Species Composition and Distribution of Pelagic Cephalopods from the Pacific Ocean off Oregon

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MUCH OF OUR PRESENT KNOWLEDGE about the species composition and distribution of cephalopods of the Pacific Ocean is derived from collections made on cruises of the "Albatross," steamer of the U.S. Fish Commission, during the late nineteenth and early twentieth centuries. "Albatross" collections along the west coast of North America were taken mainly off California and Central America or Alaska, and comparatively few collections were made off Oregon (Townsend, 1901). Neither Berry (1912) nor Hoyle (1904) lists any cephalopods taken off Oregon. A description of a new species of squid (Pearcy and Voss, 1963) and an abstract (Pearcy, 1963) are the only reports of pelagic cephalopods off Oregon.[2] Clearly, more data are needed before comparisons of fauna and generalization on zoogeographic distribution can be made.

METHODS

A total of 385 collections made between June 1961 and July 1963 with a six-foot Isaacs-Kidd midwater trawl from the "R. V. Acona" provided most of the data on pelagic cephalopods collected off the Oregon coast. Collections were made after dark within the upper 200 m (depth permitting) at a series of stations located 15, 25, 45, and 65 miles, and at another station located between 65 and 165 miles, offshore along parallels of latitude between the Columbia River and the California border (46° 14.4′N, 44° 39.1′N, 43° 20′N, and 43° 00′N). Generally the stations off the central Oregon coast, 44° 39.1′N (off Newport), were sampled every month and other stations bimonthly.

In addition to the 0–200m collections at various distances from shore, tows were made to provide data on the depth distribution of cephalopods. Over one hundred collections were made to successive depths of 200, 500, and 1000 m over the outer edge of the continental slope at a station 50 miles off Newport. For more details on sampling methods see Pearcy (1964).

Collections were preserved with 10% formalin in sea water. Cephalopods were removed from the collections, identified, and the dorsal mantle length (DML) was recorded.

Occasionally some cephalopods were collected with dip nets under lights at night and some with epibenthic otter trawls.

RESULTS

The families and species of pelagic cephalopods collected are listed in Table 1. These include 17 species in 12 families. Six species are distributional records for the northeastern Pacific Ocean, reported previously only by Pearcy (1963). They are: *Abraliopsis* sp., *Octopoteuthis sicula, Gonatopsis borealis, Taonius pavo, Cranchia scabra,* and *Vampyroteuthis infernalis.* Only eight of the seventeen species are included in the study by Berry (1912) based mainly on benthic collections.

Although most of these species were collected in the midwater trawl, several were captured by other methods. Two *Moroteuthis robusta* (DML 650 and 1350 mm) were caught in otter trawls off the northern Oregon coast in water deeper than 150 m. This species, reported from California (Smith, 1963) and Alaska (by Dall, in Berry, 1912), was recently reported off Oregon.[2] *Loligo opalescens,* a common inshore myopsid of the west coast of

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[2] Added in proof: J. M. Van Hyning and A. R. Magill. 1964. Occurrence of the Giant Squid (*Moroteuthis robusta*) off Oregon. Fish Comm. Oregon Research Briefs 10:67–68.

TABLE 1

LIST OF PELAGIC CEPHALOPODS COLLECTED FROM THE PACIFIC OCEAN OFF OREGON, JUNE 1961–JULY 1963

Loliginidae	*Loligo opalescens* Berry, 1911
Sepiolidae	*Rossia pacifica* Berry, 1911
Onychoteuthidae	*Onychoteuthis banksi* (Leach, 1817)
	Moroteuthis robusta (Dall) Verrill, 1876
Enoploteuthidae	*Abraliopsis* sp.
Veranyidae	*Octopoteuthis sicula* Ruppell, 1844
Histioteuthidae	*Meleagroteuthis hoylei* Pfeffer, 1900
Gonatidae	*Gonatus fabricii* (Lichtenstein, 1818)
	G. magister Berry, 1913
	G. anonychus Pearcy and Voss, 1963
	Gonatopsis borealis Sasaki, 1923
Chiroteuthidae	*Chiroteuthis veranyi* (Ferussac, 1835)
Cranchiidae	*Galiteuthis armata* Joubin, 1898
	Taonius pavo Lesueur, 1821
	Cranchia scabra Leach, 1817
Vampyroteuthidae	*Vampyroteuthis infernalis* Chun, 1903
Octopodidae	
Bolitaenidae	*Japetella heathi* (Berry, 1911)

