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The influence of the strong 1969 and 1970 year-classes of Cod on  
 the stock of Brown Shrimp along the Netherlands coast in 1970 and  
 1971.

by  
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The Shrimp fisheries

During the second half of 1970, the Dutch shrimppheries recovered very well from the economically bad situation which occurred in 1969 up to the first months of 1970. 1). Because of the relatively low sea water temperatures in February 1970 (mean temperature at the Lightvessel "Texel" 3.89 °C, versus 4.48 °C in February 1969), rather high landings of consumption-shrimps were expected for October 1970. This expectation was strengthened by the relatively high numbers of shrimp larvae along the Dutch coast in the first half of 1970, compared with the same period in 1969 (fig. 1). The "Young Fish and Brown Shrimp Survey" carried out in September 1970, during which the inshore and coastal waters of the Netherlands were simultaneously investigated by several research vessels, gave information about the stock of brown shrimp in that month. In the Western Waddensea the stock of brown shrimp of 40 - 54 mm length was 60% larger and those of shrimps of 54 - 67 mm length at least 40% larger in September 1970 than in September 1969.

Further offshore, with the exception of the area off the islands Texel, Vlieland and Terschelling, both categories of shrimps appeared to be considerably more abundant than in September 1969. In the Zealand estuaries the stock of shrimps of 54 - 67 mm length was more than twice as large as in September 1969.

Considering these data, the landings of consumption shrimps in October 1970 (924 tons) were very disappointing, compared with the landings in October 1969 (1213 tons). Some factors, however, have to be taken in account. In October 1970 the total number of fishing days made by shrimp boats (2635) was considerably smaller than in October 1969 (3327) and the fishing for undersized shrimps in the summer months had considerably decreased. Under normal conditions both factors should have resulted in an increase of the catch per fishing day, but only in some of the northern harbours, c.q. Harlingen and Zoutkamp, and on the fishing ground off the Danish coast (Sylt area) the catch per fishing day was higher in October 1970 than in October 1969; but the increment was smaller than expected. In November 1970 the catch per fishing day began to decline sharply in all fishing areas (table 1). From these figures the conclusion has to be drawn that an abnormally high natural mortality must have reduced the stock of brown shrimp along the coast of the Netherlands in the autumn and winter of 1970, up to the first half of 1971.

The stock of Cod

From a comparative research of the factors which could be held responsible for the observed decline of the shrimp stock, it became likely that the very strong 1969 and 1970 yearclasses of cod was the predominant one. This view was affirmed by German reports 2). Data on the quantitative composition of the food of Cod in the Dutch coastal area in the years 1968 - 1971 were available. In fig. 2 these data are combined, giving the percentual weight composition of the food of cod per lengthgroup of 10 cm. Fig. 2 clearly shows the importance of brown shrimps as food for cod, in particular for specimens under 30 cm. (In the Dutch coastal waters the stock of shrimp species other than Crangon crangon is negligible). An important point is the increment of the stomach contents with the size of the cod.

The mean weight of the shrimps per stomach increases from 0.1 gram, at a cod-length of 0-10 cm, to 1.5 gram for cods of 60-70 cm.

Preliminary results of aquarium experiments give rise to the assumption that the mean stomach content is about twice the amount of food consumed per day. Figure 3 clearly shows the remarkable strength of the 1969 cod yearclass in comparison with the yearclass 1968, whereas yearclass 1970 is also a very strong one. An estimate was made of the total cod-stock in the Dutch coastal area and in the German Bight in the winters 1968, 1969 and 1970, based on data derived from the analysis of the commercial landings and of the international young fish surveys with the herring-trawl in the months February - March 1968 - 1971. These data were used to calculate the total amount of shrimp consumed by the cods of these yearclasses. The results are given in table 2 and 3.

#### The shrimp stock

The data on the shrimp fisheries and on the stock of cod in the years 1969 - 1970 make it possible to deduce the course of the shrimp stock from September 1969, when the enormous yearclass 1969 of cod appeared in the coastal area of the Netherlands, up till August 1971. In September 1969 the juvenile cods, born in that year and about 10 cm long, sojourned North-East of Terschelling as only a small part of this cod stock entered the Waddensea and since these very small cods prefer fry of brown shrimp (and of other Crustaceans), no traceable harm to the shrimp-stock was done in that period. In the winter of 1969 - 1970 the main body of the 1969 cod yearclass (then about 17 cm long) occurred along the Dutch coast north of Hook of Holland. The shrimps preferably eaten by cod of some 17 cm have a length of 35 - 45 mm, considerably smaller than consumption shrimps (minimum length 54 mm). This selective predation of the shrimp stock by the juvenile cods explains the good catches of consumption shrimps per fishing day during this period (table 1) in spite of the huge quantities of shrimp eaten by the cod stock (table 2 and 3). Since most of the berried females are longer than the length-category of shrimps predated upon by cods of 17 cm, the production of shrimp larvae was in the first months of 1970 upon high. (fig. 1 and 4).

