

Ecological Character Description Addendum

Gippsland Lakes Ramsar Site



Author

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We honour Elders past and present whose knowledge and wisdom has ensured the continuation of culture and traditional practices.

DEECA is committed to genuinely partnering with Victorian Traditional Owners and Victoria's Aboriginal community to progress their aspirations.



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Contents

Introduction	2
Ramsar Criteria	2
Criterion 1	2
Criterion 2	2
Criterion 4	3
Criterion 5	4
Criterion 6	4
Criterion 8	5
Critical components, processes and service	5
Additional critical component: Diversity and abundance of native fish	6
Changes to existing CPS	6
Limits of Acceptable change	9
Summary of changes to Limits of Acceptable Change	9
Revised Limits of Acceptable Change	9
Threats to ecological character	16
Changes since listing	16
References	20
Attachment 1 Fish and waterbird species list	22

Introduction

An ecological character description (ECD) was completed for the Gippsland Lakes Ramsar Site in 2010 (BMT WBM 2011). Since that time, new information has been generated for the site, which has resulted in amendments to the ECD for the Gippsland Lakes Ramsar Site. An addendum to the ECD for the Gippsland Lakes Ramsar Site was completed in 2023 to incorporate new information (Hale 2023). These amendments comprised:

- a review of the Criteria for Identifying Wetlands of International Importance (Ramsar criteria) met by the site.
- a review of identified critical components, processes and service, with an update to the critical service “supports threatened species” to reflect recent changes to species listed as threatened under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the wetland dependent species supported by the site. An additional critical component “diversity and abundance of native fish”, which replaces the previously identified critical service “fisheries resource value”.
- review and update of Limits of Acceptable Change (LAC).

In January 2024, the list of threatened species under the EPBC Act was updated for a number of shorebirds; this document reflects these changes.

Ramsar Criteria

The criteria met by the site as stated in BMT WBM (2011) have been reviewed. At the time of listing, the Gippsland Lakes Ramsar Site would have met six of the current nine criteria, and continues to do so.

Criterion 1

A wetland should be considered internationally important if it contains a representative, rare, or unique example of a natural or near-natural wetland type found within the appropriate biogeographic region.

The appropriate bioregion for the site is the south-east coast drainage division (Department of the Environment, Water, Heritage and the Arts 2008) and the site contains two waterbodies considered to be in near-natural state (Lake Tyers and Lake Reeve).

Criterion 2

A wetland should be considered internationally important if it supports vulnerable, endangered, or critically endangered species or threatened ecological communities.

This criterion is only applied to wetland dependent flora, fauna and ecological communities, and the site regularly supports one ecological community, 10 fauna and one flora species listed under the EPBC Act and / or IUCN Red List:

- Subtropical and temperate coastal saltmarsh – vulnerable ecological community
- Australasian bittern (*Botaurus poiciloptilus*) – Endangered (EPBC) and Vulnerable (IUCN)
- Australian fairy tern (*Sternula nereis nereis*) – Vulnerable (EPBC and IUCN)
- Bar-tailed godwit (*Limosa lapponica*) – Endangered (EPBC)
- Common greenshank (*Tringa nebularia*) – Endangered (EPBC)
- Hooded plover (*Thinornis rubricollis rubricollis*) – Vulnerable (EPBC and IUCN)
- Latham's snipe (*Gallinago hardwickii*) – Vulnerable (EPBC)
- Sharp-tailed sandpiper (*Calidris acuminata*) – Vulnerable (EPBC and IUCN)
- Green and golden bell frog (*Litoria aurea*) – Vulnerable (EPBC)
- Growling grass frog (*Litoria raniformis*) – Vulnerable (EPBC and IUCN)
- Australian grayling (*Prototroctes maraena*) – Vulnerable (EPBC and IUCN)

- Swamp everlasting (*Xerochrysum palustre*) – Vulnerable (EPBC)

While there are isolated records of Dwarf galaxias (*Galaxiella pusilla*) in inflowing streams (Forge and Boundary Creeks) and a single record from Sale Common in 2012 (Victorian Biodiversity Atlas) there is insufficient evidence to suggest that the Gippsland Lakes Ramsar Site regularly supports this species. This species should be considered for inclusion if more data become available. There is also a single record of an Australian painted snipe (*Rostratula australis*) from Sale Common in 1970 (Victorian Biodiversity Atlas), which is insufficient evidence to indicate the site regularly supports this species.

In addition, the original ECD for the site identified a further two threatened flora species that are listed as endangered under the EPBC Act; dwarf kerrawang (*Commersonia prostrate*) and metallic sun-orchid (*Thelymitra epipactoides*). Neither of these species are inundation dependent, with metallic sun-orchid growing in coastal heathlands, open forests and woodlands and dwarf kerrawang in a wide variety of terrestrial habitats.

Criterion 4

A wetland should be considered internationally important if it supports plant and/or animal species at a critical stage in their lifecycles, or provides refuge during adverse conditions.

The basic description of this criterion implies a number of common functions/roles that wetlands provide including supporting fauna during migration, providing drought refuge, supporting breeding and moulting in waterfowl. There are 20 species of Palaearctic migratory shorebirds, five of which are regularly supported (in two thirds of seasons) by the Gippsland Lakes Ramsar Site (Table 1). The Gippsland Lakes supports breeding of waterbirds, with 50 species of wetland dependent species recorded breeding within the site (DELWP Flora and Fauna Database; see Attachment 1). Parts of the Gippsland Lakes (Jones Bay and Roseneath wetlands) are important sites for flightless moulting waterfowl, particularly black swans. In addition, freshwater wetlands are sparse in the region, and the freshwater fringing wetlands of Sale Common and Macleod Morass are considered important drought refuges.

Table 1: Palaearctic migratory waders recorded in the Gippsland Lakes and their frequency of occurrence (percentage of years observed). The five species that the site is considered to regularly support are highlighted in bold.

Common name	Species name	JAMBA	CAMBA	ROKAMBA	Frequency of occurrence
Bar-tailed godwit	<i>Limosa lapponica</i>	X	X	X	67
Black-tailed godwit	<i>Limosa limosa</i>	X	X	X	13
Common greenshank	<i>Tringa nebularia</i>	X	X	X	72
Common sandpiper	<i>Actitis hypoleucos</i>	X	X	X	26
Curlew sandpiper	<i>Calidris ferruginea</i>	X	X	X	39
Eastern curlew	<i>Numenius madagascariensis</i>	X	X	X	39
Great knot	<i>Calidris tenuirostris</i>	X	X	X	15
Grey plover	<i>Pluvialis squatarola</i>	X	X	X	13
Latham's snipe	<i>Gallinago hardwickii</i>	X	X	X	67
Lesser sand plover	<i>Charadrius mongolus</i>	X	X	X	7
Marsh sandpiper	<i>Tringa stagnatilis</i>	X	X	X	28
Pacific golden plover	<i>Pluvialis fulva</i>	X	X	X	9
Red knot	<i>Calidris canutus</i>	X	X	X	43
Red-necked stint	<i>Calidris ruficollis</i>	X	X	X	87
Ruddy turnstone	<i>Arenaria interpres</i>	X	X	X	30

Common name	Species name	JAMBA	CAMBA	ROKAMBA	Frequency of occurrence
Sanderling	<i>Calidris alba</i>	X	X	X	9
Sharp-tailed sandpiper	<i>Calidris acuminata</i>	X	X	X	87
Terek sandpiper	<i>Xenus cinereus</i>	X	X	X	37
Whimbrel	<i>Numenius phaeopus</i>	X	X	X	15
Wood sandpiper	<i>Tringa glareola</i>	X	X	X	4

Criterion 5

A wetland should be considered internationally important if it regularly supports 20,000 or more waterbirds.

Guidance from the Convention on the definition of “regularly” is as follows:

(Criteria 5 & 6) - as in supports regularly - a wetland regularly supports a population of a given size if:

- the requisite number of birds is known to have occurred in two thirds of the seasons for which adequate data are available, the total number of seasons being not less than three; or
- the mean of the maxima of those seasons in which the site is internationally important, taken over at least five years, amounts to the required level (means based on three or four years may be quoted in provisional assessments only).

Survey effort for waterbirds across the Gippsland Lakes has varied considerably over time. Annual total waterbird abundance has ranged from < 1000 to almost 80,000 individuals (Figure 1). Despite the lack of survey data in some years, there is good evidence to support the assertion that the Ramsar site regularly supports > 20,000 waterbirds annually. Maximum annual abundance in the past 15 years (2007 to 2021) has been > 20,000 in 13 years (87% of years). The average annual abundance (1975 to 2021) was 25,863.

