern California. Proc. of Cal. Acad. Sci., 42(16): 409-433.

Karpov, K.A. and G.M. Cailliet 1978. Feeding Dynamics of Loligo opalescens In: Recksiek, C.W. and H.W. Frey (eds), Biological, Oceanographic and Acoustic Aspects of the Market Squid Loligo opalescens Berry. Cal. Dept. Fish and Game Fish. Bull. 169, p.45-65.

Kashiwada, J., C.W. Recksiek and K.A. Karpov 1979. Beaks of the Market Squid, Loligo opalescens, as Tools for Predator Studies. CalCOFI, rep. 20, p.65-69.

Kenyon, K.W. and V.B. Scheffer 1955. The Seals, Sea Lions and Sea Otter of the Pacific Coast: Descriptions, Life History Notes, Photographs and Drawings. U.S. Fish and Wldl. Serv., circ. 32, 34p.

Krebs, J.R. 1978. Optimal Foraging: Decision Rules for Predators. In: Krebs, J.R. and N.B. Davies. (eds), Behavioural Ecology: an Evolutionary Approach. Blackwell Sci. Pubs., London, p.23-63.

Kritzler, H. 1952. Observations on the Pilot Whale in Captivity. J. Mamm. 33(3):321-334.

Leatherwood, S. and W.A. Walker 1979. The Northern Right Whale Dolphin Lissodelphis borealis Peale in the Eastern North Pacific. In: Winn, H.E. and B.L. Olla (eds), Behaviour of Marine Animals: Current Perspectives in Research, Vol. 3 Cetaceans. Plenum Press, N.Y., p.85-141.

LeBeouf, B.J. and K.J. Panken 1977. Elephant Seals Breeding on the Mainland in California. Proc. CAS 41(9): 267-280.

Littler, M.M. 1980. Overview of the Rocky Intertidal Systems of Southern California. In: Power, D. (ed), The California Islands: Proceedings of a Multidisciplinary Symposium. Santa Barbara Mus. Nat. Hist., 787p.

McGinnis, S.M. and R.J. Schusterman 1981. Northern Elephant Seal Mirounga angustirostris Gill, 1866. IN: Ridgeway, S.J. and R.J. Harrison (eds), Handbook of Marine Mammals, II, Seals. Academic Press, p.329-349.

McLain, D.R. and D.H. Thomas, 1983. Year-to-Year Fluctuations of the California Countercurrent and Effects on Marine Organisms. CalCOFI Rep. Vol. XXIV, p.165-181.

Mead, J.G., W.A. Walker and W.J. Houck 1982. Biological Observations on Mesoplodon carlhubbsii (Cetacea: Ziphiidae) Smith. Contrib. to Zoology, no. 344., 25p.

Miller, D.J. and R.N. Lea 1972. Guide to the Coastal Marine Fishes of California. Cal. Dept. Fish and Game, Fish. Bull. 157, 234p.

Morejohn, G.V. and D.M. Baltz 1970. Contents of the Stomach of an Elephant Seal. J. Mamm. 51:173-174.

Morejohn, G.V., J.T. Harvey and L.T. Krasnow 1978. The Importance of Loligo opalescens in the Food Web of Marine Vertebrates in Monterey Bay, California. IN: Recksiek, C.W. and J.W. Frey (eds), Biological, Oceanographic and Acoustic Aspects of the Market Squid Loligo opalescens Berry. Cal. Dept. Fish and Game, Fish. Bull. 169.

Morse, D.H. 1980. Behavioural Mechanisms in Ecology. Harvard Univ. Press, Cambridge.

Nelson, M.O. and H.A. Larkins 1970. Distribution and Biology of Pacific Hake: a Synopsis. U.S. Fish Wildl. Serv., circ. 332, p.23-33.

Norris, K.S. and J.H. Prescott 1961. Observations on Pacific Cetaceans of Californian and Mexican Waters. Univ. Cal. Publ. in Zool 63(4):291-402.

