## 5.3 The pelagic larvae of macrofauna in the central Kara Sea

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### Introduction

Formation, development and stability of benthic communities mainly depend on recruitment of larvae and juveniles from within or outside the community (Butman 1987). Only the permanent replacement of old individuals by young ones ensures the survival of species within a group (Burkovsky et al 1997). If and how new communities are formed depends very much on the reproduction modes of the species.

The bulk of benthic invertebrates in the boreo-atlantic region reproduces via pelagic larvae (Fig. 5.1), since this ensures a wide distribution of the species and a good ability for fast exploitation of new territories (Thorson 1950). Moreover the planktic stages are able to enter the euphotic zone and there instantaneously utilise the primary production in the upper water layers. But the pelagic stages very much depend on environmental factors and settlement success. Prevailing currents often carry them away to unfavourable sites resulting in high mortality.

The alternative strategy is direct development, which is lacking a pelagic phase (Fig. 5.1). This ensures that the juveniles settle in the vicinity of the adults and stay on the approved sites where already the adults survived. It guarantees a sufficient recruitment of the community. Most species with direct development also show brood protection, which reduces the mortality of the juveniles to a minimum. But since this method is very energy consuming those species can effort only very few offspring whereas specimens with planktic stages usually produce huge amounts of small larvae.

To what degree environmental factors influence the distribution and the mortality of the pelagic stages, and how far settlement success is important for the structure of benthic communities is so far unknown. But today it is commonly accepted that understanding benthos ecology without the knowledge of larval and juvenile recruitment is hardly impossible (Scheltema 1986). The absence of larvae in polar waters led Thorson (1936) to the hypothesis that many polar species reproduce directly without a pelagic stage, which he explained by the shortening of time for development and food accessibility in higher latitudes. Recent discoveries of an increasing quantity of pelagic larvae in Arctic and Antarctic waters created problems with this rule and shows how little is known on the ecology of meroplankton in the Arctic.

The aim of this study is to investigate the reproduction modes of benthic invertebrates in the Kara Sea and the spatial distribution of their larvae and juveniles to explain the invertebrate community structure with emphasis on environmental factors such as river runoff and its accompanying effects.

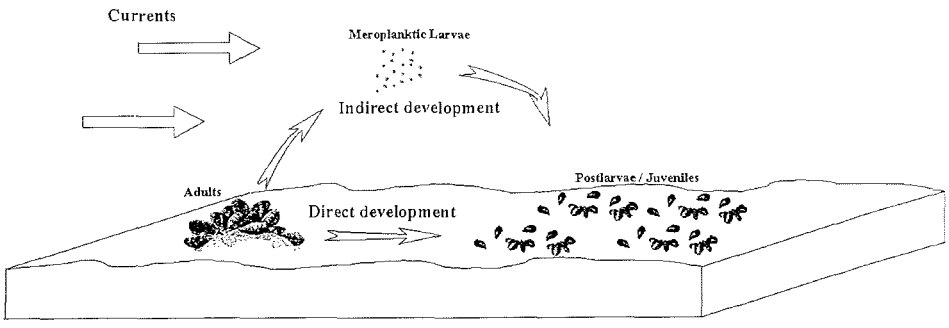


**Fig. 5.1:** Reproduction modes of benthic invertebrates

## Material and Methods

Larval plankton was collected with a Nansen Closing Net (NCN) with 55µm mesh size at a hauling speed of 0.5 m/sec at 31 Stations (Tab. 5.2, Fig. 5.2). To gather information about the spatial occurrence of the larvae in the water layers at each station three vertical net hauls was taken: under (haul 1), through (haul 2) and above (haul 3) the halocline. Close to the sea floor the larvae were fished by an Epi-Benthic sledge, mounted with an 80µm Supranet. The sledge was dredged at about 1-2 knots and between 3-6min according to plankton concentration. Samples for the distribution of postlarvae and juvenile stages were taken by a Multicorer (MUC; 28cm$^2$ surface). At each station 3-4 tubes were taken. After careful removal of the supernatant water, the upper 3-5cm of the sediment was preserved. All samples were stored, until further treatment in the laboratory, in 4% borax buffered formaline.
BP00 stays as abbreviation for the expedition carried out in 2000.

