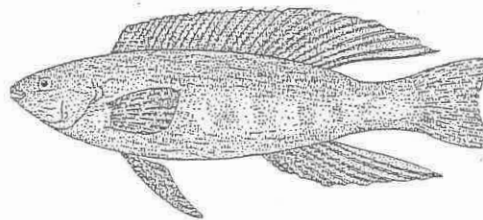
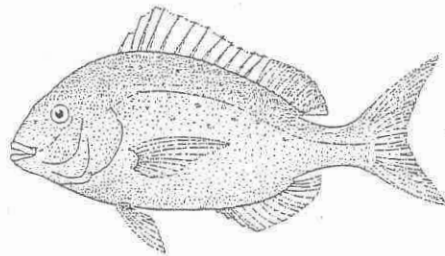
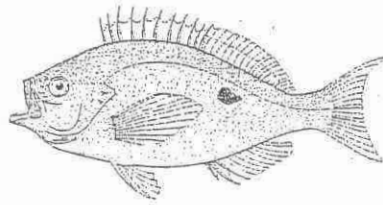


A Community Guide to Monitoring Reef-fish Populations



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For the Ministry of Fisheries

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1. Why Monitor?

The state of kaimoana stocks in particular areas of customary or special usage is at present a pressing issue for most, if not all, coastal hapu and coastal communities generally. There are concerns about the apparent decline in number and size of most reef species available to meet day-to-day and special needs (e.g. tangi and hui). Reef fish are valued kaimoana and their availability in part supports the mana of the local hapu and generally that of iwi.

Precise and reliable information about the state of these stocks, how they vary over time and how they compare to adjacent stocks, perhaps under some other management regime, is a powerful tool in making management decisions or persuading others that some management decision is necessary.

Within a community there is often a lot of anecdotal information about where reef fish were fished, how many were taken and what methods were used to capture them. Some of this information may be in the form of fishing diaries, photographs or simply memories of the older kaumatua. They are all valuable and help to define how things used to be. A well-designed and established monitoring programme will compliment these other sources of information and will enable trends in the abundance or size composition of reef fish populations to be determined. This manual documents sampling techniques that can be used to monitor reef fish populations and generate the information necessary to promote the best informed management option and convince others that the reasoning and evidence is sound.

The techniques described are straight-forward in operation and within the capability of a well-organised and motivated community. However, this is not to diminish the demands of the task. Working in or on the sea is never an easy task given the changeable weather, the bewildering array of species, the often poor underwater visibility and the difficulties and dangers of working underwater.

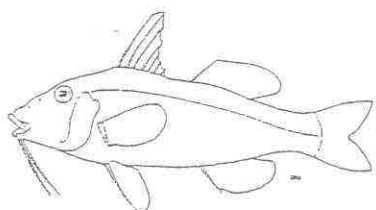
2. What is a Coastal Reef-Fish?

What is a reef-fish?

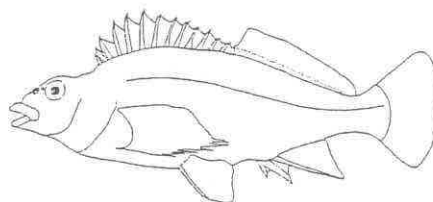
A reef-fish is simply one that is associated with coastal rocky reefs. This association may be temporary and short-term as for tarakihi and trevally or it may be a permanent feature of the fish's life and an individual may spend all its life associated with a particular reef as do red moki. About twenty species of food fish are typically found closely associated with reefs around New Zealand shores and another ten or so species are sometimes caught from these areas.

Reef fish identification

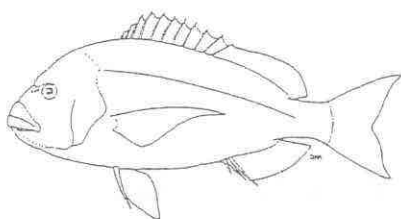
Outlined here are the profiles of many reef fishes used for food. There are some excellent books on New Zealand reef fish identification and these should be consulted if a fish species cannot readily be identified (see Box 1).



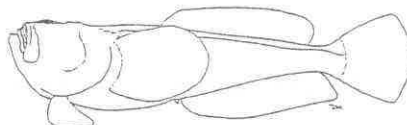
Goatfish



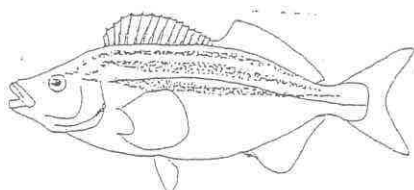
Hiwihiwi



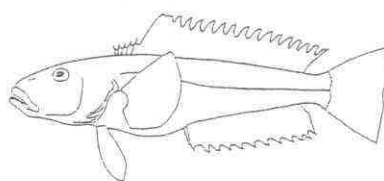
Snapper



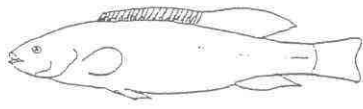
Stargazer



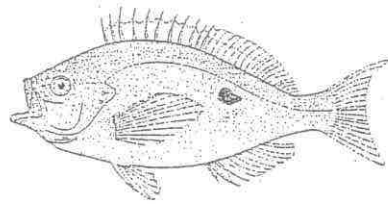
Trumpeter



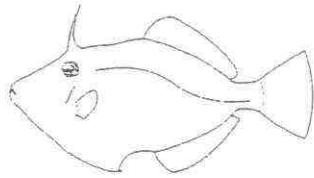
Blue cod



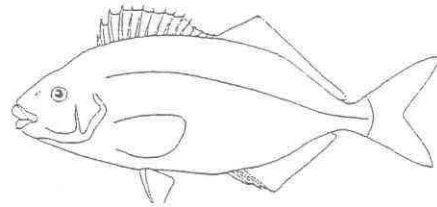
Butterfish



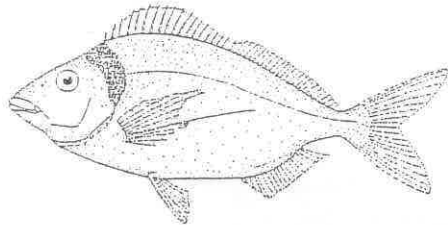
Butterfly perch



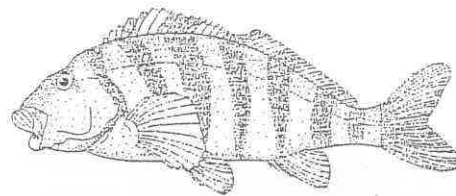
Leatherjacket



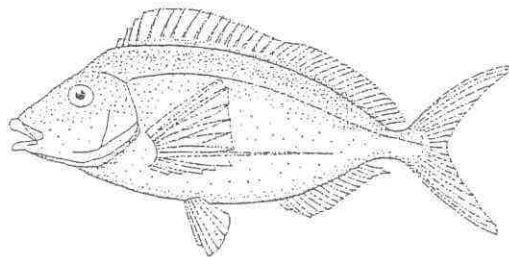
Blue moki



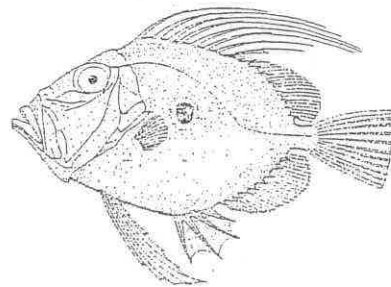
Tarakihi



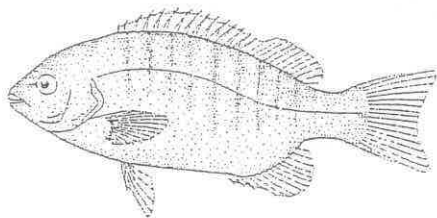
Red moki



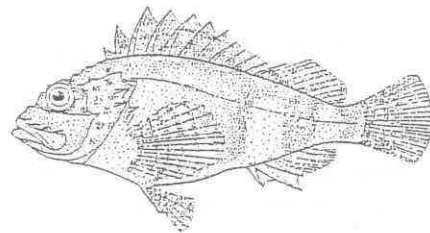
Poraе



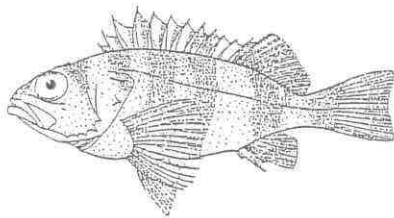
John Dory



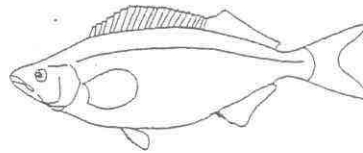
Parore



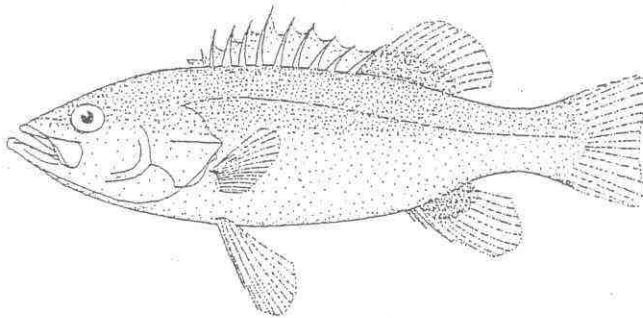
Scorpionfish



Sea Perch
or Jock Stewart



Telescope fish



Hapuku or Groper

Box 1 Books about New Zealand Reef Fishes

There are some excellent books in libraries and on the market that will help you identify reef fishes. Some have good quality colour photographs which are invaluable when learning to recognise fish underwater.

Collins guide to the seafishes of New Zealand by T. Ayling & G. J. Cox (1982). Collins, Auckland. 343 pp.

Fishes of the New Zealand region by W. Doak (1978). Hodder and Stoughton, Auckland. 135 pp.

