

Guidelines for implementing the South Australian fisheries harvest strategy policy

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GUIDELINES FOR IMPLEMENTING THE SOUTH AUSTRALIAN FISHERIES HARVEST STRATEGY POLICY

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1. INTRODUCTION

The *South Australian Fisheries Harvest Strategy Policy* (the Policy) provides an overarching framework for the development of consistent harvest strategies for South Australian fisheries, to further the objectives of the *Fisheries Management Act 2007*. The adoption of a consistent and harmonised approach to harvest strategy development is expected to lead to better managed fisheries across South Australia, as decisions on ecologically sustainable harvest levels will be made in a more transparent, timely and predictable manner, with the support and understanding of fishers and key stakeholders. The Policy reflects key domestic and international policy obligations for fisheries management and seeks to provide a transparent and predictable operating environment for the fishing industry.

This set of guidelines for the implementation of the South Australian Harvest Strategy (the Guidelines) has been developed to assist with the implementation of harvest strategies under the Policy and provide guidance on applying the Policy in various fishery circumstances. The Guidelines are intended to support harvest strategy development across the full range of South Australian fisheries, including input- and output-managed fisheries, single- and multi-species fisheries, large and small fisheries and data-rich to data-poor fisheries. The Policy advocates a risk management approach, whereby exploitation levels reduce as uncertainty around biological stock status increases. This will ensure fisheries are managed at an acceptable level of risk, irrespective of level of knowledge.

1.1 Key steps involved when developing a harvest strategy

The Policy provides the core principles of a harvest strategy. Using those principles, the Guidelines aim to provide an overview of the key steps that should be followed in the process to develop a harvest strategy, noting that some steps may not be necessary if comprehensive arrangements already exist at the individual fishery level. These key steps build on earlier work undertaken to establish the *Commonwealth Fisheries Harvest Strategy Policy and Guidelines* (Australian Government 2007) and the *National Guidelines to Develop Fishery Harvest Strategies* (Sloan et al. 2014).

1.1.1 Define the fishery to which the harvest strategy applies

An important step in determining the scope of the harvest strategy is defining the fishery. Having an agreed and clear definition of the fishery makes it easier to identify which objectives are of most relevance and utility to the fishery. This is important because objectives will vary depending on the individual fishery and its characteristics. A list of some of the information that should be considered when defining a fishery is provided in Sloan et al. (2014) and include:

- Life history characteristics for each species;
- All sources of mortality;
- Method of fishing such as gear type, vessel numbers and vessel type;
- Location of fishing, taking note whether there have been spatial changes over time;
- User groups, including any information on catch shares;
- Ecological impacts caused by fishing, including any threatened, endangered and protected species (TEPS) interactions;
- Environmental effects on the fishery; and
- Existing management arrangements in terms of the management framework currently in use.

1.1.2 Establish a mechanism to engage stakeholders in the process

Fishers and other key stakeholders provide local knowledge and much of the data required for assessment of fishery performance. For this reason, determining an appropriate mechanism to engage fishers and relevant key stakeholders is therefore an important step in the harvest strategy design process.

How this is done will need to be assessed on a case-by-case basis and will be influenced by the resources available. Expertise-based advisory committees established for a defined task and a set period of time, that include fishery managers, scientists, fishers and other key stakeholders often work well in achieving the desired level of engagement and expert input. Incorporating independent expertise in the process can also be beneficial, particularly for transparency. Actively involving fishers and other key stakeholders is also more likely to result in management arrangements that are respected and complied with willingly (Matic-Skoko et al. 2011). It leads to improved trust between stakeholders and efficiency in decision making, as fishers and other key stakeholders 'buy in' to the decisions that result from application of the harvest strategy (Sloan et al. 2014).

