

Aim

This fact sheet provides fishery stakeholders with an example of how management procedures can be applied to deepwater snapper fisheries in the Pacific region

DEEPWATER SNAPPER



Management procedures for deepwater snapper resources in Pacific Island countries and territories

Background

Deepwater snapper are a significant fisheries resource for many Pacific Island countries and territories (PICTs) where they support important domestic and export markets. However, there is a lack of management plans in most PICTs, except the US territories and Tonga, and a lack of information on the status of stocks that could be used to develop or refine management plans.

The current approach to management, where it exists, is more reactive than proactive, which increases the chances of overexploitation and reduces stakeholder certainty in the fishery. Preferably, methods for monitoring and assessment should allow a more adaptive approach to management where the signal from the monitoring directly informs management decisions.



To this end, SPC advocates integrating assessment methods that have been used successfully in other fisheries, including deepwater snapper fisheries in Australia, with a **management procedure** approach that links the assessment to the objectives of the fishery stakeholders.

Management procedures

Below is an example of a management procedure for deepwater snapper that is suitable for the Pacific region. In this example, fishing licences are used to manage the fishery. Management of deepwater snapper in the Pacific is most likely to be based on optimising the number of fishing licenses, rather than setting specific quotas on catch and effort. This is simply because of the difficulty in monitoring the total catch and effort in the fishery, which is necessary for quota management.

Indicator species

Over 100 species are captured in deepwater snapper fisheries in the Pacific region, presenting a major challenge for assessing these stocks. Therefore, the first step in the management procedure is to identify one or more indicator species that are representative, or indicative, of the status of the entire suite of species in the fishery. Using this approach for assessing and managing stocks has two main benefits: (1) resources can be prioritised to allow more frequent assessments for indicator species that indicate the status of the entire resource, and (2) monitoring and management of other deepwater species in the fishery are simplified.

A comprehensive risk assessment framework is used to select indicator species. The risk assessment is based on three criteria: (1) the vulnerability of the species to fishing, which depends on the biological characteristics of the species, (2) their relative contribution to the catch, and (3) importance to support current and future management needs. These characteristics are likely to vary regionally, so PICTs will probably choose different indicator species.

Decision rules, indicators and reference points

Once the indicator species have been selected, fishery stakeholders decide what management actions will be taken when the fishery for these species reaches predetermined **reference points** (the **management procedure**). These management actions are known as **decision rules**. A range of potential 'simple to monitor' **indicators** are then selected and the performance of these indicators is assessed using biological information and simulation modelling. Indicators that are found to be reliable across a range of circumstances can then be used by managers to 'trigger' a decision rule, if certain predetermined levels (target, threshold and limit) are reached.

An example of a decision rule may be to reduce fishing licences when the fishing pressure reaches an undesirable level. The fishing mortality rate (F) could then be a potential biological sustainability indicator, as it provides an indication of the amount of fishing pressure (exploitation rate) on the stock. **Table 1** illustrates how this decision rule could be applied. In this example, each decision rule corresponds to a specific reference point of F , including the F_{target} , $F_{\text{threshold}}$ and F_{limit} . The F_{target} level is a reference point; that is, the target level that management aims for. Between F_{target} and $F_{\text{threshold}}$ there may be no need for a management response, but the fishery should be carefully monitored at this point. Above the $F_{\text{threshold}}$ level is the point at which a rebuilding strategy should begin to be implemented. The F_{limit} level is the point at which significant management action is required. Values for each of these reference points are determined during the simulation process and are agreed to by all stakeholders prior to the assessment. To show an example, let us assume that the values for these reference points are $F_{\text{target}} = 0.1$, $F_{\text{threshold}} = 0.2$, and $F_{\text{limit}} = 0.3$.

At this point, the decision rules for when F is greater than $F_{\text{threshold}}$ are not very specific (i.e. reduce fishing licenses by 0–50%, or by 50–100%), but they can be refined to more specific percentage ranges by using the biological attributes of the indicator species as a proxy for inherent vulnerability (Table 2). The example species in **Table 2** was evaluated as having a medium vulnerability, in which case a mid-range value for the decision rules would be applied when F is between $F_{\text{threshold}}$ and F_{limit} (e.g. reduce fishing licences by 25%) or greater than F_{limit} (e.g. reduce fishing licences by 75%).

Although the biological characteristics of many species captured in deepwater snapper fisheries are currently unknown, work now underway at SPC will provide detailed information on the biology of many of the main target species.

Table 1. Example decision rule table

Fishing mortality (F) estimates	Decision rule for fishing licences
$F < F_{\text{target}}$	Number of fishing licences may increase
$F_{\text{target}} < F < F_{\text{threshold}}$	Number of fishing licences remains constant
$F_{\text{threshold}} < F < F_{\text{limit}}$	Number of fishing licences is reduced, e.g. 0%–50%
$F > F_{\text{limit}}$	Number of fishing licences is reduced significantly, e.g. 50%–100%

Table 2. Relative vulnerability of indicator species used to refine decision rules. The vulnerability scoring of an example species is given, including the overall vulnerability, which is calculated as the most frequent vulnerability score.

