CATCH-2008-07

Guidelines to the design, implementation and reporting of catch sampling programmes

Science Group
Ministry of Fisheries

21 July 2008

Preface

This report describes current best practice in the design, implementation, and reporting results of catch sampling programmes. This document should be a key resource for Research Planning Groups to specify objectives in future catch sampling programmes and to provide research providers so that they are aware of the expectations for these programmes. While this report is specifically directed at providing recommendations for at-sea catch sampling, point of landing, and on-shore shed-sampling many of the principles are applicable to the sampling of catch from research trawl surveys. This report does not cover sampling studies directed specifically at biological questions such as size-at-maturity or growth rates.

This document covers a range of topics, including discussions of the objectives of catch sampling programmes and how these influence the subsequent sampling programmes; current views of the best practice in terms of designing, implementing, and reporting the results of sampling programmes; a section discussing factors to be considered when determining which of at-sea or shore-based sampling is the most appropriate; and finally a section discussing a range of current issues that are important to the design and implementation of these programmes.

This report should be viewed as a living document that will be updated over time as new information and technology becomes available. MFish would like to thank the participants of the MFish Catch Sampling workshop held 25-26 May 2008, in Wellington for sharing their knowledge which has formed the basis of this document.

Objectives of catch sampling programmes

Information on the size, age, sex, and maturity stage of catches from a fishery provide important information for the assessment and management of exploited fish populations. These data are typically collected through dedicated sampling programmes (herein referred to as catch sampling programmes) that can occur either at-sea when the fish is captured or in fish processing sheds after they have been landed. The biological data collected will be determined by the biological characteristics of the species, e.g. does growth and/or vulnerability to fishing vary by sex or age.

Management priorities and the research planning process should determine the stocks chosen for catch sampling and the frequency of sampling. The basis for sampling catches are that fisheries provide us with a tool to sample part of the underlying population and this information can then assist us in our management of these stocks. Sampling of the fishery also allows research to investigate the characteristics and the effect of the removals on the population.

The overarching objective of any catch sampling programme must be to obtain **representative** samples of the catch to allow characterisation of the age or length composition of the catch with an appropriate level of precision. The samples could be representative of all catch from a given QMA, only catch from a particular method, or only catches from a particular method in particular sub-areas or seasons, with the required level of stratification largely determined by the management objectives which drive the sampling requirements.

While the primary goal of the sampling shouldn’t change (i.e. representative samples from a defined fishery), the end use of the data can differ. For stocks that have a formal stock assessment it is generally important to know the sizes/ages of fish that are taken by the main fishing methods. This is particularly the case for fisheries from which abundance indices (e.g. catch per unit effort) are derived using fishery-dependent data as it is important to know which component of the population (e.g. age range) is being monitored by the abundance index. In this case the goal of the catch sampling programme could be to sample the catches from the most important fishing gears to allow the selectivities of these fisheries to be estimated within the assessment. It is important that the definition of the fisheries in the assessment is matched by the catch sampling programme.

Within some stocks there can be differences between the main gear types in their ability to provide a consistent picture of the underlying population. This is related to what is known about the selectivity of each method, and how this selectivity varies from year to year. In cases where the fishery is thought to have a stable selectivity pattern and no strong selection for any part of the population (e.g. they consistently catch fish across a range of ages/sizes), the fishery might be sampled frequently and the catch sampling data used to monitor the health of a fishery in the absence of a formal stock assessment. In this case the goal of the catch sampling is to sample catches of a defined fishery in order to allow monitoring of the stock over time using the resulting catch data as an indicator of stock status. Of course these data can still be used in a formal stock assessment. Examples of fisheries which are monitored with this goal in mind include the KAH 1 non-commercial fishery.

For some species the composition of the catch (and presumably that component of the underlying population) has been shown to vary at fine spatial scales (e.g. individual seamounts) and the mixing is assumed to be low. In such instances representative sampling of landings alone would not be adequate for stock monitoring, requiring the fishery at the level of the individual fishing event. This type of issue affects the design of the sampling programme, e.g. do we sample landings which combine many fishing events or do we sample at the level of the individual fishing event. This will be considered later in the document.

