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ABSTRACT
Knowledge of the trophic ecology of pelagic dolphins is important to understanding the ecosystem of the eastern tropical Pacific. Mesopelagic species predominated in the diet of 131 striped dolphins; the myctophid *Lampanyctus parvicauda*, a melamphaeid *Melamphaes* sp., and the enoploteuthid squid *Abraliopsis affinis* were the most numerous and most prevalent. Composition varied among four regions; fish predominated in three southerly regions, and fish and cephalopods occurred in about equal numbers in a region close to the northern tropical convergence. Prey for which length could be estimated ranged from about 2 to 17 cm in length. Most feeding occurred at night or early in the morning. Species composition was similar to those for striped dolphins taken pelagically in other parts of the world in representing mainly mesopelagic species but differed from that for striped dolphins inhabiting more coastal regions, indicating flexibility in the trophic ecology of the species. The diet in the ETP resembled that of the pantropical spotted dolphin, *S. attenuata*, in the same region, although the latter may occasionally take larger prey. Overlap with the diet of the spinner dolphin, *S. longirostris*, in the same region is less; it may feed deeper, to 400m.

Introduction

The striped dolphin is a pelagic inhabitant of tropical and warm-temperate waters around the globe (Jefferson et al. 1993, Archer and Perrin 1999, Archer 2002). It ranks third in abundance among dolphin species in the offshore eastern tropical Pacific (ETP) (Ballance and Pitman 1998). In other parts of its range it is the most abundant dolphin (e.g., Mediterranean – Aguilar 2000), of intermediate rank (second among all cetaceans in the tropical Indian Ocean – Ballance and Pitman 1998; fifth in the Gulf of Mexico – Ballance and Pitman 1998), or uncommon (Philippines – Heaney et al. 1998; Dolar et al. 2006).

The only previously-available information on prey of striped dolphins in the ETP is data on five dolphins in the unpublished doctoral thesis of Galván Magaña[1], taken in tuna purse seine sets on yellowfin tuna in the region of the Costa Rica Dome. The stomach contents totaled 125g, of which the remains of the pelagic crab *Portunis xanthusii* made up 46%. The rest was composed of the remains of several small fishes of the families Myctophidae, Gonostomatidae, Phosichthyidae, Scopelarchidae, Evermannellidae, Paralepididae and Bathylagidae and cephalopods of the families Ommastrephidae, Onychoteuthidae, Enoploteuthidae, Mastigoteuthidae and Octopoteuthidae. No data were provided on frequency or prevalence of occurrence

The present study aimed to describe and compare diets of cetacean predators in the pelagic ecosystem of the ETP, with an ultimate goal of providing input for an accurate functional model of the system (see Cox et al. 2003; Olson and Watters 2003; Watters et al. 2003). We also compare the diet of the species in the ETP with that in other regions and with the diet of other dolphins of the genus *Stenella* in the ETP.

Methods and materials

The material examined is a heterogeneous assemblage of samples collected and processed opportunistically during two decades of research with other primary objectives in the eastern tropical Pacific. U.S. Government technicians aboard commercial tuna seiners collected carcasses/stomachs of 128 striped dolphins killed incidentally during fishing operations (Gerrodette 2002) during the period 1973--1989 (Table 1, Figure 1). Two of these (CJD0001-2) were taken accidentally in a set on tuna associated with a "log" (floating object); the remainder were killed incidentally in deliberate sets on dolphin schools. The number of dolphins sampled from a single set of the net ranged from 1 to 13. Stomachs were also collected from two striped dolphins collected and donated by a fishing vessel in 1973 (WFP0268 and 0269). A subsample of cephalopod beaks was collected from an additional dead dolphin found floating at sea in 1986 (MAW0045). The total number of collections (schools sampled) was 34. The samples came from four regions in the eastern tropical Pacific (Fig. 1): off Mexico (20 stomachs), far offshore to the west (36), in the Costa Rica Dome and to the west (48), and near the Galapagos Islands (27). The dolphins from the tuna fishery were taken in association with yellowfin tuna (*Thunnus albacares*) and (in two cases) skipjack tuna (*Katsuwonus pelamis*) and with other dolphins (pantropical spotted dolphin, *Stenella attenuata*, in 13 of the net sets and spinner dolphin, *Stenella longirostris,* in 10). In 10 cases, the tuna (unidentified) escaped the net set that killed the dolphins.

When collected at sea, the stomachs were tied off at the upper esophageal and lower duodenal ends and frozen for return to the laboratory. Most carcasses were returned frozen whole to the Southwest Fisheries Center (SWFSC) and the stomachs collected there. After total volume or mass was measured in the laboratory, the contents were stored in 70% ethyl alcohol. They were rough-sorted in various ways and volumes or weights of components measured at the SWFSC over a period of several years. Extracted beaks and otoliths were stored in 70% alcohol. During and after identification, the otoliths were stored dry. Varying amounts of data were available for the 131 stomach samples; the most complete suite included collection data (date, location, collector, time of day the dolphin chase started (or, in the case of the "log" set, time net was let go), associated cetacean species), total volume or mass of stomach contents; volume or mass of contents of the esophageal stomach (forestomach); volume or mass/presence-absence of fish otoliths, fish parts, cephalopod beaks, cephalopod parts, crustacean parts, nematodes, and unidentified remains. Presence was recorded as volume (in cc), mass (g) or, if < 1cc, as "trace." Where contents were originally volumed rather than weighed, total volume of the prey in the forestomach was later converted to mass with a factor of 1.02; no unsorted stomachs were available at that point, but the factor was estimated by calculating the density of unsorted prey in an available stomach of a common dolphin (*Delphinus delphis*) containing remains of fish and cephalopods. "Trace" was assigned a mass of 1g in the analysis of total mass in the forestomach. While contents of the glandular and pyloric stomachs were collected for some of the specimens, because of the fragmentary data for these compartments and the more advanced state of digestion of the contents, we report here only the contents of the forestomach; when compartment sampled was not indicated, the contents were not included. Portions of a number of samples (beaks or otoliths) were lost in storage; these samples were included in the analyses of total forestomach content by mass but not in the analyses of occurrence and prevalence; complete data for these analyses were available for forestomachs from 104 specimens (92 containing otoliths from 11,671 fish and beaks from 5,222 cephalopods; 12 empty). Crustacean remains were uncommon (present in only 13 of the 105 specimens) and usually of very small volume and well-digested. Their rareness may be due to a small role in the diet or to more rapid digestion of remains than for fish and squid. In most cases it was not possible to determine the number of prey items represented, and the taxon was recorded only as "present." Therefore, the calculations of prevalence were based only on the fish and cephalopod remains.

Cephalopod beaks were identified by WAW by comparison with a private collection of beaks from the eastern Pacific. Identification and enumeration were based almost entirely on lower beaks. The exceptions were in cases where only upper beaks were present. All teuthid beak measurements are lower beak rostral length (LRL). Octopod measurements are lower beak hood length (LHL). Otoliths were identified by KMR by comparison with a collection of otoliths at the SWFSC. Crustacean remains were identified by comparison with specimens in the pelagic invertebrates collection at Scripps Institution of Oceanography, University of California at San Diego. Left and right otoliths were counted and the higher of the two counts taken to be the number of fish represented. Subsamples of lower beaks of 30 cephalopod species from 31 stomachs (n = 1—570 per stomach) and otoliths of 12 fish species from 20 stomachs (n = 1—142 per stomach) were measured to the nearest 1/10th mm with an ocular micrometer. Measured beaks were from the forestomach, glandular stomach or pyloric stomach. Otoliths measured came only from the forestomach.

