GoodFish: Australia's Sustainable Seafood Guide

Aquaculture Assessment Criteria

2020 CONSULTATION DRAFT

GoodFish

Australia's Sustainable Seafood Guide

Australian Marine Conservation Society

The GoodFish: Australia's Sustainable Seafood Guide is produced by the Australian Marine Conservation Society (AMCS) in order to provide the public, seafood retailers and restaurants with a robust, comprehensive and independent guide to the environmental sustainability of seafood choices available in Australia. The Goodfish Guide rates the environmental performance of fisheries that supply seafood to the Australian market against a set of criteria that have been developed by AMCS, based on international best practice in seafood ratings[1].

Key Principles

AMCS adheres to the following key principles of sustainability in our GoodFish Sustainable Seafood Guide:

1. Sustainable aquaculture operations use wild fishery resources efficiently and are (or are close to) net producers of marine protein. Wild fishery resources are managed at a level sufficient to maintain the long-term integrity and functioning of the marine ecosystem, particularly in the context of our increasingly warming climate.

2. Sustainable aquaculture operations do not have significant impacts on the wildlife that interacts with them, and do not use lethal wildlife controls. They may have some impacts on wildlife and threatened species, but not enough to cause declines in populations. They prevent the escape of farmed stock into the natural environment.

3. Sustainable aquaculture operations do not impact sensitive or protected natural environments[2] and do not cause significant or lasting damage to habitats beyond farm boundaries.

4. Sustainable aquaculture management is science-based and independent from industry; prioritising environmental protection and ensuring regulations are effectively implemented and enforced.

These key principles are defined in further detail in the outline of our assessment criteria below.

[1] The Australian Marine Conservation Society is a member of the Global Seafood Ratings Alliance.

[2] See Appendix 1 for additional guidance and definitions of 'sensitive environments'.

Outline of Assessment Criteria

1. Use of marine resources

Sustainable aquaculture operations use wild fishery resources efficiently and are (or are close to) net producers of marine protein. Wild fishery resources are managed at a level sufficient to maintain the long-term integrity and functioning of the marine ecosystem, particularly in the context of our increasingly warming climate.

Criteria Principles

Species grown with no net feed input, such as mussels, oysters and abalone are the most sustainably farmed seafood options.

For omnivorous and carnivorous farmed fish that require protein/oil input, feed should be sourced from sustainable resources. These assessment criteria consider only feed ingredients of marine origin.

If broodstock are sourced from the wild, the status (abundance and age/size structure) of the stock from which brood stock are taken is sufficient to maintain the long-term integrity and functionality of the ecosystem and ecologically related species, as well as support ecologically viable fisheries into the future (i.e. stocks are maintained around B_{MEY}). The species farmed is not listed as a threatened species (if wild broodstock are used), as defined under Australian legislation (State, Territory and/or Commonwealth), international agreements (e.g. CMS, CITES) or as threatened or more severe on the IUCN Red List of threatened species.

Assessment subcriteria

a. Dependence on wild fishery inputs

This is a measure of the net production gain or loss from farming activities relative to any wild fishery feed inputs and is applicable to omnivorous and carnivorous farmed marine species.

b. Sustainability of feed source

This subcriterion considers the stock status of wild fisheries from which fish feed is sourced, and/or the degree of responsible sourcing of additional marine feed products.

c. Source of broodstock

This subcriterion differentiates between closed loop[3] and ranching/on-growing[4] operations and assesses the sustainability of either process.

[3] 'Closed loop' operations are where the life cycle of the farmed species is contained within the farming operation and the farming process does not rely on sourcing wild broodstock/juveniles from wild capture fisheries.

[4] 'Ranching' or 'on-growing' operations are reliant upon sourcing broodstock or juveniles from either wild capture fisheries (e.g. southern bluefin tuna) or natural settlement of larvae (e.g. mussels).

2. Risk to wildlife and wild fisheries

Sustainable aquaculture operations do not have significant impacts on the wildlife that interacts with them, and do not use lethal wildlife controls. They may have some impacts on wildlife and threatened species, but not enough to cause declines in populations. They prevent the escape of farmed stock into the natural environment.

Criteria principles

Aquaculture operators have publicly committed to using non-lethal methods for mitigating interactions with other marine wildlife, do not euthanize animals that recurrently interact with sea cages and have invested in appropriate deterrent measures. Cages are not situated in areas of critical importance to marine wildlife.

Suitable measures have been taken to minimise escapes, and escapees do not pose a risk to native marine wildlife through impacts on biodiversity, competition for food resources with native fauna and transmission of disease and/or parasites.

Assessment subcriteria

a. TEP species interactions and mitigation measures

An assessment of the impact of TEP species interactions from aquaculture operations, either through entanglement in infrastructure or killing problem wildlife and the impact of translocations.

b. Effects of escapees

This subcriterion assesses the impacts of escaped native and non-native farmed species on native surrounding marine fauna (e.g. competition with native species for feed, predation on native species, genetic dilution, establishment of feral populations).

c. Disease transfer potential

This subcriterion assesses of the risk aquaculture operations pose through disease transmission to wild populations of the same or other species.

d. Management of wildlife and wild fishery impacts

A consideration of the adequacy, effectiveness and enforcement of regulation related to the impacts of aquaculture operations on wildlife and wild fisheries.

3. Impacts on the natural environment

Sustainable aquaculture operations do not impact sensitive or protected natural environments[5] and do not cause significant or lasting damage to habitats beyond farm boundaries.

Sustainable aquaculture management is science-based and independent from industry; prioritising environmental protection and ensuring regulations are effectively implemented and enforced.

Criteria principles

Farming operations have been sited according to robust and transparent Environmental Impact Assessments (EIAs) with the opportunity for and due consideration of extensive community engagement and public comment in the planning phase. The type and level of operation (intensive to extensive) is appropriate to the region, the farms do not adversely impact ecologically sensitive[2] or protected aquatic or terrestrial habitat, and development or expansion is managed in a precautionary manner backed by EIAs. Ecologically sensitive coastal habitat[2] is not destroyed to develop aquaculture operations.

For sea cage operations:

- Feed delivery systems ensure minimum fish feed is lost as waste into the surrounding environment.
- Operators manage organic waste output to minimise adverse impacts on the surrounding marine environment.
- The use of chemicals is prohibited, or chemicals in use have no or minimal impact.
- Scale and siting are appropriate to the surrounding area.

For land-based tank and pond aquaculture:

- Fully recycled water systems with no wastewater are preferable.
- Where wastewater is discharged, effluent water quality is monitored on appropriate timescales and nutrient and chemical levels are at appropriate levels to ensure no adverse impacts on surrounding waterways and groundwater.

Assessment subcriteria

a. Siting considerations

This subcriterion assesses whether the scale of the aquaculture operation is appropriate to the surrounding area, whether the relevant environmental checks have been undertaken to minimise impacts and whether natural ecosystem functioning is maintained in the presence of the aquaculture infrastructure.

b. Effluent effects

This subcriterion assesses the use and possible impact of both chemicals (including, but not limited to copper anti-foulants and antibiotics) and

[5] See Appendix 1 for additional guidance and definitions of 'sensitive environments'.

nutrients (fish waste products, including excess feed) on the surrounding environment

c. Local and regional habitat impacts

This subcriterion assesses effects of aquaculture operations on surrounding habitat, accounting for the spatial and temporal scale of the impacts.

d. Management of impacts on the natural environment

A consideration of whether management of the density and scale of the aquaculture operation, in the context of cumulative impacts from other aquaculture and primary industry, is appropriate to the surrounding area.

