

# Technical information supporting the 2023 Inland waters: Established invasive species abundance and distribution and Inland waters: New incursions of invasive species environmental trend and condition report cards

Department for Environment and Water  
August, 2023

DEW Technical note 2023/29



**Government  
of South Australia**

Department for  
Environment and Water

Department for Environment and Water  
Government of South Australia  
August 2023

81-95 Waymouth St, ADELAIDE SA 5000  
Telephone +61 (8) 8463 6946  
Facsimile +61 (8) 8463 6999  
ABN 36702093234

**[www.environment.sa.gov.au](http://www.environment.sa.gov.au)**

### *Disclaimer*

The Department for Environment and Water and its employees do not warrant or make any representation regarding the use, or results of the use, of the information contained herein as regards to its correctness, accuracy, reliability, currency or otherwise. The Department for Environment and Water and its employees expressly disclaims all liability or responsibility to any person using the information or advice. Information contained in this document is correct at the time of writing.



With the exception of the Piping Shrike emblem, other material or devices protected by Aboriginal rights or a trademark, and subject to review by the Government of South Australia at all times, the content of this document is licensed under the Creative Commons Attribution 4.0 Licence. All other rights are reserved.

© Crown in right of the State of South Australia, through the Department for Environment and Water 2023

### *Preferred way to cite this publication*

Department for Environment and Water (2023). *Technical information supporting the 2023 Inland waters: Established invasive species abundance and distribution and Inland waters: New incursions of invasive species environmental trend and condition report cards*, DEW Technical report 2023/29, Government of South Australia, Department for Environment and Water, Adelaide.

Download this document at <https://data.environment.sa.gov.au>

# Acknowledgement of Country

We acknowledge and respect the Traditional Custodians whose ancestral lands we live and work upon and we pay our respects to their Elders past and present. We acknowledge and respect their deep spiritual connection and the relationship that Aboriginal and Torres Strait Islanders people have to Country. We also pay our respects to the cultural authority of Aboriginal and Torres Strait Islander people and their nations in South Australia, as well as those across Australia.

## Acknowledgements

This document was prepared by Michelle Besley (Department of Primary Industries and Regions (PIRSA)). Giverny Rodgers (PIRSA) provided principal oversight throughout and technical review of this report. Brady Stead (DEW) provided mapping support. Improvements were made to this report and associated report card based on reviews by Amy Ide (DEW) and Brad Page (PIRSA).

# Contents

<b>Acknowledgement of Country</b>	<b>ii</b>
<b>Acknowledgements</b>	<b>ii</b>
<b>Summary</b>	<b>v</b>
<b>1 Introduction</b>	<b>1</b>
1.1 Environmental trend and condition reporting in SA	1
1.2 Purpose and benefits of SA's trend and condition report cards	1
1.3 Invasive species in SA's inland waters (Aquatic pests and weeds)	2
<b>2 Methods</b>	<b>3</b>
2.1 Indicator	3
2.2 Data sources	5
2.3 Data analysis and methods to assign trend, condition and reliability	5
2.3.1 Trend	5
2.3.2 Condition	6
2.3.3 Limitation	8
2.3.4 Reliability	8
2.4 Data transparency	9
<b>3 Results</b>	<b>10</b>
3.1 Trend	10
3.1.1 Established invasive species abundance and distribution	10
3.1.2 New incursions of invasive species	11
3.2 Condition	19
3.2.1 Established invasive species abundance and distribution	19
3.2.2 New incursions of invasive species	19
3.3 Reliability	20
3.3.1 Notes on reliability	20
<b>4 Discussion</b>	<b>21</b>
4.1 Trend	21
4.1.1 Established invasive species abundance and distribution	21
4.1.2 New incursions of invasive species	21
4.2 Condition	21
4.2.1 Established invasive species abundance and distribution	21
4.2.2 New incursions of invasive species	22
<b>5 Appendices</b>	<b>23</b>
A. Managing environmental knowledge chart for Inland waters: Established invasive species abundance and distribution	23
B. Managing environmental knowledge chart for Inland waters: New incursions of invasive species (non-established invasive species)	24

**List of figures**

Figure 3.1.	Fishery statistics for European carp. CPUE for large mesh gillnets (LMGN), based on total catch and total effort that produced catches of European carp. (Source: Earl 2020)	11
Figure 3.2.	European carp biomass density estimates (kg/ha) across eastern Australia for a) river systems, and b) waterbodies. Different colours reflect variation in the density of Carp (Source: Stuart et al. 2019)	11

**List of tables**

Table 2.1	Key aquatic invasive species addressed in this assessment	4
Table 2.2.	Definition of trend classes used	5
Table 2.3.	Definition of condition classes used for established aquatic invasive species abundance and distribution	7
Table 2.4.	Definition of condition classes used for new incursions of inland waters invasive species	8
Table 2.5.	Guides for applying information currency	9
Table 2.6.	Guides for applying information applicability	9
Table 2.7.	Guides for applying spatial representation of information (sampling design)	9
Table 3.1.	Key catch statistics for European carp in South Australia's Lakes and Coorong Fishery from 2016–17 to 2018–19 (Source: Earl 2020)	10
Table 3.2.	Distribution and detections of key aquatic pests and weeds in South Australia's inland waters	12
Table 3.3.	Freshwater EEPL pest animals and weeds	19
Table 3.4.	Information reliability scores for trends for invasive aquatic species	20

# Summary

The 2023 release of South Australia's environmental trend and condition report cards summarises our understanding of the current condition of the South Australian environment, and how it is changing over time.

This document describes the indicators, information sources, analysis methods and results used to develop this report and the associated 2023 report cards:

- Inland waters: Established invasive species abundance and distribution
- Inland waters: New incursions of invasive species.

The reliability of information sources used in the report card is also described.

The report cards sit within the report card Biodiversity theme and Inland waters sub-theme. Report cards are published by the Department for Environment and Water and can be accessed at [www.environment.sa.gov.au](http://www.environment.sa.gov.au).

# 1 Introduction

## 1.1 Environmental trend and condition reporting in SA

The Minister for Climate, Environment and Water under the *Landscape South Australia Act 2019* is required to 'monitor, evaluate and audit the state and condition of the State's natural resources, coasts and seas; and to report on the state and condition of the State's natural resources, coasts and seas' (9(1(a-b))). Environmental trend and condition report cards are produced as the primary means for the Minister to undertake this reporting. Trend and condition report cards are also a key input into the State of the Environment Report for South Australia, which must be prepared under the *Environment Protection Act 1993*. This Act states that the State of the Environment Report must:

- include an assessment of the condition of the major environmental resources of South Australia (112(3(a))), and
- include a specific assessment of the state of the River Murray, especially taking into account the Objectives for a Healthy River Murray under the *River Murray Act 2003* (112(3(ab))), and
- identify significant trends in environmental quality based on an analysis of indicators of environmental quality (112(3(b))).

## 1.2 Purpose and benefits of SA's trend and condition report cards

South Australia's environmental trend and condition report cards focus on the state's priority environmental assets and the pressures that impact on these assets. The report cards present information on trend, condition, and information reliability in a succinct visual summary.

The full suite of report cards captures patterns in trend and condition, generally at a state scale, and gives insight to changes in a particular asset over time. They also highlight gaps in our knowledge on priority assets that prevent us from assessing trend and condition and might impede our ability to make evidence-based decisions.