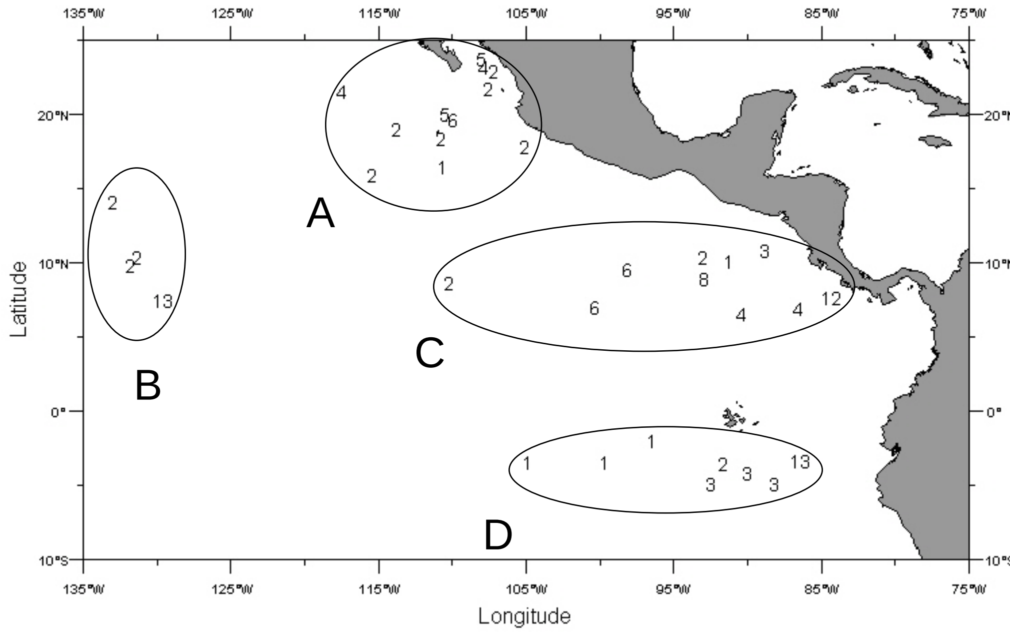


Figure 1. Sample localities for stomach contents of striped dolphins, *Stenella coeruleoalba*, collected in the eastern tropical Pacific. Numerals indicate number of stomachs from single tuna purse seine net set. Letters indicate division into samples from major regions (see text): A, off southern Mexico; B, far-western offshore; C, Costa Rica Dome; D, near Galapagos Islands.

Results

Composition of prey

The 104 forestomachs examined contained prey of ≥90 taxa (Table 2. Mesopelagic fishes predominated, making up about 2/3 of the prey overall (although this varied regionally; see below), with mesopelagic cephalopods making up nearly all of the balance. The most common species was the myctophid *Lampanyctus parvicauda*, in absolute overall numbers, prevalence in stomachs, and proportion of single-set samples in which it occurred. It was followed by the melamphaeid *Melamphaes* sp., the enoploteuthid squid *Abraliopsis affinis* and a series of other myctophids and enoploteuthid, cranchiid and ommastrephid squids. A large number of other taxa occurred sporadically and in low numbers. The only epipelagic species represented were the flying fish *Exocoetus volitans*, by two individuals in one stomach, and four nomeids; in combination these totaled less than 1.5% of the prey by number.

Variation among regions in the ETP

Composition of the diet varied among the four regions sampled in the ETP (Figure 1, Table 3). In the northernmost region (A), about equal numbers of fish and cephalopods were consumed. In the three other regions, fish made up 2/3 to 3/4 of the prey. Among the fish families, myctophids ranked first in all four regions, followed by melamphaeids in three regions and phosichthyids in the fourth. Species of other families occurred sporadically and in widely varying rank order. Enoploteuthids ranked first among the cephalopods except in Region A, where ommastrephids predominated. Cranchiids were consistently second. Onychoteuthids ranked third in Region D and were close behind cranchiids in prevalence. The remaining cephalopod families varied substantially in rank and fell far behind the 3 major families in prevalence in all regions.

The northerly Region A was the most different among the samples, perhaps reflecting its position close to the northern margin of the tropical convergence. However, Region D, south of the Galapagos Islands, was closely similar to the two core regions B and C.

Size distribution of prey items from beak and otolith measurements

Regressions of mantle length on beak length for cephalopods and body length on otolith length were available in the literature for 18 cephalopods and 6 fish species, allowing us to estimate size of some prey in the striped dolphin stomachs (Table 4 and Appendix 1). The largest fish taken among the species for which length could be estimated, a specimen of the nomeid *Cubiceps baxteri*, was estimated to be 17cm long. This species was the largest on average as well, aside from the single flying fish of 15cm. The smallest fish taken for which length could be estimated was a 5-cm myctophid (*Myctophum aurolanternum*). However, the contents included *Diogenichthys laternatus*, which only reaches a maximum size of ~25mm (Wisner 1974).

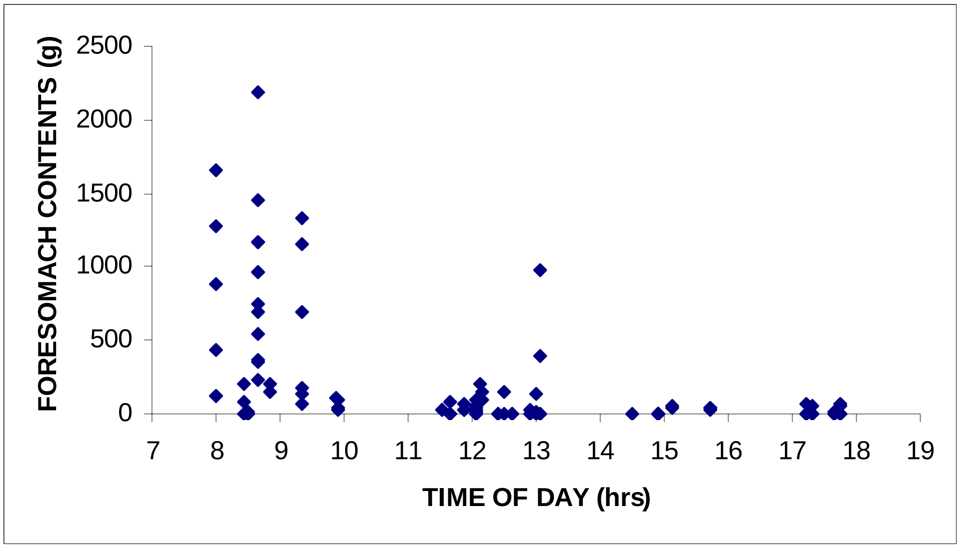
The largest cephalopod consumed (*Megalocranchia* sp.) for which a regression equation was available had an estimated mantle length of 20cm; the smallest was a 1.2-cm specimen of *Octopotheuthis deletron.* The most numerous cephalopod in the stomach contents, the enoploteuthid *Abraliopsis affinis*, averaged about 3 cm in mantle length (range 2—5cm).

