

Basin Plan Fish Monitoring Summary (2014/15 – 2023/24): Water Resource Planning Area Reports

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March 2025



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Cover image credit: NSW DPIRD FER Staff; Fish images credit: Gunther Schmida

Acknowledgements

This work is funded by the NSW Department of Primary Industries and Regional Development and the Commonwealth Government under the *Federation Funding Agreement – Environment on Implementing Water Reform in the Murray-Darling Basin*. The dataset used in the temporal analysis was generated by NSW DPIRD Fisheries from 1994–2024 and sourced from multiple internally and externally funded projects. The authors acknowledge past and present DPIRD Fisheries scientists, technicians and managers who contributed to its collection, as well as the ongoing support of external collaborators and funding agencies (in particular, the Murray–Darling Basin Authority, the Commonwealth Environmental Water Office, and the NSW Freshwater Recreational Fishing Trust). Thank you to Camila Leite Martins for assistance with formatting the reports. We continue to be thankful for the ongoing site access granted by private landholders across NSW and acknowledge that we work on Country which always was and always will be Aboriginal land. The fish surveys that generated the data used in our analyses were conducted under permits approved by the NSW Fisheries Animal Care and Ethics Committee.

Chapter 1 Introduction and Preface

This report spans 2014/15 – 2023/24 and expands upon the previous reports of [Schilling & Crook \(2023\)](#) and [Schilling & Crook \(2024\)](#). This updated report was produced as part of the [revised BPEOM-Fish program](#) but also includes relevant data from a range of projects. Each chapter reports on a different New South Wales (NSW) Water Resource Planning Area (WRPA; Figure 1.1). The New South Wales Lower Darling and Murray WRPA was split into two regions for more spatially explicit reporting.

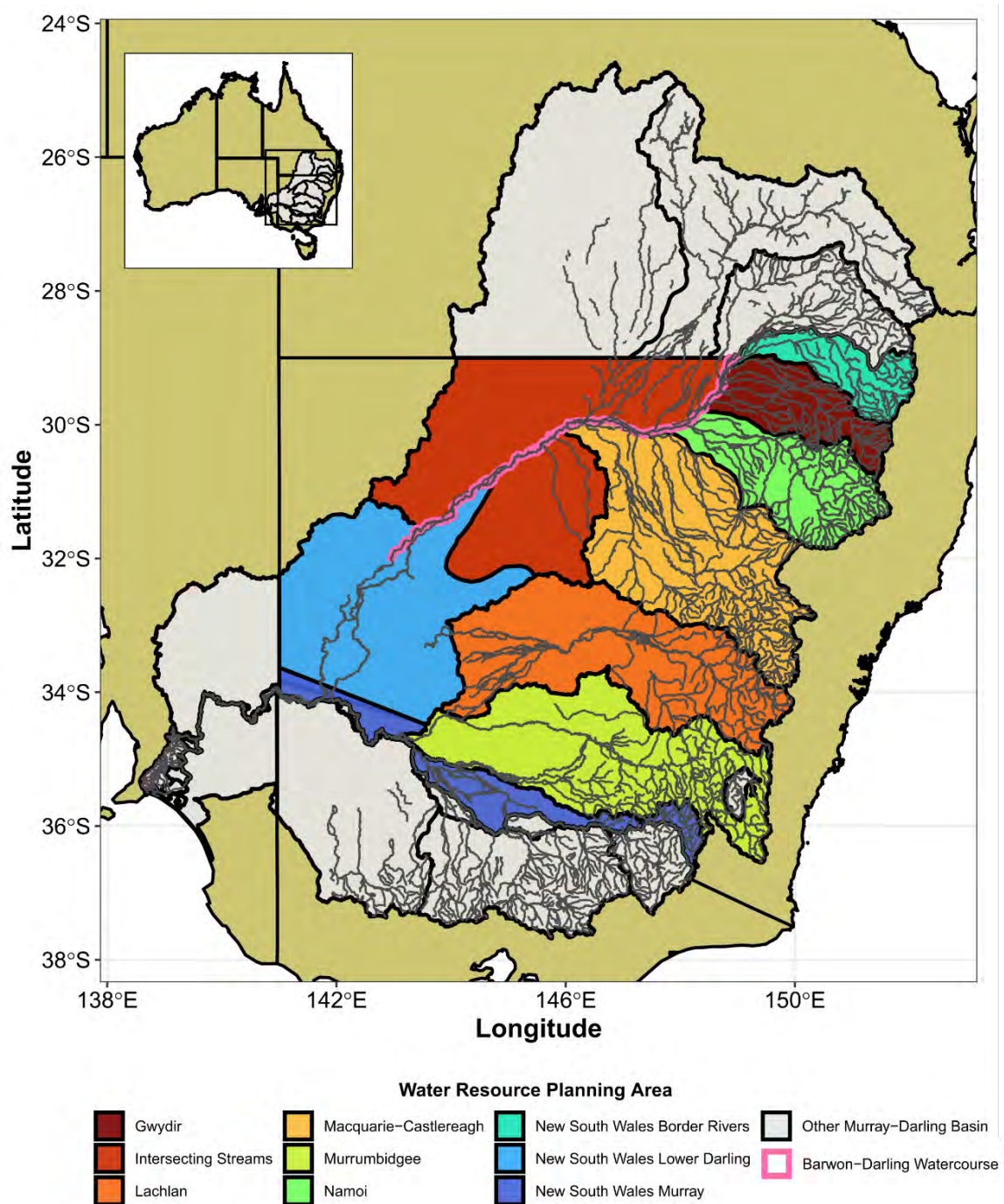


Figure 1.1: Map showing the Water Resource Planning Areas (WRPAs) contained within this report. WRPAs outside of NSW are not reported in this document. Note the New South Wales Murray and Lower Darling WRPA has been split into two separate areas for this report.

The purpose of this report is to provide succinct summaries of key information at the WRPA scale to support river and fishery management. Ultimately this information aims to inform and contribute to the Basin-wide Environmental Water Strategy. Each chapter (Chapters 2 – 11) is designed as a stand-alone report that can be viewed in isolation and, as such, there is repetition among the chapters. Each chapter is also formatted identically to aid readers in locating information.

A particular focus is given to the following six species:

- Murray cod
- Golden perch
- Freshwater catfish
- Bony herring
- Australian smelt
- Common carp

These species were specifically reported against for a variety of reasons which differed among species but included:

- They have distributions covering large portions of the NSW Murray-Darling Basin;
- Some are key species for recreational fisheries;
- Some are key components of aquatic food chains that support ecosystem function;
- Carp is the most dominant invasive fish species across the NSW MDB.

Major changes in this report compared to the previous report (Schilling & Crook 2024) are:

- The inclusion of data from 2023/24, extending the previous timeseries by 1 year;
- The analyses of abundance and biomass have been altered to provide annual estimates;
- Maps have been improved to increase readability and clarity.

References

Schilling, H., Crook, D. 2023. Basin Plan Environmental Outcomes Monitoring for Fish (2014/15 – 2019/20): Water Resource Planning Area Reports. NSW Department of Primary Industries. Fisheries NSW, Port Stephens Fisheries Institute. 517pp. (PUB23/369)

Schilling, H., Crook, D. 2024. Basin Plan Fish Monitoring Summary (2014/15 – 2022/23): Water Resource Planning Area Reports. NSW Department of Primary Industries Fisheries, Port Stephens Fisheries Institute. 572pp. (PUB25/277)

Chapter 2 Basin Plan Fish Monitoring Summary (2014/15 – 2023/24): Barwon-Darling Watercourse Water Resource Planning Area

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Chapter cover image credit: NSW DPIRD FER Staff; Fish images credit: Gunther Schmida

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Introduction

This report spans 2014/15 to 2023/24 and uses all suitable fish assemblage data collected by NSW DPIRD Fisheries using standardized electrofishing monitoring techniques. The format of the report follows and expands upon the previous reports (Schilling & Crook 2023, 2024). This report focusses on the Barwon-Darling Watercourse Water Resource Planning Area (WRPA) shown in Figure 2.1.

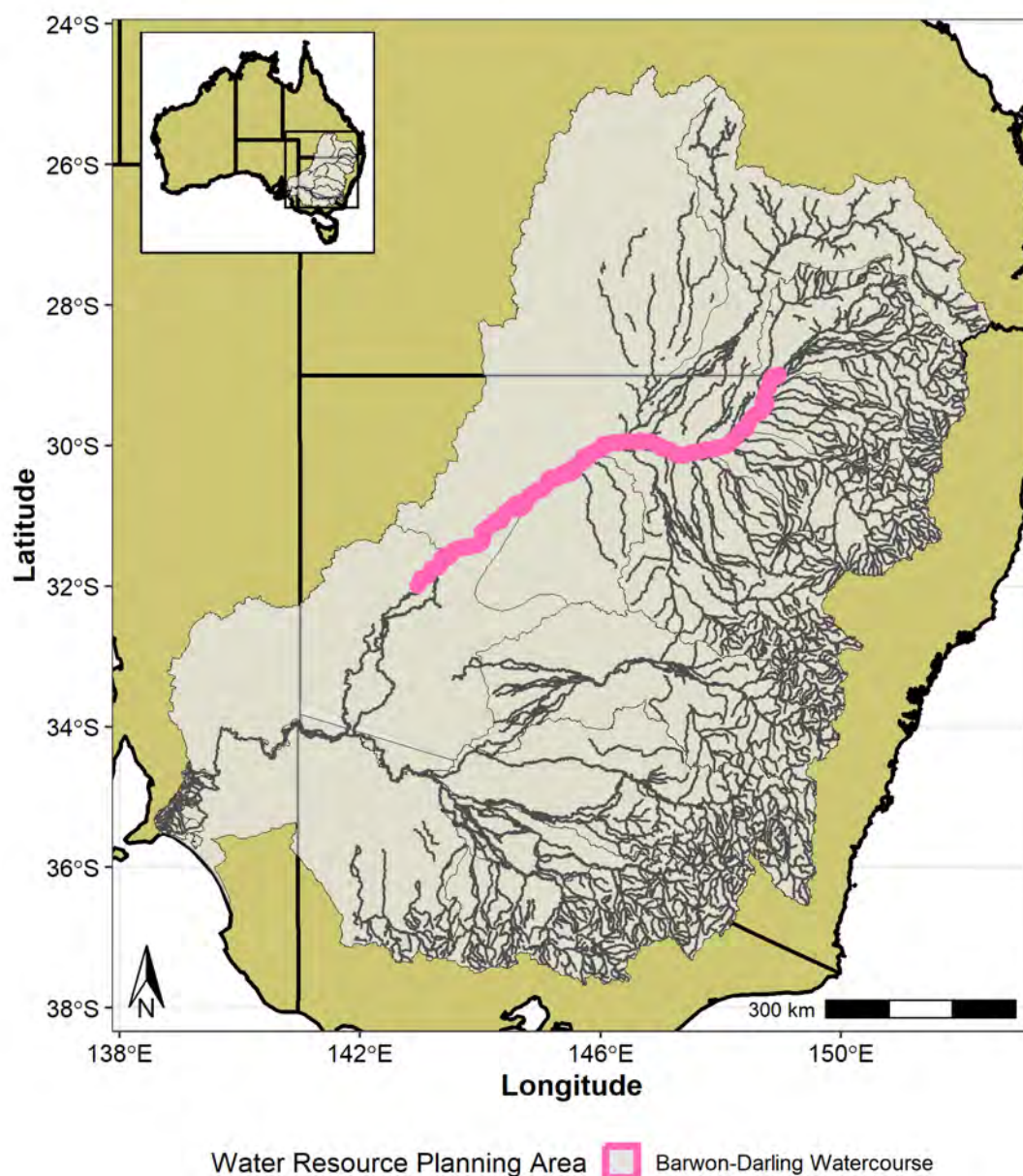


Figure 2.1: Murray-Darling Basin with the key region of this report highlighted. Inset map shows the whole of Australia with a box around the MDB.

What This Report Includes

This report starts with an overview of the standardised monitoring programs including sampling details and statistics. An overview of the hydrological and climatic conditions during the reporting period is also provided as context for interpreting the fish population status data.

Following the introductory sections, we present a summary of *fish diversity* across the Barwon-Darling Watercourse WRPAs. Separate plots for native and alien species show the total number of unique species observed at each site.

The main body of the report provides detailed information on the *population structure, relative abundance, health, and distribution* of six key fish species:

- Murray cod
- Golden perch
- Freshwater catfish (not recorded in this WRPAs over the sampling period)
- Bony herring
- Australian smelt
- Common carp

Population structure information includes length frequency plots of collected fish and the proportion of fish classified as Young of the Year (YOY). This information can be used to infer the size structure of populations and the level of recruitment each year. For additional context, we provide a summary table showing any stocking which occurred for the species in each year (if relevant).

Relative abundance and *relative biomass* (a unit-less measure representing the number (or biomass) of fish in an area) information is adapted from the modelled outputs from a more in-depth publication (Crook et al. 2023) which considers all available electrofishing data within the NSW Murray-Darling Basin (MDB). The updated analysis uses generalised linear mixed models to generate annual indices of relative abundance and biomass for each WRPAs. In this report we present the modelled time series of relative abundance showing the predicted number (or biomass) of fish observed per 90 second shot of electrofishing. The abundance and biomass trends for the Barwon-Darling Watercourse WRPAs are contrasted with the overall NSW MDB dataset. It should be noted that these are modelled estimates of relative abundance/biomass, not absolute abundance/biomass. Absolute estimates would require extensive calibration surveys that are not included in the monitoring program.

Health information is provided as a summary of any visible health conditions recorded for the key species. The number of health conditions observed in a fish population is generally reflective of water quality, competition, and many other factors. Fewer observations of health conditions indicate healthier populations. The health conditions detailed are any that were observed as part of the biological measurements taken. We provide a comparison of the prevalence of health conditions in the Barwon-Darling Watercourse WRPAs and greater MDB (excluding the Barwon-Darling Watercourse WRPAs).

Distribution maps are provided for each species to show the observed distribution of each species from electrofishing samples. The distribution maps also show the relative abundance (number of fish observed per 90 seconds of electrofishing) at each site to give an indication of how the population is spread over the landscape.

Finally, the distributions and numbers of *Threatened species* are reported. The report includes threatened species that were recorded by standardised monitoring programs in the Barwon-Darling Watercourse WRPAs during the reporting period.

For each section of the report, we provide a *Summary Statement*. This statement provides a very brief overview of the key messages for each section.

Sampling Methods

Three main methods are used during routine fish monitoring surveys: boat electrofishing, backpack electrofishing and bait traps. This report mainly includes the electrofishing data with bait trap samples informing the distribution of small bodied species. The electrofishing was conducted using the standard methodology implemented in the Sustainable Rivers Audit (SRA; Davies et al. 2010). This usually includes 12 shots of 90 seconds “power on” during each sampling event.

As parts of this report compile data from multiple projects, there is some variation in how sites were chosen and the effort of sampling conducted each year (Table 2.1). Details of which projects contributed data to this report can be seen in Table 2.7. At each site, sampling gear was applied as suited to the local conditions with either boat, backpack, or a hybrid of the two, in addition to 10 unbaited bait traps set in edge margins. Most sampling occurred between the months of September and May.

Table 2.1: Sampling effort (Number of sites sampled) each sampling season in the Barwon-Darling Watercourse WRPAs. Variation in sampling effort is due to different numbers of projects and interruptions to planned sampling such as flooding, site desiccation, and extreme weather.

Sampling Season	Number of Boat Electrofishing Sites	Number of Backpack Electrofishing Sites	Number of Hybrid Sites	Total
2014/2015	4	0	0	4
2015/2016	6	0	0	6
2016/2017	9	0	0	9
2017/2018	14	0	0	14
2018/2019	19	3	1	23
2019/2020	20	3	2	25
2020/2021	7	0	0	7
2021/2022	7	0	0	7
2022/2023	17	0	0	17
2023/2024	16	0	0	16

The sites sampled during the reporting period are shown in Figure 2.2. A breakdown of sites sampled each sampling season is shown in the Appendix (Figure 2.31).

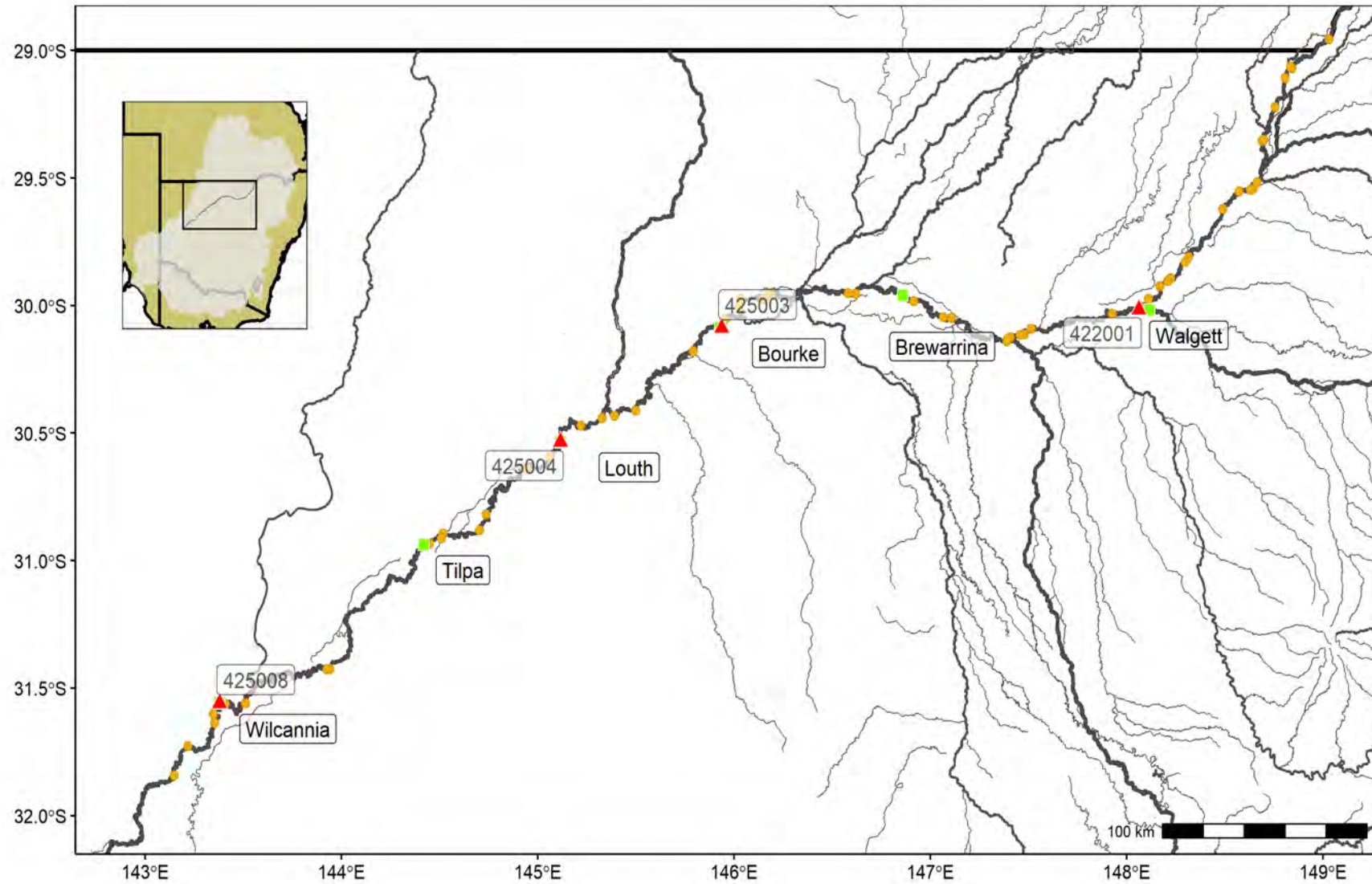


Figure 2.2: Sites (orange dots) sampled during the reporting period in the Barwon-Darling Watercourse. Triangles show key flow gauges along with their gauge ID number. Green squares show major towns.

Each sampling method has a different effectiveness at sampling each species. Table 2.2 shows the total numbers of each key species caught by each method.

Table 2.2: Number of each key species caught in the Barwon-Darling Watercourse by sample method over the whole program. Further data on total catch is provided in the Appendix.

Common name	Boat Electrofishing	Backpack Electrofishing	Bait Trap
Australian smelt	67	0	1
Bony herring	15,605	74	34
Common carp	3,597	34	117
Golden perch	877	28	12
Murray cod	55	1	0

A subset of sampled fish had biological measurements taken during the surveys, including but not limited to length and weight measurements and visual health assessments. Table 2.3 shows the number of biological measurements taken each year for the six key species.

Table 2.3: Number of biological measurements taken for the key species each sampling season in the Barwon-Darling Watercourse.

Sampling Season	Australian smelt	Bony herring	Common carp	Golden perch	Murray cod
2014/2015	2	208	42	37	8
2015/2016	3	272	49	12	4
2016/2017	0	521	242	58	4
2017/2018	1	1,045	225	90	18
2018/2019	1	1,518	247	194	11
2019/2020	48	1,028	239	194	15
2020/2021	8	542	32	60	0
2021/2022	2	779	564	109	0
2022/2023	2	1,086	997	126	2
2023/2024	1	541	336	77	0

Climate Overview

The following is a summary of the climatic conditions during the reporting period in terms of how the observed conditions compare to long term records. These are direct extracts from the [Australian Bureau of Meteorology climate summaries archive](#) and are written in the given year. To interpret, 2014 states it was the warmest year on record, meaning 2014 was the warmest year on record up to and including 2014 but not including more recent years.

2014

New South Wales experienced its warmest year on record in 2014, with several heatwaves and persistently warm conditions across the State. Rainfall was well below average in the northeast, and close to average elsewhere.

2015

New South Wales recorded well above average temperatures in 2015. Nights were particularly warm, the sixth-warmest on record for the State. Rainfall was close to average for the state as a whole.

2016

2016 was a generally wet, warm year for NSW as a whole, with substantial variability throughout the year and across the state. Following a record-warm start to the year, May to September was the wettest such period on record for NSW, with cooler weather in much of the west of the state. Minimum temperatures were the warmest on record for the State as a whole, with record-warm daytime temperatures on parts of the east coast.

2017

The year 2017 was the warmest on record for New South Wales for both mean and daytime temperatures. It was also the State's driest year since 2006. Following the warmest summer on record for the State, heavy rain in March across the east then made way for a very dry winter and start to spring. Winter overnight temperatures were the lowest since 1997, but daytime temperatures remained above average for most of the year, and were the warmest on record overall.

2018

2018 was the warmest on record for New South Wales for both mean temperature and mean maximum temperature, whilst the mean minimum temperature was fourth-warmest on record. The year was dominated by very dry conditions, with the third-driest January to September on record. October to December saw some relief from the dry, with above average rainfall across parts of the State. Despite this, New South Wales experienced its sixth-lowest annual rainfall on record; its driest year since 2002.

2019

2019 was the driest and warmest year on record for New South Wales. Despite some rain in some months, most of the State received much less rainfall than usual, with the northeast and far west particularly dry. Heatwaves in January brought very high temperatures, and large fires from September onward caused extensive damage and persistent smoke.

2020

2020 saw above average temperature and rainfall in New South Wales. Temperatures were above average across the state in most months except during autumn. There was widespread rain during autumn and spring and in December, but early winter and November rain was below average.

2021

New South Wales had its 6th wettest year on record, with 2021 rainfall 30 % above average. This included significant floods along the east coast in March, and the state's wettest November on record. It was the state's coolest year since 1996, at 0.15 °C above the 1961–1990 average.

2022

2022 was exceptionally wet with the state-averaged annual total being the second-highest on record (since 1900) and many sites recording their highest annual totals on record. Maximum temperatures were lower than average with the state-averaged annual maximum temperature being the coolest since 1992. Minimum temperatures were generally warmer than average with the state-averaged annual minimum temperature being 0.73 °C above the 1961–1990 average.

2023

The state-averaged rainfall was 22.9 % below the 1961–1990 average. Rainfall was above average over small parts of the state's south, west of the Great Dividing Range, while being below average over most of the northern half of the state, especially over parts of the Northern Tablelands, Northern Rivers, Mid-North Coast, and Upper Hunter, where annual rainfall was in the lowest 10 % of historical records (since records began in 1900). State-averaged annual maximum temperature was 1.96 °C above the 1961–1990 average, which is the third highest on record.

2024

Rainfall totals in 2024 were above average to very much above average for the northern and western areas of the state, as well as central parts of the coast. Totals were below average for large parts of the south-east, as well as small parts of the state's north-east and south-west. 2024 was the third-warmest on record for all years since 1910, 1.55 °C above the 1961–1990 average.

Flow Data

Below shows a summary of flow data from a variety of flow gauges in the Barwon-Darling Watercourse WRPAs (Figure 2.3).

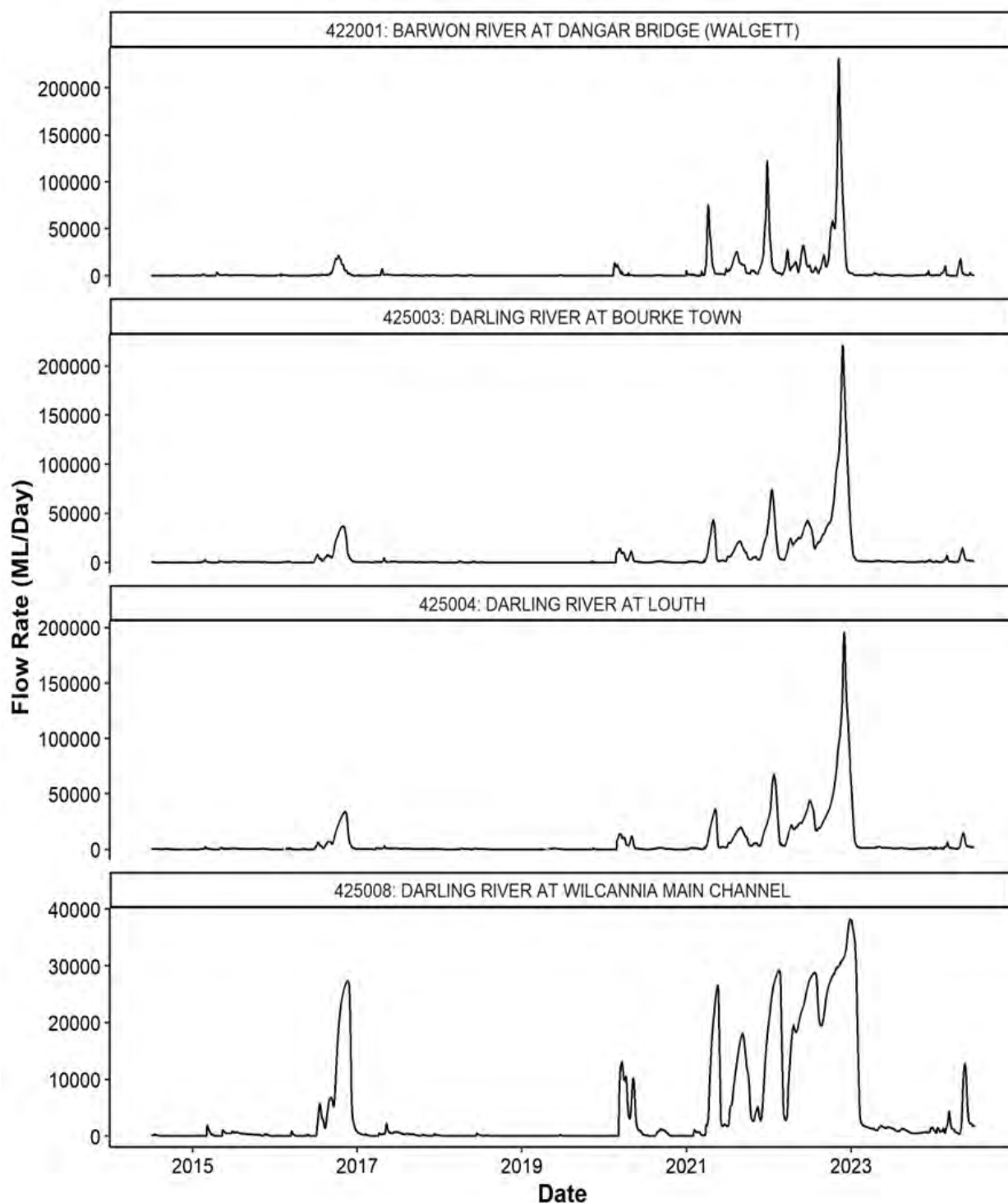


Figure 2.3: Flow data from various gauges in the Barwon-Darling Watercourse WRPAs over the reporting period. Gauge locations can be seen on Figure 2.2. Note the differing scales on the y-axis.

Water temperature data, where available, are also shown in Figure 2.4.

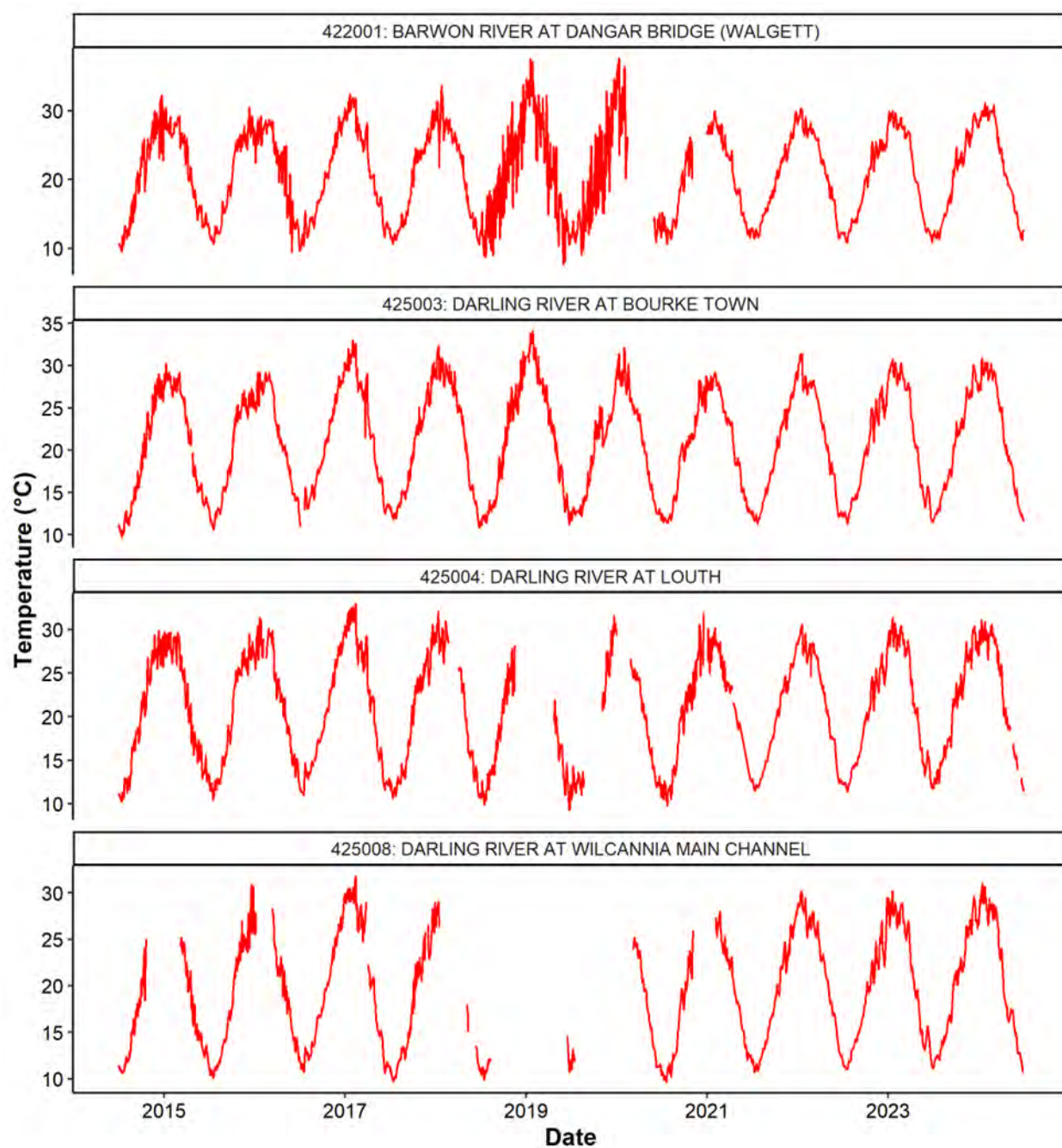


Figure 2.4: Water temperature data from various gauges in the Barwon-Darling Watercourse WRPAs over the reporting period. Gauge locations can be seen on Figure 2.2. Note the differing scales on the y-axis.

Species Diversity

A total of 12 fish species were observed across the Barwon-Darling Watercourse WRPAs including four alien species. Figure 2.5 shows the number of native species found at each site while Figure 2.6 shows the number of alien species found at each site. The full list of species caught and observed is presented in Table 2.8.

Summary Statement:

Native diversity was slightly higher north of Bourke in the Barwon-Darling Watercourse WRPAs region while the alien diversity was generally consistent across the region.

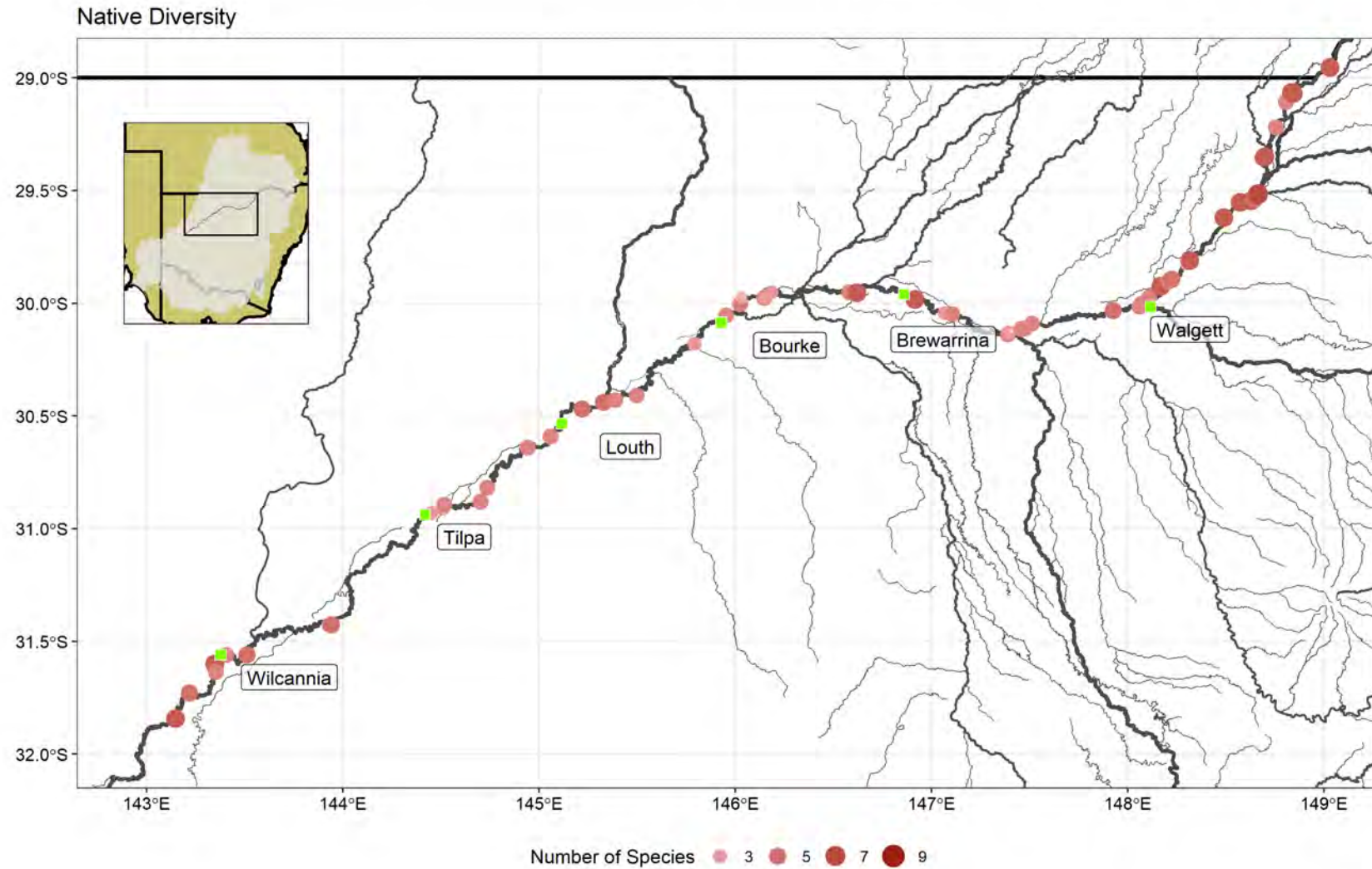


Figure 2.5: Native diversity across all sampling sites in the Barwon-Darling Watercourse. Bubble size represents the number of unique species observed at each site across all sampling methods and events. Dry sites are excluded. Green squares show major towns.

