OCCURRENCES OF THE SCOMBRID LARVAE IN SOUTH BRAZILIAN WATERS

by

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SUMMARY

Distributions of scombrid larvae in south Brazilian waters (23°S - 29°S) were studied using the plankton samples collected during November 1975 and October 1976. Five species were identified: Auxis sp., Euthynnus alletteratus, Scomber japonicus, Katsuwonus pelamis, and Thunnus alalunga. Analysis of the data indicated that only Scomber japonicus spawned during cold water season and the other four species spawned during warm water season, especially in January. The most abundant larvae was Auxis sp., which were collected from all surveyed areas. The distribution of Euthynnus alletteratus larvae was observed mainly in the coastal region. Auxis larvae less than 12 mm length showed no difference on catch ratio in day and night hauls.

RESUME

La distribution des larves de scombridés des eaux au sud du Brésil (23ºS-29ºS) a été étudiée au moyen d'échantillons de plancton récoltés au cours de la période comprise entre novembre 1975 et octobre 1976. Cinq espèces ont été identifiées: Auxis sp., Euthynnus alletteratus, Scomber japonicus, Katsuwonus pelamis et Thunnus alalunga. Les analyses des données ont montré que, seul le Scomber japonicus déposait son frai au cours de la saidon où l'eau est froide et, qu'au contraire, les quatre autres espèces le réalisait pendant la saison où l'eau est chaude, et tout particulièrement au mois de janvier. Les larves les plus abondantes provenaient d'Auxis sp., récoltées dans toutes les zones de prospection. La distribution des larves d'Euthynnus alletteratus a surtout été étudiée dans la région côtière. Pour celles d'Auxis, le taux de capture ne se voyait pas altéré si l'échantillon était prélevé pendant le jour ou pendant la nuit.

RESUMEN

Se estudiaron las distribuciones de larvas de escómbridos en aguas al sur del Brasil (23ºS-29ºS) por medio de muestras de plancton recogidas en noviembre 1975 y octubre 1976. Cinco especies fueron identificadas: Auxis sp., Euthynnus alletteratus, Scomber japonicus, Katsuwonus pelamis y Thunnus alalunga. Los análisis de los datos indicaron que sólo el Scomber japonicus habia desovado durante la temporada de aguas frias, y que las otras cuatro especies lo habian hecho en el curso de la temporada de aguas templadas, especialmente el mes de enero. Las larvas más abundantes eran de la especie Auxis sp., que se encontraron en todas las zonas de prospección. Las larvas de Euthynnus alletteratus se hallaban principalmente en la zona costera. Las larvas de Auxis inferiores a los 12 mm no mostraban diferencia alguna en la tasa de captura en lo que respecta a recogida nocturna o diurna.

INTRODUCTION

Only few works have been done with regard to larvae and juveniles of the family Scombridae in Brazilian waters. Aboussouan (1969) showed the occurrences of some scombrid larvae taken during the survey cruise of the R/V Calypso in 1972. Richards (1969a; b) using the material collected during the Equalant survey cruises, showed the occurrences of the larvae belonging to four species of Thunnus and of Katsuwonus pelamis from the tropical Atlantic waters and discussed the spawning areas of these species. Summarizing the distribution of larval tunas, billfishes and related species taken from all oceans with the R/V Shunyo-Maru and Shoyo-Maru during 1956 through 1976, Nishikawa, et al. (1978) demonstrated the occurrences of these larvae from Brazilian waters.

The FINEP program is an integrated oceanographic survey consisting of physical oceanography, primary productivity, fish egg and larval study, exploratory fishing, acoustic study and fish spotting by aircraft. The main purpose of the program is to study fishery potential of pelagic fishes and oceanographic structure of the region.

As the survey cruises conducted by the foreign research vessels were done mainly in the open seas, we intended to demonstrate distributions in the coastal waters and seasonal variation of the scombrid larvae, using the material collected during the FINEP program in south Brazilian waters.

MATERIAL AND METHODS

The plankton samples were collected with Bongo net sampler by the R/V Prof. W. Besnard during four cruises conducted from November 1975 to October 1976. Each cruise covered the same survey area between Cabo Frio ($23^{o}S$) to the south of Cabo de Santa Marta Grande ($29^{o}S$), in which 140 oceanographic stations were comprised (Fig. 1).