Francis, M. 2001: Coastal fishes of New Zealand: An identification guide by M. Francis. Third edition. Reed Publishing, Auckland. 103 p.

New Zealand fishes. Identification, natural history & fisheries by L. Paul (2000). Reed Books, Auckland. 253 p.

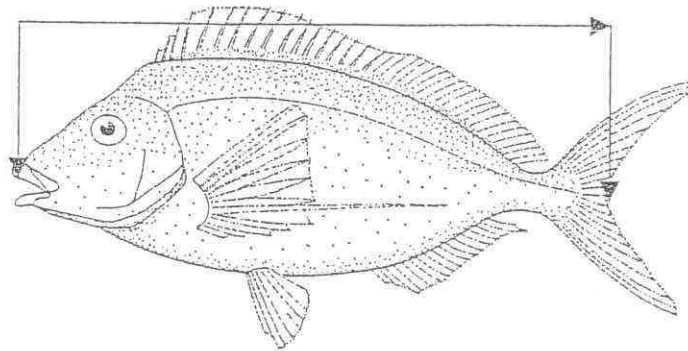
Marine fishes of New Zealand 1. Shorelines and shallow seas by L. Paul and E. Heath (1997). Mobil New Zealand Nature Series, Reed Books, Auckland. 118 p.

Marine fishes of New Zealand 2. Deeper coastal and ocean waters by L. Paul and E. Heath (1997). Mobil New Zealand Nature Series, Reed Books, Auckland. 109 p.

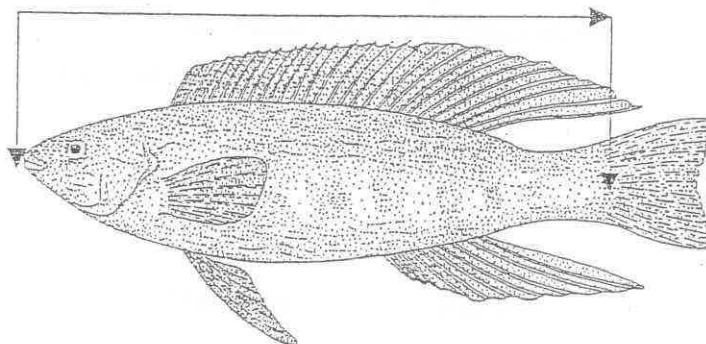
New Zealand fish: a complete guide by C. Paulin, A. Stewart, C. Roberts, & P. McMillan, (2001). Te Papa Press, 279 pp.

How to measure fish

Length is most easily measured on a fish measuring board one of which is provided in the field kit. Basically it is a wooden or metal rule inset into a wider board with an upright stock set at zero against which the fish's snout can be placed. The length is then measured off on the rule at the fish's tail. Because the tail fin is soft and friable and may be torn or broken fish are not normally measured to the tip of their tails. In fish with a deeply forked tail like porae, length is measured to the V of the tail. These should be recorded as fork length or FL. However, on fish with rounded or only slightly forked tails like butterfish, the length should be measured to the end of the backbone. This is known as the standard length (SL). The end of the backbone can be easily seen by lifting the tail slightly once the fish is on the measuring board until a crease-line forms indicating the end of the backbone. With practice this becomes routine.



Fork length



Standard length

3. New Zealand Fisheries for Reef-fish

Everywhere they occur, reef-fish support valuable recreational and customary fisheries. For some species the commercial fishery is small (e.g. butterfly) or non-existent (e.g. parore) while others support substantial commercial fisheries (e.g. snapper). In New Zealand several reef-fish species are managed under the Quota Management System (QMS) as Individual Transferable Quota (ITQ). These species include snapper, tarakihi, butterfly, stargazers, trumpeter, blue cod, groper, john dory, sea perch, blue moki, blue warehou and trevally. Others are being introduced over the period 2002-2005.

Setting the commercial catch level

The commercial quota able to be caught each year within a number of quota management areas (QMA's) around New Zealand is set through an exhaustive process which starts with the various stock assessment working groups. These groups comprise officials from Ministry of Fisheries, fisheries scientists and representatives of the fishing industry, recreational fishers, Maori and conservation groups. This is an open process that any individual or group can attend if they have something factual to contribute to the stock assessment process. This is not a venue for discussion or argument about allocation. Contact the convenor of the Inshore Stock Assessment Working Group at the Ministry of Fisheries in Wellington if you wish to participate. The working groups hold a series of meetings in Wellington starting in January to determine the present state of the stocks and how much should be set aside for commercial fishing. To do this, estimates are first made of recreational, customary and illegal catch in each QMA but often these are poorly known. If you have information that would help decide these levels then the working group will be happy to see your evidence or hear from you in person. Much of the discussion tends to be highly technical but don't let that put you off.

The stock assessment process culminates in a plenary session in mid year where the evidence and conclusions are presented to a wide group of stakeholders. Discussion is encouraged. This information is ultimately presented to the Minister of

Fisheries who then makes the final decision regarding allocation of commercial quota for the subsequent fishing year

Recreational Fishing Regulations

There are limits to the size and state and daily bag limit of reef-fish that recreational fishers can catch and these vary among northern, central and southern areas of New Zealand. In addition, in some areas, e.g. in the Marlborough Sounds there are further special restrictions. These are described in detail on the Ministry of Fisheries web pages (see <http://www.fish.govt.nz/>).

Customary Fishing Regulations

The regulations covering customary fishing are complex, differ between North and South Island and in some cases are still under development. Check the Ministry of Fisheries web site at <http://www.fish.govt.nz/customary/index.html> to obtain the latest information.

Box 2**Obtaining permits**

If your assessment methods mean that you will be catching and handling undersize reef-fish or more than the legal limit then you may be able to obtain a Customary Fishing Authorisation or a special research permit from the Ministry of Fisheries. They will inform you of the specific information required for the applications but generally you will need to include:

- Why the sampling is taking place
- The date sampling is to take place
- Who will be doing the sampling
- The area sampling is to take place
- The number of fish (approx) to be taken
- The method to be used (e.g. line fishing or trapping)
- Any other conditions (e.g. that any fish collected in reasonable condition be returned to the water)

It is important to emphasise to all participants in the programme that if the work is being conducted using a special permit **no fish can be collected**, they must all be returned to the water. The days you choose to carry out your sampling must be strictly confined to collecting data for the monitoring programme; harvesting must be left until another day. Ring your local Compliance Office of the Ministry of Fisheries in advance and let them know when and where you are planning to sample. Also, if you are sampling in a public site, where other recreational beach users may be present, it is a good idea to put signs up on the beach indicating that a survey is in progress. This should avoid people getting the wrong impression when seeing divers in known fishing areas.

4. How Does a Monitoring Programme Work?

It is usually impossible to survey an entire area, or count every individual animal; therefore we take samples of the population which are representative (typical) of the whole population. A one-off survey of reef-fish stocks in an area using this sampling approach will enable you to estimate their abundance and size distribution. By repeating this survey on a regular basis, questions about whether the stock is declining or increasing in size can also be answered. This information alone will not tell you the reason for the change; you won't know whether it is your management that is having an effect, or whether the fishery as a whole is improving.

If you need to know why your population is changing it is important to also collect comparable information at control sites from outside the area of direct concern. Doing this will enable you to distinguish between the impact of any local management decision and regional trends in the abundance of reef-fish. For instance, imagine you introduced a rahui or closure for a species of reef-fish within part of a taiapure, carried out a number of annual surveys within this area only and found an increasing trend in fish abundance. However, unbeknown to you, natural events meant that generally within the larger region very high settlement of juvenile larvae resulted in increasing abundance of the particular reef-fish species. Because you did not sample outside the rahui area you could not distinguish between the effects of your management actions and the natural increase in abundance. In these circumstances you might incorrectly conclude that the rahui had a great effect whereas in fact most of the increase may have occurred naturally.

As a rule of thumb plan to collect at least half your information from control sites. It is better to have numerous control sites rather than just one, but take care that they have similar habitat or bottom type as your area of principal concern. If there is an area of zero exploitation (e.g. a marine reserve or cableway) in your general area then you may gain permission from the Department of Conservation to sample in this area as well. Doing this could indicate what the population response in your area might be when the effects of fishing are removed.

5. Objectives of Your Monitoring Programme

This is the most crucial part of your programme as it defines how and what you do and why you want to do it. You must establish very clearly what question or questions your monitoring programme is going to answer.

- Is it to determine what species of reef-fish occur in an area?
- Is it to determine year by year trends in abundance and average size of specific reef fish species?
- Do you want to determine if the numbers and sizes of fish in an area are changing more than in similar nearby areas?

These are the most basic parts of a population monitoring programme and all other questions, perhaps about growth rates of particular species, merely build or expand upon it. If this part of the monitoring programme is planned and achieved well then a very useful body of information will build up. The different methods described in the following sections suit some species more than others, so you need to be clear about which species are of interest, choose the most appropriate method to sample it (or them) and stick with the same approach until the question has been answered.

Part of the process of defining your questions is to also define your area or the population of interest.