**Table 5.2:** Overview of meroplankton sampling stations, date, station depth, haul range, number and duration of devices used (NCN=Nansen Closing Net, MUC=Multicorer, EBS= Epi-Benthic Sledge)

| Station | | Date | Lat. ° N | Lon ° E | Depth [m] | Haul [range] | 1 Haul [range] | 2 Haul [range] | 3 NCN [N] | MUC [N] | EBS [min] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| BP01- | 1 | 14.08.01 | 74°59.12 | 76°23.41 | 38 | 35-23 m | 23-0 m | 12-0 m | 3 | 4 | 4 |
| BP01- | 19 | 21.08.01 | 72°35.7 | 80°06.4 | 28 | 24-6m | 6-0m | 3-0m | 3 | 3 | |
| BP01- | 23 | 22.08.01 | 73°29.0 | 78°50.9 | 22 | 20-9m | 9-0m | 3-0m | 3 | | |
| BP01- | 26 | 23.08.01 | 74°00.0 | 80°01.4 | 33 | 32-18m | 18-0m | 4-0m | 3 | 3 | 4 |
| BP01- | 28 | 24.08.01 | 75°56.34 | 89°15.9 | 51 | 50-20m | 20-0m | 3-0m | 3 | 4 | |
| BP01- | 30 | 24.08.01 | 76°24.75 | 88°10.76 | 47 | 48-27m | 27-0m | 5-0m | 3 | 3 | |
| BP01- | 31 | 25.08.01 | 77°34.2 | 87°54.5 | 88 | 90-17m | 17-0m | 12-0m | 3 | 3 | |
| BP01- | 34 | 25.08.01 | 77°54.29 | 89°20.15 | 91 | 90-30m | 30-0m | 18-0m | 3 | 4 | |
| BP01- | 35 | 26.08.01 | 77°54.31 | 83°45.94 | 160 | 155-40m | 40-0m | 10-0m | 3 | 4 | |
| BP01- | 37 | 26.08.01 | 77°48.9 | 86°11.9 | 144 | 130-23m | 23-0m | 13-0 m | 3 | 4 | |
| BP01- | 38 | 27.08.01 | 77°5.29 | 86°55.48 | 110 | 100-20m | 20-0m | 10-0m | 3 | 4 | |
| BP01- | 40 | 27.08.01 | 76°25.2 | 85°39.9 | 52 | 45-20m | 20-0m | 4-0m | 3 | 4 | |
| BP01- | 41 | 28.08.01 | 75°41.4 | 87°07.8 | 42 | 34-23m | 23-0m | 6-0m | 3 | 4 | |
| BP01- | 43 | 28.08.01 | 75°22.99 | 85°49.90 | 48 | 40-27m | 27-0m | 6-0m | 3 | 4 | 3 |
| BP01- | 45 | 29.08.01 | 77°6.83 | 84°44.0 | 87 | 80-23m | 23-0m | 17-0m | 3 | 4 | 5 |
| BP01- | 46 | 30.08.01 | 77°55.43 | 75°57.35 | 323 | 300-30m | 30-0m | 10-0m | 3 | 4 | |
| BP01- | 48 | 31.08.01 | 77°53.49 | 81°29.94 | 202 | 180-30m | 30-0m | 5-0m | 3 | 4 | |
| BP01- | 51 | 31.08.01 | 77°54.68 | 79°29.48 | 158 | 140-25m | 25-0m | 5-0m | 3 | 4 | |
| BP01- | 52 | 01.09.01 | 77°29.94 | 79°52.0 | 75 | 58-25m | 25-0m | 8-0m | 3 | 4 | |
| BP01- | 55 | 01.09.01 | 77°2.97 | 79°43.99 | 83 | 70-30m | 30-0m | 5-0m | 3 | 4 | 6 |
| BP01- | 56 | 02.09.01 | 76°59.58 | 75°11.48 | 176 | 170-38m | 38-0m | 8-0m | 3 | 4 | |
| BP01- | 58 | 02.09.01 | 76°48.12 | 78°21.24 | 94 | 75-35m | 35-0m | 15-0m | 3 | 4 | |
| BP01- | 59 | 03.09.01 | 76°31.16 | 74°30.95 | 176 | 155-35m | 35-0m | 5-0m | 3 | 3 | |
| BP01- | 61b | 03.09.01 | 76°12.9 | 75°53.15 | 111 | 95-38m | 38-0m | 3-0m | 3 | 4 | 5 |
| BP01- | 62 | 04.09.01 | 76°12.05 | 74°12.15 | 135 | 100-30m | 30-0m | 3-0m | 3 | 3 | |
| BP01- | 65 | 05.09.01 | 75°42.98 | 75°50.79 | 63 | 48-30m | 30-0m | 3-0m | 3 | 4 | |
| BP01- | 66 | 05.09.01 | 75°10.04 | 76°55.13 | 55 | 45-32m | 32-0m | 4-0m | 3 | 4 | |
| BP01- | 67 | 06.09.01 | 75°14.65 | 73°45.78 | 49 | 38-25m | 25-0m | 4-0m | 3 | 4 | |
| BP01- | 68 | 06.09.01 | 74°35.05 | 72°14.97 | 31 | 25-17m | 17-0m | 5-0m | 3 | 4 | 5 |
| BP01- | 70 | 07.09.01 | 72°40.16 | 74°0.22 | 22 | 16-9m | 9-0m | 6-0m | 3 | 4 | |
| BP01- | 82 | 11.09.01 | 73°11.83 | 73°01.65 | 29 | 22-9m | 9-0m | 6-0m | 3 | 4 | 5 |
| **Σ=31** | | | | | **Min=22 Max=323** | | | | **Σ=93** | **Σ=114** | **Σ=8** |