The shrimps of 35 - 45 mm long, so intensively predated upon during the winter of 1969 - 1970, reached the size of consumption shrimps around July 1970. Due to the high natural mortality of this group, catches of consumption shrimps were low in July and August 1970, especially along the coast of Holland (Scheveningen and IJmuiden) and in the Western Waddensea (Den Oever) (fig. 1) though at that time practically no juvenile cod were present in this area! Catches per fishing day rose sharply in September 1970 when the numerous shrimp larvae born in January - April 1970 began to reach the size of consumption shrimps. The catches per fishing day made by coastal shrimp fishermen from Den Oever rose from 75 kg in July and 96 kg in August to 286 kg in September and 335 kg in October. This favourable development ended abruptly when, the cods returned to the Dutch coastal area at the onset of the winter 1970 - 1971. This was the yearclass 1969, now some 30 cm long mixed with the strong yearclass 1970 (then some 17 cm long). The collective predation by both these two yearclasses had a disastrous effect on the shrimp stock. The cod-yearclass 1969 preyed upon shrimps of about the same size as caught by the fleet, including the stock of berried females, resulting in very low catches per fishing day in the first 5 months of 1971 and in an extremely small production of shrimp larvae along the Dutch coast in January 1971 (fig. 4) and in inshore waters in April 1971. (fig. 5). In June 1971 the production of shrimp larvae in the Dutch inshore waters increased markedly (fig. 5), indicating that the predation upon small shrimps by the 1970 cod-yearclass in the winter of 1970 - 1971 was of lesser importance than the losses suffered by the consumption shrimps. This was confirmed by the results of the "Young Fish and Brown Shrimp Survey" carried out in August 1971, covering the Netherlands part of the Waddensea, the Zealand estuaries, the Netherlands inshore area and the open sea off the coasts of the Netherlands, Germany and the southern part of Denmark. On a total number of 287 15 minutes hauls with a 3 meter shrimp-beamtrawl made by 4 different research-vessels, 1.579 specimens of brown shrimp over 67 mm long 179.122 specimens of 54-67 mm and 1.839.795 specimens under 54 mm were caught. Considering the fact, that brown shrimps over 67 mm caught in August are at least 11 months old, the mortality indicated by these figures is so

high that a continuing production of very strong cod-yearclasses in the years to come will make fishing for brown shrimp in the North Sea an unprofitable business.

References:

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I.C.E.S. C.M. 1970/K
- 2). Tiews, K.      Reiche Kabeljaunachwuchsjahrgänge dezimieren Nordseegarnalen-  
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Informationen für die Fischwirtschaft, 18(1971) 3, 92-93
- 3). Boddeke, R.  
and Daan, N.      Waar zijn de garnalen gebleven?  
Visserij.

TABLE 1

Catches per fishing day in different areas, mean catches per month in 1969, 1970 and 1971.

	German - Danish Coast			Waddensea - inshore						Holland - Coast						Zealand		
	Den Oever, Sylt			Zoutkamp			Harlingen			Den Oever Coast			Scheveningen			Colijnsplaat		
	1969	1970	1971	1969	1970	1971	1969	1970	1971	1969	1970	1971	1969	1970	1971	1969	1970	1971
January	489	518	260	57	404	195	115	288	158	126	341	137	178	533	118	226	430	91
February	335	478	229	122	483	118	75	146	56	124	167	73	172	266	97	145	450	62
March	342	445	80	98	189	46	61	122	35	95	154	39	111	291	71	55	247	63
April	318	763	69	120	149	22	105	93	34	113	136	37	219	288	88	84	141	59
May	360	958	76	113	187	32	128	130	54	123	227	55	200	440	---	109	234	24
June	286	801	---	112	266	52	135	92	92	181	155	89	---	389	17	155	168	43
July	264	445		147	199		138	167	---	234	75		49	---		164	310	
August	270	400		157	209		162	130	---	219	96		---	---		180	471	
September	892	403		239	269		222	111	---	265	286		238	---		229	345	
October	318	633		229	346		178	248	---	503	335		613	240		296	294	
November	550	507		309	258		288	278	---	441	315		636	407		251	215	
December	1210	340		351	175		273	198	---	448	218		615	251		292	242	

