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NSW Lobster Fishery Harvest Strategy

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Introduction

Purpose

A harvest strategy is a framework that specifies pre-determined actions in a fishery for defined species (at the stock or management unit level) necessary to achieve the agreed ecological, economic and social management objectives.

This Lobster Fishery Harvest Strategy applies to the NSW Eastern Rock Lobster Stock (*Sagmariasus verreauxi*), a species largely endemic to NSW waters and harvested by commercial, recreational and Aboriginal fishers.

The Goal of the Lobster Fishery Harvest Strategy is:

'To maintain a robust, sustainable eastern rock lobster stock biomass to support a profitable commercial lobster fishery, ongoing social, cultural and economic benefits for Aboriginal and recreational stakeholders, and ongoing benefits to the community.'

The lobster fishery is supported by a strong and healthy stock biomass that has been rebuilt from previous depletion to a point around the target biomass identified in this strategy. This strategy is designed to ensure stocks remain around the management target to deliver strong benefits and certainty to stakeholders and the NSW ecosystem.

The strategy includes specific TACC decision rules for Eastern Rock Lobster harvested in the Lobster Share Management fishery, and broad strategies for harvest in other sectors given current information. This strategy does not establish defined resource sharing arrangements.

The Strategy is established in accordance with the NSW Fisheries Harvest Strategy Policy, and brings together key scientific monitoring, assessment and management components necessary to meet legislated objectives including those established under the *Fisheries Management Act 1994* (the Act), the *Marine Estate Management Act 2014*, the Fisheries Management (Lobster Share Management Plan) Regulation 2000, and collaborative objectives established under the strategy.

This strategy recognises and supports the vision of the 2007 Fishery Management Strategy for the NSW Lobster Fishery (Lobster FMS):

"A lobster fishery that is ecologically sustainable and profitable and that works to improve the understanding and management of this valuable species through a high standard of research and compliance and pro-active co-operation amongst stakeholders"

Introduction of harvest strategies and evaluation of ecological risk in NSW Fisheries are key activities under Initiative 6 of the NSW Marine Estate Management Strategy 2018-2028.

The Lobster Fishery

The lobster fishery includes the NSW stock of Eastern Rock Lobster (*Sagmariasus verreauxi*) and commercial, recreational and Aboriginal cultural harvest sectors.

The commercial sector operates under the Lobster Share Management Fishery, one of eight major marine and estuarine based commercial fisheries in New South Wales. It is a quota managed fishery which targets eastern rock lobster, with small quantities of other species also retained as by-product.

Most catch is taken using lobster traps in inshore and offshore ocean waters, with a minor proportion of catch taken whilst diving without artificial breathing apparatus. The fishery is primarily managed by output control (Total Allowable Commercial Catch (TACC) and individual quota allocation), with additional controls including limited entry, minimum and maximum size limits, prohibition on take of berried females, tagging and reporting requirements, spatial closures and trap construction requirements.

TACC's are determined by the independent statutory Total Allowable Fishing Committee (the TAF Committee) for each fishing period between 1 August and 31 July each year. Quota is allocated to fishery shareholders in proportion to their shareholding level and the TACC for each fishing period.

The fishery extends the length of the NSW coastline, containing distinct inshore and offshore sectors. Fishing effort is concentrated at different times along the coast and throughout the range of depths fished.

Recreational and cultural (non-commercial) harvest of eastern rock lobster is subject to management controls including bag and size limits, spatial closures, prohibitions on use of artificial breathing apparatus and take of berried females, and trap construction requirements. Additional access for Aboriginal Cultural fishing is supported by the Aboriginal Cultural Fishing Interim Access Policy and a permit system for larger cultural events under the Act.

Robust catch and effort information is available through commercial reporting and monitoring programs. Estimates of recreational and Aboriginal harvest are available but contain some uncertainty.