Although both trend and condition are considered important, the report cards give particular emphasis to trend. Trend shows how the environment has responded to past drivers, decisions, and actions, and is what we seek to influence through future decisions and actions.

The benefits of trend and condition report cards include to:

- provide insight into our environment by tracking its change over time
- interpret complex information in a simple and accessible format
- provide a transparent and open evidence base for decision-making
- provide consistent messages on the trend and condition of the environment in South Australia
- highlight critical knowledge gaps in our understanding of South Australia's environment
- support alignment of environmental reporting, ensuring we 'do once, use many times'.

Environmental trend and condition report cards are designed to align with and inform state of the environment reporting at both the South Australian and national level. The format, design and accessibility of the report cards has been reviewed and improved with each release.

### 1.3 Invasive species in SA's inland waters (Aquatic pests and weeds)

Biosecurity risks in South Australia's inland waters include established and non-established (or new) aquatic invasive species. This report summarises detections between 2019 and 2022 for key aquatic invasive species (established and non-established). This assessment addresses the abundance and distribution of established aquatic invasive species and the detection of non-established aquatic invasive species.

Invasive species are animals, plants, parasites or disease-causing organisms that have become or could become established outside their natural range and become pests (IUCN 2000) in waterways, including rivers, creeks, lakes, wetlands, estuaries and dams or in damp, low lying areas.

Aquatic invasive species can harm South Australia's environment and primary industries. They may threaten the state's biodiversity including native species, and affect commercial and recreational industries such as fishing, tourism, aquaculture, pose risks to public health, amenity, and social enjoyment of aquatic environments.

Aquatic invasive species arrive in South Australia through range expansion of existing invasive species from other states, incorrect disposal of aquarium and ornamental pond species, stocking of dams, and intentional introductions of recreational fishing species, e.g. trout. Some of these species do not adapt well to South Australian conditions and do not become established. Other species, such as carp, become established pests that have the potential to impact our environment, society and economy (Bomford 2008). For example, European carp costs the recreational fisheries sector \$44 million in the Murray–Darling Basin catchments each year (McLeod 2016).

The Department of Primary Industries and Regions (PIRSA) leads the Government of South Australia's coordination and implementation of biosecurity policy in collaboration with other agencies (including landscape boards and PIRSA Fisheries and Aquaculture) to minimise the entry, establishment and spread of aquatic pests. Aquatic pest biosecurity ensures that risks from the introduction and spread of exotic aquatic organisms are appropriately managed and potential significant impacts to South Australia's industries, community and environment are minimised.

South Australia is a signatory to the Intergovernmental Agreement on Biosecurity (IGAB). This agreement includes a commitment to nationally agreed approaches amongst governments to prevent, prepare for, detect, and mitigate biosecurity risks and respond to, manage, and recover from biosecurity incidents should they occur.

Invasive species on land, and in coastal and marine waters are discussed in separate technical reports:

- Terrestrial: Established invasive species abundance and distribution and Terrestrial: New incursions of invasive species environmental trend and condition report cards
- Coastal and marine: Established invasive species abundance and distribution and Coastal and marine: New incursions of invasive species environmental trend and condition report cards.



# 2 Methods

## 2.1 Indicator

The indicator used for the Inland waters: Established invasive species abundance and distribution report card is the abundance and distribution of key established aquatic invasive species in South Australia using available data.

The indicator used for the Inland waters: New incursions of invasive species report card is the number of detections between 2019 and 2022 of key non-established (new) aquatic invasive species in South Australia.

Invasive aquatic species are exotic (non-native/non-endemic/exotic) species that can have an environmental, social or economic impact.

Key aquatic invasive species addressed in this assessment are listed in Table 2.1. The species reported include those considered 'alert species' by PIRSA Biosecurity (see Biosecurity SA [Aquatic weeds factsheet](#) and [Aquatic pests website](#)).

The distribution and detection of key invasive aquatic species (fish, invertebrates and weeds) in inland waters is summarised in Table 3.2.

**Table 2.1 Key aquatic invasive species addressed in this assessment**

(\*\* indicates they are considered established in some areas of the state)

<b>Fish</b>	
<b>Common names</b>	<b>Scientific name</b>
European carp**	<i>Cyprinus carpio</i>
goldfish**	<i>Carassius auratus</i>
gambusia (mosquito fish)**	<i>Gambusia holbrooki</i> and <i>G. affinis</i>
oriental weatherloach**	<i>Misgurnus anfuillicaudatus</i>
redfin perch**	<i>Perca fluviatilis</i>
roach**	<i>Rutilus</i>
speckled mosquitofish (speckled livebearer)**	<i>Phalloceros caudimaculatus</i>
sleepy cod**	<i>Oxyeleotris lineolata</i>
tench**	<i>Tinca tinca</i>
alligator gar	<i>Atractosteus spatula</i>
snakeheads	family Channidae
tilapia	<i>Oreochromis mossambicus</i>
<b>Invertebrates</b>	
<b>Common names</b>	<b>Scientific name</b>
red claw	<i>Cherax quadricarinatus</i>
marron**	<i>Cherax cainii</i>
<b>Alert weeds (aquatic)</b>	
<b>Common names</b>	<b>Scientific name</b>
alligator weed / pig weed	<i>Alternanthera philoxeroides</i>
arrowhead	<i>Sagittaria montevidensi</i>
cabomba	<i>Cabomba caroliniana</i>
Canadian pond weed**	<i>Elodea canadensis</i>
Eurasian water milfoil	<i>Myriophyllum spicatum</i>
horsetail	<i>Equisetum spp</i>
pennywort (hydrocotyle)	<i>Hydrocotyle ranunculoides</i>
lagarosiphon	<i>Lagarosiphon major</i>
leafy elodea**	<i>Egeria densa</i>
celery buttercup (poison buttercup)**	<i>Ranunculus sceleratus</i>
sagittaria**	<i>Sagittaria graminea var. platyphylla</i>
salvinia	<i>Salvinia molesta</i>
Senegal tea plant	<i>Gymnocoronis spilanthoides</i>
water caltrop	<i>Trapa natans</i>
water hyacinth	<i>Eichhornia crassipes</i>
water soldier	<i>Stratiotes aloides</i>

## 2.2 Data sources

Records and reports of key aquatic invasive species were sourced from:

- Research reports - in particular, information from the South Australian Research and Development Institute (SARDI), Aquatic Sciences for fish species;
- PIRSA databases - PIRSA Aquatic Pest database and the PIRSA Plant detections 2019–2022 database;
- Presence data from various research projects/databases - DEW frog and fish surveys at Chowilla floodplain Spring 2021, SA Arid Lands - Lake Eyre Basin Rivers Assessment Spring 2021 and Coongie Ramsar Fish Surveys during 2020, Murraylands and Riverland Landscape Board Wetlands Fish survey database 2021, 2022; and
- National Carp Control Plan (NCCP) <http://www.carp.gov.au/> for local abundance and distribution information as well as large-scale modelled abundance estimates of European carp. Modelled estimates of biomass were sourced from Stuart et al. (2019) report.

Incursions of exotic aquatic species are generally reported by the public (e.g. public reports through Fishwatch, PIRSA Fishing App, PIRSA website) and Landscapes SA. All reports are recorded in PIRSA’s pest database and investigated.