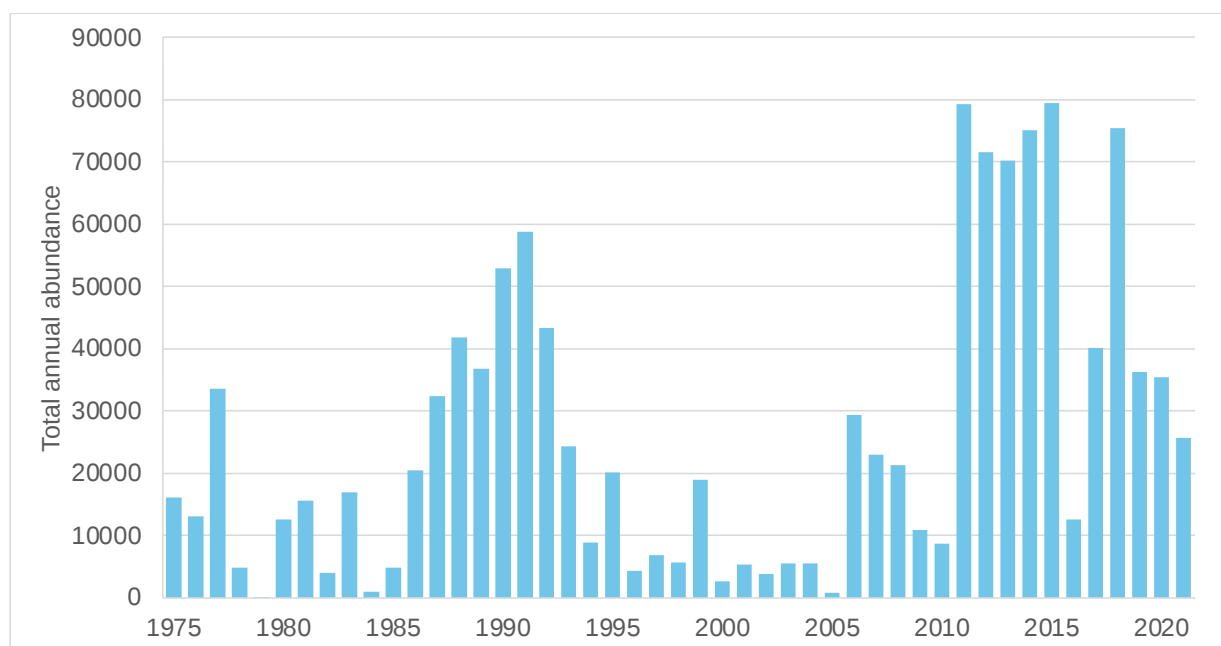


Figure 1: Annual maximum abundance of waterbirds in the Gippsland Lakes from 1975 to 2021 (data from Atlas of Living Australia, BirdLife Australia, Field and Game Australia).

Criterion 6

A wetland should be considered internationally important if it regularly supports 1% of the individuals in a population of one species or subspecies of waterbird.

Assessment of this criterion is made using the most recent official population estimates (Wetlands International 2012). Data pooled from all sources (Atlas of Living Australia, BirdLife Australia, Field and Game Australia), indicate that three species meet this criterion (Table 2).

Table 2: Species for which Gippsland Lakes regularly supported > 1% of the population over the 1975 – 2021 period (using Wetlands International 2012 estimates).

Common name	Species name	Mean max. annual count	Pop. estimate	% of pop.
		1975-2021		1975-2021
Australian fairy tern	<i>Sternula nereis nereis</i>	38	1500	2.5
Chestnut teal	<i>Anas castanea</i>	3527	100000	3.5
Little tern	<i>Sternula albifrons</i>	144	10000	1.4

Criterion 8

A wetland should be considered internationally important if it is an important source of food for fishes, spawning ground, nursery and/or migration path on which fish stocks, either within the wetland or elsewhere, depend.

The Gippsland Lakes is a recognised important recreational fishery and supports one of the largest fisheries of black bream in the State, accounting for 90 percent of the total catch (Department of Primary Industries 2011). The seagrass and other habitats within the lakes act as important nursery habitat for a range of fish and crustacean species (Warry and Hindell 2012). There is evidence that populations of black bream (and other fish species) are correlated with the extent and condition of seagrass in the Gippsland Lakes (Morison et al. 1998).

In addition, the Gippsland Lakes supports several diadromous fish species including the threatened Australian grayling, with the Lakes providing a migratory route between inland freshwater habitats and the ocean (see Attachment 1).

Critical components, processes and services

The Gippsland Lakes Ecological Character Description (ECD) identified eight components, two processes and two services that are critical to the ecological character of the Ramsar site. Detailed descriptions of these critical CPS can be found in that ECD (BMT WBM 2011):

- Marine subtidal aquatic beds (seagrass) - ECD section 3.3.1
- Coastal brackish or saline lagoons - ECD section 3.3.2
- Fringing wetlands (predominantly freshwater) - ECD section 3.3.3
- Fringing wetlands (brackish) - ECD section 3.3.4
- Fringing wetlands (saltmarsh / hypersaline) - ECD section 3.3.5
- Abundance and diversity of waterbirds - ECD section 3.4.1
- Threatened species – updated in this ECD Addenda (see below and original description in ECD sections 3.4.2, 3.4.3 and 3.8.1)
- Hydrological regime – ECD section 3.6.1
- Waterbird breeding – ECD section 3.6.2
- Fisheries resource value – replaced by the critical component “abundance and diversity of native fish (see below).

There is evidence to support the identification of an additional critical component “diversity and abundance of native fish” (see section 3.1). In addition, changes to the listed threatened species under the EPBC Act, have resulted in an update of the critical service: “Maintaining threatened species” (see section 3.2).

Additional critical component: Diversity and abundance of native fish

The ECD currently only recognises the service “fisheries resource value” with respect to native fish within the site. However, there is evidence that the Gippsland Lakes support an abundance and diversity of native fish in addition to commercially and recreationally important species (Warry and Hindell 2012). Over 230 species of fish have been recorded within the Gippsland Lakes (Hindell, DELWP, Friends of Beware Reef, unpublished data) spanning a wide range of life cycles (see Attachment 1).

Fish species within the Gippsland Lakes Ramsar Site are distributed according to their salinity tolerances. A number of freshwater native fish species occur in the freshwater and fresher of the variably saline fringing wetlands as well as the lower reaches of the rivers within the Ramsar site. This includes resident species that spend their entire lives within freshwater environments such as river blackfish (*Gadopsis marmoratus*); but more common are species that rely on the connection between freshwater and estuarine or marine environments to complete parts of their life cycles. This includes species such as shortfin eels (*Anguilla australis*) and longfin eels (*Anguilla reinhardtii*) which live the majority of their lives in freshwater environments before migrating to the sea to breed and die, with young returning to freshwater; and species such as pouched lamprey (*Geotria australis*) that live the majority of their lives in marine environments, migrating to freshwater environments to breed.

There are a small number of estuarine resident fish species within the Gippsland Lakes such as river garfish (*Hyporhamphus regularis*), estuary perch (*Macquaria colonorum*) and black bream (*Acanthopagrus butcheri*) that reside in the estuarine areas of the site (including the large coastal lagoons).

The majority of species are either estuarine opportunists or marine stragglers. These species stay in the lower to mid zones of the Lakes (utilising marine habitats such as seagrass) until conditions become too fresh. Their use of the Lakes is largely dependent on the extent of higher salinity conditions and these species will be displaced from the Lakes during high freshwater inflows. This group includes conservation significant species groups such as pipefish seahorses and dragons as well as larger species such as wrasse, cod and dory.

Justification for inclusion as a critical component against the criteria provided in the framework for describing the ecological character of Ramsar sites (Department of the Environment, Water, Heritage and the Arts 2008):

1. Important determinants of the sites unique character.

Native fish are important in terms of biodiversity and also support the beneficial uses and values of the Ramsar site. Fish are distributed across multiple wetland types according to their salinity preferences and display a large diversity and life history strategies.

2. Important for supporting the Ramsar criteria under which the site was listed.

Native fish contribute to the site meeting criteria 2 (with the vulnerable Australian grayling); 4 (with respect to migration of fish between freshwater, estuarine and marine environments to complete breeding) and 8.

