

MARINE ORGANISMS IN THE ISLAND OF
WALCHEREN (NETHERLANDS) DURING
THE INUNDATION,
OCTOBER 1944 — OCTOBER 1945,

21577



BY

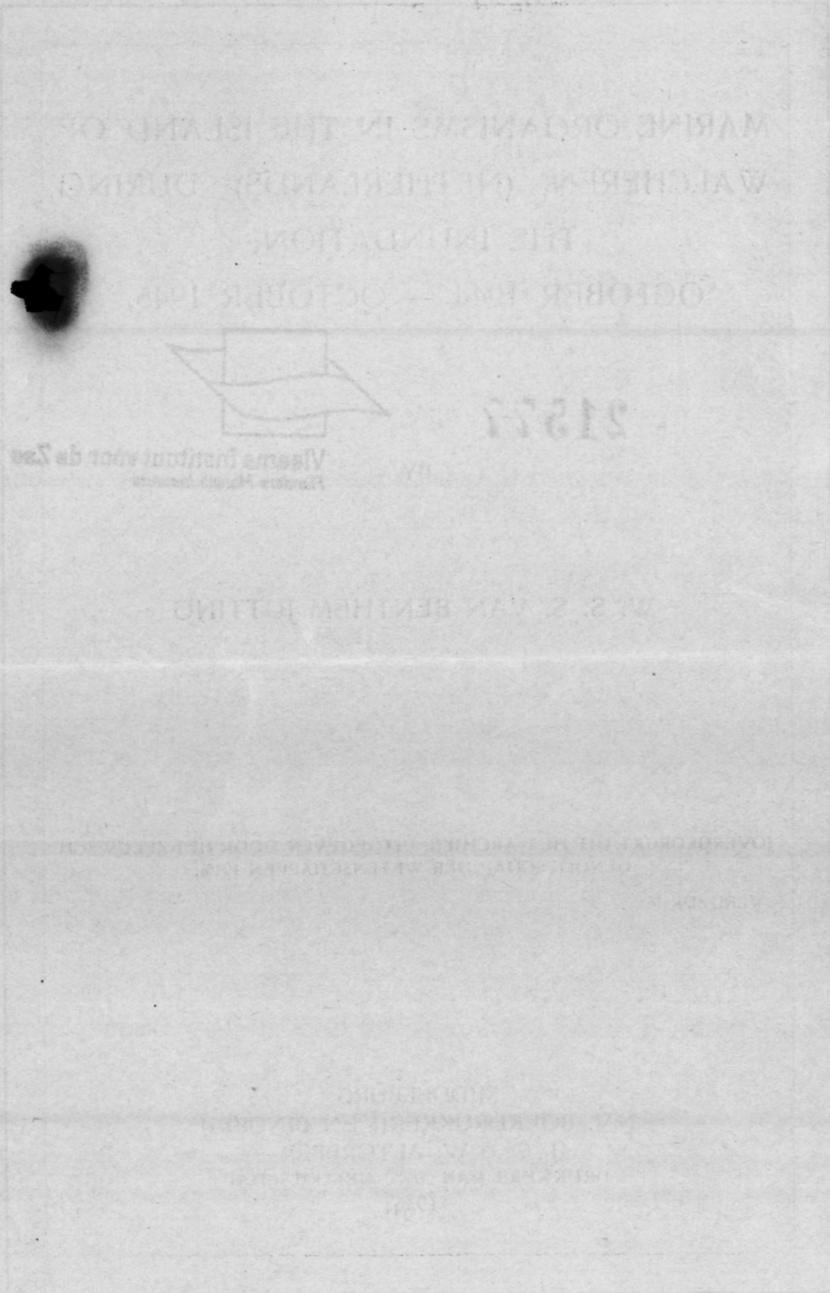
Vlaams Instituut voor de Zee
Flanders Marine Institute

W. S. S. VAN BENTHEM JUTTING

(OVERGEDRUKT UIT HET ARCHIEF, UITGEGEVEN DOOR HET ZEEUWSCH
GENOOTSCHAP DER WETENSCHAPPEN 1946).

