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Cultivation of mussels (Mytilus edulis) by use of net bags

by

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Introduction

In previous experiments with cultivation of mussels in Norway (BØHLE and WIBORG, 1967) the amount of mussels on the collecting ropes became too large and the mussels slided down the ropes. On some localities, the settlement occurred in 0-1 m depth only though growth might be satisfactory in deeper water also. Thus, a method for thinning and distribution of the spat was needed. Due to the smaller size of the Norwegian mussels, the Spanish thinning method were found unpractical in Norway. However, at the Institute of Marine Research, Directorate of Fisheries, was designed a cylindrical net bag which could be filled with mussel spat (BØHLE, 1970). The present paper gives an account of the cultivation method under development in Norway and some data on the growth and yield of mussels.

Cultivation method

In Norwegian waters the mussels usually spawn in April-May. During June the pelagic larvae metamorphose and settle readily on collecting

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ropes (which have been submerged in April). The spat grows well during the summer, and at good growth localities the spat attain mean lengths 10-25 mm during August and September. This season, when the spat may form thick and heavy clusters with 30 000 - 60 000 individuals per meter rope, is the most favourable for transplanting. The intention with transplanting spat to net bags is to obtain a moderate density of mussels which will form clusters attaching firmly to the net bags until the harvesting.

The net bags are woven of polypropylene fibres of high strength. Until this date the following types have been tried:

DESIGNATION	MESH OPENING	DIAMETER OF NET BAG
L 1.9	6.5 x 5 mm	1.9 cm
L 3.8	"	3.8 "
L 5.7	"	5.7 "
L 7.6	"	7.6 "
D 3.0	6.5 x 12 mm	3.0 "
D 3.8	"	3.8 "

The mesh openings are easily expanded by the spat. In Norway the net bags are cut in lengths of 2-4 m depending on the depth and hydrographic conditions. When transplanting, the mussels are stripped off the collecting ropes and filled in the net bags by using tube and funnel. The net bags keep their size and cylindrical form when filled with spat (for illustration, see BØHLE, 1970). At last the net bags are suspended in the sea below a raft or buoys.

In the sea the spat start crawling and moving through the mesh openings and fasten firmly to the outer side of the net bag and to each other. At 15°C this movement requires less than a week. In winter, below 8°C, it may require several weeks or the spat do not move out before the spring when the sea temperature rises again. The mussels stay in this position until the harvesting.

In experiments and by calculations the number of mussels which it is room for in the different types of net bags, has been determined (BØHLE, 1970). By using a net bag corresponding to the size of the spat, the desired number of mussels per meter net bag is obtained. The density of mussels which gives the highest amount of marketable mussels without loss by sliding, is probably dependent on the food and current conditions in the area.

Growth and yield

The main experiments with the net bags started in August 1969 on several localities. In the present paper, the data from the most successful locality will be presented. This locality is situated near Melsomvik in the Tønsberg Fjord, a sheltered area south of Tønsberg. The depths in the Tønsberg Fjord are 10-45 m. The area is usually covered by ice and snow from December to April. During the summer months, the sea temperature is 15-20 °C, in winter it is below 5 °C.

In the period 12-18 August 1969, spat with mean lengths 14 and 17 mm and collected on ropes during the summer, were transplanted to net bags of different types. The spat moved easily through the mesh openings and fastened firmly to the outer side. The mussels were length measured and weighed in December 1969 and April and August 1970.

By the age of about 6 months the mussels attained mean lengths of 31.3 - 39.7 mm (Fig. 1). The growth during the winter was very low. At the end of April the mussels had mean lengths 32.7 - 44.2 mm. During the following spring and summer the growth increased considerably, and in the beginning of August the mean lengths were 48.0 - 58.6 mm, 14 months after the settling. The figure show that the mussels on the D 3.8 net bag had relatively slow growth during the second summer. In this period it was impossible to obtain representative samples of mussels on ropes due to sliding, and therefore size of one year old mussels on ropes and net bags could not be compared. However, the impression is that the growth is at least somewhat increased on net bags.

