

ANNUAL MEETING - JUNE 1968OBSERVATIONS ON THE CATCHING EFFICIENCIES
OF TWO ZOOPLANKTON SAMPLERS

by

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Comparisons were made of the catching efficiencies of the Gulf III and paired Brown-McGowan type zooplankton samplers, as part of a cooperative investigation of plankton sampling methods initiated between the U.S. and U.S.S.R. in autumn, 1967. The paired samplers were modified by Arthur Posgay and Robert Marak of the Bureau of Commercial Fisheries Biological Laboratory, Woods Hole. They were scaled down to a mouth diameter of 20.3 cm, fitted with a 29 cm long tube of polyvinylchloride tapered to a 7 degree angle at the mouth, and designated by Posgay and Marak as the BCF Bongo .03 sampler.

A series of 10 tows were made in coastal waters off Boothbay Harbor, Maine in November, 1967. The samplers were hauled simultaneously in a step-oblique tow of 30 minutes -- 10 minutes each at 20 m, 10 m, and the surface-- during daylight on two consecutive days. The nets were on the same wire; the Bongo samplers were positioned about 25 cm above the Gulf III sampler (Fig. 1). Each of the samplers had mouth diameters of 20.3 cm, and were fitted with nets of 0.36 mesh apertures. The netting was metal in the Gulf III sampler, and nylon in the Bongo samplers. The amount of water strained was determined from a calibrated flow meter mounted in the mouth of one of the Bongo nets, and on the tail section of the Gulf III sampler. Each tow covered approximately 5.6 km and filtered about 165 m³ of water. The towing speed was 308 cm/sec (6 knots). Volumes of samples were measured in the laboratory by the mercury immersion method. Ctenophores, large coelenterate remains (>2 cm long) and all fish larvae were excluded. Zooplankton samples were divided into aliquots ranging from an eighth to a sixty-fourth, depending on the mass of the samples, and sorted into major taxonomic groups. Copepods were identified to species, and numbers of copepods and other zooplankters per 100 m³ of water were calculated.

Zooplankton Volumes

Volumes were examined for differences between the samplers with the Mann-Whitney U test. No significant differences were found between volumes of the port and starboard Bongo nets. But in each set, the volumes of the Bongo nets were significantly higher than the Gulf III volumes (table 1).

Group and Species Comparisons

Copepods were the dominant zooplankters in the samples. Their contribution to the total zooplankton ranged from 97 to 63 percent. Ten other groups (taxa) were in the samples, but

only four constituted greater than 1 percent of the zooplankton --chaetognaths, cladocerans, crustacean nauplii, and medusae. The abundance of these groups, expressed as numbers per 100 m³ of water strained per tow for each of the samplers, is shown in table 2. Catches of each of the groups collected in the Bongo nets were compared with the Mann-Whitney U test; the differences in the catches of the Bongo nets were not significantly different. The mean number of each group in the Bongo samples was compared with the simultaneous catches made in the Gulf III. Differences in the catches of copepods (the predominant zooplankters), chaetognaths, and cladocerans were significant; numbers in the Bongo nets were consistently higher. Catches of the remaining groups, medusae and crustacean nauplii, were not significantly different (table 2).

The samples included 16 copepod species. Of this number, four constituted approximately 95 percent of the total --Temora longicornis, Acartia longiremis, A. clausi, and Pseudocalanus minutus. Catches of the samplers were compared for differences with the Mann-Whitney U test; the collections of Acartia longiremis and A. clausi were combined to represent Acartia species, because of the low numbers of A. clausi in the samples. No significant differences were found between the catches of the port and starboard Bongo nets. Mean numbers per tow of T. longicornis, Acartia sp. and P. minutus in the Bongo samplers were compared with simultaneous catches of these species in the Gulf III sampler, and for each species the differences were significant (table 3); catches in the Bongo nets were higher in each set.

At present we have no satisfactory explanation for the differences observed between samplers either in volumes or among the predominant taxa and species. The differences may be related to the variation in the towing characteristics of the samplers. The Bongo nets are set in a swivel yoke and present a full mouth diameter to each level sampled during the haulback. The Gulf III does not swivel and may be straining on a different angle during haulback, a difference that could be important where zooplankters are concentrated at different levels in the water column. Although the ratio of mouth opening to filtering area of the Bongo samplers (1:14) was greater than in the Gulf III (1:9.5), the average difference in the amount of water strained per tow was only 18 m³ greater. This value is not large enough to account for the greater number (ca. 9 times) of copepods, the predominant zooplankters, in the Bongo sampler. It is possible that the flexible nylon netting of the Bongo samplers is reduced in aperture size in the lower portion of the net during the tow, thereby retaining greater numbers of the abundant smaller copepods, T. longicornis (1.3 mm, mean length), Acartia (1.2 mm, mean length) and P. minutus (1.5 mm, mean length).

