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PRELIMINARY RESULTS OF ZOOPLANKTON SAMPLING IN LAKE TANGANYIKA

by
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PREFACE

The Research for the Management of the Fisheries on Lake Tanganyika project (LTR) became fully operational in January 1992. It is executed by the Food and Agriculture Organization of the United Nations (FAO) and funded by the Finnish International Development Agency (FINNIDA).

LTR's objective is the determination of the biological basis for fish production on Lake Tanganyika, in order to permit the formulation of a coherent lake–wide fisheries management policy for the four riparian States (Burundi, Tanzania, Zaïre and Zambia).

Particular attention are given to the reinforcement of the skills and physical facilities of the fisheries research units in all four beneficiary countries as well as to the build–up of effective coordination mechanisms to ensure full collaboration between the Governments concerned.

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1. INTRODUCTION

Regular sampling programme of crustacean mesozooplankton, one of the Scientific Sampling Programme (=SSP) sub-components, was started by Lake Tanganyika Research Project (=LTR) in July 1993. This report presents zooplankton data collected from July 1993 to February 1994 as well as evaluates the sampling programme.

The pelagic zooplankton plays a vital role in the lake ecosystem transferring energy from the primary producers to the pelagic clupeids and juveniles of *Lates stappersii.* The current sampling scheme is studying the seasonal and spatial variations in the abundance and diversity of the pelagic zooplankton community. The objective is to determine predator—prey relationships, dynamics and ecological interactions between trophic stages. Eventually, the overall aim is to determine the biological basis of fish production on the lake.

In this report, the differences between the zooplankton communities at the northern and southern ends of the lake and the seasonal changes in zooplankton abundance are discussed. The diurnal vertical distribution and migration patterns at different sampling localities are also described.

2. MATERIAL AND METHODS

The sampling schedule is twofold:

(1) regular weekly sampling consisting of a vertical tow from a depth of 100 meters to the surface at 09.00 hrs using plankton net with 100 μm mesh size; and

(2) six—weekly intensive sampling consisting of four samples collected during a 24-hour cycle starting at 12.00 hrs and ending the next morning at 06.00 hrs Burundi time.

Samples were taken with a LIMNOS tube sampler (volume - 7.4 l) at depth intervals of 20 meters down to the depth of 140 m. In each case the tube sampler was lowered to the sampled depth, a messenger was sent to close the lid and the sampler was pulled up. The sample was poured into a bucket and then filtered through a 50 μm net. It was rinsed twice. All samples were preserved in 4 % formalin.

Furthermore, the efficiency of 100 and 50 μ mesh sized nets was compared in Kigoma by towing the 50 μm net after 100 μm net from 100 m depth. Sampling and analysis were carried out according to instructions in Kurki (1993) and Vuorinen (1993).

The sampling sites were at each LTR station were so that the depth for the regular weekly sampling was at least 120 m and for 24-hour sampling at least 320 m. TABLE 1 details the distances from shore and the maximum depth at each sampling point.

TABLE 1 :Distance from shore and maximum depth at LTR sampling sites on Lake Tanganyika.

Station	regular sampling km	regular sampling depth (m)	24 hours sampling km	24 hours sampling depth (m)
Bujumbura	5.5	120	9.0	>300
Kigoma	2.5	250—500	4.0	250—500
Mpulungu	6.5	120	4.0	320
Kipili	5.0	>100	-	-

TABLES 2a and 2b provide sampling dates of the regular sampling and 24 hours sampling.

TABLE 2: Sampling dates at four LTR localities during July 1993 - February 1994
= sample was taken; — = sample was not taken
l=Bujumbura. 2=Kigoma. 3=Mpulungu. 4=Kipili)

(a)regular sampling

Date	1.	2.	3.	4.	Date	1.	2.	3.	4.
09.07.93	+	—	—	—	16.11.93	—	+	+	+
13.07.93	—	+	—	—	23.11.93	+	+	+	+
20.07.93	+	+	—	—	30.11.93	—	+	+	+
27.07.93	+	+	—	—	07.12.93	+	+	+	+
17.08.93	+	+	+	—	21.12.93	+	+	—	+
24.08.93	+	+	+	—	28.12.93	—	—	+	+
31.08.93	+	+	+	—	04.01.94	+	—	+	+
07.09.93	+	+	+	—	11.01.94	+	+	+	+
28.09.93	+	+	+	—	18.01.94	+	+	+	+
05.10.93	+	+	+	—	01.02.94	—	—	—	+
19.10.93	+	+	+	—	08.02.94	+	+	+	+
09.11.93	+	+	+	+	15.02.94	+	+	+	+
					22.02.94	+	+	+	+

(b) 24 hours sampling

Date	1.	2.	3.
03.08.93	+	+	+
14.09.93	+	+	+
26.10.93	–	+	+
14.12.93	+	+	+
25.01.94	+	+	+

3. RESULTS

3.1 Weekly samples

3.1.1 Population dynamics of Cyclopoida

3.1.1.1 Nauplii

In both Kigoma and Bujumbura stations, the numbers of cyclopoid nauplii decreased from July to August 1993 and increased again during October 1993. In Bujumbura area the numbers of cyclopoid nauplii decreased in December 1993 and increased in January 1994 (FIGURES la and 2a). In Kigoma the number of cyclopoid nauplii remained low throughout the study period (FIGURE 2a). The zooplankton sampling in Mpulungu in August 1993; the number of cyclopoid nauplii decreased from August to October 1993 and increased in November 1993 (FIGURE 3a). From Kipili, which is situated some 250 km south from Kigoma, data is available only from November 1993 onwards; there cyclopoid nauplii showed slight increase in numbers in February 1994 (FIGURE 4a)

3.1.1.2 Copepodites

In Bujumbura the cyclopoid copepodites distribution showed two peaks i.e. the highest density occurred in July 1993 (average 4041 ind/m^3) and the second peak was in November (average of 2969 individuals (=ind.)/m^3). The variation in numbers during November 1993 was high (SD = 6140 ind./m^3). A decline to 200 ind./m^3 was observed during the following three months (FIGURE lb).

In Kigoma waters the density of copepodites was low during July to August 1993. The highest abundance was observed in October 1993, average being 3590 ind./m^3 (FIGURE 2b). After October 1993, the density remained more or less the same althougha slight decrease in numbers was observed.

At the southern end of the lake, off Mpulungu, cyclopoid copepodites were most abundant in August 1993 (monthly average 2144 ind./m^3). Averages decreased until October 1993, increased up to January and dropped down in February 1994 (FIGURE 3b).

This change in abundance was similar to the changes of nauplii (FIGURES 3a and 3b).

In Kipili area the number of copepodites was low during November 1993 and January 1994 and clearly higher during December 1993 and February 1994 (FIGURE 4b).

If Mpulungu and Bujumbura results are compared, both areas showed a decrease in the number of copepodites from August to September 1993; it reached a minimum in October 1993 in Mpulungu and in September 1993 in Bujumbura (FIGURES 2b and 3b).

3.1.1.3 Adult stages

In the north (Bujumbura), adult cyclopoid females were found in low numbers throughout the study period showing a slight increase only in August 1993; average was 1319 ind./m^3 and SD 2187 (FIGURE 1d). On the contrary, the number of males was high showing a decrease in September and October 1993 but increasing again to a steady number in November 1993; the average was 4872 ind./m^3 (FIGURE lc).

In Kigoma waters, cyclopoid males were increasing in number from the start of the sampling up to November 1993 (average 3511 ind./m^3), then decreasing quite considerably in numbers in December 1993 when the average of the month was only 954 ind./m^3 (FIGURE 2c). Females showed a similar trend as in males (FIGURE 2d) except that females showed a slightly higher density than males.

In Mpulungu, cyclopoid males decreased in number up to November 1993 and a clear increase in density was observed in January 1994; the November average was 282 ind./m^3 and during January 1297 ind./m^3 (FIGURE 3c). Females showed highest densities in October and November 1993 (FIGURE 3d). Abundance changes of nauplii, copepodites and males showed a similar trend when compared to each other.

In Kipili, both males and females showed the same trend in density; decrease from November to December 1993 and a clear abundance peak in February 1994 (FIGURES 4c and d).

The number of ovigerous females showed variations within one month in Bujumbura but the overall density was more stable and higher than in Kigoma or Mpulungu area, where for few months ovigerous females were undetectable (FIGURES le, 2e and 3e). In Kipili, the number of ovigerous females followed the number of cyclopoid females (FIGURE 4e).

3.1.2 Population dynamics of Calanoida

3.1.2.1 Nauplii

In Bujumbura, the number of *Tropodiaptomus simplex* nauplii did not vary much from July to November 1993; a decrease to a lower steady level was observed in December 1993 (FIGURE 5a). In

Kigoma, the numbers of nauplii increased from July 1993, reaching a peak in October 1993 and keeping a steady state until February 1994 (FIGURE 6a). In the south basin the number of Calanoida nauplii remained at the same abundance level with a drop in October 1993 and February 1994 (FIGURE 7a). In Kipili, the density of nauplii increased considerably in February 1994 (FIGURE 8a).

3.1.2.2 Copepodites and adult stages

In Bujumbura, the number of copepodites was high in July 1993 (average 3958 ind./m^3 and SD 6140) compared to the other months when the density was considerable low (FIGURE 5b). The number of males was higher than the number of females but the density changes were alike (FIGURES 5c and d). Ovigerous females were observed each month, the highest abundance being in July 1993 (average 132 ind./ m^3) (FIGURE 5e).

Off Kigoma, the copepodite stages showed two slight abundance peaks, namely in October 1993 and in January 1994 (FIGURE 6b). The number of adult Calanoida males and females was below 1000 ind./m^3 throughout the observed period. The highest abundance was observed in November 1993 (FIGURES 6c and d). In July and August 1993, no ovigerous females could be found in Kigoma, but reproduction started in September 1993 (FIGURE 6e).

In the southern basin **(=** Mpulungu), number of copepodites dropped significantly from August to September 1993, slightly increasing from November to December 1993 (FIGURE 7b). The number of Calanoid males remained steady from August 1993 to February 1994 (FIGURE 7c). Females showed quite different abundance pattern when compared to males; first an increase in ind./m^3 from August to September 1993, then a steady situation up to February 1994 when a slight increase in abundance could be observed (FIGURE 7d). Furthermore, the number of females was larger than that of males throughout the whole period. A clear peak in reproduction, observed by the presence of ovigerous females, was seen in August and December 1993 (FIGURE 7e).

3.1.3 Abundance pattern and species composition

A general observation is that the number of Cyclopidae is lower in Mpulungu area than in the northern part of the lake. In Kigoma, a clear abundance peak was observed in November 1993 which was not the case in either Bujumbura or Mpulungu. In Kigoma, ovigerous females were found in low numbers compared to Bujumbura where Cyclopidae seem to have continuous reproduction.

In Mpulungu, however, the rate of reproduction fluctuated considerably during the sampled period.

The numbers of Calanoid copepods, both nauplii and adults, were generally larger in Bujumbura than in Kigoma and Mpulungu. The number of ovigerous females was also clearly higher in Bujumbura than in Kigoma and Mpulungu.

In the northern basin, Cyclopidae seem to be the dominating Copepoda when expressed as number of ind./m^3; in the southern basin calanoid and cyclopoid copepods were in about equal numbers.

3.2 Six-weekly intensive sampling

TABLES 3a, 4a and 5a are represent the depth (meters) of the highest abundance of *Tropodiaptomus simplex* and Cyclopidae nauplii collected during 24 hours sampling at each sampling station. The tables also indicate the phase of the moon, a + sign for the full moon period and a — sign for the new moon period. TABLES 3b, 4b and 5b give the same information for copepodite and adult stages.

TABLE 3: Depth (in m) of the highest abundance of the pelagic Copepoda during 24 hours sampling in Bujumbura.

(a) nauplii

		Diaptomidae				Cyclopidae			
moon	month	12 hrs	18 hrs	24 hrs	6 hrs	12 hrs	18 hrs	24 hrs	6 hrs
+	8/93	0	0	60	0	0	40	60	0
—	9/93	20	20	20	0	0	20	0	0
+	10/93	—	—	—	—	—	—	—	—
—	12/93	60	40	20	20	60	40	20	40
+	1/94	60	40	20	40	40	40	20	40

(b) copepodites and adults•

		Diaptomidae				Cyclopidae			
moon	month	12 hrs	18 hrs	24 hrs	6 hrs	12 hrs	18 hrs	24 hrs	6 hrs
+	8/93	0	0	40	80	0	20	40	40
—	9/93	20	20	20	0	20	20	20	80
+	10/93	—	—	—	—	—	—	—	—
—	12/93	60	40	20	20	60	40	20	40
+	1/94	20	20	20	60	40	20	20	40

TABLE 4: Depth (in m) of the highest abundance of the pelagic Copepoda during 24 hours sampling in Kigoma.

(a) nauplii

		Diaptomidae				Cyclopidae			
moon	month	13 hrs	19 hrs	1 hrs	7 hrs	13 hrs	19 hrs	1 hrs	7 hrs
+	8/93	80	20	40	40	60	60	40	40
—	9/93	20	0	20	20	20	20	20	20
+	10/93	40	0	—	20	40	40	—	40
—	12/93	20	20	20	0	20	20	20	40
+	1/94	40	0	40	40	40	20	20	0

(b) copepodites and adults

		Diaptomidae				Cyclopidae			
moon	month	13 hrs	19 hrs	1 hrs	7 hrs	13 hrs	19 hrs	1 hrs	7 hrs
+	8/93	100	80	20	100	20	20	0	20
—	9/93	20	0	20	60	20	20	0	0
+	10/93	80	20	—	80	40	40	—	40
—	12/93	120	60	0	40	40	40	40	40
+	1/94	40	20	100	60	40	20	20	40

TABLE 5: Depth (in m) of the highest abundance of the pelagic Copepoda during 24 hours sampling in Mpulungu.