Best practice

Characterisation of the fishery

A carefully considered design is fundamental to a successful catch sampling programme. We need to understand how a fishery varies in time and space in order to achieve a sensible design. This type of information is generally referred to as a "characterisation" and becomes the most important input to the design of a sampling programme for a fishery. A low level characterisation is necessary to determine which fishery is sampled and how these data will contribute to a management need. In this section, we focus on the requirements for a characterisation of a fishery for the purpose of designing a catch sampling programme. This is a two step process the first step decides what fishery to sample, and the second decides how to sample it. Step one requires the determination of how much catch is taken by the various gears and where and when the catch is taken (e.g. Figure 1).

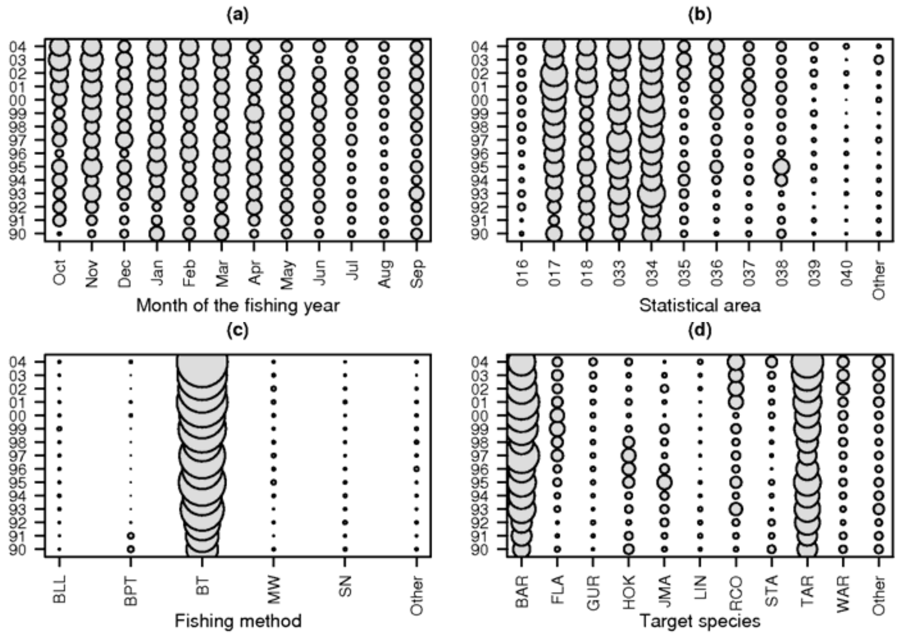

Figure 1: Example of a way to present a descriptive analysis of a fishery. Catch is proportional to the size of the circles (source: Manning, M. J.; Stevenson, M. L.; Horn, P. L. 2008. The composition of the commercial and research tarakihi (*Nemadactylus macropterus*) catch off the west coast of the South Island during the 2004–05 fishing year. NZ FAR 2008/17).

Fishery characterisations are commonly used in the same manner as underpinnings to CPUE analyses. However, a characterisation undertaken for designing a catch sampling programme might include additional factors not necessary for a CPUE analysis. Examples of the data that should be considered in developing step two, which describes how a fishery should be sampled, are provided in Table 1. Expansion of rationale for many of these are described below.

Table 1: Characterisation of a fishery for the purpose of designing a catch sampling programme and other factors that should be considered.

Fleet	**Catch**	**Landings**	**Other**
Number of vessels	Season	Mixed QMA trips	History of co-operation fishing company or LFR with previous sampling programmes
Size or other characterisation	Area	Landings by port	Stock distribution
Gear/method(s)	Method	Processed state	Availability of research survey data
Company	Target species	Number of positive landings	Past designs
Vessel nationality	Factors thought to modify age/length distribution e.g. depth	Statistical distribution of positive landing	Observer coverage
	Number of positive catches	Destination code	Any relevant biology
	Statistical distribution of positive catches		Processing/sorting on boat or in shed
	Reporting regime (e.g. CELR versus TCEPR)		Other sampling at same time

- <u>Number and size of vessels</u>: are the vessels large enough to carry observers or specific crew for at-sea sampling?
- <u>Destination code and processed state</u>: are the fish landed whole and/or are they even landed at all in NZ? This will help determine whether sampling can occur at-sea or at port. How much fish are landed to interim holding containers? If this proportion is relatively large, fish will need to be sampled at the point of catch rather than landing.
- <u>Statistical distribution of positive catches / landings</u>: what is the size of a typical catch or landing? This will help determine the cut-off of a minimum catch/landing size to sample and possibly even the criteria for increased sampling frequency/intensity.
- <u>Processing and/or sorting on boat or in shed</u>: is the catch of the sampled species being sorted and sent to different processors for different markets?
- <u>Mixed QMA (or any other relevant spatial/temporal strata) trips</u>**:** if samples are required from a single QMA or statistical area, how many trips fish across multiple area and time strata? This will be important for determining how much catch might be available for sampling if you sample at the level of the landing.
- <u>Seasonality</u>**:** does the fishery occur throughout the year or during a short time period? This will be important for determining whether the Age Length Key or Random Age Frequency method is most appropriate? This consideration will also affect the sampling strategy, with short seasonal fisheries requiring different approaches than consistent fisheries operating throughout the year.