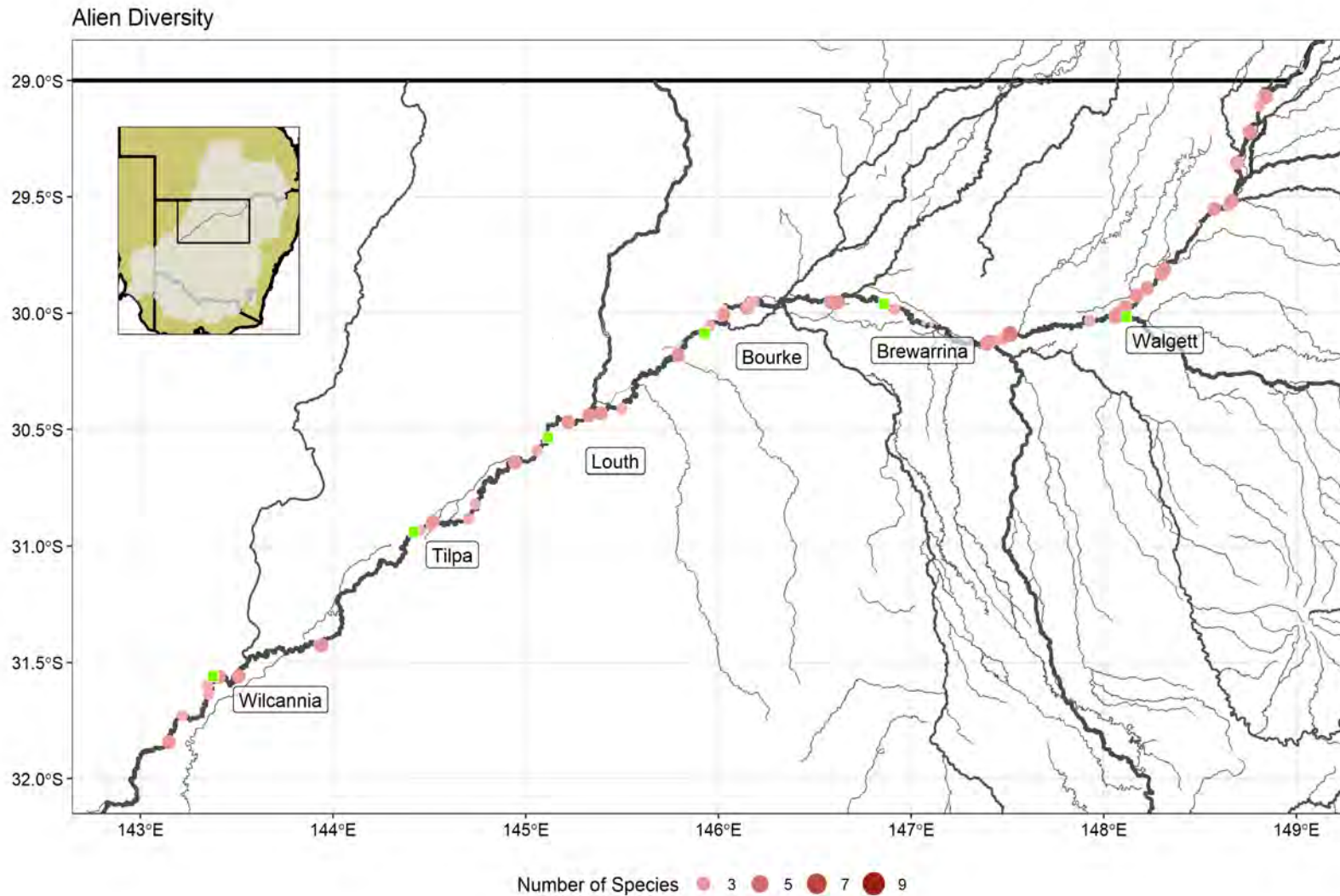


Figure 2.6: Alien diversity across all sampling sites in the Barwon-Darling Watercourse. Bubble size represents the number of unique species observed at each site across all sampling methods and events. Dry sites are excluded. Green squares show major towns.

Murray cod



Population Structure

Figure 2.7 shows the observed length frequency plot for Murray cod for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 0 to 2, and 0 % to 50 % of measured fish within a season, with a mean percentage YOY of 10 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Murray cod was 13 % (1,455 out of 11,489).

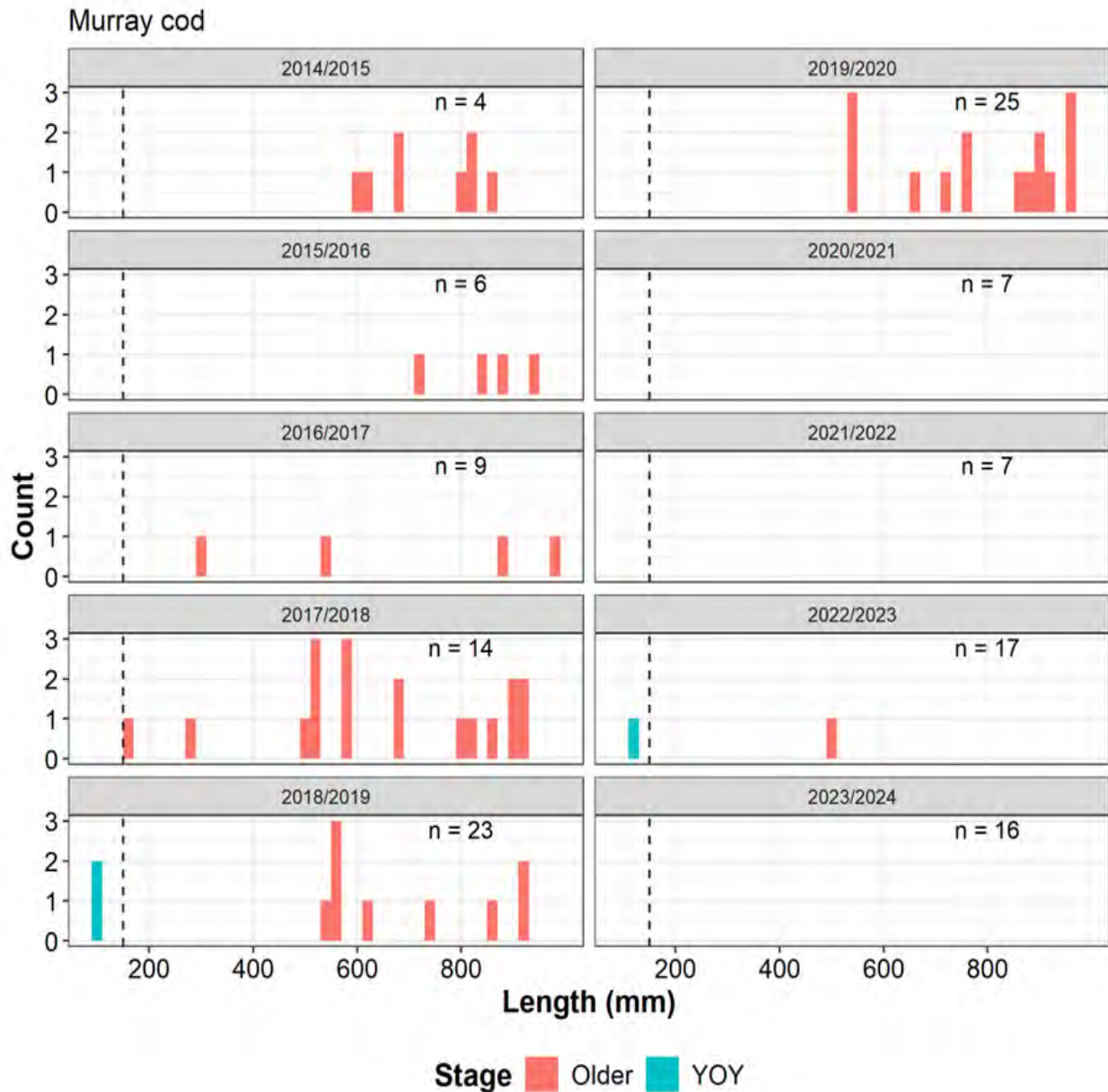


Figure 2.7: Length frequency plots for Murray cod by sampling season in the Barwon-Darling Watercourse. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRPAs in a sampling season.

Summary Statement:

No or limited evidence of recruitment in most years. Only 3 individual YOY were observed between 2014/15 and 2023/24. This suggests Murray cod recruitment in this region is failing in most years. Despite restocking efforts (see below), there is a very concerning decline in Murray cod of all sizes after 2019/20. No Murray cod were observed in 2023/24.

Stocking

A total of 289,496 Murray cod were stocked into the waterways of the Barwon-Darling Watercourse WRPA during the reporting period. Of these fish, none were stocked into impoundments while 289,496 (100 %) were stocked into rivers or creeks. Table 2.4 shows the detailed breakdown of stocking by season, location and life stage while Figure 2.8 shows the locations of stocking.

Table 2.4: Number and life stage of stocked Murray cod each sampling season in the Barwon-Darling Watercourse.

Sampling Season	River/Creek or Impoundment	Life Stage	Number Stocked
2014/2015	River/Creek	Fingerling	5,000
2014/2015	River/Creek	Fry	22,726
2014/2015	River/Creek	Sub Adult	2,500
2015/2016	River/Creek	Fingerling	5,000
2015/2016	River/Creek	Fry	22,751
2016/2017	River/Creek	Fingerling	26,228
2016/2017	River/Creek	Fry	20,000
2018/2019	River/Creek	Fry	20,000
2020/2021	River/Creek	Fry	34,091
2021/2022	River/Creek	Fry	122,200
2022/2023	River/Creek	Fry	9,000

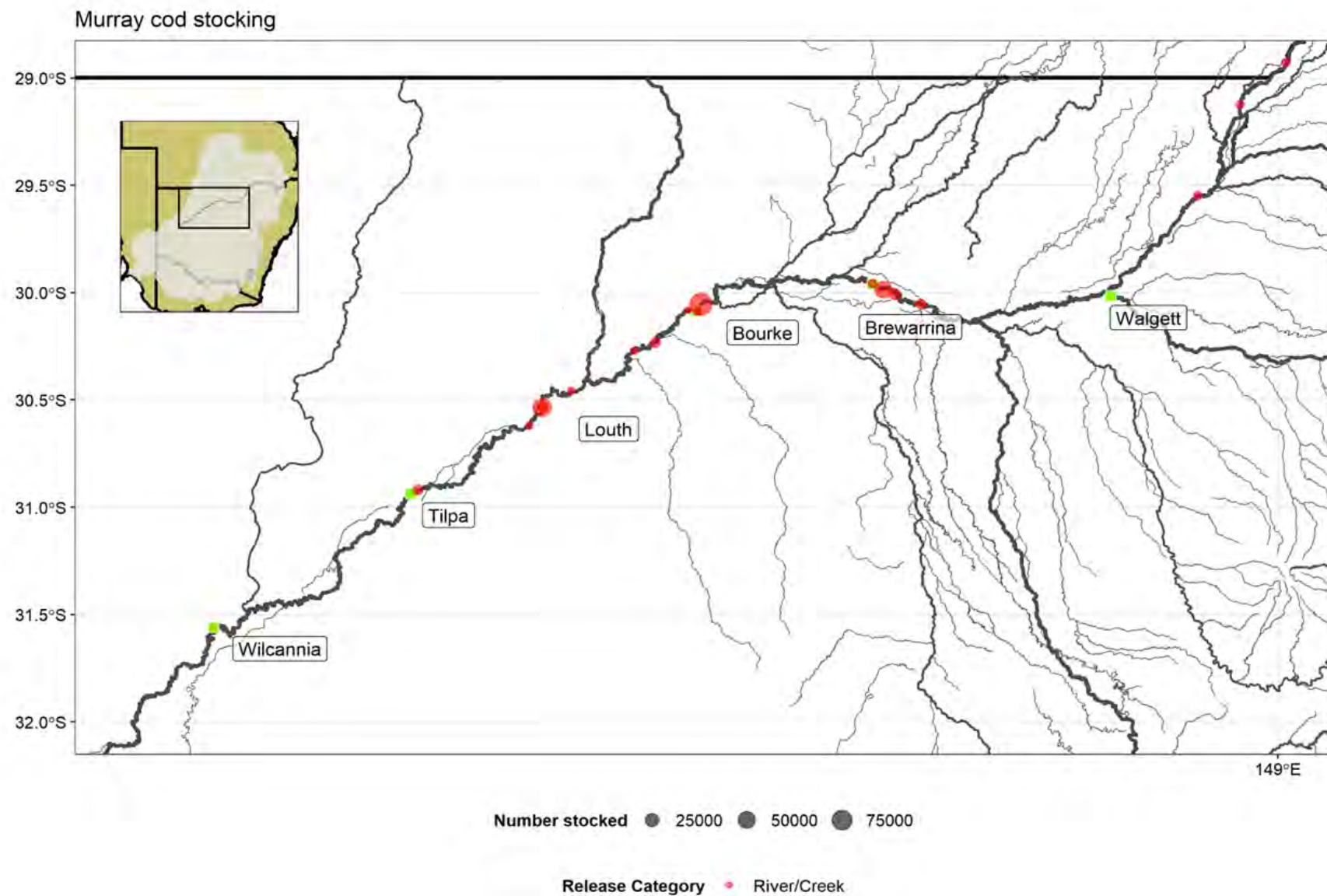


Figure 2.8: Locations of Murray cod stocking in the Barwon-Darling Watercourse. Colours show whether a site was a river/creek site or an impoundment, while the size of the point reflects the total number of fish stocked over the reporting period. Green squares show major towns.

Temporal Trends in Abundance

The relative abundance and biomass of Murray cod since 1994 was modelled based on all suitable boat electrofishing data. The left-hand panels of Figure 2.9 show the abundance and biomass trends for the Barwon-Darling Watercourse WRPA and the right-hand panels show the overall trends across the NSW MDB.

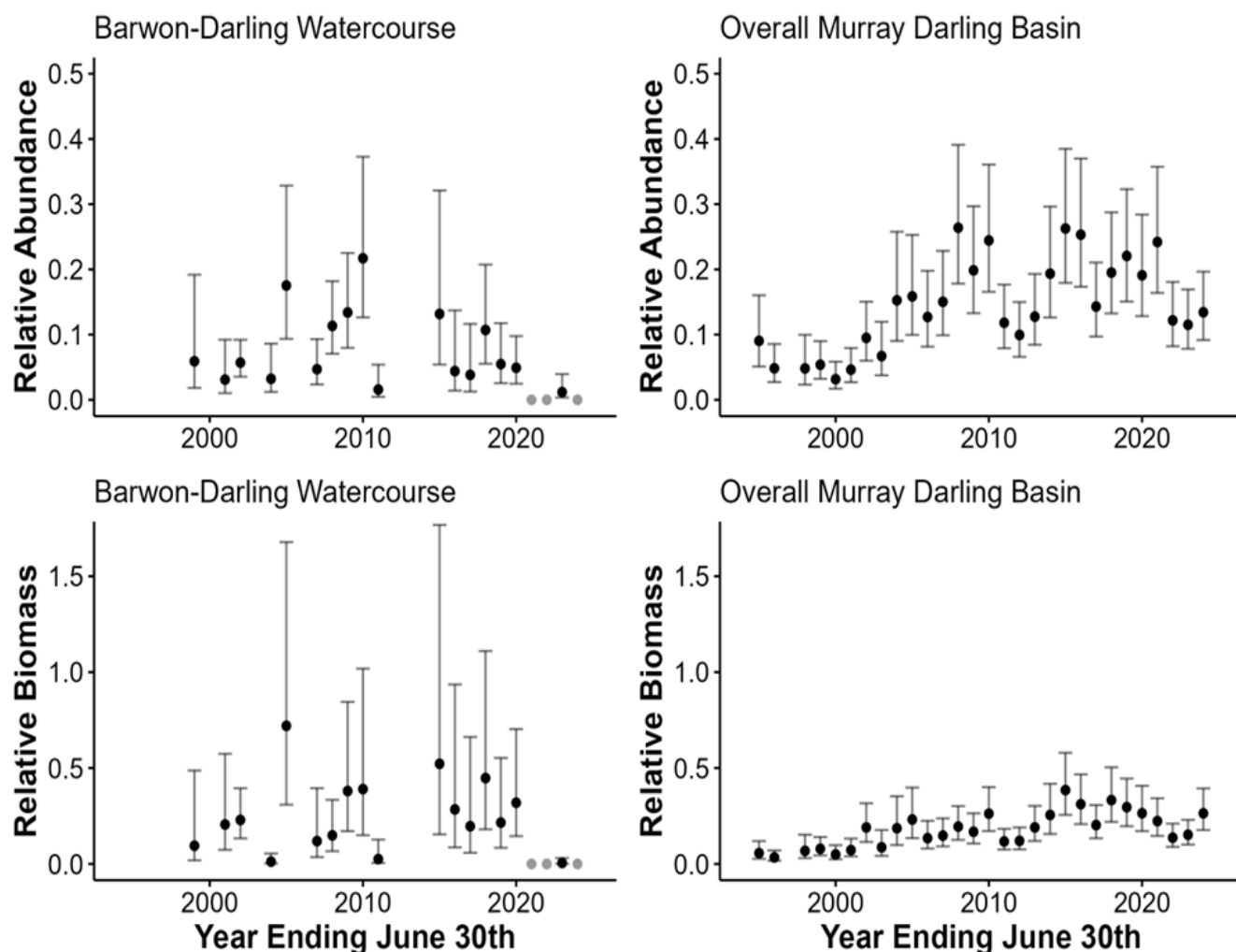


Figure 2.9: Relative abundance and biomass of Murray cod in this WRPA and the overall NSW MDB. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates. Grey dots represents years where sampling was conducted but no Murray cod were caught and hence error bars cannot be generated.

Summary Statement:

Severe reduction in abundance and biomass of Murray cod since 2020.

Health

The prevalence of any health issues ranged from 25 % of sampled fish in 2016/2017 to >80 % of sampled fish in 2014/2015 (Figure 2.10). The most common health issue for Murray cod in the Barwon-Darling Watercourse WRPAs was *Lernaea*, which was observed in a total of 30 fish, corresponding to 48 % of all Murray cod measured.

Across the other NSW MDB WRPA, 16 % of Murray cod (1,783 out of 11,489 Murray cod) showed a health condition (excludes the Barwon-Darling Watercourse WRPAs).

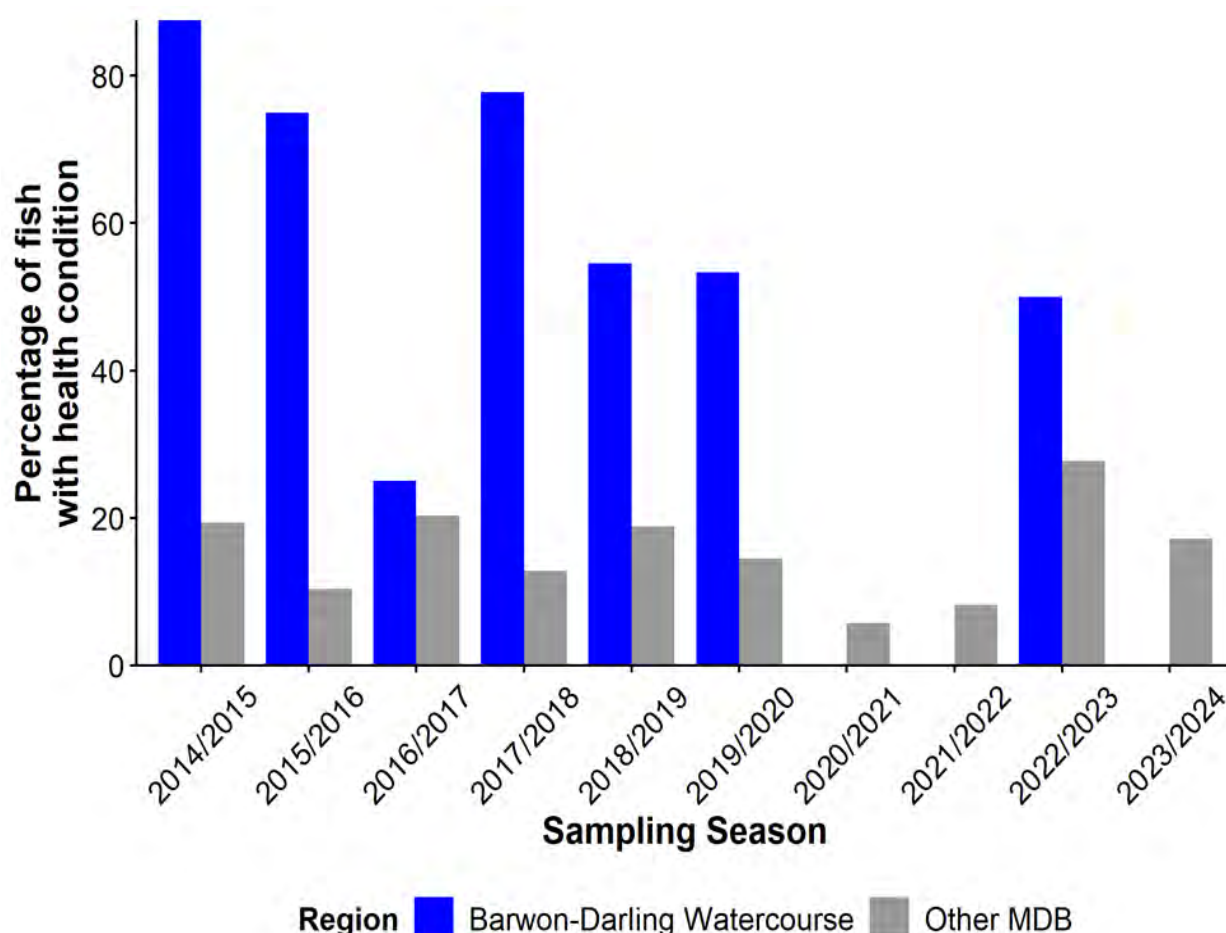


Figure 2.10: Timeseries showing the prevalence of health conditions in Murray cod. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA.

Summary Statement:

Presence of observable health conditions was generally high and, in all years, higher than the rest of the NSW Murray-Darling Basin. Note no Murray cod were caught in 2020/21, 2021/22 and 2023/24.

Distribution

Murray cod were recorded at 22 out of 58 sites in the Barwon-Darling Watercourse WRPA from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 0.25 fish caught per 90 seconds of electrofishing. Figure 2.11 shows the distribution and relative abundance of Murray cod across the Barwon-Darling Watercourse WRPA.

Summary Statement:

Murray cod were recorded across the Barwon-Darling Watercourse WRPA but in higher abundances east of Bourke. Only two individual Murray cod were caught in the region after 2019/20 (one at Cotton Pumps, north of Mungindi (2022/23) and one at Billilla (2022/23)). A third Murray cod was observed but not caught just north of Collarenebri (2021/22).

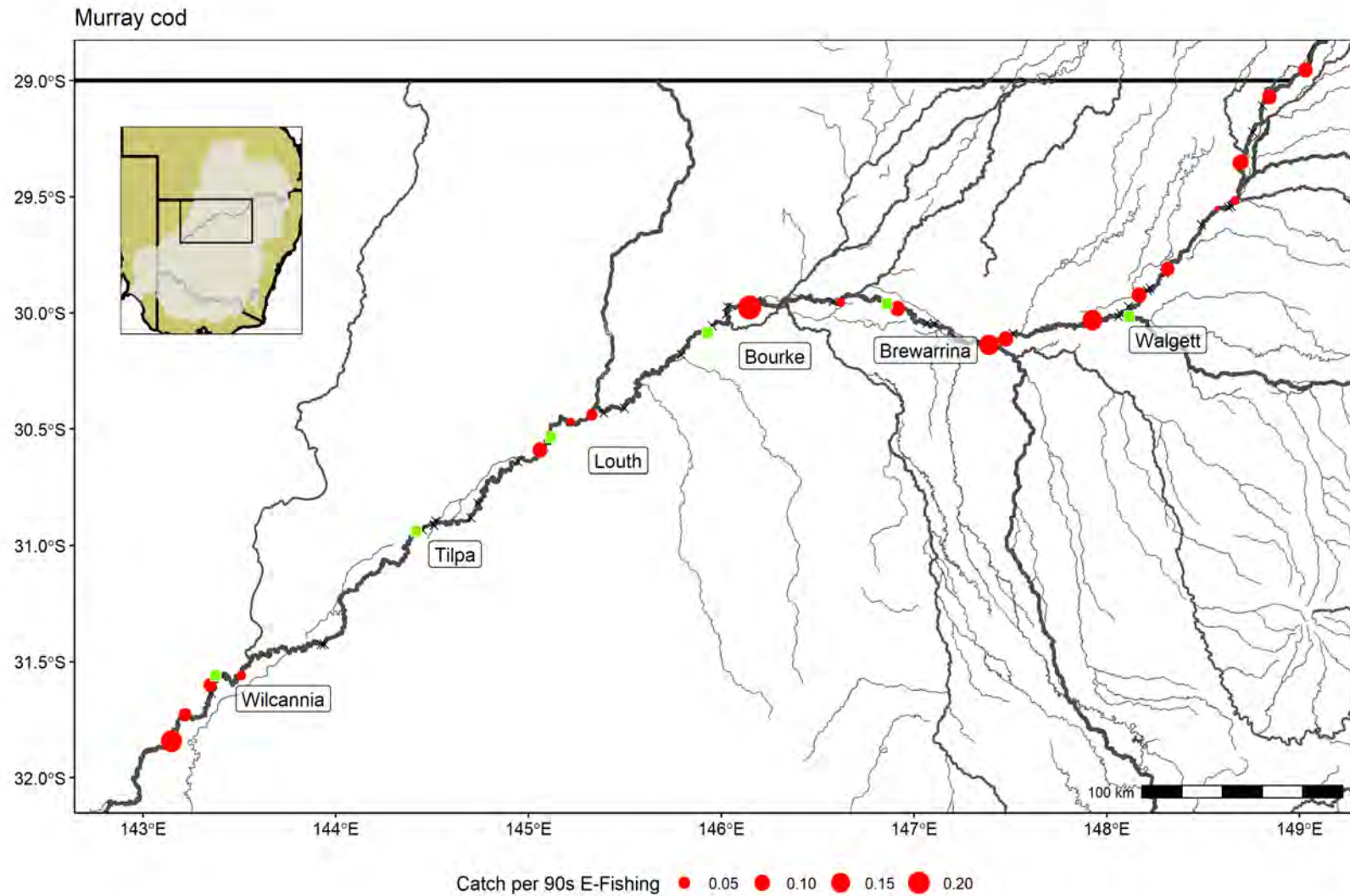


Figure 2.11: Distribution of Murray cod sampled from 2013/14 to 2023/24 in the Barwon-Darling Watercourse. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares show major towns.

Golden perch



Population Structure

Figure 2.12 shows the observed length frequency plot for Golden perch for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 0 to 42, and 0 % to 39 % of measured fish within a season, with a mean percentage YOY of 11 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Golden perch was 7 % (524 out of 7,342).

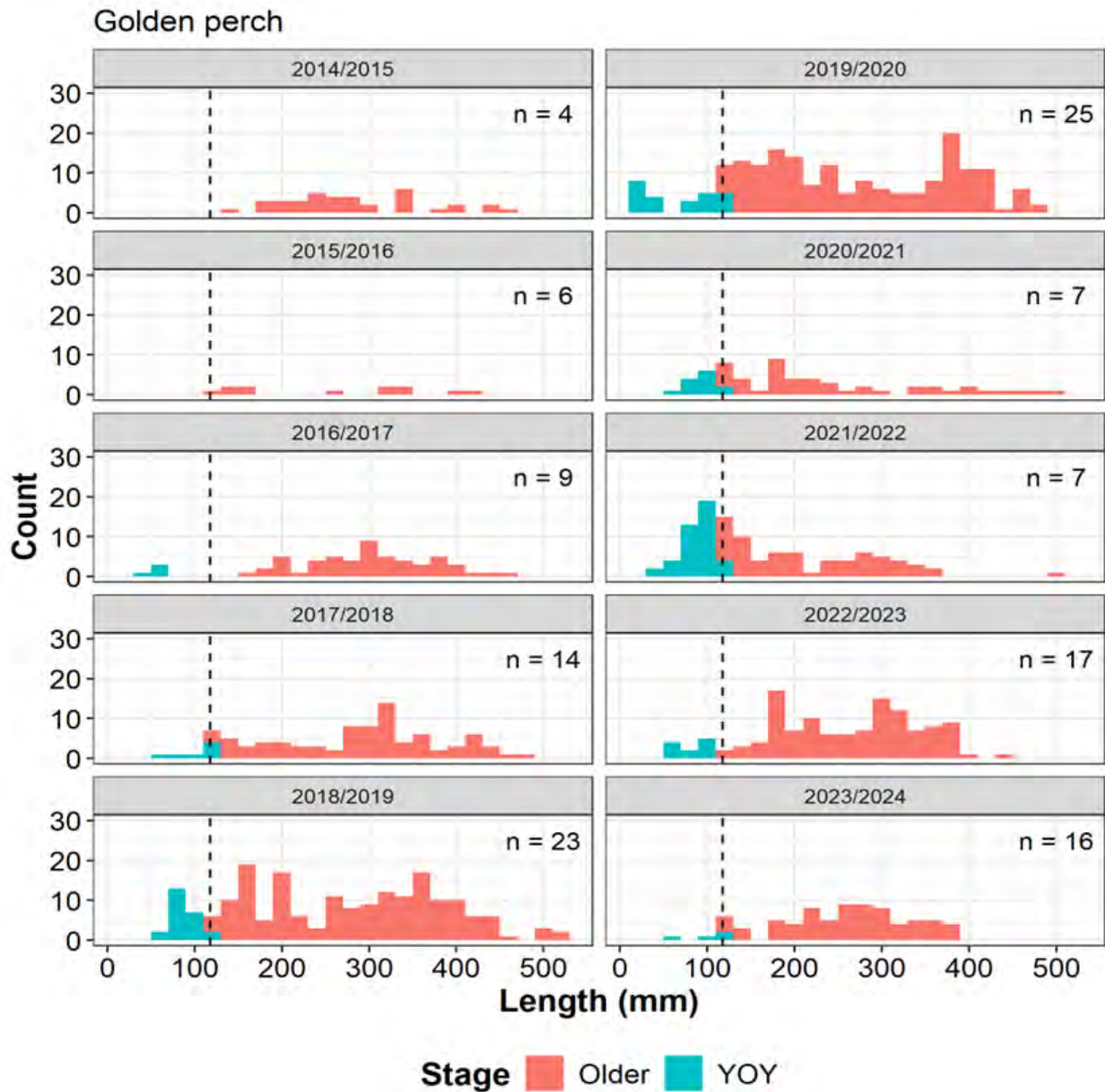


Figure 2.12: Length frequency plots for Golden perch by sampling season in the Barwon-Darling Watercourse. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRPA in a sampling season.

Summary Statement:

Evidence of recruitment in most years with young of the year present except in 2014/15 and 2015/16. 2023/24 shows very weak recruitment and there no individuals above 40 cm.

Stocking

A total of 168,166 Golden perch were stocked into the waterways of the Barwon-Darling Watercourse WRPAs during the reporting period. Of these fish, none were stocked into impoundments while 168,166 (100 %) were stocked into rivers or creeks. Table 2.5 shows the detailed breakdown of stocking by season, location and life stage while Figure 2.13 shows the locations of stocking.

Table 2.5: Number and life stage of stocked Golden perch each sampling season.

Sampling Season	River/Creek or Impoundment	Life Stage	Number Stocked
2014/2015	River/Creek	Fry	11,363
2015/2016	River/Creek	Fry	40,303
2016/2017	River/Creek	Fingerling	14,864
2017/2018	River/Creek	Fry	5,000
2020/2021	River/Creek	Fry	60,363
2022/2023	River/Creek	Fry	9,000
2023/2024	River/Creek	Fingerling	27,273

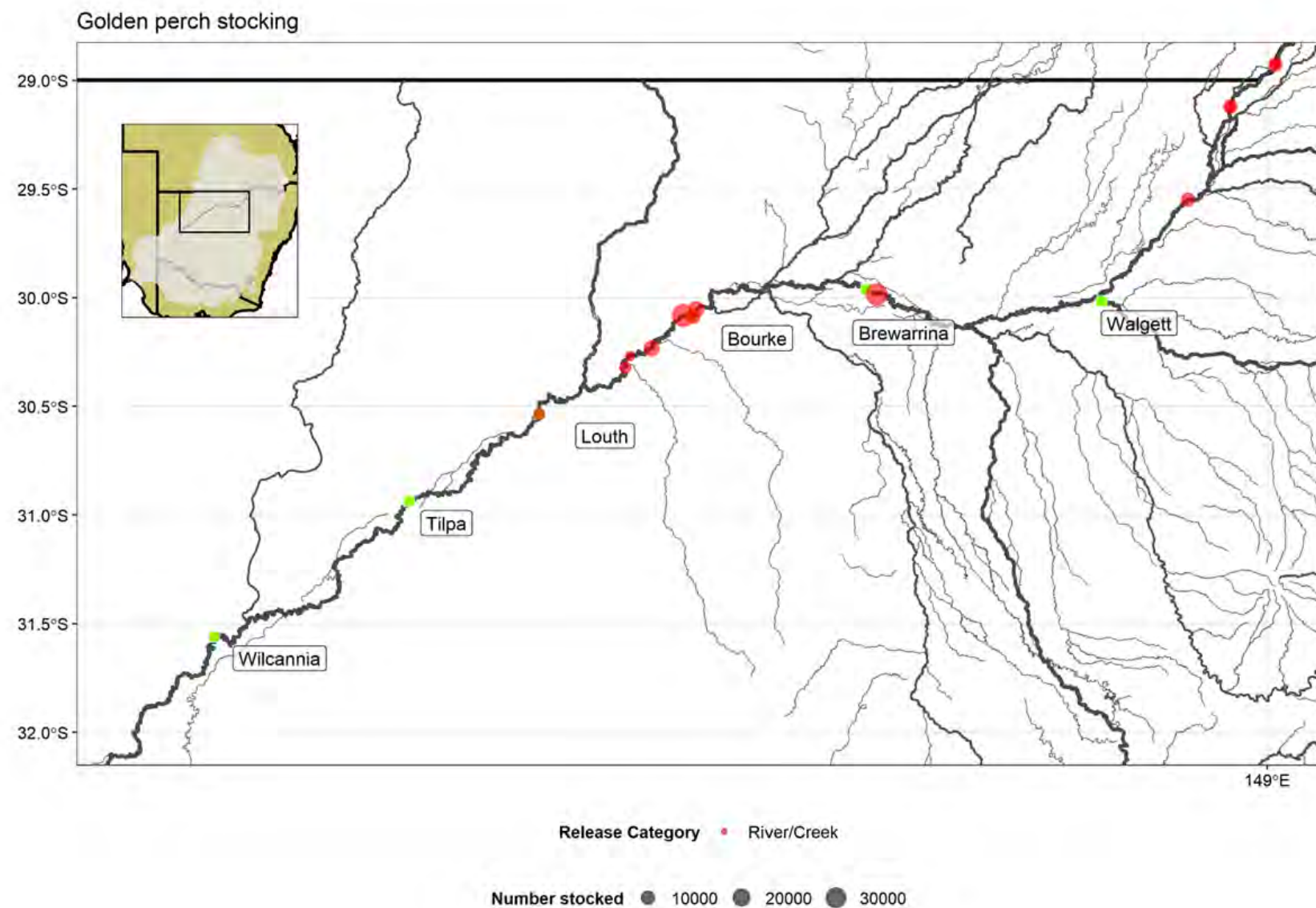


Figure 2.13: Locations of Golden perch stocking in the Barwon-Darling Watercourse. Colours show whether a site was a river/creek site or an impoundment, while the size of the point reflects the total number of fish stocked over the reporting period. Green squares show major towns.

Temporal Trends in Abundance

The relative abundance and biomass of Golden perch since 1994 was modelled based on all suitable boat electrofishing data. The left-hand panels of Figure 2.14 show the abundance and biomass trends for the Barwon-Darling Watercourse WRPA and the right-hand panels show the overall trends across the NSW MDB.

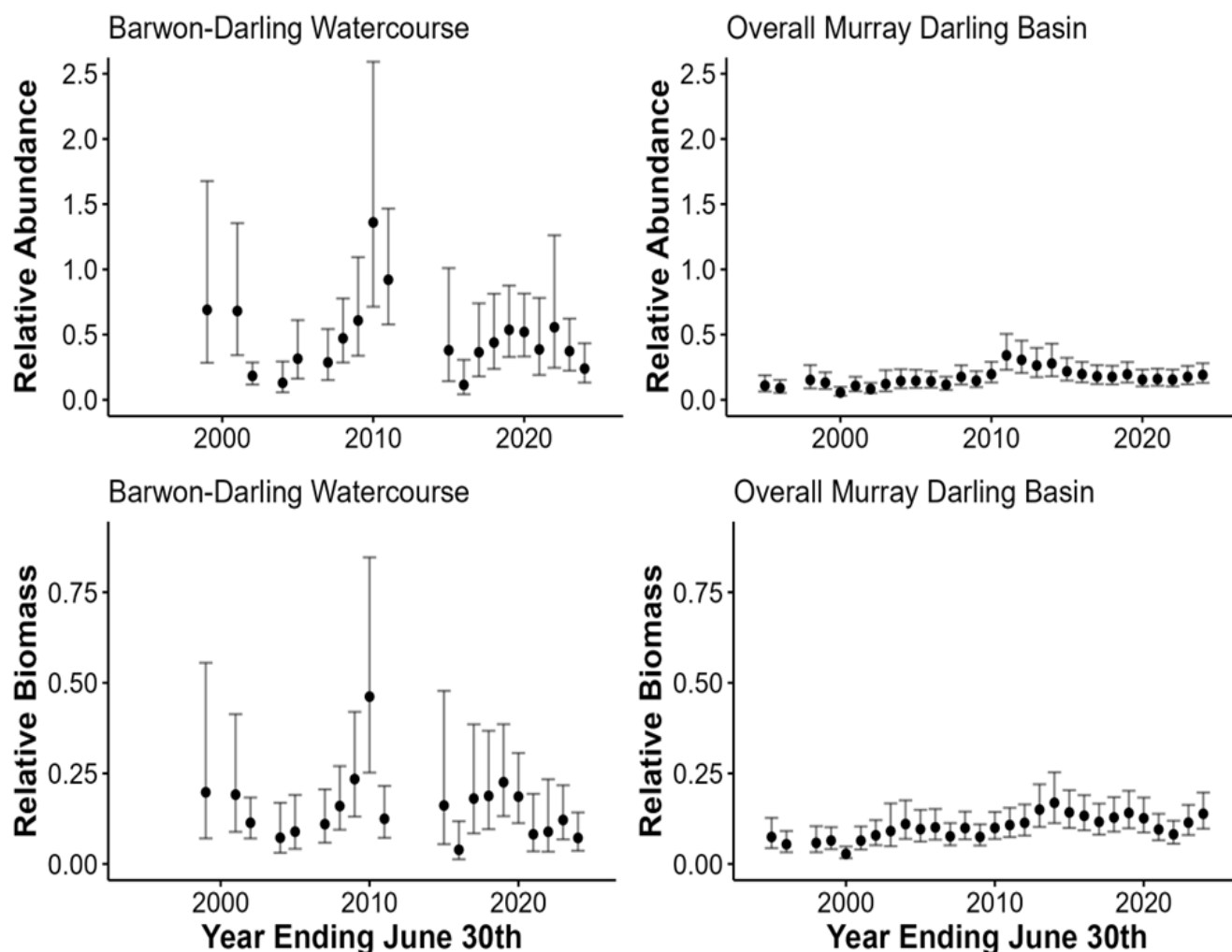


Figure 2.14: Relative abundance and biomass of Golden perch in both this WRPA and the overall Murray-Darling Basin. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates.

Summary Statement:

Current abundance approximately equal to mid-2000s levels. Abundance previously peaked around 2010 but has since declined. Relative abundance and biomass are approximately equal to the overall NSW MDB. Both abundance and biomass appear to have declined in the last three years.

