ICES STATUTORY MEETING 1993 C.M. 1993/L: 56
Biological Oceanography Committee

HORIZONTAL AND VERTICAL DISTRIBUTION OF CYCLOTHONE- AND VINCIGUERRIA-LARVAE AT A WATER MASS-FRONT IN THE NE-ATLANTIC.

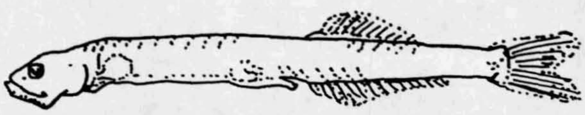
by

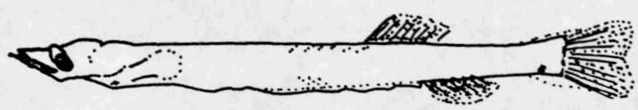
Clementine Zelck

Biologische Anstalt Helgoland (Taxonomische Arbeitsgruppe) c/o
Zoologisches Institut und Museum, Martin-Luther-King-Platz 3,
20146 Hamburg, F.R. Germany

ABSTRACT

While generally genera *Cyclothone* and *Vinciguerria* are one of the first ranking taxa in warm open ocean fish larvae, in quantitative samples from a winter cruise in the open NE-Atlantic they contributed on average only 13% of the total catch. They occurred almost exclusively above 100 m depth and preferred the upper 50 m.
Distinct clusters of higher relative abundance (<34%) occurred, contrasting between the genera and independent of the total ichthyoplankton abundance. On quantitative terms, the boundary between both genera coincided well with the boundary between North- (NACW) and South-Atlantic-Central-Water (SACW) masses. The most abundant species of *Vinciguerria*, *V. nimbaria*, is an SACW-form and revealed northward transport in the easternmost area (around the Cape Verde Islands), conform with the recent most hypothesis of the current system.





INTRODUCTION

The cosmopolitan fish genera Cyclothone (Gonostomatidae) and Vinciguerria (Photichthyidae) are broadly distributed throughout most of the subtropical and tropical Atlantic (e.g. BEKLEMISHEV et al. 1977, GREY 1964, QUÉRO et al. 1990). Larvae of these high-oceanic genera are generally among the first ranking taxa in the warm open ocean and - together with larvae of related species (as "Gonostomatidae" sensu AHLSTROM 1974) - make up 30 - 50 % of the warm open ocean fish larvae (e.g. LOEB 1979, GORDINA 1980, LOPES & JOHN 1986).

In January 1989 the German RV "Meteor" (ZENK et al. 1989) undertook a cruise to the tropical NE-Atlantic to investigate the particular zoogeography of the Cape Verde Frontal Zone on base of fish larvae.

The purpose of this paper is to show the quantitative horizontal and vertical distribution pattern of Cyclothone- and Vinciguerria-larvae during this survey, and compare them with earlier data.

MATERIAL and METHODS

Zooplankton sampling was carried out from board the German RV METEOR, cruise no. 9 (January to February 1989) to the tropical NE-Atlantic (ZENK et al. 1989).

While a neuston-net (NEU, mesh size 335 µm) collected samples from the surface waters, simultaneously an obliquely towed Multiple-opening-Closing-Net (MCN, mesh size 300 µm) caught zooplankton of the epi- and upper mesopelagial from 200 m to the sea surface in 5 discrete steps (for catching strata see table 1). Fixation and preservation of the samples followed standard methods (buffered 4%-formaldehyde-solution for the samples and STEEDMAN 2%-formaldehyde-solution for the fish larvae after sorting).

Hydrographical data were made available by the oceanography department of the "Institut für Meereskunde" (Kiel, Germany), partly published in ZENK et al. (1989); FIEKAS et al. (1992) and KLEIN (1992).

RESULTS

Horizontal Distribution

Both plankton samplers (MCN and NEU) caught a total of 7176 fish larvae (including few juveniles). 13.1 % of them belonged to the high-oceanic genera Cyclothone (N = 392) and Vinciguerria (N = 549).

While in MCN catches larvae of Cyclothone and of Vinciguerria showed a mean abundance of 2.2 n/1 m² (s = 2.6, N = 44) and 2.8 n/1 m² (s = 2.9, N = 44) respectively, peak abundances were 12.3 Cyclothone/1 m² (32.4% of total catch) and 12.6 Vinciguerria/1 m² (21.8 % of total catch), respectively.

Highest abundances of total fish larvae were encountered in the eastern part of the survey area, and north and south of the Cape Verde Islands (fig. 1). However the genera of <u>Cyclothone</u> and <u>Vinciguerria</u> revealed distinctly different distribution patterns of high abundances, with <u>Cyclothone</u> in the north and <u>Vinciguerria</u> in the southeast of the sampled area (fig. 2). Distribution patterns derived from MCN and NEU catches were broadly consistent.

