Chapter 30
The status determination process

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30.1 Legislation and policy

Fisheries Management Act 1991

The *Fishery status reports* assess the performance of Commonwealth fisheries against the objectives of the *Fisheries Management Act 1991* (FM Act, section 3); in particular:

Part 3

a. ensuring that the exploitation of fisheries resources and the carrying on of any related activities are conducted in a manner consistent with the principles of ecologically sustainable development (which include the exercise of the precautionary principle), in particular the need to have regard to the impact of fishing activities on non-target species and the long term sustainability of the marine environment; and

b. maximising the net economic returns to the Australian community from the management of Australian fisheries; and

c. ensuring accountability to the fishing industry and to the Australian community in AFMA's [Australian Fisheries Management Authority's] management of fisheries resources.

Commonwealth Fisheries Harvest Strategy Policy

The Commonwealth Fisheries Harvest Strategy Policy (HSP; Department of Agriculture and Water Resources 2018a) supports the implementation of the objectives of the FM Act. The objective of the HSP is the ecologically sustainable and profitable use of Australia's Commonwealth commercial fisheries resources (where ecological sustainability takes priority)—through the implementation of harvest strategies.

To pursue this objective, the Australian Government will implement harvest strategies that:

- ensure exploitation of fisheries resources and related activities are conducted in a manner consistent with the principles of ecologically sustainable development, including the exercise of the precautionary principle
- maximise net economic returns to the Australian community from management of Australian fisheries—always in the context of maintaining commercial fish stocks at sustainable levels
- maintain key commercial fish stocks, on average, at the required target biomass to produce maximum economic yield from the fishery
- maintain all commercial fish stocks, including byproduct, above a biomass limit where the risk to the stock is regarded as unacceptable (B_{LIM}), at least 90% of the time
- ensure fishing is conducted in a manner that does not lead to overfishing—where overfishing of a stock is identified, action will be taken immediately to cease overfishing
- minimise discarding of commercial species as much as possible
- are consistent with the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the *Guidelines for the ecologically sustainable management of fisheries* (Department of the Environment and Water Resources 2007).

Updated guidelines aimed at providing practical assistance in the development of harvest strategies that meet the intent of the HSP were also released in 2018 (Department of Agriculture and Water Resources 2018b).

30.2 Assessing biological status

Fish stock definitions

Where feasible, status is reported for the biological stock, defined as a discrete population of a species that is typically reproductively isolated in space or time from other populations of the same species, resulting in detectable genetic, biological or morphological differences in fish from different populations. Fishing is assumed to affect the entire stock, but not adjacent stocks. This independence between populations of the same species means that separate assessments and management arrangements are often required for each, and is why status is reported separately for each defined stock. The true structure and boundaries of biological stocks are often not well understood, or a stock may straddle the jurisdictional boundaries of several management agencies. In such circumstances, the stock may be treated as a series of convenient geographic components or 'management units' that are managed separately by different jurisdictions or as separate fisheries.

The Commonwealth generally manages fish resources from 3 nautical miles (nm) from the coast out to the 200 nm Exclusive Economic Zone (EEZ) limit, while states or territories manage fish resources within 3 nm. The Australian Government has negotiated Offshore Constitutional Settlement arrangements with states and territories that provide for the shared, cooperative or transferred management of some stocks that straddle this state–Commonwealth boundary. Fish stocks that occur within Torres Strait are managed cooperatively by Australia and Papua New Guinea under the 1985 Torres Strait Treaty, which provides for joint management of the shared resources in the Torres Strait Protected Zone. In the Australian area of this zone, traditional fishing and commercial fisheries are collaboratively managed by the Torres Strait Protected Zone Joint Authority, established under the *Torres Strait Fisheries Act 1984*.