The sampling method and procedure to process the material were based on the methods described by Ahlstrom, et al. (1973) and Kramer, et al. (1972).

All fish eggs and larvae were sorted from the plankton samples under binocular microscope and then the scombrid larvae were separated. Identification of larvae was based on the following papers:

Scomber japonicus: Watanabe, 1970; Berrien, 1978.

Katsuwonus pelamis, Thunnus alalunga, Euthynnus alletteratus and Auxis sp.: Matsumoto, 1958; 1959; 1962; Matsumoto, et al. 1972.

The systematic status of the Atlantic Auxis is still problematic, therefore we used the name Auxis sp. for this group.

The number of larvae taken at each station were transformed into the number per 10 m^2 of sea surface using the following expression:

$$y = \frac{d \cdot x}{v} \cdot 10$$

But, y= no. of larvae per 10 m^2 of sea surface

x= no. of larvae taken at station

d= maximum depth of the haul (m)

v= volume of water filtered (m^3) measured by flow meter.

DISTRIBUTION AND RELATIVE ABUNDANCE

Analysing the larval samples, five species of the scombrid larvae were identified: Auxis sp. Euthynnus alle-

tteratus, Katsuwonus pelamis, Scomber japonicus and Thunnus alalunga. Some Thunnus larvae were identified only to genus level because of difficulty in identification of the small larvae.

The proportion of the scombrid larvae in relation to all fish larvae was calculated. The cruise of January 1976 showed the highest value with 3.02% and that of May 1976 the lowest with 0.01%. Larval numbers of all species are shown in Figure 2. It can be noticed that many species of Scombridae spawned during the warm season and the only cold water spawning species of Scombridae was Scomber japonicus.

Auxis sp. (frigate mackerel)

Within the family Scombridae, larvae of Auxis sp. were the most abundant but they were collected from only two survey cruises (late spring and summer seasons).

In the cruise of November - December 1975, larvae were taken from all surveyed area except from the coastal stations (Fig. 4a). They were also taken from waters out of the continental shelf. The main area was located between Santos and Paranaguá in the depth zone between 50m and 200 m. During the cruise of January 1976, the spawning intensity was more pronounced and Auxis larvae were common throughout most of the surveyed area including the coastal region. Two main spawning areas were located: one between Ilha Grande and Ilha de São Sebastião and another between Paranaguá and São Francisco do Sul, both in the depth zone between 50 m and 200 m.

Euthynnus alletteratus (little tuny)

Occurrences of Euthynnus larvae approximated that of Auxis larvae (Fig. 3a), but the mean larval number of the former was less then that of the latter (Table 1). In the cruise of November-December 1975, only one larva was collected from the offshore station near Cabo Frio. Occurrences of Euthynnus larvae in the cruise of January 1976 were concentrated in nearshore stations. When the survey cruises with the research vessel and fishing boat were conducted during the summer season, many schools of Euthynnus were located at surface water in the region between Ilha Grande and Paranaguá near islands or peninsulas. These facts seem to suggest that this species prefers to spawn in the nearshore area where land mass exists. The similar phenomenon was observed with Euthynnus lineatus in the east Pacific (Klawe, 1973).

Scomber japonicus (mackerel)

On the contrary of the two species presented anteriorly the heaviest concentration of the larvae of Scomber japonicus was observed during cold water season (cruise of September-October 1976) and only a small quantity of larvae were taken in the cruises of November-December 1975 and January 1976.

During the cruise of September-October 1976, concentrations of larvae were located in three areas: Cabo Frio, Ilha Grande and Cabo de Santa Marta Grande (Fig. 5-b). In the cruise of November-December 1975, larvae were collected at only three offshore stations near Cabo Frio and in the cruise of January 1976, Cabo Frio region again showed the occurrences of Scomber larvae (Fig. 5-a).

Katsuwonus pelamis (skipjack tuna)

Two larvae of Katsuwonus pelamis were collected in the January 1976 cruise: one at the offshore station out of

Cabo Frio and another at São Francisco do Sul (Fig. 3-b). The mean temperature and salinity at 10 m depth recorded for the station were 25.8°C and 36.73°/oo.