Instructions for Assessors

This document presents the criteria used to assess the environmental sustainability of aquaculture operations as well as the methodology used to apply those criteria to determine the sustainability ranking in the Guide.

The scale of assessment should reflect the way the seafood is considered by the market. A brand/producer-scale approach can be considered where it is marketed as such, rather than by species or region, where the consumer uses the brand to choose between seafood options. This approach should also be used if requested by producers.

If appropriate, assess at farm level; if not possible, assess using best available average data for the farmed species, accounting if possible for the country or region under consideration. If considering at a broader regional scale than individual farms, consideration will need to be given to legislation and relevant policies.

Our assessments consider three criteria that encompass key aspects of aquaculture sustainability:

1. Use of marine resources

2. Risk to wildlife and wild fisheries

3. Impacts on the natural environment

Consideration of management/regulatory aspects related to each criterion is also considered, nested within each criterion.

Each criteria is scored by assessing all available information against a series of subcriteria ranked in three categories of environmental performance – denoted as 'green', 'amber' or 'red', with red signifying most environmental concern.

The overall rankings for criteria 1,2, and 3 are used to determine the final ranking for the fishery, which is listed in GoodFish: Australia's Sustainable Seafood Guide. This is applied using weightings provided in the table in section 4. If any of criteria 1, 2 or 3 result in a red ranking after assessment of the subcriteria, the stock/species/species group/aquaculture producer/company under assessment results in an automatic red rating.

A number of different species that occur at different levels in the marine food chain are farmed in Australia. Some criteria will only apply to omnivorous and carnivorous species, rather than to filter feeders (e.g. mussels) or grazers (e.g.

abalone). Criteria may also only apply to species farmed in seacages rather than closed circulation systems. In these cases, note which subcriterion have been scored.

In scoring, use the statement/s associated with green, amber or red ranking that best fit the available evidence. Where more than one statement applies for different ranking levels of each subcriterion, consider the weight of best-fit subcriteria. A perfect fit may not be available; where there is uncertainty, or where the available information may fit multiple statements within or between green, amber or red, a precautionary approach should be adopted, i.e. err on the side of caution. Ensure that this approach is consistently taken throughout the assessment process.

Justification should be provided in assessment reports for how the available information supports a particular statement/s associated with the applied ranking, along with the particular ranking statement that is applied.

Information used to inform assessments against these criteria is of varying quality and quantity across all eight jurisdictions that manage fisheries under different management regimes and legislation around Australia, and it is rarely possible to assess all aspects of fishery sustainability using quantitative, up to date information. As a result, a degree of expert judgement may be required. In order to minimize subjectivity in assessments, the best publicly available supporting evidence should always be cited in the assessment, and verified where possible. Assessments are subject to internal review by AMCS, and external peer reviewers where deemed necessary. All assessment conclusions are able to be reviewed and revised at any time if found in error, or as a result of incomplete or updated information. As a general principle, all publicly available data evidence directly relating to the unit of assessment should be applied, along with any data supplied by industry, managers or other stakeholders. Information that is of direct relevance to the unit of assessment will take precedence over information that is indirectly applicable, wherever it is available.

AMCS will provide, upon request, information required to enable an individual producer or management to improve on any ranking or understand the ranking that is applied. Final rating determinations remain the responsibility of AMCS.

Assessment Criteria

1. Use of marine resources

Assessment under this criterion is required only for farmed species/operations that use supplementary feeds of marine origin. An automatic green rating applies in these criteria where supplementary feeding or feeds of marine origin are not used. Likewise, trimmings do not represent a novel wild fish input in aquaculture production, and an automatic green ranking applies if trimmings from a sustainable source are the only source of wild fish inputs.

The process of estimating wild fish input to farmed fish output will require knowledge of the following parameters:

- Fish Feed Equivalency Ratios (FFERs)

- economic Feed Conversion Ratio (eFCRs)

Some operators and third-party certification schemes (eg ASC) publish FCR and FFERs. They may also be available in academic literature.

Trimmings can be excluded from these calculations as they do not represent a novel wild fish input in the aquaculture production

These will require direct contact with both fish feed companies and individual fish farms. For companies unwilling to divulge information, take a conservative approach to assessment[6].

Criteria a & b need only be considered if the species/operation under consideration uses wild stocks for feed input.

Criteria c is only relevant if wild broodstock are used.

If none of the criteria apply, the ranking is automatically green.

Assessment can be performed at the growout phase only, where this accounts for >90% of feed input used over the production cycle. Hatchery and nursery-phase assessment should be included where feed use across these phases constitutes >10% of the production cycle (by total volume of feed).

a. Dependence on wild fishery inputs

Sustainable aquaculture operations use wild marine resources in a highly efficient manner, and are progressing towards becoming net producers of marine protein.

Use the following method to calculate the Fish Feed Equivalency Ratio (analogous to the Forage Fish Dependency Ratio, adopting the Monterey Bay Aquarium Aquaculture Standard A 4 approach, based on the 'academic equation'[7]).

Use the best available (most recent or relevant) data:

[6] If there are substantial unknowns and any environmental concerns, rank lower, providing justification.

[7] Monterey Bay Aquarium (2020) Seafood Watch Standard for Aquaculture, Aquaculture Standard Version A4.0 (April 2020)

a) Fishmeal inclusion level* = _____ %

b) Fish Oil inclusion level* = _____ %

c) Fishmeal yield % = _____ (use 22.5[8] if value is unknown)

d) Fish oil yield % = _____ (use 5.0[9] if value is unknown)

e) eFCR = _____

**Note on fish processing by-products, trimmings, etc.* – Feed ingredients from trimmings, by-products or other processing wastes are NOT scored in this equation as it measures direct dependence on wild fisheries. If data are available for these ingredients, they can be subtracted from the inclusion levels used in the FFER calculation (lines a and b above). E.g., if total fishmeal inclusion level is 40% and one-quarter of the fishmeal comes from trimmings or by-products, the final inclusion level = 30%.

**Note on the use of whole (unprocessed) or 'trash' fish for feed* – If whole fish are used as feed, the eFCR effectively determines the FFER value. Use eFCR as the FFER value (or entering 22.5 as the FM inclusion level and 5 for FO in the equations along with the eFCR will give the same result).

Fishmeal and fish oil yield values: The calculation of the FFER ratio requires the input of the yield values for fishmeal and fish oil. Yield values that are commonly used in key literature and by industry are 22.5% for fishmeal and 5% for fish oil[10,11] (Peron 2010, Tacon & Metian 2008).

$$FFER_{FishMEAL} = \frac{a \times e}{c}$$

$$FFER_{FishOIL} = \frac{b \times e}{d}$$

Final FFER value = the greater value of $FFER_{FishMEAL}$ or $FFER_{FishOIL}$ Final FFER value.

[8] Yield values from Tacon and Metian (2008)[10]. Other (similar) values are possible from Peron et al. (2010), but data clarity is not sufficient for a robust quantification of fishery landings.

[9] On a realistic and pragmatic basis – i.e. the best current understanding of fishery sustainability (accepting that ecosystem-based forage fishery management is not yet fully developed).