More detailed description and analysis of the lobster fishery is available at https://www.dpi.nsw.gov.au/fishing/commercial/fisheries/lobster-fishery

Strategy scope

The Lobster Fishery Harvest Strategy operates as a framework for determining objectives and management actions for harvest in commercial and non-commercial sectors in the lobster fishery. The strategy recognises and is compatible with objectives and management arrangements established under the Act and commercial Lobster FMS and Share Management Plans.

The strategy provides guidance to statutory decisions of the TAF Committee for determination of Eastern Rock Lobster TACC's, and will be used for determining TACC on an annual basis for the life of this strategy (5 years), noting that:

- Determinations of TACC remain the decision and responsibility of the TAF Committee, and
- Departure of decisions from strategy guidance must contain clear justification.

The strategy also provides guidance for harvest changes in non-commercial sectors.

Ecologically sustainable development

NSW harvest strategies will seek to integrate ecological, economic, social and cultural dimensions of fisheries management as far as possible and over time as data and information improves.

An Environmental Impact Assessment (EIS) and Fishery Management Strategy have been completed for the commercial sector of the lobster fishery to assess and monitor environmental performance. As this harvest strategy provides a framework to manage harvest across all sectors, a further assessment will be undertaken using the commercial EIS as a starting point.

If an ecological risk assessment identifies fishing impacts that are considered to generate an undesirable level of risk, this may be managed through review of the harvest strategy or using external mechanisms as appropriate.

Objectives

Goal

To maintain a robust, sustainable eastern rock lobster stock biomass to support a profitable commercial lobster fishery, ongoing social, cultural and economic benefits for Aboriginal and recreational stakeholders, and ongoing benefits to the community.

Strategic objectives

The broad objectives of the harvest strategy are to:

1. Optimise utilisation of the lobster resource across all sectors within ecologically sustainable limits
2. Manage exploitation of the stock such that recruitment to the stock is not severely compromised
3. Protect the continued access of Aboriginal fishers for cultural fishing
4. Support the profitability of the commercial fishery over the long term
5. Provide quality fishing opportunities for recreational fishers

Operational objectives

1. To provide robust sustainability and optimised fishing efficiency and opportunity by maintaining the spawning biomass of the eastern rock lobster stock at a target biomass supporting Optimum Sustainable Yield (Bsp_{OSY})
2. To ensure spawning biomass remains above 20% of the unfished level, this being the level below which recruitment to the stock may be severely compromised
3. To implement the constant harvest fraction at optimum sustainable yield (u_{OSY}) to determine Total Allowable Catch when spawning biomass is above 25% of the unfished level
4. To implement a linear reduction in harvest fraction and review the harvest strategy if spawning biomass decreases to or below 25% of the unfished level
5. To implement a targeted rebuilding strategy if spawning biomass decreases to or below 20% of the unfished level

Reference points

Target reference point

Bsp_{OSY}: the depletion of spawning biomass relative to the unfished level that aims to provide robust sustainability and optimise fishing efficiency and opportunity across the whole fishery

This is the equilibrium spawning biomass associated with the equilibrium exploitable biomass that aims to optimise yield based on the proxy: $Bexp_{OSY}$ = 1.2 * $Bexp_{MSY}$

Trigger reference point

Bsp_{25} : spawning biomass is depleted to 25% of unfished spawning biomass

Limit reference point

Bsp_{20}: spawning biomass is depleted to 20% of the unfished spawning biomass

Zero-catch reference point

Bsp_{15}: spawning biomass is depleted to 15% of the unfished spawning biomass

Indicators

Indicators are used to measure fishery and strategy performance, with operational objectives and the primary indicator structured around spawning stock biomass estimates, and secondary indicators provided to assess Catch per unit effort (CPUE) trends, recruitment of new individuals to the fishery, individuals progressing from exploitable to the spawning biomass stock (including the protected portion above the maximum size limit), and economic trends in the commercial sector.

