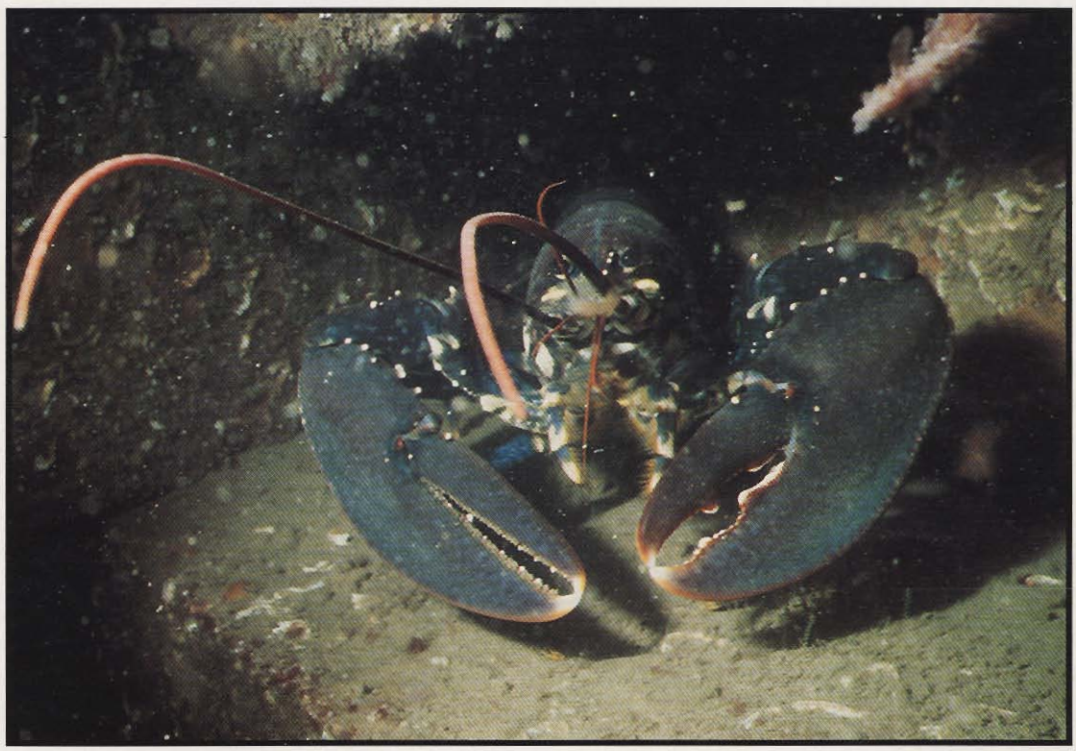
LOBSTER STOCKING : Progress and Potential

Significant results from UK lobster restocking studies 1982 to 1995

MAFF
Directorate of Fisheries Research
Fisheries Laboratories
Conwy & Lowestoft



SFIA
Sea Fish Industry Authority
Marine Farming Unit
Ardtoe

University of Southampton
Department of Oceanography

NW&NW SFC
N.Western & N.Wales
Sea Fisheries Committee
Lancaster

UK scientists from three research teams co-ordinated by MAFF have now shown that 3-month old juveniles of the European lobster, *Homarus gammarus* (L.), can be hatchery reared from wild broodstock, released onto lobster habitat, and recaptured close by in substantial numbers 4 to 6 years later, after growing to legal size.

This is a unique result which could form the basis of future lobster stocking or re-stocking programmes.

Introduction

In the late 1970s, MAFF scientists at the Fisheries Laboratory, Conwy, learned how to rear the European lobster, *Homarus gammarus* (L.), in the hatchery. Eggs from wild broodstock were grown to market-sized adults, but it was too costly to make lobster farming seem viable. Encouraged by the Shellfish Association of Great Britain and the lobster industry, MAFF turned to the idea of ranching. If lobsters were released into the wild as juveniles could they survive to adulthood in significant numbers?