3. Change is reasonably likely to occur over short to medium time scales (less than 100 years).

Native fish are sensitive to a number of pressures and stressors within the Ramsar site. The Gippsland Lakes Ramsar Site Management Plan (East Gippsland CMA 2015) indicated high risks to native fish associated with introduced marine pests, pest freshwater species (carp and gambusia), altered freshwater inflows resulting in salinity changes and nutrients and sediments from the catchment.

4. Will cause significant negative consequences if change occurs.

Native fish species are important to the site in terms of biodiversity and supporting ecosystem services related to indigenous cultural values, tourism and recreation. They are an important food source for piscivorous birds.

Changes to existing CPS

Two species of threatened flora; dwarf kerrawang and metallic sun-orchids are not inundation dependent and therefore not critical to the ecological character of the Ramsar site. Recent additions to the list of threatened species in Australia have resulted in six species of bird being added to the critical service “supports threatened species”.

Australian fairy tern (*Sternula nereis nereis*) is an Australian resident, fish eating bird species. They feed close inshore upon small schooling fish and in the Ramsar site, anchovies and pilchards are likely to comprise the majority of their diet. They breed on sand beaches within the Ramsar site in a scrape in the ground, suitable habitat devoid of dense vegetation is essential (Higgins and Davies 1996).

There has been consistent monitoring of fairy tern abundance and breeding in recent years, with the site supporting greater than 1% of the population, and in the past five years over 10% of the population of this species (Figure 2). The greatest abundance and most common breeding locations are on Crescent and Albifrons Islands (Sullivan 2020).

Hooded plover (*Thinornis rubricollis*) is an Australian resident, invertebrate eating bird species. Although its breeding habitat is largely outside the Ramsar site along the ocean beach, there are moderate numbers of adults roosting and foraging in the Ramsar site and a small number of nests recorded each year (Figure 3).

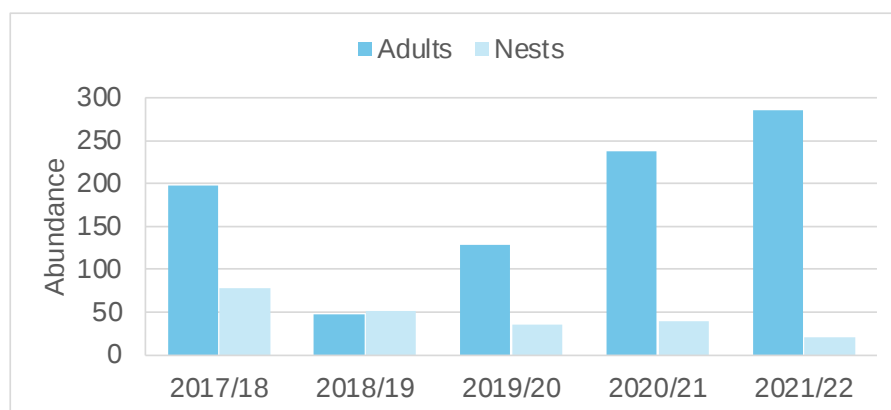


Figure 2: Number of fairy terns and nests in the Gippsland Lakes from 2017/18 to 2021/22 (data from BirdLife Australia).

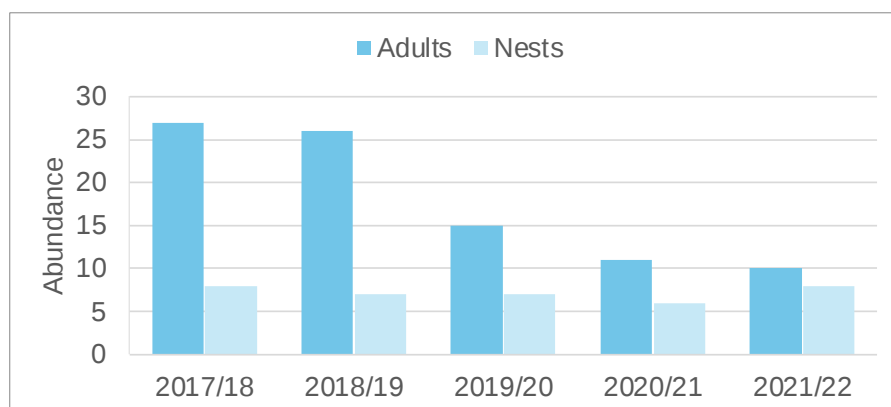


Figure 3: Number of hooded plovers and nests in the Gippsland Lakes from 2017/18 to 2021/22 (data from BirdLife Australia).

Migratory shorebirds

The Ramsar site regularly supports four threatened species from the East Asian-Australasian Flyway:

- Bar-tailed godwit (*Limosa lapponica*) – Endangered (EPBC)
- Common greenshank (*Tringa nebularia*) – Endangered (EPBC)
- Latham's snipe (*Gallinago hardwickii*) – Vulnerable (EPBC)
- Sharp-tailed sandpiper (*Calidris acuminata*) – Vulnerable (EPBC and IUCN)

These international migratory species spend the non-breeding season in the southern hemisphere. They arrive in late spring, spend the summer feeding on invertebrates in intertidal mudflats, saltmarsh and in the shallow margins of freshwater wetlands and depart for the northern hemisphere in February to March. Juveniles bar-tailed godwit who arrive in the Ramsar site spend their first one or two winters here before heading to the northern hemisphere to breed (Higgins and Davies 1996). Overwintering is rare in sharp-tailed sandpiper and Latham's snipe, with most birds departing Australia for northern hemisphere breeding

grounds regardless of age. There is some evidence that common greenshanks that remain in Australia over winter do so at a few select sites (Alcorn 1988).

All four species are regularly observed in the site (greater than two-thirds of years) but their abundance is highly variable. Bar-tailed godwit, common greenshank and Latham's snipe are typically recorded in low numbers (< 30 individuals). There are occasional records of larger numbers of sharp-tailed sandpiper within the Ramsar site boundary and several records of > 1% of the population (2015, 2006, 2003), but the site does not regularly support significant numbers of this species.

The original ECD for the Gippsland Lakes Ramsar Site listed Australian painted snipe (*Rostratula australis*) as a threatened species supported by the Ramsar site. There is only a single record of the species from within the site boundary, at Sale Common in 1970. The site does not "regularly support" this species and it should not be considered critical to the character of the Gippsland Lakes Ramsar Site.

Limits of Acceptable change

Summary of changes to Limits of Acceptable Change

LAC for the Gippsland Lakes Ramsar Site were reviewed with site managers and relevant technical experts. LAC fell into one of four categories:

1. No change
 - Phytoplankton blooms in main lakes
 - Threatened wetland flora
2. Change to wording to make the LAC more easily assessable, but numerical limit remains unchanged
 - Seagrass
3. New information resulted in a refinement / significant change to the LAC
 - Coastal brackish or saline lagoons (Lake Wellington)
 - Salinity in Dowds Morass
 - Vegetation in freshwater and brackish wetlands
 - Saltmarsh
 - Waterbirds (abundance and breeding)
 - Hydrological regime
 - Threatened species
4. Newly identified critical CPS required derivation of new LAC
 - Diversity of native fish

Revised Limits of Acceptable Change

The revised LAC are set out in Table 3.

Confidence levels have been reviewed for revised LAC (2 and 4 above). These are assigned as follows:

- High – Quantitative site-specific data; good understanding linking the indicator to the ecological character of the site; LAC is objectively measurable.
- Medium – Some site-specific data or strong evidence for similar systems elsewhere derived from the scientific literature; or informed expert opinion; LAC is objectively measurable.
- Low – No site-specific data or reliable evidence from the scientific literature or expert opinion, LAC may not be objectively measurable and/or the importance of the indicator to the ecological character of the site is unknown.