## 2.3 Data analysis and methods to assign trend, condition and reliability

### 2.3.1 Trend

Trend for the abundance and distribution of established invasive plants or animals in inland waters in South Australia was assigned to a trend class (Table 2.2) based on a review of literature from the last 5 years (2019–2023), along with any reported detections and records (Table 3.2) and expert opinion by Biosecurity SA. Trend scores were assigned to each landscape region and then aggregated to state level. No further analysis of data was conducted as part of this assessment.

Trends were not calculated in this assessment for non-established (new) invasive species in inland waters. This is because annual increases in incursions are unlikely to represent actual change. For example, public education campaigns can lead to increases in detections, which is not indicative of trends in the number of new incursions.

**Table 2.2. Definition of trend classes used**

Trend	Description	Threshold
Getting better	Over a scale relevant to tracking change in the indicator it is improving in status with good confidence	Distribution and/or abundance decreased between 2019–2022
Stable	Over a scale relevant to tracking change in the indicator it is neither improving nor declining in status	No change in abundance and distribution between 2019–2022
Getting worse	Over a scale relevant to tracking change in the indicator it is declining in status with good confidence	Distribution and/or abundance increased between 2019–2022
Unknown	Data are not available, or are not available at relevant temporal scales, to determine any trend in the status of this resource	Abundance and distribution unknown
Not applicable	This indicator of the natural resource does not lend itself to being classified into one of the above trend classes	No invasive species, or no water assets to assess.

### 2.3.2 Condition

Condition class is a single state-level statement of condition for 2022 that has been derived from the *Landscape South Australia Act 2019* and relates to invasive inland water species (see Table 2.3 for established aquatic invasive species abundance and distribution and Table 2.4 for new incursions of non-established invasive species). The classes were assigned based on a review of literature from the last 4 years (2019–2022), expert opinion by Biosecurity SA including a qualitative assessment of the impact of invasive species, the number of outbreaks (new incursions), spread of established species to new regions relative to previous years (distribution), and any information on abundance and global levels.

Condition scores were assigned to each landscape region and then aggregated to state level. No further analysis of data was conducted as part of this assessment.

**Table 2.3. Definition of condition classes used for established aquatic invasive species abundance and distribution**

<b>Condition</b>	<b>Generic description</b>	<b>Description</b>	<b>Threshold</b>
Very good	The natural resource is in a state that meets all environmental, economic, and social expectations, based on this indicator. Thus, desirable function can be expected for all processes/services expected of this resource, now and into the future, even during times of stress (e.g., prolonged drought)	Natural resources and our environmental, social, and economic expectations of these (e.g., primary productivity) are not affected by new incursions of invasive species	No new incursions of established invasive species in current reporting period. All previous incursions are under control
Good	The natural resource is in a state that meets most environmental, economic, and social expectations, based on this indicator. Thus, desirable function can be expected for only some processes/services expected of this resource, now and into the future, even during times of stress (e.g., prolonged drought)	Natural resources and our environmental, social, and economic expectations of these (e.g., primary productivity) are marginally affected by new incursions of invasive species	Incursion species are controlled and have low risk of impacting environment and industry. Stable rate of incursions
Fair	The natural resource is in a state that does not meet some environmental, economic, and social expectations, based on this indicator. Thus, desirable function cannot be expected from many processes/services expected of this resource, now and into the future, particularly during times of stress (e.g., prolonged drought)	Natural resources and our environmental, social, and economic expectations of these (e.g., primary productivity) are moderately affected by new incursions of invasive species	Incursion species are controlled and have low risk of impacting environment and industry. Rate of incursion is increasing
Poor	The natural resource is in a state that does not meet most environmental, economic, and social expectations, based on this indicator. Thus, desirable function cannot be expected from most processes/services expected of this resource, now and into the future, particularly during times of stress (e.g., prolonged drought)	Natural resources and our environmental, social, and economic expectations of these (e.g., primary productivity) are significantly affected by new incursions of invasive species	Incursion species are not controlled and have moderate or high risk of impacting environment and industry. Rate of incursion is increasing
Unknown	Data are not available to determine the state of this natural resource, based on this indicator	Data are not available to determine the impact of new incursions of invasive species on our natural resources	-

**Table 2.4. Definition of condition classes used for new incursions of inland waters invasive species**

<b>Condition</b>	<b>Description</b>	<b>Threshold</b>
Very good	The natural resource is in a state that meets all environmental, economic and social expectations, based on this indicator. Thus, desirable function can be expected for all processes/services expected of this resource, now and into the future, even during times of stress (e.g., prolonged drought)	No new incursions in current reporting period. All previous incursions are under control
Good	The natural resource is in a state that meets most environmental, economic and social expectations, based on this indicator. Thus, desirable function can be expected for only some processes/services expected of this resource, now and into the future, even during times of stress (e.g., prolonged drought)	Incursion species are controlled and have low risk of impacting environment and industry. Stable rate of incursions
Fair	The natural resource is in a state that does not meet some environmental, economic and social expectations, based on this indicator. Thus, desirable function cannot be expected from many processes/services expected of this resource, now and into the future, particularly during times of stress (e.g., prolonged drought)	Incursion species are controlled and have low risk of impacting environment and industry. Rate of incursion is increasing
Poor	The natural resource is in a state that does not meet most environmental, economic and social expectations, based on this indicator. Thus, desirable function cannot be expected from most processes/services expected of this resource, now and into the future, particularly during times of stress (e.g., prolonged drought)	Incursion species are not controlled and have moderate or high risk of impacting environment and industry.
Unknown	Data are not available to determine the state of this natural resource, based on this indicator	-
Not applicable	This indicator of the natural resource does not lend itself to being classified into one of the above condition classes	-

### 2.3.3 Limitation

There is ongoing passive surveillance and limited active surveillance for aquatic invasive species in South Australia's inland waters for established and non-established (new) aquatic invasive species.

Trends are difficult to calculate for abundance or distribution of many aquatic invasive plants, animals, algae and invertebrates as the data and subsequent assessment are based on passive surveillance (except for European carp as part of the wider Lakes and Coorong Fishery assessments).

### 2.3.4 Reliability

Information is scored for reliability based on the minimum of subjective scores (1 [worst] to 5 [best]) given for information currency, applicability, level of spatial representation and accuracy. Definitions guiding the application of these scores are provided in

Table 2.5 for currency, Table 2.6 for applicability and Table 2.7 for spatial representation.

**Table 2.5. Guides for applying information currency**

<b>Currency score</b>	<b>Criteria</b>
1	Most recent information > 10 years old
2	Most recent information up to 10 years old
3	Most recent information up to 7 years old
4	Most recent information up to 5 years old
5	Most recent information up to 3 years old

**Table 2.6. Guides for applying information applicability**

<b>Applicability score</b>	<b>Criteria</b>
1	Data are based on expert opinion of the measure
2	All data based on indirect indicators of the measure
3	Most data based on indirect indicators of the measure
4	Most data based on direct indicators of the measure
5	All data based on direct indicators of the measure

**Table 2.7. Guides for applying spatial representation of information (sampling design)**

<b>Spatial score</b>	<b>Criteria</b>
1	From an area that represents less than 5% the spatial distribution of the asset within the region/state or spatial representation unknown
2	From an area that represents less than 25% the spatial distribution of the asset within the region/state
3	From an area that represents less than half the spatial distribution of the asset within the region/state
4	From across the whole region/state (or whole distribution of asset within the region/state) using a sampling design that is not stratified
5	From across the whole region/state (or whole distribution of asset within the region/state) using a stratified sampling design

## **2.4 Data transparency**

Data transparency for these report cards is represented in Appendix A and Appendix B.



