Use of spat collectors to enhance supply of seed for bottom culture of blue mussels (*Mytilus edulis*) in the Netherlands

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The Netherlands is the largest producer of blue mussels *Mytilus edulis* in Europe (Smaal 2001). Annual mussel production can be as high as 100 x 10^6 kg. Growers depend on juveniles, which they fish from wild beds. These beds are primarily found in the Wadden Sea (Figure 1). As a result of a government policy, most juvenile mussels on tidal flats are reserved as food for shellfish eating birds. Thus, fishing for mussels for stocking is limited to those living in the deeper parts of the Wadden Sea. On assignment from the Cooperative Producers Organization Mussel culture, the Netherlands Institute for Fisheries Research carries out surveys to determine the size of mussels for stocking. Based on this, the yearly amount to be fished has been agreed upon. Fishing takes place twice a year in the most western part of the Wadden Sea. The juvenile mussels are approximately 10-30 mm in length. They are transported to bottom culture plots where they are left to grow. The plots, which are leased from the government, are located in the Wadden Sea in the north of the of young mussels is needed to sustain a yearly production of 100 x10^6 kg. This relatively low conversion is caused by considerable mortality as a result of predation by birds and starfish and losses due to storms. Depending on environmental conditions, market size (>45 mm) is reached in 1 to 3 years (Dijkema 1997).

Mussel catches show large annual fluctuations that reflect the variability in spatfall (Figure 2). Thus, the stocking mussel capture target is not always reached. Statistics for consumption of mussels show an ever-increasing popularity. This development enhances demands from the market. Landings depend, in large part, on natural fluctuations in recruitment. Sales to supermarkets, however, require a predictable supply of mussels. Thus, an important question is, how to prevent a shortage in stocker mussels?" Each spring, spawning is initiated by an increase in water temperature. Mussel larvae are then formed in the water column. Three to six weeks later, the larvae are about 0.3 mm. Depending on the local hydrodynamic conditions they will settle on hard substrates that are located on the bottom (Figure 3). This process is called spatfall. The number of larvae produced and the mortality during the larval phase determine the number of larvae that can participate in spatfall. Mortality caused by predation on both larvae and spat is very high. The use of collector substrates may enhance the survival of spat. Collecting spat with ropes is a method that is used in suspended rope culture of mussels. After settlement and growth up to a certain size, the attached mussels are removed from the ropes, thinned, placed in socks and allowed to attach themselves to ropes again. The bouchot culture approach in France also makes use of collector ropes. Spat is collected on ropes, after which the ropes are wound around large vertical poles or bouchots.

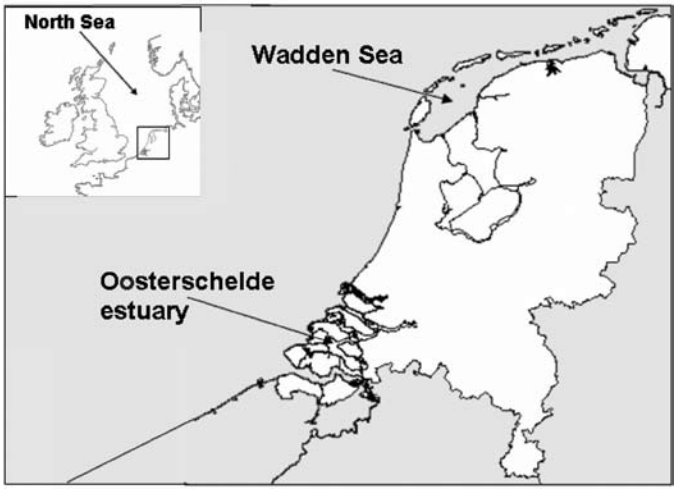

Fig. 1. Location of shellfish culture areas in the Wadden Sea and Oosterschelde estuary.

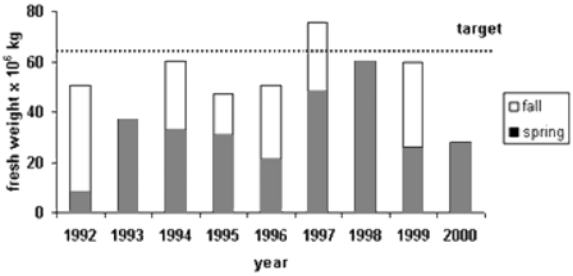

Fig. 2. Mussel seed catches in the Dutch Wadden Sea in spring and fall since 1992. The target amount is indicated with a dotted line.

