# Procedural Guideline No. 4-2 Recording benthic and demersal fish in dense vegetative cover

Thomas A. Wilding, Robin N. Gibson and Martin D.J. Sayer,
Dunstaffnage Marine Laboratory[1]

## Background

In temperate marine waters seagrass (*Zostera* spp.) meadows and kelp (*Laminaria* spp.) forests commonly form dense stands of vegetation. The importance of seagrass beds as nursery areas for fish is widely accepted although exceptions are reported (Jenkins and Wheatley 1998 and references therein). Kelps commonly dominate hard substrata, in both sheltered and exposed locations. They are found from the intertidal zone down to 30m (although kelp forests are generally found in shallower water) and, as such, form an important part of many marine biotopes. Sampling in dense vegetation is technically difficult (Kuslan 1984) and should only be undertaken when an assessment of the fish population in the vegetation is specifically required. If alternatives are available they are to be recommended, for example, an estimate of fish abundance within dense vegetation can be made by sampling fish outside the vegetated zone (Baelde 1990). If the kelp density does not preclude the use of divers or traps then these techniques should be used as discussed in Procedural Guideline No. 4-1 'Sampling benthic and demersal fish populations in subtidal rock habitats'. Additional methods for sampling fish specifically within kelp or other dense algal communities are not widely reported in the literature and for this reason only one method is described here.

Two spot gobies (*Gobiusculus flavescens* (Fabricus)) are commonly found among dense vegetation but move into shallow (intertidal) areas during summer. Also frequent are the territorial species goldsinny (*Ctenolabrus rupestris* (L.)) and corkwing (*Crenilabrus melops* (L.)). Three- and fifteen- spined sticklebacks (*Gasterosteus aculeatus* (L.) and *Spinachia spinachia* (L.) respectively) may also be found.

## Purpose

To provide as accurate an estimate as possible of the abundance, species richness and age structure of fishes found in densely vegetated environments.

### Applicable to the following attributes

Sampling fish populations will be appropriate for attributes concerning biotope quality in terms of species richness and the abundance of species and for detecting whether areas of impact away from point sources are expanding or contracting. Generic attributes are:

- Measure the species richness in the biotope and/or abundance of key species (rare, fragile, declining, representative) in biotopes.
- Measure the quantity of particular species of conservation importance (rare, fragile, declining species – those for which the site is 'special').

Also applicable to the following baseline survey objectives:

- Establish/re-establish the species which are present in biotopes at a site including their abundance and biomass within statistical limits.

1 P.O. Box 3, Oban, Argyll, PA34 4AD.

- Establish the species present in biotopes and their density within defined statistical limits.
- Establish/re-establish the species which are present along a gradient of change away from a point source of disturbance including their abundance and biomass within statistical limits.

# Methods

Four methods of sampling are described: three for sampling in seagrass (Floorless pop net, Beach seine and Others) and one for sampling in dense kelp forests (Stipe removal and analysis).

## Floorless pop net

These simple systems offer an excellent method of trapping fish within a well-defined area. They consist of a buoyant net curtain which, when released, rises from the substratum trapping fish. Fish caught can be collected using a small seine (described below) or hand net. Hand netting may be easier if used in conjunction with the anaesthetic quinaldine (see Procedural Guideline No. 4-4 'Sampling fish in rock pools').

### *Equipment*

- 25mm diameter PVC pipe
- netting; 25m x max. water depth of sampling site, mesh size 1mm
- ballast (chain and concrete blocks)
- wire or rope
- plastic buckets
- protective clothing (gloves, waders, oilskins, etc.)

### *Personnel*

At least two staff to deploy and trigger the net.

