

# Guide to AFMA's Ecological Risk Management

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**Australian Government**  
**Australian Fisheries Management Authority**

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## Abbreviations

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ACIG	Australian Continuous Improvement Group
AFMA	Australian Fisheries Management Authority
AFZ	Australian Fishing Zone
B	Biomass
B <sub>LIM</sub>	Biomass limit reference point
B <sub>MEY</sub>	Biomass that provides the maximum economic yield
B <sub>MSM</sub>	Biomass that provides the maximum sustainable fishing mortality
B <sub>MSY</sub>	Biomass that provides the maximum sustainable yield
B <sub>TARG</sub>	Target biomass
BRD	Bycatch Reduction Device
bSAFE	base Sustainability Analysis for Fishing Effects
CDR	Catch Disposal Record
CPF 2000	Commonwealth Policy on Fisheries Bycatch 2000
CPUE	Catch Per Unit Effort
CRFM	Caribbean Regional Fisheries Mechanism
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DoAWR	Department of Agriculture and Water Resources
EBFM	Ecosystem Based Fisheries Management
EM	Electronic Monitoring
EPBC 1999	Environmental Protection and Biodiversity Conservation Act 1991
ERA	Ecological Risk Assessment
ERA EF	Ecological Risk Assessment for the Effects of Fishing
ERM	Ecological Risk Management
eSAFE	enhanced Sustainability Analysis for Fishing Effects
ESD	Ecologically Sustainable Development
ESMF	Ecologically Sustainable Management of Fisheries
ETBF	Eastern Tuna and Billfish Fishery
F	Fishing Mortality
FAA 1991	Fisheries Administration Act 1991
F <sub>crash</sub>	Minimum unsustainable instantaneous fishing mortality rate that, in theory, will lead to population extinction in the long term
FIS	Fishery Independent Survey
F <sub>LIM</sub>	Fishing mortality limit reference point
FMA 1991	Fisheries Management Act 1991
FMB	Fisheries Management Branch
FMF	Fisheries Management Framework

FMP	Fisheries Management Plan
FMS	Fishery Management Strategy
$F_{MSM}$	Fishing Maximum Sustainable Mortality
FRDC	Fisheries Research and Development Corporation
$F_{TARG}$	Target fishing mortality rate
GHAT	Gillnet Hook and Trap Sector
HCR	Harvest Control Rule
HMR	Harvest Monitoring Rule
HSP	Harvest Strategy Policy 2007
ICCAT	International Commission for the Conservation of Atlantic Tunas
ISMP	Integrated Scientific Monitoring Program
ISO	International Standards Organisation
LRP	Limit Reference Point
M	Natural mortality
MAC	Management Advisory Committee
MEY	Maximum Economic Yield
MoU	Memorandum of Understanding
MSC	Marine Stewardship Council
MSM	Maximum sustainable fishing mortality
NMFS	National Marine Fisheries Service
NPF	Northern Prawn Fishery
PEER	Policy Environment Economics and Research Section
PSA	Productivity Susceptibility Analysis
R	Intrinsic rate of population increase
RAG	Research Advisory Group
RBC	Recommended Biological Catch
RRA	Residual Risk Analysis
SAFE	Sustainability Analysis for Fishing Effects
SESSF	Southern and Eastern Scalefish and Shark Fishery
SFR	Statutory Fishing Rights
SICA	Scale Intensity Consequence Analysis
SLA	Service Level Agreement
TAC	Total Allowable Catch
TAE	Total Allowable Effort
TSSC	Threatened Species Scientific Committee
TWG	Technical Working Group
UNCLOS	United Nations Convention on the Law of the Sea
UNSFA	United Nations Straddling Fish Stocks Agreement



VMS            Vessel Monitoring System  
WCPFC        Western and Central Pacific Fisheries Commission

# Foreword

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## Purpose

This document (the “ERM Guide”) provides AFMA fisheries management personnel with an overview of AFMA’s revised Ecological Risk Management (ERM) framework and a guide to implementing its processes within its broader Fisheries Management Framework. This framework will ensure consistency and transparency across all Commonwealth managed fisheries and will ensure that AFMA continues to meet its legislative requirements pertaining to ecological sustainability.

It addresses recommendations flowing from independent reviews of previous Ecological Risk Assessment (ERA) and ERM processes and aims to help AFMA ensure: improved ERM performance, accountability, regular monitoring, transparent reporting of outcomes and performance, consistent and adaptive management, world class scientific advice inputs, stakeholder involvement, and regular evaluation and improvement of management processes.

## Structure

This Guide has two main parts:

Part A ([Chapter 1](#)) is a quick reference summary guide to ERM and its processes. This is provided primarily for experienced fishery managers who are already familiar with the background and logic behind AFMA’s ERM and wish to refer to a simpler step by step guide when re-assessing fisheries.

Part B ([Chapters 2 – 7](#)) provides a more comprehensive overview of ERA and ERM processes and will benefit fishery managers who are new to ERM. It describes:

- Origins, objectives, key principles and structure of ERM ([Chapter 2](#) and [3](#)).
- A revised ERA methodology ([Chapter 4](#)).
- The integration of ERA and ERM into the broader Fisheries Management Framework, including within Fishery Management Strategies (FMS) ([Chapter 5](#)) which simultaneously address sustainability and other fishery management objectives.

## Implementation

A staged approach to the implementation of AFMA’s revised ERM will commence following endorsement of the ERM framework by the AFMA Commission. Fisheries managers will commence by developing 5 year FMS ([Chapter 5](#) and [Attachment 1](#)) and Annual Work Plans for each of their fisheries, in consultation with their MAC/RAG.

## Future development

The current ERM is consistent with the requirements of existing operational fisheries policies. However, it has been revised at a time when the two key fisheries policies, the Commonwealth Harvest Strategy Policy (2007) and the Commonwealth Policy on Fisheries Bycatch (2000), are in the process of being revised. Once these policies (along with their Guidelines) are finalised, this ERM Guide will be updated to reflect any new or varied requirements. It will continue to be reviewed and evolve over the coming years to take account of stakeholders’ needs, the FRDC’s Australian Fisheries Research and Science Standards Project and ongoing changes to legislative and management requirements. This will best position AFMA and its fisheries to meet/exceed domestic and international requirements for accreditation.

Finally, while the initial focus of this Guide is on processes for the assessment and management of ecological risks, it is AFMA's goal to expand this to become a guide to the implementation of AFMA's Fisheries Management Framework more broadly.

# **PART A - QUICK REFERENCE GUIDE TO ERM**

# 1 Quick Reference Guide

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## 1.1 Introduction

Commonwealth legislation requires that AFMA pursues Ecologically Sustainable Development<sup>1</sup> (ESD) and as one part of this, ensure the sustainability of species, populations and ecosystems with which its fisheries interact<sup>2</sup>.

This requirement sits alongside other legislative objectives that AFMA pursues including those relating to cost effective management, maximising net economic returns, accountability to industry, optimal utilisation of living resources and ensuring its fisheries take all reasonable steps to avoid killing or injuring protected species<sup>3</sup>.

AFMA, in collaboration with the fishing industry, pursues ecological sustainability through the implementation of:

- Ecological Risk Management (ERM) which provides for ongoing monitoring and management of risks to ecological sustainability ([Chapter 2](#) and [3](#)).
- A scientific risk assessment process (within ERM) referred to as the Ecological Risk Assessment for the Effects of Fishing (ERAEF) to identify and quantify these risks to ecological sustainability ([Chapter 4](#)).

AFMA will pursue ecological sustainability for each Commonwealth fishery via the development and implementation of Fishery Management Strategies (FMS). FMS combine existing components pertaining to the management of fishing interactions with commercial species (ie; Harvest Strategy), bycatch species, habitats and communities, as well as supporting strategies for research, data and monitoring ([Figure 1](#)). They outline the management approaches required in each fishery to achieve its objectives, including the ERA and ERM processes required to achieve ecological sustainability requirements.

This ERM Guide provides a guide for fisheries managers to implement the revised ERAEF for their fisheries (See [Attachment 2](#) for information on previous ERM processes). It describes the interaction between ecological sustainability and other fisheries management objectives, and the integration and role of ERA and ERM processes within FMS aimed at achieving those objectives.

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<sup>1</sup> Ecological sustainability is only one component of ESD principles, which require decision processes to “*effectively integrate both long-term and short-term economic, environmental, social and equity considerations*” (FMA 1991).

<sup>2</sup> Similarly, the FMA (1991) also requires that AFMA fisheries avoid overexploitation of living resources, consistent with ESD.

<sup>3</sup> References to species, stocks and populations in this report will be reviewed for consistency, for the final version.

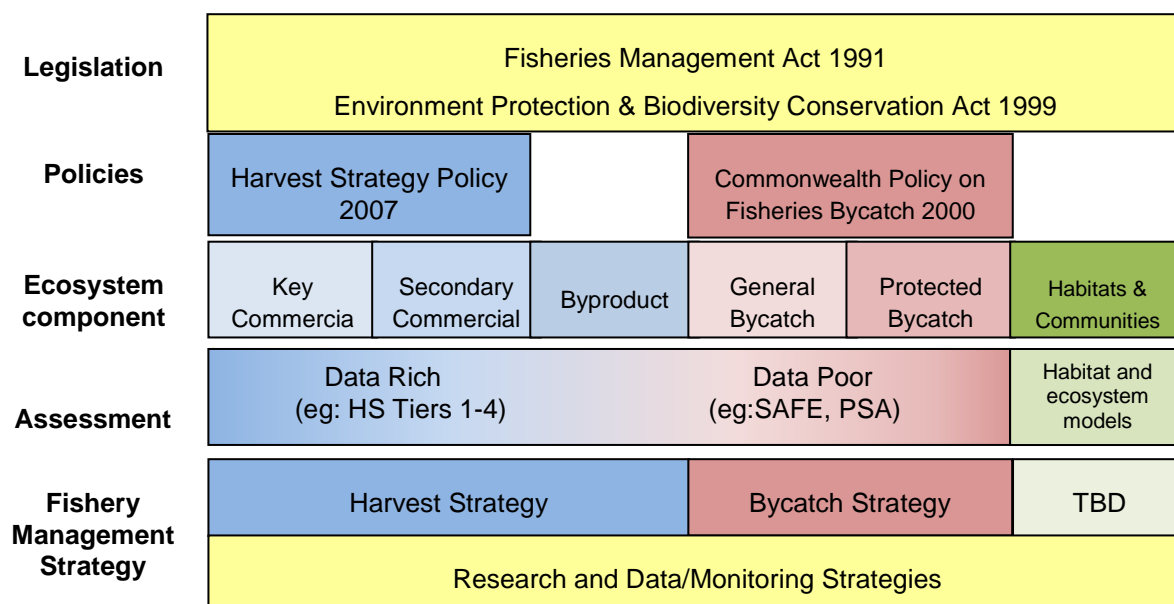


Figure 1 - AFMA's ERM and its relationship with fisheries legislation and policies, ecosystem components, risk assessment tools, and Fishery Management Strategies, which address ERM and other fisheries management objectives.

## 1.2 Scope

AFMA's ERM (including ERAEF) assesses and manages the impacts and risks posed by Commonwealth fisheries<sup>4</sup> to the following ecosystem components:

- Commercial species (including discards) which include:
  - Key commercial species – defined in the HSP Guidelines (2007) as a species that is, or has been, specifically targeted and is, or has been, a significant component of a fishery.
  - Secondary commercial species<sup>5</sup> – commercial species that, while not specifically targeted, are commonly caught and generally retained and comprise a significant component of a fishery's catch and economic return. These can include quota species.
  - Byproduct species – species that are retained for sale but comprise a minor component of the fishery catch and economic return. Byproduct species are considered to be commercial species under the CPF (2000).
- Bycatch species - not retained (ie: are non-commercial discard species). Bycatch species include:
  - General bycatch species – species that are never retained for sale and not protected (ie: species of fish, sharks, invertebrates, etc.).

<sup>4</sup>Where possible AFMA will take into account impacts by other non-Commonwealth fisheries and develop joint management responses with the relevant agencies

<sup>5</sup> Note that the use of the 'Secondary Commercial Species' category should not be used until the Commonwealth Harvest Strategy Policy is finalised.

- protected species<sup>6</sup> – being all species listed under the EPBC Act (1999), which include Protected<sup>7</sup> species (listed threatened species ie: vulnerable, endangered or critically endangered, as well as conservation dependent), cetaceans, listed migratory species and listed marine species.
- Habitats and communities -
  - Habitats: *“the biological and physical environments in which an organism lives”* (Sainsbury 2008, Hobday et al. 2011).
  - Communities: *“assemblages of species in varying proportions doing different things, and have properties that are the amalgam of the properties of individual populations and interactions among populations”* (Mangel and Levin 2005).

The relationship between legislation, policies, and ERA and ERM processes is illustrated in [Figure 1](#). It should be noted that ERM has, to date, been largely focussed on assessing and managing fishery risks to species populations, but will in future include increased focus on habitats and communities.

### 1.3 Objectives

For species interacting with Commonwealth fisheries, the primary ecological sustainability objective that AFMA pursues via ERM is ([Chapter 2.4](#)):

- To ensure that fishing (by Commonwealth commercial fisheries) does not reduce any species populations to/below a level at which the probability of recruitment failure is unacceptably high.
- Where such impacts have occurred, recover populations to above that level.

This objective is consistent with sustainability objectives in existing fisheries and environmental legislation, policies, guidelines and international agreements ([Chapter 2.5](#) and [Attachment 3](#)). A similar intent is maintained with respect to ensuring the sustainability of habitats and communities<sup>8</sup>. The interim objective for habitats is to ensure broader habitat security for non-living ecological components. In pursuing the primary ERM objective, AFMA will also pursue its other legislative objectives, including:

- ESD Principles ([Chapter 2.5](#)).
- Cost efficiency (and risk-catch-cost trade-offs) ([Chapter 2.5.2](#)).
- Economic objectives ([Chapter 2.5.3](#)).

For commercial species and protected species in particular, there are additional objectives and ESD Principles that must be pursued, as described in the FMA (1991), the HSP (2007) and the EPBC Act (1999) that can result in those species being managed to biomass levels higher than required by the ERM objective alone. It is very important that managers understand the interactions between ERM and other fisheries management objectives when developing management arrangements.

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<sup>6</sup> The term “protected species” refers to species listed under [Part 13] of the EPBC Act (1999) and replaces the term “Threatened, endangered and protected species (TEPs)” commonly used in past Commonwealth (including AFMA) documents.

<sup>7</sup> Note “protected” (with small “p”) refers to all species covered by the EPBC Act (1999) while “Protected” (capital P) refers only to those protected species that are threatened (vulnerable, endangered or critically endangered).

<sup>8</sup> Habitat and community objectives to be developed/articulated in future revisions of this Guide.

With respect to the above ERM objective, it is AFMA's intent to pursue risk equivalency across all species ([Chapter 2.4.2](#)) but noting constraints associated with current risk assessment tools and resources. It is also AFMA's intent to pursue the cooperative assessment and management of species whose populations are impacted upon by both Commonwealth and non-Commonwealth fisheries, so as to account for and manage cumulative risks/impacts ([Chapter 2.4.3](#)), to ensure ecological sustainability.

## 1.4 Key components of AFMA's ERM

AFMA's revised ERM is based on the following key elements ([Chapter 3](#)):

- Fishery Management Strategies (FMS) - These take into account results from risk/stock assessments (and other information) and outline the management processes required to achieve ERM and other key fishery management objectives on a per-fishery basis. They contain four components being Harvest<sup>9</sup>, Bycatch, Research and Data and Monitoring strategies. Each FMS should explicitly link to relevant components of existing Fishery Management Plans (FMP).
- Annual Work Plan – Outlining specific activities to be undertaken to implement the FMS (including ERM processes) in the following 12 months.

These will both be implemented via an underlying four phase Fisheries Management Framework (FMF) that:

- Supports the (1) planning, (2) implementation, (3) monitoring/reporting and (4) evaluation/improvement of FMS ([Figure 2](#) and [Chapter 3](#)).
- Will be developed to comply with an international standard management system (ISO compliant). This ERM Guide represents a key initial component of that system, which is to be further developed in 2016/17.

ERA and ERM processes are integrated within each FMS and associated management cycle/framework, alongside other processes that pursue additional management objectives. The following highlights the key ERM related processes in each stage of the broader FMF cycle.

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<sup>9</sup> Including rebuilding strategies where required.



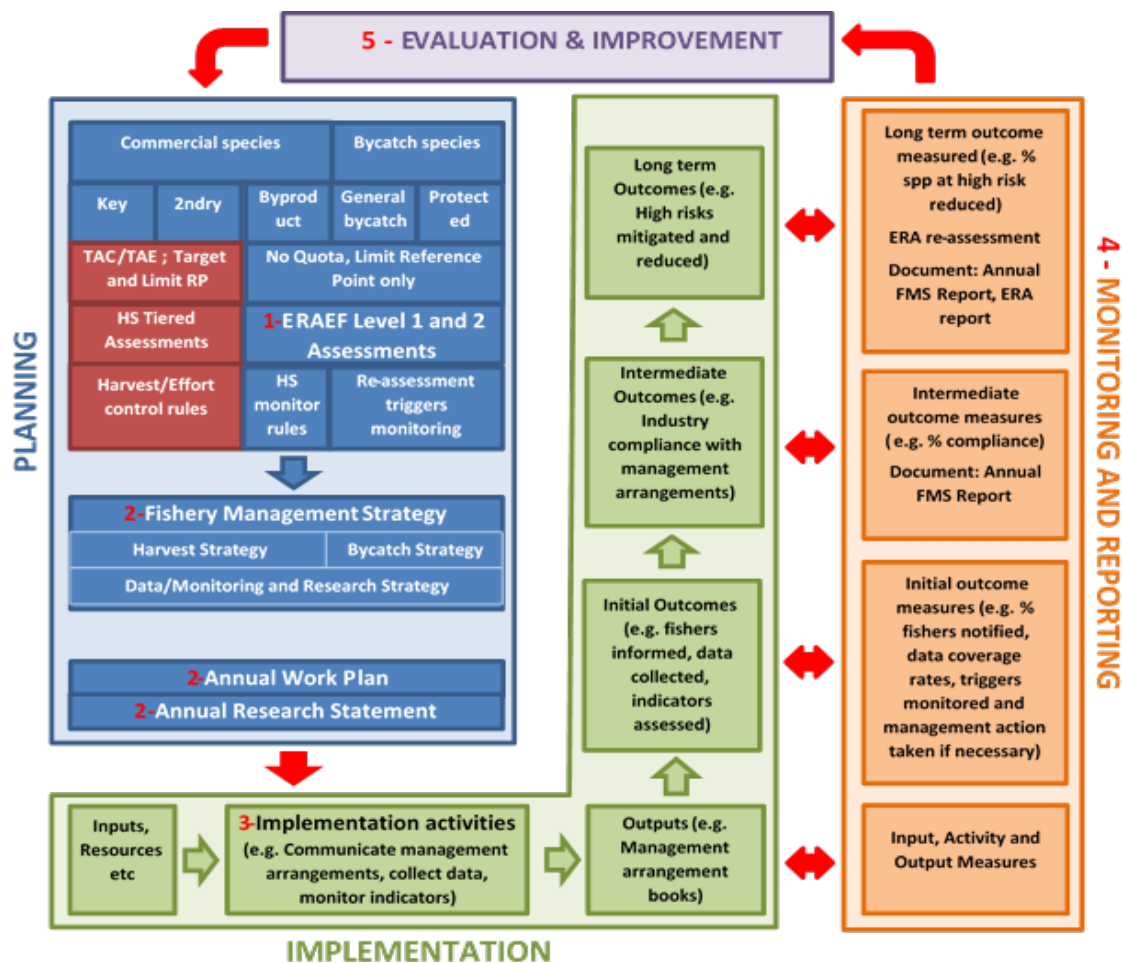


Figure 2 – Examples of key ERA and ERM activities, outputs, outcomes and performance measures relevant to each stage of the FMF, for byproduct and bycatch species assessed via ERAEF and managed via monitoring rules and triggers. Red boxes represent processes encompassed within harvest strategies for key and secondary commercial species, which are not the focus of the step by step guide (ERM guidance for these species are provided in the HSP Guidelines (2007)). Red numbers denote key ERM steps (detailed in text below).

### 1.4.1 Planning

The planning phase has three key features ([Chapter 3.3](#)):

- Risk/stock assessments – These are used to assess ecological risks to species stocks/populations and to help evaluate potential management response options to mitigate risks where required.
- Fishery Management Strategies (FMS) – Development of FMS requires collation of relevant components that will streamline management objectives and processes in a more transparent manner. These take into account results from risk/stock assessments (and other information) and outline the management processes required to achieve ERM and other key fishery management objectives. FMS will be developed and implemented in association with fishery ERA re-assessments for Commonwealth managed fisheries ([Table 1](#)).

Table 1 - Indicative timing of processes within each ERA assessment and management cycle. Red number in 'Process' relates to each step (detailed in text below).

Stage	Process	Task	Year					Roles and responsibilities		Documentation
			Y1	Y2	Y3	Y4	Y5	Lead role	Review/Endorse	
PLANNING	1. Assessment	Funding/budget process/contracting				X	X <sup>1</sup>	AFMA (Fishery Manager)	Research Provider	Fishery Budget Statements
		Data collation				X		Research Provider	AFMA	Scoping and Level 1 ERA Report
		Scoping and Level 1					X	Research Provider	AFMA/RAG/ERA TWG*	Scoping and Level 1 ERA Report; RAG minutes
		Level 2 Assessment					X	Research Provider	AFMA/RAG/ERA TWG*	Level 2 and RRA ERA Report; RAG minutes
		Residual Risk Analysis					X	Research Provider/AFMA/TWG	RAG/ERA TWG*	Level 2 and RRA ERA Report; RAG minutes
	2. Develop FMS	Develop management options					X	AFMA	RAG/MAC	Management Options paper to RAG and MAC; MAC/RAG minutes
		Revise FMS (HS, Data, Bycatch, Research)					X	AFMA (Fishery Manager)	AFMA GM/RAG/MAC/Commission	Revised FMS; MAC/RAG minutes
	2. Work Plans and research statement	Annual Work Plan	X	X	X	X	X	AFMA (Fishery Manager)	AFMA (Senior Manager)	Annual Work Plan
Annual research statement		X	X	X	X	X	AFMA (Fishery Manager)	RAG/MAC	Annual Research Statement; MAC/RAG minutes	
IMPLEMENTATION	3. Implementation	Annual Workplan activities	X	X	X	X	X	AFMA (Fishery Manager)	AFMA (Senior Manager)	Quarterly update report to Senior manager
		Data collection	X	X	X	X	X	AFMA	AFMA (Fishery Manager)	Data and Monitoring Strategy (within FMS)
		Research proposals/support	when required					AFMA (Fishery Manager)	Research Providers	Research Proposals
MONITORING/REPORTING	4. Initial outcomes (annual)	Annual work plan activity completion	X	X	X	X	X	AFMA (Fishery Manager)	AFMA (Senior Manager)	Annual FMS Report/Other reports
	4. Intermediate outcomes	Industry compliance with management regulations; Trigger monitoring		X	X	X	X	AFMA (Fishery Manager)	AFMA (Senior Manager)	Annual FMS Report/Other reports
	4. Long term outcomes (5 years)	Ecological risk status					X	AFMA (Fishery Manager)	RAG if required	Annual FMS Report/Other reports
	5. Review, evaluate and improve	Strategy evaluation & improvement				X	X	AFMA (Fishery Manger)/ERM Support Unit/Auditor	ERM Support Unit/ERA TWG	Auditor's Report

- They contain four components being Harvest<sup>10</sup>, Bycatch, Research and Data and Monitoring Strategies<sup>11</sup>. Each FMS should explicitly link to relevant components of existing Fishery Management Plans (FMP). The recommended general structure for FMS reports is provided in [Attachment 1](#). For consistency, the high level structure (chapters) should be adhered to, and the lower level structure (subheadings) adhered to where appropriate for each fishery.
- Each of the FMS components should ensure they contain information describing objectives, inputs (resources), activities (to implement each component), outputs, intended outcomes, assumptions and risks underpinning outcomes, performance indicators (for each outcome), data sources (for indicators), roles and responsibilities.
- Annual Work Plans – are developed from the FMS each year, outlining the specific activities to be undertaken to implement the FMS (including ERM processes) in the following 12 months, including resource requirements, roles and responsibilities.

### 1.4.2 Implementation

This phase requires implementing the FMS via carrying out activities in the Annual Work Plan ([Chapter 3.4](#)). Key ERM related activities include:

- Communication of management strategies, arrangements, and directions to industry/fishers.
- Harvest Strategy activities (eg: TAC/TAE setting, byproduct trigger monitoring etc).
- Bycatch strategy activities (eg: protected species interaction monitoring, ERA trigger monitoring).
- Data collection activities (eg: logbook, observer, electronic monitoring, survey etc).
- Compliance monitoring activities.
- Research support activities (eg: proposal reviews, logistical support, collaboration).

### 1.4.3 Monitoring and reporting

This phase involves monitoring the performance of the FMS (and Annual Work Plans), including the Harvest, Bycatch, Research and Data and Monitoring Strategy components ([Chapter 3.5](#)). In relation to ERM specifically, it includes monitoring:

- Initial outcomes – such as successful implementation of work plan activities.
- Intermediate outcomes – such as industry compliance with management arrangements; ERA triggers monitored on annual basis.
- Long term outcomes – successful reduction in risk to high risk ecological components and prevention of other components becoming high risk.

Performance is reported annually in Annual FMS Reports and can include other information relating to other reporting requirements (eg: Strategic assessment requirements) ([Attachment 1](#)).

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<sup>10</sup> Including rebuilding strategies where required.

<sup>11</sup> Fishery Management Strategies (FMS) integrate and combine the previously separate and fishery specific Harvest Strategies, Ecological Risk Management Strategies, Bycatch and Discard Workplans, Data Plans, and 5 year Research Strategies.

#### 1.4.4 Evaluation, review and improvement

This phase involves evaluation of FMS including its ERM components, and identification of improvements to ensure that AFMA's ERM (and other) objectives are met. Evaluation is defined as a structured process of assessing the extent to which the outcomes of a strategy, program or activity is meeting its objectives. Evaluation occurs at two levels:

- Annual Work Plans – reviewed annually.
- Fishery Management Strategies – reviewed on a 5 year cycle.

See [Chapter 3.6](#) for a detailed explanation of this process.

#### 1.4.5 ERM governance, roles and responsibilities

The following agencies, groups/committees and AFMA positions/staff will interact to ensure that ERA and ERM processes are successfully implemented within FMS:

- AFMA Fishery Managers (and their teams/staff) – fishery level planning, implementation of FMS (including ERA and ERM processes).
- ERM Support Unit (within PEER at AFMA) – supports fisheries managers engaged in implementing ERA and ERM (as part of FMS); ERM internal auditing role; EO role for the ERA Technical Working Group and the ERA Management Group; implementation and maintenance of a management system.
- ERA Management Group (senior AFMA staff, AFMA Commissioner) - advice and review of key ERM processes and the ERM approach in general.
- ERA Technical Working Group (senior AFMA staff, CSIRO and independent scientists) - advisory and review role for overarching and fishery specific ERA processes.
- Research providers – conduct risk/stock assessments and related research, including management options analyses, and provide scientific advice.
- Resource Assessment Groups (RAG) – peer review of risk assessments, indicators and triggers and management options analyses. Research advice.
- Management Advisory Committees (MAC) – provide advice relating to management responses to ERA results, harvest strategies and stock assessments.
- AFMA Commission – endorsement of ERM, ERM Guide and FMS.

### 1.5 Step by step guide to integrating ERM into Fishery Management Strategies

#### 1.5.1 Introduction

This section (discussed in detail in [Chapter 5](#)) describes the key ERA and ERM processes and steps used to pursue ERM (and other) objectives in Commonwealth fisheries, within each phase of the Fishery Management Framework cycle, and includes:

- Their integration and documentation within broader FMS.
- The key participants and their roles and responsibilities ([Table 1](#)).
- Key documentation/records required at each step.

It focuses on species components of ERM<sup>12</sup>. These species can be split into two groups depending on how they are assessed and managed for ecological risks:

- Key and secondary commercial species, typically managed under TACs (and quota) or TAEs via harvest strategies and associated harvest control rules.
- Byproduct, general bycatch and protected bycatch species<sup>13</sup> which are assessed under the hierarchical ERAEF methodology but lacking prescriptive decision rules for catch and effort control. These species are more typically managed via monitoring indicators and triggers.

Guidance for key and secondary commercial species is already available through the HSP (2007) and the HSP Guidelines (2007) and is discussed in [Chapter 6](#).

This step by step guide focuses mainly on byproduct, general bycatch and protected bycatch species. It describes the key steps involved in planning, implementing, monitoring, reporting and reviewing ERM for these species. These steps occur as part of a five year FMS “cycle” ([Figure 2](#)). The timing of each of these processes within the five year cycle is described in [Table 1](#).

## 1.6 Assess (re-assess) ecological risk (STEP 1)

### 1.6.1 Introduction

Ecological risk assessments (and stock assessments) serve two purposes within the FMS cycle ([Chapter 5.4](#)), being:

- Assessing the risk posed by fishing to species populations. For first time assessments, this occurs during the Planning phase. Once management measures are in place to mitigate risks, subsequent re-assessments serve a monitoring role (during the FMS Monitoring/Reporting phase) and provide a measure of performance against sustainability objectives.
- Exploring the likely impact of alternate management responses upon high risk species (during the FMS Planning phase) to assist in choosing an appropriate management strategy to reduce that risk to acceptable levels.

Noting this, ERA is presented here as the first step.

### 1.6.2 Revised ERAEF methodology

The revised ERAEF methodology is described in detail in [Chapter 4](#). The original 3 level hierarchical structure of the ERAEF methodology is maintained ([Figure 3](#)) and includes:

- Scoping: Establishing context and objectives.
- Level 1: Scale-Intensity-Consequence-Analysis (SICA).
- Level 2: Semi-quantitative assessment.
- Level 3: Fully quantitative assessment.

There are however a number of changes to be aware of, including:

- Revised and updated input databases and species lists.

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<sup>12</sup> Habitat and Community assessment and management processes will be included in future revisions.

<sup>13</sup> But can include target species in small and developing fisheries which lack data for stock assessment and which have (often catch and CPUE) based triggers to control fishery development, rather than TAC/TAE.

- Revised Level 2 - now includes Productivity-Susceptibility Analysis (PSA), Sustainability Analysis of Fishing Effects (SAFE) and the residual risk assessment (RRA) process.
- SAFE is the preferred Level 2 tool where data and species biology allow.
- No dual assessments. Where a Level 3 equivalent assessment already exists for a species (eg: via harvest strategies), Level 1 and 2 assessments will not be conducted.
- Species assessed as high risk under base SAFE (bSAFE) method may be further assessed using the enhanced SAFE (eSAFE) method.

Improvements to PSA input data and the PSA methodology ([Chapter 4.4](#)) should reduce the number of species requiring risk score adjustment via Residual Risk Guidelines. Results from PSA will be grouped into two categories (“robust” and “data deficient”) to further assist managers in considering the most appropriate management response. The CSIRO has also developed an online ERA tool that will allow users (AFMA managers, RAG and research providers) to re-assess species, update data inputs to assessments, and to explore management options for high risk species. Further changes to the ERAEF may be made in future as a result of ongoing research into automation of residual risk analyses, cumulative risk, calibration of risk assessment tools and risk equivalency.

