9th General Meeting SCOR 1968, La Jolla, 1970.

Reprinted from
Scientific Exploration of the South Pacific
Standard Book No. 309-01755-6
NATIONAL ACADEMY OF SCIENCES
Washington, D.C. 1970

Michel Legand
Philippe Bourret
René Grandperrin
OCEANOGRAPHES BIOLOGISTES AU
CENTRE O.R.S.T.O.M. DE NOUMEA
Jacques Rivaton
ASSISTANT DE RECHERCHE

A PRELIMINARY STUDY OF SOME MICRONEKTONIC FISHES IN THE EQUATORIAL AND TROPICAL WESTERN PACIFIC

Micronekton studies, at least those dealing with concepts of quantitative distribution, are relatively new. They were developed mainly with the increased use of the Isaacs-Kidd midwater trawl. This gear provides biologists a relatively easy method for sampling of the larger organisms of the food chain in the open ocean. Because the study of these organisms is important to understanding the biocenosis in which tunas live, a relatively large effort on this subject has been made by the O.R.S.T.O.M. Oceanographic Department of Nouméa. By now, after 3 years of cruises by the research vessel *Coriolis*, some general features of the composition of the samples have been established; to some extent, they give a new composite view of the ichthyology of the equatorial currents and surrounding area of the western Pacific and a confirmation of hitherto sparse indications of the great abundance of some micronektonic fishes. We do not know to what extent a generalization from these features to the whole tropical South Pacific will be valid, although we think that some can be justified. As the results considered are only those of cruises preparatory to more extensive work, we have restricted our aim here to a synthesis of those results and have not tried to relate them to other data.

ORIGIN OF DATA

The data are derived from three cycles of cruises of the research vessel *Coriolis* (Figure 1).

1. November 1964 to March 1965: Alize cruises from 92°W to 162°E along the equator; 33 stations made with a 5-ft Isaacs-Kidd midwater trawl (IKMT) towed obliquely to 300 m between 2000 to 2200 hours. (References to Alize cruises are only incidental.)

2. December 1965 to October 1966: Bora I–IV cruises, mainly along 170°E from 20° to 5°N; 96 stations made with a 10-ft IKMT towed obliquely down to various depths according to the cruises. The detail of the stations is: 26 (0–300 m), 14 (0–650 m), 21 (0–900 m or 0-1200 m) night hauls; 4 (0–300 m), 8 (0–650 m), 23 (0–900 m or 0–1,200 m) day hauls.

3. December 1966 to September 1967: Cyclone I to VI cruises along 170°E from 0° to 5°S, 10-ft IKMT oblique hauls were made; Cyclone I: 39 stations at various times of the day generally to 150 m (among them 5–75 m and 2–1,200 m). (Only incidental references to this cruise are made here.) Cyclone II to VI (March to September 1967): 89 oblique hauls, 0–1,200 m, made successively at 0000, 0400, 0800, 1200, 1600, and 2000 hours.

COMMENTS ON THE CATCHING EFFICIENCY OF THE IKMT

Restrictions

Several restrictions have to be kept in mind. Graded coarse meshes were used in the gear, and the escapement through the meshes is dependent not only on the size, but also on the shape of the species of fishes considered. The percentage of the stock sampled will vary as a function of these factors. Because of these considerations we have referred to observed numbers of organisms on standard courses (distance towed) of the net in the water, usually 5,000 m for shallow hauls and 10,000 m for deep hauls, rather than to standard volumes of water filtered; otherwise, we have explicitly called the results "observed." Table 1 gives examples of the size distributions for five characteristic fishes. The extreme two species in Table 1 are also those with extreme shapes: *Sternoptyx diaphana* Hermann is very high, and *Serrivomer* sp. is very long and narrow; *Ceratoscopelus townsendi* (Eigenman and Eigenman) and *Cyclothone pallida* Brauer are good examples of the average size and shape of the fishes collected with the IKMT. We can expect