Several fishery resources of commercial importance to Australia have ranges extending outside the Australian Fishing Zone into the high seas and the EEZs of other countries, particularly the highly migratory tunas. Under the United Nations Fish Stocks Agreement (1995), the high-seas components of these straddling stocks are required to be collaboratively managed by regional fisheries management organisations (RFMOs). Australia is an active member of a number of RFMOs, including the Western and Central Pacific Fisheries Commission (WCPFC), the Commission for the Conservation of Southern Bluefin Tuna (CCSBT), the Indian Ocean Tuna Commission (IOTC), the South Pacific Regional Fisheries Management Organisation (SPRFMO) and the Southern Indian Ocean Fisheries Agreement. In managing its domestic fisheries, Australia implements measures agreed by each relevant RFMO. In some cases, Australia's domestic standards exceed those agreed internationally, in which case Australia attempts to obtain international agreement to implement measures consistent with Australian standards.

Reference points and indicators

Two independent aspects of stock status are classified within these reports: the stock's biomass level and its fishing mortality status (Table 30.1). In cases where reference points or estimates of current biomass or fishing mortality have not been determined, other indicators are used to inform stock status. The HSP defines target and limit reference points for Commonwealth fisheries in terms of biomass (B_{TARG} and B_{LIM}, respectively) and fishing mortality (F_{TARG} and F_{LIM}, respectively).

The HSP guidelines allow flexibility for B_{LIM} to be determined relative to spawning biomass, exploitable biomass or total biomass. This flexibility allows for reference points to be consistent with the types of data available for stock assessments. For example, stock assessments that rely mainly on catch-per-unit-effort (CPUE) estimate depletion levels related to the exploitable biomass. Alternatively, stock assessments that use catch age analysis with auxiliary biological information allow estimates of depletion levels related to spawning biomass and overall biomass. As a result, depletion-level estimates of all assessed stocks may not necessarily refer to the same portion of the biomass.

In terms of biomass status, stocks are classified as one of the following:

- not overfished, where the biomass is above B_{LIM} and at a level where recruitment is unlikely to be significantly impaired. This indicates that the biomass is at a level sufficient to ensure that the risk to future levels of recruitment is not excessive (that is, the stock is not recruitment overfished)
- overfished, where the biomass is below B_{LIM} and at a level where recruitment is likely to be significantly impaired. The B_{LIM} threshold reflects the point at which the risk to future levels of recruitment is unacceptable
- uncertain, where there is inadequate information to determine the state of a stock's biomass and the risk to future recruitment.

In terms of fishing mortality, stocks are classified as one of the following:

- not subject to overfishing, where the fishing mortality does not exceed the limit reference point (F_{LIM}). In this case, the stock is not subject to a level of fishing mortality that would move the stock to an overfished state
- subject to overfishing, where the fishing mortality exceeds F_{LIM}. The stock is subject to a level of fishing that would move the stock to an overfished state or prevent it from rebuilding to a not overfished state
- uncertain, where there is inadequate information to determine whether the level of fishing mortality represents overfishing.

Some RFMOs report against reference points for biomass and fishing mortality when providing advice on stock status; however, these reference points may be defined differently from those in the HSP. The limit reference points adopted by the WCPFC are the same as those prescribed in the HSP. However, the IOTC determines stock status relative to target reference points, not limit reference points. For jointly managed stocks, ABARES determines stock status using the limit reference points described in the HSP, and considers the impacts of fishing mortality from all fleets on the stocks. Consequently, the status of some jointly managed stocks reported by RFMOs may differ from that reported by Australia.

In situations where there is no stock assessment–generated estimate of biomass or fishing mortality, other information is used to determine status, such as catch, catch rate (CPUE) time series, size or age. Often, several indicators are used to assess the likely state of biomass or fishing mortality for a stock (weight of evidence). Occasionally, there will be conflicting indicators, leading to no clear picture of likely status. In this situation, an uncertain classification may be determined.

The stock status classification system

The classification system for stock status has been modified several times since the first *Fishery status reports* (1992). In 2004, the 'underfished' and 'fully fished' categories were replaced by a combined category of 'not overfished'. This change was made partly because of potential confusion about the meaning of 'fully fished'. It was also difficult to classify a stock as 'underfished' because data were often lacking for stocks likely to fall into this category.

