Acta Adriat., 29 (1/2): 171—176 (1988)

YU ISSN: 0001—5113
AADRAY

UDK: 639.2.081
Original scientific paper

RETENTION EFFICIENCY OF A CONICAL PLANKTON NET

EFIKASNOST FILTRACIJE KONIČNE PLANKTONSKE MREŽE

A. Economou, M. A. Pancucci-Papadopulou* and Ch. Daoulas*

PASEGES, Athens, Greece

** National Centre for Marine Research, Athens, Greece*

The retention efficiency of a conical plankton net with 132 μm meshes was examined with the covered-net method. The net was covered externally by another net with gauze of 63 μm meshes and the proportion of organisms released through the meshes of the inner net but retained by the outer was estimated.

The data show that the greatest proportion of microzooplankters escaped through the 132 μm meshes and escapement reached 99% in copepod nauplii.

INTRODUCTION

It is almost impossible to sample quantitatively a wide spectrum of planktonic organisms using a single sampling instrument. A certain biass is inevitably introduced due to limitations of the instrument at both ends of its sampling range, i. e. in catching efficiently the large and more mobile zooplankters or in retaining small organisms.

To study the retention efficiency of the plankton nets, two methods have been used so far: either by comparing the catches from duplicate hauls with nets fitted with gauzes of different mesh size, or by covering the working net with a net of smaller mesh size. Vannucci (1968) suggested that the first method is not completely satisfactory because of the high variance between replicates. But she also indicated the possibility that the covered-net method could give unreliable results because the drag of the cover may reduce mesh velocity in the inner net.

Experiments performed by Saville (1958) with the covered-net method showed that organisms are released through the meshes of a plankton net at a considerably larger size than the mesh size alone would permit. This may be due partly to the compressibility of organisms and partly to the flexibility of the meshes. Adams (1976) noted a significant seasonal and geographical

variation in mesh selectivity values. Perhaps this variation can be attributed to differences in the flow pattern through the net or differences in handling the instrument. Economou (1987) compared the catches between covered and uncovered net. He found that a high proportion of small organisms that normally squeezed out through the meshes of the uncovered net, were in a way prevented from passing through when the cover was applied. This finding implies that Vannucci (1968) might had been essentially correct in suspecting a masking effect of the cover.

In terms of hydrodynamics, plankton nets should not behave differently from the fihing towed nets. A change in catchability and the retention efficiency of trawls was found by Davis (1934) when the cod-end was covered with a net of smaller mesh size, larger fish being caught with the uncovered net and smaller fish with the covered net. Other authors (e. g. Pope *et al.*, 1975) had similar findings and concluded that the covering of the fishing nets may alter their selectivity.

However, more careful experimentation in recent work showed that the covered-net method can give valid results if the covering of the net does not restrict water flow, neither it obstructs the cod-end meshes (Steward and Robertson, 1985).

Therefore the results from mesh selectivity experiments should be interpreted with caution. The present experiments were conducted when the necessity arised during an ecological research program to assess the extent of extrusion of copepod nauplii through the 132 μm meshes of a plankton net.

MATERIAL AND METHODS

The mesh selectivity study was based upon material collected on May 28, 1986, in the Gulf of Atalanti (North Evoikos Gulf, Greece). The net used for routine sampling over the past years, a 120 cm long conical plankton net with a 30 cm diameter mouth opening, fitted with a gauze of 132 μm meshes, was covered by an outer gauze with 63 μm meshes (Fig. 1). Both nets ended in separate detachable cod-ends consisting of netting material. Cod-ends

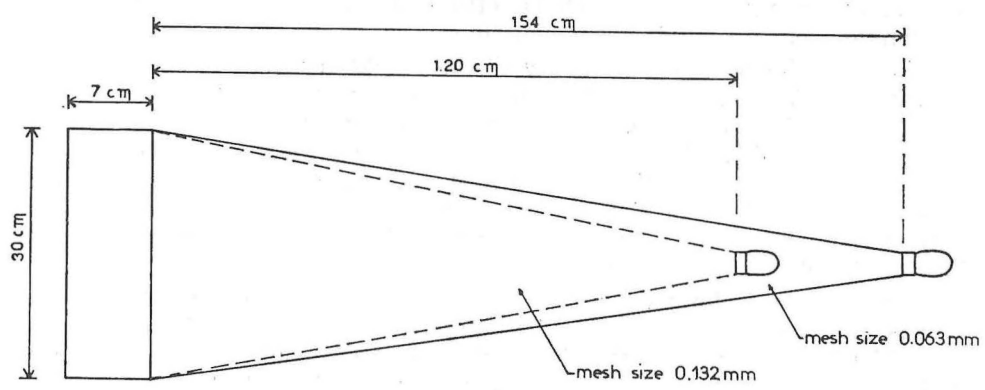

Fig. 1. Drawing of the covered net

instead of metal collection-buckets were used because previous experience had shown that the latter prevented normal water flow and increased escapement by increasing the proportion of the time that the organisms remain in the filtering area of the net (see also A d a m s, 1976).