# 3 Results

## 3.1 Trend

### 3.1.1 Established invasive species abundance and distribution

Overall at the state level, abundance and distribution of key inland waters established invasive species was stable.

European carp, goldfish, mosquito fish, oriental weatherloach, redfin perch, roach, speckled mosquitofish (also known as speckled livebearer), sleepy cod, tench, marron, Canadian pond weed, celery buttercup (also known as poison buttercup) and sagittaria are established in South Australian waterways. Outbreaks of other aquatic weeds, such as leafy elodea, are seen occasionally.

Various fish surveys are undertaken at locations across South Australia, and these surveys inform the distribution of invasive pest fish. In addition, passive surveillance for aquatic pests and weeds reports the presence of key pests. However, these reports are sometimes associated with communication and promotion activities such as public education campaigns.

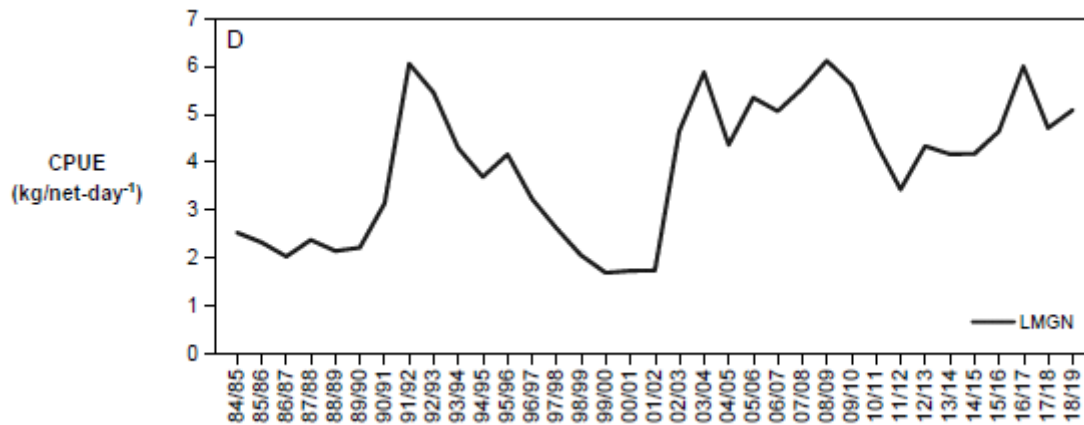
Established invasive fish species' distribution is considered 'Stable'. Their distribution has been reported in the same areas as previously recorded and spread into new regions has not been reported (see Table 3.2). Likewise, aquatic weed distribution has not been reported in new areas of the state.

Trends of established invasive aquatic species are considered stable in the Green Adelaide (GA), Hills and Fleurieu (HF), Murraylands and Riverland (MR) and SA Arid Lands (SAAL) landscape regions. This trend is considered unknown in the Eyre Peninsula (EP), Northern and Yorke (NY), Limestone Coast (LC), Kangaroo Island (KI) and Alinytjara Wilurara (AW) landscape regions due to limited data.

European carp is listed as a noxious aquatic species in South Australia under the *Fisheries Management Act 2007*. It is mostly taken as by-product in the Lakes and Coorong Fishery when other species are targeted. Total catches of European carp have been at moderate levels since 2009–10. No stock status is assigned to this fish stock (Earl 2020).

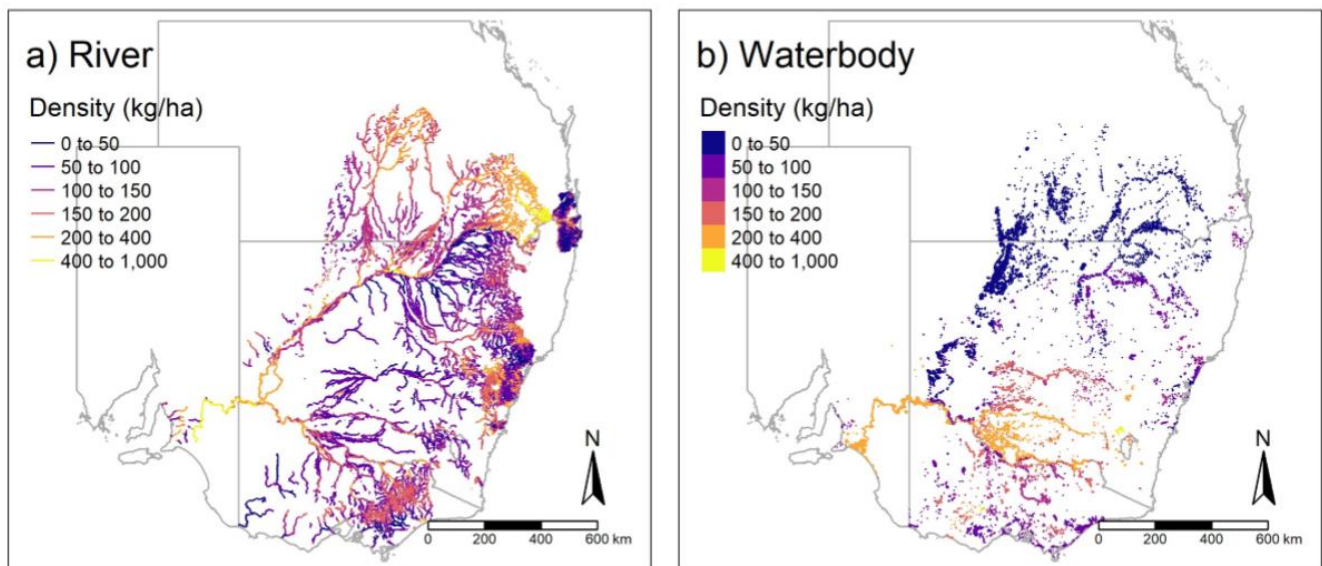
**Table 3.1. Key catch statistics for European carp in South Australia's Lakes and Coorong Fishery from 2016–17 to 2018–19 (Source: Earl 2020)**

Financial year	Catch (t)	Catch Per Unit of Effort (CPUE kg.net-day-1)
2016–17	490	6.00
2017–18	403	4.71
2018–19	375	5.12



**Figure 3.1. Fishery statistics for European carp. CPUE for large mesh gillnets (LMGN), based on total catch and total effort that produced catches of European carp. (Source: Earl 2020)**

The National Carp Control Plan (NCCP) coordinates a comprehensive national research program to understand all aspects of the use of the carp herpesvirus. Estimated biomass of carp in the South Australian section of the River Murray is approximately 550 kg/ha (Stuart et al 2019; Figure 3.2). The lower River Murray provides ideal conditions for carp with slow moving weir pools adjacent to wetlands for breeding.