Thunnus sp. (tunas)

All tuna larvae were collected from three offshore stations in the Brazil Current during the January 1976 cruise. Eleven larvae were identified as Thunnus and only one specimen was identified as Thunnus alalunga (Albacore). The mean temperature and salinity at 10 m depth were 25.9°C and 36.71°/oo.

TEMPERATURE AND SALINITY RELATION

Larvae of tunas and billfishes are assumed to distribute in the upper mixed layer, therefore we used the temperature and salinity at 10 m depth of the station as representative of the surface layer. Figure 6 shows these data for all positive stations and their 95% fiducial range for three species.

Larvae of Scomber japonicus were collected from temperature range from 20.4 to 24.2°C and salinity range from 34.02 to 37.29°/oo.

Studying the spawning areas of Scomber species from the northwest Atlantic, Berrien (1978) showed that S. scombrus spawns in nearshore waters of North Cape Hatteras during spring and summer seasons (6.3 - 16.9°C) and S. japonicus in offshore waters south of Cape Hatteras during winter and spring seasons (20.4 - 25.4°C).

The occurrences of S. japonicus larvae from south Brazilian waters coincided well with that of the north American species, i.e. the similar spawning season with the same temperature range and both belong to offshore spawning species.

Larvae of Euthynnus alletteratus were collected from the coastal low salinity waters which ranged from 34.34 to 35.92°/oo with mean salinity 35.12°/oo. But the mean temperature 25.1°C was the highest of three species.

Temperature and salinity ranges of Auxis sp. larvae varied considerably, however most of the samples were collected within the temperature range from 22.8 to 26.4°C and salinity range from 35.31 to 36.55°/oo.

NIGHT/DAY CATCH RATIO

In order to calculate the N/D catch ratio the mean number of larvae per positive station in which scombrid larvae were taken, was used (Table 2). The samples collected during time period from 06:00 to 18:00 were considered as day-time samples and the other as night-time samples. The N/D catch ratio of Auxis larvae was 0.95 and those of Euthynnus and Scomber were 0.76 and 0.89 respectively. All values were less than one, which means that the larval catch during day-time exceeded that of the night-time.

Auxis larvae were collected from most of the surveyed area and the proportion of positive stations of two cruises was 40% (Table 1). To determine the probability of equal catches of Auxis larvae in day and night hauls, we applied the Mann-Whitney U-test (Siegel, 1956). For a rank test, we used all positive stations and negative stations which showed the temperature and salinity ranges within the intervals of 22.8 to 26.4°C and 35.3 to 36.6°/oo. The probability of equal catch in day and night hauls was 0.19 ($z = 0.876$), thus we can accept the null hypothesis that there is no difference in diurnal catch of Auxis larvae.

With regard to the N/D catch ratio of Auxis larvae, some papers demonstrated no difference (Wade, 1951; Klawe, et al., 1970) and others showed more catch in night-time collection (Strasburg, 1960; Matsumoto, 1958; Klawe, 1963).

Size frequency of Auxis larvae taken in day and night were plotted in Figure 7. Up to 12mm SL, there is no difference between day and night hauls, however after this size up, night hauls collected larger larvae more frequently. Since our sampling was made obliquelly from bottom to surface or from 200 m to surface, the difference observed in larger larvae seems to prove the occurence of a net avoidance during day-time. The similar result was observed by Richards & Simmons (1971, Fig. 6) for larger Auxis larvae from southeast Atlantic.

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REFERENCES

Aboussouan, A. 1969

Sur une petite collection de larves de Teleosteens recoltee aularge du Bresil (Compagne "Calypso" 1962).

Vie et Milieu, 20(3-A):595-610.

Ahlstrom, E.H., K. Sherman & P.E. Smith 1973

Seagoing operation in icthyology plankton surveys.

FAO Fish. Tech. Paper, 122:14-26

Berrien, P.L. 1978

Egg and larvae of Scomber scombrus and Scomber japonicus in the continental shelf waters between Massachusetts and Florida.

Fish. Bull., U.S., 79(1):95-115

Klawe, W.L. 1963

Observation on the spawning of four species of tuna (Neothunnus macropterus, Katsuwonus pelamis, Auxis thazard and Euthynnus lineatus) in the eastern Pacific Ocean, based on the distribution of their larvae and juveniles.