Primary indicator

$Bsp_{CURRENT}$ / $Bsp_{UNFISHED}$: estimated depletion of spawning biomass relative to unfished spawning biomass

Secondary indicators

- Exploitation rate
- Indices of spawning stock abundance from the biennial fishery independent survey
- Indices of pre-recruits to the (i) spawning stock and (ii) protected stock (greater than maximum legal-length) from the biennial fishery-independent survey
- Indices of abundance of pre-recruits to the fishery (based on the CPUE for sub-minimum legal-length lobsters reported in the commercial fishery logbook)
- Indices of abundance of post-larval lobsters (pueruli) from the annual fishery-independent survey
- Annual catch, effort and CPUE for the commercial fishery for separate spatial components of the fishery (based on latitude and depth)
- Proportion of TACC taken annually
- Economic surveys, market, share and quota trading data

- Estimates of recreational and Aboriginal cultural harvest
- Bag and possession limits
- Estimates of illegal/unreported harvest

Secondary indicators are used:

1. In calibrating the length-structured model of the stock and fishery that is used to estimate the primary indicators,
2. By the TAF Committee in accepting the model, model-based indicators and decision rules as a reasonable basis for TACC determination,
3. As a measure of economic performance for the commercial sector,
4. As a measure of fishing opportunity for recreational and Aboriginal fishers in inshore waters.

Table 1: Objective indicators

Operational Objective	Indicator
1. To provide robust sustainability and optimised fishing efficiency and opportunity by maintaining the spawning biomass of the eastern rock lobster stock at a target biomass supporting Optimum Sustainable Yield (Bsp_{OSY}) 2. To ensure spawning biomass remains above 20% of the unfished level, this being the level below which recruitment to the stock may be severely compromised 3. To implement the constant harvest fraction at optimum sustainable yield (u_{OSY}) to determine Total Allowable Catch when spawning biomass is above 25% of the unfished level 4. To implement a linear reduction in harvest fraction and review the harvest strategy if spawning biomass decreases to or below 25% of the unfished level 5. To implement a targeted rebuilding strategy if spawning biomass decreases to or below 20% of the unfished level	***Primary:*** $Bsp_{CURRENT}$ / $Bsp_{UNFISHED}$
Strategic Objective	**Indicator**
1. Optimise utilisation of the lobster resource within ecologically sustainable limits 2. Manage exploitation of the stock such that recruitment to the stock is not severely compromised	***Primary:*** $Bsp_{CURRENT}$ / $Bsp_{UNFISHED}$

3. Protect the continued access of Aboriginal fishers for cultural fishing	***Primary:*** $Bsp_{CURRENT}$ / $Bsp_{UNFISHED}$ ***Key secondary:*** Inshore abundance (commercial CPUE <10m)
4. Support the profitability of the commercial fishery over the long term	***Primary:*** $Bsp_{CURRENT}$ / $Bsp_{UNFISHED}$ ***Key secondary:*** Relevant indicators available through economic surveys, market, share and quota trading data
5. Provide quality fishing opportunities for recreational fishers	***Primary:*** $Bsp_{CURRENT}$ / $Bsp_{UNFISHED}$ ***Key secondary:*** Inshore abundance (commercial CPUE <10m)

Monitoring & assessment

The lobster fishery has a strong and long-standing suite of commercial fishery dependent and independent data supported through commercial monitoring programs, and periodic harvest estimates for non-commercial sectors. Assessment will be informed by relevant data available at the time of assessment, taking account of any variability and uncertainty.

Data sources

- Commercial fishery logbook: catch, effort, latitude, depth, retained and discarded catch
- Biennial fishery-independent survey of spawning stock abundance
- Annual fishery-independent survey of puerulus (post-larvae) recruitment
- Surveys of recreational catch in NSW (occasional historical; and currently biennial surveys)
- Cultural permit harvest
- Estimates of illegal/unreported harvest
- Economic surveys, market, share and quota trading data

Assessment

The length-structured model of the Eastern Rock Lobster population and fishery provides:

(i) retrospective estimates of biomass (exploitable and spawning components) over the history of the fishery,

(ii) prospective estimates of biomass for alternative management settings,

(iii) comparison with secondary indicators.

Directly relevant to this harvest strategy, it provides estimates of OSY, depletions of both Bexp and Bsp at target, trigger and limit reference points and estimates of fishing mortality and exploitation rate (u) for assessment and use in the decision rules.