(a) nauplii

		Diaptomidae				Cyclopidae			
moon	month	12 hrs	18 hrs	24 hrs	6 hrs	12 hrs	18 hrs	24 hrs	6 hrs
+	8/93	60	60	60	100	40	60	60	40
—	9/93	20	80	60	100	20	80	20	80
+	10/93	80	120	60	140	20	120	40	140
—	12/93	40	40	60	60	40	40	40	40
+	1/94	80	40	0	40	40	40	40	40

(b) copepodites

and adults — Diaptomidae — Cyclopidae

moon	month	12 hrs	18 hrs	24 hrs	6 hrs	12 hrs	18 hrs	24 hrs	6 hrs
+	8/93	100	20	120	40	60	120	0	40
–	9/93	20	0	60	100	20	20	60	0
+	10/93	80	120	140	140	80	120	140	140
–	12/93	80	20	100	60	40	20	40	60
+	1/94	100	20	0	80	40	40	0	40

3.2.1 Vertical migration and distribution of nauplii

Until now the results show a difference in vertical distribution pattern in Cyclopoida nauplii between day and night. For example in Kigoma, in the beginning of August 1993, the cyclopoid naupliar stages appeared to be lacking in the surface (0-20 m) zone in daytime while the nighttime samples showed large numbers (FIGURES 13m and 13n). Similarly, the completed emptiness of the surface samples was seen in daytime on 14.09.1993 in Mpulungu while there were more than 32000 ind./m^3 at the 20 m depth zone (FIGURE 19e). The highest density during daytime was observed at the surface in Bujumbura in August 1993 (FIGURE 9e). Calanoida nauplii also occasionally absent at the surface during daytime; for example on 14.09.1993 in Mpulungu, on which occasion more than 60000 ind./m^3 were found in the 20 meters depth zone (FIGURE 19e). Nauplii were found lacking or the number was low at the surface several times also in night-time samples (FIGURES 13f, 16n, 17g and 17n, 21f, 21g and 21n)

In Kigoma, Diaptomidae nauplii showed an upward migration at the time of sunset during every 24-hour cycle sampled. A downward migration at dawn was also observed (FIGURES 13-17 e-g and TABLE 4a). Cyclopidae nauplii showed the highest density in the water layers 20-60 m in August and October 1993, while in September and December 1993 the highest abundance was recorded at 20 m and in January 1994 at 40 m (TABLE 4a).

In Bujumbura, the population maxima of *T. simplex* and cyclopoid nauplii were close to the surface (mostly 0–20 m water zone) in August and September 1993 with one exception *i.e.* midnight sampling in August 1993 when the maxima of nauplii were recorded at 60 m (FIGURES 9g and o). In December 1993 and January 1994, the highest abundance's were observed in 20-60 meters depth (TABLE 3a). The vertical migration took place most often at sunset when the nauplii migrated to the surface which was usually devoid of nauplii during daytime (FIGURES llm and n, FIGURES 12e and f, m and n)

In Mpulungu waters, the nauplii seem to occupy deeper water layers than in Kigoma or Bujumbura. Calanoida nauplii showed only once a population maximum at the surface zone, in January 1994 at midnight sampling (TABLE 5a). Calanoida nauplii showed the highest densities in the 60 m zone and cyclopoid nauplii in the 40 m zone during the study period (TABLE 5a). In December 1993, a slight shift closer to the surface was observed with both nauplii groups. The surface was devoid of nauplii in September 1993 and January 1994 during daytime but nauplii seem to migrate upwards at the time of sunset (FIGURES 19 and 22 e,f,m,n).

3.2.2 Vertical migration and distribution of copepodites and adults

3.2.2.1 Calanoida

The vertical migration of Calanoida copepodites and adults was clearest in Kigoma. For example, in August 1993, one day after the full moon and when the moon rise was observed 19.45 hrs, the Calanoida occupied the water layers 100 to 120 m deep during day time; at 19.00 hrs, movement to the surface took place; at midnight (00.01 hrs) the highest abundance was at 20 in and the next morning at 100 m. The following month, when the sampling was done during the new moon period, diurnal vertical migration could be observed as well.

In the northern basin off Bujumbura, the surface samples in August 1993 had been most probably obtained from a patch (the density at the surface was 1070700 and at 20 m depth it was 5355 ind./m^3). In September 1993, the daytime samples showed 6 - 10 times higher densities than the night and morning samples. In December 1993, the peak of the maximum density decreased from 20 to 40 in between day and evening sampling. In January 1994, the number of individuals/m^3 during day time was three times less than the next morning. The density maximum recorded was at 20 in all the time except at 06.00 hrs when it was recorded at 60 m.

In Mpulungu, the depth of the density maximum between day and evening sampling changed from 100 m to 20 m in August 1993. In September 1993, a clear abundance peak was recorded at 20 m during daytime and migration took place at dusk when the highest abundance was observed at the surface. In October 1993, the highest number of ind./m^3 was counted below 60 meters throughout day and night. In the morning, the highest density was obtained from the sample taken at 140 m. In December 1993, at sunset, the zooplankton density exceeded the one observed at all the other sampled hours. In January 1994, a diurnal vertical migration took place: at midday, the highest abundance of animals was counted in the 100 m zone, 18.00 hrs at 20 m, at midnight at the surface and the following morning at 80 m.

3.2.2.2 Cyclopoida

Cyclopoida copepodites and adults showed different distribution patterns between day and night but not as clear as Calanoida copepoda.

In Bujumbura, cyclopoid copepods showed a similar patchy distribution as calanoids at the surface in August 1993 samples. In September 1993, a similar abundance difference between day and night samples was detected as with calanoid copepods. In December 1993 as well as in January 1994, during the new moon period, a shift from the deeper water zone at day time (highest density at 60 m at 12 hrs) to the upper water layers could be detected as well as in January.

Off Kigoma, the highest abundance of cyclopoid copepodites and adults was never detected below 40 meters. In August and September 1993, cyclopoids recorded their maximum density during daytime at 20 m; a shift took place during midnight when the cyclopoids were found most abundant at the surface. In October 1993, the depth of the biggest density remained at 40 meters throughout day and night. Through the study period, cyclopoid copepodites and adults were found either in low numbers or not at all in the surface zone during daytime (13.00 hrs) sampling.

In Mpulungu, four times during the sampling period the highest abundance of cyclopoid copepodites and adults was observed at 120 or 140 m depth. Once during the sampling period, the surface layer was devoid of cyclopoids during daytime.

3.3 Comparison between the 50 and 100 μm mesh size nets

Different mesh sized nets used were compared in Kigoma (TABLE 2). First, a 100 μm net was towed from 100 m and the same was repeated with a 50 μm net. The same person did the tow keeping the towing time identical.

Using a percentage comparison, it is concluded that a 100 μm net is catching more effectively than a 50 μm net all stages except for the cyclopoid nauplii (TABLE 6). However, the variation (standard deviation calculated) within one group is high.

TABLE 6: Comparison of the efficiency between two nets in Kigoma. October-November 1993 (% = percentage of 100 μm net catch of the catch of 50 μm net; the numbers are per m^3).

(a) males

	Diaptoinidae			Cyclopidae		
date	100μm	50μm	%	100μm	50μm	%
19.10.	0	197	–	763	690	111
09.11.	139	152	91	1297	808	161
16.11.	446	383	116	757	575	132
24.11.	712	0	–	4172	1356	308
30.11.	711	209	340	7819	5233	149

(b) females Diaptomida Cyclopidae

date	100µm	50µm	%	100µm	50µm	%
19.10.	382	296	129	1718	591	291
09.11.	417	354	118	1158	768	151
16.11.	713	479	149	1292	814	159
24.11.	407	313	130	4477	1878	238
30.11.	609	523	116	11272	3454	326

(c) copepodites Diaptomidae Cyclopidae

date	100µm	50µm	%	100µm	50µm	%
19.10.	382	296	129	2863	2S62	112
09.11.	417	101	413	2S94	1870	139
16.11.	490	383	128	2940	4070	72
24.11.	916	209	438	3358	1461	230
30.11.	203	209	97	1S23	4814	32

(d) nauplii Diaptomidae Cyclopidae

date	100µm	50µm	%	100µm	50µm	%
19.10.	3435	5419	63	1336	21381	6
09.11.	324	202	160	208S	24760	8
16.11.	1158	1484	78	1980	43473	5
24.11.	1628	522	311	1323	206S0	6
30.11.	1726	628	274	1219	28570	4

3.4 Comparison between a net and tube sampler

There is a large difference between abundances observed with a net and a tube sampler. For example, maximal numbers of Cyclopoida nauplii found with tube sampling and a 50µm net reached 1491100 in Bujumbura (3.8.1993 12.00 hrs) while the maximum found using nets was about 2600 (Bujumbura in July 1993) individuals/m^3 (FIGURE la). For the adult stages, the differences were also large. For example, the maximum number found with a tube sampler was about 160000 adult cyclopoids/m^3 (Bujumbura, 14.9.1993 at 12.00 hrs) while the maximum found with the 100µm net was about 8000 (Kigoma, in November 1993). The difference between maxima found with the two methods is due to net integrating individuals from all depths sampled. Thus, net results represent an average over all depths sampled, while tube samples reveal local maxima, which may occur as high densities over narrow depth zones.

3.5 Comparison among sampling localities

There are substantial differences between sampling stations. In Mpulungu, the numbers of calanoid nauplii are about twice as high as those in Kigoma. On the other hand, the highest numbers of cyclopoids found in Kigoma are about four times those found in Mpulungu.

4. DISCUSSION

There is a seasonal peak in reproduction both in cyclopoids and calanoids. The lack of seasonality in tropical zooplankton abundance has been questioned by Twombly (1983). However, seasonal changes in Lake Tanganyika have been documented before (Narita *et al.* 1986; Mulimbwa and Bwebwa, 1987; Mulimbwa 1987, 1988, 1991).

Several peculiar features have been observed in the vertical distribution of nauplii. First, there was often a total lack of naupliar stages in the uppermost samples(=surface samples). Secondly, there is a distinct population maximum of nauplii at the depth between 40 to 60 meters. Thirdly, another peak could often be found at 100 meters depth. Furthermore, migration in Calanoida is more pronounced than in Cyclopoida. The maximum depth where zooplankton was found in large numbers is considerably deeper in Mpulungu than in Kigoma or Bujumbura (compare FIGURES 9-17 with FIGURES 18-22).

Copepod nauplii are generally found dwelling near the surface. In Lake Tanganyika this is, however, not always the case. The lack of nauplii in certain surface samples could be due to either migration or extreme patchiness. Finding maxima so deep could point to a very intense predation pressure in the surface layers which keeps egg laying adults away from the surface. The deeper maximum could point to the feeding on methane oxidizing bacteria at the oxic—anoxic interface (Hecky, 1991)

The 24—hour sampling cycle gives us information on the distribution pattern of the pelagic Copepoda during day and night. How the noon affects the distribution pattern is not clear yet and with the present sampling scheme (every second sampling during full noon period and every second sampling during new moon period) the moon effects may not be properly studied.

Comparison between the two nets showed that a 100 µm mesh is generally more efficient, the only exception was in catching of Cyclopoida nauplii.

The differences found in maximal abundance when tube and net sampling was compared are due to a better efficiency of the tube sampling (Coulter, 1991) and also to the fact that net sampling integrates all zooplankton from the whole water column, thus hiding possible maxima. Still, it would be worthwhile to make a comparison between the efficiency of the two methods by simultaneous sampling. This would give a better insight of true copepod densities available for fish when they search and encounter local population maxima of their prey species.

To some degree the present results corroborate our expectations, e.g. the fact that the southern part of the lake is more characterized by the presence of *T. simplex* and northern part by Cyclopoids (cf. Coulter, 1991). According to Van Meel (1954), the pelagic zooplankton is found in the upper water zone, especially above 40 meters, early in the evening. Our study supports this statement with the exception of Mpulungu where the highest abundances at dusk were most of the time found below 60 meters.

5. RECOMMENDATIONS

There is need to know the variance caused by local patchiness. Consequently, the variance between several tows of plankton net made on one location should be estimated. A pilot study might be possible by comparing the fresh biomass of several parallel tows with a measuring cylinder.

To reduce variability due to the patchy distribution samples from at least three localities at the pelagic area should be taken.

There is need to know how the zooplankton abundance and species composition changes under predatory pressure and which species and development stages are preferred by predators and what is the dynamics between the prey and predator. This will be possible once the research vessel will be available.

The analysis of hydrographic measurements together with the plankton data is being initiated to reveal causes of the two maxima of vertical distribution and the amplitude of the vertical migration.

A proper species identification of most important cyclopoids is needed. So far, we assumed that the most probable species to be found in a sample is *Mesocyclops aequatorialis.* This is because no proper identification can be made while counting.

Information on the phases of the moon and local weather conditions (cloud coverage) is being collected to be used in interpreting the six-weekly sampling.

We will need production measurements from different phases of the reproductive period: for October when numbers and biomasses are maximal; from August to September when numbers and biomasses start to grow; and from June to July when production is lowest. Laboratory rearing experiments should be conducted soonest.

The sampling should continue as such until at least July 1994. Few changes in the sampling scheme will be introduced in August 1994 when the second year of Scientific Sampling Programme will start:

* three replicate zooplankton tows in the pelagic area will be done;

* a new sampling device is being constructed and currently tested in Bujumbura. This new gear should reduce the loss of naupliar stages of Cyclopidae and should enhance vertical sampling as the new sampler is sturdier.