Diurnal pattern of feeding

The purse-seine sets that captured the dolphins occurred from 8:00 to 17:40 hrs. Stomachs were fullest on average

from dolphins taken early in the day (Figure 2) indicating that most feeding occurred at night or very early in the morning, when inhabitants of the deep scattering layer (DSL) are closest to the surface. One juvenile had nearly a liter of ingested seawater in its forestomach, accounting for the single elevated point at 13:00 hrs in Figure 2.

Figure 2. Scatterplot of mass of forestomach contents on time of day when captured for striped dolphins, *Stenella coeruleoalba*, killed in tuna purse seine sets in the eastern tropical Pacific.



Discussion

Comparison with diet in other regions

The stomach contents included ≥25 fishes and ≥21 cephalopods not previously reported as prey of the striped dolphin in other regions (by Fraser 1953, Miyazaki et al. 1973, Desportes[1], Sekiguchi et al. 1992, Würtz and Marrale 1993, Ross 1984, Santos et al. 1994, Blanco et al. 1995, Meotti and Podestà 1997, Pulcini et al. 1992, Rosas et al. 2002, de Pierrepont et al. 2005, Spitz et al. 2006, and Ringelstein et al. 2006). Contents varied among samples from different regions and habitats (Table 5). The prey structure for the oceanic ETP in terms of numbers by family closely parallels that of striped dolphins taken as bycatch in oceanic driftnet fisheries in the Bay of Biscay; about 2/3 fish and 1/3 cephalopods, with the fish portion dominated by myctophids and other mesopelagic species.

The stranded dolphins collected from the southwestern Indian Ocean in South Africa also had a high proportion of myctophids in their stomachs and may have originated from an oceanic population; the species is not commonly encountered in coastal waters there (Ross 1984). Stomachs from more coastal dolphins, both stranded and bycaught in the Atlantic and Mediterranean, where they are a common component of the coastal cetacean fauna, contained a higher proportion of fish prey, over 90% in three samples, and included a substantial proportion of benthic fishes such as gadids and gobies. The dolphins in two schools sampled from a drive fishery in Japan were sharply different from all the other samples in having fed heavily on crustaceans, mainly the benthesicymid shrimp *Bentheogennema borealis*, not reported from the dolphin elsewhere. The striped dolphin is migratory in the western Pacific, found inshore only seasonally and sporadically (Kasuya 1999).

The regional diversity of the striped dolphin's diet reflects foraging plasticity and adaptation to different habitats. Whether this trophic diversity is correlated with population structure is unknown and should be investigated.

Comparison with diets of other dolphins in the ETP

Earlier studies have examined the feeding habits of two other dolphins of the genus *Stenella* bycaught in the tuna fishery in the ETP and reported occurrence of fish and cephalopod prey by numbers: the most recent of these are by Robertson and Chivers (1997) for the pantropical spotted dolphin, *S. attenuata*, and Perrin et al. (1973) for the spinner dolphin, *S. longirostris* (Table 6). While the sample size for the spinner

[1]/ DESPORTES, G. 1985. La nutrition des odontocetes en Atlantique Nord-Est (côtes Françaises – l'Iles Feroe). Doctoral thesis, University of Poitiers, France. 219pp.

dolphin is small and came from only two purse-seine sets, the sample for the spotted dolphin is large and represents extensive spatial and temporal coverage similar to that for the striped dolphin.

Similarity of the spotted dolphin data to those for the striped dolphin is striking. Both diets consisted of about 2/3 fish and 1/3 cephalopods by number, with the fish component dominated by the myctophids and other small mesopelagic fishes. Of 54 fish species represented in the striped stomachs, only 16 were absent from the spotted stomachs, and only 5 of these made up more than 1% of the items in the striped stomachs. Chief among the 5 species was the mesopelagic *Bathylagus* sp., absent from the 428 spotted stomachs but comprising 2.2% of the prey items in the 105 striped dolphin. Comparing the fish prey in the other direction, 11 species present in the spotted stomachs but absent from the striped stomachs included an acropomatid, 2 exocoetids, a hemiramphid, 3 myctophids, a nomeid, a scombrid, a scopelarchid and a stromateid. Some of these are epipelagic (exocoetids, hemiramphid, nomeid, scombrid and stromateid). Epipelagic species encountered in the striped dolphin included the flying fish *Exocoetus volitans* (two individuals) and small numbers of four nomeids..

The results are similar for the cephalopod prey, composed predominantly of enoploteuthid, ommastrephid, cranchiid and onychoteuthid species. Twenty-two of 35 species present in the striped sample occurred in the spotted sample. Only 3 species occurred in the spotted stomachs but not in the striped stomachs: *Alloposus mollis*, *Architeuthis* sp., and *Argonauta* sp. The argonaut is epipelagic.

These results suggest that the striped and pantropical spotted dolphins have very similar, largely mesopelagic diets in the oceanic ETP but that both may forage epipelagically on occasion, with the spotted dolphin taking slightly larger prey. This is reinforced by stomach contents reported for 83 spotted dolphins by Perrin et al. (1973), which included numbers of the epipelagic *Oxyporhamphus micropterus* and other exocoetids and 91 frigate mackerel (*Auxis* sp.); the average length of 35 mackerel intact enough to measure was 24cm.

The smaller (and more restricted in origin) sample for the spinner dolphin differed sharply from those for the other two species, being almost completely composed of fish remains (95.5% by number). No epipelagic fishes were encountered. Myctophids and other mesopelagic fishes dominated, with 57.5% of the otoliths from a single species, *Myctophum laternatum* (*Diogenichthys* sp. in Perrin et al. 1973). All the identified fish and cephalopod species occurred also in either the striped or spotted stomachs or both. (Note: Perrin et al.—1973-- reported *Onkyia* sp. from the spinner. However, subsequent review of voucher specimens from that study by WAW revealed that these were *Onychoteuthis banksi*). These results are consistent with earlier data and opinion that the spinner dolphin may feed more deeply than the other *Stenella* species (Fitch and Brownell 1968, Perrin et al. 1973); data from the Sulu Sea in the central Philippines suggest that there it may feed down to 400m (Dolar et al. 2003).

The striped dolphin is seldom encountered together with either spotted or spinner dolphins in the eastern Pacific; it occurs typically in different water masses (Reilly 1990). The spotted dolphin and spinner dolphin occur commonly in mixed aggregations in the ETP. The results here suggest that ecological separation is driven by oceanography in the former case and by behavior (feeding at different depths and/or on slightly different prey) in the latter.