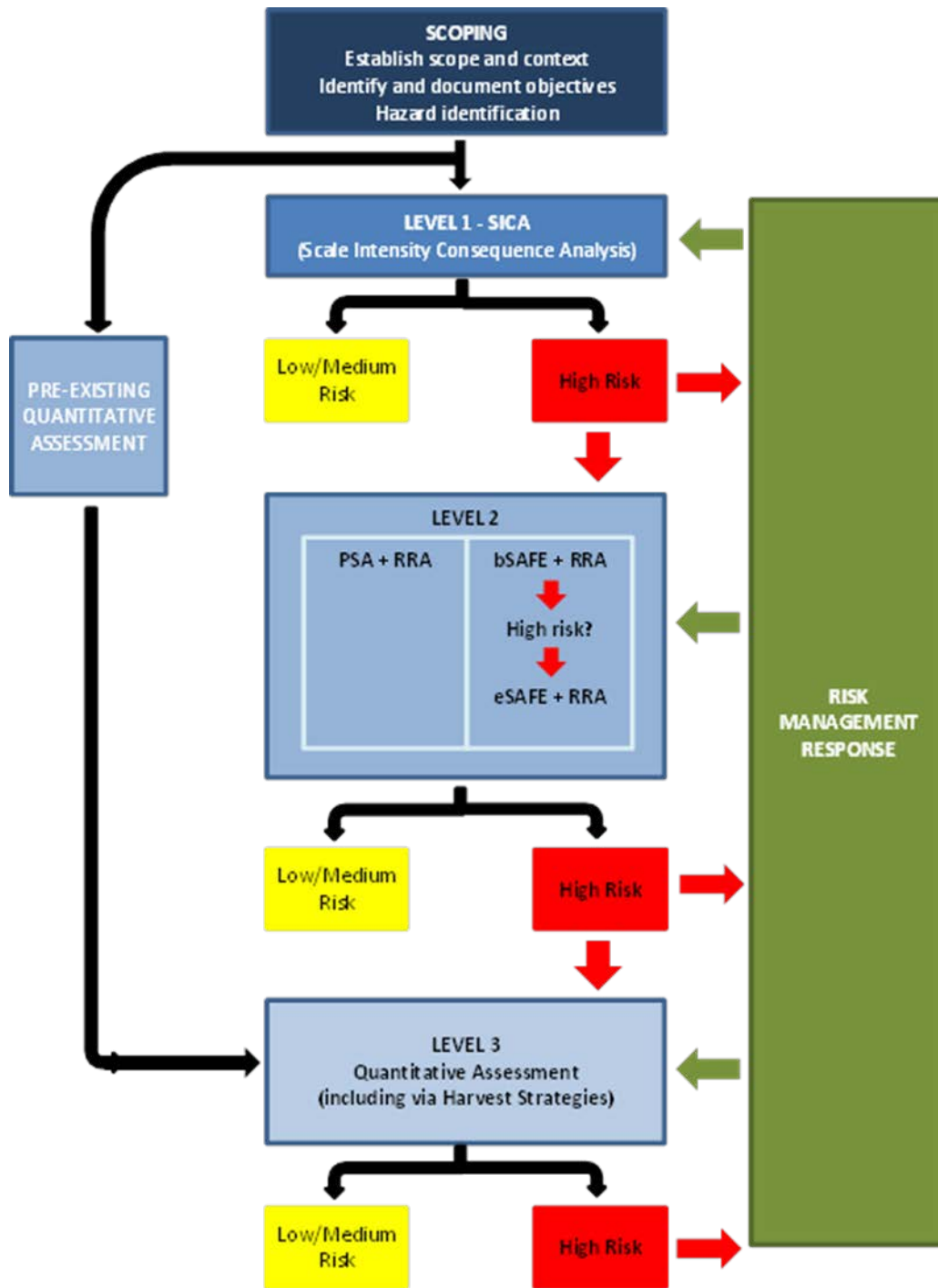


Figure 3 – Structure of the 3 level hierarchical ERAEF methodology. SICA – Scale Intensity Consequence Analysis; PSA – Productivity Susceptibility Analysis; SAFE – Sustainability Assessment for Fishing Effects; RRA – Residual Risk Analysis. T1 – Tier 1. eSAFE may be used for species classified as high risk by bSAFE.

### 1.6.3 Re-assessment schedule

The majority of AFMA's fisheries have been assessed under the ERAEF to Level 2 since 2005, and in some cases, Level 2 assessments (PSA and SAFE) have been updated subsequently (see schedule below in [Table 2](#)). None of the fisheries have yet had a full re-assessment. Note that ERAEF reassessment schedule operates independently of other key re-assessment processes (eg: Harvest Strategy). In each case, full re-assessment may take 6 months to complete followed by the development of management responses/strategies. The key processes involved in planning and implementing assessments are summarised including their timing within the 5 year re-assessment cycle ([Table 1](#)). Fishery re-assessments under the ERAEF will be undertaken every 5 years (unless an indicator is triggered).

**Table 2 – Draft schedule for ERAs and Fisheries Management Strategies as at September 2016.**

ERA	Fishery to be re-assessed	FMS to be commenced
2016/17	Eastern Tuna and Billfish	2016/17
	Small Pelagic	2016/17
	Southern Squid Jig	2016/17
	Heard and McDonald Islands	2016/17
2017/18	Macquarie Island	2017/18
	Southern and Eastern Scalefish and Shark	2017/18
	Torres Strait Rock Lobster	2017/18
	Torres Strait Prawn	2017/18
	Northern Prawn	2017/18
2018/19	Southern Bluefin Tuna	2018/19
	Bass Strait Central Zone Scallop	2018/19
	Skipjack Tuna	2018/19
	Coral Sea (Aquarium Sector)	2018/19
	Coral Sea (other sectors)	2018/19
	Torres Strait Beche-de- Mer	2018/19
2019/20	Western Tuna and Billfish	2019/20
	Torres Strait Reef/line	2019/20
	Torres Strait other (eg crab)	2019/20
	Western Deepwater Trawl	2019/20
	North West Slope Trawl	2019/20
	CCAMLR Exploratory	2019/20



## 1.6.4 Tasks, roles and responsibilities

- Budget planning – The AFMA fishery manager is responsible for budgeting for re-assessment to occur in the 5<sup>th</sup> year of the cycle, via inclusion in the 5<sup>th</sup> year fishery budget (planned in the 4<sup>th</sup> year). Similarly, if further assessment is required by eSAFE, based on bSAFE results, funding planning will need to occur in Year 5, to enable assessment late Year 5 or early Year 1 (next cycle). Managers should follow budgeting processes outlined in AFMA’s budget cycle explanation papers.
- Contracting – In coordination with the above 4<sup>th</sup> year budget planning/funding application process, the AFMA fishery manager will ensure that a research provider has been contracted to coordinate and provide the ERAEF re-assessment in the 5<sup>th</sup> year. AFMA might wish to arrange a longer term Service Level Agreement (SLA) or Memorandum of Understanding (MoU) with a research provider to ensure stability over time. Managers should refer to AFMA’s policies and procedures on contracting and research.
- Data collation – AFMA and the research provider should ensure all data collation and updating of ERA databases as required for re-assessment is undertaken in Year 4 of the cycle.
- Re-assessment - The research provider will coordinate and undertake re-assessment from the Scoping stage (if required) and then Level 1 and 2 (including RRA), in consultation with the AFMA fishery manager. The RAG will be provided opportunity to review and provide advice in relation to a written report by the research provider outlining draft results generated by each stage of the re-assessment process.
- The RAG<sup>14</sup> will endorse the final results and advise the MAC on the outcomes of its ERA review. Where resources are limited, ERA TWG review can be requested. This will occur prior to commencing the development/amendment of management strategies to address any identified potential high risk species.

## 1.7 Develop ERM responses and amend Fishery Management Strategy and Annual Work Plans (STEP 2)

### 1.7.1 Introduction

Integration of management responses will occur in two parts ([Chapter 5.5](#)):

- Responses will be reflected in appropriate components of the FMS and documented within the ‘Versions and Amendments Record’. For example, byproduct management arrangements will be integrated into the Harvest Strategy, bycatch management arrangements will be reflected within the Bycatch Strategy.
- Relevant responses will then be documented within the Annual Work Plan for action.

The results of the re-assessment will be considered by AFMA, RAG and MAC and appropriate management responses developed and documented within the FMS.

The revised FMS will be submitted to the ERA Management Group ([Chapter 3.4](#)) for review and then to the Commission for approval. Following approval, these revisions will

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<sup>14</sup> The term “RAG and MAC” should be taken to include, for fisheries that do not have these committees, or have additional advisory committees, any relevant or equivalent fishery advisory committee/group.

be reflected via the Annual Work Plan. Fisheries should aim to complete this process within 6 months of receiving assessment results.

## **1.7.2 Developing management responses**

### **1.7.2.1 Introduction**

The process of developing management responses (that may lead to the amendment of the strategies) ([Chapter 5.5.2](#)) needs to:

- Be highly consultative with AFMA staff (eg: FMB, compliance), and stakeholders via the RAG, MAC and other expert groups.
- Take into account a range of considerations that will determine what an appropriate management response is, including the large range of management tools that can be used to mitigate fishing impacts and risks.

### **1.7.2.2 Consultation process**

- AFMA should develop a draft management options paper for consideration by RAG/MAC or other expert groups.
- The RAG/MAC or other expert groups will consider the preliminary options paper and provide advice to AFMA regarding which options might best mitigate risks to high risk species.
- Once endorsed by the relevant AFMA delegate, the management responses will be documented within the revised FMS and Annual Work Plans.

### **1.7.2.3 Key considerations**

In considering options to mitigate risks to species or species groups, AFMA and its key advisory groups should consider the following issues: risk assessment ranking; key risk drivers; data status (eg: deficiency); risk-catch-cost considerations; other management objectives; existing mitigation/management measures; appropriate management tools/options; conservation status of the species; and, interactions with other fisheries (cumulative impacts). Each of these issues is explained in more detail in the main body of this Guide ([Chapter 5.5.2](#)).

### **1.7.2.4 Management tools**

AFMA employs a number of management tools for managing both commercial and bycatch species which broadly fall into two categories:

- Input controls - limit the amount of effort in a fishery, indirectly controlling species interactions (eg: effort allocations, spatial/temporal closures, gear restrictions).
- Output controls - directly limit the number of species which can be taken from the water or interacted with (eg: catch restrictions, trip limits, size limits).

These tools are described in more detail in [Chapter 5.5.2.8](#) of this Guide.

### **1.7.2.5 Developing management performance indicators**

In developing management responses to mitigate risks to high risk species, AFMA should also develop and specify within the FMS the indicators and performance measures that will be monitored to determine if the management arrangements are successful.

Performance should be tracked and determined at a number of levels:

- Management processes – are implementation activities being completed?

- Industry compliance – is industry fully complying with management arrangements designed to mitigate ecological risks?
- Ecological risk management – have “high” ecological risks been reduced as a result of mitigation measures<sup>15</sup>.

### 1.7.3 Amending the Fishery Management Strategy

#### 1.7.3.1 General process

The initial development of FMS is guided by information provided in [Chapter 3](#). Subsequent amendment of the FMS will involve alteration of its separate components (eg: Harvest and Bycatch Strategies) ([Chapter 5.5.3](#)). These should detail:

- The issue being addressed (eg: new high risk species).
- Rationale for change.
- Management response.
- Performance indicators used to measure response.
- Expected outcomes.

Amendments to FMS should be documented within the ‘Version and Amendments Record’ section. This is vital as the timeframes for amendments will differ depending on species (eg: commercial, bycatch) and the component they fall under.

#### 1.7.3.2 Commercial and bycatch species strategy amendments

The timeframes for Harvest Strategy amendments will differ depending on whether the species are key/secondary commercial species with TAC/TAE based management (and assessed at 1 – 5 year intervals) or byproduct and bycatch species with monitoring triggers and assessed every 5 years. Byproduct amendments will typically occur in conjunction with Bycatch Strategy amendments as both byproduct and bycatch are subject to the same re-assessment methods and timeframes.

#### 1.7.3.3 Data and Monitoring Strategy amendments

Data collection and monitoring activities, including those required to support ERA and ERM processes, are continuous (ie: ongoing throughout FMS cycle). Monitoring and data collection requirements to support the different components (eg: harvest and bycatch strategies) of a FMS should be identified during the development of FMS and documented as part of a Data and Monitoring Strategy. A major review of the Data Strategy should occur when the FMS is reviewed every 5 years. However, updates to the Data and Monitoring Strategy should also occur in conjunction with updates to the Harvest, Bycatch and Research Strategies and annual research statements that may occur in the intervening period. In both cases, revisions would rely on consultation with the relevant RAG, MAC or other expert group.

However, there are two key ongoing data related processes that occur throughout each ERM cycle, being:

- Collection of data to support ERA/ERM. And;
- Re-assessment indicators and triggers (based on that data).

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<sup>15</sup> It should be recognised that there may be circumstances (eg: regime shifts or where a Commonwealth fishery is not the primary source of fishing mortality on a stock) that AFMA is unable to mitigate risk.

#### 1.7.4 General data collection and monitoring

AFMA (in consultation with RAG and MAC) must identify the minimum level of data collection required to maintain and support the ongoing implementation of FMS. AFMA must then implement programs to collect that data. AFMA employs a number of monitoring programs ([Chapter 5.5.3.5](#)) to collect information on its fisheries including: catch and effort logbooks, catch disposal records (CDRs), vessel monitoring systems (VMS), observer program and electronic monitoring (EM). Further research based information collection also occurs, including via fishery independent surveys (FIS).

With respect to ERM in particular, the types of data and information collected must be sufficient to support: risk assessments (including stock assessments), re-assessment indicators and triggers ([Chapter 5.5.3.6](#)), management options development, assessment of industry compliance with management measures; and, the performance of management measures and ERM generally ([Chapter 5.7](#)). However, decisions about data collection and monitoring need to also give due regard to:

- The legislative requirement for cost effective fisheries management, including risk-catch-cost principles ([Chapter 2.5.2.4](#)).
- Data collection requirements for achieving other fishery management objectives.

AFMA fishery managers, in consultation with RAG and MAC, should briefly review data collection programs annually (or in conjunction with strategy updates) to ensure they are meeting the above requirements. A subsequent comprehensive review of the Data and Monitoring Strategy should occur as part of the 5 year FMS review.

#### 1.7.5 Research Strategies

Five year research strategies are required for each fishery and should take into account minimum information and data requirements for ERA and ERM processes (and other fishery management information needs), prioritising research towards addressing gaps in those minimum requirements. Fishery specific five year Research Strategies should be made consistent with AFMA's overall agency level Research Strategy. Annual research statements help to provide focus on immediate research needs. Five year research strategies should undergo a full review in line with the FMS five year review.

#### 1.7.6 Development of re-assessment indicators and triggers

For byproduct and bycatch species, in the periods between scheduled 5 year ERAEF re-assessments<sup>16</sup>, AFMA will monitor a set of fishery indicators and triggers, on an annual basis, so as to detect any changes in catch, effort or fishing practices that may result in a significant change (increase or decrease) in the level of risk posed by the fishery to any species ([Chapter 5.5.3.6](#)). Where indicators exceed specified trigger levels, AFMA will investigate the causes and provide opportunity for RAG comment/advice during that process. Pending outcomes of that review, and RAG advice, AFMA may, if necessary, request a species specific or full fishery re-assessment (ie: prior to the scheduled re-assessment dates).

The indicators and triggers will be developed for each fishery by AFMA in consultation with its fishery RAG (or for fisheries lacking a RAG, the ERA TWG), in association with the next planned ERA re-assessment. Research is currently underway to develop specific guidance for RAG to aid in the selection of appropriate triggers, which will in the meantime be

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<sup>16</sup> In contrast to key and secondary commercial species managed via catch/effort limits under Harvest Strategy, which depending on species and Harvest Strategy, can be re-assessed any time between 1 and 5 years.

determined using RAG expert opinion. The RAG will record both the final set of indicators and triggers chosen, and a justification for those, in the RAG minutes. Once the final set of indicators and triggers is determined for a fishery, they will require implementation ([Step 3](#)) within the FMS and a monitoring and review process ([Step 4](#)).

### 1.7.7 Develop Annual Work Plans

AFMA will develop an Annual Work Plan in each fishery to guide the implementation of ERA and ERM processes and the FMS more broadly. The Annual Work Plan will be developed by Fishery Managers and approved by relevant senior managers, and should be finalised prior to the start of each new year in the FMS cycle. These will outline key activities, resource requirements and roles and responsibilities for the coming 12 months that will achieve implementation of the FMS.

## 1.8 Implement Fishery Management Strategy (STEP 3)

The AFMA fishery manager is responsible for ensuring (in collaboration with other relevant AFMA staff and sections) the implementation of FMS ([Chapter 5.6](#)). This will occur through implementing all of the activities described in Annual Work Plans and include:

- Amendment of relevant management arrangements.
- Communication of amendments to industry prior to the commencement of the next fishing season.
- Ongoing maintenance of data collection.
- Ongoing support of required research.
- Monitoring management activities.

### 1.8.1 Implementing re-assessment indicators and triggers

Subsequent to the selection of indicators and triggers, AFMA fishery managers will be responsible for implementing:

- Appropriate data monitoring requirements and alert systems.
- Incorporation of all indicators and triggers and associated roles and responsibilities into FMS and Annual Work Plans.
- Planning and budgeting (in consultation with MAC) for any re-assessment costs.

The AFMA manager and RAG Chair will ensure that:

- The RAG (or ERA TWG) makes an assessment of trigger breaches at the earliest possible point in time and advises on the need for species or fishery re-assessment.
- The results of the RAG (or ERA TWG) assessment of indicators and triggers are recorded in the meeting minutes.

Re-assessment advice should be communicated by the RAG Chair to AFMA.

## 1.9 Performance monitoring and reporting (STEP 4)

Monitoring refers to the routine review of performance results ([Chapter 5.7](#)). The monitoring of AFMA's progress in achieving its ERM (and other) objectives relies on monitoring:

- Implementation of required management processes (eg: work plan activities are carried out) (initial outcome).
- Industry compliance with management arrangements (intermediate outcome).

- Re-assessment indicators and triggers (intermediate outcome).
- Ecological risk (long term outcome).

### 1.9.1 Performance reporting

Performance reporting will occur on an annual basis via the following mechanisms:

- Annual FMS performance report – Fishery Managers will ensure that each fishery will generate on an annual basis, a summary report of performance against key FMS indicators and reference points, including those relating to monitoring categories listed above.
- Additional “exception” reporting – Fishery Managers will report to MAC, Executive Manager Fisheries, AFMA Commission and external stakeholders (via publication of reports on website).

## 1.10 Strategy review, evaluation and improvement (STEP 5)

Due to the nature and different assessment/management cycles for different species groups (key and secondary commercial species versus byproduct and bycatch), as well as different components of the FMS, it will undergo review and revision/amendment at different points in time ([Chapter 5.8](#)). Fishery Managers will ensure the following:

- Annual Work Plans – Will be reviewed and amended on an annual basis. It is proposed that fishery managers carry out this evaluation such that the lessons from the annual evaluation will inform the development of the next Annual Work Plan.
- Fishery Management Strategy – In conjunction with component amendments and review of Annual Work Plans, a holistic evaluation, review and revision of the FMS will occur every 5 years. The FMS will be evaluated for: appropriateness; impact; effectiveness; and efficiency ([Chapter 3.6](#)). It is proposed that an evaluator (auditor) independent of the fishery conduct the strategic evaluation.

Following the independent auditors review, AFMA, MAC and RAG (or other expert groups) should:

- Consider the recommendations of the independent reviewer.
- Revise the FMS/Annual Work Plans in light of the reviews.

The ERA Management Group should then review the revised FMS/Annual Work Plan and provide recommendations for further improvement or endorsement.

# **PART B SUPPORTING INFORMATION**

## 2 Introduction

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### 2.1 Purpose

The purpose of Part B of this document is to provide AFMA fisheries management personnel with a more comprehensive overview of AFMA's revised Ecological Risk Management (ERM) and how it fits within AFMA's broader Fisheries Management Framework (FMF) (See [Attachment 2](#) for information on previous ERM processes). This document serves as a guide to implementing ERM across Commonwealth managed fisheries in a consistent and transparent manner. In doing so, this document will provide an overview of:

- The legislative and policy drivers and objectives of AFMA's revised ERM ([Chapter 2.5](#)).
- The key principles and integration of ERM within AFMA's broader FMF including within Fishery Management Strategies (FMS) ([Chapter 3](#)).
- A revised Ecological Risk Assessment (ERA) methodology that is used to identify ecological components most at ecological risk from fishing and upon which to focus management action to mitigate against that risk ([Chapter 4](#)).
- Specific guidance on ERM for bycatch species (including protected species) ([Chapter 5](#)), commercial species ([Chapter 6](#)), and habitats and communities ([Chapter 7](#)).

It should be noted that ERM to date has been largely focused on fishery risks to species populations, but moving forward will involve an increased focus on habitats and communities.

### 2.2 Background: AFMA's ERM

AFMA is responsible for the efficient management and sustainable use of Commonwealth fisheries on behalf of the Australian community. AFMA's legislated objectives are listed in the *Fisheries Administration Act 1991* (FAA 1991) and the *Fisheries Management Act 1991* (FMA 1991), and these objectives, along with those of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act 1999), are given effect by a number of subsequently developed fisheries policies and guidelines, principally:

- The Commonwealth Policy on Fisheries Bycatch (CPF 2000).
- The Commonwealth Harvest Strategy Policy and Guidelines (HSP 2007).
- Guidelines for the Ecologically Sustainable Management of Fisheries (ESMF Guidelines 2007).

Key amongst the legislative objectives is a requirement that AFMA pursues Ecologically Sustainable Development<sup>17</sup> (ESD) and as one part of this, ensure the ecological sustainability<sup>18</sup> of species populations and ecosystems with which its fisheries interact, an objective also reflected in AFMA's corporate goals. In pursuing its objectives, AFMA has

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<sup>17</sup> Ecological sustainability is only one component of ESD principles, which require decision processes to "effectively integrate both long-term and short-term economic, environmental, social and equity considerations" (FMA 1991).



adopted an Ecosystem Based Fisheries Management (EBFM) approach, and as part of this, aims to manage the risk posed by commercial fishing to ecological sustainability<sup>19</sup>.

AFMA pursues ecological sustainability through the implementation of:

- Ecological Risk Management (ERM) which provides for ongoing monitoring and management of risks to ecological sustainability ([Chapter 3](#)).
- A scientific risk assessment process (within AFMA’s ERM) referred to as the Ecological Risk Assessment for the Effects of Fishing (ERAEF) to identify and quantify risks posed by fishing to ecological sustainability ([Chapter 4](#)).

At a fishery specific level, ERA and ERM will be planned and implemented via the development of Fishery Management Strategies (FMS), which are further described in [Chapter 3.3.2](#). [Figure 4](#) outlines the linkages between legislation, policy, assessment and management processes covered by ERM. ERM has multiple components and processes, which are described in subsequent chapters.

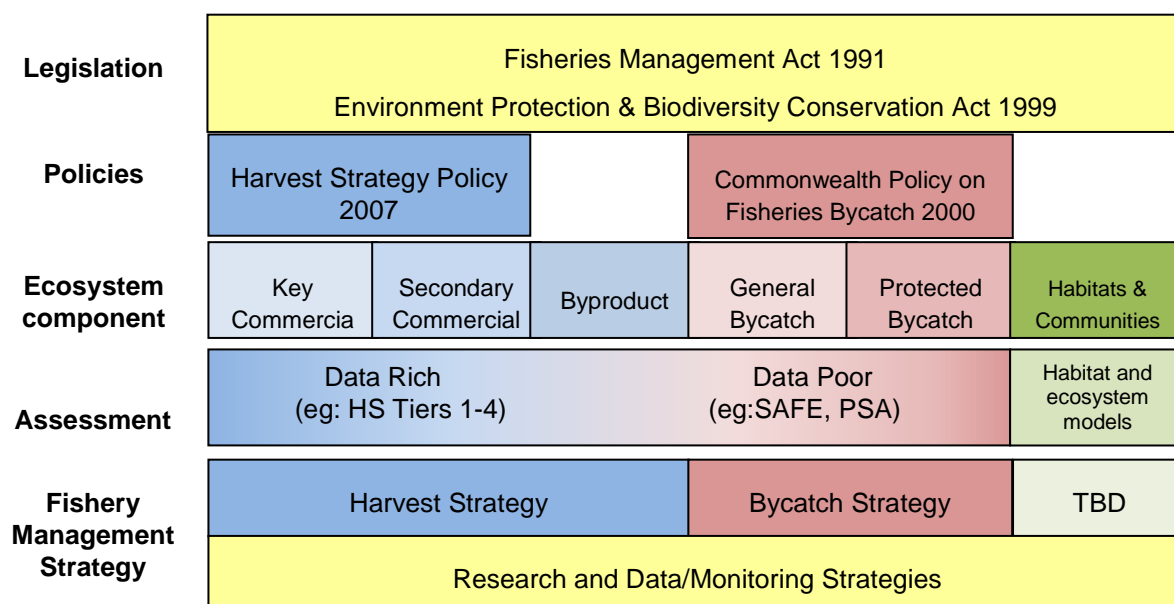
Under AFMA’s ERM, the term “risk” is defined as:

*“the probability that a [specified] fisheries management objective is not achieved.”*  
(Hobday et al. 2011)

However, operationally, AFMA’s ERM focuses on “ecological risk”, in other words:

*“the probability that fisheries management objectives relating to ecological sustainability are not achieved”*(Hobday et al. 2011).

These objectives are defined in [Chapter 2.4](#).



**Figure 4 - AFMA’s ERM and its relationship with fisheries legislation and policies, ecosystem components, risk assessment tools, and Fishery Management Strategies, which address ERM and other fisheries management objectives.**

<sup>19</sup> The term “ecologically sustainable” is defined in the ESMF Guidelines (2007) as: “use of natural resources within their capacity to sustain natural processes while maintaining the life-support systems of nature and ensuring that the benefit of the use to the present generation does not diminish the potential to meet the needs and aspirations of future generations”. AFMA’s operational interpretation of this term is defined by its ERM objective.

## 2.3 Scope

AFMA's ERM (including ERAEF), in association with industry, assesses and manages the impacts and risks posed by Commonwealth fisheries to:

Commercial species, which include:

- Key commercial species – defined in the HSP Guidelines (2007) as a species that is, or has been, specifically targeted and is, or has been, a significant component of a fishery (including discards).
- Secondary commercial species<sup>20</sup> – commercial species that, while not specifically targeted, are commonly caught and generally retained, and comprise a significant component of a fishery's catch and economic return. These can include quota species.
- Byproduct species – species that are sometimes or always retained for sale but comprise a minor component of the fishery catch and economic return. Byproduct are considered to be commercial species under the CPF (2000).

Bycatch species are species that are never retained (ie: are discarded, and includes catch that does not reach the deck of the vessel but which nonetheless is killed (or effected) as a result of the interaction with the fishing gear) and as such make no contribution to the value of the fishery. Typically, bycatch species are divided, for management purposes, into:

- General bycatch species – species that are never retained for sale (ie: species of fish, sharks, invertebrates, etc).
- protected species<sup>21</sup> – being all species listed/covered under the EPBC Act (1999), which include Protected<sup>22</sup> species (listed threatened species ie: vulnerable, endangered or critically endangered), cetaceans, listed migratory species and other listed marine species.

Habitats and Communities:

- Habitats – *“the biological and physical environments in which an organism lives”* (Sainsbury, 2008; Hobday et al. 2011).
- Communities – *“assemblages of species in varying proportions doing different things, and have properties that are the amalgam of the properties of individual populations and interactions among populations”* (Mangel and Levin 2005).

## 2.4 ERM objective

### 2.4.1 The objective

For all commercial and bycatch (including protected) species, the primary ecological sustainability (ERM) objective that AFMA pursues via ERM is:

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<sup>20</sup> Note that that 'Secondary commercial species' category is not to be used until the Commonwealth Harvest Strategy Policy is finalised.

<sup>21</sup> The term “protected” species refers to species listed under [Part 13] the EPBC Act (1999) and replaces the term “Threatened, endangered and protected species (TEPs)” commonly used in past Commonwealth Government (including AFMA) documents.

<sup>22</sup> Note “protected” (with small “p”) refers to all species covered by the EPBC Act (1999) while “Protected” (capital P) refers only to those protected species that are threatened (vulnerable, endangered or critically endangered).

- To ensure that fishing (by Commonwealth commercial fisheries) does not reduce any species populations to/below a level at which the risk of recruitment failure<sup>23</sup> is unacceptably<sup>24</sup> high.
- Where such impacts have occurred, recover populations to above that level<sup>25</sup>.

A similar intent is maintained with respect to ensuring the sustainability of habitats and communities. AFMA will further develop its habitat/community objectives and operational guidance as related Commonwealth Policies and guidelines are developed.

The ERM species population objective is consistent with the objectives and/or intent of the FMA (1991), the CPFBS (2000), the EPBC Act (1999) and associated ESMF Guidelines (2007), ERAEF Scoping objectives, the Ministerial Direction 2005, the HSP (2007) and HSP Guidelines (2007), existing FMP and a number of international agreements to which Australia is party, including UNCLOS (1987) and UNSFA (1995). A more detailed explanation of the linkages between these and the primary ERM objective is provided in [Attachment 3](#).

### 2.4.2 Risk equivalency

It is AFMA's intent to pursue risk equivalency, consistent with that described for the HSP (2007) limit reference point (LRP), across all species. This intent is referred to within the ERM objective which states "...at which the probability of recruitment failure is unacceptably high". The HSP (2007) LRP objective requires that stocks are maintained above the LRP (point below which recruitment failure has an unacceptable risk of occurring) at least 90% of the time. This effectively defines the sustainability "risk equivalency" requirement for key commercial species where sustainability risk equivalency in the HSP (2007) context means "*having a common probability of stocks falling below the limit reference point*" (Dichmont et al. 2015).

However, in pursuing risk equivalency across species, it is important to recognise that for many species (particularly byproduct and bycatch species), the ability to accurately quantify the risk of falling below the LRP is highly dependent on data availability, assessment tools that can be used for a given species, and resources available for conducting simulation testing (eg: MSE). For example, the PSA method ([Chapter 4](#)) is only able to provide an indication of relative potential risk of overfishing occurring.

### 2.4.3 Cumulative risks

The ERM objective refers to the risk posed by Commonwealth fisheries only, reflecting the fact that AFMA only has direct control over the assessment and management of fishing by Commonwealth licensed vessels. AFMA recognises that the sustainable management of fishing impacts upon species populations ideally requires the assessment and management of all sources of fishing mortality. In many Commonwealth fisheries there will be species taken which are also caught in other fisheries including other Commonwealth fisheries, State and Territory fisheries (including commercial, recreational/charter and

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<sup>23</sup> "recruitment failure" describes a sustained and significant reduction in recruits below average levels, and in the current context, as a result of fishing. Typically associated with "recruitment overfishing" which is due to "the mortality of too many fish in total, too many pre-productive fish, or too many fish that have only spawned a few times" (*Guidelines for the Ecologically Sustainable Management of Fishing, 2007*).

<sup>24</sup> With regard to the term "unacceptably high" – it is not possible to estimate the probability of recruitment failure (or breaching associated biomass levels) using most data-poor assessment methods, but an intent to ensure high probability of avoiding recruitment failure (similar to HSP 90% rule) should be pursued.

<sup>25</sup> Timeframes for recovery might be determined using advice provided in the HSP Guidelines (2007).

traditional) and international fisheries (fleets from other countries fishing outside Australian waters on the same stocks) , and also impacted by other non-fisheries resource uses.

Where all fishing mortality is due to Commonwealth fisheries, AFMA should assess and manage the cumulative impacts of its fisheries upon those populations. Where fishing mortality is contributed to by both Commonwealth and State/Territory fisheries, the Australian Government (including AFMA) should, where possible, pursue the collaborative assessment and management of fishing impacts on that species. Similarly, where fishing mortality is contributed to by both Commonwealth and international fisheries, the Australian Government (including AFMA) should, where possible, pursue the collaborative assessment and management of fishing impacts on that species.

AFMA cannot control the level of fishing mortality attributed to other jurisdictions, and data to support assessment and management in other jurisdictions may sometimes be lacking and hinder the above approaches. [Chapter 4.10](#) provides further guidance on assessing cumulative risks across multiple fisheries.

## 2.5 Consideration of other legislative objectives

### 2.5.1 Introduction to Ecologically Sustainable Development (ESD) Principles

AFMA's ERM objective addresses only one component of AFMA's requirement to pursue ESD under the FMA (1991) which defines ESD as requiring decision processes to:

*“effectively integrate both long-term and short-term economic, environmental, social and equity considerations.”*

The ESD objective also sits alongside other legislative requirements that AFMA pursues including cost effective management, maximising net economic returns, accountability to industry, optimal utilisation of living resources (FMA 1991) and ensuring its fisheries take all reasonable steps to avoid killing or injuring protected species (EPBC Act 1999).

For commercial and protected species in particular, AFMA's pursuit of these other objectives can result in some species being managed to attain or maintain population levels higher than the levels required to achieve the ERM objective alone. As a result, management decisions may result in aiming to maintain population levels that are more precautionary than strictly required by the ERM objective. There are a range of different objectives, linked risks and associated target and limit reference points which impact upon management responses for different species management categories. This Guide and the intent of ERM is primarily focused on outlining how managers can achieve the ERM objective for all ecological components of their fishery. Pursuit of aforementioned objectives are addressed within their relevant policies and guidelines outside of this document.

### 2.5.2 Fisheries Management Act 1991

#### 2.5.2.1 Economic objectives

The FMA (1991) requires that AFMA pursue:

*“maximising the net economic returns to the Australian community from the management of Australian fisheries.”*

This is given effect via the primary objective of the HSP (2007):

*“maintain key commercial stocks at ecologically sustainable levels and within this context maximise the economic returns to the Australian community” via “harvest strategies ...designed to pursue maximum economic yield.”*

In general, for individual species, biomass levels that achieve MEY significantly exceed biomass levels at which the risk of recruitment failure is high. However, for multispecies fisheries where MEY is estimated fishery wide, some species may be managed at biomass levels below the individual species  $B_{MEY}$  level, but must always be above  $B_{LIM}$  (level associated with a high risk of recruitment failure).