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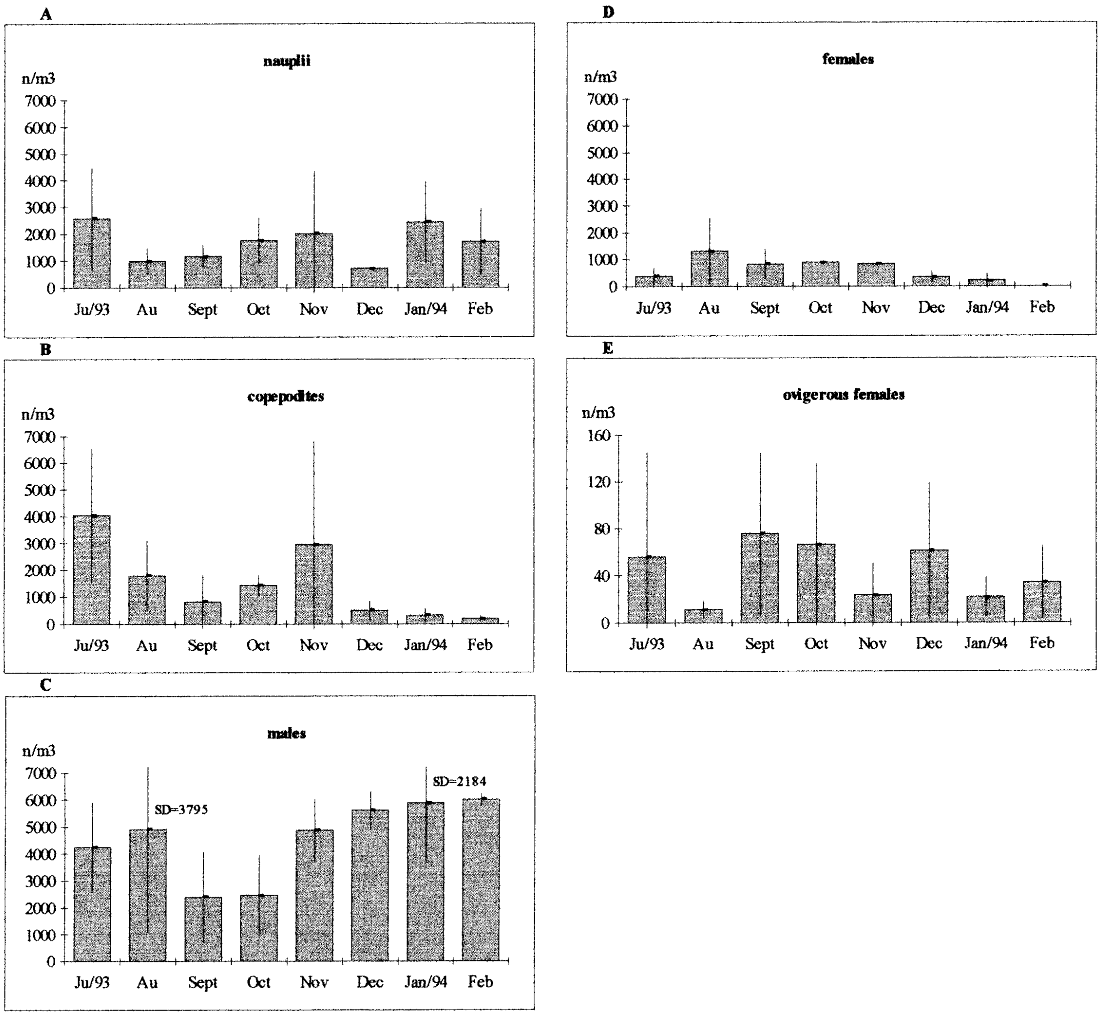

