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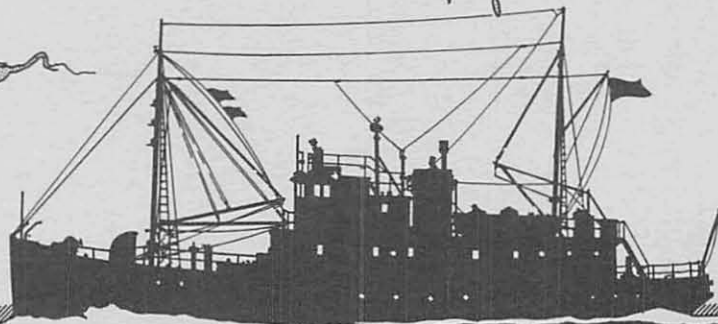
ON THE EFFECTIVE CROSS-SECTION
OF THE ISAACS-KIDD MIDWATER TRAWL

by

Karl Banse and Darrelyn Semon

National Science Foundation
Grant No. G-14732
and
Office of Naval Research
Contract Nonr-477(10)
Project NR 083 012

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August 1963



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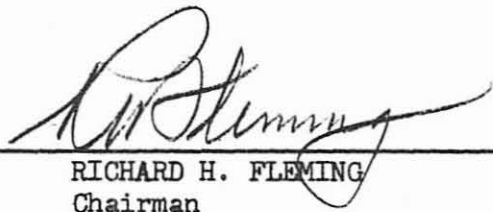
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Chairman

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ABSTRACT

Catches taken by the 6-foot Isaacs-Kidd midwater trawl and by a quantitative high speed catcher are compared. The effective cross-section of the trawl in regard to adult Euphausia pacifica is a little over 1 m².

INTRODUCTION

Between 1956 and 1960, the Department of Oceanography, University of Washington, under the direction of Dr. William Aron, collected about 1200 samples with the modified Isaacs-Kidd midwater trawl in offshore and inshore waters of the northeast Pacific Ocean. A large amount of the material is Euphausiacea (Crustacea). Except in samples taken south of 39°N lat., Euphausia pacifica (maximum length 2.5 cm, Boden, Johnson and Brinton, 1955) constitutes a large percentage of the biomass. For quantitative studies, numbers of animals per unit volume of water must be known, but at present, there are no reliable figures for the volume of water strained by the trawl, even though the duration of the tows is known. To convert numbers of animals per minute of tow into numbers per m³ of water, we have tried to estimate the effective cross-section of the 6-foot trawl for adult E. pacifica by comparing trawl catches with those of a quantitative high speed catcher.

In its present form, the Isaacs-Kidd midwater trawl is constructed of three sections, each with a different size mouth opening and a different mesh size. The first section of the 6-foot trawl is made of 3-inch (7.62 cm) stretch mesh netting, the middle section of 3-inch

(7.62 cm) stretch netting lined with 1/2-inch (1.27 cm) bait netting, and the cod end of 1/8-inch (0.32 cm) nylon netting, with cross-sectional areas for the mouth openings of 2.94 m², 1.26 m², and 0.197 m², respectively (Aron, 1962a). The front section will reliably retain only very large animals and the fine mesh of the cod end will retain animals of about 3 mm cross-section. However, the percentage of animals of intermediate size caught by each section is not known. There may be a funneling effect towards the cod end, so that more of these animals are taken by the trawl than is to be expected from the mesh sizes of the sections, as suggested by Aron (1962a), or relatively large animals may be squeezed through the meshes due to the high towing speed.