TABLE 2

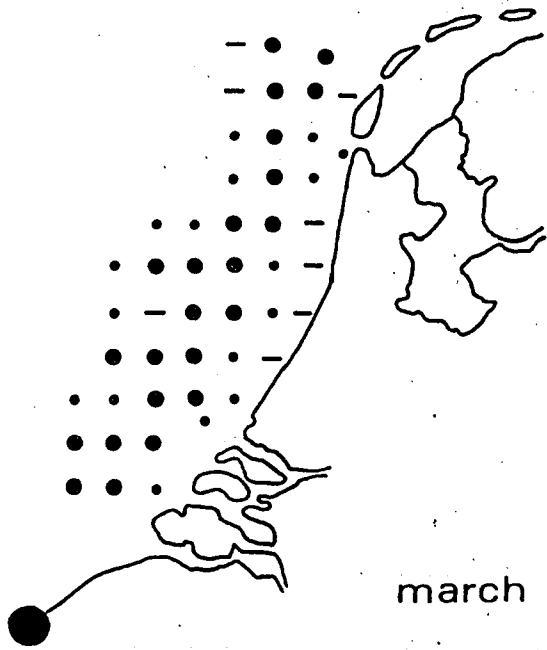
The commercial stock of Cod and the amount of Brown Shrimp consumed in the winter of 1968, 1969 and 1970.

	A	B	C	D
	Agegroup	Yearclass	Stock in millions of specimens	Total amount of Brown Shrimp consumed in six wintermonths (tons).
	=====	=====	=====	=====
Winter	II	1966	14.2	907
1967/1968	III	1965	5.3	558
	IV and older	1964 and older	1.3	44
				+
Total .....				1.509
Winter	II	1967	2.1	134
1968/1969	III	1966	4.6	484
	IV and older	1965 and older	2.1	72
				+
Total .....				690
Winter	II	1968	8.1	518
1969/1970	III	1967	1.4	148
	IV and older	1966 and older	3.1	106
				+
Total .....				772

TABLE 3

The stock of juvenile Cod and the amount of Brown Shrimp consumed in the winters of 1968, 1969, 1970 and 1971.

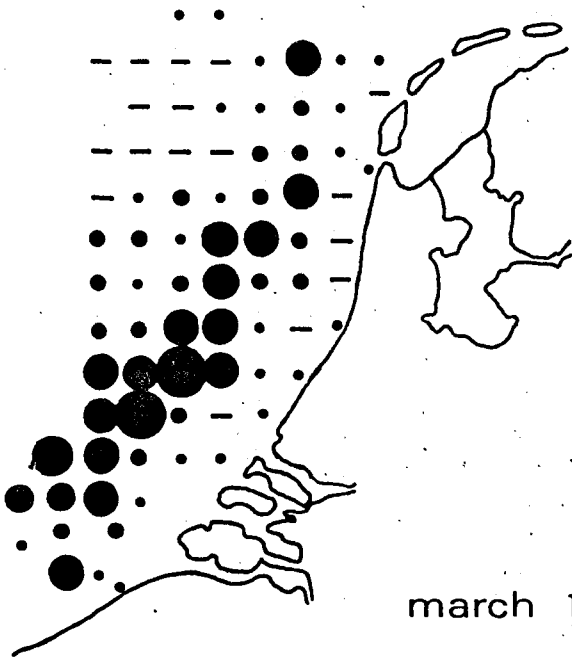
	A	B	C	D	E
	Yearclass	Index for yearclass-strength in the Dutch coastal area (Febr. surveys)	Stock in millions	Amount of t Brown Shrimp consumed (in tons) in six wintermonths	Total consumed by all cod
	=====	=====	=====	=====	=====
Winter 1967/1968	1967	(1.4)	2	54	1.563
Winter 1968/1969	1968	1	8	216	906
Winter 1969/1970	1969	28	200	5.400	6.172
Winter 1970/1971	1970	12	100	2.700	>2.700