Fig1: Abundance of Cyclopidae in Bujumbura, Burundi

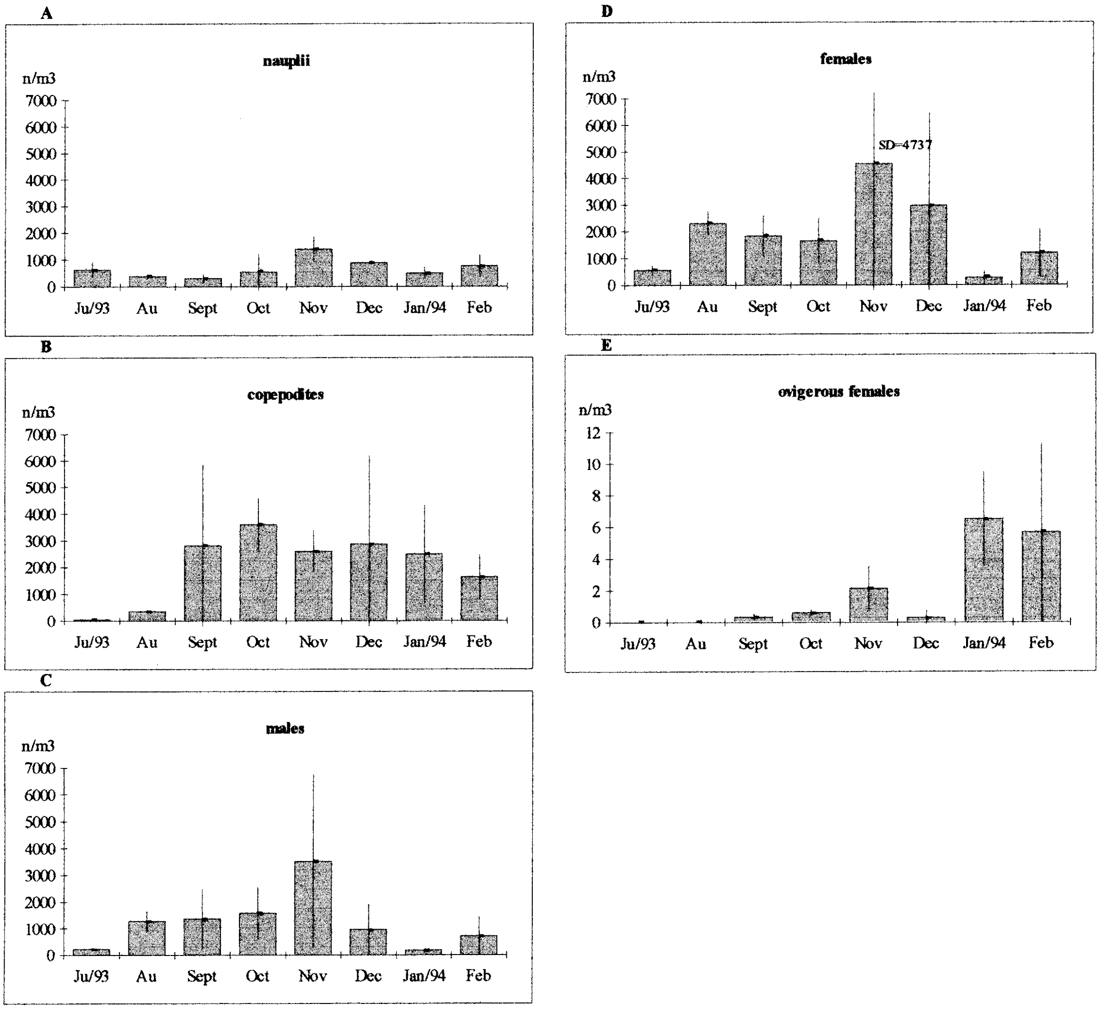

Fig 2: Abundance of Cyclopidae in Kigoma, Tanzania

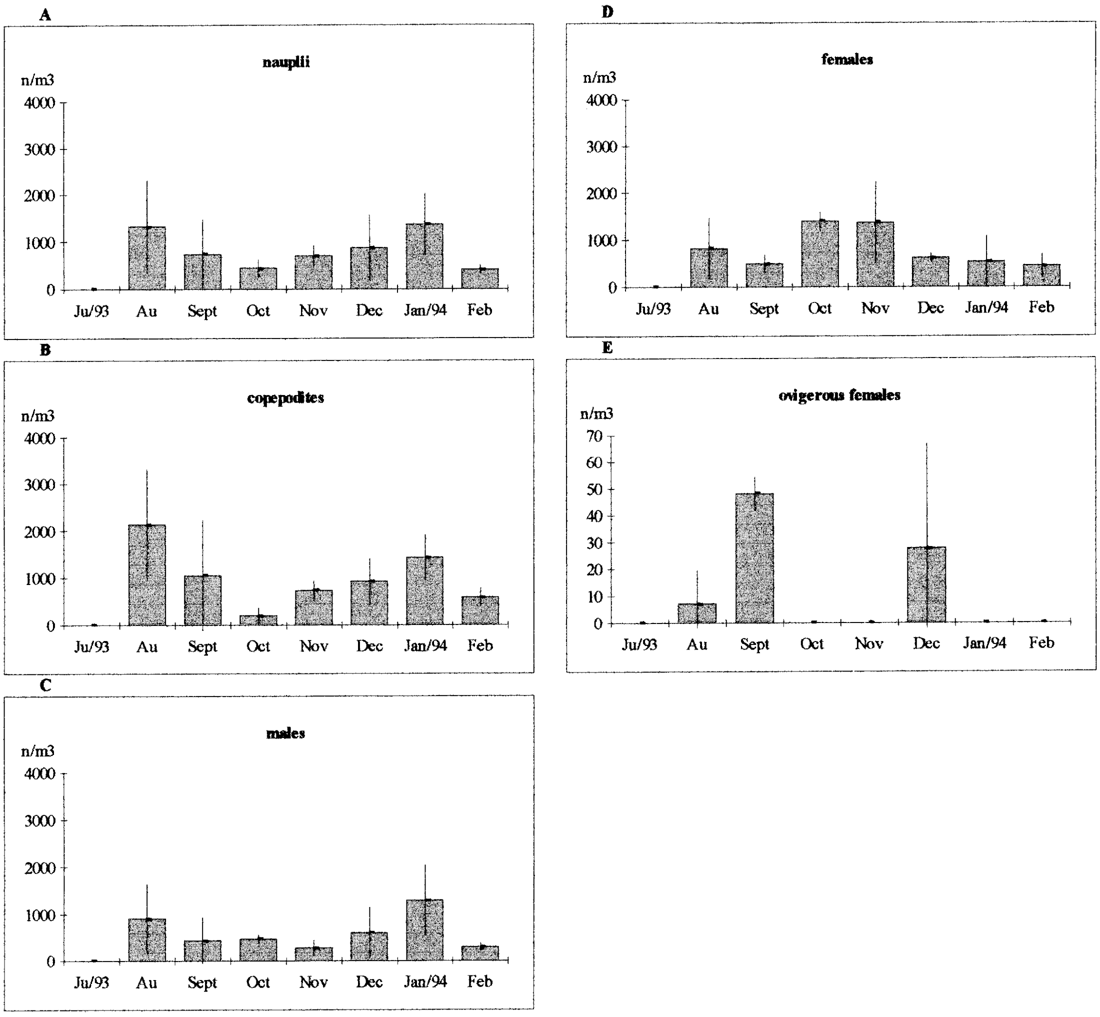

Fig3: Abundance of Cyclopidae in Mpulungu, Zambia

Note: no sampling was done in July 1993

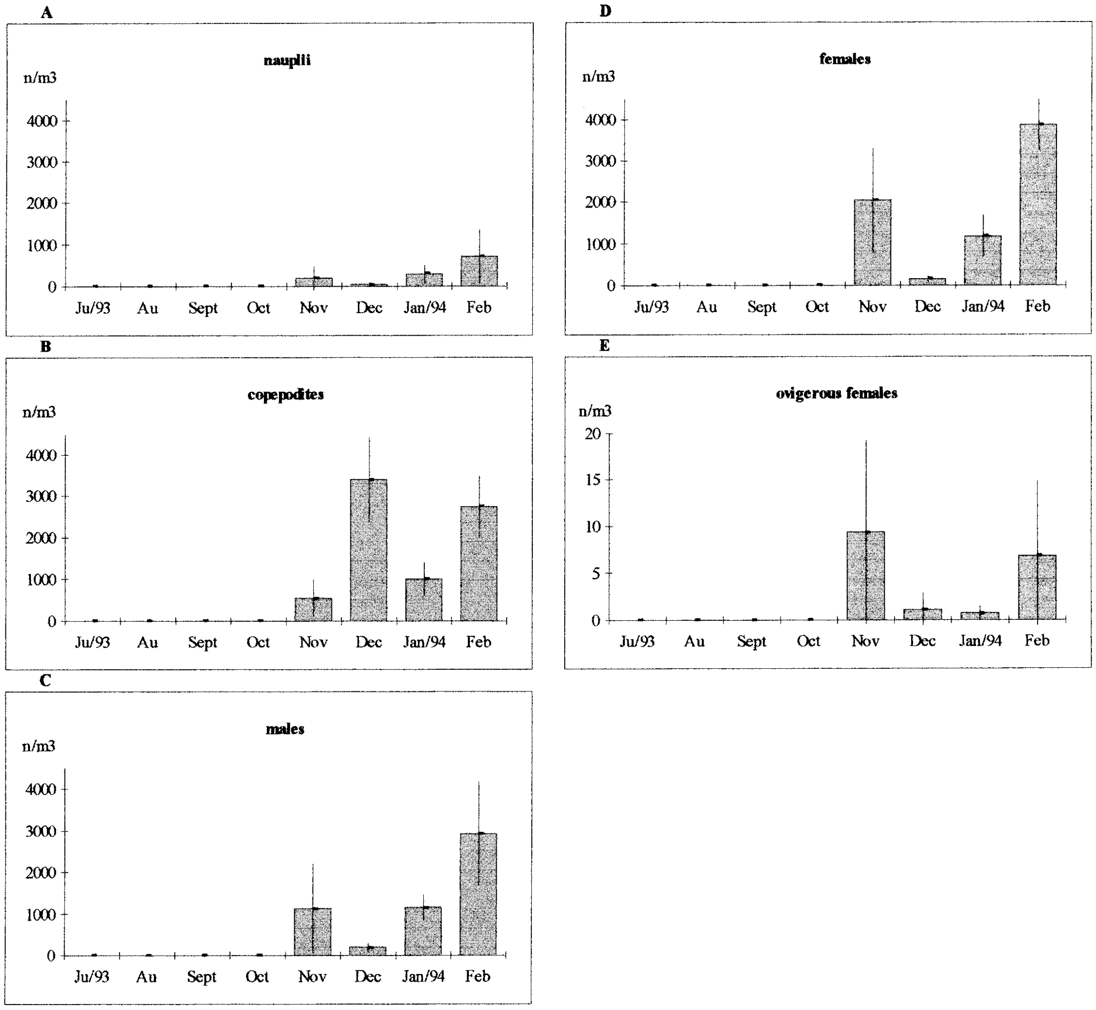

Fig 4: Abundance of Cyclopidae in Kipili, Tanzania

Note: no sampling was done in July-October 1993

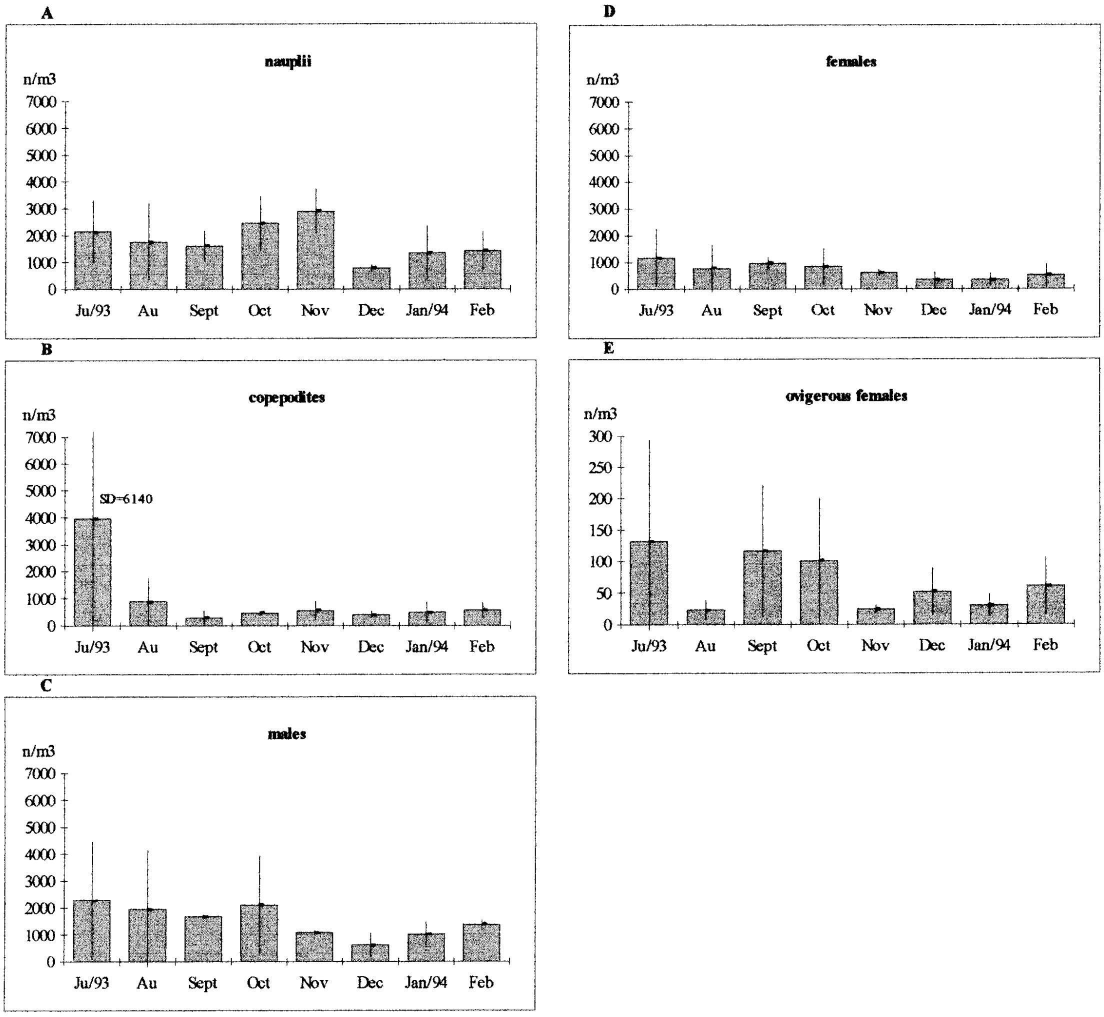

Fig 5: Abundance of Tropodiaptomus simplex in Bujumbura, Burundi

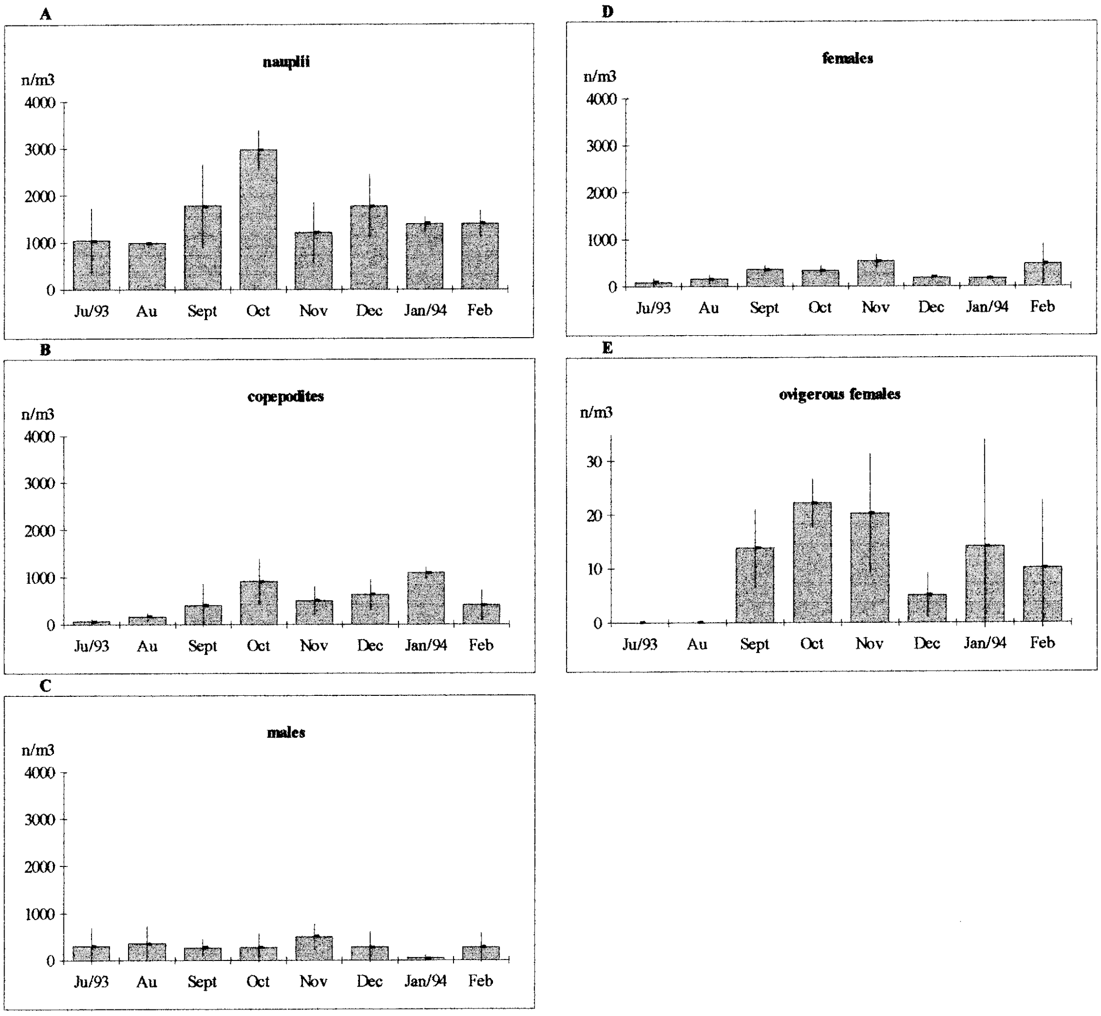

Fig 6: Abundance of Tropodiaptomus simplex in Kigoma, Tanzania

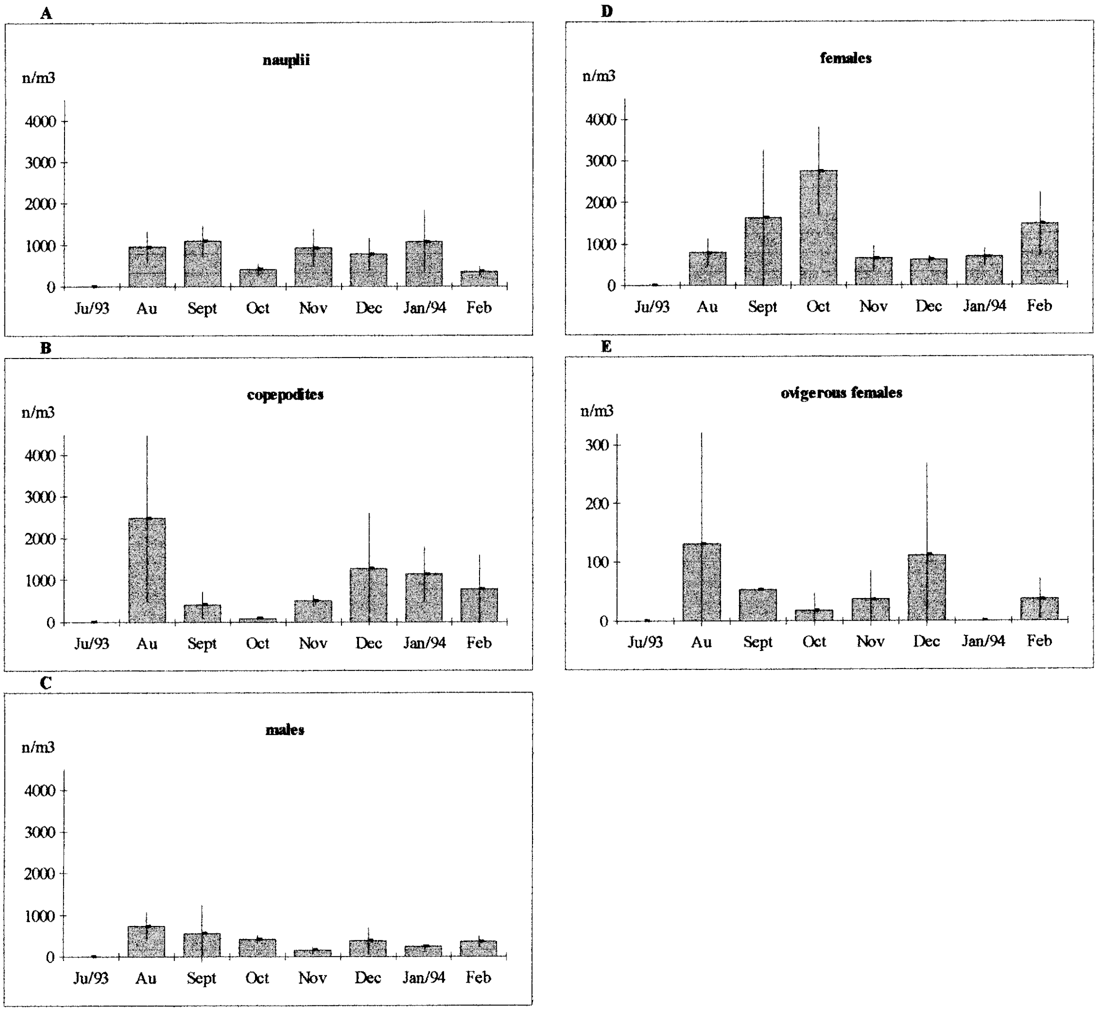