North, A.W., J.P. Croxall & D.W. Doidge 1983. Fish Prey of the Antarctic Fur Seal Arctocephalus gazella at the South Georgia Br. Antarct. Surv. Bull., no. 61, p.27-37.

Pearcy, W.G. 1965. Species Composition and Distribution of Pelagic Cephalopods from the Pacific Ocean off Oregon. Pac. Sci. 19(2):261-266.

Perrin, W.F., R.R. Warner, C.H. Fiscus and D.B. Holts 1973. Stomach Contents of Porpoise, Stenella spp., and Yellowfin Tuna, Thunnus albacares, in Mixed-Species Aggregations. Fish. Bull. 71(4):1077-1092.

Phillips, J.B. 1933. Description of a Giant Squid Taken at Monterey with Notes on Other Squid Taken off the California Coast. Cal. Fish. & Game 19(2):128-136.

Pike, G.C. and I.B. MacAskie 1969. Marine Mammals of British Columbia. Fish. Res. Bd. Can. Bull. 171:54p.

Pinkas, L., M.S. Oliphant and I.L.K. Iverson 1971. Food Habits of Albacore, Bluefin Tuna and Bonito in California Waters. Calif. Dept. Fish Game, Fish. Bull. 152, 105p.

Reid, J.L., Jr., G.I. Roden and J.G. Wyllie 1958. Studies of the California Current System. CalCOFI, rep. 1, p.28-56.

Reilly, S.B. 1978. Pilot Whale. p.112-119 In: Haley, D. (ed), Marine Mammals of the Eastern North Pacific and Arctic Waters. Pacific Search Press, Seattle, 256p.

Roper, C.F.E. and R.E. Young 1975. Vertical Distribution of Pelagic Cephalopods. Smith. Contrib. to Zoology, no. 209, p.1-51.

Roper, C.F.E., M.J. Sweeney & C.E. Nauen, 1984. FAO Species Catalogue. Vol 3, Cephalopods of the World. An Annotated and Illustrated Catalogue of Species of Interest to Fisheries. FAO Fish. Symp. 3(125): 277p.

Scammon, C.M. 1874. The Marine Mammals of the Northwestern Coast of North America, Described and Illustrated Together with an Account of the American Whale Fishery. G.P. Putnam's Sons, N.Y., 319p. [Reprinted by Dover Co., New York,1968].

Scheffer, V.B. 1964. Deep Diving of Elephant Seals. Murrelet 45(1):9.

Seagars, D.J. and J.R. Henderson 1985. Cephalopod Remains from the Stomach of a Short-finned Pilot Whale Collected Near Santa Catalina Island, California. J. Mamm. 66(4):777-779.

Sergeant, D.E. 1962. The Biology of the Pilot or Pothead Whale _Globicephala melaena_ (Traill) in Newfoundland Waters. Fish. Res. Bd. Can., bull. 132, p.25-83.

Simpson, J.G., W.G. Gilmartin and S.H. Ridgway 1970. Blood Volume and Other Hematologic Values in Young Elephant Seals (_Mirounga angustirostris_). Am. J. Vet. Res. 31(8): 1449-1452.

Townsend, C.H. 1912. The Northern Elephant Seal. Zoologica 1:159-173.

Voss, N.A. 1969. A Monograph of the Cephalopoda of the North Atlantic. The Family Histioteuthidae. Bull. Mar. Sci. 19:713-867.

Walker, W.A. 1975. Review of the Live-Capture Fishery for Smaller Cetaceans Taken in Southern California Waters for Public Display, 1966-1973. J. Fish. Res. Bd. Can. 32(7): 1197-1211.

Walker, W.A. 1981. Geographical Variation in Morphology and Biology of Bottlenose Dolphins (_Tursiops_) in the Eastern North Pacific. National Marine Fisheries Service, Southwest Fisheries Center, Admin. Rept. LJ-81-03C, 52p.

