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Larval Fish Composition, Distribution and Assemblages by Scientific Sounder from Eight Stations off Northeastern Taiwan

SHINN-PYNG YEH*

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ABSTRACT

With the help of SIMRAD EK-400 scientific sounder, a Maruchi-type larval net was used to sample fish larvae from 8 stations of which the water depth is 104 to 1210 m along shelf and slope off northeastern Taiwan, by R.V. Ocean Researcher 1, during 254 cruise, September, 1990. In all, 1992 fish larvae were collected which represented, at least, 54 families and 143 species from which 66 species could be named. The greatest contribution was the Engraulidae (33.6%), the Myctophidae (33.0%) and the Leiognathidae (4.8%). The most numerous identified species were *Engraulis japonicus* (33.5%), *Benthosema pterotum* (30.9%), *Leiognathus nuchalis* (4.6%). Higher abundance (no./250 m^3) of *E. japonicus* and *L. nuchalis* were found in shelf areas, while *B. pterotum* were found in shelf and slope areas. From the nutrient (NO_3) transect and NOAA-9 SST, higher larval diversity was near the edge of and away from the upwelling center. Using the Bray-Curtis dissimilarity values and the UPGMA algorithm, the most abundant 10 identified species from 8 stations were classified into three species and three station groups respectively. Interpretations of larval diversity and distribution in relation to hydrography were discussed.

1. INTRODUCTION

The East China Sea Shelf (ECSS) off northeastern (N.E.) Taiwan is influenced by the Kuroshio Current year round. It has been known that the hydrography in this area was mainly governed by the persistent upwelling of the Kuroshio subsurface water off the shelf of N.E. Taiwan (Wong *et al.*, 1991; Chern *et al.*, 1990).

A lot of fish species inhabiting the ECSS are exploited commercially (Ann., 1990; Okamura, 1985). In addition, the shelf region off N.E. Taiwan is a traditional fishing ground for local fisherman. Thus, fishing pressure of pelagic and demersel fishery in this area is heavy. Because little information is available on the adult and juvenile stages of pelagic and demersel fishes, the study on the planktonic stages of fish species is important for

* Department of Aquaculture, National Pingtung Polytechnic Institute, Pingtung, Taiwan, R.O.C.

understanding the recruitment and fluctuation of fish population (Richardson *et al.*, 1980; Tzeng, 1989).

The intensity of the upwelling has a great influence on the abundance, distribution, spawning habits, and reproductive strategies of herring-like fishes (Parrish *et al.*, 1983; Bakun, 1985) and many other species (Hamann *et al.*, 1981). There have been few studies dealing with larval fish species of the ECSS off N.E. Taiwan (Chiu, 1991a; Chiu and Lee, 1991). A complete picture of larval fish composition has not yet been made so far. There are also few studies elucidating the distribution and abundance of larval fish in relation to hydrography (Chiu and Lee, 1991). Furthermore, the examination in 'among species' patterns of larval fish distribution has not been made before. Knowledge of these patterns is very important for understanding processes affecting larval survival and subsequent recruitment (Richardson and Stephenson, 1978; Richardson *et al.*, 1980).

This study is part of an integrated project: Keep Edge Exchange Processes (KEEP) sponsored by the National Science Council, R.O.C. The purpose of this paper is to examine the composition, distribution and assemblages of larval fish and their possible relation to hydrographic features along shelf and slope off N.E. Taiwan.

2. MATERIALS AND METHODS

2.1 Study area and survey

Larval fish were sampled during September 18-23, 1990 by R.V. Ocean Researcher 1, 254 cruise. The study area, with 21 stations (Figure 1), was located across the shelf and slope off N.E. Taiwan, between 24°40′-26°10′N and 121°30′-123°10′E, designated as KEEP area.

Hydrographic data, sea surface temperature (SST) and salinity of every station were recorded by a SEABIRD SBE 9/11 CTD probe. Water samples at a specific depth were taken to measure its D.O., nutrient and fluorescence.

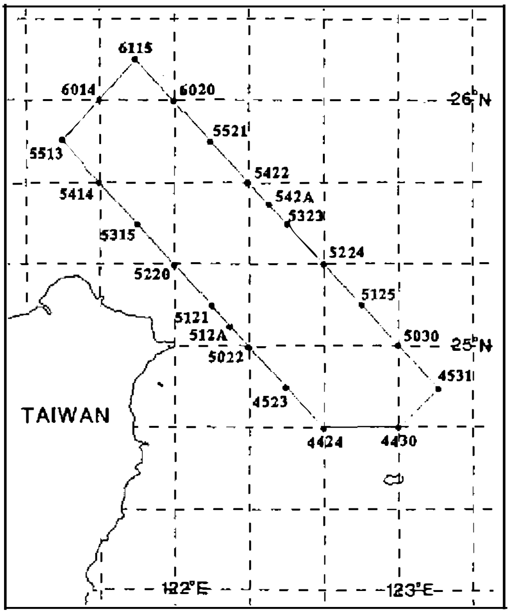


Fig. 1. KEEP sampling area and station locations, September 1990.

Based on the echo trace (Figure 2) of SIMRAD EK-400 scientific sounder, a Maruchi-type larval net (diameter: 1.3m, length: 4.5m) fitted with 0.5mm mesh was towed obliquely at 8 specific stations. Once the echo trace was recorded, the larval net was casted to the recorded depth and then heaved obliquely. The net was towed at a speed under 2 knots. Depending on the sampling depth, the oblique tow lasted 9 to 12 minutes. The basic sampling information is listed in Table 1.