Fig7: Abundance of Tropodiaptomus simplex in Mpulungu, Zambia

Note: no sampling was done in July 1993

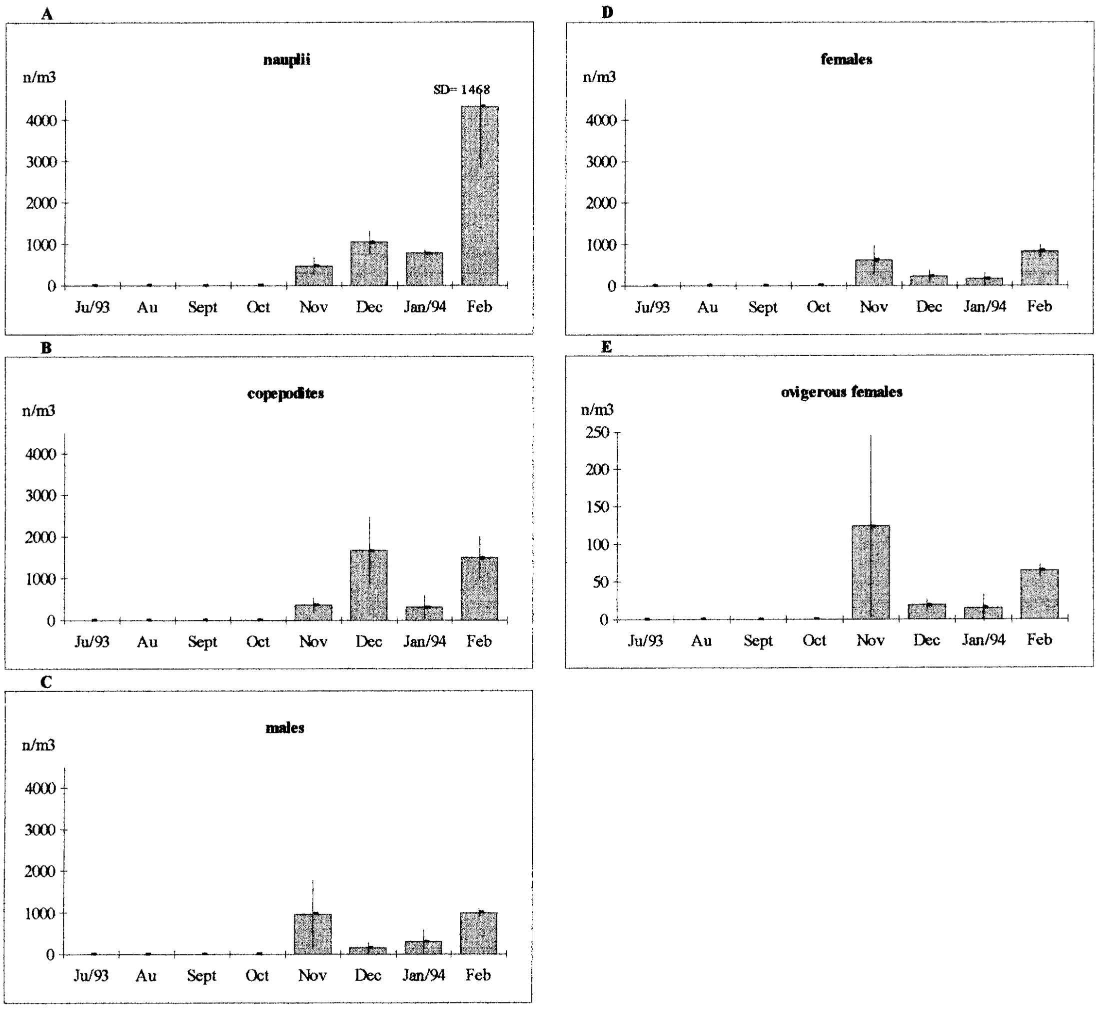

Fig8: Abundance of Tropodiaptomus simplex in Kipili, Tanzania

Note: no sampling was done in July-October 1993

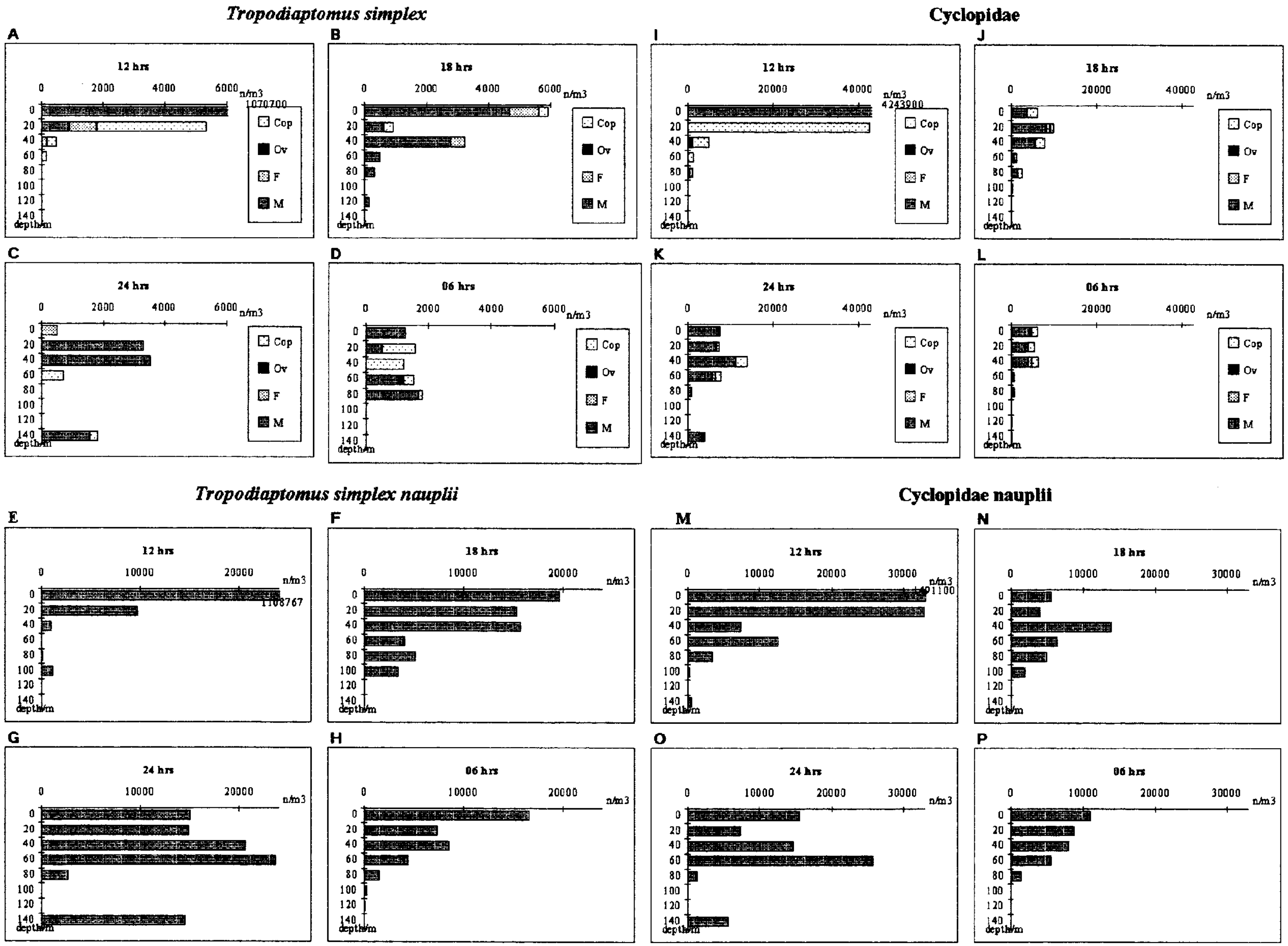

Fig 9: Vertical distribution of pelagic Copepoda on 03.08.1993 in Bujumbura, Burundi

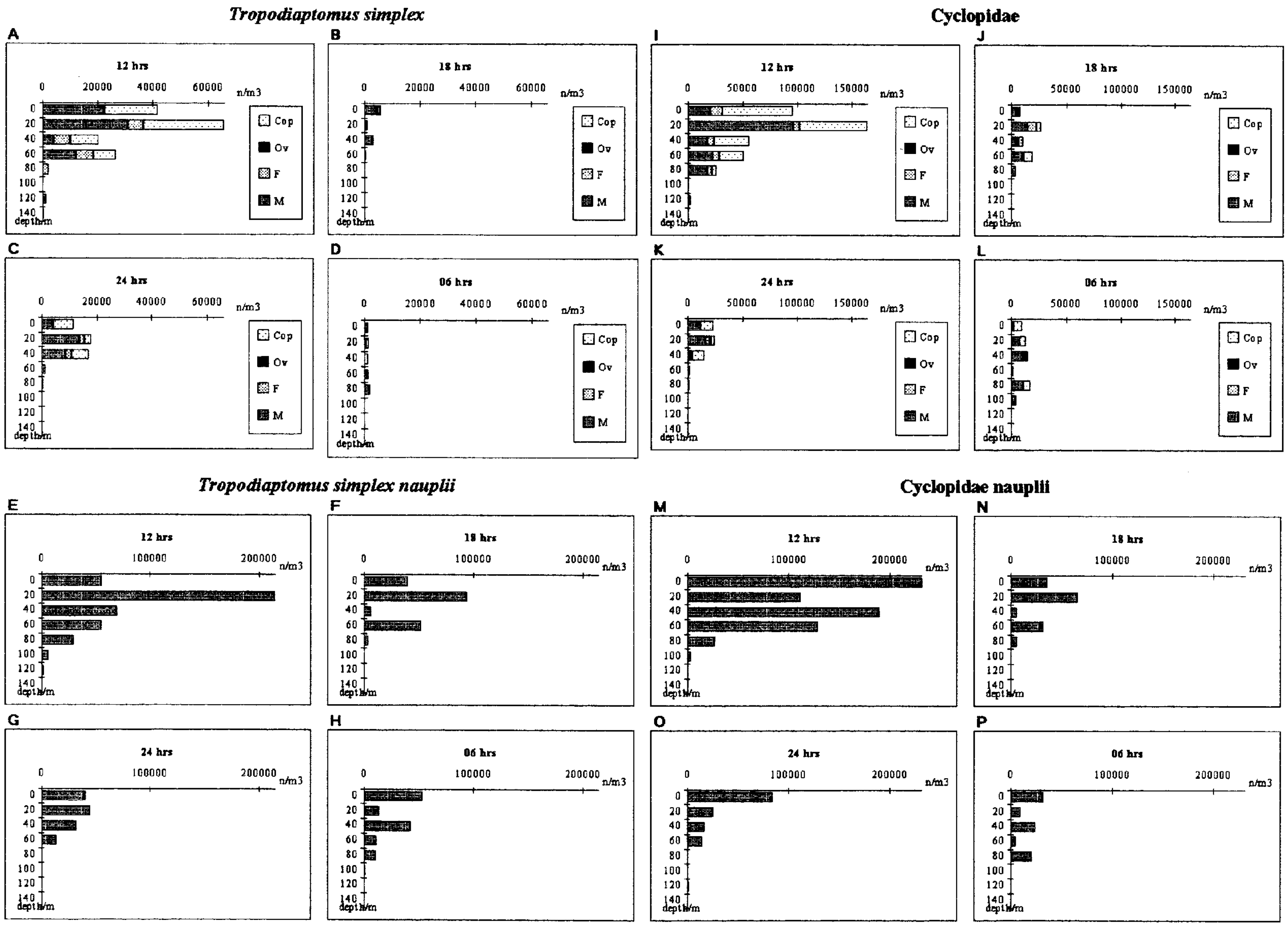

Fig 10: Vertical distribution of pelagic Copepoda on 14.09.1993 in Bujumbura, Burundi

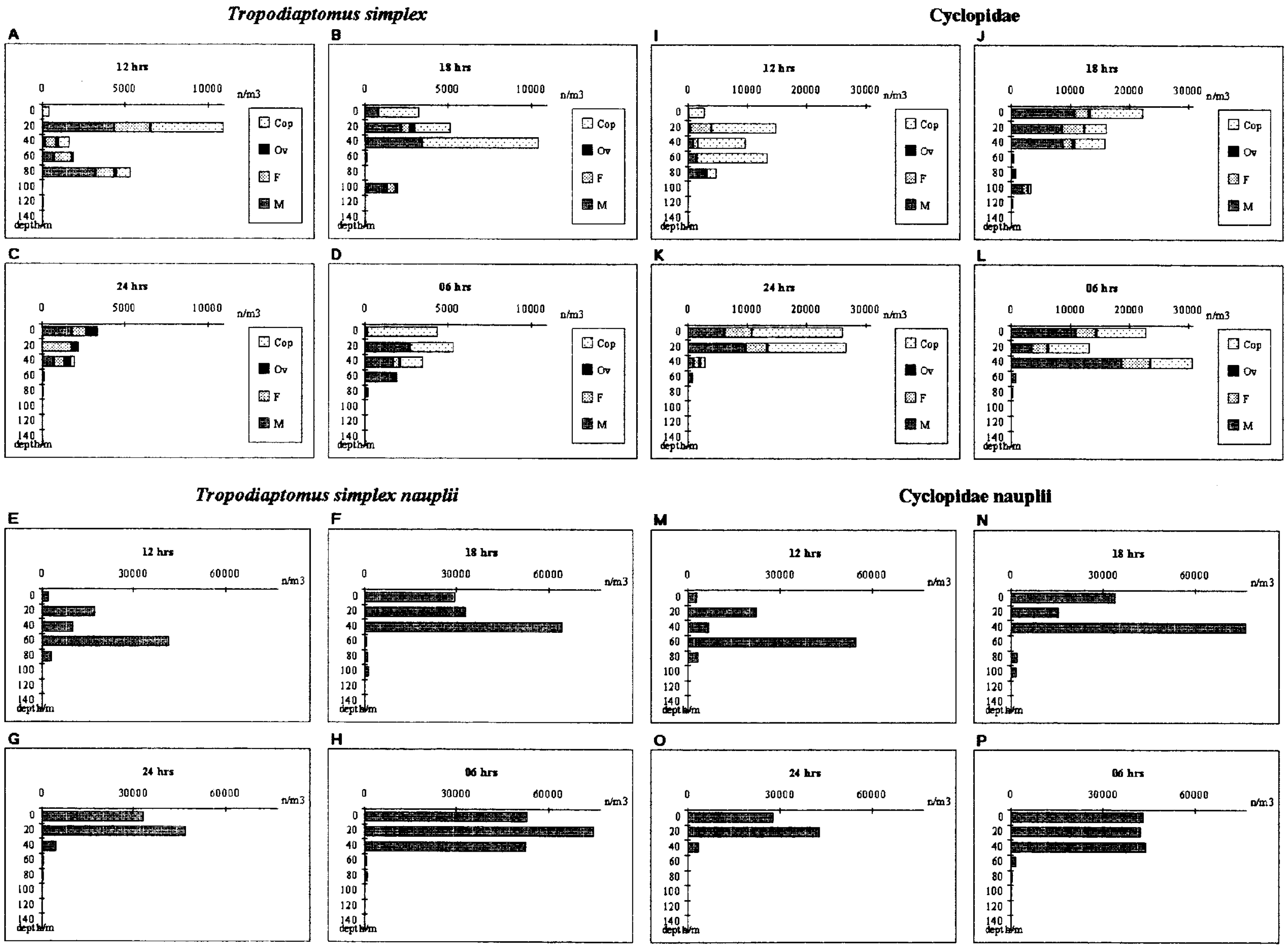

Fig 11: Vertical distribution of pelagic Copepoda on 14.12.1993 in Bujumbura, Burundi