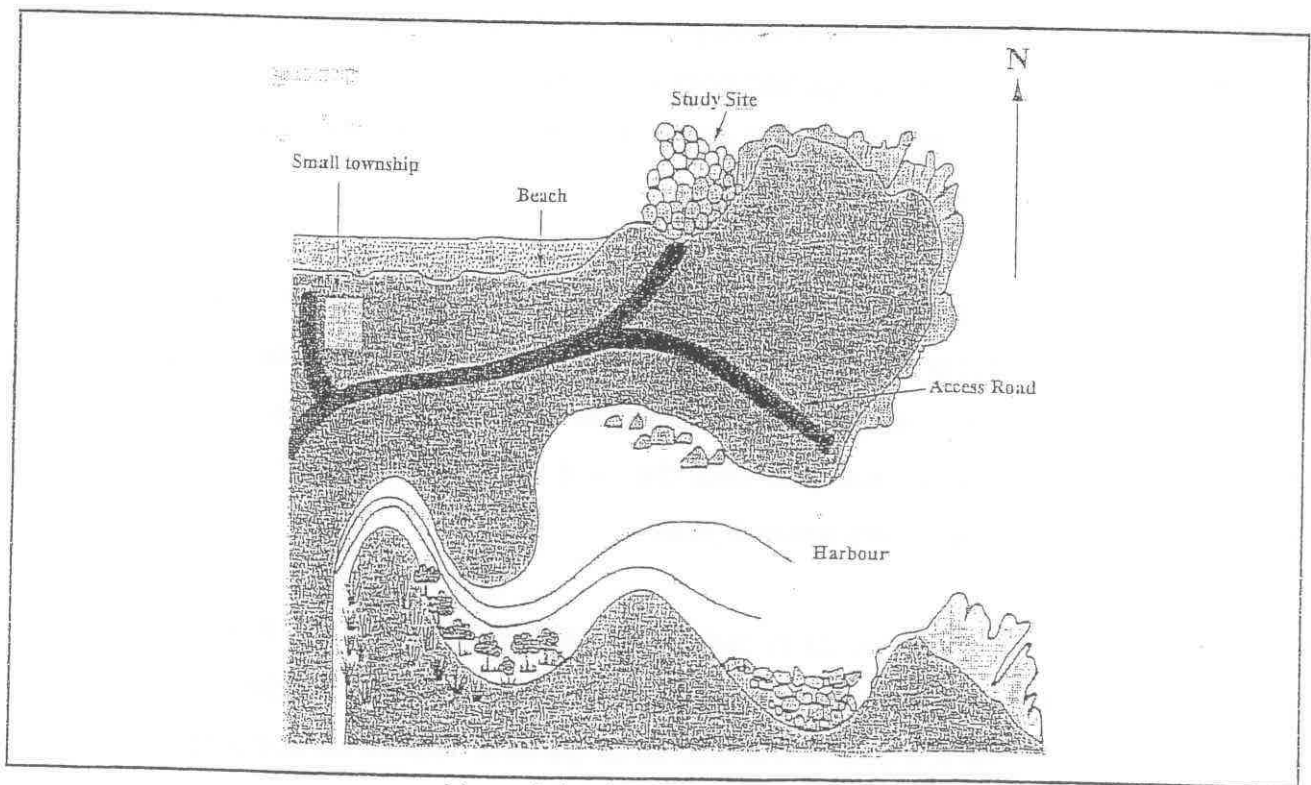
- Is it the population of a reef fish species within the whole or just part of a taia pure for instance?
- Are reef fish at all depths of interest or are you only interested in those within diving depths (less than 30m or 100 feet water depth)?

Make sure you allow enough time and discussion to establish your objectives and ensure they are clearly recorded well before the monitoring programme starts. You may wish to bring in some external help from a professional scientist at this stage.

6. Getting Started

Getting to know your coastline

You may already have an idea of the distribution of reef-fish along the coastline in your region. It is useful to draw a map of your coastline, marking on it areas of particular importance. For example, high harvest areas, popular fishing spots, river entry points, point sources for pollution and the types of land use that occur around your coastline (e.g. farming or forestry). A map provides a useful visual representation of your coastline and will help you to brief the sampling team and people who are not familiar with your area. In addition, after you have collected your data, you can use this map to illustrate the density of reef-fish at certain areas of the coastline. You may be able to obtain an aerial photograph of your study area. If this is taken at low tide on a day with no swell and good underwater visibility you may be able to distinguish areas of different underwater bottom type to depths of about 10 m. Contact an aerial photographic company to do this for you. You may need to have a standing order with them to do a fly over and obtain the shots when conditions are perfect. Alternatively, your regional council or Land Information New Zealand or Terralink may already have such photographs in their files. Try them first.



Map of the local coastal area

Getting your community involved

There are several groups of people whom you may want or need to contact before getting started. These include people from local hapu and iwi, recreational fishers, local residents, regional council representatives, fisheries representatives and local businesses (sponsorship). Also, talk to the people in your community whom you know are interested in the health of local fish stocks. These people may be interested in helping out on the sampling days. It is a good idea to find someone who is good with numbers, or owns a computer, to collate and present the data in a graphical form. Some of the survey methods used in this monitoring programme are carried out using SCUBA. Therefore, you need at least two experienced divers. If you do not have experienced divers in your community you may be able to get help from members of local dive clubs or other organisations that work in the marine environment (e.g. Universities, polytechs or NIWA). Don't forget to contact tangata whenua in your area at the very start of the planning process and invite them to join. They have a stake in the health of the local kaimoana, will be able to give some positive input into your project and may be able to provide useful historical information.

In some communities you may need to be a bit more proactive/inventive to get people involved in your project. Be equipped with information to convince people of the potential benefits that can be gained from establishing a monitoring programme. Below is a list of common questions and answers to give you a general idea of types of issues you may be queried about.

How often do surveys need to be completed? Estimates of abundance and size-class frequency distribution should be conducted every year if possible. If support and resources are limited then you may wish to concentrate your efforts on reef-fish and crayfish one year and paua and kina the next so that you obtain abundance estimates for each species every second year.

How many people are needed to carry out this monitoring programme? If divers are to be used then on each survey day you need at least 1 person to co-ordinate the survey, at least two divers, a boat driver and other general helpers for support. Ideally two teams of two divers should work out of each boat so that one pair is in the

water throughout the day. Better still arrange for several boats to be used each with a team of four divers so that you take maximum advantage of good weather. Once the survey is finished you may need someone to collate all the data and write a report.

Do the same people need to do the sampling each year? It is ideal, but not always practical, to use the same people from year to year. The main co-ordinator of the project should be someone who is likely to be in the community for a few years. This person can then pass on all the information and teach the techniques to newcomers.

How long will it take? This will depend on the number of samples, the number of people involved, the diving depth (if this approach is taken) and the weather conditions during the survey. Conducting a preliminary trial will give you an idea of the time involved in sampling. As a rule of thumb a pair of divers should be able to easily complete two 30 m x 4 m transect in deep water (20 m) and four in shallow water (<10 m) during one working day.

What will it cost? There will be some initial costs involved in getting started but, once equipment has been bought or made for the first survey, ongoing costs will be very low. The ongoing cost will mainly be related to the production and photocopying of data sheets, filling dive tanks, and boat fuel.

7. The Sampling Method

Finding out how many fish are in an area is difficult because the fish may move over large areas, they may swim away from divers or avoid lines and hooks, and because different species will react in different ways to different methods of counting them. For example, divers commonly see and may count snapper *tamure* in northeastern New Zealand, whereas they simply do not see that species while diving in the Marlborough Sounds (though it is caught on lines there). The suitability of different sampling methods may differ, even for the same species, among areas, depending on whether it is possible to see underwater, and what other species are in the area. Finally, most methods of monitoring reef-fish involve using equipment, some of which may be specialised, or require boats to haul, or only be suitable in particular areas. The approach taken here is to outline the situations in which particular methods will be most useful, and identify the techniques suitable for particular species.

Sampling designs

Most of the techniques involve sampling several units (e.g. pots, transects) at each site, and having several sites within an area of interest. A site is the area over which you might move in a dive, or from which your pot or video might attract fish. A radius of 100 m around the boat is probably a reasonable definition of a site. To show that your management is having an effect, **you need to sample inside and outside your area**. To show an effect of your management it is best to have many sites, and fewer replicates at each site, rather than lots of replicates at a few sites. If there are sites of special interest (waahi tapu) and you want to know how abundances are changing there through time, allocate more sampling effort to those separately.

Be aware of seasonal changes that may influence your sampling - water clarity may increase in summer, some species may move offshore or inshore at particular times, ... If you sample at different times during the year, it may be that the changes you find from year to year are simply due to sampling in different seasons. Do not sample all of the control sites then all of the managed area. If there are differences between the control and managed areas, you don't know whether they are because of the

management, or because of the order in which they were sampled. Make sure that the order of the sites is either interspersed or random in time.

Techniques

Line fishing

Disadvantages:

- fish may be damaged either in the mouth by hooks, or by swim bladder expansion if hauled up from deep areas
- may be biases among species
- catch rate may be biased if changes in behaviour toward hooks occur over time
- difficulties with the different skill levels of fishers
- only targets carnivorous fishes
- large (>6 people) parties and hence large vessels required

Advantages:

- equipment is cheap
- no specialised equipment or training needed
- size and catch rate information may be available
- capacity for many people to participate
- fish may be released after capture

Equipment:

At least one boat with plenty of room for the number of fishers, two anchors for the boat, handlines or rods and reels for each person fishing, berley pot, berley (e.g. tins of fish catfood or tuna), gloves for fish handlers, holding pot to release fish into, measuring board, slates to record lengths and numbers of fish.

Procedure:

Anchor the boat fore and aft, at right angles to the shore. Decide on a standard rig (e.g. 2 hooks above a sinker) that is suitable for the species you wish to monitor (it doesn't matter what the rig is, as long as it is used consistently, and the rig is recorded with the data, so that it can be used again). Don't change rigs between

boats, years or sites. Squash barbs on hooks with pliers or file them off to minimise harm to fish to be released. Set up as many of handlines or rods as you have people fishing (handlines may be cheaper and more convenient than rods) - it is usual to have 3-4 people fishing at once. Instruct the fishers to strike as soon as they feel a bite, to minimise the chances of gut-hooking fish. It may be useful to have spare hook and sinker rigs made up so that if fishers break off, a re-rig can be done as rapidly as possible.

Make sure you also have at least 2 people unhooking fish and measuring them - this can be a very busy job, and the fishers need to have their lines in the water most of the time. Handle fish gently when unhooking (wrap the fish in a damp towel). Gut hooked fish should be cut off close to the hook and treated in the same way as others. Record numbers and sizes of fish caught along with details of the date, time and position (a GPS position would be ideal). It may be useful to have a rubbish bin or other container with a mesh panel over the side of the boat in the water so that fish can recover in it prior to release. Measure fish either as they are caught, or when they have recovered in the recovery tank.