Table 1. The basic sampling information from oblique tow, During OR254 cruise, September 1990

Stn.	Position Lat.(N)	Long.(E)	Date m/dd	Time hh:mm	Depth (m)	Towing Depth (m)	Dur. (min)
6020	26°00'	122°00'	9/21	16:42	104	756	11
6115	26°10'	121°50'	9/21	14:54	106	787	11
6014	26°00'	121°40'	9/21	12:58	110	103	79
5315	25°30'	121°10'	9/23	10:43	122	103	12
5121	25°10'	122°10'	9/20	23:30	213	103	12
512A	25°08'	122°18'	9/20	22:24	260	771	12
5323	25°30'	122°30'	9/21	03:44	380	782	11
5022	25°00'	122°10'	9/20	20:40	1210	750	11

Dur. : Duration of oblique tow

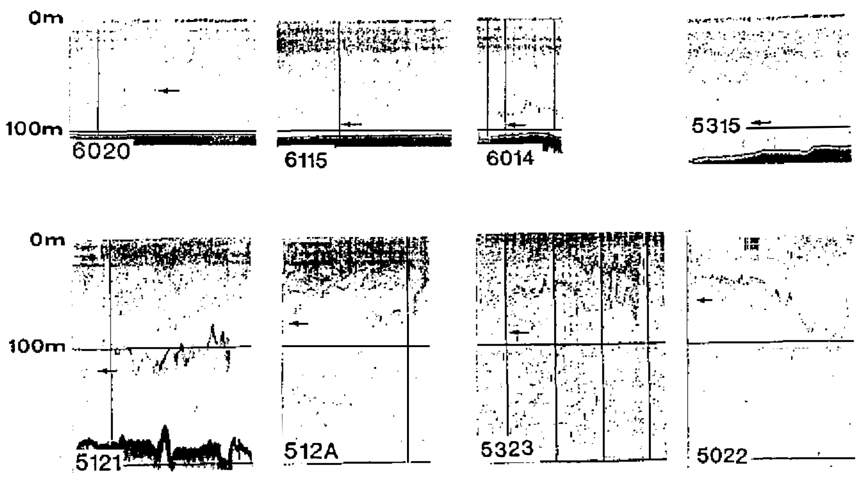


Fig. 2. Echo trace of 8 surveyed stations from SIMRAD EK-400 scientific finder, September 1990. (Arror indicated the beginning of larval net cast)

2-2. Treatment of samples

All larval fish samples were fixed in seawater with 5-10% formalin. Larvae were sorted from the plankton in a rotatable sorting ring. The larvae were then identified under a dissecting microscope, to the lowest taxonomic level possible, and counted. The larval fish abundance was expressed as number (no.) per 250m^3 calculated from volume filtered and the depth traversed by the net. The average volume of water sampled by each net at 8 surveyed stations was 772.5m^3. Identifications of larvae were based on the meristics and descriptions of Chen and Huang (1985), Leis and Rennis (1982), Leis and Trnski (1989), Moser *et al.* (1984), Okamura (1985), Okiyama (1988), and Zhang *et al.* (1985).

2-3. Data analysis

A Simpson's (Simpson, 1949) diversity and evenness indice of each station, based on the number of larvae of each species caught, was calculated. Assemblages (defined as station groups) and species association (defined as species groups) were classified by a Bray-Curtis dissimilarity values (Bray and Curtis, 1956) as the correlation coefficient, clustered by the Unweighted Pair Group Method Using Arithmetic Averages (UPGMA) method (Sneath and Sokal, 1973). A log transformed values of species abundance (log(abundance+1)) were used for the classfication of station and species. Any taxa over 1% of the the sample larvae was taken as a variable to classify hierarchically. Rare species were eliminated from the analysis due to their little classificatory information (Richardson *et al.* 1980). Prior to performing classification, the 8 stations were grouped according to their bottom depth into three main classes: coast (from 0 to 110m), shelf (110 to 300m) and slope (more than 300m).

3. RESULTS

3-1. Hydrography

The following station groups were determined based on the depth grouping method: coast (sts. 6020, 6115, and 6014), shelf (sts. 5315, 5121, and 512A), and slope (sts. 5323 and 5022). The T-S diagram of 8 stations is shown on Figure 3. Most stations had high SST (> 25°C) and low salinity (< 34.10%), except slope stations 5022 and 5323. The surface salinity fluctuated but exhibited an increasing trend toward deep water, which indicated the likely influence by the intrusion of warm and saline Kuroshio water. Among 8 stations, st. 5323 had the lowest SST and highest surface salinity.

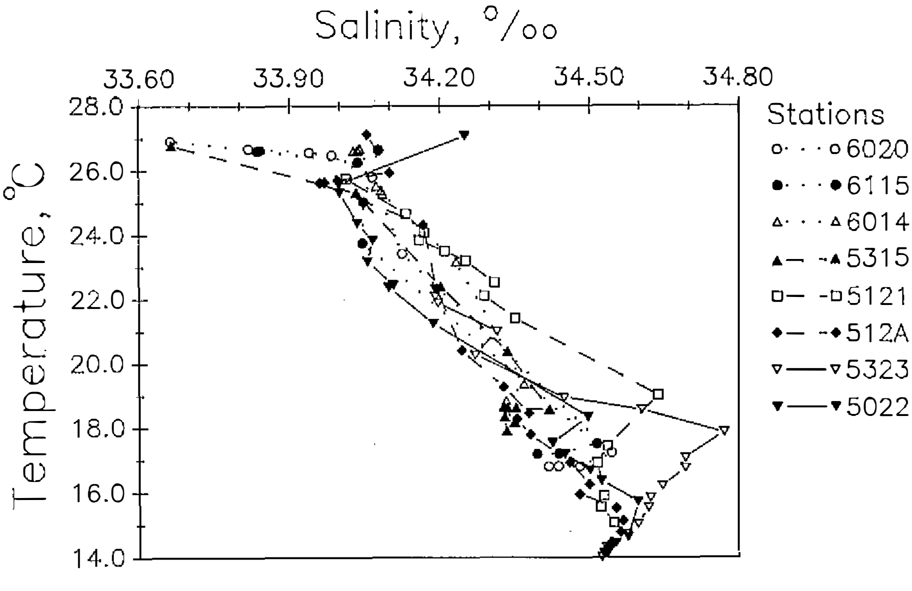


Fig. 3. The T-S diagram of 8 surveyed stations, September 1990.