**Figure 3.2. European carp biomass density estimates (kg/ha) across eastern Australia for a) river systems, and b) waterbodies. Different colours reflect variation in the density of Carp (Source: Stuart et al. 2019)**

### 3.1.2 New incursions of invasive species

Across the state there are low numbers of reports of incursion of new invasive aquatic species. However, data are limited and do not allow trends in the number of new incursions of invasive species to be determined. Trends were not calculated in this assessment for new invasive species and as such the trend is 'Unknown'. Annual increases in incursions are unlikely to represent actual change. For example, public education campaigns can lead to increases in detections, and are therefore not indicative of trends in the number of new incursions. This is the first year that all aquatic invasive species are jointly reported, previous report cards focused only on invasive fish.

Each year there are a handful of reported prohibited species in garden ponds or aquariums – these are destroyed to prevent them entering waterways where they could establish ongoing populations. There were 9 separate incursions from 2019–2022 of 5 species (Table 3.2).

**Table 3.2. Distribution and detections of key aquatic pests and weeds in South Australia’s inland waters**

(Sources – PIRSA Aquatic Pest webpages, PIRSA Aquatic Pest database, PIRSA Plant detections 2019–2022 database, PIRSA Alert weeds brochures, PIRSA Declared Plant Policies). \*\* indicates they are considered established in some areas of the state

Common names	Scientific name	Reference list	SA status/distribution	2019–2022 update
<b>Freshwater fish</b>				
European carp**	<i>Cyprinus carpio</i>	Noxious list	Established throughout many freshwater systems, especially the River Murray. In SA, carp are present in most of the rivers draining west from the Mt Lofty Ranges, from the Light River north of Adelaide south to the Inman River. They are also present in the River Murray and its lower lakes and tributaries	<p>Koi carp detected and destroyed - illegal trade in 2021</p> <p>See Section 3.1.1 for Lakes and Coorong Fishery catches</p> <p>Occasional public reports in the River Murray</p> <p>Large numbers of carp detected in frog surveys at various River Murray wetlands in 2021</p> <p>Recorded in Murraylands and Riverland Landscape Board (MRLB) fish surveys at various wetlands and floodplains in 2021</p>

Common names	Scientific name	Reference list	SA status/distribution	2019–2022 update
goldfish**	<i>Carassius auratus</i>		Established in some freshwater bodies including the River Murray  Aquarium species	Strathalbyn Field Naturalists undertook voluntary control activities (removal) in Angas River with dab nets in 2022  Recorded in frog surveys at various River Murray wetlands in 2021  Recorded in MRLB fish surveys at various wetlands and floodplains in 2021  Recorded in Lake Eyre Basin fish survey in 2021
gambusia (mosquito fish)**	<i>Gambusia holbrooki</i> and <i>G. affinis</i>	Noxious list	Established in most freshwater water bodies except the far north of the state	Recorded in frog surveys at various River Murray wetlands in 2021  Recorded in MRLB fish surveys at various wetlands and floodplains in 2021  Recorded in Lake Eyre Basin fish surveys in 2020 and 2021
oriental weatherloach**	<i>Misgurnus anquillicaudatus</i>	Noxious list	PIRSA most wanted brochure  Established, detected along the full extent of the River Murray	Occasional public reports in the River Murray over warmer periods of the year  Recorded in MRLB fish surveys at various wetlands and floodplains in 2021
redfin perch**	<i>Perca fluviatilis</i>	Noxious list	Established in many freshwater waterways including the River Murray	Recorded in MRLB fish surveys at various wetlands and floodplains in 2021

Common names	Scientific name	Reference list	SA status/distribution	2019–2022 update
roach**	<i>Rutilus rutilus</i>	Noxious list	Established in some freshwater waterways including the River Murray	
speckled mosquitofish (speckled livebearer)**	<i>Phalloceros caudimaculatus</i>	Noxious list	<p>PIRSA most wanted brochure</p> <p>In 2008 the species was found in Willunga Creek, SA. Due to this being the first record of speckled mosquitofish (speckled livebearer) in SA, a significant eradication program using an organic chemical, rotenone, was conducted in 2010. However, the species was detected in 2017</p> <p>Aquarium species</p>	Added to the noxious list in 2019
sleepy cod**	<i>Oxyeleotris lineolata</i>	Native Northern Australian fish, not native to SA.	<p>Established in the Lake Eyre Basin</p> <p>Native in northern Australia from the Ord River area, WA to Noosa, Qld</p> <p>Exotic to SA</p>	Recorded in Lake Eyre Basin fish survey in 2020 and 2021
tench**	<i>Tinca tinca</i>	Noxious list	<p>Established in the River Murray and Onkaparinga River</p> <p>Exotic to Australia- Found in NSW, Vic, Tas and SA</p>	
alligator gar	<i>Atractosteus spatula</i>	Noxious list	<p>PIRSA most wanted brochure</p> <p>Exotic to Australia- Not found in SA</p>	
snakeheads	family Channidae	Noxious list	<p>PIRSA most wanted brochure</p> <p>Exotic to Australia- Not found in SA</p>	

Common names	Scientific name	Reference list	SA status/distribution	2019–2022 update
tilapia	<i>Oreochromis mossambicus</i>	Noxious list	PIRSA most wanted brochure Exotic to Australia- Not found in SA Mozambique tilapia are present in many eastern catchments in southern, central and northern Qld. The species is also expanding its range in the Pilbara drainage division of WA. Small populations have also been found in Victoria and NSW	
<b>Invertebrates</b>				
red Claw	<i>Cherax quadricarinatus</i>	Noxious list	PIRSA most wanted brochure Native to northern Qld and NT Exotic to SA Not found in SA	<b>New incursion - detected and destroyed - aquarium shop in 2022</b>
marron**	<i>Cherax cainii</i>		PIRSA most wanted brochure Established in some waterways on Kangaroo Island and Fleurieu Peninsula Aquaculture species Native in south west WA	
<b>Invasive plants</b>				
alligator weed	<i>Alternanthera philoxeroides</i>	Aquatic Weeds of SA Brochure	Alert weed A Weed of National Significance (WoNS) Not found in SA Naturalised in Qld, NSW, and Vic, but is present in all states	
arrowhead	<i>Sagittaria montevidensis</i>	Aquatic Weeds of SA Brochure	Alert weed Not found in SA Naturalised in NSW, where it is a serious problem in the rice fields in the Murrumbidgee Irrigation Area	

Common names	Scientific name	Reference list	SA status/distribution	2019–2022 update
cabomba	<i>Cabomba caroliniana</i>	Aquatic Weeds of SA Brochure	WoNS It is not naturalised in SA but is still grown in aquaria and has become naturalised in water bodies in NSW, Vic, Qld and NT	
Canadian pond weed**	<i>Elodea canadensis</i>	Aquatic Weeds of SA Brochure	It is established in the River Murray in SA. Present in the River Murray from the NSW border downstream at least to Lock 2 near Waikerie and probably as far as Lock 1 at Blanchetown, but is rarely seen  It is naturalised in Vic, NSW, Qld and Tas	
Eurasian water milfoil	<i>Myriophyllum spicatum</i>	Aquatic Weeds of SA Brochure	Alert weed  Not present in Australia	
horsetail	<i>Equisetum spp</i>	Aquatic Weeds of SA Brochure	Alert weed  Not naturalised in Australia. Several species are present in cultivation in Australia  Not currently known to be naturalised in SA	<b>3 new incursions - detected and destroyed in 3 metropolitan backyards in 2019</b>
Pennywort (Hydrocotyle)	<i>Hydrocotyle ranunculoides</i>	Aquatic Weeds of SA Brochure	Alert weed  Deliberately introduced to Australia as an aquarium and ornamental pond plant.  Not yet naturalised in SA, but has formed infestations on the Canning River near Perth in WA	
lagarosiphon	<i>Lagarosiphon major</i>	Aquatic Weeds of SA Brochure	Alert weed  There are currently no naturalised infestations in Australia	

