Technical information supporting the 2018 inland waters: invasive fish (established invasive fish abundance and distribution) trend and condition report card

DEW Technical note 2018/04

Government of South Australia
Department for Environment and Water

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June, 2018

DEW Technical note 2018/12

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ISBN 978-1-925668-55-1

Preferred way to cite this publication

Department for Environment and Water (2018). Technical information supporting the 2018 inland waters: invasive fish (established invasive fish abundance and distribution) trend and condition report card. DEW Technical note 2018/12, Government of South Australia, Department for Environment and Water, Adelaide.

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

Consultation and acknowledgements

Document was prepared by Katelyn Ryan. Information was provided by Alex Chalupa, Michelle Beasley, Ross Meffin, David Cooke, Lindell Andrews, Brad Page (Biosecurity SA), Brett Dalzell, Leah Feuerherdt, Kym Haebick, Susan Ivory, Peter Michelmore, Greg Patrick, Grant Roberts and Peter Wilkins (DEW). Colin Cichon provided editing. Fi Taylor, Glen Scholz, Michelle Bald, Ben Smith and Sandy Carruthers (DEW, Science and Information Group) and Brad Page (Biosecurity SA) provided technical and policy reviews.

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Summary

This document describes the indicators, data sources, analysis methods and results used to develop this report and the associated report card. The reliability of data sources for their use in this context are also described.

1 Introduction

Aquatic invasive species are those plants, animals, parasites or disease-causing organisms that 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. This trend and condition report looks at the distribution and abundance of key invasive fish species that are found in the inland waters of South Australia. This assessment is part of the broader State Trend and Condition Reporting of South Australia's environmental assests and pressures. Related report cards on biosecurity in inland waters and biosecurity and invasive species in marine and coastal environments can be found in the the 2018 suite of environmental trend and condition report cards.

Invasive species arrive in South Australia through range expansion of existing invasive species, 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 cost the recreational fisheries sector $44 million in the Murray-Darling Basin catchments each year (McLeod 2016). Invasive species compete with our native plants and animals for habitat and resources, contribute to waterway degradation, cause damage to water-use infrastructure, impact recreational and commercial fisheries, and can be toxic to people, livestock or native animals (Department of the Environment and Energy 2016). Aquatic weeds and pest animals can impact cultural sites and species.

Governments and landholders invest heavily in biosecurity to protect our primary industries and natural resources against the impacts of invasive aquatic plants and animals, by preventing their introduction and spread. Regional Natural Resources Management (NRM) boards and Biosecurity SA (a division of Primary Industries and Regions SA (PIRSA)) oversee programs to destroy or contain aquatic invasive species, and prevent new ones from establishing in South Australia. Control methods include removal, smothering, chemical treatment and education in line with current threats and opportunities. For example, the national carp control plan is being prepared to explore the possible release of a carp virus, to reduce impacts of carp and improve Australia's waterways.

This assessment addresses key aquatic invasive species as listed by Biosecurity SA as freshwater fish found in South Australia, based on current policies and regulations and their current or potential impact.

2 Methods

2.1 Data sources

Species information was provided by DEW and Biosecurity SA, based on research, monitoring, control efforts, and reports by public, private and other agencies (e.g. State Herbarium of South Australia).

Sleepy cod Sternberg & Cockayne, in review

Carp information available on the http://www.carp.gov.au/ website (provides references in the FAQ section).

Oriental weatherloach Wegener & Suitor 2015.

Gambusia Murray-Darling Basin Gambusia science and management forum 2011.

2.2 Indicators

Abundance and distribution of key invasive fish in inland waters

Pest fish are those species recognised in South Australia according to Biosecurity SA information, which is founded on policies and legislation by the state and federal government, including the *South Australian Fisheries Act 2007*, the *Natural Resource Management Act 2004*, Weeds of National Significance, Pest and Weed Risk Management processes and the Weed Control Handbook.

Table 2.1. Key pest fish that are addressed in the report

Common names	Species name
European carp	*Cyprinus carpio*
Goldfish	*Carassius auratus*
Gambusia (Mosquito fish)	*Gambusia holbrooki* and *affinis*
Oriental weatherloach	*Misgurnus anfuillicaudatus*
Redfin perch	*Perca fluviatilis*
Roach	*Rutilus rutilus*
Sleepy cod	*Oxyeleotris lineolata*
Tench	*Tinca tinca*

2.3 Trend

Trend was assigned to a category (**Table** 2.2) based on a review of literature in the last five years (2013–17) that indicated populations trends of invasive plants or animals in inland waters, and expert opinion by Biosecurity SA. Trend scores were assigned to each region and then aggregated to state level. No further analysis of data was conducted as part of this assessment.