[10] Peron, G, J Mittaine, B Le Gallic (2010) Where do fishmeal and fish oil products come from? An analysis of the conversion ratios in the global fishmeal industry. *Marine Policy* doi:10.1016/j.marpol.2010.01.027

[11] Tacon AGJ, M Metian (2008) Global overview on the use of fish meal and fish oil in industrially compounded aquafeeds: Trends and future prospects. *Aquaculture* 285 (1-4): 146-158.

Green:

- Estimated wild fish input to farmed fish output (FFER) is less than or equal to 1.1:1, or is strongly and credibly trending towards achieving it in the forward scope of this assessment (two years forward).

Amber:

- Estimated wild fish input to farmed fish output (FFER) is between 1.1 and 3:1, or is strongly and credibly trending towards achieving it in the forward scope of this assessment (two years forward).

Red:

- Estimated wild fish input to farmed fish output (FFER) is greater than 3:1.
- Feed composition cannot be quantified or producers are unwilling to divulge information.

b. Sustainability of marine feed sources

Sustainable aquaculture operations use feed sources that are not overexploited, impacting TEP species or damaging sensitive environments[2]. Feed ingredients are traceable and information is transparent and available.

Refer to AMCS Wild capture fisheries Assessment Criteria – Stock impacts for guidance. Consider and follow GSRA[12] partner organization assessments of feed source fisheries where appropriate. Rank in a precautionary manner (according to the lowest performing major feed input accounting for >5% of the diet). Fishsource[13] may be used as an indicator if information is not available to satisfy other ranking criteria.

Green:

- All marine feed ingredients are independently certified as sustainable by a credible organisation, or assessed as equivalent of AMCS green or amber by an appropriate international organisation (e.g. GSRA partner organisation).
- Additional sources of marine feed ingredients are considered highly likely to be sustainably sourced (e.g. trimmings or offcuts of fish, proteins/oils from algal products).
- All fishsource scores for reduction fisheries are ≥6 AND ≥8 for 'stock health'.

Amber:

- There is no independent sustainability certification or assessment of feed sources by an appropriate international organization (e.g. Global Seafood Ratings Alliance partner organization) but the feed source is known and there are no sustainability concerns.
- All fishsource scores for reduction fisheries ≥6.

[12] https://globalseafoodratings.org/

[13] https://www.fishsource.org/

Red:

- A reduction fishery from which feed is derived is overfished and/or subject to overfishing.
- Feed is sourced from an unregulated fishery or industry.
- Feed composition cannot be determined/individual companies are unwilling to divulge information.
- Feed source (including trimmings) includes TEP species.
- Feed sources are likely to include IUU fishing.
- Any fishsource score for reduction fisheries <6.

c. Source of broodstock

Sustainable aquaculture operations cause no depletion of wild populations/stocks in order to source broodstock.

Fish stocks where broodstock are sourced from are not overfished or subject to overfishing (e.g. mussels vs southern bluefin tuna); collection of wild broodstock doesn't result in depletion of stock or wider ecosystem impacts

Green:

- Broodstock/farmed stock are from a closed life cycle hatchery.
- Wild sourced broodstock/ranched stock are from a sustainable source – stocks are at or above B_{MSY} or ranked green in AMCS Wild Capture assessments, or equivalent in assessment conducted by Global Seafood Ratings Alliance members.

Amber:

- Status of broodstock/ranched stock is unknown but there is a high level of confidence that affected stocks are not overfished.
- Collection of broodstock/ranched stock is likely to have the potential to deplete wild stocks.
- Wild sourced broodstock/ranched stock are from a source that has minor sustainability concerns – stocks may be at or below B_{MSY} (but not below the point of recruitment impairment or subject to overfishing) or ranked amber in AMCS Wild Capture assessments; or equivalent in assessment conducted by Global Seafood Ratings Alliance members.

Red:

- Broodstock are sourced from the wild and the species is a listed threatened species.
- Broodstock/ranched stock are overfished and/or subject to overfishing or ranked red in AMCS Wild Capture assessments; or equivalent in assessment conducted by Global Seafood Ratings Alliance members.

d. Overall ranking determination – use of marine resources

Overall Ranking	Subcriterion 1a	Subcriterion 1b	Subcriterion 1c
Green	Green		
	Green	Amber	Green
	Amber*	Green	
Amber	Any other combinations		
	Amber	Red	Green or Amber
	Red*	Green	Green or Amber
Red	Red	Amber or Red	Any
	Red	Red	Any
	Any		Red
	Amber	Red	Amber

*An amber or green overall rank can be scored where 1a is one rank lower IF 1b is ranked green AND there is a substantive, demonstrable improving trend in feeding efficiency in the aquaculture operation such that 1a would be likely to improve in rank two years forward (e.g. at the next assessment). See Appendix 2 for further guidance.

2. Risk to wildlife and wild fisheries

The following criteria may only be applicable to species farmed in the sea. Inland tank or pond operations do not require assessment where there are no effects of farming on native wildlife[14], and would rank as Green. If inland systems still affect wildlife (whether terrestrial or marine), assessment is required.

a. TEP species interactions and mitigation measures

Sustainable aquaculture operations operate in such a manner that does not cause declines or significantly hinder the recovery of TEP species populations or other wildlife that are likely to interact with the operation.

AMCS considers a highly precautionary approach to assessing the impacts of aquaculture operations on TEP species is appropriate, in accordance with the vulnerability of marine biodiversity to fishing impacts and the expectations of our supporters and the Australian community.

Green:

- Interactions[15] with wildlife, including TEP species, do not occur, are exceptional, or there is a high level of confidence that they do not impact the affected species (not a TEP species) it at a population level AND there is a high level of confidence in the reporting structure.
- Translocations of wildlife do not occur.
- Lethal controls, or other controls that can be used with lethal effects, are not used.

Amber:

- Interactions[15] with wildlife, including TEP species, are infrequent, result in minimal lethal controls (lethal controls must not be used for TEP species), infrequent accidental deaths, and have minor effects at a population level AND/OR interaction rates are decreasing and the operator and regulators are actively pursuing mitigation measures.
- Number and species composition of wildlife mortalities cannot be determined, but there is potential to interact with TEP species due to geographical overlap AND these interactions are highly unlikely to have population level impacts AND this is not a result of industry or government refusing to provide data.
- Translocations are limited AND there is evidence of effective investment in reduction of translocations.
- There is robust evidence that interaction rates are not preventing on-going recovery of a depleted population.

Red:

- Interactions[15] occur in numbers that are likely to cause declines to affected species at a population level.
- Lethal controls, or other controls that can be used with lethal effects, are used and there is not a high level of confidence that their use is minimized.

[14] Consider the effects from direct pest and predator control. Habitat and effluent related impacts can be considered under Criteria 2 and 3.

[15] Interactions are defined by GSRA as 'The known and likely wildlife population interactions with aquaculture production systems including lethal and non-lethal interactions with predators or other wildlife caused or contributed to by farming operations'.

- Lethal controls, or other controls that can be used with lethal effects, are used for a TEP species.
- Interaction[15] rates are likely causing declines or preventing recovery of a depleted TEP population.
- The number of translocations is at a level that is potentially causing environmental impacts AND may result in significant mortalities.
- Number and species composition of TEP species mortalities are not known, but there is a high likelihood of interaction with TEP species due to geographical overlap AND even a low level of interactions would be likely to have population level impacts AND industry or government refuses to provide data.

b. Effects of escapees

Sustainable aquaculture operations minimize or eliminate the potential for farmed stock to escape to a point where escapes pose no risk to the natural environment.