Common names	Scientific name	Reference list	SA status/distribution	2019–2022 update
leafy elodea**	<i>Egeria densa</i>	Aquatic Weeds of SA Brochure	Alert weed  Occasional outbreaks of leafy elodea have been found in the lower River Torrens and backwaters of the River Murray. These remain visible only for a few months while conditions are favorable, and may not persist  Leafy elodea has also been found in NSW, Vic, WA, Tas and Qld	
celery buttercup (poison buttercup)**	<i>Ranunculus sceleratus</i>	Aquatic Weeds of SA Brochure	Celery buttercup (poison buttercup) is established in the Chowilla area of SA, but there are older herbarium records from Wall Flat and Paiwalla Swamp on the River Murray, and from Rule Swamp on the Victorian border in the Limestone Coast region. It is widespread in NSW and Vict, and naturalised in south-east Qld, WA, and Tas	
sagittaria**	<i>Sagittaria graminea</i> var. <i>platyphylla</i>	Aquatic Weeds of SA Brochure	WoNS  <i>Sagittaria platyphylla</i> has been found in several dams and ponds in the Hills and Fleurieu landscape region where it was planted, and is also likely to persist in some ornamental garden ponds in urban areas. It has now disappeared from most sites on the River Murray but may persist in places where it is almost permanently submerged  It is widely distributed in the Murray Irrigation District, Sydney and Newcastle, Melbourne, Perth, Canberra and Adelaide	<b>New incursion - detected and destroyed - retail pond plant store in 2020</b>
salvinia	<i>Salvinia molesta</i>	Aquatic Weeds of SA Brochure	Alert weed  WoNS  Naturalised in WA, NT, Qld, and NSW, and is found as an occasional escape in Vic and SA	<b>3 new incursions - detected and destroyed - retail store (2019), backyard pond (2020) and retail store (2020)</b>



Common names	Scientific name	Reference list	SA status/distribution	2019–2022 update
Senegal tea plant	<i>Gymnocoronis spilanthoides</i>	Aquatic Weeds of SA Brochure	Alert weed  Naturalised in NSW and more recently in Qld and Vic. Restricted to isolated outbreaks in parts of eastern Australia, from south-eastern Qld, coastal district of northern and central NSW, and central Vic	
water caltrop	<i>Trapa natans</i>		Alert weed  Not yet naturalised or known to be cultivated in Australia	
water hyacinth	<i>Eichhornia crassipes</i>	Aquatic Weeds of SA Brochure	Alert weed  WoNS  Naturalised mainly in NSW and Qld, but also recorded from WA and Vic. A serious outbreak occurred on the River Murray in SA due to deliberate release at Ramco Lagoon in 1939, but was eradicated in the 1950s once modern herbicides had been developed	<b>1 new incursion - detected and destroyed - education centre 2022</b>
water soldier	<i>Stratiotes aloides</i>	Aquatic Weeds of SA Brochure	Alert weed  Not yet naturalised or cultivated in Australia	

Alert Weeds are invasive weeds that are not known to be in South Australia, or if present, occur in low numbers in a restricted area and are still capable of being eradicated. An Alert Weed would pose a serious threat to the state's primary industries, natural environments, or human health if it became established here. All Alert Weeds are declared under the *Landscape South Australia Act 2019*. Their transport and sale are prohibited, plants must be destroyed and, if found on your land, their presence must be notified to Landscape SA authorities.

In addition to the SA Alert Weeds and aquatic pests, there is a National Priority List of Exotic Environmental Pests, Weeds and Diseases (abbreviated to the Exotic Environmental Pest List (EEPL)) which lists 168 exotic species of significant environmental and social amenity risk to Australia, including 3 weeds and freshwater algae, 5 freshwater invertebrates and 2 freshwater vertebrates of high risk (see below in Table 3.3). These species are not found in Australia and none of these species have been recorded in South Australia.

**Table 3.3. Freshwater EEPL pest animals and weeds**

<b>Freshwater invertebrates</b>			<b>2022 status</b>
Asian clam	<a href="#"><i>Corbicula fluminea</i></a>	Freshwater shellfish	Not known in SA
Chinese mystery snail and Japanese mystery snail	<a href="#"><i>Cipangopaludina chinensis</i></a> and <a href="#"><i>C. japonica</i></a>	Freshwater snail	Not known in SA
golden apple snail and island apple snail	<a href="#"><i>Pomacea canaliculate</i></a> and <i>P. maculata</i>	Freshwater snail	Not known in SA
Quagga mussel and zebra mussel	<a href="#"><i>Dreissena bugensis</i></a> and <a href="#"><i>D. polymorpha</i></a>	Freshwater shellfish	Not known in SA
quilted melania	<i>Tarebia granifera</i>	Freshwater snail	Not known in SA
<b>Freshwater vertebrates</b>			<b>2022 status</b>
climbing perch	<i>Anabas testudineus</i>	fish	Not known in SA
silver carp	<i>Hypophthalmichthys molitrix</i>	fish	Not known in SA
<b>Weeds and freshwater algae</b>			<b>2022 status</b>
didymo	<i>Didymosphenia geminata</i>	Algae (Chromista - freshwater diatom)	Not known in SA
manchurian wild rice	<i>Zizania latifolia</i>	plant	Not known in SA
mikania	<i>Mikania micrantha</i>	plant	Not known in SA

## 3.2 Condition

### 3.2.1 Established invasive species abundance and distribution

At the whole of state scale, current condition for abundance and distribution of established inland waters invasive species is 'Poor'. Established invasive fish are widespread, with high biomass in some catchments. Aquatic plants are also found in many waterways.

Invasive fish are found in almost all South Australian waterways. Aquatic weeds and invertebrates are also established in South Australian waterways. Once established invasive aquatic species are difficult to eradicate.

There has been no reported spread of established invasive aquatic species to new regions.

There is very limited information on established aquatic invasive species abundance, except for European carp which is monitored as part of the wider Lakes and Coorong Fishery assessments.

### 3.2.2 New incursions of invasive species

At the whole-of-state scale, current condition of invasive aquatic species outbreaks was assessed as 'Unknown'.

There were 9 detections of new incursions of invasive aquatic species in South Australia for the last four years. These were red claw (invertebrate), sagittaria, salvinia (3 occasions), horsetail (3 occasions) and water hyacinth (aquatic plants/weeds). The detections were found in the following landscape regions: Green Adelaide (6), Hills and Fleurieu (2), and Northern and Yorke (1).

### 3.3 Reliability

The overall reliability score for the *Inland waters: Established invasive species abundance and distribution report card* is 2 out of 5, based on Table 3.4. This is considered to be 'Fair' reliability.

The overall reliability score for the *Inland waters: New incursions of invasive species report card* (i.e. reported detections of invasive aquatic species) is 1 out of 5, based on Table 3.4. This is considered to be 'Poor' reliability.