TABLE 2

AVERAGE NUMBER OF PELAGIC CEPHALOPODS COLLECTED PER HOUR OF MIDWATER TRAWLING IN TOWS TO VARIOUS DEPTHS AT A STATION 50 MILES OFF NEWPORT, OREGON

SPECIES	0–200 M (72 TOWS)	0–500 M (23 TOWS)	0–1000 M (24 TOWS)
(A) *Gonatus fabricii*	0.5	0.5	0.1
Gonatus spp.	1.2	0.2	0.1
Chiroteuthis veranyi	0.5	0.1	0.1
Abraliopsis sp.	0.7	0.1	0.1
(B) *Japetella heathi*	0.03	0.21	0.14
Octopoteuthis sicula	0.00	0.04	0.02
Galiteuthis armata	0.00	0.04	0.05
Taonius pavo	0.01	0.14	0.06
	day (9 tows) / night (63 tows)	day (14 tows) / night (9 tows)	
(C) *Gonatus fabricii*	0.2 / 0.6	0.7 / 0.2	
Abraliopsis sp.	0.0 / 0.7	0.2 / 0.1	

North America, was found in several otter trawl collections where the depth was 100 m or less, but was absent from midwater trawl collections. *Rossia pacifica,* another myopsid, was taken mainly in otter trawl collections, as was the large (DML 200 mm) *Gonatus magister. Gonatus anonychus* was collected only with a dip net under night lights (Pearcy and Voss, 1963).

The relative abundance of the cephalopods captured by midwater trawling from all stations and depths is shown in Figure 1. *Gonatus fabricii* comprised about 38 percent of the total catch. A group consisting of larval and juvenile individuals of the genus *Gonatus,* but without sufficient differentiation of hooks for specific identification, was next in numerical importance. At least three separate species of *Gonatus* may be represented (Table 1) but, judging from the relative abundance of larger gonatids, most are probably *G. fabricii.*

Geographic Distribution

Little difference in the species composition of cephalopods was noted among the latitudes. *Gonatus fabricii, G.* spp., and *Abraliopsis* dominated the midwater trawl collections at nearly all series of stations. Pelagic cephalopods, as well as mesopelagic fishes (Pearcy, 1964), were rare at the inshore stations off Newport, where the depth of water was 300 m or less.

Depth Distribution

The number of common squid captured per hour of towing appeared greater in tows to 200 m than in deeper tows; this was particularly true of *Gonatus* spp., *Chiroteuthis veranyi,* and *Abraliopsis* sp. (Table 2*A*). Since an opening and closing device was not used on the trawl, some of the animals found in tows to 500 and 1000 m were probably caught while the trawl sampled through the upper 200 m. Such differences in catches suggest that the four common squids are largely epipelagic in distribution during the night, when most of the 0–200 m collections were made. Comparisons of day and night catches of the two most abundant squids, *G. fabricii* and *Abraliopsis* sp., show that highest catches were made during the night in tows to 200 m depth but during the day in tows to 500 m (Table 2*C*). This