### 2.5.2.2 Efficient and cost effective management

Among its objectives, the FMA (1991) states that AFMA must pursue:

*“Implementing efficient and cost-effective fisheries management on behalf of the Commonwealth.”*

Cost efficiency is a key design feature of ERA and ERM which is applied to all ecological components.

For commercial species managed under Harvest Strategies ([Chapter 6](#)), risk-cost-catch principles are applied during their development. These principles effectively require the consideration of risk trade-offs between the failure, or success, of a fishery in achieving management objectives. The cost is seen not only in the operational resources used to monitor and support management objectives, but also the expected funds that are required to rebuild a stock that has crossed the lower limit, the social costs of forgone profit or catches from being overfished, and even the intangible cost to management of being seen as ineffective or worse. These are traded against the benefits of the catch.

Dowling et al. (2013) notes in particular for data-poor fisheries where less is known about stock status:

*“Many fisheries are data-poor and little is known about their stock status or broader ecological impacts. An important component of the risk–cost–catch frontier is uncertainty. As the level of uncertainty increases, the precautionary approach tends to move managers to reduce risk, usually by reducing catch, and/or increasing management costs to better assess and manage risk.”*

For species which are not managed under TAC/TAE based harvest strategies (namely byproduct and bycatch species), the hierarchical ERAEF framework ([Chapter 4](#)) is designed to filter out low and medium risk species and focus management attention on high risk species in a cost effective manner. It allows managers to take into consideration principles of risk-catch-cost when determining management responses to reduce risks. For a given potential high risk species, the management decision could be further data collection and more complex assessment to refine the risk assessment, or to accept and directly manage the risk based on the less costly (but less certain) assessment. This will depend on the relative cost benefits of each option.

## 2.5.3 Environment Protection and Biodiversity Conservation Act (1999)

### 2.5.3.1 Introduction

The EPBC Act (1999) requires ecological sustainability in Australia’s fisheries by providing for independent assessment of the environmental performance of fisheries management arrangements, through:

- Strategic assessments of Commonwealth managed fisheries (Part 10) prior to new management arrangements are brought into effect.
- Environmental assessment for international trade in wildlife (Part 13A).
- Environmental assessment of fisheries operating in Commonwealth waters for impacts on protected species (Part 13).

In assessing ecological sustainability, each fishery is assessed against the Guidelines for the Ecologically Sustainable Management of Fisheries (ESMF 2007). Within those Guidelines, Principle 1 requires the avoidance of overfishing (either recruitment or growth overfishing) and the recovery of overfished stocks and covers both commercial and byproduct species. Principle 2 requires that fishing not “threaten” bycatch species (general bycatch levels must be demonstrably sustainable); that fishing avoid mortality of, or injury to, protected species<sup>26</sup>; and fishers avoid or minimise impacts on threatened ecological communities. Both principles are consistent with the intent of the ERM objective and for protected species in particular, Principle 2 should result in protected species populations being maintained at population sizes higher than required by the ERM objective alone.

### 2.5.3.2 Threatened species listing assessments

The EPBC Act (1999) also contains processes for threatened species and ecological communities assessments (and development of recovery plans) and key threatening process assessments (and development of threat abatement plans).

Threatened species listing assessments under the EPBC Act (1999) are undertaken by the TSSC, with decisions on listing made by the Environment Minister. Under section 179 of the Act, a native species is eligible for listing as a threatened species (ie: in the critically endangered, endangered or vulnerable category), if it meets any of the criteria for the category identified in Part 7.01 of the EPBC Regulations (2000).

Due to the nature of these criteria, the TSSC has adopted ‘indicative thresholds’ based on those used by the International Union for Conservation of Nature, which they must have regard to, but there can be exceptions. These thresholds are used to help determine if a relatively large risk of extinction in the wild, sometime in the future, exists for a species. They pertain to a decline in either, the abundance, geographic distribution or the number of mature individuals, and allow for consideration of a quantitative analysis of the risk of extinction, or a combination of any of these. The minimum population decline that might result in a species being listed as threatened is 30% (where the threatening process has not ceased) or 50% (where the process has ceased).

With regard to commercially harvested marine fish, Part F of the TSSC Guidelines (2015) acknowledges that declines of up to 60% are considered acceptable as a managed fisheries outcome under the HSP (2007), and that:

*“Variations in the extent of acceptable decline depend on the biology of the individual species. The Committee is informed, but not bound, by a series of limit and target biological reference trigger points (commonly referred to as  $B_{LIM}$  and  $B_{TARG}$ ) provided in the policy for management intervention for species that decline below 60% of their pre-fishing biomass. These interventions include listing assessments.”*

In addition, the HSP (2007) states that:

*“While a stock biomass is above  $B_{LIM}$  there is no expectation that the species would be added to the list of threatened species (conservation dependent, vulnerable, endangered or critically endangered) under the EPBC Act. If the stock biomass is at or is below  $B_{LIM}$  then those stocks may be the subject of action under both the fisheries and environment legislation as the risk to the species may be regarded as unacceptably high. If an AFMA developed stock rebuilding strategy was in place, of which the cessation of the strategy would adversely affect the conservation status*

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<sup>26</sup> This relates to sections of the EPBC Act (1999) which requires that AFMA ensures its fisheries “take all reasonable steps to ensure that [protected] species (other than conservation dependent species) are not killed or injured as a result of the fishing.” This requirement is also reflected in the CPF (2000).

*of the species, consideration would be given to listing the species in the conservation dependent category<sup>27</sup>. If the stock biomass falls more substantially below  $B_{LIM}$ , there is an increased risk of irreversible impacts on the species. As such the species will likely be considered for listing in a higher threat category (ie: vulnerable, endangered or critically endangered). A listing under such categories may, in accordance with the EPBC Act, require development of a formal recovery plan. Where the biomass of a listed stock is above  $B_{LIM}$  and rebuilding towards  $B_{TARG}$ , consideration could be given to deleting the species from the EPBC Act list of threatened species, or amending the category it is in.”*

However, it is important to note that the HSP (2007) (and therefore Part F of the TSSC Guidelines (2015)) does not cover minor byproduct species, nor bycatch species taken by commercial fishing. While the TSSC indicative thresholds for byproduct and bycatch species are currently the same as those used for assessing any species' eligibility for threatened species listing under the EPBC Act (1999), to date, no fish bycatch or fish byproduct species (excluding species once targeted) taken in Commonwealth fisheries has been assessed for listing, so there is no example of how the TSSC might assess these species.

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<sup>27</sup> As per Part C of the TSSC Guidelines (2015).

## 3 Integration of ERM within AFMA's Fisheries Management Framework

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### 3.1 Purpose

ERM is one component of AFMA's broader Fisheries Management Framework (FMF). This chapter describes:

- The structure of the four phase FMF which encompasses planning, implementation, monitoring/reporting and evaluation/improvement phases and AFMA's intent to underpin the FMF with an International Standard Organisation<sup>28</sup> (ISO) aligned management system.
- The integration of ERM within the FMF and the requirement for fisheries to develop integrated Fishery Management Strategies (FMS) and Annual Work Plans.
- ERM governance, roles and responsibilities within the FMF.

### 3.2 Fisheries Management Framework and ERM

The implementation of AFMA's broader FMF can be described as having four key phases:

- Planning.
- Implementation.
- Monitoring and reporting.
- Evaluation and Improvement ([Figure 5](#)).

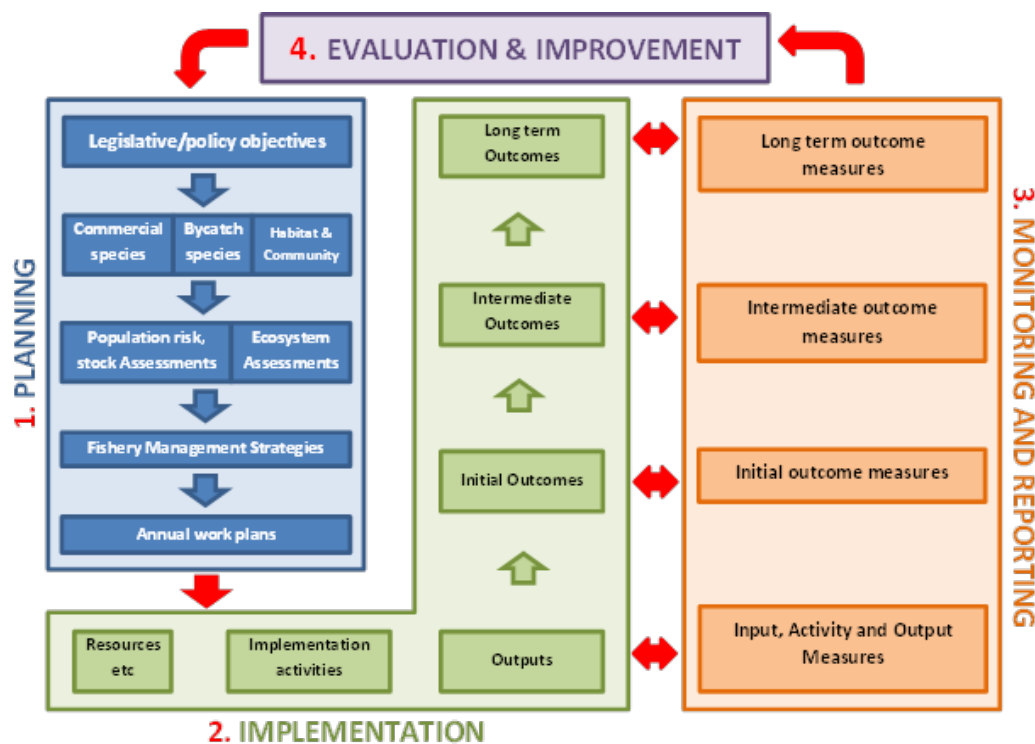
The following sections highlight the key ERM related processes in each phase of the broader FMF cycle. Future updates of this Guide may include detailed description of other processes.

In the long term, AFMA aims to develop its ERM to meet ISO management system requirements. This is effectively a system of documented Standard Operating Procedures that will ensure consistency in core processes (activities) that AFMA uses to plan, monitor, assess, manage, and report on risks to its objectives across its fisheries. This Guide represents the first major step towards documenting core processes relating to ERM that will comply with an International standard management system. AFMA will continue to work towards developing processes and documentation to meet the requirements during 2017, including revisions to this Guide.

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<sup>28</sup> International Standard Organisation – ISO is a worldwide federation of national standards bodies.





**Figure 5 – General structure of the Fisheries Management Framework (FMF) to support the planning, implementation, monitoring and improvement of Fishery Management Strategies (including ERA and ERM) for AFMA’s fisheries.**

### 3.3 Planning

The planning phase consists of producing three key documents which fulfil the required legislative objectives outlined above in Chapter 2. These consist of:

- Risk/stock assessments.
- Fishery Management Strategies (FMS).
- Annual Work Plans and research priorities.

#### 3.3.1 Risk assessments and management options analysis

These are used to assess ecological risks to species populations, and to help evaluate potential responses to mitigate risk. Their use in management response processes differs depending on whether they are part of harvest strategies or not ([Chapter 5.4](#)).

#### 3.3.2 Development of Fishery Management Strategies

FMS will be developed during the planning phase of the broader FMF. FMS will be the primary means by which AFMA pursues its legislative and policy based requirements, including those pertaining to ecological sustainability. FMS combine existing components pertaining to the management of commercial species (ie: Harvest Strategies), bycatch species, habitats and communities, research, data and monitoring. ERA and ERM are integrated within each FMS and associated management cycle, alongside other processes that pursue broader management objectives.

FMS will help make fisheries management more understandable to staff and external stakeholders. FMS will streamline and make AFMA’s current reporting and accountability processes more robust. FMS development for Commonwealth fisheries will occur as per the schedule outlined in [Table 2](#). Once a draft FMS is compiled for the first time,

subsequent revision of ERM within the FMS 'cycle' would occur during phase 3 – Monitoring and Reporting ([Figure 5](#)).

The recommended general structure for FMS is provided in [Attachment 1](#). For consistency, the high level structure (chapters) should be adhered to, and the lower level structure (subheadings) adhered to where appropriate for each fishery.

The main components of FMS are:

- Background.
- Objectives.
- Consultative processes.
- Fishery overview.
- Harvest Strategy.
- Bycatch Strategy.
- Habitats and communities.
- Data and monitoring strategy.
- Research Strategy.
- Version and Amendments Record.

The assessment and management processes detailed in FMS may be developed, reviewed and revised on different time scales. This is because Harvest Strategy and Bycatch Strategy components and associated assessment and planning processes will rarely be aligned and likely require amendment at different points in time. As such, a critical feature of the FMS is the "Version and Amendments Record" tables which will allow FMS to act as a 'living document'. Each of the FMS components (listed above, apart from "Background" and 'Objectives') should contain:

- Objectives.
- Inputs (resources).
- Activities (to implement each component).
- Outputs.
- Initial, intermediate and long term intended outcomes.
- Assumptions and risks underpinning outcomes.
- Performance Indicators (for each outcome).
- Data sources (for indicators).
- Frequency of performance measurement.
- Roles and responsibilities.
- Measure of actual performance (status).

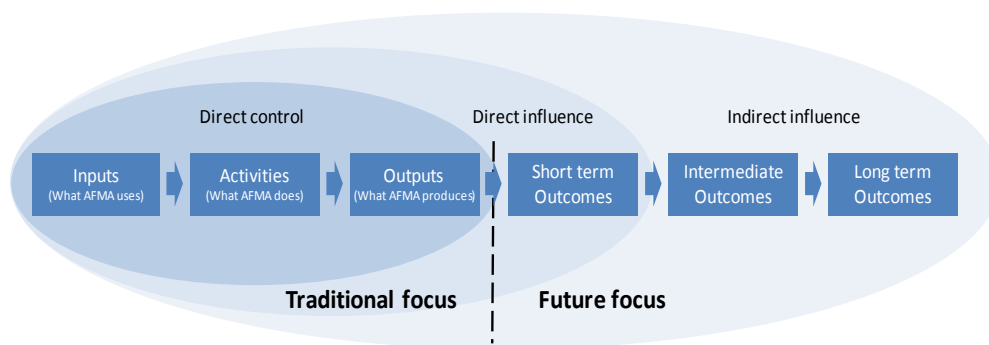
In developing FMS, AFMA may look to establish an approach whereby there is a linking of inputs and activities to outcomes, a summary of activities, outputs, outcomes, performance indicators and reference points documented in a series of worksheets that might be attached to the FMS ([Figure 6](#)). This will allow an explicit description of:

- The cause effect relationships from proposed management arrangements to the intended long term outcomes.

- Indicators and reference points for each level (short, medium and long term) of the outcomes hierarchy. And;
- Underpinning assumptions, rationale and risks.

These worksheets will continue to be refined by AFMA and document:

- Aspirational goals for fisheries - identify activities and inputs needed to achieve short, medium and long term outcomes for their fisheries (1. Outcomes Hierarchy Worksheet).
- Assumptions and risks underpinning outputs to initial, medium and long term outcomes (2. Risks and Assumptions Worksheet).
- Performance indicators, reference points, data sources, and who is responsible for measuring performance (3. Monitoring Plan Worksheet).



**Figure 6 – Relationship between inputs, activities, outputs and outcomes under AFMA’s Fisheries Management Framework. This ensures management activities and outputs are explicitly linked to management outcomes that meet AFMA’s ERM and legislative objectives.**

### 3.3.3 Annual Work Plans

Annual Work Plans will be developed each year, outlining specific activities to be undertaken to implement FMS (including ERM) in the following 12 months, including resource requirements, roles and responsibilities and activities. They should take into account the evaluation of the past year’s performance, and any changes in the operating environment. These work plans would need to align to each fishery’s activity based costings and section plans. These would be developed by AFMA fishery managers and approved via the General Manager of AFMA’s Fisheries Management Branch.

## 3.4 Implementation

This phase implements FMS via carrying out core processes/activities within the Annual Work Plan in a way that ensures high quality and consistent outputs over time and across fisheries. [Figure 7](#) outlines examples of core and supporting processes that will be included in Annual Work Plans to implement FMS, with key ERM related activities including:

- Communication of management strategies, arrangements, and directions to industry/fishers.
- Harvest Strategy activities (eg: TAC/TAE setting, ERA trigger monitoring etc).
- Bycatch Strategy activities (eg: protected species interaction monitoring, ERA trigger monitoring).

- Data collection activities (eg: logbook, observer, electronic monitoring, survey etc).
- Compliance monitoring activities.
- Research support activities (eg: proposal reviews, logistical support, collaboration).

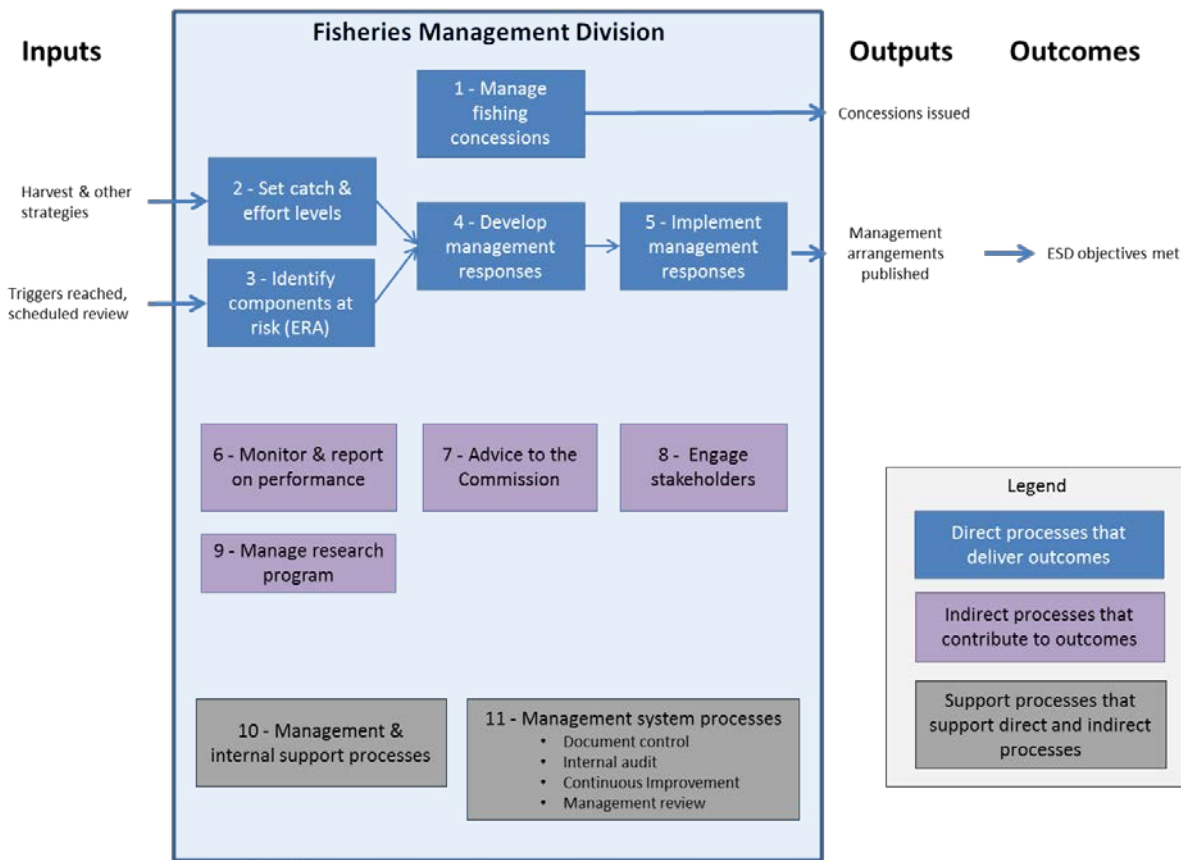


Figure 7 – Examples of direct, indirect and support processes that assist in the implementation of FMS.

### 3.5 Monitoring and reporting

Monitoring refers to the routine review of performance results. It is a continuous process that involves the collection and analysis of information on specified indicators to provide managers with an indication of the extent of progress towards the achievement of outcomes. In relation to FMS, this phase involves monitoring the performance of Harvest, Bycatch, Research and Data components. In relation to ERM processes within the FMS, it includes monitoring:

- Initial outcomes – such as successful execution of work plan activities.
- Intermediate outcomes – such as industry compliance with management arrangements; ERA triggers monitored on annual basis.
- Long term outcomes – primarily the successful reduction in risk to high risk species and prevention of other species becoming high risk.

The indicators and reference points for assessing performance can be identified during development of FMS (and may draw upon advice in established policy Guidelines and this ERM Guide).

### Planning and Policy

Minister for Agriculture  
 Department of Agriculture  
 Minister for the Environment  
 Department of Environment  
 AFMA CEO/Commission  
 AFMA Management  
 ERA Technical

Performance is reported annually in Annual FMS Reports and can include other information relating to other reporting requirements (eg: strategic assessment requirements).

### 3.6 Evaluation, Review and Improvement

This phase involves evaluation of FMS, including its ERM components, and identification of improvements to ensure that AFMA's ERM (and other) objectives are met (See [Chapter 5.8](#)). Evaluation is defined as a structured process of assessing the extent to which the outcomes of a strategy, program or activity is meeting its objectives. Evaluation occurs at two levels:

- Annual Work Plans – reviewed annually.
- Fishery Management Strategies – reviewed on a five year cycle.

Typical evaluation questions may include:

- Appropriateness - To what extent does the FMS continue to reflect best practice for contributing to the corporate goal and fishery level objectives given what is known about the social, economic, scientific or environmental context? To what extent does the FMS reflect best known practices?
- Impact
  - To what extent are the intended outcomes being delivered?
  - What unanticipated positive or negative outcomes have resulted?
  - To what extent have the underlying assumptions remained the same?
  - To what extent can any changes in outcomes be attributed to the management strategy?
- Effectiveness
  - To what extent have the planned activities and outputs been completed?
  - Could the outputs/outcomes be delivered as effectively using different activities?
- Efficiency
  - How could resources be used differently to deliver more value to stakeholders?
  - What could be done differently to improve implementation or reduce costs?

### 3.7 ERM governance, roles and responsibilities

Description of ERA and ERM related roles and responsibilities of all agencies, stakeholders and positions (eg: within AFMA) are described in this Guide at three different scales, being:

- Agencies, committees and stakeholder groups - involved in ERA and ERM processes that occur during different phases of the fishery management strategy cycle are identified in [Table 3](#).
- AFMA staff/positions, sections and committees - roles and responsibilities, are summarised in [Table 4](#).
- Task specific roles and responsibilities are also indicated in the technical guidance chapters to follow (Chapter [5](#), [6](#) and [7](#)).

Table 3 – ERA and ERM roles and responsibilities within each phase of a Fishery Management Framework cycle. Red - Approval/endorsement; Blue – Responsible for development; gold – Responsible for implementation; yellow – involvement; green – are consulted with.

	Minister for Agriculture	Department of Agriculture	Minister for the Environment	Department of Environment	AFMA CEO/ Commission	AFMA Management	ERA Technical Working Group	Management Advisory Committees	Resource Assessment Groups	Research providers	Industry
<b>Planning and Policy</b>											
Commonwealth policies eg: Harvest and Bycatch Strategies and Guidelines	Red	Blue		Green	Green	Green		Green	Green	Green	Green
Ecological Risk Management (ERM) Guide					Red	Blue	Yellow		Green	Green	Green
Fishery Management Strategies (FMS)					Red	Blue		Yellow	Yellow	Yellow	Yellow
Annual Work Plans						Blue					
Development and review of ERA methodology					Red	Yellow	Gold	Green	Green	Blue	Green
<b>Implementation</b>											
Implementation of Commonwealth policies						Gold		Yellow	Yellow	Yellow	Yellow
Implementation of FMS and Annual Work Plans						Gold		Gold	Green		Gold
Provide Technical advice and guidance on ERA						Yellow	Gold				
Undertake ERAs						Yellow		Green	Yellow	Gold	Green
<b>Monitoring and Reporting</b>											
ERM Performance monitoring/reporting					Red	Gold	Gold	Gold	Yellow		Yellow
AFMA Annual report					Red	Gold					
Data collection and monitoring						Gold		Yellow	Yellow	Yellow	Gold
<b>Evaluation and Improvement</b>											
EPBC Accreditation			Red	Gold		Gold		Yellow	Green	Green	Green
Internal/External Auditing of ERM					Red	Gold					
MSC Accreditation											Gold
ISO Standards						Gold					

**Table 420 - ERM roles and responsibilities of AFMA staff and committees.**

<b>Role</b>	<b>Responsibilities</b>
Executive Manager Fisheries	<ul style="list-style-type: none"> <li>• Overall performance and endorsement of ERM.</li> <li>• Review and endorsement of FMS.</li> </ul>
Senior Manager, Policy Environment Economics and Research (PEER)	<p>Implementation of ERM including:</p> <ul style="list-style-type: none"> <li>• Supporting fishery managers in their implementation of ERM.</li> <li>• Resourcing of the ERM Operational Support Unit (staff located within PEER).</li> <li>• Development, implementation and maintenance of an international standard management system.</li> </ul>
Environment Manager, ERM Operational Support Unit (PEER)	<ul style="list-style-type: none"> <li>• Management of the ERM Operational Support Unit and ERA Management Group.</li> <li>• Coordinate and support the implementation of ERM across fisheries.</li> <li>• Provide expertise in monitoring, reporting and evaluation of ERM implementation.</li> <li>• Facilitate continuous improvement of ERM.</li> <li>• Co-ordinate internal/external auditing of ERM's performance.</li> <li>• Secretariat support of ERA TWG.</li> </ul>
ERA Management Group	<ul style="list-style-type: none"> <li>• Annual oversight of ERM operation.</li> <li>• 5 year review of the performance of ERM.</li> <li>• Provide annual and 5 year reports to the AFMA Commission, outlining recommendations for improvement.</li> </ul> <p>The proposed structure of the ERA Management Group includes:</p> <ul style="list-style-type: none"> <li>• AFMA Commissioner (from the Finance and Audit Committee).</li> <li>• Executive Manager, Fisheries Branch.</li> <li>• Senior Fisheries Managers, Fisheries Branch.</li> <li>• A representative from AFMA's Corporate Governance/Risk Management area.</li> <li>• Senior Manager, PEER (Convenor and Chair).</li> <li>• Relevant PEER staff</li> </ul>
Management Systems personnel	<ul style="list-style-type: none"> <li>• Establish/maintain the quality/environmental Management System.</li> <li>• Co-ordinate/conduct internal/external audits of procedures within the Fisheries management Branch.</li> <li>• Review the performance of the Management System.</li> <li>• Co-ordinate staff training in Management System.</li> </ul>
ERA Technical Working Group	<ul style="list-style-type: none"> <li>• Provide review and advice on fishery specific ERA re-assessments, including inputs to residual risk analyses, in line with its Terms of Reference</li> <li>• Provide review and advice on fishery specific ERA re-assessments, including inputs to residual risk analyses, in line with its Terms of Reference</li> </ul>

	<ul style="list-style-type: none"> <li>• Annually review, report on and monitor the performance of the ERA methodologies against AFMA's targets and objectives for the environmental management of its fisheries.</li> <li>• Provide advice and assist in the development of improved ERA methodologies where required.</li> </ul>
Fishery Managers	<p>Within their fishery:</p> <ul style="list-style-type: none"> <li>• Overall performance of ERM and FMS (including planning, implementation, monitoring, review and improvement).</li> <li>• Development of effective indicators and reference points for all components.</li> <li>• Adherence to management system.</li> <li>• Timely reporting of performance and corrective and improvement actions.</li> </ul>
Fishery RAG	<ul style="list-style-type: none"> <li>• Provide review of ERA re-assessments.</li> <li>• Provide scientific/technical advice to assist in development of management options to mitigate risk for species.</li> <li>• Provide review and scientific advice on the development of FMS.</li> <li>• Identify data and research gaps and priorities.</li> </ul>
Fishery MAC	<ul style="list-style-type: none"> <li>• Participate and contribute to the strategic planning stage, including management arrangements, development of expected outcomes, indicators and reference points.</li> <li>• Review annual monitoring reports.</li> <li>• Provide management advice to assist in development of management options in response to ERA.</li> <li>• Annual review of ERM performance and providing recommendations for improvement.</li> <li>• Reporting to the AFMA Commission on fishery management outcomes.</li> </ul>



## 4 Ecological Risk Assessment - Revised Methodology

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### 4.1 Purpose

This chapter provides fishery managers with a clear understanding of the current Ecological Risk Assessment for the Effects of Fishing (ERAEF) methodology and process, including recent changes and improvements. It is primarily focused on the assessment of risk (as defined in [Chapter 2](#)) of Commonwealth commercial fisheries to species populations. Habitats and communities will receive more detailed attention in future updates to this Guide. The broader implementation and review of ERAEF within AFMA's Fisheries Management Framework is discussed in subsequent [Chapters 5, 6 and 7](#).

### 4.2 Introduction

#### 4.2.1 What is the ERAEF?

The ERAEF is the primary methodology underpinning AFMA's Ecological Risk Management (ERM). The ERAEF was developed to assess and monitor the risk posed by Commonwealth fisheries to the ongoing sustainability of ecosystem components that interact with Commonwealth fisheries. AFMA uses results from the ERAEF to inform its ERM responses (see [Chapter 5](#)) which in turn are designed to assist AFMA in meeting its related legislative, corporate and policy objectives (eg: EPBC Act 1999) and assist its fisheries to gain certification against other standards/processes (eg: MSC).

ERAEF was initially developed by CSIRO in collaboration with AFMA from 2000-2006 with the goal of providing an assessment framework by which to assess risks against "ecological sustainability" across five ecological components being:

- Commercial species<sup>29</sup>.
- Byproduct and bycatch species.
- protected species<sup>30</sup>.
- Habitats.
- Ecological communities.

This holistic ERA approach was implemented predominantly as a result of:

- A shift in the 1990s and 2000s in Commonwealth government thinking towards implementing an ESD approach to fisheries management (as required by the FMA 1991) and more recently Ecosystem Based Fisheries Management (EBFM).
- A demonstrated need to assist in evaluating impacts of fishing for strategic assessments under the EPBC Act (1999) (Hobday et al. 2007).

The ERAEF was implemented during a period in which there was relatively little policy regarding how AFMA could meet its "sustainability" objectives. As a part of the ERAEF process, fisheries stakeholders were required to specify sustainability objectives and typically relate those objectives (for species) to avoiding fishing impacts that would lead to recruitment failure (or similar). The ecological risk being assessed under the ERAEF and managed under ERM, along with the broader legislative and policy context, is discussed in detail in [Chapter 2](#).

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<sup>29</sup> Previously the term "Target" was used to describe "Commercial" species.

<sup>30</sup> Previously the term "Threatened, endangered and protected" was used to describe "protected" species.

## 4.2.2 Original design

In its original form, the ERAEF framework involves a hierarchical approach ([Figure 8](#)) to assessing risk across each of the 5 ecological components. The original methodology is described in detail in two key documents, Hobday et al. (2007) and Hobday et al. (2011). Assessment occurs sequentially through the following phases:

- Scoping - This phase identifies the fishery context, species lists, ecological sustainability objectives, and hazards (fishery activities that may impact the ecosystem).
- Level 1 (SICA) - A comprehensive but qualitative analysis of risk in which the most vulnerable “unit”<sup>31</sup> in each component (eg: group of species) is assessed. This phase serves to exclude “low risk” components from analysis at Level 2, as if the most vulnerable species is low risk, so will all the less vulnerable species.
- Level 2 (PSA) - A species specific (or habitat/community specific) semi-quantitative approach which assesses fishery risks to each unit (eg: species) carried forward from Level 1. Units assessed to be at high risk at Level 2 can either be managed directly or carried forward to Level 3 for fully quantitative assessment.
- Level 3 - A unit-specific, quantitative “model-based” approach that accounts for spatial and temporal dynamics of units and fisheries and quantifies uncertainties around stock status.

This approach had a number of significant advantages over previous more ad-hoc approaches to managing for ecological sustainability, including being:

- Comprehensive.
- Consistent – it allows managers to provide a sound and consistent “best available evidence” based means to justify management responses for any given species (reducing the risk of perception or assumption driven decision making).
- Resource and cost efficient - any potential activities/hazards are screened out at Level 1, so that the more intensive and quantitative analyses at Level 2, and ultimately at Level 3, are limited to a subset of the higher risk activities associated with fishing.
- Identify high-risk activities - which in turn can lead to immediate remedial action (risk management response) where it may be inappropriate to delay action pending further analysis.
- Precautionary - in the sense that fishing activities are assumed to pose high risks in the absence of information, evidence or logical argument to the contrary.