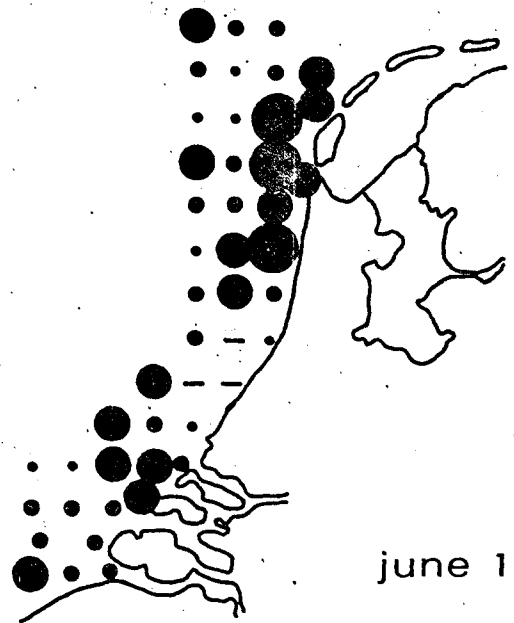
march 1969



june 1969



march 1970



june 1970

- 0
- 1-5
- 6-25
- 26-125
- > 125

SHRIMPLARVAE UNDER  $1 \text{ M}^2$  ALONG  
THE NETHERLANDS COAST IN MARCH  
AND JUNE OF THE YEARS 1969 AND  
1970.