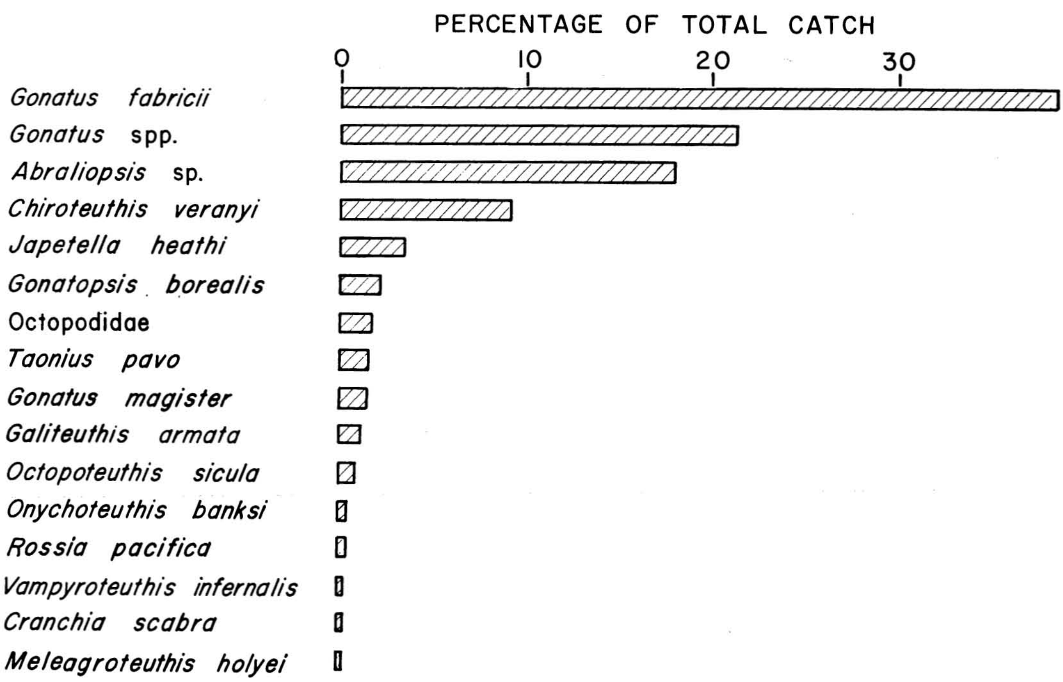

FIG. 1. The relative abundance of pelagic cephalopods found in midwater trawl collections off Oregon.

suggests diurnal vertical migration of these species.

Some of the cephalopods were uncommon in epipelagic waters and are considered to be of basically mesopelagic (200–1000 m) distribution. Four species were more abundant in deep tows than in shallow tows (Table 2*B*). With the exception of *G. armata,* individuals of these species were occasionally collected in 0–200 m tows after dark at other stations, but they were smaller than those from deeper collections. The bathymetric distribution of *G. armata,* summarized by Sasaki (1929), also suggests that it is a deep water species. *Vampyroteuthis infernalis,* another deep water species, was taken only in tows below 500 m.

Seasonal Variations

Seasonal differences in relative abundance were striking, though species composition apparently was not greatly influenced by season. The number of animals per tow during the summer was about an order of magnitude greater than it was during other months.

TABLE 3

SEASONAL OCCURRENCE OF COMMON CEPHALOPODS, 0–200 M COLLECTIONS, ALL STATIONS

SPECIES	AVERAGE NUMBER PER TOW	
	JULY–SEPT. (79 TOWS)	OCT.–JUNE (205 TOWS)
Gonatus fabricii	4.9	0.61
Gonatus spp.	1.9	0.32
Chiroteuthis veranyi	0.71	0.20
Abraliopsis sp.	1.9	0.33

Catches of *G. fabricii* were about eight times higher during the summer, of *Gonatus* spp. and *C. veranyi* about six times higher (Table 3).

Such seasonal differences indicate marked changes in the availability of cephalopods due to changes in susceptibility to capture or to changes in actual abundance. Since the differences could be related to the life history of the

