Collaborative Fisheries Research Involving Commercial Fishing Fleets

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Abstract
This paper documents the history of collaborative research with commercial fishing fleets by scientists at the University Marine Biological Station Millport. A résumé of each of the contracts undertaken to date is given and the importance and relevance of such studies are discussed.

A History of Collaborative Research with Fishers at Millport
The University Marine Biological Station Millport (UMBSM) has traditionally enjoyed a good relationship with the local fishing fleet. Prior to the 1990s the level of collaboration was limited to requests to leave areas free from fishing for short periods whilst experiments were carried out, or occasional requests for material when the marine station research vessels, *RV Aora* and *RV Aplysia,* were not available.

Since the early 1990s, the Marine Station has been successful in the procurement of a series of European Commission-funded research projects variously under the management of Dr Jim Atkinson and Professor Geoff Moore, some of which are ongoing. Two of the initial projects (IMBC *et al*. 1994; Marrs *et al.*, 1996) concerned stock assessment of *Nephrops norvegicus.* This species, which has a variety of common names including scampi, Dublin Bay prawn, langustine and Norway lobster, is the main species fished in the Clyde Sea area (see Bailey, this volume).

It was whilst undertaking these initial contracts, that the staff at the Marine Station became aware that the best way to increase the credibility of the research being carried out at the Marine Station with the people with whom it was likely to have the greatest impact, i.e. fishers, was to directly involve the fishing fleet in the work.

Thus, the first contract to involve the commercial fishing fleet directly commenced in April 1997. This project investigated the fate of undersized *Nephrops* and 'heads' discarded from fishing vessels and was undertaken by Dr Sabine Wieczorek. Shortly after this, funding became available for two PhD projects concerned with fisheries research, from the bequest of the eminent Millport scientist, Dr Sheina Marshall. One studentship, awarded to Ms Melanie Bergmann, was closely aligned with the EC-funded project and studied the fate of incidentally caught non-target invertebrates discarded from *Nephrops* trawlers. The second studentship, awarded to Mr Jason Combes, was to study the biology and fisheries ecology of two crustacean species, the velvet swimming crab *Necora puber* and the squat lobster *Munida rugosa,* both of which have a relatively recent history of commercial exploitation. Extra financial support for this project was supplied by PESCA funding, facilitated by the Highlands Council, Highlands Enterprise and the West of Four Fishermen's Association. Jason worked further afield than the Clyde Sea, working with creel fishers in Skye, the Summer Isles and the Western Isles, as well as undertaking studies in local waters.

Following the successful collaboration between Sabine and Melanie and a few local *Nephrops* trawler skippers, a more vessel-intensive project was attempted which involved 20 trawlers from the fishing ports around the Clyde. Again funded by the European Commission, this project mapped the fishing effort and landings of the Clyde *Nephrops* fleet during 1998/99 with a view to improving the stock assessment of this species. A pilot study only, this project was very successful, and proved to be the most detailed study of its kind to have been completed in Europe to date. Further funding has been obtained from the EC to continue this work. This contract is ongoing (April 2000 - March 2002), and again involves 20 fishing vessels - 15 of which are new to the study. Both contracts were undertaken by Dr Sue Marrs, with technical support from Mr Tom Stevenson.

Two new projects have recently commenced relating to the *Ensis* or razor clam fishery, which has emerged over the last 3-5 years in Scotland. Dr Chris Hauton began an EC-funded contract in April 2000 and is investigating the impact and efficiency of hydraulic dredging for these molluscs. Working in conjunction with this study a PhD studentship, awarded to Ms Samantha Jones, is concerned with the ecology of *Ensis* spp. and the operation of the hand-picked fishery using SCUBA diving. Funding for this studentship comes from a variety of sources including Scottish development agencies and fisheries organisations. Both projects involve collaboration with commercial fishers.

Collaborative Research on the Clyde *Nephrops* Fishery
Due to the location of UMBSM, the Clyde *Nephrops* ground is one of the most extensively studied in Europe. With official landings in the region of 4,000 tonnes per annum, this small area provides approximately 7% of the world landings. Ninety-five percent of the *Nephrops* landed from the Clyde Sea area are caught using otter trawls (for an illustration of the gear see Coggan, this volume, Figure 1). During the trawling process non-target species and undersized *Nephrops,* known as discards, can also be caught.