Following the development of the original ERAEF and the progression of species component ERA assessments to Level 2 across Commonwealth fisheries, two further developments occurred that improved the species-specific assessments of risk. The first was the development and application of Residual Risk Analysis (RRA) for the PSA, in recognition that the PSA methodology was unable to account for some management arrangements that mitigate risk (see [Chapter 4.8.3](#)). The second was the development of a more quantitative rapid risk assessment tool called ‘SAFE’, which ultimately was used in addition to PSA for some species groups (see [Chapter 4.8.4](#)) and was often referred to as Level “2.5”.

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<sup>31</sup> Unit is a generic term, and refers to an individual species, habitat or community type.

In the period since the initial development of the ERAEF and ERM, additional fisheries policies (eg: HSP 2007 and Guidelines) and other Guidelines (eg: ESMF Guidelines (2007)) have been developed and/or implemented. The interaction between these and the ERAEF and ERM are explained further in [Chapter 2](#) and [Attachment 3](#).

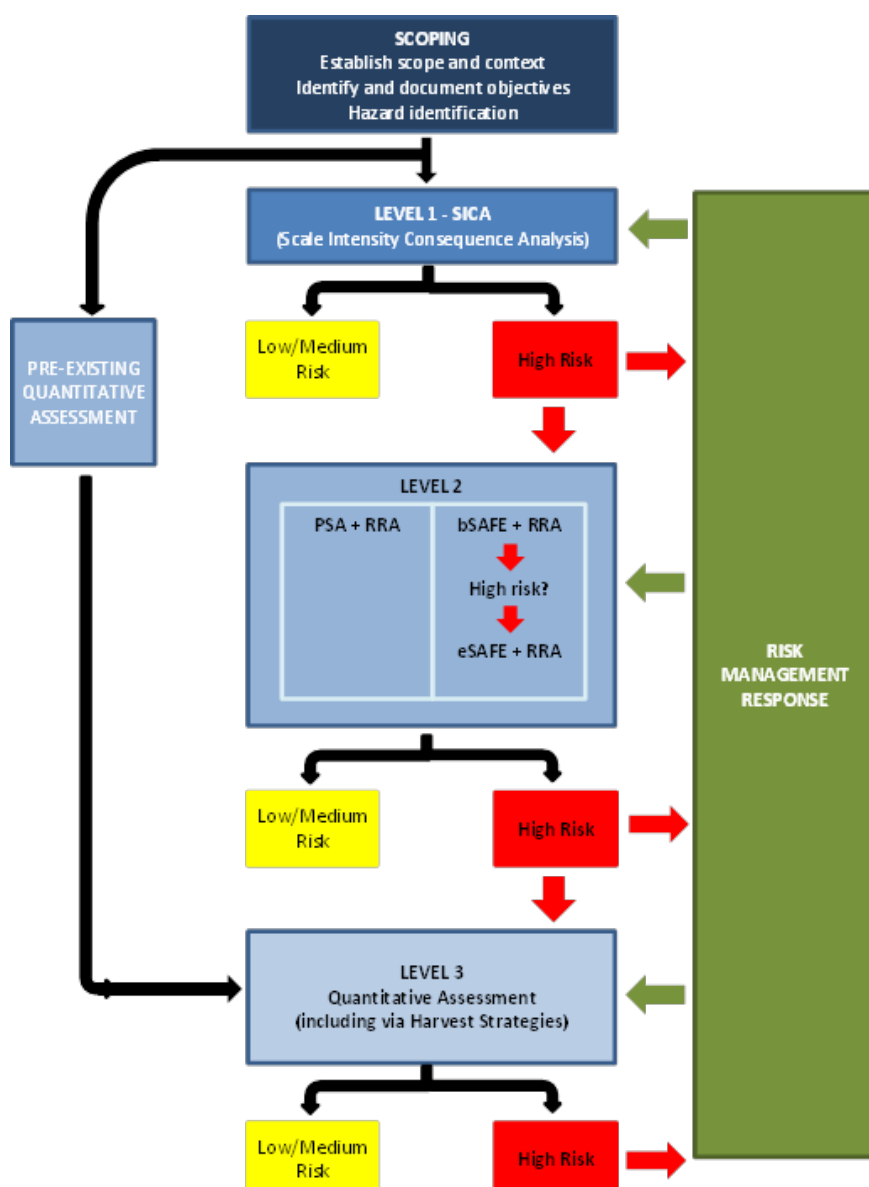


Figure 8 - Structure of the 3 level hierarchical ERAEF methodology. SICA – Scale Intensity Consequence Analysis; PSA – Productivity Susceptibility Analysis; SAFE – Sustainability Assessment for Fishing Effects; RRA – Residual Risk Analysis. T1 – Tier 1. eSAFE may be used for species classified as high risk by bSAFE.

### 4.2.3 Application of ERAEF

The majority of AFMA’s fisheries underwent ERA to Level 2 by 2007 and subsequently residual risk assessments and in many cases further quantitative risk assessment via SAFE. Some fisheries have under-gone partial re-assessment (eg: via SAFE) in more recent years, however others are overdue for re-assessment. A schedule for re-assessments by fishery is presented in [Table 2 \(Part A\)](#), while development and implementation of reassessment triggers is discussed in [Chapter 5.5.3.2](#).

Since completing development of the method described above, the ERAEF approach has been used and modified for specific purposes by a range of international groups (Hobday et al. 2011), including MSC, the International Commission for the Conservation of Atlantic Tunas (ICCAT) working group on ecosystems, the Western Central Pacific Fisheries Commission (WCPFC), the Caribbean Regional Fisheries Mechanism (CRFM), the National Marine Fisheries Service (NMFS) in the US (Patrick et al. 2009, 2010), as well as in south east Asian Fisheries (Leadbitter et al. 2013), in Atlantic tuna fisheries (Cortes et al. 2010, Arrizabalaga et al. 2011) amongst others (eg: Gallagher et al. 2012, Micheli et al. 2014,). Some groups have chosen to use only some elements within the ERAEF, particularly the PSA approach (Patrick et al. 2009), and have further modified the selection of attributes and cut-offs for the particular situation.

### 4.3 Reviews and recommendations for improving the ERAEF

Credibility of the science and analyses underpinning the ERAEF and ultimately the ecological risk management of fisheries is critical to general stakeholder acceptance, as well as to meeting the objectives of fisheries management. Methods need to be able to withstand stakeholder scrutiny and technical peer review. As such, the ERAEF should be subject to periodic review and a continual improvement process (Hobday et al. 2011).

AFMA undertook a review of its ERA/ERM approach in 2013/14, with the subsequent ACIG report (2014) recommending a number of improvements to ERAEF. Subsequently, AFMA established an ERA TWG to assist in dealing with recommendations from that report, as well as improvements identified by CSIRO and AFMA.

AFMA also engaged CSIRO in 2014 to undertake technical work to address these issues and improve the ERAEF methodology. CSIRO submitted a draft report to AFMA in September 2014 outlining proposed revisions to the ERAEF. It recommended:

- A simplified risk assessment and management process.
- Refining the species list considered in the ERAEF assessment.
- Incorporation of current management arrangements in the ERAEF including accounting for residual risk in the Level 2 tools.
- PSA updates and improvements including:
  - Continuous scoring for Availability attribute.
  - Careful screening of the list of species – reduce false positive species.
  - Evaluate the number and choice of the productivity attributes used – based on new data (eg: consider using growth, R, etc.) plus other data revision. As new information is available.
  - Refinement of the cut-off scores – calibration.
  - Differentiate data deficient species (missing > 2 attributes, and hence potentially a false positive) versus robustly assessed species (no missing attribute data).
- Improvements to SAFE: default approach and enhancement.
- Online simulation testing of possible management responses.

The suite of proposed changes were designed to improve both the credibility and cost effectiveness of ERAEF and ensure that it is an adaptable approach going forward that can allow for consideration of new information, species, reference points, methods/tools or adaptation to new standards and policy developments. In addition, further relevant

technical work is ongoing under the FRDC-funded Bycatch Policy Guidelines project, which will contribute solutions to some of the technical issues described earlier.

In September 2015, AFMA engaged the ERA TWG to review recent research relevant to the ERAEF methodology and summarise the current status of ERAEF methods, so as to inform the drafting of this Guide. The ERA TWG focused, in particular on work relating to 7 key areas of improvement, being:

- More explicitly defining the risk being assessed and managed via ERM (now defined in [Chapter 2.4](#)).
- A revised ERAEF methodology, focusing on Level 2 tools, but including clarification of interactions with Level 3 assessments already undertaken as part of harvest strategies ([Chapter 4.4.2](#)).
- Clarifying the explanation of PSA and SAFE methods, including limitations with respect to assessing the risk of fisheries being overfished ([Chapter 4.83](#) and [4.84](#)).
- Development of a PSA “management axis” to help automate and standardise how Residual Risk is accounted for<sup>32</sup>.
- International approaches to assessing cumulative risk via PSA.
- ERA re-assessment timeframes and triggers ([Table 2 – Part A](#)).
- ERA roles and responsibilities under AFMA’s revised ERM ([Chapter 3.7](#) and [Table 4](#)).

Recommendations for changes to the ERAEF stemming from this meeting are detailed below.

## 4.4 Revised Methodology

The revised ERAEF methodology described in this chapter was endorsed by the ERA TWG as an interim methodology for use by AFMA until such time as further technical work under the FRDC Bycatch Guidelines project is completed. It is envisaged that this chapter and report will be revised to include any improvements at that stage.

At this stage, the focus of the revised methodology is on improvements to the species components of the ERAEF methods (commercial, bycatch/byproduct, protected species) in particular at Level 2. Habitat and community considerations will be considered in more detail in future revised versions following the development of specific policy guidance (by the Australian Government) relating fishery interactions with those ecosystem components.

The overall 3 tiered hierarchical structure (ie: Levels 1, 2, 3) of the ERAEF is maintained under the revised methodology ([Figure 8](#)). A relatively detailed description of each of these levels is provided below. In addition, the five general ecological ‘components’ that are intended to be evaluated are also maintained (ie: key and secondary commercial species, byproduct/bycatch species, protected species, habitats, ecological communities). ERAEF will be undertaken at five year intervals, with assessors investigating the previous five years of fishery (and other relevant) data to best reflect the current management of each fishery. Some circumstances may permit investigation of fisheries data from greater than five years during ERAEF to also be considered.

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<sup>32</sup> The final development of this method has been delayed pending other improvements to databases and methods, which may preclude the need for a “management axis”.

#### 4.4.1 Key changes to ERAEF

In relation to species-specific risk assessments (the focus of this chapter), there are a number of important changes to processes within the tiered structure that should be noted and which are reflected in [Figure 8](#). These are as follows:

##### Scoping and Level 1

- Selection of ERA objectives - The primary objective to be pursued for species assessed under ERA is that of ensuring populations are maintained at biomass levels above which recruitment failure is likely, as stated in [Chapter 2.4](#). This is consistent with current legislation and fisheries policies and represents a change from when the ERAEF was first developed and there was less policy or legislation based guidance on sustainability objectives. A range of secondary objectives remain available to stakeholders for selection where in some instances they may also be appropriate, and particularly provide guidance for assessing habitats and ecological communities (eg: tables 5A-C in Hobday et al. 2007). These are contained in [Attachment 4](#).
- Re-assessments will look to cost-effectively review and update the previous scoping information, and utilise existing consultation forums and meetings (principally RAG, MAC, ERA TWG and the Commission).
- Species list generation: With increased observer coverage and improved ERA methodology, there is now scope to improve methods involved with the generation of species lists to enable improved time and resource efficiency, without sacrificing the precautionary nature of ERA. Within the scoping process, the use of species-accumulation-curves may now be used as a tool for developing the species list. As assessment of these curves will inform assessors and AFMA as to whether or not the species list is adequate, or if it is likely to be missing species. If it is deemed adequate, species lists will be compiled using only the species included in the curve. Where the curve is not considered to be mature, the species list must be based on all species with a range and depth overlap with the fishery.
- Expansion of generic species listings: Traditionally, all generic species listings (eg: albatross) have been expanded to all species within that group. However, this leads to the ballooning of the number of species that require assessment, many of which likely do not interact with the fishery. To improve this process, only those species that have a range and depth overlap with the fishery will now be included. Interactions recorded in logbooks at the species level will be included within the species list. However, where interactions are listed to Family level in logbooks, it will not be expanded. Instead, expansion of species lists will only be based on observer data.
- Assigning of species to ecosystem components: It is important that species are assigned to the correct component. As part of the Bycatch Project, ABARES is currently developing catch and economic indicators which may inform how species should be designated between each component. MACs and RAGs are responsible for making a final decision on how species are categorised, using this information if applicable. Note that the 'Secondary Commercial Species' category should not be used until the Commonwealth Harvest Strategy Policy is finalised.
- Species list for Level 1 (SICA): Once the scoping species list is developed, species which already have re-occurring Level 3 Quantitative assessments (eg: in association with harvest strategies, rebuilding strategies or other management processes) should be removed from the list to generate a final species list for Level

1 SICA. Species with Level 3 assessments or equivalent (including conservation dependent species with such assessments) should not be included in Level 1 or Level 2 analyses. There may be some cases where a harvest strategy based assessment is not available but the RAG considers other available and recent assessments/indicators for a particular species to provide a more robust assessment of risk than level 2 ERA assessment tools.

- Level 1 bypass mechanism: A mechanism whereby fishery RAGs can request to bypass level 1 for species components ONLY, and directly undertake level 2 has been developed. This will reduce costs and improve the efficiency of the ERA process without compromising outcomes for fisheries that are likely to be assessed as 'at-risk' as a result of level 1. This option has been developed for large fisheries that are likely to always require assessment of species at level 2 given their level of interaction with certain species and the precautionary nature of SICA.

## Level 2

- This will now include both PSA and SAFE methods (noting the latter has been previously described as level 2.5 or 3), with the preferred assessment tool being bSAFE (base SAFE, rather than eSAFE, extended SAFE). SAFE is considered more robust due to its use of explicit reference points and a continuous scale for attributes (greater sensitivity relative to PSA) and greater utility for assessing management responses (Smith et al. 2014).
- PSA should be applied for species with insufficient data (eg: distributional data) or having biological characteristics (eg: colonial breeders) that are not suitable for assessment by bSAFE (CSIRO 2015). Typically this has been the case for protected species (especially mammals, reptiles and seabirds) and invertebrates.
- It should be noted that PSA and SAFE are only two of a spectrum of tools that might appropriately be used at Level 2 and at this level a merger with the Tier structure of harvest strategies or the addition of any equivalent other tool might be possible in future.
- It is recommended that species assessed to be at high risk via bSAFE analyses should then be assessed via eSAFE, providing AFMA does not wish to take management action based on bSAFE alone or the required data is not available.
- SAFE has been further developed to be able to account for cumulative risk across multiple fisheries.
- Residual Risk Guidelines have been revised to reflect updates to the ERA methodology and a review of the original Guidelines.
- Residual Risk Guidelines will be applied to species assessed as high risk via PSA and species assessed as high/medium risk via SAFE due to the increased possibility of false negatives via the SAFE method.

### **4.4.2 Moving between ERAEF Levels**

The rationale that needs to be applied when determining whether to progress species between levels of the ERAEF (Hobday et al. 2011) remains essentially the same in the revised process. Such decisions depend on:

- Estimated risk at the current level (ie: low risk species will not be assessed at the next level).
- Risk-catch-cost principles – is the cost of assessing at the next level greater than the cost of managing directly (with appropriate precaution) at the current level?

- Whether the “high risk” estimate may be due to a lack of data.
- Availability of data to proceed to the next level (eg: data collection may be required first, or may not be cost justified, and management action might be taken without higher level assessment).
- Management response to risks identified at the current level. For example, if the risk is high but immediate changes to management regulations or fishing practices will reduce the risk (without unacceptable economic impacts on industry), then analysis at the next level may be unnecessary.

#### 4.4.3 Precautionary elements

The ERAEF approach has a number of features that result in a precautionary or conservative approach to identifying and ranking ecological risk. Principal among these is assuming potential high risk in the absence of data or information to the contrary. This feature provides an incentive to collect data to support future assessments. In general, the precautionary approach will result in more false positives (units identified at higher risk than would occur when assessed at a higher level with more data) than false negatives (units scored at a lower risk than would occur when assessed at a higher level with more data). This bias is important, as false positive results can be screened out at higher levels in the ERAEF hierarchy, while false negatives result in improper elimination of a hazard or unit, with no further opportunity to consider it at later stages in the ERAEF. While no error would be preferable, the uncertainty associated with the qualitative and semi-quantitative risk assessments at Levels 1 and 2 argues in favour of maintaining a bias against false negative results (Hobday et al. 2011). Although this may reduce the efficiency of this process in some instances, it increases the likelihood of ERAEF identifying all components that are at risk which is its most important function.

#### 4.4.4 ERAEF performance criteria

It is intended that the revised ERAEF meet, to the greatest extent possible (recognising there are trade-offs between some factors below), the following criteria (Hobday et al. 2011):

- Comprehensive (identify and analyse all potential hazards).
- Flexible (applicable to all types of fishery, irrespective of size, fishing method, species).
- Understandable (easy for stakeholders to grasp) and clearly articulated/communicated. This includes clarifying its role/interaction with other processes, such as harvest and bycatch strategies.
- Transparent and repeatable (be clear about the methods, data and assumptions used in the analyses).
- Cost effective (make use of existing knowledge, information and data within realistic limits of time and resources).
- Scientifically defensible (be able to withstand independent scientific peer review).
- Useful for management (inform appropriate risk management responses).
- Take a precautionary approach to uncertainty.
- Where possible ensure risk equivalency across tools and levels (#DB).



A key to success of the new framework and methods will be greater acceptance and transparency for stakeholders. This will be facilitated by improved credibility of the methods and assessments themselves, as well as by having a more cost- and time-efficient process (Smith et al. 2014).

#### 4.4.5 Key processes in the ERAEF

Full details of the ERAEF methods, including a step-by-step user guide, are in Hobday et al. (2007) and these should be referred to when undertaking a fishery re-assessment, but in conjunction with the changes to that process highlighted in this Chapter. Hobday et al. (2007) will itself be updated during the next round of fishery re-assessments.

The following overview is presented here to highlight the key principles, features and most importantly, changes to the processes initially described in Hobday et al. (2007). The following sections provide an overview of the 5 key phases/processes of the ERAEF:

- Stakeholder consultation.
- Scoping.
- Level 1 SICA (qualitative risk assessment).
- Level 2 (semi-quantitative and quantitative methods).
- Level 3 (fully quantitative methods).

### 4.5 Stakeholder consultation

Participation of stakeholders is an important feature of ERAEF, and is particularly important in the more qualitative levels of the hierarchy (Scoping and Level 1). Stakeholders are defined as those people who have a direct interest in a fishery, and can include: commercial fishers, managers, recreational fishers, indigenous fishers, conservation focused non-government organizations, fishery scientists, and experts in particular taxa (Hobday et al. 2011).

Stakeholder participation in the process not only improves the assessments, but also increases the chance of uptake of results and helps in identifying suitable management responses. In many fisheries in Australia, a wide range of stakeholders are already involved in the management process. Without a good representation of stakeholders, issues may not be correctly identified or evaluated, particularly at Level 1 in the ERAEF. Most often, stakeholders are engaged through face-to-face meetings, usually after initial draft documents have been prepared (Hobday et al. 2011). A record of stakeholder involvement is kept as part of the ERAEF process, via a Proforma: *Summary Document SD1. Summary of stakeholder involvement for fishery* (Hobday et al. 2007).

### 4.6 Scoping

Scoping involves six key steps. The following is a brief overview of these steps, relevant to a fishery being assessed for the first time. It should be noted that for fisheries being re-assessed, Scoping may comprise a more simplified updating of previously compiled information. These steps are described in more detail in Hobday et al. (2007).

#### Step 1 – Characterisation of the fishery

This step involves the development of a general fishery characteristics document which provides a reference for discussions and clarification of analysis for Levels 1 and 2 at stakeholder meetings. The information used to complete this step may come from a large range of management and research documents relevant to the fishery being assessed. The information obtained is used to complete a fishery characterisation proforma: *Scoping Document S1 General Fishery Characteristics* (Hobday et al. 2007).

## Step 2 – Listing of units of analysis (eg: species, habitats or community assemblages)

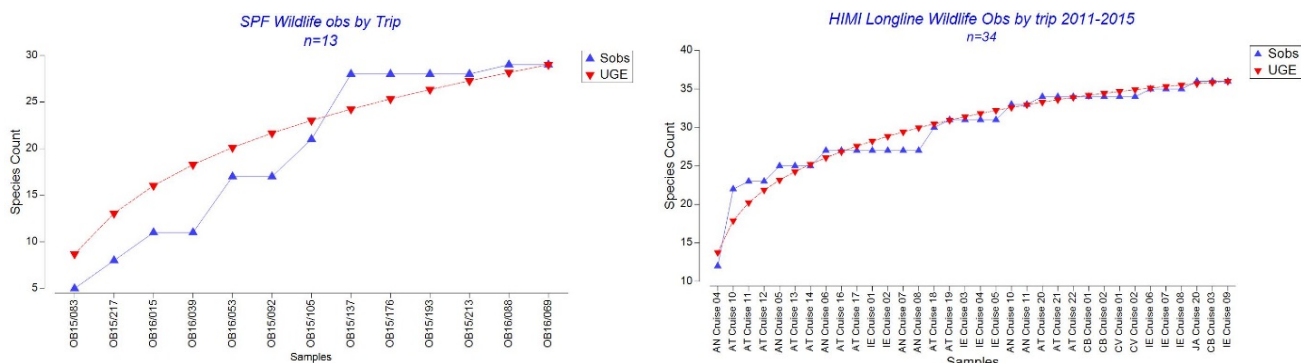
A revised process for developing species lists for assessment has been developed. With increased observer (and electronic monitoring) coverage and a revised ERAEF methodology, there is scope to improve the efficiency of this process. A step-by-step process will now be applied when developing species lists as follows:

- AFMA to provide initial species list to assessor, including all observer, logbook, electronic monitoring and any other relevant data from the entire time series for the fishery.
- Remove any mis-identified species that do not have a spatial or depth overlap with the fishery.
- Undertake statistical Species Accumulation Curve to inform decision on whether or not existing sampling levels have provided an adequate species list. I.e: it contains all/most species likely interacting with the fishery. Fishery managers should consider issues such as the level of observer coverage, percentage of total species expected and how many species would be expected in the next year to make a judgement on the “maturity” of the curve.
  - If the curve is considered to be “mature”, it forms the species list.
  - If the curve is not “mature” the species list includes all species that have a spatial and depth overlap with the fishery.
- All species inclusions and exclusions must be fully justified in the ERA report.
- Expand generic species listings (eg: albatross): Where interactions are recorded in logbooks to the species level, these species are to be included in the list. Where they are listed at the Family level in the logbook, the Family is not to be expanded. Expansions from Family level are only to be based on observer data.
- The final list will be presented to RAG/AFMA/expert groups for review and endorsement.

Species Accumulation Curve plots show the rate of accumulation of new species observed within a fishery over time ([Figure 9](#)). If this curve plateaus, then the occurrence of new species in the fishery is rare, and therefore, all species that are likely to interact with the fishery have been recorded, assuming no major changes in the fishery (eg: spatial effort, gear). If this plot has not plateaued, and the number of new species being recorded is still occurring on a common basis, then species recorded in the previous five years may not sufficiently represent all those that are interacting with the fishery. If this is the case, species not recorded should also be considered for assessment.

Although this revised technique may be considered less precautionary, it is also important to note that any new species observed in intervening years will be immediately assessed using the new Level 2 online PSA/SAFE tool during annual reporting and review of fisheries. Therefore, the likelihood of a species that is interacting with the fishery significantly remaining unassessed is very low, maintaining the precautionary nature of ERAEF.

The set of habitats is based on geo-morphology (Williams et al. 2011). Substratum and faunistic characters and the community units are either qualitative or model-based food-web descriptions. These are recorded via *Scoping Documents S2A, S2B and S2C* (Hobday et al. 2007). Development of improved habitat and community data is an ongoing priority.



**Figure 9: A comparison of Species Accumulation Curves for two AFMA fisheries. A) Small Pelagic Fishery and; B) Heard and Macquarie Island Fishery. The rate of species accumulation in the HIMI is much lower due to 100% observer coverage and the longevity of the fishery. In contrast, the SPF, a relatively new fishery, is still interacting with new species commonly despite 100% observer coverage. Therefore, species not observed in the SPF should be considered for assessment, whereas the HIMI seems to have adequate observer coverage with just six new species observed throughout the last two thirds of sampled trips.**

**Step 3 – Identification of objectives for components and subcomponents**

Management objectives need to be identified for each component (core objectives) and sub-component (operational objectives), with the latter expressed as limits to acceptable change (what is “acceptable” needs to be defined in each case). Core objectives (also called endpoints) identify what you are trying to achieve. Operational objectives (or measurement endpoints) are objectives stated in ways that can be measured. It is important to identify objectives that managers, the fishing industry, and other stakeholders can agree on, and that scientists can quantify and assess. The identified objectives are used as part of the Level 1 SICA analysis. For species, it is important that the objectives chosen are consistent with those in fisheries policies and Guidelines and the ERM. The key species level risk being managed for under the ERM objective is avoiding recruitment failure (Chapter 2.4). Other optional objectives are contained in Attachment 4. These may be used where applicable and measurable.

**Step 4 – Hazard identification**

The set of activities is selected from a comprehensive checklist. Formally, these activities are known as hazards (Burgman 2005). In ERAEF, hazards are the activities undertaken in the process of fishing, together with any external activities, which have the potential to adversely impact on ecological components (ie: species, habitats, communities). The fishery-specific hazards are divided into the following categories based on the major effect of the activity:

Attribute	Low susceptibility	Medium susceptibility	High susceptibility
<ul style="list-style-type: none"> <li>Capture/removal.</li> <li>Direct impact without capture.</li> <li>Addition/movement of biological material.</li> <li>Disturbance of physical processes.</li> </ul>	<p>(low risk, score=1)</p> <p>&lt;10% overlap</p> <p>Globally distributed</p>	<p>(medium risk, score=2)</p> <p>10-30% overlap</p> <p>Restricted to same hemisphere/ocean basin as fishery</p>	<p>(High risk, score=3)</p> <p>&gt;30% overlap</p> <p>Restricted to same country as fishery</p>
<p><b>Availability 1. Overlap of species range with fishery.</b></p>			
<p><b>Availability 2. Global distribution. Also need to consider stock proxies</b></p>			

- External hazards.

These categories are then subdivided into fishing activities (of the fishery being evaluated) and external activities (including other fisheries) (Hobday et al., 2007). These fishing and external activities are scored on a presence/absence basis for each fishery. Only those activities that are scored as present in a fishery are then carried forward for analysis in subsequent levels.

#### Step 5 – Bibliography

All references are to be included in the ERA Results Report bibliography (#2).

#### Step 6 – Decision rules to move to Level 1

Any hazards that are identified at “Step 4 Hazard Identification” as occurring in the fishery are carried forward for analysis at Level 1 (Hobday et al. 2007).

#### **4.6.1 Summary of key changes to Scoping process:**

- Re-assessments will look to cost-effectively review and update the previous scoping information, not start from the beginning, and utilise existing consultation forums and meetings (principally RAG, MAC, ERA TWG and the Commission).
- Objectives need to be consistent with those stated in current fisheries policies and with the risk (objectives) being managed under ERM ([Chapter 2](#)).
- A revised process for generating species lists has been developed.

### **4.7 Level 1 - Scale Intensity Consequence Analysis (qualitative risk assessment)**

Scale Intensity Consequence Analysis (SICA) uses an exposure-effects risk assessment approach that is only applied to the “most vulnerable” unit (ie: species) of an ecological component. This makes SICA an efficient screening process of low risk components as those deemed to be low risk are ejected at level 1. It scores each fishing activity (hazard) for impact against a core objective. The scale and intensity of the activity are each scored (≈exposure), and then the consequence score (≈effect) is selected from a component-specific set of scoring Guidelines (Hobday et al. 2007). These scoring tables, adapted from Fletcher et al. (2002), reflect a range of impact levels from negligible (score 1) to extreme (score 6). Scores of 3 or higher within a component result in that component being examined at Level 2.

The scale and intensity scoring reflects potential changes in the catch/removal term of the logistic model ( $q$  and  $E$ ) due to the hazard, while the consequence scoring reflects the effect the hazard will have on the intrinsic rate of increase ( $R$ ). For example, a high intensity score would indicate that “removal” is highly likely, while a high consequence score indicates that the rate of increase or carrying capacity would be greatly reduced by this activity. The effort term ( $E$ ) is approximated by the spatial and temporal scale of the activity, which is an important consideration in evaluating the risk for particular activities.

SICA relies on expert judgement and stakeholder input throughout. Stakeholders provide feedback on three key components of SICA initially compiled by the assessor. Stakeholders and experts provide input during selection of the “most vulnerable” unit of an ecological component for subsequent assessment. Once agreed upon, assessors will undertake the analysis. Draft results are then presented to stakeholders to provide input on scale and intensity scores and overall risk rankings. Lastly, stakeholders provide input detailing appropriate rationale of overall risk scores which is important for the broader public uptake of results and to increase transparency.

### 4.7.1 Uncertainty and precautionary elements

SICA employs a “plausible worst case” approach to evaluation of risk, rather than considering all possible interactions. In assigning a consequence score for each activity/component combination, the highest-scoring (worst case) plausible scenario is selected. For example, in scoring the direct impact of fishing on the bycatch component, the stakeholders would consider the relative vulnerability to the gear among the bycatch species, and select the most vulnerable species based on the combination of exposure to the gear and potential rate of recovery of the species to impact. The highest score consistent with a plausible scenario is reported. If the plausible worst case scenario is not assessed to be at significant risk, then all other hazards will be at even lower risk. This leads to considerable efficiency in screening out low risks. The level of consequence that is deemed “significant” can also be selected with precaution in mind. In Australian applications to date, any consequence level above “minor” (score of 2) either elicits a management response, or is analysed further at a higher level in the hierarchy.

Inclusion of current management arrangements can be incorporated into SICA because these are based on expert judgement that can include knowledge of such arrangements (Smith et al. 2014).

### 4.7.2 Issues to be aware of:

- SICA can cause frustration among stakeholders who may consider that time and effort is wasted on documenting issues that they do not consider to be an issue. Pre-prepared drafts of key documents by assessors and AFMA for RAG and stakeholder advisory groups will reduce this problem.
- There is also the potential for different groups to arrive at different scores, and so documenting rationale is critical. Processes should ensure consistency (Hobday et al. 2011).
- For fisheries that have significant bycatch components and are likely to require assessment at level 2, a mechanism has now been developed whereby stakeholders/AFMA can decide to bypass Level 1 for species components only (habitats and communities still assessed at Level 1) and be directly assessed at Level 2. This will reduce costs and improve the efficiency of the ERA process without compromising outcomes for fisheries that are likely to be assessed as ‘at-risk’ as a result of level 1. This may also aid fisheries in attaining external sustainability certification (eg: MSC).
- Where an external hazard (eg: coastal development) is considered to be a high risk activity at Level 1, it must be appropriately handled. Because this is an external hazard and not within the jurisdiction of AFMA, this will not move to level 2 and a management response will likely be ineffective. Therefore, it is the responsibility of AFMA fishery managers to make the relevant authority (eg: Department of the Environment and Energy) aware of this risk.

## 4.8 Level 2 (semi-quantitative and lower tier quantitative methods)

When the risk of an activity at Level 1 (SICA) on a species component is moderate or higher and no planned management interventions that would remove this risk are identified, an assessment is required at Level 2 (to determine if the risk is real and provide further information on the risk). The tools used to assess risk at Level 2 allow units (eg: all individual species) within any of the ecological species components (eg: commercial, bycatch, and protected species) to be effectively and comprehensively screened for risk. The units of analysis are identified at the scoping stage. To date, Level 2 tools have been designed to measure risk from direct impacts of fishing only (ie: risk of overfishing, leading

to an overfished fishery), which in all assessments to date has been the hazard with the greatest risks identified at Level 1<sup>33</sup>.

#### 4.8.1 Changes to Level 2 since the original ERAEF

In the period since the first ERAEF was implemented across Commonwealth fisheries, much of the management focus has been on the assessment results associated with Level 2 and 3 risk assessment methods, which comprise semi-quantitative or rapid simple quantitative methods (eg: PSA and SAFE). This level has been subject to the greatest level of change and improvement and these are discussed in the following sections. Additional improvements are being developed for implementation in the near future ([Chapter 4.13](#)).