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 2013–17
Stable	Over a scale relevant to tracking change in the indicator it is neither improving or declining in status	No change in Distribution and abundance between 2013–17
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 2013–17
Unknown	Data are not available, or are not available at relevant temporal scales, to determine any trend in the status of this resource	Distribution and abundance 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.

2.4 Condition

Condition score is a single state-level statement of condition for 2017 that has been derived from the *Natural Resource Management Act 2004* and related to invasive inland water species (Table 2.3). It was assigned based on a review of literature in the last five years (2013–17) and expert opinion by Biosecurity SA.

Condition scores were assigned to each 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

Condition	Description	Threshold
Very good	Natural resources and our environmental, social and economic expectations of these (e.g. primary productivity) are not affected by invasive species.	N/A
Good	Natural resources and our environmental, social and economic expectations of these (e.g. primary productivity) are marginally affected by invasive species.	N/A
Fair	Natural resources and our environmental, social and economic expectations of these (e.g. primary productivity) are moderately affected by invasive species.	N/A
Poor	Natural resources and our environmental, social and economic expectations of these (e.g. primary productivity) are significantly affected by invasive species.	N/A
Unknown	Data are not available to determine the impact of invasive species on our natural resources	-
Not applicable	Invasive species impact does not lend itself to being classified into one of the above condition classes	-

2.5 Reliability

Information is scored for reliability based on the average of subjective scores (1 [worst] to 5 [best]) given for information currency, applicability and level of spatial representation. Definitions guiding the application of these scores are provided in Tables 2.4, 2.5 and 2.6, respectively.

Table 2.4. Guides for applying information currency

Currency score	Criteria
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 2.5. Guides for applying information applicability

Applicability score	Criteria
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 2.6. Guides for applying spatial representation of information (sampling design)

Spatial score	Criteria
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

3 Results

3.1 Reliability

The overall reliability score for this report card is 1, based on Table 3.1

Table 3.1 Information reliability scores for distribution of invasive species

Indicator	Applicability	Currency	Spatial	Reliability
Invasive species data	4	1	2	
Overall	-	-	-	Reduced to 1

This assessment is a review of current literature. Some data on pest fish are available via the Biological Databases of South Australia but calculations to model distribution and abundance are under review.

The reliability assessment here does not qualify the reliability of the background reports that inform this assessment. Rather, it measures their ability to draw standardised conclusions about the change in distribution and abundance of pest fish in the 5-year assessment period, as well as the impact of pest fish.

Recent literature, while comprising reliable data, are limited in their ability to determine changes in the trend and condition of key invasive species (plants and animals) across the South Australian inland waters between 2013–17. For example, data from these reports have differing time frames, methods, locations and assessments, which prevents a whole-of-state assessment of aquatic invasive species.

In summary, the reliability of data in this report has been classed as poor because data do not adequately represent changes in the distribution and abundance of invasive plants and animals, at the scale and reporting timeframe required in this report.

This assessment does not address aquatic invasive plants and other aquatic vertebrate pests. Information about these can be found on Biosecurity SA factsheets, see aquatic weeds and pests.

3.2 Trend

Based on expert opinion and at the state level, trends in the abundance and distribution of pest fish are getting worse and condition is poor.

There are local scale projects that monitor the abundance of invasive freshwater species, and these projects have been used to inform the regional and state trends provided by Biosecurity SA staff.

Sleepy cod detection and establishment in Coopers Creek system – Distribution and reports (Sternberg & Cockayne, in review).

Carp have increased their distribution and biomass due to recent increased flow and inundation of the wetland breeding habitats – information available on the http://www.carp.gov.au/ website (provides references in the FAQ section).

Oriental weatherloach have increased distribution within the River Murray and are found the full length within South Australia (Wegener & Suitor 2015).

Gambusia (mosquito fish) – spread throughout SA and cause impacts to freshwater species within ecosystems (Murray-Darling Basin Gambusia science and management forum 2011).

Some studies have been undertaken at local scales that help us to understand the relative abundance and biomass of invasive species in response to water flows. Flooding has been linked with increased recruitment of invasive species, in particular carp, oriental weatherloach and gambusia (Stuart & Jones 2006; Beesley *et al*. 2012). Drought can have a reducing effect but this depends on conditions and connected refuges. For example, trends in the biomass of European Carp in the Lower Lakes and Coorong estimated using fishing catch data from 1985–2015 show a decline in carp during the millennium drought (Figure 4.2).