Wourms J.P. 1977. Reproduction and Development in Chondrichthyan Fishes. Amer. Zool. 17:379-410.

Young, R.E. 1972. The Systematics and Areal Distribution of Pelagic Cephalopods from the Seas off Southern California. Smith. Contrib. to Zoology, no. 97, 159p.

Yount, J.L. 1958. Distribution and Ecologic Aspects of Central Pacific Salpidae (Tunicata). Pac. Sci. 12(2):111-130.

TABLE 1. Collection data for <u>Globicephala</u> <u>macrorhynchus</u> examined from the Southern California Bight.

SAMPLE	SEX	LENGTH (cm)	DATE	POSITION
[1] SBMNH 77-54	unk.	approx. 440	11/23/77	34°06'N, 119°53'W
[2] WAW - 404	F	461	10/14/75	33°44'N, 118°22'W
WAW - 405	M	660	11/07/75	33°44'N, 118°24'W
WAW - 790	M	540	12/10/69	33°50'N, 118°24'W

1 Santa Barbara Museum Natural History, Santa Barbara, CA.
2 W.A. Walker private collection, L.A. County, CA.

TABLE 2. Collection data for Mirounga angustirostris examined from the Southern California Bight.

SAMPLE	SEX	LENGTH (cm.)	DATE	POSITION
[1] WAW-795	F	161	3/12/69	33°45'N, 118°23'W
WAW-M/1	F	143	2/14/70	34°01'N, 118°30'W
[1] 72-77S	M	152	1/31/72	34°01'N, 118°30'W
WAW 796	M	163	2/20/72	34°01'N, 118°49'W
WAW 797	M	159	1/10/72	33°45'N, 118°23'W
72-86S	M	140	4/24/72	33°44'N, 118°22'W
WAW-798	F	156	1/20/72	34°02'N, 118°40'W
73-124S	M	166	1/18/73	33°44'N, 118°22'W
73-133S	F	163	2/14/73	33°56'N, 118°27'W
73-135S	M	150	2/21/73	33°44'N, 118°22'W
73-141S	F	143	3/22/73	33°53'N, 118°25'W
WAW-799	M	123	3/12/73	33°42'N, 118°17'W
WAW-800	M	173	4/01/73	33°43'N, 118°11'W
WAW-801	F	231	4/08/73	33°50'N, 118°24'W
WAW-802	F	196	5/10/73	33°43'N, 118°19'W
WAW 803	M	157	7/21/73	34°02'N, 118°45'W
73-202S	M	201	12/16/73	34°02'N, 118°35'W
[2] SBMNH 77-52	M	186	11/15/77	34°25'N, 119°53'W
SBMNH 79-18	M	380	4/17/79	34°25'N, 119°46'W
SBMNH 81-12	F	187	4/13/81	34°25'N, 119°40'W
SBMNH 83-34	M	134	5/03/83	34°26'N, 119°57'W

[1] W.A. Walker private collection, L.A. County, CA.
[2] Santa Barbara Museum Natural History, Santa Barbara, CA.

TABLE 3. Stomach contents of Globicephala macrorhynchus examined from the Southern California Bight.

PREY	NUMBER no.	NUMBER %	OCCURRENCE no.	OCCURRENCE %	SAMPLE
Total	647	100	4	100	WAW 404; 405; 790 SBMNH 77-54
Cephalopods Total	647	100	4	100	
Loliginidae					
Loligo opalescens	617	95	4	100	WAW 404; 405; 790 SBMNH 77-54
Histioteuthidae					
Histioteuthis cf. dofleini	9	1.4	2	50	WAW 405; 790
Histioteuthis cf. heteropsis	3	0.5	1	25	WAW 404
Octopoteuthidae					
Octopoteuthis deletron	1	0.2	1	25	WAW 790
Gonatidae					
Gonatus sp. (three types)	4	0.6	1	25	WAW 405
unidentified (probably Berryteuthis magister or Gonatopsis borealis)	2	0.3	1	25	WAW 405
Onychoteuthidae					
Onychoteuthis borealjaponicus	4	0.6	2	50	WAW 404; 405
Moroteuthis robustus	7	1.1	3	75	WAW 404; 405; 790

TABLE 4. Stomach contents of *Mirounga angustirostris* from the Southern California Bight.