The transect of nutrient (NO_3) revealed that there was an upwelling of nutrient at both transect A and B (Figure 4). Satellite remote sensing of SST (Figure 5) also showed an upwelled of cold water centering between 25°20′-25°40′N and 122°00′-122°20′E, near sts. 5315, 5121, 512A, 5022, and 5323.

3-2. Larval fish composition

In all, 1992 fish larvae were caught which represented at least 54 families and 143 species (Table 2). And 143 species could be assigned to 66 particular species, 51 genus, 1 subfamily and 25 families. Five larvae could not be identified due to the severe body damage.

The Engraulidae, Myctophidae and Leiognathidae each contributed more than 4.0% of the total number of larvae (TOL) and accounted for > 71.0% of that number (Figure 6). The contribution of following families was 2.1-3.1% of TOL: Gobiidae, Trichiuridae and Sciaenidae. Thirteen larval families contributing > 1.0% of TOL totalled 87.0% (Figure 6).

Engraulis japonicus and *Stolephorus* sp. were the species within the Engraulidae (Table 2). The Myctophidae contained 7 species, of which *Benthosema pterotum* dominated and *Neoscopelus microchir* was the second dominant (Figure 7). The Leiognathidae comprised two species, *Leiognathus nuchalis* and *L. rivulatus*. The Gobiidae and Sciaenidae consisted of 20 and 5 species respectively (Table 2). The larvae of the 10 most abundant species contributed more than 1.0% and were approximately 79% of TOL (Figure 7). These 10 species contributed from 1.1% of *Nibea albiflora* to 33.6% of *E. japonicus* to TOL.

3-3. Larval fish distribution and abundance

Table 3 exhibits the relative abundance (no./250m^3) of 10 major species and total larvae by depth grouped stations. It indicates that shelf stations had higher larval abundance followed by slope and coastal stations. Stations 512A and 5315 each occupied the highest and lowest abundance respectively in 8 stations.

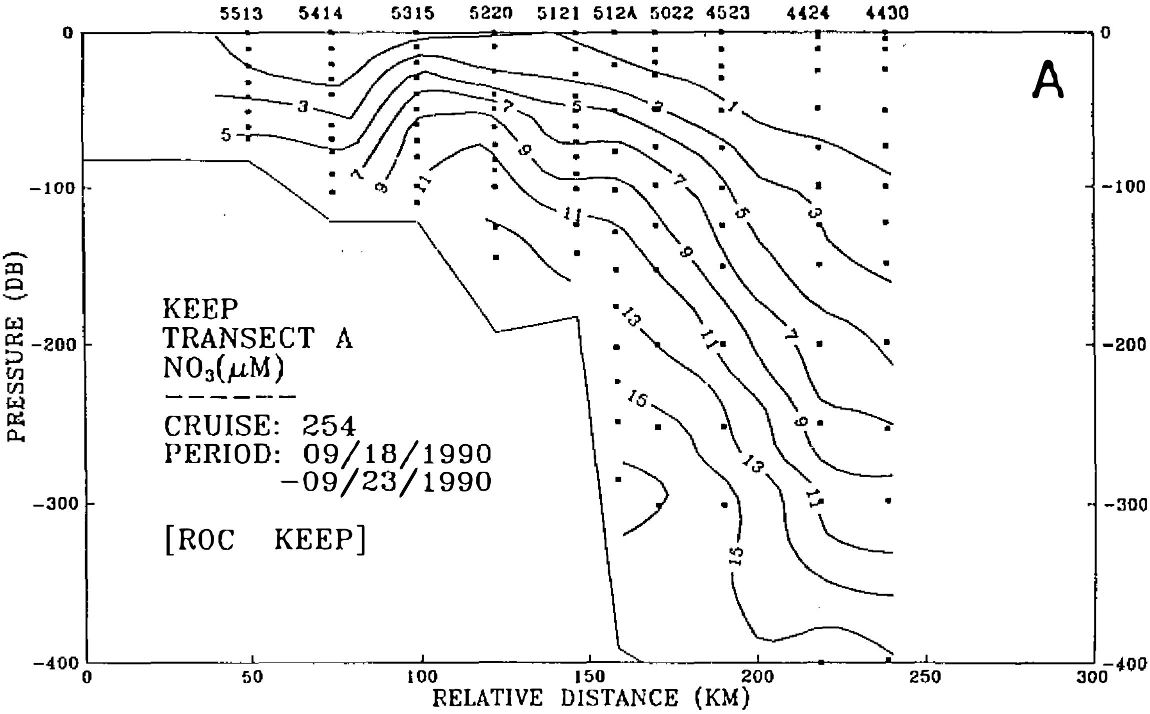
Among the 10 species of larvae, B. pterotum existed in all stations. This species had higher abundance in slope stations than that in shelf and coastal stations (Table 3). The distribution of *E. japonicus* was more abundant at shelf stations than at slope and coastal stations. This similar phenomenon was also observed for the other 8 species, except Platycephalidae sp1. (Figure 8) and *T. lepturus*. Platycephalidae sp1. and *T. lepturus* had higher abundance in coastal stations.

3-4. Larval fish taxa and diversity

The number of taxon by station is shown in Figure 8. The taxon of 512A was about four times more than that of sts. 6020, 6115 and 5315. Referring to the diversity and evenness indices (Figure 9), the highest indice was at st. 6115 followed by st. 6014, 512A, 5323 and 5121. And the lowest indice appeared at st. 5315.

3-5. Cluster analysis of larval fish abundance

Figures 10 and 11 are the cluster analysis and two-way coincidence table. Eight station groups were delimited from an examination of the complete dendrograms and two-way coincidence table. These groups were classified into three major groups (assemblages), coast, transition (shelf) and offshore (Figure 10). The offshore group C contained sts. 5323 and 5022. The transitional group B had sts. 6020, 5121 and 512A. The coastal group A was comprised of sts. 6115 and 6014. These three groups occupied more than 93% of TOL. Station 5315 was isolated from the A, B and C groups.