fig 1

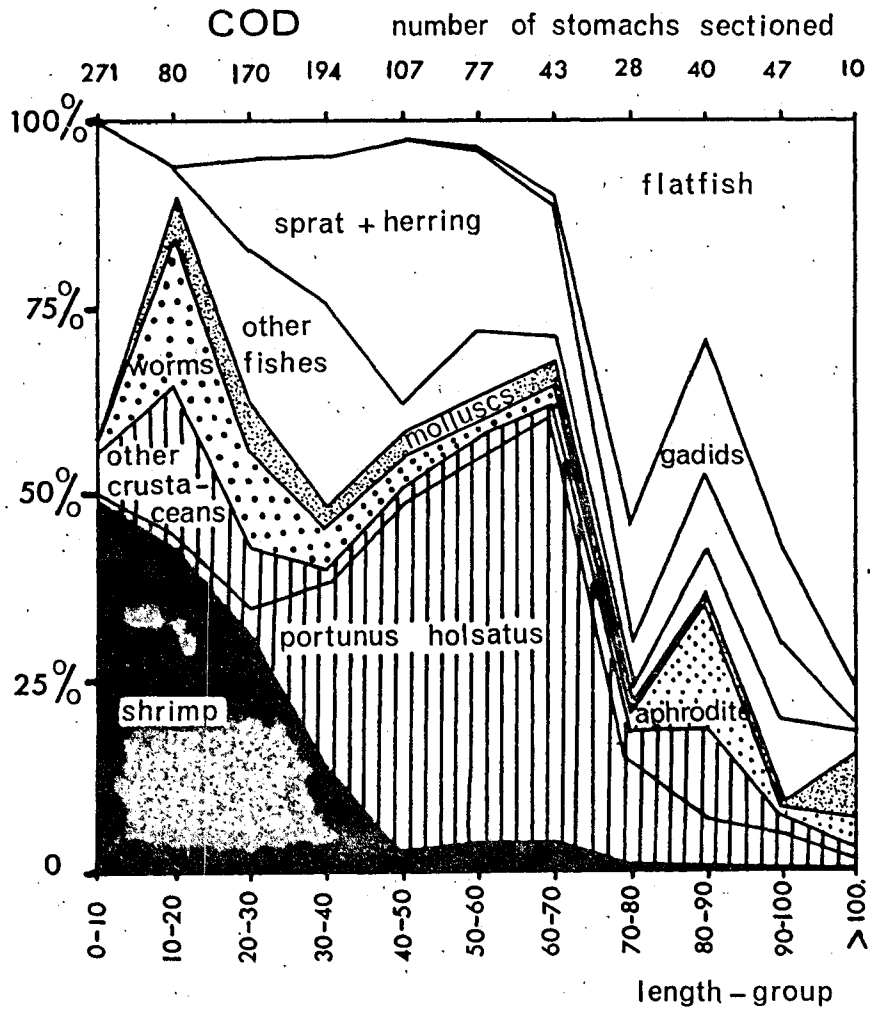
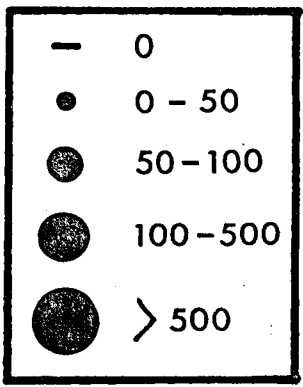
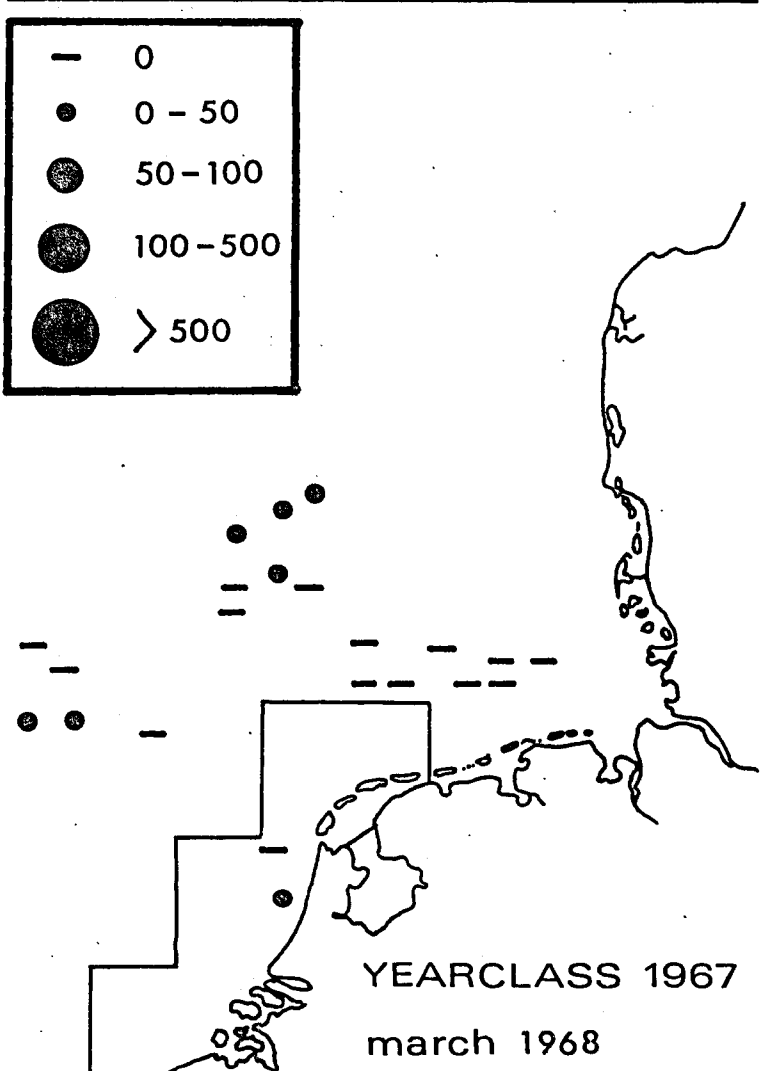
