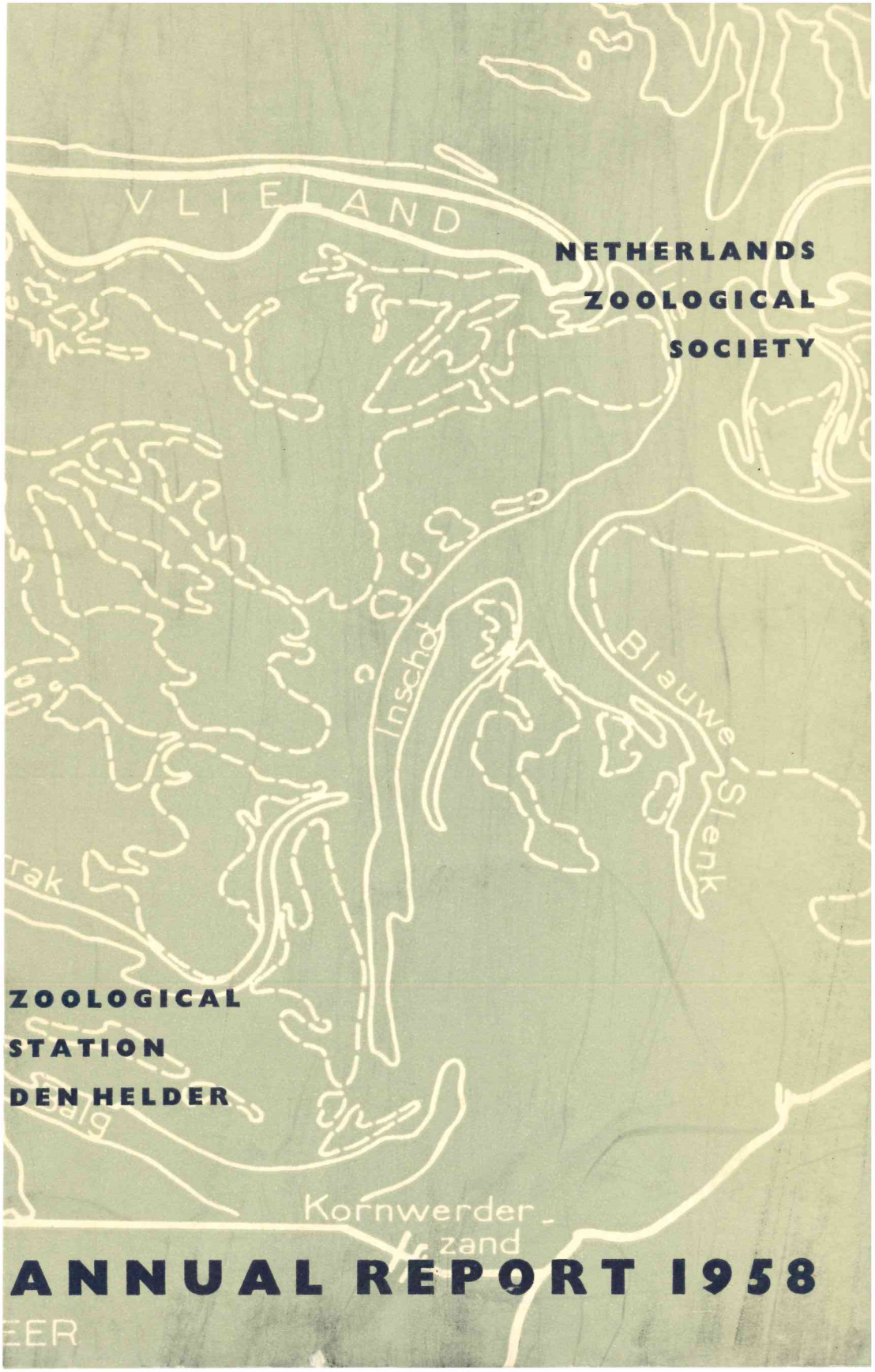

NETHERLANDS
ZOOLOGICAL
SOCIETY

ZOOLOGICAL
STATION
DEN HELDER

ANNUAL REPORT 1958


HOE ZIT DAT

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

Zoological Station of the Netherlands Zoological Society at Den Helder. Marine 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 Defense.

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 Traffics 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.

Extrait des Archives Néerlandaises de Zoologie, Tome XIII, 4e livraison p. 556-571

ANNUAL REPORT OF THE ZOOLOGICAL STATION OF THE NETHERLANDS ZOOLOGICAL SOCIETY FOR THE YEAR 1958

In this report on the research carried out by the Zoological Station in 1958 we intend to break with the custom founded in post-war years, viz. to open the report with the results of the ecological investigations on shell-fish. For years on end such investigations have played an important part in the whole, but gradually other aspects of biological research have come to the foreground and it seems reasonable to start with those items now.

