ABUNDANCE OF BIVALVES *ABRA ALBA* AND *MYTILUS EDULIS*, IN AN ORGANICALLY ENRICHED AREA

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ABSTRACT

Variations in abundance of *Abra alba* and *Mytilus edulis* were studied in Alrø Sund, east coast of Jutland, Denmark. Samples were taken in May, August, and October 1995 with a view to test if organic enrichment from a nearby trout farm would affect the populations of bivalves. Abundance of the two bivalve species was not correlated with fluctuations in total organic carbon and total organic nitrogen in sediments. Organic enrichment of the magnitude created by this trout farm could not alone have caused the observed fluctuations of bivalves. The abundance of *A. alba* reached its maximum in May and *M. edulis* in August.

INTRODUCTION

Abra alba and *Mytilus edulis* are common bivalve species of Danish fjords (Petersen 1918; Rasmussen 1973; Fallesen 1994; Vejle Amt 1994). They are characteristic of the *Abra*-community (Rasmussen 1973). Their variation was studied during a period from summer to fall with a view to test if organic matter from a nearby trout farm would affect the abundance of *A. alba* and *M. edulis*.

MATERIAL AND METHODS

The study area was in Alrø Sound, Horsens Fjord, Denmark (Fig. 1). Three sampling stations were fixed along a transect from a fish farm which contributed with organic material to the bottom (food waste and faeces of cultured fish). The positions and depths of the stations are given in Tab. 1. Samples were collected on 2 May, 22 August and 3 October, 1995. Quantitative macrofauna samples were obtained with a Haps core sampler (0.0123 m^2). Ten samples were collected at each station, except at Station 2 where only nine samples were obtained in May. Samples were sieved through 1 mm mesh size and the residue preserved in 96 % ethanol. Bivalves were sorted from plant debris and other animals under a binocular microscope.

Five bottom sediment samples, 5-10 cm thickness, were analysed for organic content in May. Two samples were analysed from each station in August and October. Samples were centrifuged two times at 13,000 rpm for 20 minutes, and dried at 110 °C for

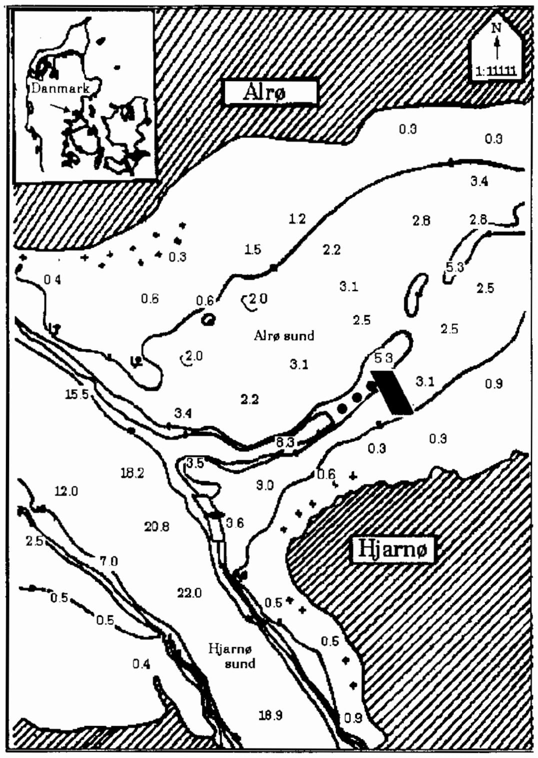

Figure 1. Study area and the three sampling stations. Sampling stations are indicated by black dots. Station 1 is the nearest to the fish farm (rhombic area). Station 3 is farthest off.

Table 1. The positions and depths of the sampling stations.

	Station 1	Station 2	Station 3
Position	55°50'261" N 10°03'876" E	55°50'251" N 10°03'827" E	55°50'214" N 10°03'746" E
Fish farm distance	20 m	90 m	180 m
Depth	3.2 - 3.5 m	4.0 - 4.3 m	4.4 - 5.3 m

Table 2. Ranges of selected environmental variables in Alrø Sund at three stations.

	Surface	Bottom
Salinity	14.52 - 16.20 ‰	15.35 - 17.36 ‰
Temperature	21.89 - 22.28 °C	21.14 - 21.58 °C
Oxygen concentration	7.7 - 8.3 mg l-1	7.0 - 8.3 mg l-1

12 hours. They were analysed for total organic carbon and total organic nitrogen according to Nelson & Sommers (1982), and Bremner & Mulvaney (1982) respectively.
Salinity, temperature, and oxygen concentrations were measured on 22 August. Salinity and temperature were measured using the Aanderaa RMC7 while oxygen concentration was measured using the AROP (Automatic Registration of Oceanographic Parameters). Variables are shown in Tab. 2.