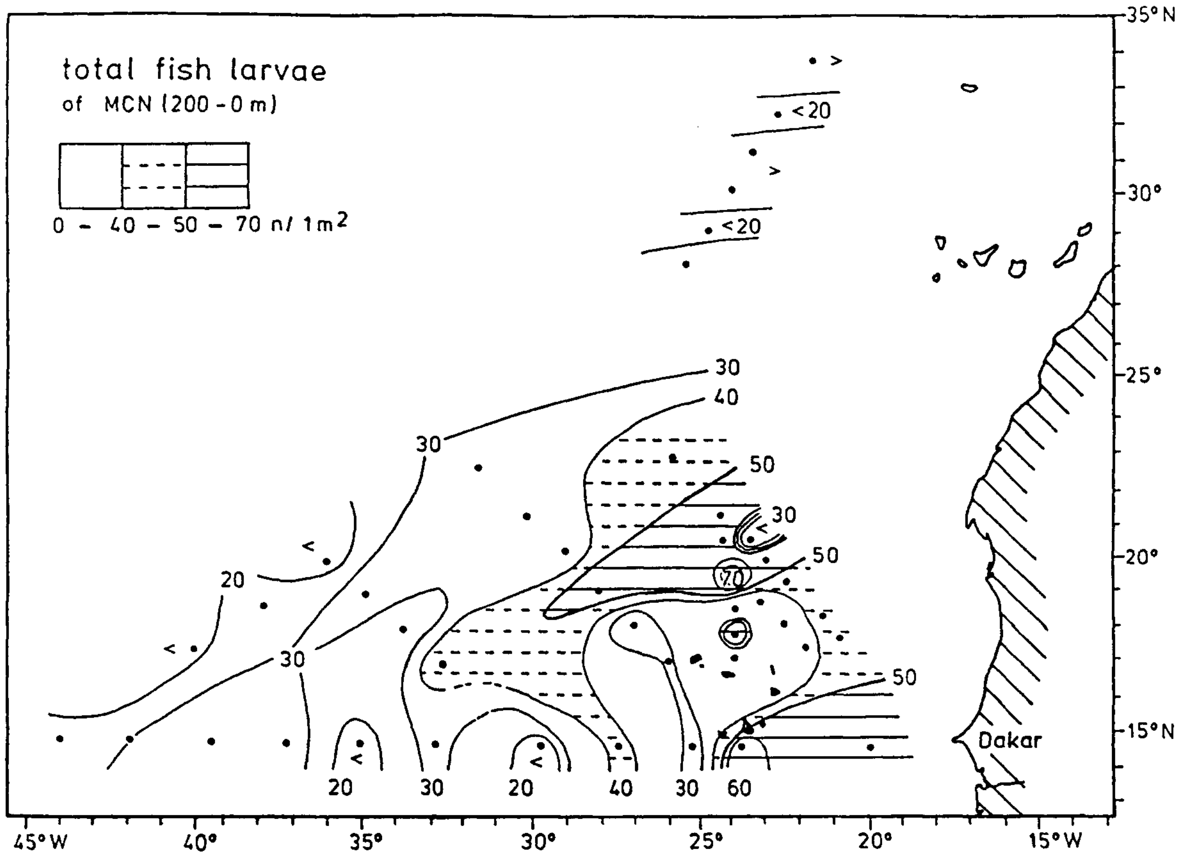


Fig. 1: Quantitative horizontal distribution of total fish larvae from MCN-catches (200 - 0 m) in the tropical NE-Atlantic. (Winter cruise METEOR # 9, 1989).