To answer this, researchers started a long term scientific study, now nearing completion. From 1983 to 1988 baby lobsters were reared in large numbers every year, and released at carefully chosen coastal sites. Since 1988 full grown lobsters from these sites have been tested to show whether hatchery lobsters have survived long enough to be caught by fishermen. The work was carried out at four sites (Figure 1) by three research teams working independently, but co-ordinated by MAFF:-

MAFF
Ministry of Agriculture Fisheries & Food
(the pioneeering group),
Fisheries Laboratories, Conwy & Lowestoft.

SFIA
Sea Fish Industry Authority, Marine
Farming Unit, Ardtoe.

NW & NW SFC
North Western & North Wales Sea Fisheries
Committee, Lancaster.

This leaflet highlights key points to help you understand and interpret the results. You can find further details in the references quoted later, or by contacting the addresses at the end of the leaflet.

Figure 1. Where the lobster restocking trials took place

Lessons from history

Historic reports describe dozens of attempts to rear lobster or to restock lobster populations, going back to at least 1850. Various schemes were tried, including transplantation of adults; rearing to adulthood; creating non-fished sanctuaries for egg-bearing ("berried") females; rearing and releasing larvae or juveniles. Notable large-scale operations occurred on the Canadian east coast from 1891 to 1917, when 900 million stage 1 larvae of *Homarus americanus* were released, and later in New England, USA, where millions of larvae have been released since 1949.

Results from these trials have not been conclusive because in most cases hatchery lobsters were not distinguishable from wild stock, and because stock or landings were not monitored effectively.

Learning from history, lobsters released at our sites were all tagged using a small microwire tag (see Box1) and the coastal sites and their fisheries have been carefully monitored for survivors.

Lessons from biology

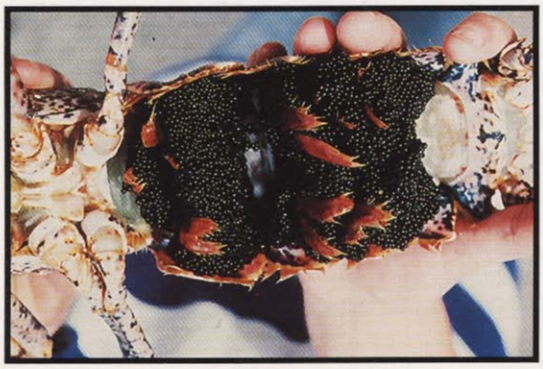
Lobsters require shelter throughout life. In the wild, free-swimming lobster larvae complete their dispersal phase by searching the seabed to find shelter in crevices, or amongst pebbles or boulders, or even burrow into cohesive mud. There they remain for at least two years before foraging more widely. As adults, lobsters still shelter in between their intermittent feeding forays, or during moulting, mating and egg laying. The distribution of lobsters and their fisheries is therefore limited by the extent of available habitat.

Learning from biology, we chose sites with typical lobster habitat, ranging from cobble and boulder clustered on sand and clay, to boulder screes at cliff edges, or rocky slabs and bedrock with ledges and crevices. Sites at Bridlington, Aberystwyth, and Ardtoe were exposed to onshore winds and swell, but sites in Scapa Flow were more sheltered.

Juvenile lobsters on typical habitat at Bridlington (Crown copyright /MAFF)

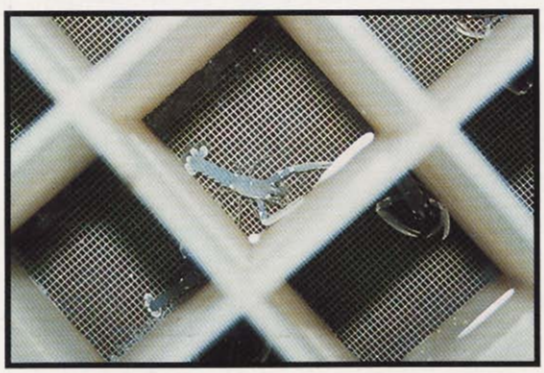
BOX 1. KEY EXPERIMENTAL STEPS

- hatchery-rearing lobster larvae to juveniles of 12-15 mm carapace length (CL) – this takes about 3 months in water warmed to 18-21°C.
- tagging each individual with a magnetised microwire tag inserted in the non-edible base of the 5th walking leg – etching on the tag identified each release year.
- release in summer and autumn (the warm water period) onto sheltered habitat on the seabed using divers (MAFF, SFIA) or through an underwater pipe (NW&NW SFC). **Good site selection is critical.**
- recapturing microtagged lobsters by fishing on release sites, or testing commercially caught lobsters at landing places or storage tanks. Lobsters with microtags were detected using a metal detector.
- removal of microtag, and reading of the etched code to assign lobsters to their release year and batch.
- assessing the catch rate and estimating the survival rate.



