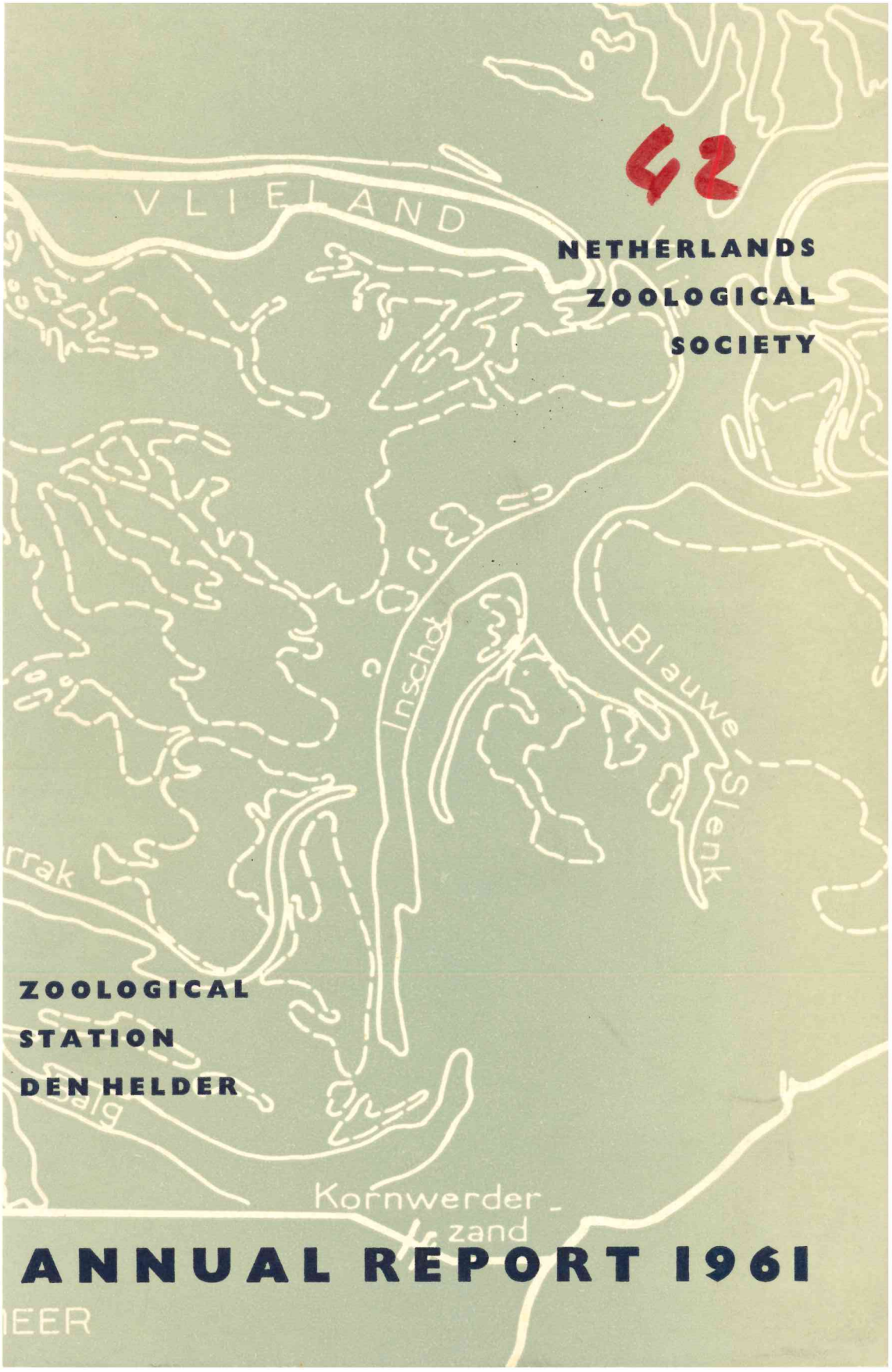
42

NETHERLANDS
ZOOLOGICAL
SOCIETY



ZOOLOGICAL
STATION
DEN HELDER

ANNUAL REPORT 1961

HOE ZIT DAT

Marine research in the Netherlands is carried out by the following Institutions:

Netherlands Institute for Sea Research at Den Helder. Marina biological and hydrographical research. University extension work. Expenses paid by the State: Ministry of Education, Arts and Sciences.

Department for estuarine research (Delta-onderzoek) of the Hydrobiological Institution. Its task is to study the biological changes in the estuarine waters of the province of Zeeland, as well as their causes. These changes will be due to the closing of these waters in the near future. The Hydrobiological Institution itself (which is a fresh water station) is at Nieuwersluis (province of Utrecht), the Department for estuarine research is at Yerseke (province of Zeeland). The Institution (including its Department) is run by the Royal Netherlands Academy of Sciences at Amsterdam. The expenses are paid by the State: Ministry of Education, Arts and Sciences.

Government Institution for fisheries research at IJmuiden. Sea, coastal and inland fisheries. Fish preservation. Oyster research at Bergen-op-Zoom and, temporarily, at Wemeldinge for studies in connection with the closure of the estuaries in the province of Zeeland. Ministry of Agriculture and Fisheries.

Oceanographical Department of the Royal Netherlands Meteorological Institute at De Bilt (Utrecht). Physical oceanography and maritime meteorology. Ministry of Roads and Waterways.

Hydrographical Department of the Navy. Office at the Hague. Bathymetrical surveys. Study of tides. Chart construction. Ministry of Defense, Dept. of the Navy.

Research Department of the Rijkswaterstaat. Headoffice at the Hague, research departments scattered. Current, tides, sedimentation, erosion, reclaiming of land. Ministry of Roads and Waterways. The service of the Zuiderzee works, with office at the Hague, under whose direction reclamation of land in the Zuiderzee is organized, is under the junction of the same Ministry.

Geological Institute of the State University at Groningen. Marine geology.

Reprinted from
Netherlands Journal of Sea Research
2, 1, 1963, p. 102–122

ANNUAL REPORT OF THE NETHERLANDS INSTITUTE FOR SEA RESEARCH FOR THE YEAR 1961

As in previous years the annual report on the work of the Netherlands Institute for Sea Research may be divided into a scientific and a non-scientific part.

I. SCIENTIFIC PART

Just as the annual report for 1960 the present report starts with Mr. De Blok's research on lunar and tidal influence on the reproduction of marine animals. This research has now arrived at a more or less critical stage.