PREY	NUMBER no.	NUMBER %	OCCURRENCE no.	OCCURRENCE %	SAMPLE
Total	307	100	21	100	21
Fish Total	165	54	21	100	
Myxinidae					
Eptatretus stoutii, Pacific hagfish	12	3.9	2	9.5	
Oviparous					
(specimens - fleshy remains)	(2)		(1)		WAW-795
(egg cases)	(10)		(2)		WAW-795; 72-77S
Squalidae					
Squalus acanthias, spiny dogfish	2	0.7	2	9.5	WAW-797; 72-77S
Viviparous					
Squatinidae					
Squatina californica, angel shark	1	0.3	1	4.8	73-124S
Viviparous					
Heterodontidae					
Heterodontus francisci, horn shark	3	1.0	2	9.5	
Oviparous					
(specimens - fleshy remains)	(2)		(1)		72-86S
(egg cases)	(1)		(1)		73-133S
Scyliorhinidae					
Cephaloscyllium ventriosum, swell shark	5	1.6	4	19	
Oviparous					
(specimens - fleshy remains)	(2)		(2)		WAW-798; 72-86S
(egg cases)	(3)		(2)		WAW-803; SBMNH 79-18

TABLE 4. Stomach contents of *Mirounga angustirostris* from the Southern California Bight. (cont. - 2)

PREY	NUMBER		OCCURRENCE		SAMPLE
Fishes (cont.)	no.	%	no.	%	
Platyrhinidae					
Platyrhinoides triseriata, thornback	3	1.0	3	14	
Ovoviviparous					
(specimens - fleshy remains)	(3)		(3)		WAW-801; 72-86S; 73-141S
(egg cases)	(0)		(0)		
Rajidae					
Raja binoculata, big skate	7	2.3	3	14	
Oviparous					
(specimens - fleshy remains)	(0)		(0)		
(egg cases)	(7)		(3)		WAW-798; 72-77S; 73-124S
Raja sp., skate	6	2.0	3	14	
Oviparous					
(specimens - fleshy remains)	(1)		(1)		SBMNH 77-52
(egg cases)	(5)		(2)		WAW-800; 73-133S
Chimaeridae					
Hydrolagus colliei, ratfish	17	5.5	7	33	
Oviparous					
(specimens - fleshy remains)	(12)		(5)		WAW-795; WAW-797; WAW-800; 73-133S; M-1;
(egg cases)	(5)		(2)		WAW-798; WAW-803
unidentified elasmobranch	1	0.3	1	4.8	WAW-803

TABLE 4. Stomach contents of *Mirounga angustirostris* from the Southern California Bight. (cont. - 3)

PREY	NUMBER		OCCURRENCE		SAMPLE
Fishes (cont.)	no.	%	no.	%	
Egraulididae					
Engraulis mordax, northern anchovy	1	0.3	1	4.8	SBMNH 77-52
Batrachoididae					
Porichthys notatus, plainfin midshipman	16	5.2	4	19	WAW-796; WAW-799 73-141S; M-1
Merlucciidae					
Merluccius productus, Pacific hake	35	11	7	33	SBMNH 77-52; WAW-796 SBMNH 81-12; WAW-803 72-86S; 73-135S; 73-202S
Ophidiidae					
Chilara taylori, spotted cusk-eel	37	12	9	43	WAW-795; WAW-797; WAW-799; WAW-802; WAW-803; 72-77S; M-1 73-124S; 73-135S
Zoarcidae					
Lycodes diapterus, black eelpout	1	0.3	1	4.8	WAW-802
Scorpaenidae					
Sebastes sp., rockfish	8	2.6	3	14	WAW-796; WAW-799; M-1
Anoplopomatidae					
Anoplopoma fimbria, sablefish	7	2.3	1	4.8	WAW-803
Embiotocidae					
Damalichthys vacca, pileperch	1	0.3	1	4.8	WAW-796