In the 1957-report we gave a survey of the progress made by Mr. DE BLOK in the years 1955–57, when he designed and built his apparatus to study lunar and tidal influences on the reproductive periodicity of marine animals. In 1958 Mr. DE BLOK, until then employed by the Netherlands Organization for Pure Research, took up his post with the Zoological Station, and this was also the first year in which his experiments were definitely started. The point at issue was the influence of duration, intensity and shifting of the moonlight, together with the influence (varying with the tides) of intensity of sunlight and of pressure, on the reproduction of the mussel *(Mytilus edulis)*, the oyster *(Ostrea edulis)*, the sea-urchin *(Psammechinus miliaris)* and the polychaete worm *Spirorbis borealis*. The reproduction of the animals was checked by stating the presence of eggs or larvae in the outlet of the aquaria.

This check, carried out three times a week, yielded much extra work for Mr. DE BLOK and Miss STEINFORT SCHAAP at the times when eggs were delivered. The animals were kept in slowly running water with aeration. The sea-urchin was fed mussel-flesh and sealettuce *(Ulva lactuca)*, the other animals got the chrysophyce *Phaeodactylum tricornutum* as food, which was obtained from a culture put up by Mr. DE WOLF in connection with his *Balanus*-work, which made part of his investigations on the fouling of ships carried out at Den Helder, on behalf of the Netherlands Organization for Applied Research. Quite contrary to our expectations the oyster, fed with *Phaeodactylum*,

produced large numbers of larvae, while the mussel, which as a rule is not very particular in its wants, did not deliver any eggs at all. The sea-urchin did, but very irregularly. *Spirorbis* did reproduce, as there appeared new animals along with the old ones, but it seemed that we had not got hold of the right technique to catch the larvae.

So the only results which allow further elaboration are those of the oyster and they point to the existence of a periodicity of 28 days, notwithstanding the fact that the lunar month to which Mr. DE BLOK exposed his animals had 34 days. If this periodicity of 28 days is reliable it is not linked up with the moon or the actual tide in the sea, so that it might be likely that the animals experience an inherent periodicity of 28 days, which, however, as concerns the times of appearance, has shifted with regard to the lunar and tidal cycle outside the laboratory. In how far this shifting is due to the environment as it was offered in the experiment we cannot say as yet; so far there are no certain indications that the circumstances of the experiment have influenced reproduction. If the existence of an 28-days period should be confirmed in future, this will be an important additional result of the experiments.

In the past year Mr. CREUTZBERG, employed by the Organization for Pure Research, continued his investigation on the orientation of the elver, in which an important stage was reached. In the months of February to April a number of further data were collected by nightly fishing, completing the picture of the migration in the sea. It is now clear that the animals reach the inland waters in spring by passive transport during the flood, while they stop this transport during the ebb. This movement may be reversed by a drop in temperature, while it is probably a combination of temperature and salinity that decides on the question up to where the animals enter brackish water. In this area they let themselves be transported up and down with flow and ebb until (possibly not before many weeks have passed) the time has come to enter fresh water.—While these outdoor data were collected by our skipper, Mr. CREUTZBERG himself tried to prove by experiments that changes in salinity and temperature in the course of flood and ebb are indeed used for discrimination between the tides. To this end he designed an apparatus in which every current velocity and change in temperature or salinity might be applied. The outcome of this experiment meant a great disappointment, since nothing showed that the animals could distinguish flood and ebb. Later experiments indicated that his starting point had probably been wrong, because ebb- and flood-water are apparently not distinguished by temperature or salinity, but in another way. It looks as if Mr. CREUTZBERG may be able to wind up a substantial part of his elver-investigations in 1959 and

publish the results. The data are an important addition to our knowledge of the migration-mechanism of species with passive transport into a certain direction.

During his work in 1957 Mr. CREUTZBERG obtained data indicating that the shrimp *(Crangon crangon)* has an ebb-flood mechanism similar to that of the elver, enabling his transport into a certain direction (towards and away from the coast). A closer study of this question was taken up as a graduation subject by Mr. STERK, University of Utrecht. He found that shrimps leave the Waddensea by passive transport during ebb and enter it in the same way during flood. Just as with the elver there are apparently all sorts of transitions between transport into one and transport into both directions and this decides whether the animals stick to a certain area or not. The crucial point is certainly the combination of temperature and salinity in the area concerned, but this does not necessarily imply that ebb- and flood-water are distinguished by temperature and salinity.

Especially since HAVINGA's investigations (1930) we know that there are differences in the time of departure and of return of juvenile and adult shrimps and that the ♂♂ and the sexually mature ♀♀ go farther out in winter than the juvenile ♀♀. The return migration of the adult ♀♀, starting with the third decade of March, was very conspicuous. They were extremely late as a consequence of the late spring. It is remarkable that the relation between the nubmers of juvenile and adult animals during one and the same period is approximately the same with flood and with ebb. All this makes the whole picture very complicated. In autumn the total numbers are large with ebb, in spring they are large with flood. As the migration season proceeds the relation juvenile/adults changes, but within any given period it is the same with ebb and flood. This would probably mean that part of the animals, transported outward with the ebb current, come back with the flood. Finally there is a difference in the requirements of ♂♂ and ♀♀, which makes the picture even more complicated, while the intricate hydrographical conditions off the tidal outlet of Texel, as proved by DIETRICH's studies (1953), probably greatly influence the movements within the sea.