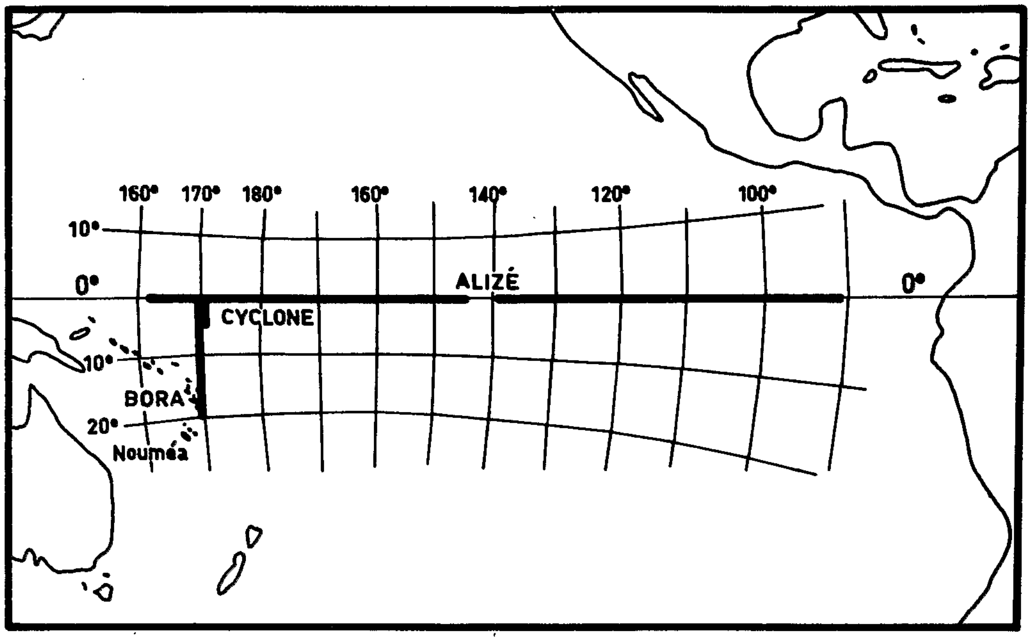

FIGURE 1 N. O. *Coriolis*: Cruises Alize, Bora, Cyclone tracks.

TABLE 1 Size Groups Frequencies for IKMT Fishes at 96 Stations of the Bora Cruises (170°E, 5°N to 20°S, 4 Cruises) (Modal Size Groups Underlined; First 50 Percent of Total Observed Number Bordered)

L (total length in mm)	*Sternoptyx diaphana* (in % of the total number)	*L*	*Vinciguerria nimbaria*	*L*	*Ceratoscopelus towsendi*	*L*	*Cyclothone pallida*	*L*	*Serrivomer* sp.
5	23								
10	27	10	33	10	1	10	2		
15	13	15	28	15	18	15	13		
20	15	20	20	20	42	20	25		
25	7	25	11	25	15	25	28		
30	10	30	5	30	14	30	23		
		35	2						
40	5	40	1	40	8	40	6		
				60	2	50	2	50	0.3
								75	9
								100	30
								150	33
								200	14
								250	9
								400	5
	N = 998		N = 1,035		N = 369		N = 6,388 (No. of measured specimens)		N = 289

that small species of "normal" shape, as well as small specimens of species of "normal" size and an important fraction of the elongated species, are undersampled by the trawl, while higher species and larger specimens are relatively oversampled, at least until they again become undersampled because of their size-related ability to avoid the IKMT.

Conditions of Sampling

It should also be noted that the conditions of sampling are not really constant during the whole haul. Figure 2 gives a reproduction of bathykymograph traces for seven night stations made to 1,200 m on the Bora IV cruise. Usually after lowering and before starting up, the trawl follows a more-or-less horizontal course; this could result in oversampling of the fauna of the deepest level. Conversely, shallower species could be undersampled even if they were very densely distributed, but in a thin layer. Their density in a short vertical section would be divided by the depth of the whole column sampled; so we can get an idea of their importance relative to the whole column, but not of their eventual predominance at a particular level. Irregularities in the sampling might also arise from variations in speed and direction of the currents crossed by the net on its way down and up, as is the case in equatorial waters.

Replicability of IKMT Hauls

The replicability of the IKMT hauls should also be considered. During the Cyclone I cruise, six 150-m stations were made at 0200 hours during 6 consecutive nights (November 23–28, 1966) at a constant position (00°36′S, 169°32′E). These results allow an approach to the study of the variability of sampling in this area for a 10-ft IKMT. One can even consider that sampling variability is overestimated because of an evident continuous evolution during these 6 days of the hydrology as well as of the populations of the various organisms sampled. The following coefficients of variation were calculated from the six original counts, corrected for an average tow distance of 5,000 m: Fishes, 14 percent; Cephalopods, 21 percent; Fish larvae, 30 percent; Crustacea larvae, 36 percent; Carids, 39 percent; Amphipods, 41 percent; Stomatopod larvae, 45 percent; Euphausiids, 118 percent.

So if we consider that adult and larval fishes and juvenile cephalopods were the most "micronektonic" organisms caught by the IKMT, they were also the organisms best sampled by this gear.

The detail by species for the fishes collected in the six shallow hauls follows (average M and coefficient of variation V, in percentage of the average):

Fishes	$M = 346$, $V = 14\%$
Diaphus fulgens	$M = 38$, $V = 85\%$
Diaphus schmidti	$M = 38$, $V = 38\%$
Diaphus malayanus	$M = 8$, $V = 44\%$
Vinciguerria nimbaria	$M = 146$, $V = 21\%$
Diaphus regani	$M = 29$, $V = 28\%$
Bregmaceros	$M = 13$, $V = 47\%$

From these probably overestimated variations, we can conclude that a ratio of 1 to 2 between numerations of two different stations for the most common species corresponds to a difference significant at the 5 percent level.

In the following text, we shall not consider variations from station to station but compare means calculated on various numbers of stations, so the significance level between these means should be reached for a ratio smaller than 1 to 2.