Testing spat collectors for bottom culture

In 2000, the Netherlands Institute for Fisheries Research started a project to study the use of spat collectors to enhance the supply of seed for bottom culture of mussels. Lows in seed production can be avoided. This will eventually result in a more regular supply of mussels for the market. In addition, the collector

method may promote sustainable use of natural resources. Results of the first year of the project are presented here.

Different types of substrate were tested at three locations in the Oosterschelde estuary and one in the Wadden Sea. Water column setup were used in which collector ropes were suspended in the water (Figure 4). Five types of rope were tested that had different origins. They came from New Zealand (NZ), Scotland (SC), Spain (SP) and from the Netherlands (FR and RO). In the Oosterschelde estuary, the test sites were a suspended culture site in the West (Neeltje Jans), in the East (Krammer) and in a location near a bottom culture plot (Zijpe). The ropes were placed in May and collected in July. In the Wadden Sea, the test ropes were suspended from a pontoon ship in which mussels were cultured (Malzwin). Those ropes were placed in August and collected in October. In addition, different substrates were attached to frames that were placed on mussel culture plots on tidal flats in the Oosterschelde estuary (Philipsdam, Zandkreek, Stavenisse). The substrates on the frames were the five types of collector rope, two types of net (shadow net [SW] and bird net [VO]) straw (ST) and empty shells of mussels (MU) and cockles (CO) as shown in Figure 5. The straw and shells were placed in oyster bags. The frames were either placed on the tidal flat (low) or 40 cm above it (high). In this way, we expected to be able to differentiate between suitability of the substrate for attachment of the spat (collector above bottom with few predators present), and protection against predation (collector on bottom with many predators present). The frames were placed in May and collected in August.

Fig. 3. Newly settled mussel spat on hydroid polyp from mussel culture plot in Oosterschelde estuary.

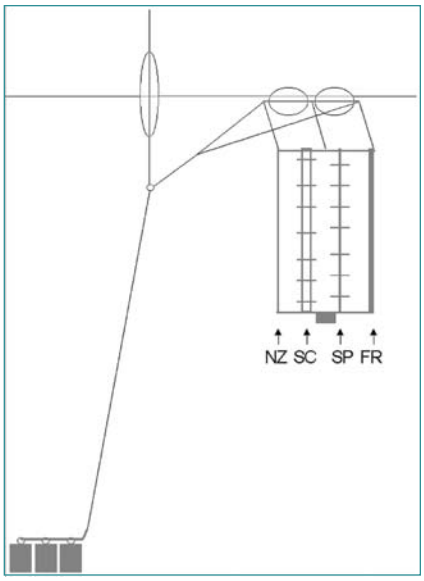

Fig. 4. Water-column set-up for spat collecting ropes. Ropes of 3 m long from New Zealand (NZ), Scotland (SC), Spain (SP) and the Netherlands (FR) are suspended 1 m below water surface.