As the next item of our report the investigation by Mr. DUDOK VAN HEEL be mentioned. As already stated in the previous report he was interested in the perception of sound by the seal *(Phoca)* and porpoise *(Phocaena)*. Together with Mr. DE HAAN, warden of the Texel Museum, he tried, in December 1957 and January 1958, to obtain a number of porpoises with the help of Danish fishermen near Middelfart in Denmark, where the animals pass in substantial numbers during autumn migration from the Baltic to the open sea.

Nineteen animals in all were caught there. Three specimens, and later yet another five, were taken to Holland by road. One of these stayed alive from the end of January till the 6th of June in a brackish water pond on the island of Texel. With this animal a series of observations were carried out to test the accuracy of sound location under water. It was taught to come and fetch a fish at one of two underwater sources of sound and fortunately it could also be taught not to come if no signal was given, so that its reactions to sound could be properly studied. Experiments proved that the animal was able to locate the direction of the signal under water, as long as the angle between the two signals was at least 16°. This angle is probably dependent on the frequency of the sound. A short communication on this subject is shortly to appear in Nature (see Vol. **183**, p. 1063, April 11, 1959). The work was subsidized by the Netherlands Organization for Pure Research, by Mr. DEN HERDER at Harderwijk, the Laboratory for Comparative Physiology of Utrecht University, and the Linnaeus Fund in Amsterdam.

In the 1957-report we also mentioned Mr. VAN ERP's research on the influence of temperature on strobilation and the formation and fission of ephyrae of jelly-fish polyps. The investigation exceeded the original scheme because, along with strobilation, stolonization of the polyps and the formation of so-called podocysts played an important part. Essentially, stolonization is the formation of buds, followed by the growth of stolons. Podocyst-formation is the development of encysted groups of cells which after some time may grow into new polyps. One might call the podocysts encysted buds which, after a resting period, are capable of revival. Strobilation is the well-known formation and subsequent fission of ephyrae which develop into the sexually mature jelly-fishes. In summer this jelly-fish produces eggs, out of which planula-larvae develop. Very quickly the latter grow into polyps, which may reproduce either by stolonization of by the formation of podocysts, and at last may give off ephyrae. Because the development of ephyrae is confined to a fixed time of the year it seems obvious that either light or temperature may govern this periodicity. The data so far obtained seem to indicate that light has no influence, but that temperature has; besides, there is also something like an autonomous periodicity. The polyps of *Chrysaora hysoscella* only showed strobilation above 8°C, but, also when kept at constant temperatures, not before mid-April; the polyps of *Cyanea capillata* showed strobilation at constant temperatures of 3, 6, 9 and 12°C, especially in midwinter with the lower, at the end of winter with the higher temperatures. The number of strobilating polyps increased with higher temperatures; also the strobila delivered

more ephyrae and in less time. So the jelly-fish production is then greatly increased. It must be kept in mind, however, that what we call higher temperatures here are in fact still low temperatures, viz. 9–12°C.

In Mr. VAN ERP's experiments stolonization played a large part with *Aurelia aurita*, of which one polyp may give rise to an offspring of tens of polyps in a few months time. It played no part at all with the two other species, *Chrysaora hysoscella* and *Cyanea capillata*, of which stolonization is mentioned in literature.

Podocyst formation played an enormous part with *Cyanea capillata*, for which it was not described before. According to Mr. VAN ERP it is quite a normal way of asexual reproduction with this species. Podocysts were also observed with *Aurelia* and *Chrysaora*. It looks as if podocysts occurred especially at the higher of the temperatures used (9–12°).

The polyps of *Aurelia* and *Cyanea capillata* can stand lower temperatures well, those of *Chrysaora* cannot. This is in accordance with the southern distribution and the late appearance in the season of the lastnamed species.

It is very much to be hoped that these investigations, with their many interesting aspects, will be taken up again by other students. There are not many facts known in this field of research.

Mr. H. L. DE BEAUFORT, who, in 1956, had been studying the causes of the development of one of the colour patterns of *Sepia officinalis*, the common cuttle, returned to Den Helder in 1958, hoping to make this work the subject for a doctor's thesis. The experiments have not yet yielded sufficient data to summarize the results, but a few words may be said on the keeping of the animals in question. When working with *Sepia* the main difficulty is the chance of injuries. Though now we have special basins available, measuring 5 × 1 meter, they hurt themselves so often when swimming backwards that they are unfit for experiments after three months at the utmost. It would be better to use much larger basins to prevent these injuries, but this also has its drawbacks, because it is not possible to keep more than one animal in one tank, as they maul each other badly. It was also tried to rear young *Sepias* from the egg, but we discovered too late that the water was undersaturated in respect to oxygen. A rather large number of young hatched, but they all died before they were 3 cm at the utmost, probably because the oxygen content of the water was somewhat too low. Perhaps, however, other factors, a.o. too low a temperature, also played a part. When still very young the animals already took *Mysis* and small shrimps.

On the suggestion of Prof. WOLVEKAMP, Mr. OSSE of Leyden University carried out a tentative research on the respiration of *Cancer pagurus* with various oxygen pressures in the environment. The intention was

to find out whether the intake of oxygen depended on the oxygen pressure, and, if so, in how far this dependence was connected with a small diffusion velocity of the epithelium of the gills, as was found by REDMOND for some American crustaceans, or whether it was due to the absence of any regulation of the oxidation within the tissues. The time could not be found, however, to determine the oxygen pressure in the blood, as would have been necessary to answer this question. Some attention was paid to the relation between oxygen pressure and body size.