## Results and Discussion

During the expedition on 31 stations meroplankton (=93 samples) and juvenile benthos (=114 surfaces) samples were taken (Fig. 5.2). Additional close-bottom plankton samples with the EBS were obtained on 8 stations (Tab. 5.2).

In general the meroplanktic inventory is comparable to that in BP00 (Fetzer 2001). Again pluteus larvae of brittle stars dominated the meroplankton at all stations. Here mainly larvae of *Ophiocten sericeum* were found. Formin (1989) reported that ophiurid larvae are typical representatives for the Kara Sea meroplankton and are present throughout the year. Generally the ophiuplutei were present at all stations, although their main distribution area was the northern and middle part of the investigation area. Only within the estuaries no larvae were present. The reason for their distribution is the

freshwater inflow by the rivers, which restricts the stenohaline (=tolerant to narrow salinity range) adults, where the larvae finally descend from, to the northern parts. In their horizontal distribution the highest concentrations were usually present in the upper water layers (haul 2+3), above the pycnocline (Tab. 5.2). Here they usually outnumber the abundance of the larvae from below the pycnocline by 5-10fold. As observed earlier, the ophiurid larvae seem to be more tolerant to osmotic stress than their adults (Halsband and Hirche 1999, Fetzer 2001). In the upper water layers they may be able to utilise the phytoplankton and the river imported organic material as food source. Interestingly hardly any larvae were found in net samples of the deeper layers (>100m haul depth) in the northwest part of the investigation area (e.g. sts. 34, 35, 46, 48, 56, 59, 62). These stations lay at the shallow northern and western rim of the Kara Sea Shelf. Although ophiurids are the dominant taxon in high latitudes from the shallow waters down to the deep sea (Piepenburg and von Juterzenka 1994), it seems that only shallow living species, as e.g. *Ophiocten sericeum*, produced offspring at this time of the year, which may explain why larvae were found only at the shallow shelf area. *Asterias* sp. larvae were also quite common in the samples but not as abundant as in BP00. They mainly occurred in the deeper parts below the pycnocline.