Table 4. Stomach contents of Mirounga angustirostris from the Southern California Bight. (cont. - 4)

PREY	NUMBER		OCCURRENCE		SAMPLE
Fishes (cont.)	no.	%	no.	%	
Bothidae					
Citharichthys sp., sanddab	1	0.3	1	4.8	WAW-796
unidentified teleost	1	0.3	1	4.8	SBMNH 83-34
Cephalopods	no.	%	no.	%	
Total	135	44	17	81	
Loliginidae					
Loligo opalescens	90	29	13	62	SBMNH 77-52; WAW-795 WAW-798; WAW-799; WAW-800; WAW-801 WAW-803; 72-77S, M-1 73-124S; 73-133S; 73-135S; 73-202S
Histioteuthidae					
Histioteuthis cf. dofleini	6	2.0	1	4.8	SBMNH 77-52
Histioteuthis cf. heteropsis	1	0.3	1	4.8	WAW-797
Octopoteuthidae					
Octopoteuthis deletron	5	1.6	2	9.5	SBMNH 77-52; 81-12
Gonatidae					
Gonatus sp.	8	2.6	3	14	SBMNH 77-52; 73-202S SBMNH 81-12
unidentified (probably Gonatopsis borealis or Berryteuthis magister)	2	0.7	2	9.5	SBMNH 77-52 SBMNH 81-12

TABLE 4. Stomach contents of *Mirounga angustirostris* from the Southern California Bight. (cont. - 5)

PREY	NUMBER		OCCURRENCE		SAMPLE
Cephalopods (cont.)	no.	%	no.	%	
Onychoteuthidae					
Onychoteuthis borealijaponicus	5	1.6	2	9.5	73-202S; SBMNH 77-52
Chiroteuthidae					
Chiroteuthis sp.	1	0.3	1	4.8	73-202S
unidentified (probably *Chiroteuthis* sp.)	1	0.3	1	4.8	SBMNH 77-52
Ocythoidae					
Ocythoe tuberculata	1	0.3	1	4.8	SBMNH 83-34
Octopodiae					
Octopus bimaculoides	14	4.6	7	33	WAW-795; WAW-803; 72-77S; 73-133S; M-1 73-141S; 73-202S
Vampyroteuthidae					
Vampyroteuthis infernalis	1	0.3	1	4.8	WAW-803
Crustaceans					
Squillidae					
Hemisquilla ensigera californiensis	7	2.3	5	24	WAW-795; WAW-803; 72-77S; 73-124S; 73-135S
*Galatheidae					
Pleuronocodes planipes	23 ml. volume		1	4.8	SBMNH 83-34

TABLE 4. Stomach contents of *Mirounga angustirostris* from the Southern California Bight. (cont. - 6)

*Tunicates				
Pyrosomatidae				
Pyrosoma atlanticum	10	1	4.8	SBMNH 83-34
Pyrosoma cf. *atlanticum*	1	1	4.8	SBMNH 83-34
Salpidae				
Thetys vagina (aggregate form)	5	1	4.8	SBMNH 83-34

*Tunicates and the Galatheidae are not included in the enumeration of total number and % categories

TABLE 5. Previous accounts of the stomach contents *Mirounga angustirostris*, 1874-1984. (Citings listed are restricted to prey remains from stomachs only).

