Clam cultivation:
localised environmental effects

Results of an experiment in the
River Exe, Devon (1991-1995)

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Summary: *a clam growing experiment was set up on the intertidal shore of the River Exe estuary to measure whether any localised changes to the animal and plant communities and to the sediment composition might occur. The experiment showed that plots covered with netting encouraged the proliferation of certain sediment-feeding worm species, a small increase in the organic content of the sediment and in one component of particle sediment size. Changes occurred irrespective of whether or not clams were present in the net-covered plots. These changes may have been partly influenced by the presence of a green alga which grew on the nets and by the associated feeding activity of periwinkles. These changes were recorded soon after planting the clams and remained throughout the cultivation cycle until harvesting took place 2½ years later. The immediate effects of harvesting by hand-raking caused a reduction of invertebrate species and numbers in the sediment by 50% whereas suction harvesting caused a reduction of >90%. Trenches formed by suction harvesting were infilled naturally within 3-4 months. Recovery of the invertebrate community following the spring recruitment, occurred quite quickly, in this case within 8 months of harvesting.*

Introduction

Since UK commercial bivalve hatcheries were established in the mid-1960s, the shellfish industry has been slow to show interest in the cultivation of hatchery-reared clams (e.g. American hard shell clam, *Mercenaria mercenaria* and the palourde or carpet-shell, *Tapes decussatus*. A modest change in attitude came about in the mid-1980s with the introduction of the non-native Manila clam, *Tapes philippinarum* which was readily available from commercial hatcheries and was a hardy and fast-growing species. It was introduced into the UK via the quarantine facilities at the MAFF, Fisheries Laboratory, Conwy, from where disease- and pest-free broodstock were given to the commercial hatcheries for rearing.

At about the same time, nature conservationists were showing concern that the two non-native species of bivalves, the Manila clam and the Pacific oyster, *Crassostrea gigas*, which were cultivated widely in the British Isles, might pose a threat to the natural ecology of British coastal waters. Their concern lay with the prospect of these bivalves spawning and establishing a self-sustaining broodstock, or by competing with natural communities for space and food. Although the Pacific oyster has been cultivated in British waters since the mid-1960s, and natural spat seen on occasions, it has not become established. Natural spatfalls of the Manila clam have not been recorded. The study described in this pamphlet was set up to answer some of the questions relating to whether clam cultivation has an effect on natural intertidal communities and whether these changes are reversed after harvesting.

The site

The River Exe, Devon (Figure 1), was selected as the site for the clam cultivation experiment. The estuary has extensive sheltered areas that are used for the commercial cultivation of mussels and Pacific oysters but, at the time of the start of the experiment, not for Manila clams.

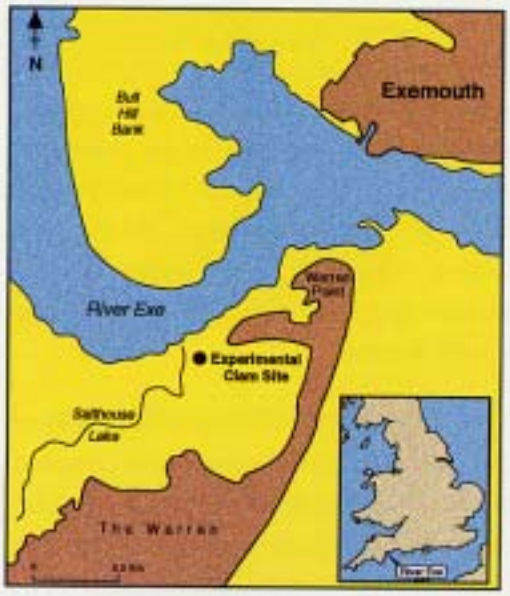

Figure 1. Clam cultivation site in River Exe

The experimental site, comprising a stable muddy sand sediment, was situated intertidally near to low water of spring tides. The site was approximately 1.5 m above chart datum and exposed for several hours during spring tides.

The experiment

The experiment incorporated four treatments, replicated three times (Figure 2). These were:

(i) clams with net covers (NC);
(ii) net covers only (N);
(iii) control plots without clams or net covers (C);
(iv) control plots without clams or net covers or human activity (W).