In the middle and southern region high amount of polychete larvae were present in the samples. Besides spionid larvae (*Prionospio* sp.), larvae of *Phyllodoce groenlandicum*, *Pholoe minuta*, *Glycera capitata* and some species of the genus *Terebellida* were found. Although the spectrum of polychete species was not as wide as one year ago but the species present showed much higher abundances. Remarkable was that most of the polychete trochophora were much further developed and bigger as those present the samples of BP00. Almost all of them were caught below the pycnocline close to the bottom. Most of them were about to metamorphose soon and obviously prepare to settle. This might be explained by the fact that the expedition was carried out about three weeks later than BP00. Obviously the polychete meroplankton was already in a later successional stage than the ones caught during BP00. Also here no planktic stages of polychetes were caught in the northern deeper waters. This lack as well is explained by the absence of the adults in these areas.

One big difference was the frequent occurrence of bivalve veligers in the plankton samples compared to BP00 (Fetzer 2001). The observed specimens were rather big and exclusively found in the lower net samples, so it seems that these animals were about to settle soon. In opposition to BP00 there were no mollusc larvae present. Either their larvae appear later in the year or had already settled. Since the specimen of BP00 were quite far developed the latter seems more likely.

The above-mentioned results still need to be evaluated by careful examination of the taken samples in the laboratory. After the identification of the juveniles and larvae in the home laboratory the data need to be compared to the adult fauna to get a better understanding of the complexity of the larvae-juvenile-adult interaction. To explain their distribution the found data need to be statistically correlated to biotic (e.g. abundance and distribution of the adult fauna) and abiotic (e.g. current regimes, salinity distribution, food availability) factors to help to understand their importance on the structure of the adult fauna and their role within the Kara Sea ecosystem.

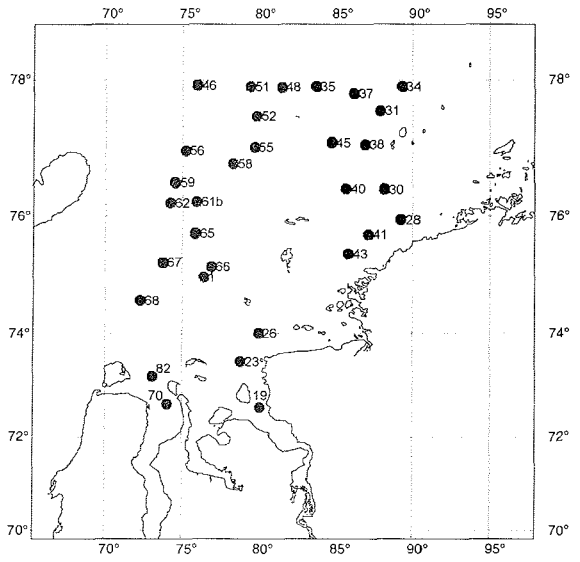


**Fig. 5.2:** Map of meroplanktic sampling stations

## 5.4 Spatial distribution of zooplankton in the southern Kara Sea

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### Introduction

The previous scientific cruises within the SIRRO project (BP-97, BP-99 and BP-00) covered in particular the Ob and Yenisei Rivers estuaries and the southern Kara Sea (Halsband and Hirche 1999, Fetzer and Arndt 1999, Suck 2001). Analysis of the plankton samples collected during these three expeditions produced detailed information on the spatial distribution and abundance of zooplankton species in the above regions (Fetzer and Hirche 2002). Nevertheless, the picture remained incomplete because little was known about other important parts of the Kara Sea, i.e. the areas north of 77°N and east of 85°E. To close this gap this year's cruise focused on these two regions.

### Sampling of Mesozooplankton

Zooplankton samples were obtained at 39 stations (Tab. 5.3) using a Nansen-Closing-Net (NCN) with a mouth diameter of 0.75 m and a mesh size of 150 µm. The net was hauled vertically with approximately 0.5 $ms^{-1}$. At each station a near-bottom to surface haul was taken. When the previously made CTD cast gave evidence of the presence of a pycnocline an extra two hauls were usually made (one from near-bottom to below-pycnocline and a second from above-pycnocline to surface). Subsequently, samples were transferred to 250 ml Kautex bottles and preserved in 4% borax buffered formalin for later identification and counting.