International Council for the Exploration of the Sea.
Statutory Meeting, Dublin, 1993

C.M. 1993/F:32
Mariculture Committee
Ref. K

Scallop spat production within sea-loughs by means of induced synchronised spawnings- a possible solution.

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ABSTRACT

Scallops may be held in hanging culture near the sea surface to maximise gonadal growth. In the late spring these can be suspended at depths >16m before being raised to the surface some weeks later to spawn, once there is a vertical sea temperature difference of more than 1.1°C. Following spawnings development of larvae, using plankton tows, could be followed and from their growth settlement time predicted. Spat may then be collected in the normal way, using collectors. In Mulroy Bay wild settlements are concentrated within one region, this was consistent over the years studied. The fertilisation success following spawnings and survival to settlement is presently unknown.

Introduction

Spat of the scallop, *Pecten maximus,* for cultivation are presently either sourced from hatcheries or from natural collections. Hatchery-reared spat produced early in the year are larger than natural settlements entering their first winter; this may compensate for their added cost. Natural settlements occur in Irish waters from late May to October, but within partly enclosed sea-loughs the experience is of settlements in the mid to late summer (Minchin, 1992a). Production of spat from wild settlements is usually cheaper although they are of a smaller size in their first winter. Late settlements are of little value, the smaller spat are easily washed out of collector bags and require more handling.

There are no direct observations of *in situ* spawnings of *P. maximus.* However indirect evidence suggests local spawnings often take place close to the same time; but at varying times at different localities. In Mulroy Bay scallops undergo partial spawnings during the summer.

Studies by Minchin (1992b) demonstrate that scallops can be induced to spawn in the sea if they are previously held at depth for some weeks before being raised to the surface (Figure 1). Spawning normally commenced within an hour of being raised and was sufficiently profuse to reduce underwater visibility (Figure 2). Following spawning, gonads were found to have expressed most of their gametes. Developing embryos were obtained from water samples following spawnings, some of these developed into 'D' veligers.

Mulroy Bay

Induced spawning took place in two Irish sea loughs, Lough Hyne, on the south coast and Mulroy Bay, on the north. Both loughs have restricted connections to the sea which results in a reduction of tidal amplitude. These features are also found in some Scottish sea loughs (Milne, 1972). Where the water exchange in loughs is reduced, scallop larvae produced within them may remain and settle there, as in Mulroy Bay (Minchin, 1981).

In the North Water of Mulroy Bay, the native population has declined over a period of about fourteen years despite the sowing of ongrown Mulroy scallops in more recent years to supplement the adult population. Diving surveys of the adult population in 1980, 1984 and 1985 and annual collector studies indicated poor or no recruitment for year classes 1982-85, which may have been due to use of TBT within the Lough over this time (Minchin, Duggan & King, 1987). In addition, the population at that time consisted of middle to old aged scallops. Extrapolations based on an instantaneous mortality rate of 0.3, known age structures and the variability of gonad weight with age and depth enabled an estimate for the total biomass of reproductive tissue (Figure 3) (Minchin & Ni Donnachada, 1991). This biomass declined from almost 9 tonnes in 1978 to 1.5 tonnes in 1993 (Figure 4).

With this decline in reproductive biomass there is likely to be a change in nearest neighbour distances. This is probably of importance for spawning synchrony and fertilisation success and would thereby influence settlement intensity. By the control of spawning it may be possible to promote settlement at a known time and earlier in the year with the result that spat for culture will be larger at the beginning of winter.

Technique

Scallops are held within lantern nets near the sea surface to enhance their reproductive growth. In the late spring scallops are suspended at 16m+ for some weeks, before being raised to near the sea surface once there is a difference of more than 1.1°C between the surface and the depth at which they had been stored. The nearest neighbour distances required so as to maximise fertilisation yet minimise polyspermy (Gruffydd & Beaumont, 1972) are not known, and probably depend on

water current speeds at the time of spawning, stocking density within cages and distance and orientation of cages from each other.

Following spawnings it should be possible to follow the development of larvae, using plankton tows, once they attain the umbonate stage. From sequential plankton tows growth can be calculated and from this the settlement time can be predicted (Slater, 1980). Spat may then be procured by means of collectors in the normal way. In the case of Mulroy Bay settlements were concentrated within one region of the bay. This was consistent over the years studied.

Discussion

In areas where scallop populations have become depleted, there may be insufficient parent scallops remaining to produce significant settlements for replacement. The technique explained in this account may enable restocking of these bays indirectly by means of controlled spawnings leading to natural settlements. The technique is simple, low in cost and in some areas could readily be combined with suspended cultivation of scallops. The controlled spawning of scallops, as described here, does result in complete spawnings and production of some larvae. The production of significant numbers of larvae by this method have not yet been demonstrated.