Performance criteria & acceptable risk

This harvest strategy commences with current assessment information indicating the lobster stock is at or around the target reference point.

Decision rules are constructed to maintain stocks at the target level, with increasing safeguards to support ongoing sustainability and return to target levels should trigger or limit reference points be breached due to issues including fishing mortality, data uncertainty and unforeseen environmental events or stock impacts.

Model-based estimates of $Bsp_{CURRENT}$, Bsp_{OSY} (target), Bsp_{25} (trigger), Bsp_{20} (limit), Bsp_{15} (zero-catch) and u_{OSY} (target exploitation rate) are the median estimates from the base-case scenario of the model of the lobster population and fishery.

The minimum performance criterion for Management Strategy Evaluation (MSE) of this strategy is that the limit reference point should be breached no more than 1 in 10 years. MSE has confirmed that this strategy meets acceptable performance and risk requirements.

Decision rules for determining Total Allowable Catch

Decision rules for determining TAC determine the total harvest taken in all sectors combined, and under this, subsequent rules are used to determine:

1. A defined component of the TAC as TACC;
2. Changes to recreational bag/possession limits;
3. Protection of Aboriginal cultural harvest;

within the TAC.

Therefore, the TAC defines the total harvest which includes components for Aboriginal, recreational, illegal/unreported, and commercial harvest (Figure 1).

Figure 1: TAC and harvest components

Decision rules for determining TAC are provided in Table 2.

These decision rules are designed to ensure that the stock is maintained at or around the target reference point Bsp_{OSY}. This is achieved by linking the exploitation rate (i.e. fishing mortality) to estimates of spawning stock abundance (biomass), resulting in increased TAC when biomass is above target and decreased TAC when below target. This feedback mechanism results in return of the fishery to the target reference point (and biomass).

The exploitation rate is determined based on estimates of current spawning biomass from the assessment model, which is converted to a fraction of the estimated exploitable biomass available for harvest (Figure 2).