After the transplanting it was a general decrease in the number of mussels on the net bags (Fig. 2). It seemed as the number of mussels in firm clusters stabilized at about 500. The decrease is due to that single mussels fall off and small mussels inside the clusters die. As the mussels grow and the weight increases, part of clusters may loose and fall off. This circumstance is the probable reason why the sample taken of D 3.0 net bag in August 1970 gives very small number of mussels. Also the data for L 1.9 net bag from April 1970 has been influenced by sampling error as the number should be higher.

The weight of all mussels per meter net bag (exclusive mud, empty shells etc), P_{TOT}, increased rapidly (Fig. 3). During the autumn, the highest yield of mussels was observed on the net bags with the largest diameter. For example, the spat transplanted 18 August, increased its weight per meter from ca. 1 kg to 7.5 kg. On the L 1.9 net bag the weight increased from 0.4 to 4.2 kg. During the winter the weight increase slowed down, but in the following spring and summer the weight increased rapidly. From 29 April to 5 August 1970, the weight on the L 1.9 net bag increased from 4.6 to 11.5 kg, i.e. 2.5 times.

Except for the D 3.0 net bag (sampling error), the weight of mussels per meter in August 1970, was about 11.5 kg for D 3.0 (transplanted 18 August 1969) and D 3.8 net bags.

In Norway is no minimum size for mussels. On the other hand, it is believed that a prospective mussel industry will require a minimum size which probably may be set to 50 mm shell length. So, the weight of mussels $\geq$ 50 mm, P_{50}, is an expression for the marketable mussels. In December, when the mussels were 6 months old, the P_{50} value was very small, and was still relatively small at the end of the winter. During the spring and summer the P_{50} value increased rapidly and when the mussels were 14 months old (August), the P_{50} value for the mussels on the L 1.9 and D 3.0 net bags (transplanted 18 August 1969) constituted 97.4 and 99.1 % respectively of the total mussel weight. Though the P_{50} value for the mussels on the D 3.8 net bag was 9.5 kg, it constituted only 79% of the total mussel weight (P_{TOT}). This was probable due to too high density (ca. 900 mussels per meter).

The mussels cultivated on rafts and net bags have shown to be of high quality. The shells are smooth, thin and with sharp posterior edge which indicate high growth rate. The condition index, the weight of steamed meat to the total weight of mussel inclusive shell water, is usually 25-40% from August to April.

At localities with good growth conditions was obtained an harvest of 11 kg of marketable mussels per meter net bag per 14 months. If 100 net bags of lengths 2.5 m are used per raft (7.5 x 5 m = 37.5m^2), the annual harvest per raft is estimated to be:

$$11 \text{ kg} \times 2.5 \times 100 \times \frac{12}{14} = 2350 \text{ kg}.$$

If it is assumed that it is possible to cover 25% of the sea surface in an area with rafts, the annual harvest per hectar is estimated to be:

$$2.35 \text{ ton} \times \frac{10000}{37.5} \times \frac{25}{100} = 156 \text{ ton}.$$

This indicates that in the Melsomvik area, it is possible to harvest more than 150 ton of mussels per hectar per year, provided there will be no adverse effect due to the high number of rafts in the area. The current velocity may be a minimum factor.

Though high growth rates have been obtained, there are still problems to be solved. Firstly, the experience show that the pelagic larvae of starfish (Asterias rubens) settle on the collecting ropes and cause heavy predation on the small mussel spat during the summer. Secondly, the spatfall of mussel larvae frequently occur on the one year old mussels. In this case, a simultaneous spatfall of starfish may be

favourable. Other problems are connected with rough weather in the autumn and ice conditions in the winter and spring.

The introduction of net bags into the experiments with cultivation of mussels in Norway solved serious problems which arised in the first experimental period (1966-1967). By transplanting mussel spat to net bags was obtained optimal density and sliding of mussels was avoided. By use of net bags it may be possible to move spat to other localities where food conditions are good, where starfish are scarce and where settlement of new spat on old mussels is negligible.