MIDDELBURG
N.V. BOEKDRUKKERIJ EN BINDERIJ
J. C. & W. ALTORFFER
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Vlaamse Instaat voor de Zee
Wetenschappelijke Dienst

W. S. VAN BENTHUM, J. T. JONG

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RESEARCH ON THE BEHAVIOUR OF
MOLLUSKS IN THE SAND OF
THE WADZOUK (WESTERVAARD) DURING

THE WINTER

W. S. VAN BENTHEM, JR.

RESEARCH REPORT NO. 10
1964

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W. S. S. VAN BENTHEM JUTTING
(ZOOLOGICAL MUSEUM, AMSTERDAM)

OOSTERSCHELDE

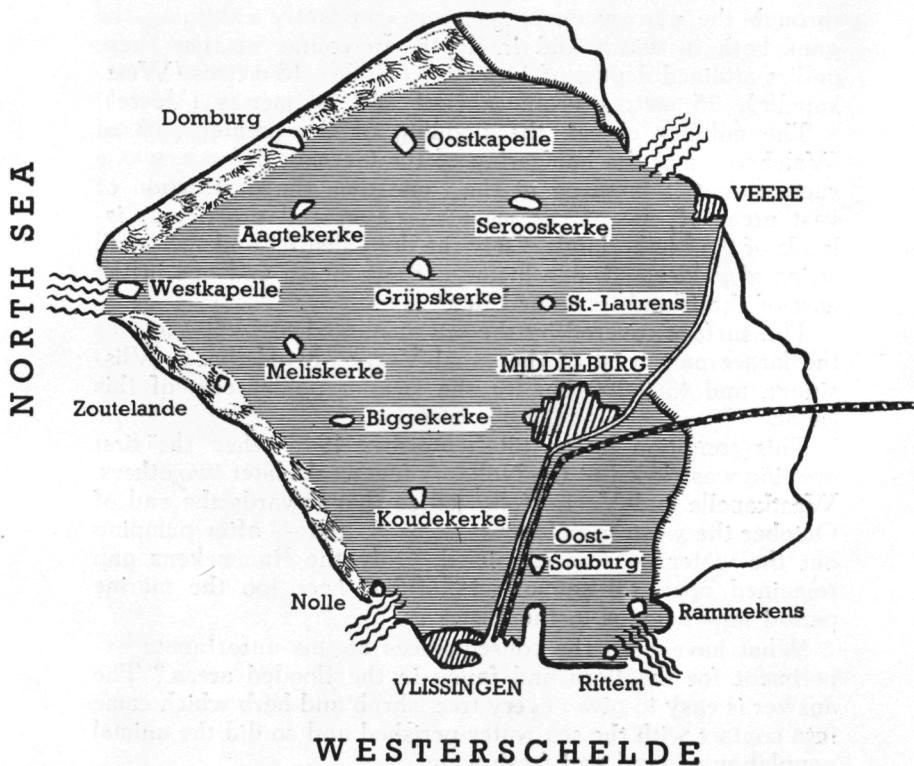


Fig. 1. Sketch-map of the island of Walcheren, showing gaps in dikes and flooded area.

In October 1944 bombers of the allied forces bombed the dikes of the island of Walcheren (province of Zeeland) in order to inundate the island and to drive the German occupation out, this being the first step in making free the shipping route through the Westerschelde to Antwerp for the great attack on, and subsequent liberation of North West Europe.

The Westkapelle dike was bombed October 3rd and 17th, the Nolle dike and the one near Rammekens October 7th, and the one near Veere October 11th (Fig. 1).

The result was that in the sea-defence works huge gaps were made, the gap at Westkapelle being about 600 metres wide, at the Nolle 350 metres, at Rammekens 750 metres and near Veere 900 metres. From that fatal date onward large masses of sea water covered almost the entire island. The currents of the rising and the falling tide rapidly rushed through the narrow openings, thus constantly enlarging the gaps both in width and in depth. In course of time these gullies attained depths of 11 metres (Nolle), 18 metres (Westkapelle), 25 metres (Rammekens) and 20 metres (Veere).

The military object, the flooding of the greater part of Walcheren and the hampering of the German defence, was a success, but it involved at the same time the destruction of vast areas of one of the most charming and prosperous islands of the Netherlands. Only the dune district and two small strips of polderland, one in the extreme north and one in the east of the island, remained dry.

The surface covered by the sea amounted to 13,500 ha. for the larger part west of the canal Veere—Middelburg—Vlissingen and to 2,000 ha. for the smaller polder east of this canal.