Green:

- Aquaculture operation has no connection to natural water bodies.
- Open net systems have proven escape prevention methods in place and rates of escapes are demonstrably low, with no significant escapes occurring over the ≤5 years pre-assessment.
- Species is non-native and has a fully established population in the region in question.
- Species is non-native and highly unlikely to establish viable populations.
- Pond culture systems (or supporting infrastructure eg bunds) are sited above a 1/100yr flood level.
- Pond systems have significant average annual daily exchange to the receiving environment (>10%) but have multiple or fail-safe effective escape prevention methods in place.

Amber:

- Escape incidences are infrequent (occurring on average less than 1 in 5 years) and are insignificant[16] AND no significant escapes have occurred ≤5 years pre-assessment.
- Indirect impacts on the receiving environment as a result of escapes are a possibility (e.g. competition for resources; no effect on TEP species allowed) but are not likely to be lasting or significant.
- Non-native populations have been established historically (and are not currently established), but management is likely to effectively prevent any re-establishment.
- Pond systems have significant average annual daily exchange to natural water bodies (>10%) and there are not multiple or fail-safe effective escape prevention methods in place.
- Pond culture systems (or supporting infrastructure eg bunds) are sited below a 1/100yr flood level, but likely effective additional escape risk mitigation is in place AND farmed species are not known to establish wild populations in comparable natural environment.

[16] 'insignificant' escape incidences can be defined as <5% of a production cycle (a year class at any discrete production site/lease) by number or weight. 'Significant' escape incidences can be defined as ≥5% of a production cycle by number or weight.

- Significant[16] escape incidences have occurred in the ≤5 years pre-assessment, but significant corrective action has been taken and is highly likely to be effective.

Red:

- Significant[16] escape incidences are frequent (occurring on average more than 1 in 5 years, including ≤5 years pre-assessment) events.
- There is evidence of non-native escape impact on native fauna either directly (e.g. predation) or indirectly (e.g. competition for food resources).
- Establishment of a feral population of a non-native species is likely or is occurring at time of assessment.
- There is evidence that native escapees negatively affect wild populations.
- Escaped fish (native or non-native) are likely to have a significant impact on a TEP species.
- Pond systems are sited in areas that are beneath 1/100yr flood level or flood prone areas AND farmed species are known to establish populations in comparable natural environment.
- Pond systems have significant average annual daily exchange to natural water bodies (>10%) and there are no escape prevention methods in place.

c. Disease transfer/amplification potential

Sustainable aquaculture operations pose no disease[17] threat to species in the receiving environment.

Green:

- The operation poses little disease risk to wild populations of the same species or other species.
- Historical transfers of pathogens have occurred with no demonstrable impact on wild populations of marine fauna AND effective management measures are now in place prevent reoccurrence.
- The production system has no connection to natural water bodies.

Amber:

- There is clear potential[18] risk of disease transfer between farmed and wild populations or there have been low levels of disease transfer between farmed and wild populations in the past but effective management actions are in place to address the issue AND disease transfer issues do not impact on TEP species.
- Disease risk to wild populations id poorly understood but there are significant (proven effective in comparable circumstances) operational measures in place to reduce risk.

Red:

- There is evidence of disease transfer from farmed to wild populations that has been significant at a population level.

[17] GSRA definition: 'The risk or known impacts that aquaculture operations pose to wildlife through disease and parasite transmission and/or amplification'.

[18] 'Clear potential' can be established if there are wild populations of the same species in the receiving environment, or if any parasite or pathogen that occurs in the farming operation is known to affect wild species found in the receiving environment.

- There is evidence that disease transfer at any level has impacted on TEP species in ≤15 years pre-assessment.

d. Management of wildlife and wild fishery impacts

Sustainable aquaculture operations have regulations in place that minimise risk to, and effectively addresses any impacts to wildlife and wild fishery impacts.

In principle, amber or red rankings for management should not penalize overall ranking for Criteria 2 if industry practice is ensuring a higher level of environmental outcomes. This is reflected in the overall ranking determination.

Green:

- Where necessary (multiple aquaculture operations and/or primary industries affect the receiving environment) a comprehensive and effective regional level management framework is in place (note: consideration not required when the operation has no connection to the natural environment) to address wildlife and wild fishery impacts.
- Management and monitoring of wildlife and wild fishery impacts is robustly independent from industry.
- Robust regulatory standards relating to aquaculture infrastructure provide effective protection for wildlife and wild fisheries.
- The use of lethal controls for TEP species is prohibited.
- Regulations are effectively enforced and there is no evidence of misreporting wildlife interactions.
- Robust and independent baseline monitoring of potentially impacted TEP species is established where aquaculture operations expand into new areas.

Amber:

- Where necessary (multiple aquaculture operations and/or primary industries affect the receiving environment) an inadequate or partially effective regional level management framework is in place (note: consideration not required when the operation has no connection to the natural environment) to address wildlife and wild fishery impacts.
- Management frameworks are in place to address wildlife and wild fishery impacts with specific actions relating to TEP species where applicable, but these plans are not comprehensive and there are concerns about their effectiveness.
- Management and monitoring of wildlife and wild fishery impacts occurs, but there are concerns about whether programs are adequately independent from industry.
- Management actions have not been enacted to reduce impacts of disease transfer OR management actions have been enacted to reduce impacts but have so far proved ineffective.
- Management of wildlife and wild fishery impacts is inadequate but industry initiatives reduce some risk to wildlife and wild fisheries.
- Regulatory requirements around infrastructure are inadequate or lacking, but there have been no recent (≤15yrs pre-assessment) incidents of infrastructure failure that have led to potential impacts on wildlife or wild fisheries.

- There are some inadequacies in regulatory enforcement, and evidence of historic (any incidences have occurred >5 years pre-assessment) misreporting of wildlife interactions, but there is no evidence of significant impacts to wildlife or wild fisheries.
- There is some baseline monitoring of potentially impacted TEP species established where aquaculture operations expand into new areas but these plans are not comprehensive and there are concerns about their effectiveness.

Red:

- Multiple aquaculture operations and/or primary industries affect the receiving environment and there is no effective regional level management framework in place to address wildlife and wild fishery impacts[19].
- Management frameworks to manage wildlife and wild fishery impacts are in are not appropriate to the scale of the operation, and are not likely to be effective.
- The use of lethal controls for TEP species is currently permitted AND there is evidence that lethal controls have been used.
- There are serious inadequacies in regulatory enforcement, and evidence of recent (incidences have occurred ≤5 years pre-assessment) misreporting of wildlife interactions, and there is evidence of significant impacts to wildlife or wild fisheries.
- Management and monitoring of wildlife and wild fishery impacts is not independent from industry AND there is evidence of resultant increased risk to wildlife and wild fisheries.
- Regulatory requirements around infrastructure are inadequate or lacking, and there have been recent (≤5years pre-assesment) incidents of infrastructure failure that have led to potential impacts on wildlife or wild fisheries.