PREY	SOURCE
Fishes	
Myxinidae	
Eptatretus stoutii, Pacific hagfish eggs (clusters)/vertebral column (tentative)	Pike and McAskie, 1969
Petromyzontidae	
Lampetra tridentata, Pacific lamprey	Antonelis and Fiscus, 1980
Squalidae	
Squalus acanthias, spiny dogfish	Huey, 1930; Morejohn, et al., 1978
Scyliorhinidae	
Apristurus brunneus, brown cat shark egg case(s)	Morejohn and Baltz, 1970; Morejohn et al.,1978; Jones, 1981; Condit and LeBeouf, 1984
Cephaloscyllium ventriosum, swell shark	Huey, 1930
Rajidae	
Raja, sp. (egg cases)	Huey, 1930
unidentified elasmobranch vertebral column sharks, skates and rays	Morejohn and Baltz, 1970 Kenyon and Scheffer, 1955
Chimaeridae	
Hydrolagus colliei, ratfish	Huey, 1930

TABLE 5. Previous accounts of the stomach contents *Mirounga angustirostris*, 1874-1984. (cont. - 2) [Citings listed are restricted to prey remains from stomachs only].

PREY	SOURCE
Fishes (cont.)	
Clupeidae	
Clupea pallasii, Pacific herring	Morejohn et al., 1978
Sardinops sagax, Pacific sardine	Townsend, 1912
Batrachoididae	
Porichthyes notatus, plainfin midshipman	Morejohn and Baltz, 1970; Morejohn et al., 1978
Merlucciidae	
Merluccius productus, Pacific hake	Morejohn et al., 1978; Jones, 1981; Condit and LeBeouf, 1984
Ophidiidae	
Chilara taylori, spotted cusk eel	Morejohn and Baltz, 1970; Morejohn et al., 1978
Scorpaenidae	
Sebastes paucispinus, Bocaccio	Morejohn et al., 1978
Sebastes sp., rockfish	Morejohn et al., 1978; Condit and LeBeouf, 1984
unidentified (possibly *Sebastes* sp., rockfish)	Anthony, 1925
Sebastes (probably *goodei* or *paucispinus*)	Morejohn and Baltz, 1970
Bothidae	
Citharichthyes sordidus, Pacific sanddab	Antonelis and Fiscus, 1980
Pleuronectidae	
Glyptocephalus zachirus, rex sole	Antonelis and Fiscus, 1980
unidentified (possibly *Glyptocephalus zachirus*, rex sole)	Morejohn et al., 1978
Pleuronectid (*Glyptocephalus* or *Lyopsetta*), sole	Morejohn and Baltz, 1970
unidentified (possibly *Lyopsetta exilis*, slender sole)	Morejohn et al., 1978
Unidentified teleost (possibly bass)	Huey, 1930

TABLE 5. Previous accounts of the stomach contents *Mirounga angustirostris*, 1874-1984. (cont. - 3) (Citings listed are restricted to prey remains from stomachs only).

PREY	SOURCE
Cephalopods	
Sepiolidae	
Rossia pacifica	Antonelis and Fiscus, 1980
Loliginidae	
Loligo opalescens	Huey, 1930; Morejohn et al, 1978; Condit and Lebeouf, 1984
Histioteuthidae	
Histioteuthis sp.	Condit and LeBeouf, 1984
Octopoteuthidae	
Octopoteuthis sp.	Antonelis and Fiscus, 1980
Octopoteuthis deletron	Condit and LeBeouf, 1984
Taningia danae	Condit and LeBeouf, 1984
Gonatidae	
Gonatus sp.	Morejohn et al., 1978
Gonatus sp. (two types)	Antonelis and Fiscus, 1980
Gonatopsis borealis	Antonelis and Fiscus, 1980
Gonatopsis cf. *borealis*	Condit and LeBeouf, 1984
Onychoteuthidae	
Moroteuthis robustus	Condit and LeBeouf, 1984
Onychoteuthis borealijaponicus	Antonelis and Fiscus, 1980; Condit and LeBeouf, 1984
Chiroteuthidae	
Chiroteuthis calyx	Condit and LeBeouf, 1984
Chiroteuthis sp.	Antonelis and Fiscus, 1980

TABLE 5. Previous accounts of the stomach *Mirounga angustirostris*, 1874-1984. (cont. - 4) (Citings listed are restricted to prey remains from stomachs only).

