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Biological description of a dumping area for industrial
waste derived from a titanium dioxide process

by

R. De Clerck and J. Van de Velde (*)
Fisheries Research Station, Ostend, Belgium

INTRODUCTION

In March 1970, the Ministry of Communications issued a permit for the dumping of industrial waste derived from the production of titanium dioxide of a factory located in Antwerp.

Research was carried out on the density and distribution of fish, fish plankton and shrimps in the dumping area and the results are summarized in this report. As regards the study of invertebrates reference can be made to paper C.M. 1974/K :22.

As the investigations are only in an early stage, this report must be considered more as descriptive rather than conclusive.

DUMPING METHOD AND CHARACTERISTICS OF THE WASTE

Actually, the dumping takes place in an area with a radius of 1.5 miles, the centre of the area being 51°30' N - 3°00'E (figure 1).

The dumping is carried out in the wake of the ship in order to dilute the waste as much as possible. The pumping rate is about 750-900 tons/hour.

From year to year the quantity of the dumped material increased nearly constantly (figure 2). In the second half of 1973 138,000 tons of waste were dumped against 62,874 tons in the second half of 1970. Approximately 1,500 tons is dumped every two or three days. The composition of the waste is as follows (figures from the factory).

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H ₂ SO ₄	: 18 - 25 %	Mn	: 0.02 - 0.03 %
Fe	: 1 - 2 %	Va	: 0.02 - 0.03 %
Al	: 0.2 - 1 %	Cr	: 0.02 %
Mg	: 0.2 - 0.8 %	Ca	< 0.01 %
Ti	: 0.05 - 0.2 %		

in suspension : 0 - 2.1 % of which $\pm$ 50-60 % SiO₂

: $\pm$ 20-22 % TiO₂

: $\pm$ 0-20 % Al₂O₃ and undissolvable compounds of Fe, Mg and Ca

DISTRIBUTION AND DENSITY OF FISH, FISH PLANKTON AND SHRIMPS

1. Material and methods.

During the period March 1973 - March 1974 monthly series of hauls were carried out by the R.V. "Hinders" on four stations in the dumping area (figure 1). The catch resulting from a 15 minutes' haul was sampled. Fishing took place with an otter trawl (mesh size 18 mm) during day time.

From March till December 1973 fish plankton samples have been taken by means of a Dutch type Gulf Sampler. During sampling the speed of the vessel was about 1.5 knots.

2. Results.

2.1. Commercial fish.

The dumping area has been determined in a zone where scarcely any fishing took place in the past. For this reason a permanent but unimportant fish stock could be expected and was indeed present on the dumping ground. The observed species were the following : plaice (Pleuronectes platessa L.), dab (Limanda limanda L.), flounder (Pleuronectes flesus L.), cod (Gadus morhua L.), whiting (Merlangus merlangus L.), sole (Solea solea L.), mackerel (Scomber scombrus L.), horse mackerel (Trachurus trachurus L.), sprat (Sprattus sprattus L.), tub gurnard (Trigla lucerna L.), garfish (Belone bellone L.), pout (Gadus luscus L.), roker (Raya clavata L.), tope (Galeorhinus galeus L.), bull rout (Myoxocephalus scorpius L.), lumpsucker (Cyclopterus lumpus L.), twaite shad (Clupea finta Cuv.) and lemon sole (Pleuronectes microcephalus Danov.).

The quantitative analysis given in table 1 during the period under review indicates that

- the highest concentrations of whiting were found during August (319 species/h.f.) and during February (350 species/h.f.).
- the 0-group soles had a maximum during October.
- a maximum density of 150 0-group dabs/h.f. occurred in October.
- pout and sprat were very abundant.

It must also be taken into account that no dead, affected or damaged fish were ever reported.

2.2. Commercial fish plankton.

From table 2 it is clear that the dumping area is relatively important as spawning area for sprat. From March to June the numbers of sprat eggs and sprat larvae exceeded 50 % of the total numbers of fish eggs and larvae (table 3).

Sole eggs appeared mainly in April and May. Sole larvae however had their maximum in May (table 2 and 3).

The remaining commercial species turbot (Rhombus maximus L.) and anchovy (Engraulis encrasicolus L.) appeared very temporarily (table 2 and 3).

2.3. Non-commercial fishes.

The by-catch analysis showed the presence of dragonet (Callionymus lyra L.), sand goby (Pomatoschistus minutus Pallas), hook-nose (Agonus cataphractus L.), transparent goby (Aphia minuta Risso) and sea snail (Liparis liparis L.).