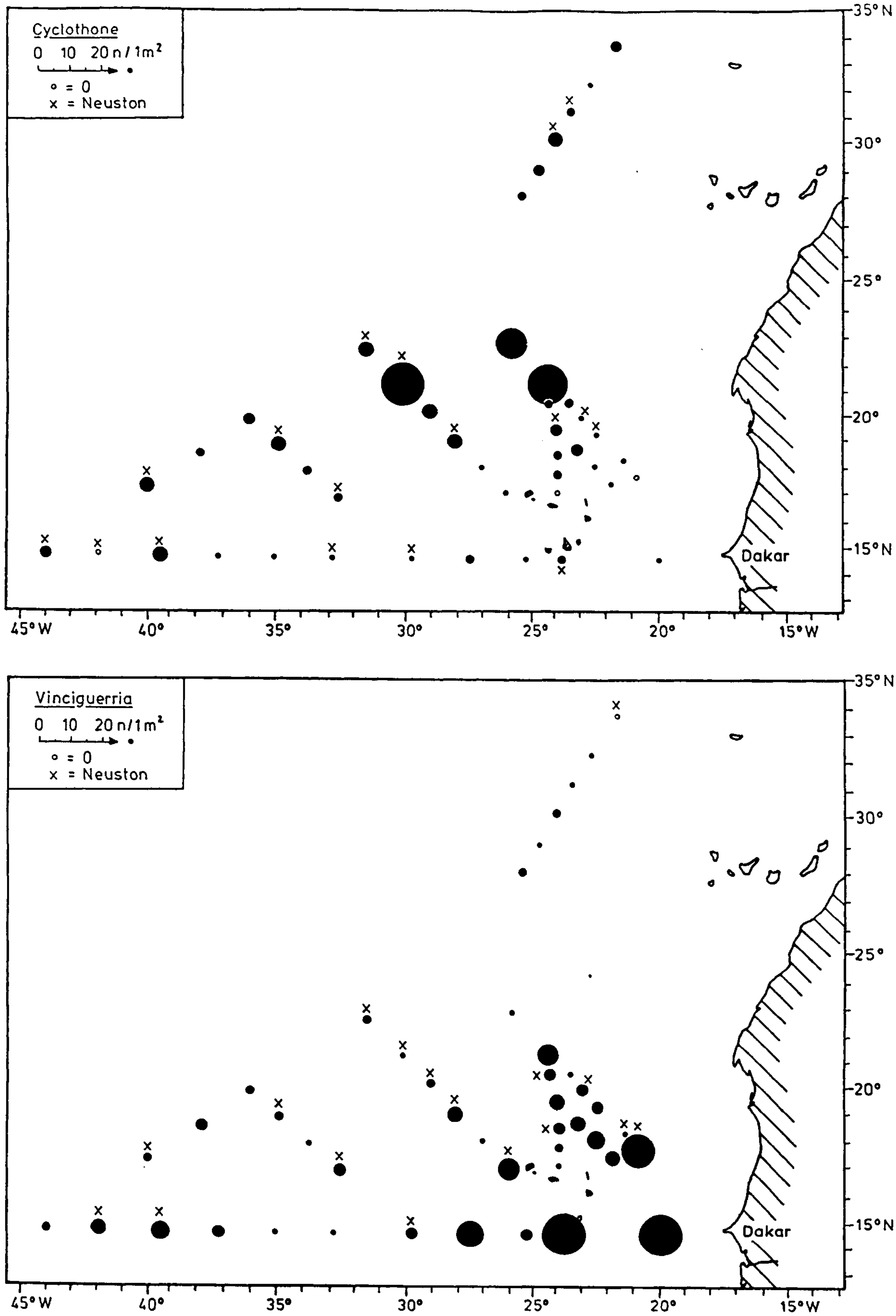


Fig. 2: Quantitative horizontal distribution of <u>Cyclothone</u>- (TOP) and <u>Vinciguerria</u>-larvae (BOTTOM) from MCN-catches (200 - 0 m) in the tropical NE-Atlantic.
(Stations with positive Neuston-catches are marked with an "x").

Distribution of certain species

Only one Cyclothone and 16 Vinciguerria specimens were in the metamorphosing stage, and most of the larvae were in an early developmental stage and therefore often impossible to identify to the species. However two Cyclothone species could be assigned to Cyclothone braueri (N = 42) and C. acclinidens (N = 2). Of the other genus (Vinciguerria) V. nimbaria (N = 193) was the most abundant species (35.2 % of the genus), while V. attenuata (N = 7) and V. poweriae (N = 10) were rare in the material (or 3.1 % of total Vinciguerria). Thus V. nimbaria was the only species to be dealt with in quantitative terms.

Figure 3 shows the quantitative horizontal distribution of V. nimbaria. Compared with the overall distribution of the genus, the species was more concentrated to southern stations except for the area off Mauritania.

