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MATHEMATICAL MODEL OF THE
POLLUTION IN THE NORTH SEA

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FURTHER RESULTS ON THE EFFECTS OF DUMPED ORGANIC INDUSTRIAL WASTE
DERIVING FROM THE PRODUCTION OF PROTEOLYTIC ENZYMES ON DENSITY AND
DISTRIBUTION OF FISH AND SHRIMPS

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INTRODUCTION.

In a previous report (1) the effects of dumped industrial waste from the production of proteolytic enzymes on the fish and shrimp stocks were investigated. This report describes the further results of these investigations covering the period december 1972 - August 1973. During this second period trawling experiences on and around the dumping ground were carried out in order to study further the densities and distribution of fish and shrimps.

MATERIAL AND METHOD.

Monthly series of hauls were carried out by the R.V. "Hinders". From the results of the first report, it became clear that only two reference stations south of the dumping area were necessary instead of four. In addition two new reference stations north of the dumping area were chosen (figure 1). The same methods of sampling and of expressing the data as during the first experiment were used.

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RESULTS.

These investigations confirmed again the predominance of shrimps and whiting in the area. For this reason the results of the densities of both species have been set out on figures 2 and 3. The data concerning the other commercial fishes are listed in the tables 1 to 4.

The main conclusions of this study can be described as follows :

- Shrimps - The density of undersized and sized shrimps was generally higher in the dumping area. This phenomenon, ascertained during the first experiment, was this time more pronounced for the undersized than for the sized shrimps.

- Whiting - Large quantities of undersized whiting in the dumping area were again present. The ratio as against the reference area was 2.0. The occurrence of dense whiting concentrations in the dumping area must be contributed to the fact that shrimps constitute the major part of the food intake by undersized whiting (2)(3). The amount of sized whiting was in both areas too small to draw any conclusions.

- Plaice, dab, sprat and sole - The general picture of the densities of plaice, dab, sprat and sole along the Belgian coast was one of overall low density (4)(5). Due to this fact no reliable stock density comparisons between the dumping area and the reference area, as listed in tables 1 to 4, could be made.

- Other marine organisms - A quantitative investigation of the other marine organisms (5) indicated a notable higher concentration in the dumping area of common starfish (*Asterias rubens* L.) in the order of 1.5 times more, of brittle-star (*Ophiura texturata* L.) in the order of 8.0 times more and of common hermit crab (*Pagurus bernhardus* L.) in the order of 9.0 times more.

CONCLUSIONS.

This second approach to the knowledge of the effects of dumped organic waste on the fish and shrimp stocks confirmed the earlier findings and proved the fact that the waste had no negative effects.

The densities of shrimps, whiting, common starfish, brittle-star and common hermitcrab were generally higher in the dumping area than in the reference area.

REFERENCES.

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- (2) R. De Clerck, 1973 - Studie van de vis- en garnaalpopulaties in de visgronden van het "Westdiep" gedurende de periode mei 1970 - mei 1972. Comm. T.W.O.Z. doc. 73/46 (in druk).
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Table 1 - The densities of plaice (*Pleuronectes platessa* L.) in numbers per hour fishing.

Month	Undersized		Sized	
	Dumping area	Reference area	Dumping area	Reference area
December	4	10	20	13
January	-	6	-	1
March	-	4	16	1
April	-	-	6	3
May	4	4	64	22
June	52	41	52	20
August	-	6	-	20

Table 2 - The densities of dab (*Limanda limanda* L.) in numbers per hour fishing.

Month	Undersized		Sized	
	Dumping area	Reference area	Dumping area	Reference area
December	20	55	32	35
January	28	22	-	14
March	-	2	-	-
April	12	35	-	23
May	-	15	-	5
June	96	35	36	4
August	4	8	-	-

Table 3 - The densities of sprat (*Sprattus sprattus* L.) in numbers per hour fishing.

Month	Undersized	
	Dumping area	Reference area
December	40	41
January	164	86
March	-	3
April	-	11
May	4	13
June	8	204
August	56	36

Table 4 - The densities of sole (*Solea solea* L.) in numbers per hour fishing.