Bull. Inter-Am. Trop. Tuna Comm., 6:447-540

Klawe, W.L., J.J. Pella & W.S. Leet 1970

The distribution, abundance and ecology of larval tunas from the entrance to the gulf of California.

Bull. Inter-Am. Trop. Tuna Comm., 14(4):505-544

Kramer, D. et al 1972

Collecting and processing data on fish eggs and larvae in the California current region.

NOAA Tech. Rept., NMFS, Circ. 370:1-38.

Matsumoto, W.M. 1958

Description and distribution of larvae of four species of tuna in central Pacific waters.

U.S. Fish. & Widl. Serv., Fish. Bull., 58(128):30-72

1959

Descriptions of Euthynnus and Auxis larvae from the Pacific and Atlantic oceans and adjacent seas.

Dana Report, 50:1-35

_____ 1962

Identification of larvae of four species of tuna from the Indo-Pacific region I.

Dana Report, 55:1-16

_____ et al. 1972

On the clarification of larval tuna identification particularly in the genus Thunnus.

U. S. Fish. Bull., 70(1):1-12

Nishikawa, Y. et al. 1978

Distribution atlas of larval tunas, billfishes and related

species-Results of larval surveys by R/V Shunyo-Maru, and Shoyo-Maru, 1956-1975.
Far seas Fish. Res. Lab., S. Ser., 9:1-99

Richards, W.J. 1969a
Tropical Atlantic tuna larvae collected during equalant surveys.
U.S. Fish & Wildl. Serv., Comm.Fish. Rev., 31(9):33-37

_____ 1969b
Distribution and relative apparent abundance of larval tunas collected in the tropical Atlantic during equalant surveys I and II.
Proc. Symp. on oceanography & Fish. Resources of the Tropical Atlantic, p. 289-315

_____ & D.C. Simmons 1971
Distribution of tuna larvae (Pisces, Scombridae) in the northwestern Gulf of Guinea and Sierra Leone.
U.S. Fish. Bull., 69(3):555-568

Siegel, S. 1956
Nonparametric statistics for the behavioral sciences.
McGraw-Hill Book Company, Inc., New York.

Strasburg, D.W. 1960
Estimates of larval tuna abundance in the central Pacific.
U. S. Fish. Bull., 60:231-255

Wade, C.B. 1951
Larvae of tuna and tuna-like fishes from Philippine waters.
U.S. Fish. Bull., 51:445-485

Watanabe, T. 1970
Morphology and ecology of early stages of life in Japanese common mackerel, Scomber japonicus Houttuyn, with special reference to fluctuation of population. (in japanese)

Table 1. Number of scombrid larvae collected with Bongo net.

Species	A	B	(B/A)x100	C	C/B	Cruises
Auxis	280	112	40.0%	3 486.20	31.13	Nov-Dec.'74 Jan.'75
Euthynnus	280	17	6.1%	211.27	12.43	Nov-Dec.'74 Jan.'75
Scomber	420	35	8.3%	1 368.80	39.11	Nov-Dec.'74 Jan.'75 Sep-Oct.'76

A = Number of routine stations.

B = Number of positive stations with scombrid larvae.

C = Total number of standarized larvae.

Table 2. Night/Day catch ratio of scombrid larvae collected with Bongo net.

Species	Day (D)			Night (N)			N/D	Cruises
	A	B	B/A	A	B	B/A		
Auxis	54	571	10.57	58	585	10.08	0.95	Nov-Dec.'74 Jan.'75
Euthynnus	6	39	6.50	11	54	4.91	0.76	Nov-Dec.'74 Jan.'75
Scomber	12	180	15.00	23	308	13.39	0.89	Nov-Dec.'74 Jan.'75 Sep-Oct.'76

A = Number of positive stations.

B = Total larvae taken.