All fishing sectors (commercial, recreational, charter, Aboriginal traditional) and the wider community have an interest in the sustainability of the State's fisheries resources and how they are managed. The roles of fishers, key stakeholders and government need to be clearly stated in the harvest strategy design process because priorities often vary between different stakeholder groups. Unless there is a mutual understanding of the different stakeholders' priorities, there is no clarity on how the fishery should be operated in terms of addressing ecological, economic and social performance outcomes. Lack of clarity can result in *ad-hoc* decisions and sub-optimal use of resources, which increases the probability of serious conflicts, as different interest groups jostle for greater shares of the benefits (Cochrane 2002). Understanding these differences will help in the identification of 'best compromise' outcomes and requires careful consideration of the range of stakeholders who should be included in the priority setting process for the objectives.

1.1.3 Identify relevant legislation and overarching policy objectives

There are various pieces of international, Commonwealth and State legislations and overarching policies related to the ecologically sustainable development (ESD) of fisheries. International obligations are contained in treaties such as the *United Nations (UN) Convention on the Law of the Sea* (1982)¹, the *UN Straddling Fish Stocks Agreement* (UNCLOS 1995) and the *FAO Code of Conduct for Responsible Fisheries* (FAO 1995). Relevant conservation-focused international obligations include the *Convention on Biological Diversity*, *Convention on Conservation of Migratory Species of Wild Animals* and *Convention on International Trade in Endangered Species (CITES) of Wild Fauna and Flora*. Relevant Commonwealth legislation includes the *Environment Protection and Biodiversity Conservation Act 1999* and the *Fisheries Management Act 1991*. Within South Australia, relevant legislation includes the *Fisheries Management Act 2007* and the *National Parks and Wildlife Act 1972*. Administration of these Acts, and related broad policy frameworks lies within PIRSA Fisheries and Aquaculture and the Department of Environment Water and Natural Resources (DEWNR), respectively.

The management objectives in the aforementioned international, Commonwealth and State legislations and overarching policy frameworks are 'high-level' and frequently expressed in broad terms, such as 'maximise benefit for the community' and are not designed to be used as actual operational targets for a harvest strategy.

¹ http://www.un.org/Depts/los/convention_agreements/convention_overview_convention.htm

1.1.4 Developing defined conceptual fishery management objectives

Traditionally, high level objectives have been translated into guiding 'conceptual' fishery management objectives, usually contained within fishery-specific management plans (Sloan et al. 2014). These conceptual objectives are designed to be relevant at the fishery-specific level and to management of individual fisheries, consistent with legislation and overarching policies (Sainsbury and Sumalia 2003). They sit above the operational objectives needed for the purposes of harvest strategy development and should reflect the interests and input of fishers and other key stakeholders.

Conceptual objectives should relate to the species, fish stock or fisheries management unit that they apply to and need to be developed in the context of the existing fisheries legislation, overarching policy objectives and any relevant ministerial directives. These conceptual objectives should ideally be defined and agreed upon by the various stakeholders early on in the development of a harvest strategy because they directly influence the management options suitable for the fishery (Dowling et al. 2011).

When developing the conceptual management objectives, the trade-offs between the ecological, economic and social outcomes being sought should be considered at the beginning of the harvest strategy design process, preferably in consultation with all key stakeholders. These trade-offs should be identified and understood so that the agreed management objectives can be achieved.

Following the establishment of agreed conceptual management objectives for a particular fishery, a set of operational objectives should be clearly defined for individual species in the fishery. These operational objectives should be specific, easily measured and linked to the performance indicators, reference points and decision rules of a harvest strategy. The operational objectives should also clearly identify the fish stock or fisheries management unit they apply to (see Section 1.1.6 - Building the technical elements of the harvest strategy).

As an example, Box 1 demonstrates the linkages between the three tiers of management objectives for the South Australian Pipi Fishery:

- 1) High-level legislative objectives;
- 2) Conceptual management objectives established for an individual fishery; and
- 3) Operational management objectives established for defined species (see Sloan et al. 2014).