**Table 3.4. Information reliability scores for trends for invasive aquatic species**

Indicator	Applicability	Currency	Spatial	Reliability
Inland waters: Established invasive species abundance and distribution	2	3	2	2
Inland waters: New incursions (reported detections) of invasive aquatic species	1	3	1	1

#### 3.3.1 Notes on reliability

Invasive aquatic species in inland waters information can be somewhat detailed at regional scale (presence/absence) from passive surveillance reports and information from various research projects/databases. This data does not inform trends in invasive plants or animals over time. There is limited information on abundance of invasive aquatic species apart from European carp in South Australia.

For the *Inland waters: Established invasive species abundance and distribution report card*: Applicability was given a score of 3 as all data are from indirect measures of the indicator, e.g. Lakes and Coorong Fishery carp abundance and ad hoc reports of pests' locations from various research projects/databases. Currency was scored 3 as the Lakes and Coorong Fishery assessments are undertaken regularly with reported commercial catches, however other pest species numbers for abundance are largely unknown and from reports over various timeframes. Some aquatic invasive species distribution information is recorded in the biosecurity databases and data collected via other research projects. Spatial was scored 2, as the data are only detailed in the Coorong for carp, and limited other data exists across the state for abundance and distribution.

The *Inland waters: New incursions of invasive species (reported detections of invasive aquatic species report card)*: Applicability was scored 2 as the data are based on indirect indicator – public reports. Currency was given a score of 3 because while the reports are recent there is very limited surveillance undertaken. Spatial was given a score of 1 as there are limited reports from around the state, and these are largely from metropolitan areas where the populations are greater.

# 4 Discussion

## 4.1 Trend

### 4.1.1 Established invasive species abundance and distribution

At the scale of the whole-of-state, the current trend for established invasive species abundance and distribution in inland waters in South Australia is stable.

European carp, goldfish, mosquito fish, oriental weatherloach, redfin perch, roach, speckled mosquitofish (also known as speckled livebearer), sleepy cod, tench, marron, Canadian pond weed, celery buttercup (also known as poison buttercup) and sagittaria are established in South Australian waterways. Outbreaks of other aquatic weeds, such as leafy elodea, are seen occasional.

The introduction and spread of aquatic invasive species is regarded by many as a major threat to global freshwater biodiversity and hence ecological sustainability. Distribution is monitored through passive surveillance, with reports of invasive species through public reports and indirectly through projects that monitor the ecological health of freshwater systems, and at times through targeted local surveys.

### 4.1.2 New incursions of invasive species

At the scale of the whole-of-state, the current trend in new incursions of invasive aquatic species in inland waters in South Australia is unknown. There were 9 reported new incursions of invasive aquatic species reported in 2019–2022, for 5 species.

Trends were not calculated in this assessment for new invasive species. Annual increases in incursions are unlikely to represent actual change. For example, public education campaigns can lead to increases in detections, which is not indicative of trends in the number of new incursions. In addition, this is the first year that all aquatic invasive species are jointly reported for inland waters (previous reporting focussed only on fish) and as such there is no baseline for comparison.

## 4.2 Condition

### 4.2.1 Established invasive species abundance and distribution

Invasive aquatic species are distributed in large numbers in South Australia's waterways. At the scale of the whole-of-state, the current condition for established invasive species abundance and distribution in inland waters is poor because established invasive fish are widespread, with high biomass in some catchments and aquatic plants are also found in many waterways.

Invasive fish are found in almost all South Australia's waterways. Aquatic weeds and invertebrates are also established in South Australian waterways. Once established invasive aquatic species are difficult to eradicate.

There have been no reports of established invasive aquatic species spreading to new regions.

There is very limited information on abundance, except for European carp which is monitored as part of the wider Lakes and Coorong Fishery assessments.

#### **4.2.2 New incursions of invasive species**

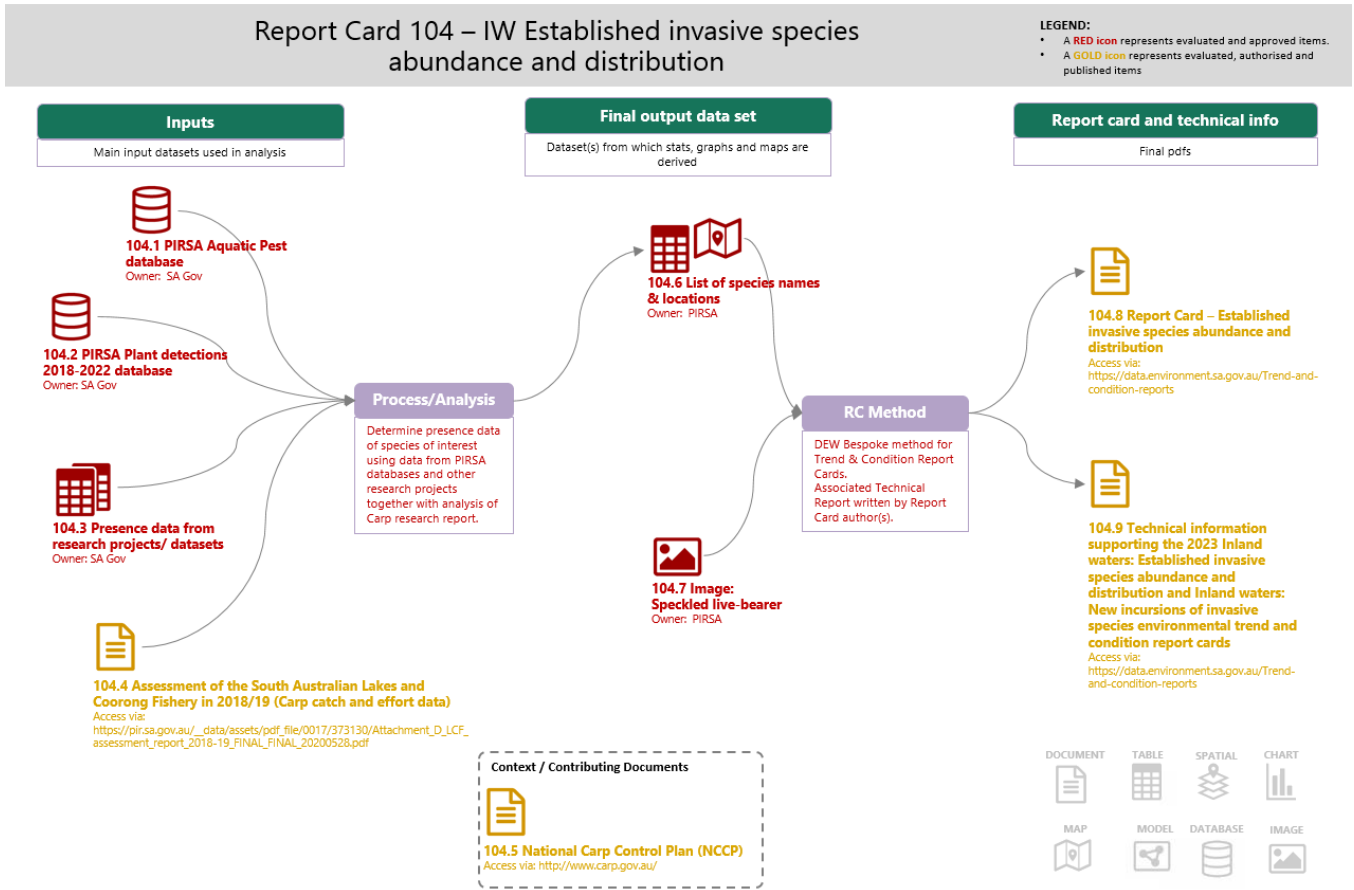
At the whole-of-state scale, current condition of aquatic invasive species outbreaks was assessed as unknown.