Health

The prevalence of any health issues ranged from 0 % of sampled fish in 2021/2022 to 86 % of sampled fish in 2014/2015 (Figure 2.15). The most common health issue for Golden perch in the Barwon-Darling Watercourse water resource planning area was *Lernaea*, which was observed in a total of 191 fish, corresponding to 20 % of all Golden perch measured.

Across the other WRPA's, 24 % of Golden perch (1,795 out of 7,342 Golden perch) showed a health condition (excludes Barwon-Darling Watercourse).

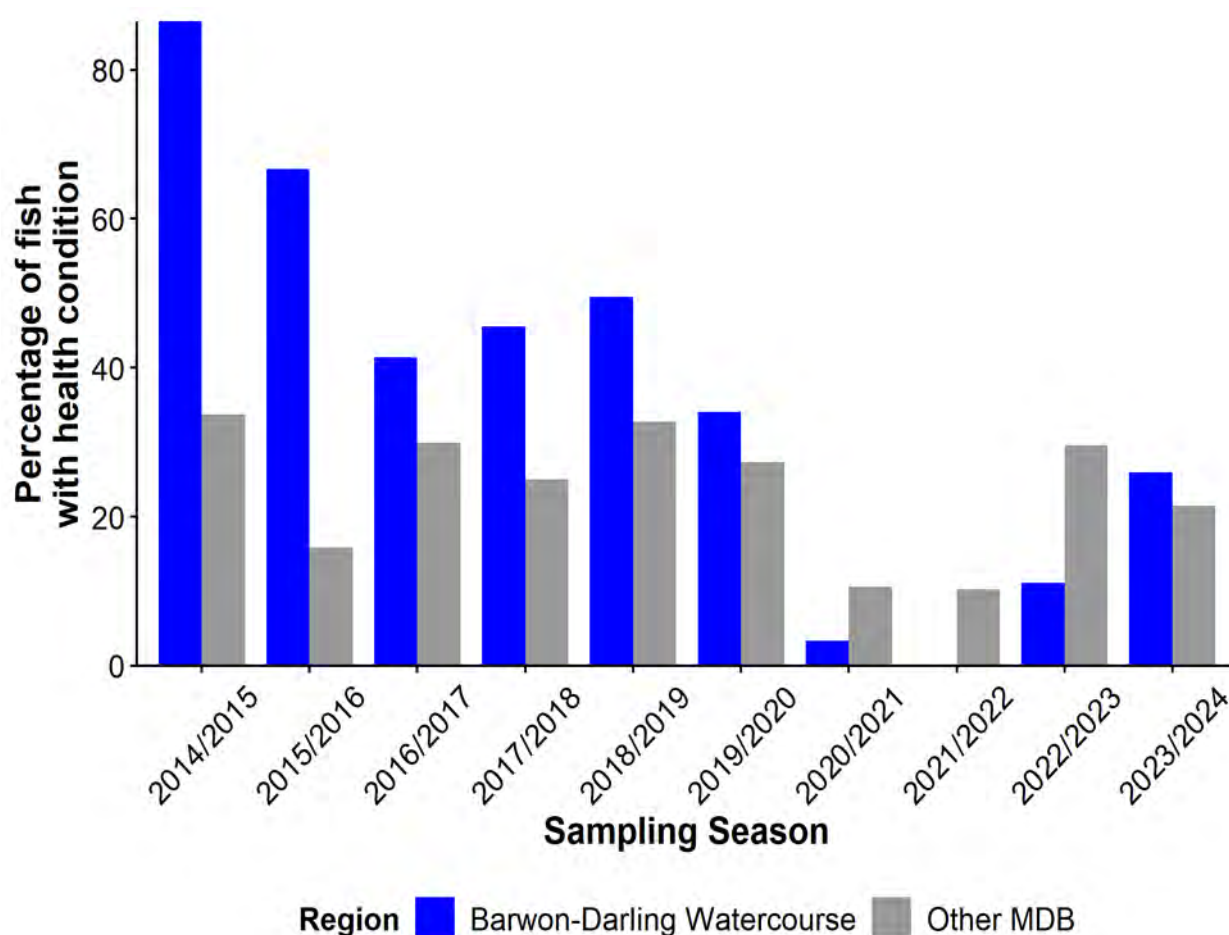


Figure 2.15: Timeseries showing the prevalence of health conditions in Golden perch. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA's.

Summary Statement:

The presence of observable health conditions for Golden perch in the Barwon-Darling Watercourse has declined consistently since 2014/15 although 2023/24 shows a moderate increase compared to 2022/23.

Distribution

Golden perch were recorded at 54 out of 58 sites in the Barwon-Darling Watercourse WRPAs from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 2.1 fish caught per 90 seconds of electrofishing. Figure 2.16 shows the distribution and relative abundance of Golden perch across the Barwon-Darling Watercourse WRPAs.

Summary Statement:

Golden perch were widely distributed across the Barwon-Darling Watercourse WRPAs.

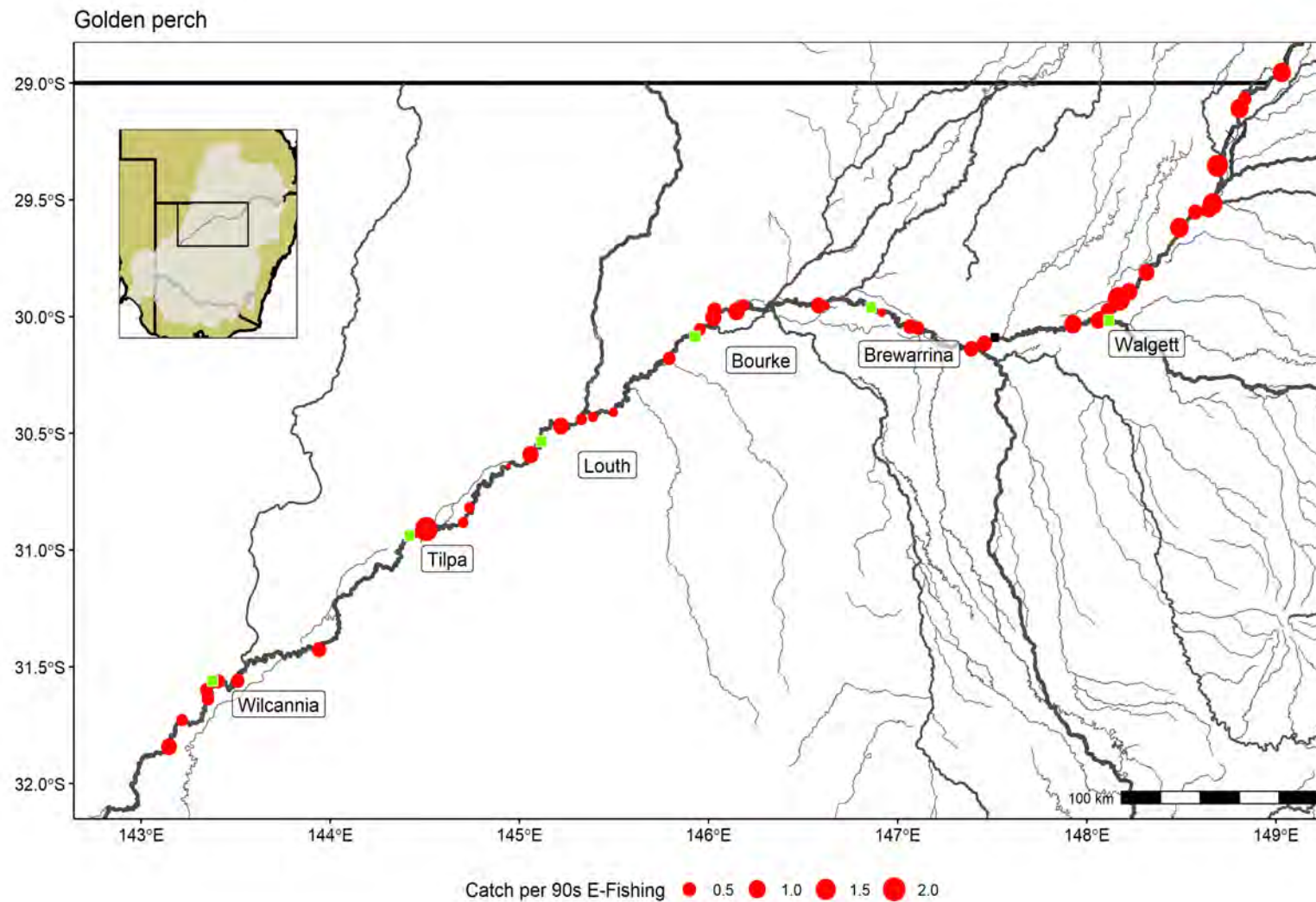


Figure 2.16: Distribution of Golden perch sampled from 2013/14 to 2023/24 in the Barwon-Darling Watercourse. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares show major towns.

Freshwater catfish



Summary Statement:

No Freshwater catfish were caught in the Barwon-Darling Watercourse during the reporting period, suggesting they are in very low abundance or absent from the area.

Bony herring



Population Structure

Figure 2.17 shows the observed length frequency plot for Bony herring for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 31 to 824, and 6 % to 55 % of measured fish within a season, with a mean percentage YOY of 29 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Bony herring was 24 % (11,422 out of 46,645). Bony herring are not a stocked species.

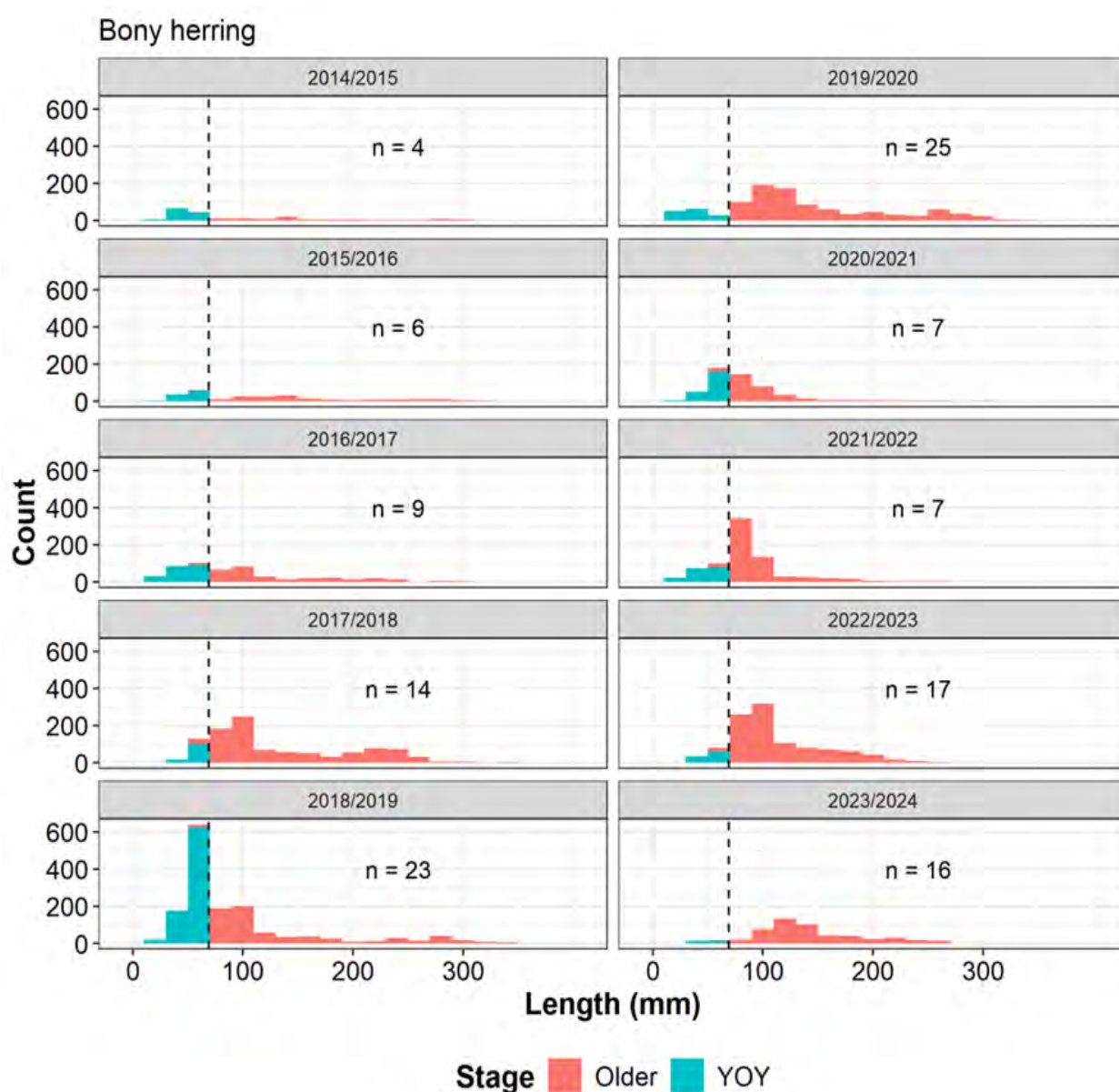


Figure 2.17: Length frequency plots for Bony herring by sampling season in the Barwon-Darling Watercourse. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRPA in a sampling season.

Summary Statement:

Regular recruitment with multiple cohorts evident in some years. 2023/24 shows weak recruitment although there is some evidence of larger fish (>25 cm).

Temporal Trends in Abundance

The relative abundance and biomass of Bony herring since 1994 was modelled based on all suitable boat electrofishing data. The left-hand panels of Figure 2.18 show the abundance and biomass trends for the Barwon-Darling Watercourse WRPA and the right-hand panels show the overall trends across the NSW MDB.

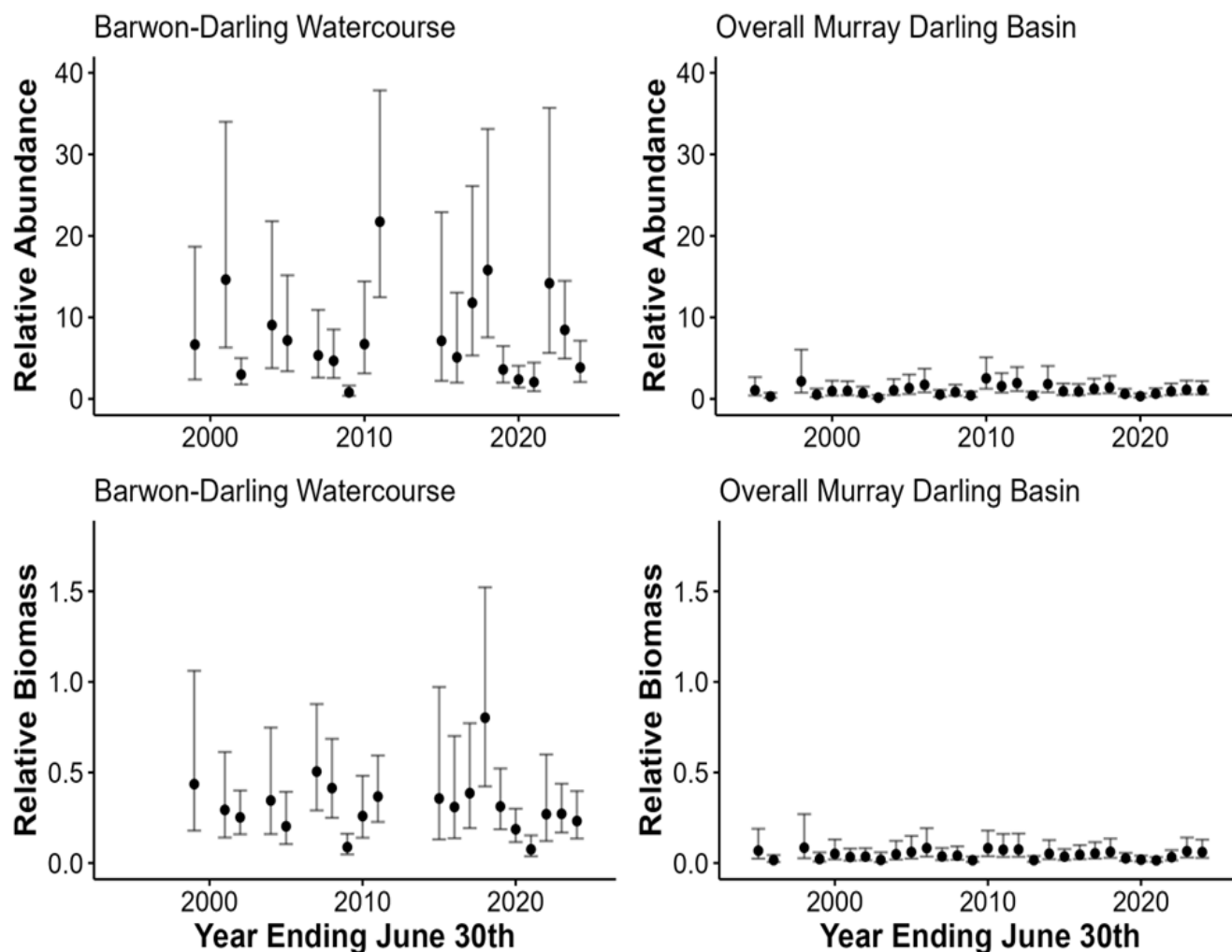


Figure 2.18: Relative abundance and biomass of Bony herring in both this WRPA and the overall NSW MDB. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates.

Summary Statement:

Abundance and biomass have fluctuated since the 1990s. Abundance and biomass were relatively low for this WRPA in 2023/24 but higher than the overall NSW MDB.

Health

The prevalence of any health issues ranged from 0 % of sampled fish in 2021/2022 to 14 % of sampled fish in 2023/2024 (Figure 2.19). The most common health issue for Bony herring in the Barwon-Darling Watercourse WRPAs was Fungus, which was observed in a total of 62 fish, corresponding to 1 % of all Bony herring measured.

Across the other NSW MDB WRPA, 0.89 % of Bony herring (416 out of 46,646 Bony herring) showed a health condition (excludes the Barwon-Darling Watercourse WRPAs).

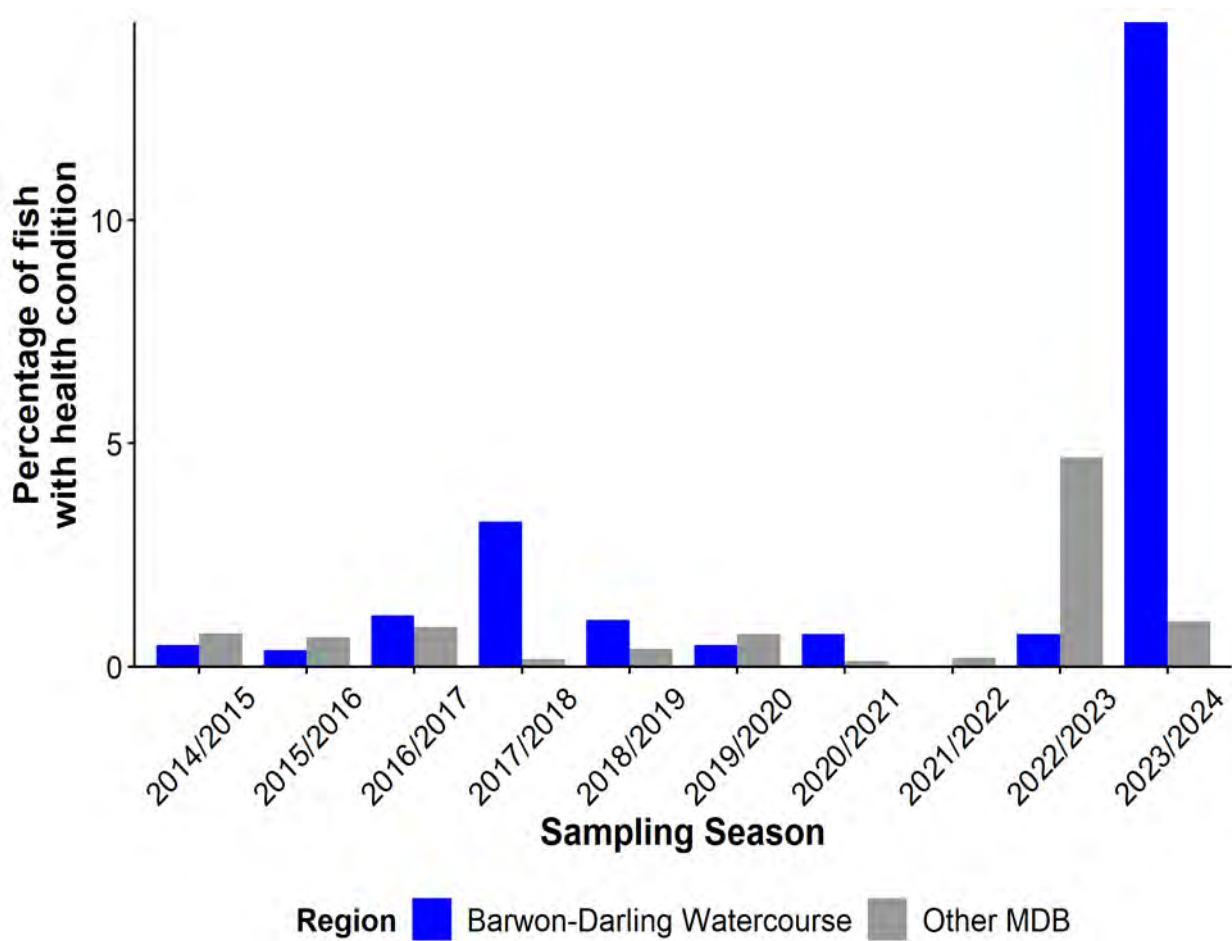


Figure 2.19: Timeseries showing the prevalence of health conditions in Bony herring. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA.

Summary Statement:

Presence of observable health conditions was low in all years except 2023/24 when there was large increase in prevalence.

Distribution

Bony herring were recorded at 55 out of 58 sites in the Barwon-Darling Watercourse WRPAs from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 101 fish caught per 90 seconds of electrofishing. Figure 2.20 shows the distribution and relative abundance of Bony herring across the Barwon-Darling Watercourse WRPAs.

Summary Statement:

Bony herring were recorded across the Barwon-Darling Watercourse WRPAs.

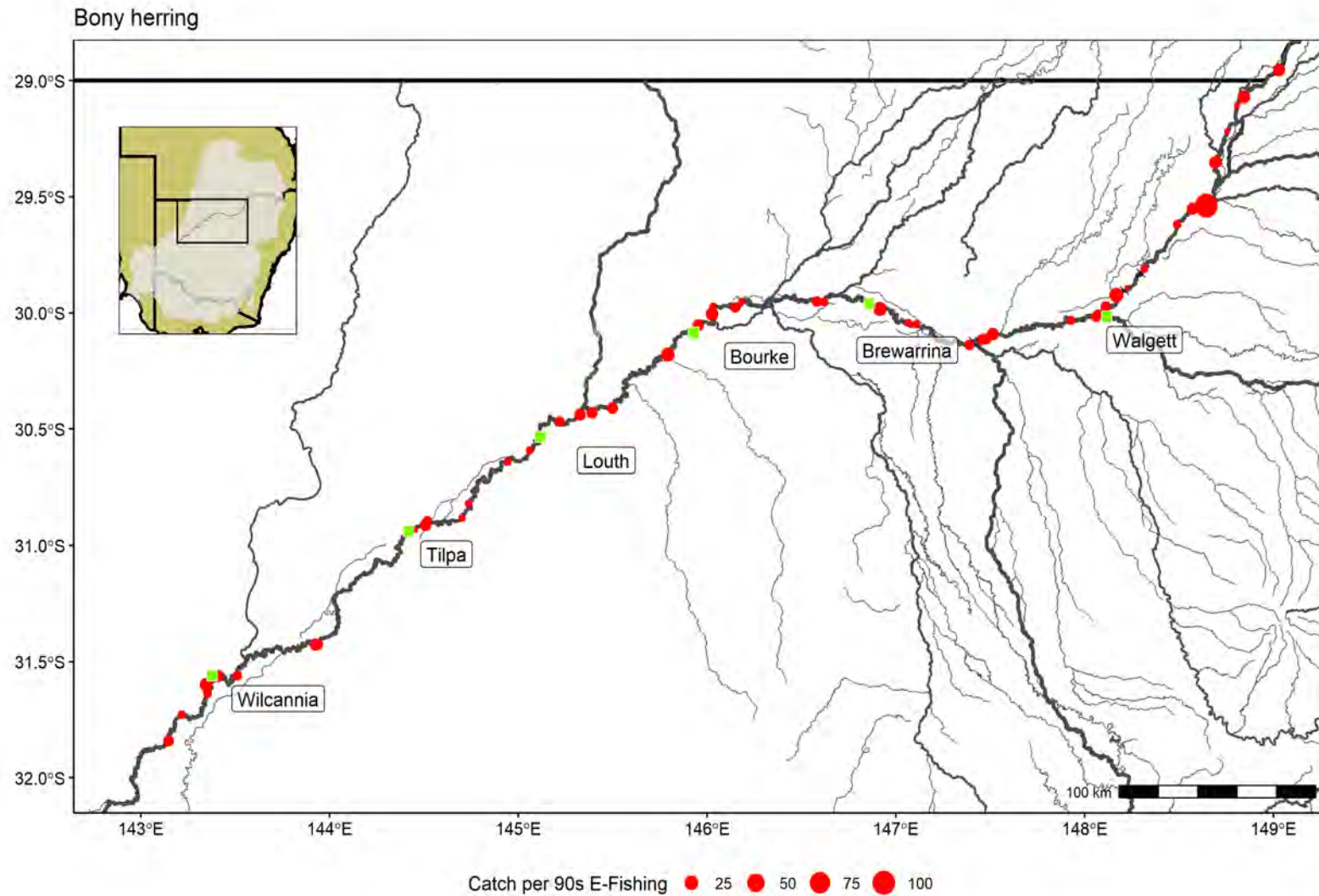


Figure 2.20: Distribution of Bony herring sampled from 2013/14 to 2023/24 in the Barwon-Darling Watercourse. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares show major towns.

Australian smelt



Population Structure

Figure 2.21 shows the observed length frequency plot for Australian smelt for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 0 to 43, and 0 % to 100 % of measured fish within a season, with a mean percentage YOY of 66 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Australian smelt was 41 % (11,461 out of 27,860). Australian smelt are not a stocked species.

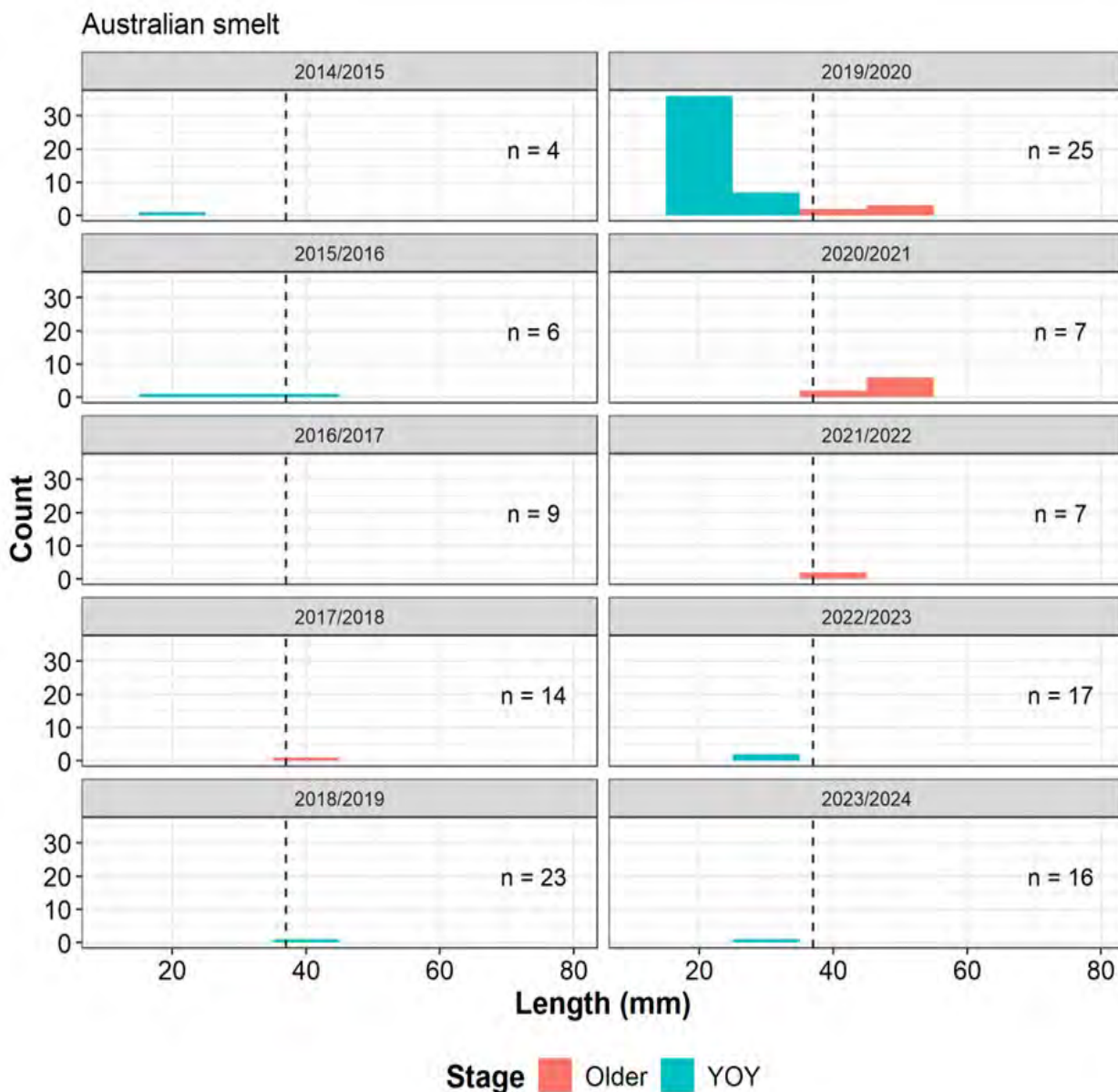


Figure 2.21: Length frequency plots for Australian smelt by sampling season in the Barwon-Darling Watercourse. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRPA in a sampling season.

Summary Statement:

Limited evidence of recruitment in most years except 2019/20 which shows stronger recruitment. Very few individuals have been observed in recent years suggesting overall poor recruitment.

Temporal Trends in Abundance

The relative abundance of Australian smelt since 1994 was modelled based on all suitable boat electrofishing data. The left-hand panel of Figure 2.22 show the abundance trends for the Barwon-Darling Watercourse WRPAs and the right-hand panel show the overall trend across the NSW MDB.

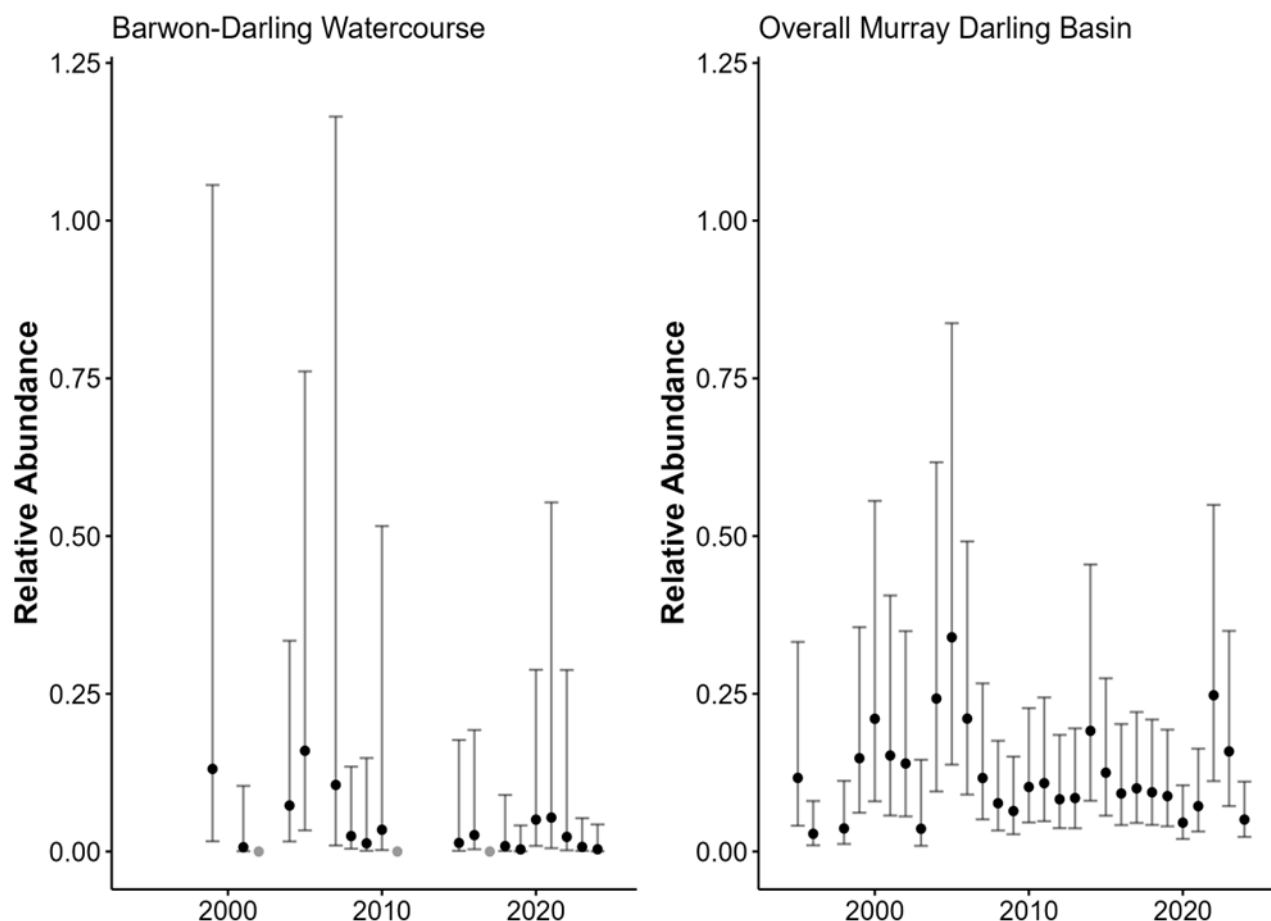


Figure 2.22: Relative abundance of Australian smelt in both this WRPAs and the overall NSW MDB. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates. No modelling of biomass was done for Australian smelt.

Summary Statement:

Abundance of Australian smelt is variable but it is likely to have declined over the last two decades. Current abundance is lower than the overall NSW MDB.

Health

No health issues have been recorded in Australian smelt in the Barwon-Darling Watercourse (Figure 2.23).

Across the other NSW MDB WRPA, 1 % of Australian smelt (174 out of 27,862 Australian smelt) showed a health condition (excludes the Barwon-Darling Watercourse WRPA).

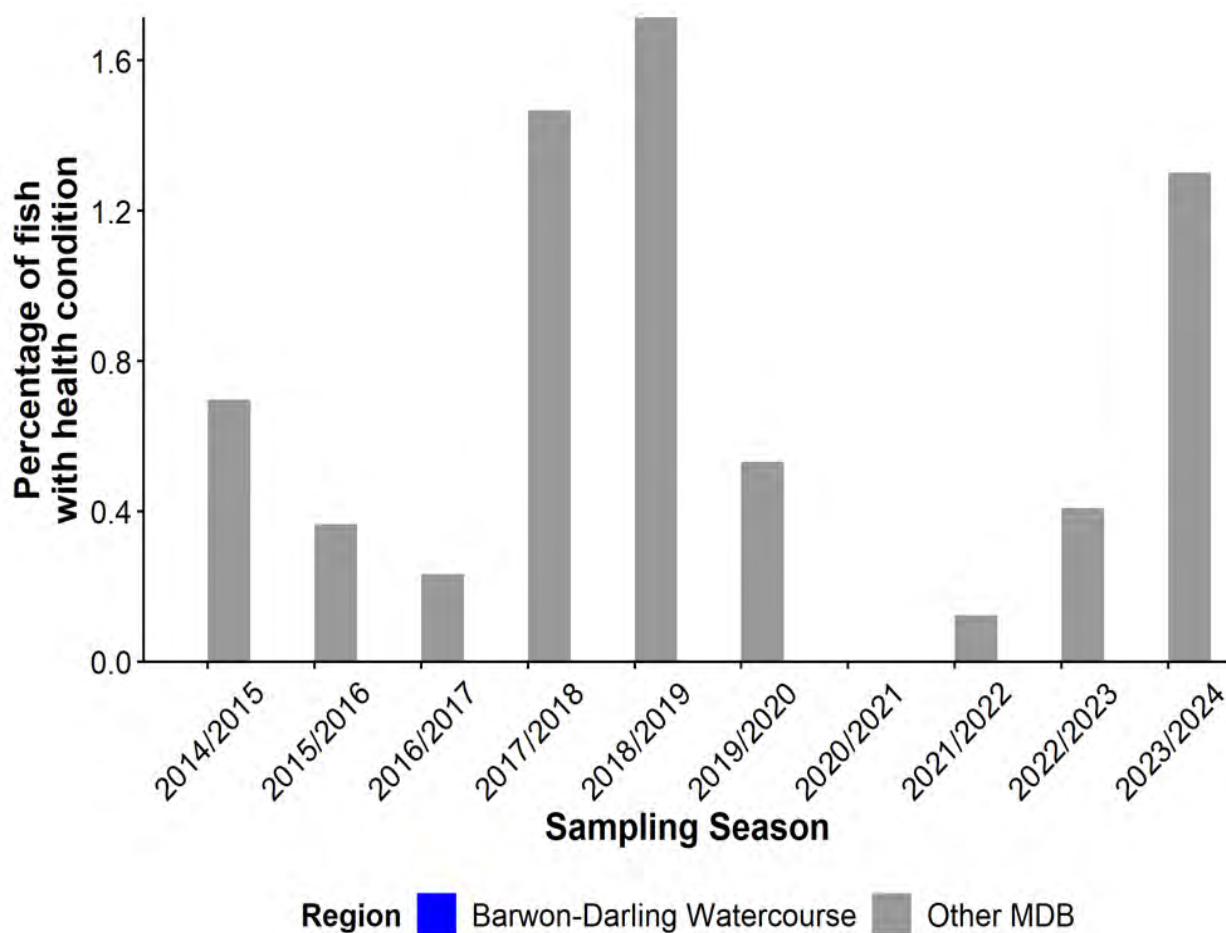


Figure 2.23: Timeseries showing the prevalence of health conditions in Australian smelt. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA.

Summary Statement:

No health issues were recorded in Australian smelt in the Barwon-Darling Watercourse.