Box 1: Example of the linkage between 'high-level' legislative objectives, 'conceptual' fishery management objectives and 'operational' management objectives for the Pipi Fishery

TIER 1-High level legislative objective (Fisheries Management Act 2007)

-To protect, manage, use and develop the aquatic resources of the State in a manner that is consistent with ecologically sustainable development

TIER 2-Conceptual fishery management objective (Lakes and Coorong Fishery Management Plan)

-Ensure the Lakes and Coorong Fishery resources are harvested within ecologically sustainable limits

TIER 3-Operational management objective for Pipi Fishery (Lakes Coorong Fishery Management Plan)

-Maintain a target Pipi relative biomass above 10 kg/ 4.5 m² and not less than 8 kg/ 4.5 m²

-Ensure the Pipi relative biomass does not drop below 4 kg/ 4.5 m²

-Maximise Fishery Gross Margin

Determining the biological stock status of the fishery being managed is an important step in the harvest strategy design process because the priorities or objectives for a fishery are often linked to biological stock status. For example, an overfished stock may require additional resources for assessment and have more restrictive decision rules than a stock that is sustainable. To ensure consistency, the guidelines in the National Fish Stock Status Reporting Framework (Flood et al. 2012; 2014) will be used to assess fishery biological status and the reference points defined in this framework will be linked to the harvest strategy, to assist with reporting of biological status.

To enable a harvest strategy to incorporate all aspects of ESD (and not just focus on the ecological aspects), the economic and social performance of each fishery should also be considered, where appropriate. An effective way to establish the overall ESD status and context of a fishery is to use the national ESD reporting framework tool developed by Fletcher et al. (2002) to conduct an assessment of the ecological, economic and social risks to the fishery. Conducting an ESD risk assessment will assist to identify and prioritise the full suite of ecological, economic and social issues in the fishery and help inform harvest strategy development in the context of achieving ESD outcomes for the fishery. While conducting an ESD risk assessment is not considered to be critical to developing a harvest strategy, it is recommended that this occurs because it will facilitate a holistic approach to ensure the full set of ESD characteristics of a fishery are incorporated in the harvest strategy.

Ensuring the ecological, economic and social objectives are considered together enables identification of any trade-offs or conflicts, and agreement on how to prioritise issues across the three types of objectives. Often, it is possible to balance ecological, economic and social goals, but when it is not possible, ecological objectives such as protecting aquatic resources from over-exploitation and ensuring they are not endangered have primacy over economic and social objectives.

Conducting an ESD risk assessment will also ensure issues such as by-catch, by-product and broader ecosystem impacts including TEPS interactions are taken into account. It is important to note that while issues like TEPS interactions may influence harvest strategy design, they should not be considered a determining factor, as there are many ways in which such issues can be managed within the overall fisheries management system.

1.1.6 Building the technical elements of the harvest strategy

The key technical elements of a harvest strategy form an integrated package and should be developed together to create a formal structured decision making framework (Sloan et al. 2014).

Develop operational management objectives

Because the conceptual fishery management objectives are frequently expressed in broad terms, the desired outcomes for a harvest strategy need to be translated into 'operational' management objectives that are relevant for defined species within a fishery. Operational management objectives are more precise and formulated in such a way that the extent to which they have been achieved during a specified period should be measured (Cochrane 2002; Fletcher et al. 2002; Sloan et al. 2014). To be effective, operational objectives should be consistent with higher level legislative and conceptual fishery management objectives articulated in the management plan and linked to performance indicators and reference points. Often, a particular reference level of a performance indicator can be translated directly into an operational objective. Establishing linkages between the operational objective, performance indicator and reference point in this way, helps to ensure that the performance of the fishery can be measured and audited against the operational objectives.

Develop performance indicators, reference points and acceptable levels of risk

The indicators and reference points developed for a particular fishery and/or stock in accordance with the policy will be largely determined by the availability of information. This will depend on both availability of past data, but also on decisions made about future monitoring and assessment methods to be used in the fishery, noting the 'catch-cost-risk' trade-off inherent in such choices (Fletcher et al. 2002; Sainsbury 2005; Dowling et al. 2013).