The Nature of the Cruises Considered

Finally, referring to the cruises considered, it must be pointed out that they were preliminary in nature and were devoted to the study of sampling conditions or of the particular features of the distribution of some organisms.

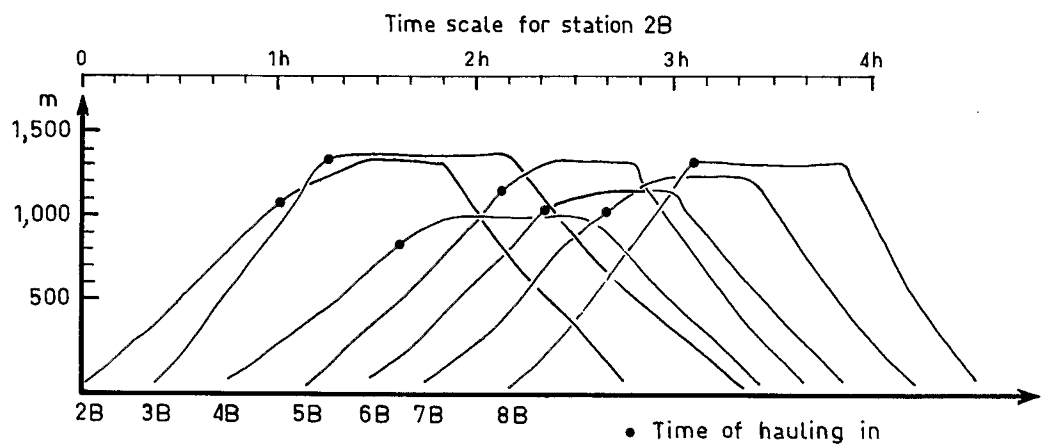

FIGURE 2 Bora IV: bathykymograph tracks for seven night stations.

Alize stations were made with a 5-ft trawl and only reached shallow depths.

The seasonal coverage of the Bora cruises was complete, but the cruises were too infrequent and the methodology was not consistent.

On Cyclone II to VI, the methodology was consistent, and the density of the stations was sufficient to conveniently describe diurnal and seasonal variations, but the cruises covered only 7 months and were too restricted geographically.

Nevertheless, to summarize, we shall consider here the results from 185 Bora and Cyclone stations made during 22 months, and for the most part, reaching depths greater than 600 m. We can thus expect to have a sufficient description of the usual composition of the ichthyofauna sampled by the 10-ft IKMT, except for a certain overestimation, relative to other species, for the smaller specimens of *S. diaphana* and for a large underestimation of the smaller specimens for the Apodes, and generally for the very elongated fishes. One must also point out that the juveniles of most species are much more abundant in the sampled population than appears in the results. An empiric rule could be that for "normally" shaped fishes, specimens and species of sizes between 2 and 10 cm are the bulk of the ichthyofauna sampled by the 10-ft IKMT.

ICHTHYOFAUNA IN THE WESTERN EQUATORIAL PACIFIC

Only the most common species were generally determined in the western equatorial Pacific.

Table 2 shows the composition of the ichthyofauna caught by the 10-ft IKMT during Bora and Cyclone cruises.

There are some differences in the results of these cruises, which could derive to some extent from the differences in sampling methods or differences in the areas sampled; there are also some clear and important common points.

1. The three dominant species are identical in the two series of cruises; *C. pallida** is largely the main species, constituting more than one half the total number; the two others, *V. nimbaria* and *S. diaphana*, represent together from 11 to 14 percent of the total number.
2. We can notice the poor influence of the Myctophids in the whole 1,200-m column, i.e., they represent only 13 to 15 percent of the total number.
3. In the two sets of cruises, 18 to 22 species composed approximately 90 percent of the total number.
4. Despite some differences in their order, of the eight species following the three main ones, by order of abundance, six were common to the two sets of cruises.

*Some preliminary studies were made to check the homogeneity of the *Cyclothone* designated here under *C. pallida*. Their number is so high, and in many cases these delicate fishes are in such bad condition that further consideration is needed. Nevertheless, in the first examination, the *Cyclothone* considered here appear to constitute a monospecific group with exceptions limited to a few individuals, and generally conform to the *C. pallida* description according to V. A. Mukhacheva (1964, On the genus *Cyclothone (Gonostomidae pisces)* of the Pacific Ocean. *Trud. Inst. Okeanol.*, 73, 93–108).

SEASONAL VARIATIONS IN THE EQUATORIAL AREA AND SOME DOMINANT SPECIES

The average number and percent of the dominant species of fishes for the equatorial area are presented in Tables 3a and 3b, respectively, for each cruise.

Considering the coefficient of variation of the averages per cruise as an index of the variability in time, the contrast between the great stability of *Cyclothone* and *S. diaphana* and the great variability of *V. nimbaria* is quite noticeable. *V. nimbaria* show two very high peaks during the 2 years of the cruises, and consequently, have varied each year from less than 1 percent to 18 percent of the total catch.

SOUTH-NORTH VARIATIONS IN THE TROPICAL AND EQUATORIAL AREA FOR SOME DOMINANT SPECIES

Table 4 summarizes the variations in abundance along the track of some Bora cruises.