[19] Note: consideration not required when the operation has no connection to the natural environment.

e. Overall ranking determination – risk to wildlife and wild fisheries

Do not consider ranking in Criteria 2d if 2a, 2b and 2c are ranked green

<table>
<tr><th>Overall Ranking</th><th>Subcriterion 2a</th><th>Subcriterion 2b</th><th>Subcriterion 2c</th><th>Subcriterion 2d</th></tr>
<tr><td rowspan="5">Green</td><td colspan="3">Green</td><td>N/A</td></tr>
<tr><td colspan="2">Green</td><td>Amber</td><td rowspan="3">Green or Amber</td></tr>
<tr><td>Green</td><td>Amber</td><td>Green</td></tr>
<tr><td>Amber</td><td colspan="2">Green</td></tr>
<tr><td>Green</td><td colspan="2">Amber</td><td>Green</td></tr>
<tr><td rowspan="4">Amber</td><td colspan="2">Amber</td><td>Green or Amber</td><td>Any</td></tr>
<tr><td>Amber</td><td>Green or Amber</td><td>Amber</td><td>Any</td></tr>
<tr><td>Green or Amber</td><td colspan="2">Amber</td><td>Amber or red</td></tr>
<tr><td>Green</td><td colspan="2">Any one red</td><td>Green</td></tr>
<tr><td rowspan="3">Red</td><td>Red</td><td colspan="2">Any</td><td>Any</td></tr>
<tr><td>Any</td><td>Red</td><td>Any</td><td>Amber or red</td></tr>
<tr><td colspan="2">Any</td><td>Red</td><td>Amber or red</td></tr>
</table>

3. Impacts on the natural environment

a. Siting considerations

Sustainable aquaculture operations are sited in locations where the impacts of production can be assimilated/dispersed, and do not damage sensitive environments[2].

For land-based aquaculture, consider the previous uses of the site. If the site was previously used for primary industry, consider whether the aquaculture operation represents a more or less efficient or environmentally impactful food production system compared to historical use.

Green:

- The aquaculture operation is sited in an area where evidence is strong that natural carrying capacity/assimilative potential for existing/additional aquaculture impacts is high [20] OR highly effective remediation/mitigation measures are in place, such that there is no evidence of significant additional impacts from aquaculture operation.
- The siting of the aquaculture operation is not connected to receiving environments considered of outstanding value (ie World Heritage or Ramsar Listed area, National park or IUCN I or II spatial zone) OR there is a clear connection, but regulation prohibits impacts on those environments and is effectively monitored and enforced (see criteria 3d).
- There is no direct connection to the receiving environment (eg some indoor tank culture).
- Where expansion is planned, adequate environmental monitoring programs are in place, and appropriate baseline data is collected prior to development commencement.
- There is robust evidence that cumulative impacts of aquaculture operation and other primary industries are within the assimilative capacity of the local environment.

Amber:

- There is evidence[21] the siting of the aquaculture operation has caused habitat alteration in the receiving environment, but not to any habitats that are considered environmentally sensitive[2].
- There is evidence[21] the siting of the aquaculture operation has affected natural ecosystem functioning in the receiving environment though there is not clear evidence of negative impacts as a result of this stressor (eg oxygen depletion or disruption of breeding for key species has occurred).
- The aquaculture operation is sited in an area where evidence[21] is strong that natural carrying capacity/assimilative potential for existing/additional aquaculture impacts is moderate AND there is evidence that aquaculture is negatively impacting key environmental indicators in the receiving environment (but not a sensitive environment).

[20] Refer definitions of site sensitivity in assessment guidelines or GSRA core elements.

[21] Evidence might include monitoring data from the aquaculture operation, regulator or external environmental monitoring.

Red:

- There is evidence[21] that scale of habitat alteration through siting considerations has significantly impacted the receiving environment and the area is a sensitive environment[2].
- The siting of the aquaculture operation has created significant potential for environmental impacts to occur on natural environments considered of outstanding value (ie World Heritage or Ramsar Listed area, National park or IUCN I or II spatial zone).
- The aquaculture operation is sited in an area where evidence is strong that natural carrying capacity/assimilative potential for existing/additional aquaculture impacts is low AND there is evidence that aquaculture is significantly negatively impacting key environmental indicators in the receiving environment.
- The aquaculture operation is occurring in a known habitat for TEP species and there is clear evidence that environmental impacts are occurring that potentially impact TEP species.

b. Effluent effects

Sustainable aquaculture operations produce effluent at levels that does not exceed, or contribute to exceeding, the carrying capacity of the receiving environment. They effectively minimize and reduce effluent by adopting more efficient and less toxic chemical and feed inputs and invest in reducing or avoiding discharging effluent.

Effluent includes excess feed, excretions or byproducts of fish production, chemical treatments or antifoulants, and pond 'sludge' disposed after a production cycle. Consider whether effluent is recycled in polyculture or used in additional food production in a way that reduces other nutrient or chemical inputs.

Green:

- The operation uses a closed recirculation system.
- Chemical[22] treatments are not used OR chemicals used are known to have no effect on the receiving environment OR the chemicals used have an insignificant impact on the receiving environment, and the surrounding environment is not a sensitive area.
- Land-based: Effluent is treated prior to release in line with appropriate local regulation and with appropriate checks and controls OR effluent is used for secondary purposes (eg fertilizer for crops) that results in negligible additional environmental impacts from the aquaculture operation.
- Sea cage: Effluent has an insignificant impact on the receiving environment beyond seacage boundaries.
- Treatment of effluent is unnecessary as there are no feed or chemical inputs.

Amber:

- There is evidence that chemicals used affect the receiving environment AND the receiving environment is not considered environmentally sensitive.

[22] 'Chemicals' includes antifoulants, parasiticides, antibiotics

- Land-based: Effluent may have some or no treatment prior to discharge and is likely to add significant inputs to the receiving environment AND the receiving environment is not a sensitive area AND there is no evidence of serious effluent related impacts (eg algal blooms, smothering of benthic habitat) that negatively impact ecosystem function.
- Sea cage: Effluent has some impact on the receiving environment beyond seacage boundaries AND the receiving environment is not a sensitive area AND there is not evidence of serious ongoing effluent related impacts (e.g. algal blooms, smothering of benthic habitat) that negatively impact ecosystem function.

Red:

- Data relating to chemical usage is not available.
- Chemical usage results in transfer of chemicals into the receiving environment at levels that are known to cause harmful environmental impacts.
- Land-based: Effluent may have some or no treatment prior to discharge and is likely to add significant inputs to the receiving environment AND there is evidence of serious effluent related impacts (e.g. algal blooms, habitat alteration, altered nutrient budgets) that negatively impact ecosystem function.
- Sea cage: Effluent has significantly impacted the receiving environment beyond seacage boundaries AND the surrounding environment is a sensitive area AND/OR there is evidence of serious ongoing effluent related impacts (eg algal blooms, smothering of benthic habitat) that negatively impact ecosystem function.

c. Local and regional habitat impacts

Sustainable aquaculture operations do not impact sensitive or protected natural environments[23] and do not cause significant or lasting damage to habitats beyond farm boundaries.

Consider habitat impacts[24] over a time scale of 15 years pre-assessment, and whether land/site use occurs in areas already heavily modified[25]. Consider this criterion at the spatial scale of the 'area of operation[26]' (immediately below seacages, within the aquaculture lease, or around water intake or

[23] See Appendix 1 for additional guidance and definitions of 'sensitive environments'.

[24] Habitat impacts include changes to species composition, diversity, and function. Consider benthic and pelagic habitats in the coastal and marine environment.