Attribute	Vulnerability			Vulnerability score for example species
	Low	Medium	High	
Distribution and movement of adults	Widespread or highly mobile	Limited distribution or movement	Restricted, endemic or sedentary	Medium
Longevity, growth and natural mortality (M)	Short lived (< 10 years), or rapid growth, high M	Modest (10-20 years), or variable growth, moderate M	Long lived (>20 years), or slow growth, low M	High
Reproduction mode, spawning behaviour	Separate sexes, or extended spawning season, or does not form spawning aggregations	Pre-maturational sex change, or limited spawning season, or forms non-predictable spawning aggregations	Post-mature sex change, or restricted spawning season, or forms large predictable aggregations	Medium
Recruitment/Replenishment of stocks	Regular, or consistent recruitment (~20%) that is predictable, or larvae widely dispersed (100s km)	Recruitment is relatively consistent (~50%) but variable over short periods (3 yr), or limited dispersal of larvae (10s km)	Infrequent, highly variable and unpredictable recruitment (0–100%) or restricted dispersal of larvae and juveniles (<10s km)	Unknown
Recovery prospects after depletion	Good, documented examples where this has occurred	Moderate	Poor, recruitment dynamics and other factors suggest it may take decades to recover	Medium
Resilience to change caused by human activity, or environmental change	Highly adaptable to variable environments, or environments/habitats are healthy and in optimum condition	Moderate levels of resilience, or environments/habitats are not in optimum condition but are recovering	Limited adaptability to environmental change, or environments/habitats are degraded or under threat	Low
Overall vulnerability				Medium

Estimating fishing mortality

A reliable and efficient method for estimating fishing mortality (F) is critical to this example of a management procedure. There are numerous methods for estimating F for fish stocks, but the use of catch curves is perhaps the most appropriate for deepwater snapper. Catch curves use the age structure of the fish population to estimate the rate of total mortality (Z). Age estimates are derived from otoliths collected from fish caught in the fishery. An example age structure constructed from age estimates is shown in Figure 1. The declining slope (straight line in Fig. 1) provides an estimate of total mortality, in this case $Z = 0.25$.

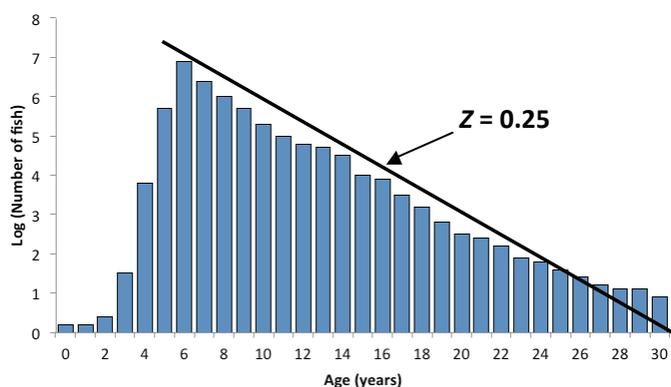


Figure 1. An example age structure from a fish population. The slope of the straight black line provides an estimate of total mortality (Z).

Total mortality (Z) consists of two components: natural mortality (M) and fishing mortality (F), such that $Z = M + F$. Therefore, to estimate F from our catch curve estimate of Z , we need to know what M is. For deepwater snapper, SPC has collected biological samples from remote seamounts where there has been little or no fishing. By deriving age estimates from these samples from populations that have not been exposed to fishing mortality, the estimate of Z from the catch curve is a good approximation of M (i.e. $Z = M$). Assuming that we estimate M to be 0.1 from our remote seamounts, our estimate of F for the above example would be 0.15 (i.e. $0.25 = 0.1 + 0.15$).

This estimate of F is then compared to the reference levels in **Table 1** to determine what management action should be taken. In this example, the values of our reference points are $F_{\text{target}} = 0.1$, $F_{\text{threshold}} = 0.2$, and $F_{\text{limit}} = 0.3$. Therefore, our estimate of F (0.15) is between our F_{target} and $F_{\text{threshold}}$ values, which indicates that the number of fishing licenses should remain constant, but the fishery should be carefully monitored to ensure that fishing mortality does not increase above $F_{\text{threshold}}$.

For more information

Dr Ashley Williams
Senior Fisheries Scientist
ashleyw@spc.int

Dr Simon Nicol
Principal Fisheries Scientist
simonn@spc.int



CONTACT DETAILS

Secretariat of the Pacific Community

SPC
Headquarters
BP D5, 98848
Noumea Cedex
New Caledonia
Tel: +687 26 20 00
Fax: +687 26 38 18

SPC
Suva Regional Office
Private Mail Bag
Suva, Fiji Islands
Tel: +679 337 0733
Fax: +679 337 0021

SPC
Regional Office
PO Box Q, Kolonia
Pohnpei, 96941 FM
Federated States of Micronesia
Tel: +691 3207 523
Fax: +691 3202 725

SPC
Solomon Islands Country Office
PO Box 1468
Honiara, Solomon Islands
Tel: +677 25543 +677 25574
Fax: +677 25547

Email: spc@spc.int
Website: www.spc.int