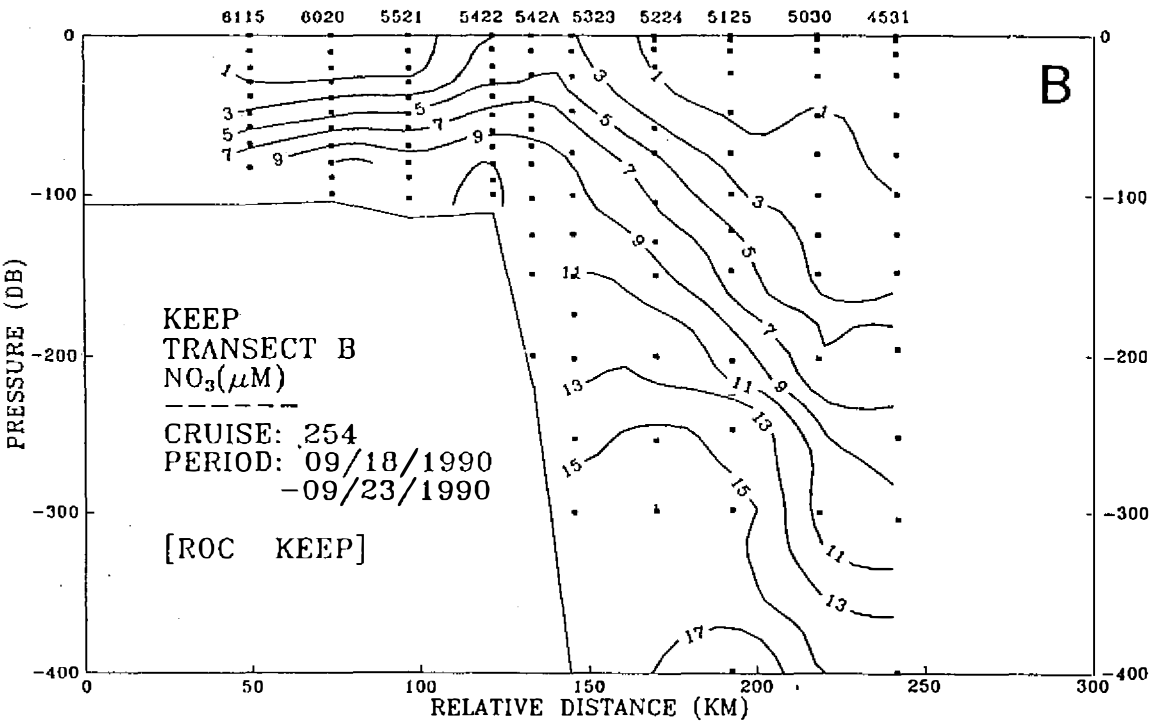


Fig. 4. The nutrient (NO_3) contour plot for transect A and B in September 1990 (Courtesy of KEEP Hydrograhpy Group).