Level 2 was originally designed to rely on a single risk assessment methodology, the Productivity-Susceptibility Analysis (PSA) ([Chapter 4.8.3](#)), however a more quantitative method called the Sustainability Assessment for Fishing Effects (SAFE) ([Chapter 4.8.4](#)) was developed early in the implementation of the ERAEF and is now the preferred Level 2 methodology. SAFE has been developed in two forms, base SAFE (bSAFE) and enhanced SAFE (eSAFE). eSAFE has greater data and resourcing (time/money) requirements than bSAFE but is able to more appropriately model spatial availability aspects when sufficient data are available.

Under the revised ERAEF:

- bSAFE has now been reclassified as the preferred Level 2 method (over PSA) where sufficient spatial and biological data (to support bSAFE) are available. Typically this has been used for teleost and chondrichthyan species.
- Species estimated to be at high risk under bSAFE may then be assessed under eSAFE which may provide reduced estimates of uncertainty pertaining to the actual risk.
- Where either the data or species biological characteristics are insufficient to support bSAFE analyses, it is recommended that PSA be applied instead. This will be the case for many protected species, invertebrate bycatch species and some other species.
- At Level 2, either PSA or SAFE methods should be applied to any given species, not both.
- For high risk species it is a management choice whether to progress to eSAFE, pursue a Level 3 fully quantitative stock assessment, or to take more immediate management action to reduce the risk. The types of considerations required in making that choice (ie: moving up the ERAEF assessment hierarchy or taking direct management action) are outlined in [Chapter 5.5](#).
- Residual Risk Analysis will be undertaken for high risk species for both SAFE and PSA, with medium risk species also considered under SAFE due to the increased possibility of false negatives.

It is also recognised that a number of additional tools, including some of the “data poor” assessment tools that are used to inform harvest strategies, could potentially be included within the Level 2 toolkit. They are distinguished from Level 3 quantitative tools (ie: stock assessment models) that are more data rich and able to more precisely quantify the uncertainty.

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<sup>33</sup> Future iterations of the methodology will include PSAs modified to measure the risk due to other activities, such as gear loss.

## 4.9 Productivity – Susceptibility Analyses (PSA)

The PSA approach used under the ERAEF follows on from an approach developed by Stobutzki et al. (2002) and is based on the assumption that the risk to a unit (eg: species, habitat or community) will depend on two characteristics of that unit:

- The extent of the impact due to the fishing activity, which will be determined by the susceptibility of the unit to the fishing activities (Susceptibility), and;
- The productivity of the unit (Productivity), which will determine the rate at which the unit can recover after potential depletion or damage by fishing.

It is important to note that the PSA essentially measures relative potential risk of overfishing (hereafter noted as risk) and does not provide a measure of absolute risk, which requires some direct measure of abundance or mortality rate for the unit (ie: species) in question. The PSA approach examines attributes of each unit that contribute to or reflect its productivity or susceptibility to provide a relative measure of risk to the unit. Full details of the methods are described in Hobday et al. (2007).

PSA is designed to be precautionary in how it assigns risk (Hobday et al. 2011), because:

- Attributes default to high risk values if there is missing information.
- Independently verified information can be used to modify scores.
- Some assumptions are precautionary – for example, assuming that the spatial extent of stocks doesn't extend outside a fishery when estimating spatial overlaps.

Thus PSA is designed to be more likely to produce “false positive” results (classify species as high risk when they are not) than false negative results (classify species as low risk when they are high risk). The residual risk analysis process was put in place largely to reduce the number of false positive results, but could be used to assess false negatives in future.

### 4.9.1 Recent improvements

Managers should be aware of the following recent improvements to the PSA methodology:

- Continuous scoring for the Availability attribute in the Susceptibility axis – will allow more continuous measurement of on-water changes.
- Evaluation of the set of indicators used in the productivity axis – with more data available, some of the previously neglected indicators (eg: growth) may be used, as may the direct measure “R”.
- Refinement of the cut-off scores ([Tables 5 and 6](#)) to decrease the frequency of false positives and false negatives.
- Differentiate the PSA results into those that are data deficient and those that are robust (no or little missing data).
- Inclusion of residual risk elements within PSA (in the susceptibility axis and/or proposed management axis) to reduce the need for residual risk analysis previously included as part of Level 2.

**Table 5 – Productivity cut off scores for species attributes for the ERAEF Level 2 PSA method. These cut offs have been determined from analysis of the distribution of attribute values for species in the ERAEF database, and are intended to divide the attribute values into low, medium and high productivity categories.**

Attribute	Low productivity	Medium productivity	High productivity
Average age at maturity	> 15 years	5-15 years	< 5 years
Average maximum age	> 25 years	10-25 years	< 10 years
Fecundity	< 100 eggs per year	100-20,000 eggs per	> 20,000 eggs per
Average maximum size	> 300 cm	100-300 cm	< 100 cm
Average size at maturity	> 200 cm	40-200 cm	< 40 cm
Reproductive strategy	Live bearer	Demersal egg layer	Broadcast spawner
Trophic level	> 3.25	2.75-3.25	< 2.75

**Table 6 - Susceptibility cut off scores for species attributes for the ERAEF Level 2 PSA method. These example cut offs have been determined from analysis of the distribution of attribute values for species in the ERAEF database, and are intended to divide the attribute values into low, medium and high susceptibility categories. A choice of attributes exists for some susceptibility aspects, such as availability; where data are available, Availability 1 is preferred over Availability 2, while for Encounterability, the maximum score of the two attribute choices (Encounterability 1 and Encounterability 2) is used. More specific detail is provided in the PSA spreadsheets.**

Attribute	Low susceptibility (low risk, score=1)	Medium susceptibility (medium risk, score=2)	High susceptibility (High risk, score=3)
<b>Availability 1. Overlap of species range with fishery</b>	<10% overlap	10-30% overlap	>30% overlap
<b>Availability 2. Global distribution. Also need to consider stock proxies</b>	Globally distributed	Restricted to same hemisphere/ocean basin as fishery	Restricted to same country as fishery
<b>Encounterability 1 – Habitat (scores vary by fishery)</b>	Low overlap with fishing gear	Medium overlap with fishing gear	High overlap with fishing gear
<b>Encounterability 2 – Depth check (scores vary by fishery)</b>	Low overlap with fishing gear	Medium overlap with fishing gear	High overlap with fishing gear
<b>Selectivity (scores vary by gear type, this example is for set gillnets)</b>	Species < mesh size, or >5 m in length	Species 1-2 times mesh size, 4-5 m in length	Species >2 times mesh size, to say, 4 m in length
<b>Post-capture mortality (scores vary by fishery)</b>	Evidence of post-capture release and survival	Released alive	Retained species, or majority dead when released



## 4.9.2 Steps

Step 1 - Identify the units excluded from analysis and document the reason for exclusion (Hobday et al. 2007)

Step 2 - Score units for productivity

The level of fishing impact a unit (eg: species population) can sustain will depend on its inherent productivity. Productivity determines how rapidly a species can recover from depletion or impact due to fishing. The productivity of a unit such as a species or population is determined by species attributes such as longevity, growth rate, fecundity, recruitment and natural mortality. The attributes used to score productivity for the three species components (ie: commercial, bycatch, protected species) are described in [Table 5](#). While units have inherent productivity, fishing can also affect productivity of the unit depending on the size of reduction in the unit and the life stage of a species taken by a fishery (Hobday et al. 2011).

Step 3 - Score units for susceptibility

The level of fishing impact that a unit can sustain depends on its susceptibility to capture or damage by fishery activities. Following Walker et al. (2005), susceptibility is estimated as the product of the following four independent aspects:

- Availability - considers overlap of the fishing effort with a species distribution. Where a fishery overlaps a large proportion of a species range the risk is high because the species has no refuge, and the potential for impact is high.
- Encounterability - considers the likelihood that a species will encounter fishing gear that is deployed within the geographic range of that species. The main component of encounterability considered for each species is its adult habitat. This habitat is also checked to determine if it lies within a bathymetric zone where fishing is permitted.
- Selectivity - for species that encounter fishing gear, selectivity considers the potential of gear to capture or retain the species.
- Post Capture Mortality - evaluates the case that, if captured, a species would be released in a condition that would permit subsequent survival.

The cut-off scores associated with each of these attributes are presented in [Table 6](#). A multiplicative approach is considered more appropriate for susceptibility because low risk for any single aspect acts to reduce the overall risk to a low value.

The treatment of these aspects has been tailored to utilize original datasets (eg: FishBase), and incorporate additional information, such as outputs from the BIOREG Project (Lyne et al., 2005), and additional distributional information compiled specifically for protected species that represents an improvement over previous datasets.

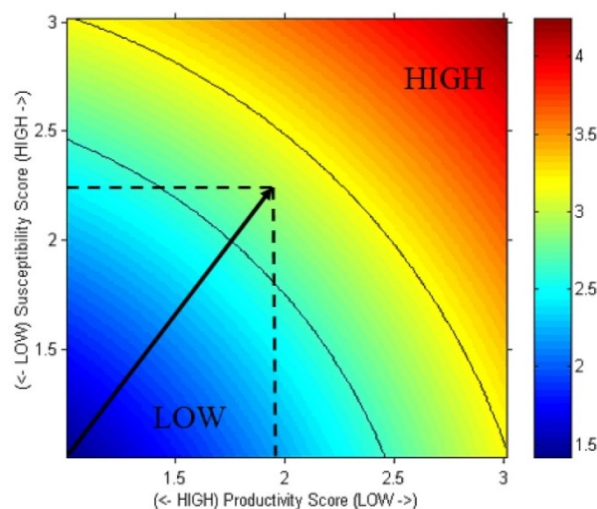
Step 4 - Plot individual units of analysis onto a PSA Plot

The productivity and susceptibility attributes in Steps 2 and 3 are scored as 1 (low), 2 (medium) or 3 (high). Missing attributes are scored as a 3. The average productivity and multiplied susceptibility scores for each unit of analysis (eg: for each species) are then displayed on a PSA plot ([Figure 10](#)). The relative position of the units on the plot will determine relative risk at the unit level as per the PSA plot. An overall risk score is the Euclidean distance from the origin, which allows a single risk ranking (Hobday et al. 2007, 2011).

- Units that fall in the upper third of the PSA plots are deemed to be at high risk.

- Units with a PSA score in the middle are at medium risk.
- Units in the lower third are at low risk with regard to the productivity and susceptibility attributes.

The divisions between these risk categories are based on dividing the area of the PSA plots into equal thirds. If all productivity and susceptibility scores (scale 1-3) are assumed to be equally likely, then 1/3<sup>rd</sup> of the Euclidean overall risk values will be greater than 3.18 (high risk), 1/3<sup>rd</sup> will be between 3.18 and 2.64 (medium risk), and 1/3<sup>rd</sup> will be lower than 2.64 (low risk). It is important to note that these risk values are mostly determined by “intrinsic” properties of the species (productivity), and while the relative fishery interactions are measured through the susceptibility attributes, assessment of the actual impact of the fishery on the species is not made. None of these risk thresholds relate directly to actual population status reference points.



**Figure 10 – Example PSA plot showing the paired productivity/susceptibility scores for example species, relative to the low, medium and high risk areas of the plot.**

#### Step 5 - Uncertainty ranking of overall risk to each unit

The uncertainty is due to missing attributes, which is partly handled by the division into data deficient and robust categories.

#### Step 6 - Residual Risk Analysis

Due to the semi-quantitative nature of a Level 2 PSA assessment there is a number of limitations. In particular, certain management arrangements which mitigate the risks posed by a fishery, as well as additional information concerning levels of direct mortality, may not be easily taken into account in the assessments. Further, the number of interactions recorded for each unit is purposefully not included within PSA due to historical issues of low observer coverage and how to define risk based on interaction numbers given the large variation in population abundance for different species.

Residual risk analysis (RRA) is used to consider additional information, particularly the mitigating effects of management arrangements that were not explicitly included in the attributes. RRA also considers factors such as the number of interactions recorded by observers/logbook data and whether or not new or missing data is available that may influence a species risk status. RRA analysis is undertaken for species assessed as high risk under PSA due to its bias towards false positives. However, in theory RRA could also be used to determine if some species have been incorrectly classified as low/medium risk.

Residual Risk Guidelines have been recently revised, to assist in making accurate judgments consistently across all fisheries. At the moment, the Guidelines are applied to

species and are not applicable to habitats and communities. The Residual Risk Guidelines have been revised and decreased to 6 guidelines (from 9 previously), being:

- Guideline 1. Risk rating due to missing, incorrect or out of date information.
- Guideline 2. At risk due to external factors (cumulative risks).
- Guideline 3. At risk in regards to level of interaction/capture with a zero or negligible level of susceptibility.
- Guideline 4. Effort and catch management arrangements for key and secondary commercial and byproduct species.
- Guideline 5. Management arrangements to mitigate against the level of bycatch.
- Guideline 6. Management arrangements relating to seasonal, spatial and depth closures.

The Guidelines are not seen as a definitive guide on the determination of residual risk and it is expected that in a small number of cases, the Guidelines may not apply. Care must also be taken when applying the Guidelines to ensure residual risk results are appropriate in a practical sense. There are a number of conditions which underpin the residual risk Guidelines and should be understood before the Guidelines are applied:

- All assessments and management measures used within the residual risk assessment must be implemented prior to the assessment with sufficient data to demonstrate the effect. Any planned or proposed measures can be referred to in the assessment but cannot be used to revise the risk score.
- When applied, the Guidelines generally result in changes to particular "attribute" scores for a particular species. Only after all Guidelines have been applied to a particular species, should the overall risk category be re-calculated. This will ensure consistency, as well as facilitating the application of multiple Guidelines.
- Unless there is clear and substantiated information to support applying an individual guideline, then the attribute and residual risk score should remain unchanged. All supporting information considered in applying these Guidelines must be clearly documented and referenced where applicable. This is consistent with the precautionary approach applied in ERAs, with residual risk remaining high unless there is evidence to the contrary ensuring a transparent process is applied.
- The results (including supporting information and justifications) from residual risk analyses must be documented in "Residual Risk Reports" for each fishery (or can be integrated into the Level 2 risk assessment report). These will be publically available documents.

#### Step 7 – Evaluation of reasons for "high" risk rankings

Following the Level 2 PSA and RRA, the high and medium risk species can be divided into five categories that highlight potential reasons for the higher risk scores. These categories should also help identify any remaining areas of uncertainty and assist decisions regarding possible management responses for these species. The categories are independent and species are allocated to each category in the order the categories are presented below:

- Category 1: Missing attributes data.
- Category 2: Spatial overlap (widely distributed or low overlap).
- Category 3: Very low (susceptibility) attribute score outweighed by low productivity.
- Category 4: Spatial uncertainty (unreliable distributional data).

- Category 5 Other: risk score not affected by 1-4 considered above.

#### Step 8 - Evaluation of the PSA analysis after Residual Risk Analysis

This involves the summarisation and reporting of PSA results to stakeholders via a template report format specified in Hobday et al. (2007).

#### Step 9 – Management response to risk assessments

Following Residual Risk Analysis (or in future, the application of a PSA with management axis<sup>34</sup>) those species identified as potentially being at high risk are expected to be the focus of further work, either through:

- Implementing a management response to address the risk to the vulnerable species.
- Collection of missing attribute information and re-assessment at Level 2 (for species where high risk ranking may be due to missing attribute data).
- Further examination for risk within the particular ecological component at Level 3.

Units at low risk will be deemed not at risk from the sub-fishery and the assessment is concluded for these units. Units at medium risk may not be a focus of initial management attention, but may receive attention where resources allow and high risk units have been addressed to the extent possible.

The ERM processes in [Chapter 5](#) outline how AFMA intends to ensure all fisheries follow a consistent process in reporting on and responding to the results of ERA. FMS will document the reasons why species are at high risk and what actions the fishery will implement to respond to the risks.

### **4.9.3 Issues to be aware of**

PSA provides a measure of relative potential risk, rather than absolute risk. It helps fishery managers to understand which species, amongst a group of species caught in a fishery, is at a relatively higher potential risk of overfishing. In situations where the fishery has not been overfished in the past (or currently) it may also provide an indication of the relative potential risk of the population becoming overfished in future (assuming constant values for susceptibility attributes).

However, the methodology as it currently stands has a number of limitations:

- Unlike Level 3 stock assessments, PSA cannot quantify the probability that overfishing is occurring.
- PSA cannot estimate any measure of biomass, nor can it indicate either the relative or absolute risk of a fish stock being overfished.
- Furthermore, where an overfished fishery has occurred and is still current, it *may* be that the relationship between “susceptibility” and risk (of overfishing) is also modified. This point requires further exploration (See Continual Improvement List).
- PSA is designed to be biased towards false positive results (ie: its precautionary) and in addition, is unable to take account of some management measures, such as catch or effort restrictions, which might lower the inherent susceptibility of a given species. It is for this reason that an additional process, Residual Risk Analysis, was developed.

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<sup>34</sup> This refers to research currently underway to determine if the residual risk analysis process can be automated, for example through the additional of a third axis to the PSA to account for residual risk issues.

- Residual Risk Analysis has also been subject to criticism that it may be prone to inconsistent application. Subsequently, CSIRO is investigating the possible development of a more automated approach to dealing with residual risk.
- It should be noted that PSA is now used on a much smaller subset of species (protected species and invertebrates mainly) than occurred when the ERAEF was developed.
- PSA is not currently configured to allow for the assessment of cumulative risk across multiple fisheries. See [Chapter 4.13](#).

AFMA and CSIRO will need to give consideration to the development of Level 2 methods that might be able to indicate the relative risk of a species population or stock having been or already being in an overfished state (eg: investigating a retrospective PSA that takes into account historical shifts in fishing distribution, selectivity and availability).

Finally, if consistency and clear links to reference points used in assessments are a priority, quantitative reference point methods (such as SAFE) may need to be developed for species currently required to be assessed by PSA (eg: marine mammals, seabirds and remaining invertebrates), including estimated fishing impact and reference points.

## 4.10 Sustainability Analysis for Fishing Effects (SAFE)

SAFE has been developed in two forms, base SAFE (bSAFE) and an enhanced SAFE (eSAFE). eSAFE has greater data and resourcing (time/\$) requirements and is recommended to only be used to assess species estimated to be at high risk via bSAFE.

### 4.10.1 bSAFE

Relative to the PSA approach, the bSAFE approach (Zhou and Griffiths, 2008; Zhou et al. 2011) is:

- A more quantitative approach (analogous to stock assessment) that is able to provide an absolute measure of risk of overfishing by estimating fishing mortality rates relative to fishing mortality rate reference points (based on life history parameters).
- Requires less productivity data than PSA.
- Is able to account for cumulative risk.
- Potentially out performs PSA in several areas, including consistency with Tier 1 overfishing assessment classifications (Zhou et al. 2016).

Like PSA, the bSAFE method is a transparent, relatively rapid and cost effective process for screening large numbers of species for risk, and is far less demanding of data and much simpler to apply than a typical quantitative stock assessment.

As such it is recommended that bSAFE be used as the preferred Level 2 assessment tool for all fish species and some invertebrates and reptiles (eg: some sea snakes) with sufficient data.

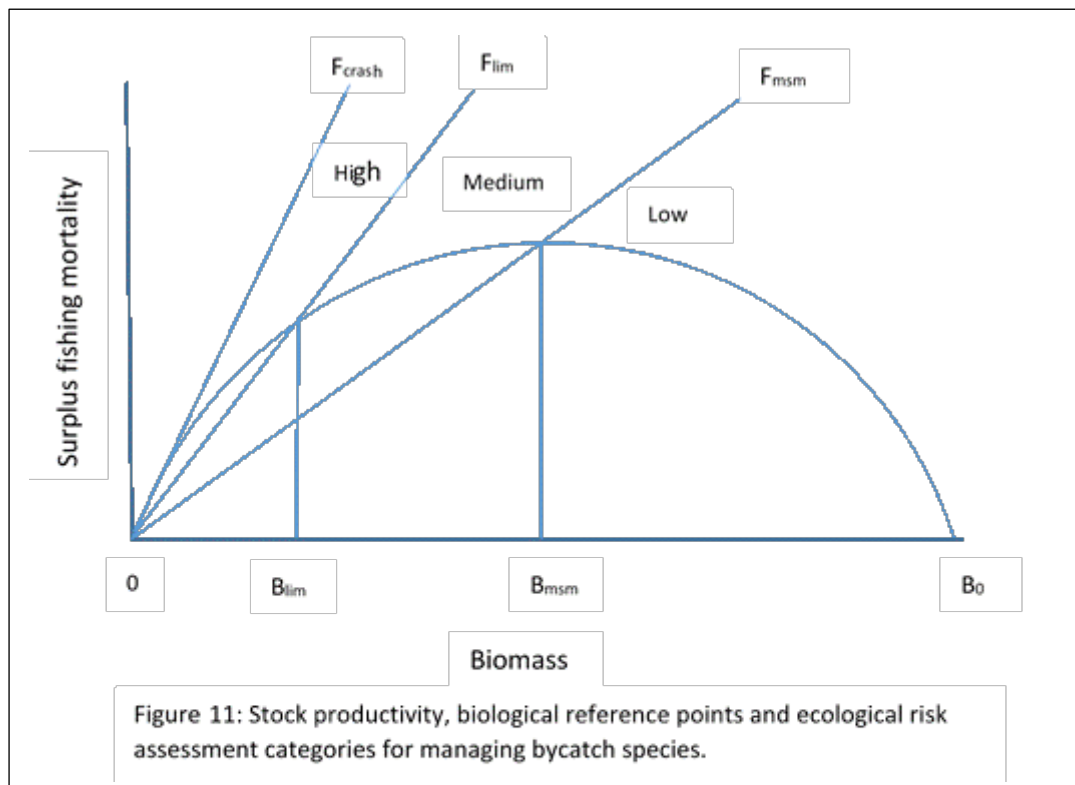
In estimating fishing mortality, bSAFE utilises much of the same information as PSA, to estimate:

- Spatial overlap between species distribution and fishing effort distribution.
- Catchability resulting from the probability of encountering the gear and size-dependent selectivity.
- Post-capture mortality.

Fishing mortality is essentially the fraction of overlap between fished area and the species distribution, adjusted by catchability and post-capture mortality. Uncertainty around the estimated fishing mortality is estimated by including variances in encounterability, selectivity, survival rate and fishing effort between years.

The three biological reference points are based on a simple surplus production model:

- **F<sub>MSM</sub>** – instantaneous fishing mortality rate that corresponds to the maximum number of fish in the population that can be killed by fishing in the long term. The latter is the maximum sustainable fishing mortality (MSM) at  $B_{MSM}$ , similar to target species MSM. Species assessed to be below this line will be considered to be at low risk.
- **F<sub>LIM</sub>** – instantaneous fishing mortality rate that corresponds to the limit biomass  $B_{LIM}$  where  $B_{LIM}$  is assumed to be half of the biomass that supports a maximum sustainable fishing mortality ( $0.5B_{MSM}$ ). Species assessed to be below this line, but above  $F_{MSM}$ , will be considered to be at medium risk.
- **F<sub>CRASH</sub>** – minimum unsustainable instantaneous fishing mortality rate that, in theory, will lead to population extinction in the long term. Species assessed to be above this line, but above  $F_{LIM}$ , will be considered to be at high risk ([Figure 11](#)).



This methodology produces quantified indicators of performance against fishing mortality based reference points ([Figure 12](#)) and as such does allow calibration with other stock assessment and risk assessment tools that measure fishing mortality. It allows the risk of overfishing to be determined, via estimates of fishing mortality relative to reference points. Uncertainty (error bars) are related to the variation in the estimation of the scores for each axis.

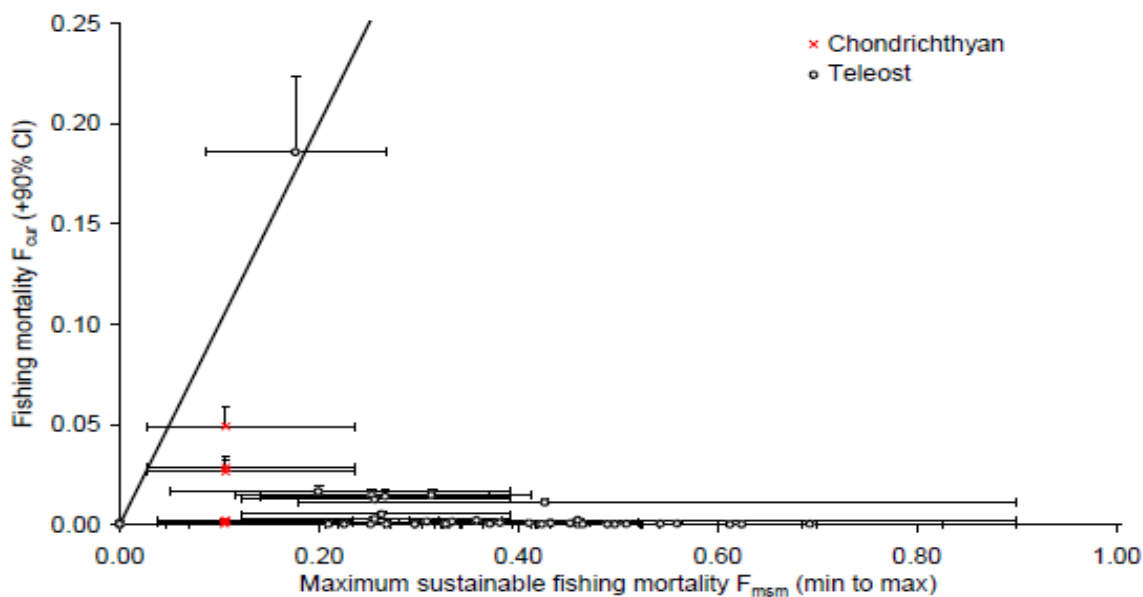


Figure 12 - Example comparison of estimated “recent” fishing mortality  $F_{CUR}$  and the reference fishing mortality corresponding to the maximum sustainable mortality.

#### 4.10.2 eSAFE

Enhanced SAFE (eSAFE) appears, based on calibration with Level 3 assessments, to provide improved estimates of fishing mortality relative to bSAFE (Zhou et al. 2016). eSAFE requires more spatially explicit data and takes more analysis time than bSAFE, and so might only be used to further assess species that were identified at high risk using bSAFE (and which have not had further direct management action taken). eSAFE enhances the bSAFE method by estimating varying fish density across their distribution range as well as species- and gear-specific catch efficiency for each species.

#### 4.10.3 Issues to be aware of:

- Comparisons of PSA and SAFE for the same fisheries and species support the claim that PSA generally avoids false negatives but can result in many false positives. Limited testing of SAFE results against full quantitative stock assessments suggest that there is less “bias” in the method, but that both false negatives and false positives can arise (Zhou et al. 2016).
- SAFE analyses retain some of the key precautionary elements of PSA, including assumptions that fisheries are impacting local stocks (within the jurisdictional area of the fishery).
- Although bSAFE provides direct estimates of uncertainty in both the exploitation rate and associated reference points, they are less explicit about uncertainties arising from key assumptions in the method, including spatial distribution and movement of stocks.
- For bSAFE, the method assumes there would be no local depletion effects from repeat trawls at the same location (ie: populations rapidly mix between fished and unfished areas). The fishing mortality will likely be overestimated if this assumption is not satisfied.

- The method also assumes that the mean fish density does not vary between fished area and non-fished area within their distributional range. Hence, the level of risk would be over-estimated for species found primarily in non-fished habitat, while risk would be under-estimated for species that prefer fished habitat (ERA TWG 2015).
- The SAFE methodology makes greater assumptions than Tier 1 stock assessments in coming to its F estimates (due to a lack of the data relative to that used in a Tier 1 assessment) and it is not capable of measuring risk of a stock being already overfished (so the type of risk it measures relates only to overfishing, which may then lead to future overfished state). The limitations of SAFE with respect to measuring overfished risks are the same essentially as for PSA.
- Residual Risk Analysis will be applied to species identified by SAFE as medium or high risk. The assessment of medium risk species is due to the increased likelihood of false negatives occurring relative to PSA.

### 4.11 Level 3 (fully quantitative risk assessments)

Level 3 is the point in the ERAEF hierarchy where a fully quantitative assessment is first undertaken (Hobday et al. 2011). A range of methods and approaches already exists at this level, but there remain challenges in finding methods that can work within the constraints of limited data and time for analysis. Application of Level 3 assessments can occur via two mechanisms:

- There is a pre-existing and re-occurring level 3 quantitative assessment already run as part of a Harvest Strategy or other research (eg: protected species population assessments) or management processes.
- Management decision to develop a new Level 3 assessment following determination of high risk status for a given species at Level 2.

### 4.12 Spatial considerations and assessing cumulative risks

In assessing ecological risks of fishing to species, the assessments need, where possible, to take account of:

- Species stock structure and overlaps with the spatial extent of the fishery.
- Interactions and cumulative impacts with adjacent fisheries. In many Commonwealth fisheries there are species taken which are also caught in other Commonwealth fisheries, State/Territory fisheries and/or international fisheries.

The following text describes four different scenarios relating to these two issues and provides guidance as to how these scenarios may be assessed and managed.

Scenario A – the area of the fishery and the stock are the same (complete overlap) or the stock area lies entirely within the Commonwealth fishery area. Under this scenario, only the Commonwealth fishery impacts the stock and available assessment tools (eg: stock assessment, SAFE, PSA etc) work relatively well.

Scenario B – the area of the fishery encompasses the area of two separate stocks of the same species. Where there is no information on population structure, the ERA process assumes by default that species comprise a single stock. However, in conducting risk assessments it is important to identify and consider all information pertaining to stock structure and where there is evidence to support the existence of two or more stocks, then each stock should be assessed separately. Failure to assess stocks separately (where separate stocks exist) can potentially lead to fishing pressure on one stock becoming too high, but not being picked up by the combined assessment. Even where the evidence may be weak, it may be more precautionary to assume separate stocks.



**Scenario C** – the area of the stock overlaps two (or more) adjacent Commonwealth fisheries which all interact with (ie: catch from) the stock. Under this scenario, a cumulative risk assessment should be conducted which identifies the fishery specific impacts/risk and the total cumulative risk. Such cumulative risk assessment is currently possible using the Level 2 SAFE tool (used to assess most byproduct and bycatch species) but is not possible using PSA (used to assess protected birds, mammals, reptiles and some invertebrates). Redevelopment of the PSA to assess cumulative risk, or adaptation of SAFE to assess species currently assessed via PSA, will be required in future to address this issue.

**Scenario D** – the area of the stock overlaps the area of both the Commonwealth fishery and adjacent (or distant) non-Commonwealth fisheries, which can include state commercial or recreational fisheries or international fisheries, which also interact with (ie: catch from) the stock. Under this scenario:

- Every effort should be made to identify, obtain and use data that will allow assessment of the impacts of all fisheries upon the stock. This will require cooperation between the agencies monitoring/managing each fishery. Ideally, an assessment would identify the impacts of each fishery (including Commonwealth) upon the stock and of the combined fishery impacts on the stock. It is often the case however that information pertaining to other fishery catches is not available.
- It should not be assumed that low local (Commonwealth) fishing mortality means that there is a low risk of overfishing or an overfished stock, as other fisheries may be imparting significantly higher impacts, or the cumulative impacts may be high.

In all of the scenarios above, it may often be the case that information is not available pertaining to stock structure, stock spatial distribution, of total fishing mortality/catches, creating uncertainty in the risk assessment results. In such cases, the assumptions underpinning the assessments must be clearly documented.

### 4.13 Evaluation and review of the ERAEF

Evaluation and review of the ERAEF should occur every 5 years in conjunction with the review of FMS, ERM and ERM Guide (See [Chapter 3](#) and [5](#)). The evaluation and review may be assisted by continuing research into improving ERA methodologies. AFMA should look to maintain a “continual improvement” list, which will identify areas for further research and improvement of ERA methods. The current continual improvement list is as follows:

- For tools such as PSA and SAFE, investigate how the relationship between “susceptibility” and risk (of overfishing) change if a fishery has already reached an overfished state in the past (eg: PSA and SAFE spatial overlap attributes may not account for contractions in core range).
- Investigate the potential to develop a “retrospective” PSA that takes into account historical shifts in fishing distribution, selectivity and availability, and thus highlights the risk of an overfished fishery already existing.
- Development of an automated process for accounting for residual risks (eg: additional of a third “management” axis to the current 2D PSA).
- PSA cumulative risk – reconfigure the PSA to allow for the assessment of cumulative risk across multiple fisheries.
- Adaptation of SAFE to assess species currently assessed via PSA.

## 5 Integrating ERM into Fishery Management Strategies

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### 5.1 Purpose

This chapter provides guidance on the integration of ERA and ERM processes, primarily for byproduct and bycatch species not already covered by existing policies, into Fishery Management Strategies (FMS).