Mr. DUBBELDAM, also of Leyden University, visited Den Helder to study the influence of various current velocities on the chances of survival of the hydroid polyp *Hydractinia echinata*. In coastal waters this species occurs mainly on the shells inhabited by the hermit crab *Eupagurus bernhardus* and seldom on shells still inhabited by gastropods. This must be because *Eupagurus*, which wanders about quite a lot, makes the water move around the shell, thus helping *Hydractinia* to get rid of settling silt. Where *Hydractinia* occurs in coastal waters on an immobile substratum there is either a strong current or the water is sufficiently clear. Now, our idea was to use recently settled young colonies and to measure their growth as an indication for current sensitivity. This meant we had to raise young colonies, as had been done by Miss SCHIJFSMA (1934). The whole scheme went wrong, however, since Mr. DUBBELDAM obtained only 2 male colonies in 200, all the other colonies being female. He found that in Woods Hole in 1894 Martha BUNTING stated an excess of ♂♂ in June and of ♀♀ in July. This was attributed by her to a change in external conditions. It is thought to be possible that the species is subject to a periodical change of sex and it might be worth while to set up further investigations. Mr. DUBBELDAM's observations with older colonies seemed to indicate that a one-way current was less favourable than an alternating one. Moreover, it seemed that a one-way current of 16 cm/sec was less favourable than a weaker one.

By order of Mr. KORRINGA and on behalf of the State Institution of Fishery Research Mr. H. OBREEN, Utrecht University, investigated the influence of current velocity on the food intake of the oyster. This research was started in the laboratory at Wemeldinge and continued afterwards at Den Helder. The results point to an unfavourable influence of the stronger currents (30 cm/sec) on the food intake. The experiments were carried out in the apparatus designed by Mr. CREUTZBERG. Food was provided in the form of *Phaeodactylum*, reared by Mr. DE WOLF, and the food intake was deduced from the increase in weight of young oysters, weighed under water in the manner described by HAVINGA (1928).

Mr. DEN HARTOG entered service with the Delta Research Department of the Hydrobiological Institute and spent the first months of his

employment at Den Helder. We will report on his work further below.

When, in the beginning of this report, we said that we did not start new investigations on shellfish, this does not mean that we dropped the subject, on the contrary. The study of the numbers and size of the mussel spat present in plankton, which was started by Mr. NUBOER in April 1957, was continued by Mr. DRAL, who studied water samples, collected at least twice a month until May 1958. New larvae turned up in the plankton in all months from April to November. Apparently, new animals were even born in January (1958). On the other hand no larvae were present at all in mid-May 1958, undoubtedly due to the cold spring. It is clear that 1957 has been an exceptionally good year for the production of spat.

Counting and measuring the mussel larvae from the water samples collected during Mr. NUBOER's investigation also took up a lot of time. They were meant to give an idea about the numbers present in the water as compared to the numbers settled on frames hung out at various depths in the sea. This work was done by Mr. DRAL, together with Miss STEINFORT SCHAAP and Mr. DE VRIES.

Finally, we must mention that Mr. DE BLOK worked out the data collected by himself and Miss GEELEN in 1952, on the conditions required by the mussel when settling on thread-like substrata. This publication forms part of the Supplement to part 13 of the Archives. In addition to the requirements of the mussel spat during settlement also the growth of the animals is dealt with. The plankton data for 1957 also yielded some data on growth, especially during the period preceding settlement. In brief, the results come to this. Spat of 100–260 μ showed an increase in length of 2.5% on an average and 4.5% as a maximum per day in mid-April. End May 1952 young mussels of 400–1600 μ showed a maximum growth of 8%, decreasing in the case of the bigger animals to 5%. Without further data we cannot say in how far the differences between spat and already settled mussels are due to the differences in temperature between mid-April and end May. Reliable data of this kind are scarce.

Continuing his former speculations Mr. WESTENBERG developed a theory on the cybernetics of populations, in which for the time being he did not include quantitative speculations. It served as a contribution to the summer course. We may add that his recent summary on the development of fishery theories, of which a Dutch, French and German version existed, unexpectedly turned up in a Russian translation as a separate publication. His contribution to the summer course of 1957 which, as mentioned in the previous report, was published in the "Vakblad voor Biologen", appeared in Italian in Archivio di Oceanografia e Limnologia, Venezia, Vol. **11**, p. 265–273.

Finally, we may add that Mr. VERWEY gave a summary of our knowledge of the orientation of aquatic animals as compared to that of birds, which appeared in the above supplement of part 13 of the Archives. He devoted much time to the study of the literature on the influence of radioactivity on life in the sea, and, moreover, worked up the results of the investigations carried out between 1920 and 1950 in the Zuyderzee and IJsselmeer into a lecture on the occasion of the Commemoration Day of the Leyden University.