When in 1953 Mr. De Blok started his research on the causes of lunar periodicity his idea was that it might be of advantage to use the widest possible range of variations in the experimental factors tested. Thus it would be possible to include in the experiments animals with only a weak periodicity in their reproduction as well as animals which have no periodicity themselves, but are closely related to species which have. In the North Sea and adjoining waters such indistinct periodicities are the rule. A rather large number of such species were exposed to the experimental factors on a small scale. Most of them were species of which it was assumed that they would be easy to keep. Though in many cases reproduction was obtained no periodicity was apparent. In the first years especially the sea-urchin *Psammechinus miliaris* was used. It has a long reproductive period, showing many peaks. Other species which were easily maintainable and the reproduction of which was known to show a certain periodicity, such as *Mytilus edulis*, did hardly show any reproduction at all, even in carefully arranged experiments. It was assumed that the common oyster, *Ostra edulis*, might make a very useful test animal, since Korringa proved the existence of a rather distinct lunar periodicity in this species and it is easy to keep. It was therefore especially this species on which Mr. De Blok had set his hopes. Though every experiment with oysters yielded a large number of larvae several times in a season, the data collected during four years did not show any evidence of a correlation between reproduction and the various factors of the 34 days period presented to the animals, nor was there any correlation with the true lunar period of 29 days. The indication mentioned in the previous annual report that there might

be some evidence for a correlation with the duration of the moonlight was not confirmed this year. Moreover, the large number of oysters, used in 1961 in order to obtain more data on this problem, for some unknown reason failed to show a satisfactory reproduction.

Mr. DE BLOK gradually started to look for species which were known to have a more pronounced periodicity, but so far no favourable results have been obtained. *Pecten opercularis*, living in the southern North Sea far off shore, did not survive at first. Gradually, it did better, but no reproduction was obtained. *Spirorbis borealis* did reproduce, but it seems that the larvae had some means of resisting their transport by the off flowing water, which is filtered to catch the eggs or larvae for examination. Other species again were not obtainable in the field in sufficient numbers. Such species can only be used for experiments if they can be reared in the laboratory in order to increase their numbers. Such a species is *Platynereis dumerilii*, which is known to have a very pronounced lunar periodicity. It had been found in the Oosterschelde by KORRINGA, but in 1957–'59, when Mr. DE BLOK tried to obtain it for his research, it was not found. After that it was found again in 1960 and 1961; however, Mr. DE BLOK did not succeed in obtaining a lasting stock, though HAUENSCHILD in Tübingen was successful with his species. A species of which we now hope to get a stock is *Teredo pedicellata*, a shipworm from the Mediterranean, of which a number of generations were obtained already.

All things considered, it is clear that the investigations of Mr. DE BLOK met with many difficulties. Research on a periodicity of 34 or 17 days within a reproductive season that is limited in itself is bound to yield only a few data each year. Keeping and rearing test animals is an additional problem. In our region the number of animals with a clear-cut periodicity is limited. The effect that large amplitudes and the elimination of disturbing factors in the experiment were thought to have has probably been overrated.

The next question is whether better results may be expected with the natural lunar period of 29 days instead of that of 34 days. The latter period was chosen in order to be able to identify a possible autonomous period of 29 days. From the very beginning the possibility was considered that a period of 34 days might not lead to the desired result and that we would have to revert to a period of 29 days, involving alteration of the cog-wheels. HAUENSCHILD's experiments with *Platynereis dumerilii* have proved, however, that when the normal period is shortened reproductive periodicity is shortened in accordance. HAUENSCHILD obtained these results by ordinary artificial light, just as is used by Mr. DE BLOK. It seems that also with year and day periodicities the duration of the period may be shortened or lengthened without any difficulty. It

does not seem very likely therefore that a 29 days period would improve the results.

Mr. DE BLOK intends to summarize the data so far obtained in the hope that they may shed some light on this question and to decide about continuation of this research after consideration of these data.

Following-up his research on orientation of the elver Mr. CREUTZBERG started to investigate the internal and external factors governing the behaviour of the elver during migration.

It is known from field research as well as from literature that below a temperature of the water of about 6° C. elvers avoid fresh water and at a temperature of about 2° C. also brackish water. It could be proved experimentally that, at very low temperatures (about 1° C.), the animals die in fresh water, while in sea water they remain fit.

Furthermore, it appeared that with migration into fresh water some internal factor must be involved, a conclusion already arrived at by DEELDER in 1958 (Journal du Conseil, vol. 24, pp. 135–146). Independently of temperature influence migration shows a delay of two to four weeks at the moment the animals are about to enter fresh water. Mr. CREUTZBERG found by histological research that the thyroid gland has its maximum activity during the time the elvers enter fresh water, and that activity is at its height in the elvers immediately in front of the locks. This fact, together with the possible influence of the thyroid on osmoregulation, induced Mr. CREUTZBERG to study the influence of fresh or sea water with and without iodine on the activity of the thyroid at different temperatures. The results of these experiments are still under preparation. Special attention is also given to the distribution of the smelt (*Osmerus eperlanus*) and the activity of its thyroid gland.

Moreover, an investigation was started on the structure of the interrenal tissue in the same elvers. According to research by the school of FONTAINE this tissue is said to play a part in the salt and water regulation of fishes.

Following up Mr. CREUTZBERG's research Mr. B. WEZEMAN, from the University of Groningen, started an investigation in order to find the nature and origin of the components which enable the elver to distinguish between ebb- and flood-water and guide the animal to inland waters. The research was carried out in the second half of 1961 in consultation with Mr. CREUTZBERG. The animals used were already pigmented, so they were young eels really.

A large number of inland waters of widely different origin were sampled and checked on the attraction for those eels. More or less clear differences were observed. Incidentally it was found that water filtered through either SEITZ EKS filters or Millipore AA filters lost its attraction to a great extent; however, it could be proved that this was caused by

repellents, given off by these filters; normal analysis filters (SCHLEICHER and SCHÜLL) did not have this effect.

From October onward the positive reactions of the test animals to the waters presented decreased. Although this was an interesting discovery it made further research on the compounds causing attraction impossible. The cause of the change may be sought in an internal, seasonal change in the young eels. When carrying out training experiments TEICHMANN (Zeitschr. vergl. Physiologie, vol. 42, pp. 206–254, 1959) found arguments in favour of an annual cycle in the sensitivity of the olfactory organ of young eels. According to his work we might expect an increase in the reactions of the eels around the end of January. This increase was indeed observed.

In order to get some idea about the character of the internal change the influence of thyroxine was tested. To this end the eels were kept for a few days in a thyroxine solution of 1 : 20,000 (expressed in grams per liter). In several cases a stronger reaction could be established in treated than in non-treated animals. Unfortunately, Mr. WEZEMAN had to break off his research. If possible, it will be continued by others.

Mr. VAN HEEL devoted much time to the preparation of his doctor's thesis, dealing with the precision of directional hearing in *Phocaena phocaena*. On the 3rd May Mr. VAN HEEL read a paper on directional hearing in *Phocaena* as part of a Symposium on Biological Acoustics, organized by the Zoological Society of London and the Committee on Biological Acoustics. On the 12th May he read a paper in the Sorbonne, Paris, on the possible cause of mass-strandings of whales. Mr. VAN HEEL is to take his doctor's degree on this subject before long. Moreover, Mr. VAN HEEL wrote a contribution on the role of sound perception in the various methods of whale-catching, considered from the point of view of the possible general use of asdic by these animals.

Continuation of the experiments on the role of photo- and geotaxis in *Littorina* confirmed the data, mentioned in the previous annual report, on certain differences between *Littorina littorea* and *L.obtusata*. *Littorina littorea* has a strong tendency to stick to the direction in which it is placed in the beginning of the experiment. Negative phototaxis is stronger and negative geotaxis weaker in *L.littorea* than in *L.obtusata*, and the tendency to crawl into a direction perpendicular to the direction of the light in *L.littorea* is either weak or absent. Preliminary observations on *L.saxatilis* agree with those of FRAENKEL on *L.neritoides*. Just as *L.obtusata* both species have a strong negative geotaxis and a phototaxis which differs according to whether the animals are moving along the upper side or the under side of a glass plate.