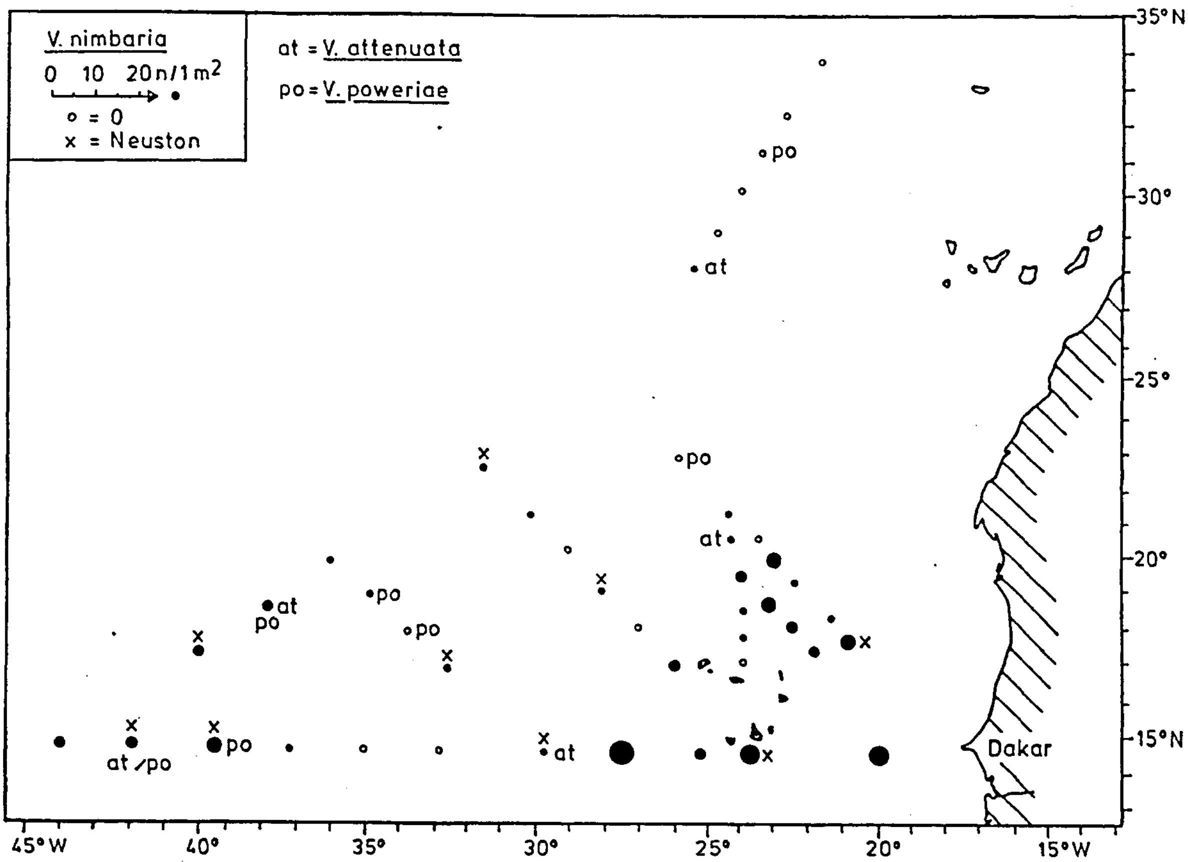


Fig. 3: Quantitative horizontal distribution of V. nimbaria from MCN-catches (200 - 0 m). Stations with respective positive Neuston-catches are marked with "x", additionally positive stations for the rarer species are marked with the abbreviations: at = V. attenuata and po = V. poweriae.

Vertical distribution

The overall vertical distribution of total fish larvae and of Cyclothone- and Vinciguerria-larvae is shown in table 1. Most of the total fish larvae were caught in the upper 100 m (> 80%), with a relatively deep mode in the 50 - 100 m stratum. In contrast Cyclothone- and Vinciguerria-larvae had their relative maximum concentration in the two layers above (0 - 50 m).

Table 1: Relative vertical distribution of all fish larvae, Cyclothone and Vinciguerria (in percentages of standardized total catch, N = 44).

catching strata of MCN - nets	total fish larvae	Cyclothone	Vinciguerria
	%	%	%
0 - 25 m	25.0	34.7	38.4
25 - 50 m	26.2	41.7	31.6
50 - 100 m	31.8	22.6	23.8
100 - 150 m	12.1	0.8	3.4
150 - 200 m	4.9	0.2	2.8
	(100.0)	(100.0)	(100.0)

The vertical distribution patterns of Cyclothone- and Vinciguerria-larvae within the survey area is exemplified by data from a diagonal transect, together with the in-situ temperature and salinity situation (fig. 4).

In areas with high salinities (>37 psu) larvae of Cyclothone showed their highest concentrations with modes above 50 m, while larvae of Vinciguerria were scarce and avoided the shallowest stratum sampled. To the southeast, in the transition zone between 37 and 36.5, psu larvae of Vinciguerria seemed to replace Cyclothone. On the two southernmost stations larvae of Vinciguerria dominated and were concentrated above 100 m, with a tendency to a shallower occurrence with the rise of the 20 °C isotherm.

DISCUSSION

Only 13 % of all fish larvae of the winter samples from the tropical NE-Atlantic belonged to the genera Cyclothone and Vinciguerria, which are generally first ranking elsewhere. Even together with the remaining species of the "Gonostomatidae" (sensu AHLSTROM 1974, e.g. Maurolicinae, Gonostoma) they still make up only 16.1 % of all fish larvae contrasting with the "normal" percentage of 30 - 50 % in the warm open ocean (LOEB 1979, GORDINA 1980, LOPES & JOHN 1986). East of the investigated area, in the Mauritanian Upwelling region, a so called "Cyclothone hole" was described by JOHN (1986), suggesting that at least the low findings of Cyclothone-larvae in winter are normal for the whole investigated area.