Either fish for a fixed length of time (to get catch rate), or fish until a set number of fish (e.g. 60) are caught (to get catch rate and a reliable estimate of size distribution in the population). If it is taking more than 2 hrs to get the required number of fish, you probably need more fishers, or lower the target number. (If you catch fewer than 30 fish of a species in the entire area the sample will probably not be useful for size estimation). Once you have completed fishing at the first station move to the next pre-selected fishing spot and start again.

If fish are being brought to the surface with their stomachs forced out through their mouths, line-fishing is inappropriate for that species in those depths. Record if fish are being consumed by barracouta or sharks. If this happens the data may be unreliable.

Traps / pots

Blue cod are the main fish targeted by pot fisheries in New Zealand, but other fishes may also be successfully caught.

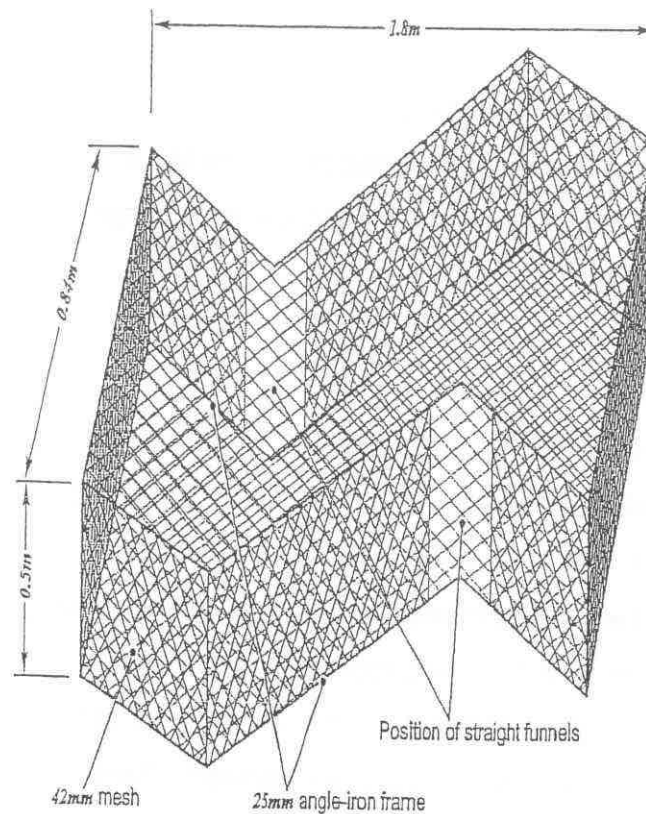


Diagram of a Z-trap

Disadvantages:

- require large deckspace and hauling gear on vessel
- equipment not cheap
- only target carnivores
- traps may damage seabed organisms
- catch rates may depend on currents
- may be interactions at the pot that modify catch rates
- need reliable bait source

Advantages:

- catch can be released with minimal harm
- accurate size information available
- numerous pots can be set at once

- few people needed in field, no specialised training needed
- vessel doesn't need to stay on-site when pots are set

Equipment:

Vessel suitable for raising and lowering pots, several (>3) pots, ropes, floats, etc., bait (will vary with target species - use local knowledge, pilchards and paua guts are 2 popular choices), waterproof paper to record catches on. Large buoys will be easier to relocate, and easier to pick up.

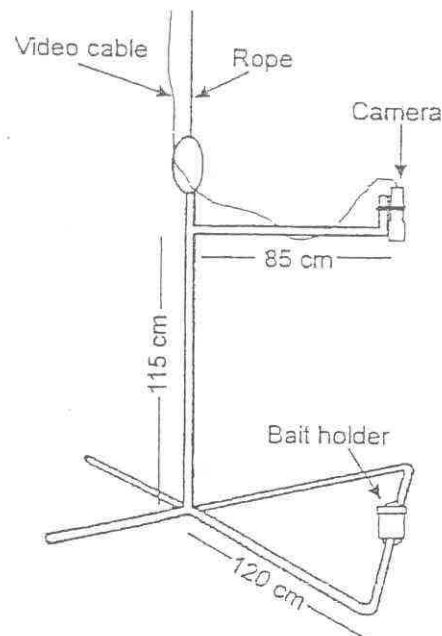
Procedure:

This will vary with the target species and the area fished. Pots are set for a standard duration, hauled, catch recorded and measured and perhaps released. The protocol suggested here relates to blue cod, but other species may require different soak times (e.g. overnight sets). Be aware that in areas with high current flows, floats may be dragged under by the tide. Set pots near appropriate topography (e.g. edge of the reef for blue cod) and haul them after about 30 mins. A piece of old carpet on the deck may reduce damage to the fish when they are landed. Gently place pot on deck, get all fish out of the pot carefully (if you want them to survive when put back), record numbers and measure them. Repeat at different sites.

If you are catching congers or other fish that appear to be eating the target species, the technique may not be appropriate. Pilchard bait catches more congers than paua guts. Hagfish slime may deter fish entering in subsequent sets. Fish with swim bladders will be damaged by hauling them out of deep water - reconsider the approach if you are damaging many fish.

Baited video

This is a new technique, that appears to have good potential for carnivorous fishes in areas where the water is fairly clear. This method has not been widely tried yet, but is likely to provide reliable, cheap information, although at high initial cost.



Disadvantages:

- requires expensive, specialised equipment worth \$6-10,000 in March 2002
- requires vessel to be stationary near the bait at all times (cf. pots, where vessel can be elsewhere)
- sea conditions need to be fairly calm
- only targets carnivorous species
- currents may modify attraction range
- need reliable bait source
- interactions among fish at the bait may make it biased
- lengthy analysis onshore that may require specialised equipment
- no catch for koha.

Advantages:

- fish not harmed
- video is good to show others the area
- lab analysis provides opportunity for non-seagoers to be involved

- have times on-screen so can get timecourse of entry to pots, ...

Equipment:

Vessel, video stand, video lens, cable, handycam, videotapes, bait,

Procedure:

The equipment is baited and lowered to seabed for standard duration (30 or 60 mins). Video is viewed on VCR and analysed for numbers (maximum number at bait at one time), and sizes of individuals.

Carry out some form of pilot study to make sure that the equipment and technique will work. This could involve determining whether shorter sets will be useful, but must involve a check on the field of view on the seabed, and check that the target species approach the bait near the seabed (so that accurate measures of size are obtained). Having divers watch a set may be useful.

Anchor the vessel near the reef edge (to prevent the video stand being snagged in rocks). Ensure that the boat isn't going to swing wildly in the wind (anchor fore and aft if necessary). Place bait in the bait container and lower the video over the side. Start recording when the stand reaches the seabed. Record for up to 60 mins, and then move to another site. It will be helpful to have a slate with the site number attached to the frame, so that the location and date is permanently in each frame. Playback the video on the surface after each set to make sure that it has recorded Ok. Remember that you have a piece of fragile cable in the water, and it needs to be kept away from the propellor. If the boat is swinging in the wind, you will have to let out a lot of slack cable - check that the stand hasn't been tipped over.

Tape analysis:

In the pilot study you may want to record the time when fish arrive at the bait, so that you can check the effects of different deployment times. View the videotape, counting how many fish of each species are in the field of view at any time. The variable that has been found most useful in northeastern New Zealand is the maximum number of each species present in a single videoframe. So for each set, you need to determine the maximum number of each of the target species present.

You need to be able to freeze-frame the tape, count the fish, and continue until the end of the time allocated. Afterward, information concerning fish size may be obtained by taking random frames from the videotape and measuring fish on the screen relative to a scale bar. Random frames should be chosen until at least 50 fish of each species have been measured.

Diver transect counts

This is the best-known way of quantifying fishes on reefs, but it may have shortcomings in some areas, and it depends on divers being able to swim against currents, and the water being fairly clear.

Disadvantages:

- requires expensive specialised SCUBA equipment (though this is generally available)
- requires clear water
- no catch for koha
- requires training and experience to be reliable
- size estimates may be unreliable
- behaviour of fish toward divers may change through time

Advantages:

- relatively small vessels can be used
- can sample most species
- only way to sample some fish (e.g. butterfly).

Equipment:

Diving gear, 50 m tape measure, slate / underwater paper on board, with underwater pencil attached, and preferably with a ruler scale on one edge. Wrap insulation tape round the tape at the 10 m mark - this will give a tug on the tape as it runs out, indicating that the count should commence, and another larger one at 40 m so that the diver knows when to stop the count. Also, tape the small L-shaped end closed if it has one, or it'll get stuck in rocks.

Procedure:

Practice counts should be done before recording true data. Diver counts fish in a strip while swimming tape out. Statistically it is better to do fewer counts at more sites (we recommend 4-5 transects per site) than lots of counts at just a few sites. We recommend limiting counts to less than 15 m depth if this suits your monitoring objectives as this increases underwater time and the safety margin. Routine counts at depths below 20 m are not recommended because of the limited bottom time available. Safety considerations should over-ride the most desirable way of doing things e.g. if the dive starts getting too deep, stop the counts, rather than continue. If underwater visibility is less than 4 m counts should not be attempted because they will be unreliable.

Descend to an appropriate area of reef, write the date, site number, your name, and the transect number on the datasheet. It may be helpful to have a list of the things to be counted written down on the slate as a reminder. If you are counting all fish species then it is probably easiest to just write down species with a code and the estimated length (e.g. B25 for blue cod estimated at 25 cm total length), for each fish as you encounter it for each transect, and then draw a line across the sheet to indicate where one transect stops and another starts. However if you are counting just a few key species then you can print up some data sheets with boxes for all the appropriate bits of information to be recorded.