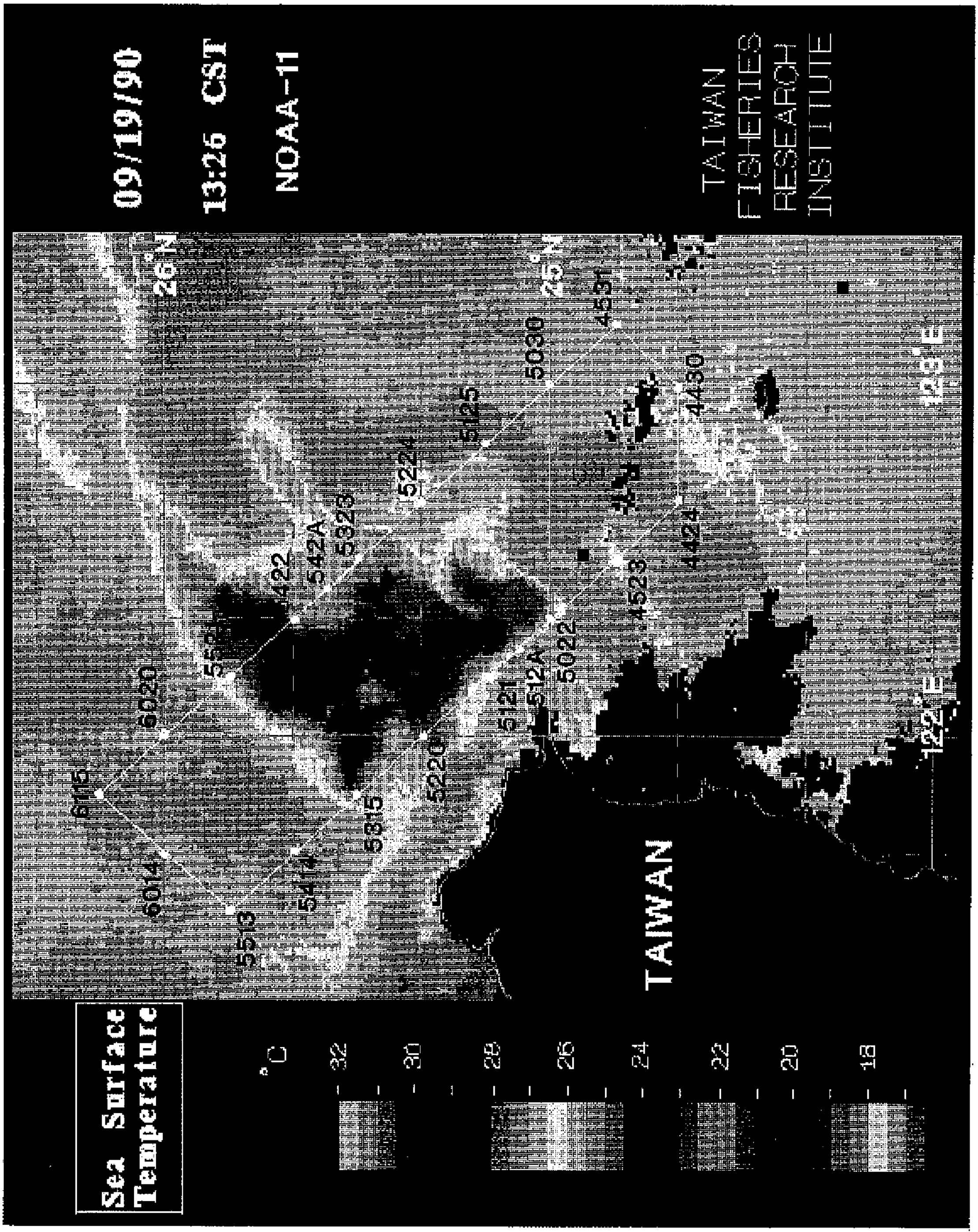


Fig. 5. NOAA-9 satellite remote sensing of SST on September 19, 1990 in KEEP area (Courtesy of Taiwan Fisheries Research Institute).

Table 2. Catch of fish larvae from oblique tows on OR254 cruise, September, 1990. Taxa(family, genus or species are arranged in alphabetical order)

Acanthuridae	
Naso sp	1
Acropomatidae	
Acropoma japonicum	4
Apogonidae	
Apogon endekataenia	13
A. kinensis	10
A. lineatus	3
A . sp2	8
A . sp3	2
Aulopodidae	
Aulops japonicus	1
Blenniidae	
Blenniini sp	2
Scartella sp	1
Bothidae	
Crossorhombus sp	1
Engyprosopon grandisquama	1
E. multisquama	2
E . sp	1
Tarpnops oligolepis	2
Bregmacerotidae	
Bregmaceros arabicus	1
B. nectabanus	6
B . sp	6
Callionymidae	
C. sp	17
Caranagidae	
C. sp	1
Caranx macarellus	3
Decapterus lajang	4
D. macarellus	3
D. maruadsi	1
D . sp	1
Selar boops	2
Trachurus japoicus	1
Champsodontidae	
Champsodon sp	7
Coryphaenidae	
Coryphaena hippaena	1
Cynoglossidae	
Crossorhombus sp	1
Cynoglossus joyneri	23
C . sp	1
Dysommidae	
Dysomma sp	1
Eleotridae	
E. sp	6
Engraulidae	
Engraulis japonicus	669
Stolephorus sp	1
Fistulariidae	
Fistularia petimba	1
Gerreidae	
Gerres sp	1
Gobiidae	
Species 1	3
Species 2	2
Species 3	2
Species 4	3
Species 5	3
Species 6	1
Species 7	1
Species 8	1
Species 9	5
Species 10	1
Acentrogobius sp	1
Amblychaeturichtys sp	1
Bathygobius cotticeps	2
Heteroplopomus barbatus	3
Luciogobius sp	1
Parachaeturichthys sp1	2
Periophthalnus sp	1
Taenipides cirratus	1
Tridentiger barbatus	2
Gonorhynchidae	
Gonorhynchus abbreviatus	16
Labriidae	
Cheilinus sp1	1
C . sp2	1
Cheilio inermis	1
Pseudolabrus japonicus	1
Xyrichthys dea	1
X . sp	1
X . sp2	3
Leiognathidae	
Leiognathus nuchalis	91
L. rivulatus	5
Lobotidae	
Lobotes surinamensis	1
Lophiidae	
Lophiomus sp	1
Macrouridae	
M. sp	1
Menidae	
Mene maculata	16
Mullidae	
Upeneus bensasi	12
Upeneus sp	1
Muraenesocidae	
Muraenosox cinereus	1
M . sp	3
M . sp2	1
Myctophidae	
M. sp	3
Benthosema pterotum	615
B . sp	2
Diaphus latus	2
Lampadena luminosa	1
L . sp	1
Myctophum nitidulum	4
Neoscopelus microchir	31
Triphoturus microchir	1
Nemipteridae	
Nemipterus sp	1
Scolopsis sp	1
Nettastomidae	
Chlopsis sp	1
Nomeidae	
Psenes sp	1
Ophichthyidae	
Ophichthinae sp3	1
Paralepidae	
Lestidiops indopacifica	1
Percichthyidae	
P. sp	1
Doederleinia sp	5
Platycephalidae	
Species 1	31
Species 2	1
Species 3	1
Platycephalus indicus	1
Polyemidae	
Polydactylus sexfilis	2
Priacanthidae	
Priacanthus macracanthus	14
Scaridae	
Scarus sp1	2
Scarus sp3	6
Sciaenidae	
S. sp	1
Argyrosomus argentatus	24
A . sp	1
Nibea albiflora	21
N . sp	13
Scombridae	
Auxis orientalis	1
A. tapeinosoma	5
A . sp	5
Euthynnus yaito	7
Katsuwonus pelamis	5
Scomberomorus commerson	7
S . sp	1
Thunnus thynnus	3
Scorpaenidae	
Species 1	1
Species 2	2
Sebastes sp	1
Seriolidae	
Seriola sp2	5
Serranidae	
Chelidoperca sp	3
Epinephelus akaara	3
E . sp	2
Siganidae	
S. sp	1
Sillaginidae	
Sillago japonica	7
S . sp1	1
Soleidae	
Aseraggodes kobensis	1
A . sp	5
Sparidae	
Pagrus major	1
Taius tumifons	18
Sphyraenidae	
Sphyraena pingus	4
S . sp	1
Synodontidae	
Saurida wanieso	5
S. fuscus	2
S. macrops	2
Trachinocephalus myops	22
Tetraodontidae	
Lagocephalus sp	1
Teraponidae	
T. sp	1
Terapon jarbua	4
T . sp	3
Trichiuridae	
Benthodesmus elongatus pacificus	2
Trichiurus lepturus	36
T . sp	5
Trichonotidae	
Linmichthys sp	1
Trypauchenidae	
T. sp	19
Unidentified	5

Table 3. The relative abundance (no./250m^3) of 10 major fish larvae species from 8 surveyed stations on OR254 cruise, September 1990