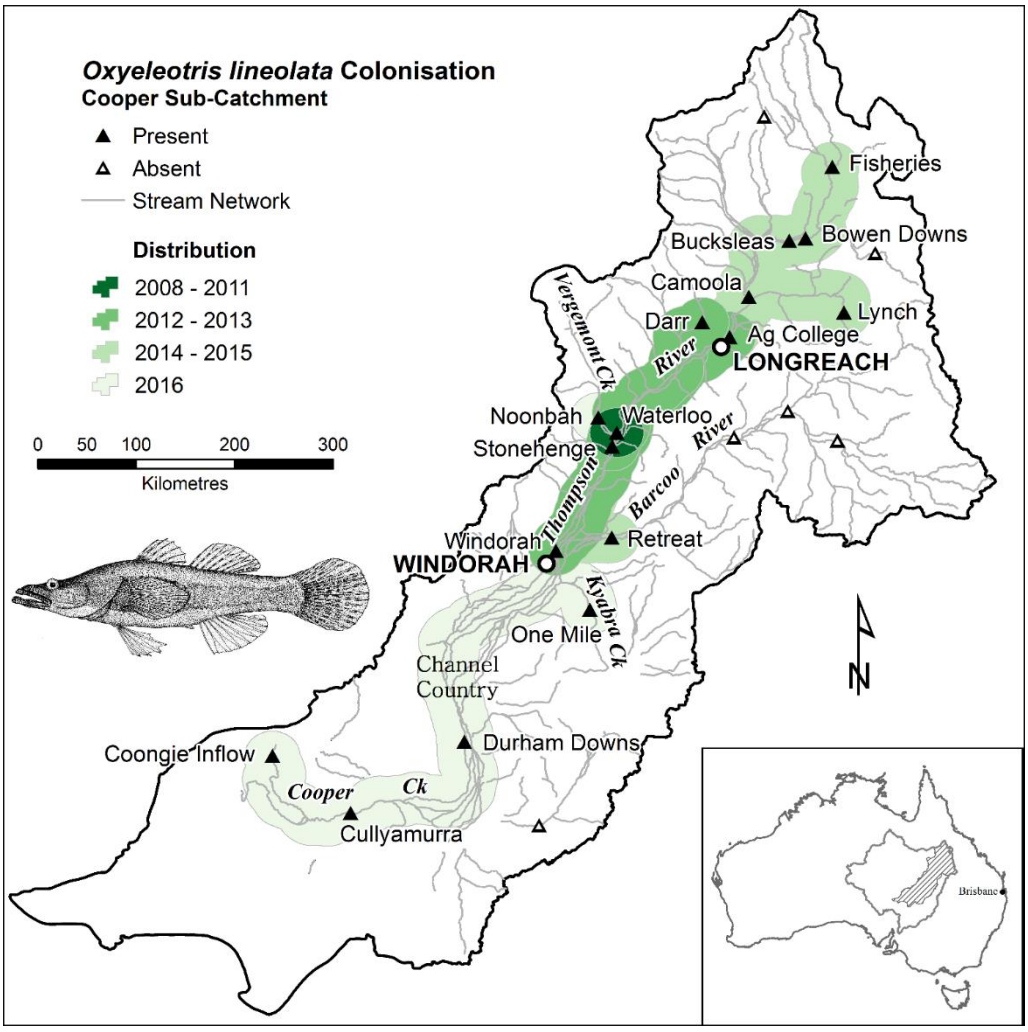

Figure 3.1 (Figure from Sternberg and Cockayne in Review) Sleepy cod were first recorded in the Lake Eyre Basin in 2008, at 'Waterloo' waterhole at the confluence of Vergemont Creek and the Thomson River (Kereszy 2010). Since 2008 Sleepy cod has spread throughout the Cooper Creek catchment, crossing the Qld–SA state jurisdictional boundary and colonising the Coongie Lakes Ramsar site.