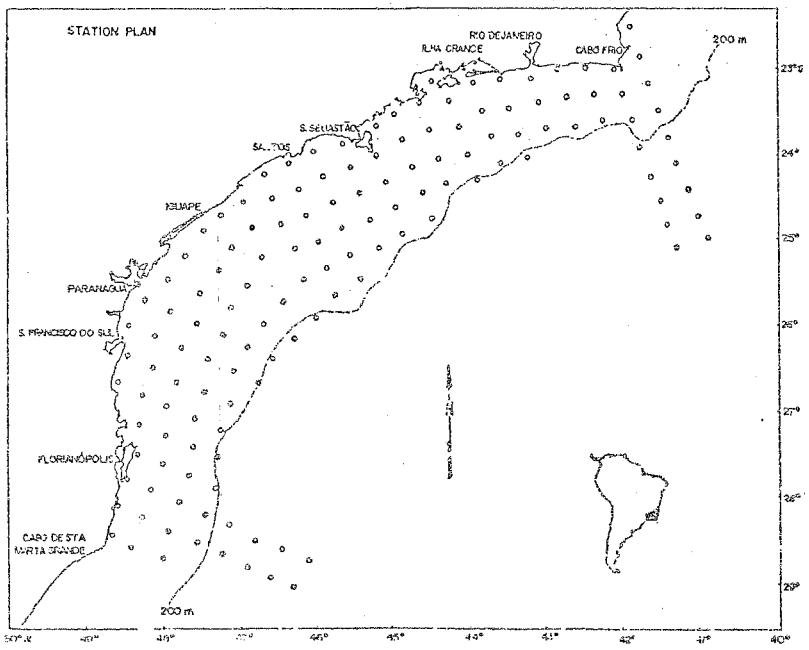

Figure 1. Stations occupied by the R/V"Prof.W.Besnard" during four survey cruises made in 1975 and 1976. Each cruise comprised 140 oceanographic stations in the region between Cabo Frio (23°S) and Cabo de Santa Marta Grande (29°S).

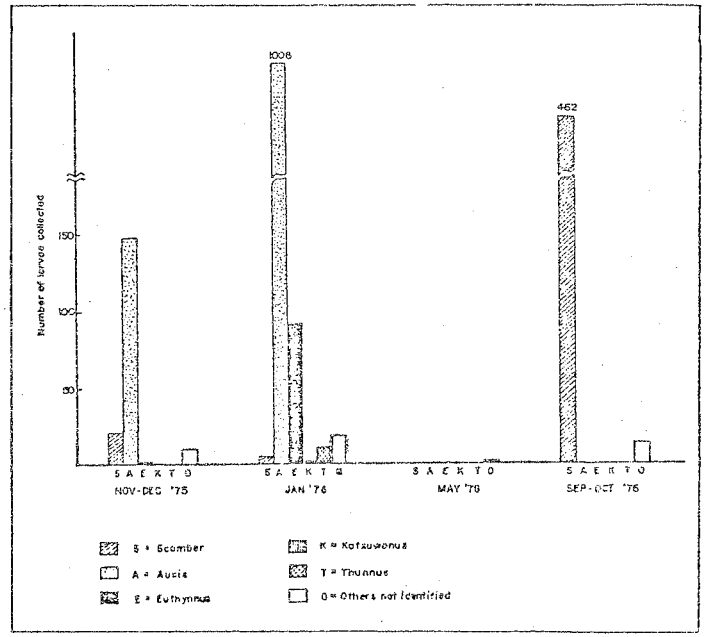

Figure 2. Larval number of all scombrid species collected during four survey cruises of the FINEP program.

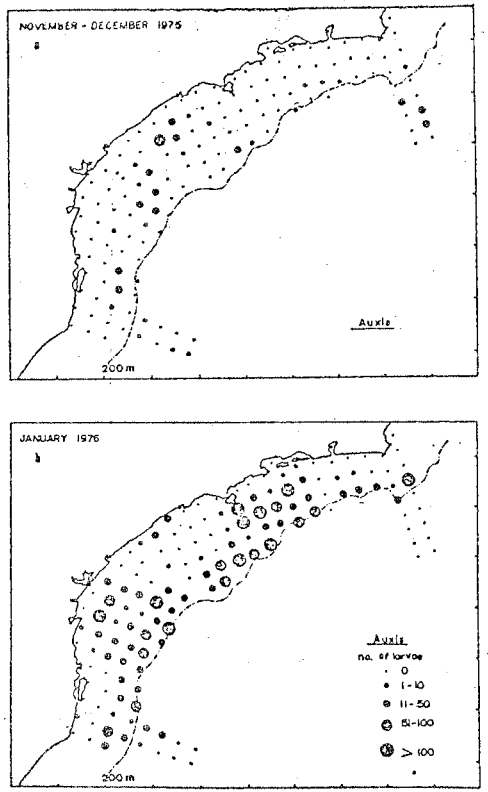

Figure 4. Distribution of Auxis sp. larvae in south Brazilian waters collected during the FINEP program in 1975 and 1976.