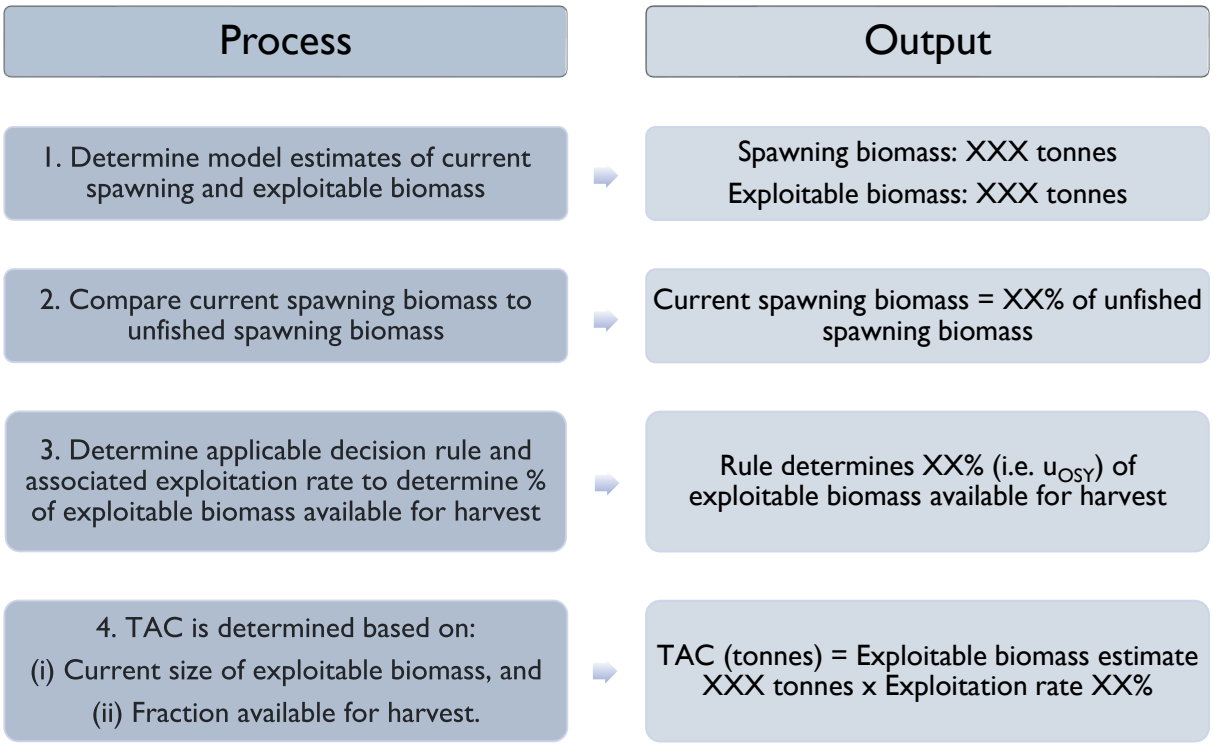

Figure 2: TAC Decision rule process and example outputs

Under these rules, a spawning biomass greater than target will result in greater harvest and/or a higher fraction of biomass to be harvested, and vice versa. Increased harvest will induce reduction of biomass to the target level, and reduced harvest will induce an increase in biomass to the target level.

Should the biomass trigger reference point be breached, the decision rules will increasingly reduce the exploitation rate (u) the further biomass is below the trigger level. The target exploitation rate is proportionately reduced from u_{OSY} down to 0 at the zero-catch reference point, providing increasing impetus to return the fishery to the target biomass.

Table 2: Decision rules for determining TAC

Condition	Rule
$Bsp_{CURRENT} > Bsp_{25}$ (Biomass is at or above the trigger reference point)	Set TAC based on the exploitation rate associated with OSY, u_{OSY}
$Bsp_{25} \geq Bsp_{CURRENT} > Bsp_{20}$ (Biomass is below the trigger and at or above the limit reference point)	Set TAC based on the reduced exploitation rate, $u = u_{OSY} * (Bsp_{CURRENT} - Bsp_{15}) / (Bsp_{25} - Bsp_{15})$ Review Harvest Strategy to prepare rebuilding strategy
$Bsp_{20} \geq Bsp_{CURRENT} > Bsp_{15}$ (Biomass is below the limit and at or above the zero-catch reference point)	Implement rebuilding strategy under revised Harvest Strategy using a further reduced exploitation rate, $u < u_{OSY} * (Bsp_{CURRENT} - Bsp_{15}) / (Bsp_{25} - Bsp_{15})$
$Bsp_{15} \geq Bsp_{CURRENT}$ (Biomass is below the zero-catch reference point)	Set TAC of 0, based on exploitation rate, $u = 0$

Under these rules:

TAC (Total Allowable Catch) is based on the exploitation rate, *u*, according to the applicable decision rule and calculated as:

$TAC = u * Bexp$

The TAC decision rules and example TAC are graphically represented in Figures 3 and 4, noting that the resulting TAC may increase or decrease slightly each year when the assessment model is updated with new information (catch, CPUE, spawning stock index, etc.). This is due to the recalibrated model providing updated estimates of OSY, spawning and exploitable biomass depletions at OSY and the exploitation rate at OSY.