An egg-carrying female (Copyright: SouthamptonUniversity Dept. of Oceanography/ SEIA Ardtoe)

Larvae being reared in the hatchery at Conwy (Crown Copyright / MAFF)



A juvenile lobster in the hatchery (Copyright: Southampton University Dept. of Oceanography / SFIA Ardtoe)

The Release and Recapture strategies

From 1983 to 1988 some 91 000 juveniles were released at the four sites, in depths ranging from 5 to 20 metres. **This total comprised small batches released at many individual locations at each site over the five year period.**

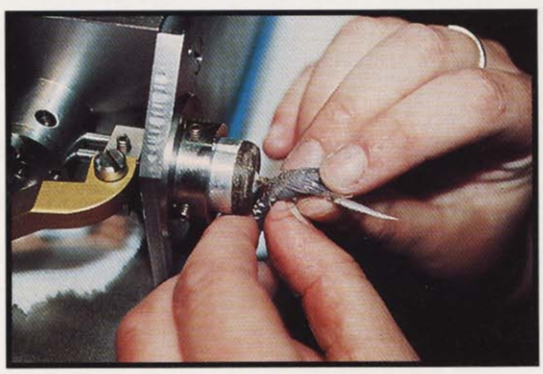
Near Bridlington, MAFF released 80 batches ranging from 200 to 2000 lobsters, in an area of 150 sq km. SFIA released batches of 40 to 500 at 6 locations near Ardtoe, Argyll, and batches of 400 to 1370 at 21 different positions in Scapa Flow, Orkney. At Aberystwyth in North Wales, lobsters were released at one offshore site, and several locations at an inshore site.

A widespread low-density release pattern reduced competition between batches, and perhaps between hatchery-reared and natural stock, but it may have reduced the chance of finding survivors later.

SFIA used scuba divers to obtain the first few recaptures of tagged lobster at Ardtoe and Scapa in 1985-87. The method is unsuitable for large-scale searches, however, and the main recapture programme was based on testing lobsters caught either in commercial lobster pots, or in *Nephrops* creels. The lobsters tested came from commercial landings (sampled at landing places or in storage tanks), or were collected at sea by scientists on board boats fishing in the release areas.

Monitoring at landing places enabled large numbers of legal sized lobsters to be tested from many boats, but gave few details about individual recapture positions. Lobsters collected at sea included the full size range caught in pots (lobsters larger than about 50 mm CL), and came from known fishing positions. In the MAFF study the recapature and analysis programme were carried out by scientists from Lowestoft.

We are grateful for the considerable help received from shellfishermen and lobster merchants during this work.



Microtagging a juvenile lobster (Copyright: Southampton University Dept. of Oceanography / SFIA Ardtoe)

BOX 2. RESULTS

The numbers of lobster juveniles released and recaptured are shown in Table 1 overleaf

As an example, at the east coast MAFF site, we :

- released **49 000** lobsters on 80 individual reefs (1983 to1988)
- tested an average of 10 000 lobsters annually (1988 to 1994)
- recaptured **650** microtagged lobsters – these ranged in age from 3 to 9 years, and were clustered within 5 km of known release sites (Figure 2)
- recaptured 10 egg-bearing females, showing that hatchery-reared lobsters can mate and contribute to population egg production.

Lobsters of 18 mm CL were caught by SFIA divers during initial sampling in Scotland, but recaptures from lobster and *Nephrops* creels ranged in size from 50 to 120 mm CL. Most lobsters needed 4 to 6 years to reach the legal size (85 mm CL).

From all trial sites, results so far total **1468** recaptures from **91 000** lobsters released. They show similar patterns and scale.