From our comparisons, it appears that for our present studies of herring ecology the Bongo nets collect more of the forage utilized by herring, and may provide a better estimate of prey distribution and abundance than the Gulf III sampler. Comparisons of the catching efficiencies of the two samplers will be continued during each of the seasons in 1968 for a measure of the effects of seasonal changes in zooplankton composition between the two samplers.

The BCF Bongo .03 sampler used in the study was kindly made available by Robert Marak and Arthur Posgay, Bureau of Commercial Fisheries Biological Laboratory, Woods Hole, whose cooperation is greatly appreciated.

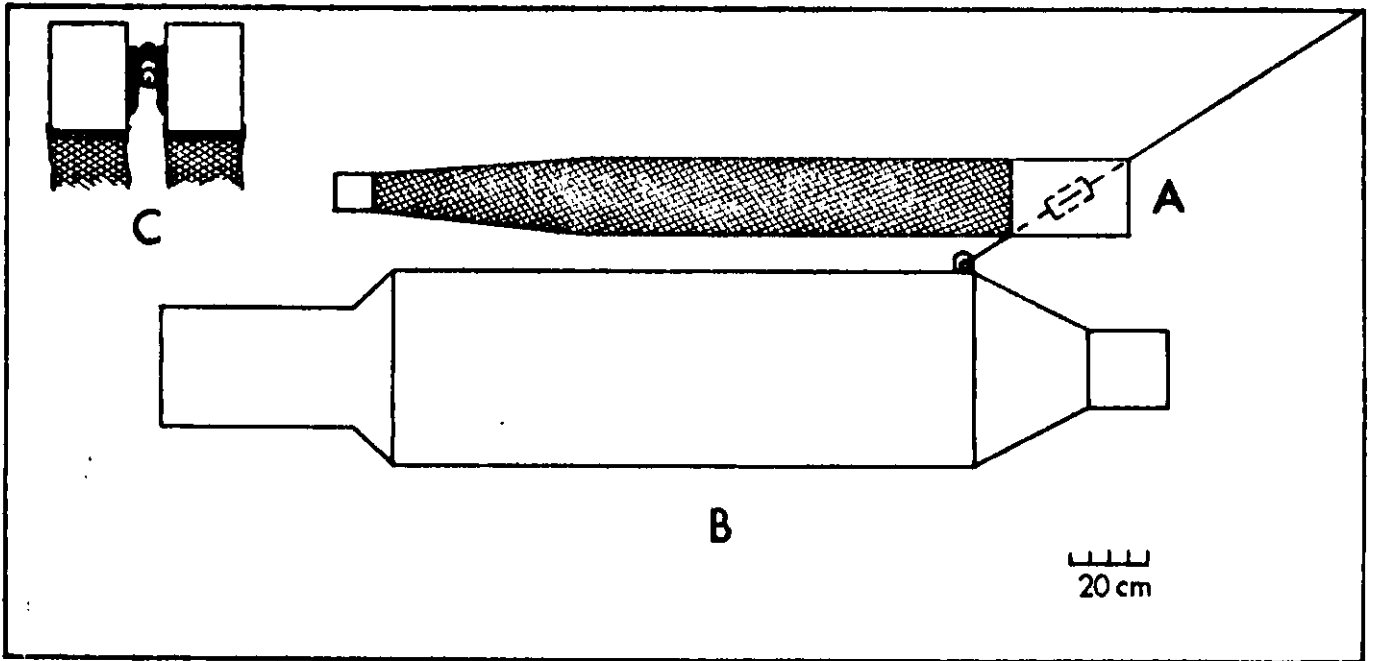


Figure 1. Position of the Bongo (A) and Gulf III (B) samplers on the towing wire. (C) Top view of the Bongo samplers; a wire swivel clamp is positioned between the two nets.

Table 1. Sample volumes (cc/100m³ of water) for each of the 10 simultaneous tows made with the Bongo and Gulf III samplers. (Mann Whitney U and probability values are listed for each comparison).

Tow	Sampler		Sampler		Sampler		Water strained (m ³)	
	Port	Starboard	Port	Gulf III	Starboard	Gulf III	Bongo	Gulf III
1	1.39	1.85	1.39	0.97	1.85	0.97	169.03	159.26
2	1.22	1.37	1.22	0.83	1.57	0.83	169.95	174.34
3	1.67	1.98	1.67	0.63	1.98	0.63	167.90	158.88
4	1.20	1.60	1.20	0.42	1.60	0.42	164.21	157.92
5	1.75	1.73	1.75	1.17	1.73	1.17	162.10	118.08
6	1.67	1.92	1.67	0.09	1.92	0.09	163.68	143.14
7	1.74	1.68	1.74	0.62	1.68	0.62	166.32	178.88
8	2.07	1.97	2.07	0.59	1.97	0.59	165.92	139.10
9	1.68	1.86	1.68	0.80	1.86	0.80	165.13	145.06
10	2.17	2.38	2.17	1.26	2.38	1.26	166.52	152.26
	U value 34		U value 2		U value 0			
	P value >0.05		P value <0.001		P value <0.001			

Table 2. Catches of the dominant zooplankton groups per 100m³ of water made with the Bongo (B) and Gulf III samplers. (Mann Whitney U and probability values are listed for each comparison).