Regular sampling on commercial trawlers during 1997-1998 provided the first assessment of the catch and discard composition from commercial *Nephrops* trawlers in the Clyde Sea area. Invertebrates represented up to 90% by volume of the discards with crustaceans (swimming crabs, squat lobsters) and echinoderms (starfish, brittlestars) being the most important groups. Trawling and sorting of the catch caused both physical damage and physiological stress. Invertebrate groups with protruding limbs such as brittle stars and some crustaceans were more prone to damage than those with hard protective shells such as hermit crabs or scallops. Although a significant number of animals may be alive when discarded, long-term (21 days) survival experiments revealed higher mortalities than previous shorter duration (5 day) studies had reported. All trawled brittlestars died within 2 weeks, whilst all hermit crabs and whelks survived. Physical injury increased mortality rates of swimming crabs and rendered starfish more susceptible to bacterial infection and subsequent death (Bergmann, in prep).

Discard utilisation experiments showed that discarded material was rapidly consumed by scavengers. Seabirds, if given a choice, would preferentially select roundfish (e.g. juvenile whiting, cod or herring) over crustacean discards. Although if offered singly, crustaceans would be eaten, particularly by juvenile seabirds. Observations at the seabed using SCUBA in shallow (<30m) water and underwater television with infra-red lights in deeper (40-110m) waters demonstrated that non-living discard material was consumed within 24-48 hours. Fast moving crab species were consistently recorded as the first to arrive with slower moving species, such as starfish and common whelks, arriving later. *Nephrops* were observed consuming discarded conspecifics and other species. There was no evidence of mid-water utilisation produced by this study, but the possibility cannot be rejected (Wieczorek *et al.*, 1999).

Landings from the *Nephrops* fishery are restricted by a Total Allowable Catch (TAC or quota) set by the European Commission for each stock, based on the size of the stock and previous levels of fishing effort. Current stock assessment techniques for *Nephrops* use methods that are based on length measurements, landings data and population characteristics such as growth rates and size of the animal at reproductive maturity. The techniques are applied to statistical rectangles of size 30km x 30km and are considered to work well for stocks that are uniform at this scale. The Clyde Sea area, however, has complex sedimentology. Differences in the sediments in which *Nephrops* burrow has been shown by earlier studies to correlate with differences in the growth of *Nephrops* (Tuck *et al.*, 1997). It may be more appropriate to relate the stock assessment to sediment type rather than arbitrary squares; however, official landings data are at best only allocated to statistical squares.

The effort mapping projects use satellite-based position data loggers that record latitude and longitude every ten minutes. These loggers were fitted to 20 vessels operating around the Clyde during 1998 - 1999. Using the output from the loggers, the location of trawling was accurately mapped for 18 of these vessels. Complimentary landings logbooks were filled out by the skippers and daily landings could be accurately allocated to trawl position. Total landings from these vessels accounted for *ca* 20% of the total landings for the entire fleet. Landings from the participating vessels were scaled to the whole fleet and these data were used to run standard stock assessments relating the landings to sediment type. The ability to apply more appropriate growth parameters to the landings data should produce a more accurate stock assessment and provides more detailed information on the state of exploitation of the stock (Marrs *et al.*, 2000). A second survey is ongoing, this time also including vessels that operate to the west of the Kintyre Peninsula.

Studies on New and Emerging Fisheries

As well as detailed investigations into an established fishery, UMBSM has been aware of recent trends in the fishing industry and has taken steps to provide baseline data where none is available. The velvet swimming crab creel fishery is regulated; however, there is little information on the biology of the species in Scotland. The squat lobster fishery is still, as yet, in its infancy and is unregulated. Data on fishing effort and landings of both these species are being collated from a combination of fishers logbooks, producer organisation records and fishery office returns. Biological parameters including, growth, moulting, natural mortality and fecundity have been investigated, and a large-scale tagging programme has provided data on migration, sex ratios and recruitment. Data analyses are still underway, but when completed, these results will form a basis for future stock assessments (Combes, in prep).

The most recent fishery to be investigated by UMBSM scientists is that of the razor clams. There is currently very little baseline biological data to underpin regulation of the fishery for *Ensis* species. This, has led to concerns being expressed at both local and international levels over the sustainability and impact of the fishery.