### 5.2 Introduction

Up until 2016, ERM requirements and strategies for Commonwealth fisheries were planned and documented via:

- Fishery specific Harvest Strategies (focused mainly on key and secondary commercial species).
- Fishery specific ERM (focused on byproduct and bycatch including protected species).
- Fishery specific Bycatch and Discard Action Plans.
- 5 year Research Strategies.

These strategies and plans simultaneously pursue independent management objectives (eg: Harvest Strategies pursue biological and economic objectives, ERM Strategies pursue avoidance of protected species etc), and therefore tended to be developed via independent processes, increasing the risk of inconsistency and inefficiency in how AFMA pursues its different objectives.

From 2016 onwards, AFMA will require each Commonwealth fishery to begin transitioning these strategies and plans to a single combined FMS which will reflect, in an integrated and transparent manner, management processes that pursue both ERM and other fishery management objectives. This single strategy approach will ensure greater consistency, clarity, transparency and cost efficiency in how AFMA develops, documents and implements its management processes and will better explain the linkages between these ([Chapter 3.3.2](#)).

This chapter focuses on how ERM in particular will be implemented within FMS. However, AFMA's pursuit of ERM objectives occurs hand in hand with the pursuit of other objectives as required by relevant legislation and policies ([Chapter 2.5](#)). As such, consideration of these other objectives when developing ERM responses is also discussed.

### 5.3 ERM – key steps

ERM is implemented via FMS which is a single document that combines a number of existing strategies and documents. FMS contain a Harvest Strategy for commercial species and a Bycatch Strategy for bycatch components. Together, these two strategies are supported by Data and Monitoring and Research Strategies to ensure appropriate assessment and ERM for species.

Guidance on applying assessments and ERM to key and secondary commercial species is provided in the HSP Guidelines (2007). Subsequently the following steps focus mainly on ERA and ERM for byproduct and bycatch species (ie: non quota, non TAE managed species). ERA and ERM for byproduct and bycatch in each fishery operates on a five year cycle and comprises a number of processes, as outlined in [Figure 5](#) and [Table 1 \(Part A\)](#). The fourth and fifth years in the cycle are resource intense and require careful forward budgeting, planning, coordination and consultation amongst participating agencies and industry.

## 5.4 Assess (or re-assess) ecological risk (STEP 1)

### 5.4.1 Introduction

Ecological risk and stock assessments serve two purposes within FMF cycle, being:

- Assessing the risk posed by fishing to species populations. For first time assessments, this occurs during the Planning phase. Once management measures are in place to mitigate risks, subsequent re-assessments serve a monitoring role (during the FMF Monitoring/Reporting phase) and provide a measure of performance against the ERM objective (See [Figure 5](#) and [Table 1 \(Part A\)](#)).
- Exploring the likely impact of alternate management responses upon high risk species (during the FMF Planning phase) to assist in choosing an appropriate management strategy to reduce risk to acceptable levels.

Noting this, ERA is presented here as the first step.

### 5.4.2 ERAEF methodology

The ERAEF hierarchical assessment process and technical tools used as part of the ERAEF are described in detail in [Chapter 4](#). The key processes involved in planning and implementing assessments are summarised in [Table 1 \(Part A\)](#), including their timing within the 5 year re-assessment cycle.

### 5.4.3 Species classification

The allocation of species to different groups (eg: key, secondary, byproduct, general bycatch, protected) and subsequently to either strategy, will in the short term be based on the expert opinion of RAG and MAC. In the longer term, it is expected that the revised CPF (2000) and HSP (2007) will provide clear guidance on classifications. This classification should occur prior to the re-assessment of a fishery and during the initial development of FMS. In the longer term they are likely, in some fisheries, to be based on more formalised decision rules that utilise data pertaining to species catch, discarding, economic value and protected status. The research to develop such rules is currently in progress.

### 5.4.4 Re-assessment planning and processes

Fishery re-assessments for byproduct and bycatch species under the ERAEF will be undertaken every 5 years<sup>35</sup> or sooner if triggered by re-assessment triggers ([Step 2](#)). The 5 year timeframe is based on a number of factors including:

- The time it takes to implement risk management measures; for populations to respond to those measures to a degree detectable by monitoring processes; and to collect sufficient data to determine the effectiveness of those measures.
- Alignment with other management and accreditation processes.
- The cost of re-assessments.
- The review period for FMS.

The current re-assessment schedule is shown in [Table 2 \(Part A\)](#). It is estimated that full re-assessment should take 6 months to complete, followed by the development of management responses/strategy.

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<sup>35</sup> Based on a recommendation by the ERA Technical Working Group, September 2015.

#### 5.4.4.1 Budget planning

The AFMA fishery manager is responsible for budgeting for re-assessment to occur in Year 5 of the cycle via inclusion in the Year 5 fishery budget (planned in Year 4). Similarly, if further assessment is required, by eSAFE, based on bSAFE results, funding planning will need to occur in Year 5, to enable assessment late Year 5 or early Year 1 (next cycle). Managers should follow budgeting processes outlined in AFMA's budget cycle explanation papers.

#### 5.4.4.2 Contracting

In coordination with the above Year 4 budget planning process, the AFMA fishery manager will ensure that a research provider has been contracted to coordinate and provide the ERAEF re-assessment in Year 5 of the cycle. AFMA might wish to arrange a longer term Service Level Agreement (SLA) or Memorandum of Understanding (MoU) with a research provider to ensure stability over time and compliance with Commonwealth Procurement Guidelines. Managers should refer to AFMA's policies and procedures on contracting and research.

#### 5.4.4.3 Data collation

AFMA and the research provider should ensure all data collation and updating required for re-assessment is undertaken in Year 4 of the cycle. The ERM Implementation Group will take responsibility for working with the research provider to ensure that information which underpins the ERA (eg: FishBase) is maintained and regularly updated.

#### 5.4.4.4 Re-assessment

During Year 5 of the cycle, the research provider will coordinate and undertake the re-assessment in close consultation with the fishery RAG and AFMA manager. The RAG will have input into the residual risk assessment. See [Chapter 4](#) for details regarding ERAEF methods.

The results of Scoping (if required), Level 1 and 2 will be written up into a report by the research provider in collaboration with AFMA and presented to the RAG and MAC for endorsement prior to commencing the development/amendment of management strategies to address any identified potential high risk species.

### 5.5 Develop management responses and amend the Fishery Management Strategy and Annual Work Plan (STEP 2)

#### 5.5.1 Introduction

Following re-assessment of fisheries under the ERAEF process, results will be considered by AFMA, RAG and MAC and appropriate management responses developed and documented within the FMS ([Attachment 1](#)).

Integration of management responses will occur in two parts:

- Responses will be reflected in appropriate components of the FMS and documented within the 'Versions and Amendments Record'. For example, byproduct management arrangements will be integrated into the Harvest Strategy (Chapter 6.5), bycatch management arrangements will be reflected within the Bycatch Strategy.
- Relevant responses will then be documented within the Annual Work Plan for action.

The revised FMS will be submitted to the ERA Management Group for review and then to the Commission for approval. Following approval, these revisions will be reflected via the

Annual Work Plan. Each fishery should aim to complete this process within 6 months of receiving assessment results. The following sections provide guidance around the development of management responses and amendment of FMS and Annual Work Plans.

## 5.5.2 Developing management responses

The process of developing management responses (that may lead to the amendment of the strategies) needs to be highly consultative and appropriately consider all available management tools. In developing responses, managers should consult:

- AFMA staff (eg: FMB, compliance).
- Stakeholders via RAG, MAC and other expert groups<sup>36</sup>.

This can be achieved via the development of a draft management options paper that is submitted to these groups for consideration and subsequently endorsed based on feedback and review. Once endorsed<sup>37</sup>, the management response can be documented within the FMS and Annual Work Plans. Below, is an outline of options that should be considered when developing a management response.

In considering options to mitigate risks to species, AFMA and its key advisory groups should consider the following issues:

- Risk assessment ranking (low, medium, high).
- Key risk drivers.
- Data deficiency.
- Risk-catch-cost considerations.
- Other management objectives.
- Existing mitigation/management measures.
- Management tools.
- Conservation status of the species.
- Cumulative risk. This is further discussed in [Chapter 2.4.3](#) and [4.10](#).

The following sections discuss each of these in more detail.

### 5.5.2.1 Risk ranking/result

ERM for low and medium ranked byproduct and bycatch species will in general be restricted to monitoring of fishery catch and effort levels and gear usage to monitor changes in fishery operations that might result in a change of risk to species. However, low and medium risk species might also be subject to “non-ERM” management measures due to AFMA’s pursuit of other objectives.

High risk bycatch species are the main focus of specific ERM responses, including additional data collection, higher level assessment, and development of measures to mitigate risk.

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<sup>36</sup> In addition to RAG and MAC, there are a number of other expert advisory groups that AFMA uses during the development of management options. For example, the Marine Mammal Working Group, and the SPF Scientific Panel, amongst others. The term “expert groups” refers to these other entities.

<sup>37</sup> Responsibility for final endorsement for any given management response is dependent upon the nature of the response itself, with some responses requiring an AFMA Commission decision, following advice from the relevant management advisory committee and resource assessment group.

### 5.5.2.2 Key risk drivers

Risk assessments should identify the key attributes that result in a species being classified as high risk. Managers should identify whether risks are due to:

- Spatial overlaps between species and fishery distribution.
- Gear selectivity.
- Catchability factors.
- Fishing effort levels.
- Lack of data on key attributes.
- Other factors.

This information informs the development of targeted and appropriate management options to reduce risk, or in the case of data deficiency, helps identify the need for additional data.

### 5.5.2.3 Data Deficiency

If the risk assessment classifies a “high risk” species as “data deficient” (lacking the required data to determine a more reliable estimate of risk), AFMA is left with a choice to either:

- Collect required data to allow re-assessment of the actual risk (and in the meantime assume high risk). or;
- Assume the species is at high risk and explore management options to mitigate assumed risk.

The choice will depend on whether the cost of required additional data collection and re-assessment is greater than the cost of potential direct management of the risk. For example, assuming a species is at high risk may lead to management that minimises interactions and/or mortality, which may impact on the economics of the fishery.

### 5.5.2.4 Cost

Cost considerations play a role in management decisions for species deemed to be at high risk, and this consideration occurs at each level in the ERAEF. For example, for species assessed at Level 2 and determined to be at high risk (not data deficient), AFMA faces two choices:

- Assume the assessment is correct and take management action to mitigate the risk.  
Or;
- Seek re-assessment with a higher level tool (eg: eSAFE for bSAFE assessed species) to reduce uncertainty around the risk.

In either case, AFMA will need to consider the cost (both money and time) of developing a more comprehensive assessment versus the cost of immediate direct management and whether this would represent an unacceptable level of risk to the population.

### 5.5.2.5 Existing management measures

If existing management measures are in place to mitigate risk to the fishery for a particular species then AFMA will need to consider and investigate:

- Whether they have had any effect upon risk?
- Are existing measures appropriately targeted at the key drivers of risk?

- Why have existing measures not mitigated the risk to the required level?
- What additional or alternative management actions will be required to mitigate the risk?
- Are there other factors at play (eg: regime shifts, historically overfishing, interacting fisheries and cumulative impacts, etc)?

#### 5.5.2.6 Other management objectives

The influence of other fisheries management objectives upon ERM decision making processes is discussed in [Chapter 2.5](#).

#### 5.5.2.7 High risk “protected” species

AFMA is required under the EPBC Act (1999) to ensure that its fisheries take all reasonable steps to avoid injuring or killing protected species. Management measures which are incorporated into the Bycatch Strategy component of FMS, which are aimed at ensuring avoidance of harm to protected species, should assist in reducing the risk posed by fishing to the ecological sustainability of protected species populations. However, where ERA determines that fishing poses a high risk to the ecological sustainability of a protected species population, AFMA, as soon as practicable, will develop and implement measures to reduce that risk to acceptable levels. It should be noted that the TSSC uses the TSSC Guidelines (2015) to determine if a species is at risk of (threatened with) extinction. The TSSC Guidelines (2015) list criteria pertaining to the level of population change (decline) that would indicate if a species should be listed as a threatened species. ERA Level 2 tools used to assess protected species do not provide such information, but rather are based on relative or actual changes in fishing based mortality.

#### 5.5.2.8 Management tools

AFMA employs a number of management tools for managing commercial, byproduct and bycatch species which broadly fall into two categories: input and output controls. Use and selection of tools will be fishery and situation specific, and all should be considered when looking to implement a management response.

##### Input controls

Input controls limit the amount of effort in a fishery, indirectly controlling interactions with ecosystem components (eg: key commercial species, byproduct). Input controls can manifest in a range of management tools including:

- Effort quotas - Limits the amount of effort allowed within a fishery. Commonly achieved through restricted licensing or effort quotas, which can be both fishery wide or at the individual fisher level (eg: number of days fished).
- Closures – Includes both spatial and temporal closures. Commonly implemented to protect a proportion of stock biomass or important life processes (eg: spawning grounds or seasons).
- Gear restrictions – Used to limit interactions with unwanted species or individuals (eg: bycatch, protected species, juvenile commercial species).

AFMA fisheries commonly implement these tools to manage fisheries. For example, gear restrictions are commonly used to restrict or reduce interactions with unwanted (eg: bycatch, byproduct) species. For example:

- ‘Pinkies’ designed to deter seabirds during trawl operations (SESSF).
- Circle hooks to reduce turtle captures (ETBF).

- Turtle Exclusion Devices to exclude turtles (NPF).

### Output controls

Output controls directly limit the weight/harvest of species that can be taken from the water or interacted with. Output controls commonly implemented include:

- Catch restrictions – limits total harvest weight for species. Can be implemented fishery wide (eg: TAC) or for individual fishers (eg: SFR). Catch restrictions are commonly implemented for primary and secondary commercial species via a Harvest Strategy however, they can also be implemented for bycatch species which are subject to a rebuilding strategy (recommended by RAG), allowing them to rebuild while accounting for unavoidable harvest.
- Catch triggers – used as a precautionary tool commonly used to monitor bycatch levels (eg: shark bycatch triggers in GHAT).
- Trip limits – designed to reduce targeting of certain species and encourage active avoidance.
- Size limits – Prevents fishers from harvesting fish above/below a certain size class. Used to protect spawning biomass, either by limiting juvenile mortality via a minimum size limit or large breeding individuals via a maximum size limit.

#### 5.5.2.9 Developing management performance indicators

In developing management responses to mitigate risk to high risk species, AFMA should also develop and specify within the FMS the indicators and performance measures that will be used to determine if management responses are successful. Performance should be tracked at a number of levels:

- Management processes – auditing to ensure that implementation activities are being completed.
- Industry compliance – monitoring and reporting on compliance by industry with management arrangements designed to mitigate ecological risks.
- Ecological risk reductions – Mitigation measures should be regularly reviewed to check that they are reducing ecological risks as expected<sup>38</sup>, and that species at lower risk categories are being maintained in those categories.

These elements are described further in [Step 4](#).

### 5.5.3 Amending the Fishery Management Strategy

The initial development of FMS is guided by information provided in [Chapter 3](#). Subsequent amendment of the FMS will involve alteration of its separate components (eg: Harvest and Bycatch Strategies) which is discussed below. These should detail:

- The issue being addressed (eg: new high risk species).
- Rationale for change.
- Management response.
- Performance indicators used to measure response.
- Expected outcomes.

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<sup>38</sup> It should be recognised that there may be circumstances (eg: regime shifts or where a Commonwealth fishery is not the primary source of fishing mortality on a stock) that AFMA is unable to mitigate risk.



Amendments to FMS should be documented within the 'Version and Amendments Record' section.

### 5.5.3.1 Commercial species strategies amendments

The timeframes for Harvest Strategy amendments will differ depending on whether the species are key/secondary commercial species with TAC/TAE based management (and assessed at 1 – 5 year intervals) or byproduct species with monitoring triggers and assessed every 5 years. Byproduct associated amendments within harvest strategies may typically occur in conjunction with Bycatch Strategy amendments as both byproduct and bycatch are generally subject to the same re-assessment methods (eg: ERAEF Level 1 and 2) and timeframes. The incorporation of byproduct species into harvest strategies is discussed in [Chapter 6.5](#).

### 5.5.3.2 Bycatch Strategy amendments

The amendment of Bycatch Strategy components within FMS will occur after 5 year re-assessments (or after triggered re-assessments) and may also, where necessary, include revision of species specific management strategies (eg: seabird threat abatement plan, dolphin management strategies) that may sit within or be linked to FMS.

Bycatch Strategies provide an overarching summary of bycatch management responses intended to address ecological risk and other bycatch objectives. Some fisheries may need to develop species specific management strategies. In these cases, the Bycatch Strategy would either:

- Provide a brief overview of the species specific strategy but refer the manager/reader to the more detailed and separate species specific strategy documents. Or;
- Incorporate the detailed species specific strategy and performance indicators into the Bycatch Strategy.

The choice will depend on the complexity of the species specific strategy and other fishery specific factors. Examples of such strategies from the SESSF and ETBF are provided below:

- [Threat Abatement Plan \(2014\) for the Incidental Catch \(or bycatch\) of Seabirds](#)
- [Seabird Management Plans](#)
- [Shark and Ray Handling Practices - A guide for commercial fishers in southern Australia](#)
- [National Plan of Action for the Conservation and Management of Sharks 2012 - Shark-plan 2](#)
- [Dolphin Strategy 2014](#)
- [Australian Sea Lion Management Strategy 2015](#)
- [Upper-Slope Dogfish Management Strategy 2012](#)

In addition there are a number of Guidelines and codes of conduct:

- [Chondrichthyan Guide for Fisheries Managers](#)
- [Industry Code of Practice to Minimise Interactions with Seals](#)
- [Code of Practice for Automatic Longline operators encountering gulper sharks](#)

Monitoring and data collection requirements to support the different components (eg: harvest and bycatch strategies) of a FMS should be, and typically have been, identified when first developing those components. Under the FMS, these will be documented as part of a Data and Monitoring Strategy. A major review of the Data Strategy should occur when the FMS is reviewed every 5 years ([Step 5](#)). However, updates to the Data and Monitoring strategy should also occur in conjunction with updates to Harvest, Research (eg: annual research priorities) or Bycatch Strategies that may occur in the intervening period. In both cases, revisions would rely on consultation with the relevant RAG and MAC (or other relevant fishery advisory committees).

### 5.5.3.3 General data collection and monitoring

AFMA (in consultation with RAG and MAC) must identify the minimum level of data collection required to maintain and support the ongoing implementation of FMS. AFMA must then implement programs to collect that data ([Table 7](#)). AFMA employs many different forms of data collection and monitoring to support the management of Commonwealth fisheries. The types of information collected must be sufficient to support ERM and FMS requirements:

- Assessment – ecological risk assessments (including stock assessments) which inform ecological risk management responses ([Chapter 4](#)).
- Monitoring - monitoring of fishery triggers to alert managers of changes in the fishery which might result in changes to the risk posed by the fishery to some or all species.
- Management options analysis - the development of management options and measures to mitigate the impacts of fishing on high risk species ([Step 2](#)).
- Compliance - monitoring of adoption/uptake of mitigation and management arrangements aimed at reducing risk.
- Performance - monitoring of species interaction levels before and after management measures have been put in place to reduce risks ([Step 4](#)).
- Research - research that may be used to develop advice on the management of high risk and other species.

However, decisions around data collection and monitoring should give due regard to:

- The legislative requirement for cost effective fisheries management, including risk-catch-cost principles ([Chapter 2.5.2.2](#)).
- Data collection requirements for achieving other fishery management objectives.

AFMA fishery managers, in consultation with RAG and MAC, should briefly review data collection programs annually (or in conjunction with strategy updates) to ensure they are meeting the above requirements. A subsequent comprehensive review of the Data and Monitoring Strategy should occur as part of the 5 year FMS review.

Table 7 – Data types used in each stage of ERA and ERM.

	Data type				
	Catch/Discards (quantity, area, date, species)	Fishing Effort (quantity, area, date)	Fishing methods (gear types, strategy, materials)	Biological data (e.g. age, growth, size, M, r, sex, maturity)	Economic data
ERAEF Scoping and L1	✓	✓	✓		
ERAEF L2 (e.g. PSA, SAFE and RRA)	✓	✓	✓	✓	
ERAEF L3 (stock assessments)	✓	✓	✓	✓	✓
Trigger monitoring	✓	✓	✓		
Management options analyses	✓	✓	✓	✓	✓
Compliance with management arrangements	✓	✓	✓		✓
Performance monitoring	✓	✓			
Research to support ERM	✓	✓	✓	✓	✓

#### 5.5.3.4 Data collection programs/tools

AFMA employs a number of monitoring tools to collect information on fishing activity in its fisheries. The degree to which each is used varies between fisheries, depending on the size, value, complexity and risks posed by the fisheries. Monitoring tools include:

##### Logbooks

It is mandatory for all operators to complete logbooks. Catch, effort and fishing method data are recorded and used to monitor the level of harvest and the status of stocks. Logbooks also provide information on gear design, including bycatch reduction devices (BRDs). There is a requirement to record all interactions with protected species in the logbooks. Information collected is used for stock assessments, harvest strategies and development of management arrangements for the fishery.

##### Catch disposal records (CDRs)

On landing, a fisher is required to complete a form detailing the species caught and their accurate weight. AFMA integrates the catch information with records of quota entitlements and provides periodic updates to management and industry on the remaining quota available for a fishing year. CDRs provide an additional means of tracking retained catches.

##### Vessel Monitoring System

The Vessel Monitoring System (VMS) consists of a tracking unit on the fishing vessel which transmits data about vessel positions to AFMA through a satellite communications network and an internet connection. In relation to ERA and ERM, VMS allows AFMA to ensure that vessels are not fishing in areas that they are not permitted, including areas that are closed in order to reduce risks to ecological sustainability.

## Observer Program

The Observer Program places AFMA trained observers on domestic and if required, foreign vessels fishing within the AFZ and some adjacent high seas areas under international arrangements. In addition to collecting standard catch, effort and methods information, observers are trained in specialised sampling techniques including the collection of otoliths (fish ear bones), biological samples such as the sex and length of a fish and environmental observations such as whether birds and other wildlife are seen during a fishing trip.

The structure and nature of observer programs differ between fisheries. For example:

- In the SESSF, a key component of the observer program is the Integrated Scientific Monitoring Program (ISMP). The purpose of the ISMP is to provide reliable, verified and accurate information on the fishing catch, effort and practice of a wide range of vessels operating inside the SESSF.
- In the NPF there are two separate components, being a scientific observer program run by AFMA and a crew member observer program run by the Northern Prawn Fishing Industry, and each collects different information to serve different objectives.
- The ETBF used the AFMA observers allocated to achieve a minimum coverage but these are being phased out as electronic monitoring is implemented.

Each year the requirements and priorities for the Observer Program are determined by AFMA after consultation with the relevant MAC and RAG. Observer data are used as inputs to ecological risk (including stock) assessments and can be used when considering management options to mitigate risks to high risk species. In fisheries without electronic monitoring (see below) observer data is particularly critical in providing an indication of the full suite of species the fishery interacts with (ERA Scoping phase), including interaction rates.

## Electronic monitoring

Electronic monitoring (e-monitoring) is a system of sensors and video cameras capable of monitoring and recording fishing activities which can be reviewed later to verify logbook data. Similar to the objectives of the Observer Program, e-monitoring systems are used to ensure that AFMA has reliable, verified and accurate information on catch, discards, fishing effort and interactions with protected species. E-monitoring systems are recording at all times while the vessel is fishing and video footage is reviewed to verify if the fisher has accurately completed their logbooks. E-monitoring systems can also be used to collect biological information such as fish length frequencies.

In the SESSF, e-monitoring systems are required on all full time gillnet and demersal longline vessels. Lower effort vessels will continue to be monitored using other methods and based on their risks. The ETBF has also implemented e-monitoring for all vessels fishing more than 30 days per year.

## Fishery independent surveys

Fishery independent surveys (eg: in the SESSF) are used to provide a time series of abundance indices that can be used in addition to, or instead of, commercial CPUE data (Knuckey et al. 2014), for assessing the status of fish stocks and helping to determine TACs.

### **5.5.3.5 Research Strategies**

Five year research strategies are required for each fishery and should take into account minimum information and data requirements for ERA and ERM processes (and other

fishery management information needs), prioritising research towards addressing gaps in those minimum requirements. Fishery specific 5 year Research Strategies should be made consistent with AFMA's overall agency level Research Strategy. Annual research statements help to provide focus on immediate research needs. 5 year research strategies should undergo a full review in line with the FMS 5 year review.

#### **5.5.3.6 Development of re-assessment indicators and triggers**

For byproduct and bycatch species, in the periods between scheduled 5 year ERA reviews<sup>39</sup>, AFMA will develop and monitor a set of fishery indicators and triggers, on an annual basis, so as to detect any changes (increase or decrease) in the level of risk posed by the fishery to any species. Where indicators exceed specified trigger levels, AFMA will investigate the causes and provide opportunity for RAG comment/advice during that process. Pending outcomes of that review, and RAG advice, AFMA can if necessary, request a species specific or full fishery re-assessment (ie: prior to the scheduled re-assessment dates).

The ERA TWG (September 2015) identified five key indicators upon which such triggers could be based, these being changes in:

- Gear type/use.
- Mitigation measures (use or type).
- Area fished.
- Catch or interaction rate.
- Fishing effort.

Where possible, the triggers should look to take into account additional sources of risk from interacting non-Commonwealth fisheries. In addition, if a major management change is planned for a fishery, such as a move from input to output controls, the fishery will need to be reassessed prior to that management change coming into effect. In considering each indicator and trigger level, the RAG should consider the following:

- The data upon which the indicator is based must be sufficiently representative of actual changes in catch, effort, area, gear or mitigation methods. Consideration should be given to the level of uncertainty associated with the data underpinning any prospective indicator.
- The trigger level chosen should not be overly sensitive to the normal inter-annual variance that is typical of the indicator and independent of fishing pressure, assuming such variance is unlikely to relate to a significant change in the risk posed by the fishery to any or all species.
- The trigger level should equate to the minimum level of change that the RAG (by its expert opinion) considers might potentially represent a significant change in the risk posed by the fishery.
- The trigger level could represent an absolute change (number/level) in an indicator or a percentage change in an indicator.
- The RAG should consider whether a “temporal” condition should be placed on the trigger (ie: the trigger is breached 2 years in a row) to further reduce the likelihood

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<sup>39</sup> In contrast to key and secondary commercial species managed via catch/effort limits under Harvest Strategies, which depending on species and Harvest Strategy, can be re-assessed any time between 1 and 5 years.

of natural population variance or data errors triggering a re-assessment unnecessarily.

The final set of indicators and triggers will be developed for each fishery by AFMA in consultation with its fishery RAG (or for fisheries lacking a RAG, the ERA TWG), in association with the next planned re-assessment. A RAG may choose a subset of these indicators and triggers, or include an additional indicator/trigger(s), based on consideration of the availability and reliability of data upon which to base any of the above indicators/triggers, however justification of this must be provided.

Research is currently underway to develop specific guidance for RAG to aid in the selection of appropriate triggers, which will in the meantime be determined using RAG expert opinion. In the longer term it may be possible to refine indicators and triggers using the existing PSA and SAFE methods to test which attributes the end risk scores are most sensitive to (ERA TWG 2015)<sup>40</sup>. The RAG will record both the final set of indicators and triggers chosen, and a justification for those, in the RAG minutes. Once the final set of indicators and triggers is determined for a fishery, they will require implementation within the FMS ([Step 3](#)) and a monitoring and review process ([Step 4](#)).

### 5.5.4 Development of Annual Work Plans

Annual Work Plans will be revised by AFMA Fishery Managers to reflect specific activities and priorities to implement FMS in the coming 12 months. This will include resource requirements, roles and responsibilities and activities. Amendments will be reviewed and approved by the General Manager of the Fisheries Management Branch.

## 5.6 Implement Fishery Management Strategy (STEP 3)

### 5.6.1 General implementation Processes

The AFMA fishery manager is responsible for ensuring (in collaboration with other relevant AFMA staff and sections) the implementation of the FMS. This will occur through implementing all of the activities described in Annual Work Plans and include:

- Amendments of relevant SFR, permit conditions and closure directions which give legal effect to any changes to management arrangements.
- Communication of changes in management arrangements/strategies to industry prior to the commencement of the next fishing season. This typically occurs through:
  - Publication and distribution (via mail) to fishers (skippers and crew) of annual or seasonal management arrangements and information booklets and directions.
  - Letters and emails to industry (quota holders, skippers etc.).
  - Direct communication to industry representatives (eg: industry associations).
  - RAG and MAC and industry meetings.
  - Port visits.

Communication of management arrangements may also occur mid-season, for example to enforce Harvest Strategy control rules.

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<sup>40</sup> ERA TWG recommendation, September 2015

- Ongoing maintenance of data collection to support ERM and FMS.
  - Logbook and CDR submissions are monitored by the Licensing and Data Services section at AFMA, in liaison with the AFMA VMS staff.
  - Observer data collection is overseen by the AFMA Observer Program.
- Ongoing support of required research to support ERM and FMS via the annual research statements and associated research funding applications.
- Monitoring activities which can detect when management processes and compliance are not occurring are also a critical component of ensuring effective implementation of the FMS.

In co-managed fisheries the role of industry in some of the above elements may be significantly greater.

### 5.6.2 Implementing re-assessment indicators and triggers

Implementation of re-assessment indicators will require AFMA fishery managers:

- Implement appropriate data monitoring requirements and alert systems for all indicators and triggers. This can be done via automatic database based tracking (Oracle Business Intelligence Enterprise Edition), or via manual compilation of data and subsequent assessment on an annual basis by the AFMA Fishery Manager.
- Incorporation of all indicators and triggers and the associated roles and responsibilities for monitoring and reporting are incorporated into the FMS.
- Planning and budgeting (in consultation with industry via MAC) for any re-assessment costs.

The AFMA fishery manager and RAG chair will ensure that:

- The RAG (or ERA TWG) makes an assessment of trigger breaches at the earliest possible point in time and advises on the need for species or fishery re-assessment. RAG may also recommend that immediate management action be taken prior to the outcome of a reassessment to mitigate any potential or obvious risk.
- The results of the RAG assessment of indicators and triggers are recorded in the RAG meeting minutes.
- Re-assessment advice should be communicated by the RAG Chair to AFMA.

Development of management options for species re-assessed to be at high risk from fishing should follow the process outlined in [Step 2](#).

## 5.7 Performance monitoring and reporting (STEP 4)

Monitoring refers to the routine review of performance results. It is a continuous process that involves the collection and analysis of information on specified indicators to provide managers with an indication of the extent of progress towards the achievement of outcomes. Performance will be monitored and reported on an annual basis (unless otherwise required by legislation) basis in line with AFMA's corporate reporting requirements.

The indicators and reference points for assessing performance will be identified during the development of the FMS and may draw upon advice in established policy Guidelines and this ERM Guide. Monitoring includes collecting evidence on the performance of activities

and outputs, initial and intermediate outcomes, and assumptions underpinning the model. Long term outcomes will be assessed by the next ERA.

The monitoring of AFMA's progress in achieving its ERM (and other bycatch) objective rely on the following processes:

### **5.7.1 Monitoring of management processes (initial outcomes)**

Under the management system to be developed in 2016/17, all of AFMA's ERM related processes will be monitored according to international standard principles. In effect, this will ensure that required processes are undertaken within required timeframes or higher management officers in AFMA notified. This will be important in ensuring proper implementation. This would include processes detailed under Annual Work Plans and species specific strategies and the over-arching FMS. This monitoring will be internally reported to senior managers annually.

### **5.7.2 Monitoring compliance (intermediate outcomes)**

AFMA monitors compliance by fishers with all management arrangements, including those aimed at reducing fishing risks to high risk species. AFMA compliance officers and/or the specific AFMA fishery manager will be responsible for reporting annually to the Senior Manager and Fishery MAC on an annual basis.

### **5.7.3 Monitoring re-assessment indicators and triggers (intermediate outcomes)**

Once in place, re-assessment indicators and triggers will be monitored on an annual basis, with a subsequent comprehensive review occurring with re-assessment (every 5 years) unless triggered earlier.

Annual reports will be provided to the RAG or TWG outlining indicator status and notified of any breaches by the Fishery Manager. For efficiency, the RAG/TWG might only be presented with information pertaining to breaches of trigger levels, not summaries of every indicator. The RAG should be notified, as soon as possible, of any trigger breaches who can then advise on how to best mitigate any potential or obvious risk present. The RAG may recommend immediate management action or a re-assessment of the fishery, or for a single species. Re-assessment advice will be communicated by the RAG Chair to AFMA. Development of management options for species re-assessed to be at high risk from fishing should follow the process outlined in Step 3.

In conjunction with re-assessment (5 year cycle), triggers and indicators will be reviewed and reset based on updated risk information. This will be undertaken as per the implementation process outlined in [Step 2](#).