Thus the various species of *Littorina* are clearly different in their reactions to light and gravity. In fact, it was the difference between the

specimens of *L.obtusata* studied by us and the specimens of *L.neritoides* studied by FRAENKEL, which induced us to take up this research.

Mr. FONDS continued his attempts to rear the larvae of fishes, as mentioned in the previous annual report. He had some success with larvae of *Cottus scorpius*, *Gobius microps*, *Solea lutea* and especially *Atherina presbyter*. During the time the plankton was rather poor the larvae of *Cottus* were fed with *Artemia*-larvae and freshwater Copepods; the other larvae were reared on marine plankton. The *Cottus*-larvae were obtained from eggs in the laboratory, those of *Atherina* from animals spawning in the aquarium, those of the other two species came from the plankton itself. New-born *Syngnathus acus* were also reared in this way.

Mr. FONDS also tried to make the sea-trout, *Salmo trutta*, spawn after transferring it gradually to fresh water. So far he has failed. The species is regularly caught in small numbers in the Waddensea, a.o. by our own fisherman. Most of the animals are about 35–60 cm long and either immature or spent. Only in 4 cases did the catch concern a mature or maturing animal. Mr. FONDS feeds his animals with living *Gobius* and young herring.

The proper subject of research of Mr. FONDS is the possible influence of temperature and salinity on the number of vertebrae of *Gobius minutus*. It was mentioned already in the previous report that Mr. FONDS obtained some indications that the number of vertebrae of *Gobius minutus* shows a slight gradation along the Dutch coast from North to South. He intends to make *Gobius minutus* spawn in the aquarium so that the experiments may be carried out on the eggs. This is necessary because the number of vertebrae is probably fixed in the egg. A considerable amount of time was spent in 1961 in arranging this experiment.

The work of Mr. FONDS on the identification of fish-larvae and young fishes from the macroplankton catches on board the lightship Texel will be dealt with below; the same holds for his work connected with the catches of fish in the Waddensea.

Just as in 1960 Mr. WESTENBERG occupied himself with the statistical method for comparing relative frequencies in two samples of different size, containing *e.g.* plankton organisms, sediment grains or pollen. To this end he continued tabulation of the FISHER-YATES test to arrive at nomograms for a quick application of this test.

For Mr. VERWEY this was the second year in which the plans for the extension of the Institute left him no time for research. He could only rejoice in other people's results, which, for that matter, was a pleasure in itself.

Besides Mr. WEZEMAN a few more students worked at Den Helder. Mr. H. KRUUK, from the University of Utrecht, investigated in detail

the distribution within the Waddensea of the tube-dwelling Polychaete *Lanice conchilega*, in the hope that he might get some insight into the factors influencing this distribution. It appeared from his work that *Lanice* is rare on a clean sand bottom in a strong current and that it is numerous in places where some form of shelter is present, such as mussel- or cockle-beds, *Zostera nana* or green algae, planted osiers and the like. The main significance of this shelter seems to be protection against shifting sand; it is not clear yet, whether it works by way of the settling of the animals, by way of food, or in both ways, since places which give protection for settling worms will also allow deposition of suspended material, which (as shown by ZIEGELMAYER) serves for food. It seems that *Lanice* avoids places with clay or soft mud. KRUUK's investigations did not show any preference for a special grain size of the sand. It would now be worth while to study the settlement of *Lanice* after affording shelter on clean sands and study the preference of the larvae themselves.

On his own initiative Mr. Vader, of the University of Leiden, investigated the reactions of some bottom animals of the Waddensea to tidal changes in water level. To this end he used an apparatus, designed by Mr. DE BLOK, which enabled him to obtain any desired change of level at any time interval in a very simple way. Though it is still too early to give any definite results it is clear that the Polychaete *Nereis diversicolor* does indeed carry out vertical movements in his tube, connected with the tidal changes in water level.

Mention should also be made of the work of Mr. LAMMENS, Free University, Amsterdam, Mr. WILLEMSE, Municipal University, Amsterdam, Mr. NOORDHOORN, geologist of the Bataafse Petroleum Maatschappy, The Hague, and Miss DUMOULIN, University of Leiden.

From June to the end of the year Mr. LAMMENS at regular intervals collected specimens of the lamellibranch *Macoma balthica* in order to study a possible periodicity in its neurosecretion. The investigations proper are carried out in Amsterdam.

Mr. WILLEMSE came a few times to collect Cestodes from stickleback, smelt, flounder and other species for closer examination in Amsterdam.

Mr. NOORDHOORN used Den Helder as a foothold for a research on the occurrence and reproduction of a number of Foraminifera.

Miss DUMOULIN, finally, came to Den Helder to get some experience before going to visit the Caribbean Marine Biological Institute in Curaçao, where she is to carry out a research on differences in the behaviour of a number of species of snails inhabiting the tidal zone.

A certain amount of time was spent in fieldwork, not only by the hydrographers, but also by the biologists. In the latter connection the macroplankton-work of Miss VAN DER BAAN should be mentioned, the

research of Mr. CREUTZBERG and Mr. FONDS in the Waddensea, the work of our fisherman BEUMKES, and the acquisition of animals from the fishing fleet.

Strictly speaking, the macroplankton-work of Miss VAN DER BAAN is a continuation of the investigations of Mr. CREUTZBERG on the occurrence of the elver off the coast, but now in a more extended form. Thanks to the co-operation of the crew of the lightship Texel continuous fishing during ebb as well as flood with a net with an opening of 1 m^2 and meshes of 2 mm was carried out, weather permitting. At first our intention was to obtain more data on the periodicity in the occurrence of Scyphomedusae, starting with the ephyra-stage. At the same time additional data on the elver would be obtained. Gradually, other groups came to be included in the research: hydromedusae, various groups of crustaceans, the worms and the fishes. For identification we gratefully acknowledge the help of Mr. L. B. HOLTHUIS, J. A. W. LUCAS, W. J. M. VADER and W. VERVOORT, all from the State Museum of Natural History at Leiden, while Mr. FONDS dealt with the fish larvae and young fishes.

At the start of the investigations, on 17 January, *Cyanea*-specimens were already present, and, according to our experience in the winter '61–'62, the ephyrae may occur from the end of November onward. The smallest jelly-fishes are still colourless and Miss VAN DER BAAN was not sure whether they were *Cyanea capillata* or *lamarcki* or both. The two species occurred regularly till about the 10th of March, and in small numbers till the end of August. Both species had their peaks of occurrence mainly in the ebb samples, when, according to Mr. CREUTZBERG's conclusions (Neth. Journal of Sea Research, vol. 1, no. 3, 1961, p. 289), usually water from farther off the coast is passing along the lightship.

Aurelia aurita occurred from 4 March to the end of June, the smallest animals, less than 20 mm, being found till mid-May. This species occurred especially in the flood samples, which, for the lightship, implies that usually water from nearer the coast is passing by.