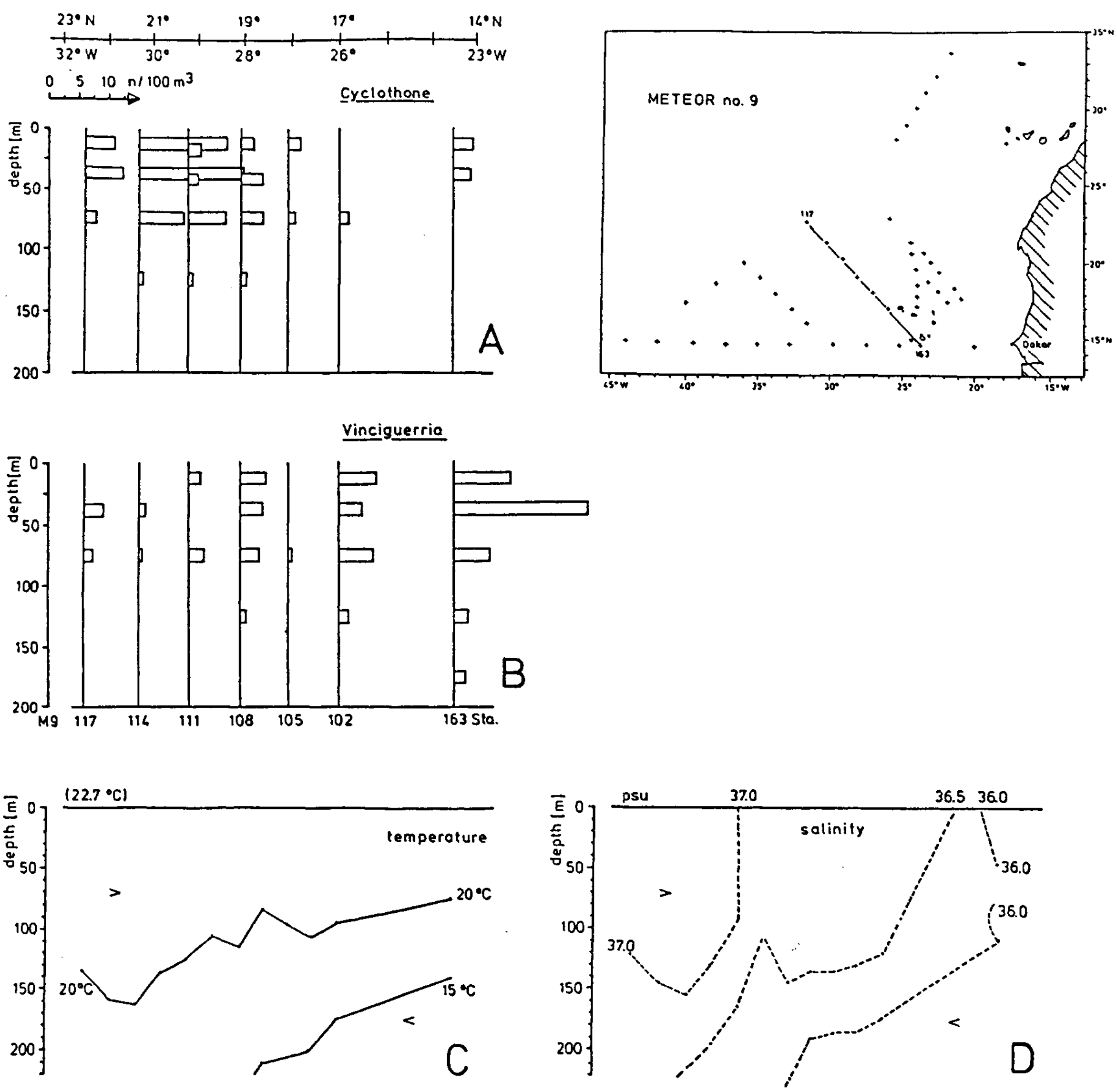


Fig. 4: Vertical distribution of Cyclothone (A) and Vinciguerria (B) along a diagonal transect between stations 117 and 163 (see map). C); D): Temperature and salinity data within the catching range of the MCN.

However, some exceptional clusters of high relative abundances occurred. Though both genera showed similar shallow vertical distribution patterns (preferring the upper 50 m), their centres of high abundance were distinctly disjunct. While larvae of Vinciguerria showed highest abundances in the southeast of the investigated area, Cyclothone-larvae were more abundant to the north. These results complement other findings from other cruises to the east and south of the survey area (ZELCK, unpublished; HERMES 1987; fig. 5).

The described boundary between high abundances of Cyclothone and Vinciguerria-larvae corresponds well with the boundary of two water masses. North-Atlantic-Central-Water (NACW) - characterized roughly by high salinities and low temperatures - and South-Atlantic-Central-Water (SACW) - with relatively less salinities and higher temperatures - meet in this area to form the Cape-Verde-Frontal-Zone (fig. 6, top; data from B. KLEIN, published in KLEIN 1992). These water masses differ further more in nutrient and oxygen concentration (KLEIN 1992 and literature cited). Northwards and southwards of the front a broadly front-parallel water mass transport to the west exists, with low convergence near the water mass boundary (fig. 6, bottom; FIEKAS et al. 1992).