There were 9 incursion incidents from 2019–2022 of 5 species. These were red claw (invertebrate), sagittaria, salvinia (3 occasions), horsetail (3 occasions), and water hyacinth (aquatic plants/weeds). These species have all previously been detected in the past in South Australia. Each incursion was investigated, and the population destroyed. The detections were found in the following landscape regions: Green Adelaide (6), Hills and Fleurieu (2), and Northern and Yorke (1).

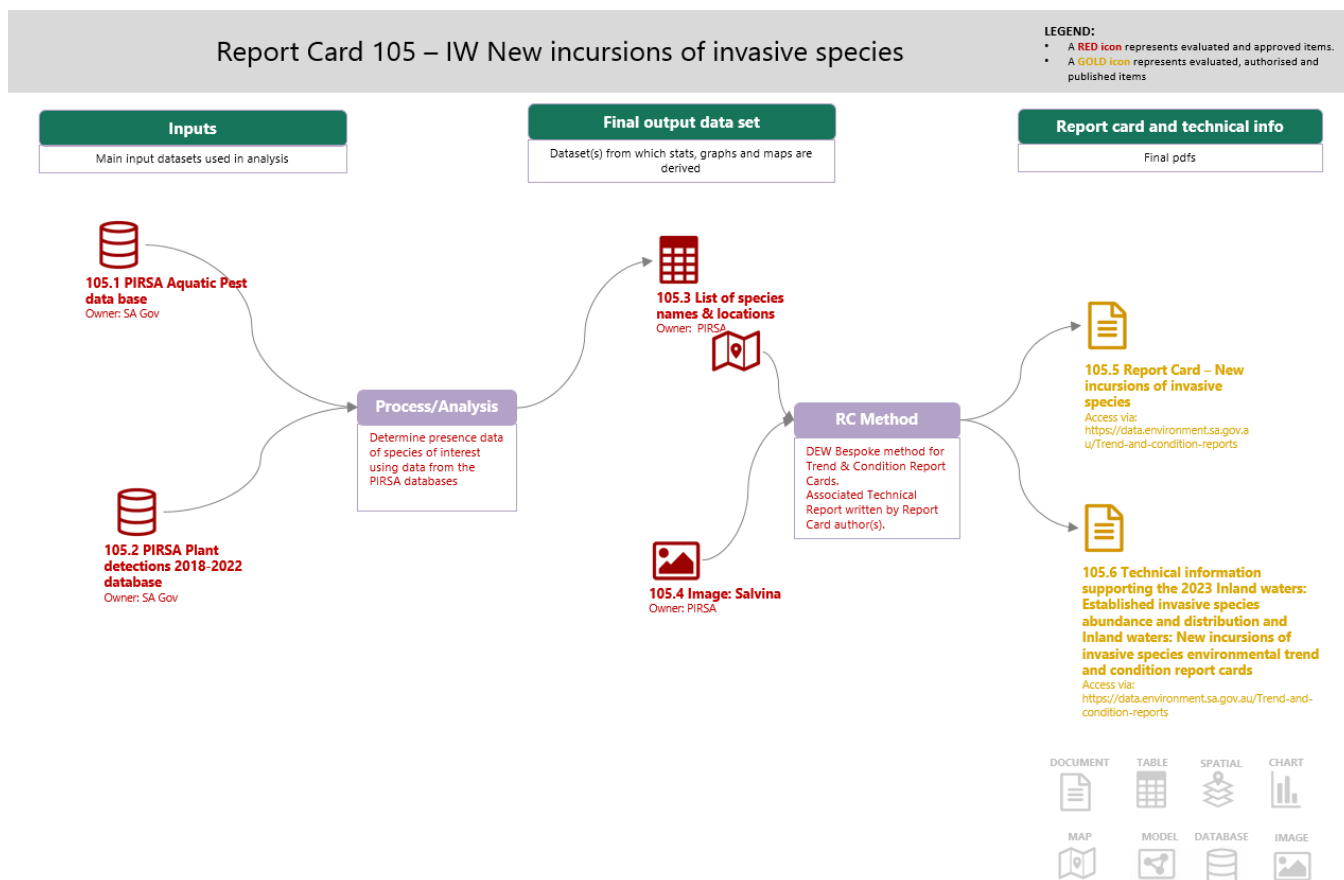
These incursions were reported by the public and were found in backyards and retail settings. No new incursions were reported in the environment.

# 5 Appendices

## A. Managing environmental knowledge chart for Inland waters: Established invasive species abundance and distribution



## B. Managing environmental knowledge chart for Inland waters: New incursions of invasive species (non-established invasive species)



## 6 References

Bomford M (2008). Risk assessment models for establishment of exotic vertebrates in Australia and New Zealand. Invasive Animals Cooperative Research Centre, Canberra.

Earl, J (2020). Assessment of the South Australian Lakes and Coorong Fishery in 2018/19. Report to PIRSA Fisheries and Aquaculture. South Australian Research and Development Institute (Aquatic Sciences), Adelaide. SARDI Publication No. F2020/000208-01. SARDI Research Report Series No. 1059. 81pp.

Government of South Australia (date unknown). Aquatic weeds of South Australia brochure, Government of South Australia, Adelaide,

[www.pir.sa.gov.au/data/assets/pdf\\_file/0019/137008/nrmbu\\_Aquatic\\_weeds\\_in\\_SA\\_broch\\_final.pdf](http://www.pir.sa.gov.au/data/assets/pdf_file/0019/137008/nrmbu_Aquatic_weeds_in_SA_broch_final.pdf).

IUCN (2000). *IUCN guidelines for the prevention of biodiversity loss caused by alien invasive species*, IUCN–The World Conservation Union, Gland, Switzerland.

McLeod R (2004). Counting the Cost: Impact of Invasive Animals in Australia 2004. Cooperative Research Centre for Pest Animal Control. Canberra.

McLeod (2016). Cost of pest animals in NSW and Australia, 2013-14. eSYS Development PTY Ltd, 2016. Report prepared for the NSW Natural Resource Commission.

MDBA (2011). Mozambique tilapia: The potential for Mozambique tilapia *Oreochromis mossambicus* to invade the Murray–Darling Basin and the likely impacts: a review of existing information, Murray–Darling Basin Authority, [www.mdba.gov.au/sites/default/files/pubs/Tilapia-report.pdf](http://www.mdba.gov.au/sites/default/files/pubs/Tilapia-report.pdf).

Stuart I, Fanson B, Lyon J, Stocks J, Brooks S, Norris A, Thwaites L, Beitzel M, Hutchison M, Ye Q, Koehn J & Bennett A (2019). A national estimate of carp biomass for Australia. Unpublished Client Report for the Fisheries Research and Development Corporation. Arthur Rylah Institute for Environmental Research, Department of Environment, Land, Water and Planning, Heidelberg, Victoria.





**Government  
of South Australia**

Department for  
Environment and Water