The performance indicators that are chosen should be able to measure the extent to which the objectives are being achieved. Importantly, the development of indicators and reference points is an iterative process. There will often be a range of available indicators and reference points and the choice of which to use will be influenced by the objectives chosen and by the relative costs of data collection and stock assessment required to determine the performance indicators.

Harvest strategies should be designed to meet the probability and risk thresholds specified for the management of the fishery, in accordance with the policy, and regardless of the level of uncertainty of assessments. This is an explicit recognition of the need for precaution in the face of uncertainty. In general terms, it requires that increasing assessment or management uncertainty will be mitigated by reducing exploitation rates. This should result in acceptable levels of risk of breaching a biological limit reference point (as defined in the Policy) being achieved no matter the level of uncertainty. In general, harvest strategies that adopt higher levels of exploitation should adopt higher levels of monitoring and more regular assessment, which inherently involves higher costs. Therefore, in a cost-limited context, a more cautious strategy should be adopted in data-poor fisheries.

A tiered approach is a useful way to deal with different levels of information and uncertainty in assessments of stocks (e.g. Smith et al. 2008). Each tier corresponds to a given availability of data and a method to assess biological status. The decision rules may also vary across tiers, and should be selected at each tier to achieve the same acceptable level of biological, economic and social risk. This inevitably means that tiers based on less certain information will need to be more precautionary in nature.

Regardless of the level of uncertainty in assessments, all harvest strategies must ensure that there is a 'high likelihood' that the biological objectives will be achieved, particularly those that are designed to avoid a stock or management unit becoming overfished or recruitment overfishing occurring (i.e. those that are linked to biological limit reference points). The correct interpretation of the risk criterion is that the stock or management unit should stay above the limit at least 90% of the time (i.e. a 1 in 10 year risk that stocks will fall below the limit), under the application of the harvest strategy. However, there may be highly variable species (e.g. some small pelagic species such as Sardines) where this criterion could be violated even in the absence of fishing. The harvest strategy for such species will need to reflect this and the risk criterion be suitably amended (Australian Government 2007).

Develop the monitoring and assessment system and the decision rules

There will often be a range of available data collection, monitoring and assessment methods to consider when developing the harvest strategy. The right option will require judgement on a case by case basis to suit the individual fishery needs and will be influenced by the available data, future needs and the relative costs associated with the different methods. As noted in Sloan et al. (2014), decision rules can take many forms and need to be part of the overall package. The decision rules are linked directly to the reference points and performance indicators and are dependent on the monitoring and assessment strategy that is chosen. These choices need to be pragmatic and take account of the design principles listed in Sloan et al. (2014) prior to implementation.

1.1.7 Testing the robustness of a harvest strategy

In recognition of the inherent uncertainty in knowledge of the past and current biological stock status of fish stocks or fisheries management units, and their response to different levels of harvest and their current and future productivity, an evaluation/testing of the likely performance of any proposed harvest strategy to achieve operational objectives should be undertaken prior to implementation (Davies et al. 2007). Such testing is particularly important when information on the fishery is incomplete and imprecise, and when the relationship between the harvest decision rule and management actions is complex (Davies et al. 2007). One approach is to use a simulation model to represent the underlying dynamics of the fishery and evaluate how different operational objectives in a harvest strategy will impact on future fishery performance, through comparing the relative performance of possible alternatives. This allows for the explicit calculation of the probability of breaching reference points (Australian Government 2007).

However, an evaluation of a harvest strategy need not just be simulation-based. More qualitative methods can also be applied, and 'empirical' tests can also be undertaken to evaluate scenarios such as 'what if' the harvest strategy had been applied in the past, given the history of biological status observed (Smith et al. 2004; Prince et al. 2011) or how well the approach worked in the past, in the fishery being assessed, or in similar fisheries. The focus of the evaluation is to identify whether the proposed harvest strategy is likely to be suitably 'robust' based on known and plausible sources of uncertainty in the biological stock status and dynamics of the fishery (Davies et al. 2007).