- Reporting regime**:** Do the fishers record fishing effort at the level of the individual fishery event or is the effort amalgamated before recording? This will determine if it will be possible to link samples back to the individual fishing event and thus associated with factors that might be considered important, e.g. depth or time of day.
- Research surveys: are there surveys occurring in the area that could provide supplementary samples or other data?
- Any relevant biology: is fish size or sex thought to vary on a fine spatial or temporal scale (e.g. seamounts)? Will it be important to collect information on sex or maturity stage for this species? When are the peak growing periods and spawning period and how do these relate to the timing of the fishery? Is there a time of year when otolith ring deposition occurs and can this be avoided to reduce aging error. The collection of otolith samples over a shorter period of time (i.e. 6 months c.f year-round) will could reduce the level of reader error and therefore increase precision in age estimation. The size range of the catch of a species will influence the size of the length frequency sample required under the length frequency plus age-length key approach.
- Observer coverage: will observers be deployed in the fishery? If yes, what is the level of coverage and what is the reason for the coverage, e.g. protected species monitoring or for stock assessment purposes.
- Other sampling programmes: are there are concurrent sampling programmes scheduled for other species in the same fishery which could be amalgamated to save costs or increase efficiency?
- Access issues: Are there political or practical problems that prevent catch sampling occurring in specific companies? What are the implications (potential bias issues) of not sampling these companies or over-sampling compliant companies to in order to obtain the perquisite number of samples?

Point of sampling

Based on the programme objectives and the fishery characterisation, the best location for sampling can then be determined. It is most preferable and thus should be the default to sample at-sea by each fishing event. In many instances, an equally high level of resolution while still sampling on-shore can be met if catches from individual fishing events are put aside systematically. In other situations, sampling the catch from entire trips (e.g. combined fishing events) at the point landing may be completely adequate, depending on the fishery and the management requirements.

Initially, it was hoped that a ‘decision tree’ could be developed to assist when making this choice, but at present, it is probably simpler to make qualitative decisions in terms of the trade-off in data quality influenced by a range of factors (Table 2).

Table 2: Factors to be considered in determining the point of sampling for a catch sampling programme.

Factor	**Issue**	**Sampling preference**
Landed state	Can we get the data we need from the state the fish is landed?	At-sea sampling is essential for fish processed before landing if the necessary parts are lost during processing (unless the required measurements can be back calculated from measurements of the processed fish)
Fine-scale patterns	Is the size/age/sex composition of the catch thought to vary at the individual fishing even level?	At-sea sampling is needed to match of catches to fishing events. But measurements could still be made ashore if appropriate samples from individual fishing events can be set aside at-sea.
Catch vs landings	Do we need to sample the entire catch, including fish smaller than the MLS or subject to Sixth Schedule provisions?	At-sea sampling would be the most appropriate way to sampling catches, but measurements could still be made ashore if appropriate samples are taken and labelled (may require a special permit if a minimum legal size exists).
Catches grading	Are catches sorted at-sea and/or sent to different processors?	Unless it is possible to sample all landings and/or account for any catch sorting, it is necessary to sample prior to sorting
Observer coverage	Are observers currently deployed in this fishery? If yes, is the species a target or bycatch and are there other tasks (e.g. protected species work) which could influence their ability to collect samples?	If there is sufficient observer coverage and there is confidence that observers can collect samples, then it may be useful to use this opportunity. Otherwise, observers could provide a useful audit capacity for any other adopted sampling protocol
Past performance	What sampling approach has been used in the past and was it successful?	
Cost	What are the costs associated with different sampling approaches?	
Other data	Is there other information that could be useful, e.g. product information or some limited observer data?	

Consideration of some of these factors may lead to definitive conclusions, e.g. for fish are processed at-sea. In most instances there will always be trade-offs between cost and data quality.