Summary

Mussel spat, settled on collecting ropes in June, in August and September have mean lengths 10-25 mm and are then transplanted to net bags at a density of 1000-1200 per meter. The spat move through the mesh openings in less than a week and form mussel clusters, firmly fastened to the outer side of the net bags.

At good growth localities in Norway mussels of 14 months age on net bags may attain mean length up to 58 mm and yield 11.5 kg of marketable mussels per meter net bag. During the growth period half of the spat and mussels are lost and the result is about 500 mussels per meter.

The cultivated mussels are of high quality with condition index 25-40%. At good growth localities (Melsomvik) it is estimated that the annual yield may be 156 ton per hectar.

References

BØHLE, B. 1970. Forsøk med dyrking av blåskjell (Mytilus edulis L.) ved overføring av yngel til nettingstrømper. [Experiments with cultivation of mussels by transplanting spat to net bags.] Fiskets Gang, 56 : 267-271.

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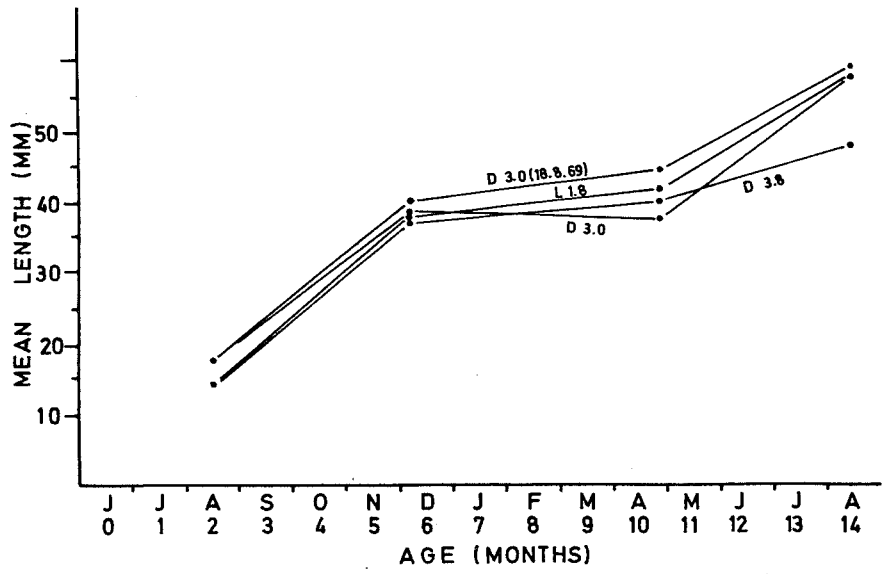