PREY	SOURCE
Cephalopods (cont.)	
Cranchiidae	
unidentified Cranchiidae (two genera)	Condit and LeBeouf, 1984
Octopodidae	
unidentified *Octopoda* (two species)	Condit and LeBeouf, 1984
Octopus sp.	Antonelis and Fiscus, 1980

FIGURE 1. Length-frequency distribution of upper hood length on *Loligo opalescens* from the stomach contents of *Globicephala macrorhynchus* and *Mirounga angustirostris* in the Southern California Bight

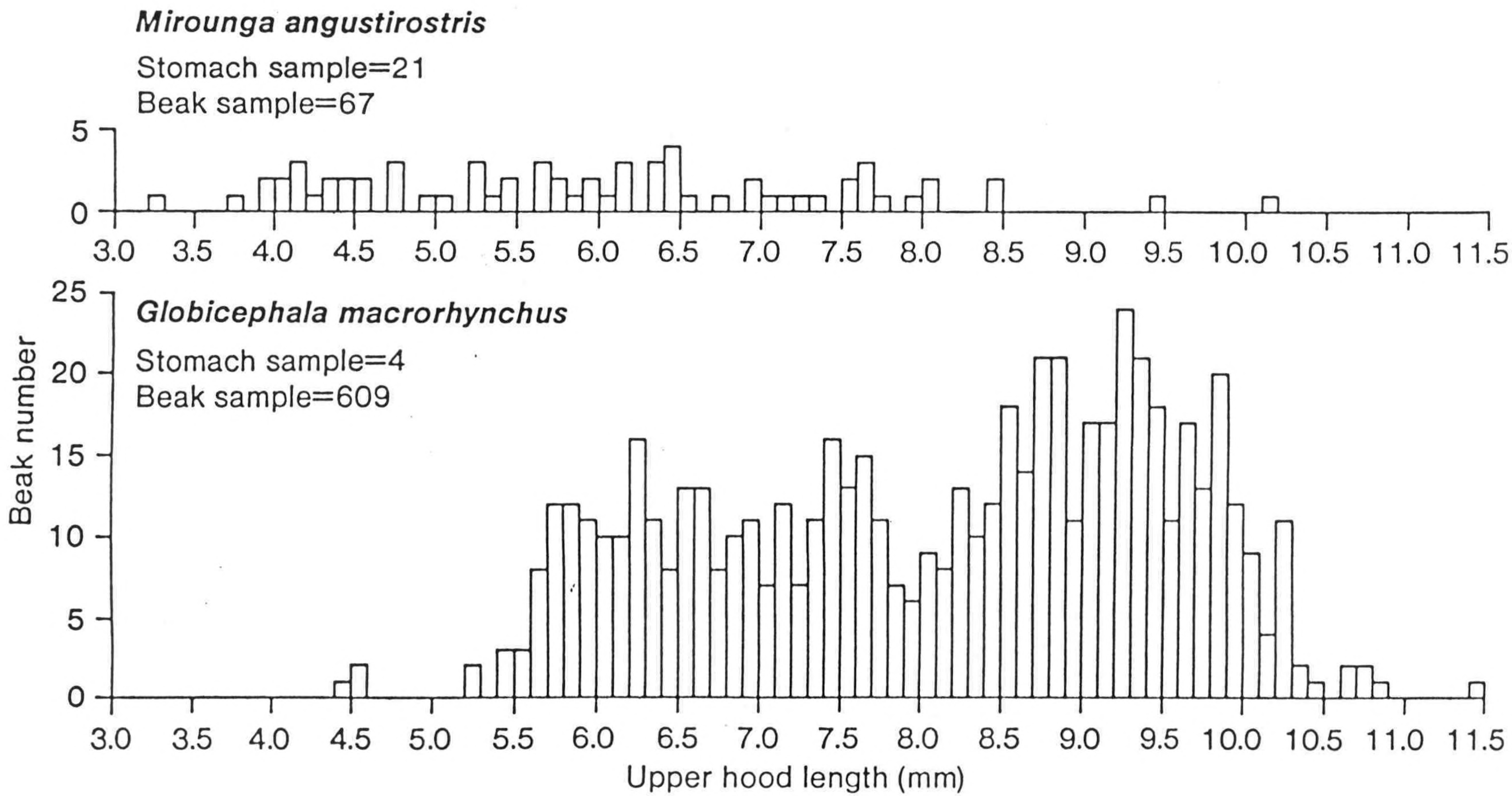