Chrysaora hysoscella occurred between 30 May and 10 September, with a few late specimens till 9 November. Young animals (less than 20 mm diameter) were found till the end of August. There was no obvious preference either for ebb or flood water.

Rhizostoma pulmo appeared so late and in such low numbers that we may say that the species is practically absent in the surface water near the lightship. It is numerous near Den Helder; this also applies to the very young animals. For the time being we cannot offer any explanation for its absence near the lightship.

The Leptomedusa *Aequorea vitrina* was first observed at the end of

May and occurred regularly especially in July, once as many as 6 specimens in one haul. We may get some idea about the frequency of such a species by assuming with Mr. CREUTZBERG that a net, as used in this work, filters about 10–15.000 m^3 of water during one period of ebb or flood. This works out to one *Aequorea* in 2000 m^3 of water at the utmost. This goes to show how futile the usual hauls of plankton-nets are when it comes to these kinds of species, since only some 200–400 m^3 of water may be filtered in the usual plankton hauls.

The crustaceans are as yet only partly identified. According to Mr. HOLTHUIS *Idotea metallica*, which was caught twice, is a new species for the southern North Sea. Another fact of some interest is that the larvae of *Squilla desmarestii* were caught several times.

As to the fish larvae and young fishes, about 25 species were caught. Of them *Caranx trachurus*, before the war hardly observed near Den Helder, was by far the most common species from May onward. Besides this species *Arnoglossus laterna*, the scalefish, *Trachinus vipera*, the lesser weever, *Clupea sprattus*, the sprat, *Ammodytes tobianus*, the lesser sand-eel, *Gadus merlangus*, the whiting, *Onos mustelus*, the five-bearded rockling, and *Gobius minutus*, the common goby, were common as larvae in summer. In winter herring larvae took their place. The occurrence of adult *Solea lutea*, *Gobius minutus* and especially *Syngnathus rostellatus* points to tidal transport of these species.

The investigations will be continued in 1962. Afterwards, because of the amount of work it involves, it will probably be stopped, at least for some time, in order to enable us to summarize the results. Macroplankton research like this, in which there is practically continuous fishing all the year round, has not often been done and it is therefore likely to give results which will greatly stimulate further study.

In October 1961 Mr. CREUTZBERG and Mr. FONDS started an investigation into the annual cycle in the occurrence of bottom fishes in the Waddensea. This research at the same time aims at obtaining information on the detailed distribution of *Gobius minutus* and *G.microps* in various seasons and on the local variation of *Gobius minutus*. To this end every four weeks hauls with a fine-meshed trawl were made over 1 km at fixed stations.

In winter a number of species practically disappear from the Waddensea. This applies, among others, to young cod, whiting and sole, the common dragonet, the lesser pipe-fish, the common goby, the swimming crab *Portunus holsatus* and the shore-crab *Carcinus maenas*. At the same time the smelt and *Gobius microps* have spread all over the Waddensea. Some of the above species are poor swimmers and we may assume that they use a tidal mechanism for transport. This research is also to be continued in 1962.

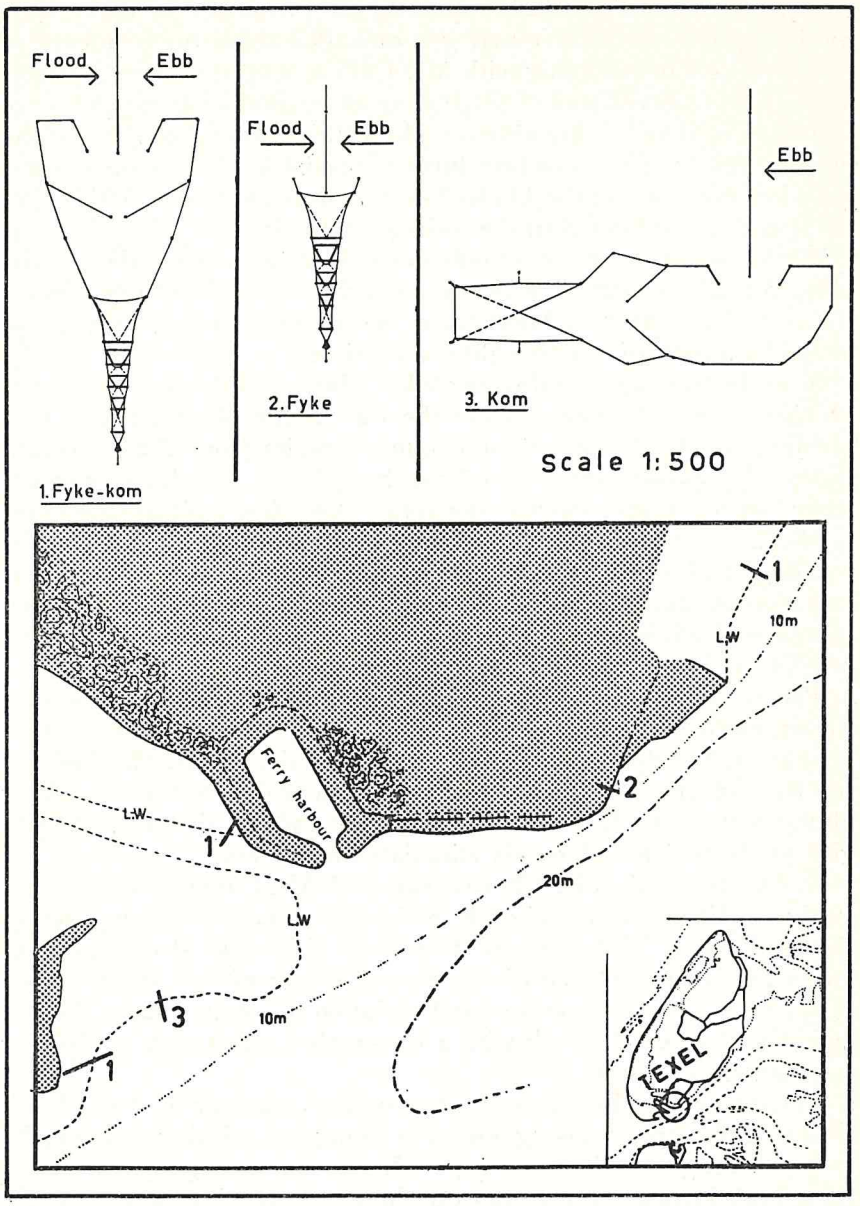


Fig. 1. The length of the central fence of the nets depends on the distance between coast and fyke, kom or fyke-kom. The fence may vary in length from a few to some 20 times 4.5 metres.

The work of our fisherman BEUMKES at 't Horntje, Texel, is gradually yielding promising results, on the one hand because BEUMKES has come to understand our purposes, on the other hand because we could appeal to the experience and skill of his father – who taught him his trade – for mending the nets. Mr. VAN HEEL is our intermediary for this work and he gave much of his time to the work of BEUMKES.