Synchronised spawnings of some molluscan species have been studied *in situ* (Minchin, 1992c) and in these cases great quantities of gametes are released which also reduce underwater visibility. Larvae thought to have arisen from these spawnings were observed in the following days. These observations provide a further indication that intensive spawning activity can result in viable larvae. The dispersion and subsequent distribution of the larvae will depend on hydrographic conditions and larval behaviour. For this reason prediction of settlement areas may be more difficult in some bays or loughs than others, particularly since the knowledge of most bay systems is presently poor.

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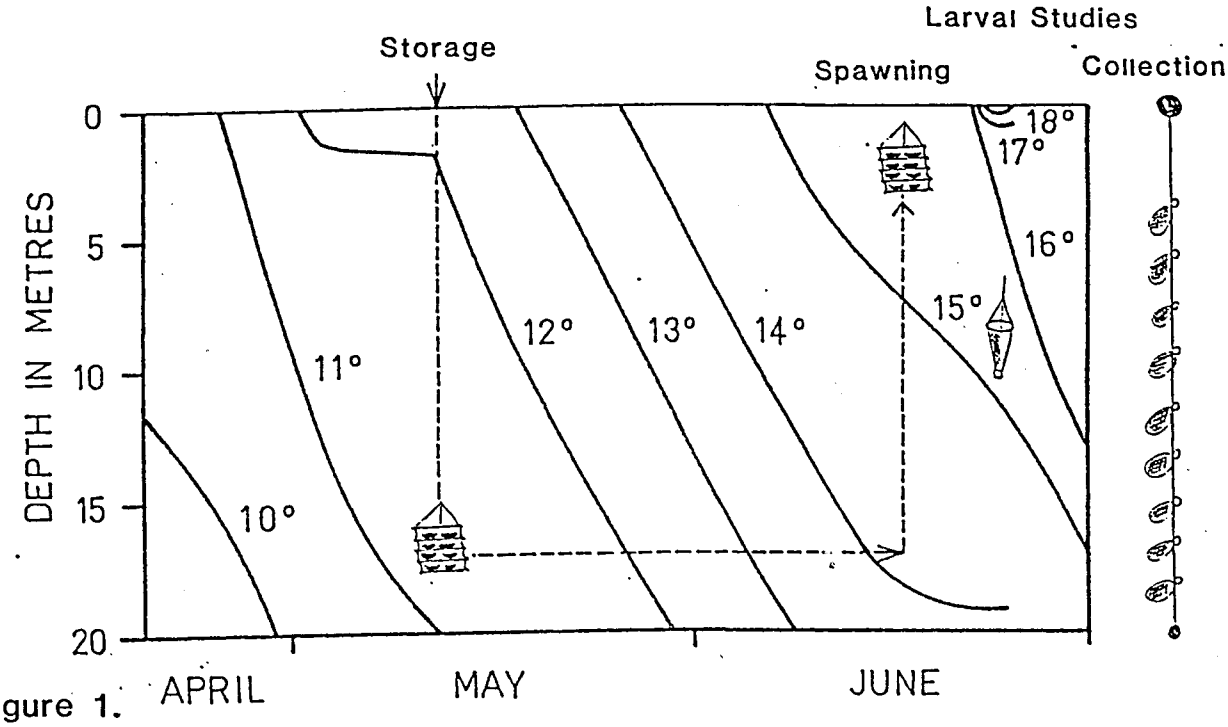

Figure 1.

Spawning can be controlled by holding scallops that have near to full gonads at depth within lantern nets. Spawning takes place within 30-200 minutes of being raised to the surface once there is a temperature difference of over 1.1°C. It may be possible to follow larval development using plankton tows to the time of settlement. Scallops may then be aquired on collectors in the normal way.