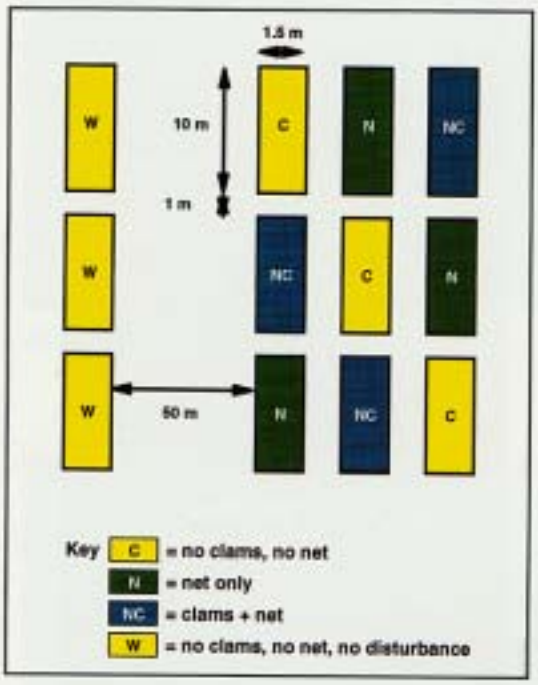

Figure 2. Experimental layout

The netting, made from polypropylene, initially had 5 mm mesh apertures but after one year was replaced with netting with 10 mm mesh more suited to the size of the clams. Each plot (see Frontispiece) was 10 m long x 1.5 m wide and was covered with a 2 m wide piece of netting buried at the edges to prevent escape of clams and predation by crabs. Avenues 1 m wide around the perimeters of the plots, provided access when sampling or servicing the experiment. A further set of control plots without clams or net covers was established ca. 50 m away from the main experiment to check whether the relatively higher human activity during the monthly husbandry was having an effect on the fauna and flora.

At monthly intervals, the nets were brushed free of accumulated silt and the green alga, *Enteromorpha* (Figure 3), which actively grew on them from May to October. Infauna, cultivated Manila clams and other components of the sediment were sampled.

Figure 3. Net cleaning with squeegee

The experiment, which lasted from 1991 to 1995, incorporated observations outside of the cultivation period (spring 1992 to winter 1994). These included pre-planting and post-harvest information and hence data on the recovery of the site.

The clams

Eighteen-month old clams (shell length, 11.8 mm; live weight, 0.3 g) originally from the hatchery at the Fisheries Laboratory, Conwy and kept in trays in the Menai Strait, were used for seeding the plots. In March 1992, the clams were held on the River Exe site in trays for one month to adjust to the local conditions prior to planting them on the ground in April 1992. Approximately 22,500 clams were hand-spread as evenly as possible, onto the three replicate plots at a rate of about 500 per m^2 and covered with netting.

Results

Changes during cultivation:

(a) to the sediment

The presence of the netting and the green alga growing on it, irrespective of whether clams were present, caused an increase in sedimentation rate compared to the control plots. Thus, the netted plots became slightly humped in profile with their central areas elevated about 10 cm above surrounding levels. Associated with this, the sediment composition of the netted plots altered slightly, showing a slight increase in the proportion of silt. A small increase in organic content and chlorophyll breakdown products of the sediment was probably caused by the presence of the weed and the extra numbers of periwinkles grazing on it, and by the extra abundance of deposit-feeding worms beneath the nets.

(b) to the animal community in the sediment

The numbers of some worm species (Figure 4) increased substantially beneath the netted plots irrespective of whether clams were present. This increase occurred within 6 months of net placement and persisted until the clams were harvested, 2½ years after seeding (Figure 5).

Figure 4. Some commonly occurring worm species in the netted plots. Approximate sizes of specimens are shown