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Table 1. Stomach samples from striped dolphins in the eastern tropical Pacific. Number of stomachs from single net set (school) in parentheses. Location letter (A, B, C, D) indicates major region within ETP (see text). Associated species: Spot = *Stenella attenuata*, Spin = *S. longirostris*, YF = *Thunnus albacares*, SK = *Katsuwonus pelamis.*

	SPECIMEN(S)	SEX	BODY LENGTH (cm)	DATE	LOCATION	TIME OF DAY	ASSOCIATED SPECIES
1.	BKL0144--148 (5)	1M, 4F	113--194	27 Mar 1979	23.77°N, 108.05°W (A)	1719	YF
2.	BDJ0001--8 (8)	5M, 2F, 1?	178--194	13 Dec 1978	9.02°S, 92.03°W (D)	1745	Unident. dolph.; no tuna caught
3.	CCM0045,46, 48, 62--68[1], 101--104 (13)	4M, 8F, 1?	153--222	22 Feb 1976	3.27°S, 86.40 °W (D)	0840	Spot, Spin, YF
4.	CJD0001—2 (2)	1M, 1F	113--201	16 Aug 1978	9.92°N, 131.83°W (B)		SK; a set on a "log"
5.	CMF0056, 62-64 (4)	2M, 2F	184--198	5 Feb 1974	7.00°N, 86.50°W (C)	1713	No tuna caught
6.	DJT0026,29,31,33 (4)	2M, 2F	177--225	26 Mar 1979	23.27°N, 107.83°W (A)	1303	YF
7.	GLF0049--50 (2)	2F	190--194	28 Feb 1975	18.42°N, 110.80°W (A)	0851	No tuna caught
8.	GRW0013--25 (13)	9M, 4F	174--196	27 Jun 1989	7.55°N, 129.58°W (B)	1204	Spot, YF
9.	JKO0013	F	103	29 May 1977	3.33°S, 104.90°W (D)	1430	No tuna caught
10.	JLN0023--25 (3)	1M, 2F	186--192	8 Feb 1976	4.83°S, 88.20°W (D)	1543	Spot, YF
11.	JOC0044,46 (2)	1M, 1F	180--199	21 Jul 1978	14.20°N, 133.02°W (B)	1124	Spot, Spin, YF
12.	JOC0063,64 (2)	2F	199--201	8 Aug 1978	10.50°N, 131.30°W (B)	0954	YF
13.	JVG0018	M	153	8 Oct 1977	1.92°S, 96.50°W (D)	1245	Spot, YF
14.	KDS0257--68 (12)	8M, 4F	172--206	9 Apr 1973	7.77°N, 84.33°W (C)	1455	YF
15.	LAM0011	M	196	20 Dec 1989	3.33°S, 99.72°W (D)	0953	Spot, Spin, YF
16.	LGP0153,180 (2)	1M, 1F	198--201	20 Feb 1976	3.43°S, 91.68°W (D)	1255	Spot, Spin, YF
17.	MAW0045	F	199	21 Oct 1986	10.22°N, 91.30°W (C)	-----	Not from tuna seiner
18.	MSM0003--4 (2)	1M, 1F	194--196	15 Jun 1976	16.00°N, 115.42°W (A)	1230	Spot, YF
19.	OS 0013—17 (5)	2M, 4F	209	7 Jan 1975	20.10°N, 110.48°W (A)	1140	YF
20.	PCS0032--34 (3)	1M, 2F	120--195	21 Oct 1979	10.92°N, 88.80°W (C)	0826	YF
21.	PLR0003	F	194	16 Aug 1976	16.52°N, 110.65°W (A)	1208	Spot, Spin; no tuna caught
22.	RDP0114--115 (2)	2M	193--212	11 May 1979	10.50°N, 93.05°W (C)	1715	YF
23.	RDS0003—8 (6)	2M, 4F	149--206	8 Jun 1981	19.72°N, 109.97°W (A)	0920	No tuna caught
24.	RKF0097--100 (4)	4M	110--138	11 Apr 1975	6.68°N, 90.37°W (C)	0830	No tuna caught
25.	RSG0254--55 (2)	2M	187--193	12 May 1974	17.88°N, 105.10°W (A)	1300	No tuna caught
26.	RWB0028--30 (3)	2M, 1F	189--201	13 Feb 1976	4.03°S, 89.97°W (D)	1210	Spot, Spin, YF

27.	SER0026--27 (2)	1M, 1F	207--213	2 Apr 1979	23.02°N, 107.15°W (A)	1508	YF
28.	SWJ0096--99 (4)	3M, 1F	175--190	27 Jul 1977	21.65°N, 117.45°W (A)	1153	Spot, YF, SK
29.	TBS0066, 68--72 (6)	6M	148--216	19 Feb 1975	9.68°N, 98.12°W (C)	0800	No tuna caught
30.	TBS0342, 343, 345, 348, 350, 351 (6)	1M, 5F	120--210	14 Aug 1975	7.08°N, 100.35°W (C)	1740	No tuna caught
31.	TCF0100--102 (3)	1M, 2F	180--187	30 Sep 1977	4.75°S, 92.50°W (D)	1237	Spot, Spin, YF
32.	TMD0323--324 (2)	1M, 1F	174--204	18 Jan 1975	8.72°N, 110.25°W (C)	1225	No tuna caught
33.	WFP0268--269 (2)	1M, 1F	176--195	26 Mar 1973	19.05°N, 113.75°W (A)	----	Spot, YF
34.	WHO0003--4 (2)	1M, 1F	194--206	26 Jan 1980	21.80°N, 107.53°W (A)	1501	YF
	TOTAL 131	70M, 60F, 1?	103--225	1973--1989	23.77°N--9.02°S, 84.33--133.02°W	0800--1745	

[1]One stomach from either CCM0065 or CCM0067; tags partially obliterated in field.

Table 2. Occurrence (absolute number and percentage of total fish and cephalopod number), overall prevalence (frequency of occurrence and percentage of stomachs), and prevalence in 34 single-school samples (frequency and percentage of schools) for prey recovered from striped dolphins, *Stenella coeruleoalba*, (n=104) from the eastern tropical Pacific. Families listed in alphabetical order. Species previously unreported from the striped dolphin indicated with asterisk.

PREY	OCCURRENCE		OVERALL PREVALENCE		PREVALENCE IN SCHOOLS	
	NO.	% OF PREY	FREQUENCY (DOLPHINS)	% OF DOLPHINS	FREQUENCY (SCHOOLS)	% OF SCHOOLS
OSTEICHTHYS	11,704	69.7	79	75.2	30	88.2
Ateleopodidae						
Ateleopus sp.	10	0.1	4	3.8	1	2.9
Bathylagidae						
Bathylagus sp.	367	2.2	7	6.7	2	5.9
Bregmacerotidae						
*Bregmaceros bathymaster**	6	<0.1	1	1.0	1	2.9
Caproidae						
Unid. caproid	6	<0.1	4	3.8	3	8.8
Diretmidae						
*Diretmus argenteus**	2	<0.1	1	1.0	1	2.9
Exocoetidae						
*Exocoetus volitans**	2	<0.1	2	1.9	2	5.9
Gempylidae						
*Gempylus serpens**	64	0.4	2	1.9	1	2.9
Melamphaidae	1,909	11.4	57	54.3	19	55.9
Melamphaes sp.	755	4.5	27	25.7	12	35.3
*Poromitra crassiceps**	192	1.1	8	7.6	3	8.8
*Scopelogadus bispinosus**	962	5.7	54	51.4	19	55.9
Microstomatidae	50	0.3	10	9.5	2	5.9
Nansenia sp.	38	0.2	9	8.6	1	2.9
Xenopthalmichthys sp.	14	0.1	5	4.8	2	5.9
Myctophidae	6,266	37.3	71	67.6	24	70.6
*Benthosema panamense**	45	0.3	7	6.7	3	8.8
Ceratoscopelus warmingii	4	<0.1	2	1.9	2	5.9
Diaphus mollis	18	0.1	8	7.6	4	11.8
*Diaphus splendidus**	154	0.9	154	14.3	6	17.7
Diaphus sp.	18	0.1	8	7.6	6	17.7