Again we can notice a strong differentiation between the main species.

- As a general rule there are two marked peaks at the two ends and a minimum between 14° to 4°S.
- *C. pallida* is very stable from south to north, with only slight increases at the ends of the legs.
- *S. diaphana* shows a more marked increase northward but remains well distributed elsewhere.
- *V. nimbaria* shows a very high variability along the leg, with a small peak at the south and a strong development in the equatorial area.

When examining in detail the latitudinal variations of the number per haul of 10,000-m tow distance for *V. nimbaria*, this species shows that the northward increase is never observed at more than two or three consecutive stations between 0° and 2°N. This suggests a relation between this increase and the equatorial circulation. For example, its abundance in number per haul in the equatorial area for two Bora cruises is as follows:

Cruises \ Position	4°S	3°S	2°S	1°S	0°	1°N	2°N	3°N	4°N
Bora III	6	30	10	30	258	222	194	0	0
Bora IV	0	1	1	2	55	14	9	5	–

TABLE 2 Fishes Collected by Midwater Trawling in the Equatorial Southwestern Pacific (170°E) on Bora and Cyclone Cruises

Species[a]	Bora Cruises, Various Depths, Stations between 4°N and 5°S[b] (% of total)	Cyclone Cruises 0–1,200 m 0° to 5°S[c] (% of total)
Cyclothone pallida Brauer 1902	59.6	56.1
Vinciguerria nimbaria (Jordan & Williams 1895)	5.8	8.6
Sternoptyx diaphana Hermann 1781	5.1	5.1
	70.5	69.8
Lampanyctus festivus Tåning 1928	1.4	2.6
Diaphus schimdti Tåning 1932	1.3	1.9
Serrivomer sp.	1.5	1.8
Ceratoscopelus townsendi (Eigenman and Eigenman 1889)	1.0	1.8
Diaphus regani Tåning 1932	1.8	1.7
Diaphus fulgens Brauer 1904	3.3	1.4
Myctophum rufinum Tåning 1928	0.4	1.3
Chaulodius sloanei Block & Schneider 1801	1.2	1.2
	11.9	13.6
Bregmaceros sp.	not sorted	0.9
Gonostoma elongatum Günter 1878	1.7	0.8
Lampanyctus pyrsobolus Alcock 1890	0.8	0.8
Diaphus malayanus Weber 1913	0.2	0.6
Lampanyctus niger Günter 1887	0.9	0.5
Valencienellus tripunctulatus (Esmark 1871)	0.4	0.5
Hygophum benoiti (Cocco 1838)	1.0	0.4
Diaphus lutkeni Brauer 1904	not sorted	0.4
Gonostoma bathyphilum (Vaillant 1888)	not sorted	0.4
Sternoptychid undetermin	1.1	0.3
Myctophum asperum Richardson 1844–1848	not sorted	0.3
Diogenichthys laternatus (Garman 1899)	0.4	0.2
	6.5	6.1
Various sorted species	*4 species*	*15 species*
	1.1	1.2
Total sorted species	*23 species*	*38 species*
	90.0	90.8
Total percent of Myctophids	*13 species sorted*	*all species sorted (25)*
	13.2	14.7

[a]By order of importance for the Cyclone cruises.
[b]Number of stations selected = 62; number of fishes collected per station = 262 (corrected for a course of 10,000 m of the trawl).
[c]Number of stations selected = 84; number of fishes collected per station = 377 (corrected for a course of 10,000 m of the trawl).

INDICATIONS ON THE NIGHTTIME VERTICAL DISTRIBUTION OF THE DOMINANT SPECIES. RELATIONSHIP WITH THE SHALLOWER FAUNA ALONG THE EQUATORIAL CURRENT (ALIZE CRUISES)

Vertical Distribution of *C. pallida* and *S. diaphana*

Considering that *C. pallida* and *S. diaphana* were more stable in number during the 2-year period of sampling than the other species, we can examine in Table 5 their variation of abundance on the Bora cruises as a function of the depths of the haul.

To complete Table 5, we note that on Cyclone I, during which night hauls to 150 m were made, no specimens of the two species were collected. Also, on the Bora cruises, south of 5°S, *S. diaphana* was never observed shallower than 300 m at night, and only 6 percent of the total of the *Cyclothone* were taken in the shallow tows. During the Alize cruise (see Table 6), *Cyclothone* were no more than 0.8 to 3 per haul in the night 0-300-m hauls, and *S. diaphana* in their peak region were no more than 0.4 per

TABLE 3a Number per Haul (for a 10,000-m Course) for the Main Species in Equatorial Area