### *Technique*

Connolly (1994) describes the following method. Using 25mm diameter PVC pipe make a square covering an area of $25m^2$. Ensure all joints are sealed. Attach a 1.4m high fibreglass net of 1mm mesh size to the pipe. At the bottom of the net attach ballast (a light chain may be suitable). In the field stake and push the bottom of the net into the substratum and neatly concertina the net under the pipe. Push the pipe down until it is flush with the substratum (or as near as practically possible). Rest concrete blocks over the pipe and leave for one tidal cycle. The objective is to make the pop net as inconspicuous as possible, thereby reducing the effect of the gear on any subsequent fish catches. On the following high tide, and using 10m long wires attached to the concrete blocks, simultaneously pull all the blocks off the buoyant pipe. The buoyant pipe then lifts the net off the substratum and traps any fish within its boundaries. A similar but smaller trap ($9.3m^2$) has been described in Serafy *et al.* (1988) and would be particularly useful where ease and speed of construction is of paramount importance. In both the above examples fish trapped in the pop-net were removed by wading out to the net and using a small seine net. Connolly (1994) removed the fish immediately after the release of the pop net while Serafy *et al.* (1988) removed the vegetation prior to fishing with the seine net. If used in deep water, the trapped fish could be collected by SCUBA diver with or without the assistance of the anaesthetic quinaldine (see Sayer *et al.* 1994 for description of the underwater use of quinaldine).

### *Cost and time*

Net construction may take several days. Intertidal deployment is rapid. Serafy *et al.* (1988) indicate 15 minutes each for deployment, vegetation removal and fish collection. This method is relatively cost-effective, especially if a home-made device can be manufactured.

### *Advantages*

- high accuracy (most fish are confined by the rising net)

### *Disadvantages*

- has only been tried in relatively shallow water (1–2m)
- may be necessary to remove vegetation prior to fish collection

## Beach seine

Seine nets consist of a wall of netting weighted at the bottom and provided with floats at the top. They can vary in length from over 100m to less than 10m. The mesh size usually decreases from the wings towards the centre of the net, which is sometimes extended into a bag to assist retention of the fish. Efficiency has been shown to vary with species, fish behaviour, fish size and the bottom type (Gibson 1999). Seines perform optimally in areas with flat, smooth substrata containing no obstacles. Samples are best taken at low tide because at this time tidal migrants are concentrated at lower levels on the beach and the net will also sample those species that do not migrate intertidally.

### *Equipment*

- seine net (Bridport Gundry, Bridport, Dorset)
- boat
- board for carrying and shooting the net
- measuring board/scales
- plastic buckets
- protective clothing (rubber gloves, waders, oilskins, etc.)

### *Personnel*

At least two staff depending on net size and deployment method

### *Technique*

Attach one length of rope to a weighted wooden pole attached to each end of the seine net and fold the net neatly onto a flat board. Secure one end of the rope to the shore (normally held by an assistant) and place the board and net in the bows if using a powered boat or in the stern if using a rowing boat. Ensure the net will run out smoothly from the boat. Propel the boat away from the shore paying out the rope behind it. When the length of rope has been paid out, turn the boat parallel to the shore and deploy one end of the net. Moving slowly parallel to the shore deploy the rest of the net. Once the full length of the net is deployed turn 90 degrees and return to the shore trailing the other length of rope. The net and rope should delineate a rectangle. If no boat is available, the net can be deployed by hand by wading out to a suitable depth and deploying the net from a board or large bin. Once set, slowly pull the ropes in and recover the net, the midpoint of which will be last to be drawn ashore and will contain most of the captured fish. During hauling the people pulling on the ropes should move gradually towards one another, slowly closing the net. It is essential that the weighted footrope stays on the bottom at all times and precedes or stays level with the head rope during hauling. Once the net begins to come ashore, and assuming four people are available, two should keep the footrope close to the ground whilst the others pull in the head rope. If only two people are available and to ensure the footrope stays close to the bottom the net should be pulled up the beach until it is completely out of the water. The length of rope and the net length determine the area swept. The area covered by a beach seine net can be calculated by following the procedure given by Kubecka and Bohm (1991) and Ross *et al.* (1987) which, together with estimates of efficiency (Kjelson and Colby 1976; Pierce *et al.* 1990; Ross *et al.* 1987; Weinstein and Davis 1980) can be used in the calculation of absolute fish densities. To increase efficiency in seagrass the footrope can be made extra heavy (Jenkins *et al.* 1997); accurately delineating the seine netting area can be achieved by fishing between poles placed in the substratum (Ferrell and Bell 1991).