Divers releasing lobsters onto the seabed (Copyright: Southampton University Dept. of Oceanography / SFIA Ardtoe)

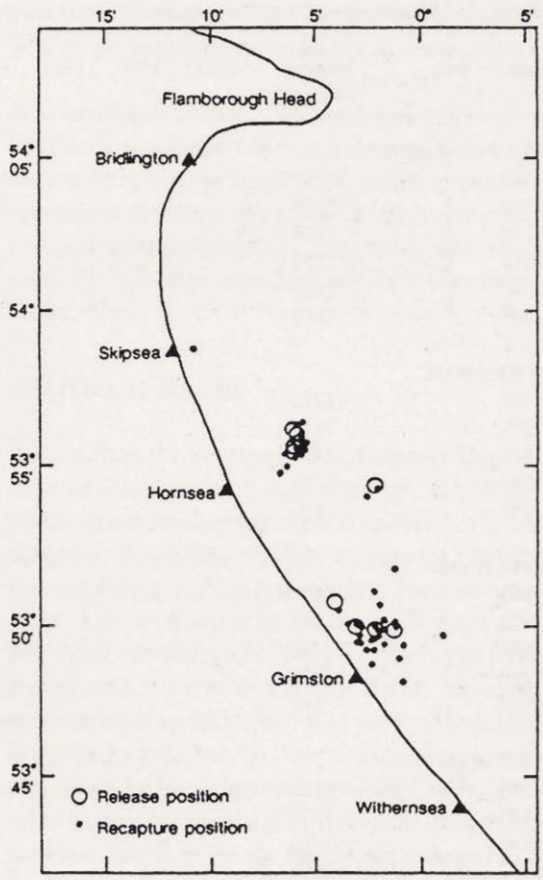


Figure 2. Hatchery lobsters released at Bridlington were recaptured close to their release positions (data for release year 1984)

Collecting lobsters at sea off Bridlington during the monitoring programme (Crown copyright / MAFF)

Table 1. The number of hatchery-reared lobsters recaptured since 1985

Release Year	Number released	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	Total	No. per 1000 released
MAFF Bridlington													
1983	2390				14	19	6	0	0	0		39	16
1984	8616				12	67	97	25	14	0		215	25
1985	7979					24	112	21	5	0		162	20
1986	11562						1	28	39	5		73	6
1987	12629						2	41	72	20		135	11
1988	5952								22	7		29	5
NW&NWSFC													
1984	1250						33	6	3			42	34
1985	3760				5		67	74	31	11		188	50
1986	2438					3	5	28	26	2		64	26
1987	5079							2	36	23		61	12
1988	6706							3	40	44	11	98	15
SFIA Ardtoe													
1984	451	2	2	3	9	8	1					25	55
1985	1268				2	6	5	1				14	11
1986	513)												
1987	553)				1	4	8	4	1			18	16
1990	259									1		1	3
SFIA Scapa Flow													
1984	4469	3		18	3	16	84	68	23	1		216	48
1985	3800					1	10	3	12	1		27	7
1986	2356								5			5	2
1987	3610								37	5		42	8
1988	2260							1	8	4		13	26
1989	3025									1		1	0
											Total	1468	

Site Fidelity

Results from target fishing at known positions, and from testing lobsters caught outside the release areas, show whether lobsters tend to stay in the release area, or move away.

At Bridlington and Scapa Flow, most recaptures were clustered close to release positions, and did not disperse through time. At Ardtoe and Aberystwyth, however, several lobsters have emigrated 20 km or more. At Aberystwyth numerous lobsters released inshore were also recaptured 10 km away at the offshore site.

In general, a high proportion of juvenile lobsters released on lobster ground seem likely to stay close by, but in some circumstances larger movements, including 'recruitment' from inshore to more offshore grounds, may occur. Results are similar when naturally settled lobsters are tagged.

Recapture Rate

Overall, the total number of recaptures varied from 1% to 5% of the number released, depending on site and release year (Table 1), although the recapture rate of some batches at some sites was higher e.g. 9% for one offshore release at Aberystwyth. Recapture number is affected by the scattered release pattern, the small batch numbers, competition with naturally settled lobsters, and the effectiveness of the monitoring programme. Potential recapture rates in the future might be higher if hatchery juveniles are released in larger numbers throughout an entire fishery.

