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On Feeding of Long-finned Squid (*Loligo pealei*) Juveniles in Subareas 5 and 6

by

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Abstract

The feeding of Loligo pealei (Le Sueur, 1821) juveniles with mantle length of 1.0 to 20.0 cm is analysed. A total of 322 stomach contents was examined. The qualitative composition of food and feeding variability with age were studied.

The squid juveniles up to 4.0 cm in length are predators on small plankton organisms, mainly copepods, in the pre-bottom layer. Squids attaining the sizes of 4.1-8.0 cm pass to the bottom life. The appearance of bottom animals (crabs, polychaete, Anomura, shrimps) in their feeding is indicative of this. The variety of food objects is also characteristic of this group. Squids lose the close connection with pre-bottom organisms at the transition to the "adult" type of feeding and feed on active nekton forms (fish, squids).

Introduction

The North-American squid Loligo pealei (Le Sueur, 1821) is an abundant species in the waters between Cape Cod and Cape Hatteras (Summers, 1968). This predator plays an important role in the ecosystem of the shelf and upper part of the continental slope (Vovk, 1975). The food composition of the adult squid L. pealei is well studied (Vovk, 1972; Vinogradov, Noskov, 1979),

while the feeding of juveniles is quite unknown. The age variations in the food habits of Cephalopoda are rather considerable. Thus, the investigations of this feeding aspects are the basis for the analyses of the relationship between animals of different trophic levels (Vovk, 1975).

Materials and Methods

The materials on feeding of juveniles L.pealei were collected aboard the SRTM EKLIPTIKA on the USA shelf in November. The depth range of 50-100 m was sampled. The bottom trawl with 10-mm mesh chafer was used to catch the squid juveniles. The young squid are not retained by the standard trawl as a rule.

The stomach contents of 322 individuals of 12 to 200 mm in length were examined under the microscope MBS-1. Among these individuals the specimens with mantle length of 1.1-8.0 cm, 8.1-16.0 cm , and over 16.0 cm constituted 35%, 62%, and 3% respectively.

The occurrence of different food objects and their proportion in the food mass were analysed. The food in the squid stomachs was reduced to small fragments in most cases and the taxonomic groups of food components were identified mainly by the separate fragments. The stomach filling index was estimated by the conventional 5-division scale.

Discussion

A total of 70 stomachs out of 322 were empty, and stomachs with filling of 1+2+3+4 units constituted 29, 30, 16 and 4% respectively. The number of stomachs with inconsiderable filling (1-2 units) and without any food totals 80% in all. It is indicated that the feeding intensity is comparatively low in that period that is connected with our data on decreasing of feeding activity of the whole squid population during the fall months compared with the spring and summer periods (Vovk, 1972). This is likely to be associated with deteoration of fattening condi-

tions (diminution of the daylight period, food amount, etc.) as well as with peculiarities of the squid population structure in the fall. By this period the population recruits by the considerable number of juveniles and as it was stated (La Roe, 1971; Hurley, 1975) they are characterized by the more frequent food consumption and higher digestion rate compared with adult individuals. If the availability of 50% empty stomachs and 50% stomachs with filling of 3-4 units may be considered as mean fattening activity then in this case the juveniles should always have the food mass of 1-2 units. Squids with stomach filling of 1-2 units constituted 60% in our samples.

The North-American squid juveniles feed on a large number of species (table 1.). The bulk of the ration forms by the representatives of different taxonomic and ecological groups, i.e. polychaete, fish, squids, Chaetognatha, various crustaceans.

The major food for squid is the fish larvae and juveniles, and copepoda, the squids and other species being of less importance. Fish prevail according to the occurrence frequency (42.6%). These are mainly young representatives of Clupeidae and Myctophidae families, other fish fry and juveniles. Copepod is of primary importance in the food mass. The large prportion of copepoda against the fish in the feeding of juveniles is connected with the availability and abundance of these food objects. The stomach contents of the examined squids of 3.0 to 8.0 cm in length consisted completely of copepoda (90%). It means that the squid juveniles feed more frequently on fish than on copepoda, however in smaller numbers.