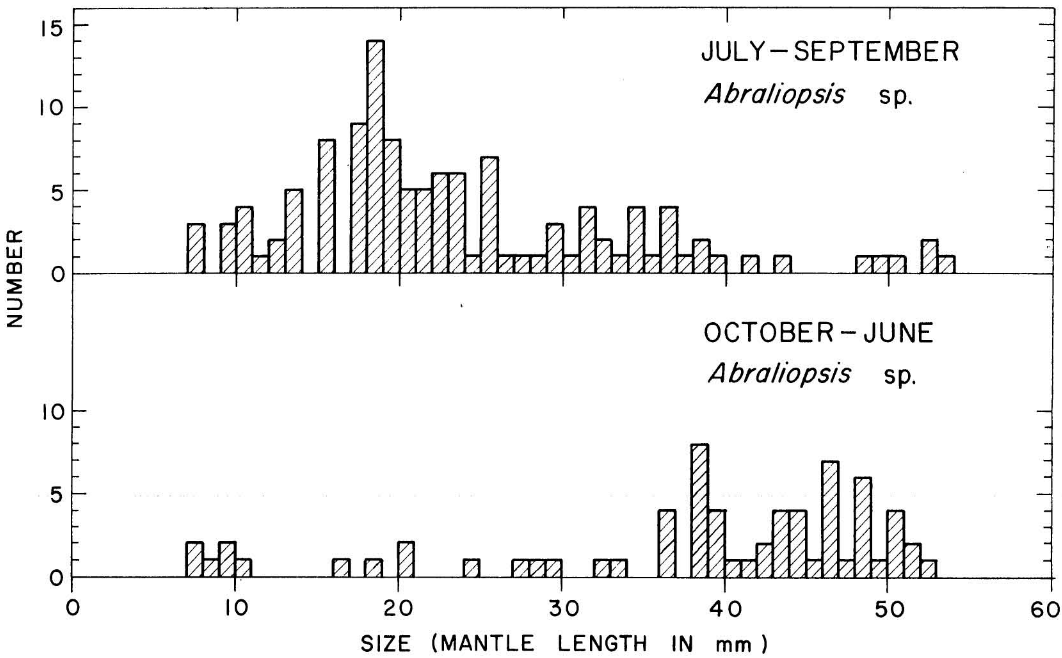

FIG. 2. Size-frequency distributions of *Abraliopsis* found in midwater trawl samples during the summer (July–September) and other seasons of the year (October–June).