Have the dive buddy hold the free end of the tape, hold the tape reel and the slate in one hand, and the pencil in the other, and swim steadily in a the chosen direction. You may choose to run all your transects along a depth contour, parallel to the shore, or run in a randomly chosen direction determined by a set of random directions carried by the divers (see Appendix C). Whichever method you use stick to it for the whole survey as this helps to remove the diver's personal bias in selecting for or against prime reef-fish habitat. If you reach the edge of the reef or encounter a different type of habitat while running out the tape then it is best to start again in a different direction. When the 10 m mark on the tape is reached, start recording sizes of fish that occur in a 2 m lane either side of your path (i.e. transect is

4 m wide). Do not include fish that move into the transect from behind you. You will soon get a feel for how different species of fish behave; it may be necessary to count the shy species or large individuals a considerable distance ahead, whereas smaller individuals or species that are diver-neutral can be counted closer. Having reached the end of the transect, stop swimming, settle on the bottom, give the tape 3 sharp tugs to indicate that your buddy can swim back to you now, and reel the tape in as they swim to you (don't let them bundle it up as they swim or you'll get a huge tangle). (It may be possible for the buddy diver to record whether the transect was mainly sand, seaweed, bare rock, the type of seaweed, the rock type (boulders, bedrock reef)). Estimate underwater visibility from the length of tape out when your buddy becomes visible and write it down on the datasheet (probably only necessary to do once per site).

Once you have finished your first transect check your air supply and bottom time to see whether you have enough time to complete another. If so, choose a random direction from your list and swim in that direction for a set pre-chosen distance (e.g. 30 m) or time (e.g. 1 min). Attach your tape and run it out according to the pre-selected method (i.e. along depth contour, parallel to shore or random direction).

It is useful to spear a fish or 2 of each species to check the size estimates. If that is not possible, check your estimates of sizes against the slate if you can get close to the fish, or note where the nose and tail sit on a rock for sedentary species, and measure those when the fish has moved off.

If you are not counting more than 1 fish on average in your transects, it will be necessary to change to a longer transect; 60 m and 100 m tapes may be available, or you may be able to run two 50 m tapes together (this will be inconvenient to retrieve).

Combined Counts:

It is possible to accomplish underwater fish counts and crayfish counts in the same dive. Once the fish count has been completed the tape is run out to the full 50 m and then is searched for crayfish as described in the accompanying guide on monitoring crayfish. To minimise the number of times the divers need swim the length of the

tape when combined counts are made, the tape reel should be tied off at the start point and the diver doing the initial fish counts should run out the free end of the tape. Once the fish count is complete the second diver joins the first and they both work their way back towards the reel end of the tape counting crayfish. They then wind in the tape and move off to the next transect start point. The data for fish and crayfish can be kept well ordered if two separate data sheets are clipped to either side of the slate.

Description of methods appropriate to key reef-fish species

Blue cod

Numbers, sizes, and behaviour of blue cod all respond to fishing pressure. This species is easy to sample with most techniques, and robust to handling (it has no swim bladder). Most abundant at reef - sand borders.

Butterfish

Numbers, sizes, and behaviour of butterfish will respond to fishing pressure. Only able to be sampled by divers. Found mainly in shallow water among seaweed.

Snapper

Numbers, sizes and behaviour will respond to fishing pressure. Readily sampled by divers in northern areas, seldom seen in more southern areas, though present. Found over reef and sand, small individuals patchily distributed, larger ones more evenly distributed. Small fish in northeastern NZ associated with urchin-dominated areas, larger fish found anywhere.

Blue moki

Numbers and sizes will respond to fishing pressure. Most readily sampled by divers, but may enter pots with appropriate entrances. Relatively even distributions, often associated with areas of rough bottom.

Red moki

Size and abundance respond to fishing pressure. Readily sampled by diver counts. Not attracted to bait, but may enter pots. Relatively even distributions, associated with areas of rough complex bottom (boulders, lots of peaks, caves and gutters).

Tarakihi

Sizes, abundances and perhaps behaviour respond to fishing pressure. Can be sampled by diver counts, traps or line fishing. Patchy distributions, often associated with reef edge or sandy areas.

Conger Eels

During the day conger eels hide in holes and often only the head or part of the body is visible. They sometimes enter pots or are caught on baited lines but the most reliable estimates are produced by counts carried out during underwater surveys of crayfish stocks. See the handbook on crayfish surveys for a description of this method.

The pros and cons of each sample method for several reef-fish species are summarised in Box 3.

Box 3. Techniques for sampling each species				
Species	Line fishing	Pots / traps	Baited video	Diver counts
Blue cod	Yes	Yes	Yes	Yes
Butterfish	No	No	No	Yes
Snapper	Yes	Yes	Yes	In some places
Blue moki	In some places?	?	?	Yes
Red moki	No	Yes	No	Yes
Tarakihi	Yes	Yes	?	Yes
Conger	Yes	Yes	No	Yes
Trumpeter	?	?	?	Yes
All species	No	No	No	Yes

Different environmental conditions suit different assessment methods. These are summarised in Box 4.

Box 4. Environmental conditions that suit different methods of reef-fish assessment.				
<i>Environmental condition</i>	<i>Line fishing</i>	<i>Pots / traps</i>	<i>Baited video</i>	<i>Diver counts</i>
Current	Yes	Yes	Yes	No
Murky water	Yes	Yes	No	No
Water < 15 m	Yes	Yes	Yes	Yes
Water > 15 m	Yes	Yes	Yes	Little time at depth
Vertical reef	Yes	No	No	Yes
Swell >2 m	Yes	Yes	Difficult	Difficult in shallows
Wind >20 knots	Yes	Yes	Difficult	Yes

The potential effect that intense fishing activity can have on various reef-fish species and the habits of these fishes are listed in Box 5.

Box 5. Do humans affect the apparent population characteristics of the species listed, and the habits of common fish species.						
<i>Species</i>	<i>Numbers</i>	<i>Size</i>	<i>Behaviour</i>	<i>Habitat</i>	<i>Schools</i>	<i>Seasonal</i>
Blue cod	Yes	Yes	Yes	Reef edge	Seldom	No
Butterfish	Yes	Yes	Yes	Shallow seaweed	No	No
Snapper	Yes	Yes	Yes	All	Sometimes	Yes
Blue moki	Yes	Yes	No	Rough	Seldom	Yes
Red moki	Yes	Yes	No	Rough	No	No
Tarakihi	Yes	Yes	Yes	Reef edge	Yes	Yes
Conger	Yes	Yes	No	Holes & boulders	No	No
Trumpeter	Yes	Yes	?	All	Yes	?

8. Special Equipment Required

Underwater tapes

The easiest way to mark out a transect under water is to use a fibre-glass tape measure marked in metres on both sides. One is provided in the field kit. You will need at least one for each pair of divers and preferably they should carry another each in order to check on their distance from the centre line of the transect. If purchasing further tapes ensure that imperial and metric measures are not printed on alternate sides of the tape. This will lead to confusion underwater.

Catch Bags

All the equipment needed to work underwater should be carried in a catch bag. Catch bags are available from sports or dive shops in various shapes and sizes (around \$70). They are usually made of mesh nylon, so they drain quickly, with a wire frame to hold the top open or closed. Most have a locking device to secure them in a closed position. You could make your own using an onion bag and a wire hoop.

Underwater record keeping material

Due to the environment that you will be working in, some special equipment will be needed to record the information that you gather. You will have to count and estimate the size of every reef-fish along each transect line. This information has to be recorded whilst underwater. There are a few alternatives to choose from.

- *Plastic Slate Boards* are made of high impact styrene. It is easy to make your own from PVC plastic. Visit a plastic product company (e.g. Progressive Plastics Ltd., Dunedin) and ask for off-cuts of PVC plastic between A4 and A5 size. This should only cost a few dollars. Drill a hole in two of the corners to attach a piece of cord to tie your pencil on. Lightly roughen both surfaces using a fine grade sand-paper. This will ensure you can write directly onto the plastic board with a pencil without it getting smudged. However, if you choose to do this, the data must be transferred to paper data sheets each time the board is filled. It can be cleaned with a lightly abrasive household cleaning fluid or the pencil marks rubbed off with an eraser.

- *Underwater Paper.* Special underwater paper is available from most paper suppliers or printing companies at around \$6 - \$7 for 20 A4 pages. Attach this paper onto the slate board with rubber bands or clips at the top and bottom. Have it ruled up into the appropriate columns in advance. Only one type (Xerperm Lazerprint 3R 96094) can be used in a photocopier to print up the sheets with headings and columns etc. If any other type is used it will melt inside the copier!!
- *Pencils.* Regular HB pencils can be used to write on the underwater paper or slate board. Pencils should be attached to the slate by string or cord. Drill a hole in the end (or middle) of the pencil and tie to the piece of string attached to the slate board. It is a good idea to sharpen both ends of the pencil. If one end breaks you have a spare ready.

Global Positioning System (GPS)

A handheld GPS is invaluable in determining exactly where the samples came from. This information should be recorded on the data sheets and on the map or chart. A handheld GPS is not expensive and will accurately determine the sample position to within a few metres.

Programme log book

It is useful to keep a logbook for your monitoring programme. This way useful information can be kept in one place and passed on to future organisers, if necessary. The type of information that is useful to record is: equipment costs, suppliers and contact details, details from meetings, a record of events leading up to and including the sampling day, phone numbers of volunteers, and sketches of the study area.

Using a boat?

The diving methods outlined in this guide are easiest to use using a boat. Shore diving may be possible in some areas with good access but in most cases the distances involved and the weight of gear demands fast and easy access. If you decide to use a boat, remember to factor in the additional cost of fuel and boat maintenance. Also, you will need an extra person to drive the boat and you will need to consider the additional safety issues associated with boat use.

9. Equipment Checklist

Go through this list on the day to make sure you have everything before you set out to the beach. Each person will have slightly different requirements depending on their role in the programme.