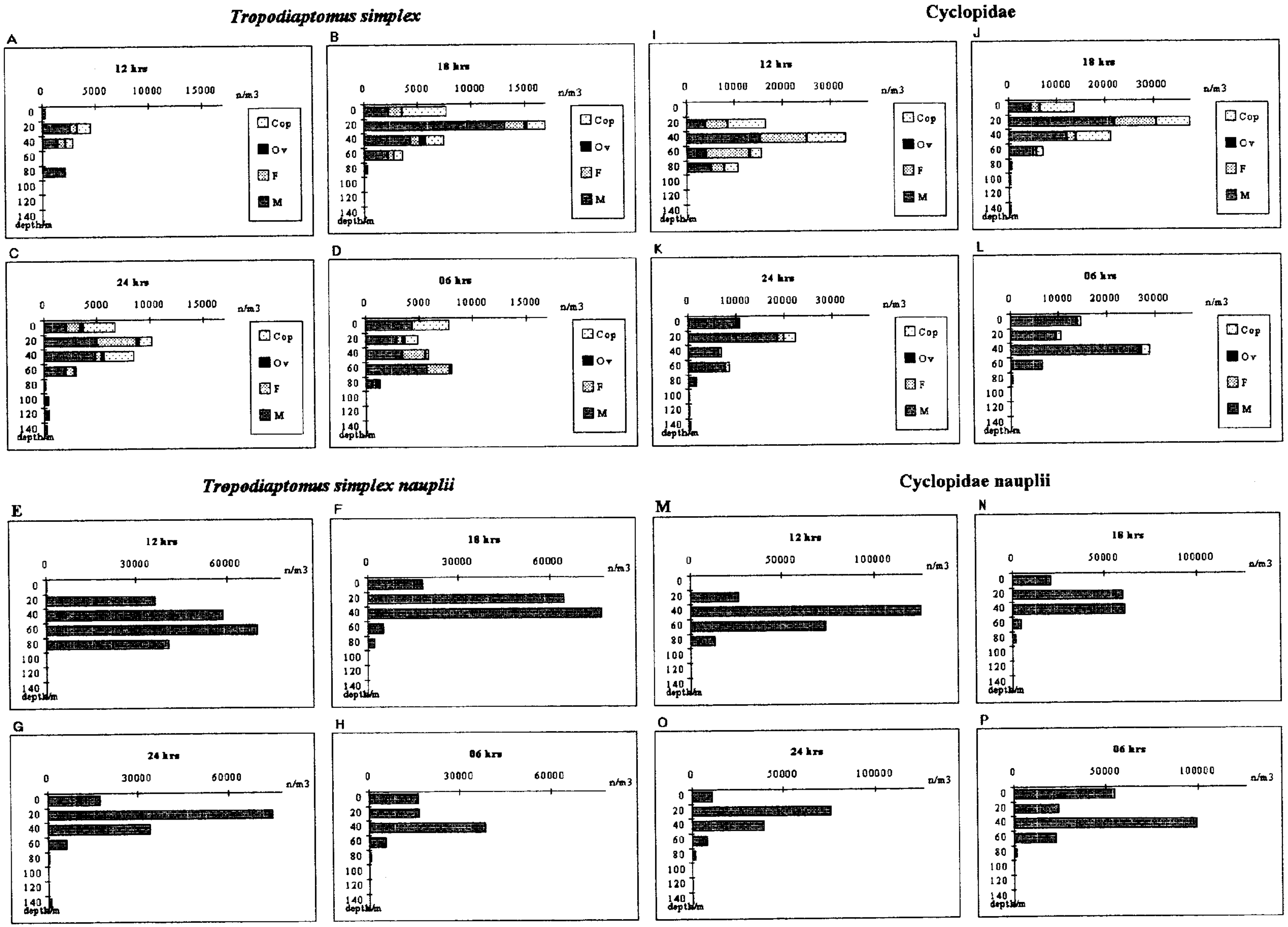

Fig 12: Vertical distribution of pelagic Copepoda on 25.01.1994 in Bujumbura, Burundi

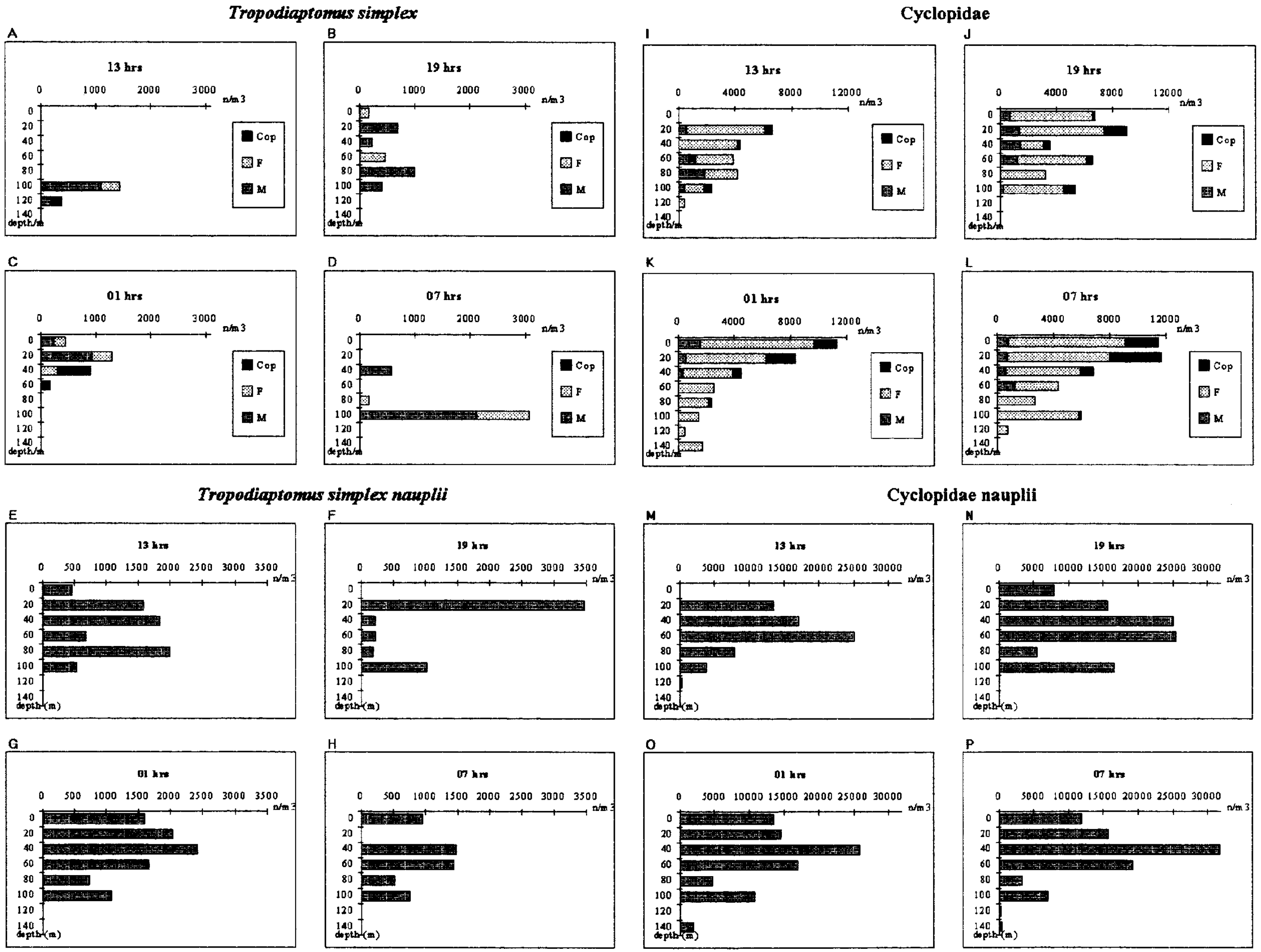

Fig 13: Vertical distribution of pelagic Copepoda on 03.08.1993 in Kigoma, Tanzania

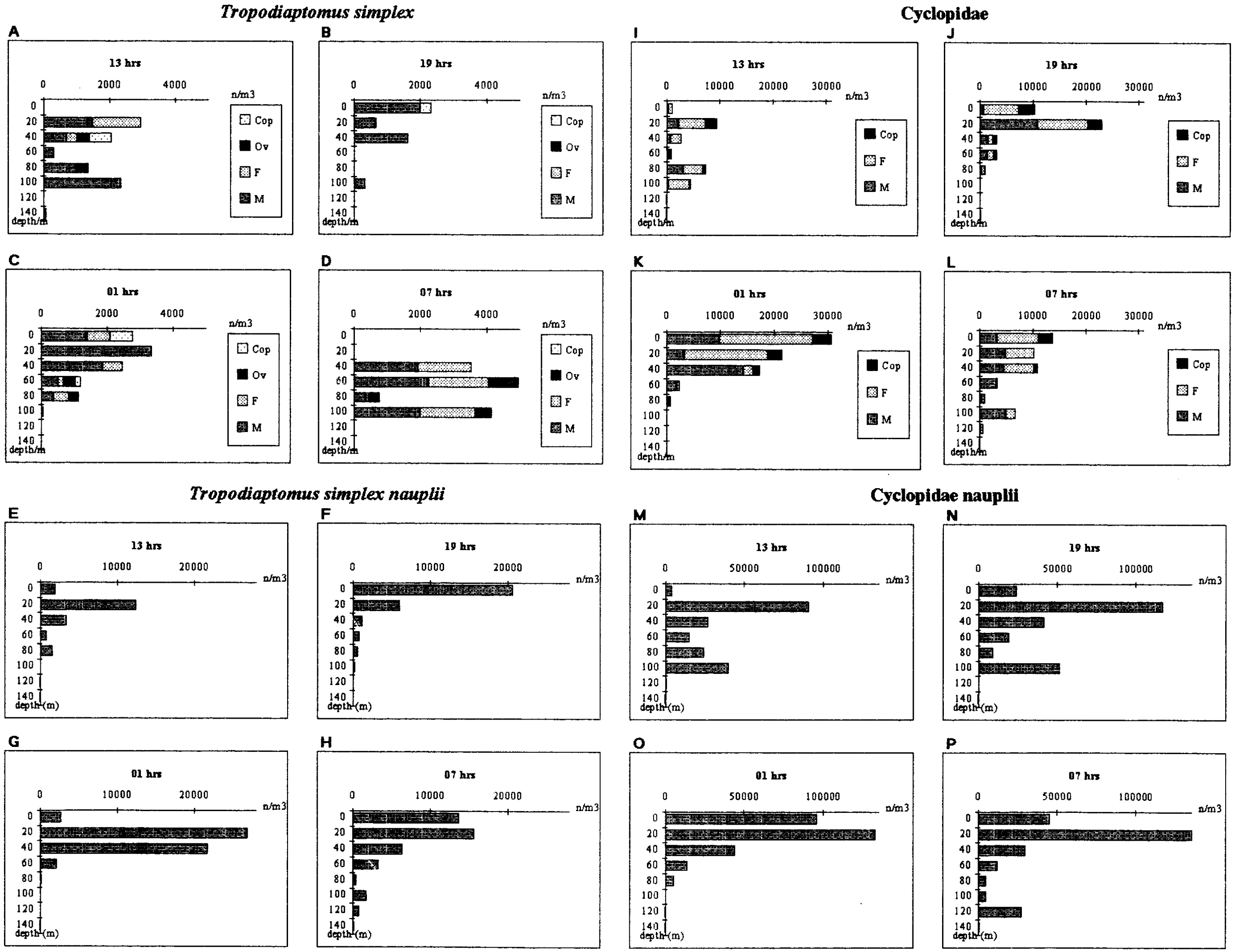

Fig 14: Vertical distribution of pelagic Copepoda on 14.09.1993 in Kigoma, Tanzania

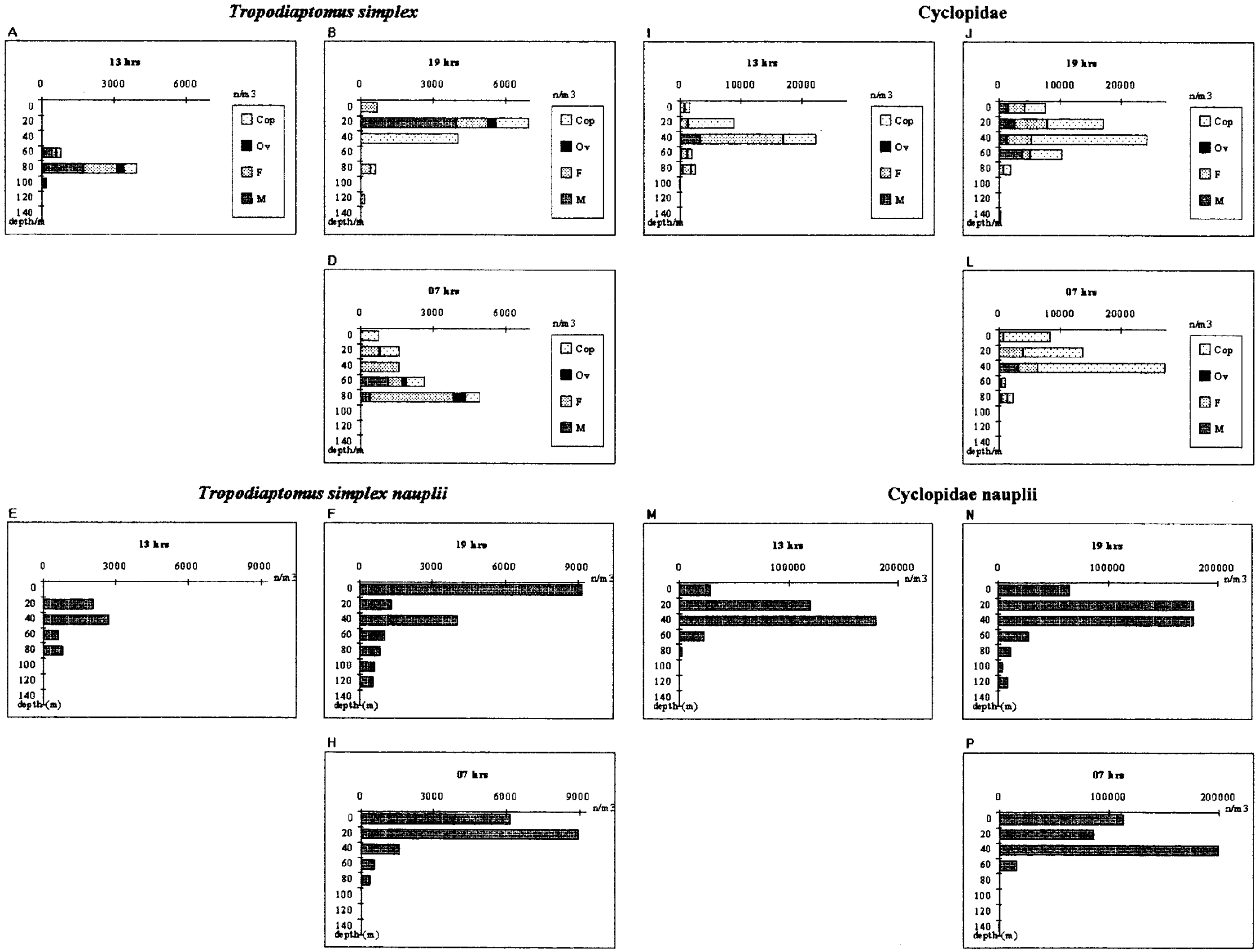

Fig 15: Vertical distribution of pelagic Copepoda on 26.10.1993 in Kigoma, Tanzania