This condition lasted till September 1945 when the first opening was closed at the Nolle. A few weeks later two others, Westkapelle and Veere, followed so that towards the end of October the western polder was closed, and — after pumping out the water — was reclaimed. Only the Rammekens gap remained open till January 1946, but here too the marine period now belongs to the past.

What have been the consequences of this unfortunate experiment for the flora and fauna in the flooded areas? The answer is easy to give: every tree, shrub and herb which came into contact with the sea water perished and so did the animal population of land and fresh water.

Only the dunes, the two polders in the North and East, the three cities, Middelburg, Vlissingen and Veere, and the

village centres which are lying at a small elevation were refuges for vegetation and fauna.

On all the rest of the once so fertile island organic life was obliterated and now, after reclaiming, these areas are an endless barren plain without a single blade of grass, recalling the earth in the beginning of the Creation: „And the earth was without form and void”.

The sea, in its turn, brought along its own population. Some few months after the inundation barnacles, algae and other sessile organisms were already growing on all suitable substrata: dead trees, houses, meadow fences etc., and on the innumerable quantities of driftwood which were carried hither and thither by the waves. Especially when the tide was out, exposing to the air a zone of about $1\frac{1}{2}$ metres in height, millions of white specks, the barnacles, and flapping festoons of green algae could be observed. Between them, in the open water, shoals of fish, prawns and shrimps, jellyfish and other invertebrates were swimming, and bottom-living animals such as worms, crabs, shellfish etc. settled on and in the mud. It is even said that seals and porpoises penetrated now and then into this inland sea and played their graceful caprioles in the centre of the island.

Now, after the reclaiming of Walcheren, a satisfactory survey of the entire population of the marine phase cannot be given. The animals which were able to swim actively ultimately made their escape through the gaps in the dikes. Only the sessile animals, i.e. those which were firmly attached to their substratum, and the bottom fauna remained. Inevitably they had to perish when their natural medium vanished. But their remains can be studied now at leisure and give us an idea as to how sea-organisms can settle, live and grow within a certain amount of time (October 1944—October 1945).

That a good many organisms felt quite at home in the new quarters is easily demonstrated by the unusually large quantities and the luxuriant growth in which they occurred. The reasons for this richness are readily understood if we realize the conditions controlling the animals' distribution: in sea water of a density varying between 30 and 34 ‰, which is in constant regular motion, with moderate temperatures, well aerated and carrying plenty of food.

The common mussel (*Mytilus edulis* L.) for instance, with the aid of their byssus threads had attached themselves to almost every solid submerged object, literally covering trees and walls, forming regular mats on the ground and hanging

like queer fruit in the shrubs of gardens and groves (Fig. 2, 3).

The dimensions of 100 of the larger shells varied between 35 and 55 mm length and 18 to 24 mm height. Here we must bear in mind that these specimens cannot be more than about 6 months old as the parent mussels breed at earliest in March. Compared with the figures which Redeke mentioned in his paper on the growth of Zuiderzee mussels (Versl. Staat Ned. Zeevissch. 1910 (1911) Extra bijl. p. 89—100): 50—60 mm at most in the first 8 months of their existence, it is evident that our Walcheren mussels which approach these figures so closely must have lived under almost optimal conditions. This is also demonstrated by their form and texture: rather thin, slender shells, and colour: plain light brown or straw-colour with radiating brown stripes. Winterrings are missing.

The coating of the mussels on the houses and the pavements on the ground had one advantage: it formed a not unimportant protection for the human settlements against the remorseless violence of the waves.

The mussel communities in their turn afforded plenty of opportunity for settling to other organisms. The increase of surface attracted all sorts of sedentary animals and seaweed, whereas the little nooks and crevices between the musselshells were unsurpassed hiding places for motile creatures such as worms, snails, crabs, isopods, amphipods etc., either in the adult stage or as larvae. Thus the mussel zones called into existence an entire association of organisms in which the members — although not directly advantageous to each other — live in a sort of tolerant companionship.

However, it is granted that it is not all roses and raptures in this mussel population: the apparently harmless lodgers may turn out to be predators or parasites. Others are competitors in nutrition, straining off the fine microscopic plankton organisms which also make the mussels' diet. A third danger may arise from a too profuse settling of new organisms on the top of the old ones. In this way the lower layers are likely to be suffocated by the newcomers.

From a few samples, taken in October 1945 in the outskirts of Middelburg, I could easily obtain a dozen species, some of which will be discussed here.