Group Gear (this gear is best kept with the main organiser of the programme)

- ✓ First Aid Kit
- ✓ Mobile phone or radio (if available – for safety and coordination)
- ✓ Log book
- ✓ Tide tables
- ✓ Weather report
- ✓ Permit (copy for each boat and shore team)

Boat Gear (per boat)

- ✓ Mobile phone or radio (for safety and coordination)
- ✓ Log book (for logging dive times)
- ✓ Tide tables
- ✓ Weather report
- ✓ Permit
- ✓ Appropriate safety equipment (life jackets, flares etc)
- ✓ Fish measuring board
- ✓ Handheld GPS

Scientific Gear (per diver)

- ✓ Fibreglass tape
- ✓ Diver catch bag
- ✓ Data sheets/waterproof paper
- ✓ Slate board with pencil attached + spare pencils
- ✓ Compass

Personal Gear

- ✓ Warm clothing
- ✓ Food and drink (hot and cold)
- ✓ SCUBA and snorkel gear, dive gloves & spare tanks
- ✓ Sunblock, sunglasses and sunhat

10. When to Sample

One of the major factors that will determine when you carry out your main sampling event is the weather. The weather can affect visibility and wave exposure. Ideally, you want high underwater visibility and low wave exposure to make sampling as easy as possible and less time-consuming. Have a back-up date in mind in case the weather conditions change.

The time of year (season) is also an important factor to take into consideration. This may be particularly relevant to those conducting surveys in the far south of New Zealand where water temperature may be an important factor in determining when you will sample. The warmer the water temperature the more comfortable conditions will be to work in and divers will be able to stay in the water longer and collect more information. Some reef fishes may move away from the reef at various times of the year to spawn for example. Obviously you need to sample when they are present in your area.

The time taken to complete the sampling event will depend on the number of samples, the sampling conditions and the number of divers. Ideally, a diving survey should be done over a short period of time (1-5 days). If sampling needs to be carried out over several weekends then try to keep the entire sampling period within a 4 week period. Sampling should be carried out at the same time of year in future years.

The presence of strong tidal currents will also influence when you will carry out sampling. Whether you sample at low or high tide will depend on the topography of your sample site. If you are sampling close in to shore it may be easier to wait until high tide. This may stop the surge from shifting the divers around too much.

Planning when to sample is one of the most important factors in successfully carrying out your survey. As you can imagine, it is often difficult to get all the factors listed above at their optimum at the same time (fine weather, low swell/surge, high visibility, tides at a convenient time of day and availability of volunteers).

11. Pre-survey Preparation

Establishing a sampling team

You should by now have a group of people who are going to participate in the monitoring programme. The number of people involved will vary between programmes and will depend on factors such as the size of the area to be surveyed. However, a minimum number is required to ensure the work can be done safely in 1 – 5 days. Establish the responsibilities of each person so everyone is 100% sure of their role in the programme.

- Principal Organiser – This person is probably the one who instigated the monitoring programme and their role is generally to oversee the whole project. Specifically, this person will be organising equipment and sampling times, and recruiting volunteers, or at least delegating these tasks to others. On the sampling day the role of the principal organiser is to ensure everything runs smoothly.
- Boat drivers – all the techniques outlined here rely on experienced boat drivers. There should be one other person on board each boat who knows how to operate the boat equipment, start the engine and drive the boat in case the driver becomes incapacitated.
- Divers – if you are using diver counts at least two experienced divers are required but the more you have the faster a dive survey will be completed. Two boats each with two teams of two divers is a good number to work with and provides backup if breakdowns occur.
- Data Collectors – these people are responsible for collecting the data from the divers and copying it onto a permanent data source (if it has been recorded directly onto the slate board), or giving the divers more paper when required.
- Support Crew – some people are needed onshore to be available to assist when the divers finish sampling. The support crew can provide the divers and data collectors with hot drinks, food, and dry clothing.
- Data Analyst – this person is responsible for collating and analysing the data.
- Extras – photographer, representatives from other organisations (e.g. regional council).

Pre-survey meeting

Before the main sampling event, arrange a time to meet with the people who will be involved in the monitoring programme. If the weather is fine this meeting can take place at the study site.

Checklist of objectives for pre-survey meeting:

- Discuss the objectives of the survey with the sampling team.
- Ensure participants are familiar with the study site.
- Go over the methods to be used in the survey. The divers should be familiar with the techniques of measuring and counting reef fish. Check all the equipment is functional (e.g. is the tape measure broken or tangled?). A broken fibreglass tape can be joined by overlapping a short section and gluing with super-glue.
- Go for a practice dive before the main survey. This will identify any shortcomings in diver or scientific gear and enable the divers to practice estimating reef-fish size. Practice counting and measuring reef-fish in a couple of transects and record how long it takes (this will help assess the time needed for the main survey).
- Try to foresee any other equipment requirements or potential hazards and discuss safety issues.

12. Recording the Data

Initial data will be recorded on your special underwater paper or slate board. It is vital that these data get transferred to a permanent source at the end of each dive. This can later be transferred to a computer spreadsheet (e.g. Microsoft® Excel) for analysing the data and producing graphs. It is important to make copies of all your data and keep the duplicate copy in a separate location. A blank datasheet is shown in Appendix G.

Kapiti Island FISH COUNT DATA SHEET

Site Arapahaiti Pt

Depth Range 17-20 m

Transect No. C

Diver Rob Stewart

Date 28-1-99

Width 5 m Length 50 m

Species	Estimated Fish Lengths (cms)									
Blue Cod	35	35	25	30						
Butterfish	45	50	50	45	50					
Tarakihi	30	27								
Blue Moki										
Red Moki										
Butterfly Percch	15 @ 25-30 cm									

Kapiti Island

Site Arapahaiti Pt

Depth Range 16-17 m

Transect No. D

Diver Rob Stewart

Date 28-1-99

Width 5 m Length 50 m


Species	Estimated Fish Lengths (cms)									
Blue Cod	25	30	35	26	35	30	40	33		
Butterfish										
Tarakihi										
Blue Moki										
Red Moki	50									

Example of data sheet

13. Analysing the Data

While underwater diver counts of some species of reef-fish yield you a count per unit area of bottom, others, such as the baited video stations, will give you an index of abundance. However, for all the methods you will be able to calculate an average density or index for a particular area. Work through the following calculations to determine the average number of a reef-fish species per transect, video drop or trap set.

Box 6**Determining average abundance**


$$\text{Average} = \frac{\text{Total number of a reef-fish species observed}}{\text{Number of transects, video drops or trap sets}}$$

E.g.1 Red moki counted in 30m x 4m transects

- Total number of red moki observed = 94
- Total number of 30m x 4m transects = 20

$$\begin{aligned}\text{Average} &= \frac{94}{20} \\ &= 4.7 \text{ red moki per } 120\text{m}^2 \\ &\text{or } 0.03917 \text{ red moki per square metre}\end{aligned}$$


E.g.2 Blue cod counted in 30 minute video drops

- Total number of blue cod observed = 155
- Total number video drops = 12

$$\begin{aligned}\text{e.g. Average} &= \frac{105}{12} \\ &= 8.75 \text{ blue cod per video drop}\end{aligned}$$

If you have an estimate of the total area of your study site either from a detailed map or aerial photograph then for the species that are reliably counted in diver transects you could also calculate the total number of fish in your study site from your estimates as shown in Box 7. In this case the study site is 400 long and 70 m wide.

Box 7: Determining an estimate of total stock size in your study site

 Number of red moki = Area of study site \times density of red moki per m^2
e.g. $= (400 \text{ m} \times 70 \text{ m}) \times 0.03917 \text{ red moki per m}^{-2}$
 $= 28,000 \text{ m}^2 \times 0.03917 \text{ fish per m}^{-2}$
 $= 1,097 \text{ red moki}$

Note: because all of the study area may not be suitable red moki habitat a factor estimating the percentage of the whole area as available habitat to red moki may need to be added to the equation to avoid over-estimating stock size.

Box 8: Correction factor if not all of area is suitable red moki habitat

For example, if only two-thirds (66%) of the coastline surveyed was suitable habitat then:

$$\begin{aligned}\text{Number of red moki} &= 1,098 \times 0.66 \\ &= 725 \text{ red moki}\end{aligned}$$