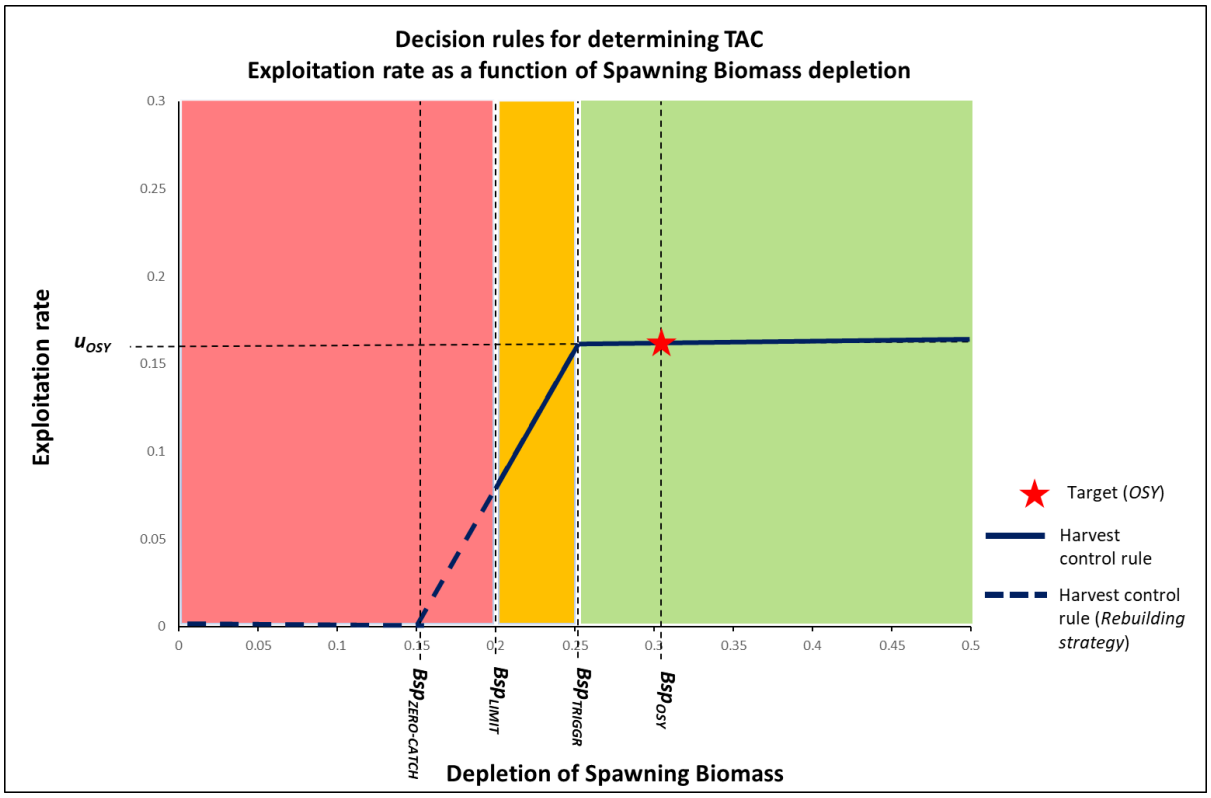

Figure 3: Decision rules for determining TAC - Exploitation rate as a function of spawning biomass depletion