[25] Note the following Seafood Watch guidance on habitat impact timescales: "This factor is intended to describe whether the assessed industry has maintained functionality of ecosystem services in the habitats where it operates, or has contributed to a loss of ecosystem services historically (>15 years ago), in the recent past (<15 years), or is having an ongoing impact. Fifteen years was chosen as the threshold date for 'historical' or 'recent' due to the adoption of the mission of the RAMSAR Convention by its Parties in 1999 ("the conservation and wise use of all wetlands..."). Although Ramsar is specific to wetland habitat, we would suggest that it serves as an appropriate industry-wide threshold date, after which existed a rapidly building awareness of the importance of functioning habitats and the increasing consensus that ongoing conversion of pristine habitats is unacceptable." From SFW aquaculture standard A3.2 (October 2016).

[26] Consider the scale of assessment here, and differentiate at appropriate scales (eg region, jurisdiction, species, or company)

discharges) and the 'receiving environment' (all habitats downstream of or otherwise affected by the presence of the aquaculture operation).

Green:

- The aquaculture operation does not significantly impact sensitive habitats.
- Habitat impacts are negligible in the receiving environment beyond the area of operation and unlikely to cause alteration to habitat function.
- There is negligible/minimal modification of habitats (species composition, diversity, richness etc.).
- Localised (limited to the area of operation) impacts are moderate and temporary, offset by effective, precautionary management (3d is ranked Green).
- Area of operation is new (<5yrs old) but there is a high level of confidence that aquaculture use has lower habitat impacts than previous uses (eg some agricultural uses).

Amber:

- Modification of habitats in the area of operation is apparent (species composition, diversity, etc.) but effects are localised and potentially addressed by management.
- There is evidence of impacts to habitats in the receiving environment but:
    - There is no evidence that habitat function has changed and there is evidence that the impacted habitat can recover within a reasonable time frame (<15yrs) AND
    - The affected habitats are not of environmental significance or high sensitivity AND
    - There are effective actions being implemented to recover the affected habitat.

Red:

- There is evidence that the aquaculture operation significantly impacts habitats in the receiving environment of environmental significance[27] or high sensitivity, or habitats with long recovery time (>15 years).
- There is evidence that the aquaculture operation has resulted in significant destruction of sensitive or high importance terrestrial, coastal or marine habitat.
- There is evidence of significant negative impacts to benthic habitats (hypoxia, species composition, diversity, richness etc.) in the receiving environment and management or industry actions are not effectively supporting recovery.

[27] Environmentally significant habitats include those within or protected by environmental legislation, eg World Heritage Areas, Ramsar listed wetlands, Marine Protected Areas, Indigenous Protected Areas or equivalent.

d. Management of impacts on the natural environment

Sustainable aquaculture management is robust and transparent, and fully independent from industry. It effectively monitors and manages the cumulative environmental impacts of all aquaculture operations and other industries that affect the receiving environment in a precautionary manner that effectively minimizes or offsets risk to the natural environment.

Sustainable aquaculture management allows for significant alteration of habitats and ecosystem function within the area of operation[26], but effectively minimizes such effects in the wider receiving environment.

Consider management of environmental impacts including chemical and nutrient effluent, disease, escapes and habitat effects in this criterion.

In principle, amber or red rankings for management should not penalize overall ranking for Criteria 3 if industry practice is ensuring a higher level of environmental outcomes. This is reflected in the overall ranking determination.

Green:

- The siting of the aquaculture operation is based on robust, transparent and credible Environmental Impact Assessments.
- Management comprehensively considers aquaculture operation siting with cumulative impacts of other primary industries at a regional scale.
- Management requires monitoring and reporting of environmental impacts relating to TEP species and wildlife, effluent and habitat at a scale and level of transparency that gives high confidence in the ability of management to respond to address any such impacts OR there are inadequacies in management, but the aquaculture operation employs best practice.
- Management and monitoring of impacts on the natural environment are robustly independent from industry.
- Regulation requires treatment of effluent to sewerage (for land-based operations) or comparable treatment standard to a level that is likely to add no environmentally significant impacts to the receiving environment.
- Management has demonstrable capacity to respond and mitigate effectively if impacts to the receiving environment become more than minor.
- There are potentially significant impacts to the receiving environment as a result of the aquaculture operation but effective management protections in place in the form of regional scale environmental regulation that considers cumulative impacts – supported by strong evidence - mitigates these impacts.
- Regulations are effectively enforced and there is no evidence of misreporting environmental impacts.
- Management requires consideration of impacts of the aquaculture operation on any area of special environmental significance (ie World Heritage or Ramsar Listed area, National park or IUCN I or II spatial zone) within the receiving environment AND enforcement and monitoring is effective.

Amber:

- Legitimate and credible concerns exist over the quality and/or transparency of Environmental Impact Assessments or approvals process where the aquaculture operation is expanding into new sites, but the expansion is occurring in areas that are unlikely to be environmentally sensitive.

- Farm impacts on natural environment are individually likely to be minor, but are not managed cumulatively with other primary industries impacting the receiving environment.
- Management and monitoring of wildlife and wild fishery impacts occurs, but there are concerns about whether programs are adequately independent from industry.
- There are some inadequacies in regulatory enforcement, and evidence of historic (5-10 years pre-assessment) misreporting of environmental data requirements, but there is no evidence of significant resultant environmental impacts.
- Management has been demonstrably responsive if recent (≤5 years pre-assessment) impacts to the receiving environment become more than minor but there are concerns or limitations around effectiveness of mitigation requirements.
- Monitoring and reporting of environmental impacts is not required at sufficient scale or transparency to minimize risk to the receiving environment AND there is no evidence of significant resultant environmental impacts.
- There are significant impacts to the receiving environment as a result of the aquaculture operation but there are significant management protections in place that consider regional scale and cumulative impacts that partially – supported by strong evidence - offset or mitigate these impacts.
- There is some baseline monitoring of potentially impacted environmental values established where aquaculture operations expand into new areas but these plans are not comprehensive and there are concerns about their effectiveness.

Red:

- Inadequacies exist in management of Environmental Impact Assessments or approvals process where the aquaculture operation is expanding into new sites AND this creates significant potential for serious environmental impacts in the receiving environment.
- Management has demonstrably and recently (≤5 years pre-assessment) failed to respond in a timely or effective manner when impacts to the receiving environment have been more than minor.
- Management does not require transparent disclosure of chemical usage.
- Monitoring and reporting of environmental impacts relating to effluent and habitat impacts is not required at sufficient scale or transparency to minimize risk to the receiving environment, AND there is evidence of significant resultant environmental impacts.
- Management has failed to be adequately precautionary relative to the environmental values of habitats in the receiving environment.
- There are significant impacts to the receiving environment as a result of the aquaculture operation and management actions to offset or mitigate these impacts are likely ineffective.
- There are inadequacies in regulatory enforcement, and evidence of recent (≤5 years pre-assessment) misreporting of environmental data requirements AND there is evidence of significant resultant environmental impacts.
- There is no, or ineffective, baseline monitoring of potentially impacted environmental values established where aquaculture operations expand into new areas.