	Bora Cruises (1966)				Cyclone Cruises (1967)						
Species	B I (Dec.)	B II (March)	B III (June)	B IV (Sept.-Oct.)	C II (March-Apr.)	C III (May)	C IV (June)	C V (July)	C VI (Sept.)	Gen. Average	$V = \frac{100\sigma}{m}$
C. pallida	192	155	222	205	225	198	173	211	238	202	13 %
V. nimbaria	2	5	84	10	79	27	29	13	12	29	107 %
S. diaphana	13	15	24	17	18	16	18	22	21	18	17 %
L. festivus	1.0	3.1	7.6	5.0	8.5	12.1	5.4	10.0	10.9	7.1	52 %
D. schmidti	0.4	3.8	6.2	7.6	13.2	4.9	5.3	5.0	7.0	5.9	58 %
Serrivomer sp.	4.0	4.0	4.6	3.4	5.8	5.9	4.3	8.8	9.0	5.5	38 %
C. townsendi	5.7	1.3	1.8	2.4	4.7	6.7	1.7	6.7	11.8	4.8	71 %
Total number of fishes	282	238	458	317	447	343	298	356	415	350	22 %
Number of stations selected[a]	9	6	9	9	18	18	12	18	18	tot. = 117	σ calculated on 9 values
Types of hauls selected	900-m/day and night	900-m/day	650-m/ night	1,200-m/night	1,200-m/six times a day	1,200-m/ six times a day	1,200-m/ six times a day	1,200-m/ six times a day	1,200-m/ six times a day	–	–

[a]For the Bora Cruises, the deeper stations only were selected.

TABLE 3b Percentage of the Total Number of Fishes, Corresponding to the Values Presented in Table 3a

	Bora Cruises (1966)				Cyclone Cruises (1967)					
Species	B I (Dec.)	B II (March)	B III (June)	B IV (Sept.-Oct.)	C II (March-Apr.)	C III (May)	C IV (June)	C V (July)	C VI (Sept.)	Gen. Average
C. pallida	69.1	65.1	48.8	63.6	50.2	57.7	58.1	59.2	57.4	57.7
V. nimbaria	0.7	2.1	18.5	3.1	17.7	8.0	9.6	3.7	2.9	8.3
S. diaphana	4.7	6.3	5.3	5.3	4.1	4.8	5.9	6.2	5.0	5.1
L. festivus	0.4	1.2	1.7	1.6	1.9	3.5	1.8	2.8	2.6	2.0
D. schmidti	0.1	1.6	1.3	2.3	2.9	1.4	1.8	1.4	1.6	1.7
Serrivomer sp.	1.4	1.7	1.0	1.0	1.3	1.7	1.4	2.5	2.2	1.6
C. townsendi	2.0	0.5	0.4	0.7	1.0	2.0	0.6	1.9	2.8	1.4

TABLE 4 South–North Repartition of the Dominant Species during Bora Cruises (Number per Haul)

Area of the 170°E	20°–15°S	14°–10°S	9°–5°S	4°–0°	1°–4°N	Ratio, max. average / min. average
C. pallida	198[a]	153	164	148	209	1.4
S. diaphana	7.5	6.4	10.4	11.7	22.9	3.6
No. of stations selected[b]	(6)	(5)	(7)	(15)	(9)	–
V. nimbaria	8.6	2.9	1.2	13.6	28.3	23.4
L. festivus	1.8	1.3	5.0	2.7	4.8	3.8
D. schmidti	2.9	1.7	0.3	4.1	4.8	16.0
Serrivomer sp.	0.7	1.8	2.8	4.7	3.0	6.7
C. townsendi	7.4	7.3	5.9	3.8	1.2	6.2
Total no. of fishes	290	151	166	240	286	1.9
No. of stations selected[b]	(7)	(7)	(9)	(20)	(11)	–

[a]Maxima and minima underlined.
[b]This table has been established by using for each Bora cruise only the hauls of the same type made all along the leg. *C. pallida* and *S. diaphana* being absent in tropical area and rare in equatorial area above 300 m, the Bora I 300-m hauls were not considered in their case.

haul (but *Argyropelecus lynchus*, another Sternoptychid, was important in the eastern part of the cruise).

So, for these two species there is a clear trend for the bigger adults and also the youngest juveniles to remain in the middle and deeper levels. In equatorial waters, only medium-sized *C. pallida* and *S. diaphana* were found in appreciable quantities shallower than 300 m; but, compared with *C. pallida*, the shallow water maximum of *S. diaphana* was composed of younger and less numerous classes. Figure 3 shows this situation as a hypothetical vertical distribution of the main species according to their size development.

Vertical Distribution of *V. nimbaria*

Because of their large seasonal variations it is impossible to apply a similar treatment to the *Coriolis* data on *V. nimbaria*. But there are other possible sources for evaluation of its depth distribution. First, Alize results should be considered (Table 6).

Vinciguerria sp. are always important along the equator. The percentages of *Vinciguerria* in the Alize 300-m hauls, relative to the absence of *Cyclothone* and *Sternoptyx*, are quite comparable with what they were in some of the Bora or Cyclone cruises, in which they were at their maximum. Thus, the Alize sampling to 300 m gives better results than the Bora and Cyclone deep sampling for *V. nimbaria*. It is interesting to note that east of 110°W all the *Vinciguerria* were *V. lucetia; V. nimbaria* replaces this species quite sharply at 115°W, only one or two individuals of each species being found in the area of the other one.