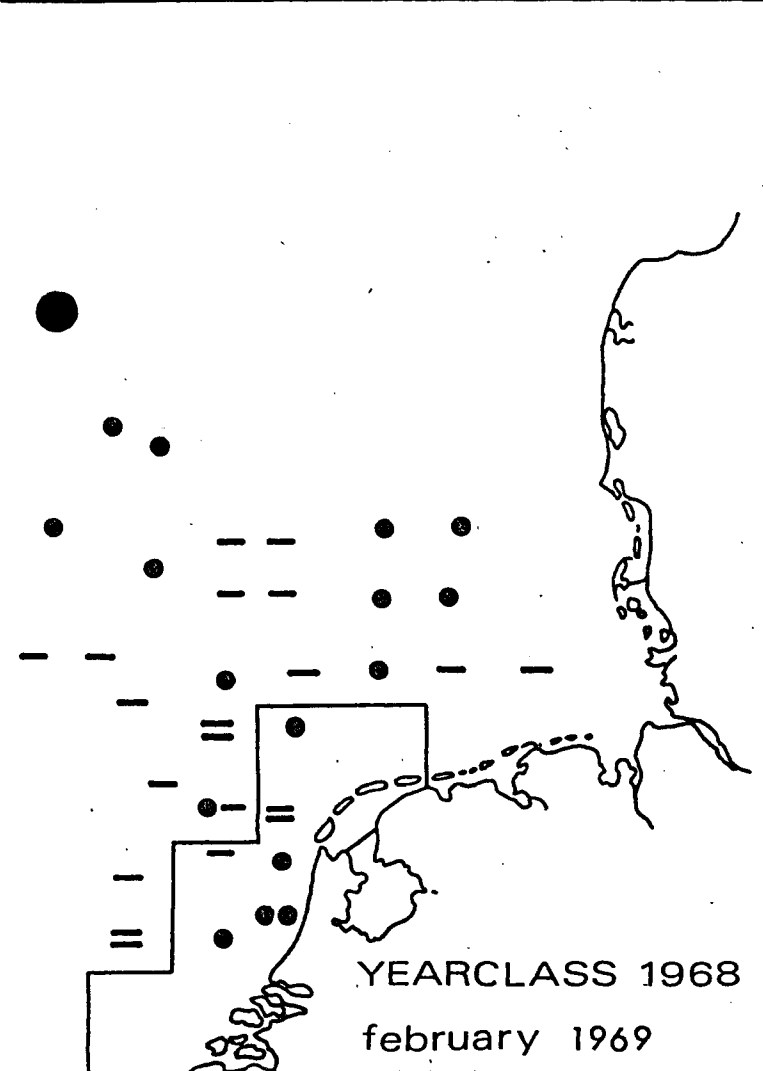
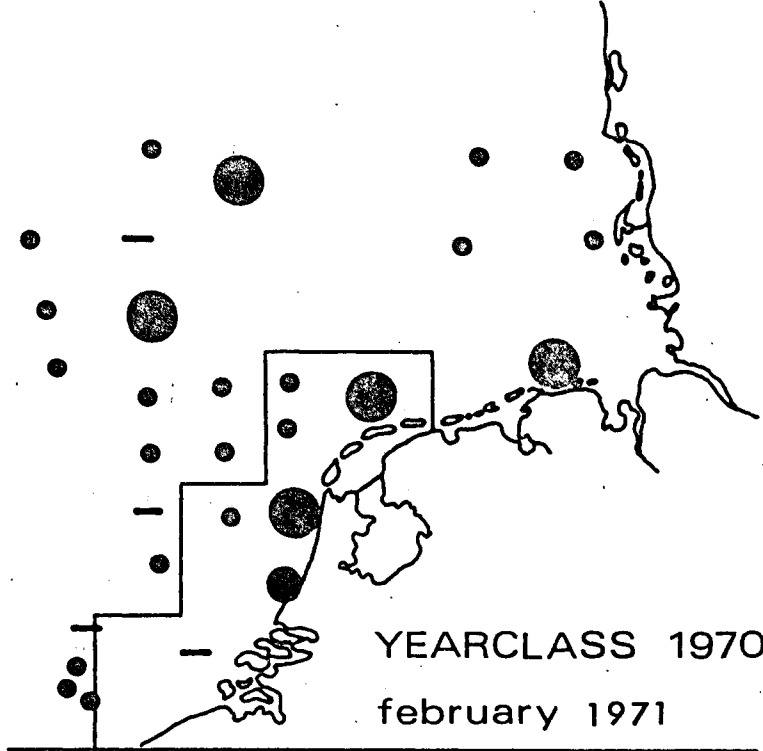
