Contribution from the BIOICE programme: Benthic invertebrates of Icelandic Waters

The BIOICE station and sample list:

revised compilation, March 2020.

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The BIOICE research programme is designed to explore biodiversity of benthic invertebrates within the 200-mile economic zone of Iceland. The main objectives are to compile an inventory of benthic invertebrate species, update their taxonomy, record distributions, and relative abundance. Icelandic waters are one of the most productive seas in the world and an important foundation of the nation's economy. Knowledge of species composition of benthic communities at a given time is of crucial interest to evaluate possible effects of environmental changes, both from scientific and economic points of view.

The sampling area is 753.000 km^2 and covers a part of the biogeographic boundary of the Arctic and Boreal regions of the North-Atlantic. The sampling phase started in 1991 and was completed 2004, after nineteen sampling expeditions on three research vessels: eight cruises on Bjarni Sæmundsson (Marine Research Institute, Reykjavík); six cruises on Håkon Mosby (University of Bergen, Norway); and one cruise on Magnus Heinason (Marine Research Institute of the Faroe Islands). In all, 1412 samples were collected at 579 stations, spanning a water depth range from 20 to 3000 m, near bottom water temperature from -1°C to over 9°C, salinity range from 34‰ to over 35‰, and various kinds of bottom types.

Immediately after sampling, larger animals were handpicked from the samples and most of the finer sediment washed away with in seawater through series of sieves, and fixed in buffered 2% formalin. A small fraction (0,5 liter) of unwashed sediment was kept for reference. At the Bioice laboratory, of the Sandgerdi Marine Center, invertebrate specimens were picked and sorted to 55 of the major taxonomic groups, of which the Amphipoda and Polychaeta were sorted further to families. This primary sorting process was completed in 2012. The resulting collection of preserved material is stored in 80% ethanol at the Icelandic Institute of Natural History and is a subject of ongoing taxonomic research.

Sampling plan

Sampling stations were selected according to a stratified random scheme. The sampling area was divided into 1144 squares, each 0.25 x 0.25 degrees. Several environmental variables within each square were considered: (1) mean bottom temperature and salinity, (2) standard deviation of temperature and salinity, (3) estimated bottom slope, (4) water depth, (5) bottom type; rock, gravel, sand or mud. The mean of numerical variable was allocated at the centre of each square. A clustering algorithm was used to minimize the sum of within group sum of squares or the sum of squared distance between points. The results of the cluster analysis divided the sampling area into 17 strata and different proportions of stations were allocated to each strata. Exact positioning of most stations were randomized, but some stations were selected according to interesting topographic bottom features discovered during the cruises, and a few stations were the same as those of the standard ground fish survey program of the Marine Research Institute in Iceland (Pálsson et al. 1989).

Sampling procedure

The sampling gears Agassiz trawl, RP-sledge, Detritus sledge, and Triangluar dredge, were routinely applied to sample different components of the benthos; epifauna, infauna and hyperbenthos. In addition, Shipek grabs were routinely deployed for sediment analysis.

Agassiz trawl and RP-sledge were only applied on smooth bottom with soft sediment and Triangular dredge was the only gear used on rough rocky bottom. Detritus sledge was deployed on various bottom types, including soft sediment, rough gravel, and stony bottom. Most of the samples were taken at stratified random stations, or 800 samples, 526 samples at selected topographic stations, and 86 at standard MRI ground fish survey stations.