Month	Undersized		Sized	
	Dumping area	Reference area	Dumping area	Reference area
December	4	8	-	-
January	-	5	-	-
March	-	3	-	-
April	-	1	-	-
May	8	6	12	2
June	-	7	-	1
August	16	50	-	4

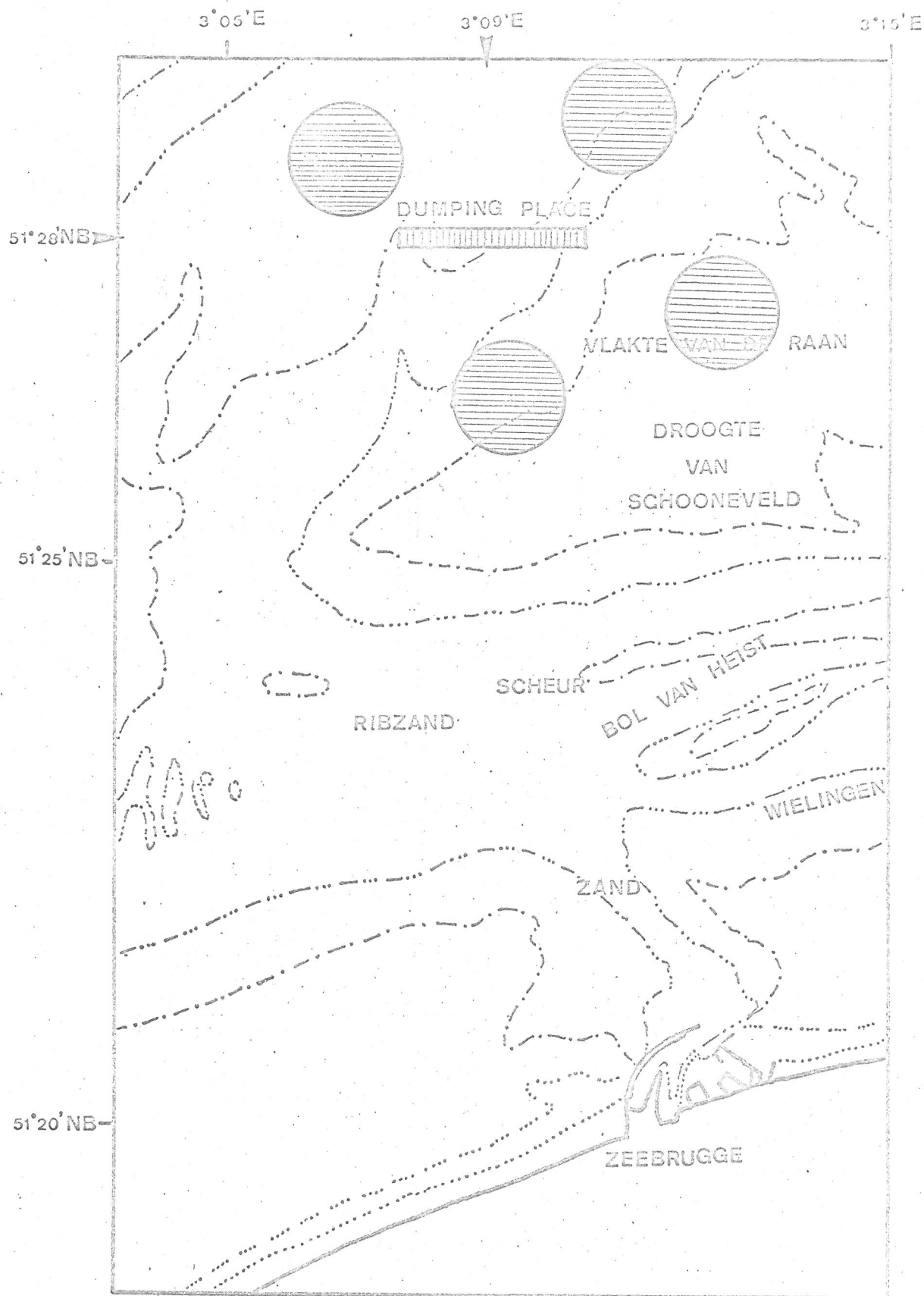


Figure 1 - Position of the dumping place and the 5 sampled stations.