BEUMKES fished from 24 March to 23 December, nine months in all. He used three types of nets: a so-called "kom" (a fish trap), a bow net (fyke) and a kind of combination of the two types (fyke-kom). Fig. 1 gives a sketch of those nets and the way they are placed around 't Horntje. On account of its size the "kom" is the best net to obtain undamaged fish. The "combination" is the best type for catching, since it catches during both tides, while the "kom", which is built in the direction of the current, catches mainly during ebb. The bow net naturally is the handiest net, but also the smallest. Species like the garfish and the horse-mackerel, which need a lot of space, are mostly caught in the "kom", which has a large entrance.

Table I gives a general survey of the catches in the various months of the year, together with the first and last dates of occurrence. Although, in various months and places, different types of net have been used, the periodicity of many species is very striking. Sand smelt (*Atherina pres-*

TABLE I

Total numbers fished by BEUMKES

	M	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*Total*	*First catch*	*Last catch*
Dasyatis pastinaca	—	2	—	1	22	1	1	—	—	—	27	26-IV	1-IX
Clupea pilchardus	—	—	1	5	3	2	8	2	1	—	22	10-V	1-XI
Engraulis encrasicholus	—	8	93	4	—	—	—	—	—	—	105	16-IV	13-VI
Salmo trutta	3	14	20	23	8	10	34	48	50	16	226	28-II	20-XII
Belone belone	—	59	481	674	474	317	61	55	—	—	2121	22-IV	24-X
Gadus luscus	—	—	1	—	6	2	5	7	—	—	21	23-V	25-X
Gadus pollachius	—	—	1	2	33	±115	210	325	133	16	835	6-V	8-XII
Morone labrax	1	1	14	16	5	4	1	6	13	8	69	25-III	12-XII
Caranx trachurus	—	3	±5900	±5860	±2100	±846	±47	95	—	—	14851	28-IV	16-X
Spondyliosoma cantharus	—	—	—	—	2	—	—	—	—	—	2	7-VII	7-VII
Scomber scomber	—	—	—	—	5	3	1	—	—	—	9	17-VII	22-IX
Mugil ramada	2	88	198	81	37	27	33	±331[1]	32	15	844	25-III	14-XII
Atherina presbyter	53	870	80	26	75	228	211	±170	—	—	1713	25-III	30-X
Cottus bubalis	—	—	—	1	—	3	—	4	1	—	9	19-VI	1-XI
Sepia officinalis	—	—	18	8	3	—	—	—	—	—	29	4-V	14-VII

[1] A.o. one school of about 225 young; in the last months of the year chiefly young were caught.

byter) and bass (*Morone labrax*) have obvious peaks of migration in spring and autumn, which, for the sand-smelt, is confirmed by the catches near Den Helder off the coast. Garfish (*Belone belone*) and horse-mackerel (*Caranx trachurus*) are most numerous from May to July, the pollack (*Gadus pollachius*) has its peak in October. The number of sea-trout (*Salmo trutta*) caught by BEUMKES was remarkable, especially in October and November. It is not known from where they come.

It would be of advantage to the research if the same type of net could be used in different places for a long time. In that case the combined "fyke-kom" net would be the best type, but it would mean forgoing the valuable catches of undamaged and larger fish with the "kom" and the easy handling of the fyke net. Gradually, a compromise will be found between the demands of the research-worker and the possibilities of the fisherman. This compromise will also be determined by the demand for undamaged, living fish, for which the "kom" is excellently suited.

Of course, the purchase of species from the fishing fleet was continued as usual. This work, as well as providing the universities with material for study, also falls to Mr. VAN HEEL, assisted by Mr. BUHRE. Part of the catches is summarized in Table II. We want to mention especially the catch of a male of *Pristiurus melanostomus*, the black-mouthed dogfish, a deepwater species, caught in Botney Gut on 22 December. In the southern North Sea this species is practically never observed, although it does occur in the deeper northern part of the North Sea.

Migrants reaching the North Sea through the northern entrance, such as *Brama raii* and *Scomberesox saurus*, were not brought in during the winter of 1961–'62.

Sepia officinalis arrived remarkably early in 1961. In April 40 specimens were brought in, the first one on the 14th. The last (3) specimens of the 1960 autumn migration were caught as late as 9 February. *Sepia* is a rather hardy species, which might be able to stand mild winters, as they occur in the southern North Sea in the last series of years. At the same time the species is very dependent on temperature.

Worth mentioning is the fact that in 1961 the Opisthobranch *Scaphander lignarius* in the southern North Sea was rather numerous. It was suddenly rather common in hauls from the beginning of March onward. The species had hardly been brought in before. The fact may be similar to the occurrence in the southern North Sea of species like the Polychaete *Sabellaria alveolata* and the sea-urchin *Spatangus purpureus*, which may also be common in some years.

Before passing on to the work on radioactivity and the hydrographical part of this report it should be mentioned that the research on aquarium water mentioned in the Report for 1960 was continued for

some months in 1961. It is undertaken with a view to the schemes for the new sea water plant on Texel. Mr. DE BLOK carried out a number of experiments for improving the oxygen condition in the aquaria.

The research on the influence of radioactive isotopes on life in the sea got gradually under way. Unfortunately, we did not succeed in finding anyone to fill the vacancy of a zoologist with experience in physiology, so that the research came to be started with Mr. DUURSMA as a chemist and Mr. DRAL as a laboratory assistant for the biological part. Moreover, the purchase and testing of new apparatus took up much time.

Mr. DUURSMA's research for the greater part dealt with improving old and developing new techniques. Construction was started of an apparatus to determine size and number of mud particles in suspension, following the principle of the Coulter counter for counting blood cells. It is not easy to make this apparatus fit for direct use when out at sea with the help of a plunger; the difficulties are especially concerned with electronics.

Together with the hydrographic department it was tried to improve filtration technique on board the ship. It was found that filtration time might be shortened considerably by covering the filters by a thin layer of filling material in the form of $CaCO_3$ or some similar substance. In this way the filtration capacity of the filters is not perceptibly reduced.

Furthermore, Mr. DUURSMA adapted the apparatus used for determination of dissolved organic C to a more intensive use by building it in threefold and constructing the coulometric part of the apparatus according to a more simple and sensitive principle. A short publication on this subject is to appear in the Netherlands Journal of Sea Research.

Mr. DUURSMA's own research will especially deal with the interchange between the ions dissolved in water and those in solid matter (either in the sediment or in suspension), so that we may arrive at some correlation between the characteristics of the element or ion and the physical or chemical characteristics of the matter in which it is incorporated. To this end determination was started of Ca, Sr and Fe in sea water and of Ca, Fe, S, H_2S and organic matter in suspended mud and bottom material. It was also tried to get some insight into the differences in concentration of these elements in bottom material from the Waddensea. Mr. DUURSMA also tried to obtain some data on the diffusion of certain dissolved substances in the upper 30 cm of a firm Waddensea bottom. This diffusion is very slight, so that intake of ions in the bottom is sure to be very slow.