As usual this report gives a list of species of which the occurrence is interesting from a distributional point of view or for other reasons. Items worth mentioning are 5 specimens of the lesser fork-beard, *Raniceps raninus*, from the months of spring, 4 *Blennius gatterugine* from December, 1 *Mullus surmuletus* from January, 1 *Solea lascaris* from June, all pointing to a southern influence in 1958.

Further, we heard of at least 8 specimens of the thresher, *Alopias vulpes*, all caught in September off the Dutch coast by pilchard fishermen. The sharks measured from about 1.5 to 4 metres.

In autumn *Lepas anatifera* were numerous on floating material in the southern North Sea. Mr. DEN HARTOG told us that at the time many algae of southern origin occurred with southern animal species attached, so, evidently, the goose barnacles had reached the North Sea by the Straits of Dover. It is well known that the distribution of *Lepas anatifera* is greatly influenced by strong and prevailing winds from a certain direction. The species is not indigenous in the southern North Sea.

As to the species reaching us by the northern route, 14 specimens of the skipper, *Scomberesox saurus*, were brought in, of which 2 were caught at sea near Den Helder and the others washed ashore, all in January. Further 2 specimens of ray's bream, *Brama raii*, were brought in, one washed ashore near Callantsoog, the other one caught West of Texel. One specimen of the squid, *Illex illecebrosus*, was found on the beach near Egmond in April. All three species belong to the group of species that are known often to strand alive.

A specimen of the flatfish *Zeugopterus punctatus* was caught in January off Texel, a specimen of *Maurolicus mülleri* in the Texelstroom in March.

Hydrographical work was carried out by Mr. POSTMA and Mr. DUURSMA as before, while, moreover, the Zoological Station extended hospitality to Mr. HOEKMAN, who joined the Delta Research Department of the Hydrobiological Institute as a chemist-hydrographer.

Research in the Wadensea was a continuation of the work of previous years, while data were again collected in the IJsselmeer, the Delta-region and the large rivers.

Species	*Sex; Size (cm)*	*Locality (ST means buoy on the Silverpit-Texel route)*
MIGRANTS SUPPOSED TO HAVE ENTERED THE NORTH SEA VIA DOVER STRAIT		
Petromyzon marinus	72; 77	Locks Den Oever; off Falga; off Cocksdorp (Texel)
Raia montagui	♂♂ and ♀♀ 40–99	Off Falga; ST 3; Texel Hole; Terschelling Bank
Raia blanda (brachyura)	living	Off Falga
Squatina squatina	♀ 67	Terschelling Bank, 32 m
Raniceps raninus	living ± 7	Off Den Helder; Waddensea
Mullus surmuletus	26.5	Texel Hole
Spondyliosoma cantharus	38	Texel Hole
Blennius gattorugine	living	Off Texel
Trigla cuculus	♂♂ and ♀♀ 25–31	Texel Hole
Solea lascaris	27.5	Texel Hole
Sepia officinalis	♂♂ and ♀♀	Off Petten, off Den Helder, Molengat, Terschelling Bank, Tea Kettle Hole, Black Bank
Octopus vulgaris	10; 11; 13; 13	Texel Hole
MIGRANTS SUPPOSED TO HAVE ENTERED THE NORTH SEA VIA THE NORTHERN ENTRANCE		
Scomberesox saurus	5 ♂♂ and 9 ♀♀ 34–39	Stranded near Den Helder; Molengat, Texel Hole
Brama raii	♂ 53; ♀ 53	Texel Hole; Stranded at Callantsoog
NORTHERN SPECIES, RARE IN THE SOUTHERN NORTH SEA		
Anarhichas lupus	54	10′ ONO ST 2; Black Bank
Eledone cirrhosa		20′ NW Texel Lightvessel; 2′ N Molengat 60′ NNW Den Helder; Terschelling Bank
SPECIES, WHOSE DISTRIBUTION IS UNCERTAIN		
Alopias vulpes	158–400	Off IJmuiden, Scheveningen, Zandvoort
Maurolicus mulleri		southern Texelstroom
Spinachia spinachia	10.7	Den Helder (seaw. side New Harbour)
Ctenolabrus rupestris	8; 9; 12.3 living	Westgat (Haaks grounds); Molengat
Zeugopterus punctatus	16	Texel Hole
Illex illecebrosus	♂ ? 36.4	Stranded at Egmond
Loligo vulgaris	♂♂ and ♀♀ 11–28.5	Texel Hole, off Callantsoog, Haaks grounds
Loligo forbesi	♂♂ and ♀♀ 11–35	Texel Hole, Terschelling Bank

