Subtidal macrozoobenthos western Dutch Wadden Sea 1981-2010

Sampling programme on subtidal (= under low-water line) soft-sediment macrozoobenthos in the western Dutch Wadden Sea.
Aim: to describe the distribution and numbers of the relative poorly known subtidal macrozoobenthos, initially focussed on depths between low water line and NAP -5 m.
Periods: samplings took place in two distinct periods: 1981-1982, and 2008-2010.

**Period 1981-1982**

Due to limitations of the available research vessel a Reineck box-corer, the preferred sampling gear (see Beukema, 1974a), could not be used. In stead, two sampling gears were used to take macrozoobenthos and sediment samples.
- 0.2 m² Van Veen grab was used to collect benthos and sediment samples. Disadvantage of the grab is the limited penetration depth of 5-10 cm, depending on the sediment type (see Beukema, 1974a).
- A 0.02 m² Van Arkel flushing sampler, adapted for operation from a vessel in deeper water (down to ± 5 m depth) (see Van Arkel & Mulder, 1975; Mulder and van Arkel, 1980; Dekker, 1982).
Samples were taken in all season of the year, although most samples were taken in the period September – November 1981.

Field operation practice

At each sampling location the research vessel was anchored.
Due to the connection of a hose between the flushing sampler and a pump on deck, the maximum operation depth of the flushing sampler was limited to about 5 m below the water surface. For operation details see Dekker (1982). Moreover, at some locations, the flushing sampler was not able to penetrate into the sediment (mussel beds, sediments with firm peat or clay layers) and hence did not yield a proper sample.
One Van Veen grab sample was taken and emptied of a 1-mm round-hole sieve. From this sample a sediment sample was taken with a small ~1.5 cm ø core up to 5 cm deep. The sediment sample was labeled and deep frozen. The sample in the sieve was washed with running sea water, the remains were put in plastic bags and deep frozen (in case the flushing sampler could be used), or put in a jar and preserved in 4% formaldehyde (in case the flushing sampler could not be used).
The flushing sampler, mounted with a 1-mm square-mesh sieve, was lowered 3 times on the same sampling location. The resulting washed and pooled sample, representing a surface of 0.06 m², was stored in a jar and preserved in 4% formaldehyde.
The samples, both preserved and deep-frozen, were **not** stained with Rose-Bengal or another staining agent.

Laboratory practice

The preserved samples were washed in running fresh water for ± 15 minutes before sorting. Sorting of the samples was done in flat trays with the naked eye, all organisms, alive during sampling, were picked out and stored in a jar with 4% formaldehyde. In case of small organisms in large quantities (e.g. small polychaetes, mudsnails *Peringia ulvae*), subsamples were made.

Deep-frozen samples were, after defrosting, shortly rinsed with running sea water. All larger organisms (larger polychaetes, larger crustaceans (shrimps, crabs), all molluscs except *Peringia ulvae*) were sorted out in large trays with the naked eye. In case of large quantities of organisms of one species (e.g. *Mytilus edulis* in mussel beds), subsamples were taken.
Hard substrate organisms (acorn barnacles, Hydroids, Bryozoans, Tunicates) were not collected, of sea anemones only larger specimens were collected.
After sorting all organisms were stored in 4% formaldehyde upon identification.

Identification

All organisms were counted, and, except Oligochaetes, were identified up to species level, bivalve molluscs were sorted up to year-classes.

Biomass-determination

For biomass determination, all organisms per species (or year class in case of bivalves) were put in porcelain cups and dried for at least 3 days in a ventilated stove. Of the bivalves the soft parts were separated from the shells and further processed, After that the cups were weighed, then put in an oven for 3 hours at 560°C, and after cooling weighed again. The difference between the two weight measurements is the ash-free dry mass (AFDM), a measure for biomass.

**Period 2008-2010**

During this period a 0.06 m² Reineck box corer was available. 392 of the 459 stations sampled in the 1981-1982 period were resampled in 2008. 5 Stations were relocated as the original stations proved to be shifted from a subtidal station to an intertidal station. The research in the period 2008-2010 was embedded in a research programme on the importance of subtidal (i.e. under low water line) mussels (*Mytlus edulis*), both natural occurrences as well as in culture plots in the western Wadden Sea. For this programme 60 locations were selected and sampled in 2008, 2009 and 2010 each, per year 30 stations on sites of natural occurrence of mussels, and 30 in culture plots.

Field operation practice

On each selected station a sample was taken with a Reineck box-corer. Box-core samples less than 15 cm deep into the sediment were discarded and a new one was taken. On deck from each box-core sample a sediment sample, depth 5 cm, was taken. If, at close inspection, large densities of small molluscs were observed at the sediment surface (i.e. the gastropod *Peringia ulvae*, juvenile bivalves), an additional subsample with a round corer, Ø 4.25 cm, was taken. The sediment sample was stored in a plastic jar and subsequently deep-frozen. Subsamples were not sieved and put entirely in a plastic jar and immediately preserved with 10% formalin. The remaining part of the sample was sieved on deck over a 1-mm round-hole sieve with running sea water. The sieved material was stored in a plastic jar with 10% formalin.