On Cyclone I, hauls to 150 m were made at the same hour on six successive nights at 00°36′S, 169°32′E; on the seventh night, one haul to 75 m was made at the same position. The observed number of *V. nimbaria* in the 75-m haul was only slightly smaller than the average number observed in the six 150-m hauls, and the size distribution for the shallower station was different. In the 75-m haul, only 9 percent of the fishes were longer than 20 mm, and none was longer than 29 mm, while in the 150-m hauls 40 percent of the observed fishes were longer than 20 mm and 11 percent were longer than 29 mm, reaching 45 mm.

The average number of *V. nimbaria* in the 0–150-m hauls, corrected for a 10,000-m course, is 292; assuming that the entire population was concentrated in the 0–150-m layer, a 0–1,200-m haul would collect 37 individuals. On the last day of the above observations, two 0–1,200-m hauls were made, yielding a corrected average of 23 *Vinciguerria*. This is not in contradiction of the hypothesis that all the *Vinciguerria* were shallower than 150 m (Figure 3).

Relationship with the System of Equatorial Currents

Finally, all this being considered, it is quite probable that *V. nimbaria* is mainly concentrated in the upper 300 m at night and probably in a much shallower layer. The relative abundance of the species appears to be about the same all along the equator west of 115°W. The specimens smaller than 20 mm caught at night could be related with the westward South Equatorial Current, and the older ones with the eastward Cromwell Undercurrent.

A part of the medium-sized *Cyclothone* can also be influenced by the Cromwell Current, but younger and older ones, and practically all the *S. diaphana*, seem to be independent of both currents (see Figure 3).

Different patterns in the horizontal distribution of the

TABLE 5 Schematic Vertical Distribution of *Cyclothone pallida* and *Sternoptyx diaphana* at Night, According to Their Size (Bora cruises, equatorial area only)

Number of Hauls Averaged	Considered Layers	Theoretical Percent of the Population[a]	*Cyclothone pallida* (size groups) 10mm	15mm	20mm	25mm	30mm	35mm	Over 40mm	Total Population
4 (0–300m)	0–300m	25	11	30	33	51	31	18	12	31 %
5 (0–650m)	300–650m	29	11	28	21	28	27	8	22	21 %
4 (0–1,200m)	650–1,200m	46	78	42	46	21	42	74	66	48 %
	Observed number per 0–1,200-m haul for the whole section		100 = 4.5	26	60	54	26	34	22	227

Number of Hauls Averaged	Considered Layers	Theoretical Percent of the Population[a]	*Sternoptyx diaphana* (size groups) 5mm	10mm	15mm	20mm	25mm	30mm	Over 40mm	Total Population
11 (0–300m)	0–300m	25	8	28	18	7	0	5	0	13 %
9 (0–650m)	300–650m	29	55	40	45	93	56	5	5	44 %
9 (0–1,200m)	650–1,200m	46	37	32	37	0	44	90	95	43 %
	Observed number per 0–1,200-m haul for the whole section		100 = 4.8	4.7	2.7	1.5	1.6	2.1	1.8	19.2 %

NOTE: Numbers are expressed as percentage of the observed average number of the deepest night hauls. The shallower hauls were successively subtracted from the next deeper. For instance, the 300–600-m result is:

$$\left(\frac{\text{0–600 result x 100}}{\text{0–1 200 result}}\right) - \left(\frac{\text{0–300 result x 100}}{\text{0–1 200 result}}\right).$$

[a]Assuming a homogeneous distribution of the population and homogeneous conditions of hauling on the whole 1,200-m section.

TABLE 6 Some Data on the Ichthyofauna of the Upper 300 m along the Equator (Alize cruise).

Limit of the Considered Area Along 0°	A 92°-110°W	B 115°-138°W	C 145°-168°W	D 170°W-162°E
Number of Stations (IKMT 5-foot)	7	9	8	9
Number of Fishes per Haul[a]	97.8	35.5	89.8	51.0
Percent of the Number of Fishes for:				
Cyclothone sp.	0.8	8.4	1.0	0.4
V. lucetia (Garman 1899)	60.2	1.6	0	0
V. nimbaria	0	23.7	48.9	59.2
S. diaphana	0	0	0	0
A. lynchus Garman 1899	13.0	0.3	0.4	0
Total of Myctophids	23.3	61.6	46.2	36.9