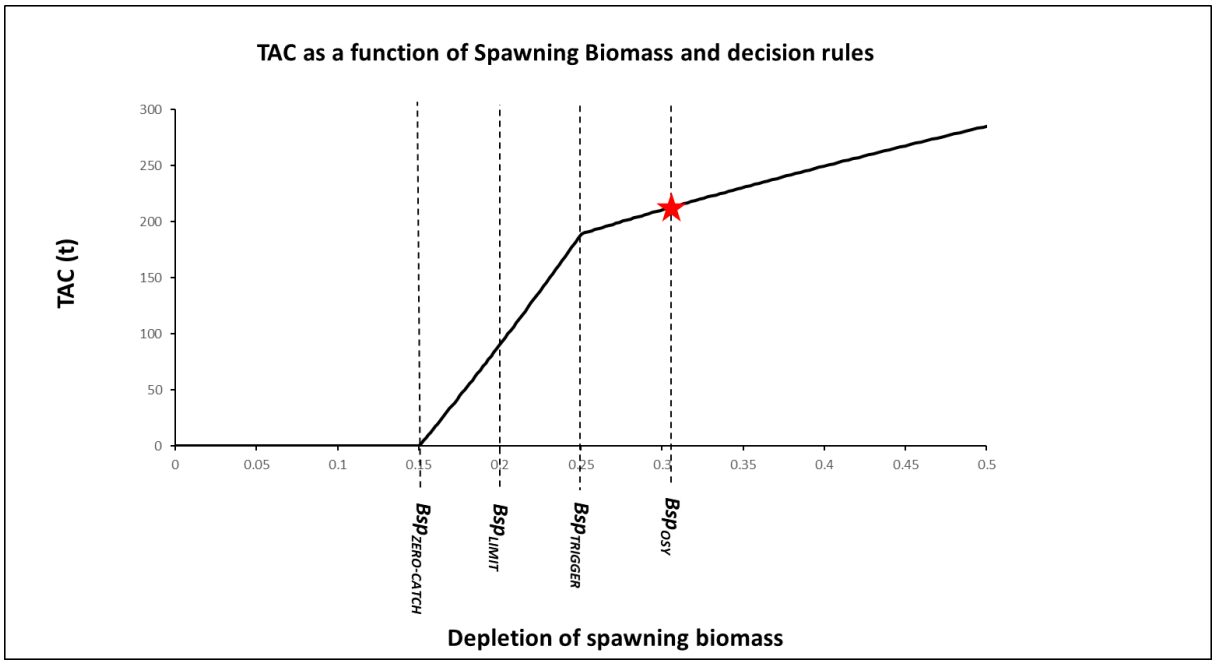

Figure 4: Decision rules for determining TAC - Example TAC as a function of spawning biomass depletion

Rebuilding strategy

Under these decision rules, if the trigger reference point is breached the strategy will be reviewed to prepare a rebuilding strategy, and if the limit reference point is breached the rebuilding strategy will be implemented as a revised harvest strategy. This is a precautionary mechanism established as:

(i) the existing decision rules may have failed the objective to maintain the stock around the target level,

(ii) unforeseen environmental impacts may have reduced stock biomass, and

(iii) modifications to monitoring strategies, performance indicators and assessment methods are likely to be necessary given changes to patterns of fishing that may result from substantially lower TACCs.

If triggered, the rebuilding strategy (and decision rules therein) will:

(i) maintain the zero-catch reference point of Bsp_{15} used in this harvest strategy;

(ii) be designed to recover the stock to levels above the limit reference point within the timeframe T_{min} to $2T_{min}$, where T_{min} is the theoretical number of years required to rebuild the stock to the limit reference point in the absence of fishing;

(iii) determine that the stock has rebuilt to the limit reference point when the 25^{th} percentile of estimates of Bsp from the base-case of the model is greater than the limit. This is equivalent to 75% probability that Bsp has rebuilt to the limit reference point.

Decision rules for determining TACC from TAC

Decision rules for setting commercial TACC's under this strategy are specific and include the rules to determine TAC and calculations to account for harvest estimates from non-commercial sectors (Table 3).

Table 3: Decision rules for determining TACC from TAC

Condition	Rule
TAC is determined	TACC (Total Allowable Commercial Catch) is calculated as: **TACC = TAC – estimates for Aboriginal harvest, recreational harvest and illegal/unreported harvest**

Meta rules for TACC decision rules

1. Small Change Limiting Rule : To promote stability and minimise small increments in TACC, the TACC will only increase or decrease from the existing level if the primary decision rule determines an increase or decrease in the TACC of more than 5 t.
2. Large Change Limiting Rule : To limit excessive change from year to year, the annual change to the TACC will be limited to a maximum of +/- 20 t, unless it is considered that limiting a decrease in TACC will pose a significant risk to stock status.

Break-out rule

The Total Allowable Fishing Committee retains discretion to set a TACC other than that determined by the model-based decision rules where appropriately justified, in particular where:

(i) substantial changes to secondary performance indicators are out-of-step or not well fitted by the model, or

(ii) evidence is available that indicates substantial problems with underlying model assumptions.

Decision rules for recreational harvest

For the recreational sector, maintaining stock biomass at the target level supports higher stock abundance and availability, supporting increased harvest opportunities. Recreational catch is controlled using indirect management measures (size, bag and possession limits).

Rules are provided to change recreational limits in response to changes to stock abundance derived from changes to TAC and respective TACC (Table 4).