FIG.1 MEAN LENGTH(MM) OF MUSSELS TRANSPLANTED TO NET BAGS AT MELSOMVIK, 12.AUGUST 1969

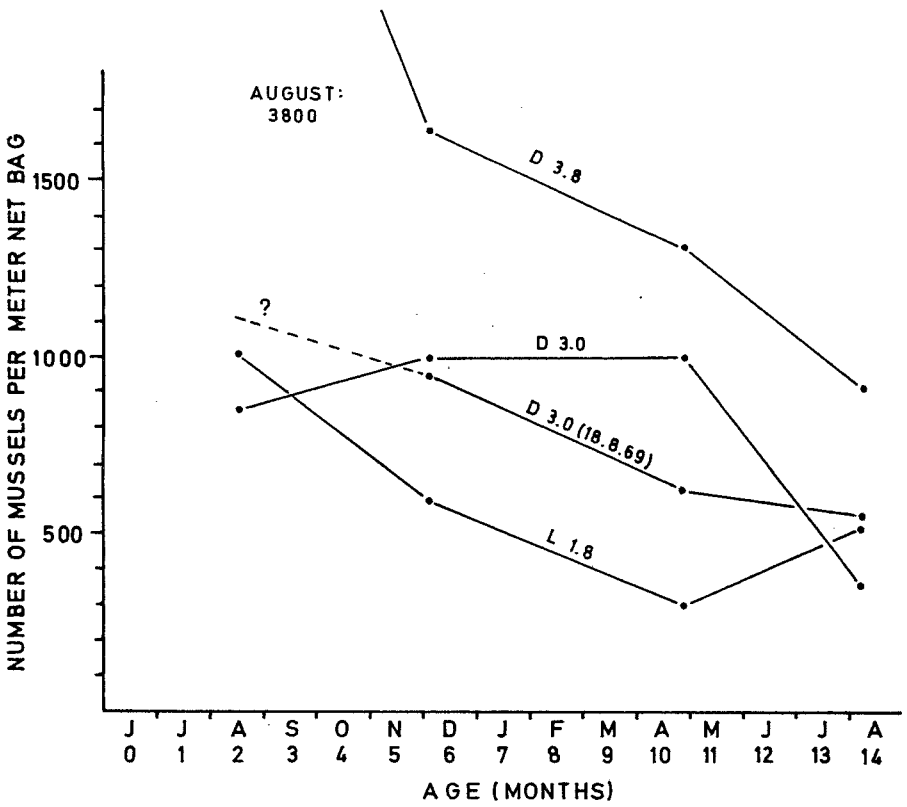

FIG. 2 NUMBER OF MUSSELS PER METER NET BAG AT MELSOMVIK, TRANSPLANTED 12. AUGUST 1969

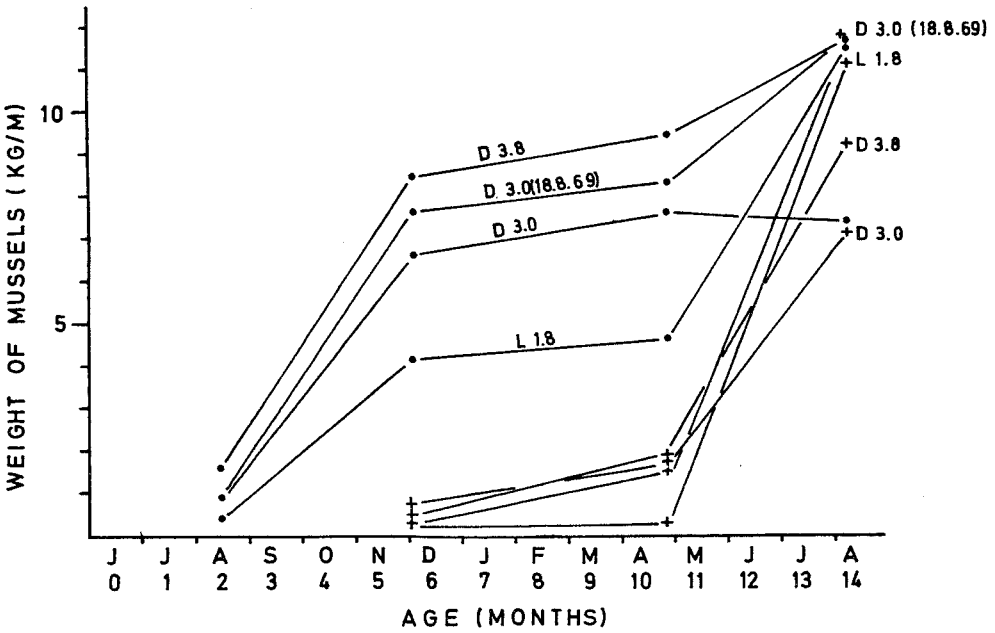

FIG. 3 WEIGTH OF MUSSELS PER METER NET BAG: •——• ALL MUSSELS(P_{TOT}), +——+ MUSSELS ≥ 50 MM (P_{50}), TRANSPLANTED 12. AUGUST 1969