Major species	St6020	St6115	St6014	St5315	St5121	St512A	St5323	St5022	Total
B. pterotum	22.50	9.79	14.29	0.25	28.93	27.27	45.36	105.16	253.54
E. japonicus	0.00	0.00	0.66	11.47	57.30	95.59	8.21	24.74	200.98
L. nuchalis	0.00	0.00	0.33	0.00	9.37	12.12	0.36	7.10	29.27
Playtcephalidae sp1.	0.00	8.39	0.00	0.25	0.00	0.28	6.07	0.00	14.99
T. lepturus	0.00	0.00	9.63	0.00	1.93	0.00	0.00	0.00	11.56
N. microchir	0.00	0.00	0.00	0.00	2.48	3.03	3.93	0.00	9.44
T. myops	0.71	0.70	0.00	0.00	1.10	2.48	0.71	2.58	8.29
A. argentatus	0.00	0.00	0.00	0.00	2.75	1.65	2.50	0.65	7.55
C. joyneri	0.00	0.00	0.00	0.00	3.31	2.75	0.00	0.00	6.06
N. albiflora	0.00	0.00	0.33	0.00	1.93	3.58	0.00	0.00	5.84
Subtotal	23.21	18.88	25.25	11.97	109.09	148.76	67.14	143.23	547.53
Others	11.43	16.78	11.63	4.24	20.94	36.91	22.14	29.03	152.46
Total abundance	34.64	35.66	36.88	16.21	130.03	185.67	89.28	172.26	699.99

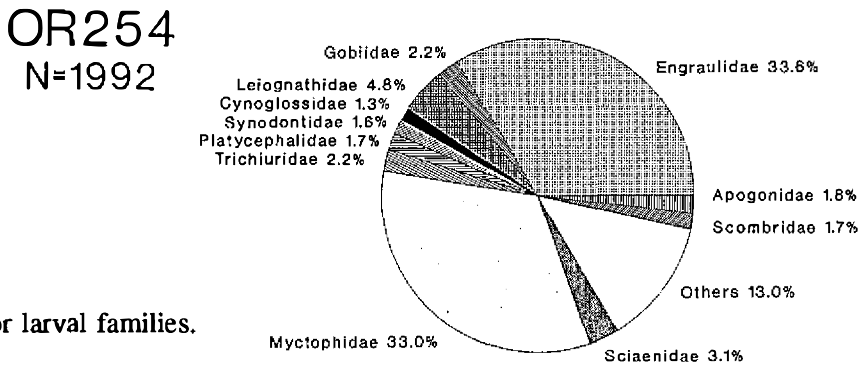


Fig. 6. Pie-chart of major larval families.

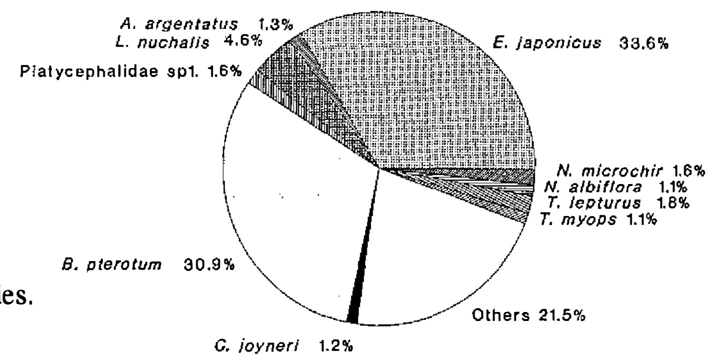


Fig. 7. Pie-chart of major larval species.

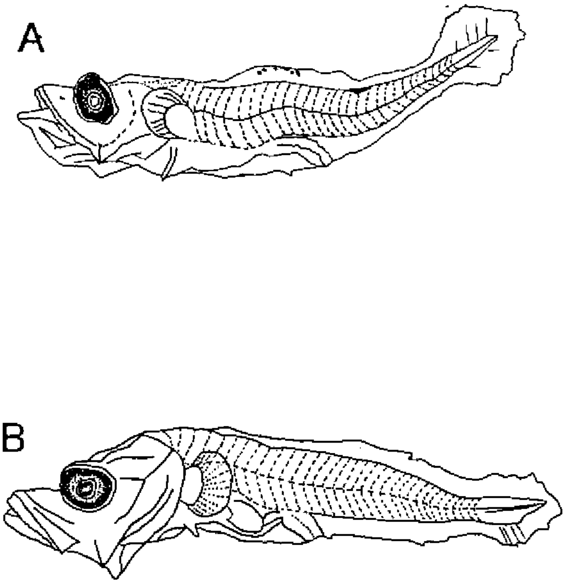


Fig. 8. Lateral view of Platycephalidae spl. larvae, (A) 3.8 mm and (B) 4.8 mm of standard length.

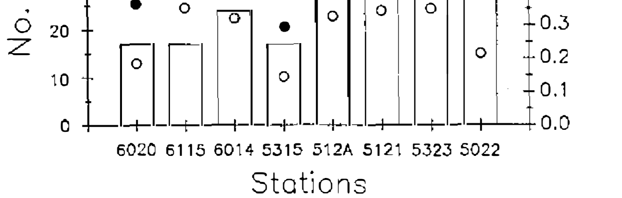


Fig. 9. The number of taxon and the diversity and eveness indices in 8 stations.

The classification method categorized the 10 major species from 8 stations into three species groups (Figure 11). The transitional group 2 consisted of three species, namely, *B. pterotum*, *E. japonicus* and *L. nuchalis* taking nearly 70.0% of TOL. The offshore group 3 contained five species, *N. albiflora*, *N. microchir*, *C. joyneri*, *Argyrosomus argentatus* and *T. myops* and the coast group 1 had two species, *T. lepturus* and Platycephalidae spl. Group 1 and 3 took 6.0% and 3.4% respectively.