<u>Design</u>

At this stage, it is possible to formulate a design for the sampling programme. Table 3 below lists some elements of the design and provides some examples.

Table 3: Elements of a catch sampling programme design with examples taken from the sampling programmes for snapper in SNA 1 and SNA 8.

Element	**SNA 1**	**Sna 8**
Fishery to sample	Bottom longline catches of snapper in SNA 1	Single trawl in SNA 8
Seasonal / temporal strata	Spring and summer catches combined, but separated into three sub-areas (HAGU, BPLE, and ENLD)	Spring and summer catches combined
Sampling approach	Shore-based sampling at fish processing sheds	Shore-based sampling at fish processing sheds
Landing selection criteria	Trips must be entirely within each sub-area and the total snapper catch must be more than 100 kg	Trips must be entirely within SNA 8 and the total snapper catch from each vessel must be more than 3 tonnes
Number of landings	Ten samples per month in each area	15 samples per split 8:7 for spring:summer or relative to the commercial catch over the sampling period.
Size of samples to be taken from each landing	Bins in landing / Otoliths collected 10 / 15 20-30 / 20 40-60 / 25 70-90 / 30 100-150 / 35 > 200 / 40	Otoliths subsampled from each landing sampled for length frequency with the aim to fulfil the required numbers in each length class in the age-length key by the end of the sampling period.
Sampling methodology	Random age frequency sampling	LF + ALK sampling
Fish selection	Sample every 10th fish	Sample each landing for length frequency with a random selection of bins (clusters) within each stratum, measuring the entire contents of each selected bin (cluster).

There are many ways to select fish from an eligible landing to achieve representative sampling. The design should carefully consider the approach to fish selection and consider how to minimise bias due to factors such as grab sampling (e.g., sampler having to randomly select a subset of fish from a bin), potential sorting of the catch prior to the sampling point (e.g., bins containing fish of similar size), and aspects of the capture or unloading process that can lead to trends in fish size through a catch/landing (e.g. larger/smaller fish coming out of the pen/well first). The fish sampling criteria should be as simple as possible to avoid differences in implementation across samplers.

In cases where samples are collected through the MFish Scientific Observer Programme (SOP) it is important to consider the specific instructions for sampling each species in the biological sampling manual. This relates to both the frequency and level of sampling and how the instructions in the manual are interpreted[1].

This proposed design should then be tested against relevant historical data. There are two facets of the design to be evaluated: 1) will it achieve the performance criteria,

[1] Participants at the May 2008 workshop noted that for many 'secondary' species the observer instructions are to take a sample of x fish every y days. There is a concern that some observers attempt to get that sample **over** those days rather than from a single fishing event **within** that time window.

e.g. the mean weighted CV or other selected criteria; and 2) how representative can we expect the samples to be? The first calculation is more commonly used when designing sampling programmes. The second test is done less often.

In relation to the second test, it is important that the 'landing selection criteria' should be evaluated against historical data to determine the expected proportion of the total catch of the fishery that would be eligible for selection and whether this proportion varies significantly across the spatial-temporal strata to be sampled. For example, in the example in Table 3 which presumed shed sampling, it is important to estimate the proportion of landings that comes from trips which fished in multiple sub-areas as these landings will not be eligible for sampling. Similarly the landing size criterion can be tested in a similar way.

No quantitative criterion has been set to determine if too much catch has to be dropped because to met the sampling design, but it is expected that sampling designs will be reviewed by the relevant working group. An important consideration is whether the ineligible catch differs in some way from the eligible sampled catch. In these situations an alternative sampling strategy may be required.

Implementation

Access to fish

Guaranteed access to fish is fundamental to a successful sampling programme. Good access typically comes about through a good relationship with the relevant fishing or fish processing company. It has been shown that these relationships can be enhanced by some of the following factors:

- Maintaining a single point of contact, e.g. giving an opportunity to build a relationship;
- Ensuring that the value of the information is known;
- Minimising the effect of the sampling on the day-to-day operation of the commercial activity; and
- Providing feedback on the performance of the sampling and the results.

In instances where a research provider is having difficulty getting access to the fish so that the ability to meet the objectives of the programme are potentially compromised, MFish should be immediately informed to ensure that they are aware of the issue and to see if the situation can be rectified.

It is essential that the catch and effort data associated with the sampling event (either at the level of a landing or a fishing event, depending on what is being sampled) are acquired (or the ability to access). Samples without this auxiliary information are useless.