Table 3: Revised LAC for the Gippsland Lakes Ramsar Site

Critical CPS	Existing LAC	Evidence	Revised LAC	Confidence
C1 Marine subtidal aquatic beds	Total seagrass extent will not decline by greater than 50 percent of the baseline value of Roob and Ball (1997) (that is, by more than 2165 hectares) in two successive decades at a whole of site scale. Total mapped extent of dense and moderate <i>Zostera</i> will not decline by greater than 80 percent of the baseline values determined by Roob and Ball (1997) in two successive decades at any of the following locations: Fraser Island, Point Fullerton, Lake King, Point King, Raymond Island, Lake King, Gorcrow Point – Steel Bay, Lake Victoria, Waddy Island, Lake Victoria.	The wording of the original LAC is somewhat ambiguous and requires looking up the original data in Roob and Ball (1997). The updated LAC simply reflects a change in wording to make the LAC more easily assessed against.	Total seagrass extent will not decline below 2000 hectares for a period of greater than 20 continuous years. Greater than 15 percent of the total seagrass extent will have a density of “medium” or “dense”.	High
C2 Coastal brackish or saline lagoons	Long-term: No change in wetland typology from the 1994 classification. A long-term change in ecosystem state at Lake King, Lake Victoria or Lake Tyers from relatively clear, seagrass dominated estuarine lagoons to turbid, algae dominated system (characteristic of Lake Wellington) will represent a change in ecological character. Short-term: No single cyanobacteria algal bloom event will cover greater than 10 percent of the combined area of coastal brackish/saline lagoons (that is, Lake King, Victoria, Wellington and Tyers) in two successive years.	While the majority of the existing LAC are appropriate, the first sentence “No change in wetland typology from the 1994 classification” is problematic. The 1994 classification was based on a system described by Corrick and Norman (1980). Under this system, Lakes Victoria, King and Tyers were classified as permanent, saline lakes and Lake Wellington as a permanent freshwater lake. It appear that Lake Wellington was mis-classified as the definition of “freshwater” was for conditions < 3 ppt throughout the year (Department of Environment, Land, Water and Planning 2014). There is modelled and measured evidence that Lake Wellington around the time of listing fluctuated in salinity between < 1 ppt and > 20 ppt. According to the new Victorian Wetland Classification, Lakes King, Victoria, Wellington and Tyers are all classified as “permanent saline lakes”. To avoid confusion, reference to the 1994 classification has been removed from the LAC.	A long-term change in ecosystem state at Lake King, Lake Victoria or Lake Tyers from relatively clear, seagrass dominated estuarine lagoons to turbid, algae dominated system (characteristic of Lake Wellington) will represent a change in ecological character. No single cyanobacteria algal bloom event will cover greater than 10 percent of the combined area of coastal brackish/saline lagoons (that is, Lake King, Victoria, Wellington and Tyers) in two successive years.	Medium

Critical CPS	Existing LAC	Evidence	Revised LAC	Confidence
C3 Freshwater wetlands	Long-term: The total mapped area of freshwater marshes (shrubs and reed wetland types) at Sale Common and Macleod Morass will not decline by greater than 50 percent of the baseline value for 1980 (that is, 50 percent of 402 hectares = 201 hectares) in two successive decades. Short-term: In existing freshwater wetland areas, the annual median salinity should not be > 1 ppt in two successive years.	Recent mapping of vegetation from Sale Common indicates that a mosaic of habitat is present at the site (Frood et al. 2015) and historical evidence indicates this was also the case at the time of listing. The three dominant habitat types are: 45 – 50% open water; 20 – 25% freshwater emergent native vegetation (sedges, rushes and reeds) and 20 % woody vegetation (swamp scrub and floodplain woodland). At Macleod Morass there is also a mosaic comprising of 20 – 30% open water, 40 – 55% freshwater emergent macrophytes and a smaller area of swamp scrub (Hale and Brooks 2020). The balance between emergent vegetation and open water in both wetlands fluctuates seasonally and over longer climatic cycles (Brooks and Hale 2021a). A LAC that accounts for the mosaic of habitat types is required as sustained dominance of one vegetation type or open water would constitute a change in character.	A habitat mosaic will be maintained at Sale Common and Macleod Morass that comprises open water, freshwater emergent native vegetation (sedges, rushes and reeds) and woody vegetation (swamp scrub and floodplain woodland), with no habitat comprising more than 70 percent of the total wetland area for more than five successive years. In existing freshwater wetland areas (Sale Common and the upper portion of MacLeod Morass), the annual median salinity should not be > 1 ppt in two successive years.	High

Critical CPS	Existing LAC	Evidence	Revised LAC	Confidence
C4 Brackish wetlands	Long-term: The total area of common reed at Dowd Morass will not decline by greater than 50 percent of the 1982 baseline value (that is not less than 245 hectares) in two successive decades. Short-term: The annual median salinity will be < 4 ppt in five successive years.	At the time of listing (1982) it is estimated that Dowd Morass contained approximately 400 hectares of swamp paperbark and 450 hectares of common reed, based on mapping from historical imagery (Boon et al. 2007). Noting that these figures include the entire wetland and not just the portion that was in the Ramsar site. Recent mapping indicates that the entire wetland contains 430 hectares of common reed and 400 hectares of swamp paperbark (Frood et al. 2015), suggesting that the area of these two vegetation communities has not changed significantly despite earlier concerns. The LAC should represent only the portion of Dowd Morass in the Ramsar site boundary, which is currently 320 hectares of common reed, 230 hectares of swamp paperbark and 260 hectares of open water. The site is characterised by a mosaic of habitats and a change in ecological character would represent the permanent loss or dominance of one habitat. Salinity in Dowd Morass, however, is highly variable over seasonal and longer climatic cycles. These changes in salinity are a characteristic of the wetland, and a LAC for salinity is therefore not justified.	A habitat mosaic will be maintained at Dowd Morass that comprises open water, common reed and swamp paperbark, with no habitat comprising more than 70 percent of the total wetland area for more than five successive years.	High
C5 Saltmarsh	Medium-term: The total mapped area of salt flat, saltpan and salt meadow habitat at Lake Reeve Reserve will not decline by greater than 50 percent of the baseline value outlined in VMCS for 1980 (that is, 50 percent of 5035 hectares = 2517 hectares) in two successive decades.	The original LAC included bare salt affected ground. Coastal saltmarsh is now listed as a vulnerable ecological community under the EPBC Act and it is the area of vegetation that is a critical component of the ecological character of the Ramsar site. More recent mapping of saltmarsh indicates that there is around 4780 hectares of saltmarsh vegetation communities within the entire Ramsar site. There is no indication that the area of saltmarsh within the Ramsar site has changed since listing (Boon et al. 2011). Saltmarsh is a community that is known to be slow to recover from disturbance and a 25 percent decline was considered by site managers to be a more realistic LAC. LAC for condition of saltmarsh is also desirable and Boon et al. (2011) suggested EVC benchmarks for the community. However, there is no benchmark of condition against which change could be assessed.	Total saltmarsh extent across the entire Ramsar site will not decline below 3585 hectares.	Medium

Critical CPS	Existing LAC	Evidence	Revised LAC	Confidence
C6 Abundance & diversity of waterbirds	The number of standard 20 minute searches (within any ten year period) where waterbird abundance is less than 50 individuals will not fall below 50 per cent of the 'baseline' value (based on Birds Australia count data – 1987-2010), for the following species: black swan = 15 percent of surveys chestnut teal = 10 percent of surveys Eurasian coot = 11 percent of surveys. The absence of records in any of the following species in five successive years will represent a change in character: red-necked stint, sharp-tailed sandpiper, black swan, chestnut teal, fairy tern, little tern, musk duck, Australasian grebe, grey teal, Eurasian coot, great cormorant, red knot, curlew sandpiper.	Assessment against the current LAC is difficult as number of surveys is often not known. A LAC based on abundance of waterbirds in functional groups would be desirable as this allows for potential causes of declines due to habitat or food sources to be considered. In order to ensure that the LAC is assessing conditions at the site and not broader impacts to populations, the LAC is expressed in terms of percentage of population, rather than absolute numbers. Indicator species have been selected for major functional groups (with the exception of migratory waders, for which there is no consistent count data prior to the shorebirds 2020 program commencing in 2010). Conditions at the time of listing are based on counts from 1987 to 1991 (when regular counts across many wetlands in the Ramsar site were conducted; DELWP flora and fauna database). LAC is based on a 50% change from baseline conditions.	Mean maximum counts (calculated over a minimum of five years) will not drop below the following population thresholds (Wetlands International relevant population): Black swan = 0.3% Chestnut teal (ducks) – 2.5% Eurasian coot (coots & rails) – 0.15% Fairy tern (terns) – 1.5% Little tern (terns) – 0.5% Little black cormorant (fishers) – 0.01% Straw-necked ibis (large wading) – 0.05%	Medium
C7 Threatened frog species	Insufficient data to develop a LAC for this critical component, nor to assess changes in populations over time.	During the development of the management plan for the site in 2015, expert opinion was used to set resource condition targets (RCTs) for the threatened frog species (Jim Reside, personal communication): "Green and golden bell frog and growling grass frog are recorded at Dutson Downs, Heart Morass, Clydebank Morass, Dowd Morass, Macleod Morass within a five- year period. Successful breeding of green and golden bell frog and growling grass frog at a minimum of five sites in any five-year period, as evidenced by tadpoles and juveniles." RCTs are aspirational targets and used to assess the effectiveness of management actions. A LAC should be set at a level below an RCT and this has formed the basis for the LAC.	Green and golden bell frog and growling grass frog are recorded breeding in at least one location within the Ramsar site every five years.	Low