Distribution

Australian smelt were recorded at 12 out of 58 sites in the Barwon-Darling Watercourse WRPAs from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 2.7 fish caught per 90 seconds of electrofishing. Figure 2.24 shows the distribution and relative abundance of Australian smelt across the Barwon-Darling Watercourse WRPAs.

Summary Statement:

Australian smelt appear to be restricted to south of Wilcannia and the eastern portion of the Barwon River.

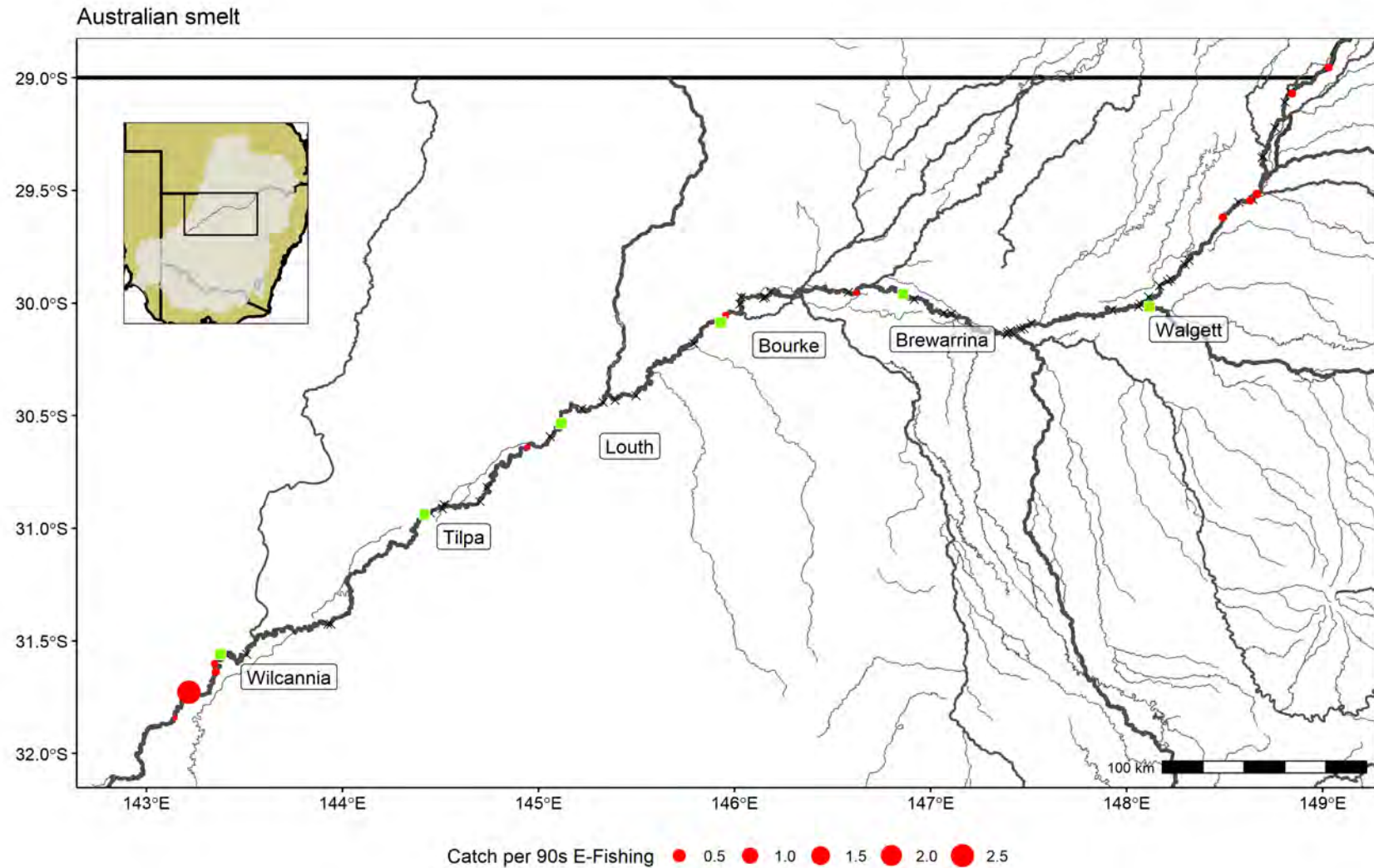


Figure 2.24: Distribution of Australian smelt sampled from 2013/14 to 2023/24 in the Barwon-Darling Watercourse. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares represent major towns.

Common carp



Population Structure

Figure 2.25 shows the observed length frequency plot for Common carp for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 1 to 556, and 2 % to 87 % of measured fish within a season, with a mean percentage YOY of 32 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Common carp was 55 % (34,077 out of 61,517). Common carp are not a stocked species.

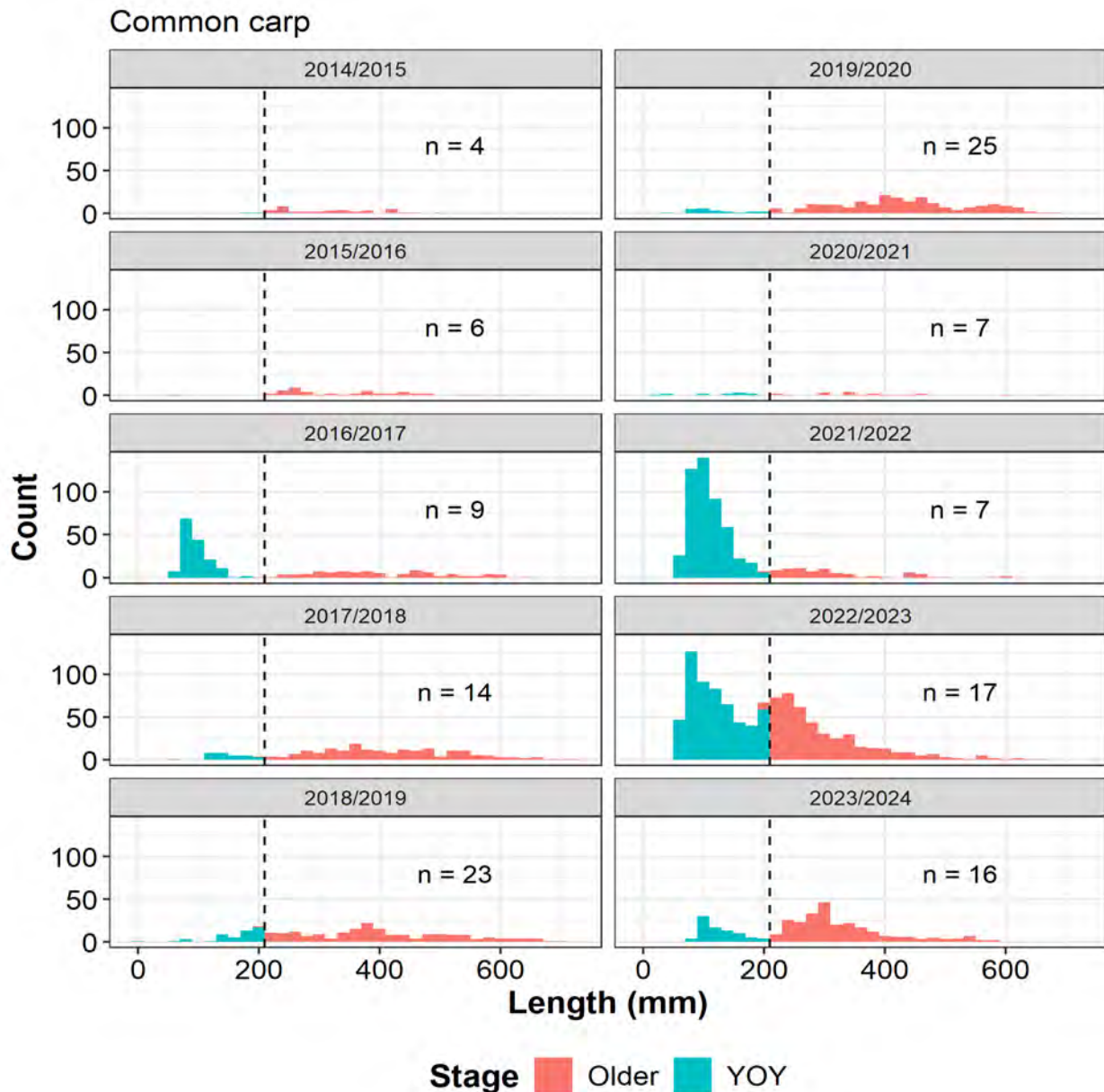


Figure 2.25: Length frequency plots for common carp by sampling season in the Barwon-Darling Watercourse. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRPA in a sampling season.

Summary Statement:

Variable recruitment with very strong peaks in 2016/17, 2021/22 and 2022/23. Large fish (>500 mm) present in all years. 2023/24 shows evidence of cohort progression following the strong recruitment events in 2021/22 and 2022/23.

Temporal Trends in Abundance

The relative abundance and biomass of Common carp since 1994 was modelled based on all suitable boat electrofishing data. The left-hand panels of Figure 2.26 show the abundance and biomass trends for the Barwon-Darling Watercourse WRPA and the right-hand panels show the overall trends across the NSW MDB.

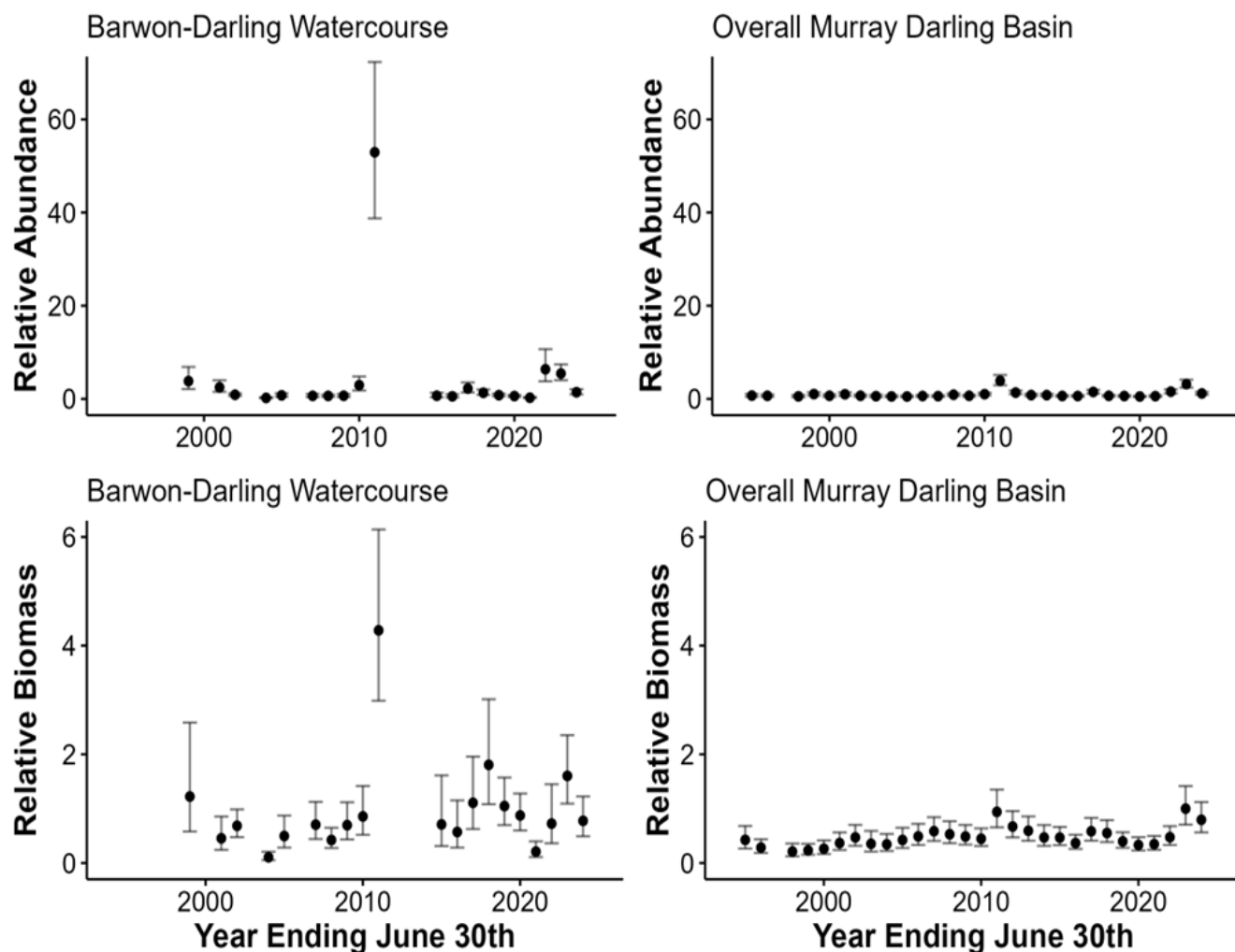


Figure 2.26: Relative abundance and biomass of Common carp in both this valley and the overall Murray-Darling Basin. These are model estimates based upon all electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates.

Summary Statement:

For Common carp in the Barwon-Darling Watercourse, there is no evidence of changes in abundance since the 1990's although it has fluctuated annually. Relative abundance and biomass declined between 2022/23 and 2023/24, and are comparable to the overall NSW MDB.

Health

The prevalence of any health issues ranged from 0 % of sampled fish in 2021/2022 to 21 % of sampled fish in 2023/2024 (Figure 2.27). The most common health issue for Common carp in the Barwon-Darling Watercourse water resource planning area was *Lernaea*, which was observed in a total of 101 fish, corresponding to 3 % of all Common carp measured.

Across the other WRPA's, 4 % of Common carp (2,250 out of 61,519 Common carp) showed a health condition (excludes Barwon-Darling Watercourse).

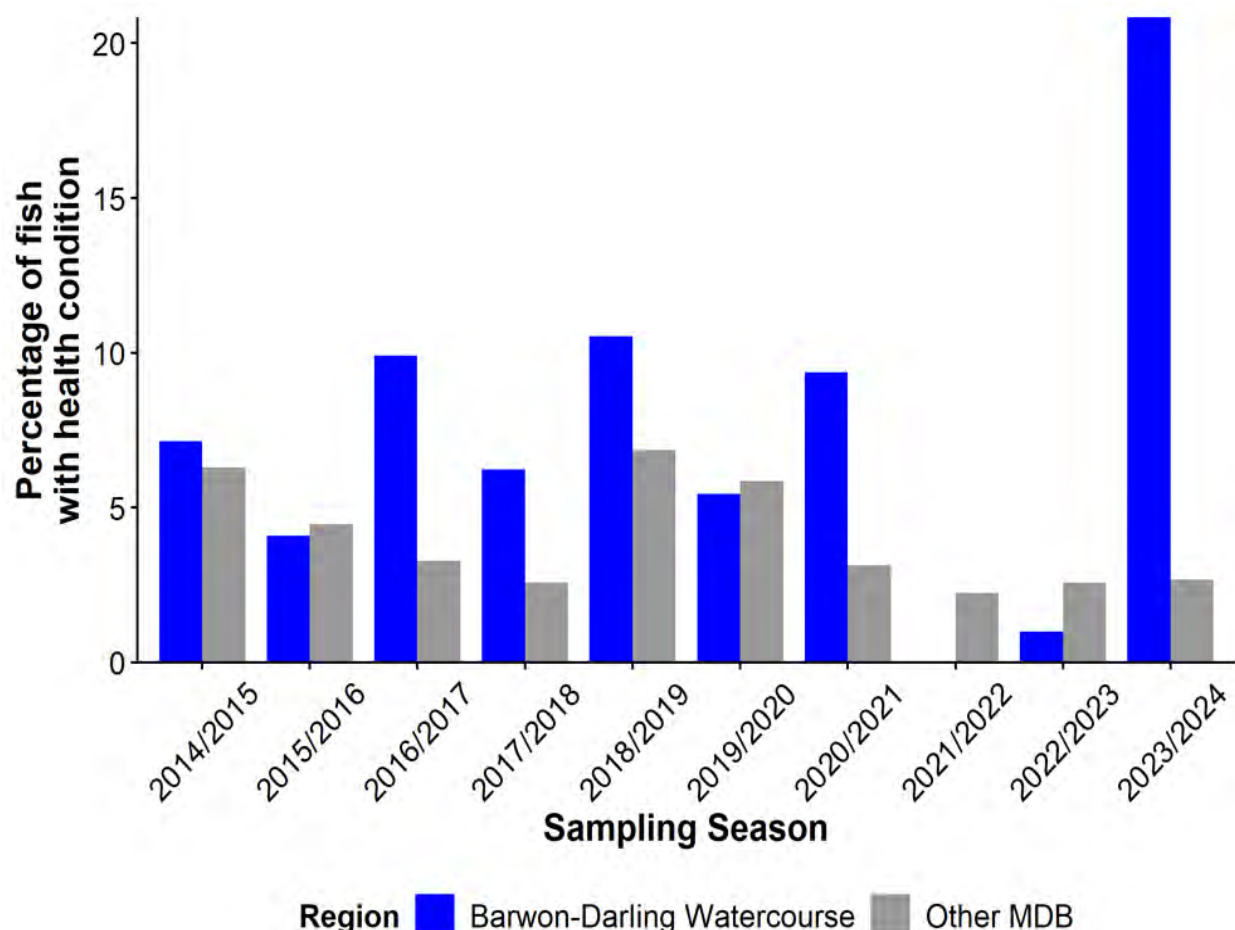


Figure 2.27: Timeseries showing the prevalence of health conditions in Common carp. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA's.

Summary Statement:

The presence of observable health conditions for Common carp in the Barwon-Darling Watercourse was generally low to moderate except 2023/24 which shows much higher rates of observable health conditions.

Distribution

Common carp were recorded at 56 out of 58 sites in the Barwon-Darling Watercourse WRPA from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 8.8 fish caught per 90 seconds of electrofishing. Figure 2.28 shows the distribution and relative abundance of Common carp across the Barwon-Darling Watercourse WRPA.

Summary Statement:

Common carp were found across the Barwon-Darling Watercourse region.

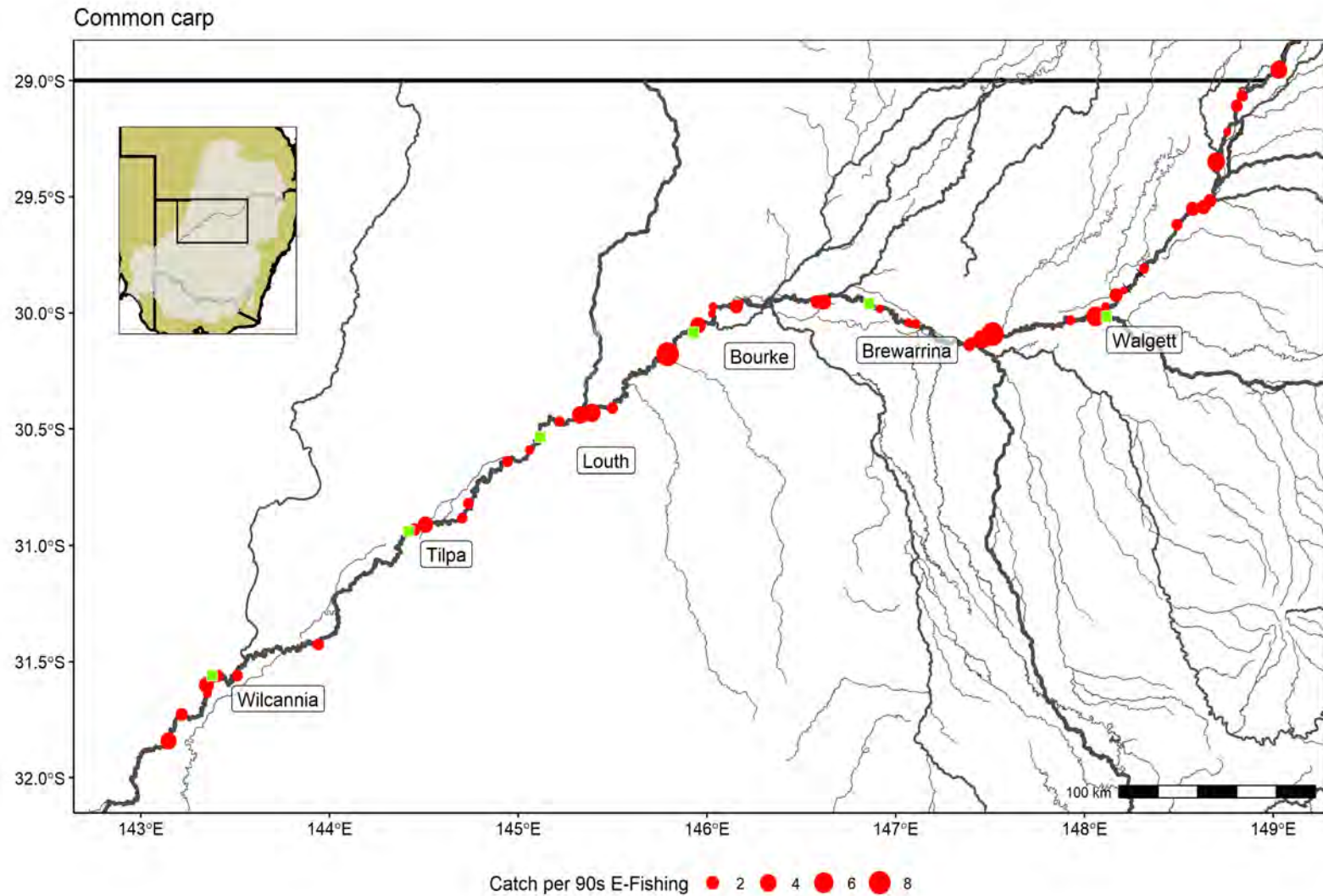


Figure 2.28: Distribution of Common carp sampled from 2013/14 to 2023/24 in the Barwon-Darling Watercourse. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares represent major towns.

Threatened Species

The following table (Table 2.6) shows the fish species listed under either the *NSW Fisheries Management Act 1994* (FMA) or the *Commonwealth Environmental Protection and Biodiversity Conservation Act 1999* (EPBC) which were observed during standardised electrofishing surveys in the Barwon-Darling Watercourse Water Resource Planning Area during the reporting period as part of standardized electrofishing. A list of all threatened fish species observed by NSW DPIRD Fisheries (as part of any sampling program in any area) is provided in Table 2.10.

Table 2.6: Listed species which were observed in this region during the sampling period. (* = FMA, # = EPBC)

Species	Common name	Total caught (observed)
<i>Bidyanus bidyanus</i>	Silver perch*#	1 (0)
<i>Maccullochella peelii</i>	Murray cod#	56 (26)

Note: Olive perchlet were also observed in this WRPA but not during the standardised electrofishing (Table 2.11).

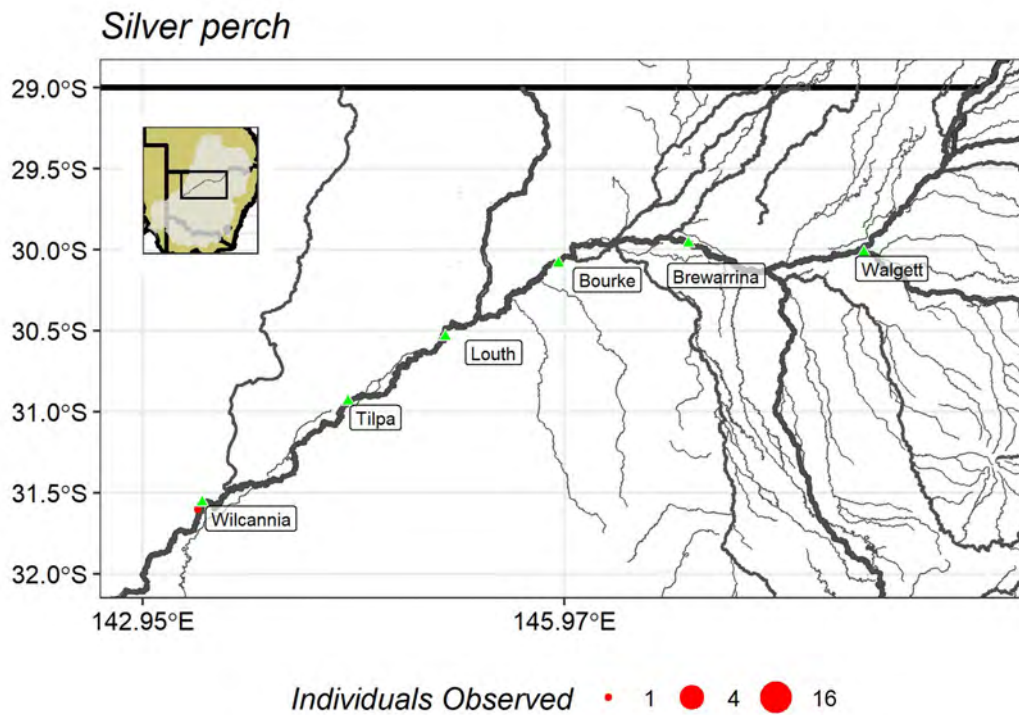


Figure 2.29: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the Barwon-Darling Watercourse. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance.

Summary Statement:

A single Silver perch (134 mm) was captured in 2017/18 near Wilcannia.

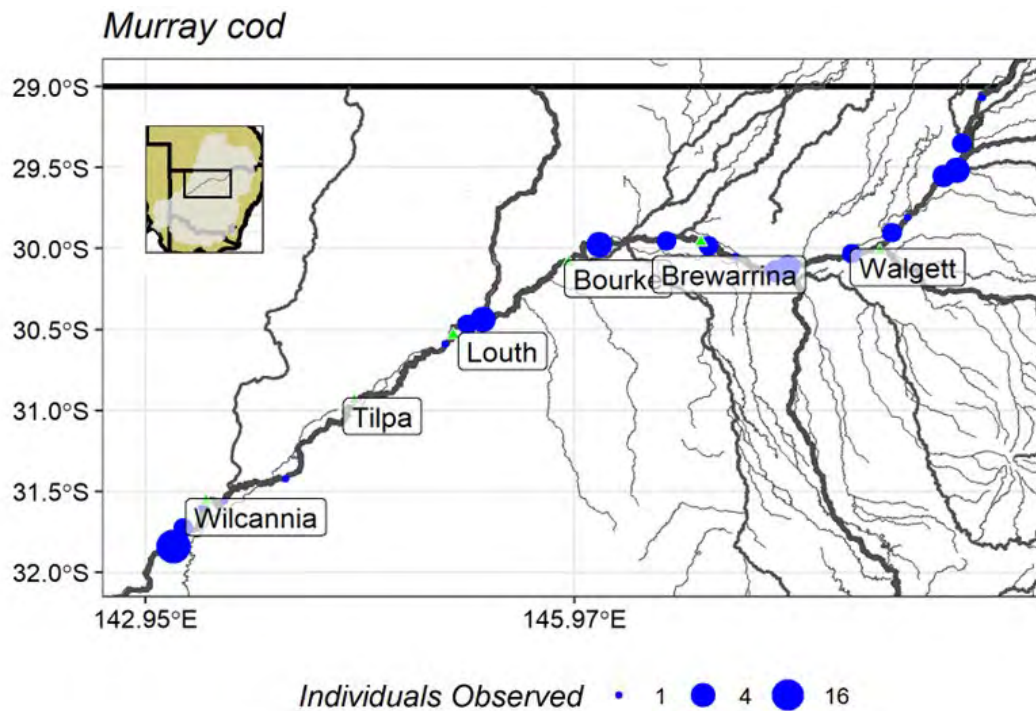


Figure 2.30: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the Barwon-Darling Watercourse. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance. Note the lower image shows a juvenile Murray cod.

Summary Statement:

56 Murray cod were captured across 22 sites across the Barwon-Darling Watercourse but only 2 individuals have been caught since 2019/20 (and 1 observed but not caught) suggesting the population is currently at very low abundance.

Appendix

This report contains data from the projects listed in Table 2.7.

Table 2.7: Projects included in this report. Sampling Events show the total number of sampling events included from each project. Sampling Seasons shows which sampling seasons each project contributed data to.

Project Name	Sampling Seasons	Sampling Events
Basin Plan Environmental Outcomes Monitoring	2014/2015, 2015/2016, 2016/2017, 2017/2018, 2018/2019, 2019/2020	62
Basin Plan Environmental Outcomes Monitoring 2	2022/2023, 2023/2024	25
Carp Biomass Project (NCCP)	2017/2018	1
Darling River Health	2023/2024	4
Golden perch Macquarie migration pathways	2022/2023	1
Murray-Darling Basin Fish Surveys	2014/2015, 2015/2016, 2016/2017, 2017/2018, 2018/2019, 2020/2021, 2021/2022, 2022/2023, 2023/2024	36
Toorale Long Term Intervention Monitoring	2019/2020, 2020/2021, 2021/2022, 2022/2023, 2023/2024	27

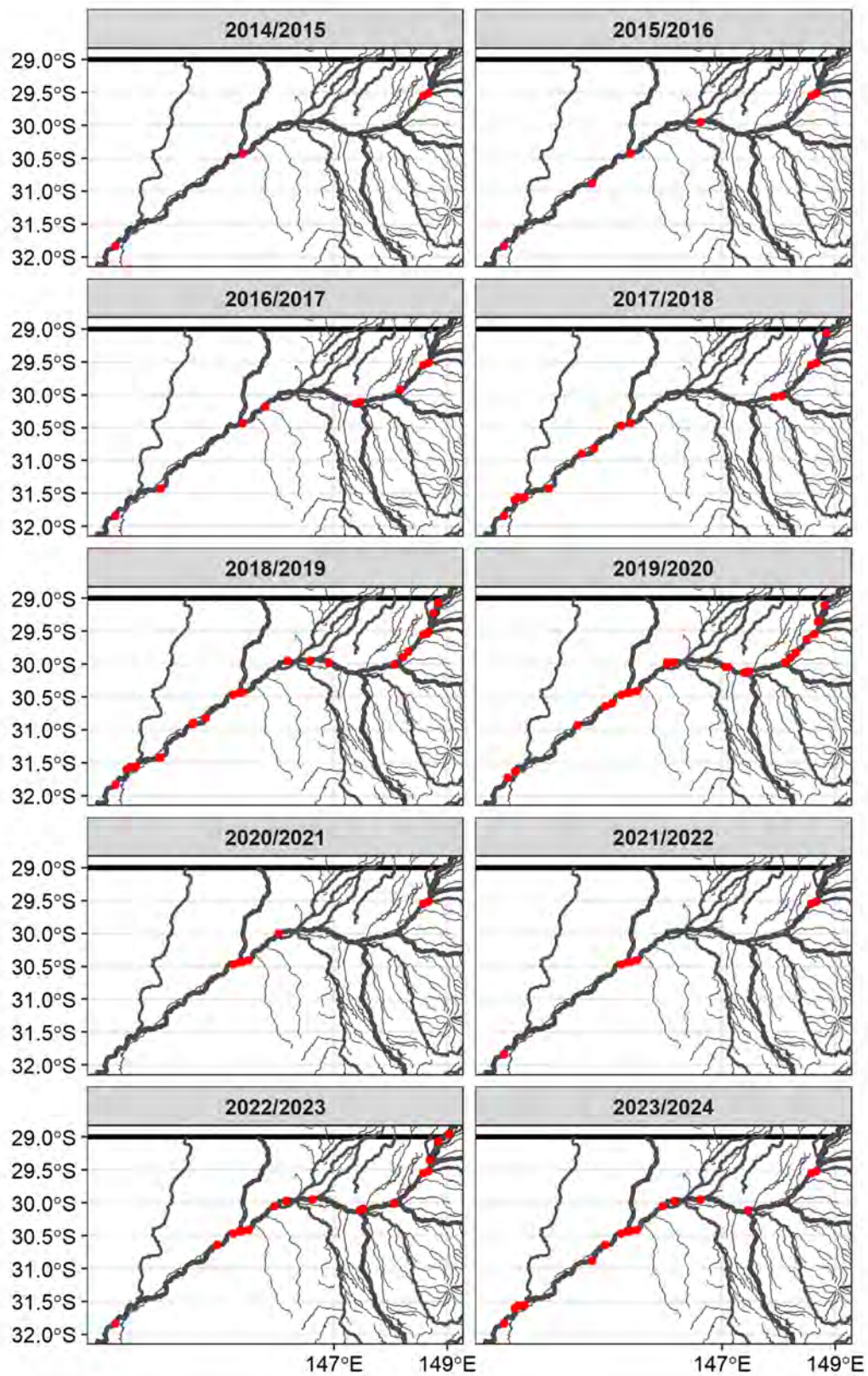


Figure 2.31: Sites sampled and included in this report by sampling season. Dry sites are not shown.

Table 2.8 shows all species detected during this survey period as part of standardised monitoring projects (see Table 2.7). Note there are variations in effort between sampling seasons so this information should be considered in conjunction with Table 2.1. The Expected from Modelling column identifies species which are possible to occur based upon MaxENT habitat modelling (likelihood threshold > 0.33; NA represents no modelling was undertaken). Species that were possible from the modelling but not observed during standardised sampling in the Barwon-Darling Watercourse WRPA were: Olive perchlet, Unspecked hardyhead, Southern purple-spotted gudgeon, Hyrtl's catfish, Freshwater catfish. It should be noted that the MaxENT modelling models habitat availability and is not always a reliable index of abundance, it merely indicates possible distribution based upon habitat. A full list of species observed during this period across the standardised monitoring protocols and sampling methods is presented in Table 2.11.

Table 2.8: Total number caught of each species by sampling season in the Barwon-Darling Watercourse.

Common name	Expected from modelling	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24
Australian smelt	YES	2	3	0	1	1	48	8	2	2	1
Bony herring	YES	451	533	1,434	2,380	3,594	1,697	913	1,839	2,055	817
Carp-gudgeon species complex	YES	657	28	23	115	5,022	2,751	25	0	1	0
Common carp	NA	42	48	302	224	245	240	32	751	1,505	359
Common carp - Goldfish hybrid	NA	0	0	0	0	0	0	0	0	2	0
Eastern gambusia	NA	18	10	16	39	254	149	16	16	10	1
Golden perch	YES	34	9	56	86	177	187	60	109	126	73
Goldfish	NA	2	3	106	34	94	64	14	23	275	78
Murray cod	YES	8	4	4	15	11	12	0	0	2	0
Murray-Darling rainbowfish	YES	9	18	12	37	144	41	35	12	13	0
Silver perch	YES	0	0	0	1	0	0	0	0	0	0
Spangled perch	YES	1	1	41	7	219	7	14	140	362	72

The following table summarises the sampling methods for each species caught (Table 2.9).

Table 2.9: Total catch of each species by sampling method in the Barwon-Darling Watercourse.

Common name	Backpack Electrofishing	Bait Trap	Boat Electrofishing
Australian smelt	0	1	67
Bony herring	74	34	15,605
Carp-gudgeon species complex	245	7,631	746
Common carp	34	117	3,597
Common carp - Goldfish hybrid	0	0	2
Eastern gambusia	160	114	255
Golden perch	28	12	877
Goldfish	95	7	591
Murray cod	1	0	55
Murray-Darling rainbowfish	23	12	286
Silver perch	0	0	1
Spangled perch	87	180	597

Table 2.10: Listed threatened species recorded in the Murray-Darling Basin (from the NSW DPIRD Fisheries Freshwater Ecosystem research database). Species are listed under either the NSW Fisheries Management Act 1994 (FMA) or the Commonwealth Environmental Protection and Biodiversity Conservation Act 1999 (EPBC).

Genus, species	Common Name	EPBC Status	FMA Status
<i>Ambassis agassizii</i>	Agassiz's glassfish, olive perchlet, western New South Wales population	NA	Endangered Population
<i>Bidyanus bidyanus</i>	Silver Perch, Bidyan	Endangered	Vulnerable
<i>Craterocephalus fluviatilis</i>	Murray Hardyhead	Endangered	Critically Endangered
<i>Galaxias rostratus</i>	Flathead Galaxias, Beaked Minnow, Flat-headed Galaxias, Flat-headed Jollytail, Flat-headed Minnow	Critically Endangered	Critically Endangered
<i>Galaxias tantangara</i>	Stocky Galaxias	NA	Critically Endangered
<i>Maccullochella macquariensis</i>	Trout Cod	Endangered	Endangered
<i>Maccullochella peelii</i>	Murray Cod	Vulnerable	NA
<i>Macquaria australasica</i>	Macquarie Perch	Endangered	Endangered
<i>Mogurnda adspersa</i>	Southern Purple Spotted Gudgeon	NA	Endangered
<i>Nannoperca australis</i>	Southern Pygmy Perch	Vulnerable	Endangered
<i>Tandanus tandanus</i>	Freshwater catfish, eel tailed catfish, Murray-Darling Basin population	NA	Endangered Population

Table 2.11 shows all species detected during this survey period across all programs and methods. Due to variations in project methods protocols, this data is presented only to give a complete list of species observed in the region. The Expected from Modelling column identifies species which are possible to occur based upon MaxENT habitat modelling (likelihood threshold > 0.33; NA represents no modelling was undertaken). Species that were possible from the modelling but not observed during standardised sampling in the Barwon-Darling Watercourse WRPAs were: Southern purple-spotted gudgeon, Hyrtl's catfish, Freshwater catfish. It should be noted that the MaxENT modelling actually models habitat availability and is not always a reliable index of abundance, it merely indicates possible distribution based upon habitat. A list of species caught as part of standardised monitoring during this period is in Table 2.8.

Table 2.11: Total catch of each species by all sampling programs and all methods in the Barwon-Darling Watercourse. Note these include projects with sampling not representative of the community and the data should be used with caution.

Common name	Expected from modelling	2014/ 15	2015/ 16	2016/ 17	2017/ 18	2018/ 19	2019/ 20	2020/ 21	2021/ 22	2022/ 23	2023/ 24
Australian smelt	YES	2	3	0	1	1	53	9	2	2	1
Bony herring	YES	451	533	1,434	2,380	3,594	1,865	1,031	2,366	2,079	852
Carp gudgeon species complex	YES	657	28	23	115	5,022	7,551	134	0	1	35
Common carp	NA	42	48	302	224	245	248	43	5,341	3,024	480
Common carp - Goldfish hybrid	NA	0	0	0	0	0	0	0	0	2	0
Eastern gambusia	NA	18	10	16	39	254	231	20	17	22	6
Golden perch	YES	34	9	56	86	177	235	82	189	126	73
Goldfish	NA	2	3	106	34	94	74	18	44	486	95
Murray cod	YES	8	4	4	15	11	12	0	0	2	0
Murray-Darling rainbowfish	YES	9	18	12	37	144	41	35	12	13	1
Olive perchlet	YES	0	0	0	0	0	0	1	0	0	2
Silver perch	YES	0	0	0	1	0	0	0	0	0	0
Spangled perch	YES	1	1	41	7	219	13	16	2,949	1,034	565
Unspecked hardyhead	YES	0	0	0	0	0	0	1	0	0	0

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Chapter 3 Basin Plan Fish Monitoring Summary (2014/15 – 2023/24): Gwydir Water Resource Planning Area

Hayden Schilling & David Crook

March 2025



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Citation Details

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Chapter cover image credit: Dion Wedd (NSW DPIRD); Fish images credit: Gunther Schmida

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Introduction

This report spans 2014/15 to 2023/24 and uses all suitable fish assemblage data collected by NSW DPIRD Fisheries using standardized electrofishing monitoring techniques. The format of the report follows and expands upon the previous reports (Schilling & Crook 2023, 2024). This report focusses on the Gwydir Water Resource Planning Area (WRPA) shown in Figure 3.1.