An important statistic is the actual catch rate of hatchery lobsters at a release site. At Bridlington this ranged from 0, through 1 to 2 lobsters per 30 traps, to some 'hot-spots' hauls with 4 to 6 lobsters per 30 traps, and the overall average was **6 hatchery lobsters per 100 pot hauls**. On these occasions hatchery-reared lobsters contributed 20 - 40% of the legal sized lobsters, and 6-15% of all sizes.

At Bridlington, survivors from a seeding operation using scattered batches of only 200 to 2000 hatchery-reared lobsters therefore formed a worthwhile component of the local catch rate.

Survival Estimates

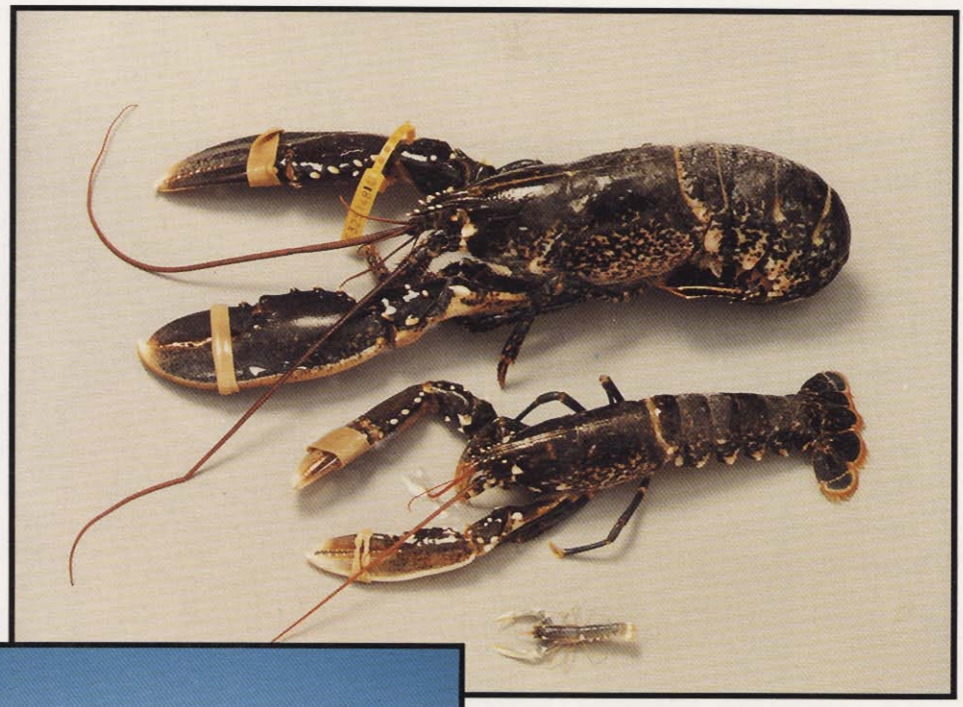
Using these catch rates, MAFF scientists have estimated how many hatchery survivors may be on the seabed, for comparison with the original number of lobsters released. This calculation is preliminary, and involves various assumptions, but it suggests that survival from release at three months to recapture at, on average 5 years, could average 50%. A good survival rate is consistent with the protection given to lobsters by their shelters.

We cannot tell whether hatchery reared survivors have truly augmented the natural stock, or simply displaced it, but the number of hatchery animals released at Bridlington was substantially less than the total natural population, suggesting that mortality due to competition may not be a significant factor.

Artificial Reefs

A team from the Southampton University Department of Oceanography contracted by MAFF has shown that a small experimental artificial reef deployed in Poole Bay quickly attracted a population of lobsters, crabs and some fish. The reef comprises 8 small mounds of blocks made from fuel ash, gypsum and cement. Fifty to 80 lobsters have moved onto the reef at different times, including some animals resident for 3 to 4 years. Models to examine the best crevice structure for a large scale reef are under investigation by MAFF Conwy, and other work is planned to study how reef design and structure might influence the number and size of the lobster population. The use of coastal defence structures to create additional lobster habitat is being explored.