Critical CPS	Existing LAC	Evidence	Revised LAC	Confidence
C8 Threatened wetland flora species	The three threatened flora species (<i>Rulingia prostrata</i> , <i>Thelymitra epipactoides</i> and <i>Xerochrysum palustre</i>) continue to be supported within the boundaries of the Gippsland Lakes Ramsar Site.	Two of these species (<i>Rulingia prostrata</i> and <i>Thelymitra epipactoides</i>) are not inundation dependent and are found growing in terrestrial habitats (Carter and Walsh 2010, and http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=11896). Swamp everlasting, remains critical to the character of the Ramsar site.	The threatened flora species swamp everlasting (<i>Xerochrysum palustre</i>) continues to be supported within the boundaries of the Gippsland Lakes Ramsar Site	Moderate
C9 Native fish diversity and abundance	Not identified as a critical CPS so no LAC was developed.	The current ECD only contains LAC for the indicator recreational and commercial species black bream. The diversity of native fish at the site is, however, high; but only a portion of the total species is ever captured in monitoring surveys and this is highly dependent on the selection of sampling equipment (Warry and Hindell 2012). There is insufficient data to set a quantitative LAC in terms of diversity or abundance and so an interim qualitative LAC has been established based on representatives from different life history strategies.	Native fish within the Ramsar site will represent each of the following life history strategies: estuarine dependent, estuarine opportunists, marine migrants, diadromous and obligate freshwater species.	Low
P1 Hydrological regime	Wetland wetting frequency, flushing frequency and flushing volume are maintained as follows: Sale Common: annual wetting; flushing 2 – 3 times per decade, 4GL. Dowd Morass: Wetting 5 – 7 times per decade; flushing 2 – 3 times per decade, 15GL. Heart Morass: Wetting 5 – 7 times per decade; flushing 2 – 3 times per decade, 15GL.	This LAC is equivalent to the environmental water requirements for these three wetlands (Tilleard and Ladson 2010). These should be considered aspiration targets and are not indicative of potential thresholds of change in character. Discussions with site managers suggested that a higher threshold was required and that a permanent change of wetland type, with respect to hydrology would indicate a change in character. It was considered that the duration of dry periods (or inundation) was more important in terms of identifying change than volumes or number of wet / dry periods.	Sale Common shall not remain dry for more than 36 continuous months. Dowd and Heart Morass shall not remain dry for greater than 60 continuous months.	Medium

Critical CPS	Existing LAC	Evidence	Revised LAC	Confidence
P2 Waterbird breeding	Abandonment or significant decline (greater than 50 per cent) in the productivity of two or more representative breeding sites (based on two sampling episodes over a five-year period) within any of the following site groupings: Lake Coleman, Tucker Swamp and Albifrons Island - Australian pelican. Bunga Arm and Lake Tyers – little tern and fairy tern. Macleod Morass, Sale Common and Dowd Morass – black swan, Australian white ibis, straw-necked ibis, little black cormorant and royal spoonbill.	Quantitative breeding records from within the site are only available for Australian fairy tern. Evidence from Western Port indicates that these species can be highly variable in terms of breeding with individuals using the same site for many consecutive years then being absent for periods of years (Lacey and O'Brien 2015). LAC is based on sustained absence of breeding in species that are known to breed regularly within the site.	Successful breeding of all of the following indicator species within the Ramsar site at least once every five years: Australian fairy tern, Australian white ibis, Australian pelican, black swan, chestnut teal, little black cormorant, little tern and royal spoonbill.	Low
S1 Maintaining threatened species	Australian grayling continues to be supported in one or more of the catchments draining into the Gippsland Lakes.	LAC for C6, C7 and C8 above adequately cover Australian fairy tern, threatened frog species and threatened flora. The Australian grayling passes through the Ramsar site as part of its lifecycle but is unlikely to be easily detectable within the Ramsar site during these brief periods of migration. The current LAC for this species is adequate. There is insufficient data to set a quantitative LAC for other threatened bird species that are regularly observed in the site. Therefore, a LAC based on presence / absence only is proposed.	Presence of the following threatened bird species within the Gippsland Lakes Ramsar Site annually: • Australasian bittern • Hooded plover • Sharp-tailed sandpiper in two thirds of years: • Bar-tailed godwit • Common greenshank • Latham's snipe LAC for Australian grayling remains unchanged: Australian grayling continues to be supported in one or more of the catchments draining into the Gippsland Lakes.	Medium

Threats to ecological character

The 2011 ECD and the 2015 management plan for the Gippsland Lakes Ramsar Site (East Gippsland CMA 2015) contains a comprehensive risk assessment and identification of priority threats for management. DELWP reassessed threats at the site in 2016 as part of an assessment of ecological character status. No additional threats beyond those identified in the 2015 management plan have been identified. Details on threats to the site can be found in the section 5 of the management plan (East Gippsland CMA 2015).

Changes since listing

The results of a 2022 assessment of the status of the critical CPS against the updated LAC is set out in Table 4.

All of the LAC for the Gippsland Lakes Ramsar Site are met (or likely met). There was insufficient data to assess the salinity LAC for Sale Common. A water quality meter, however, was installed in 2022 and future assessments against LAC will be possible.

Table 4: Summary of assessment against LAC for the Gippsland Lakes Ramsar Site

Critical CPS	Limit of Acceptable Change	Assessment
C1 Marine subtidal aquatic beds (seagrass / aquatic plants)	Total seagrass extent will not decline below 2000 hectares for a period of greater than 20 continuous years. Greater than 15 percent of the total seagrass extent will have a density of "medium" or "dense".	Between 2017 and 2021, total extent of seagrass ranged from 2235 to 2854 hectares, with 32 to 38% occurring as dense patches (Brooks and Hale 2021b). LAC is met.
C2 Coastal brackish or saline lagoons (open water phytoplankton dominated habitats)	Long-term: A long-term change in ecosystem state at Lake King, Lake Victoria or Lake Tyers from relatively clear, seagrass dominated estuarine lagoons to turbid, algae dominated system (characteristic of Lake Wellington) will represent a change in ecological character.	Lakes King and Victoria have remained seagrass dominated. Lake Tyers estuary has opened several times in the past two years (June 2021; September 2021; April 2022); with anecdotal reports of changes from tannin stained water to clear "blue" water conditions when the system is open and tidal (http://www.laketyersbeach.net.au/index.html)

Critical CPS	Limit of Acceptable Change	Assessment
	Short-term: No single cyanobacteria algal bloom event will cover greater than 10 percent of the combined area of coastal brackish/saline lagoons (that is, Lake King, Victoria, Wellington and Tyers) in two successive years.	Blooms have been defined as an algal level of “high” as indicated by DEECA phytoplankton monitoring (https://www.water.vic.gov.au/waterways-and-catchments/rivers-estuaries-and-waterways/blue-green-algae). There have been nine algal blooms in the main lakes in the past two decades; 2001/02 to 2020/21: • 2001/02 – <i>Nodularia</i> • 2007/08 – <i>Synechococcus</i> • 2010/11 – <i>Nodularia</i> • 2011/12 – <i>Nodularia</i> • 2015/16 – <i>Pseudo-nitzschia</i> • 2017/18 – <i>Synechococcus</i> • 2018/19 – <i>Nodularia</i> • 2019/20 – <i>Nodularia</i> and <i>Synechococcus</i> • 2021/22 – <i>Nodularia</i> and <i>Microcystis</i> There were successive blue-green algal blooms in the lakes in 2010/11 and 2011/12; and in the three years from 2017/18 to 2019/20. The extent of the algal blooms is difficult to determine, but it is likely that the <i>Nodularia</i> bloom in 2010/11 covered greater than 10 percent of the main lakes. The bloom in 2011/12 was, however, smaller as was the 2017/18 bloom. The <i>Nodularia</i> bloom in March 2019 was localised to around Marley Point, but the March 2020 <i>Synechococcus</i> bloom was widespread and likely covered more than 10% of the system as did the bloom in 2022. There have therefore been several blooms that covered more than 10% of the Lakes in the past two decades, but not in successive years. LAC is met.
C3 Freshwater wetlands	Long-term: A habitat mosaic will be maintained at Sale Common and Macleod Morass that comprises open water, freshwater emergent native vegetation (sedges, rushes and reeds) and woody vegetation (swamp scrub and floodplain woodland), with no habitat comprising more than 70 percent of the total wetland area for more than five successive years.	Mapping for MacLeod Morass in May 2020 indicates: 24% open water; 50% emergent native vegetation (shallow marsh and reedbed); and 12% woody vegetation (Brooks and Hale 2021a). The mapping for Sale Common indicates a difference between the wet phase in 2016 and drier conditions in 2019. The LAC, however, is met on both occasions (Hale and Brooks 2020, Brooks and Hale 2021a): • Open water – 51% in 2016; 9% in 2020 • Native emergent vegetation – 16% in 2016; 47% in 2020 • Woody vegetation – 29% at both time frames LAC is met.
	In existing freshwater wetland areas, the annual median salinity should not be > 1 ppt in two successive years.	Water quality data from Sale Common is limited with spot Waterwatch data most recently collected in 2017. Salinity at that time remained less than 1 ppt. Median salinity in the upper MacLeod Morass (2020-21) was 0.17 ppt (data from the Water measurement information system). LAC is met from MacLeod Morass. Insufficient data to assess LAC for Sale Common.