- Management allows the aquaculture operation to impact an area of special environmental significance (i.e. World Heritage or Ramsar Listed area, National park or IUCN Category I or II zone) AND/OR does not require effective monitoring of impacts on such areas.

e. Overall ranking determination – impacts on the natural environment

Do not consider ranking in Criteria 3d if 3a, 3b and 3c are all ranked green

<table>
<tr><th>Overall Ranking</th><th>Subcriterion 3a</th><th>Subcriterion 3b</th><th>Subcriterion 3c</th><th>Subcriterion 3d</th></tr>
<tr><td rowspan="5">Green</td><td colspan="3">Green</td><td>N/A</td></tr>
<tr><td>Green</td><td>Amber</td><td>Green</td><td rowspan="3">Green or Amber</td></tr>
<tr><td colspan="2">Green</td><td>Amber</td></tr>
<tr><td>Amber</td><td colspan="2">Green</td></tr>
<tr><td colspan="3">One Green, others Amber</td><td>Green</td></tr>
<tr><td rowspan="4">Amber</td><td>Green or Amber</td><td>Amber</td><td>Green or Amber</td><td rowspan="3">Any</td></tr>
<tr><td>Amber</td><td colspan="2">Green or Amber</td></tr>
<tr><td colspan="2">Green or Amber</td><td>Amber</td></tr>
<tr><td colspan="3">One Red, others Green</td><td>Green</td></tr>
<tr><td rowspan="3">Red</td><td>Red</td><td colspan="2">Any</td><td rowspan="3">Any</td></tr>
<tr><td>Any</td><td>Red</td><td>Any</td></tr>
<tr><td colspan="2">Any</td><td>Red</td></tr>
</table>

4. Final Ranking Determination

This determines the overall ranking for the Unit of Assessment that will appear in the GoodFish: Australia's Sustainable Seafood Guide; and is applied using the weightings provided in the table below.

In principle, amber or red rankings for management subcriteria (2d and 3d) should not penalize overall ranking for Criteria 2 or 3 if industry practice is ensuring a higher level of environmental outcomes. This is reflected in the overall ranking determination.

Green:

- Criterion 1 must be green
- Criterion 2 can be green or amber
- Criterion 3 must be green
- 1, 2, 3 are green, the overall rank is green.
- 1 and 3 green and 2 is amber, the overall rank is green.

Amber:

- Criterion 1 can be green or amber
- Criterion 2 can be green or amber
- Criterion 3 can be green or amber
- 1, 2, or 3 are amber, the overall rank is amber
- If 1 or 3 are amber, 2 is green or amber, the overall rank is amber

Red: If overall ranking for any of criterion 1, 2 or 3 is red, the rank is red.

Overall Ranking	Criteria 1	Criteria 2	Criteria 3
Green	Green		
	Green	Amber	Green
Amber	Amber		
	Amber	Green or Amber	Green
	Green	Green or Amber	Amber
	Amber	Green	Amber
Red	Any Red		

Appendix 1: Further guidance on sensitive environments.

If the receiving environment includes the following habitats, it should be considered a sensitive environment:

- Coastal intertidal
- Coastal/terrestrial shoreline
- Estuaries
- Tidal wetlands and forests
- Freshwater wetlands
- Seagrass/algae beds
- Freshwater lakes
- Rivers and streams
- Tropical broadleaf and mixed forests
- Critical habitats for any TEP species[28] (such as breeding, foraging, or nursery habitats)

The receiving environment should also be considered a sensitive environment if it includes areas of the following environmental significance:

- Marine Protected Areas with IUCN Category I or II zoning (or equivalent)
- World Heritage Listed (or nominated) Areas
- Ramsar sites
- Parks, such as State or National Parks with IUCN I or II zoning (or equivalent)
- Indigenous Protected Areas with IUCN Category I or II zoning (or equivalent)

Note that consideration of sensitive environments is not required where the aquaculture operation has no connection to the natural environment, and that consideration can be given to previous land uses in land-based aquaculture operations (prior to conversion to aquaculture), where the area of operation represents a less impacting activity. For example, the unit of assessment may have less impact on the receiving environment than prior uses of the site for activities such as a quarry or some horticultural/agricultural uses. In this can, a higher ranking can be awarded with robust justification.

Appendix 2: Further guidance on ranking under Criterion 1.

In the 2020 draft update to the GoodFish: Australia's Sustainable Seafood Guide Aquaculture Assessment Criteria, AMCS is trialling a new approach where, for scoring subcriteria 1a and b, a higher overall rank can be achieved in circumstances where 1b is ranked green and 1a is ranked amber or red AND there is a substantive, demonstrable improving trend in feeding efficiency in the aquaculture operation such that 1a would be likely to improve in rank two years forward (e.g. at the next assessment).

AMCS generally takes the position that our assessments capture the sustainability of a fishery or aquaculture operation based on the most recently available data, not any future commitments or intentions, such that consumers are able to choose

[28] Threatened, endangered and protected species are defined as those listed under Australian legislation (State, Territory and/or Commonwealth), international agreements (e.g. CMS, CITES) or listed as Vulnerable, Endangered or Critically Endangered on the IUCN Red List of threatened species.

between seafood options based on realised performance with regard to sustainability.

However, in this aspect of sustainability, AMCS seeks to incentivize progress and drive implementation of higher efficiency feed from trials into production practices; and to avoid penalizing diversification of the suite of species that are commercially farmed (where efficient feeding protocols are more likely to be in a developmental phase), that may currently or in future be more sustainably farmed in local growing conditions.

This is done under the justification that this approach is acceptable when a very high standard of wild fishery feed ingredient sourcing is in place; and that there is a high level of confidence that the necessary improving trend in feed efficiency is well defined and will be implemented in full production.

In order to support a higher overall score, this trend of increasing feed efficiency must be sufficient that a higher rank for 1a would likely be attained two years forward of the current assessment.

In order to provide the required level of confidence, our expectation is that the aquaculture operation should provide assessors, at least:

- Full disclosure of feed ingredients and sourcing.
- At least 3 most-recent years of production and any feed trial data relating to feed efficiency (including feed inclusion levels of wild fishery products).
- Evidence of a contractual agreement with feed suppliers to substitute wild fishery ingredients with trimmings or non-wild fishery ingredients to achieve the necessary FFER (note that trimmings are completely discounted in the calculation of FFER), and have this applied to commercial production within two years forward of the current assessment.

Any information provided by an aquaculture operation should be treated as commercial-in-confidence.

Glossary

This glossary of common terminology can be considered as definitions and guidance for assessors, and may also be used to support assessment reports.

Area of Operation. The area within or around an aquaculture operation immediately below seacages, within an aquaculture lease, around water intake or discharges, or the boundaries of a pond-based system.

Benthic. Associated with the seabed/bottom of a water body.

Biodiversity. Biological diversity; variety among living organisms, including genetic diversity, diversity within and between species, and diversity within ecosystems.

Broodstock. Broodstock are fish or shellfish cultured for the purposes of breeding in a closed-cycle production system or harvested from the wild. They are typically reared and maintained under a different regime to stock reared for production purposes, to support maximum fecundity and predictable breeding. Broodstock are also typically reared as part of selective breeding programs aimed at improving growth rates, disease resistance and other characteristics that support efficient rearing of production stock.

Closed loop aquaculture operations. The life cycle of the farmed species is contained within the farming operation and the farming process does not rely on sourcing wild broodstock/juveniles from wild capture fisheries.