The representatives of Copepoda were arranged with regard for the occurrence frequency and volume: Centropages typicus, Candacia armata, Gaidius tenuispinus, Calanus finmarchicus, Scaphocalanus brevicornis, Mitridia lucens, Temora longicornis. It should be noted that two or three species of copepoda occurred in the stomachs as a rule, one of them predominated. The copepod eggs are found almost in the half of the samples that is indic-

ative of fattening of juveniles on spawning concentrations of small crustaceans. The above-mentioned copepoda are comparatively large, and in the major cases they are predators, demersal-pelagic, neritic forms. Therefore, in the fall juveniles of up to 8.0 cm stick to the bottom feeding on different crustaceans (in addition to copepoda the remains of young euphausiacea Meganictiphanes sp. occurred in each fourth stomach).

Squids of the same species are on the third place with regard for occurrence frequency and volume. The remains of young Illex illecebrosus were found in 49 stomachs. Squids of family Enoploteuthidae occurred in one stomach. Euphausiacea, shrimps, Chaetognatha occurring two or three times rarely against the major food components are less important. Other components do not play an important role in feeding and can be considered as incidental.

It is rather difficult to estimate the number and size of species swallowed by squid. So even the negligible information is of great importance.

It was determined by the number of eyes, crustacean mandibles and lens of fish that squids of 4.1-10.0 cm can consume up to 100 sp. of small crustaceans and 4-21 sp. of young euphausiacea. Three specimens of shrimp Crangon occurred in the stomachs of squids 14.0 cm in length; two full mature females of shrimp Pandalus borealis were found in 17.0 cm squid. Squids of over 16.0 cm in size swallowed less than 1-2 fish or squids as a rule. As is evident from the above-stated data the number of organisms which constitute simultaneous food portion decreases with increase of squid length (from 50-150 sp. for 4.0-8.0 cm squids). The prey sizes also increase.

Food habits and behaviour of squids change considerably in the size range examined (fig. 1). The major food for juveniles of 1.0-4.0 cm in length is small demersal plankton organisms, such as copepoda, and young euphausid being of less importance, i.e. 10% and 25% of occurrence respectively.

Squids of 4.1-6.0 cm in length constitute the group within which the transition from feeding on mesozooplankton to macroplankton consumption occurs. The occurrence of copepoda in their stomachs decreases sharply while the proportion of euphausid and Sagitta increases.

Copepoda completely disappear from the feeding of squids of 6.1-10.0 cm size group. They begin to feed on young crabs, Anomura, Stomatopoda as well as on shrimps and polychaete.

Then the fish and squid juveniles appear in the food mass of 10.1-12.0 cm individuals. Sagitta, young crabs, euphausid and shrimps are also of great importance in their feeding.

The size group of 12.1-16.0 cm may be considered as the transition to the "adult" type of feeding by the food habits. Different species of fish and squids prevail in this type of feeding, however the crustaceans are still of certain importance.

Squids of over 16.0 cm in size characterize by steady "adult" type of feeding. They feed almost exclusively on fish and squids.

Conclusion

Thus, in the ontogeny of the North-American squid four types of food spectrum may be distinguished:

1 - postlarval - for the juveniles of 1.1 to 8.0 cm in length - multi-component composition of food mass with sharp predominance of small mesoplankton organisms, mainly copepoda (dozens), and with frequent food consumption;

2 - for 8.0-12.0 cm juveniles - variety of food groups of pre-bottom - pelagic complex with predominance of macroplankton crustaceans and young fish, decrease of the food organism proportion in the food portion (5-20 sp.);

3 - transitional - for 12.0-16.0 cm size group - predominance of different fish and squid species in the food mass, however euphausid is also present;

4 - adult - for individuals of over 16.0 cm - food portion is of 1-3 sp. of food organisms, mainly of micronekton forms (fish and squids).

The age variability in the squid feeding characterizes by the transition to the hunting for the larger and more active species. The food spectrum of squids attaining the sizes over 12 cm becomes stable and remains invariable on the whole. Judging from the food composition squid juveniles of up to 4 cm feed in the pre-bottom layer (about 10 m). Squids of 4.1-8.0 cm in size pass to the bottom life. The bottom animals, such as shrimps, polychaete, Anomura, squids, appear in their feeding. The great variety of food objects is also characteristic of this group. Squids lose the close connection with pre-bottom organisms at the transition to the "adult" type of feeding. The major food is the active and large micronekt on forms. Squids transit with age from grazer to attacking predator hunt types. The ratio of the prey sizes to the squid length also changes with age, i.e. about 5% and 20-25% for juveniles and squids over 15.0 cm in size respectively.