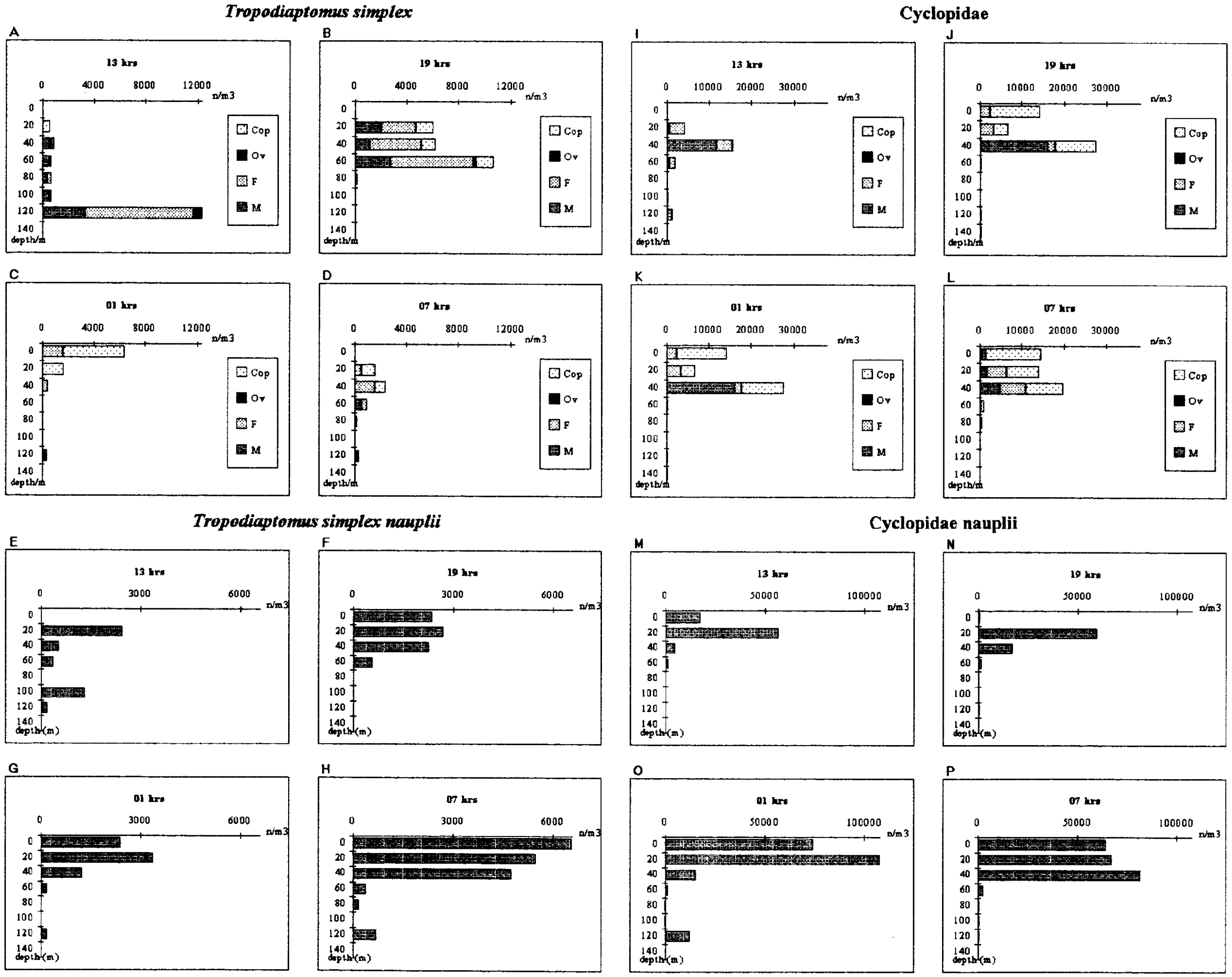

Fig 16:Vertical distribution of pelagic Copepoda on 14.12.1993 in Kigoma, Tanzania

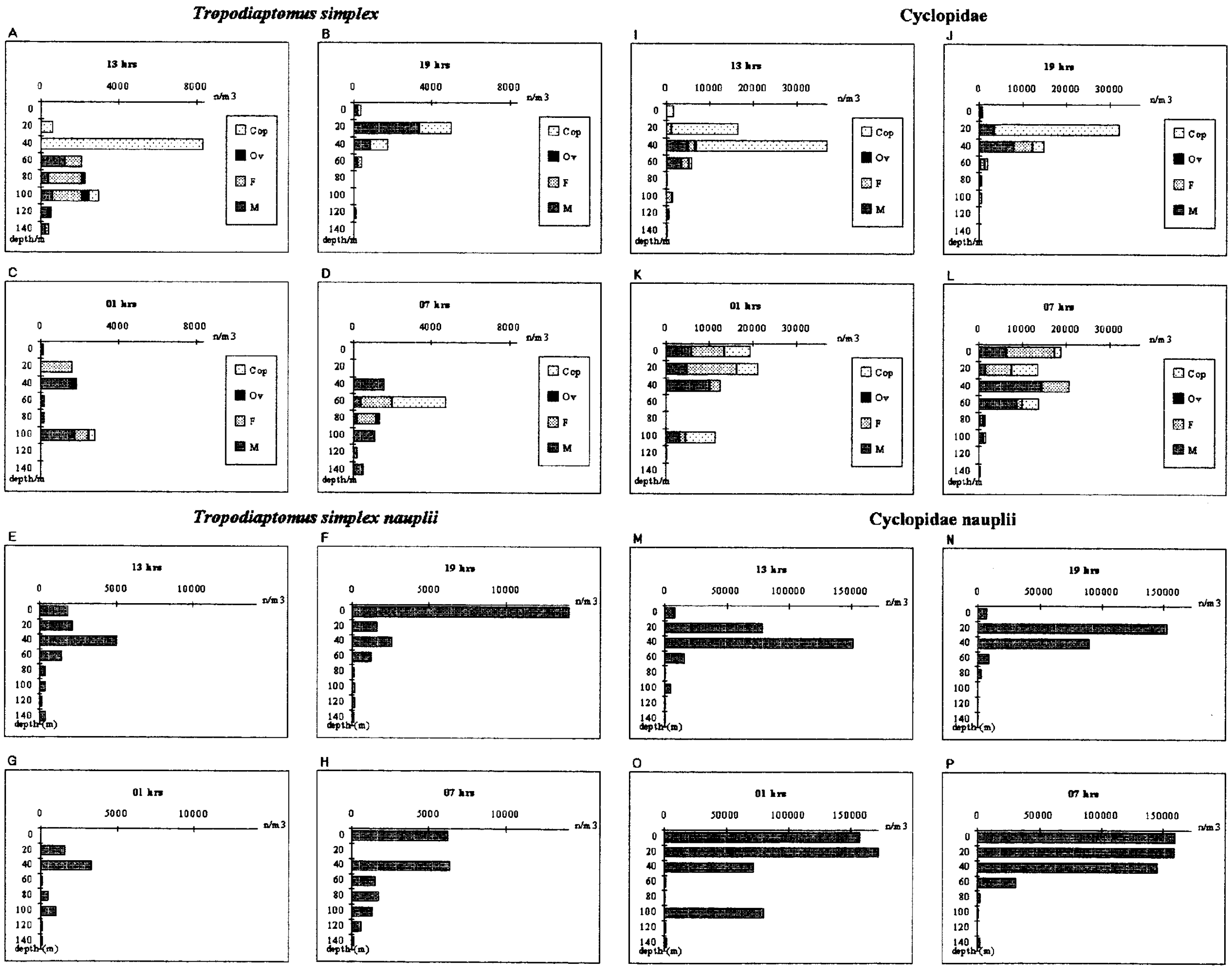

Fig 17: Vertical distribution of pelagic Copepoda on 25.01.1994 in Kigoma, Tanzania

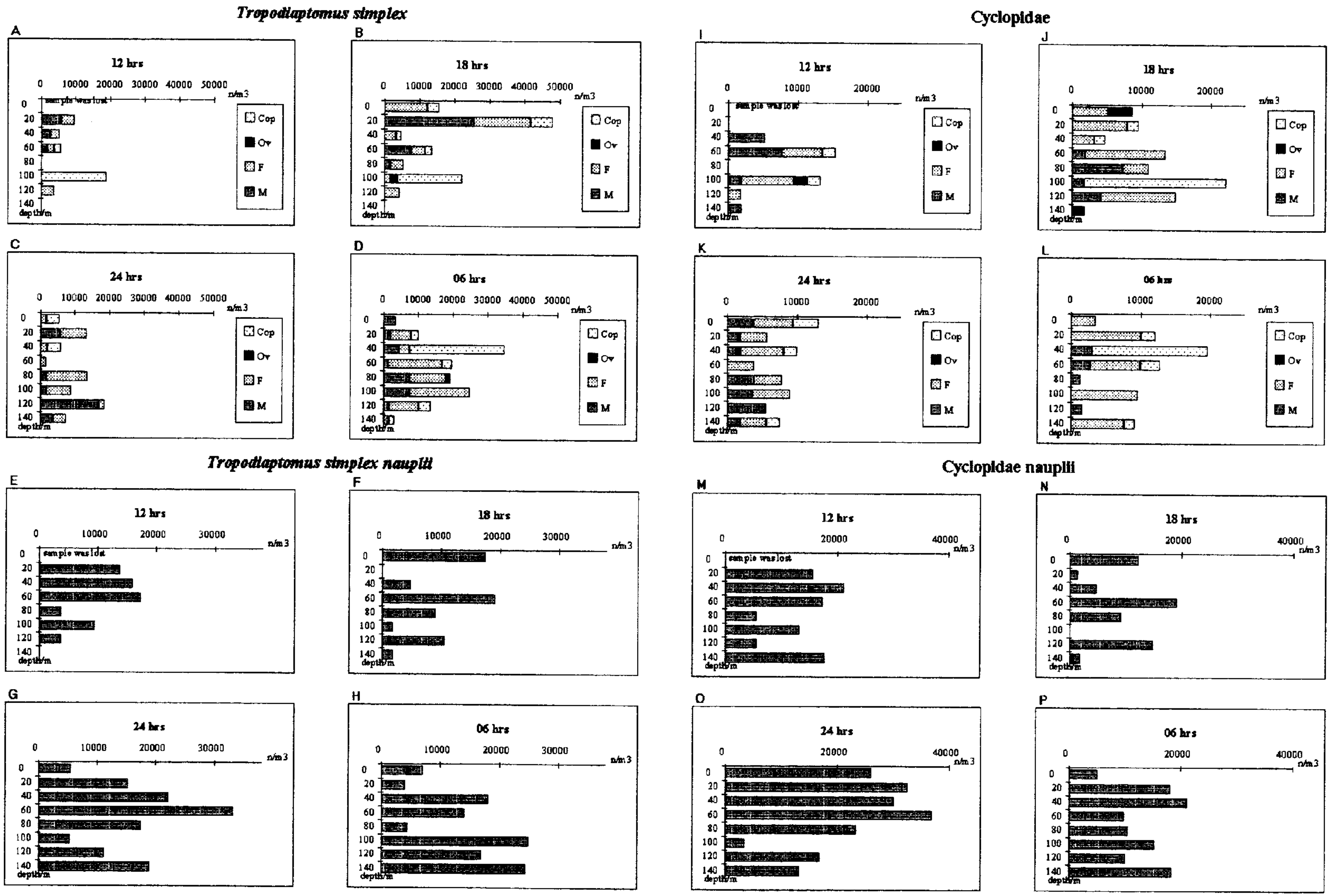

Fig 18: Vertical distribution of pelagic Copepoda on 03.08.1993 in Mpulungu, Zambia