1.1.8 Periodic review and update of the harvest strategy

A key function of harvest strategies is to provide for increased certainty, transparency and predictability in the management of fisheries. However, this must also be balanced with the need for flexibility to allow for changing circumstances and for new information to be considered (Hilborn and Walters 1992). Experience world-wide has demonstrated that irrespective of the amount of prior testing of a harvest strategy (Smith et al. 2008), periodic amendments to ensure management decisions are being made are likely and indeed necessary. For example, when there is new information that substantially changes understanding of the biological stock status of a fishery; when problems are identified in application of the harvest strategy; or when uncertainties that were not previously understood arise (Australian Government 2007).

One way to build in flexibility is to identify the 'exceptional circumstances' that may trigger departure from or even suspension of the harvest strategy. This allows for flexibility in a structured way, but not so much flexibility that it undermines the intent of having a harvest strategy. In this sense, understanding the boundaries of flexibility in a harvest strategy is part of the iterative process to develop mutual understanding among managers, fishers and stakeholders about expectations from adopting a formal harvest strategy. Specifically, this could include defining the exceptional circumstances that may trigger such a change. Having flexibility to change the framework to deal with exceptional or unforeseen circumstances should not be confused with flexibility in interpreting the results of assessments and applying the harvest decision rules within years, which will tend to undermine the process itself (Smith et al. 2008).

1.2 Considerations for specific fishery scenarios

The *National Guidelines to Develop Fishery Harvest Strategies* (Sloan et al. 2014) outlines a set of considerations to be taken into account when designing a tailored harvest strategy for particular types of fisheries. It is proposed that the fishery specific scenarios outlined in the National Guidelines are used where necessary to provide additional guidance to harvest strategy development for fishery specific scenarios under the *South Australian Fisheries Harvest Strategy Policy*.

2. ACRONYMS or ABBREVIATIONS

CITES	Convention on International Trade in Endangered Species
CPUE	Catch Per Unit Effort
EBFM	Ecosystem Based Fisheries Management
ESD	Ecologically Sustainable Development
FAO	Food and Agriculture Organization of the United Nations
FRDC	Fisheries Research and Development Corporation
ITQ	Individually Transferable Quota
MEY	Maximum Economic Yield
MSY	Maximum Sustainable Yield
PIRSA	Department of Primary Industries and Regions South Australia
TAC	Total Allowable Catch
TACC	Total Allowable Commercial Catch
TEPS	Threatened, Endangered and Protected Species

3. GLOSSARY

Aboriginal traditional fishing: Fishing engaged in by an Aboriginal person for the purposes of satisfying personal, domestic or non-commercial, communal needs, including ceremonial, spiritual and educational needs, and using fish and other natural marine and freshwater products according to relevant Aboriginal custom.

Allocation: Distribution of the opportunity to access fisheries resources, within and between fishing sectors.

Biomass (B): Total weight of a stock or a component of a stock; for example, the weight of spawning stock biomass is the combined weight of sexually mature animals.

Biomass limit reference point (B_{LIM}): Stock biomass below which the risk to the stock is regarded as unacceptably high. This is usually expressed as a fraction of the average adult biomass before the commencement of fishing.

Biomass at maximum economic yield (B_{MEY}): Average biomass corresponding to maximum economic yield.

Biomass at maximum sustainable yield (B_{MSY}): Average biomass corresponding to maximum sustainable yield.

Co-management arrangements: An arrangement in which responsibilities and obligations for sustainable fisheries management are negotiated, shared and delegated between government, fishers, and other interest groups and stakeholders.

Commercial fishing: Fishing undertaken for the purpose of trade or business.

Compliance and enforcement: Enforce the provision of the *Fisheries Management Act 2007* through the detection and investigation of illegal fishing activity in South Australia waters.

Cost of management: Commercial fishery management services will generally include biological monitoring and reporting; policy, regulation and legislation development; compliance and enforcement services; licensing services and research.

Cost recovery policy: A framework for consistent, transparent and accountable cost recovery arrangements, which promote the efficient allocation of resources.