Diogenichthys lanternatus	134	0.8	21	20.0	10	29.4
*Gonichthys tenuiculus**	60	0.4	9	8.6	7	20.6
*Hygophum proximum**	65	0.4	4	3.8	3	8.8
*Hygophum reinhardti**	3	<0.1	1	1.0	1	2.9
Lampadena luminosa	482	2.9	24	22.9	8	23.5
Lampadena sp.	41	0.2	4	3.8	2	5.9
*Lampanyctus festivus**	293	1.7	4	3.8	2	5.9
*Lampanyctus omostigma**	268	1.6	3	2.9	7	20.6
Lampanyctus parvicauda	2,039	12.1	63	60.0	19	55.9
Lampanyctus sp. #1	81	0.5	9	8.6	4	11.8
Lampanyctus sp. #2	183	1.1	7	6.7	2	5.9
*Myctophum asperum**	130	0.8	5	4.8	1	2.9
*Myctophum aurolaternatum**	256	1.5	13	12.4	5	14.7
*Myctophum nitidulum**	30	0.2	4	3.8	2	5.9
*Nannobrachium idostigma**	6	<0.1	3	2.9	1	2.9
*Notoscopelus resplendens**	939	5.6	24	22.9	9	26.5
*Parvilux ingens**	1,232	7.3	36	34.3	15	44.1
Protomyctophum sp.	9	0.1	4	3.8	2	5.9
Symbolophorus sp.	407	2.4	34	32.4	12	35.3
Taaningichthys sp.	28	0.2	9	8.6	3	8.8
Triphoturus mexicanus.	89	0.5	8	7.6	3	8.8
Unid. myctophid (worn)	837	5.0	52	49.5	22	64.7
Nomeidae	224	1.3	33	31.4	13	38.2
*Cubiceps baxteri**	62	0.4	15	14.3	7	20.6
*Cubiceps caeruleus**	30	0.2	4	3.8	2	5.9
*Cubiceps pauciradiatus**	126	0.8	25	23.8	10	29.4
Psenes sp.	6	<0.1	2	1.9	1	2.9
Notosudidae						
Scopelosaurus sp.	1	<0.1	1	1.0	1	2.9
Paralepididae						
*Sudis atrox**	169	1.0	17	16.2	7	20.6
Phosichthyidae	625	3.7	30	28.6	14	42.4
Ichthyococcus sp.	290	1.7	22	21.0	12	35.3
Vinciguerria lucetia	335	2.0	18	17.1	6	17.7
Scopelarchidae	153	0.9	10	9.5	12	35.3
*Scopelarchus analis**	39	0.2	7	6.7	5	14.7
Scopelarchus guentheri	82	0.5	12	11.4	10	29.4

Unid. scopelarchid	32	0.2	5	4.8	3	8.8
Sternoptychidae	12	0.1	6	5.7	2	5.9
*Argyropelecus sladeni**	9	0.1	3	2.9	1	2.9
Argyropelecus sp. cf. *A. affinis*	3	<0.1	3	2.9	2	5.9
Zoarcidae						
Unid. zoarcid	1	<0.1	1	1.0	1	2.9
Unidentifiable (worn or Broken)	1,032	6.1	48	45.7	22	64.7
CEPHALOPODA	5,096	30.3	60	57.1	26	76.5
Bolitaenidae						
*Japatella heathi**	4	<0.1	4	3.8	4	11.8
Brachioteuthidae						
Brachioteuthis sp.	157	0.9	15	14.3	3	8.8
Chiroteuthidae						
Valbyteuthis sp.	7	<0.1	3	2.9	3	8.8
Cranchiidae	933	5.6	44	41.9	17	50.0
*Galiteuthis pacifica**	1	<0.1	1	1.0	1	2.9
*Leachia dislocata**	585	3.5	33	31.4	14	41.2
Liocranchia reinhardti	321	1.9	20	19.1	6	17.7
Megalocranchia sp.	20	0.1	11	10.5	6	17.7
Unid. cranchiid (very small juveniles)	6	<0.1	2	1.9	2	5.9
Ctenopterygidae						
*Ctenopteryx sicula**	4	<0.1	4	3.8	4	11.8
Cycloteuthidae	31	0.2	14	13.3	7	20.6
Cycloteuthis sp.	12	0.1	9	8.6	4	11.8
Discoteuthis sp.	19	0.1	8	7.6	6	17.7
Enoploteuthidae	2,041	12.2	49	46.7	19	55.9
*Abraliopsis affinis**	1,312	7.8	48	45.7	18	52.9
*Ancistrocheirus lesueuri**	17	0.1	8	7.6	6	17.7
*Pterygioteuthis giardi**	712	4.2	28	26.7	11	32.4
*Pyroteuthis margaritifera**	8	0.1	5	4.8	3	8.8
Grimalditeuthidae						
*Grimalditeuthis bonplandi**	21	0.1	12	11.4	6	17.7
Histioteuthidae	100	0.6	20	19.1	7	20.6
*Histioteuthis hoylei**	41	0.2	11	10.5	3	8.8

*Histioteuthis meleagroteuthis**	30	0.2	5	4.8	1	2.9
Histioteuthis sp.	29	0.2	11	10.5	7	20.6
Mastigoteuthidae	177	1.1	30	28.6	12	35.3
Idioteuthis sp.	8	0.1	5	4.8	4	11.8
*Mastigoteuthis dentata**	169	1.0	29	27.6	11	32.4
Octopoteuthidae	157	0.9	26	24.8	12	35.3
Octopoteuthis deletron	110	0.7	18	17.1	7	20.6
Octopoteuthis sp.	18	0.1	7	6.7	3	8.8
*Taningia danae**	29	0.2	10	9.5	5	14.7
Ocythoidae						
*Ocythoe tuberculata**	4	<0.1	2	1.9	2	5.9
Ommastrephidae	638	3.8	32	30.5	16	47.1
Dosidicus gigas	2	<0.1	2	1.9	2	5.9
*Eucleoteuthis luminosa**	28	0.2	5	4.8	3	8.8
*Hyaloteuthis pelagica**	288	1.8	21	20.0	10	29.4
*Ommastrephes bartrami**	2	<0.1	2	1.9	1	2.9
Sthenoteuthis oualaniensis	232	1.4	23	21.9	12	35.3
Unid. ommastrephid (very small juveniles)	85	0.5	7	6.7	5	14.7
Ommastrephid upper beak	2	<0.1	1	1.0	1	2.9
Onychoteuthidae	376	2.2	32	30.5	14	41.2
Moroteuthis sp.	8	0.1	4	3.8	3	8.8
Onychoteuthis banksii	368	2.2	32	30.5	14	41.2
Pholidoteuthidae						
*Pholidoteuthis boschmai**	53	0.3	14	13.3	4	11.8
Thysanoteuthidae						
*Thysanoteuthis rhombus**	7	<0.1	2	1.9	2	5.9
Tremoctopodidae						
*Tremoctopus violaceus**	27	0.2	8	7.6	3	8.8
Unid. lower beaks	20	0.1	10	9.5	4	11.8
Unid. upper beaks	14	0.1	2	1.9	1	2.9
CRUSTACEA	----	----	12	11.4	4	11.8
Unid. caridean	----	----	5	4.8	1	2.9
Unid. penaeidean	----	----	5	4.8	2	5.9
Unid. isopod	----	----	3	2.9	3	8.8
Unid. crustacean	----	----	4	3.8	4	11.8

Table 3. Relative importance of fish vs. cephalopods and of fish and cephalopod families in prey of striped dolphins, *Stenella coeruleoalba*, in four regions in the ETP (see Figure 1), in terms of rank order, within Osteichthys and Cephalopoda, and number of otoliths or beaks per dolphin. Sample sizes in parentheses. Families with totals less than 0.1% of total numbers overall (Table 2) not included. Families listed in alphabetical order. Ratio of fish to cephalopods for regions A—D, respectively, = 0.98, 4.36, 4.86, 3.04.