*** Note: Additional Calculations ***

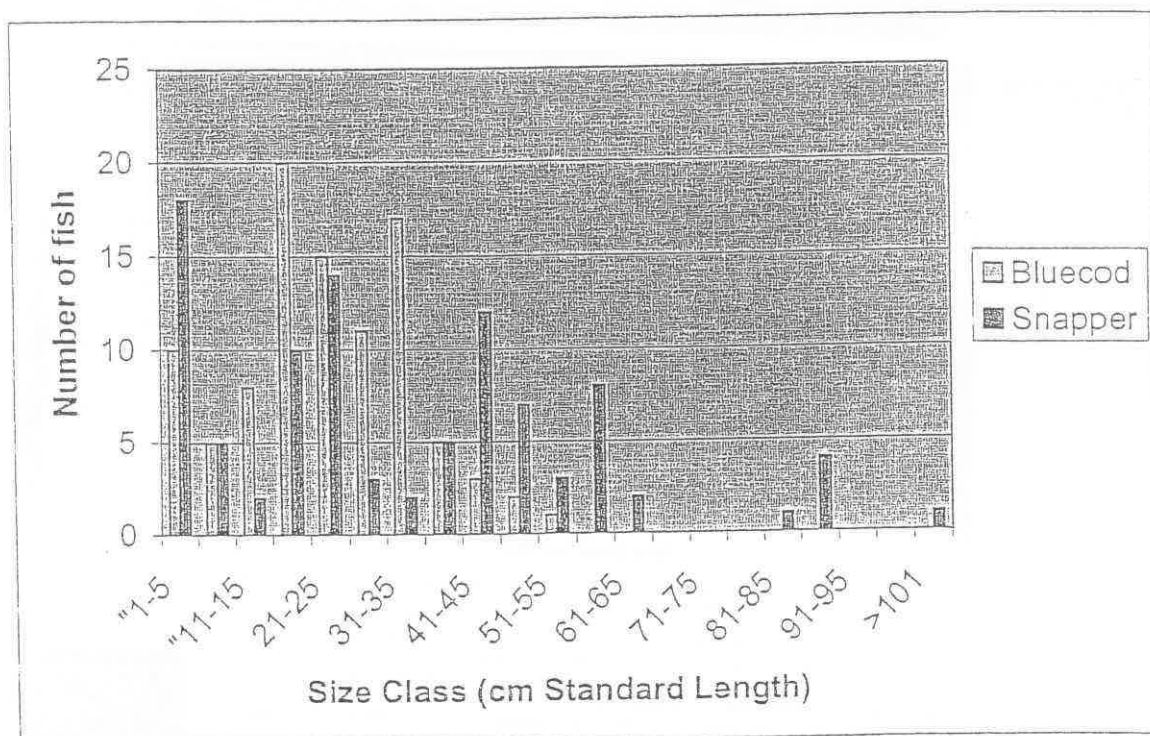
The calculations above give the basic information needed to get an idea of the reef-fish stocks. However, more detailed calculations can be completed to give you more information. This is especially valuable after your monitoring programme has been running for a few years. These calculations find the standard deviation (indicator of variability in population and reliability in data), standard error, confidence intervals, proportion of legal size fish, etc. If you want to go further, contact the Ministry of

Fisheries or a science provider such as a University Department or NIWA for this information.

Presenting the size-class frequency data

Graphs are extremely useful in conveying a visual description of the results of your survey. From your data sheets recording the information on size, add up the numbers of a reef-fish species found in each size class and present in a table, as illustrated below:

<i>Total number of reef fish in each size class (cm)</i>		
Size Class (cm)	Bluecod	Snapper
1-5	10	18
6-10	5	5
11-15	8	2
16-20	20	10
21-25	15	14
26-30	11	3
31-35	17	2
36-40	5	5
41-45	3	12
46-50	2	7
51-55	1	3
56-60	0	8
61-65	0	2
66-70	0	0
71-75	0	0
76-80	0	0
81-85	0	1
86-90	0	4
91-95	0	0
96-100	0	0
>100	0	1
>101	0	1

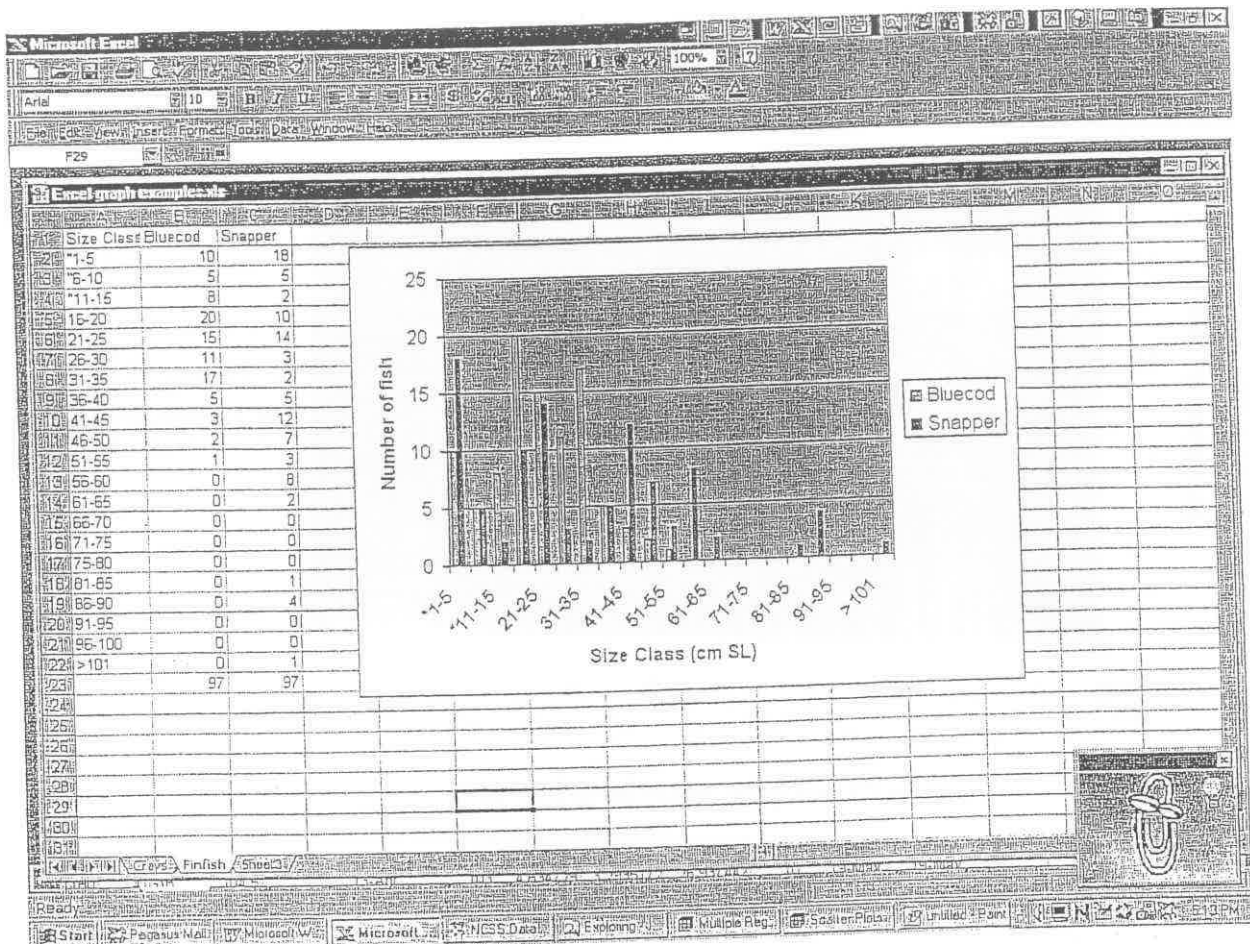


Size-class frequency graph

This information can now be recorded as a graph, making interpretation of the results easier. Graph the total number of a reef-fish species in each size class by plotting the number of fish on the vertical left axis (Y axis) against the size class categories on the bottom axis (X axis). This is called a size frequency graph.

This can tell you what size classes of fish are abundant, and which group is the focus of harvesting pressure. Notice this graph shows that there is a small proportion of legal size fish. Because juveniles were counted it can tell you about recruitment into the population.

These types of graphs are easy to draw by hand on graph paper. Alternatively, if you have a computer available, you can do it in a computer programme such as Microsoft® Excel. Below is an example of how to enter data onto a spreadsheet in order to obtain a size-class frequency graph for blue cod and snapper.



14. Interpretation of the Results from your Survey

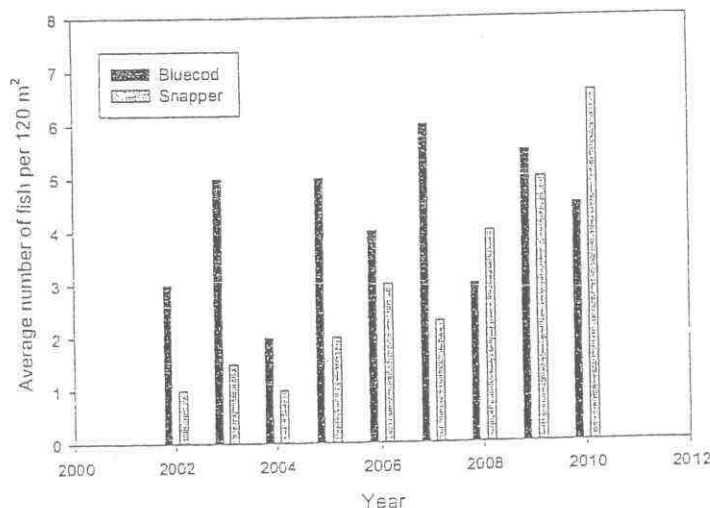
What to do with your result?

1) Firstly, you may want to add the abundance information to the map or sketch of your survey area. Draw the symbols shown below onto your map to build up a visual picture of your different stocks of reef-fish. This provides some general information from a quick glance and is a useful tool for showing people the outcome of your monitoring programme.

- Absent (0 blue cod)
- Low (1 – 50 blue cod per ha)
- Medium (50 – 200 blue cod per ha)
- High (200 – 500 blue cod per ha)
- Very High (> 500 blue cod per ha)

2) Secondly, for your own reference, you may want to add the density information for different-reef-fish species to a graph so you can see changes from year to year.

Trends in density of blue cod and snapper in the area of interest.



In this case the numbers of blue cod are quite variable from year to year and show no obvious trend. The abundance of snapper, however, appears to be increasing over the eight year period. This may be because of your management regime but you will not be able to tell unless you also sampled snapper in control areas subject to normal fishing regimes.

Remember that the information you have obtained is relevant for your study area only and care must be taken about the interpretation of these results. Differences can occur over small distances of your coastline.

If you have collected data from your area of particular interest and adjacent "control" areas or if you have surveyed the area for a number of years then you could analyse the data to see whether from a statistical point of view the populations differ in abundance and/or size. This is a technical task and needs specialist input. The Ministry of Fisheries may be able to help you do this analysis. Alternatively, if you have sufficient funding you could approach specialists at a University, Polytech or NIWA to complete the analysis.

15. Where to Next?

Treat your first survey as a pilot to plan your sampling in the following years. After your first survey has been completed get in contact with the Ministry of Fisheries. Ask them to advise you whether the sampling programme you have started has the statistical capacity to detect the sort of changes in abundance of reef fish you expect over the time frame of any management regime you might put in place. For instance, a ban in fishing from an area may only be in place for two years. Will your sampling design allow you to detect say a 25% increase in abundance of blue cod? If not, you will have to increase the sampling effort.