Numbers per month											
J	F	M	A	M	J	J	A	S	O	N	D
—	—	—	1	1	—	—	—	3	—	—	—
6	3	1	—	1	—	1	—	1	1	1	6
—	—	1	—	—	—	—	—	—	—	—	—
1	—	—	—	—	—	—	—	—	—	—	—
1	—	4	2	1	—	—	—	—	—	—	—
1	—	—	—	—	—	—	1	—	—	—	—
—	—	—	—	—	—	—	—	1	—	—	—
—	—	—	—	—	—	—	—	—	—	—	4
—	—	—	—	5	6	—	1	—	—	—	—
—	—	—	—	—	1	—	—	—	—	—	—
—	—	—	—	59	48	23	231	169	17	—	—
4	—	—	—	—	—	—	—	—	—	—	—
14	—	—	—	—	—	—	—	—	—	—	—
1	—	—	—	—	—	—	—	—	—	1	—
—	—	—	2	—	—	—	—	—	—	—	—
—	1	1	3	—	—	1	—	—	—	—	—
—	—	—	—	—	—	—	—	8	—	—	—
—	—	1	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	1	—	—
—	—	3	—	—	—	—	—	—	—	—	—
1	—	—	—	—	—	—	—	—	—	—	—
—	—	—	1	—	—	—	—	—	—	—	—
—	—	—	—	12	?	?	?	?	?	?	2
—	—	—	—	2	7	46	?	?	>14	>2	1

In the previous annual report attention was paid to the form in which chlorophyll occurs in coastal water. More arguments were collected in support of the assumption that by far the largest part of the chlorophyll is present in dead matter. It bore out the view that this material is only of minor value as a measure for the living phytoplankton. In certain cases, however, chlorophyll appeared to be useful as a special characteristic of that part of the suspended material of which it is a component. Mr. POSTMA used a.o. the chlorophyll percentage of the total amount of suspended organic matter in the Dollart region to demonstrate that this matter is for the greater part brought down by the river Eems and not formed on the spot or brought in from the North Sea. He wrote a paper on this subject, which is to appear shortly, together with contributions of others studying various problems in the Dollart-Eems estuary.

In connection with previous investigations measurements were carried out near Ameland concerning the way in which materials in suspension are held in the Waddensea. At the time Mr. POSTMA set up a theory, which afterwards was extended by Mr. VAN STRAATEN and Prof. KUENEN of Groningen University. In this theory the sedimentation velocity of the material in suspension plays an important part. It is still too early to say anything on the data collected near Ameland, except that an important fraction of the suspended silt settles more slowly than was originally supposed.

In the course of 1958 Mr. HOEKMAN and Mr. POSTMA made a number of trips to the Delta region with the Max Weber to investigate the distribution of salinity and silt and of various biologically important components of the water in different parts of the Zeeland waters. In the previous annual report the purpose of this investigation was shortly mentioned.

The IJsselmeer data were collected at the same places and in the same season as in the previous year. The purpose was to find out in how far the distribution of biologically important elements in this area might be disturbed by material from dyke building and dredging, as was supposed in the previous annual report. The disturbing effect turned out to be substantially lower than was supposed on account of the previous observations and hardly to play a role at all. We may assume that the observed horizontal distribution of the various components does represent the situation as it would be without human interference. It is remarkable how far eutrophy has progressed in the area west of the line Enkhuizen–Lelystad, where the concentration of nutritious matter exceeds that of the rivers. At the same time the water leaving the sluices is poorer in nutritious components than that which is brought in by the river IJssel.

Mr. DUURSMA, who in 1958 was still employed by the Netherlands Organization for Pure Research, again devoted much of his time to preparatory work, and, lateron, to the study of water samples collected in 1958 by the German research vessels "Gauss" and "Anton Dohrn" on his behalf. These vessels made two trips, one in spring (March/April) and one in autumn (August/September). Mr. DUURSMA determined the carbon, nitrogen and phosphor content of the organic material in solution of some hundreds of samples in a transect from the southern point of Greenland to the South. These determinations took up a lot of time, and a large part of the next year will be taken up by working out the results. The description of the method has now got ready, however.

The concentrations of dissolved organic carbon, and therefore also of dissolved organic material, present in the open ocean, turned out to be much smaller than former investigations—especially those by KROGH (1934)—had led us to believe. The carbon content averaged about 0.5 mg/l, which amounts to a content of dissolved organic matter of somewhat over 1 mg/l. Furthermore, it appeared that—also contrary to former assumptions—there may be substantial differences between the carbon values in various places, while, moreover, in the surface waters important seasonal variations were observed. From these facts it seems clear that we must not consider the dissolved organic matter as having been put more or less aside from the cylce, but as forming an integral part of it.

In order to check these facts Mr. DUURSMA set up an investigation nearer home on the seasonal variation of dissolved organic matter and the factors which may be responsible for it. To this purpose every fortnight water samples from the North Sea, taken near the lightvessel Texel, were investigated on their content of dissolved and suspended organic matter and of plankton. This series of observations will be continued in 1959.

Just as in previous years a number of water and bottom samples were investigated on behalf of "Rijkswaterstaat", department Hoorn. We must also mention that regularly water samples from the southern point of Texel were investigated in view of a possible future inlet of sea water for the new Zoological Station.

The research on the fouling of ships, carried out under the direction of Mr. DE WOLF at Den Helder by the Netherlands Organization for Applied Research, was brought over in June to a wooden laboratory, built to that end outside the Zoological Station. It has a private seawater circulation, which draws its water from one of the 35 m^3 tanks of the Zoological Station. Besides an aquarium space, it contains a

separate air-conditioned room for the algae-nursery. The presence of these cultures is of great value to the Zoological Station so that the benefits of the neighbourship are mutual.