Decision rule: Pre-determined actions, linked directly to performance indicators and information about current status, and designed to maintain fishery performance in line with operational objectives. These management actions may also be linked to reference points.

Ecologically sustainable development (ESD): Using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased. ESD principles require that:

- decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equity considerations
- if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation
- the principle of inter-generational equity: that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations
- the conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making and
- improved valuation, pricing and incentive mechanisms should be promoted.

Ecosystem: A dynamic complex of plant, animal, fungal, and micro-organism communities and the associated non-living environment interacting as an ecological unit.

Environmentally limited stock: Spawning stock biomass has been reduced to the point where average recruitment levels are significantly reduced, primarily as a result of substantial environmental changes/impacts or disease outbreaks (i.e. the stock is not recruitment overfished). Fisheries management has responded appropriately to the environmental change in productivity.

Fishery: A term used to describe the collective enterprise of taking fish. A fishery is usually defined by its purpose (commercial, recreational or Aboriginal), a combination of the species caught (one or several), the gear and/or fishing methods used, and the area of operation.

Fishing mortality (F): The instantaneous rate of fish deaths due to fishing a designated component of the fish stock. F reference points may be applied to entire stocks or segments of stocks and should match the scale of management unit. Instantaneous fishing mortality rates of 0.1, 0.2 and 0.5 are equivalent to 10 per cent, 18 per cent and 39 per cent, respectively, of deaths of a stock due to fishing. See also Mortality, Natural mortality (M).

Fish stock: A discrete population of a fish species, usually in a given geographical area and with negligible interbreeding with other biological stocks of the same species.

Fishery management unit: Defined in terms of the area of water or seabed that is fished, the jurisdictional boundaries that exist, the people involved in the fishery, the species caught, the fishing methods and types of boats used.

Harvest strategy: Framework that specifies pre-determined actions in a fishery for a defined species (at the stock or management unit level) necessary to achieve the agreed ecological, economic and social management objectives (Sloan et al. 2014).

Limit reference point: Defines the values of a performance indicator for a fish stock or fisheries management unit that are not considered acceptable.

Management plan: Document created under *Fisheries Management Act 2007* to manage a fishery.

Management strategy evaluation: Qualitative or quantitative procedure, whereby alternative management strategies are evaluated and compared before implementation.

Maximum Economic Yield (MEY): The sustainable catch level for a commercial fishery that allows net economic returns to be maximised. For most practical discount rates and fishing costs, MEY implies that the equilibrium stock of fish is larger than that associated with maximum sustainable yield (MSY).

Maximum Sustainable Yield (MSY): The maximum average annual catch that can be removed from a stock over an indefinite period under prevailing environmental conditions.

Operational objective: An objective that has a direct and practical interpretation in the context of a fishery and against which performance can be evaluated (in terms of achievement) (Fletcher et al. 2002).

Overfished stock: Spawning stock biomass has been reduced through catch, so that average recruitment levels are significantly reduced (i.e. recruitment overfished). Current management is not adequate to recover the stock, or that adequate management measures have been put in place but have not yet resulted in measurable improvement.

Performance indicator: A quantity that can be measured and used to track changes in an operational objective.

Precautionary principle: Approach to fisheries management where the lack of full scientific certainty should not be used as a reason for postponing measure to conserve target species, associated or dependent species and non-target species and their environment.

Protected: A species of aquatic resource declared by the regulations to be a protected species for the purposes of the *Fisheries Management Act 2007*.

Recreational fishing: Fishing other than commercial fishing or Aboriginal traditional fishing, where the catch is released or used for personal consumption or taken for sport.

Recruitment overfished: The point at which a stock is considered to be recruitment overfished is the point at which the spawning stock biomass has been reduced through catch, so that average recruitment levels are significantly reduced.

Quantitative model-based stock assessment: An assessment that produces information on the biological status of a stock using a mathematical model of the population to make inferences from data. Common examples include the estimation of biomass and egg production, which are not usually measured directly but can be inferred through modelling observed patterns in catch rate, size structure, growth, etc.