One of the organisms which rapidly took advantage of the new surroundings was the Polyzoon, *Membranipora (Electra) crustulenta* (Pallas) var. *fossaria* (Hincks). Obviously it did not settle on large, flat surfaces for colonizing, but preferred branches of shrubs and rushes, starting as a thin, delicate



Fig. 2. Mussels growing on trees near Westkapelle (Foto J. Merk).

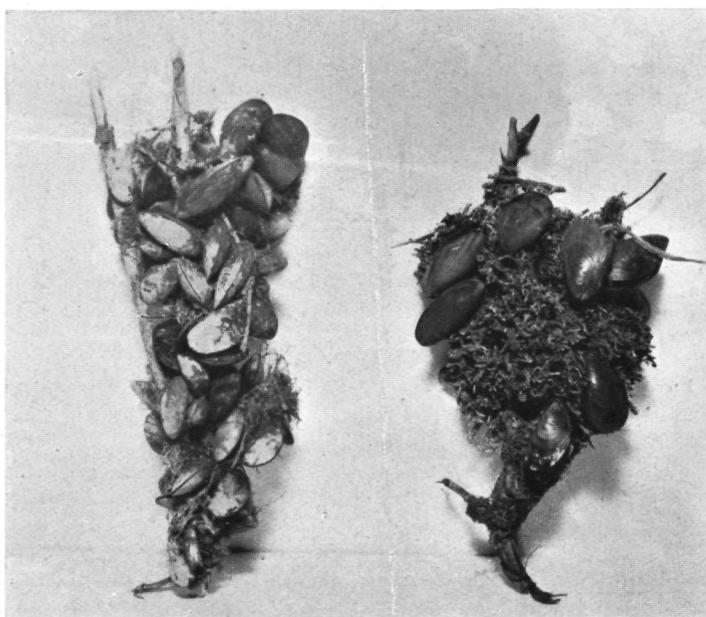


Fig. 3. Details of mussels and polyzoa growing on rushes and branches near St. Laurens (Foto Regter).

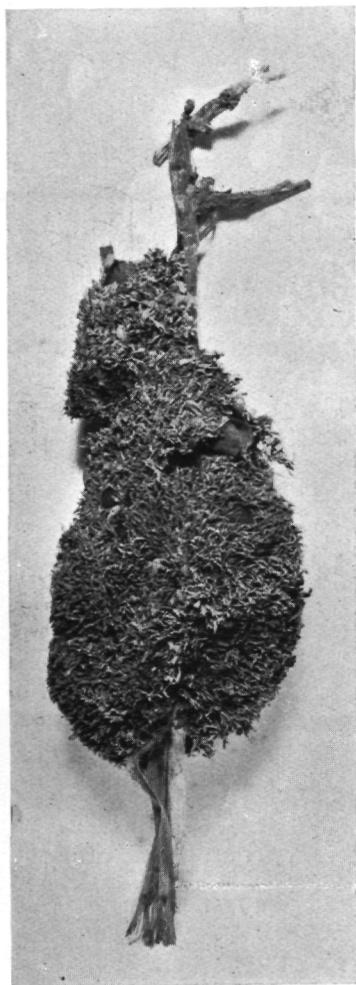


Fig. 4. Large colony of *Membranipora crustulenta* (Pall.) var. *fossaria* (Hincks) from hawthorn hedge near St. Laurens (foto Regter).

network which in course of time developed into large, irregular cushions or balls, often overgrowing mussels and barnacles already living in the neighbourhood. The accompanying figure gives an idea of how these minute animals within the course of one year can accumulate to mighty colonies of 200 mm. and more in length (Fig. 4).

Another settler, even the most rapid of them all, was the barnacle *Balanus crenatus* Brug. Almost from the very beginning of the inundation young barnacles could be encountered on any object lying between the tidemarks. All the samples which came into my hands consisted of shells of the broad, shield-like type, as are characteristic for specimens which have sufficient room for individual expansion. The dimensions of the 5 largest shells are (in mm) :

Diameter in carino-rostral direction at top	Id. at base	Height
13	24	14
11	22	13
14	22	12
11	22	11
9	15	10

The high, narrow, tube- or corolla-shaped individuals which are so characteristic for specimens living in closely set crowds on a restricted substratum, are quite unknown in the inundated area.