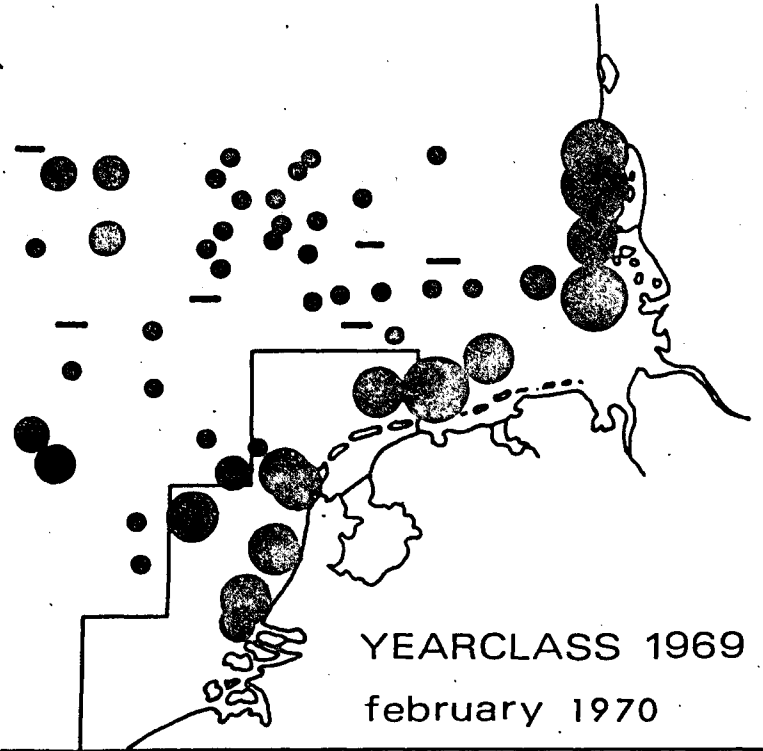
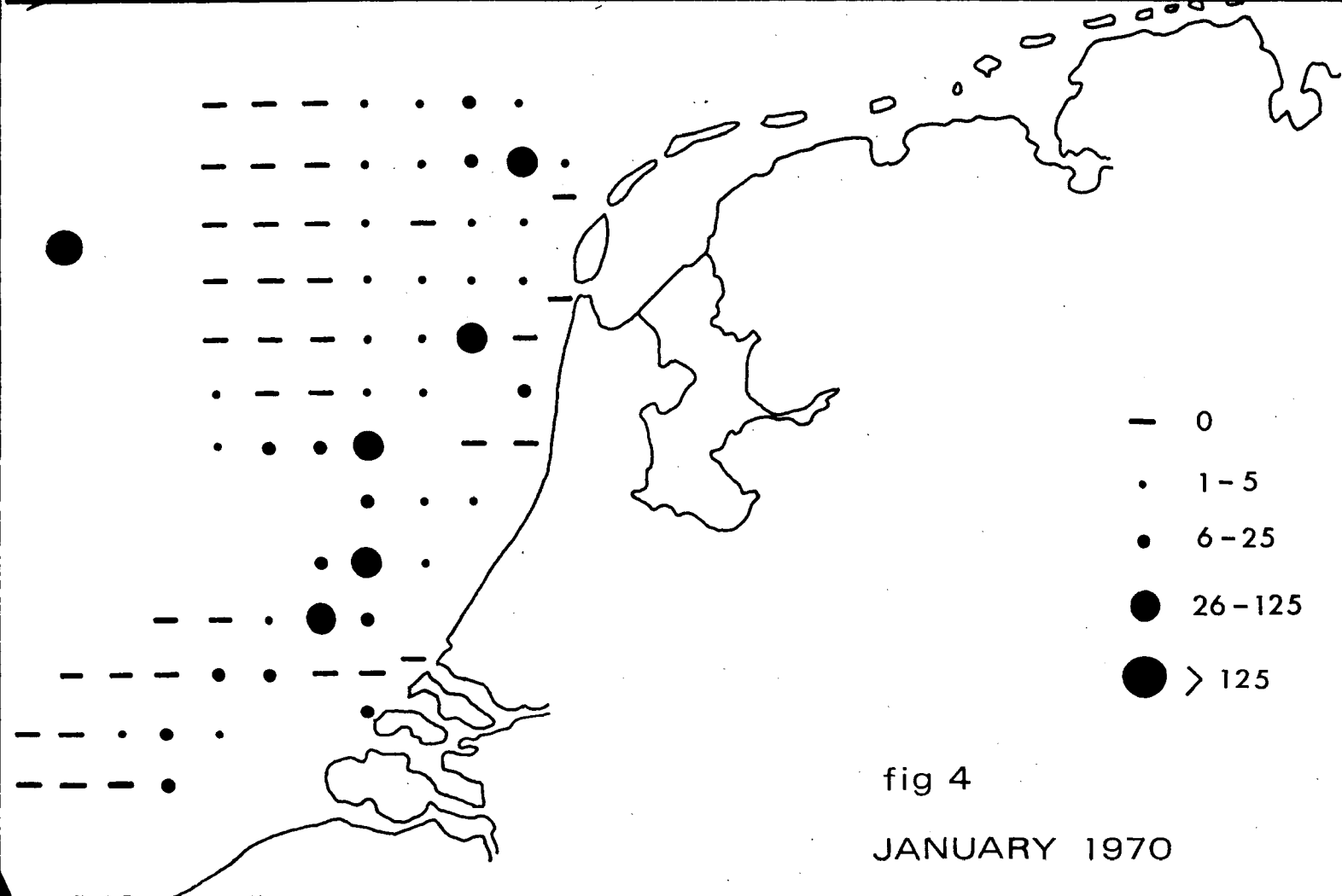
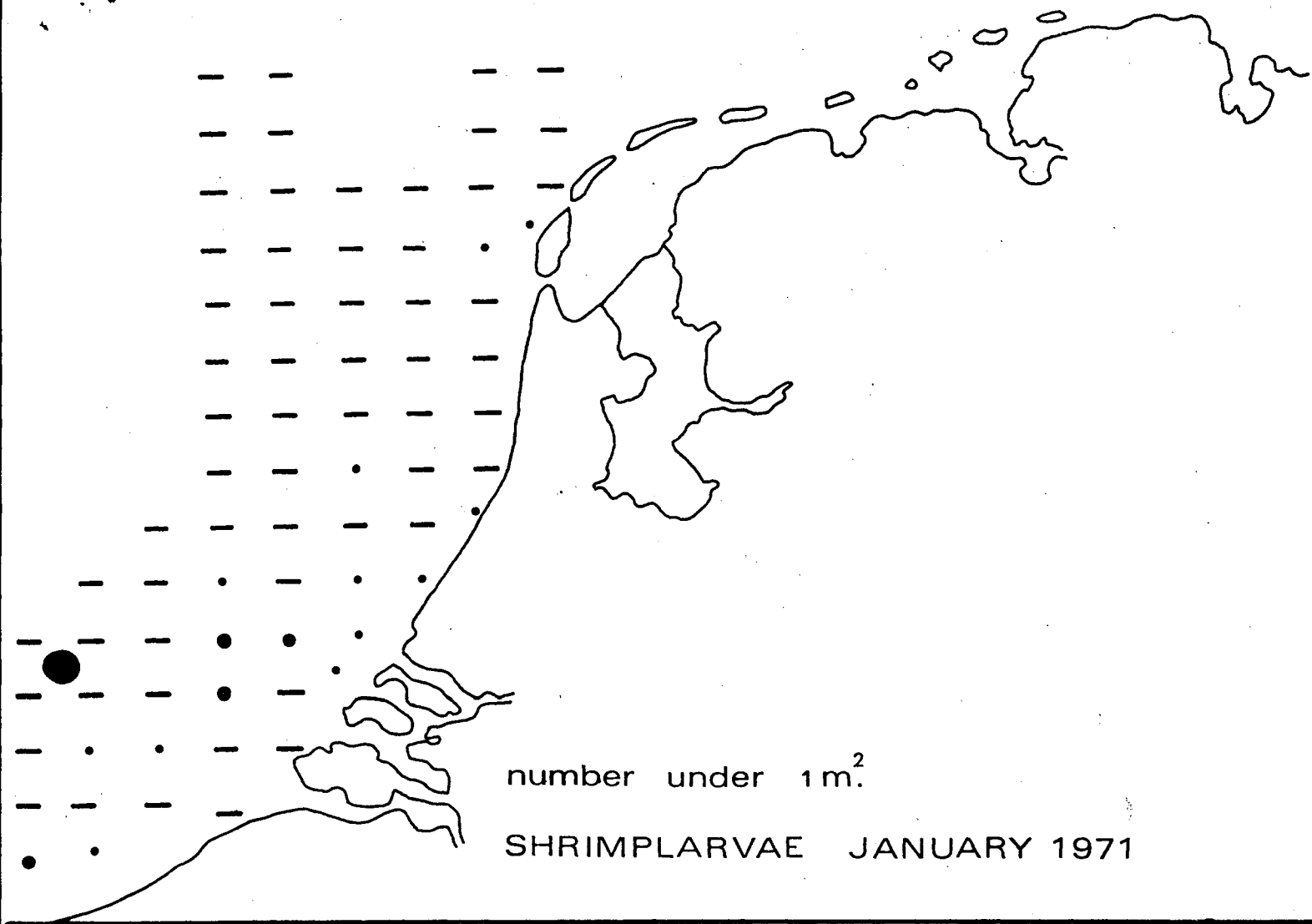


fig 2



NUMBER OF 1 YEAR OLD COD PER/HOUR FISHING.





# WESTERN WADDENSEA

NUMBER OF LARVAE UNDER 1M.<sup>2</sup>