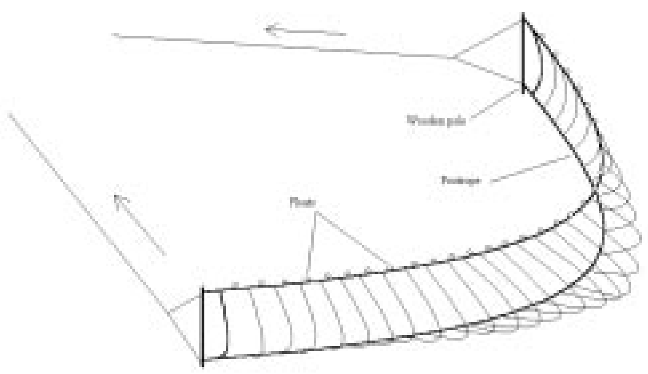

**Figure 1** Seine net during hauling

### *Cost and time*

The time required for one haul depends on the size of the net and the presence of weed fragments or obstructions on the bottom and the speed of any currents. As a rough guide, a net of 40m can deployed and recovered within 15 minutes. A 40m beach seine costs about £200 excluding the ropes for hauling. The cost of this sampling technique can be reduced when the requirement for a boat can be avoided.

### *Advantages*

- easy to operate
- faster and cheaper than a pop net (Connolly 1994)

### *Disadvantages*

- less efficient than a pop-net (Connolly 1994)
- difficult to deploy in rough conditions

## Other methods

The following methods have also been used to sample in seagrass beds but are not conventional or described in detail.

| *Technique* | *Notes* | *Reference* |
|---|---|---|
| SCUBA survey | Likely to be inefficient over dense vegetation | Jansson et al. 1985; Isaksson and Pihl 1992 |
| Drop nets | Used in the USA to sample small areas (1m2): a rather elaborate technique | Fonseca et al. 1990; Fonseca et al. 1996 |
| Gill net | A destructive technique with potential mammalian and avian by-catch problems | Pihl et al. 1994; Sogard et al. 1989 |

## Stipe removal and analysis

This technique is described by Gordon (1983) and relies on the close association that some fish species have with the bulbous holdfasts of the laminarian group of seaweeds.

### *Equipment*

- plastic/net bags
- plastic buckets
- protective clothing (boots, gloves, oilskins, etc.)

### *Personnel*

Diving unit (comprising at least three qualified divers)

### *Technique*

Divers should identify a suitable plant and carefully cut the stipe about 45cm above the holdfast. Disturbance should be minimised wherever possible. The holdfast should then be eased off the rock using a knife. As quickly as possible after removal, the holdfast should be placed inside a plastic or mesh bag and a tight knot (or cable tie) used to seal the bag around the stipe. Once the sampling has been completed all the stipes can be returned to the surface. Once on the surface the holdfast should be cut up and any fish removed. These can be measured and returned or preserved for further analysis depending on the experimental protocol.

### *Cost and time*

Each holdfast should take 5–10 minutes to bag. The total survey time will depend on the number of samples required. Laboratory work duration will depend on the experimental protocol. Costs per sampling effort can be quite high as a result of the requirement for divers (up to £500 per dive at the time of writing).

### *Advantages*

- ease of collection

### *Disadvantages*

- only samples fish that live in kelp holdfasts

## Accuracy testing

Where appropriate and where known, methods of assessing sampling accuracy are either outlined or referenced in the description of methods given above or in QA/QC (see below).