Information to collect from fish

Costs associated with sampling individual fish vary depending on data requirements and the value of the fish to the processor. There will be fixed costs for collecting the fish, even if all that is done is to take the length of the fish. However, additional costs may be incurred if the fish is damaged when collecting required biological information (such as obtaining an otolith or determining the sex). Often these fish must be purchased at market value when they are sold intact. In other instances, the processor can use these fish in landed states (e.g., fillets) where there is no loss in final value. These considerations should be taken into account when in the design of the sampling programme which includes the information collected from the sampled fish. Even when it is not thought that there are significant sex-specific differences in growth, the extra cost of sexing fish that are cut to collect otoliths is likely minimal compared to the potential value of the additional data. It is recommended that even when sex or maturity stage are not part of the stratification for the sampling programme, consideration be given to collecting that information where appropriate.

On the other hand, it may be prudent to skip or reduce the number of fish which are sampled destructively in instances where this information is less important and it could potentially reduce cooperation and /or access to fish.

Sampling staff

A successful sampling programme requires good quality staff and an adequate level of supervision. Sampling fish is not a simple matter and there are several important attributes that need to be included in the implementation of a sampling programme:

- Understanding of the importance of following sampling protocols without deviation;
- Good record keeping at all levels, including the labelling and tracking of biological samples;
- Ability to take samples correctly (e.g. accurate length measurements and otoliths removed intact); and
- A capacity to operate successfully in a factory setting (either on a fishing boat or a processing shed). This includes good relationships with the factory staff and integrating the sampling process into the ongoing commercial activities.

There is strong support for the establishment of a 'standard' for catch sampling work that ensures that all samplers have had the same basic level of training. Research providers should be aware of these factors when training sampling staff and, in the longer-term, this training could be developed into a formal training package.

Samplers may be tempted to deviate from instructions on the basis of previous training or experience. Any real improvements suggested might be incorporated in the study protocol, but are should be taken to ensure that this does not lead to incompatible data.

It has been demonstrated that it is important to closely oversee/audit the performance of sampling staff, particularly when they first begin sampling. This includes debriefing the sampler. Once confidence in the sampler is established, regular monitoring/auditing of performance is still required, but at a lesser frequency.

The level of training and monitoring is not lessened even when the samplers are subcontractors rather than staff of the research provider. In particular, a formal auditing process should be implemented whenever subcontractors are used as they are often at arms length from the research provider. The results of audits should be reported to MFish and the relevant working groups, if appropriate. While subcontractors, in principle are the responsibility of the research provider, the research provider must report to MFish whenever there are problems with the subcontractors which may have an impact on the ability to meet the objectives of the programme.

Monitoring in-season performance

In addition to monitoring the performance of the samplers, it is critical to monitor the performance of the sampling programme relative to the stated design. This is in part due to the fact that the design is based on historical information and that fisheries respond dynamically to changing market situations. Such changes can be quite sudden and could affect the appropriateness of the original design and/or the ability to meet the performance criteria.

For instance, using the SNA 1 example in Table 3, if fisherman who had been longlining in the Hauraki Gulf unexpectedly moved to the Bay of Plenty to get better quality fish or higher catch rates, it might be necessary to modify the level of sampling in each area. In another example, if a fishery which previously had an even monthly distribution of catch that was being sampled year round suddenly showed a strong seasonal pattern, it might be necessary to change the temporal distribution of sampling effort.

A variety of information sources are available for monitoring in-season performance of the fishery/sampling programme. The most obvious can be obtained from talking with fishing companies and/or requesting the Monthly Harvest Return data from MFish (available at about a 1 month lag). The sampling design should be modified in those instances where it this possible. However, MFish should be informed of any major changes to the sampling strategy (e.g. a decision to not sample a stratum) and/or any fishery changes which cannot be accommodated through design shifts (e.g. no fishery in a given year and a change in method used).

In cases where samples are collected through the MFish SOP there has often been a view that the research provider has little or no control in how the sampling effort is allocated. Rather advice is provided to the SOP through the research planning process and supervision of this programme is effected through the MFish Science and Observer Groups. Essentially, the SOP deploys observers who collect samples, and a research project is set up to analyse these data (after they have been collected) without an opportunity to direct how the samples are collected. In some instances, the data collected in this way has not been suitable for the intended purpose.
However, it is important that the fundamentals of design and monitoring be the same for shore-based shed sampling and at-sea sampling by SOP observers. While the multiple roles of the SOP mean that it can not be expected that a researcher provider will have the equivalent control over sampling effort that they might have over a shed-sampling programme, ideally research providers should liaise closely with the SOP both before and during the sampling period to ensure the best possible outcomes. While this has seldom occurred in the past, this will need to be considered in the specifications for future catch sampling programmes that use the SOP.