FIGURE 2. Age estimates from otoliths of *Merluccius productus* collected from the stomach contents of *Mirounga angustirostris* in the Southern California Bight

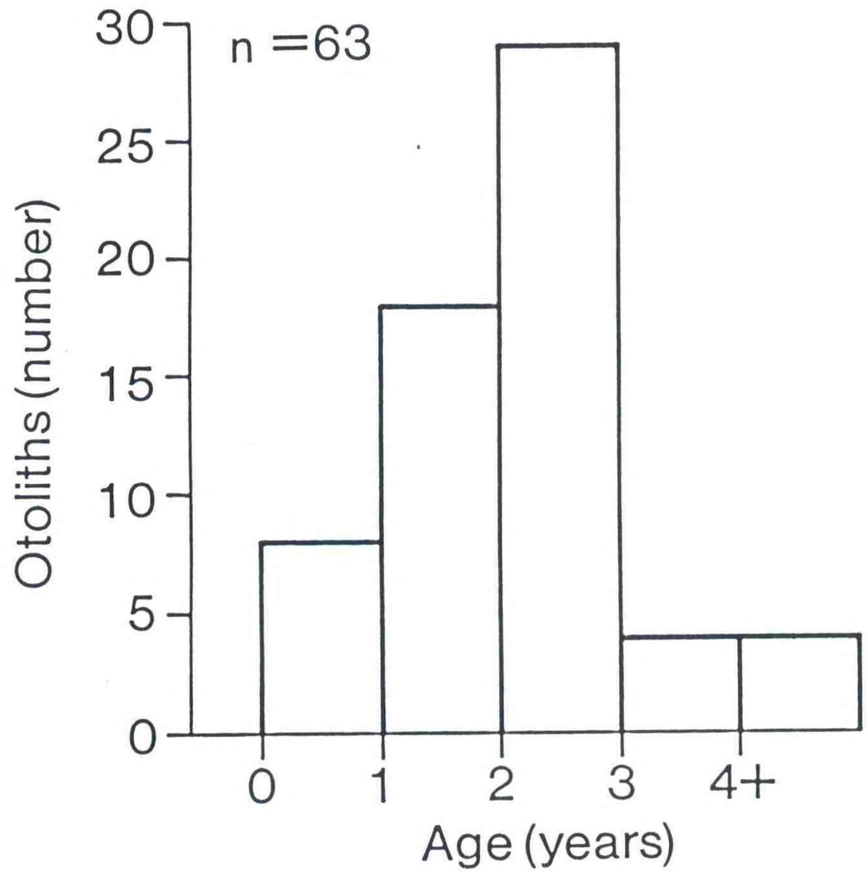

FIGURE 3. The upper and lower beak from an unidentified gonatid squid (probably <u>Berryteuthis</u> <u>magister</u> or <u>Gonatopsis</u> <u>borealis</u>) found in the stomachs of <u>Globicephala</u> <u>macrorhynchus</u> and <u>Mirounga</u> <u>angustirostris</u> from the Southern California Bight (Dorsal and ventral view of the beaks are on a scale of 5mm.)