Laboratory practice

At return of each sampling trip the benthos samples all were stained with Rose Bengal. In the laboratory all stained organisms, i.e. organisms that were alive at the moment of preservation, were picked out with the nacked eye from flat white trays. From very abundant (small)

species or size-classes subsamples were taken from the sorting trays. In contrast to the 1981-1982 survey, during the survey in the period 2008-2010 hard substrate organisms were sorterd out and counted as well. Animals were identified up to species level, exept Oligochaetes. Bivalve molluscs were sorted into year-classes. Encrusting hard-substrate species (e.g. some Bryozoan species) were only quantified, but not weighed.
All animals were put into porcelain cups, per age- or size class. The shell content of bivalves was separated from the shells and put in cups per year class and mm-class.

**Reading and working with the database**

All data are summarized in one table
sampling: unique sampling ID
date:
X-pos: X-position in Dutch RD-coördinates;
Y-pos: Y-position in Dutch RD-coördinates;
Deg N: position N in decimal degrees;
Deg E: position E in decimal degrees;
Depth: depth of the sea floor at the sampling location in m relative to the mean sea level (NAP);
Medgrain: median grain size (µm) of the sediment
Silt: silt content (weight %, if measured) of fraction of the sediment <16µm;
Nspec: species number as used in the NIOZ-COS benthos laboratory procedures;
Species: Scientific species name, which may change due to new taxonomic insights (check WORMS for the most recent nomenclature);
Yrclass: yearclass to which bivalve are attributed based on growth band readings on the shell;
Surface: surface of the sampling device the density and biomass data per species of year-class refer to;
Mult: in case of subsampling the factor with which density and biomass data should be multiplied to obtain the correct estimate at the entire sampled surface;
L: maximum shell length in bivalves (in mm), maximum carapace width in crabs (in mm), or entire length in shrimps (in mm);
N: number of individuals of the species or year-class in the sample or subsample;
AFDW: Ashfree dry mass of the individuals of the species or year-class in the sample or subsample;
Corfac: correction factor with which the biomass values should be multiplied to obtain a mean annual biomass-value, as generally been found during the October-November period in many invertebrates in the Wadden Sea (see Beukema, 1974b);
Mosselperc: the sample was taken inside (1) or outside (0) an area marked on the sea-map or by poles as a commercial mussel culture plot, irrespective wether the plot is occupied or not occupied by mussels (*Mytilus edulis*) at the moment of sampling;
Mosseldest: the sample was taken in an area that, shortly before the date of sampling, was identified as actually being occupied (1) or not occupied (0) by mussels (*Mytilus edulis*);
Remarks: F leeg: no life animals in the flushing sample (obviously unsuccessfull sample)
V leeg: no life animals in the Van Veen grab sample (obviously unsuccessfull sample)
Sipho: only a sipho of a *Mya arenaria* was present in the sample
Geschat: biomass estimated, based on data of nearby samples
Niet verzameld: not collected, biomass estimated
Niet gew.: not weighed (encrusting hard-substrate organisms)

Extrapol.: biomass extrapolated based on length-weigth relationship of specimens of other size-classes of the same species;
CF per Ycl: biomass of different size-classes estimated, based on lumped actually measured biomass of different size-classes

**Papers and reports related to this database:**


Dekker, R., 1989. The macrozoobenthos of the western Dutch Wadden Sea. I. Biomass and species richness. —Neth. J. Sea Res. 23: 57-68.

Dekker, R. & J. Drent, 2013a. The macrozoobenthos in the subtidal of the western Dutch Wadden Sea in 2008 and a comparison with 1981-1982. —Internal Report NIOZ 2013-5.

Drent, J. & R. Dekker, 2013b. How different are subtidal *Mytilus edulis* L. communities of natural musselbeds and mussel culture plots in the western Dutch Wadden Sea? —Internal Report NIOZ 2013-6.

Drent, J. & R.Dekker, 2013c. Macrofauna associated with mussels, *Mytilus edulis* L., in the subtidal of the western Dutch Wadden Sea. —Internal Report NIOZ 2013-7.


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Beukema, J.J., 1974b. Seasonal changes in the biomass of the macro-benthos of a tidal flat area in the Dutch Wadden Sea. —Neth. J. Sea Res. 8: 94-107.

Dekker, 1982. Vergelijking van de bruikbaarheid van de Van Veen-happer met de Van Arkel flushing sampler voor het bemonsteren van het sublitorale macrobenthos van de Waddenzee. —Internal Report NIOZ 1982-9: 1-9.

Mulder, M. & M.A. van Arkel, 1980. An improved system for quantitative sampling of benthos in shallow using the flushing technique. —Neth. J. Sea Res. 14: 119-122.

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