Conservation-dependent species. The *Environment Protection and Biodiversity Conservation Act 1999* dictates that a native species is eligible to be included in the conservation-dependent category at a particular time if, at that time, (a) the species is the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered or critically endangered;

or (b) the following subparagraphs are satisfied: (i) the species is a species of fish; (ii) the species is the focus of a plan of management 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; (iii) the plan of management is in force under a law of the Commonwealth or of a state or territory; and (iv) cessation of the plan of management would adversely affect the conservation status of the species.

Conservative ranking. (or 'rank conservatively') A more environmentally precautionary ranking, such as *red* in place of *amber*, made in any assessment criterion or subcriterion, specifically called for where there are uncertainties or inadequacies in the data available to inform the assessment.

Ecological role. The natural trophic role of a stock within the ecosystem under consideration in an assessment.

Economic Feed Conversion Ratio (eFCR). The economic Feed Conversion Ratio (eFCR) is a measure of feed efficiency that is used for all livestock production. In this case FCR represents the number of units of 'dry' aquafeed required to produce a net unit of 'wet' fish or crustacean (including production losses, initial stocking weight, etc, where necessary).

Ecosystem. A complex of plant, animal and microorganism communities that, together with the non-living components, interact to maintain a functional unit.

Effluent (also: waste water). The discharge from an aquaculture operation, likely to contain organic, inorganic particulate and dissolved nutrients from excess feed inputs, faecal matter and any therapeutic or prophylactic treatments.

Environment Protection and Biodiversity Conservation Act 1999 **(EPBC Act).** The central piece of Commonwealth environmental legislation. It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places—defined in the EPBC Act as matters of national environmental significance. Parts 10, 13 and 13A relate specifically to aspects of fisheries.

Environmental Impact Assessments (EIAs). A process that seeks to assess the likely or possible impacts of a development or project before a decision is made as to whether or not the development or project should proceed, and if so, under what conditions.

Escapee. Farmed stock that find their way into the natural environment.

Extensive aquaculture. Extensive aquaculture is a low cost but relatively inefficient farming approach where farmed stock are produced at stocking densities that are not much higher than would occur in natural populations. There is typically low external or artificial feed inputs. Disease risks, operational costs and some environmental impacts tend to be lower, but this farming method often requires a relatively very high level of space and time per unit of production. There is also typically a low level of manipulation of the farmed species through selective breeding, genetic techniques or feeds and treatments. Intensive production is an increasing dominant farming approach.

Feed Fish Equivalency Ratio/Forage Fish Dependency Ratio (FFER/FFDR). The Forage Fish Dependency Ratio (FFDR) is a conceptual mechanism for describing the quantity of wild fish used in feeds in relation to the quantity of farmed fish produced, in fed aquaculture systems. FFDR is expressed as a ratio that takes into account the amount of fishmeal and fish oil in the feed that originates from wild stock, and is calculated on a site specific basis taking into account the (economic) Food Conversion Ratio (FCR).

Growout. There are typically three phases of aquaculture production: hatchery, nursery and growout. The growout phases involves the rearing of juvenile finfish or shellfish in their adult form until they reach a desired market adult size. The growout phase of an aquaculture operation is always assessed.

Hatchery. There are typically three phases of aquaculture production: hatchery, nursery and growout. The hatchery phase involves the rearing and maintenance of broodstock and the cultivation of eggs and larvae. There are typically very different nutritional and other operation requirements to other aquaculture production phases.

Intensive aquaculture. Intensive aquaculture is a high cost but highly efficient farming approach where farmed stock

Inorganic waste. Typically particulate inorganic effluent that includes Nitrogen, Phosporous and potentially metal components. This may derive from fertilisers, unused feed, treatments or feces.

Marine reserve/Marine park. *See MPA*

MPA/Marine Protected Area. An area closure to some or all extractive activities, established for conservation (non-fishery management) management purposes. Often implemented in network form, the most effective MPAs are designed in accordance with Comprehensive, Adequate and Representative principles, with no-take zoning at its core. MPAs may provide meaningful protection and resilience additional to fishery and other environmental management for target stocks, bycatch and protected species, and habitats and ecosystems if designed well.

Offcuts. See trimmings

Organic waste. Waste or effluent that derives from living organisms, typically including dead stock, feces, fouling, excess feed.

Pond farming. A form of aquaculture production that uses outdoor ponds or dams that may or may not be connected to the marine or freshwater natural environment for the purposes of growing out stock. Some pond farming may involve the use of cages or pens within a larger dam/artificial lake. Pond farming may use recirculating or flow through water management systems.

Precautionary approach. The precautionary approach involves the application of prudent foresight. Taking account of the uncertainties in fisheries systems and considering the need to take action with incomplete knowledge, the precautionary approach requires, inter alia: (i) consideration of the needs of future generations and avoidance of changes that are not potentially reversible; (ii) prior identification of undesirable outcomes and measures to avoid or correct them promptly; (iii) initiation of any necessary corrective measures without delay and on a timescale appropriate for the species' biology; (iv) conservation of the productive capacity of the resource where the likely impact of resource use is uncertain; (v) maintenance of harvesting and processing capacities commensurate with estimated sustainable levels of the resource and containment of these capacities when resource productivity is highly uncertain; (vi) adherence to authorized management and periodic review practices for all fishing activities; (viii) establishment of legal and institutional frameworks for fishery management within which plans are implemented to address the above points for each fishery, and (ix) appropriate placement of the burden of proof by adhering to the requirements above (modified from FAO 1996).

Ranching. or 'on-growing' operations are reliant upon sourcing broodstock or juveniles from either wild capture fisheries (e.g. southern bluefin tuna) or natural settlement of larvae (e.g. mussels).

Receiving environment. The aquatic or terrestrial environment, including benthic and pelagic habitats and their ecological communities, reasonably likely to be connected to or affected by the aquaculture operation.

Recirculating Aquaculture Systems (RAS). Recirculating aquaculture systems are indoor, tank-based systems in which fish are grown at high density under controlled environmental conditions. Generally, farmers adopt a more intensive approach (higher densities and more rigorous management) than other aquaculture production systems. Water used for production is typically filtered and treated and reused with a low level of

discharge. These aquaculture systems tend to have a relatively low impact on the natural environment, though are highly demanding in terms of infrastructure, capital and operational costs.

Sea cage farming. A form of aquaculture production that uses floating or suspended cages or pens for the purposes of growing out stock.

Tank farming. A form of aquaculture production that uses indoor tanks for the purposes of growing out stock. Tank farming often uses Recirculating Aquaculture Systems (RAS) culture methods, and typically (but not always) discharges waste water to municipal waste water treatment or agricultural secondary use, rather than to the natural environment. Tank farming is typically exempt from assessment for impacts on wildlife and the natural environment in these circumstances.

TEP species. Threatened, endangered and protected species are defined as those listed under Australian legislation (State, Territory and/or Commonwealth), international agreements (e.g. CMS, CITES) or listed as Vulnerable, Endangered or Critically Endangered on the IUCN Red List of threatened species. TEP species typically have additional management considerations (eg reporting requirements and recovery plans) relative to other species.

Threat abatement plan. Plan formalised under endangered species legislation to reduce the effects of a process that threatens a species or taxon (eg seabirds).

Trimmings. Components of an artificial aquaculture diet that are derived from processing of other wild caught or farmed fish

Wildlife. Fauna that interacts or potentially interacts with the operation of the Unit of Assessment but is not part of production. For the purposes of assessment, wildlife does not include recognized non-native pest species.