Lobster growth : juvenile at release, recaptured adolescent and adult (Crown Copyright / MAFF)



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These are the first results to provide quantitative evidence that juvenile lobsters released into the wild on lobster habitat can survive to legal size in substantial numbers, enter baited pots set by commercial lobstermen, and contribute to commercial catches and the breeding stock.

Lobster stocking therefore seems to be feasible biologically, and requires to be tested economically and on a larger scale.

Where to now?

UK lobster populations are small. Stocks are not collapsing, but many are heavily exploited, and have been reduced to less than a quarter of their unfished level. Biologically, the present results could form a basis for lobster stocking programmes, along several lines:

1. augmenting breeding stock and egg production in exisiting fisheries

2. increasing the actual catch or value of existing fisheries

3. creating new stock on suitable habitat not normally settled by natural juveniles

4. creating new stock on coastal defence structures and artificial reefs

5. ranching for profit on a 'put and take' basis

Some of these options could be undertaken as 'public good' operations, part funded by co-operatives, licensing, or by parallel revenue earning operations. They could also be adopted as a mitigating measure to compensate for other planned uses of the seabed.

Site selection is a critical part of any operation. It is essential to have habitat with suitable shelter, to consider how lobster larvae are likely to be transported to or from the area, and to assess whether any natural stock is sparse enough to make lobster stocking worthwhile.

Although lobster fisheries are usually small, the scale of activity involved needs to be fully appreciated. A typical coastal lobster fishery along 10 to 20 miles of coastline involves 10 to 20 lobstermen, each probably landing a minimum of 4 500 lobsters a year (say 150 fishing days x an average of 30 lb of lobsters a day). A restocking scheme therefore requires to augment a total annual catch of at least 45 000 lobsters per annum. Creating a new fishery of this size would be a very substantial long-term undertaking. A more tenable objective may be to add say 10% to the annual yield, a figure similar to the benefit expected from raising the minimum landing size by 5 mm.

From an economic viewpoint, scientific studies may not provide a realistic guide to future commercial possibilities. Designs being developed by MAFF Conwy and SFIA Ardtoe for a small two-man hatchery producing 10 000 to 15 000 lobsters twice a year could involve approximately £100 000 to set up, and about £20 000 to £40 000 per annum to run, depending on various operational factors, but these costs are based on starting from scratch. It may be possible to convert and run an existing hatchery much more cheaply. Again, at the present mid-season lobster price of £3.00 to £4.50 per legal sized animal, a financial appraisal suggests that to cover the above costs would need a 20 to 40 % recapture rate over 25 years, but such calculations are very sensitive to lobster price, production costs, and scale. Producing three times as many lobsters for the same investment and running costs, or less, would reduce the required recapture rate, or reduce the length of time required to break even. Clearly entrepreneurs will have their own views on these aspects. In the meantime, attempts are in progress by SFIA Ardtoe to release and recapture half-sized juveniles in order to decrease production costs, and results are awaited.

To prevent future benefits being dissipated by increased fishing effort it will be essential to manage access and harvesting effectively, and possibly in the long term to grant individual ownership rights.

Authorship and Credits

This leaflet was written by Dr Colin Bannister of the MAFF Directorate of Fisheries Research, Fisheries Laboratory, Lowestoft, with the assistance of MAFF colleagues, Dr Eric Edwards of the Shellfish Association of Great Britain, and additional material kindly provided by the other team leaders. Photographic material was supplied by MAFF, Southampton University Department of Oceanography (including Cover photograph), and SFIA Ardtoe.

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MAFF Directorate of Fisheries Research, Fisheries Laboratory, LOWESTOFT NR33 0HT.

Key References

History

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FURTHER INFORMATION

Lobster rearing, hatchery design and costs

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Coastal Defence Structures /Artificial Reefs

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Video Information:

A video is available entitled – Lobster Stock Enhancement Investigations 1983-1993 by J. F. Wickins, R. C. A. Bannister, T. W. Beard and A. Howard (1995). A video record of techniques used to rear, tag, release and monitor recaptures of hatchery-reared lobsters. Fish. Res. Video Rept., MAFF Direct. Fish. Res., Lowestoft. (1): 42 min.

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