Order/Family	Region A (34)		Region B (17)		Region C (20)		Region D (33)	
	Rank	No./ dolphin	Rank	No./ dolphin	Rank	No./ dolphin	Rank	No./ dolphin
OSTEICHTHYS	----	42.8	----	126.5	----	84.0	----	214.6
Ateleopodidae	----	0.0	----	0.0	----	0.0	9	0.3
Bathylagidae	----	0.0	----	0.0	4	1.9	4	10.0
Gempylidae	----	0.0	3	3.8	----	0.0	----	0.0
Melamphaeidae	2	7.4	2	35.1	2	22.7	3	18.8
Microstomatidae	----	0.0	----	0.0	7	0.1	7	2.1
Myctophidae	1	24.1	1	67.1	1	54.2	1	135.7
Nomeidae	5	0.4	4	3.2	6	1.2	5	4.0
Paralepididae	6	0.2	7	0.9	----	0.0	6	3.9
Phosichthyidae	3	4.5	5	2.7	3	2.2	2	25.1
Scopelarchidae	4	2.1	6	1.9	5	1.7	8	0.9
Sternoptychidae	----	0.0	7	0.1	----	0.0	9	0.3
CEPHALOPODA	----	43.5	----	28.9	----	17.3	----	70.3
Brachioteuthidae	6	0.2	----	0.0	----	0.0	10	4.4
Cranchiidae	2	13.5	2	3.6	2	4.9	2	9.2
Cycloteuthidae	7	0.1	7	0.3	6	0.3	9	0.5
Enoploteuthidae	3	10.7	1	19.0	1	6.7	1	34.5
Grimalditeuthidae	6	0.2	----	0.0	7	0.2	11	0.1
Histioteuthidae	7	0.1	6	0.6	8	0.1	6	2.4
Mastigoteuthidae	5	0.6	5	0.9	8	0.1	4	4.0
Octopoteuthidae	----	0.0	6	0.6	4	1.1	5	3.7
Ommastrephidae	1	16.5	4	1.2	3	2.8	11	0.1
Onychoteuthidae	4	1.1	3	1.9	5	0.5	3	8.4
Pholidoteuthidae	9	0.0	8	0.1	----	0.0	7	1.5
Tremoctopodidae	8	<0.1	----	0.0	----	0.0	8	0.8

Table 4. Mean, standard deviation and range of mantle length of cephalopod species and length of fish species consumed by striped dolphins, *Stenella coeruleoalba*, in the oceanic eastern tropical Pacific. Measured beaks and otoliths were unbroken and unworn. Lengths estimated from regressions in Clarke (1986), Butler (1979), Wolff (1984) and Nafpaktitis and Paxton (1968); calculated for this study (one species); and as used by Robertson and Chivers (1997) (two species). Species listed alphabetically within cephalopods and fishes. ML = mantle length in mm, RL = lower beak rostral length in mm, TL = total length, SL = standard length, OL = otolith length in mm.

Species of prey	*N*	Estimated prey length (mm)			Regression	Source
		Mean	SD	Range		
OSTEICHTHYS						
Cubiceps baxteri	10	133.8	26.45	91--171	TL = 15.8OL	Baxter
Cubiceps pauciradiatus	26	94.9	22.36	68--131	TL = 21.1OL	Baxter
Exocoetus volitans	1	149	----	----	TL = 3.81 + 21.71OL	Unpub[1]
Lampadena luminosa	92	81.3	17.06	55—111	TL = 13.1OL	Nafpaktitis & Paxton
Myctophum aurolaternatum	35	72.8	14.01	48—107	SL = 5.34 +19.54OL	This study[2]
Symbolophorus sp.	9	85.4	14.87	58—102	TL = -6.29 + 17.97OL	Unpub[1]
CEPHALOPODA						
Abraliopsis affinis	570	33.2	4.42	19—45	ML = 9.8 + 19.28RL	Wolff
Ancistrocheirus lesueuri	7	91.8	21.82	65—122	ML = -41.3 + 40.75RL	Clarke
Brachioteuthis sp.	66	59.5	9.15	43—75	ML = 16.31 = 20.18RL	Clarke
Ctenopteryx sicula	3	37.6	3.24	34—41	ML = 11.69 + 32.42RL	Clarke[3]
Cycloteuthis sp.	7	76.6	19.91	40—102	ML = 31RL	Clarke[4]
Eucleoteuthis luminosa	9	115.6	19.52	90--150	ML = 11.12 + 37.61RL	Wolff
Histioteuthis hoylei	35	36.8	15.47	21—80	ML = 7.69 + 14.55 RL	Wolff[5]
Hyaloteuthis pelagica	71	97.4	11.88	72—118	ML = 17.81 + 28.55RL	Wolff
Leachia dislocata	268	30.3	6.28	12—48	ML = 7.69 + 14.55RL	Wolff
Liocranchia reinhardti	178	83.4	40.27	33—218	ML = 1.09 + 80.22RL	Wolff[6]
Mastigoteuthis dentata.	103	70.9	16.35	30—106	ML = -1.8 + 29.08RL	Clarke[7]
Megalocranchia sp.	8	199.1	93.13	65—304	ML = -70.9 + 68.13RL	Clarke
Octopoteuthis deletron	74	53.7	22.96	12—130	ML = -0.4 + 17.33RL	Clarke[8]
Onychoteuthis banksi	238	76.2	26.12	26—185	ML = -28.9 + 61RL	Wolff
Pholidoteuthis boschmai	19	117.3	27.62	77—163	ML = 11.3 + 41.09RL	Clarke
Pterygioteuthis giardi	376	35.1	4.86	20—56	ML = 6.2 + 33.16RL	Wolff
Symplectoteuthis oualaniensis	21	159.7	39.76	105—203	ML = 6.98 + 39.25RL	Wolff
Thysanoteuthis rhombus	11	97.4	57.22	20--197	ML = -112.6 + 110.53RL	Clarke

1. Used in Chivers and Robertson. (1997)

[2.] See Appendix 1.
[3.] Based on *Ctenopteryx* sp
[4.] Based on *Cycloteuthis* sp.
[5.] *H. dofleini* in Wolff
[6.] Based on *L. danae*
[7.] Based on *Mastigoteuthis* sp
[8.] Based on *Octopoteuthis* sp.