### **5.7.4 Monitoring ecological risk (long term outcomes)**

Determining if management measures aimed at reducing ecological risks have been successful should require:

- Re-assessment of ecological risk through time (ie: conduct ERA).
- Where possible (ie: where sufficient data exists), the monitoring of interaction rates (and total fishing effort) in the fishery for high risk species. This will help to determine if interaction rates decrease after management action/mitigation is put in place, without increasing effort / total catch. In some fisheries, it may be that evidence from scientific mitigation trials is considered sufficient to demonstrate a reduction in risk.



AFMA will implement an internal auditor role within the ERM Operational Support Unit<sup>41</sup> to monitor and support fisheries in making progress against their ERM objectives, via the above monitoring indicators.

## **5.7.5 Performance reporting process and timeframes**

### **5.7.5.1 Timeframes**

Fishery managers will:

- Collect evidence of performance for each indicator within the FMS. This will include indicators from monitoring of management processes/activities. Some outcomes develop slowly and may not show any significant changes over short time frames. In these cases the most recent performance measure will be recorded and timing of the next update noted.
- Review the performance measure and assess whether performance is:
  - On track against expectations.
  - Not on track but does not warrant corrective action. It may warrant closer monitoring.
  - Off track and requires corrective action.

During 2016/17, AFMA's ERM Operational Support Unit (PEER) will continue to work with AFMA's Corporate and Data areas to develop automated systems to streamline these monitoring and reporting processes.

### **5.7.5.2 Reporting**

Performance will then be reported via the following mechanisms on an annual basis:

- Annual FMS performance report - Each fishery will generate a summary report of performance against key FMS indicators and reference points. This will sit alongside the FMS and is designed to meet many of AFMA's reporting requirements. These reports will summarise performance across HS, bycatch, research and data and monitoring components of the FMS.
- Reporting to MAC - Fishery managers will table the draft annual report to the relevant MAC for comment prior to it being finalised. Since MAC meetings occur at differing frequencies, the reports will be tabled for information and not for endorsement of any corrective action.
- Reporting to the Executive Manager Fisheries - Fishery managers will provide an exception report to the Executive Manager Fisheries. An exception report is limited to those outcomes that are not on track. The Executive Manager Fisheries will endorse the corrective actions recommended in response to outcomes not on track.
- Reporting to the AFMA Commission - The ERM Operational Support Unit will compile a consolidated exception report for the AFMA Commission, accompanied by any comments from the Executive Manager Fisheries, for the Commission's approval.
- Reporting to external stakeholders. Upon endorsement of the exception report by the Executive Manager Fisheries, the Operational Support Unit will publish each

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<sup>41</sup> Fisheries officers in the ERM section of the Policy Environment Economics and Research section of AFMA.

fishery report, and the Commission approved exception report, on AFMA's web page no later than three months after the end of each financial year.

## 5.8 Strategy review, evaluation and improvement (STEP 5)

Evaluation is defined as a structured process of assessing the extent to which the outcomes of a strategy or program of activity are meeting the objectives. Due to the different scheduling and structured nature of assessment/management cycles for each species group (eg: commercial, bycatch etc.), as well as the different components of the FMS, it will undergo review and revision/amendment at different points in time.

Annual Work Plans – Annual Work Plans will be reviewed and amended on an annual basis. This evaluation will focus on the effectiveness, efficiency and impact of work plan activities. It is proposed that fishery managers carry out this evaluation such that the lessons from the annual evaluation will inform the development of the next Annual Work Plan.

Fishery Management Strategy - In conjunction with component amendments and review of Annual Work Plans, a holistic strategic evaluation, review and revision of the FMS will occur every 5 years. The FMS will be evaluated for: appropriateness; impact; effectiveness; and efficiency. The results of this evaluation will inform the development of the next strategy. It is proposed that an evaluator (auditor) independent of the fishery conduct the strategic evaluation. The auditor should include consultation with AFMA, the fishery RAG and MAC, industry members and other relevant stakeholders. This process might be reduced or not used for small fisheries.

Following the independent auditors review, AFMA, MAC and RAG (or other expert groups) should

- To consider the recommendations of the independent reviewer.
- Revise the FMS/Annual Work Plans in light of the reviews.

The ERA Management Group should then review the revised FMS/Annual Work Plan and provide recommendations for further improvement or endorsement. See [Chapter 3.6](#) for details on evaluating these documents under appropriateness, impact, effectiveness and efficiency.

## 6 ERM of commercial species

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### 6.1 Overview

Between 2012 and 2014, the current HSP (2007) was subject to a comprehensive review and a number of recommendations came from the review to improve the Policy and Guidelines. This ERM Guide refers to the current Policy but will be updated once the revised Harvest Strategy Policy is ready for implementation.

Under AFMA's ERM, FMS are required to include a Harvest Strategy<sup>42</sup> for commercial species in each fishery, where commercial species are defined to include:

- Key commercial species.
- Secondary commercial species.
- Byproduct species.

The HSP (2007) refers to key commercial and, in a limited way, secondary species, but does not explicitly require inclusion of byproduct species in fishery harvest strategies. However, AFMA will now require the inclusion of byproduct in fishery specific harvest strategies, in recognition of their status as commercially exploited species and to formalise a consistent process for planning and documenting their assessment and management.

AFMA will also require within fishery Harvest Strategies (and associated sections of Annual Work Plans), where required and appropriate, the inclusion of measures to monitor and manage commercial species discards. Prior to the development of FMS, such measures were included as part of fishery specific Bycatch and Discard Work Plans. However, where possible, discards will be accounted for within harvest strategy associated stock assessments for key commercial species and thus, subsequent monitoring and management of discards sits appropriately within the broadened scope of AFMA harvest strategies.

Noting the above, this chapter is split into three main sections:

- Key and secondary commercial species ([Chapter 6.3](#)) - The HSP (2007) provides detailed guidance for managing these species to achieve sustainability and economic objectives. Hence, this section provides a brief overview of key issues plus links. Fishery managers should refer to the full HSP Guidelines (2007) when developing or revising harvest strategies for these species.
- Byproduct species ([Chapter 6.5](#)) - Provides guidance on the incorporation of byproduct species into fishery specific harvest strategies, noting that:
  - Such guidance is not currently provided by the HSP (2007) or CPFBS (2000).
  - The monitoring, assessment and management of byproduct species has been required by ERA/ERM and ESMF Guidelines (2007), which provide AFMA guidance for ensuring ecological sustainability for these species.
  - These species are rarely managed under quota and as such the form and intent of Harvest Strategy decision rules for these species will differ from those of key commercial species.
  - The primary objective for these species is ensuring sustainability.

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<sup>42</sup> Previously a separate stand-alone document

- Commercial discards ([Chapter 6.5](#)) – Provides a very brief overview of the inclusion and consideration of commercial discards monitoring and management within fishery harvest strategies.

## 6.2 ERM objectives for commercial species

For key commercial species, the overarching ERM objective that AFMA pursues is consistent with the objectives and requirements of the Ministerial Direction 2005 and the subsequent HSP (2007) (amongst others) which require species to be maintained at  $B_{MEY}$  and above  $B_{LIM}$ .

Secondary commercial species are defined in the HSP Guidelines (2007) as species of lesser commercial value which may be maintained at biomass levels less than  $B_{MEY}$  but always greater than  $B_{LIM}$ . These species are occasionally targeted or species that are not targeted but very commonly caught and retained for sale. In the SESSF, secondary commercial species are managed to a  $B_{MSY}$  target using HCR within harvest strategies.

Byproduct species are not explicitly covered by either the HSP (2007) or the CPF (2000). However, AFMA<sup>43</sup> considers the ERM objective to apply equally to byproduct species, consistent with the objectives and intent of existing legislation (eg: FMA 1991), international agreements (UNCLOS 1982 and UNSFA 1995), the Ministerial Direction 2005, existing FMP, the ESMF Guidelines (2007), and scoping objectives from the ERAEF. This is explained in detail in [Chapter 2](#) and [Attachment 3](#).

## 6.3 Harvest strategies - ERM for key and secondary commercial species

This section provides an overview of what harvest strategies are and how the HSP (2007) requirements relate to AFMA's pursuit of the ERM objective for key and secondary commercial species. It then provides links to key sections of the HSP Guidelines (2007) which managers can refer to when developing or revising harvest strategies for these species.

### 6.3.1 Harvest Strategies

AFMA is required by the HSP (2007) to “*maintain key commercial stocks at ecologically sustainable levels and within this context, maximise the economic returns to the Australian community*”. The HSP (2007) requires that AFMA pursue these objectives through the implementation of harvest strategies.

A Harvest Strategy sets out the management actions necessary to achieve defined biological and economic objectives in a given fishery (HSP 2007). AFMA's harvest strategies contain:

- A process for monitoring and conducting assessments of the biological and economic conditions of the fishery.
- Rules that control the intensity of fishing activity according to the biological and economic conditions of the fishery (as defined by the assessment).

Harvest control rules are designed to keep the fishery on track in pursuit of its defined objectives by specifying the management actions or decisions that need to be taken in response to assessment information about the current (economic and biological) status of the stock (HSP Guidelines 2007). For control rules to be clear and effective, the objectives need to be expressed in the form of quantifiable reference points.

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<sup>43</sup> With support from the ERA TWG meeting in September 2015

Reference points used in harvest strategies are often based on stock biomass (B) levels and fishing mortality (F) rates and are commonly of two types:

- Target reference points express the desired status of stocks (eg:  $B_{TARG}$ ) and desired fishing intensity ( $F_{TARG}$ ).
- Limit reference points ( $B_{LIM}$  and  $F_{LIM}$ ) express situations to be avoided because they represent a point beyond which the risk to the stock as the basis of a commercial fishery is regarded as unacceptably high.

[Figure 13](#) illustrates the relationship between an example HCR and key B and F based target and limit reference points, including the point at which biomass becomes “overfished” and fishing mortality constitutes “overfishing”. The HCR is the line labelled on the right hand side by  $F_{TARG}$  and is shown as a function of the biomass level of the stock. It consists of a constant exploitation rate while the stock size is above  $B_{MSY}$ , and reduces to zero as the stock reduces to  $B_{LIM}$ .

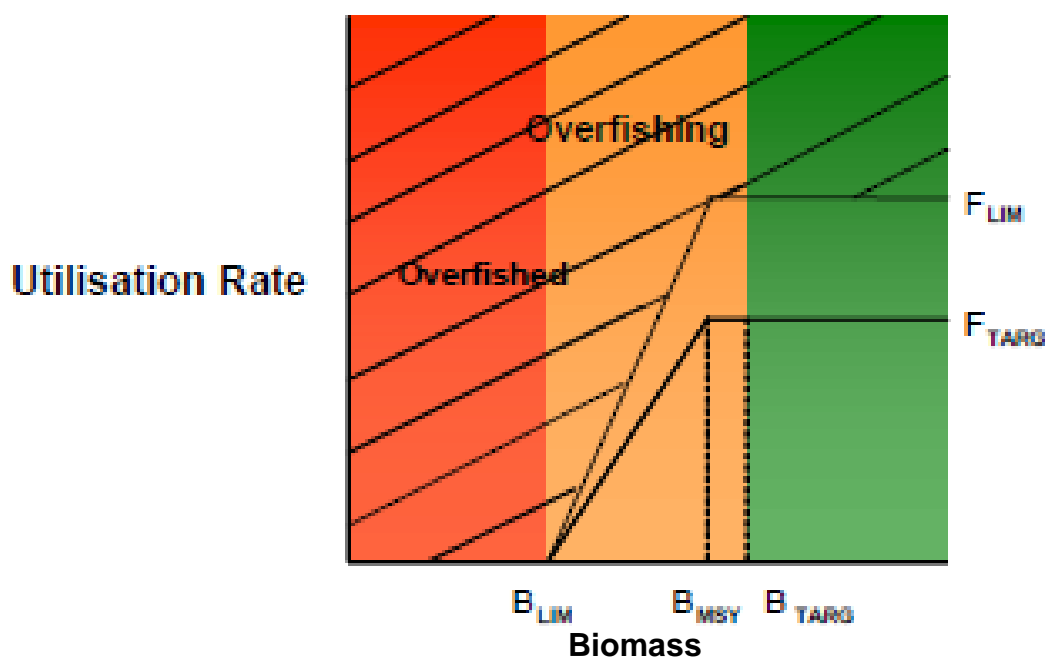


Figure 13 – Example of a HCR that is consistent with the Harvest Strategy Policy (HSP 2007).  $B_{LIM}$  is the limit reference point,  $B_{MSY}$  is the biomass that gives maximum sustainable yield and  $B_{TARG}$  is the target biomass. The HSP specifies  $B_{TARG}$  as  $B_{MEY}$ , the biomass that gives maximum economic yield.  $F_{LIM}$  and  $F_{TARG}$  are the limit and target fishing mortality rates respectively. In this example, the Recommended Biological Catch (RBC) is calculated by applying  $F_{TARG}$  to the current biomass. The Harvest Control Rule (HCR) specifies that as the biomass reduces below  $B_{MSY}$ ,  $F_{TARG}$  is reduced to zero at  $B_{LIM}$ . In this figure, the red area indicates overfished ( $B < B_{LIM}$ ), the hatched area overfishing ( $F > F_{LIM}$ ), the green area where the stock is at or above target, and the amber area where management action is required to rebuild the stock to  $B_{TARG}$ .

The form of the control rules will depend on the management tools being used in the fishery. If output controls are in use, the control rules will specify the level of catch for any given level of stock. Where input controls are used, the control rules will specify the levels of input (eg: effort levels, size limits, season length, etc.) for a given status of the stock. An overview of different input and output controls is provided in [Chapter 5.5.2.8](#) of this Guide.

The performance of harvest strategies against economic and sustainability objectives is determined by comparing relevant indicators (eg: biomass over time) against the chosen reference points to estimate performance measures ([Figure 14](#)).

### 6.3.2 Reference points and control rules

The HSP (2007) specifies minimum standards for reference points as detailed below:

- $B_{TARG}$  (or proxy) equal to or greater than  $B_{MEY}$ . In cases where  $B_{MEY}$  is unknown, a proxy of  $1.2B_{MSY}$  (or a level 20% higher than a given proxy for  $B_{MSY}$ ) is to be used<sup>44</sup>. AFMA may approve the use of an alternative proxy for  $B_{MEY}$  if it can be demonstrated that a more appropriate alternative exists.
- $B_{LIM}$  (or proxy) equal to or greater than  $\frac{1}{2} B_{MSY}$  (or proxy).
- $F_{LIM}$  (or proxy) less than or equal to  $F_{MSY}$  (or proxy)<sup>45</sup>.
- $F_{TARG}$  (or proxy) at the level required to maintain the stock at  $B_{TARG}$ .

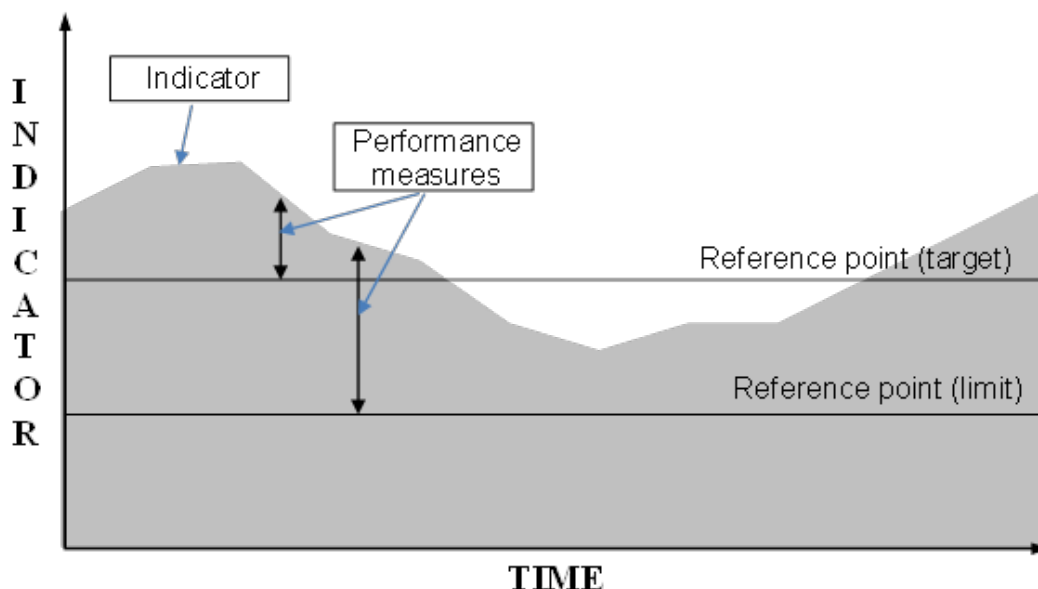


Figure 14– The relationship between indicators, reference points and performance measures.

Harvest Strategy control rules should:

- Ensure that the fishery is maintained at (on average), or returned to, a target biomass point  $B_{TARG}$  equal to the stock size required to produce maximum economic yield ( $B_{MEY}$ ), or an appropriate proxy (see above).
- Ensure fish stocks in the long term will remain above a biomass level where the risk to the stock is regarded as too high, that is  $B_{LIM}$ , or an appropriate proxy (see above).
- Ensure that the stock stays above the limit biomass level at least 90% of the time (ie: a 1 in 10 year risk that stocks will fall below  $B_{LIM}$ ). The 90% probability will form a key performance criterion in evaluating prospective harvest strategies when conducting management strategy evaluation analyses. It is important to note that this is a minimum standard, and that most harvest strategies that achieve the targets on average should perform better than this standard with regard to the probability of exceeding the limits.

<sup>44</sup>  $B_{MSY}$  is a significant interim goal between stocks rebuilding from  $B_{LIM}$  to  $B_{TARG}$ . Once a stock has reached  $B_{MSY}$ , it is the responsibility of the individual MAC and AFMA board to ensure that the stock is on a trajectory to achieve  $B_{MEY}$ .

<sup>45</sup> 'Fish down' strategies (where  $F_{CUR} > F_{LIM}$ ) are acceptable only where there is strong evidence that stock biomass is well above  $B_{TARG}$  and there are effective monitoring arrangements in place to ensure that as  $B_{TARG}$  is approached,  $F_{CURRENT}$  is reduced to  $F_{TARG}$ . For stocks above  $B_{TARG}$ , the rate of 'fish down' toward the target level will be determined by fishery specific harvest strategies.

- Progressively reduce the level of fishing when a stock moves below  $B_{MSY}$  and moves toward  $B_{LIM}$ .

### 6.3.3 Rebuilding strategies

Relevant to AFMA's ERM objectives, harvest strategies are designed to prevent key commercial stocks falling below the LRP (ie: the point of likely recruitment failure). While a species biomass is above  $B_{LIM}$  there is no expectation that the species/stock would be added to the list of threatened species under the EPBC Act (1999). However, under the HSP (2007), once a key commercial stock is below the LRP, all targeted fishing must cease, and AFMA must develop and implement a stock rebuilding strategy which is designed to rebuild the stock to the target reference point.

Furthermore, if a stocks biomass falls more substantially below  $B_{LIM}$ , there is an increased risk of irreversible impacts and the species will likely be considered for listing in a higher threat category (ie: vulnerable, endangered or critically endangered), in accordance with the EPBC Act (1999), and subsequently may require development of a formal recovery plan (HSP 2007). The relationship between the HSP (2007) and the EPBC Act (1999) is summarised in [Table 8](#) and provides details of the key elements of stock rebuilding and stock recovery plans.

**Table 8 – The relationship between the Harvest Strategy Policy (HSP 2007) and the Environment Protection and Biodiversity Conservation Act (1999).**

$B_{TARG}$		Strong economic performance. High stock resilience. No expectation to undertake consideration of listing as threatened species under EPBC Act
$B_{LIM}$		No expectation of listing under the EPBC Act but harvest strategy in place to rebuild towards $B_{TARG}$
	Conservation Dependent	Targeted catch set to zero. AFMA managed stock rebuilding strategy in place. May be listed as conservation dependent under the EPBC Act.
Eg $0.75B_{LIM}$	Listed Threatened Species	Markedly increased risk of irreversible impacts on the species. Likely consideration of listing as vulnerable, endangered or critically endangered under the EPBC Act. Such a listing may require development of a formal recovery plan under the EPBC Act.

### 6.3.4 Key issues in developing harvest strategies

AFMA's ERM is structured around four key process elements:

- Management planning.
- Implementation.
- Monitoring and reporting.
- Evaluation and improvement.

The HSP Guidelines (2007) provides guidance pertaining to each of these processes with respect to harvest strategies for key and secondary commercial species.

### 6.3.4.1 Planning

In managing Commonwealth fisheries, AFMA adopts a partnership approach through its MAC, RAG and other expert groups. These groups play a key role in developing and reviewing harvest strategies before final approval by the AFMA Commission. There are numerous factors that must be considered during the development or revision of harvest strategies. These are not repeated or summarised here but rather the reader is referred to [Table 9](#) which lists links to sections within the HSP Guidelines (2007) that provide guidance on many of these issues.

Table 9 - Key links within the Harvest Strategy Policy (2007) and Guidelines (2007) to the ERM process.

Process type	Description	Reference/link
<b>Planning</b>	Process for developing harvest strategies	HSP s5, pp 19
	HS design criteria	HSPG s4, pp 26
	Cost efficiency and risk catch cost	HSPG s2.6, pp 21
	Multispecies fisheries	HSPG s3.3, pp 25
	Data poor fisheries	HSPG s7, pp 35
	Highly variable fisheries	HSPG s9 pp 41
	Shared stocks	HSPG s2.3, pp 18
	Risk and uncertainty	HSPG s8, pp 40
<b>Implementation</b>	Implementation steps	HSPG s2.5, pp 19
<b>Monitoring and reporting</b>		HSP s2, pp 16
<b>Evaluation and improvement</b>		HSPG s2, pp 15

### 6.3.4.2 Implementation

Once developed, implementation of harvest strategies involves:

- Data collection to support assessments and Harvest Strategy - described various data collection processes.
- Annual or multiyear re-assessment of biological and economic status of key commercial stocks/fishery.
- Annual (or multiyear) determination of allowed catch or effort levels (along with other management measures required as part of Harvest Strategy).
- Communication of management controls to industry.
- Compliance monitoring of industry to management controls.

### 6.3.4.3 Monitoring and reporting

AFMA is to report on the implementation of the HSP (2007) and of fishery specific harvest strategies consistent with the Policy in its Annual Reports and otherwise as requested by the Minister for Agriculture and Water Resources.



The Policy is to be reviewed with a report provided to the Minister for Agriculture and Water Resources and the Minister for the Environment within five years of commencement. The DoAWR will initiate review and ensure that stakeholders are engaged in the review process.

#### **6.3.4.4 Review, evaluation and improvement**

The HSP Guidelines (2007) notes that one of the key aims of the HSP (2007) is to provide for increased certainty and predictability in the operating environment surrounding Commonwealth managed fisheries. Accordingly, amendments to harvest strategies should occur infrequently once they are fully established (every three-five years for most stocks). However, the HSP (2007) recognises that it may be necessary to amend harvest strategies more regularly. The HSP (2007) identifies that this may be due to the following:

- There is new information that substantially changes understanding of the status of a fishery.
- External drivers that increase the risk to a fishery and fish stocks.
- It is clear that harvest strategies are not working effectively and the intent of the HSP (2007) is not being met.

The process for amending harvest strategies should follow that of the initial development described in Section 2.5 of the HSP Guidelines (2007). The RAG or working group outlines the reasons for the proposed change and demonstrates their scientific basis. The MAC should support any proposed changes followed by approval by the AFMA Commission.

## **6.4 ERM for byproduct species**

### **6.4.1 Introduction**

Byproduct species do not currently (in 2016) fall under the scope of either the HSP (2007) or the CPF (2000), and as such lack the policy guidance that is available for key commercial, bycatch and protected species. However, the monitoring, assessment and management of byproduct species has been required by both ERAEF and ERM and by the ESMF Guidelines (2007) (see provisions 1.1.1 – 1.1.8 under Principle 1) since their inception, which have provided AFMA some guidance for ensuring ecological sustainability for these species.

In the past, processes for developing and implementing management arrangements for byproduct species have varied between Commonwealth fisheries. Byproduct species have either been managed as part of fishery specific harvest strategies, fishery specific ERM strategies (including bycatch work plans and species group specific strategies), or both in combination. These choices were influenced by a number of factors, including catch and economic value, past or occasional targeting, OCS agreements, ERA outcomes, discarding trends, developmental status of fishery and whether any given species was managed under quota.

### **6.4.2 Future direction**

Under AFMA's revised ERM, byproduct species:

- Are considered to be commercial species, due to the fact that they are sometimes or often retained for sale.
- Will be transitioned to be solely managed under each fisheries Harvest Strategy.
- Will be managed to remain above the LRP. Existing policies do not require byproduct to be managed to a target reference point.

- Fall into two major management categories: quota (minority) and non-quota (majority) managed byproduct species.

The transition to managing byproduct under harvest strategies will maintain many of the key management decision processes apparent under ERM strategies<sup>46</sup> and will:

- Better reflect their status as commercial species.
- Make for more consistent management approaches across fisheries.
- Assist management responses should a byproduct species transition<sup>47</sup> to being a key commercial species.

Managing byproduct under harvest strategies does require a broadening of the current Commonwealth definition of what a Harvest Strategy is (HSP 2007), to be more in line with the concept of harvest strategies used in other parts of the world where a Harvest Strategy is a predefined management approach that is designed to achieve a management objective. Currently, the HSP (2007) defines a Harvest Strategy as having:

*“Rules that control the intensity of fishing activity according to the biological and economic conditions of the fishery (as defined by the assessment). ....Control rules are designed to keep the fishery on track in pursuit of its defined objectives by specifying the management actions or decisions that need to be taken. For control rules to be clear and effective, the objectives need to be expressed in the form of quantifiable reference points. These reference points are used to guide management decisions.”*

This type of Harvest Strategy is designed largely around tightly controlling catch or effort levels (via HCR) to achieve a target reference point (and avoid a LRP). However, byproduct species must only be managed to ensure they stay above a LRP, and providing that objective is achieved, tight control of catches is neither required nor cost effective.

Under ERM, harvest strategies for byproduct species may, where appropriate, include a second category of decision rule – harvest monitoring rules (HMR) –which do not tightly control catch or effort but will ensure any increased potential risk to byproduct species is detected and reviewed and if necessary, managed.

The type of monitoring, assessment and management applied via harvest strategies to byproduct species will differ between quota and non-quota managed species and will need to consider:

- The amount of information/data available to support assessment.
- The risk posed by the fishery.
- Economic importance and potential for targeting.

### **6.4.3 Assessment requirements**

Consistent with the revised ERM, all byproduct species will be subject to either:

- ERA at 5 year, fishery specific schedules. Or;
- A higher level assessment, if that already exists under a pre-existing Harvest Strategy or separate process.

Cost effective assessment processes are particularly critical in managing byproduct species, noting that:

<sup>46</sup> Current ERM Strategies will be revised to become Bycatch Strategies within the FMS focusing solely on bycatch species and will no longer include byproduct nor commercial discards.

<sup>47</sup> Initially such transitions might be determined by the expert opinion of RAG/MAC but in future may be based on decision rules utilising catch and value information.

- Byproduct species are not targeted, and ecological risks will on average tend to be lower (due to lower catchability and selectivity), relative to key commercial species (of similar productivity).
- Byproduct are not required to be maintained at MEY based target biomass levels.
- Byproduct have relatively low economic value and any reduction in catch levels (that might result from precautionary measures that account for uncertainty associated with data poor assessment methods) will have less economic impact than reduced catches of key commercial species.

For these reasons, lower cost assessment methods should be applied whenever possible. Regardless of which assessment method is applied, predefined and unambiguous rules (for either harvest control or harvest monitoring) should be specified within a Harvest Strategy that will direct management responses based on assessment results, in order to pursue ecological sustainability for these species.

#### 6.4.4 Decision rule requirements

The two main forms of decision rule that should be used to direct management actions for byproduct under fishery specific harvest strategies are:

- Harvest Control Rules (HCR)<sup>48</sup>.
- Harvest Monitoring Rules (HMR).

The form of decision rules used will depend mainly on whether the byproduct species is a quota or non-quota managed species<sup>49</sup>.

##### 6.4.4.1 Quota species

Quota species will be managed in the same manner as other commercial species<sup>50</sup>. They will be subject to assessments and HCR consistent with the HSP Guidelines (2007) that will be designed to estimate and modify RBCs (which impact TACs) depending on assessment outputs, and potentially meta-rules and discount factors<sup>51</sup>. Byproduct species are often “data poor” and the HSP Guidelines (2007) provides advice on developing and implementing harvest strategies for data poor commercial species that may be relevant to quota managed byproduct species. Examples of current Harvest Strategies for quota managed byproduct species are found within the [Southern and Eastern Scalefish and Shark Fishery Harvest Strategy](#).

##### 6.4.4.2 Non-quota species

Non-quota byproduct species will be subject to a hierarchical decision rule that is structured according to the indicator monitoring and risk assessment results. For example, for low and medium risk non-quota byproduct species, HMR should specify:

- The monitoring indicator (eg: catch, effort, CPUE) and trigger level being used to identify when potential changes to the ecological risk posed by the fishery have

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<sup>48</sup> They would not necessarily pre-specify the management action required to achieve the reduction in fishing mortality (risk) for non-quota species.

<sup>49</sup> The vast majority of byproduct species are non-quota managed, with only a few SESSF species managed under quota.

<sup>50</sup> Re-assessments will tend to be set on a more regular basis than occur under the ERAEF.

<sup>51</sup> This doesn't preclude other management measures being put in place permanently such as spatial closures, gear restrictions etc. that are ongoing, outside the quota process.

occurred (in between re-assessment periods). Where sufficient data exist, the indicator and trigger could proxy the LRP (eg:  $0.2CPUE_{F=0}$ ) but will more often be catch or effort based (see example fishery links below).

- Review process to determine the cause of any trigger level breaches. Species specific or fishery wide re-assessment of ecological risk where review determines that the trigger breach is due to an increase in risk
- Where re-assessment indicates the species to be at high risk, there will be a requirement to undertake either:
  - Direct management action to reduce the fishing mortality on the stock to a level that no longer poses a high risk to the sustainability of the stock.
  - Re-assessment at a higher assessment tier/level to determine a more certain estimate of the risk posed by the fishery, and if necessary, then implement direct management action to reduce the fishing mortality. See Chapter 5.5 for further discussion.

Indicator monitoring is required for all species and fisheries as part of ERM. The HSP Guidelines (2007) provide advice on appropriate indicators for “data poor” species (typical of most byproduct). Please see [Chapter 5.5.3.2](#) for further guidance on setting re-assessment indicators and triggers for species and fisheries.

Examples of existing HMR and triggers for byproduct species within harvest strategies can be found here:

- [Northern Prawn Fishery Harvest Strategy 2014](#)
- [Harvest Strategy for the Western Deepwater Trawl Fishery and North West Slope Trawl Fishery 2011](#)

For species determined to be at high risk, the decision to re-assess or directly manage the risk will be dependent on a range of factors. See [Chapter 5.5](#) for further discussion on these factors and available management options.

#### **6.4.5 Data and monitoring requirements**

Data and monitoring requirements for the assessment and management of byproduct species (and all other species) are described in [Chapter 5.5.3.3](#).

#### **6.4.6 Transition to Harvest Strategies**

For those fisheries in which byproduct species are managed under ERM strategies, the timing of the transition to harvest strategies would occur in conjunction with the development of the FMS or reviews of associated Harvest Strategy and ERM. Initially, the transition might simply constitute an update to the Harvest Strategy to include byproduct species requirements, but in future, further requirements might stem from updated HSP Guidelines (2007).

### **6.5 Commercial discards**

Harvest strategies should where appropriate consider and document any required monitoring and management of commercial discards. From an ERM perspective, discarding can play a significant role in increasing the risk posed by fishing to the ecological sustainability of commercial species populations, particularly where discarding is poorly monitored or not properly taken into account in assessments designed to monitor the status of stocks and risk of fishing to those stocks. There are other legislative and policy objectives (e.g. optimal utilisation) that require commercial discards to be monitored and managed.

Harvest strategies should outline:

- Data monitoring processes required to collect quantitative information about discard amounts. For key commercial and secondary commercial stocks, discarding should be considered when assessing the sustainability of the stocks and setting catch and effort to sustainable levels<sup>52</sup>. For byproduct species, the priority given to collecting information about discards should take into account the risk status of the species (collecting such information is a higher priority for high risk species)
- Qualitative information about discarding practices and the reasons for discarding should be considered. Where AFMA's management measures are demonstrated to cause discarding, the costs and benefits of retaining these measures should be weighed up.
- Incentives, options or measures for the fishing industry to reduce discarding.
- Requirements to account for discards in assessments - AFMA currently accounts for discards in TAC setting. Accounting for all sources of fishing mortality (including discards) in TAC setting is a part of the Commonwealth Harvest Strategy Policy.