[a]Corrected for a 5,000-m course

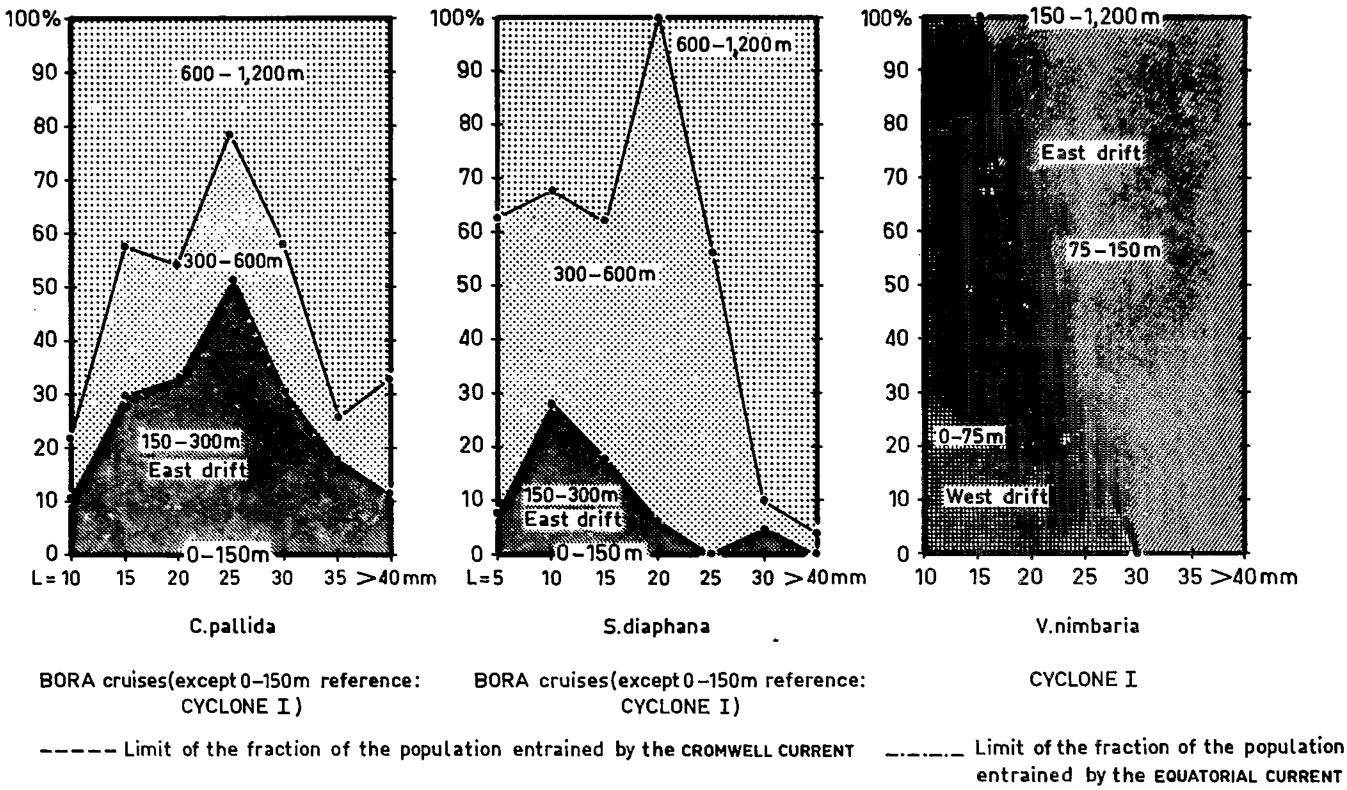

FIGURE 3 Assumed vertical distribution of the three main species of fishes in the West Equatorial Pacific as a function of their sizes, referred to the Equatorial Current and the Equatorial Undercurrent (*Coriolis* cruise data).

biomass of these three species could derive from differences in their vertical distributions. For instance, from 150° to 155°W enormous concentrations of postlarval *V. nimbaria* were collected during Alize cruises, causing an increase from one to four of the biomass of the total IKMT plankton evaluated at the peak station. So we can assume that *V. nimbaria* could be aggregated in large patches in the equatorial currents in the central Pacific; the movement of these patches to the west is a possible explanation for the marked seasonal peaks of juveniles observed for this species along 170°E during the Bora and Cyclone cruises.

CONCLUSION

These results constitute a description of the ichthyofauna of the upper 1,200 m in the western equatorial and southern tropical adjacent area and give more composite ideas for the study of the so-called micronektonic fishes in the equatorial area of the western Pacific.

1. Three dominant species constitute the biggest part of the fauna, the *Cyclothone* being more than one half in number of the total.

2. *Cyclothone* and *Sternoptyx* were observed to be very stable in abundance during the 2 years of sampling, and the density of *Cyclothone* did not change greatly from 0° to 20°S.

V. nimbaria was also present everywhere; however, it appears to exhibit marked seasonal peaks in equatorial water*; this could be related to enormous concentrations of larval stages further east.

3. *V. nimbaria* in the equatorial region appears to be shallower and restricted to the westward South Equatorial Current and eastward Cromwell Undercurrent. This distribution could influence successively the juveniles and the maturing adults. Some of the medium-sized *Cyclothone* are possibly influenced by the undercurrent; oldest and juvenile *Cyclothone* and most of the *Sternoptyx* remain below the active part of the Equatorial Current system.

Questions of interest concerning these organisms include the following:

1. At present we have no results to report on the food of the *Cyclothone* and the *Sternoptyx. V. nimbaria* food is under study in our laboratory; results for the eastern tropical Indian Ocean gave an average food weight of 4.5 percent of their body weight on night stations, consisting mainly of Copepods.