Another change in 2004 was the inclusion of a distinction between biomass status and fishing mortality status. Before 2004, each stock was given a single status classification, based on the worst-case scenario. For example, if a stock was considered 'subject to overfishing', it was classified as 'overfished', and there was no separate determination of stock biomass status. Also, stocks were only classified as 'not overfished' if overfishing was also not occurring.

In 2007, this classification system was aligned with the reference points defined in the HSP (Table 30.1).

TABLE 30.1 Reference points for fishing mortality and biomass, with associated status implications in line with the HSP

Biomass (B) \ Fishing mortality rate (F)	$F < F_{TARG}$ (fishing mortality is below the target)	$F_{TARG} < F < F_{LIM}$ (fishing mortality is between the limit and the target)	$F > F_{LIM}$ (fishing mortality is above the limit)
$B \geq B_{TARG}$ (biomass is greater than or equal to the target)	Not overfished. Overfishing is not occurring.	Not overfished. Overfishing is not occurring.	Not overfished. Overfishing is occurring: note possible planned fish-down where overfishing would not be occurring.
$B_{TARG} > B > B_{LIM}$ (biomass is between the limit and the target)	Not overfished: rebuild to B_{TARG}. Overfishing is not occurring.	Not overfished: rebuild to B_{TARG}. Overfishing may not be occurring, provided that fishing mortality will allow rebuilding towards target.	Not overfished: rebuild to B_{TARG}. Overfishing is occurring.
$B < B_{LIM}$ (biomass is below the limit)	Overfished: adopt and follow a rebuilding strategy to rebuild biomass above B_{LIM} within a required time frame. Overfishing may not be occurring.	Overfished: adopt and follow a rebuilding strategy to rebuild biomass above B_{LIM} within a required time frame. Overfishing may not be occurring, provided that fishing mortality will allow rebuilding towards target within a required time frame.	Overfished: adopt a rebuilding strategy to rebuild biomass above B_{LIM} within a required time frame. Overfishing is occurring: reduce fishing mortality.

Note: Colours show how these reference points relate to stock status classifications used for each stock.

Fishing mortality Not subject to overfishing Subject to overfishing

Status determination framework

A weight-of-evidence decision-making framework for biological status determination was a key output of the Reducing Uncertainty in Stock Status (RUSS) project, undertaken from 2009 to 2012 (Larcombe, Noriega & Stobutzki 2015). Application of the framework requires the assembly of an evidence base to support status determination and is analogous to a review of fisheries indicators. The framework provides a structure for the assembly and review of indicators of biomass and fishing mortality status. The framework provides guidance on interpreting these indicators, and aims to provide a transparent and repeatable process for status determination. It requires a description of attributes of the stock and the fishery, documentation of lines of evidence for status, and presentation of the key information used to support the status classification. Expert judgement plays an important role in status determination, with an emphasis on documenting the key evidence and rationale for the decision. Separate decision-making processes are used to determine biomass and fishing mortality. This framework is relatively more important and more often applied in the absence of formal stock assessments.

The framework is more heavily relied upon when status is not immediately obvious (for example, when directly output from a robust and reliable stock assessment), and multiple indicators of status need to be used to support a determination.

30.3 Assessing economic status

The economic status of each Commonwealth fishery (excluding jointly managed Torres Strait fisheries) is determined by assessing management performance against the economic objective of the FM Act, which is to maximise net economic returns (NER) to the Australian community from the management of Australian fisheries. Performance against this objective is evaluated using three criteria: key economic trends, management arrangements and performance against the HSP's economic objective.

The economic status of Torres Strait fisheries is also evaluated. However, because these fisheries are managed under the *Torres Strait Fisheries Act 1984*, the HSP and its economic objective do not apply. Therefore, performance of these fisheries is assessed against fishery-specific objectives, as well as those of section 8 of the *Torres Strait Fisheries Act 1984*. These are:

- to acknowledge and protect the traditional way of life and livelihood of Traditional Inhabitants, including their rights in relation to traditional fishing
- to manage commercial fisheries for optimum utilisation
- to have regard, in developing and implementing licensing policy, to the desirability of promoting economic development in the Torres Strait area and employment opportunities for Traditional Inhabitants.