During their life history the squid juveniles are consecutively the consumers of 2,3 and 4 orders in the ecosystem. At the earlier growth stages the juveniles are the competitors of plankton-eating fish of the second trophic level and then of young demersal fish species. They complete finally with pelagic predators of the third order. The squid juvenile is the major food object for a large number of commercial fish species and other animals (birds and mammals) of the Northwest Atlantic. Among these species are different bottom and demersal fish, plankton--eaters; large, bottom nekton predators (tunas, sharks and mammals).

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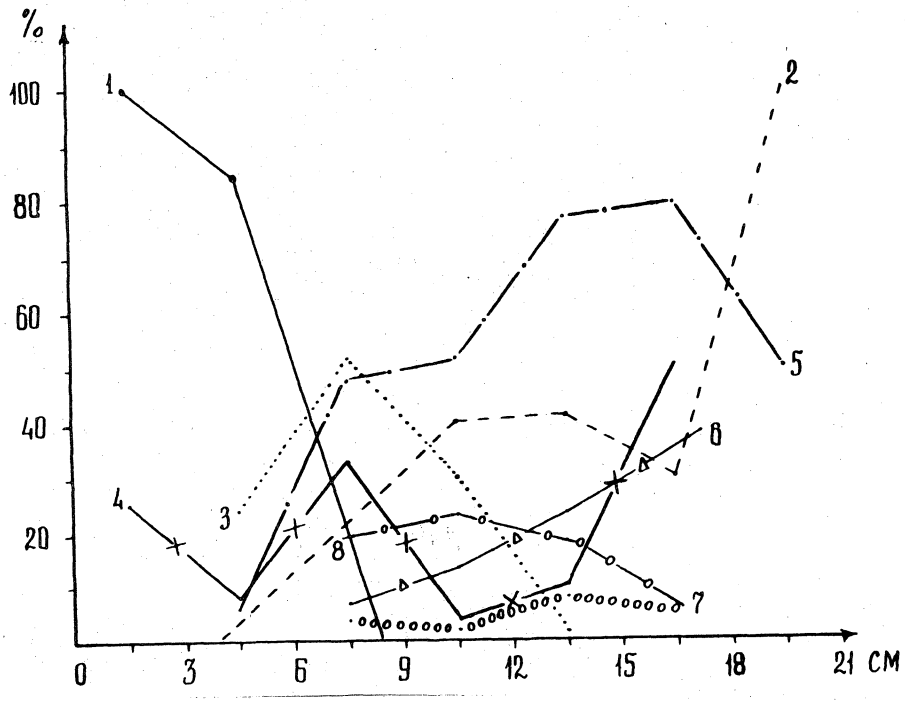
Table 1. Occurrence of food items in the diet of Loligo pealei.

Food object	% of occurrence	in the food mass (%)
Fish	42.6	26.0
Copepod	32.5	27.6
North-American squid	24.5	13.3
Sagitta	19.4	8.5
Euphausid	15.6	6.2
Shrimp	11.4	6.1
Anomura	6.3	3.8
Sand	4.1	0.4
Polychaete	2.9	2.5
Not identified crustaceans	2.4	1.8
Young crabs	2.1	1.9
Megalops	2.1	1.0
Amphipod	0.8	0.3
Not identified remains	0.8	0.1
Stomatopoda	0.4	0.5



Designations:

1. ———————— copepod
2. – – – – – – – – s q u i d
3. · · · · · · · · Sagitta
4. ——— x ——— euphausid
5. ——— · ——— fish
6. ——— △ ——— shrimp
7. ° ° ° ° ° ° ° polychaete
8. ——— ° ——— crab, megalops, Anomura, stomatopoda

Fig. 1. Age variability of juveniles (L. pealei, Le Sueur, 1821) feeding in the fall period.