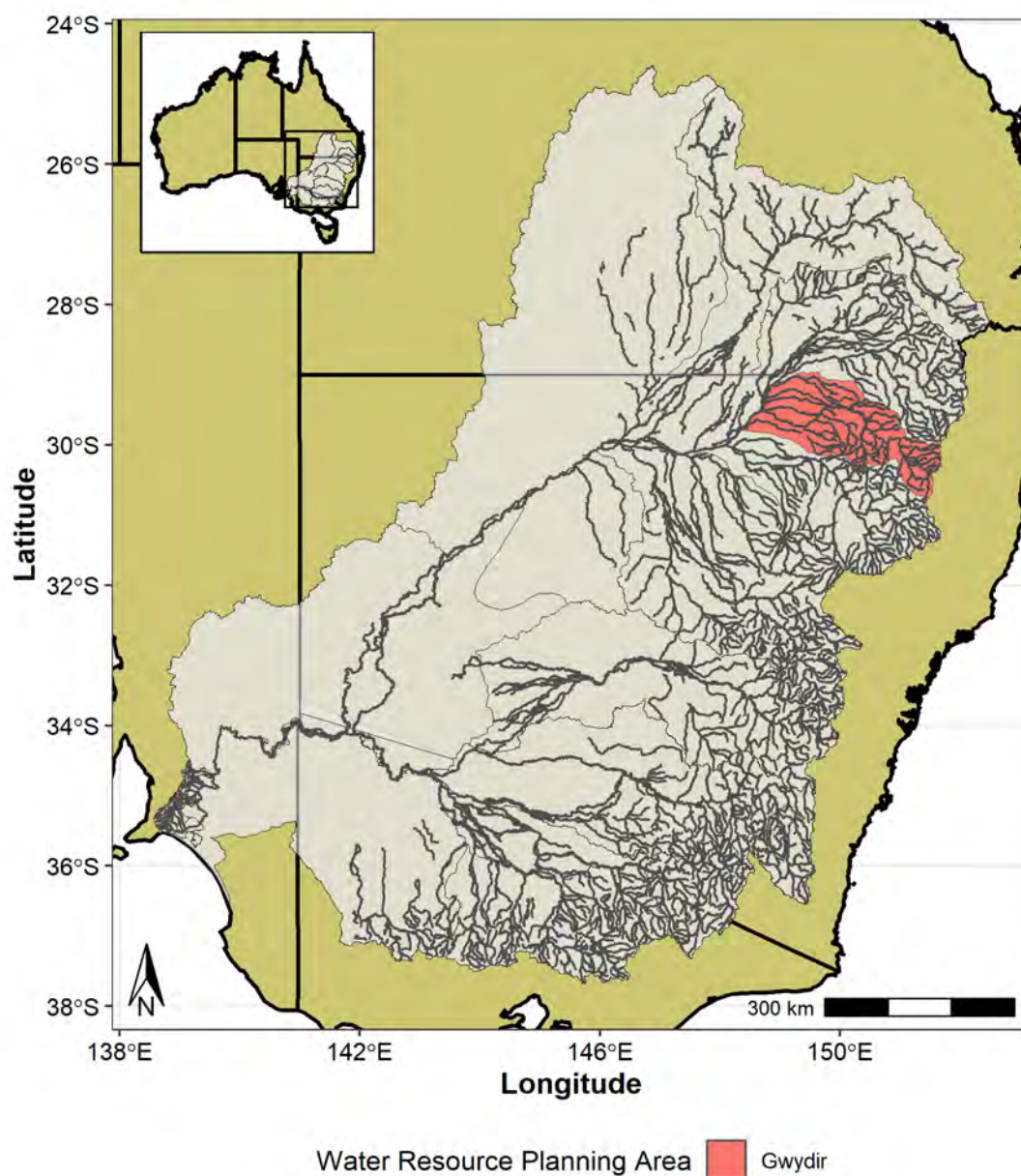


Figure 3.1: Murray-Darling Basin with the key region of this report highlighted. Inset map shows the whole of Australia with a box around the MDB.

What This Report Includes

This report starts with an overview of the standardised monitoring programs including sampling details and statistics. An overview of the hydrological and climatic conditions during the reporting period is also provided as context for interpreting the fish population status data.

Following the introductory sections, we present a summary of *fish diversity* across the Gwydir WRP. Separate plots for native and alien species show the total number of unique species observed at each site.

The main body of the report provides detailed information on the *population structure, relative abundance, health, and distribution* of six key fish species:

- Murray cod
- Golden perch
- Freshwater catfish
- Bony herring
- Australian smelt
- Common carp

Population structure information includes length frequency plots of collected fish and the proportion of fish classified as Young of the Year (YOY). This information can be used to infer the size structure of populations and the level of recruitment each year. For additional context, we provide a summary table showing any stocking which occurred for the species in each year (if relevant).

Relative abundance and *relative biomass* (a unit-less measure representing the number (or biomass) of fish in an area) information is adapted from the modelled outputs from a more in-depth publication (Crook et al. 2023) which considers all available electrofishing data within the NSW Murray-Darling Basin (MDB). The updated analysis uses generalised linear mixed models to generate annual indices of relative abundance and biomass for each WRP. In this report we present the modelled time series of relative abundance showing the predicted number (or biomass) of fish observed per 90 second shot of electrofishing. The abundance and biomass trends for the Gwydir WRP are contrasted with the overall NSW MDB dataset. It should be noted that these are modelled estimates of relative abundance/biomass, not absolute abundance/biomass as absolute estimates would require extensive calibration surveys that are not included in the monitoring program.

Health information is provided as a summary of any visible health conditions recorded for the key species. The number of health conditions observed in a fish population is generally reflective of water quality, competition, and many other factors. Fewer observations of health conditions indicate healthier populations. The health conditions detailed are any that were observed as part of the biological measurements taken. We provide a comparison of the prevalence of health conditions in the Gwydir WRP and greater MDB (excluding the Gwydir WRP).

Distribution maps are provided for each species to show the observed distribution of each species from electrofishing samples. The distribution maps also show the relative abundance (number of fish observed per 90 seconds of electrofishing) at each site to give an indication of how the population is spread over the landscape.

Finally, the distributions and numbers of *Threatened species* are reported. The report includes threatened species that were recorded by standardised monitoring programs in the Gwydir WRP during the reporting period.

For each section of the report, we provide a *Summary Statement*. This statement provides a very brief overview of the key messages for each section.

Sampling Methods

Three main methods are used during routine fish monitoring surveys: boat electrofishing, backpack electrofishing and bait traps. This report mainly includes the electrofishing data with bait trap samples informing the distribution of small bodied species. The electrofishing was conducted using the standard methodology implemented in the Sustainable Rivers Audit (SRA; Davies et al. 2010). This usually includes 12 shots of 90 seconds “power on” during each sampling event.

As parts of this report compile data from multiple projects, there is some variation in how sites were chosen and the effort of sampling conducted each year (Table 3.1). Details of which projects contributed data to this report can be seen in Table 3.7. At each site, sampling gear was applied as suited to the local conditions with either boat, backpack, or a hybrid of the two, in addition to 10 unbaited bait traps set in edge margins. Most sampling occurred between the months of September and May.

Table 3.1: Sampling effort (Number of sites sampled) each sampling season in the Gwydir WRP. Variation in sampling effort is due to different numbers of projects and interruptions to planned sampling such as flooding, site desiccation, and extreme weather.

Sampling Season	Number of Boat Electrofishing Sites	Number of Backpack Electrofishing Sites	Number of Hybrid Sites	Total
2014/2015	12	18	4	34
2015/2016	6	12	2	20
2016/2017	17	20	3	40
2017/2018	15	23	5	43
2018/2019	21	29	5	55
2019/2020	11	35	10	56
2020/2021	7	1	2	10
2021/2022	13	10	1	24
2022/2023	24	14	3	41
2023/2024	17	19	4	40

The sites sampled during the reporting period are shown in Figure 3.2. A breakdown of sites sampled each sampling season is shown in the Appendix (Figure 3.37).

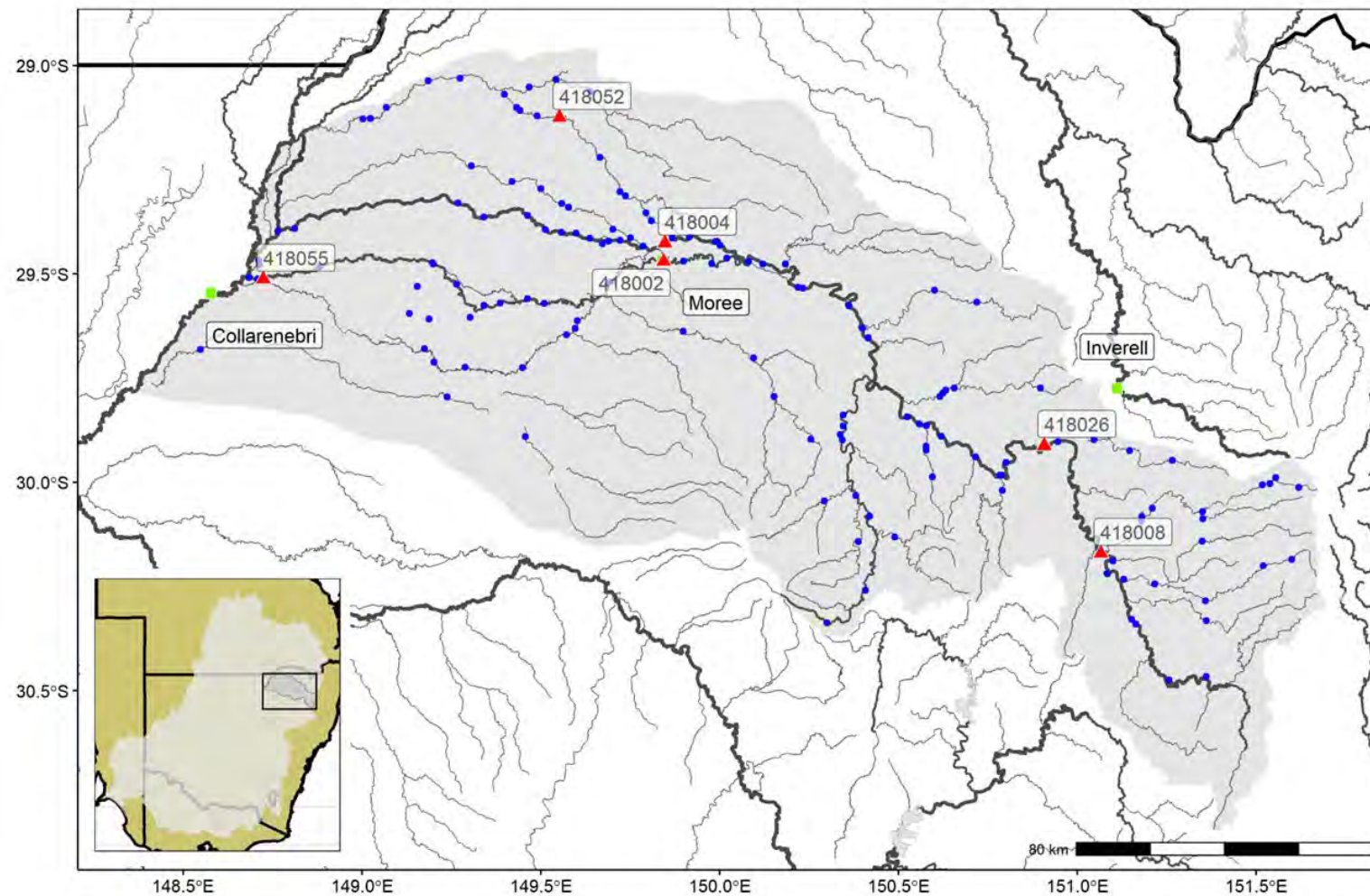


Figure 3.2: Sites (dots) sampled during the reporting period in the Gwydir WRPA. Triangles show key flow gauges along with their gauge ID number. Green squares show major towns.

Each sampling method has a different effectiveness at sampling each species. Table 3.2 shows the total numbers of each key species caught by each method.

Table 3.2: Number of each key species caught by sample method over the whole program in the Gwydir WRP. Further data on total catch is provided in the Appendix.

Common name	Boat Electrofishing	Backpack Electrofishing	Bait Trap
Australian smelt	477	651	4
Bony herring	4,519	1,222	16
Common carp	3,631	3,317	162
Freshwater catfish	159	212	11
Golden perch	433	24	0
Murray cod	1,100	152	0

A subset of sampled fish had biological measurements taken during the surveys, including but not limited to length and weight measurements and visual health assessments. Table 3.3 shows the number of biological measurements taken each year for the six key species.

Table 3.3: Number of biological measurements taken for the key species each sampling season in the Gwydir WRP.

Sampling Season	Australian smelt	Bony herring	Common carp	Freshwater catfish	Golden perch	Murray cod
2014/2015	209	288	303	5	34	103
2015/2016	7	261	227	53	23	31
2016/2017	280	1,194	900	55	39	166
2017/2018	188	918	309	14	29	143
2018/2019	43	590	590	27	40	317
2019/2020	145	233	1,164	97	19	88
2020/2021	0	92	97	2	5	5
2021/2022	43	362	628	17	62	54
2022/2023	49	603	1,241	88	88	176
2023/2024	108	486	558	22	123	162

Climate Overview

The following is a summary of the climatic conditions during the reporting period in terms of how the observed conditions compare to long term records. These are direct extracts from the [Australian Bureau of Meteorology climate summaries archive](#) and are written in the given year. To interpret, 2014 states it was the warmest year on record, meaning 2014 was the warmest year on record up to and including 2014 but not including more recent years.

2014

New South Wales experienced its warmest year on record in 2014, with several heatwaves and persistently warm conditions across the State. Rainfall was well below average in the northeast, and close to average elsewhere.

2015

New South Wales recorded well above average temperatures in 2015. Nights were particularly warm, the sixth-warmest on record for the State. Rainfall was close to average for the state as a whole.

2016

2016 was a generally wet, warm year for NSW as a whole, with substantial variability throughout the year and across the state. Following a record-warm start to the year, May to September was the wettest such period on record for NSW, with cooler weather in much of the west of the state. Minimum temperatures were the warmest on record for the State as a whole, with record-warm daytime temperatures on parts of the east coast.

2017

The year 2017 was the warmest on record for New South Wales for both mean and daytime temperatures. It was also the State's driest year since 2006. Following the warmest summer on record for the State, heavy rain in March across the east then made way for a very dry winter and start to spring. Winter overnight temperatures were the lowest since 1997, but daytime temperatures remained above average for most of the year, and were the warmest on record overall.

2018

2018 was the warmest on record for New South Wales for both mean temperature and mean maximum temperature, whilst the mean minimum temperature was fourth-warmest on record. The year was dominated by very dry conditions, with the third-driest January to September on record. October to December saw some relief from the dry, with above average rainfall across parts of the State. Despite this, New South Wales experienced its sixth-lowest annual rainfall on record; its driest year since 2002.

2019

2019 was the driest and warmest year on record for New South Wales. Despite some rain in some months, most of the State received much less rainfall than usual, with the northeast and far west particularly dry. Heatwaves in January brought very high temperatures, and large fires from September onward caused extensive damage and persistent smoke.

2020

2020 saw above average temperature and rainfall in New South Wales. Temperatures were above average across the state in most months except during autumn. There was widespread rain during autumn and spring and in December, but early winter and November rain was below average.

2021

New South Wales had its 6th wettest year on record, with 2021 rainfall 30 % above average. This included significant floods along the east coast in March, and the state's wettest November on record. It was the state's coolest year since 1996, at 0.15 °C above the 1961–1990 average.

2022

2022 was exceptionally wet with the state-averaged annual total being the second-highest on record (since 1900) and many sites recording their highest annual totals on record. Maximum temperatures were lower than average with the state-averaged annual maximum temperature being the coolest since 1992. Minimum temperatures were generally warmer than average with the state-averaged annual minimum temperature being 0.73 °C above the 1961–1990 average.

2023

The state-averaged rainfall was 22.9 % below the 1961–1990 average. Rainfall was above average over small parts of the state's south, west of the Great Dividing Range, while being below average over most of the northern half of the state, especially over parts of the Northern Tablelands, Northern Rivers, Mid-North Coast, and Upper Hunter, where annual rainfall was in the lowest 10 % of historical records (since records began in 1900). State-averaged annual maximum temperature was 1.96 °C above the 1961–1990 average, which is the third highest on record.

2024

Rainfall totals in 2024 were above average to very much above average for the northern and western areas of the state, as well as central parts of the coast. Totals were below average for large parts of the south-east, as well as small parts of the state's north-east and south-west. 2024 was the third-warmest on record for all years since 1910, 1.55 °C above the 1961–1990 average.

Flow Data

Below shows a summary of flow data from a variety of flow gauges in the Gwydir WRP (Figure 3.3).

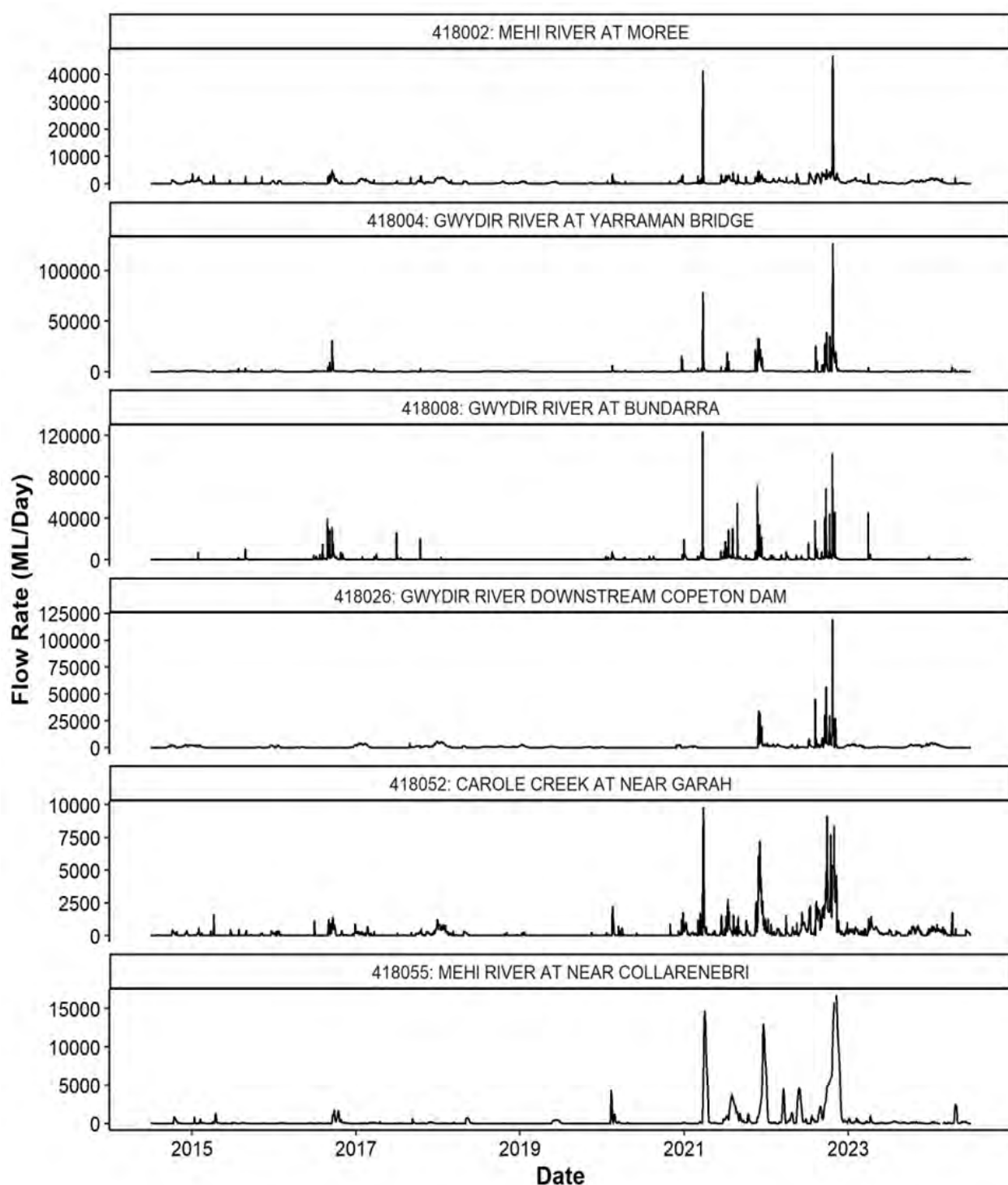


Figure 3.3: Flow data from various gauges in the Gwydir WRP over the reporting period. Gauge locations can be seen on Figure 3.2. Note the differing scales on the y-axis.

Water temperature data, where available, are also shown in Figure 3.4.

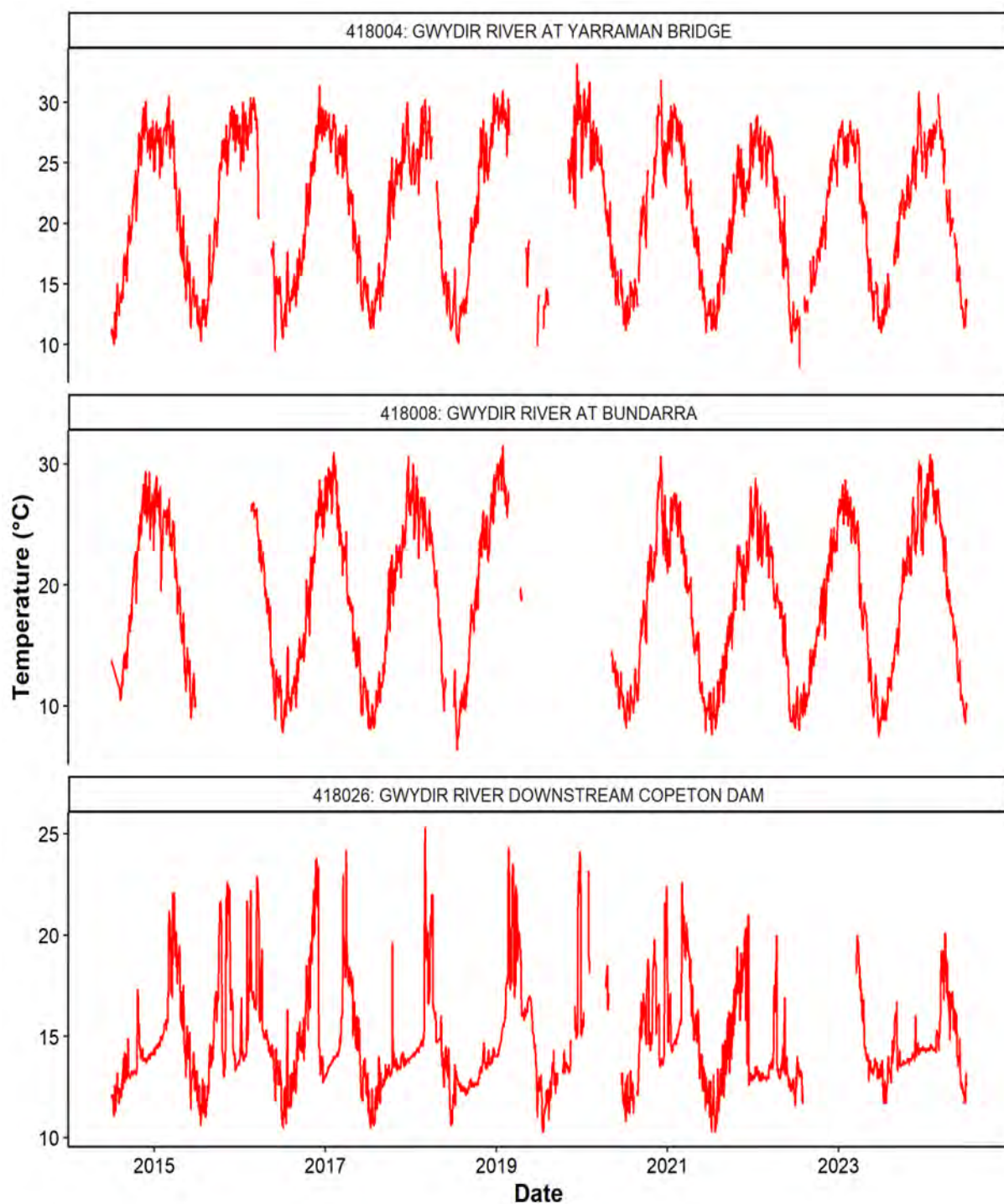


Figure 3.4: Water temperature data from various gauges in the Gwydir WRPA over the reporting period. Gauge locations can be seen on Figure 3.2. Note the differing scales on the y-axis.

Species Diversity

A total of 20 fish species were observed across the Gwydir WRPA including five alien species. Figure 3.5 shows the number of native species found at each site while Figure 3.6 shows the number of alien species found at each site. The full list of species caught and observed is presented in Table 3.8.

Summary Statement:

Native diversity was slightly higher in the central region compared to other areas while alien diversity was generally consistent across Gwydir region.

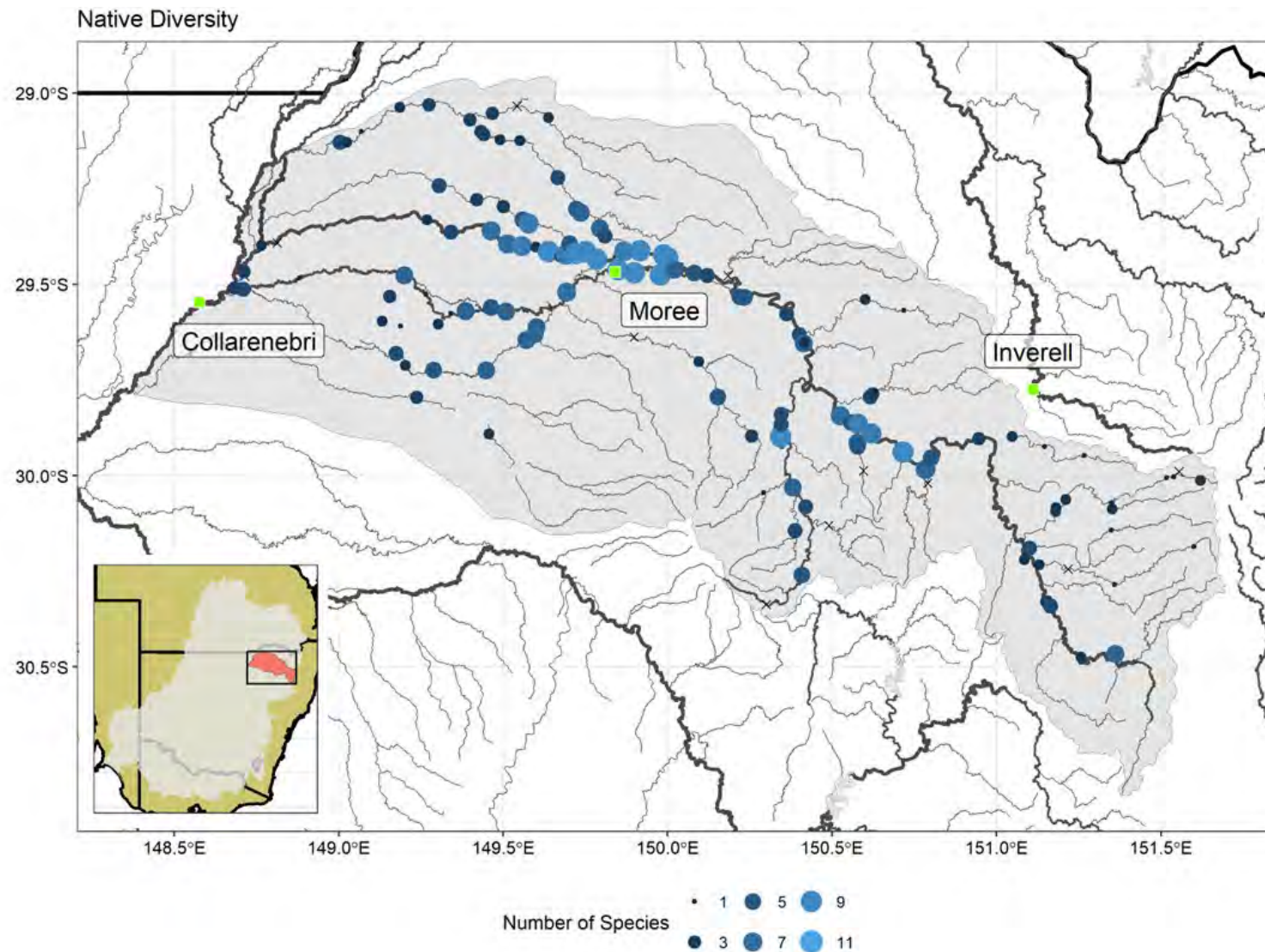


Figure 3.5: Native diversity across all sampling sites in the Gwydir WRP. Bubble size represents the number of unique species observed at each site across all sampling methods and events. X represents a site that had water and was sampled, but no fish species were caught at all. Dry sites are excluded. Green squares represent key towns.

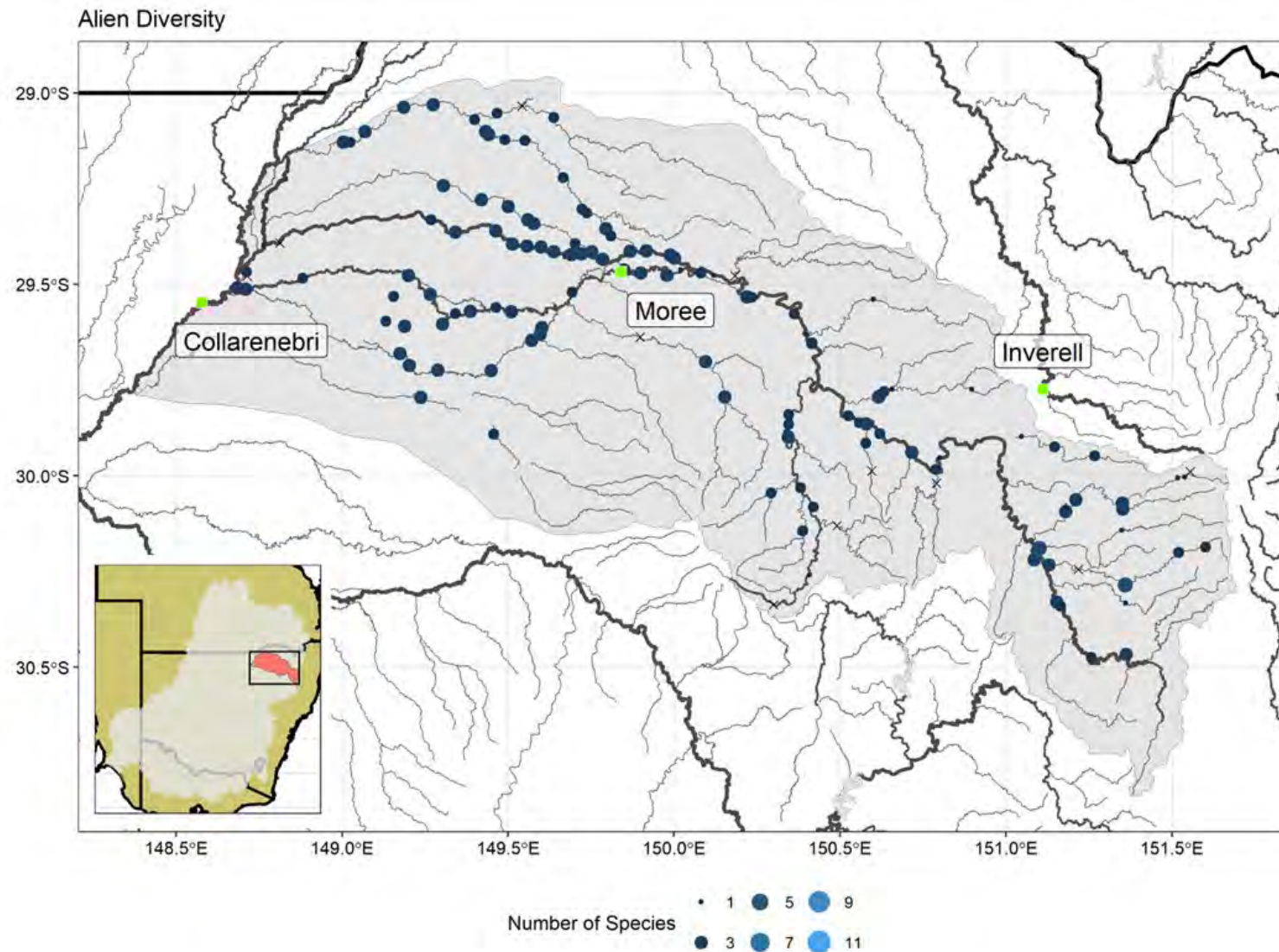


Figure 3.6: Alien diversity across all sampling sites in the Gwydir WRPA. Bubble size represents the number of unique species observed at each site across all sampling methods and events. X represents a site that had water and was sampled, but no fish species were caught at all. Dry sites are excluded. Green squares represent key towns.

Murray cod



Population Structure

Figure 3.7 shows the observed length frequency plot for Murray cod for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 0 to 26, and 0 % to 41 % of measured fish within a season, with a mean percentage YOY of 13 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Murray cod was 13 % (1,316 out of 10,306).

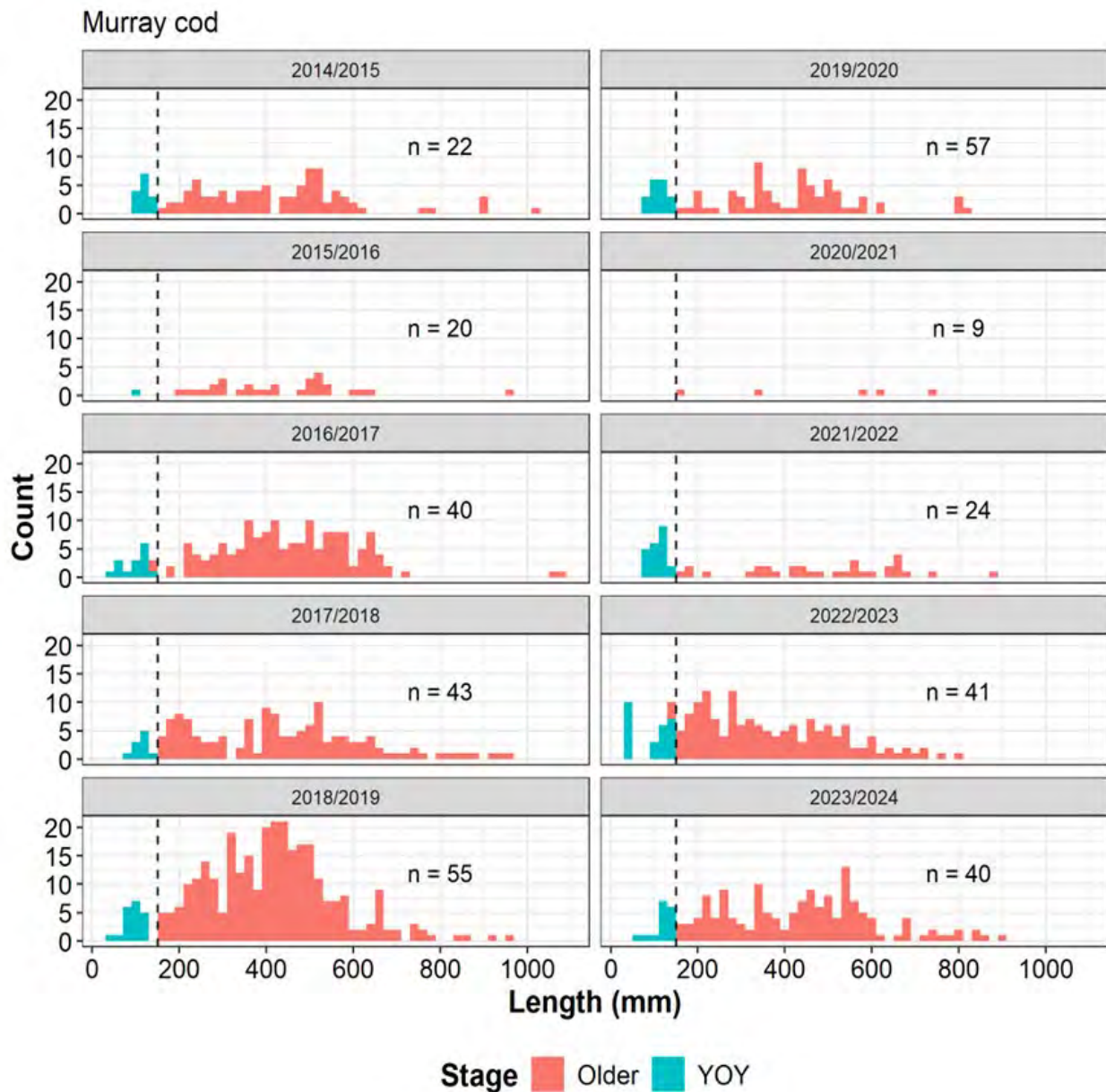


Figure 3.7: Length frequency plots for Murray cod by sampling season in the Gwydir WRPA. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRPA in a sampling season.

Summary Statement:

Recruitment evident in most years with possible recruitment failures in 2015/16 and 2020/21. A good range of size classes including YOY were observed in 2023/24.

Stocking

A total of 535,315 Murray cod were stocked into the waterways of the Gwydir WRP during the reporting period. Of these fish, 512,285 (96 %) were stocked into impoundments while 23,030 (4 %) were stocked into rivers or creeks. Table 3.4 shows the detailed breakdown of stocking by season, location and life stage while Figure 3.8 shows the locations of stocking.

Table 3.4: Number and life stage of stocked Murray cod each sampling season.