2.4. Non-commercial fish plankton.

As shown in table 3 the larvae of sand goby were quantitatively the most important.

Eggs and larvae of horse mackerel appeared very temporarily (table 2 and 3).

The densities of eggs of flounder, rockling spec. (Onos spec.) and dragonet were rather unimportant.

2.5. Shrimps.

The highest concentrations were found in August with 65,500 undersized and 6,500 sized shrimps per h.f. (table 1).

SUMMARY

The study gives the first results of investigation on the density and distribution of fish, fish plankton and shrimps in a dumping area for industrial waste derived from a titanium dioxide process. Taking into account the numerous interactions of other abiotic influences (currents, hydrological and meteorological conditions) further research on this problem will be continued in order to determine the long-term effects of the dumping.

Table 1 - The densities of the commercial fish and shrimp stocks per station and per month

Station and month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
<u>Station 44</u>																				
73/III	34.470	-	-	12	4	8	4	-	-	12	-	4	-	12	-	-	-	-	-	-
IV	16.061	-	-	-	-	4	-	-	-	-	4	-	-	4	-	-	-	-	-	-
V	21.920	-	-	-	-	12	4	-	-	-	-	4	-	4	-	-	-	-	-	-
VI	3.232	60	24	-	-	36	16	532	208	-	8	16	-	60	-	-	-	-	-	-
VIII	6.560	8	-	-	-	632	16	-	-	4	12	-	-	1.260	8	-	-	-	-	-
X	57.932	20	268	-	8	44	100	-	-	-	24	4	-	60	-	4	-	-	-	-
XI	13.860	9	42	3	-	12	-	-	-	-	24	-	-	12	-	-	3	-	-	-
XII	17.120	24	40	8	-	20	-	-	-	8	104	-	-	8	-	-	-	-	-	-
74/I	10.740	32	8	12	4	48	-	-	-	8	40	-	-	88	-	-	-	-	-	-
II	2.224	20	52	28	-	336	-	-	-	32	24	-	-	392	-	-	-	-	-	-
III	4.384	4	4	16	4	8	16	-	-	-	12	-	-	12	-	-	-	4	-	-

<u>Station 45</u>																				
III	16.632	4	-	-	-	16	16	-	-	-	-	-	-	24	-	-	-	-	-	-
IV	26.142	8	-	-	-	20	4	-	-	-	4	-	-	-	-	-	-	-	-	-
V	29.160	4	4	-	-	12	20	-	-	-	-	-	-	-	-	-	-	-	-	-
VI	13.520	44	12	-	-	64	12	-	12	-	4	4	-	124	-	-	-	-	-	-
VIII	192.096	36	-	8	-	212	36	12	4	4	8	-	-	456	-	4	-	-	-	-
X	118.498	8	156	8	-	72	148	-	-	-	8	12	-	68	-	-	-	-	-	-
XI	792	-	4	-	-	-	4	-	-	-	8	-	-	16	-	-	-	-	-	-
XII	14.560	16	32	8	-	40	8	-	-	-	748	-	-	28	-	-	-	-	-	-
74/I	4.128	-	-	8	-	4	-	-	-	12	28	-	-	-	-	-	-	-	-	8
II	5.520	40	96	12	-	668	-	-	-	4	8	-	-	144	-	-	-	-	-	4
III	7.328	-	8	-	4	-	12	-	-	16	64	-	-	24	-	-	-	-	-	-

1 : shrimps

2 : plaice

3 : dab

4 : flounder

5 : cod

6 : whiting

7 : sole

8 : mackerel

9 : horse mackerel

10 : herring

11 : sprat

12 : tub gurnard

13 : garfish

14 : pout

15 : roker

16 : tope

17 : bull rout

18 : lumpsucker

19 : twaite shod

20 : lemon sole

Station and month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
<u>Station 46</u>																				
73/III	31.760	-	-	-	8	56	4	-	-	-	-	-	-	-	-	-	-	-	-	-
IV	27.174	12	-	8	-	92	-	-	-	-	-	-	-	-	-	-	-	-	-	-
V	54.400	12	4	4	8	72	12	-	-	-	-	4	-	28	4	-	-	-	-	-
VI	3.920	32	4	60	-	64	4	-	24	-	-	16	-	52	-	-	-	-	-	-
VIII	54.800	20	-	28	288	148	20	28	12	-	24	-	-	168	-	-	-	-	-	-
X	32.677	24	132	-	12	52	80	-	4	-	4	24	4	68	-	-	-	-	-	-
XI	13.920	4	-	8	8	44	-	-	-	-	20	4	-	36	-	-	-	-	-	-
XII	24.640	20	40	-	4	48	-	-	-	12	424	-	-	16	4	-	-	-	-	-
74/I	23.040	16	24	8	4	36	124	-	-	-	-	-	-	28	-	-	-	-	4	-
II	5.984	28	32	-	12	304	-	-	-	-	-	-	-	-	-	-	-	-	-	-
III	10.080	4	-	-	-	4	68	-	-	-	-	-	-	40	-	-	-	-	-	-