METHODS

To determine the catching efficiency of the midwater trawl for E. pacifica, trawl catches from two cruises in inshore waters were compared with the number of E. pacifica per m³ of water established with a quantitative high speed catcher (Bary et al., 1958). A calibrated meter was fitted into the tail of the catcher so that the volume of water filtered could be calculated. An Atlas flow meter was installed for the cruise on 24 May, 1962, and a Japanese T.S.K. (Tsurumi-Seiki-Kosakusho Co., Ltd.) flow meter was used for the cruise on 24 September, 1962. The trawl was lowered open and retrieved open; the catcher was lowered open and closed before retrieving. Number of animals per m³ was determined by the catcher, and knowing the numbers caught per distance by the trawl, we were able to calculate the cross-sectional area of the trawl effective in catching E. pacifica.

A cruise to Puget Sound was made aboard the M.V. BROWN BEAR on 24-25 May, 1962 (Cruise BB 307). Between 2142 and 0159 hours PST, six hauls at about 10 m were taken with the high speed catcher and five with

the midwater trawl at a speed of about 5.7 knots, for periods of 11-15 minutes each (Table 1). The ship turned 180° after each haul in order to sample in approximately the same water. A bathythermograph was attached to the catcher to determine the maximum depth reached by the gear, and a depth-distance recorder was attached to the trawl.

Since the numbers of Euphausiacea caught during this cruise were low, another night cruise to Saanich Inlet, British Columbia, on board the M.V. HOH was made on 24-25 September, 1962 (Cruise HH 2, Table 1). Five-minute tows were made between 2130 and 0036 hours PST. Eight hauls in alternating pairs were taken with the catcher and seven with the midwater trawl, the ship turning 180° after each haul. Depths were estimated from wire angles and length of wire payed out, and time was recorded with a stopwatch.

The quantities of Euphausiacea caught by the trawl in Saanich Inlet on Cruise HH 2 were so large that they had to be subsampled on board ship. The coefficient of variation of subsampling sample No. 8 five times was $\pm 6.2\%$. In the laboratory, the catches were allowed to stand in graduated cylinders for at least one hour before settling volumes were recorded. The midwater trawl samples or subsamples for HH 2 were divided with the Folsom splitter (McEwen et al., 1954), the adults of E. pacifica in aliquots of not less than 100 ml were counted, and the total number of animals per haul was calculated. The entire sample taken with the high speed catcher on both cruises was counted for adult E. pacifica. The number of animals per 100 m³ of water was calculated for the samples from the catcher, whereas for the trawl, the number of animals captured per 100 m travelled was determined (Table 1). Mean values are given in Table 2.

RESULTS AND DISCUSSION

By taking the mean value for animals per 100 m caught by the trawl and dividing by the mean of the number of animals per 100 m³, as determined by the catcher (Table 2), we obtained the effective cross-sectional area of the midwater trawl, in respect to adult Euphausia pacifica. The values were 1.081 m² for Cruise BB 307, and 1.297 m² for Cruise HH 2 (1.633 m² without the very large catch by haul No. 11). The average for both cruises was 1.189 m², not significantly different from the area of the opening of the middle section, 1.26 m². It is suggested that a possible funneling effect of the front section of the trawl is compensated for by loss of animals through the 1/2-inch (1.27 cm) bait netting which lines the second section of the trawl.

The available data are inadequate to warrant a detailed statistical analysis. In particular, the number of hauls is small, and too few animals were collected with the catcher on Cruise BB 307. Furthermore, for Cruise HH 2, the numbers of E. pacifica per 100 m caught by the midwater trawl decreased with successive hauls, whereas for the catcher samples, this was not so. No explanation can be given. Therefore, only the trend of the data is presented here.