Sampling Season	River/Creek or Impoundment	Life Stage	Number Stocked
2014/2015	Impoundment	Fry	20,000
2015/2016	Impoundment	Fry	45,000
2015/2016	River/Creek	Sub Adult	300
2016/2017	Impoundment	Fingerling	5,600
2016/2017	Impoundment	Fry	66,000
2016/2017	River/Creek	Fingerling	5,198
2017/2018	Impoundment	Fry	2,000
2018/2019	Impoundment	Fry	45,000
2018/2019	River/Creek	Fry	6,000
2019/2020	Impoundment	Fry	13,000
2019/2020	River/Creek	Fry	4,200
2020/2021	Impoundment	Fry	25,185
2021/2022	Impoundment	Fry	110,500
2021/2022	River/Creek	Fry	1,500
2022/2023	Impoundment	Fry	140,000
2022/2023	River/Creek	Fry	832
2023/2024	Impoundment	Fingerling	40,000
2023/2024	River/Creek	Fingerling	5,000

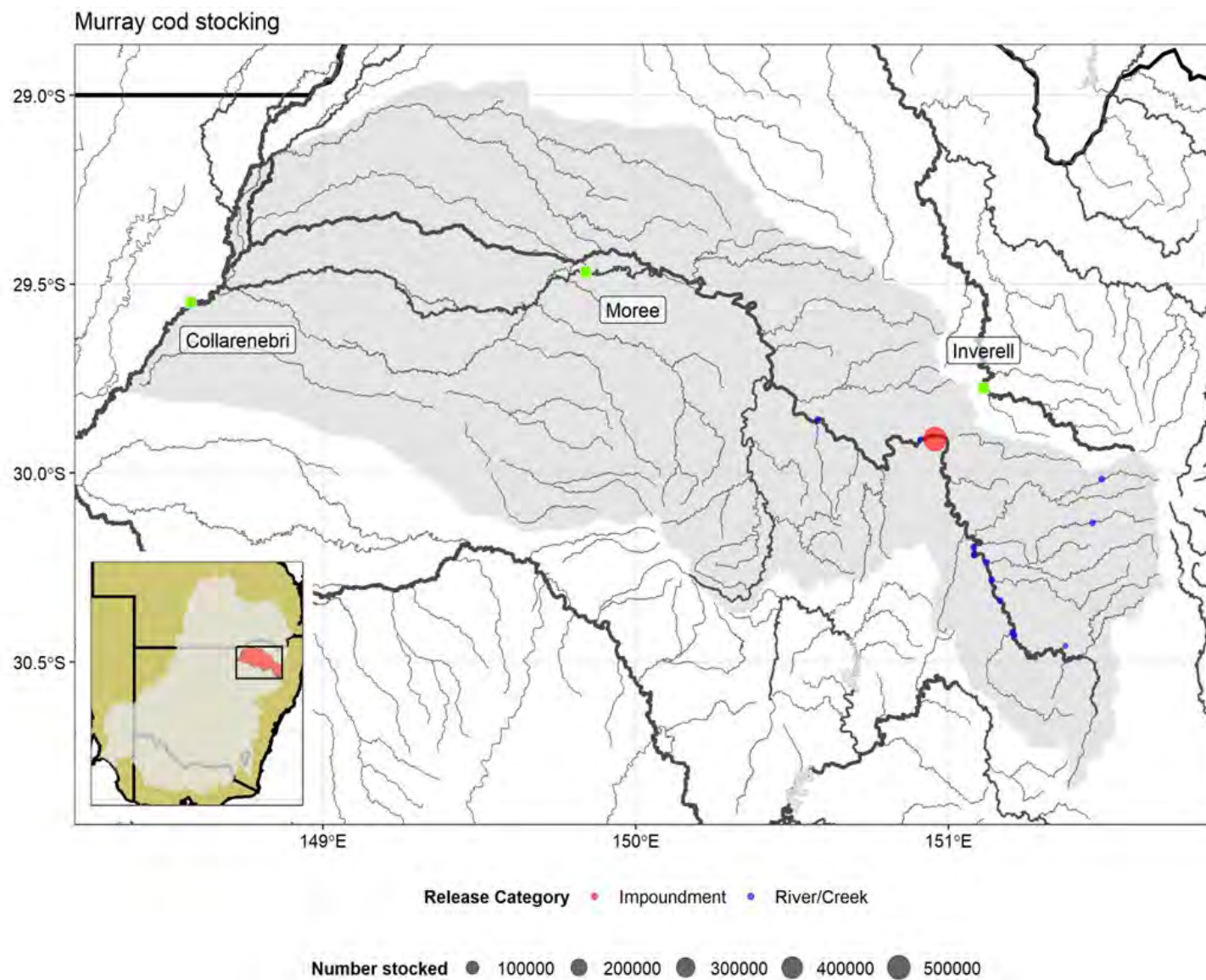


Figure 3.8: Locations of Murray cod stocking in the Gwydir WRPA. Colours show whether a site was a river/creek site or an impoundment, while the size of the point reflects the total number of fish stocked over the reporting period. The vast majority of stocking in the Gwydir WRPA was at Copeton Dam (large red dot). Green squares represent key towns.

Temporal Trends in Abundance

The relative abundance and biomass of Murray cod since 1994 was modelled based on all suitable boat electrofishing data. The left-hand panels of Figure 3.9 show the abundance and biomass trends for the Gwydir WRP and the right-hand panels show the overall trends across the NSW MDB.

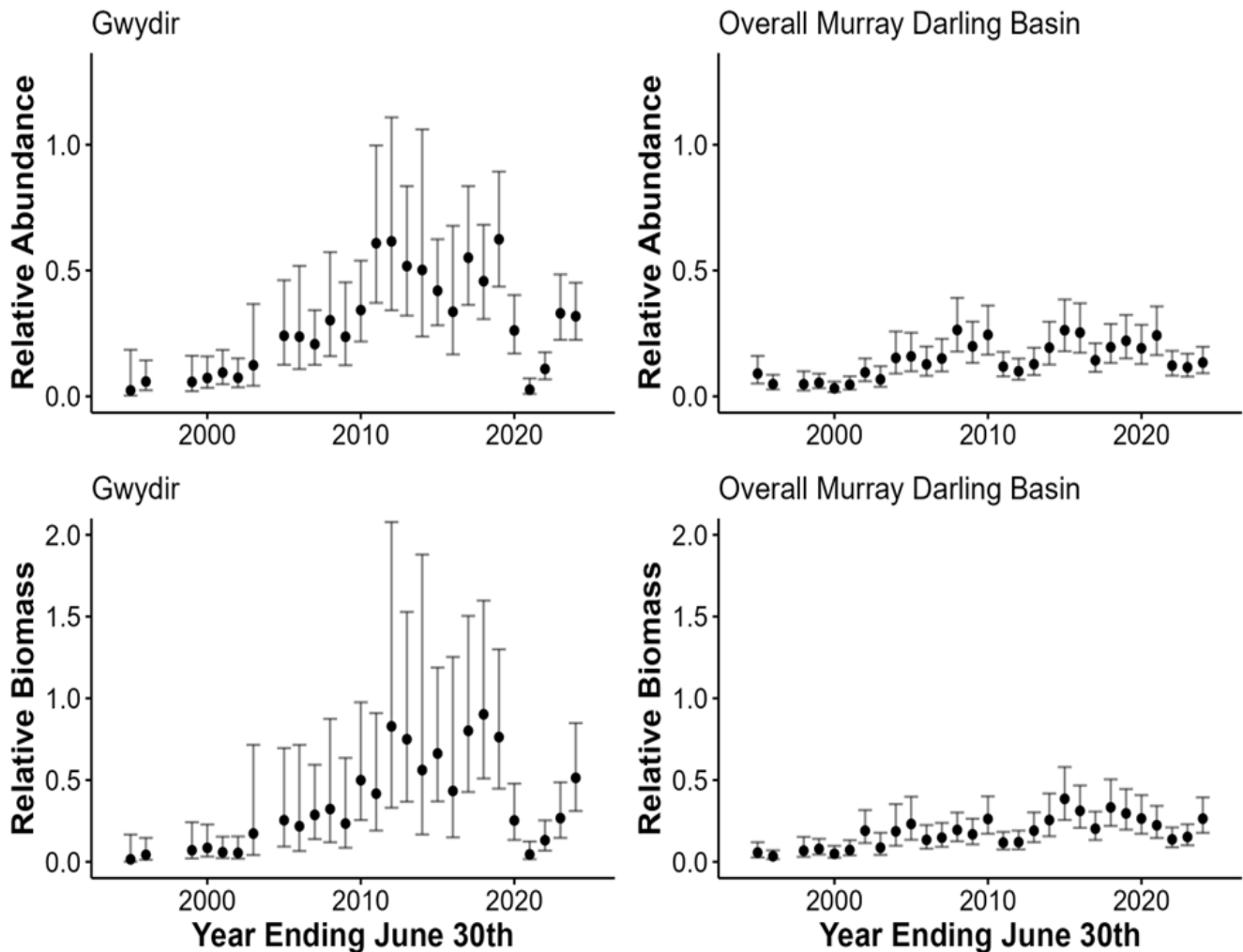


Figure 3.9: Relative abundance and biomass of Murray cod in both the Gwydir WRP and the overall NSW MDB. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates.

Summary Statement:

Overall increases in abundance and biomass since the 1990s. Both Abundance and biomass declined from 2018 to 2020 but have recovered since and are now slightly higher than the overall NSW MDB.

Health

The prevalence of any health issues ranged from 0 % of sampled fish in 2020/2021 to 16 % of sampled fish in 2015/2016 (Figure 3.10). The most common health issue for Murray cod in the Gwydir WRPAs was *Lernaea*, which was observed in a total of 70 fish, corresponding to 6 % of all Murray cod measured.

Across the other NSW MDB WRPA, 17 % of Murray cod (1,727 out of 10,306 Murray cod) showed a health condition (excludes the Gwydir WRPAs).

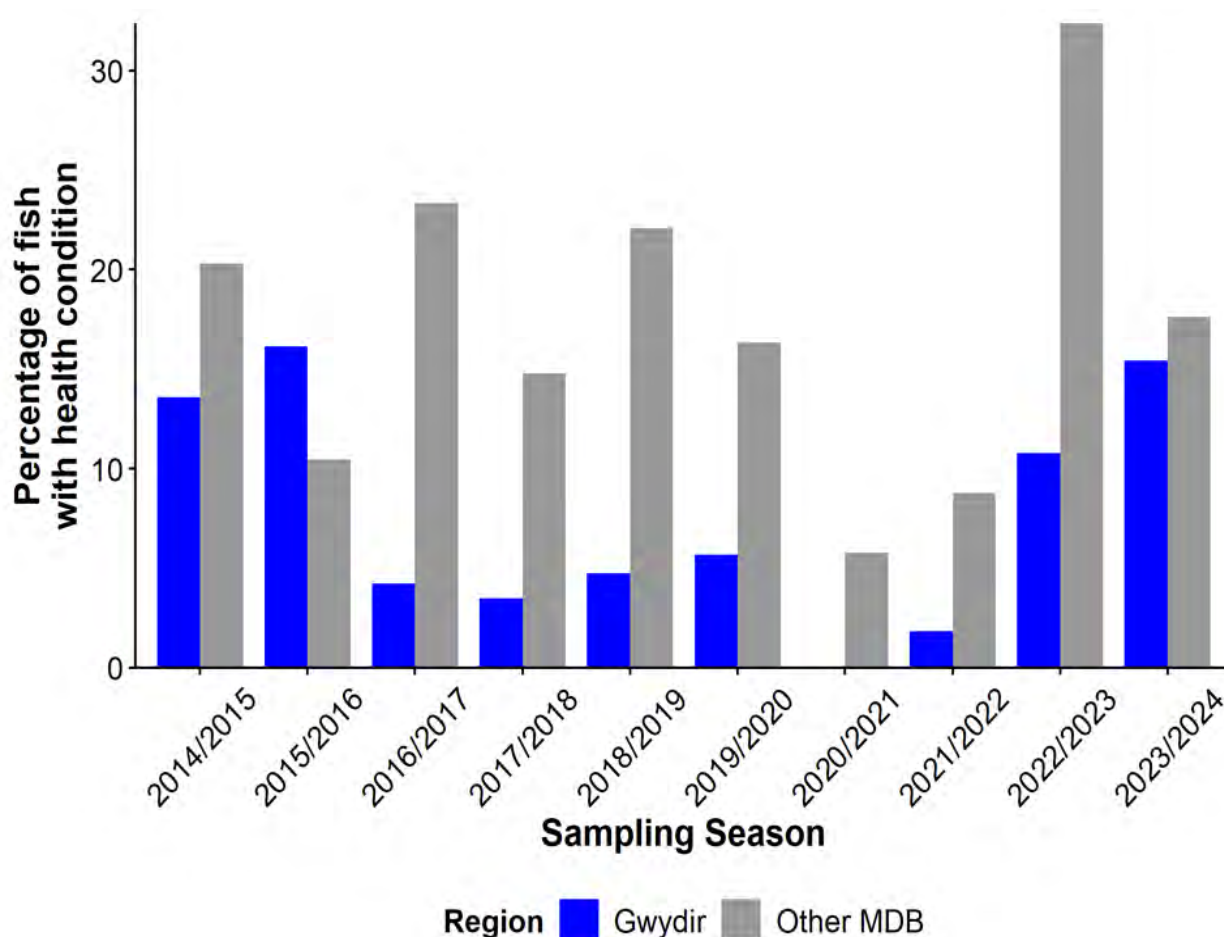


Figure 3.10: Timeseries showing the prevalence of health conditions in Murray cod. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA.

Summary Statement:

Presence of observable health conditions was generally low and lower than the overall Murray-Darling Basin in all years except 2015/16. There was a moderate level of observed health issues in 2023/24.

Distribution

Murray cod were recorded at 54 out of 143 sites in the Gwydir WRPA from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 1.7 fish caught per 90 seconds of electrofishing. Figure 3.11 shows the distribution and relative abundance of Murray cod across the Gwydir WRPA.

Summary Statement:

Murray cod were recorded across the eastern portion of the Gwydir WRPA but less abundant or absent in western sites.

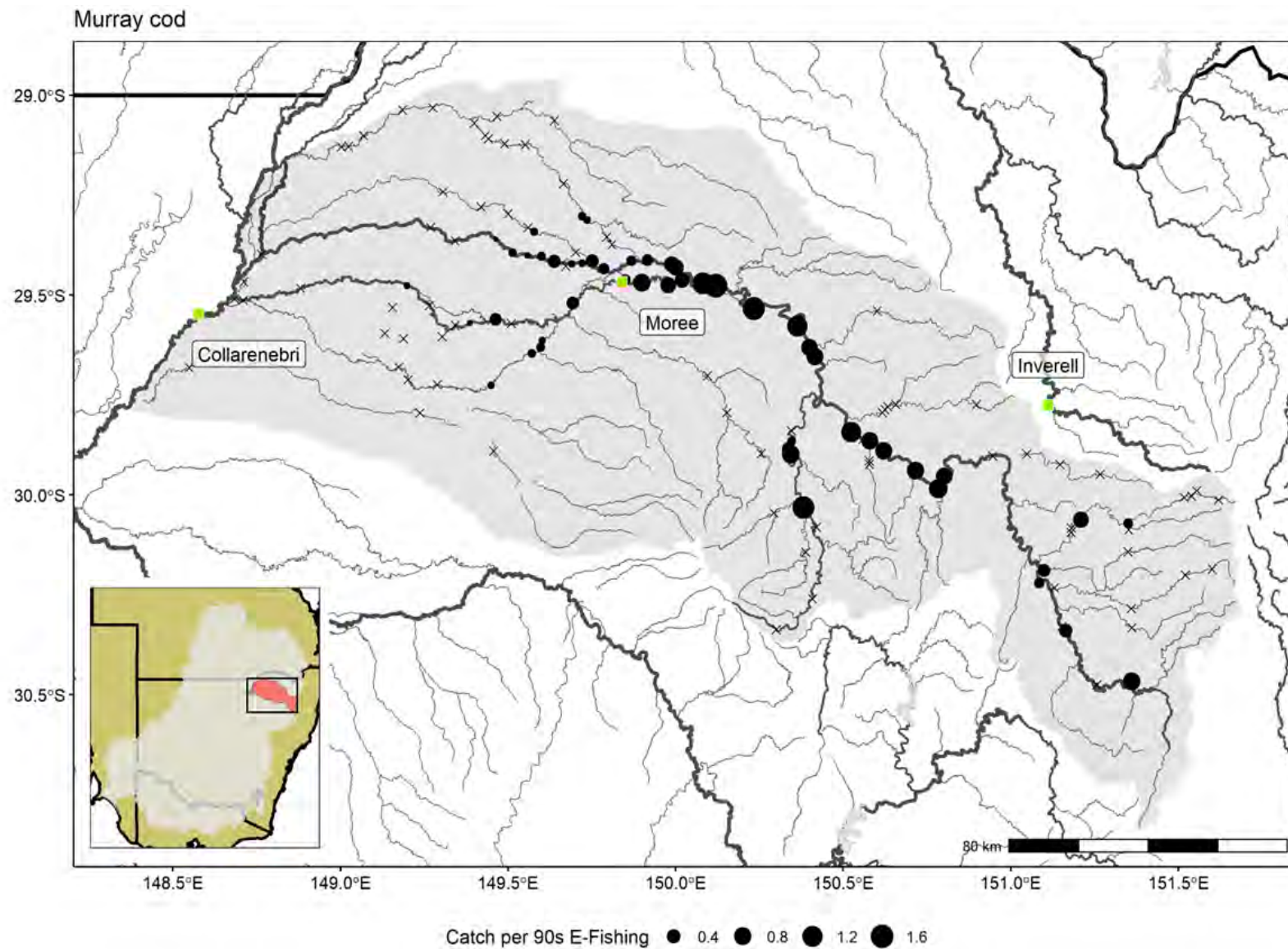


Figure 3.11: Distribution of Murray cod sampled from 2013/14 to 2023/24 in the Gwydir WRP. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares represent key towns.

Golden perch



Population Structure

Figure 3.12 shows the observed length frequency plot for Golden perch for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 0 to 5, and 0 % to 20 % of measured fish within a season, with a mean percentage YOY of 7 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Golden perch was 8 % (638 out of 7,837).

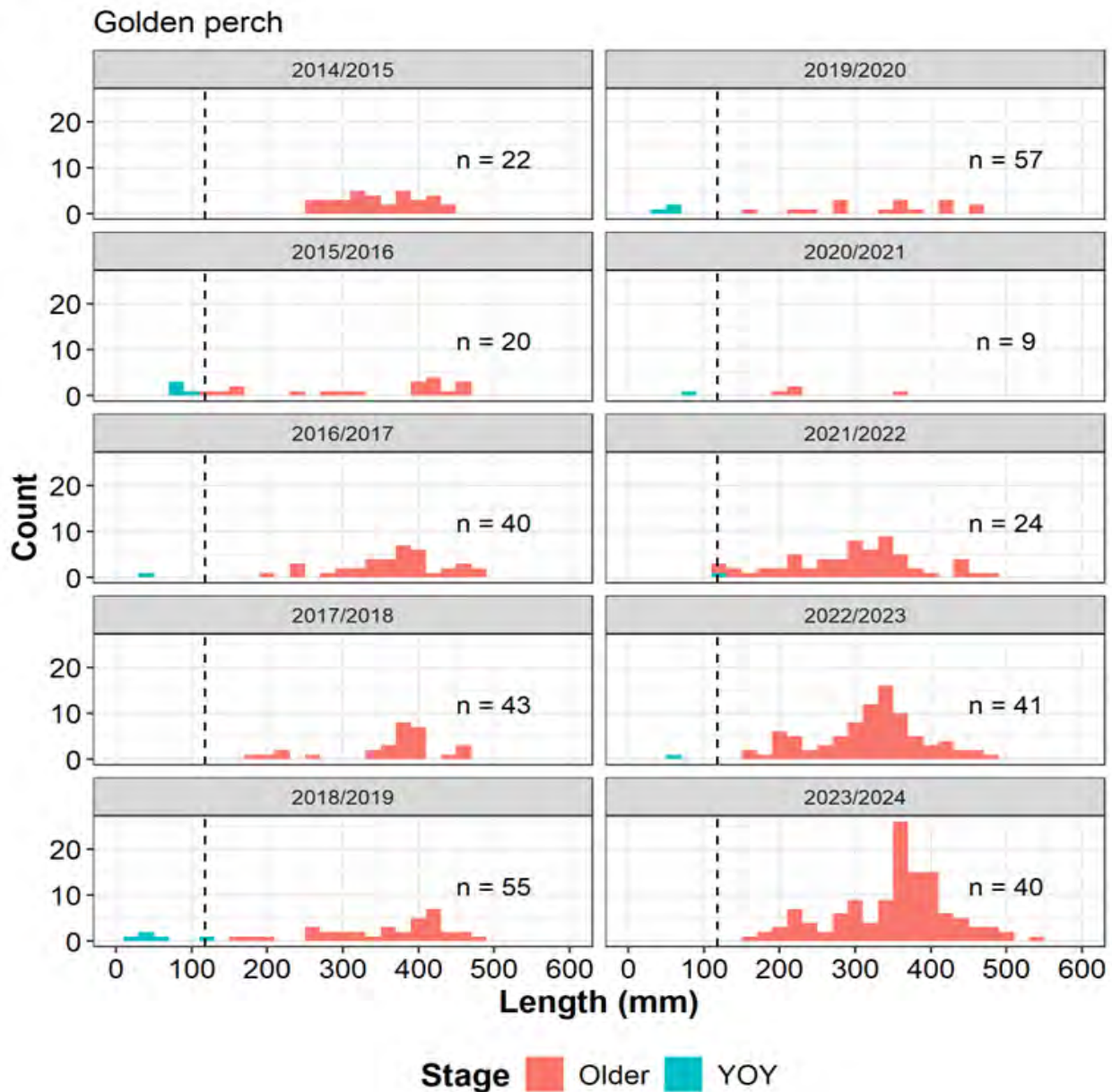


Figure 3.12: Length frequency plots for Golden perch by sampling season in the Gwydir WRPA. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRPA in a sampling season.

Summary Statement:

There is a high proportion of large fish in most years. Recruitment appears to be very limited with only small numbers of YOY observed in some years.

Stocking

A total of 622,025 Golden perch were stocked into the waterways of the Gwydir WRP during the reporting period. Of these fish, 514,140 (82.7 %) were stocked into impoundments while 107,885 (17.3 %) were stocked into rivers or creeks. Table 3.5 shows the detailed breakdown of stocking by season, location and life stage while Figure 3.13 shows the locations of stocking.

Table 3.5: Number and life stage of stocked Golden perch each sampling season.

Sampling Season	River/Creek or Impoundment	Life Stage	Number Stocked
2014/2015	Impoundment	Fry	60,000
2015/2016	Impoundment	Fry	50,300
2015/2016	River/Creek	Fry	32,246
2016/2017	Impoundment	Fingerling	1,285
2016/2017	Impoundment	Fry	60,000
2017/2018	Impoundment	Fry	80,000
2017/2018	River/Creek	Fry	5,000
2018/2019	Impoundment	Fry	30,000
2020/2021	Impoundment	Fry	60,555
2020/2021	River/Creek	Fry	40,000
2021/2022	River/Creek	Fry	4,280
2022/2023	Impoundment	Fry	80,000
2022/2023	River/Creek	Fry	16,132
2023/2024	Impoundment	Fingerling	92,000
2023/2024	River/Creek	Fingerling	10,227

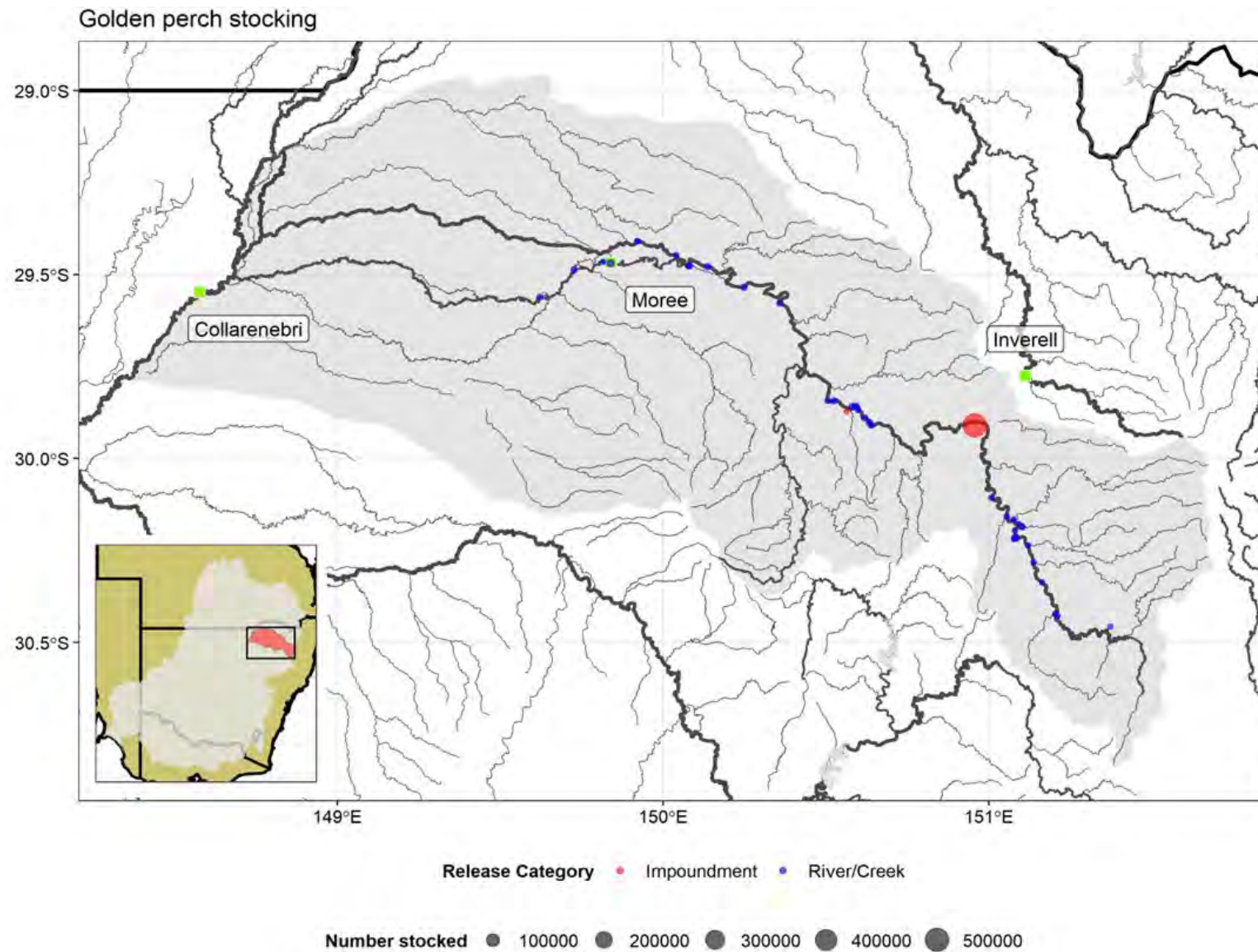


Figure 3.13: Locations of Golden perch stocking in the Gwydir WRP. Colours show whether a site was a river/creek site or an impoundment, while the size of the point reflects the total number of fish stocked over the reporting period. The vast majority of stocking in the Gwydir WRP was at Copeton Dam (large red dot). Green squares represent key towns.

Temporal Trends in Abundance

The relative abundance and biomass of Golden perch since 1994 was modelled based on all suitable boat electrofishing data. The left-hand panels of Figure 3.14 show the abundance and biomass trends for the Gwydir WRPA and the right-hand panels show the overall trends across the NSW MDB.

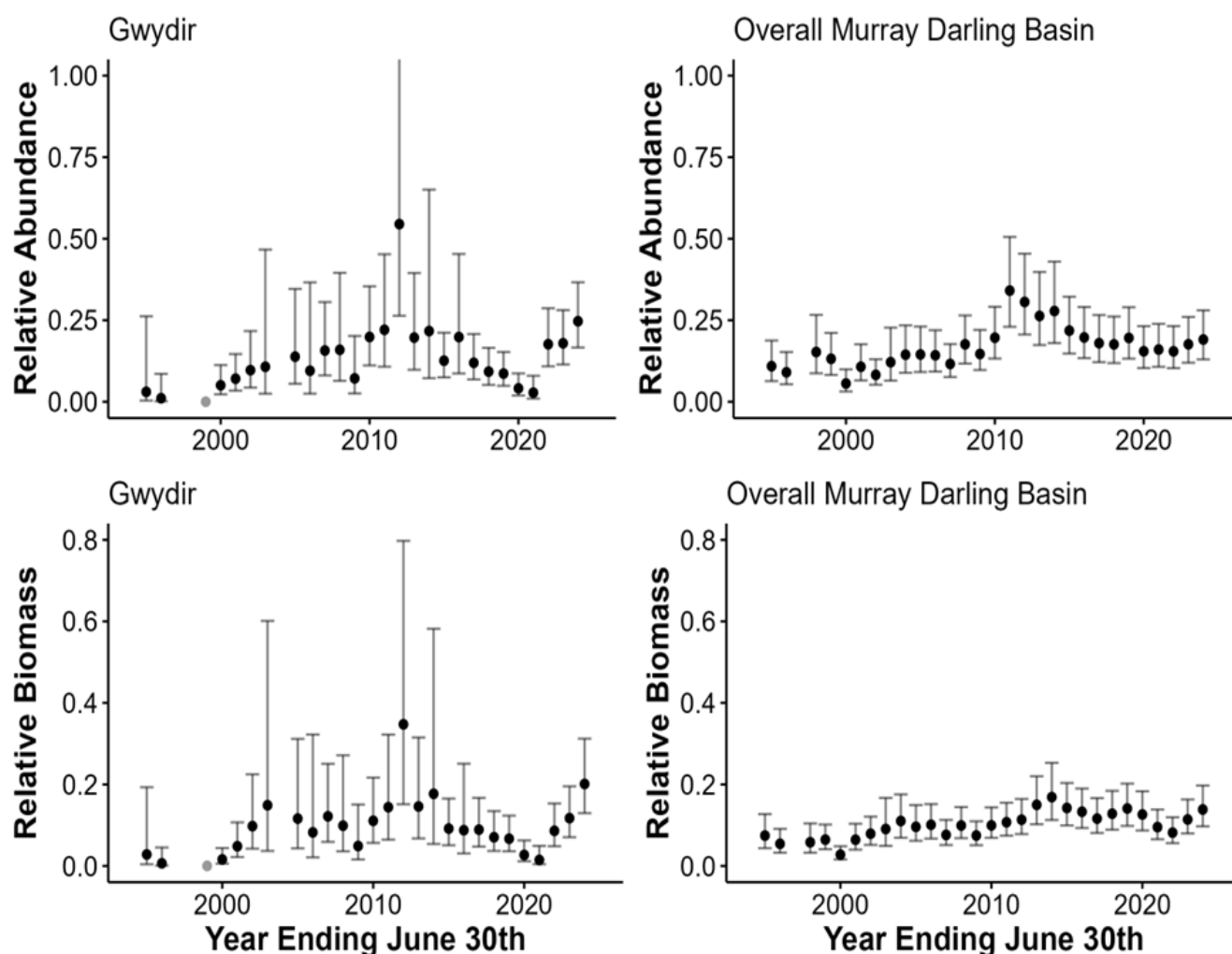


Figure 3.14: Relative abundance and biomass of Golden perch in both this valley and the overall Murray-Darling Basin. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates.

Summary Statement:

Strong evidence of increases in both abundance and biomass since the 1990s although there are large fluctuations including both abundance and biomass declining substantially in 2020 and 2021. Currently, abundance and biomass are both slightly higher than the overall NSW MDB.

Health

The prevalence of any health issues ranged from 3 % of sampled fish in 2017/2018 to 48 % of sampled fish in 2015/2016 (Figure 3.15). The most common health issue for Golden perch in the Gwydir water resource planning area was *Lernaea*, which was observed in a total of 46 fish, corresponding to 10 % of all Golden perch measured.

Across the other WRPA's, 26 % of Golden perch (2,011 out of 7,837 Golden perch) showed a health condition (excludes Gwydir).

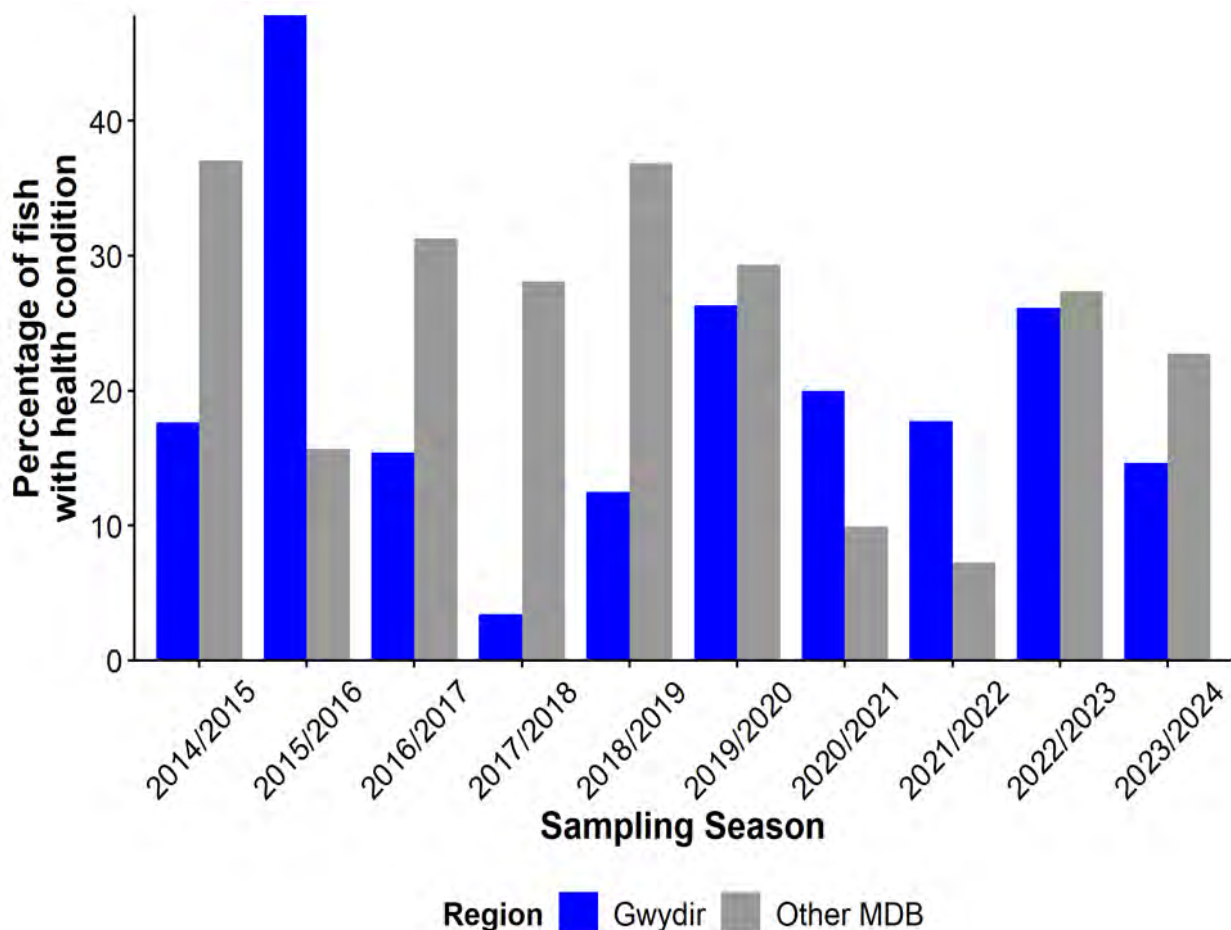


Figure 3.15: Timeseries showing the prevalence of health conditions in Golden perch. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA's.

Summary Statement:

The presence of observable health conditions for Golden perch in the Gwydir was variable and ranged from low to moderate. In 2015/16 there was a substantially higher level of observed health issues compared to the rest of the NSW MDB. Recent years have shown a moderate level of observable health issues.

Distribution

Golden perch were recorded at 37 out of 143 sites in the Gwydir WRP from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 0.6 fish caught per 90 seconds of electrofishing. Figure 3.16 shows the distribution and relative abundance of Golden perch across the Gwydir WRP.

Summary Statement:

Golden perch were generally present across most of the Gwydir region although they were absent or recorded in low numbers in the eastern region.

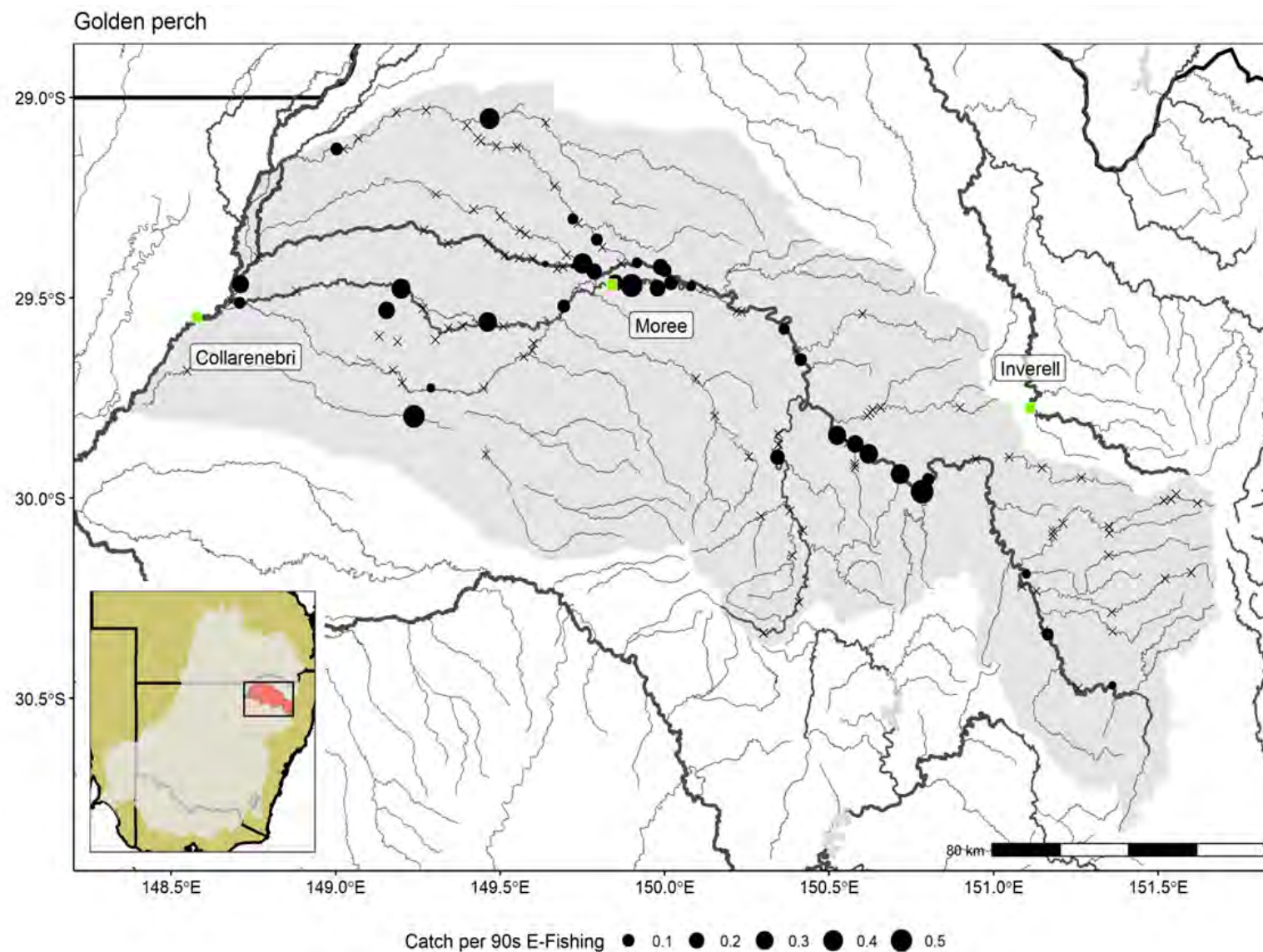


Figure 3.16: Distribution of Golden perch sampled from 2013/14 to 2023/24 in the Gwydir WRPA. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares represent key towns.