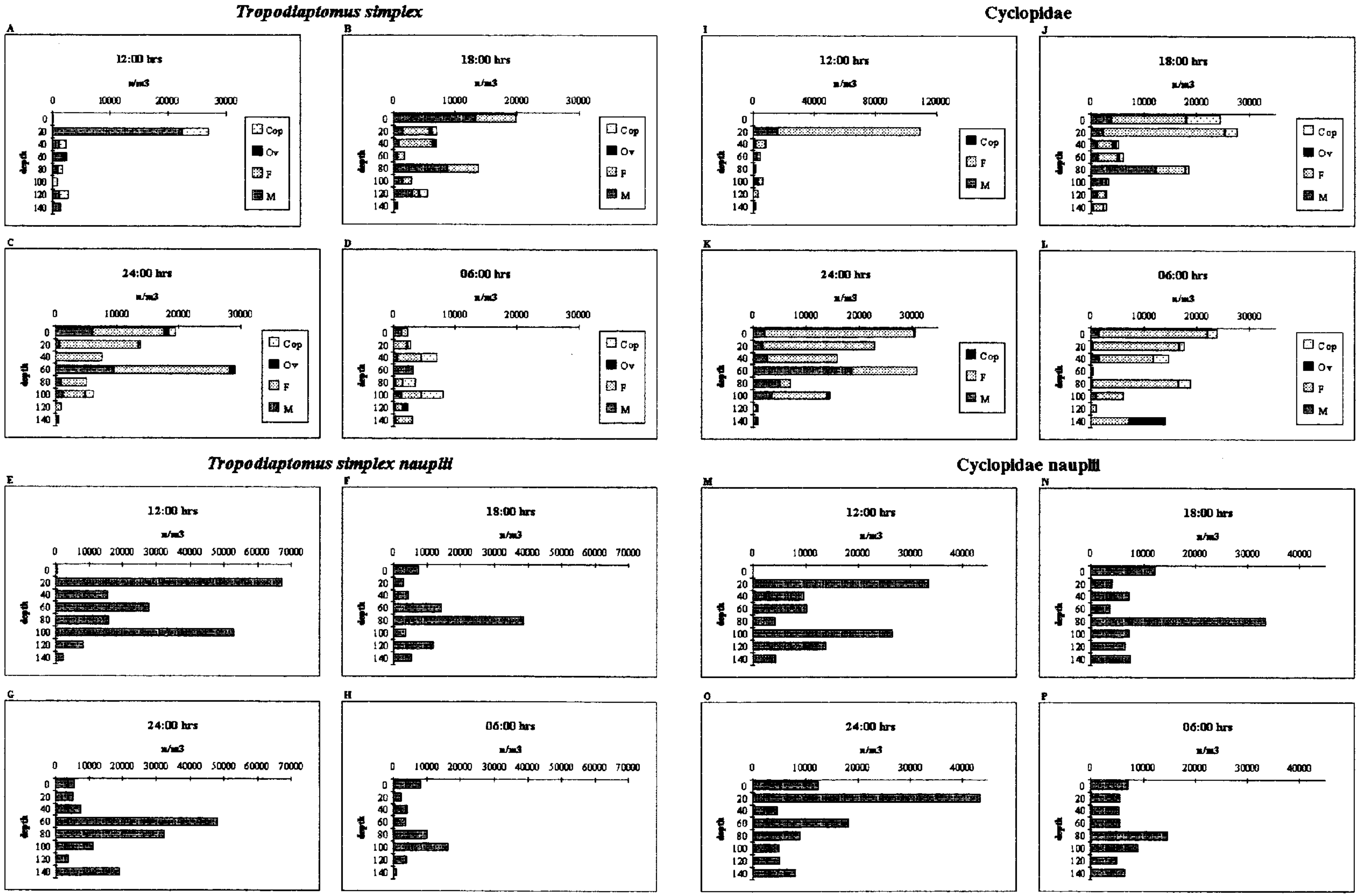

Fig 19: Vertical distribution of pelagic Copepoda on 14 09 94 in Mpulungu

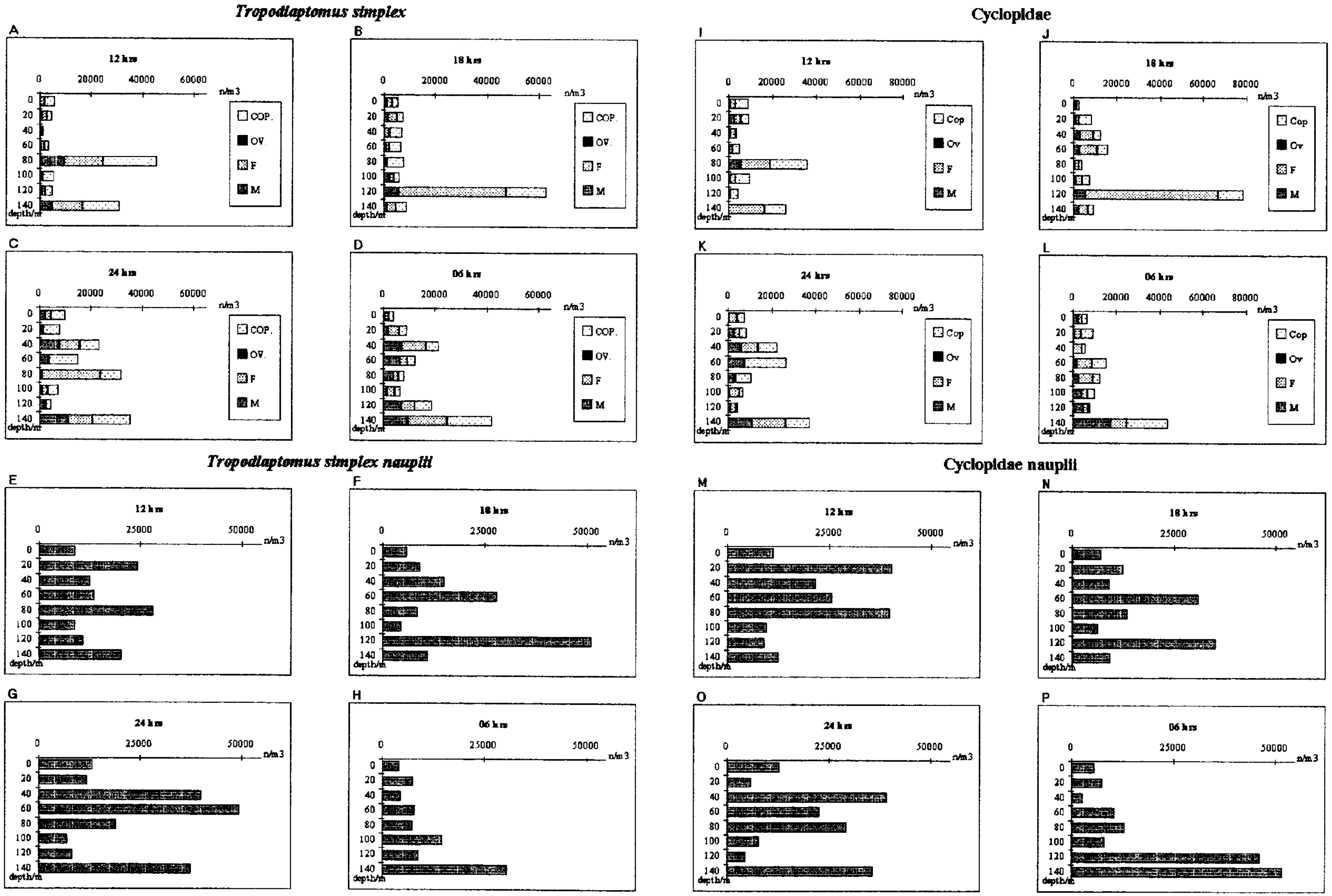

Fig 20: Vertical distribution of pelagic Copepoda on 26.10.1993 in Mpulungu, Zambia

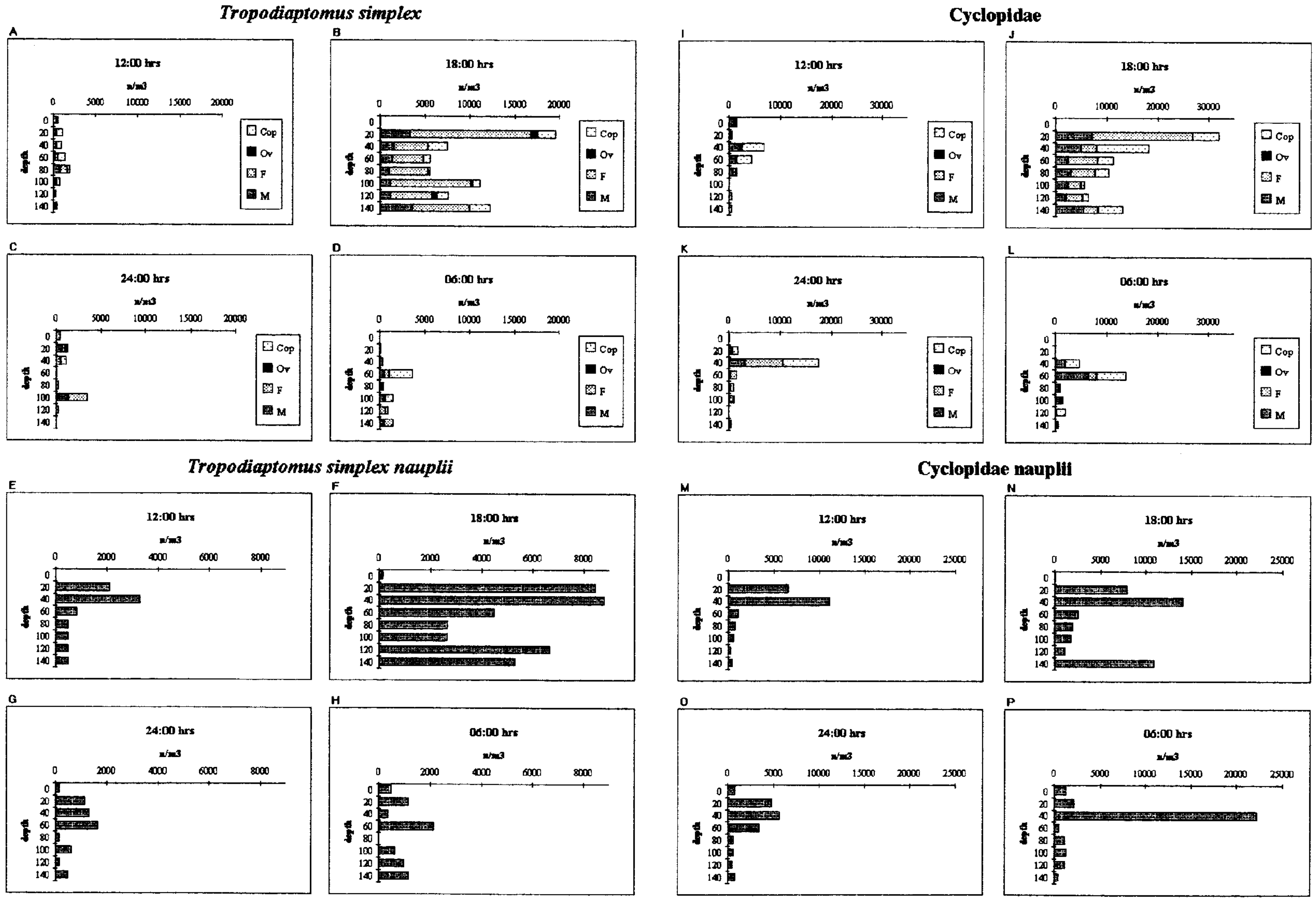

Fig21: Vertical distribution of pelagic Copepoda on 14 12 94 in Mpulungu

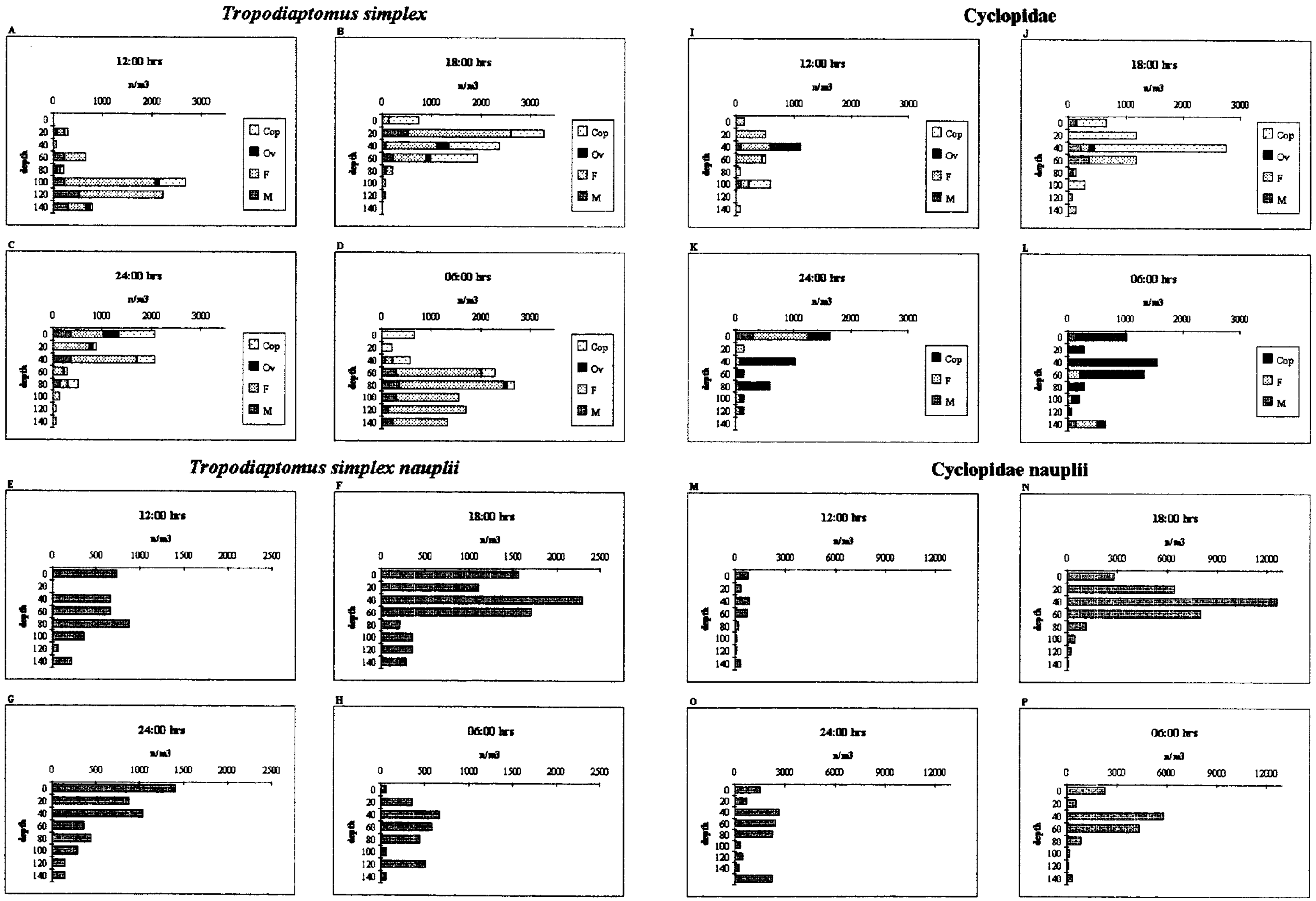

Fig 22: Vertical distribution of pelagic Copepoda on 25 01 94 in Mpulungu