Routine sampling gears. *Gears only occasionally applied as part of auxiliary programs	***Mesh size (mm) of gear net***	***Faunal component sampled***	***Other component sampled***	***Sample processing method on board. Mesh size (mm) of sieve series used in washing sediments from the samples.***
RP-sledge	0.5	Hyperbenthos		16 mm, 8 mm, 4 mm, 2 mm, 1 mm, 0.5 mm
Detritus sledge (Sneli)	1.0	Macro-infauna		5 mm, 1 mm, 0.5 mm
Agassiz trawl	21	Mega-epifauna		Hand-picked (rarely sieved)
Triangular dredge	21	Mega-epifauna on rocky bottom		Hand-picked
Shipek grab	Not applicable		Sediment composition	Preserved whole for later sediment analysis in lab
*van Veen grab	Not applicable		Sediment composition	Preserved whole for later lab analysis
*Smögen box corer	Not applicable	Infauna		Preserved whole for later lab analysis
*Gravity corer	Not applicable		Sediment composition & microfossils	Preserved whole for later lab analysis

A B C D E

Figure 1. Sampling devices A-D routinely used for zoological sampling. A) RP-sledge, B) Detritus sledge, C) Agassiz trawl, D) Triangular dredge. E) Shipek grab, samples taken for sediment analysis only.

The BIOICE sample list – explanation of column headings.

(NA entries indicate inapplicable data or missing values).

Sample number: A unique number that identifies each individual sample.
Cruise ID and **Station no**: The combined values in these two columns comprise a unique identifier of a sampling site. At each station, different sampling gears were deployed to sample different components of the benthos, except when hard and rough bottom type

prohibited usage of Agassiz trawl, RP-sledge and sometimes the Detritus sledge. (The initials HM, B, and MH in the column **Cruise ID**, identify the research vessels, Håkon Mosby, Bjarni Sæmundsson and Magnus Heinason, respectively.)
Sampling gear, method: Identifies the sampling device that was used.
Depth 1 (m) and **Depth 2 (m)**: Indicate depth at start and end of tow. A single depth is given for grabs and other non-dredging gears.
Bottom temp (°C) and **Salinity ($^0/_{00}$)**: Near bottom water temperature and salinity was measured about 10 m above the bottom with a CTD meter.
Sulphur smell: Applies to only to fine silt or mud samples. Missing values indicate inapplicable sediment or bottom types.
Latitude at start of tow; Longitude at start of tow; Latitude at end of tow; Longitude at end of tow: Geographic coordinates in these columns are in degrees, minutes in 60 parts, and seconds in 100 parts. Minus sign indicates westerly longitude. Geographic positions were recorded when the dredging gear touched the bottom and when the gear left the bottom.
Decimal degrees at start of tow; Latitude; Longitude: The same geographic coordinates given columns J to O, transformed to decimal degrees.
Sampling year; Sampling month; Sampling day: Date of sampling.
Sampling local time 1; Sampling local time 2: Refers to Icelandic time zone (GMT). For gears that are not towed, time is recorded when gear is placed over board.
Sample volume (litres): Estimated total catch volume (litres) of a sample.
Volume sieved (litres): For large samples only a fraction of the whole sediment was sieved and processed.
Volume picked: Applies mainly to samples collected with the Agassiz and the Triangular dredges. Large animals (> 2-5 cm) were hand-picked from the samples, either partly or the whole sample.
Substrate description: The categories, silt, sand, gravel, rocks, stones/boulders, and corals, were used to describe sediments caught in the sampling devices. For mixed sediments, the most abundant sediment was scored as the primary component and the next most abundant as secondary. However, in several cases other terms were used to describe the sediments.
Remark on sample: Various comments made while processing the samples on board; unusual characteristics of a sample, abundant taxa, etc.

NOTE: An earlier version of the BIOICE sample list is available in open access (http://utgafa.ni.is/greinar/BIOICE_station_list_91-04_Paper_A2.pdf), albeit without associated metadata. The present compilation remedies that need; column headings have been changed from previous version to match the explanations. Another change is that data in two columns only of the previous version has been reformatted in this new version. These columns are positions at end of tow ("lat & long (deg. min. sec.) at end of tow"). In the present version the minutes are presented as 60^{th} parts. The contents and format of the data in the previous and the present BIOICE sample lists are otherwise identical, except for style of presentation.

General references

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