Stock assessment: An assessment that produces information on the biological status of a stock.

Stakeholder: An individual or a group with an interest in, or connection with, the conservation, management and use of a resource.

Sustainable stock: Biomass (or biomass proxy) is at a level sufficient to ensure that, on average, future levels of recruitment are adequate (that is, not recruitment overfished) and for which fishing pressure is adequately controlled to avoid the stock becoming recruitment overfished.

Target reference point (BTARG): The desired biomass of the stock.

Target reference point: Defines the values of a performance indicator for a fish stock or fisheries management unit that are desirable or ideal and at which management should aim.

Total Allowable Commercial Catch (TACC): For a fishery, a catch limit set as an output control on fishing. Where resource-sharing arrangements are in place between commercial and recreational fishers, the term total allowable commercial catch (TACC) applies. The term 'global' is applied to TACs that cover fishing mortality from all fleets, including Commonwealth, state and territory fleets.

Transitional-depleting stock: A deteriorating stock—biomass is not yet recruitment overfished, but fishing pressure is too high and moving the stock in the direction of becoming recruitment overfished.

Transitional-recovering stock: A recovering stock—biomass is recruitment overfished, but management measures are in place to promote stock recovery, and recovery is occurring.

Trigger reference point: Defines the values of a performance indicator for a fish stock or fisheries management unit at which a change in management is considered or adopted.

Undefined stock: Insufficient information exists to determine stock status.

4. REFERENCES

- Australian Government (2007). Commonwealth Fisheries Harvest Strategy: Policy and Guidelines. Australian Government Department of Agriculture, Fisheries and Forestry, Canberra, Australia. 55pp.
- Cochrane K.L. (ed.) (2002). A fishery manager's guidebook. Management measures and their application. FAO Fisheries Technical Paper. No. 424. Rome, FAO. 231pp.
- Dichmont C.M. and Brown I. (2010). A case study in successful management of a data-poor fishery using simple decision rules: the Queensland Spanner Crab Fishery. *Marine and Coastal Fisheries: Dynamics, Management, and Ecosystem Science* 2: 1–13.
- Dichmont C.M., Dowling N.A., Smith A.D.M., Smith D.C. and Haddon, M. (2011). Guidelines on developing harvest strategies for data-poor fisheries. CSIRO Marine and Atmospheric Research, Hobart, Australia. 27pp.
- Dowling N.A., Dichmont C.M., Venables W., Smith A.D.M., Smith D.C., Power D. and Galeano D. (2013). From low to high value fisheries: is it possible to quantify the trade-off between management cost, risk and catch? *Marine Policy* 40: 41-52.
- Dowling N.A., Haddon M., Smith D.C., Dichmont C.M. and Smith A.D.M. (2011). Harvest strategies for data-poor fisheries: A brief review of the literature. CSIRO Marine and Atmospheric Research, Hobart, Australia. 43pp.
- Dowling N.A., Smith D.C., Knuckey I., Smith A.D.M., Domaschitz P., Patterson H.M. and Whitelaw W. (2008). Developing harvest strategies for low-value and data-poor fisheries: Case studies from three Australian fisheries. *Fisheries Research* 94(3): 380-390.
- FAO (1995). Code of conduct for responsible fisheries. Food and Agriculture Organization, Rome, 41p.
- Flood M, Stobutzki I, Andrews J, Begg G, Fletcher W, Gardner C, Kemp J, Moore A, O'Brien A, Quinn R, Roach J, Rowling K, Sainsbury K, Saunders T, Ward T and Winning M (eds) (2012). Status of key Australian fish stocks report 2012. Fisheries Research and Development Corporation, Canberra, Australia, 419 p.
- Flood M, Stobutzki I, Andrews J, Ashby C, Begg G, Fletcher R, Gardner C, Georgeson L, Hansen S, Hartmann K, Hone P, Horvat P, Maloney L, McDonald B, Moore A, Roelofs A, Sainsbury K, Saunders T, Smith T, Stewardson C, Stewart J and Wise B (eds) (2014), Status of key Australian fish stocks reports 2014. Fisheries Research and Development Corporation, Canberra, Australia, 620p.
- Fletcher W.J., Chesson J., Fisher M., Sainsbury K.J., Hundloe T., Smith A.D.M. and Whitworth, B. (2002). National ESD Reporting Framework for Australian Fisheries: The 'How To' Guide for Wild Capture Fisheries. FRDC Project 2000/145, Canberra, Australia. 120pp.
- Hilborn R. and Walters C.J. (1992). Quantitative Fisheries Stock Assessment: Choice, Dynamics and Uncertainty. Chapman and Hall, New York. 570pp.
- Hundloe T.J. (2000). Economic performance indicators for fisheries. *Marine Freshwater Research* 51(5): 485-491.
- Matic-Skoko S., Stagicic N., Pallaoro A., Kraljevic M., Dulcic J., Tutman P. and Dragicevic, B. (2011). Effectiveness of conventional management in Mediterranean type artisanal fisheries. *Estuarine, Coastal and Shelf Science* 91(2): 314-324.
- Prince J.D., Dowling N.A., Davies C.R., Campbell R.A. and Kolody, D.S. (2011). A simple cost-effective and scale-less empirical approach to harvest strategies. *ICES Journal of Marine Science* 68: 947-960.