After your monitoring programme has been running for a few years you can start to look for any changes and trends in the reef-fish populations you have been monitoring. You will also be able to try to identify the potential source of any problem detected. Once you have collected your data, it may be a good idea to consult with the Ministry of Fisheries, who will be able to give you further help in interpreting results, and will be able to advise on management issues. If you find a negative trend in your reef-fish populations, you can start to work on management measures to take care of the problem.

Once you are comfortable with the methods and procedures in this manual, and when more time is available to commit to the project, you may want to expand your sampling to additional sites. Also, you may want to promote the monitoring programme to other communities around the coast and share information. This allows a picture to be built up of what is going on over a wider range of the coastline.

You may wish to obtain funding to support your monitoring efforts. Try your district council, the Ministry of Fisheries, the Ministry for Environment or the Lotteries Board.

If you have information on reef fish abundance and sizes from a number of areas of differing management, say a marine reserve, a taiapure and adjacent coastlines open to all forms of fishing then these may be interest to the Inshore Species Stock Assessment Working Group (see Chapter 3 for more detail).

Appendix A: Looking after your Reef-fish Stocks

- Undersized reef-fish are next year's or future years' harvests and should be treated with care.
- Change your fishing locations often and take a few fish from several different reefs. This will ensure your favourite fishing spots are not depleted.
- Fish on deck to be measured should be kept in the shade, damp and covered. They will die rapidly if not protected from the heat and sunlight.
- Stick to the daily bag limits but take only what you need.
- Observe the size limits.
- Report any suspicious activity to the Ministry of Fisheries, including details on location, time, date, description of boat or vehicle type, colour, registration number, and details of the people and activities observed.

Appendix B: Contact Addresses for Ministry of Fishery Offices

Head Office

P O Box 1020, Wellington Phone: 04 470 2600

ASB Bank House, 101-103 The Terrace, Wellington Fax: 04 470 2601

Auckland Office

PO Box 3437, Auckland Phone: 09 379 4700

23 Hargreaves Street, College Hill, Ponsonby, Auckland Fax: 09 377 4245

Nelson Office

Private Bag 14, Port Nelson, Nelson Phone: 03 548 1069

118 Vickerman Street, Port Nelson, Nelson Fax: 03 546 9327

Dunedin Office

Private Bag 1926, Dunedin Phone: 03 474 0333

1st Floor, 45 Filleul Street, Dunedin Fax: 03 477 6275

Invercargill Office

P O Box 1065, Invercargill Phone: 03 214 2640

1st Floor, 137 Spey Street, Invercargill Fax: 03 214 4325

Christchurch Office

P O Box 8324, Christchurch Phone: 03 358 0812

585 Wairakei Road, Christchurch Fax: 03 358 0817

Kaitaia Office

P O Box 143, Kaitaia Phone: 09 408 2936

Braidwood House, 5 Allen Bell Drive, Kaitaia Fax: 09 408 2951

Whangarei Office

Private Bag 9013, Whangarei Phone: 09 437 5543

17 Keyte Street, Kensington, Whangarei Fax: 09 437 1851

Tauranga Office

P O Box 13-125, Tauranga Phone: 07 577 1640

Cnr of Elizabeth and Durham Streets, Tauranga Fax: 07 577 9621

Appendix C: Random Number Table

Below is a table of random numbers that could be used to select a transect direction or determine the direction to swim in to start the next one. Haphazardly pick a starting position anywhere on the table by closing your eyes and letting your finger fall onto the page. The number your finger lands on is the first sampling direction. Then use the next 40 consecutive numbers. For example let 0 = North, 1 = Northeast, 2 = East and so on. Convert these numbers to compass directions and write them down on your slate. Draw a line through each direction as you use it.

5	2	5	7	3	3	1	0
6	2	7	6	4	2	3	3
4	6	6	7	6	7	1	0
2	2	3	2	2	3	6	6
1	0	1	3	0	7	7	6
5	7	7	4	3	2	3	1
6	7	4	7	0	3	3	4
7	7	2	0	6	6	1	3
1	2	5	6	7	0	5	1
6	4	4	5	1	2	1	5
6	5	6	3	5	2	1	1
3	6	5	2	5	1	5	5
2	5	3	6	2	6	4	7
1	3	2	2	5	0	3	5
1	6	4	3	3	5	3	4
3	4	1	5	7	1	4	7
1	1	2	7	0	4	1	7
7	6	1	3	7	7	3	2
5	0	7	5	3	5	3	2

Appendix D: Useful sources of information

The Adopt a Beach Programme: A handbook to assist community groups in conducting their own surveys of local shellfish resources by Ministry of Fisheries and Sea Keepers.

A Community Guide to Monitoring a Cockle Population by M. Cassidy, H. Suter, and I. McGee (1997) Ministry of Fisheries, Dunedin.

Nature Watching at the Beach by J. Walsby (1990) Wilson and Horton.

A Guide to the New Zealand Seashore by D. Gunson (1993) Viking Pacific.

Studying temperate marine environments. A handbook for ecologists by M. Kingsford and C. Battershill, (eds.). (1998) Canterbury University Press, Christchurch.

Appendix E: Equipment Suppliers

50m metric tape: 50 m Yamayo measure tape - \$55 + GST
Trig Instruments
7 McCormack Place
Ngauranga
Wellington Tel. 04 473 7935

Plastic Calipers (150 mm): \$5-\$7 Try Placemakers / Mitre 10 or The Wharehouse

PVC sheet (4mm) for dive slate about \$5 (A4 size). Any Industrial Plastics supplier.
You may be able to obtain a suitable sized offcut otherwise they sell them by the
2400mm x 1800 mm sheet! (expensive).

Underwater writing paper: Only one type (Xeroperm Lazerprint 3R 96094) can be
used in a photocopier to print up the sheets with headings and columns etc. If any
other type is used it will melt inside the copier!!
\$55 plus GST for 100 sheets
from Fuji Xerox NZ Ltd
49-55 Tory Street
Wellington

Field Kit Bag: The field kit comes in a swagger bag (\$48 each) made by

Bennet Enterprises Ltd
PO Box 38171
Wellington Mail Centre
Ph: 04 568 6532
Fax: 04 568 7532

Appendix F: Glossary of Terms

Abundance: an index of how many fish are present. It may not be accurate, but needs to be sufficiently consistent that it can be compared among places, or among times. All sampling methods discussed here will provide an estimate of abundance.

Accurate, accuracy: how repeatable an estimate is. An accurate estimate is what we want to get from our sample. Inaccuracies may arise because of errors inherent in how we measure or count things.

Bias: getting an inaccurate picture of what the world is like because the sampling method is slanted toward one species or size class. For example, cod pots are biased toward large blue cod; they don't catch small ones in proportion to their abundance.

Carnivorous: flesh eating. As opposed to herbivorous fishes, which eat plants. Some carnivorous fish can be baited in to videos and traps, whereas those that eat microscopic crustaceans - e.g. red moki - cannot.

Census: a full count of all the individuals in an area. Very difficult to get.

Density: an abundance per area of seabed. Only diver counts provide densities; other methods provide estimates of relative abundance.

Distribution: where things occur. For example, a description of the distribution of butterfish might be "shallow seaweed stands".

Duration: the length of time a pot or video is set for.

Gut-hooking: having a hook lodge down the alimentary canal so that it is difficult to remove without killing the fish.

Habitat: the type of seabed present, classified by the substratum type (e.g. rocky reef), and vegetation (seaweed forest).

Maximum: the biggest number seen.

Patchy: things that are found in clumps have patchy distributions. Fish that live in schools have patchy distributions, and as a result estimates of their abundance are often not precise.

Precise: all of the replicates having similar values.

Random: not determined by choice. There are tables of random digits available, and these can be used to decide which order to sample the sites in. This is a way of avoiding biases in the data.

Replicates: repeated sampling units within a single area. For example 5 replicate transects per site, 3 replicate pot-sets per day. Often indicated by " n =" in written reports.

Rugose: bumpy or rugged, e.g. where there are large boulders on bedrock, or pinnacles.

Sample: when you can't collect everything that you're interested in, you need to sample, so you can estimate the total number. For example, if you count fish in replicate transects at a site, you can estimate the total number in the area, although you haven't carried out a full census.

Sedentary: things that don't move very much. Jock stewarts or scorpionfish are sedentary, because they spend most of their time sitting on the bottom of the ocean.

Site: a defined area in which replicate samples are taken. It is usual to sample a number of sites within an area of interest, and compare them with nearby areas that have different management regimes.

Soak-time: how long a piece of sampling gear is left set. e.g. nets may have overnight soak times, whereas baited videos may have 30 min soak times.

Transect: an area of seabed, usually longer than it is wide, in which fish are counted.

VCR: video cassette recorder, a more specialised item than a handycam, which is not used in the field. One with shuttle playback and a good pause function may be useful for reviewing tapes and recording data.

Visibility: how far you can see underwater. This can be estimated by using the distance at which an object (e.g. a diver, or dive slate) vanishes from view. Visibility < 4 m is unsuitable for fish counts, whereas at offshore islands with little runoff from land, visibility in excess of 20 m may be encountered. Fish are often more easily spooked by divers in poor visibility, and more relaxed in good visibility.

Appendix G: Blank data Sheet

FISH COUNT DATA SHEET

Site Diver
 Depth Range Date

Transect No. Width Length

Species	Estimated Fish Lengths (cms)												
Blue Cod													
Butterfish													
Tarakihi													
Blue Moki													
Red Moki													

Site Diver
 Depth Range Date

Transect No. Width Length

Species	Estimated Fish Lengths (cms)												
Blue Cod													
Butterfish													
Tarakihi													
Blue Moki													
Red Moki													