Key economic trends

NER are a major indicator of a fishery's economic performance. NER measure the difference between the revenue a fishery earns in a given year and the economic costs it incurred earning those revenues. These include costs associated with fuel, crew, repairs, fishery management, depreciation, and the opportunity cost of capital and owner–operator labour.

Survey estimates of NER calculated by ABARES are available for some of the most valuable Commonwealth fisheries. For other fisheries, indicators of fishery revenue and costs are analysed to evaluate likely changes in profitability. Although estimates of a fishery's gross value of production are readily available and provide an indicator of revenue, information on costs is more difficult to obtain. Measures of fishing effort and fuel prices are used for some fisheries to provide an indication of total fishery costs. For data-poor fisheries, the level of unused fishing rights ('latency') can provide an indication of NER. High latency suggests that the fishery is operating at or above a point equivalent to its theoretical open-access equilibrium—at this point, average NER are zero, and all potential resource rents from using the resource are likely to be lost.

Changes in a fishery's NER reflect changes in factors that are both external and internal to the control of fishers and fishery managers. External factors include fish prices and fuel prices, while internal factors include catch and fishing effort. The evaluation of a fishery's economic status primarily focuses on factors that are under the control of fishery managers. However, external factors can be highly variable and complicate the determination of economic status. Therefore, a fishery's NER should be interpreted over time (that is, in terms of its NER trend), and use other fishery information and performance indicators. For example, if a fishery generates positive NER, this does not necessarily mean a positive economic status in the context of maximising NER from the resource. Management arrangements may be impeding the generation of additional NER. Similarly, the catches generating these positive NER may be associated with overfishing. In these cases, economic status could be improved by reducing management constraints or rebuilding stock status.

Economic productivity measures support the interpretation of a fishery's trend in NER and its overall economic status. Productivity measures indicate how effectively a fishery's inputs (such as fuel, labour, capital and the fish stock) are converted into output (catch). At given output prices, an improvement in fishery productivity will be associated with an improvement in NER. Productivity growth in a fishery over time will reflect some combination of improved production decisions by fishers and improvements in fishery management.

Management arrangements

Management arrangements can be a key influence on whether a fishery achieves its full economic potential. The assessment of economic status therefore considers whether a fishery's NER could be improved under alternative arrangements. An informed assessment requires an understanding of a fishery's characteristics, which can vary considerably across fisheries. This allows evaluation of the relative advantages and disadvantages of alternative management arrangements for that fishery.

Management arrangements in Commonwealth fisheries can be categorised as either input controls (for example, effort limits) or output controls (for example, catch limits). Input controls restrict a fishery's effort—for example, by restricting gear use, fishing time or fishing areas. If a fishery manager is trying to control a fishery's catch, input controls alone provide no guarantee that a catch target will be met. Over time, such controls can lead to overcapacity and lower economic returns, especially if the controls are not frequently adjusted to counteract an increased efficiency of the limited number of fishing effort units. However, input controls are often associated with lower implementation and monitoring costs than output controls (Rose 2002). They can also have advantages where attempts to control catch are complicated by a stock's high variability and unpredictability.

Output controls restrict a fishery's harvest through the setting of total allowable catches (TACs). Individual transferable quotas (ITQs) are the dominant form of output control used in Commonwealth fisheries—a stock's TAC is allocated to holders of ITQs. Each quota entitles its owner to a share of the TAC in a given season, which can then be sold or leased. An advantage of ITQs is that, once fishers have been allocated a TAC share, the incentive to race to fish against other operators may be diminished and replaced with an incentive to maximise profit for their given catch allocation (Grafton 1996). By directly controlling catch, the need to restrict inputs (and operator efficiency) to indirectly limit catch is reduced, and operators are afforded greater flexibility to choose the most efficient mix of fishing units. However, input controls may still be required to meet other management objectives (for example, controlling bycatch). The transferability of ITQs also means that quota can gravitate to the most efficient fishers, improving overall economic performance of the fishery. However, ITQs can have drawbacks, including high set-up and monitoring costs, and incentives to discard and high-grade catch (Copes 1986; Rose 2002).