Critical CPS	Limit of Acceptable Change	Assessment
C4 Brackish wetlands	Long-term: A habitat mosaic will be maintained at Dowd Morass that comprises open water, common reed and swamp paperbark, with no habitat comprising more than 70 percent of the total wetland area for more than five successive years.	Mapping for Dowd Morass in July 2020 indicates: 37% open water; 27% emergent native vegetation (shallow marsh and reedbed); and 31% woody vegetation (Brooks and Hale 2021a). LAC is met.
C5 Saltmarsh	Total saltmarsh extent across the entire Ramsar site will not decline below 3585 hectares.	Total extent of saltmarsh in 2021 was 4924 hectares (calculated from mapping in Brooks and Hale 2021b). LAC is met.
C6 Abundance & diversity of waterbirds	Mean maximum counts (calculated over a minimum of five years) will not drop below the following population thresholds: - Black swan = 0.3% - Chestnut teal (ducks) – 2.5% - Eurasian coot (coots & rails) – 0.15% - Fairy tern (terns) – 1.5% - Little tern (terns) – 0.5% - Little black cormorant (fishers) – 0.01% - Straw-necked ibis (large wading) – 0.05%	Data pooled from multiple sources (GLCC BirdLife monthly counts, Field and Game Australia counts, Atlas of Living Australia, DELWP Summer Waterfowl Counts) indicate the following five-year averages (2017/18 – 2020/21): - Black swan = 3000 (0.3%) - Chestnut teal (ducks) = 4547 (4.5%) - Eurasian coot (coots & rails) = 8255 (0.8%) - Fairy tern (terns) = 180 (12%) - Little tern (terns) = 113 (1.1%) - Little black cormorant (fishers) = 1138 (1.1%) Straw-necked ibis (large wading) = 3412 (0.3%). LAC is met.
C7 Threatened frog species	Green and golden bell frog and growling grass frog are recorded breeding at least one location within the Ramsar site every five years.	Green and golden bell frog have been recorded breeding in Heart Morass in 2021 and growling grass frog have been recorded breeding in Clydebank Morass in 2022 (Greening Australia unpublished data). LAC is met.
C8 Threatened wetland flora species	The threatened flora species swamp everlasting (<i>Xerochrysum palustre</i>) continues to be supported within the boundaries of the Gippsland Lakes Ramsar Site.	There is a small population of the species in Blonde Bay, with over 100 individuals recorded in 2020-21 (Trust for Nature unpublished data). LAC is met.
C9 Native fish diversity and abundance	Native fish within the Ramsar site will represent each of the following life history strategies: estuarine dependent, estuarine opportunists, marine migrants, diadromous and obligate freshwater species.	Surveys by Friends of Beware Reef have recorded over 100 species of fish representing all the life history categories in surveys conducted between 2017 and 2019. LAC is met.
P1 Hydrological regime	Sale Common shall not remain dry for more than 36 continuous months. Dowd and Heart Morass shall not remain dry for greater than 60 continuous months.	Heart and Dowd Morass were inundated annually from 2016/17 to 2019/20. Sale Common was 90% inundated in 2019/20 after 18 months of being dry (Clements and Suter 2020). LAC is met.

Critical CPS	Limit of Acceptable Change	Assessment
P2 Waterbird breeding	Successful breeding of the following indicator species within the Ramsar site at least once every five years: Australian fairy tern, Australian white ibis, Australian pelican, black swan, chestnut teal, little black cormorant, little tern and royal spoonbill.	All indicator species have been recorded breeding in the Ramsar site in the past two years (GLCC waterbird monitoring; Field and Game Australia monitoring; Atlas of Living Australia): • Australian fairy tern – all five years • Australian white ibis – all five years • Australian pelican – all five years • Black swan – all five years • Chestnut teal – all five years • Little black cormorant – three years • Little tern – all five years • Royal spoonbill – all five years LAC is met.
S1 Maintaining threatened species	Australian grayling continues to be supported in one or more of the catchments draining into the Gippsland Lakes.	Australian grayling has been recorded annually in the Thomson River from 2005 to 2020 (Tonkin et al. 2020). LAC is met.
	Presence of the following threatened bird species within the Gippsland Lakes Ramsar Site annually: • Australasian bittern • Hooded plover • Sharp-tailed sandpiper in two thirds of years: • Bar-tailed godwit • Common greenshank • Latham's snipe	Surveys of the cryptic species Australasian bittern have only been conducted in recent years, with confirmed observations in 2020, 2021 and 2022. Hooded plover, bar-tailed godwit, common greenshank and sharp-tailed sandpiper have been recorded in the site annually and Latham's snipe in four of the past five years (2019 – 2023; GLCC monitoring, Atlas of Living Australia). LAC is met.

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Attachment 1 Fish and waterbird species list

Fish of the Gippsland Lakes from Hindell (unpublished), Atlas of Living Australia and Friends of Beware Reef surveys. Diadromous fish that migrate between fresh, estuarine and / or marine habitats for parts of their lifecycles are shaded.

Species name	Common name	Life history strategy
<i>Acanthaluteres spilomelanurus</i>	Bridled leatherjacket	Marine
<i>Acanthaluteres vittiger</i>	Toothbrush leatherjacket	Marine
<i>Acanthistius ocellatus</i>	Easern wirrah	Marine
<i>Acanthopagrus australis</i>	Yellow-fin bream	Estuarine
<i>Acanthopagrus butcheri</i>	Black bream	Estuarine
<i>Afurcagobius tamarensis</i>	Tamar River goby	Estuarine
<i>Alabes dorsalis</i>	Common shore-eel	Marine
<i>Alabes hoesei</i>	Dwarf shore-eel	Marine
<i>Alabes parvulus</i>	Pygmy shore-eel	Marine
<i>Aldrichetta forsteri</i>	Yellow-eye mullet	Estuarine
<i>Allomycterus pilatus</i>	Small-spined porcupinefish	Marine
<i>Ambassis jacksoniensis</i>	Port Jackson glassfish	Marine-estuarine opportunist
<i>Ammotretis elongatus</i>	Elongate flounder	Marine
<i>Ammotretis rostratus</i>	Longsnout flounder	Marine
<i>Anguilla australis</i>	Shortfin eel	Estuarine dependent freshwater
<i>Anguilla reinhardtii</i>	Longfin eel	Estuarine dependent freshwater
<i>Aplodactylus lophodon</i>	Rock cale	Marine
<i>Aracana aurita</i>	Shaw's cowfish	Marine-estuarine opportunist
<i>Arenigobius bifrenatus</i>	Bridled goby	Estuarine
<i>Arenigobius frenatus</i>	Half-bridled goby	Estuarine
<i>Argyrosomus hololepidotus</i>	Southern meagre	Marine-estuarine opportunist
<i>Argyrosomus japonicus</i>	Mulloway	Estuarine dependent marine
<i>Arripis georgiana</i>	Tommy rough	Marine-estuarine opportunist
<i>Arripis trutta</i>	Eastern Australian salmon	Estuarine dependent marine
<i>Arripis truttaceus</i>	Western Australian salmon	Marine-estuarine opportunist
<i>Aspasmogaster costata</i>	Eastern clingfish	Marine
<i>Aspasmogaster tasmaniensis</i>	Tasmanian clingfish	Marine-estuarine opportunist
<i>Atherinason hepsetoides</i>	Smallscale hardyhead	Marine-estuarine opportunist
<i>Atherinosoma microstoma</i>	Smallmouthed hardyhead	Estuarine dependent marine
<i>Atypichthys strigatus</i>	Australian mado	Marine
<i>Bathygobius krefftii</i>	Frayedfin goby	Estuarine dependent marine
<i>Brachaluteres jacksonianus</i>	Southern pygmy leatherjacket	Marine
<i>Brachirus nigra</i>	Black sole	Marine
<i>Brachynectes fasciatus</i>	Weedy threefin	Marine
<i>Caesioperca rasor</i>	Barber perch	Marine
<i>Callorhynchus milii</i>	Elephant fish	Estuarine dependent marine
<i>Centropogon australis</i>	Eastern fortesque	Marine-estuarine opportunist
<i>Cepola australis</i>	Australian bandfish	Marine
<i>Chaetodon guentheri</i>	Crochet butterflyfish	Marine