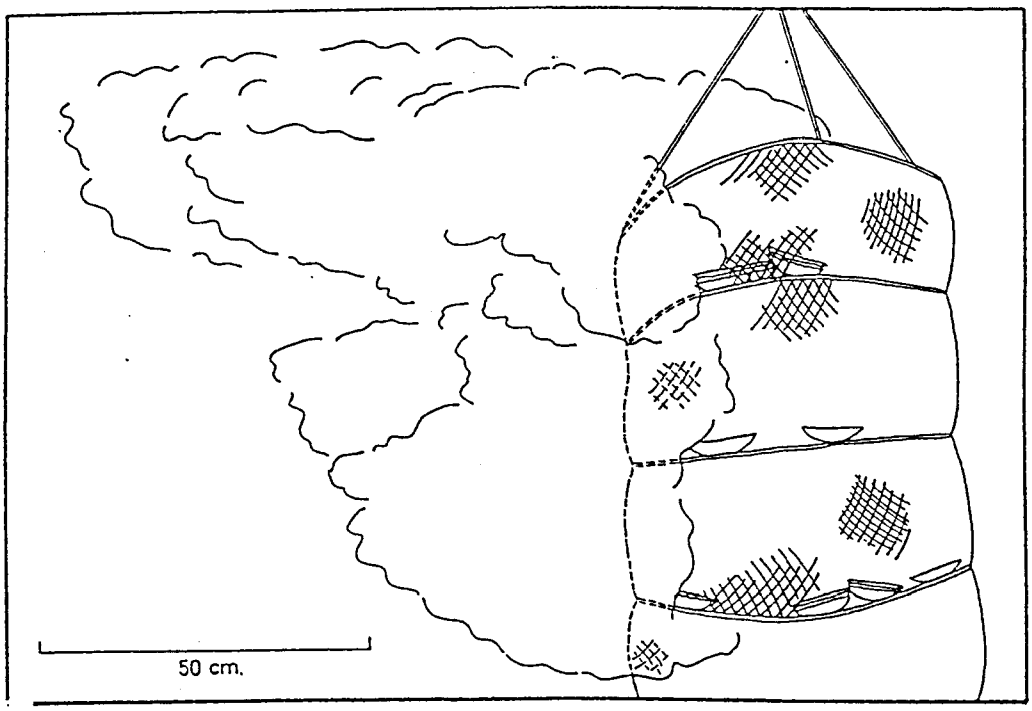

Figure 2.

Scallops spawned following transfer to surface waters, both male and female gametes were released. Scallops following spawnings were found to have become completely spent.

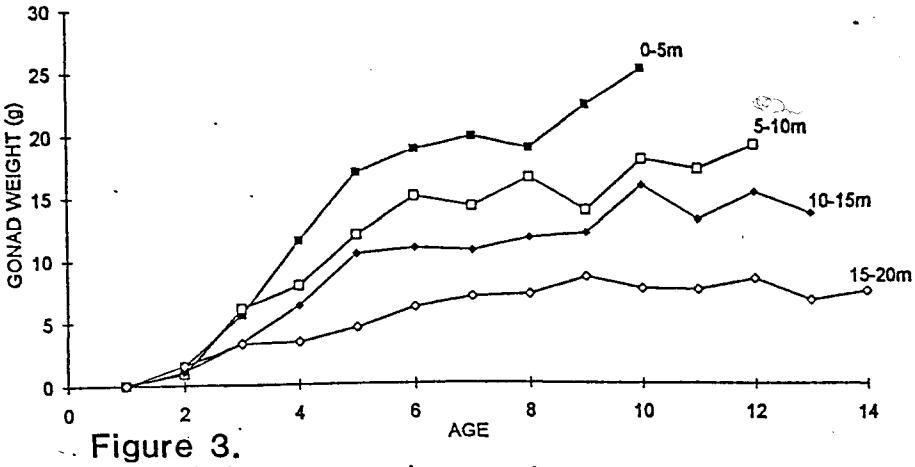

Figure 3.
Gonadal biomass at each age varies according to depth. Shallow water scallops produce a greater amount of reproductive material. Sowings of scallops, when done to enhance the spawning stock, should take place in areas where the greatest amount of reproductive biomass can be produced. As areas to 5m depth can be exploited using a brideog (hoop net), depths of 5-10m should be sown first.

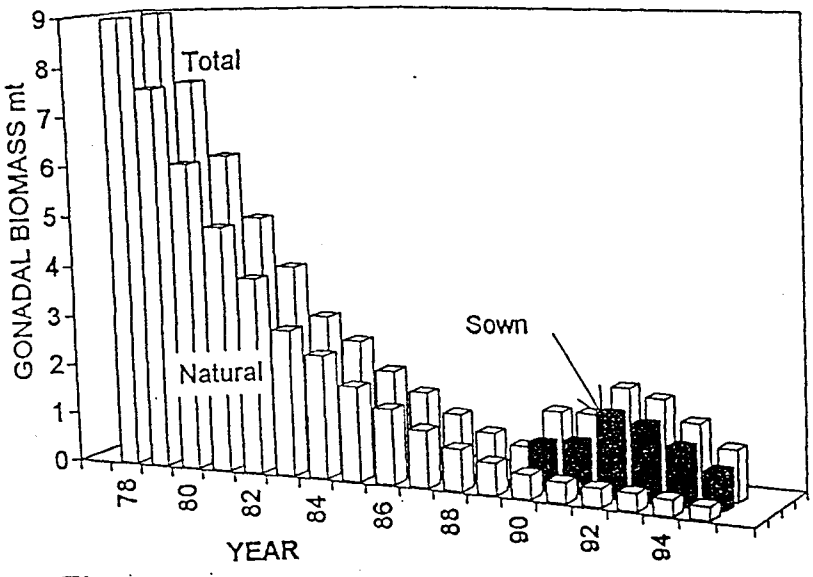

Figure 4.
Estimated gonadal biomass of scallops within the North Water of Mulroy Bay. The gonadal biomass of sown scallops is presenetly thought to exceed those of the natural population.