Although both projects in relation to the razor clam fishery are very much in the preliminary stages, investigations into the basic biology of razor clams are underway with special reference to geographical trends in spawning and recruitment. To ensure a wide relevance to the Scottish fishery the population biology project is working with the assistance of commercial razor clam divers in the Clyde Sea area, the Highlands and Islands and the Western Isles. The hydraulic dredging project is, with co-operation of commercial fishers, investigating the types of gear used, their efficiency for the target species and the potential impacts, on both the target species and the environment. Collaborative work with local fishers, who are developing new dredge designs aimed at reducing the impact of this fishery on the environment, are also being carried out. The combined results of both studies will ultimately generate management recommendations with which to provide a framework for the future regulation of this fishery.

The Relevance of Collaborative Research

Whilst such collaborative projects with fishing fleets provide a wealth of information that hitherto has not been available, it is essential that the results are brought to the attention of fisheries managers. In Scotland, much of the scientific and technical advice for fisheries management is supplied to the Scottish Executive by the Marine Laboratory in Aberdeen (MLA). MLA has been involved to a varying degree in all the collaborative fisheries research undertaken at UMBSM to date. As well as ensuring that the results of research studies may be integrated into actual management processes, the involvement of MLA gives UMBSM access to a wide range of technical expertise and equipment.

Communication with the fishers themselves is of vital importance to the success of these collaborative projects. To this end, fishers participating in research projects are provided with feedback on the data that either they have supplied, or that has been collected by scientists on board their vessels. To fuel the communication link between local fishers and scientists at UMBSM, an open day for the local fishing fleet was held in February 1999, showing the products of some 20 years of fisheries related research. Following the success of this meeting a second open day has been requested by the local fishers and will take place in the near future.

It is clear from the above that UMBSM is deeply committed to research that is of practical relevance to local fisheries. We see great strength emerging in partnership between scientists and fishers to the benefit of all concerned. The pressure is forming now for local management of fished resources and it is only with the involvement of all concerned parties at grass-roots level in decision making that sensible working solutions to fisheries management problems will emerge (Moore, 1999).

References

Bergmann, M. (in prep) *The fate of discarded invertebrates from the Clyde Nephrops fishery.* PhD thesis, University of London.

Coggan, R. (2000) Environmental effects of fishing and evaluation of methods for the rapid assessments of the impact of otter trawls. This volume.

Combes, J.C.H. (in prep) *The biology and fisheries ecology of the velvet swimming crab,* Necora puber *(L.), and the squat lobster,* Munida rugosa *(Fabricus), (Crustacea: Decapoda) in Scottish waters.* PhD thesis, University of London.

IBMC, UMBSM & IRPEM (1994) Nephrops norvegicus: *Stock variability and assessment in relation to fishing pressure and environmental factors.* Final report to the European Commission. Contract XIV.1/MED/91/003, 84pp + figures and appendices.

Marrs, S.J., Atkinson, R.J.A., Smith, C.J. & Hills, J.M. (1997) *Calibration of the towed underwater TV technique for use in stock assessment of* Nephrops norvegicus. Final report to the European Commission. Reference 94/069. 155pp.

Marrs, S.J., Tuck, I.D., Arneri, E., Atkinson, R.J.A., Santojanni, A. & Stevenson, T.D.I. (2000) *Improvement of* Nephrops *stock assessment by use of micro-scale mapping of effort and landings.* Final report to the European Commission. Reference 97/0100. 202pp.

Moore, P.G. (1999) Fisheries exploitation and marine habitat conservation: a strategy for rational coexistence. Aquatic Conservation: Marine and Freshwater Ecosystems. **9**:585-591.

Tuck, I.D., Chapman, C.J. & Atkinson, R.J.A. (1997) Population biology of the Norway lobster, *Nephrops norvegicus* (L.) in the Firth of Clyde, Scotland - I: growth and density. *ICES Journal of Marine Science,* **54**, 125-135.

Wieczorek, S.K., Campagnuolo, S., Moore, P.G., Froglia, C., Atkinson, R.J.A., Gramitto, E.M. & Bailey, N. (1999) *The composition and fate of discards from* Nephrops *trawling in Scottish and Italian waters.* Final Report to the European Commission. Reference 96/092, 323pp.