RESULTS

Station 1 had lower organic carbon and nitrogen than Stations 2 and 3 (Fig. 2). The organic carbon content at Station 1 decreased somewhat in August and increased again in October. It differed in this respect from Stations 2 and 3. At those stations, the organic carbon content increased in August, and decreased in October.
High variation was recorded in the abundances of *A. alba* and *M. edulis* as shown in Figs. 3 and 4. *A. alba* was most abundant in May while *M. edulis* peaked in August.

DISCUSSION

Abra alba

This bivalve was quite abundant in May (very few adults were present), but popula-

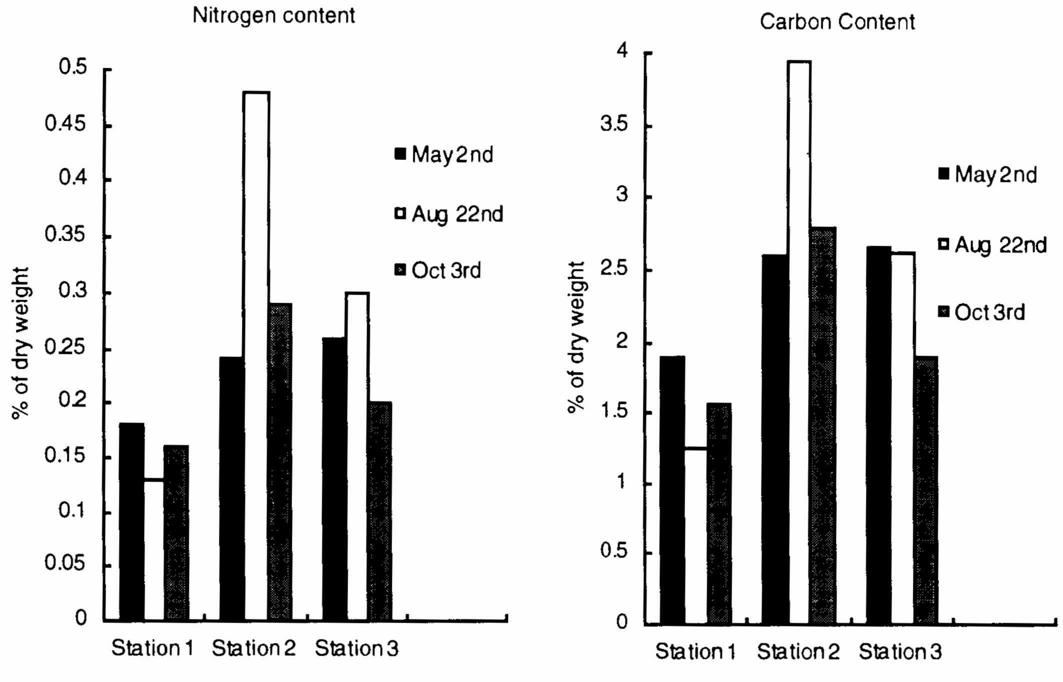

Figure 2. Total organic nitrogen and total organic carbon content in the sediment (% of dry sediment).

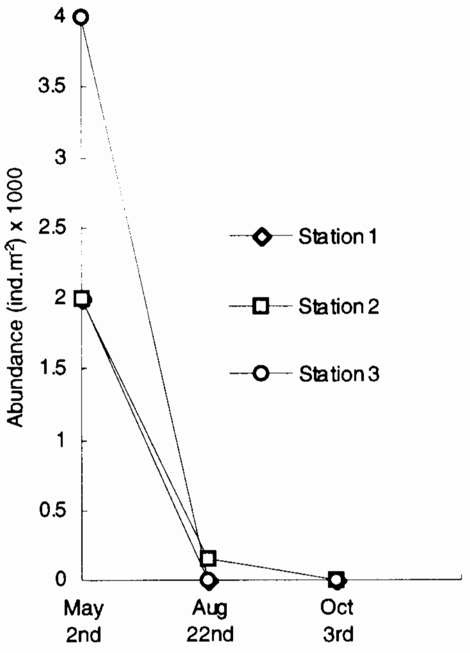

Figure 3. Abundance of *Abra alba*.

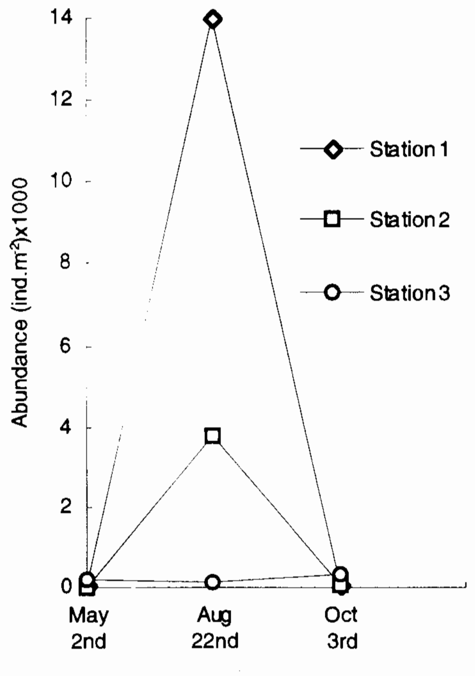

Figure 4. Abundance of *Mytilus edulis*.

tion density became very low in August and October. The spawning period of *A. alba* in Danish waters is from June to November (Muus 1973; Rasmussen 1973; Blanner 1982; Fallesen 1994), but it may also spawn earlier in spring (Muus 1973). The dominance of juveniles in May is interpreted as the result of a spring spawning in accordance with Muus (1973).