A close contact was kept with the Delta-Research Department of the Hydrobiological Institute, which started working in 1957 and continued in 1958, largely from Den Helder. There the chemist-hydrographer, Mr. HOEKMAN, found accommodation from March 1st, Mr. DEN HARTOG from July 15th, the analyst Miss J. DE JONGE from October 1st. The director, Mr. K. F. VAAS, who entered service on the 1st of July, came often to Den Helder, and the Max Weber made four trips to Zeeland on behalf of the work there. It is therefore clear that co-operation was close. The hydrographical work in that area was mentioned above. The work of Mr. DEN HARTOG consisted mostly of drawing up inventories for a starting-point. At the meeting of the Hydrobiological Society on January 30th he suggested a classification of the Delta-area on ecological-geographical grounds, as illustrated by a number of Amphipods and worms. For the sake of completeness it must be mentioned that Mr. BEEFTINK, also attached to the Delta-Research Department, is working on plant sociological subjects in Zeeland.

There were also regular contacts with the State Institute for Fishery Research at IJmuiden. Miss W. DE LIGNY of this institute spent a week at Den Helder in connection with her bloodgroup-determination of spring herring, which is still caught in very small numbers there. As always the contact with "Rijkswaterstaat, section Hoorn", was good. The schemes for extension of the Zoological Station met with sympathetic co-operation there.

The summer courses took up less time than in former years, since only 15 participants entered. Although this is to be regretted, it meant that our staff could spend more time on their own research. The participants were 5 students from Groningen University, 8 from Utrecht and 2 from Amsterdam. Mr. VAAS, the director of the Delta biological research, also joined the course. Separately, the Physiological Laboratory in Amsterdam gave a course for 24 of its own students, which was conducted by Mr. KRISTENSEN and Mr. PARMA. Further, the Free University, Amsterdam, also gave a course for its own students, in which 20 people took part.

The total number of man-days, spent in 1958 at the Zoological Station by research workers and course-participants, the Delta-people excluded, was about 1115. The average for the years 1947–58 is about 1120.

Visitors from abroad included Dr. W. BERGMANN, Professor of Chemistry, Yale University, New Haven (Conn.), U.S.A., Dr. and Mrs Ralph BUCHSBAUM, Pittsburgh (Penns.), U.S.A., Dr. Walter A. CHIPMAN, Beaufort (North Carolina), U.S.A., W. HIATT, Honolulu, Hawaii, temporarily employed with the U.S. Office of Naval Research in London, Dr. Fergus O'ROURKE, Professor of Zoology, Cork, Ireland, Dr. E. SCHÜZ, Museum für Naturkunde, Stuttgart, Germany. The Zoological Station was also visited by 5 students of Prof. DE CONINCK, Ghent, Belgium, who came to study the method of collaboration between the Zoological Station and the Universities.

As considers the item Staff we have already mentioned that Mr. DE BLOK was taken over from the Netherlands Organization for Pure Research. He joined our staff on January 1st, 1958. Mr. G. DE BOER was appointed as servant from Febr. 10th onward, and two new analysts entered our service: Mr. D. J. DE VRIES and Mr. J. W. ROMMETS, on March 1st and April 1st resp. Mr. DE VRIES took the place of Mr. T. DE VRIES, who entered service with the Research on fouling of the Organization for Applied Research. Starting December 1st Miss J. VAN DER VLIET was appointed typist. To our regret Mr. DIJKSTRA was absent for 3 months owing to illness.

In connection with his work Mr. DUURSMA, with a grant of the Netherlands Organization for Pure Research, visited the German Hydrographic Institute in Hamburg and the Institut für Meereskunde in Kiel on 12–15 February and 10–12 July respectively, and Mr. POSTMA, who accompanied Mr. DUURSMA on his first trip, also visited Prof. STEEMANN NIELSEN in Copenhagen on 23–28 March, in connection with his study of the CO_2-cycle. The trips of Mr. DUDOK VAN HEEL to Denmark were mentioned above. During his holidays Mr. VERWEY spent a few days in the Laboratory of the Marine Biological Association at Plymouth, England.

In the past year especially Mr. VERWEY devoted much time to the schemes for extension of the Zoological Station. After it had become more and more obvious that at Den Helder no proper site for a new building would be found our attention was concentrated on the southern point of the island of Texel. The "Rijkswaterstaat" obliged us by putting at our disposal valuable hydrographic data for that area, which in the course of 1958 were completed by data of our own. The distribution of salinity and temperature at the place in question begins to take shape. It must be mentioned that not only the Zoological Station itself, but especially Prof. BAERENDS as the President of the Society and Mr. KOSTER of the direction of the State Building Serv-

ice, devoted much time to discussions on these extension schemes.

Pending this question no alterations were made in the building itself, but we spent *f* 1000.— on upkeep of the roof, an amount of about *f* 1000.— on exterior painting and *f* 1500.— on painting the window-frames inside and the course-room. Moreover, in consultation with the Municipality, we put an end to the perilous condition of the electric mains in the building, which cost *f* 3000.— in 1958. It is a very great improvement that the old furniture could be replaced and that at the same time oil stoves took the place of the old coal stoves. This improvement took *f* 11 000.— so that the total expenditures on building and furniture amounted to *f* 17 500.—.