<u>Station 47</u>																				
73/III	26.160	4	4	20	-	12	4	-	-	-	-	-	-	32	-	-	-	-	-	-
IV	9.157	-	8	-	4	-	-	-	-	-	8	-	-	8	-	-	-	-	-	-
V	29.016	-	-	-	-	24	12	-	-	-	-	4	-	-	-	-	-	-	-	-
VI	2.320	24	-	4	-	92	-	4	240	-	-	96	-	16	-	-	-	-	-	-
VIII	34.832	-	-	-	8	284	20	-	-	-	12	-	-	276	4	4	-	-	-	-
X		4	44	-	-	20	32	-	-	-	24	92	-	40	-	-	-	-	-	-
XI	22.304	-	-	8	-	16	-	-	-	-	44	-	-	8	-	-	-	-	-	-
XII	8.320	8	68	8	-	28	-	-	-	8	200	-	-	-	-	-	-	-	-	-
74/I	7.500	12	-	72	-	12	-	-	-	12	588	-	-	36	-	-	-	-	-	-
II	2.592	-	48	-	8	92	-	-	-	84	84	-	-	124	4	-	-	-	-	-
III	3.224	-	12	-	-	12	8	-	-	-	216	-	-	28	-	-	-	-	-	-

Table 2 - Average numbers of fish eggs per stations and per 1.000 m² during the period January - December 1973.

	<u>March</u>	<u>April</u>	<u>May</u>	<u>June</u>	<u>Aug.-Dec.</u>
<i>Sprattus sprattus</i> (L)	436	1.494	424	258	-
<i>Solea solea</i> (L)	-	14	13	-	-
<i>Platichthys flesus</i> (L)	7	-	-	-	-
<i>Onos</i> sp.	5	3	4	4	-
<i>Engraulis encrasicolus</i> (L.)	-	-	4	25	-
<i>Rhombus maximus</i> (L.)	-	-	5	-	-
<i>Caranx trachurus</i> (L.)	-	-	18	-	-
<i>Callionymus lyra</i> (L.)	-	-	3	-	-

Table 3 - Average numbers of fish larvae per stations and per 1.000 m² during the period January - December 1973

	<u>March</u>	<u>April</u>	<u>May</u>	<u>June</u>	<u>Aug.-Dec.</u>
<i>Sprattus sprattus</i> (L)	13	15	477	117	3
<i>Solea solea</i> (L)	4	2	15	4	-
<i>Pomatoschistus minutus</i> (Pallas)	6	-	-	17	30
<i>Caranx trachurus</i> (L.)	-	-	-	18	-