As the first radio-isotope for the above interchange experiments Ca45 was chosen. By using a specially constructed rotation apparatus

Species	*Sex; Size (cm)*	*Locality*
MIGRANTS SUPPOSED TO HAVE ENTERED THE NORTH SEA THROUGH DOVER STRAIT		
Petromyzon marinus	73	Eierlandse gronden
Raja montagui	♂♂ and ♀♀ 23.5–60	Haaksgronden, 20 and 35 miles n. and 80 miles wnw. of Molengat, near buoy ST3 and ST4, Tea Kettle Hole
Raja brachyura	♂♂ and ♀♀ 57.5–78	Texel Hole
Raja naevus	♀♀ 46, 46.5	W. of ST3
Raniceps raninus	♂♂ and ♀♀ 8.1–20 and living	Harbour of Den Helder, Haaksgronden, near ST4
Spondyliosoma cantharus	♂♂ and ♀♀ 18.3–40	Texel Hole, 54°0′30″ N., 6°20′ E., near buoy ST4, near Borkum, Tea Kettle Hole
Blennius pholis	living	Dike Den Helder
Trigla cuculus	♂♂ and ♀♀ 20–32.7	Texel Hole, West Hole, near buoy ST2
Spinachia spinachia		Off Texel
Sepia officinalis	♂♂ and ♀♀ 16.8–29	Den Helder harbour, Texelstroom, off the coast between Texel and Petten, Texel Hole, 30 miles wnw. of Molengat, 10–12 miles e. of ST2–3
Octopus vulgaris	16, 11.5 and living	Near buoy P5, Texel Hole, near ST2, Botney Gut
MIGRANTS SUPPOSED TO HAVE ENTERED THE NORTH SEA THROUGH THE NORTHERN ENTRANCE		
Pristiurus melanostomus	♂ 63	Botney Gut
Scomberesox saurus		Beach near Huisduinen
NORTHERN SPECIES NOT COMMON IN THE SOUTHERN NORTH SEA		
Onos tricirratus	living	Fyke in harbour Den Helder
Onos cimbrius	living	Haaksgronden
Anarrhichas lupus	living	Texel Hole
Cottus bubalis	♂♂ and ♀♀ 6–10.6 and living	Malzwin near Den Helder, Molengat, off the coast between Texel and Petten
Hyas coarctatus		Near buoy P2, Cleaverbank, 52° N., 1°30′ E., Botney Gut
Eledone cirrhosa	13.5 and living	Near buoys ST3 and P2, 10 miles se. of buoy P3, Botney Gut
SPECIES WHOSE DISTRIBUTION IS UNCERTAIN		
Labrus berggylta	17.6 and living	Terschellingergronden, 't Horntje (Texel), dike Den Helder, off Texel
Zeugopterus punctatus		2–3 Miles w. of Zandvoort

Numbers per month

J	F	M	A	M	J	J	A	S	O	N	D
—	—	—	1	—	—	—	—	—	—	—	—
—	4	1	2	1	1	1	—	—	1	6	24
1	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	2	—	—
1	—	—	—	3	10	3	—	—	—	—	—
5	1	2	—	1	1	—	1	—	1	—	1
—	—	—	—	—	—	—	—	—	1	—	—
—	—	—	1	2	4	—	—	—	—	1	—
—	1	—	—	—	—	—	—	—	—	—	—
1	3	—	40	209	14	2	1	—	1	2	4
2	1	1	—	—	2	1	—	—	1	1	1
—	—	—	—	—	—	—	—	—	—	—	1
1	—	—	—	—	—	—	—	—	—	—	—
—	—	1	—	—	—	—	—	—	—	—	—
—	—	—	1	—	—	—	—	—	—	—	—
—	—	—	1	—	—	—	—	—	—	—	—
6	3	2	—	—	—	—	1	—	—	1	8
—	1	1	1	—	2	—	1	—	—	—	—
—	2	—	—	—	1	1	—	—	—	—	—
—	—	1	—	—	—	—	—	1	1	1	—
—	—	1	—	—	—	—	—	—	—	—	—

it is possible to study the interchange of ions between radioactive matter in sea water and suspended or bottom matter at various temperatures and, with a view to phytoplankton present in the matter, with admission or exclusion of light. This rotation apparatus may also be used for so called productivity determinations in sea water with the help of C 14.

Mr. DRAL intends to study the trail of certain isotopes which the mussel, as a filterfeeder, takes in with suspended matter. Not only is fixation of these isotopes to be studied, but also the role of pseudofaeces and faeces in the excretion of the matter back to the environment. In this way he hopes to gain some insight into the problem to what extent an animal like the mussel interferes with the distribution of isotopes. Investigation of faeces and pseudofaeces was started. On account of the uptake of isotopes by the animal much attention was paid to histological technique. Mr. DRAL devoted part of his time to preparing a publication on his former research on the feeding mechanism of the mussel.

Passing to the hydrographical part of this report it is of interest that research on the distribution of nitrogen compounds in the water of the Waddensea was continued all through the year. To this end every four to six weeks water samples were taken between Den Helder and Holwerd on the Frisian coast. It is still too early to publish results, but it is clear that the concentration of all compounds studied: nitrate, nitrite, ammonia and organic nitrogen, present in solution as well as in suspended material, is much higher in the Waddensea than in the North Sea. Contrary to what we find in phosphates considerable amounts of inorganic nitrogen are present in solution even in summer. Much mineralized nitrogen is supplied by the IJselmeer, but the figures indicate that an additional substantial amount of nitrate, nitrite and ammonia is formed by mineralization of organic matter on the spot.

Chemical analyses for this research were carried out by Miss BOSCH and Mr. BEKE. In the course of these investigations the latter succeeded in improving the determination of ammonia, based on a method of J. P. RILEY (Journal Mar. Biol. Assoc., vol. 36, p. 161, 1957), by using the results of an investigation by W. T. BOLLETER *et al.* (Anal. Chem. vol. 33, pp. 592–594, 1961).

Research into the composition of dissolved organic matter in sea water, which had already been started by Mr. DE BRUIN in 1960, was continued from February 1 to August 1, when Mr. DE BRUIN was employed by the Netherlands Organization for Pure Research. Mr. DE BRUIN was assisted by Mr. ROMMETS. After it had become clear that chromatographical methods could not be used for classification of organic compounds in sea water it was tried to separate these compounds

by means of coprecipitation with hydroxides of iron and aluminium. It turned out that in principle such a separation was possible for at least part of the compounds. An additional difficulty was that it proved to be practically impossible to prepare hydroxides without any trace of organic matter. Unfortunately, Mr. DE BRUIN left when this research was still in a preliminary stage.

Together with Mr. DUURSMA, Mr. ROMMETS carried out an investigation on photometric determination of fluorescence in fresh and sea water. The results were published in Netherlands Journal of Sea Research, vol. 1, pp. 391–405, 1961. Mr. ROMMETS and Mr. BEKE carried out determinations of dissolved organic matter in water samples from the Dead Sea and the Pacific near New-Zealand. The former samples were obtained through the kind offices of Dr. NEEV from the Israel Geological Survey; for the latter samples we are obliged to Dr. J.W. BRODIE, Oceanographical Institute, Wellington. The study of samples from various regions of the sea will be continued.

Mr. POSTMA continued his study of data relating to the coast of British Guiana. It was already mentioned in the previous annual report that research there was carried out by the Hydraulics Laboratory at Delft. The results are to be published in a report to the Government of British Guiana; it may be expected that publication in a scientific paper will follow.