Table 5. Variation of diet of striped dolphins, *Stenella coeruleoalba*, by region, as percentage of total prey items. Families listed alphabetically. ETP from this study; western Pacific (Japan) from Miyazaki et al., 1973; Southeastern Indian Ocean (South Africa) from Ross (1984); Northeast Atlantic from Desportes (1985, France and Faroe Islands), Spitz et al. (2006, France), and Ringelstein et al. (2006, Bay of Biscay); Mediterranean from Würz and Marrale (1993). Values for ETP calculated based on only fish and cephalopods.

	Eastern Tropical Pacific	Western Pacific	South-eastern Indian Ocean	Northeast Atlantic (France and Faroe Islands)	Northeast Atlantic (France)	Northeast Atlantic (Bay of Biscay)	Mediter-ranean Sea
Sample Size	104	27	15	34	32	60	23
Source	Bycatch	Direct catch	Stranding, bycatch	Stranding, bycatch	Stranding	Bycatch	Stranding
Habitat	Oceanic	Coastal?	Oceanic?	Coastal	Coastal	Oceanic	Coastal
OSTEICHTHYS	69.7	27.5	80.4	92.0	91.2	62.1	91.0
Alepocephalidae					0.1	0.4	
Ateleopodidae	0.1						
Atherinidae				8.6	16.6		
Bathylagidae	2.2					0.9	
Belonidae							0.3
Bregmacerotidae	<0.1						
Caproidae	<0.1						
Carangidae				2.9			
Chauliodontidae		2.1				1.1	0.4
Chiasmodontidae						0.1	
Clupeidae				2.1			
Diretmidae	<0.1						
Emmelichthyidae		2.2					
Engraulidae					0.2		2.8
Exocoetidae	<0.1						
Gadidae				66.9	45.2		31.2
Gempylidae	0.4					<0.1	
Gobiidae					24.3		
Gonostomatidae		<0.1	2.7				
Melamphaidae	11.4						

Merluccidae			9.1	1.0	0.5		1.3
Microstomatidae	0.3						
Mugilidae				5.7	0.1		
Myctophidae	37.3	17.6	66.3		2.1	49.4	15.6
Nemichthyidae		3.6					
Nomeidae	1.3					<0.1	
Notosudidae	<0.1						
Paralipididae	1.0	0.7				2.4	
Phosichthyidae	3.7						
Platytroctidae						0.2	
Scomberosocidae						0.1	
Scopelarchidae	0.9						
Serrivomeridae						<0.1	
Sparidae					0.5		2.9
Sternoptychidae	0.1	0.4			0.5	3.1	23.8
Stomiatidae							11.9
Stomiidae						0.8	
Zoarcidae	<0.1						
Other and unidentified	6.1	1.6	2.3	11.5	1.1	3.5	0.8
CEPHALOPODA	30.3	35.2		8.0	8.7	32.4	7.3
Bolitaenidae	<0.1						
Brachioteuthidae	0.9				0.2	9.9	
Chiroteuthidae	<0.1		0.1	0.2		<0.1	
Cranchiidae	5.6		0.1	0.1	0.1	10.9	
Ctenopterygidae	<0.1						
Cycloteuthidae	0.2						
Enoploteuthidae	12.2						
Gonatidae				0.4	1.4	3.7	
Grimalditeuthidae	0.1						
Histioteuthidae	0.6		0.9	0.3	0.1	6.3	1.3
Loliginidae			6.7	2.8	1.3		0.4
Lycoteuthidae			9.9				
Mastigoteuthidae	1.1						
Octopoteuthidae	0.9					0.1	
Ocythoidae	<0.1						
Ommastrephidae	3.8	0.9	0.4	1.6	0.6	<0.1	3.4

Onychoteuthidae	2.2		0.3			1.1	1.4
Pholidoteuthidae	0.3					<0.1	
Sepiolidae					3.9	0.3	
Sepidae					0.3		
Thysanoteuthidae	<0.1						
Tremoctopodidae	0.2						
Other and unidentified	0.2	34.3	0.9	6.8	0.8	<0.1	0.5
CRUSTACEA	----	37.5	<0.1	<0.1	0.5	5.3	
Benthesicymidae		35.6					
Other and unidentified		1.9	<0.1	<0.1	0.5	5.3	

Table 6. Comparison of diet of striped dolphin, *Stenella coeruleoalba*, with those of pantropical spotted dolphin, *S. attenuata*, and spinner dolphin, *S. longirostris*, in the eastern tropical Pacific, in terms of percentage of total number of prey items. Calculation for striped dolphin based on only fish and cephalopod components (crustaceans less than 1% in other two spp.). Families listed alphabetically. *S. attenuata* from Robertson and Chivers (1997); *S. longirostris* from Perrin et al. (1973).

Prey	Striped dolphin *n*=105 (% of 16,800)	Pantropical spotted dolphin *n*=428 (% of 49,798)	Spinner dolphin *n*=37 (% of 5,934)
OSTEICHTHYS	69.7	66.6	95.5
Acropomatidae			
Howella sp.		0.2	
Ateleopodidae			
Ateleopus sp.	0.1		
Bathylagidae			
Bathylagus sp.	2.2		0.2
Bregmacerotidae			
Bregmaceros bathymaster	<0.1	3.7	
Bregmaceros sp.			14.2
Caproidae			
Unid. caproid	<0.1		
Diretmidae			
Diretmus argenteus	<0.1		
Exocoetidae			
Exocoetus volitans	<0.1	0.9	
Exocoetus monocirrhus		0.1	
Cheilopogon sp.		<0.1	
Gempylidae			
Gempylus serpens	0.4		
Gonostomatidae			
Vinceguerria sp.			3.2
Unid. gonostomatid		<0.1	
Hemiramphidae			
Oxyporhampus micropterus		0.7	
Melamphaidae	11.4	1.8	7.1
Melamphaes sp.	4.5		0.1
Poromitra crassiceps	1.1		
Scopelogadus bispinosus	5.7	1.8	7.0
Microstomatidae	0.3		
Nansenia sp.	0.2		
Xenopthalmichthys sp.	0.1	<0.1	
Myctophidae	37.3	49.7	70.6
Benthosema panamense	0.3	<0.1	4.7
Ceratoscopelus warmingii	<0.1	0.5	
Diaphus mollis	0.1	0.4	
Diaphus splendidus	0.9	3.8	
Diaphus spp.	0.1	6.1	
Diogenichthys lanternatus.	0.8	0.7	57.5
Gonichthys tenuiculus	0.4		
Hygophum proximum	0.4	0.7	
Hygophum reinhardtii	<0.1	<0.1	
Hygophum sp.			0.1
Lampadena luminosa	2.9	2.7	