Dries & Theede (1974), Arntz & Rumohr (1986), and Fallesen (1994) showed that temperature and oxygen concentrations influenced abundance of *A. alba* populations. Increase in organic material was noted as a factor causing reduction in the numbers of *Abra prismatica* (Gray *et al.* 1990). During this study there were no catastrophic events in the environmental conditions. Organic material increased in some cases but it did not generate oxygen depletion (Vejle Amt 1995; unpublished data), and it did not either seem to enhance food availability for *A. alba*. Apparently the organic matter was in a form which could not be utilised by *A. alba*. Lopez & Levinton (1987) stated that characterisation of the food resources for deposit feeders such as *A. alba* is elusive. The size of organic particles may be important (Whitlach 1981) but in general it is rather difficult to estimate food value of detritus in the field with any degree of confidence (Hylleberg & Riis-Vestergaard 1984; Wilson 1991).

Competition for resources and predation are other factors influencing the abundance of *A. alba*. Competition in soft bottom communities will only affect the growth of bivalves (Wilson 1991). But Muus (1973) recorded that recruitment can be controlled by intense predation, hence predation is suspected to be the crucial factor behind oscillation of the *A. alba* populations. *A. alba* is preyed upon by a variety of invertebrates and fish (Arntz 1980; Allen 1983; Hily & Le Bris 1984; Jensen 1988). Hily & Le Bris (1984) found that an increase in the number of brittle star *Ophiura albida* coincided with the disappearance of two cohorts of *A. alba* in the Bay of Brest. *O. albida* was not abundant in the study area (Wardiatno 1996), so it may not be an important predator in this case. The importance of infaunal predators was demonstrated by Reise (1979) and Commito (1982). Within the present community there is a number of large infaunal predators such as the polychaete *Nephthys hombergii* (Wardiatno 1996) known to consume juvenile bivalves (Ockelmann & Muus 1978). Its abundance increased in August (Wardiatno 1996) while the abundance of *A. alba* decreased.

Flatfish are important predators. Rainer (1985) calculated that predation on *A. alba* by dab, flounder, and plaice of commercial size was about 1 % of the estimated production of *A. alba* in Kiel Bay, Germany. For such values the predation may have only a very limited effect on *A. alba* populations, but if all sizes of fish are taken into account, predation by fish may become important for the bivalve abundance. Predation as a factor controlling the population of *A. alba* in the Danish Limfjord was also suspected by Jensen (1988). Unfortunately, no data is available on the predation of fish on *A. alba* in the study area nor in the adjacent waters.

Mytilus edulis

A high number of juvenile *M. edulis* were found at Stations 1 and 2 in August. According to Rasmussen (1973) spawning of *M. edulis* occurs during the whole year with peaks in the early summer, *i.e.*, June. It should also be noted that most of the samples during this period contained some pieces of *Fucus* spp. and filamentous algae. Mostly *M. edulis* were found adhered to these. Settlement of *M. edulis* is induced by the presence of filamentous algae (Paine 1974; Suchanek 1978; Petersen 1984; King *et al.* 1990).

The high number of *M. edulis* coincided with a high number of two crustaceans, *Corophium insidiosum* and *Microdeutopus gryllotalpa* (Wardiatno 1996). These tube-building crustaceans stabilise the sediment (Luckenbach 1986), and make the sediment surface more rough, scarred, and fibrous which is attractive to prospecting plantigrades (Seed 1969; Dare *et al.* 1983; King *et al.* 1990).

The population of *M. edulis* decreased abruptly in October. This could be caused by predation (Sukhotin & Kulakowski 1992), or postlarval mussels having a secondary settlement. Maas Geesteranus (1942) found that postlarval mussels attached and detached themselves many times before they finally settled on the established mussel bed, but direct settlement of *M. edulis* larvae on adult mussel beds may also occur (McGrath *et al.* 1988). Predation might have a limited effect since the main predator, the sea star *Asterias rubens* (Hancock 1955) and the shore crab *Carcinus maenas* (Worral & Widdows 1984) were encountered in low numbers (Wardiatno 1996).

The conclusion is rather trivial, namely that several factors may have caused the observed variations in abundance of *A. alba* and *M. edulis*. But it is evident that organic enrichment of the magnitude created by this trout farm could not alone have caused the observed fluctuations of the bivalves.

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