Species name	Common name	Life history strategy
<i>Cheilodactylus fuscus</i>	Red morwong	Marine
<i>Cheilodactylus nigripes</i>	Magpie perch	Marine
<i>Cheilodactylus spectabilis</i>	Banded morwong	Marine
<i>Chelidonichthys kumu</i>	Red gurnard	Marine
<i>Chironemus marmoratus</i>	Kelpfish	Marine
<i>Contusus brevicaudus</i>	Prickly toadfish	Estuarine
<i>Creocele cardinalis</i>	Broad clingfish	Marine
<i>Cristiceps australis</i>	Southern crested weedfish	Marine-estuarine opportunist
<i>Dactylophora nigricans</i>	Dusky morwong	Marine
<i>Dasyatis brevicaudata</i>	Smooth stingray	Marine
<i>Dasyatis thetidis</i>	Black stingray	Marine
<i>Decapterus muroadsi</i>	Temperate scad	Marine
<i>Dicotylichthys punctulatus</i>	Three-barred porcupinefish	Marine-estuarine opportunist
<i>Dinolestes lewini</i>	Longfin pike	Marine
<i>Dinolestes lewini</i>	Longfin pike	Marine
<i>Diodon nictemerus</i>	Globefish	Marine
<i>Engraulis australis</i>	Australian anchovy	Estuarine dependent marine
<i>Enoplosus armatus</i>	Old wife	Estuarine dependent marine
<i>Eocallionymus papilio</i>	Painted stinkfish	Marine
<i>Eubalichthys gunnii</i>	Gunn's leatherjacket	Marine-estuarine opportunist
<i>Eubalichthys mosaicus</i>	Mosaic leatherjacket	Marine-estuarine opportunist
<i>Eupetrichthys angustipes</i>	Snakeskin wrasse	Marine
<i>Favonigobius exquisitus</i>	Exquisite sandgoby	Marine-estuarine opportunist
<i>Favonigobius lateralis</i>	Long-finned goby	Marine-estuarine opportunist
<i>Favonigobius lentiginosus</i>	Eastern longfin goby	Marine
<i>Fistularia petimba</i>	Red cornetfish	Marine
<i>Foetorepus calauropomus</i>	Common stinkfish	Marine
<i>Gadopsis marmoratus</i>	River blackfish	Freshwater
<i>Galaxias maculatus</i>	Common galaxias	Estuarine dependent freshwater
<i>Galaxias olidus</i>	Mountain galaxias	Freshwater
<i>Galaxias truttaceus</i>	Spotted galaxias	Estuarine dependent freshwater
<i>Galaxiella pusilla</i> (V)	Dwarf galaxias	Freshwater
<i>Genus A sp. 2</i>	Brownspotted spiny clingfish	Marine
<i>Genus B sp.</i>	Rat clingfish	Marine
<i>Genus C sp.1</i>	Grass clingfish	Marine
<i>Genypterus tigerinus</i>	Rock ling	Marine
<i>Geotria australis</i>	Pouched lamprey	Estuarine dependent freshwater
<i>Gerres subfasciatus</i>	Southern silver biddy	Marine-estuarine opportunist
<i>Girella elevata</i>	Black dummer	Marine
<i>Girella tricuspidata</i>	Luderick	Marine-estuarine opportunist
<i>Girella zebra</i>	Zebra fish	Marine
<i>Gobiomorphus australis</i>	Striped gudgeon	Freshwater
<i>Gobiomorphus coxii</i>	Cox's gudgeon	Freshwater

Species name	Common name	Life history strategy
<i>Gobiopterus semivestitus</i>	Glass goby	Marine-estuarine opportunist
<i>Gonorynchus greyi</i>	Beaked salmon	Marine-estuarine opportunist
<i>Gymnapistes marmoratus</i>	Soldierfish	Marine-estuarine opportunist
<i>Haletta semifasciata</i>	Blue rock whiting	Marine-estuarine opportunist
<i>Herklotsichthys castelnaui</i>	Castelnau's herring	Estuarine dependent marine
<i>Heteroclinus adalaidae</i>	Adelaide weedfish	Estuarine
<i>Heteroclinus johnstoni</i>	Johnston's weedfish	Marine
<i>Heteroclinus kuiteri</i>	Kuiter's weedfish	Marine
<i>Heteroclinus perspicillatus</i>	Spotshoulder weedfish	Marine
<i>Heteroclinus puellarum</i>	Little weedfish	Marine
<i>Heteroclinus roseus</i>	Rosy weedfish	Marine
<i>Heteroclinus sp.3</i>	Longtail weedfish	Marine
<i>Heteroclinus tristis</i>	Longnose weedfish	Marine
<i>Hippocampus abdominalis</i>	Big-bellied seahorse	Marine-estuarine opportunist
<i>Hippocampus breviceps</i>	Shortsnout seahorse	Marine-estuarine opportunist
<i>Hippocampus whitei</i>	White's seahorse	Marine-estuarine opportunist
<i>Histiogamphelus briggsii</i>	Brigg's crested pipefish	Marine-estuarine opportunist
<i>Hyperlophus vittatus</i>	Sandy sprat	Estuarine dependent marine
<i>Hypnos monopterygium</i>	Australian numbfish	Marine
<i>Hypoplectrodes nigroruber</i>	Banded seaperch	Marine
<i>Hyporhamphus australis</i>	Eastern Sea garfish	Marine-estuarine opportunist
<i>Hyporhamphus melanochir</i>	Southern Sea garfish	Marine-estuarine opportunist
<i>Hyporhamphus regularis</i>	River garfish	Estuarine
<i>Hypseognathus rostratus</i>	Knifesnout pipefish	Marine
<i>Hypseoltris compressa</i>	Empire gudgeon	Estuarine dependent freshwater
<i>Iso rothophilus</i>	Surf sardine	Marine
<i>Kathetostoma laeue</i>	Common stargazer	Marine
<i>Kaupus costatus</i>	Deepbody pipefish	Marine
<i>Lactoria cornuta</i>	Longhorn cowfish	Marine
<i>Lepidoblennius haplodactylus</i>	Eastern jumping blenny	Marine
<i>Lepidotrigla papilio</i>	Spiny gurnard	Marine
<i>Leptatherina presbyteroides</i>	Silver fish	Marine-estuarine opportunist
<i>Lissocampus caudalis</i>	Smooth pipefish	Marine-estuarine opportunist
<i>Lissocampus runa</i>	Javelin pipefish	Marine-estuarine opportunist
<i>Liza argentea</i>	Gold-spot mullet	Marine
<i>Lovettia sealii</i>	Tasmanian whitebait	Estuarine dependent marine
<i>Macquaria colonorum</i>	Estuary perch	Estuarine
<i>Macquaria novemaculeata</i>	Australian bass	Estuarine dependent freshwater
<i>Maxillcosta scabriceps</i>	Little gurnard perch	Marine
<i>Meuschenia flavolineata</i>	Yellow-striped leatherjacket	Marine
<i>Meuschenia freycineti</i>	Six-spined leatherjacket	Marine-estuarine opportunist
<i>Meuschenia hippocrepis</i>	Horseshoe leatherjacket	Marine
<i>Meuschenia scaber</i>	Velvet leatherjacket	Marine
<i>Meuschenia scaber</i>	Velvet leatherjacket	Marine