Lampadena sp.	0.2	<0.1	
Lampanyctus festivus	1.7	1.7	
Lampanyctus omostigma	1.6	1.8	
Lampanyctus parvicauda	12.1	13.7	5.2
Lampanyctus sp. #1	0.5		
Lampanyctus sp. #2	1.1		
Myctophum asperum	0.8	0.3	
Myctophum aurolaternatum	1.5	2.8	0.5
Myctophum nitidulum	0.2	0.4	
Myctophum spinosum		0.2	
Myctophum spp.		<0.1	<0.1
Nannobrachium idostigma	<0.1	0.5	1.3
Notoscopelus resplendens	5.6	<0.1	
Parvilux ingens	7.3	<0.1	
Protomyctophum sp.	0.1		
Symbolophorus spp.	2.4	8.1	0.1
Taaningichthys spp.	0.2	0.6	
Tarletonbeania crenularis		<0.1	
Triphoturus mexicanus.	0.5	0.4	
Unid. myctophid (worn)	5.0	6.8	1.1
Nomeidae	1.3		
Cubiceps baxteri	0.4	0.1	
Cubiceps caeruleus	0.2		
Cubiceps c.f. *C. paradoxus*		<0.1	
Cubiceps pauciradiatus	0.8	5.9	
Psenes sp.	<0.1		
Notosudidae			
Scopelosaurus sp.	<0.1	0.1	
Paralipididae			
Stemonosudis sp.		<0.1	
Sudis atrox	1.0		
Unid. paralepidid			<0.1
Phosichthyidae	3.7		
Ichthyococcus sp.	1.7	<0.1	
Vinciguerria lucetia	2.0	1.6	
Scombridae			
Auxis thazard		<0.1	
Scopelarchidae	0.9		
Benthalbella sp.		<0.1	
Scopelarchus analis	0.2		
Scopelarchus guentheri	0.5	<0.1	
Unid. scopelarchid	0.2		0.1
Sternoptychidae	0.1		
Argyropelecus sladeni	0.1		
Argyropelecus sp. cf. *A. affinis*	<0.1		
Stromateidae			
Hyperglyphe sp.		<0.1	
Unid. stromateid			<0.1
Zoarcidae			
Unid. zoarcid	<0.1		
Unid. and unidentifiable (worn or broken) otoliths	6.1		<0.1
CEPHALOPODA	30.3	32.6	
Alloposidae			
Alloposus mollis		<0.1	

Architeuthidae			
Architeuthis sp.		<0.1	
Argonautidae			
Argonauta sp.		<0.1	
Bolitaenidae			
Japatella heathi	<0.1	<0.1	
Brachioteuthidae			
Brachioteuthis sp.	0.9		
Chiroteuthidae			
Valbyteuthis sp.	<0.1		
Unid. chiroteuthid			<0.1
Cranchiidae	5.6	4.1	
Galiteuthis pacifica	<0.1		
Leachia dislocata	3.5	2.3	
Liocranchia reinhardtii	1.9	0.7	
Megalocranchia sp.	0.1	1.3	
Unid. cranchiid (very small juveniles)	<0.1		
Ctenopterygidae			
Ctenopteryx sicula	<0.1	0.1	
Cycloteuthidae	0.2		
Cycloteuthis sp.	0.1		
Discoteuthis sp.	0.1		
Enoploteuthidae	12.2	10.4	2.7
Abraliopsis affinis	7.8	9.8	2.7
Ancistrocheirus lesueuri	0.1	0.4	
Pterygioteuthis giardi	4.2	0.2	
Pyroteuthis margaritifera	0.1		
Grimalditeuthidae			
Grimalditeuthis bonplandi	0.1	<0.1	
Histioteuthidae	0.6		
Histioteuthis hoylei	0.2	<0.1	
Histioteuthis meleagroteuthis	0.2	<0.1	
Histioteuthis sp.	0.2		
Mastigoteuthidae	1.1		
Idioteuthis sp.	0.1		
Mastigoteuthis dentata	1.0	2.3	
Octopoteuthidae	0.9	0.2	
Octopoteuthis deletron	0.7	0.2	
Octopoteuthis sp.	0.1	<0.1	
Taningia danae	0.2		
Ocythoidae			
Ocythoe tuberculata	<0.1		
Ommastrephidae	3.8	9.2	1.2
Dosidicus gigas	<0.1	0.7	
Eucleoteuthis luminosa	0.2	1.4	
Hyaloteuthis pelagica	1.8	0.6	
Nototodarus c.f. *N. hawaiiensis*			
Ommastrephes bartrami	<0.1	4.1	
Sthenoteuthis oualaniensis	1.4	1.0	
Ommastrephid spp.		1.2	1.0
Unid. ommastrephid (very small juveniles & upper beak)	0.5		0.2
Onychoteuthidae	2.2	2.3	0.5
Moroteuthis sp.	0.1		
Onychoteuthis banksii	2.2	2.1	0.5

Onychoteuthis spp. (2)		0.2	
Pholidoteuthidae			
Pholidoteuthis boschmai	0.3	0.5	
Thysanoteuthidae			
Thysanoteuthis rhombus	<0.1	0.3	
Tremoctopodidae			
Tremoctopus violaceus	0.2	<0.1	
Unid. lower and upper beaks	0.2	3.1	0.1
GASTROPODA		<0.1	
CRUSTACEA	----	0.7	

Appendix 1. Standard length/otolith length relationship for *Myctophum aurolaternatum.*

We calculated length in relation to otolith length for 30 frozen and thawed specimens of the myctophid fish *Myctophum aurolaternatum* ranging in standard length from 32 to 97 mm and in otolith length from 1.3 to 4.6 mm based on linear regression (Fig. 1).

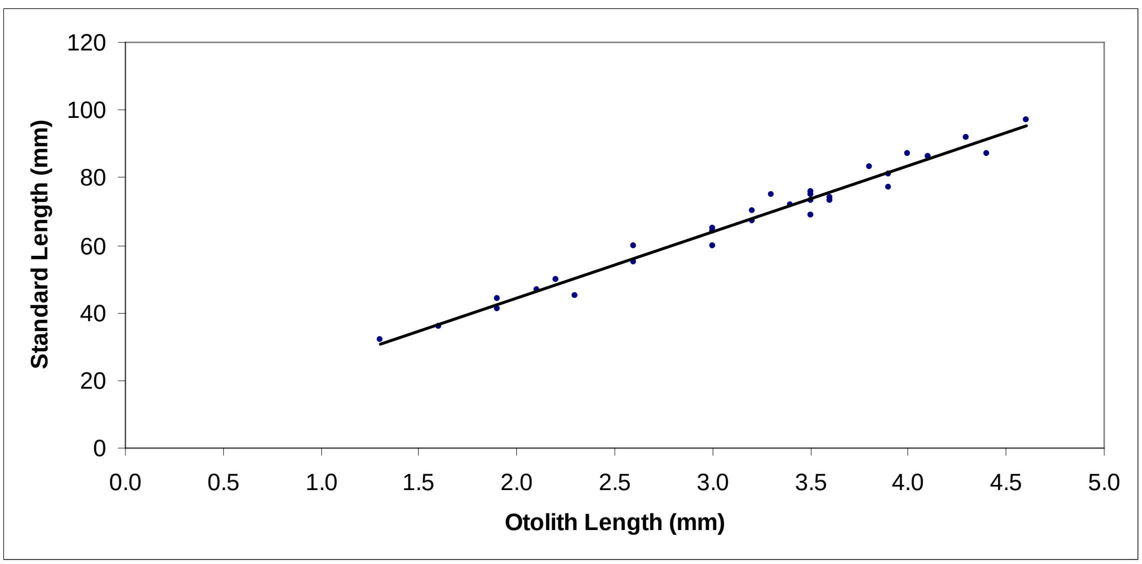

Figure 1. Linear regression of standard length on otolith length for *Myctophum aurolatenatum.*

Standard length is estimated as STDL = 19.54(OL) + 5.34mm where STDL = standard length and OL = otolith length.

R^2 = 0.97; standard error = 2.78 mm.

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