From October 1, 1961, Mr. EISMA, a physical geographer who graduated at the University of Utrecht, carried out an investigation into the composition and chemical characteristics of sands from the dune area, from the beach and from the North Sea immediately along the Dutch coast between IJmuiden and Den Helder. This research concerns the possible cause of the difference in lime content of the sands south and north of the village of Bergen (province of Noordholland), a difference that is correlated a.o. with differences in mineral content. The difference is reflected in the flora near Bergen. Assisted by Mr. ROMMETS, Mr. EISMA gave much time to working out analytical methods for a quick determination of calcium, magnesium and iron. As far as possible the analysis will be carried out after separation of grainsize fractions, and attention will be paid to difference in roundness of the sand grains and in heavy mineral content. Mr. EISMA will try to correlate the occurrence of certain sands in the sea and on the coast and the influence of hydrographical conditions in that area. From January 1, 1962, onward, the expenses for this research will be paid by the Netherlands Organization for Pure Research.

II. NON-SCIENTIFIC PART

After a stand-still of a year the plans for the new Institute on the island of Texel were taken up again in the beginning of April. The delay was caused by the uncertainty concerning a safe berth for our ships. On the insistence of the Ministry of Education and in consultation with the Public Building Service our demands were worked out in more detail by the Bureau for the Composition of Building Programms Ltd. at Delft. The first meeting with this Bureau took place on August 8, and for the rest of the year both the staff of this office and of our institute worked hard to put the plans into a form suitable for the architect. Most of the time was taken up by the plans for the sea-water plant, which gradually begin to take shape, but will still need a great deal of consultation in 1962.

The choice of an architect was also decided upon in May 1961, when the office of POT and POT-KEEGSTRA in Amsterdam was contacted. In 1961, however, connections went not beyond their taking stock of the situation.

The problem of our own harbour entered a new stage when the Hydraulic Laboratory at De Voorst rejected a plan for a pier and jetty at the SE side of 't Horntje, Texel, where the new institute is to be built. As a result the possibility of building a small separate harbour at the N. side of 't Horntje – a possibility that had often been discussed before – was suggested again, and when the Ministries of Education and Finance had agreed the Service of Roads and Waterways was asked to work out this plan in details. At the SE-side of 't Horntje, opposite the Institute, there is now to come a jetty, where ships may load and unload, while their safe berth will be the harbour at the N. side of 't Horntje.

Another item of interest is that we managed to buy an enclave of 880 m^2 in our grounds in the polder 't Horntje, with a cottage and shed, for fl. 10. 712.10.

As stated already in the previous annual report the extension of personnel, following from the 15-years plan, leads to an ever growing overcrowding, and it is to be hoped that the Texel plans will indeed bring relief within a measurable space of time.

The Max Weber was used during 92 days. On one of its cruises in the Waddensea, for collecting hydrographical data, it was held in pack-ice and put aground, and the crew, consisting of the skipper OVERSLUIZEN and the analysts BEKE and ROMMETS, lived through some critical days. As a result, the ship was provided with a wireless transmitting and receiving set. After this event the engine and echo sound-

ing installation were overhauled, to which the insurance contributed fl. 1.540. Although the ship was much used the engine has given no trouble since.

With the help of H. C. EKAMA, naval architect, Mr. DUDOK VAN HEEL and Mr. DUURSMA gave a fair amount of time to the plans for a new ship for work in the Waddensea, to be built in 1962, for which the State has granted the sum of fl. 250.000. The outcome is a plan for a small research vessel, to be built by the shipyard G. DE VRIES LENTSCH Jr., Amsterdam. The vessel is to be 19 m long, 4.75 m wide, with a maximum draught of 1.45 m. It will have two DAF engines of 80 H.P. each, two rudders, and a separate engine and propeller for slow speed. It will also have a small laboratory and room for a crew of seven.

New instruments for 1961 include a Beckson analytical balance, to be used for histological work, a Manesty distillation apparatus, a Philips pH meter, a Zeiss drawing apparatus for microscopy, a Cornwall Luer–Lok syringe, a Zeiss stereo-microscope, a Medvac vacuum pump, a Depa balance, a Jabsco pump, a rotary regavolt apparatus and a Rolley projection apparatus. Moreover, the radioactivity department obtained an Elko III-colorimeter, a Heraeus heating apparatus for Kjeldahl flasks, one Jabsco and two Stuart pumps, a Philips pH meter and furthermore a Philips anticoincidence apparatus for measuring very low ß-radiation intensities, parts for an apparatus to measure number and size of suspended particles which is still to be built, a portable monitor, two table monitors, a Philips oscillograph and, finally, a table-microvoltmeter as an extension for the apparatus for carbon-determination. The last two instruments are at the same time intended for general use. The expenditure for the first batch of instruments amounted to fl. 7.500.—, that for the second batch to fl. 32.296.—. The isotope laboratory is now fairly launched.

Two windows in the library were shut off by steel book-racks. In this way 44 m of space was gained for periodicals.

The higher allowance for the library was spent mainly in the purchase of new books and in binding. Books were bought to the value of about fl. 2000.—. They are especially of marine biological and marine chemical interest, but part of them are on radiobiology and radiochemistry. Binding took another fl. 2000.—, the arrears in binding were partly made up. A valuable asset was the purchase of the complete series of the Journal of Animal Ecology, vol. 1–29, for fl. 1267.—. Some fl. 1000.— was spent on periodicals. Since in the 1961 budget the Ministry had granted a sum for the issue of a private journal the first two numbers of the Netherlands Journal of Sea Research could appear. The doctoral theses of Mr. DUURSMA and Mr. CREUTZBERG were published in it. Space permitting, the Journal is open for publi-

cations in the domain of marine research, especially for the Netherlands, but also for other areas. The first two numbers run to slightly over 400 pages.

There was another extension of personnel in 1961. Miss S. M. VAN DER BAAN joined us as a laboratory assistant on Jan. 1st, Miss G. M. BOERMAN and Miss W. SEVENHUYSEN as laboratory workers on March 1st and May 15th, G. DE HART as a chauffeur-handyman on August 1st, G. W. H. BISSELINK as a laboratory worker on September 1st, J. S. M. VAN ULDEN as a clerk on November 6th. On the other hand, Mr. D. D. DE VRIES, analyst, left us on February 1st. Mr. FONDS, who joined us as a student-assistant on December 1st, 1960, after passing his doctoral examination, became a graduate assistant from July 1st. As mentioned in the scientific part of this report Mr. EISMA also came to work at Den Helder; his appointment was due to a request to the Netherlands Organization for Pure Research of Prof. ZONNEVELD, Utrecht, Dr. POSTMA and Dr. VERWEY. It should be mentioned further that Mr. J. B. HULSCHER, a student from Groningen, and Mr. A. SPAANS, a student from Leiden, were given the opportunity of working as assistants for two months on the island of Vlieland. They have been investigating there for several years the influence of oystercatcher and black-headed gull on the numbers of several species of invertebrates.