Many repeated trials could improve the precision of the gear comparison. However, the conversion factor would hold only for adult Euphausia pacifica. It would be strictly valid even for this species only when the behavior of the animals, which may change from season to season, does not influence the catch rate. This is not known. Furthermore, when collections were made by the Department, the distance travelled by the trawl through the water was not controlled, and only the duration of the haul and the ship's engine revolutions were recorded. Wind and

waves change the resulting speed of the ship; in addition, the trawl may fish through water which moves at speeds different from those at the surface. Thus, we believe that it is inadvisable to expend further effort in finding a better conversion factor for our previous midwater trawl collections, but new collections should be made with improved gear. However, the Isaacs-Kidd midwater trawl in its present form appears to be well suited for sampling a wide range of nekton, as pointed out by Aron (1962b). If the distance travelled by the gear is measured, the trawl samples should be comparable. To obtain quantitative collections, the trawl must be constructed of a single mesh size, chosen according to the interests of the investigator. Only then is it useful to attach a flow meter. For studying deep water, it is advisable to install an opening-closing device and a depth recorder.

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Table 1

Settled volumes of Euphausiids and numbers of adult Euphausia pacifica caught by high speed catcher and midwater trawl for Cruises BB 307 and HH 2

Cruise No.	Haul No.	Gear	Depth (m)	Speed of Tow (knots)	Time (min)	Volume of Sample (ml)	Total No. of <u>Euphausia pacifica</u>	Aliquot Counted	Adult <u>Euphausia pacifica</u>		
									(no/100 m ³)	(no/100 m)	
BB 307	1	CAT	13-10	5.7	13	15	17	Total	131		
	2		10	5.7	14	7	12	"	172		
	3		10	5.7	11	35	42	"	193		
	6		13	5.7	12	38	63	"	253		
	7		10	5.7	11	10	14	"	76		
	8		10	5.7	13	38	87	"	133		
	4		MWT	9	5.7	15	1,450	8,512	1/64		322
	5			10	5.7	11	350	1,744	1/8		90
	9	10		5.7	14	400	2,656	1/16		108	
	10	10		5.7	13	400	3,008	1/16		131	
	11	10	5.7	13	775	4,896	1/32		214		
HH 2	2	CAT	9	4.25	5	50	398	Total	4,020		
	3		8	4.25	5.08	60	475	"	4,360		
	6		8	4.25	5	40	300	"	3,090		
	7		8	4.25	5	50	385	"	3,770		
	10		8	4.25	5.5	35	255	"	4,250		
	11		8	4.25	5.58	80	1,232	"	12,200		
	14		8	4.25	5	45	293	"	3,710		
	15		8	4.25	5	60	457	"	4,660		
	1	MWT	9	4.20	5.17	3,800	67,338	1/87		10,040	
	4		8	4.20	5.25	3,700	61,974	1/99		9,099	

Table 1 (cont'd)

Cruise No.	Haul No.	Gear	Depth (m)	Speed of Tow (knots)	Time (min)	Volume of Sample (ml)	Total No. of <u>Euphausia</u> <u>pacifica</u>	Aliquot Counted	Adult	
									<u>Euphausia</u> <u>pacifica</u> (no/100 m ³)	<u>pacifica</u> (no/100 m)
HH 2	5	MWT	7	4.20	5.08	3,100	40,052	1/68	6,078	
	8		9	4.20	5	2,500			5,427	
	A						33,630*	1/114		
	B						32,574*	1/89		
	C						36,594*	1/114		
	D						35,226*	1/114		
	E						37,962*	1/111		
	9		9	4.20	6.5	2,900	56,112	1/84	6,655	
	12		9	4.20	5.25	1,800	26,240	1/82	3,852	
	13		9	4.20	5.33	2,100	30,000	1/120	4,338	

* Total number obtained from counting aliquots of subsamples A through E

Table 2

Mean values, range of values, standard deviations and coefficient of variation for the high speed catcher (numbers of Euphausia pacifica / 100 m³) and for the midwater trawl (numbers of Euphausia pacifica / 100 m).

Cruise	Gear	Mean	Observed Range	Standard Deviation	Coefficient of Variation
BB 307	CAT	160	177	\pm 60.84	38%
BB 307	MWT	173	232	\pm 95.86	55%
HH 2	CAT	5,010	9,110	\pm 2945.00	59%
HH 2	MWT	6,498	6,188	\pm 2321.00	36%

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