2. Around New Caledonia, *Sternoptyx diaphana* was, by order of occurrence, one of the most important prey species of the *Alepisaurus ferox* (Lancet fish) and was also important in the stomach contents of the Albacore tuna (*Alepisaurus* being also an important food for this tuna in the same area). In the same area *Vinciguerria* were found in the stomachs of Yellowfin more often than any other micronektonic fishes. The enormous concentration of postlarval *Vinciguerria* could be an important source of food for the bigger epipelagic species but could also have an important predatory effect on the available plankton.

3. Relation of tropical stocks of these species with their equatorial stocks have to be studied mainly for *V. nimbaria*.

The abundance of these species and their relationships with different parts of the meso and epipelagic zones, mainly in the Equatorial Current system, suggest that it could be very interesting to confirm the above remarks and to understand better their biology and their position in the oceanic food chain.

*Work in progress in the O.R.S.T.O.M. laboratory also indicates seasonal increases for this species in the tropical waters of the Indian Ocean.

BIBLIOGRAPHY

Backus, R. H., G. W. Mead, R. L. Haedrich, and A. W. Ebeling (1965) The mesopelagic fishes collected during cruise 17 of the R/V *Chain* with a method for analyzing faunal transects. *Bull. Mus. Comp. Zool. Harv.*, *134*(5), 139–198.

Brauer, A. (1906) Die Tiefsee Fisch. I Systematischer Teil. *Wiss. Ergebn. 'Valdiva'*. Bd. XV.

Fraser-Brunner, A. (1949) A classification of the fishes of the family Myctophidae. *Proc. Zool. Soc. Lond.*, *118*(4), 1019–1106.

Gilbert, C. H. (1905) The deep sea fishes of the Hawaiian Islands. In *The aquatic resources of the Hawaiian Islands, II*. D. S. Jordan and B. W. Evermann. *Bull. U.S. Fish Comm.*, *23*(2), 575–713, 45 Plates, 44 Illus.

Grandperrin, R. (1967) Etude comparative d'échantillons de macroplancton et de micronecton récoltes par trois filets différents. *Cahier O.R.S.T.O.M. Océanogr.*, *5*(4), 14–29.

Grandperrin, R., and M. Legand (1967) Influence possible du système des courants équatoriaux du Pacifique sur la répartition et la biologie de deux poissons bathypélagiques. *Cahier O.R.S.T.O.M. Océanogr.*, *5*(2), 69–77.

Grandperrin, R., and J. Rivaton (1966) *Coriolis* Croisière Alize. Individualisation de plusieurs ichtyofaunes le long de l'équateur. *Cahier O.R.S.T.O.M. Océanogr.*, *4*(4), 35–49.

Jespersen, P., and A. V. Taning (1926) Mediterranean Sternoptychidae. *Rep. Danish Oceanogr. Exped. Med.*, *2*(9), 1–59.

King, J. E., and R. I. B. Iversen (1962) Midwater trawling for forage organisms in the central Pacific. *Fish Bull. U.S.*, *62*(210), 271–321.

Koefoed, E. (1958) Isospondyli 2. Heterophotodermi -1-. *Rep. Sars. N. Atl. Deep Sea Exped.*, *4*, part 2(6).

Legand, M., and J. Rivaton (1967) Cycles biologiques des poissons mésopélagiques dans l'est de l'Océan Indien. Deuxième note: Distribution moyenne des principales espèces de l'ichtyofaune. *Cahier O.R.S.T.O.M. Océanogr.*, *5*(4), 73–98.

Norman, J. R. (1930) Oceanic fishes and flat fishes collected in 1925–27. *Discovery Rep.*, *2*, 261–370.

Parr, A. E. (1927) The Stomiatoid fishes of the suborder Gymnophotodermi. *Bull. Bingham Oceanogr. Coll.*, *3*(2).

Parr, A. E. (1928) Deep sea fishes of the order Iniomi from the waters around the Bahama and Bermuda Islands. *Bull. Bingham Oceanogr. Coll.*, *3*(3).

Parr, A. E. (1928) Deep sea Berycomorphi and Percomorphi from the waters around the Bahama and Bermuda Islands. *Bull. Bingham Oceanogr. Coll.*, *3*(6).

Pearcy, W. G., and R. M. Laurs (1966) Vertical migration and distribution of mesopelagic fishes off Oregon. *Deep Sea Res.*, *13*, 153–165.

Regan, T., and E. Trewavas (1929) The fishes of the families Asthonestidae and Chauliodontidae. *Rep. Danish Dana Exped.* (5).

Regan, T., and E. Trewavas (1930) The fishes of the families Stomiatodae and Malacosteidae. *Rep. Danish Dana Exped.* (6).

Roule, L., and L. Bertin (1929) Les poissons apodes appartenant au sous-ordre des Nemichthydiformes. *Rep. Danish Dana Exped.*, (4).

Schultz, L. P. (1961) Revision of the marine silver hatchet fishes (family Sternoptychidae). *Proc. U.S. Nat. Mus.*, *112*(3449), 587–649.