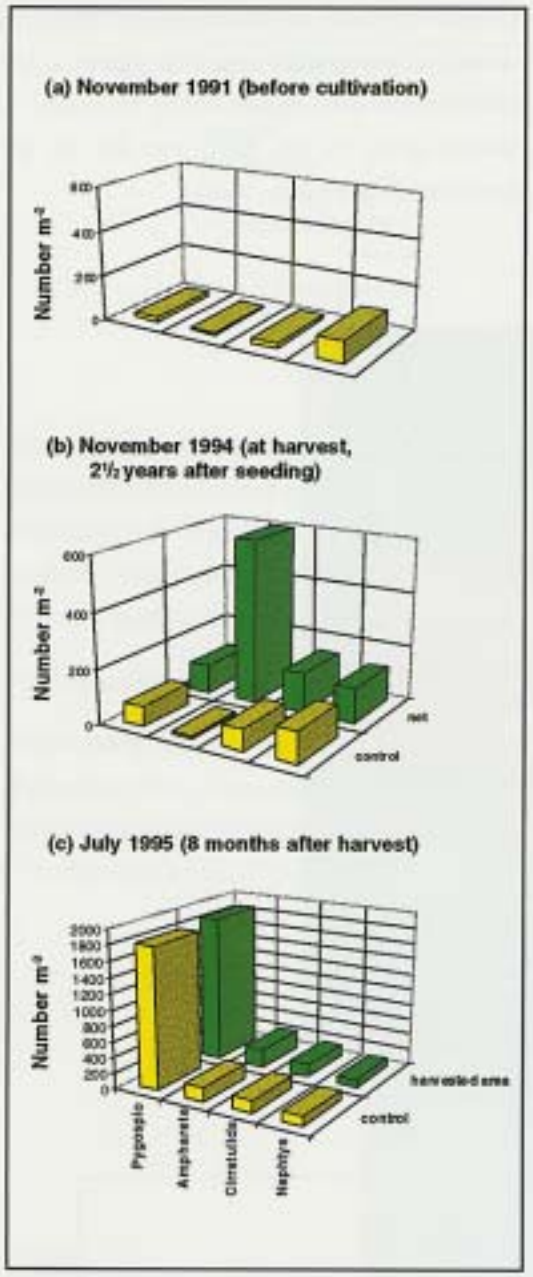

Figure 5. Changes in worm abundance

Figure 6(a). Removing net before harvesting

Figure 6(b). Plot ready for harvesting

Figure 7. Hand-raking clams from plot

Changes caused by harvesting

(a) to the sediment

The clams reached marketable size (30 g) by November 1994. The plots were prepared for harvesting by removing the nets (Figures 6(a) and (b)). The first harvesting was accomplished by hand-raking (Figure 7). This activity was immediately followed by the use of a commercial suction device (Figure 8)

to compare the effects of both methods on the other creatures in the sediment. Suction harvesting created an increased sediment load in the water which dispersed to near background levels within 40 m of the device (Figure 9). Some of the suspended particles settled on the seabed as a thin veneer a few metres wide downstream of the harvester. A trench about 10 cm deep was left by the harvester (Figure 10).

Figure 8. Suction harvesting of clams

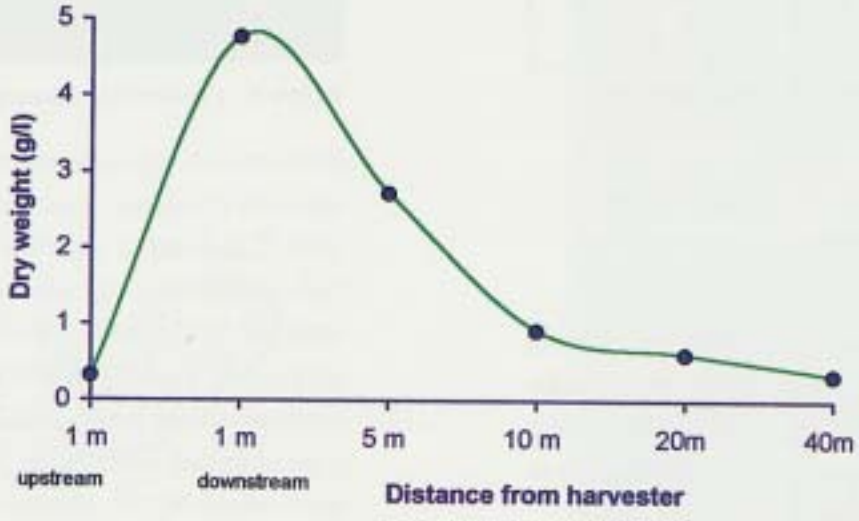

Figure 9. Quantity of sediment particles (g/l) in the water plume of suction harvester

Conclusions

- **The netting rather than clams:**
  - increased sedimentation and a slight enrichment of organic content, some particle components and pigment level of the sediment.
  - acted as a substrate for the growth of green seaweed. This attracted a higher abundance of periwinkles which grazed upon it.
  - encouraged a higher abundance of some sedentary worm species but without affecting the overall level of species diversity. This may be a positive benefit to animals higher up the food chain e.g. crabs and birds.
  - the increased sedimentation beneath the netting caused elevated, hump-shaped plots about 10 cm high at their apex.
- **Harvesting by hand-raking caused ca. 50% reduction in species diversity and abundance.**
- **Suction harvesting:**
  - created a plume of sediment in the water which reduced to background levels within 40 m.
  - left a trench 10 cm deep which infilled naturally within 3-4 months.
  - caused ca. 90% reduction in species diversity and abundance.
- **Regeneration of species diversity and abundance, after harvesting in the winter, was completed by the following summer.**

Recommendations to reduce environmental effects of clam cultivation

1. ***Ensure that netting is kept in good repair to prevent escape of non-native species.***
2. ***With native clams, remove netting once danger of crab redation has passed (probably at end of first year of cultivation).***
3. ***Where possible, harvest by hand-raking to reduce disturbance of the sediment.***
4. ***Where possible, harvest between autumn and spring to ensure that natural invertebrate settlement can quickly regenerate communities affected by harvesting.***

This pamphlet, prepared by B. E. Spencer, Fisheries Laboratory, Conwy, Gwynedd, is based on a programme of work carried out in the River Exe. The assistance of local commercial shellfishmen, including River Exe Shellfish Farms, and Seasalter Shellfish (Whitstable) Ltd is gratefully acknowledged.

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This leaflet has been prepared as information for the shellfish industry, conservationalists and managers. It is not intended for scientific citation. The following selected bibliography may be helpful in providing additional information within and outside of the subject area of this pamphlet.

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