Group	Tow	Sampler		Mean (B)	Gulf III
		Port (B)	Starboard (B)		
Copepods	1	17,417	12,938	14,928 ^{1/}	1,612
	2	21,051	7,607	14,325	1,501
	3	10,025	18,868	14,447	1,249
	4	14,654	14,615	14,635	2,275
	5	11,627	17,846	14,737	2,419
	6	12,551	14,428	13,490	1,777
	7	19,048	21,279	20,164	1,542
	8	8,409	12,960	10,685	2,030
	9	13,333	14,185	13,759	1,131
	10	7,418	19,409	13,445	1,687
		U value	37		0
	P value	>0.05		<0.001	
Chaetognatha	1	379	757	568	686
	2	640	377	509	463
	3	1,010	1,372	1,191	312
	4	1,247	1,189	1,218	846
	5	217	217	217	108
	6	508	626	567	101
	7	577	596	587	101
	8	540	559	550	98
	9	736	911	824	55
	10	788	1,326	1,057	144
		U value	40.5		15
	P value	>0.05		<0.01	
Cladocera	1	265	95	180	65
	2	132	19	76	37
	3	76	229	153	191
	4	429	175	302	208
	5	316	237	277	122
	6	254	430	342	235
	7	481	770	626	332
	8	193	463	328	247
	9	446	407	427	171
	10	384	442	413	278
		U value	49		25
	P value	>0.05		<0.05	
Crustacean nauplii	1	38	--	19	30
	2	19	19	19	--
	3	--	38	19	30
	4	--	--	--	71
	5	--	39	20	34
	6	--	39	20	11
	7	38	19	29	12
	8	39	19	29	52
	9	39	39	39	28
	10	96	58	77	16
		U value	43.5		48.5
	P value	>0.05		>0.05	

^{1/} To nearest whole number

Table 2. Cont'd.

Group	Sampler				
	Tow	Port (B)	Starboard (B)	Mean(B)	Gulf III
Medusae	1	--	--	--	20
	2	--	14	7	14
	3	38	76	57	30
	4	--	19	10	132
	5	39	20	29	41
	6	156	196	176	50
	7	173	96	135	42
	8	19	116	68	46
	9	78	233	156	22
	10	288	192	240	58
U value		59		41	
P value		>0.05		>0.05	

Table 3. Catches of the dominant copepod species per 100m³ of water made with the Bongo (B) and Gulf III samplers. (Mann Whitney U and probability values are listed for each comparison).

Species	Sampler				
	Tow	Port (B)	Starboard (B)	Mean (B)	Gulf III
<u>Temora</u>					
<u>longicornis</u>	1	5,414	4,922	5,183	1,160
	2	5,573	2,391	3,982	835
	3	2,897	6,404	4,651	549
	4	3,936	4,443	4,190	892
	5	5,310	7,778	6,544	1,728
	6	5,239	5,904	5,572	1,012
	7	8,235	7,888	8,162	961
	8	3,375	5,439	4,407	1,087
	9	4,535	4,457	4,496	618
	10	2,652	6,149	4,351	1,009
U value		33		0	
P value		>0.05		<0.001	
<u>Acartia</u>					
	1	9,655	6,096	7,876	282
	2	12,380	4,576	8,478	445
	3	5,756	10,368	8,062	458
	4	8,730	8,370	8,550	856
	5	5,409	8,647	7,028	414
	6	6,178	7,781	6,980	570
	7	9,082	11,428	1,026	398
	8	4,417	6,403	5,410	661
	9	7,170	8,023	7,597	260
	10	3,536	10,723	7,130	373
U value		38		0	
P value		>0.05		<0.001	
<u>Pseudocalanus</u>					
<u>minutus</u>	1	1,515	909	1,212	10
	2	2,222	377	1,300	32
	3	839	1,258	2,348	15
	4	1,130	974	1,052	51
	5	533	711	622	34
	6	626	196	411	11
	7	1,039	1,000	1,020	24
	8	289	463	376	40
	9	814	659	737	22
	10	594	1,422	1,009	26
U value		44		0	
P value		>0.05		<0.001	