Another key management consideration for determining economic status is latency. High levels of latency over a long period indicate low levels of NER and suboptimal fishery economic performance. Latency creates additional issues for fisheries managed with tradeable fishing rights (such as ITQs or effort). These mechanisms can capture efficiency gains through having fishing rights traded towards their most efficient use, but, if TAC or effort levels are maintained above economically viable levels so that latency prevails, the value of fishing rights will be low. This reduces the incentive to trade fishing rights and limits the potential efficiency improvements through the movement of rights to more efficient users (Elliston et al. 2004). Interpretation of latency must consider the characteristics of the fishery. For example, if a fishery targets a highly variable stock, fluctuations in fishing rights latency would be expected.

Management in pursuit of other FM Act objectives relating to sustainability, bycatch and the environment can affect a fishery's profitability. Whether these objectives have been met with the lowest possible cost should also be a key consideration when determining economic status. Costs include not only the management costs incurred in meeting these objectives, but also costs associated with any reduction in NER that results from such management.

Performance against economic objective

The HSP supports the implementation of the economic objective of the FM Act by recommending that harvest strategies are designed to achieve biomass levels that can be expected to maximise a fishery's overall NER. The assessment of economic status considers how well a fishery's harvest strategy meets the economic objective of the FM Act.

This assessment first involves evaluating a fishery's harvest strategy target reference points in terms of how well they reflect a maximum economic yield (MEY) target for that fishery. For some fisheries, target reference points are biomass based (that is, B_{MEY}), and the evaluation will focus on whether the adopted target is consistent with MEY, given the biological and economic characteristics of the stock. For other fisheries, alternative targets are used because biomass targets are considered inappropriate (for example, if the fishery is data-poor or targets highly variable stocks). Such alternatives include catch-rate targets, catch triggers and effort triggers. In these cases, the evaluation focuses on how well the economic objective of the HSP is being met by these alternative approaches.

If a fishery's harvest strategy targets are consistent with MEY, performance indicators can be compared with targets to assess whether the fishery is achieving MEY. For multispecies fisheries, performance against harvest strategy targets is evaluated across the predominant and most valuable stocks caught in the fishery. Performance indicators that are close to target for these stocks will indicate that management is meeting the HSP's economic objective for the fishery. If the performance indicators are off target but moving towards target, performance against MEY is improving. If neither is occurring, then management settings have resulted in suboptimal outcomes for the stock, and management adjustments may be required. Such evaluation focuses on recent historical performance over a number of years (rather than just one year), given the variability in factors that influence a fishery's MEY. If harvest strategy targets do not exist for a fishery, the evaluation focuses on how well the intent of the HSP is being met under the current harvest strategy.

30.4 Assessing environmental status

The Australian Government's fisheries management objectives recognise the need to consider the broader effects of fishing on bycatch species (including species protected under the EPBC Act), marine habitats, communities and ecosystems. *Fishery status reports 2019* reports on key bycatch issues in each fishery and information from ecological risk assessments (ERAs) by AFMA.

Bycatch species

In 2018, the Department of Agriculture released the *Commonwealth Fisheries Bycatch Policy* (Department of Agriculture and Water Resources 2018c). The bycatch policy aims to minimise fishing-related impacts on general bycatch species in a manner consistent with the principles of ecologically sustainable development, and with regard to the structure, productivity, function and biological diversity of the ecosystem. The bycatch policy advocates the use of bycatch strategies that will meet the objectives of the policy, and was released with an associated set of guidelines—*Guidelines for the implementation of the Commonwealth Fisheries Bycatch Policy* (Department of Agriculture and Water Resources 2018d).

Ecological risk assessment

In the early 2000s, AFMA and CSIRO, with funding from the Australian Government, initiated the development of ERAs to assess the impacts of fishing activities on ecological components of fisheries, such as target, bycatch and byproduct species; protected species; habitats; and communities. Broadly speaking, the ERA methodology is hierarchical, moving from a low-level, qualitative analysis of risks (level 1) to fully quantitative assessments of the level of fishing mortality (level 3) (Hobday et al. 2007). Low-risk activities and species are screened out at each step in this process.