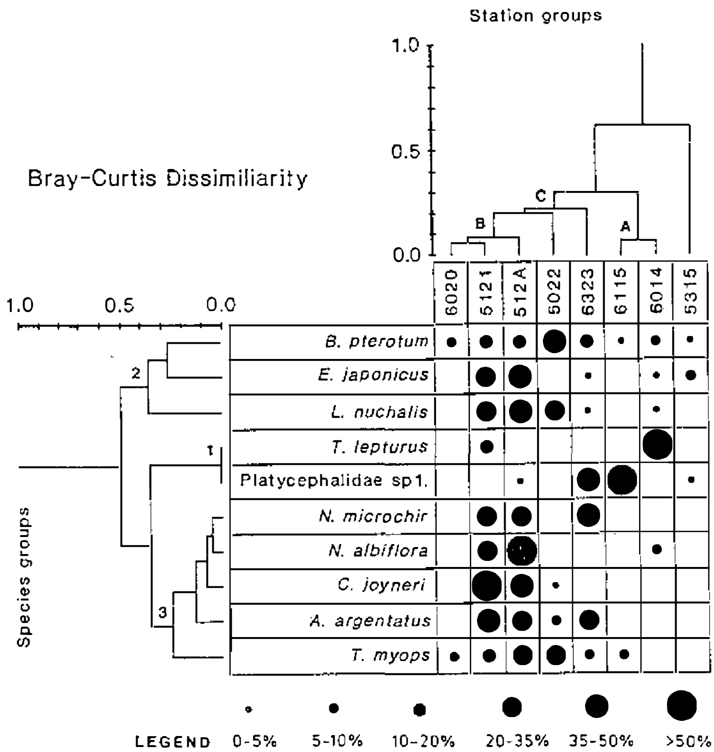


Fig. 10. Summary of the cluster analysis results for 10 major larvae species from 8 stations during OR254 cruise, September, 1990, with emphasis on the distribution of species groups within a station group. The symbols in the two-way table summary represent the percentages of species groups within a station group; thus the percentages for a station group (column) sum to 100%.

4. DISCUSSION

In this study, the Engraulidae and Myctophidae dominated within 8 surveyed stations (Figure 6) which agrees with the previous study in the East China Sea and its adjacent regions (Hattori, 1964; Ozawa and Tsukahara, 1971) and in the area of southern Japan (Ida, 1972; Kidachi, 1983; Minami annd Tamaki, 1980). It is known that Engraulidae constitutes the major contribution in the pelagic area of inshore waters (Minami and Tamaki, 1980; Wu 1989). My study also exhibites the same result that the Engraulidae has the largest proportion, 33.5% of TOL (Figure 6).

The contribution of Myctophidae (32.9%) is next to Engraulidae (Figure 6). Chiu and Lee (1991) also found the Myctophidae dominated along shelf and slope of N.E. Taiwan. This fish is widely spread in the Kuroshio Current and the area influenced by the Current. With vertical migration, Myctophidae was present everywhere in the water column of the

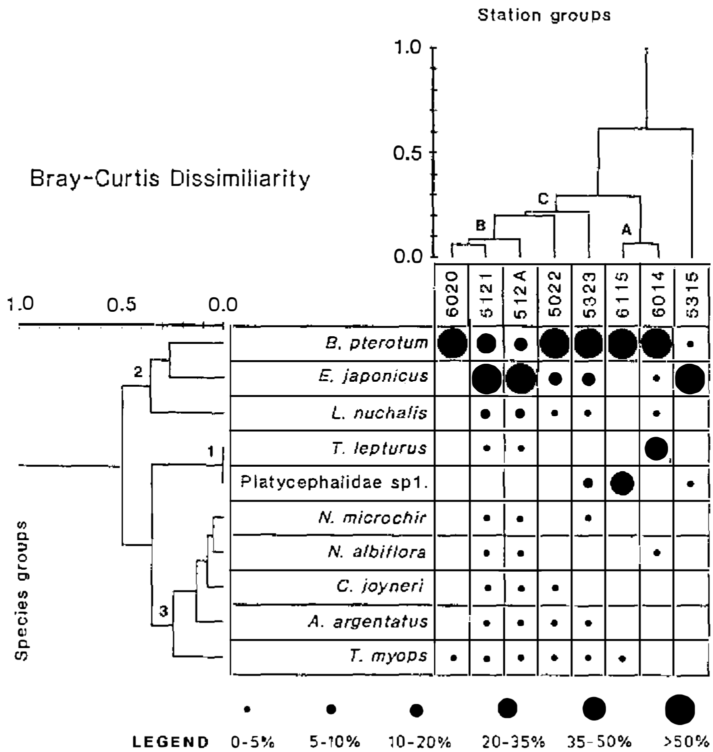


Fig. 11. Summary of the cluster analysis results for 10 major larvae species from 8 stations during OR254 cruise, September, 1990, with emphasis on the distribution of species groups within a station group. The symbols in the two-way table summary represent the percentages of a species groups which occur in station groups; thus the percentages for a station group (row) sum to 100%.

Kuroshio water (Kawaguchi, 1974; Tzeng, 1989). Therefore, this fish is often used as an indicator species of Kuroshio water.

The result indicates that thirteen families occupy 87.0% of TOL off N.E. Taiwan. Within the same area, Chiu (1991a) studied the diurnal depth change of ichthyoplankton at one shelf station and found that 11 families accounted for over 72.0% of the total larvae in the nighttime mid-water collection and 8 families for over 49.0% in the daytime mid-water collection. Chiu (1991a) also identified 93 species comparing to 143 species (Table 2.) of my study. This different result mainly originated from the different sampling stations and schemes. Since Chiu's (1991a) study is the only available reference at present, it has valuable information to accompany my study to generate a large picture of the major families off N.E. Taiwan. As to the eastern waters of Taiwan, influenced by the Kuroshio water, Tzeng (1989) showed that 7 families accounted for over 53.0%, while Chiu (1991b) found that 4 families accounted for over 50.0%.

The overall larvae distribution patterns (Table 3 and Figure 5), higher abundance in shelf stations and lower abundance in coastal stations, reflect the distribution of productivity in the study area. The distribution patterns of 10 major identified larvae are the most interesting, which suggest the hydrographic influences are involved.