Freshwater catfish



Population Structure

Figure 3.17 shows the observed length frequency plot for Freshwater catfish for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 1 to 55, and 6 % to 85 % of measured fish within a season, with a mean percentage YOY of 44 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Freshwater catfish was 36 % (250 out of 696).

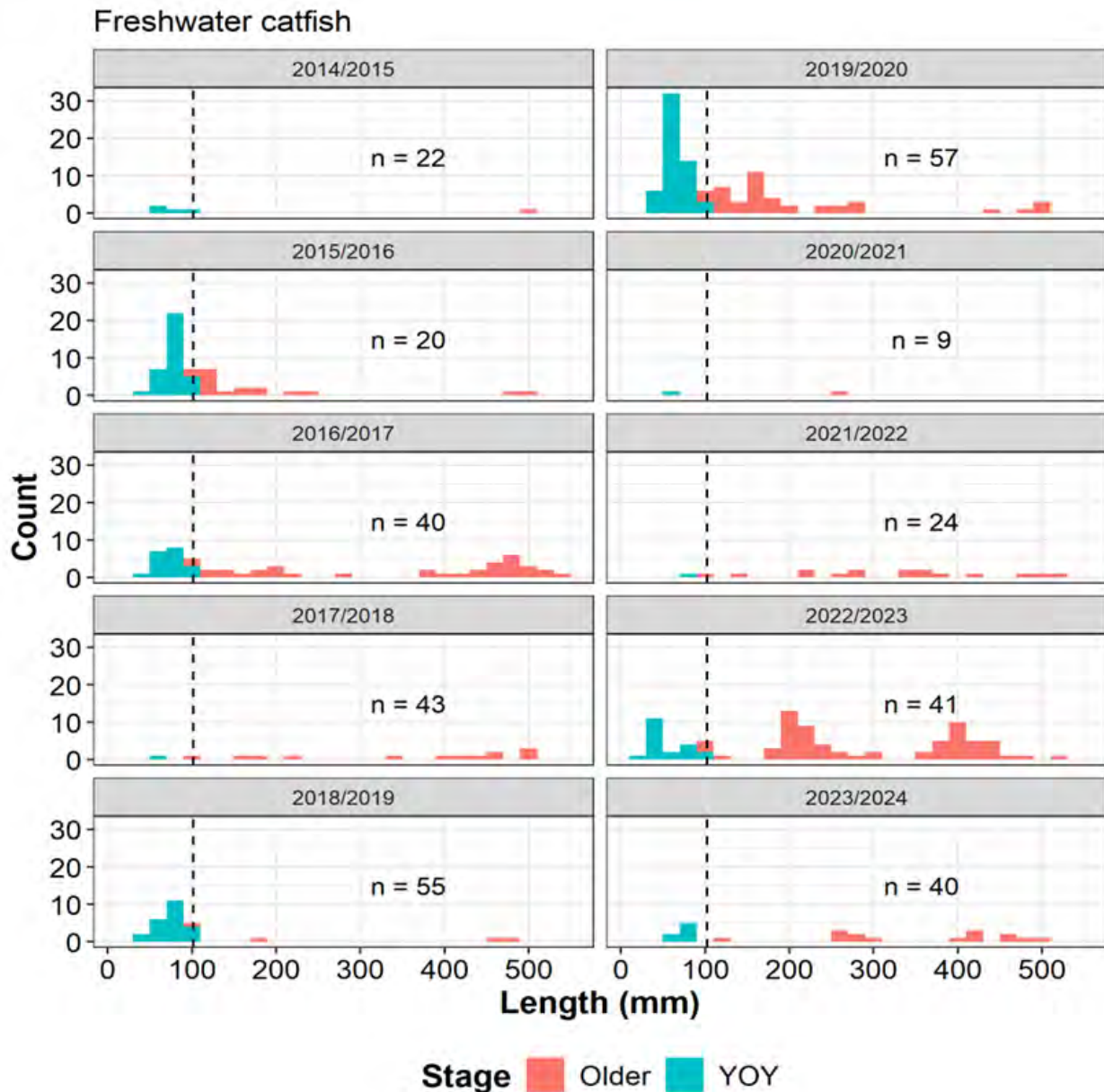


Figure 3.17: Length frequency plots for Freshwater catfish by sampling season in the Gwydir WRPA. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRPA in a sampling season.

Summary Statement:

Sporadic recruitment with recruitment events evident in 2015/16, 2016/17, 2018/19, 2019/20, 2022/23 and 2023/24. A good range of sizes in the 2023/24 likely including multiple age classes.

Temporal Trends in Abundance

The relative abundance and biomass of Freshwater catfish since 1994 was modelled based on all suitable boat electrofishing data. The left-hand panels of Figure 3.18 show the abundance and biomass trends for the Gwydir WRPA and the right-hand panels show the overall trends across the NSW MDB.

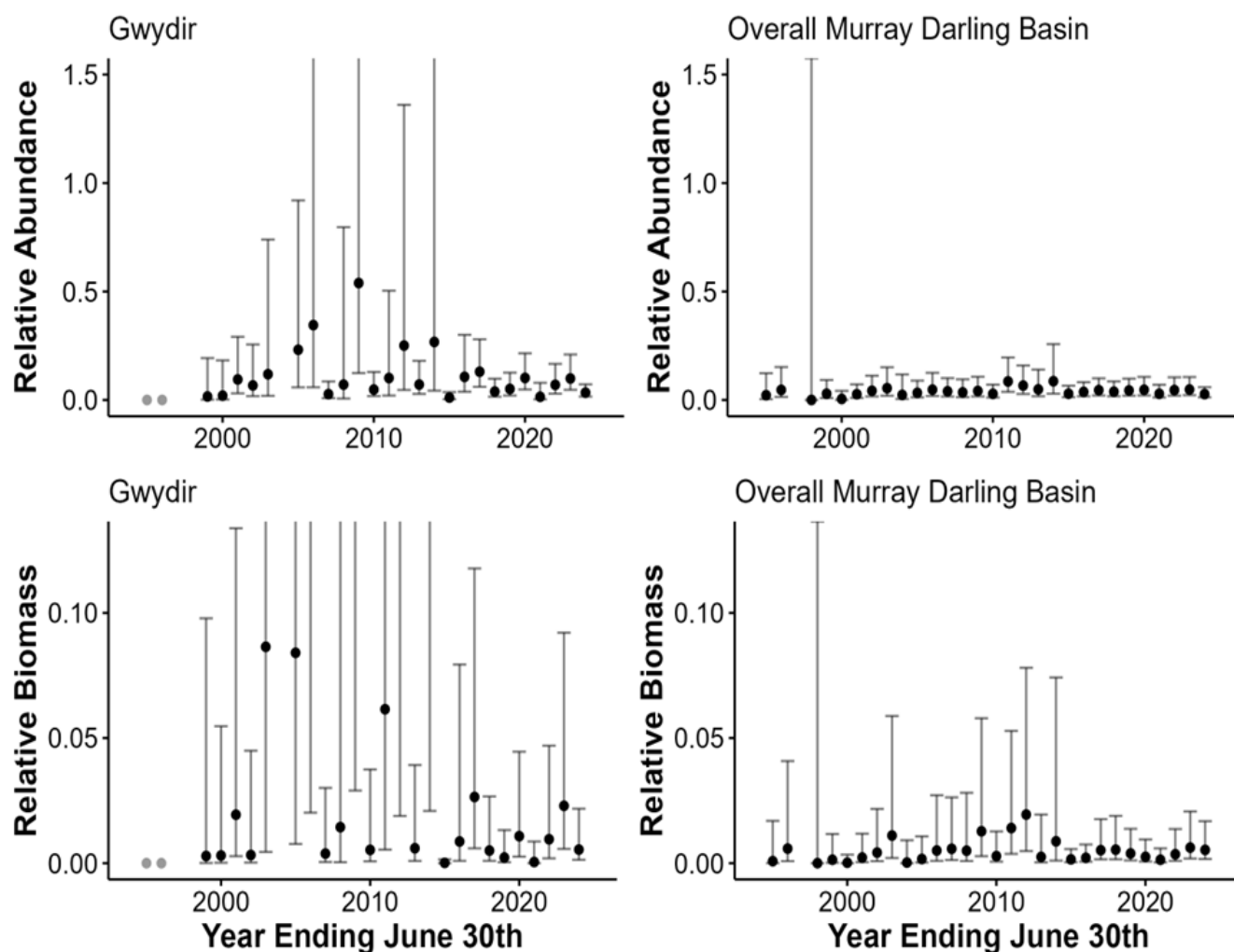


Figure 3.18: Relative abundance and biomass of Freshwater catfish in both this valley and the overall Murray-Darling Basin. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates. Note some error bars are truncated for clarity.

Summary Statement:

Abundance and biomass trends are uncertain over time but are likely higher than the 1990s when no Freshwater catfish were observed. Abundance and biomass both show evidence of decline in the most recent year and are comparable to the wider NSW MDB.

Health

The prevalence of any health issues ranged from 0 % of sampled fish in multiple years to 6 % of sampled fish in 2021/2022 (Figure 3.19). The most common health issue for Freshwater catfish in the Gwydir water resource planning area was Other, which was observed in a total of 1 fish, corresponding to <1 % of all Freshwater catfish measured.

Across the other WRPA's, 2 % of Freshwater catfish (16 out of 696 Freshwater catfish) showed a health condition (excludes Gwydir).

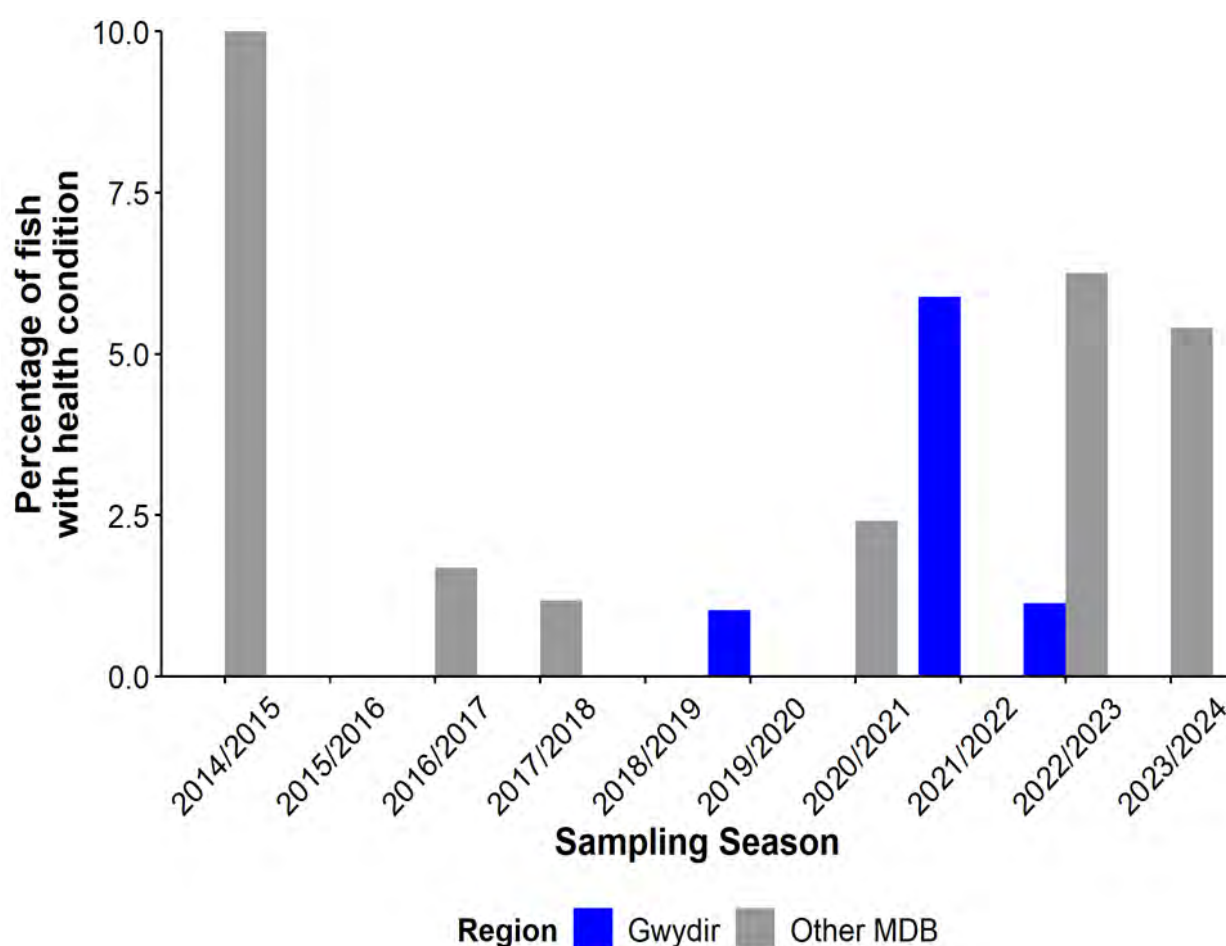


Figure 3.19: Timeseries showing the prevalence of health conditions in Freshwater catfish. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA's.

Summary Statement:

The presence of observable health conditions for Freshwater catfish in the Gwydir was overall low.

Distribution

Freshwater catfish were recorded at 41 out of 143 sites in the Gwydir WSPA from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 2.5 fish caught per 90 seconds of electrofishing. Figure 3.20 shows the distribution and relative abundance of Freshwater catfish across the Gwydir WSPA.

Summary Statement:

Freshwater catfish were generally present across the eastern Gwydir region. Lower abundances were evident in the central region around Moree, and they were absent in the lowland western region and upland areas in the east.

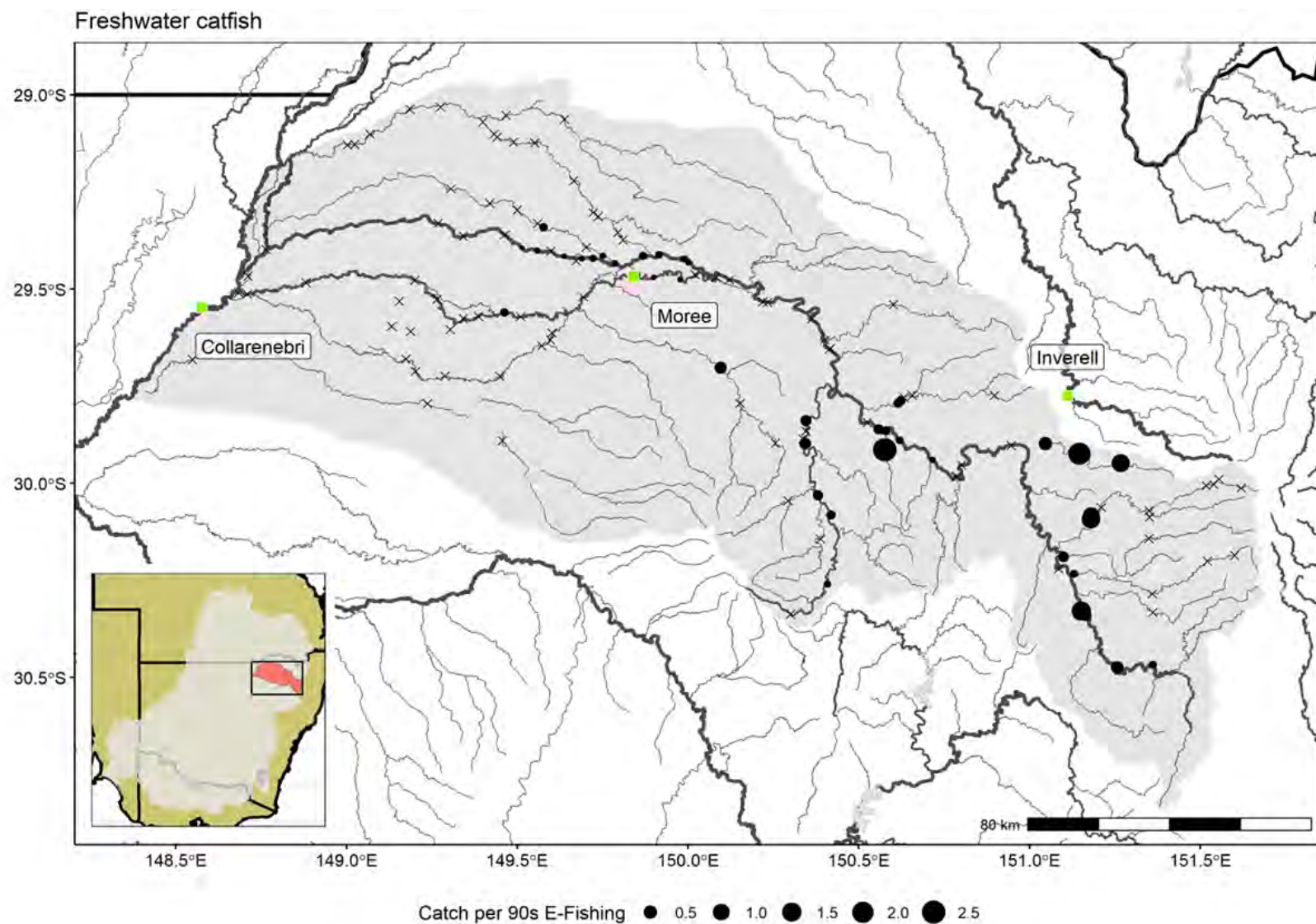


Figure 3.20: Distribution of Freshwater catfish sampled from 2013/14 to 2023/24 in the Gwydir WRPA. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares represent key towns.

Bony herring



Population Structure

Figure 3.21 shows the observed length frequency plot for Bony herring for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 15 to 328, and 3 % to 30 % of measured fish within a season, with a mean percentage YOY of 17 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Bony herring was 26 % (12,565 out of 49,158). Bony herring are not a stocked species.

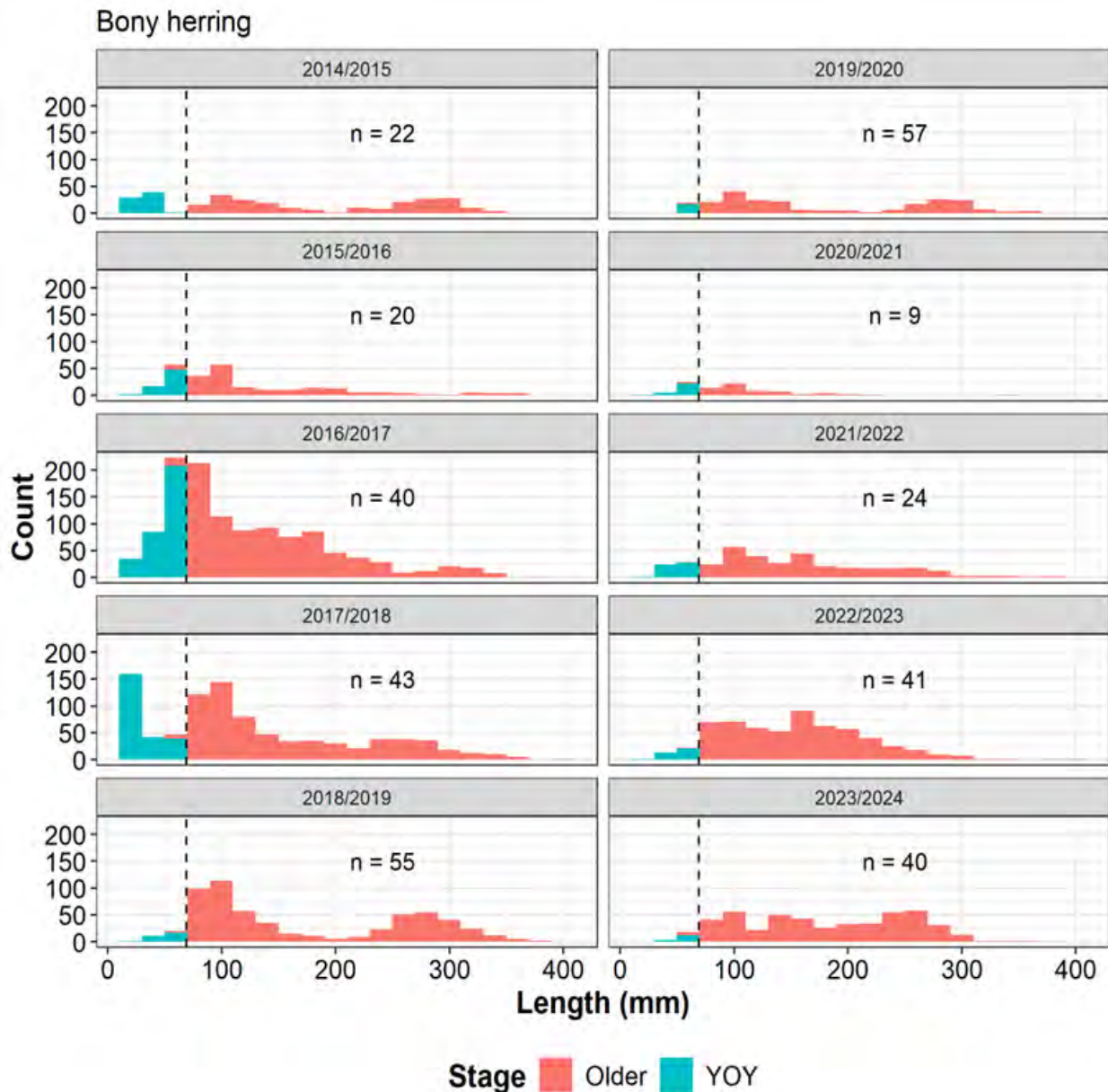


Figure 3.21: Length frequency plots for Bony herring by sampling season in the Gwydir WRP. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRP in a sampling season.

Summary Statement:

Regular recruitment with variable numbers of young-of-year. Strong recruitment evident in 2016/17, 2017/18 and 2021/22. Low recruitment evident in 2022/23 and 2023/24 but good range of larger sizes.

Temporal Trends in Abundance

The relative abundance and biomass of Bony herring since 1994 was modelled based on all suitable boat electrofishing data. The left-hand panels of Figure 3.22 show the abundance and biomass trends for the Gwydir WRPA and the right-hand panels show the overall trends across the NSW MDB.

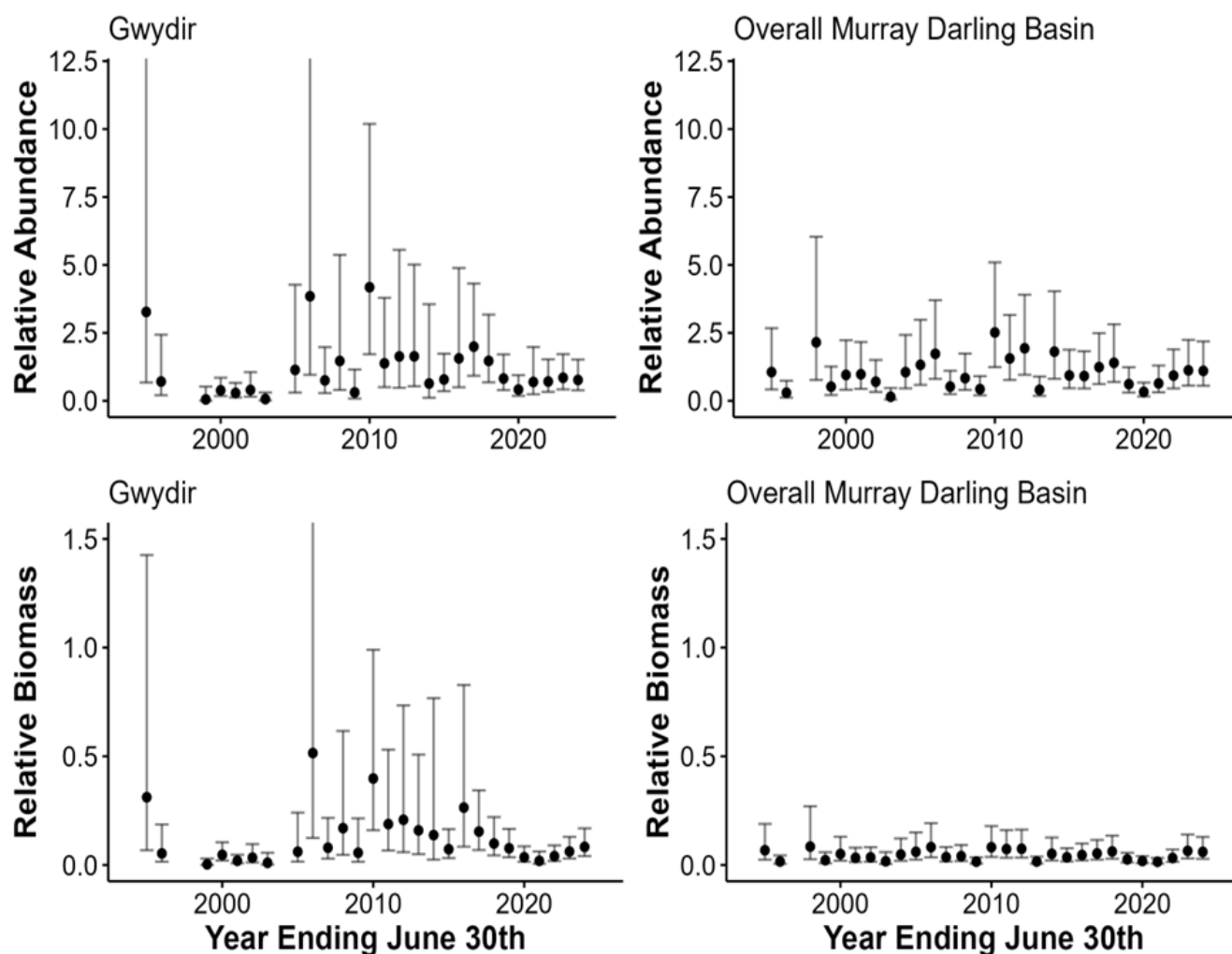


Figure 3.22: Relative abundance and biomass of Bony herring in both the Gwydir WRPA and the overall NSW MDB. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates. Note some error bars have been truncated.

Summary Statement:

Abundance and biomass both likely higher than the early 2000s. Abundance has been relatively stable since 2021 and biomass appears to have increased slightly since 2021. Both abundance and biomass are comparable to the wider NSW MDB.

Health

The prevalence of any health issues ranged from 0 % of sampled fish in 2016/2017 and 2020/21 to 1 % of sampled fish in 2015/2016 (Figure 3.23). The most common health issue for Bony herring in the Gwydir WRPAs was Lesions, which was observed in a total of 5 fish, corresponding to 0 % of all Bony herring measured.

Across the other NSW MDB WRPA, 1.12 % of Bony herring (550 out of 49,159 Bony herring) showed a health condition (excludes the Gwydir WRPAs).

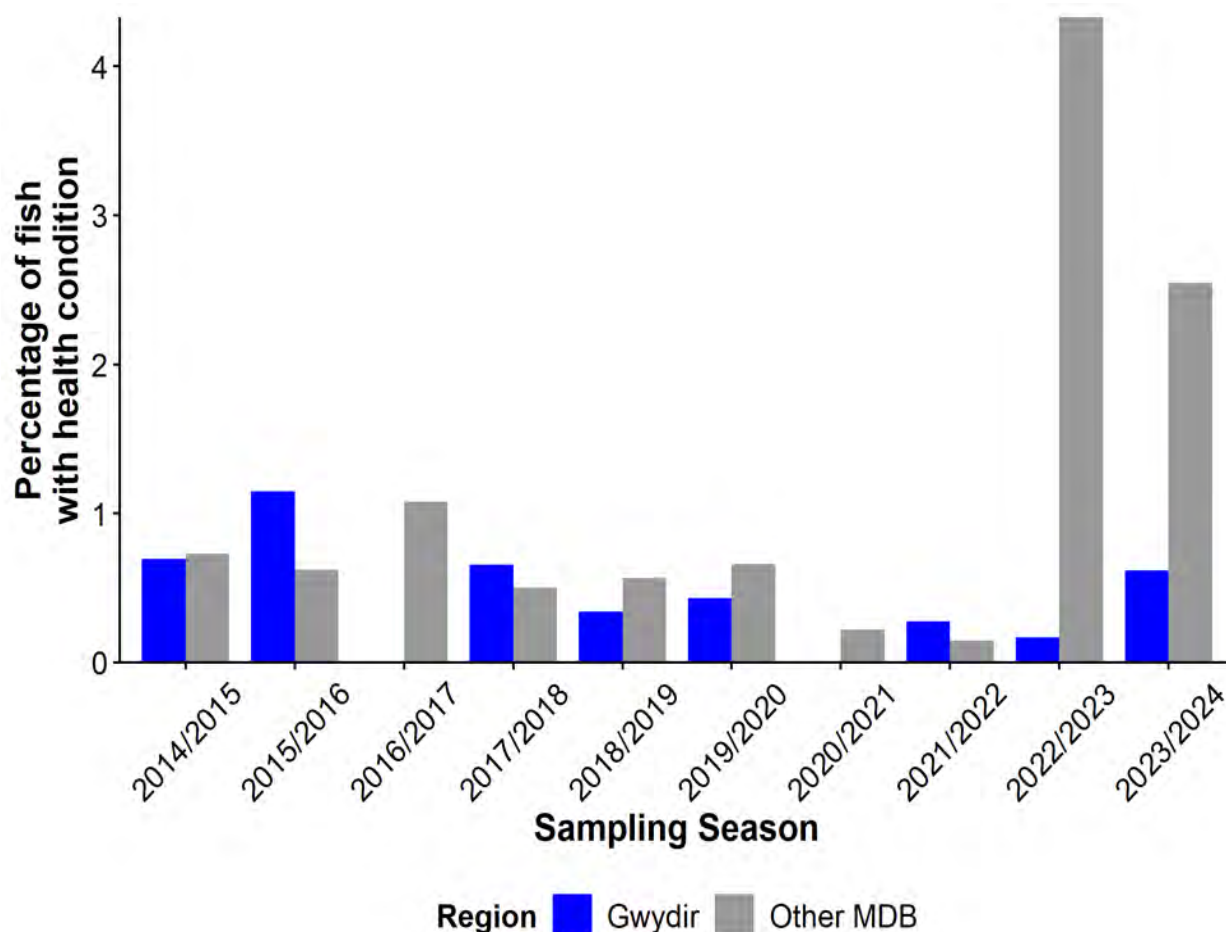


Figure 3.23: Timeseries showing the prevalence of health conditions in Bony herring. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA.

Summary Statement:

Presence of observable health conditions was very low in all years.

Distribution

Bony herring were recorded at 72 out of 143 sites in the Gwydir WRP from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 9.5 fish caught per 90 seconds of electrofishing. Figure 3.24 shows the distribution and relative abundance of Bony herring across the Gwydir WRP.

Summary Statement:

Bony herring were recorded across the western half Gwydir WRP but are generally absent or in low abundance in the eastern region.

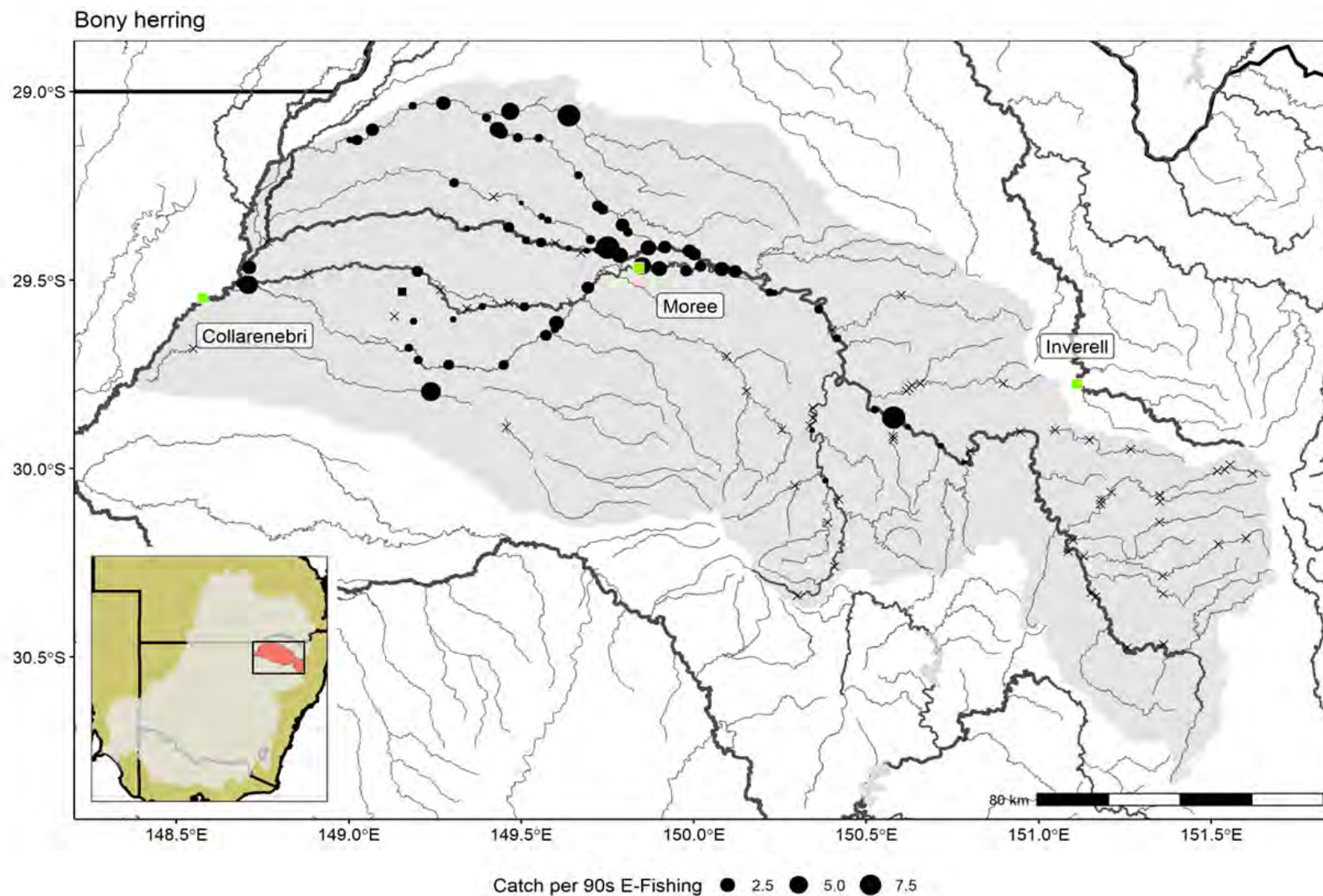


Figure 3.24: Distribution of Bony herring sampled from 2013/14 to 2023/24 in the Gwydir WRPA. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares represent key towns.

Australian smelt



Population Structure

Figure 3.25 shows the observed length frequency plot for Australian smelt for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 1 to 65, and 2 % to 71 % of measured fish within a season, with a mean percentage YOY of 28 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Australian smelt was 42 % (11,287 out of 26,856). Australian smelt are not a stocked species.

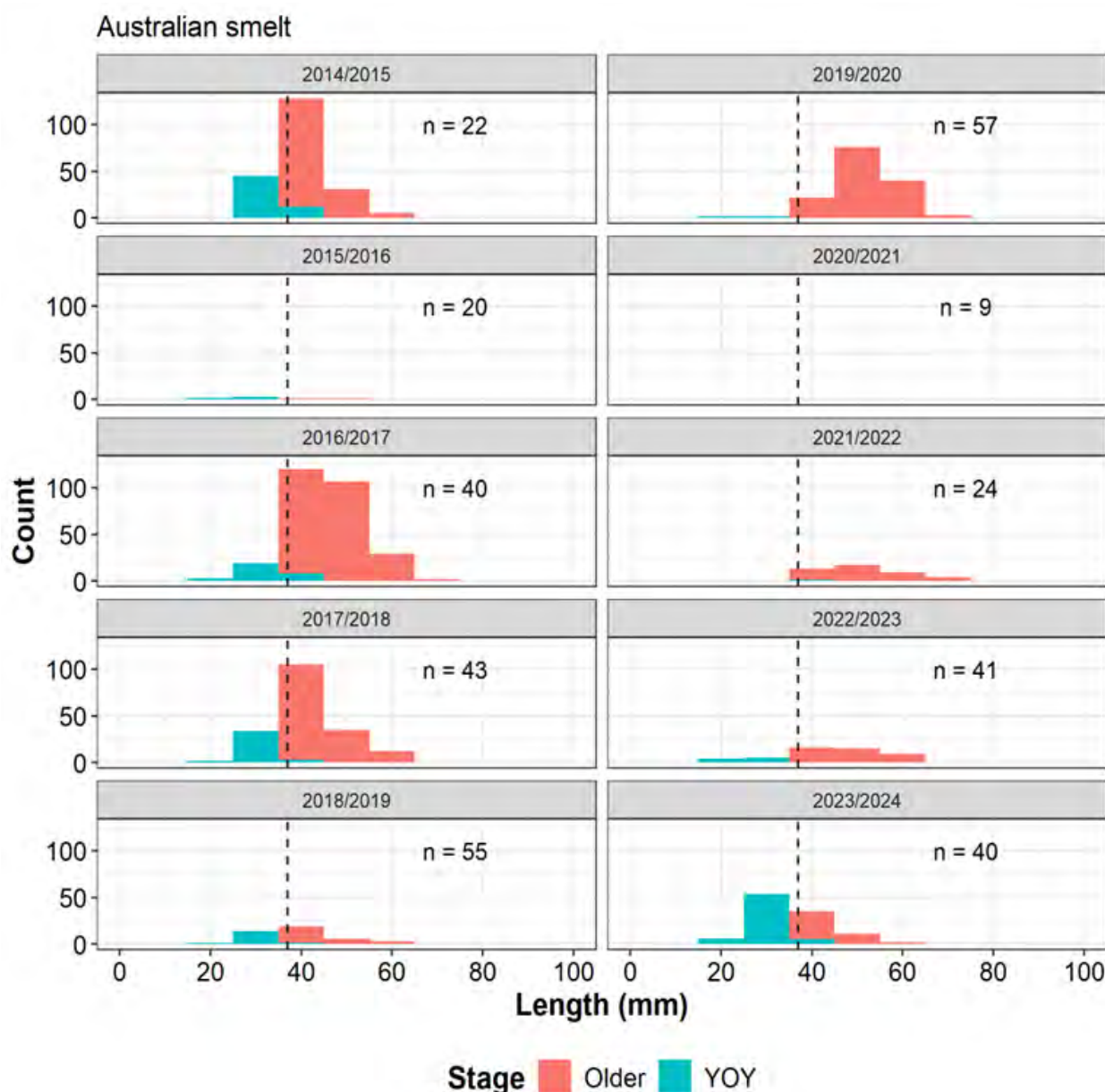


Figure 3.25: Length frequency plots for Australian smelt by sampling season in the Gwydir WRP. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRP in a sampling season.