Reporting results and diagnostics

There has been considerable variation in the level of detail when reporting the outcomes from sampling programmes from various sampling programmes in the past. Table 4 outlines some of the basic results that should routinely be reported to working groups and/or provided in reports. Some examples of plots that display some of this information are also provided (Figures 2 and 3), but there is no expectation that these plots should be followed exactly.

Table 4: Elements of the outcomes of a catch sampling programme that should be reported to MFish or to the Working Group

Element	Comment
Summary of fishery in year sampled	How did the fishery compare to what had been seen previously and/or used as the basis of the design, e.g. seasonality or absolute level of catch
Sampling effort	Compare actual samples achieved against that planned and explain any differences
Sampling coverage	How much of the catch was eligible to be sampled? How much was actually sampled? and How representative the sampled catch against key factors, e.g. spatial/temporal strata, target species etc.
Sample data	Plots/tables of the characteristics sampled (e.g. catch-at-age) and report against the performance criteria
Sampling performance	Results of the audit / monitoring process that was used to provide quality assurance of the sampling
Time series of samples	Compare the current samples to those taken in previous years
Covariates	Examination of how the age/size composition varies against factors thought to be important, e.g. target species or depth. This is probably better done when multiple years of data are available.
Linking	Details should be provided to MFish (in some form) to allow linking of sample data to landings and/or fishing operations (part of data submission).

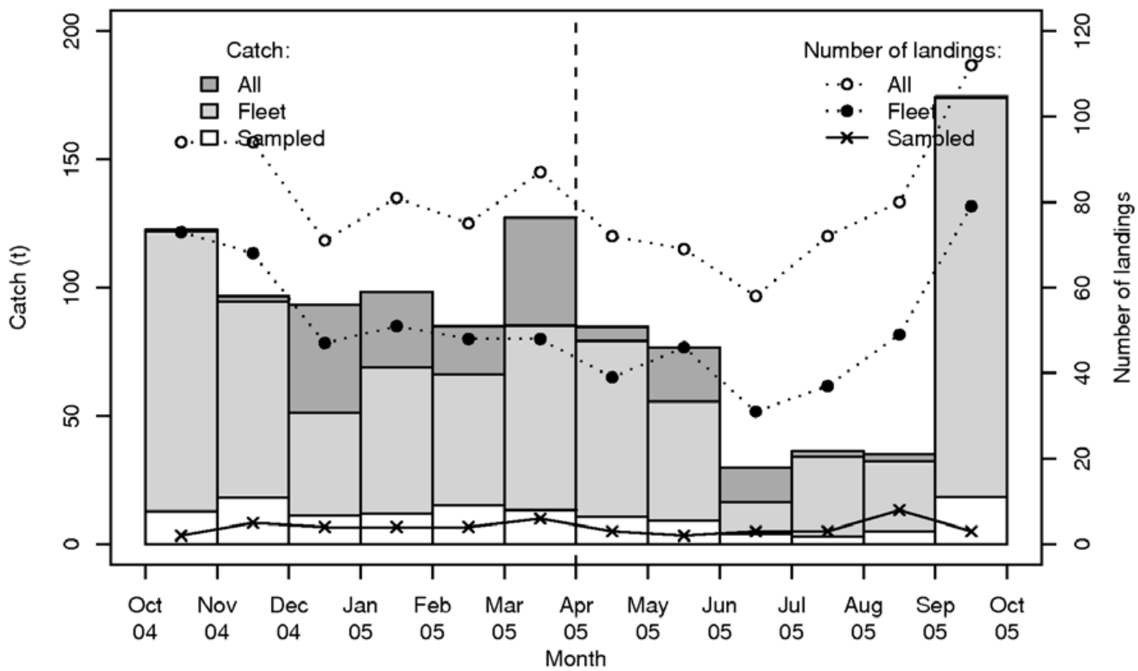

Figure 2: Example of a way to present information on the level of coverage of a catch sampling programme (source: Manning, M. J.; Stevenson, M. L.; Horn, P. L. 2008. The composition of the commercial and research tarakihi (*Nemadactylus macropterus*) catch off the west coast of the South Island during the 2004–05 fishing year. NZ FAR 2008/17).