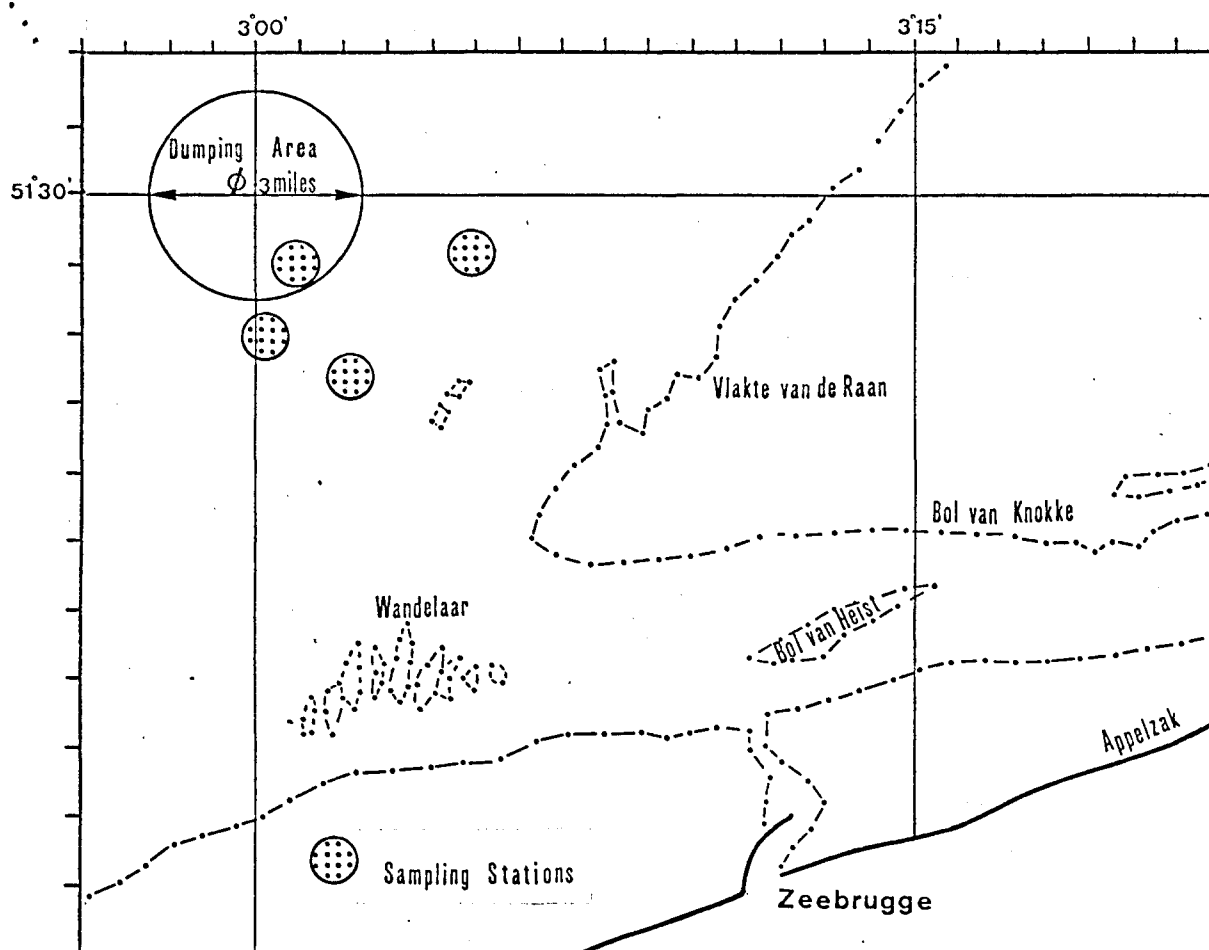


Figure 1 - Position of the dumping area and the sampling stations.

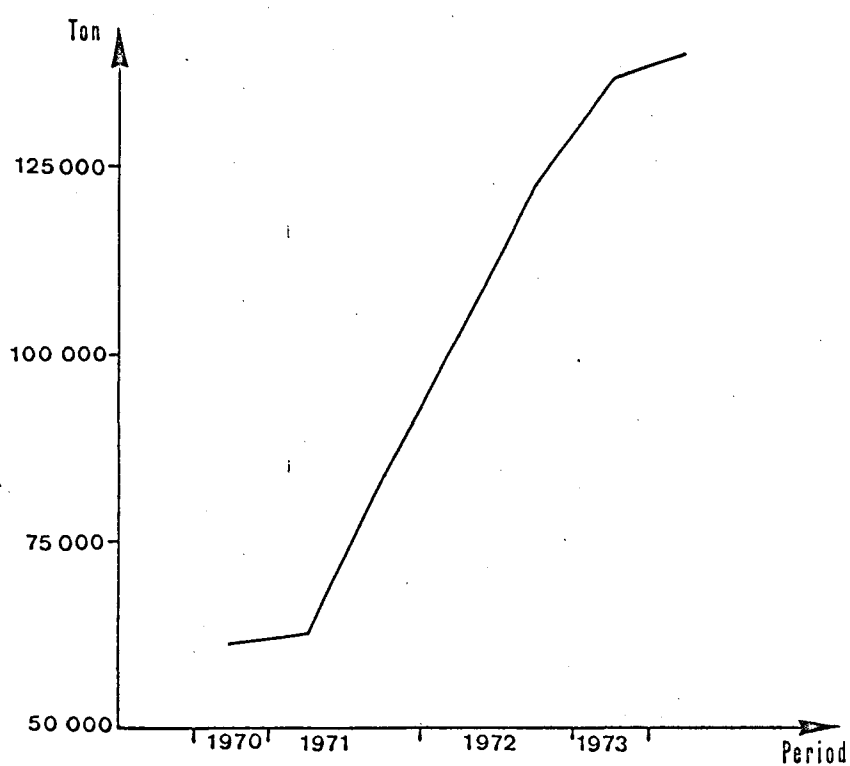


Figure 2 - The amount of dumped material during the period 1/7/1970 - 31/12/1973.