The V. nimbaria specimens caught in the southeast of the survey area should belong to the "equatorial type" of the species (JOHNSON 1986) and can thus be related to SACW. The occurrence of V. nimbaria-larvae north of the Cape Verde Islands coincided with the transport system depicted by FIEKAS et al. (1992, cf. fig. 6). Well separated by the Cape Verde Frontal Zone the few larvae of V. nimbaria in the far west of the area might belong to the "central type" defined by JOHNSON (op. cit.).

The rare findings of V. nimbaria-larvae off Mauritania (cf. fig. 5 D) can be explained by existing transport models of the region. The thermophile V. nimbaria-larvae, advected by the northward transport of SACW with the upwelling undercurrent (HAGEN & SCHEMAINDA 1984), should ascend to the Ekman-layer and be transported southwards by the winter surface transport (MITTELSTAEDT 1991).

High abundances of Cyclothone-larvae are more likely in regions north of the water mass boundary and can thus be related to NACW. Thus the variable course of the NACW/SACW front (ZENK et al. 1991) explains the occurring of a "Cyclothone-hole" (JOHN 1986) in winter.

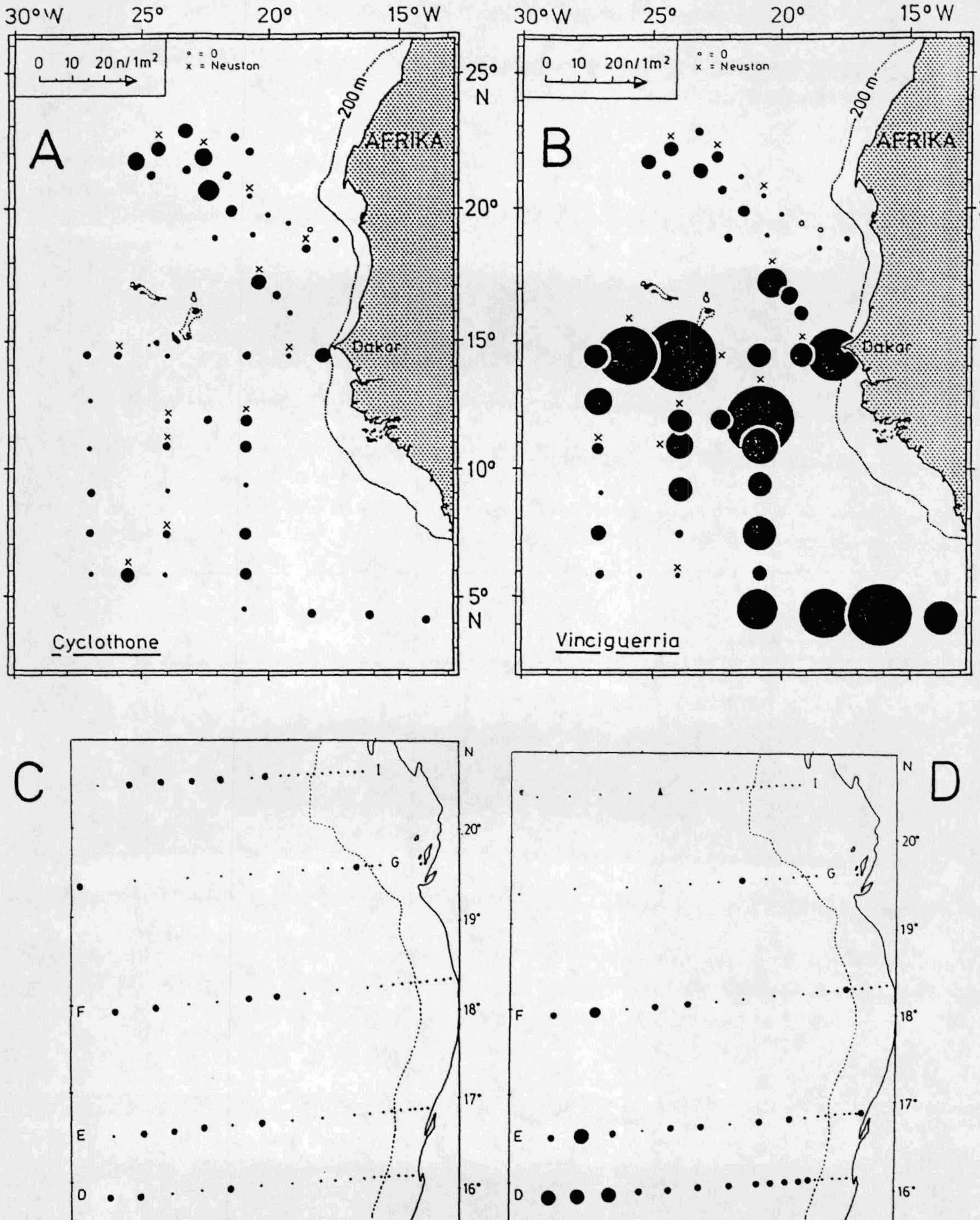
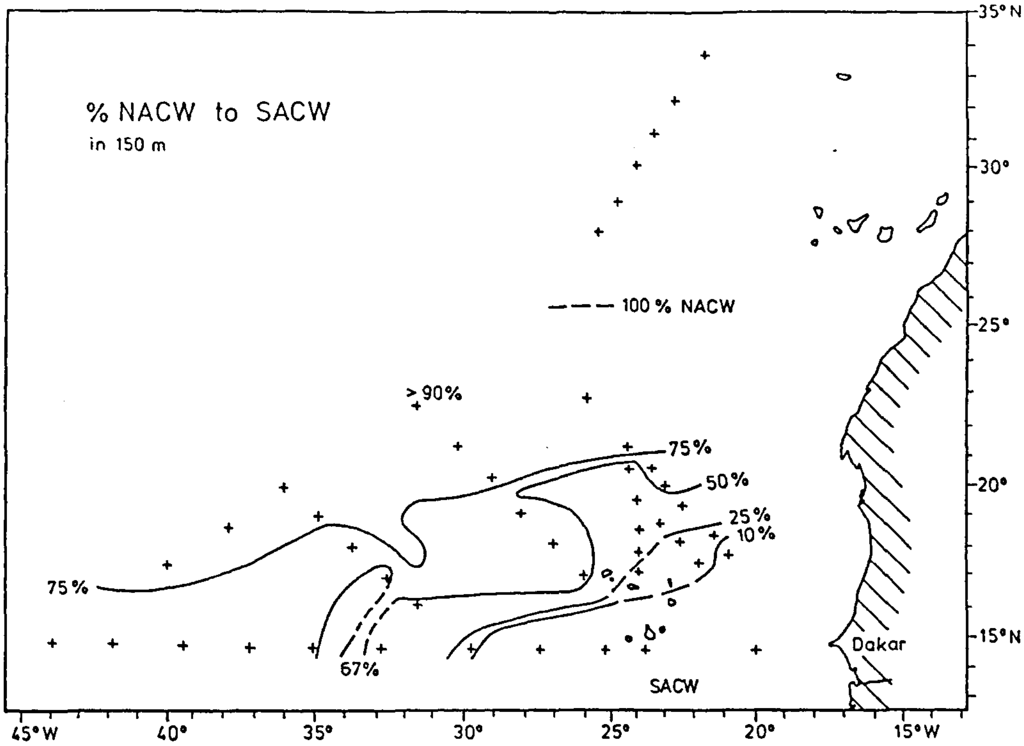