A very great disappointment was the departure on August 1st of Mr.A. DE BRUIN, a graduate chemist, who on February 1st had been appointed by the Netherlands Organization for Pure Research to study the composition of dissolved organic matter in the sea. The research was intended as a continuation of DUURSMA's investigations into the distribution and origin of dissolved organic matter.

On the 4th of July Mr. CREUTZBERG took his doctor's degree at the University of Groningen on his research on the orientation of the elver in tidal areas.

On January 3–5 Mr. DUURSMA visited the firm of Ströhlein at Düsseldorf to improve his apparatus for carbon determination. In October Mr. POSTMA, as a delegate of the Netherlands Government, attended the first meeting of the International Oceanographic Committee of UNESCO in Paris, to discuss international marine research. From September 16th to October 1st Mr. CREUTZBERG was in England, where he visited the fishery-laboratory at Lowestoft, the shellfish laboratory at Burnham-on-Crouch and the Plymouth laboratory. In the latter institute he took part in a Symposium on Speciation in the Sea. From October 15 to 18 Mr. DE BLOK attended a symposium at Kiel, Germany, dealing with laboratory experiments in marine biological research and with problems concerning the food cycle in the sea. On

14–17 April Mr. VERWEY attended a conference at Naples on the future development of the Stazione Zoologica.

As usual a number of visitors from abroad visited the Institute. In 1961 their number was small. They were D. L. BARTELINK, Pacific Biological Station, Nanaimo, British Columbia, Canada; J. M. BARDACH, University of Michigan, Ann Arbor, who worked in the Zoological Laboratory at Groningen for some time; John D. COSTLOW, Duke University Laboratory, Beaufort, North Carolina; Eugene CROIN, director Natural Resources Institute and director Chesapeak Biological Laboratory, Maryland; L. PROVASOLI, director Haskins Laboratories, New York; T. H. RICE, director of the Bureau of Commercial Fisheries Radiobiological Laboratory, Beaufort, North Carolina; R. S. SCHELTEMA, Woods Hole Oceanographic Institution, Mass.; Bernard Einar SKUD, U. S. Bureau of Commercial Fisheries Biological Laboratory, Boothbay Harbor, Maine.

Besides visitors from abroad there were a great many from our own country on October 6–7, when the Netherlands Zoological Society held a scientific meeting at Den Helder, which was attended by some 60–70 members. A trip was made to 't Horntje, Texel, where the new institute is to be built.

Co-operation with related institutes was good. The oceanographic department of the Royal Netherlands Meteorological Institute investigated the water circulation in the North Sea off the inlet of Texel, an investigation in which we took part. As usual the research workers of the State Institute of Fisheries Research and of our institute met to discuss scientific results obtained. In principle these meetings take place twice a year. The T.N.O. antifouling research laboratory next to our institute was extended and became almost twice its former size.

For the summer course in 1961 there were 30 participants, 8 girls and 22 boys; 22 of them came from Groningen, 3 from Utrecht, 2 from Leiden and 1 from Amsterdam University. Moreover, a teacher took part. As customary, the course was given by all members of the scientific staff. Besides, the Zoophysiological Laboratory of the University of Amsterdam held a course of its own under guidance of Mr. PARMA on 27–30 March and 4–8 April, for 17 and 14 students respectively. Dr. P. J. KIPP, Utrecht, gave a course for 21 students from Utrecht on May 8–10. The Roman Catholic University at Nijmegen held its own courses on 23–27 May and from 27 May to 1 June, in which 28 and 27 students took part under the guidance of Miss GEELEN. The Free University, Amsterdam, held its own courses on 5–10 May, in which 34 students and 4 assistants took part under the guidance of Mr. ANTHEUNISSE.

Students visiting Den Helder for research purposes were dealt with

in the scientific part of this report. The total number of man-days for research-workers and participants in the courses was about 1424, a very high number, the average over 1947–1961 being 1130.

Receipts for study material amounted to about fl. 13.925.72 in 1961, exclusive of the costs of packing, which amounted to about fl. 1215.69. Expenditure for animals amounted to about fl. 6.802.94, those for packing, formalin, alcohol *etc.* to about fl. 3.222.81, so that the total expenditure amounted to about fl. 10.025.75. This means a credit-balance of about fl. 5.115.54, a relatively high sum.

Furthermore, though they represent only a small sum, the receipts and expenditure of Mr. BEUMKES' fishery at 't Horntje should be mentioned. At the suggestion of Mr. BEUMKES more trouble than before was taken to sell those fish that were of commercial value. The results were that fish were sold for about fl. 900.—, that the animals for the aquarium and for study brought to Den Helder may be said to have represented a few hundred guilders, and that 1800–2000 kg of fish were sent to the Texel Museum to feed the seals. The total receipts may therefore be valued at about fl. 1500.— at the least. Since about fl 2600.— were spent on nets and boat the real expenditure amounted to about fl. 1000.—. The scientific results of BEUMKES' work are dealt with in the scientific part of this report.

The costs of the van amounted to fl. 511.23 for petrol and lubrication, to fl. 216.75 for repairs, to fl. 380.— for insurance and taxes and to fl. 1108.— in all. The van covered 7685 kilometers. Without writing-off this makes about 14 cents per kilometre, which is rather much, but every other means of transport is less efficient. Gradually, the van has become of great value for transporting study material.

At this moment the correct figures for expenditure in 1961 are not yet known, but they will be of the order of fl. 283.000.— for personnel and fl. 145.000.— for materials, making about fl. 430.000.— in all. A sum of fl. 18.656.66 was paid to the Bureau for the Composition of Building Programms Ltd.

Den Helder, February 1963 J. VERWEY

The Netherlands Zoological Society has issued the following publications, which are obtainable from the Director of the Netherlands Institute for Sea Research, Den Helder, against the following prices per volume, postage not included.

Tijdschrift van de Nederlandsche Dierkundige Vereeniging

Series I, vols 1—7, 1874—1885, out of print	
„ II, „ 1—20, 1887—1927, partly out of print . . .	8.50
„ III, „ 1—3, 1928—1933, partly out of print . . .	5.—
Supplement to vol. 1 (Ser. I), 1883—'84	6.—
Supplement to vol. 2 (Ser. I), 1888	6.—
Index to Tijdschrift, 1874—1909	1.20

Archives Néerlandaises de Zoologie, issued in cooperation with the Holland Society of Sciences at Haarlem

Vol. 1—7, 1934—1947	22.—
„ 8, 1947—1951	25.—
„ 9—15, 1952—1963	30.—

Supplements to vol. 3, 7, 10 and 13 come extra.

Netherlands Journal of Sea Research, specially devoted to the work of the Netherlands Institute for Sea Research.

Vol. 1—3, 1960—1966	20.—

Flora en Fauna der Zuiderzee. In Dutch. 4°. 460 pages, 1922. Out of print.

Supplement Flora en Fauna der Zuiderzee.

In Dutch. 4°. 258 pages, 1936	10.—

Veranderingen in de Flora en Fauna der Zuiderzee sinds haar afsluiting in 1932. In Dutch. with English summary. 4°. 359 pages, 40 figures, 11 plates, many maps and tables, 1954 . 15.—

De Biologie van de Zuiderzee tijdens haar drooglegging, parts 1—6, 1928—1944 . . . . . Per set 10.—