As the shortage of space made itself felt more and more strongly, after consultation with the Ministry we proceeded to buy a house near the Zoological Station which will serve as a students' lodge instead of the old one. It was bought for *f* 17 000.— and until the end of 1958 we spent *f* 20 000.— on building expenses. It may easily accommodate 30 people. The existing students' lodge "De Potvis" on the grounds of the Zoological Station will be used as a work shop. The acquisition of the house has been made possible by a Government grant of *f* 40000.— for 1959.

The budget for the library was enlarged from *f* 1100.— to *f* 2500.— starting with 1958. So this year for the first time we could buy a number of handbooks, which means a great asset to our work. Among them are part 1 and 2 of The Fishes by BROWN, HUTCHINSON's Treatise on Limnology, MOORE's Marine Ecology, DIETRICH's Allgemeine Meereskunde, a new Polish Atlas for the North Sea, a.o. Through intermediary of the Office of Naval Research our library obtained a number of valuable reports on the influence of radioactivity on marine organisms. The exchange proceeds normally. To make an end to the increasing lack of space, which is the consequence of these activities, the middle steel cases in the library were heightened, so that a space of 100 metres could be added. In this way it was possible to do away with the book cases in two of the working rooms and to bring all the periodicals together again. Unfortunately, the relief is only for one year, after that the problems will start all over again.

The item Instruments also went up starting with 1958, viz. from *f* 4000.— to *f* 6500.— with a temporary increase of *f* 8000.—. This made it possible to buy a.o. 8 Czech microscopes for the courses in the hope that it will be possible to avoid dragging private microscopes to Den Helder and back, at least for some of our visitors. Further we bought a Leitz Laborlux microscope, a Melag incubator and paraffine-stove, a vacuum pump, a muffle-furnace and a Ferrograph echo-sounder for the Max Weber. It must be mentioned that the Netherlands

Organization for Pure Research handed over the lunar and tidal apparatus of Mr. DE BLOK to the Netherlands Zoological Society.

In 1958 much use was made of the Max Weber, both in the Wadden area and in the province of Zeeland. The ship made 127 navigation days, which is a lot. In addition to the cost of upkeep of *f* 3500.— we had to spend an extra amount of about *f* 3000.— on a thorough revision of the clutch, which used to give trouble of late. The money was found on other items. Besides its echo-sounder the Max Weber got a wireless apparatus and butagas.

The income from study materials in 1958 amounted to *f* 10325.—. We bought animals for *f* 5525.— and spent *f* 2100.— on preserving liquids, wickerbottles and other materials for transport, so that the expenditures amounted to *f* 7625.—. This makes a balance of *f* 2700.—, which is *f* 600.— less than that of 1957. The Zoological Station is much obliged to the State Institute for Fishery Research, which took care of buying and preserving sharks at IJmuiden, since at Den Helder not enough sharks are supplied to meet all the demands. To the end of the year we bought a Ford delivery van, so that the transport to the Railways is now in our own hands. This saves a lot of extra-work and transport is quicker.

The total costs of exploitation, excluded the amounts granted by the Netherlands Organization for Pure Research, made *f* 220000.—in all. As compared to 1957 the amount has increased by about *f* 50000.—, to which another *f* 24000.— in single grants has to be added. This is all due to the goodwill of the Government regarding the extension schemes of the Zoological Station, of which a first stage was realized in 1958 in the form of amounts for extension of staff, acquisition of furniture and extension of the instrumentary.

Den Helder, 18th Febr. 1959 J. VERWEY

The Netherlands Zoological Society has issued the following publications, which are obtainable from the Director of the Zoological Station, Den Helder, at the prices given below:

Tijdschrift van de Nederlandse Dierkundige Vereniging

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:	
Report on oyster research	6.—
Supplement to vol. 2 (Ser. I), 1888:	
Report on certain fisheries	6.—
Index to Tijdschrift, 1874—1909	1.20

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

Vols. 1—7, 1934—1947	22.—
„ 8, 1947—1951	25.—
„ 9—13, 1948—1958	30.—
Suppl. to vol. 3, 1938	10.—
„ „ „ 7, 1946	2.—
„ I„ „ 10, 1953	8.50
„ II„ „ 10, 1953	8.50
„ I„ „ 13, 1958	40.—

Flora and Fauna of the Zuiderzee. In Dutch. 4°. 460 pages, 1922. Out of print.

Supplement to Flora and fauna of the Zuiderzee. In Dutch. 4°. 258 pages, 1936 . . . . . 7.—

Changes in the flora and fauna of the Zuiderzee since its closure in 1932. In Dutch, with English summary. 4°. 359 pages, 40 figures, 11 plates and many maps and tables, 1954 . . 15.—

De Biologie van de Zuiderzee tijdens haar drooglegging, parts 1-6, 1928-1944 . . . . . Per set 10.—
Per part 2.—

Mededelingen Commissie faunistisch onderzoek Zuiderzeepolders, parts 1-2, 1949 . . . . . Per set 1.50

Catalogue of the Society's library. 1907. 1924. Out of print.

*) Prices in Dutch guilders per volume, reduced prices for members. Postage extra.