All hauls were taken in the same position at speed of 1.5 knots, with the net towed horizontally at a depth of 1m from the surface. After the end of haul the flowmeter reading was recorded and the two fractions of the sample were preserved in a 4% solution of neutralized formalin in separate jars.

To test whether changes in mesh selectivity occur in the presence of the cover, hauls were also made with the outer cover removed, all other conditions of the tow kept similar. A single haul with a WP 2 net, fitted with a gauze of 200 μm meshes was performed, and the results are included for comparison.

RESULTS

The estimated density of zooplankters (Nos m^{-3}) with the covered, the uncovered and the WP2 nets are presented in Table 1. There were no significant differences in the catches of the net with 132 μm meshes, either covered or uncovered, which implies that the covering of this net did not alter its selectivity. This is due to the fact that care was taken during the construction of the nets and the design of the experiment to reduce the effects of clogging and to avoid a drop of the filtration efficiency during hauling. In no case a reduction of the volume of water accepted by the mouth of the net was noted after the addition of the cover.

Table 1. Average density of zooplankters appearing in the plankton atches (Number of individuals/m^3).

Density GROUPS	Uncovered net (132 μm)	Covered net inner (132 μm)	Covered net outer (63 μm)	total	WP2 (200 μm)
Copepods & Copepodites	1651	1452	97	1549	980
Copepod nauplii	175	128	12044	12173	1
Gastropod larvae	304	566	390	1056	9
Bivalve larvae	19	41	110	151	
Polychaeta larvae	2				
Cladocerans	33	44		44	18
Jelly-fishes	74	39		39	16
Appendicularians	262	567		567	61
Cirripedia larvae	15	8		8	
Echinoderm larvae		1		1	
Crustacean larvae	158	186		186	213
Chaetognaths	20	9		9	6
Isopods	10	3		3	3
Shiphonophors	1				3
Fish eggs & larvae	37	40		40	37
Total	2760	3084	12741	15886	1347

The effect of mesh size on the retention efficiency seems to be selectively distributed over the size range of the organisms caught. The larger organisms (copepods and other crustaceans, chaetognaths etc.) were sufficiently retained

by the 200 μm and the 132 μm nets. The smaller organisms (copepod nauplii and molluscs) were almost exclusively extruded through the meshes of the 200 μm net and their extrusion through the meshes of the 132 μm net was significant. Excluding cases of fragmentation, most groups of organisms were not present in the samples of the cover (63 μm) of the double net. This is peculiar because some organisms of small size, e. g. the smallest cladocerans, should normally be found in the samples of the 63 μm net. The explanation might be that their flat and rigid body and the presence of hairy appentages prevented them from passing through the meshes of the 132 μm.

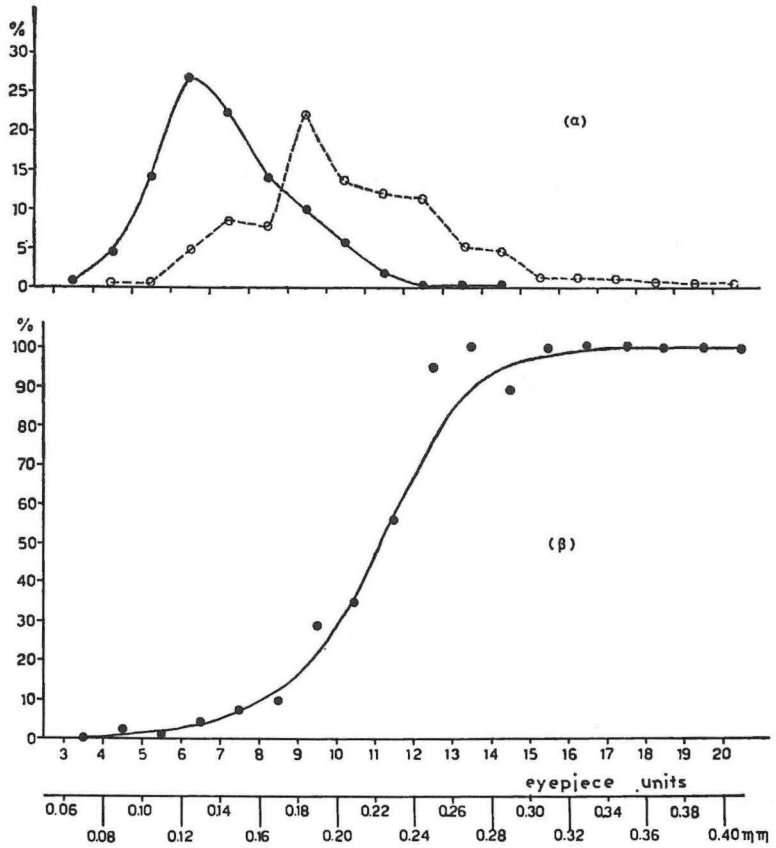

Fig. 2a. Length distribution of copepod nauplii in the inner (●) and the outer (○) net.
b. Selection curve for copepod nauplii as a function of their size

The size distribution of nauplii in the 63 μm and the 132 μm nets of the covered net is shown in Fig. 2a. The *t*-test showed that the size of nauplii in the two nets was different ($P < 0.05$) but no significant differences in the

size of nauplii in the same net from different hauls could be found (Table 2). A selection curve was drawn which shows the proportion of nauplii retained by the inner net as a function of their size (Fig. 2 b).