Based on nutrient (Figure 4) and SST (Figure 5), sts. 6115, 6014, 512A, 5121 and 5323 could be separated into two types. One included st. 5323 and sts. 512A and 5121 in the northern and southern edge of upwelling center. The other, sts. 6115 and 6014, was away from the upwelling center.

Except for *T. lepturus*, other 9 major larvae occurred near the edge of the upwelling center. This result is consistent with the result found in the other upwelling regions (Hamann *et al.* 1981). In the Mauritanian upwelling area, higher concentration of fish larvae occurred above the slope and above outer shelf areas (Hamann *et al.* 1981). Off California, most *Engraulis mordax* larvae appeared in upwelling area (Ahlstrom, 1959). The other examples are *E. encrasicolus* larvae off North West Africa (John, 1985) and *E. capensis* larvae in the southern Benguela system (Shelton and Hutchings, 1982). It seems that Engraulidae larvae is more abundant near upwelling regions all over the world.

Since the larval collection does not represent a record of all fish in the ecosystem, it is necessary to calculate larval diversity to reflect the complete ecosystem (Frontier, 1985). I found that st. 6115 has the highest larval diversity but less taxon number (Figure 8). Further, st. 5121 occupies the largest number of taxon and less diversity (half of st. 6115). This result is in accordance with Simpson (1949), Frontier (1985) and Peet (1974) that higher index indicates fewer species and a simpler ecosystem and *vice versa*.

Larval fish diversity has been related to hydrological conditions. Olivar (1987) reported that high larval diversity seemed to be related to hydrological stability, and low larval diversity was related to upwelling centers. Although this study did not collect fish larvae and CTD data at upwelling center, the hydrographic conditions are less stable at upwelling center than at the edge of and away from the center. Under this circumstance, the fact of higher larval diversity found in this study is consistent with the result of Olivar (1987).

Moreover, sts. 5315, 6020, and 5022 all have less larval diversity. From numerical classification (Figure 10), I find that st. 5315 was isolated from the identified three assemblages. In addition, this station has the lowest abundance. That may partly explain why st. 5315 has the lowest larval diversity. As to low diversity at sts. 6020 and 5022, there is no explanation but it may be attributed in part to the spawning areas and the current circulation. It is interesting to note that these two stations are grouped together as slope stations.

Clustering analysis of the 10 most abundant larvae from 8 stations (Figure 11) suggests that three geographically distinct species groups exist in ECSS off N.E. Taiwan and their occurrence reflects the distribution patterns of the larval fish. The transitional group 2 is presented by *E. japonicus*, *B. pterotum* and *L. nuchalis*. The former two species appeared in all stations except for the absence of *E. japonicus* at sts. 6020 and 6115. This result is in accordance with the previous study (Hattori, 1964; Kawaguchi *et al.* 1972; Oawa and Tsukahara, 1971). According to depth category, *B. pterotum* and *E. japonicus* (Table 3) are more abundant at slope than shelf stations, while *L. nuchalis* is more abundant at shelf and slope stations. The result also reveals that *B. pterotum* occupied >14.0% of its total abundance at shelf stations. In other words, the contribution of this species in shelf area shall not be ignored.

The offshore group 3 (Figure 11) constitutes five species taking 6.0 % of TOL. Except for *T. lepturus*, *N. microchir*, *N. albiflora*, *C. joyneri*, *A. argentatus* and *T. myops* are more abundant in shelf areas than in coastal and slope areas (Table 3). When reaching market size, *N. albiflora*, *C. joyneri*, *A. argentatus* and *T. myops* are all target species for local fisherman (Anon, 1990). They are all coastal and shelf fishes. *N. mirochir*, one of the laternfish, is typical prey for larger predator, such as *T. lepturus* (Chen, 1991). Alternatively, *N. albiflora* and *A. argentatus* are always absent from slope stations and *N. microchir* doesn't exist in coastal station. The *C. joyneri* is never included in coastal and slope station. The coastal group 1 contains *T. lepturus* and Platycephalidae sp1. which inhabitat coastal and shelf areas (Tzeng, 1985).

The explanation about coastal species occuring in shelf and slope stations is not easy. It is presumably a result of offshore drift (Richardson *et al.* 1980). For example, eddy circulation existing near and beyond the shelf edge can transport young larvae offshore on one hand and return the older larvae to coastal area on the other hand. To understand the mechanisms regulating larval fish distributions requires the knowledge of biology of fishes and their environment (Richardson *et al.* 1980).

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臺灣東北部海域中八個測站之仔稚魚魚種組成、分佈及聚集

葉信平

國立屏東技術學院

摘要

利用海研一號研究船1990年9月OR254航次探測東海陸棚南部海域的機會，配合船上的SIMRAD EK-400型科學魚探記錄，我使用MARUCHI-D型仔稚魚網在台灣東北部海域8個測站分別自水深50~103米不等水深處斜拖至表層採樣，共計採得1992尾仔稚魚。 經鑑定至少有54科、143種魚種，其中僅有66種只鑑定到種名。 優勢科有鯷科(佔33.6%)、 燈籠魚科(33.0%)、其次是鰏科(4.8%)。優勢種有日本鯷 (佔33.5%)、七星燈籠魚(30.9%)及頸斑鰏(4.6%)。仔稚魚的分佈中，七星燈籠魚以陸棚及陸坡測站之相對豐度(尾數/250立方米海水)較高， 日本鯷及頸斑鰏則在陸棚測站較高。 由NOAA-9衛星遙測水溫圖及硝酸鹽斷面圖來看，仔稚魚在湧昇流中的邊緣及遠離中心的西北側魚種歧異度較大。 經由Bray-Curtis相異指數及UPGMA法則去對測站及主要魚種(佔總數1%以上)作聚類分析，結果可將測站及魚種各分成三類。關於仔稚魚之分佈及歧異度與水文間關係、本文亦有討論。