The ERA methodology has evolved since its initial implementation and now focuses on aspects of the fishery that are not assessed in other ways (for example, through stock assessment). The AFMA website details each ERA. AFMA has recently developed an ecological risk management guide (AFMA 2017) that helps fishery managers to better implement ERA and ecological risk management across fisheries.

EPBC Act and its interactions with fisheries management

The EPBC Act is the key piece of national legislation for conserving the biodiversity of Australian ecosystems and protecting the natural environments that support these ecosystems. Commonwealth marine areas are 'matters of national significance' under the EPBC Act. The EPBC Act broadly requires that fishing activities do not have a significant negative impact on the Commonwealth marine environment and its biodiversity, including protected species and ecological communities. This is achieved through the requirement for all Commonwealth fisheries to undergo a strategic environmental assessment to determine the extent to which management arrangements will ensure that the fishery is managed in an ecologically sustainable way.

The strategic assessments determine whether a fishery should be accredited for the purposes of part 13 (protected species provisions) and part 13A (wildlife trade provisions) of the EPBC Act. Fisheries management also needs to consider the requirements of species recovery plans, wildlife conservation plans and threat abatement plans that are implemented under the EPBC Act.

Protected species

If a species is protected under the EPBC Act (with the exception of those listed as conservation-dependent), it is an offence to kill, injure, take, trade, keep or move an individual unless the action is covered by a permit issued by the environment minister or is otherwise exempt. In the case of fisheries, interactions with protected species are not offences if they have occurred in a fishery with a fishery management plan or regime accredited under the EPBC Act. This recognises that some level of interaction may be inevitable, but that all reasonable steps should be taken to minimise interactions. Fishers are obliged to report any interactions with protected species, and it is an offence under the EPBC Act and the FM Act not to do so. Interactions with protected species are reported in the *Fishery status reports* for each fishery.

30.5 Presentation of fisheries data

Graphing

Data presented in *Fishery status reports 2019* were obtained from a number of sources. Most were obtained from AFMA daily fishing logs, AFMA catch disposal records, observer databases and the ABARES commodities database. Other sources include fishery-specific stock assessments, CSIRO, public-domain catch-and-effort data from the WCPFC, the IOTC nominal catch database (public domain data), the CCSBT database, the Commission for the Conservation of Antarctic Marine Living Resources, and the SPRFMO database.

Mapping

Relative fishing intensity has been mapped where five or more vessels have fished within a certain area. This fishing intensity is mapped using the kernel density function in ArcGIS and an appropriate radius from each fishing operation point, depending on the extent and spacing of fishing operations. The density function results in a smoothing and spreading of estimated fishing effort, and can result in the total area over which fishing operations take place appearing larger than it is. Where necessary, fishing intensity maps have been truncated to limit fishing to management areas.

Fishing intensity is usually mapped as effort, but, in some fisheries (for example, the Bass Strait Central Zone Scallop Fishery), it is mapped as catch. Three levels of fishing intensity are shown, arbitrarily classified as low, medium and high. As far as possible, the same range classes have been used as in previous years. However, if there has been a major shift in effort or catch, this may not be possible. Fishing operations have been mapped for the 2018 calendar year or the 2017–18 financial year.

The total area fished has been mapped for most fisheries, except for those fisheries with a restricted range, such as the Torres Strait fisheries. For these fisheries, the total area fished is mapped at 111 km^2 (the equivalent of one degree of latitude squared) and does not show catch or fishing effort. This conforms with AFMA's information disclosure policy (AFMA 2010).

Fishery management area boundaries are shown for reference, but area closures are not shown except for certain major closures. The 200 m isobath (bathymetric contour) is shown on all maps, where relevant. This approximates the edge of the continental shelf. Place names, including ports, capes, islands and seas, have been included for reference and orientation.

In most cases, the maps are in the geographic coordinate system (that is, without being projected). All maps of domestic fisheries use the geocentric datum for Australia (GDA94).

30.6 References

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