Table 2. Test for difference in size between the copepod nauplii in the inner and the outer net. The mean length of nauplii is expressed in eyepiece microscope units.

Haul number	Net	Number of individ.	Mean length	t-test	Net	Haul number	t-test
1st	inner	100	10.171±0.431	5.992*	inner	1st—2nd	0.841
	outer	330	7.313±0.204			1st—3rd	1.080
2nd	inner	43	11.398±1.393	3.181*		2nd—3rd	0.102
	outer	300	6.931±0.179				
3rd	inner	30	11.587±1.230	3.688*	outer	1st—2nd	1.409
	outer	300	7.017±0.150			1st—3rd	1.170
Total 1, 2, 3	inner	173	10.721±0.475	7.434*		2nd—3rd	0.356
	outer	930	7.106±0.104				

* $P < 0.05$

DISCUSSION

It becomes evident that sampling with nets of different mesh size results in different assessments of the abundance and species composition of the zooplankton community. This is mainly due to differences in the retention of the smallest components of the community by nets of different meshes. The retention of copepod napulii by the net of 200 μm meshes was negligible and by the net of 132 μm meshes was particularly low, 1% of the combined catch with the two nets of the covered net. The small size of nauplii, the compressibility of their body and the lack of the developed appentages that copepodites and adult copepods are equipped with, facilitate their extrusion through relatively small mesh appertures.

In comparison to the present data, the retention of copepod nauplii in the North Sea by nets of 250 μm meshes, covered by nets of 68 μm meshes, ranged between 0 and 10%, depending on the size of nauplii, the type of sampling gear used and the conditions of towing (Saville, 1958; Adams, 1976). In mesh selectivity experiments with the method of parallel net tows performed by Evans and Sell (1985) in the Michigan Lake, nets of 76 μm meshes retained 8—12 times more nauplii than nets of 156 μm meshes.

Despite the numerical predominance of copepod nauplii and other small organisms in the plankton, the larger zooplankters comprise the greatest proportion of a catch in biomass terms. The use of nets with fine meshes is preferable when the aim of the investigation is the study of the dynamics and

the quantitative relationship between the elements of the zooplankton community. However the employment of such nets leads to a quick clogging and to avoidance of the net by the larger zooplankters. Therefore, it depends on the scope of the investigation and the kind of question which should be answered to select the proper type of sampling gear and the size to be used.

REFERENCES

Adams, J. A. 1976. The Bridger version of the Gulf III high speed plankton sampler. Scott. Fish. Res. Report 3, 42 pp.

Davis, F. M. 1934. Mesh experiments with trawls, 1928—1933. Fish. Invest., ser. II, 14: p. 56.

Economou, A. N. 1987. Ecology of survival in some gadoid larvae of the northern North Sea. Env. Biol. Fish., 19: 241—260.

Evans, M. S. and D. W. Sell. 1985. Mesh size and collection characteristics of 50 cm diameter conical plankton nets. Hydrobiologia, 122: 97—104.

Pope, J. A., A. R. Margetts, J. M. Hamley and E. F. Akyuz. 1975. Manual of methods for fish stock assessment. Part III. Selectivity of fishing gear. FAO Fish. Techn. Papers (Revision 1), 41, 65 pp.

Saville, A. 1958. Mesh selection in plankton nets. J. Cons. Perm. int. Explor. Mer, 23: 192—201.

Stewart, P. A. M. and J. H. B. Robertson. 1985. Small mesh codend covers Scott. Fish. Res. Report 32, 11 pp.

Vannucci, M. 1968. Loss of organisms through the meshes. In: UNESCO Monographs on Oceanogr. Methodology, 2: 77—86.

Accepted: April 13, 1988

EFIKASNOST FILTRACIJE KONIČNE PLANKTONSKE MREŽE

A. Economou, M. A. Paneucci-Papadopolou* and Ch. Daoulas*

PASEGES, Atena, Grčka

**Nacionalni centar za istraživanje mora, Atena, Grčka*

KRATKI SADRŽAJ

U radu je istraživana efikasnost filtracije konične planktonske mreže veličine oka 132 μm metodom pokrivene mreže.

Mreža veličine oka 132 μm bila je prekrivena drugom, vanjskom mrežom, veličine oka 63 μm i proračunata je količina organizama koji su prošli kroz unutarnju mrežu, a zadržala ih je vanjska.

Rezultati pokazuju da je najveći dio mikrozooplanktona prošao kroz mrežu veličine oka 132 μm (čak 99% nauplija kopepoda na primjer).