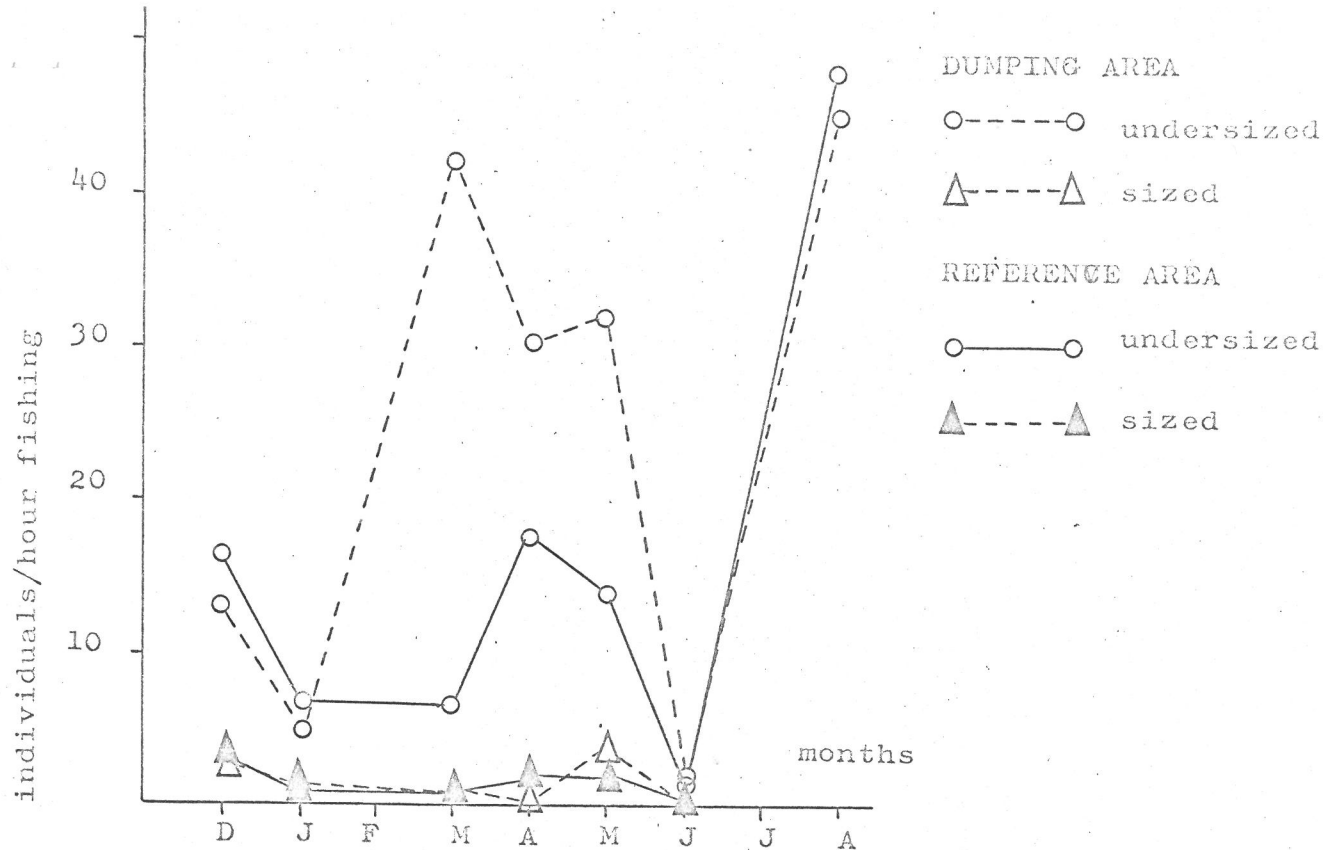


Figure 2 - Distribution and density of shrimps