Fig. 5: Comparative horizontal distributions of <u>Cyclothone</u> (A; C) and <u>Vinciguerria</u> (B; D) off NW-Africa from previous cruises:
A & B: Autumn cruise METEOR # 6 (ZELCK, unpublished)
C & D: Winter cruise METEOR # 64 (HERMES 1987)



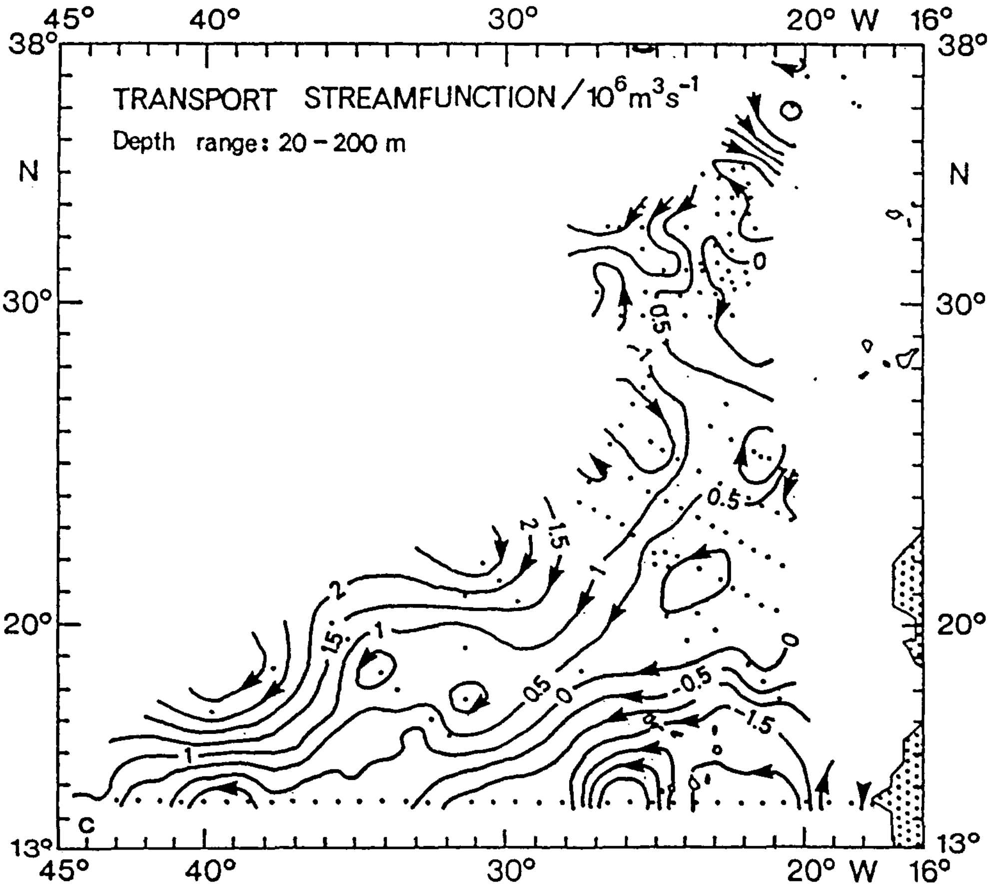


Fig. 6: TOP: Distribution of North- (NACW) and South-Atlantic-Central-Water (SACW) at 150 m deep (expressed in % NACW, data from B. KLEIN, IfM, Kiel, pers. com.).
BOTTOM: Current system of the area and within the MCN-catching range (FIEKAS et al. 1992)

ACKNOWLEDGEMENTS

I would like to thank V. FIEKAS, B. KLEIN and W. ZENK who made available hydrographical data and information on the area. H.-Ch. JOHN and M. KLOPPMANN helped with the English manuscript. Sampling and evaluation of the material was financially supported by the DEUTSCHE FORSCHUNGSGEMEINSCHAFT.

LITERATURE CITED

AHLSTROM, E.H. 1974: The diverse patterns of metamorphosis in Gonostomatid fishes - An aid to classification. - IN: BLAXTER, J.H.S. (ed.) 1974: The early life history of fish: Springer, Berlin, Heidelberg, New York: 659 - 674.

BEKLEMISHEV, C.W.; PARIN, N.B. & SEMINA, G.N. 1977: Ocean Biogeography. Pelagial. - In: VINOGRADOV, M.E. (ed.): Biogeographical structure of the ocean. I Ocean Biogeography. Akademia Nauka, Moscow: 219 - 261 (in russian).

FIEKAS, V.; ELKEN, J.; MÜLLER, T.J.; AITSAM, A. & ZENK, W. 1991: A view of the Canary Basin thermocline circulation in winter. - J. Geophy. Res. (97) C8: 12,495 - 12,510.

GORDINA, A.D. 1980: Composition and distribution of ichthyoplankton in open waters of the subtropic and equatorial Atlantic in winter period. - Ekol. Morya, Kiev 3: 19-25, (in russian)

GREY, M. 1964: Gonostomatidae. - In: Fishes of the western North Atlantic. Mem. Sears. Fdn mar. Res. 1(4): 78 - 240.

HAGEN, E. & SCHEMAINDA, R. 1984: Der Guineadom im ostatlantischen Stromsystem. - Beitr. Meereskd. 51: 5-27.

HERMES, R. 1987: Fischlarvendrift vor Mauretanien. - Thesis, Univ. Hamburg: 186 pp.

JOHN, H.-Ch. 1986: On currents off north-west Africa as revealed by fish larvae distributions. - In: Pierrot-Bults, A.C.; Van der Spoel, S.; Zahuranec, B.J. & Johnson, R.K. (Eds): Pelagic Biogeography. UNESCO Tech. Pap. mar. Sci. 49: 149 - 155.

JOHNSON, R.K. 1986: Polytypy, boundary zones and the place of broadly distributed species in mesopelagic zoogeography. In: PIERROT-BULTS, A.C.; VAN DER SPOEL, S.; ZAHURANEC, B.J. & JOHNSON, R.K. (Eds): Pelagic Biogeography. - UNESCO Tech. Pap. mar. Sci. 49: 156 - 165.

KLEIN, B. 1992: Die Kapverden-Frontalzone. - Ber. Inst. f. Meereskunde, C.A.-Univ. Kiel 227: 191 pp.

MITTELSTAEDT, E. 1991: The ocean boundary along the northwest African coast: Circulation and oceanographic properties at the sea surface. - Prog. Oceanog. 26: 307-355.

LOEB, V.J. 1979: Larval fishes in the zooplankton community of the North Pacific Central gyre. - Mar. Biol. 53: 173-191.

LOPES, P.C. & JOHN, H.-Ch. 1986: Ichthyoplankton at the surface of the Equatorial Atlantic. - Bol. Soc. Port. Ciênc. Nat. 23: 83-111 (published Feb. 1988)

QUÉRO, J.C.; HUREAU, J.C.; KARRER, C.; POST, A. & SALDANHA, L. (Eds./ Red.) 1990: CLOFETA - Checklist of the fishe of the eastern tropical Atlantic. - UNESCO, Paris, 3 Bde.: 1492 pp.

ZENK, W., B. KLEIN & M. SCHRÖDER, 1991: Cape Verde Frontal Zone. Deep-Sea Res., Vol. 38, Suppl. 1, pp. 505 - 530.