On the breeding of *Balanus crenatus* we have almost no information. I only found an incidental remark by Broch (Kükenthal-Krumbach, Handb. d. Zool. Bd. III, Lief. 5, 1927, S. 533) that under favourable conditions *B. crenatus* in two years can attain a height of 35 mm and a carino-rostral top-diameter of about 15 mm. Meanwhile there can be no doubt that the Walcheren barnacles are at most 12 months old, but generally less, as during the winter reproduction is retarded or even stopped. It is however, probable that breeding occurs more or less in all seasons, for specimens of all ages between a pin's head and a sixpence were living side by side towards the end of the marine phase.

Oysters (*Ostrea edulis* L.) were much less frequent than any of the preceding species. Small and fragile shells were found locally hanging in the shrubs and lying on twigs on the ground. Their dimensions vary between 38 and 24 mm. height and 42—28 mm. breadth. Some spat had fallen on *Balanus crenatus* of good size (diameter circa 15 mm.) which is a proof that the oysters settled a good long while later than the barnacles. This is in agreement with the breeding habits of

the oysters which spawn in July or August, whereas the barnacles — as we have seen — are capable of reproduction almost the whole year.

Consequently we can take it for granted that the Walcheren oysters in October 1945, when their existence came abruptly to an end, were between 3 and 4 months old.

In their turn several oyster shells were bearing barnacles on their upper valves. The largest of these reached about 3 mm. in diameter. It is evident that these barnacles must be younger than oysters, being at most 2—3 months old. Herewith we have another demonstration of the extremely rapid development of these creatures.

Of the bottom dwellers I could examine a shovelful of the common cockle (*Cardium edule* L.) and about a dozen clams (*Mya arenaria* L.)

The cockles varied between 27 and 14 mm length, and 24—13 mm height, the Mya's between 54 and 37 mm length, and 35—22 mm height. Just like the mussels the cockles and clams do not show winterrings.

The cockles have strong, equilateral shells. There is no tendency to develop a produced posterior end as in the case of animals living in brackish water. Like the *Cardium* the *Mya* too are representatives of the high sea. None of them show the fragile, stunted form which occurs in the Zuiderzee or in the Baltic.

Cardium and *Mya*, although they are in fact not actually sessile yet physiologically they can be regarded so, because they live permanently imbedded in the mud, *Mya* never, and *Cardium* rarely, quitting their milieu.

According to Havinga (Handb. Seefisch. Nordeuropas, Bd. III, Heft 2, 1929, S. 108) *Cardium edule* breeds in Holland between February and October. After one year the length amounts to ± 20 mm. Compared with the Walcheren specimens which are about 9 months old, it is evident that the latter are none the worse for it.

On the development of *Mya* information is much more incomplete. Breeding takes place in summer, larvae are found in the plankton between June and September. The youngest bottom stages crawl freely on the mud, or attach themselves by means of delicate byssus threads to algae, hydroids and other substrata. Not until a few weeks later are the clams going to burrow in the mud, at first superficially, with increasing age deeper and deeper.

In my opinion the Walcheren clams are derived from young

specimens which entered the inland sea as larvae in the first days of October 1944. Sooner or later these veligers precipitated and metamorphosed to young bivalves. In this stage they hibernated and in the following spring growth set in rapidly. Thus in about a year's cycle the little clams attained about 50 mm length which is about one third of their possible maximum size.

Two carapaces of the common crab (*Carcinides maenas* L.) of resp. 43 and 38 mm breadth were also collected. It is possible that these animals were actually bred in the Walcheren inland sea, but in the case of such vagrant and migratory creatures it will always remain uncertain whether they were inhabitants from their birth or may have entered the area much later in the adult stage.

Still rarer were the records of starfish (*Asterias rubens* L.) which was observed only once. The common periwinkle (*Littorina littorea* L.) has not been recorded.

The marine phase in the history of Walcheren has not led to a condition in which the fauna of the flooded area was representative of the sea fauna in the immediate vicinity of the island, i.e. the fauna of the Oosterschelde, the Westerschelde or the North Sea off Westkapelle and Domburg. For that purpose the time during which the invasion lasted was far too short and the communication between the inland sea and the exterior too fragmentary, so that only a fraction of the number of species had the opportunity to enter. The marine fauna of Walcheren therefore was composed of species which either could swim actively or which had pelagic larvae. Animals with a slow rate of locomotion such as various gastropods, had little or no chance to take possession of the new habitat.