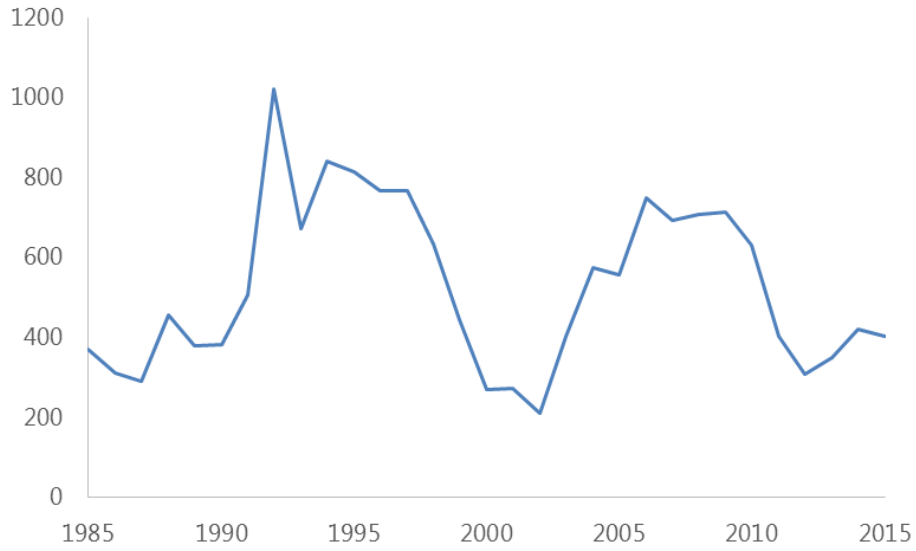

Figure 3.2 Commercial catch of European Carp, Cyprinus carpio, in the Lower Lakes and Coorong fisheries

Sleepy cod are an example of how an invasive species spread. Sleepy cod are a native species to the coastal drainages of north eastern Australia and the Gulf of Carpentaria but is not native to the Lake Eyre Basin (Pusey *et al.* 2004). In 2008 sleepy cod were detected in the Queensland area of Cooper Creek catchment (Kereszy 2010), they spread throughout the catchment and have colonised the Coongie Lakes Ramsar site.

Studies of the distribution of sleepy cod in the Lake Eyre Basin show that private persons are the most likely vector of transport and introduction into the Lake Eyre Basin (Kereszy 2010). The trend for this species is getting worse, and has increased its distribution and relative biomass to native fishes (Sternberg & Cockayne 2017). Relative biomass stayed below 10 per cent in the early years (2011–13), and rapidly increased in later years to an average of 30 per cent in 2016 (but as high as 45 per cent in some areas). Sleep cod are a serious conservation risk to fish species outside its natural range. Sleep cod can negatively influence native fish assemblages through both direct and indirect competition in dry-season waterholes (Sternberg & Cockayne 2017). Sleepy cod are a particular threat to the native catfish (Arthington & Cockayne 2017).

Eradication of sleepy cod from the Cooper Creek catchment is likely impossible given the widespread distribution and remoteness of the receiving landscape, and the current lack of impetus to effect change (Sternberg & Cockayne 2017).

3.3 Condition

The current condition of invasive fish are estimated to be poor in 2017 based on current abundance and impact on freshwater biodiversity.

Invasive fish are a recognised threat to freshwater fish, by competition, predation, aggression, habitat modification, transfer of diseases and parasites, and genetic impacts, according to the 2009 Action Plan for South Australian Freshwater Fishes.

Invasive fish have environmental, social and economic impacts in our waterways. They can alter the structure and function of aquatic ecosystems, compete with native species, reduce water quality, spread disease, and affect recreation and tourism. For example apart from the direct environmental impact, carp are estimated to cost the recreational fisheries sector $44 million annually in the Murray-Darling Basin.

Invasive fish can disperse beyond their natural range and become established naturally or by human activity, such as translocation of fishing species. With increasing trade, transport and development the risk of new incursions is high. Invasive fish distribution and abundance can change in response to climate, and changes in water flows and availability. Some invasive species are not easily seen and may be hard to identify, meaning that they are more likely to establish

The primary focus of invasive species management is community education, for prevention of human assisted dispersal. Human assisted dispersal is by far the most common source of non-native species range expansion in freshwater systems, and the relatively low diversity of the fish fauna of Australia's inland drainages renders them particularly susceptible to invasion (Lintermans et al. 2004). Community education is therefore a key invasive species management action for the prevention of future non-native fish introductions. This is particularly important in areas which currently have few or no invasive species such as some of our central arid waterways, the Upper South East region, and parts of the southern Fleurieu Peninsula.

Once an invasive fish is established in a natural waterway, its removal is near impossible. For species that are already established, control options include removal, smothering and chemical treatment. Management activities also include compliance, but these are secondary to education.

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