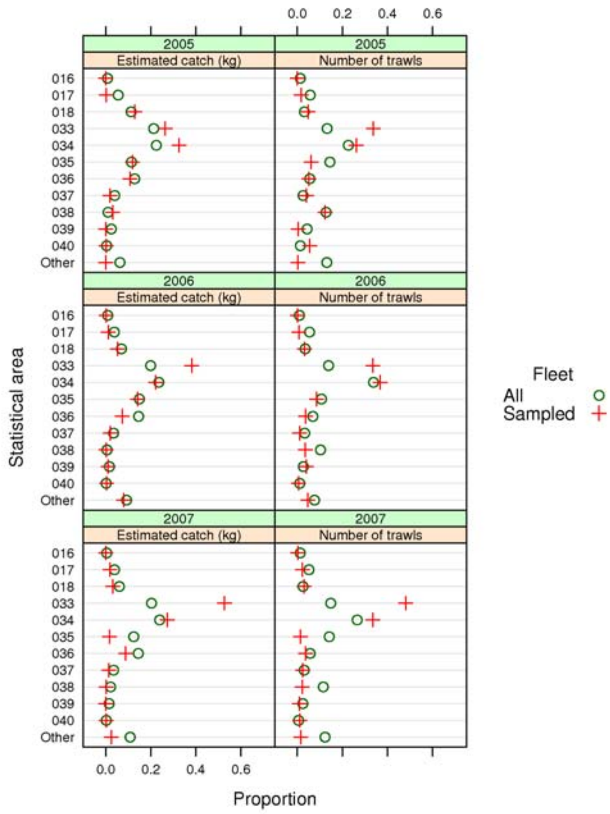

Figure 3: Example of a way to present information on the representativeness of the catch sampling against important factors (source: Manning, M. J.; Stevenson, M. L.; Horn, P. L. 2008. The composition of the commercial and research tarakihi (*Nemadactylus macropterus*) catch off the west coast of the South Island during the 2004–05 fishing year. NZ FAR 2008/17).

Currently there are no accepted obvious candidate for quantitative measures which assess whether samples are sufficiently representative or whether coverage was sufficient. These issues will no doubt be discussed through the Working Group process and progressed over time.

Other issues

Synergies between programmes

In some instances there might be consideration given to whether it might be more cost effective to sample multiple species within the same sampling programme. This is often the case when several species are taken by the same fishing method in similar spatial and depth locations (e.g., east coast South Island bottom trawl fishery). A full characterisation for each of the species taken in the fishery is still the required first step to determine if there is sufficient overlap so that both species can be sampled adequately.. Following that, an analysis of historical data should be undertaken to establish the year-to-year variation. Of critical importance will be what proportion of the landings that meet the eligibility criteria for **both** species. Such an overlap could reduce costs associated with sampling landings.

Based on the experiences of participants at the May 2008 workshop, the actual number of species/fisheries for which this could be done a part of a shed sampling programme is likely to be small, but this would need to be evaluated on a case by case basis. Other issues to be considered when looking for catch sampling efficiencies:

- Cost of collecting samples versus other project costs, e.g. otoliths preparation and reading
- Catch/market impacts, e.g. could we end up 'cutting' a large proportion of the catch
- Continuity of staff, e.g. if we do multiple species in one year and then have a gap for a few years then there is likely to extra costs associated with training and retraining
- Otolith processing, e.g. will all the otoliths be able to be processed in a timely manner

The synergies considered above relate to the sampling of stocks which, in their own right, require a sampling programme. Synergies could also be considered that would allow cost-effective sampling of "bycatch" species that would not otherwise be sampled.

Observers undertaking at-sea sampling often take samples from multiple species on the same trip, but typically not all species are treated the same in terms of frequency and intensity of sampling. If sampling is undertaken by observers, careful consideration should be given to the current instructions in the observer biological sampling manual for the species of interest to ensure that sampling effort is appropriate (e.g. you might want to have a particular species treated as a 'target' rather than a bycatch every second or third year).

Random Age Frequency vs Age-length keys

The two sampling methodologies commonly used for obtaining catch-at-age estimates are Age Length Key (ALK) and Random Age Frequency (RAF) approaches, which are briefly described below.