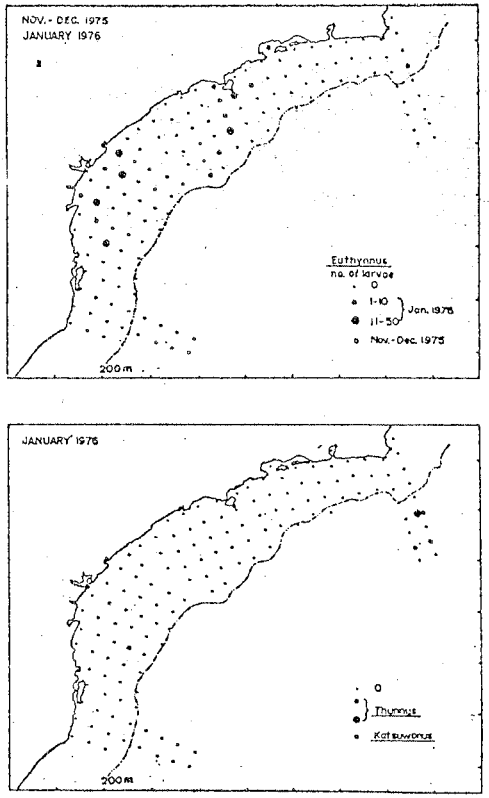

Figure 3. Distribution of larvae of Euthynnus alletteratus, Katsuwonus pelamis and Thunnus sp. in south Brazilian waters in 1975 and 1976. Each circle indicates number of larvae per 10 m^2 of sea area.

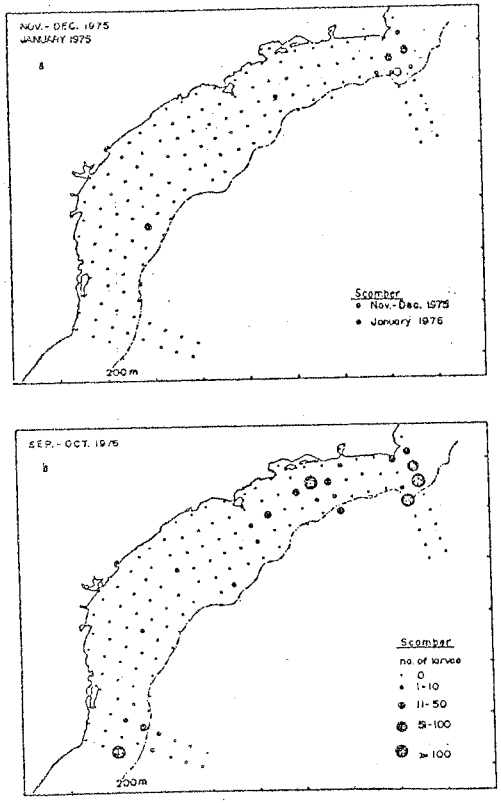

Figure 5. Distribution of Scomber japonicus larvae in south Brazilian waters collected during the FINEP program in 1975 and 1976.

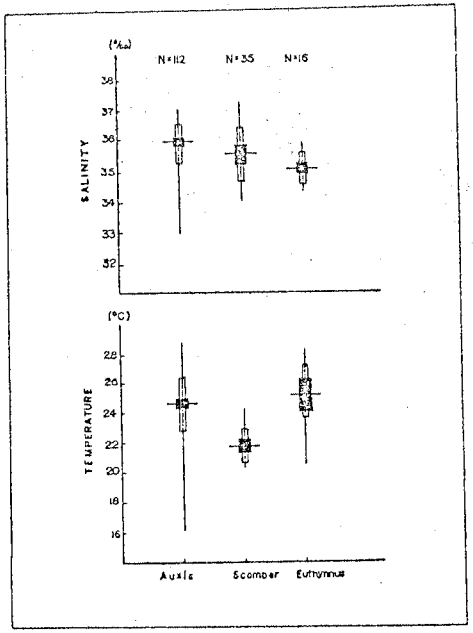

Figure 6. Temperature and salinity ranges of positive stations in which scombrid larvae were taken. In each sample, the crossbar indicated the mean, the hollow rectangle shows a range of standard deviation on each side of the mean and the black rectangle shows 95% fiducial range of the mean.