Punt A.E., Smith A.D.M. and Cui, G.R. (2002). Evaluation of management tools for Australia's South East Fishery 3. Towards selecting appropriate harvest strategies. *Marine and Freshwater Research* 53(3): 645-660.

Sainsbury K. (2005). Cost-effective management of uncertainty in fisheries. *Outlook 2005*, Australian Bureau of Agricultural and Resource Economics, Canberra, Australia.

Sainsbury K.J. and Sumalia U.R. (2003). Incorporating ecosystem objectives into management of sustainable marine fisheries, including 'best practice' reference points and use of Marine Protected Areas. Pp 343-361 In 'Responsible Fisheries in the Marine Ecosystem', M. Sinclair and G. Valdimarsson (eds). CABI Publishing, Oxon, UK.

Sloan, S. R., Smith, A.D.M., Gardner, C., Crosthwaite, K., Triantafillos, L., Jeffries, B. and Kimber, N (2014) National Guidelines to Develop Fishery Harvest Strategies. FRDC Report – Project 2010/061. Primary Industries and Regions, South Australia, Adelaide, March. CC BY 3.0. 70pp.

Smith A.D.M., Sachse M., Smith D.C., Prince J., Knuckey I.A, Baelde P., Walker T.J. and Talman S. (2004). Alternative management strategies for the Southern and Eastern Scalefish and Shark Fishery. Qualitative Assessment Stage 1, Report to the Australian Fisheries Management Authority, Canberra, Australia. 94pp.

Smith A.D.M., Smith D.C., Tuck G.N., Klaer N., Punt A.E., Knuckey I.A. Prince J., Morison A., Kloser R., Haddon M., Wayte S., Day J., Fay G., Pribac F., Fuller M., Taylor B. and Little L.R. (2008). Experience in implementing harvest strategies in Australia's south-eastern fisheries. *Fisheries Research* 94(3): 373-379.

Smith D.C., Punt A.E., Dowling N.A., Smith A.D.M., Tuck G.N. and Knuckey I.A. (2009). Reconciling approaches to the assessment and management of data-poor species and fisheries with Australia's Harvest Strategy Policy. *Marine and Coastal Fisheries: Dynamics, Management and Ecosystem Science* 1: 244-254.

UNCLOS (1995). United Nations Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks. Division for Ocean Affairs and the Law of the Sea, Office of Legal Affairs, United Nations. 40pp.

Western Australian Department of Fisheries (2011). Resource Assessment Framework (RAF) for finfish resources in WA. Fisheries Occasional Publication 85. 24pp.