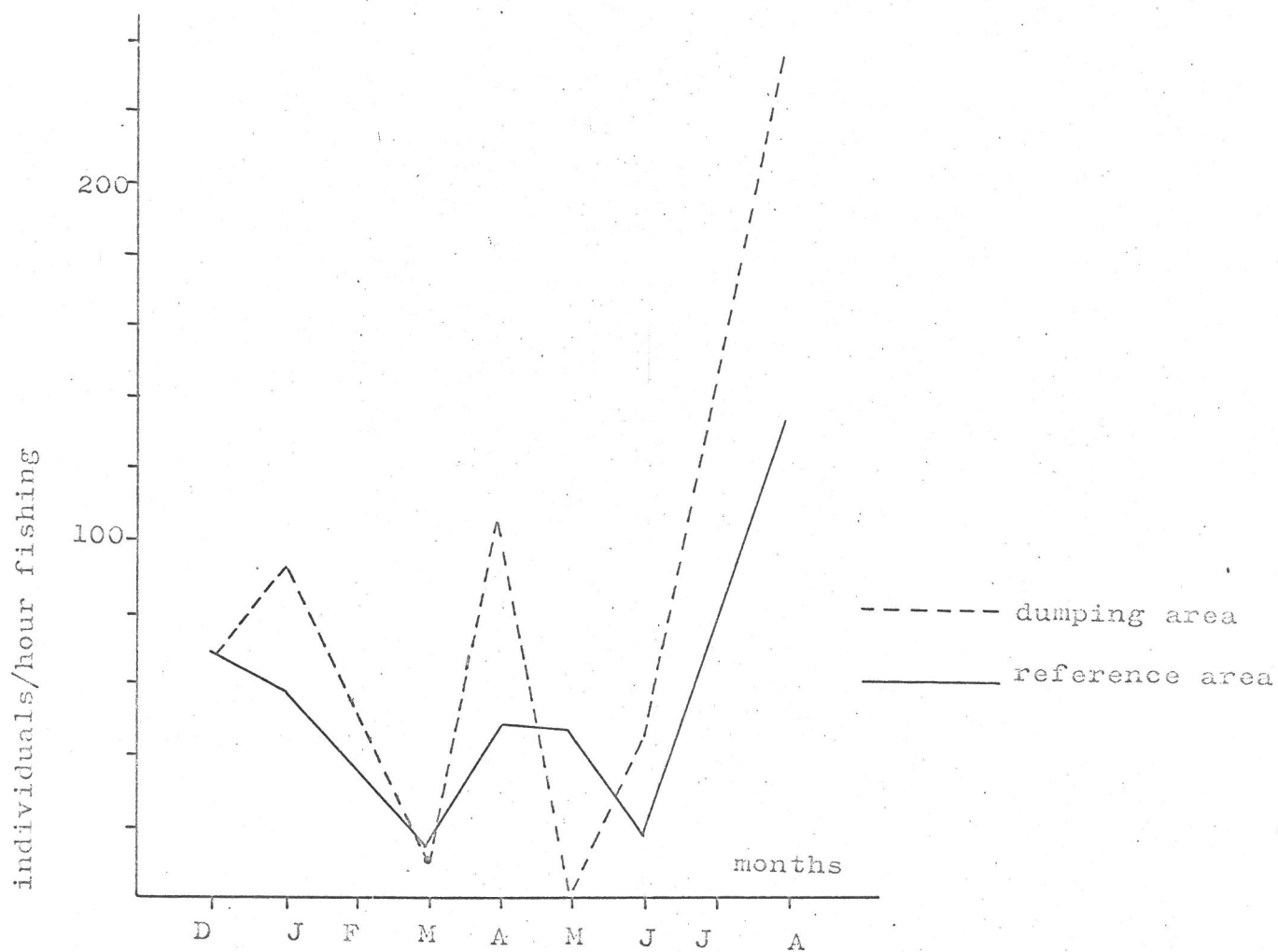


Figure 3 - Distribution and density of undersized whiting.