AFMA is currently developing an overarching "AFMA Discard Management Strategy" to provide further guidance for fishery managers.

## **6.6 HS Roles and responsibilities, consultation and communication**

See Chapters [3](#) and [5](#).

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<sup>52</sup> Note: AFMA currently accounts for discards in TAC setting. Accounting for all sources of fishing mortality (including discards) in TAC setting is a part of the Commonwealth Harvest Strategy Policy.

## 7 Habitats and Communities

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### 7.1 Purpose

This chapter provides an overview of ERAEF and ERM for habitats and ecological communities to date, including a review of relevant objectives, ERA methods, recent research and future directions.

### 7.2 Introduction

The original ERAEF (Hobday et al. 2007) was designed to include risk assessments for the impacts of fishing on marine habitats and ecological communities, in recognition of the fact that fishing has impacts beyond the direct effects of harvesting individual species. In accounting for impacts on these components, AFMA's ERA and ERM is consistent with the objectives of the FMA 1991 and EPBC Act 1999, including the principles of ESD.

Under AFMA's ERA and ERM, habitats and communities are defined as:

- Habitats: *“the biological and physical environments in which an organism lives”* (Hobday et al. 2011, Sainsbury, 2008).
- Communities: *“assemblages of species in varying proportions doing different things, and have properties that are the amalgam of the properties of individual populations and interactions among populations”* (Mangel and Levin 2005).

### 7.3 Management objectives

Specific fisheries policy relating to fishing impacts on habitats and communities is yet to be developed. Subsequently, habitat and community objectives have historically been defined by AFMA and stakeholders within the scoping process of ERAEF. Typically, these were to:

Habitats:

- Avoid negative impacts on the quality of the environment
- Avoid reduction in the amount and quality of habitat

Communities:

- Avoid negative impacts on the composition, function, distribution and structure of the community

Future policy developments may provide further guidance on objectives which can be incorporated into future revisions of this document.

### 7.4 Methods

In-depth methodological explanation of ERAEF for habitats and communities can be found in Hobday et al. (2007) for habitats and Hobday et al. (2011) for communities. Future versions of this guide will consider ERA methods for habitats and communities in more detail and reflect the development of specific policy guidance (where available) by the Australian Government.

Historically, it has proven challenging to implement the ERA methodology to habitats and communities due to a paucity of data. Recent development of ERA methodology has been undertaken to allow these ecosystem components to be assessed at level 2. As such, analyses can be applied to habitats and communities in a similar fashion to other ecosystem components. Level 2 methods were developed for both habitats and communities using the PSA approach, occurring in 2009 for habitats (Hobday et al. 2007) and 2011 for communities (Hobday et al. 2011). Inclusion of residual risk analyses within

the assessment framework is also similar for these non-species components. There is a need for improved data and methods to facilitate better use of current ERA methodologies.

### **7.4.1 Scoping**

The aim of the Scoping stage is to develop a profile of the fishery being assessed. This provides information needed to complete Levels 1 and 2 of the ERA. The challenge for both habitats and communities is a paucity of data and the identification of appropriate units ('types') within each fishery.

For habitats, there are two types of data that are used to inform habitat units based on data availability (Hobday et al. 2007). When available, habitat is identified using images from extensive video surveys (method 1). If not, a mixture of geophysical and GIS mapping has been incorporated to identify habitat units for assessment within ERAEF (method 2).

For communities, units of analyses were devised using a food-web based "assemblage" (Hobday et al. 2011). This was achieved by grouping similar species based on their functional group and connecting them based on predator prey interactions. From this, a generic food-web was developed that could be applied to all fisheries. Data used to populate these food-webs was supplied from numerous sources, but primarily the bioregionalisation studies of the Australian marine and coastal environment (Lyne et al. 2005).

### **7.4.2 Level 1 – Scale Intensity Component Analysis**

SICA aims to identify which hazards lead to a significant impact on any ecosystem component. Analysis at Level 1 is for whole components (commercial, bycatch and habitats and communities), not individual sub-components. This approach is precautionary, ensuring that elements determined to be 'low risk' can be confidently omitted from further steps.

### **7.4.3 Level 2 – Productivity Susceptibility Analysis**

When the risk of an activity at Level 1 (SICA) is identified and no existing management is in place to mitigate that risk, a level 2 analysis is undertaken. PSA is a method of assessment which allows all units within any of the ecological components to be effectively and comprehensively screened for risk. The PSA approach is based on the assumption that risk to an ecological component will depend on two characteristics of the component units: (1) the extent of the impact due to the fishing activity, which will be determined by the susceptibility of the unit to the fishing activities (Susceptibility) and (2) the productivity of the unit (Productivity), which will determine the rate at which the unit can recover after potential depletion or damage by fishing.

#### **7.4.3.1 Habitats**

Development of level 2 ERA for habitats occurred within AFMA's initial ERAEF document (Hobday et al. 2007). Since its inception, ERA for habitats has been applied to nine AFMA managed fisheries. However, there has been a lag in the incorporation of these analyses within ERM. This occurred in a subsequent project that occurred in 2011.

Once habitat units have been identified through SICA, their resilience and susceptibility to fishing from specific activities is assessed. Two productivity attributes (eg: rate of regeneration) and nine susceptibility attributes (eg: selectivity of gear to habitat) are ranked from 1-3 representing low-high risk. From this, habitat units can be assessed as low, medium or high risk. Sixteen habitats were assessed as at high risk on the mid-slope in waters between 700-1500 m. The 700 m depth closure was initially introduced to protect stocks of orange roughy and other deepwater species, but has effectively eliminated

trawling in that area. Further actions were deferred pending the outcomes of a CSIRO investigation of the representation of various habitats in closed areas and the effect of different trawl methods on the ecosystem (see below).

#### **7.4.3.2 Communities**

Each community is assessed based on a range of unique productivity and susceptibility attributes. These include productivity attributes such as fish species richness and mean trophic level, and susceptibility attributes such as spatial effort overlap, mean trophic level of catch and total catch percentage. Once these attributes are ranked and averaged for each community within the fishery, the level of risk can be assigned. For the SESSF, a total of 27 communities were assessed with a total of 6 considered to be at high risk as a result of the PSA (Hobday et al. 2011). With this technique developed, it can now be progressively incorporated into AFMA's fisheries and, subsequently, appropriate measures implemented to enable appropriate steps to be taken based on outcomes of the ERA.

### **7.5 Current status of research in Commonwealth Fisheries**

#### **7.5.1 Pitcher report**

Under a recent project (Pitcher et al. 2016), the impact of AFMA trawl fisheries on demersal habitats was assessed with consideration of existing spatial management. The project aimed to quantify the overlap of mapped seabed assemblages with trawl footprints, and with areas of spatial management that exclude trawling, by building on previously collated data and assemblage mapping as well as data for Commonwealth demersal trawling effort, fishery closures and marine reserves. These trawl exposure and protection estimates provide information that AFMA can use to focus on priorities or gaps, regarding the needs for any future for habitat ERAs. This report investigated the intensity of trawl footprints on different habitat types to assess the probable impact of fishing on these habitats in association with knowledge of existing spatial management plans. This report showed that the majority of habitats that overlap with AFMA trawl fisheries are minimally exposed to trawl effort or adequately protected by existing spatial closures. Thus, managers can focus future analyses on the remaining at-risk habitats to better assess their risk to fishing activities. This allows fishery managers to minimise the need to conduct resource intense ERA analyses for habitats that are known to be at low risk. The techniques employed are not intended to replace ERA, but instead streamline resource use by excluding low-risk habitats/fisheries from subsequent resource-intensive ERA. Consideration of existing fisheries management actions is an important component in assessing the overall risk of ecosystem components to fishing activities and allows managers to better prioritise resource use.

### **7.6 Future directions**

#### **7.6.1 Cumulative impacts**

There is a need to consider and assess the impact of fishing impacts on ecosystem components outside of single Commonwealth fisheries, which is the scale at which assessments are undertaken. Managers must consider the impact of fishing activities from other Commonwealth managed fisheries, state and Territory fisheries and international fisheries cumulatively. Where fishing impacts also occur outside of Commonwealth managed fisheries, managers should where possible pursue a collaborative approach to the assessment and management of relevant ecosystem components.



## **7.6.2 Research and management development**

It is AFMA's intent to continue to develop and progress ERA and ERM for habitats and communities. As it stands, development of level 3 methodologies has not been undertaken. Prior to the development of level 3 techniques, there is a need for improved data collection at appropriate scales to better inform level 1 and 2 analyses. Furthermore, research into the selection of appropriate reference points to inform ERM decisions is required (Smith et al. 2007). These values currently do not exist for these habitat and ecological community components, or are somewhat arbitrarily determined (Hobday et al. 2011).

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## Attachment 1 – Template structure for the development of Fishery Management Strategies (FMS)

The template below is intended to guide the development of Fishery Management Strategies (FMS) in each Commonwealth fishery managed by AFMA. AFMA requires that the high level (PART A – G) structure is maintained across all fisheries, and prefers where possible that the lower level structure is maintained to the greatest degree possible, but recognising that changes to the sub-structure may be necessary to suit fishery specific circumstances.

In developing the structure of each FMS, fishery managers should look to ensure that it will meet the various internal and external reporting requirements for that fishery.

Table 43 – Template structure of a Fishery Management Strategy (FMS).

<b>PRELIMINARIES</b>	
	Title page
	Version control and amendments history table
	Acknowledgements
	Glossary/Acronyms
	Contents
	Executive Summary
<b>PART A - BACKGROUND</b>	
	Legislation and Policy background (including FMP)
	Management frameworks and Guidelines (HS, ERM, MS)
	Consultative Processes (RAG, MAC, etc)
	Purpose of FMS
	FMS cycle and timeframes
<b>PART B – OBJECTIVES</b>	
	Introduction - Pursuing multiple objectives
	Ecological Sustainability
	Economic (yield, efficiency)
	Societal values
	Risk-cost-catch trade-offs
	Consistency with existing FMP

<b>PART C – FISHERY OVERVIEW</b>	
	Fishery area
	Fleet structure
	Species <ul style="list-style-type: none"> <li>• Commercial (key, secondary, byproduct)</li> <li>• Bycatch (protected, other)</li> </ul>
	Habitat/community interactions
	Economic value
	Current management regime <ul style="list-style-type: none"> <li>• (incl. FSRs, access rights etc)</li> <li>• Communication via info/management books, directions</li> </ul>
	Closures
	Data collection and monitoring <sup>53</sup>
	Research
	Compliance
<b>PART D – COMMERCIAL SPECIES HARVEST STRATEGY<sup>54</sup></b>	
	Background (nature and role of a HS)
	Current Stock Status <sup>55</sup>
	HS overview <ul style="list-style-type: none"> <li>• Overview</li> <li>• Consistency with HSP (2007) and HSP Guidelines (2007) (and EPBC Act?)</li> <li>• Species classification</li> </ul>
	Operational objective(s)
	Fishery monitoring to support HS
	Assessments <ul style="list-style-type: none"> <li>• Quota spp (key, secondary)</li> <li>• Non-quota spp (e.g secondary, byproduct)</li> </ul>
	Reference points

<sup>53</sup> This might be better dealt with in a separate “Data and Monitoring Strategy”

<sup>54</sup> Structure of part D may depend on the nature of each fisheries Harvest Strategy.

<sup>55</sup> Current status would not normally go in a “strategy” however should be included for reporting purposes

	<p>Decision rules</p> <ul style="list-style-type: none"> <li>• Quota spp (key, secondary)</li> <li>• Non-quota spp (e.g secondary, byproduct)</li> </ul>
	<p>Determining TACs from RBCs</p> <ul style="list-style-type: none"> <li>• Discount factors</li> <li>• Metarules</li> </ul>
	Other management arrangements (eg: closures etc)
	Evaluation (eg: MSE etc)
	Implementation, roles and responsibilities
	Reporting requirements
	Review process
<b>PART E – BYCATCH STRATEGY</b>	
	Background (nature and role of a BS)
	<p>BS overview</p> <ul style="list-style-type: none"> <li>• Overview, including development process</li> <li>• Consistency with CPF, EPBC Act, AFMA Bycatch Strategy</li> <li>• Species classification</li> </ul>
	Operational objective(s)
	Fishery monitoring to support BS
	Ecological Risk Assessment Results (summary)
	<p>Management arrangements</p> <ul style="list-style-type: none"> <li>• Non-protected bycatch <ul style="list-style-type: none"> <li>* Low/medium risk species management</li> <li>* High risk species</li> </ul> </li> <li>• Protected species <ul style="list-style-type: none"> <li>* Species specific arrangements</li> <li>* Species group strategies</li> </ul> </li> </ul>
	Other management arrangements (eg: closures etc)
	Evaluation
	Implementation, roles and responsibilities
	Reporting and performance monitoring requirements
	Review/evaluation process

<b>PART F – BROADER ECOLOGICAL INTERACTIONS</b>	
	Introduction – habitats and community interactions
	Assessment results
	Management arrangements
	Monitoring and Research
	Future directions
<b>PART G – DATA STRATEGY<sup>56</sup></b>	
	Overview of current data collection programs
	Key data gaps
	Revisions to data collection processes
<b>PART H – RESEARCH STRATEGY (5 year)</b>	
<b>PART I – COMMUNICATION (info books, directions, instruments) and REPORTING<sup>57</sup></b>	
<b>REFERENCES</b>	
<b>ATTACHMENTS</b>	
	<ul style="list-style-type: none"> <li>• Logic modelling worksheets</li> </ul>

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<sup>56</sup> Tentative – could alternatively be spread through each of the other strategies?

<sup>57</sup> Lauren Posmyk looking into this

## Attachment 2 – Previous ERM context

### ERM framework: 2007 - 2015

The ERM Framework that AFMA has utilised between 2007 to present has been typically represented as outlined in [Figure 1](#). Under this framework, for a given fishery:

1. Initial ecological risk assessments (Level 1 SICA and Level 2 PSA) were undertaken and the results documented in fishery specific ecological risk assessment reports.
2. Residual risk analyses (RRA) would then be applied to determine which high risk species (from the initial assessment) could be re-classified, based on consideration of existing management actions or observed interaction levels and other factors (eg: pre-existing Tier 1 HS assessments) that were not considered in the initial assessments. The results of RRA were also reported.
3. Additional quantitative analyses (SAFE) were often applied which resulted in further reclassification of risks or were considered as part of the RRA.
4. Throughout the above process the fishery RAG would be involved in reviewing the various assessments undertaken.
5. Once the final set of high risk species had been agreed upon AFMA would develop, in consultation with RAG and MAC, a fishery specific ecological risk management strategy (ERM Strategy) aimed at putting in place management responses to reduce fishery risks to high risk species.
6. Once agreed and finalised, AFMA would then look to implement the ERM Strategy through the range of agreed management processes outlined in the ERM Strategy.
7. It was then intended that after a certain period, AFMA would re-assess fisheries under the ERAEF and revise its ERM Strategies to account for any changes in the risk status of species in each fishery.

Fishery specific Ecological Risk Management reports spanning all Commonwealth

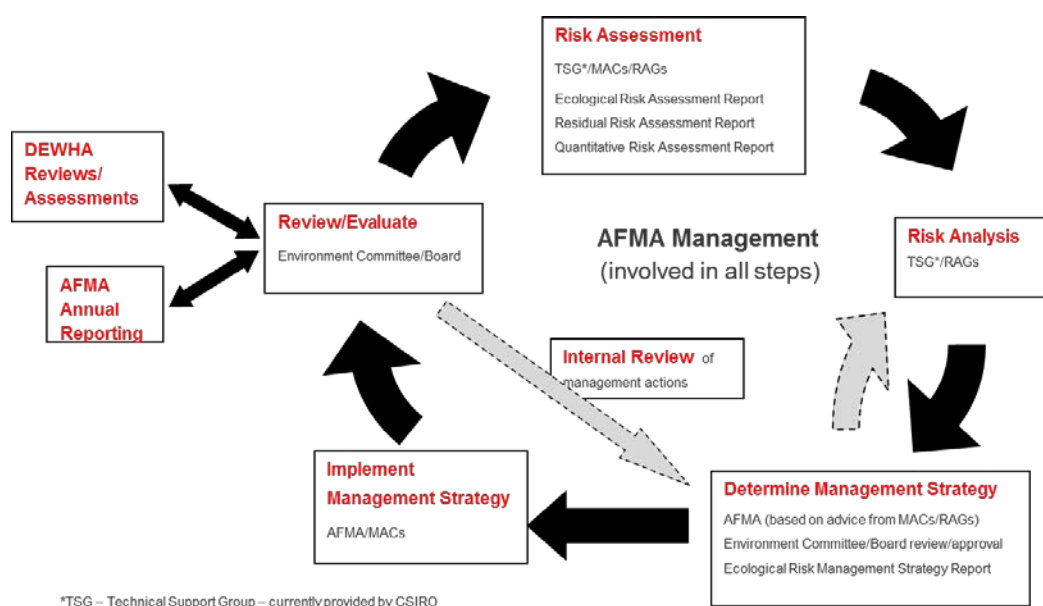


Figure 1 – ERM framework used by AFMA in the period 2007 – 2015.

managed fisheries can be found on the AFMA website.



## Attachment 3 – Legislative and policy background to the ERM Objective

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### Introduction

The requirement for the Commonwealth Government to ensure “ecological sustainability” of species populations which interact with Commonwealth fisheries is a common and consistent theme throughout the key legislation, policies and Guidelines that define AFMA’s fisheries management objectives and processes/activities ([Table 1](#)). In each of these the language used to describe that requirement varies, but nonetheless AFMA interprets these as expressing a consistent requirement<sup>58</sup>.

AFMA’s “species level” ecological sustainability objective under ERM (Sections 1.3 and 2.4 of this ERM Guide), has been developed to reflect that consistent theme. It recognises that all species (commercial and bycatch) which interact with Commonwealth fisheries, regardless of economic and other objectives that also influence their management, must as a minimum be maintained at biomass levels above that at which there is an unacceptable risk of recruitment failure. This objective effectively defines AFMA’s interpretation of ecological “sustainability” for species populations.

Other objectives may result in management decisions that ensure that species populations are maintained at biomass levels significantly higher than that required by AFMA’s ERM objectives (e.g. the MEY objective of the HSP 2007).

The following sections summarises how AFMA’s ecological sustainability objective is aligned with sustainability objectives and requirements associated with key legislation, policies and Guidelines.

### Commercial species

For commercial species, the requirement to ensure that species populations are maintained above a level at which recruitment failure occurs, flows from the following key drivers:

- The 2005 Ministerial Direction
- The Commonwealth HSP (2007) and Guidelines
- EPBC Act (1999) and its associated
  - TSSC Guidelines (2015)
  - The Guide to the Ecologically Sustainable Management of Fisheries (2007) (hereafter referred to as the *ESFM Guidelines 2007*)

The 2005 Ministerial Direction clearly states that AFMA will manage its fisheries so as to avoid overfishing and overfished stocks, including a requirement that fishing mortality rates are to be reduced if a population declines below  $B_{MSY}$  or  $40\%B_0$ , and fishing would cease if population levels reached  $20\%B_0$ .

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<sup>58</sup> This interpretation was endorsed by the Ecological Risk Assessment Technical Working Group at its meeting in September 2015.

**Table 1– A summary of “sustainability” objectives and requirements from existing legislation, policies, Guidelines and agreements, highlighting the species categories to which each is relevant and consistent with the primary objective of ERM.**

	Commercial Species		Bycatch Species	
	Key commercial	Byproduct	General bycatch	Protected species
UNCLOS (1982) and UNSFA (1995)		For non-target species - Maintain/restore populations above levels at which reproduction becomes seriously threatened (Section ??)		
FMA 1991	Ensuring that the exploitation of fisheries resources .....are conducted .... consistent with the principles of <b>ecologically sustainable</b> development .... (P1-3(1b)), in particular the need to...			
		...have regard to the impact of fishing on <b>non-target species</b> and long term <b>sustainability</b> of the marine environment (P1-3(1b))		
	Ensuring, ... that the living resources of the AFZ are not endangered by <b>over-exploitation</b> (P1-3(2a))			
				....that measures adopted ... must not be inconsistent with the ... conservation and protection of ...whales (P1-3(2d)).
FMPs	check	Examples of performance criteria: <b>1) SESSF FMP 2003</b> - catch of non-target species reduced to/below level that allows stocks to be maintained at ecologically sustainable levels; <b>2) ETBF FMP 2011</b> - catch limits or other measures set for non-quota species if there is a risk to the sustainability of the species.	check	
Bycatch Policy 2000			Ensure that bycatch species and populations are maintained (pp 6) <sup>1</sup>	
				Improve protection for vulnerable species
EPBC Act 1999				<ul style="list-style-type: none"> <li>• For listed threatened species - fisheries must not “adversely affect the survival or recovery in nature of the species”</li> <li>• For non-threatened protected species - fisheries must not “adversely affect the conservation status of ....that species”. ...i.e. ensure they do not become threatened (breach TSSC guideline population thresholds).</li> </ul>
				Take all reasonable steps to ensure that [protected ] species are not killed or injured as a result of fishing. (208A/222A/245/265) <sup>2</sup>
ESM guidelines 2007	Principle 1 - Avoid overfishing and recover overfished stocks. <b>Objective 1</b> - maintain ecologically viable stock levels at an agreed point or range, with acceptable levels of probability <sup>3</sup>		Principle 2 - <b>Objective 1.</b> The fishery is conducted in a manner that does not threaten bycatch species.	
				Principle 2 - <b>Objective 2.</b> The fishery is conducted in a manner that avoids mortality of, or injuries to, endangered, threatened or protected species and avoids or minimises impacts on threatened ecological communities.
TSSC Guidelines	Part F - <b>Thresholds for commercially harvested marine fish:</b> The Committee is informed ... by a series of limit and target biological reference trigger points ...provided in the [HSP 2007] for management intervention for species that decline below 60% of their pre-fishing biomass. <sup>4</sup>			
Ministerial Direction 2005	Avoid overfishing and overfished stocks			
HSP and Guidelines 2007	Maintain or restore populations to above B <sub>lim</sub> (point of recruitment failure)			
ERAEF (2005-2007) scoping objectives	Common across many fisheries for all species groups/components (though not TEPs in SESSF) - "Avoiding recruitment failure" and "avoiding negative consequences for populations".			

The subsequently developed HSP (2007) and HSP Guidelines (2007) defined overfishing and overfished as follows<sup>59</sup>

- *Overfished – a fish stock with a biomass below the biomass limit reference point*

According to the HSP Guidelines (2007), the limit reference point (LRP) that defines overfished should equate to a spawning stock biomass level below which future recruitment levels may be jeopardised, ie: the point at which recruitment failure may occur.

- *Overfishing – a stock is experiencing too much fishing and the removal rate from the stock is unsustainable*

This effectively refers to a fishing mortality rate that is above the agreed fishing mortality rate limit reference point.

To ensure clarity in the use of this Guide, AFMA restricts its terminology to “overfishing” and “overfished”, noting that under the above definition, overfished and recruitment overfishing are effectively analogous. Furthermore, AFMA interprets overfishing as occurring when the fishing mortality rate exceeds the limit fishing mortality rate ( $F_{LIM}$ ). This is a rate which, if not reduced, would result in the fishery eventually becoming overfished ( $biomass < B_{LIM}$ ).

The HSP (2007) and HSP Guidelines (2007) also require that a limit reference point (proxied by  $20\%B_0$  in the absence of more specific information) be applied to ensure sustainability of key commercial stocks:

- *Ensure fish stocks will remain above a **limit** biomass reference point ( $B_{LIM}$  or proxy) - where the risk to the stock is regarded as too high (HSP pp4)..... for example the point at which recruitment overfishing is thought to occur (HSP Guidelines pp. 23).*
- *Ensure that the stock stays above the limit biomass level at least 90% of the time (HSP pp4).*

The HSP (2007) and HSP Guidelines (2007) recognised the wide biological diversity of key commercial species and accept that where appropriate data /analyses exist, different levels for  $B_{LIM}$  might be justified for different species. For highly variable stocks (eg: banana prawn) determining such reference points is extremely difficult (leading to escapement based harvest strategies).

For key and secondary commercial species, AFMA must also have regard to requirements stemming from the EPBC Act (1999) in combination with the TSSC Guidelines (2015). The TSSC Guidelines (2015) state population size (in numbers of individuals) thresholds that trigger listing of species as Conservation Dependent or threatened. The population size thresholds are:

- >50% if the cause is reversible and ceased.
- 30% if it's uncertain whether causes are reversible, or have ceased, or this decline is projected/suspected to occur in future.

While these thresholds are significantly higher than the  $20\%B_0$  threshold of the HSP (2007) (and are only one set of multiple criteria for listing), the TSSC Guidelines (2015) have two important provisions relevant to commercial species:

## **Part F: Thresholds for assessing commercially harvested marine fish.**

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<sup>59</sup> The HSP Guidelines (2007) also refer to “recruitment overfishing”, which is analogous to an overfished fishery (ie: “occurs when excessive fishing effort or catch reduces the spawning stock biomass to a level below which future recruitment levels may be jeopardised; this spawning biomass level should correspond closely to the biomass limit reference point.”). This Guide will only use the term “overfished”.

*The Committee is informed, but not bound, by a series of limit and target biological reference trigger points (commonly referred to as  $B_{lim}$  and  $B_{targ}$ ) provided in the [Commonwealth Harvest Strategy] policy for management intervention for species that decline below 60% of their pre-fishing biomass. These interventions include listing assessments.*

### **Part C: Conservation dependent (section 197(6))**

This section effectively states that if a fish species is managed under a legislated plan that provides for “*management actions necessary to stop the decline of, and support the recovery of, the species so that its chances of long term survival in nature are maximised*” and where cessation of the plan “*would adversely affect the conservation status of the species*” then the species is listed as Conservation Dependent.

Part F allows for HSP (2007) settings to be used to assess (for listing) commercially harvested fish stocks (ie: including key and secondary commercial species). Part F and Part C combined infer that commercial fish species might become “conservation dependent” if they go below  $20\%B_0$ , providing the TSSC applies settings of the HSP (2007).

While byproduct species are “commercially harvested” it would seem unlikely that this provision applies to them (as byproduct species do not currently fall under the scope of either the HSP (2007) or, for that matter, the CPF (2000)). However, byproduct are effectively treated as commercial species under the ESMF Guidelines (2007), specifically Objective 1 of Principle 1 (and the associated Guidelines 1.1.1-1.1.7) which requires the avoidance of overfishing and the recovery of overfished stocks.

The Bycatch Policy provisions also state that byproduct species are subject to commercial management arrangements and as such are not considered bycatch for the purposes of that policy. The ERM objective for byproduct is also consistent with the intent of objectives expressed for non-target species by key international agreements (UNCLOS, UNSFA) to which Australia is party.

### **General (non-protected) bycatch species**

General (non-protected) fish bycatch species depletion thresholds or fishing-based mortality rates which might be used to describe sustainability limits, are not defined under current Commonwealth fisheries policies and guidelines. Furthermore, AFMA does not interpret the term “commercially harvested species” in Part F of the TSSC Guidelines (2015) to include bycatch species (of any type)<sup>60</sup>.

However, for non-protected bycatch species (and byproduct species), the objectives of effectively avoiding overfishing ( $F > F_{LIM}$ ) and an overfished state ( $B < B_{LIM}$ ) are clearly consistent with the intent of objectives expressed for non-target species by key international agreements (UNCLOS, UNSFA) to which Australia is party, and to the intent and objectives of the Guidelines for Ecologically Sustainable Management of Fisheries 2007, as well as the FMA (1991), and with FMP objectives, performance measures and performance criteria for non-target species. They are consistent with objectives documented during the original ERAEF process, which in numerous fisheries revolved around avoiding recruitment failure (for all ecosystem components). See [Table 1](#) for a summary of objectives provided in these key drivers.

AFMA’s conclusion is that consistently, the intent expressed for general fish bycatch species (and indeed byproduct species) is to avoid depleting populations to the point of recruitment

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<sup>60</sup> However, this might change if “commercially harvested” was simply a reference to capture by commercial fishery gears, rather than to the type of species caught (commercial versus bycatch).

failure (defined as recruitment overfishing and overfished fishery for commercial species). This conclusion is consistent with the views expressed in Sainsbury (2008) who states in regards to bycatch species reference points:

*“In that limit reference points are set so as to prevent slowly reversible or irreversible biological impacts there is no biological basis for by-catch and retained species having different limit reference points. Unless there is a management intention to cause such impacts on by-catch species the same limit reference points should apply to populations of bycatch and retained species. Consequently the best practice limit reference points for bycatch species are the same as for target and retained species.....The indicator and limit reference point may not be directly measurable for all bycatch species because there is often very limited information available about ....catches,...abundances or the key biological and ecological properties. ....In these cases, proxies for the limit reference points can be developed in a risk assessment framework....”.*

It is also consistent with the conclusions reached by Penney (2015) in his review of operational objectives for the Bycatch Guidelines project, and recommendations for interpretation of the revised draft Bycatch Policy.

*“Similar to the concept of recruitment overfishing for commercial species, this should be the minimum viable population level required for successful annual recruitment, required to prevent population declines and/or required to allow for recovery of depleted populations. Such an approach has been adopted by the Marine Stewardship Council in setting benchmarks for bycatch sustainability”.*

## Protected species

With regard to protected species, the objective to avoid depleting populations to the point of recruitment failure (or an analogous reduction in reproductive capacity) is consistent with requirements under the EPBC Act 1999 for gaining fishery accreditation, whereby:

- For listed threatened species, fisheries must not “*adversely affect the survival or recovery in nature of the species*”
- For non-threatened species they must not “*adversely affect the conservation status of a listed migratory species or a population of that species*”.

It is also consistent with the Commonwealth Policy on Fisheries Bycatch (2000) which contains an objective:

- To improve protection for vulnerable<sup>61</sup> species (ie: protected and threatened species\*)

However, AFMA’s management of protected species interactions under the EPBC Act requires that AFMA ensures its fisheries:

*“take all reasonable steps to ensure that [protected<sup>62</sup>] species<sup>63</sup> are not killed or injured as a result of the fishing.”*

This approach reflects the special status given to these species under the EPBC Act noting that the objectives of the EPBC Act go beyond ecological sustainability.

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<sup>61</sup> While this is the wording of the Policy, the word vulnerable in fact pertains to only one of three categories of threatened species listing (vulnerable, endangered and critically endangered).

<sup>62</sup> The EPBC Act 1999 repeats this statement in four sections (208A/222A/245/265) for each of the following protected species groups: listed threatened species, cetaceans, listed migratory species and listed marine species.

<sup>63</sup> Other than conservation dependent species

Thus, while the ERM objective ensures a minimum biomass level is maintained to protect sustainability, the EPBC Act 1999 requirements can result in protected species population sizes being managed to attain significantly higher levels than required by the ERM objective alone.

It should be noted that for protected species (\*not including any commercially harvested fish), the TSSC criteria and thresholds are intended to be directly applied when considering species for listing, and the “risk being managed” would seem to be effectively defined by the criteria thresholds for vulnerable listing. (eg: avoid > 30% or > 50% depletion in population size in numbers, plus thresholds for the other four criteria). The TSSC thresholds are set at levels that signal population depletions that may indicate risks to the reproductive capacity of protected species populations (and signal an initial risk of future extinction if depletion processes are not managed), and as such are not inconsistent with the intent of the ERM objective.

## **Conclusion**

AFMA’s ERM was implemented to ensure that AFMA could meet legislative and policy requirements for achieving ecologically sustainable fisheries, which at a species level is achieved by ensuring populations stay above the point at which recruitment failure is likely.

## Attachment 4 – Secondary objectives that may be pursued in Ecological Risk Assessments

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### Target Species

- Avoid recruitment failure of the target species
- Avoid negative consequences for species or population sub-components

### Byproduct and Bycatch

- Avoid recruitment failure of the byproduct and bycatch species
- Avoid negative consequences for species or population sub-components

### Protected Species

- Avoid recruitment failure of protected species
- Avoid negative consequences for protected species or population sub-components
- Avoid negative impacts on the population from fishing

### Habitats

- Avoid negative impacts on the quality of the environment
- Avoid reduction in the amount and quality of habitat

### Communities

- Avoid negative impacts on the composition/function/distribution/structure of the community

**Reference:** Hobday, A. J., A. Smith, H. Webb, R. Daley, S. Wayte, C. Bulman, J. Dowdney, A. Williams, M. Sporcic, J. Dambacher, M. Fuller, T. Walker. (2007) Ecological Risk Assessment for the Effects of Fishing: Methodology. Report R04/1072 for the Australian Fisheries Management Authority, Canberra.