Table 4: Decision rules for recreational harvest

TACC Range (tonnes)	Recreational bag/possession limit	Meta rule
0	0	Change initiated when TACC determined in respective band for two consecutive fishing periods
1 - <90	1	
90 - <150	2	
150 +	3	

Decision rules for Aboriginal cultural harvest

Decision rules for Aboriginal cultural harvest will be determined in consultation with the Aboriginal Fishing Advisory Council (AFAC).

Meta rules for Aboriginal cultural harvest

1. If decision rules for determining TAC set a TAC of 0, arrangements to protect Aboriginal cultural fishing will be determined in consultation with the Aboriginal sector.

Harvest Strategy review

This strategy will be reviewed through a consultative Working Group established by DPI within 5 years from commencement, or if required by decision rules.

The Deputy Director General Fisheries may decide to review this harvest strategy at any time if, considering the best available information, that its objectives are unlikely to be achieved, or where clear justification (such as availability of additional stock, economic or operational information) becomes available.

Strategic development

There are several strategic issues that this first harvest strategy does not fully resolve. These could be addressed in a future revised harvest strategy as better information becomes available and if there is support from stakeholders.

The following operational issues are identified for future development:

1. Increase knowledge and integrity of estimates for recreational and Aboriginal harvest
2. Investigate the risks and benefits associated with alternative legal-size limits to support objectives
3. Utilise regulatory tools and education programs to reduce illegal and unreported lobster harvest across sectors

Stock status classification

Mapping between the stock status classification under this harvest strategy and the Status of Australian Fish Stocks (SAFS) classification scheme is:

Status under Harvest Strategy	**SAFS status**
$Bsp_{CURRENT} > Bsp_{25}$	Sustainable
$Bsp_{25} \geq Bsp_{CURRENT} > Bsp_{20}$ *and* *Bsp is stable or on an upward trajectory toward* $B_{TRIGGER}$	Sustainable
$Bsp_{25} \geq Bsp_{CURRENT} > Bsp_{20}$ *and* *Bsp is on a downward trajectory toward* Bsp_{20} *despite the management control rule*	Depleting
$Bsp_{20} \geq Bsp_{CURRENT}$ *and* *Bsp is on an upward trajectory toward* Bsp_{20} *and is expected to recover within the acceptable timeframe*	Recovering
$Bsp_{20} \geq Bsp_{CURRENT}$ *and* *Bsp is not demonstrably recovering toward* Bsp_{20} *despite the Rebuilding Strategy*	Depleted

Definitions

AFAC: Aboriginal Fishing Advisory Council, being the statutory Council appointed to provide strategic level advice to the Minister on issues affecting Aboriginal fishing

Bexp: Exploitable biomass, being the legally harvestable biomass of lobsters between the minimum and maximum size lengths

Bsp: Spawning biomass, being the biomass of the adult (reproductively mature) lobster stock

Decision Rule: pre-agreed management actions to control intensity of fishing in order to achieve the objectives

Exploitation rate: annual catch as a proportion of the exploitable biomass

Indicator: a quantity that can be measured and used to track changes with respect to an objective

Limit Reference Point: the value of an indicator that is unacceptable because the stock or management unit has become depleted or recruitment-overfished

MSY: Maximum Sustainable Yield, being the maximum catch that can be removed from a population over an indefinite period

Objective: an objective that has a direct and practical interpretation in the context of a fishery and against which performance can be evaluated

Reference point: the value of an indicator that can be used as a benchmark of performance against an operational objective

TAC: Total Allowable Catch, being the total harvest by all sectors

TACC: Total Allowable Commercial Catch, being the total catch limit determined for the commercial sector

TAFC: Total Allowable Fishing Committee, being the independent statutory Committee with responsibility for determining total allowable catch or effort

Target Reference Point: the value of an indicator that is desirable or ideal and at which fisheries management should aim

Trigger Reference Point: the value of an indicator for a fish stock or management unit at which a change in the level of monitoring or management is considered or adopted

u_{OSY}: The exploitation rate associated with maintaining spawning biomass at the target level associated with Optimum Sustainable Yield