## QA/QC

High natural variability and the problems of observation and capture efficiency mean that standardisation of the techniques used to assess a fish population is essential if other sources of variation are to be minimised. Quality assurance depends on the technique chosen (see advantages and disadvantages). However, in general terms apparent changes in abundance may simply be caused by a change in catchability (Beja 1995; Costello *et al.* 1995; *Sayer et al.* 1994; Sayer *et al.* 1996) or by movements into or out of the sampling area (Allen *et al.* 1992; Claridge *et al.* 1986; Gibson *et al.* 1993; Ross *et al.* 1987). It is, therefore, difficult to link cause and effect unless extensive background data on the behaviour of the fish species of interest are available or intensive surveys with control sites and sufficient replication can be carried out (Barber *et al.* 1995). The techniques described in this section are well suited to detect inter-annual changes because direct comparisons between years are valid when all other factors associated with sampling are standardised. To reduce experimental error and to make the survey as easy and meaningful as possible the following are recommended:

- Choose well-researched common species and familiarise the survey team with the chosen species' behaviour and ecology.
- Utilise survey methods that are simple, that can be undertaken routinely and where access to the sampling site is easy and reliable.
- Standardise the date and time when the survey is carried out. When annual trends are being investigated carry out the survey as nearly as possible on the same date. More importantly, surveys must be undertaken at the same state of the tide (low tide is preferable) and equivalent point in the diel cycle rather than at a specific time. Dusk, for example, may be at 16.00 in winter but 21.00 in summer. Diving surveys are best undertaken during neap tides because tidal currents are weaker and their influence on fish behaviour may, therefore, be reduced .
- Practise the survey technique (new staff should be trained on 'dummy' sites). Identification skills can be tested using photographs or preserved specimens and, if estimating size visually, using fish models of known length.
- Use, wherever possible, the same survey teams. This is particularly important when conducting visual surveys and manual searches which involve considerable skill.
- Maintain skill continuity during personnel changes by training all members of the survey team in every aspect of the survey technique.
- If spurious results are suspected be prepared to check the fishing gear (if relevant) and possibly repeat the survey. Repeat surveys on successive days to get an indication of day-to-day variability and incorporate these data in any statistical analysis.
- Expect large variation in fish abundance. Where assessing inter-annual variability a minimum of three years data is required.

## Data analysis and products

Survey work will normally generate data on species, abundance and size. Analysis will depend on the experimental protocol and should be analysed using standard statistical techniques (Sokal and Rohlf 1995). Fish populations show high inter-annual variability and this must be considered before drawing conclusions regarding cause and effect. Prior to the survey, and depending on the survey objectives, it is advisable to measure the variability of the factors of interest. Carrying out surveys on successive days gives an indication of the reliability of the survey data and these data can be used to predict the number of surveys that will be required to show significant changes (Chapter 9 in Sokal and Rohlf 1995). Comparisons of abundance between species should always take into account their differing catchabilities. If the results of the survey show a significant change in fish population this may be due entirely to natural causes (Collette 1986; Henderson 1989; Rogers and Millner 1996). Where significant fish population changes have been shown and a cause postulated, it is recommended that additional tests be carried out, the nature of which will depend on the postulated cause. Where pollution is suspected as a significant factor the relevant authorities should be contacted (Environment Agency (England and Wales) or the Scottish Environment Protection Agency).

## Health and safety

The primary rule in any fieldwork is Never Work Alone. When working in areas covered in seaweed care should be taken to avoid slipping. Unusually large waves can catch the unwary when working near the tide line; waders can become swamped, making escape very difficult and increasing the chance of an accident. Quinaldine is unpleasant to handle and, when in use, the guidelines given in the Control of Substances Hazardous to Health (CoSHH) hazard data sheet should be followed.

Members of staff employed to undertake diving survey work must be suitably qualified and obey the rules and regulations as stipulated by the Health and Safety at Work Regulations (Dean *et al.* 1997). In addition, individual organisation codes of conduct relating to fieldwork must be adhered to and, where employing external diving contractors to undertake diving work, your organisation will have considerable responsibilities as the diving contractor.

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