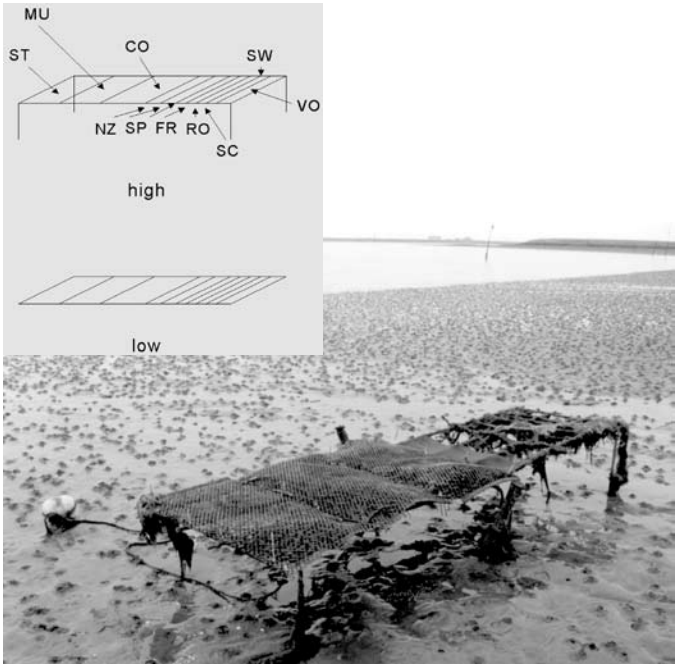

Fig. 5. Set-up for spat collectors near bottom. Frames of 1x3 m with five types of collector rope from New Zealand (NZ), Scotland (SC), Spain (SP) and the Netherlands (FR and RO), two nets of 30x75 cm; shadow net (SW) and bird net (VO), 7 kg of straw (ST) and 7 kg of empty shells.

Effect of collector type

The material from which the different collectors were made affected spat settlement. Ropes from Spain and New Zealand collected the most spat (Figure 6). Spat settled better on ropes than on empty shells, straw or plastic netting. At the tidal flat test sites, the amount of spat collected was highest on mussel or cockle shells, but never more than 400/kg shell, which is a little more than the lowest numbers on 1 m suspended rope (Figures 7 and 8).

Effect of location

Most spat were collected on ropes suspended at the test location in the Wadden Sea. Whether this is a location or a time effect can not be determined, because the experiment in the Wadden Sea was carried out later in the season. Within the Oosterschelde estuary, the number of spat collected on the suspended ropes showed

Fig. 6. Spat collecting rope from New Zealand with mussel spat after 50 days in the Oosterschelde estuary.

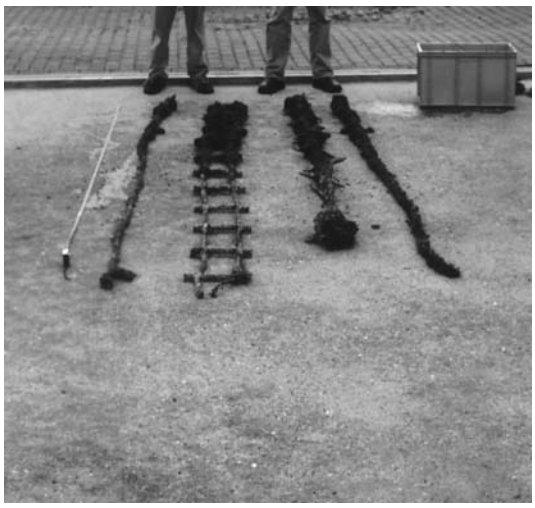

Fig. 9. Spat collecting ropes from the Netherlands (RO, first from left), Scotland (second from left), Spain (third from left) and New Zealand (fourth from left) after 68 days in the Wadden Sea.

large variability (Figure 8). In general, ropes near a suspended mussel culture farm (Krammer, Neeltje Jans) collected more spat than those near bottom culture plots (Zijpe). Ropes suspended in the water yielded higher numbers of spat than ropes placed near the sediment or on the surface of the sediment (Figures 8 and 9). At the tidal flat, no effect of height above bottom was found. The spatfall was generally better on the upper parts of the ropes (Figure 10).

Conclusions

Spatfall was best on suspended ropes from Spain in the Wadden Sea. When considering the material costs, cheaper rope from New Zealand was a good alternative. Spatfall on the tidal flat was best on shells. In 2001, experiments continued in cooperation with a number of mussel growers of both suspended rope and bottom culture. An efficient method to remove spat from collector ropes will receive extra attention. In addition, the use of labor extensive bottom substrates such as shells or degrading material will be explored further. Ropes and nets of artificial and natural fibers, as well as empty shells will be deployed in culture areas in the Wadden Sea and the northern part of the Oosterschelde estuary. Based on the results of year 1 of the project, the following preliminary estimate can be made. An area of 70 ha will be needed for spat production of 2 x10^6 kg at the best location and with the best collector rope. This clean spat can be an important addition to the catch from wild beds. At the end of the project, a selection of suitable collector material will be available. This offers a tangible perspective to optimize the use of spat collectors for bottom culture. An important step in this process is comparison of the survival rate of collector spat and wild spat on the culture plots. Finally, the results of the project should lead to commercial application in practice.

Notes

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