Under the ALK approach a large sample of fish is measured for length and a smaller sample is aged. Usually the age samples are taken systematically by length to ensure that adequate representation is obtained for all length classes. The paired age/length observations are used (sometimes within a model along with distributional assumptions) to derive an age-length key which is then applied to the large length sample to determine the age structure of the catch. With the RAF approach, there is no separate length sample, and the only a sample is for the fish that are aged. This sample must be taken randomly and is typically somewhat larger than the age sample collected under the ALK approach.

There are several factors that might influence whether the ALK or RAF is most appropriate for a particular fishery and these are covered below (Table 5). A formal cost benefit analysis that takes into account the cost of collecting the various length and age estimates and ageing otoliths should be undertaken to determine which approach should be used.

Table 5: Factors to consider when deciding between an Age Length Key and Random Age Frequency approach.

Factor	Issue	Comment
Seasonality of fishery	Does the fishery occur within a short period or is it throughout the year?	The ALK approach is best suited to fisheries that occur over a short time period. Year around fisheries can be sampled using the ALK approach, but it will often require developing separate ALKs for each season.
Growth period	What is the rate of growth during the period of the fishery?	ALK approaches are best for fisheries where the growth over the season is negligible. As above, if there is significant growth during the fishing season, then multiple ALKs or a RAF approach might be needed
Contrast in length	How much information of age is contained in the length data?	If the range of ages in the catch is much less than the range of sizes, then there is considerable information in the length data and a ALK approach might be more useful as sampling of fish in the margins of a length distribution can be deliberately intensified (but noting issues above).
Accessibility to fish	With high-valued species (e.g. snapper) there are significant costs associated with handling the fish (even for length measurements)? In recreational collections (e.g. KAH), otolith samples may not always be guaranteed.	The number of fish to be 'handled' is much less with the RAF approach, and compensation, if required, need only be made for only the collected samples. Fewer fish may be handled, but more will be cut with an RAF approach. In the case of a recreational fishery, unreliable access militates for the ALK approach.
Random sampling	How easy is it to get a random fish?	The RAF approach relies on being able to take small random samples of fish for ageing. If it is difficult to get a small random sample then the larger length samples required by the ALK approach may lead to less bias in age estimates.
Stock assessment needs	Is selectivity an age- or length-based process	Describing selectivity well is crucial to most stock assessments and selectivity as a process is primarily length based. Modern age-structured stock assessment models often accommodate length based processes such that selectivity ogives can be either length- or age-based. In some instances gear selectivity may be better described through more intensive length sampling and the collection of an age-length transition matrix. Random age sampling due to the collection of fewer length measurements usually results in a less precise fishery length characterisation than with ALK sampling.

Performance criteria

The only consistent performance criterion currently applied to catch sampling programme outputs is the mean weighted c.v. (MWCV) for catch-at-age. While this measure is thought to have some important shortcomings, there is no obvious replacement. MFish views the MWCV is a performance criterion that a catch sampling programme should be designed to achieve, i.e., a research provider would be expected to show how the MWCV target could be met with the proposed design with a slightly greater than a 50% probability. It would be unnecessary to design the programme with high level of sampling which would be expected to achieve the target MWCV with nearly 100% probability.

Even with a good design and implementation the observed MWCV could be different to the expected outcome determined through simulations. Large, unpredicted changes in the fishery or the population (e.g. large recruitment pulse) could lead to a situation where the ‘parameters’ of the fishery are outside that seen with the historical data used in the design phase.

The MWCV should be based of the level of variation in the data that is acceptable, allowing for detectable changes in the size or age compositions. This is best answered in the context of a simulation study that uses the data as intended, e.g., as a stock assessment input or in a catch curve analysis. Such analysis is outside the scope of work to be done when designing and implementing a catch sampling programme.

In the objectives of the programme it should be clear how the MWCV has been calculated, e.g. data pooled across sexes, fisheries, or seasons.

As mentioned previously, there is a need to try and develop quantitative measures of the representative nature of the sampling relative to the total fishery. In the meantime, working groups will qualitatively assess representativeness based on the diagnostics discussed above.

For random age frequency sampling formal tests of the randomness of sampling should be carried out where possible. The rank tests currently available require separate length frequency samples. These may not generally be available in RAF programmes, but could be collected as part of the audit process.

New Technologies

There have been some considerable advances in the collection and capture of catch sampling data. Research providers should feel free to share insights or raise technological issues that could lead to improvement in data collection and quality.