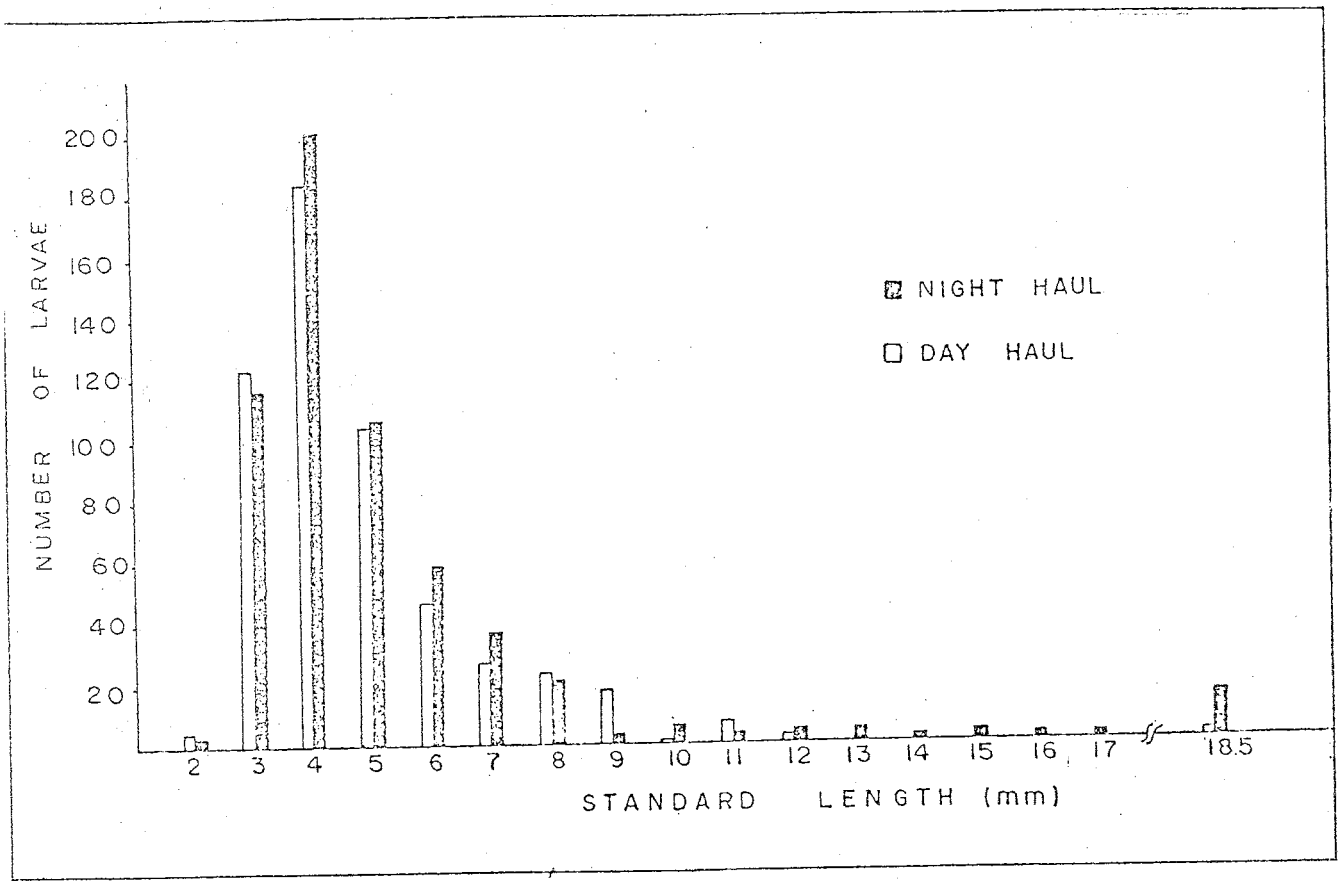

Figure 7. Size frequency of Auxis larvae taken during day and night times.