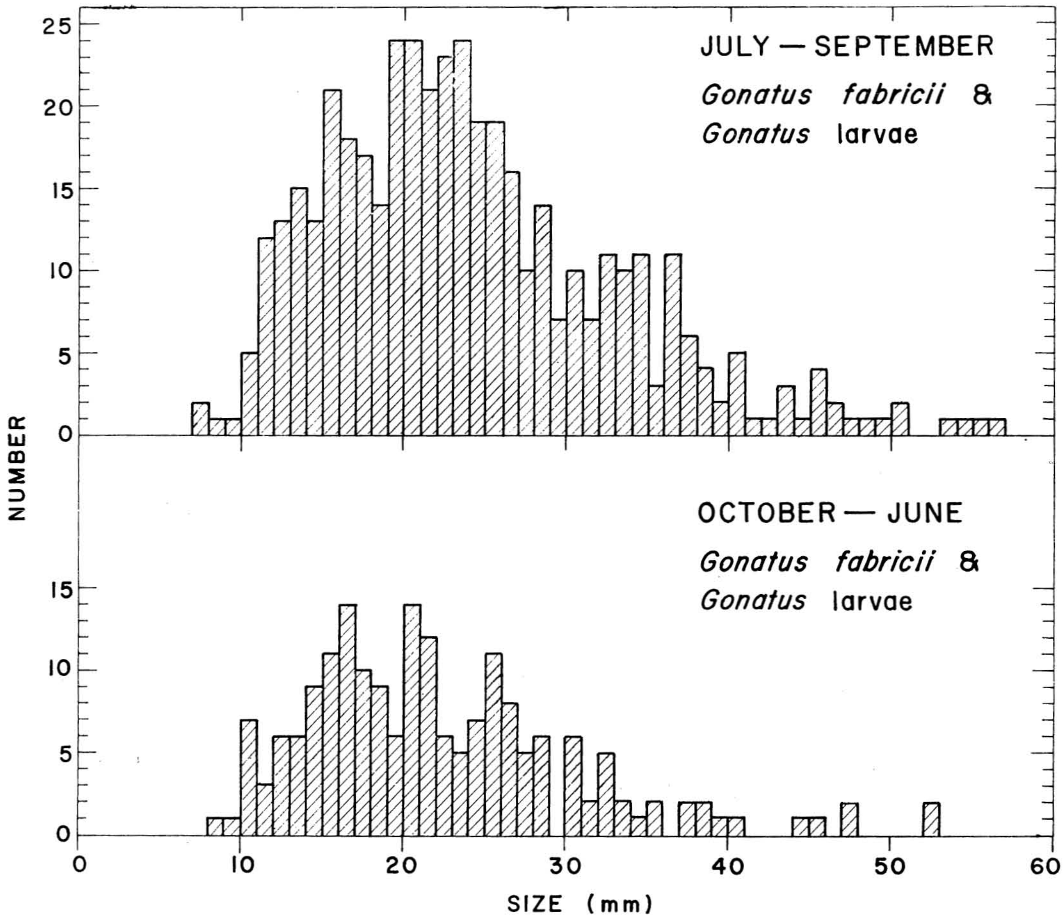

FIG. 3. Size-frequency distribution of *Gonatus fabricii* and *Gonatus* larvae found in midwater trawl samples during the summer (July–September) and other seasons of the year (October–June).

squid in either case, size–frequency distributions were examined.

During the summer the catch of *Abraliopsis* sp. consisted mainly of small individuals (less than 30 mm DML), whereas during other seasons larger squid predominated (Fig. 2). On the other hand, the size distribution of *Gonatus* larvae and *G. fabricii* (assuming they are in fact one species) are similar for both summer and non-summer periods (Fig. 3). This suggests that breeding of *Abraliopsis* is largely seasonal, while that of *Gonatus* is not.

Seasonal differences between the size structures of each species may result from growth, mortality, and movements of the populations. Growth, and attendant mortality, may explain differences between the size modes and relative abundance of *Abraliopsis* during the two periods. But other factors appear to be involved with *Gonatus*. *Gonatus* specimens over 30 mm in length constituted a larger proportion of the total catch during the summer than in other seasons (21% *versus* 7%). In addition, the catch of large *Gonatus* per tow during the summer was greater than that of small *Gonatus* (30 mm) during the other seasons. These differences suggest an influx or migration of these squid into slope waters during the summer. Perhaps this is caused by oriented swimming of squids or by a concentrating effect of ocean circulation.

DISCUSSION

Some squid are notoriously fast swimmers; others are more planktonic than nektonic. Such differences in swimming ability obviously determine the catch composition by any sampling method. Most of the cephalopods collected in the midwater trawl were small. Although a large *Gonatopsis borealis* (DML, 250 mm) was captured, there was evidence that smaller squids than this readily avoid the midwater trawl. For example, *Onychoteuthis banksi* (DML of 100 mm and over) were often observed around night lights, but were rarely if ever captured in midwater trawl collections at the same station and time. The average size of squid was larger in otter trawl than in midwater trawl collections, and, in general, the largest squid were captured in the largest trawls.

Of the identifiable cephalopods found in the stomachs of 66 albacore tuna (*Thunnus alalunga*) collected off Oregon during the summer of 1962, small gonatids predominated. Inasmuch as predators often obtain effective samples of cephalopods (Clarke, 1963), this agreement between the catches of two independent sampling "devices," the midwater trawl and the albacore, was encouraging.

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REFERENCES

BERRY, S. W. 1912. A review of the cephalopods of western North America. U.S. Bur. Fish. Bull. 30:267–336.

CLARKE, M. R. 1963. Information obtained by using squid predators as samplers. Proc. XVI Int. Congress of Zool. 1:67.

HOYLE, W. E. 1904. Reports on the Cephalopoda. "Albatross" Reports. Bull. Mus. Comp. Zool. 43(1):1–71.

PEARCY, W. G., and G. L. VOSS. 1963. A new species of gonatid squid from the northeastern Pacific. Proc. Biol. Soc. Washington 76:105–112.

——— 1936. Distribution of oceanic cephalopods off Oregon, U.S.A. Proc. XVI Int. Congress Zool. 1:69.

——— 1964. Some distributional features of mesopelagic fishes off Oregon. J. Mar. Res. 22:83–102.

SASAKI, M. 1929. A monograph of the dibranchiate cephalopods of the Japanese and adjacent waters. J. Fac. Agric. Hokkaido Univ. 20(Suppl.):1–357.

SMITH, A. G. 1963. More giant squids from California. Calif. Fish and Game 49:209–211.

TOWNSEND, C. H. 1901. Dredging and other records of the United States Fish Commission Steamer "Albatross," with bibliography relative to the work of the vessel. Rept. U.S. Commission of Fish and Fisheries, Pt. 26: 387–562.