Species name	Common name	Life history strategy
<i>Meuschenia trachylepis</i>	Yellow-finned leatherjacket	Marine
<i>Microcanthus strigatus</i>	Stripey	Marine-estuarine opportunist
<i>Mitotichthys semistriatus</i>	Halfbanded pipefish	Marine
<i>Monacanthus chinensis</i>	Fanbelly leatherjacket	Marine
<i>Mordacia mordax</i>	Shorthead lamprey	Estuarine dependent marine
<i>Mordacia praecox</i>	Non-parasitic lamprey	Freshwater
<i>Mugil cephalus</i>	Flathead mullet	Marine-estuarine opportunist
<i>Muraenichthys breviceps</i>	Short-headed worm-eel	Marine
<i>Myliobatis australis</i>	Eagle ray	Marine
<i>Myxus elongatus</i>	Sand mullet	Marine-estuarine opportunist
<i>Nannoperca australis</i>	Southern pygmy perch	Freshwater
<i>Nannoperca sp. 1</i>	Flinders pygmy perch	Freshwater
<i>Narcine tasmaniensis</i>	Tasmanian numbfish	Marine
<i>Nelusetta ayraudi</i>	Chinaman leatherjacket	Marine
<i>Neoodax balteatus</i>	Little rock whiting	Marine
<i>Neoplatycephalus aurimaculatus</i>	Toothy flathead	Marine
<i>Neosebastes scorpaenoides</i>	Common gurnard perch	Marine
<i>Nesogobius hinsbyi</i>	Girdled goby	Marine
<i>Nesogobius pulchellus</i>	Australian sailfin goby	Marine
<i>Nesogobius sp. 3</i>	Speckled sandgoby	Marine
<i>Nesogobius sp. 5</i>	Sicklefin sandgoby	Marine
<i>Norfolkia clarkei</i>	Common threefin	Marine
<i>Notolabrus fucicola</i>	Saddled wrasse	Marine
<i>Notolabrus gymnogenis</i>	Crimsonband wrasse	Marine
<i>Notolabrus tetricus</i>	Bluethroat wrasse	Marine
<i>Omobranchus anolius</i>	Oyster blenny	Marine
<i>Ophiclinops varius</i>	Variegated snakeblenny	Marine
<i>Ophisurus serpens</i>	Serpent eel	Marine
<i>Pagrus auratus</i>	Snapper	Estuarine dependent marine
<i>Parablennius intermedius</i>	Horned blenny	Marine-estuarine opportunist
<i>Parablennius tasmanianus</i>	Tasmanian blenny	Marine-estuarine opportunist
<i>Parequula melbournensis</i>	Silverbelly	Marine
<i>Parma microlepis</i>	White-ear scalyfin	Marine
<i>Parupeneus spilurus</i>	Blackspot goatfish	Marine-estuarine opportunist
<i>Parvicrepis parvipinnis</i>	Little clingfish	Marine
<i>Parvicrepis sp. 1</i>	Longsnout clingfish	Marine
<i>Parvicrepis sp. 2</i>	Obscure clingfish	Marine
<i>Pegasus lancifer</i>	Sculptured seamoth	Marine
<i>Philypnodon macrostomus</i>	Dwarf flat-headed gudgeon	Freshwater
<i>Phyllopteryx taeniolatus</i>	Weedy Seadragon	Marine
<i>Pictilabrus laticlavius</i>	Senator wrasse	Marine
<i>Platycephalus bassensis</i>	Southern sand flathead	Marine

Species name	Common name	Life history strategy
<i>Platycephalus caeruleopunctatus</i>	Eastern blue-spotted flathead	Marine
<i>Platycephalus fuscus</i>	Dusky flathead	Marine
<i>Platycephalus laevigatus</i>	Rock flathead	Marine
<i>Platycephalus richardsoni</i>	Tiger flathead	Marine
<i>Pomatomus saltatrix</i>	Tailor	Marine
<i>Potamalosa richmondia</i>	Freshwater herring	Estuarine dependent freshwater
<i>Pristiophorus nudipinnis</i>	Southern sawshark	Marine
<i>Prototroctes maraena</i>	Australian grayling	Estuarine dependent freshwater
<i>Pseudaphritis urvillii</i>	Tupong	Estuarine
<i>Pseudocaranx dentex</i>	Silver trevally	Marine
<i>Pseudocaranx wrighti</i>	Skipjack trevally	Marine
<i>Pseudogobius olorum</i>	Western blue-spotted goby	Estuarine
<i>Pseudogobius sp. 9</i>	Eastern blue-spotted goby	Estuarine
<i>Pseudophycis breviuscula</i>	Bastard red cod	Marine
<i>Pseudophysis barbata</i>	Bearded rock cod	Marine
<i>Pseudorhombus jenynsii</i>	Smalltooth flounder	Marine-estuarine opportunist
<i>Pugnaso curtirostris</i>	Pugnose pipefish	Estuarine
<i>Raja lemprieri</i>	Thornback skate	Marine
<i>Raja whitleyi</i>	Melbourne skate	Marine
<i>Redigobius macrostoma</i>	Large-mouthed goby	Marine-estuarine opportunist
<i>Retropinna semoni</i>	Australian smelt	Freshwater
<i>Retropinna semoni</i>	Australian smelt	Freshwater
<i>Rhabdosargus sarba</i>	Tarwhine	Marine-estuarine opportunist
<i>Rhombosolea tapirina</i>	Greenback flounder	Marine
<i>Sardinops neopilchardus</i>	Pilchard	Marine
<i>Scobinichthys granulatus</i>	Rough leatherjacket	Marine
<i>Scomber australasicus</i>	Blue mackerel	Marine
<i>Scorpaena papillosus</i>	Red rock cod	Marine
<i>Scorpius aequipinnis</i>	Sea sweep	Marine
<i>Seriola lalandi</i>	Yellowtail kingfish	Marine-estuarine opportunist
<i>Sillaginodes punctata</i>	King George whiting	Marine-estuarine opportunist
<i>Sillago ciliata</i>	Sand whiting	Marine
<i>Sillago flindersi</i>	School whiting	Marine
<i>Siphamia cephalotes</i>	Wood's siphon fish	Marine-estuarine opportunist
<i>Siphonognathus attenuatus</i>	Slender weed whiting	Marine
<i>Solegnathus spinosissimus</i>	Spiny pipehorse	Marine
<i>Sphyaena novaehollandiae</i>	Australian barracuda	Marine
<i>Sphyaena obtusata</i>	Obscure barracuda	Marine-estuarine opportunist
<i>Spratelloides robustus</i>	Fringe-scale round herring	Marine
<i>Sprattus novaehollandiae</i>	Australian sprat	Marine-estuarine opportunist
<i>Stigmatopora argus</i>	Spotted pipefish	Marine-estuarine opportunist
<i>Stigmatopora nigra</i>	Wide-bodied pipefish	Marine-estuarine opportunist
<i>Stipecampus cristatus</i>	Ring-backed pipefish	Marine-estuarine opportunist
<i>Synaptura nigra</i>	Black sole	Marine

Species name	Common name	Life history strategy
<i>Synodus dermatogenys</i>	Sand lizardfish	Marine
<i>Taratretis derwentensis</i>	Derwent flounder	Marine
<i>Tasmanogobius gloveri</i>	Marine goby	Estuarine
<i>Tasmanogobius lasti</i>	Lagoon goby	Marine-estuarine opportunist
<i>Tasmanogobius lordi</i>	Tasmanian goby	Estuarine dependent freshwater
<i>Tetractenos glaber</i>	Smooth toadfish	Marine-estuarine opportunist
<i>Tetractenos hamiltoni</i>	Common toadfish	Marine-estuarine opportunist
<i>Thyrsites atun</i>	Baracouta	Marine-estuarine opportunist
<i>Torquigener pleurogramma</i>	Weeping toado	Marine-estuarine opportunist
<i>Trachurus novaezelandiae</i>	Yellowtail horse mackerel	Marine-estuarine opportunist
<i>Trygonoptera mucosa</i>	Western shovelnose stingaree	Marine
<i>Trygonorrhina dumerilii</i>	Southern fiddler ray	Marine
<i>Upeneichthys vlamingii</i>	Bluespotted goatfish	Marine
<i>Upeneus tragula</i>	Freckled goatfish	Marine-estuarine opportunist
<i>Urocampus carinirostris</i>	Hairy pipefish	Marine-estuarine opportunist
<i>Urolophus curciatus</i>	Banded stingaree	Marine
<i>Urolophus gigas</i>	Spotted stingaree	Marine
<i>Urolophus paucimaculatus</i>	Sparsely-spotted stingaree	Marine
<i>Vanacampus margaritifer</i>	Mother-of-pearl pipefish	Marine
<i>Vanacampus phillipi</i>	Port Phillip pipefish	Marine
<i>Zeus faber</i>	John dory	Marine