Summary Statement:

Sporadic and generally low proportions of YOY suggesting poor recruitment. Likely recruitment failure in 2020/21 and 2021/22 with poor recruitment in 2022/23 followed by strong recruitment in 2023/24.

Temporal Trends in Abundance

The relative abundance of Australian smelt since 1994 was modelled based on all suitable boat electrofishing data. The left-hand panel of Figure 3.26 show the abundance trends for the Gwydir WRP and the right-hand panel show the overall trend across the NSW MDB.

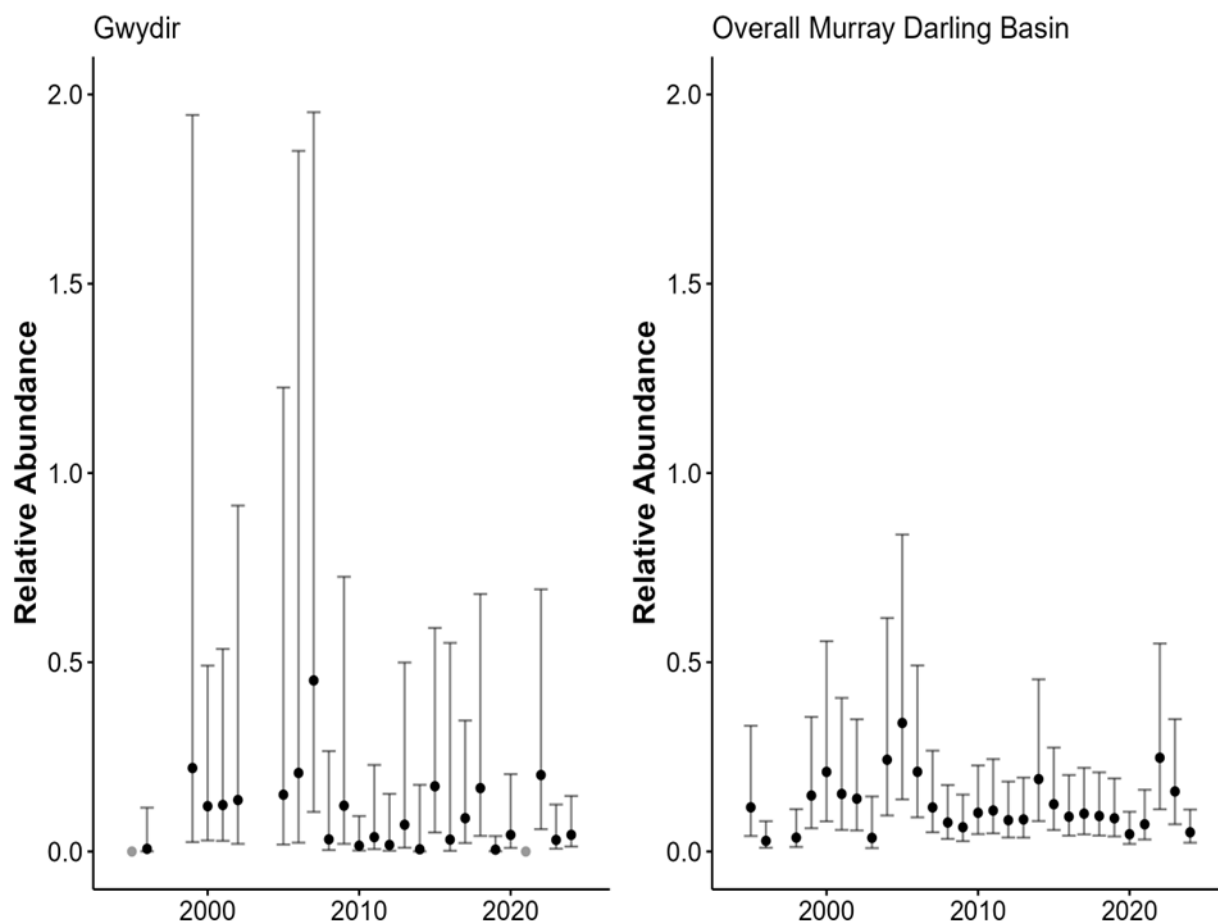


Figure 3.26: Relative abundance of Australian smelt in both the Gwydir WRP and the overall NSW MDB. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates. No modelling of biomass was done for Australian smelt.

Summary Statement:

Abundance is highly variable over the timeseries but was likely at relatively low levels in 2023/24, similar to the overall NSW MDB.

Health

The prevalence of any health issues ranged from 0 % of sampled fish in most years to 2 % of sampled fish in 2022/2023 (Figure 3.27). The most common health issue for Australian smelt in the Gwydir WRPAs was *Lernaea*, which was observed in a total of 3 fish, corresponding to <1 % of all Australian smelt measured.

Across the other NSW MDB WRPA, 1 % of Australian smelt (148 out of 25,317 Australian smelt) showed a health condition (excludes the Gwydir WRPAs).

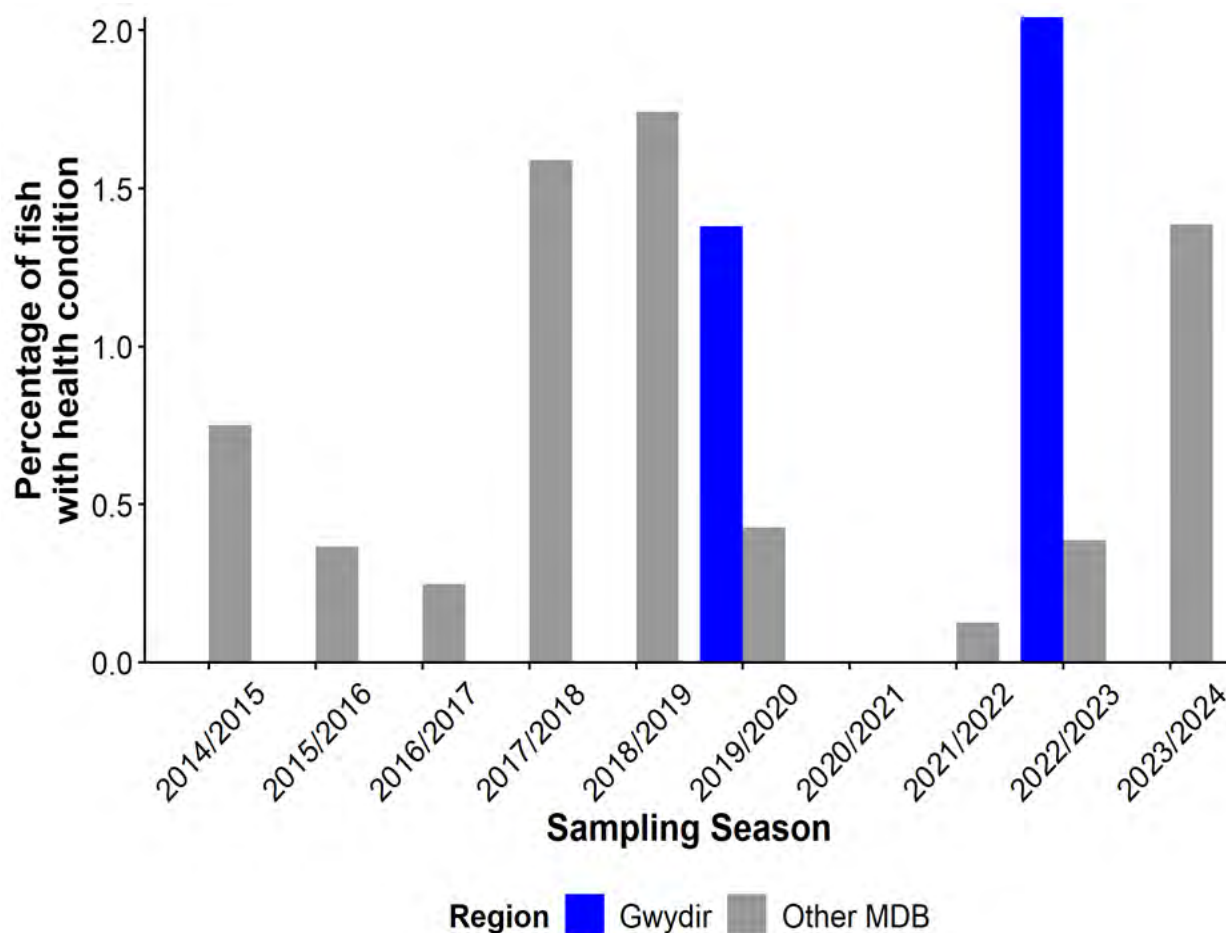


Figure 3.27: Timeseries showing the prevalence of health conditions in Australian smelt. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA.

Summary Statement:

Very few health issues were observed in Australian smelt in the Gwydir.

Distribution

Australian smelt were recorded at 48 out of 143 sites in the Gwydir WRPA from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 3.5 fish caught per 90 seconds of electrofishing. Figure 3.28 shows the distribution and relative abundance of Australian smelt across the Gwydir WRPA.

Summary Statement:

Australian smelt were recorded across the western and central region of the Gwydir WRPA. There were no observations in the eastern upland area.

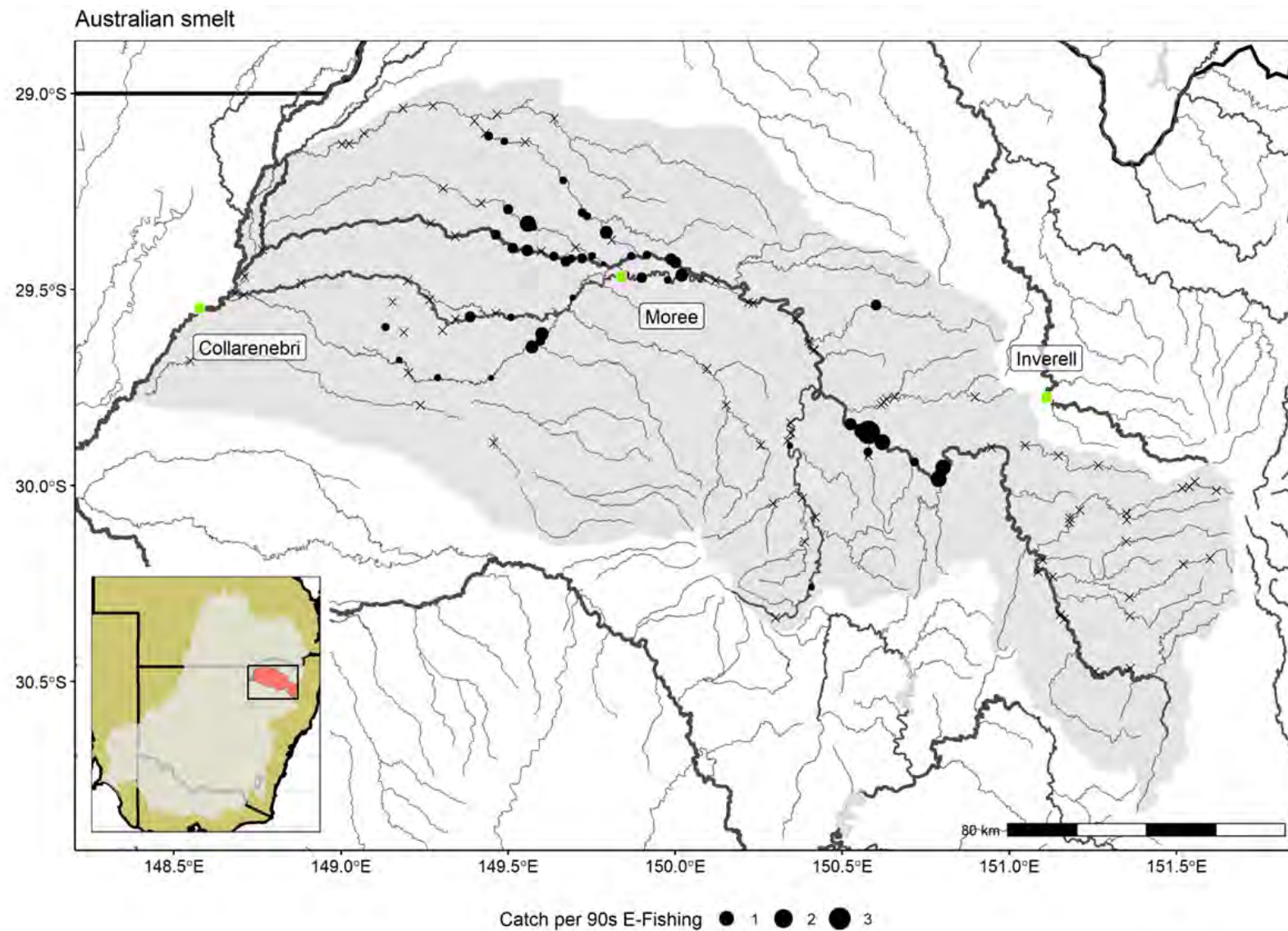


Figure 3.28: Distribution of Australian smelt sampled from 2013/14 to 2023/24 in the Gwydir WRPA. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares represent key towns.

Common carp



Population Structure

Figure 3.29 shows the observed length frequency plot for Common carp for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 46 to 1,053, and 8 % to 90 % of measured fish within a season, with a mean percentage YOY of 57 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Common carp was 55 % (31,991 out of 58,473). Common carp are not a stocked species.

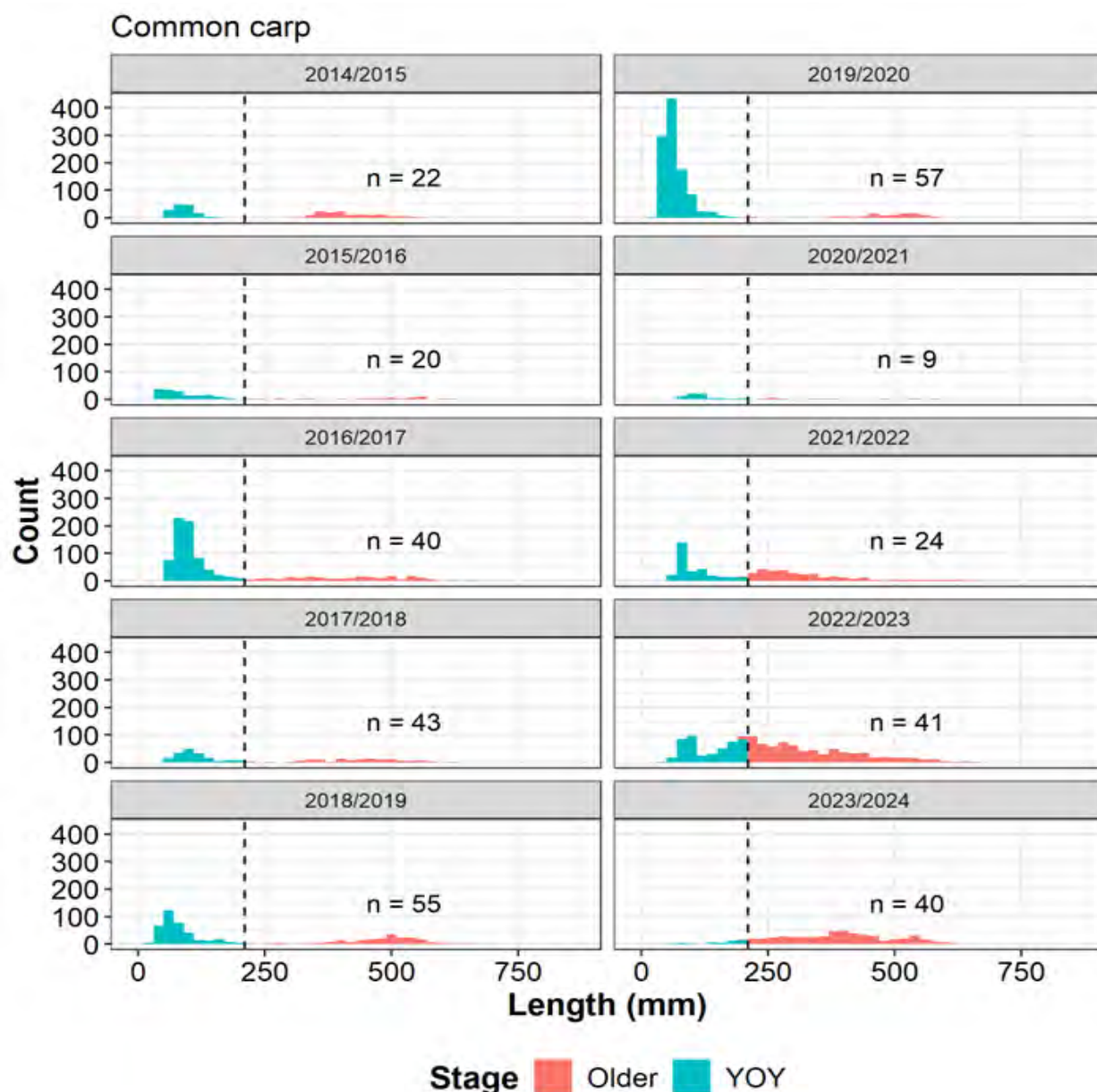


Figure 3.29: Length frequency plots for common carp by sampling season in the Gwydir WRPA. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRPA in a sampling season.

Summary Statement:

Variable recruitment with 2023/24 showing low recruitment although there is evidence of survival of year classes from recruitment events in previous years.

Temporal Trends in Abundance

The relative abundance and biomass of Common carp since 1994 was modelled based on all suitable boat electrofishing data. The left-hand panels of Figure 3.30 show the abundance and biomass trends for the Gwydir WRPA and the right-hand panels show the overall trends across the NSW MDB.

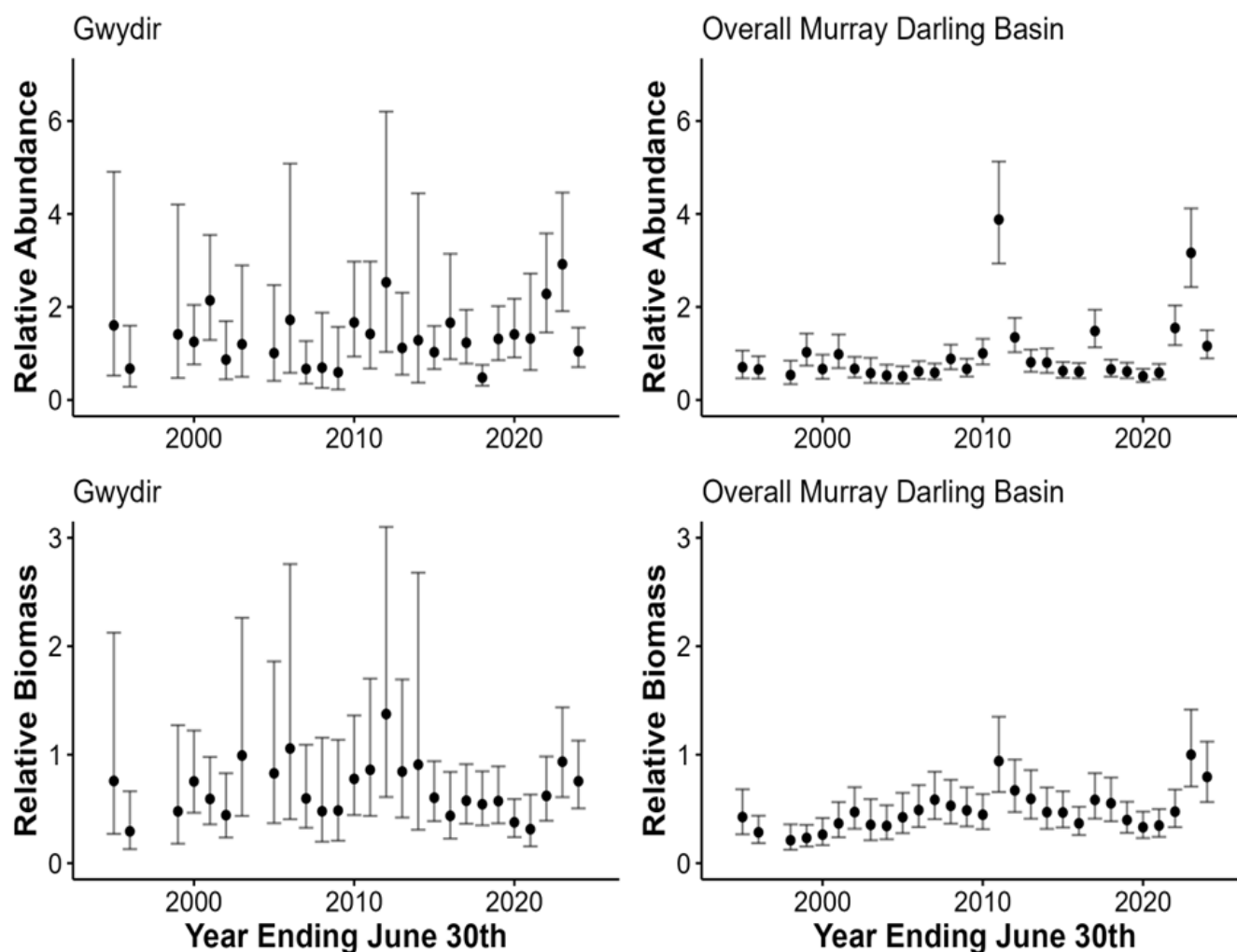


Figure 3.30: Relative abundance and biomass of Common carp in both this valley and the overall Murray-Darling Basin. These are model estimates based upon all electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates.

Summary Statement:

No long term trends in abundance or biomass of carp in the Gwydir WRPA but abundance decreased sharply in 2023/24 compared to 2022/23. Biomass has not declined from the recent peak. Overall, both abundance and biomass are comparable to the overall NSW MDB.

Health

The prevalence of any health issues ranged from 0 % of sampled fish in 2014/2015 to 7 % of sampled fish in 2021/2022 (Figure 3.31). The most common health issue for Common carp in the Gwydir water resource planning area was Lesions, which was observed in a total of 52 fish, corresponding to 1 % of all Common carp measured.

Across the other WRPA's, 4 % of Common carp (2,301 out of 58,475 Common carp) showed a health condition (excludes Gwydir).

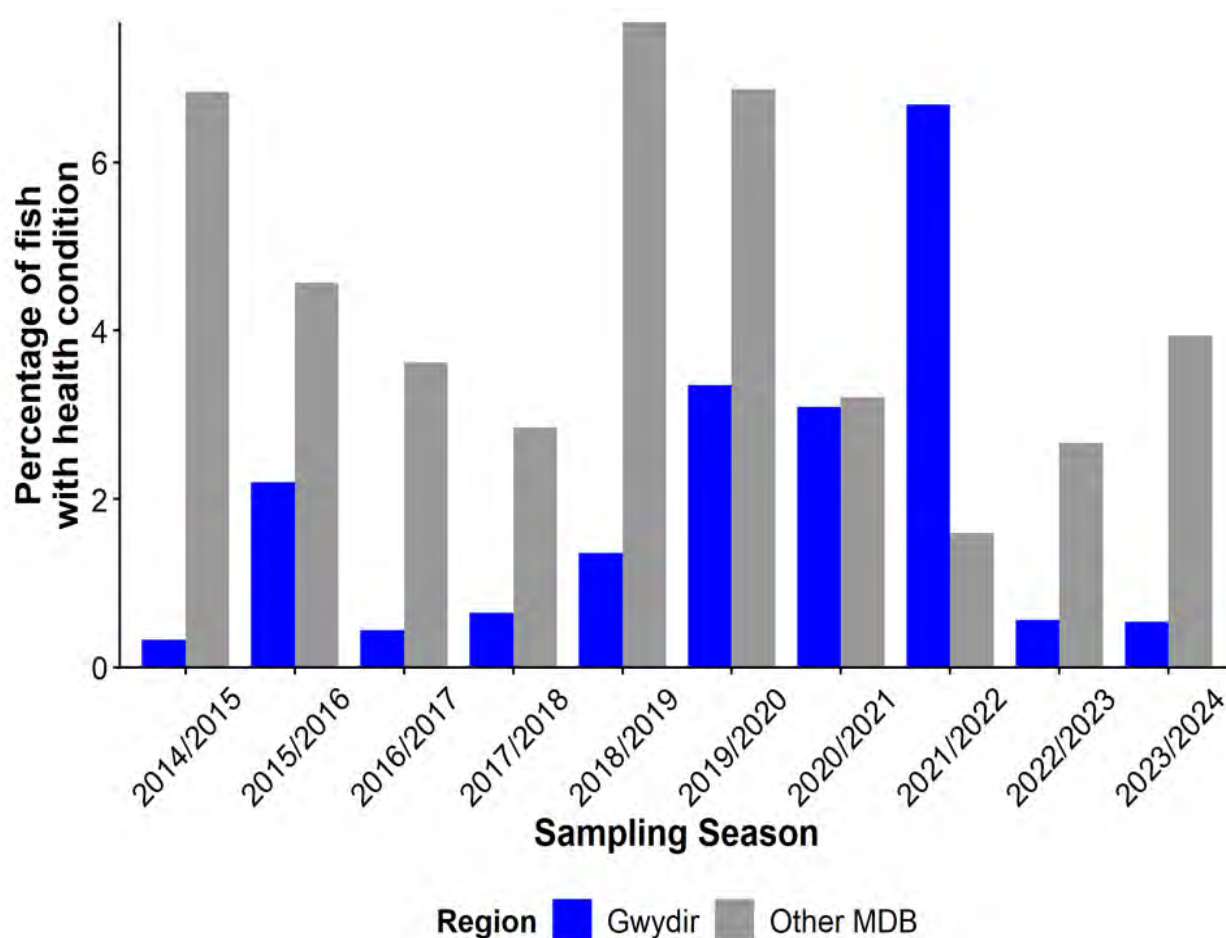


Figure 3.31: Timeseries showing the prevalence of health conditions in Common carp. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA's.

Summary Statement:

The presence of observable health conditions for Common carp in the Gwydir was low in all years and generally similar to the wider NSW MDB except for 2021/22 when the Gwydir showed a higher proportion of health issues.

Distribution

Common carp were recorded at 98 out of 143 sites in the Gwydir WSPA from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 26.2 fish caught per 90 seconds of electrofishing. Figure 3.32 shows the distribution and relative abundance of Common carp across the Gwydir WSPA.

Summary Statement:

Common carp were found across the Gwydir region except above Copeton Dam where they are currently absent.

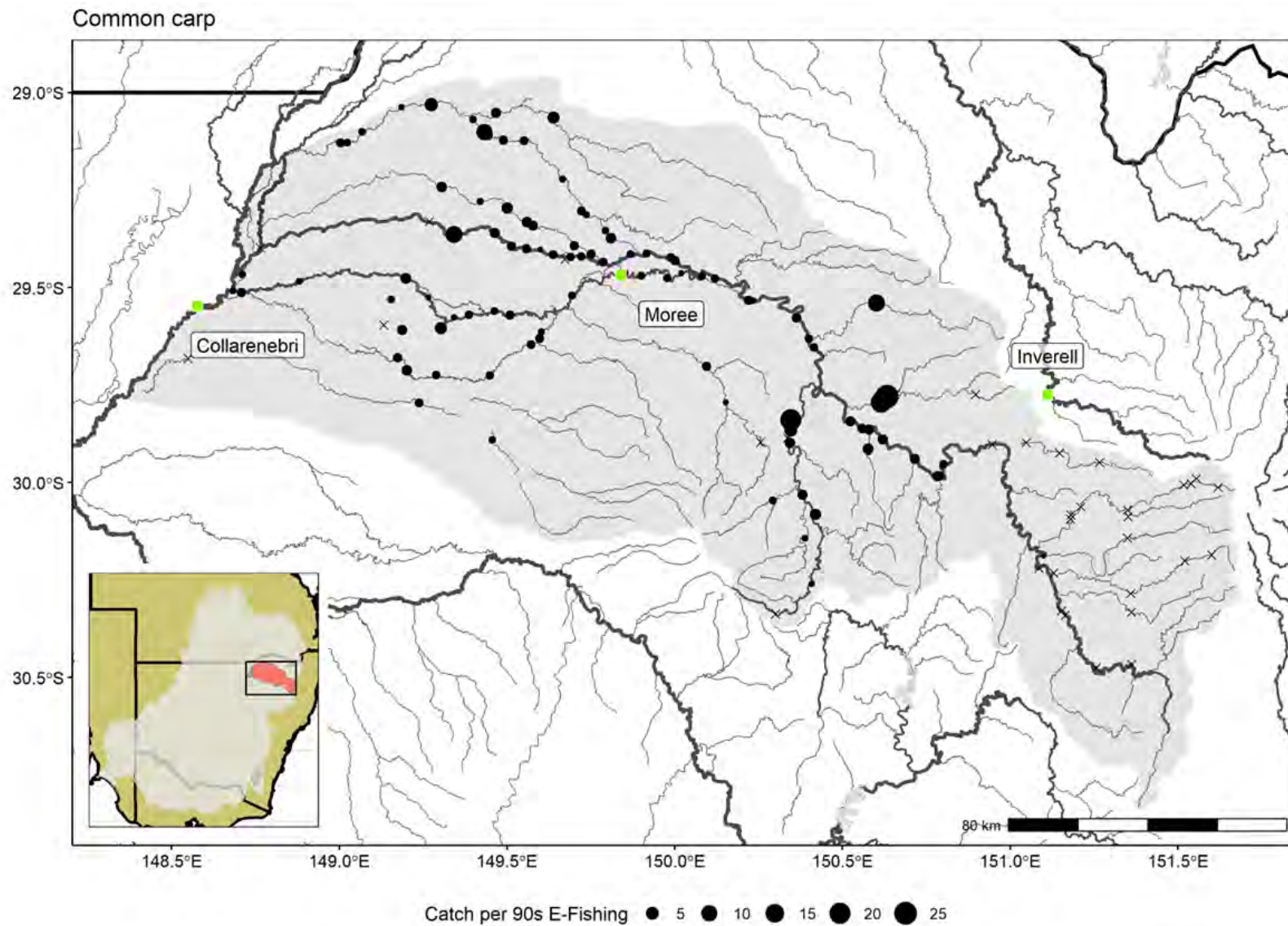


Figure 3.32: Distribution of Common carp sampled from 2013/14 to 2023/24 in the Gwydir WRPA. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares represent key towns.

Threatened Species

The following table (Table 3.6) shows the fish species listed under either the *NSW Fisheries Management Act 1994* (FMA) or the *Commonwealth Environmental Protection and Biodiversity Conservation Act 1999* (EPBC) which were observed during standardised electrofishing surveys in the Gwydir Water Resource Planning Area during the reporting period. A list of all threatened fish species observed by NSW DPIRD Fisheries (as part of any sampling program in any area) is provided in Table 3.10.

Table 3.6: Listed species which were observed in this region during the sampling period. (* = FMA, # = EPBC)

Species	Common name	Total caught (observed)
<i>Ambassis agassizii</i>	Olive perchlet*	1 (0)
<i>Maccullochella peelii</i>	Murray cod#	1,252 (384)
<i>Mogurnda adspersa</i>	Southern purple-spotted gudgeon*	47 (8)
<i>Tandanus tandanus</i>	Freshwater catfish*	382 (126)

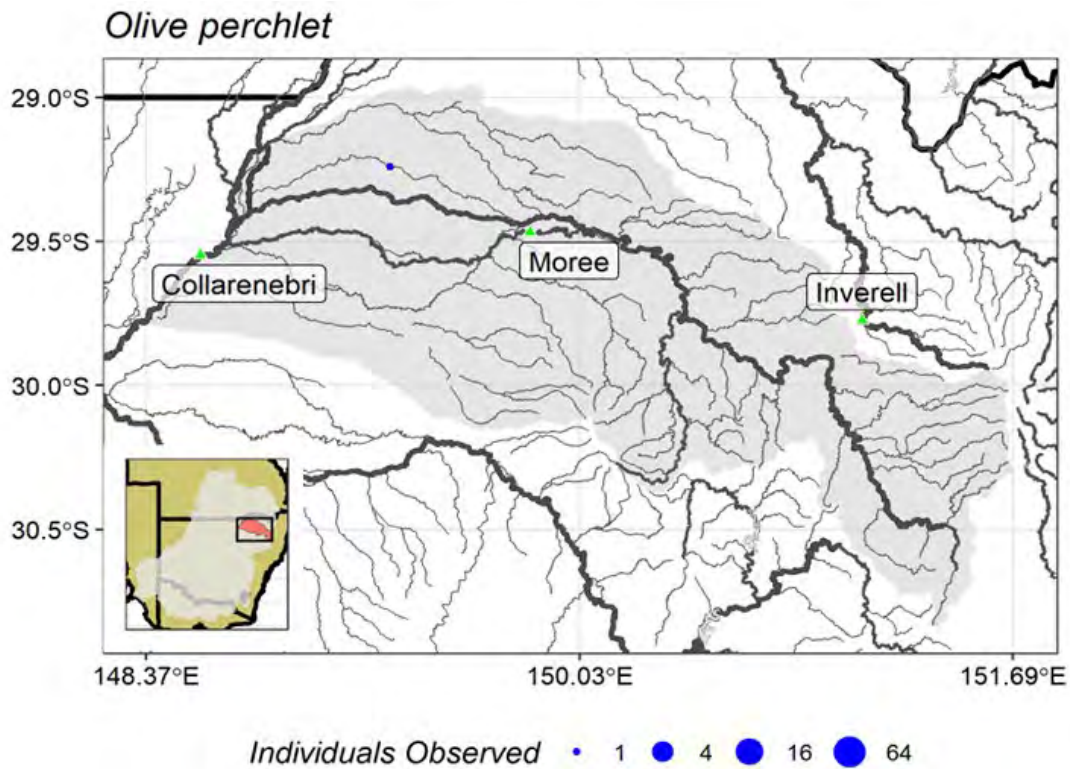


Figure 3.33: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the Gwydir WRPA. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance.

Summary Statement:

A single Olive perchlet was captured in 2016/17 in Gingham Waterhole. Olive perchlet were stocked at this site in 2020/21 (n = 360).

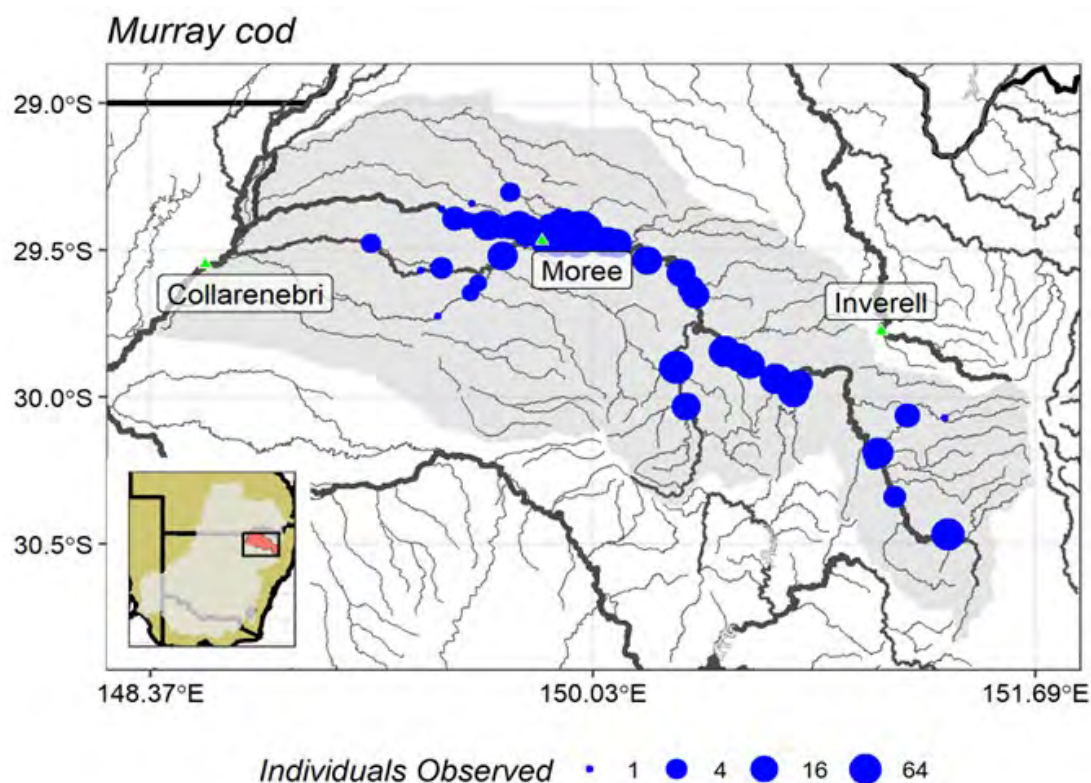


Figure 3.34: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the Gwydir WRPA. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance. Note the lower image shows a juvenile Murray cod.

Summary Statement:

Murray cod are widespread across the Gwydir WRPA with 1,252 being caught over the reporting period. For further details see the Murray cod section.

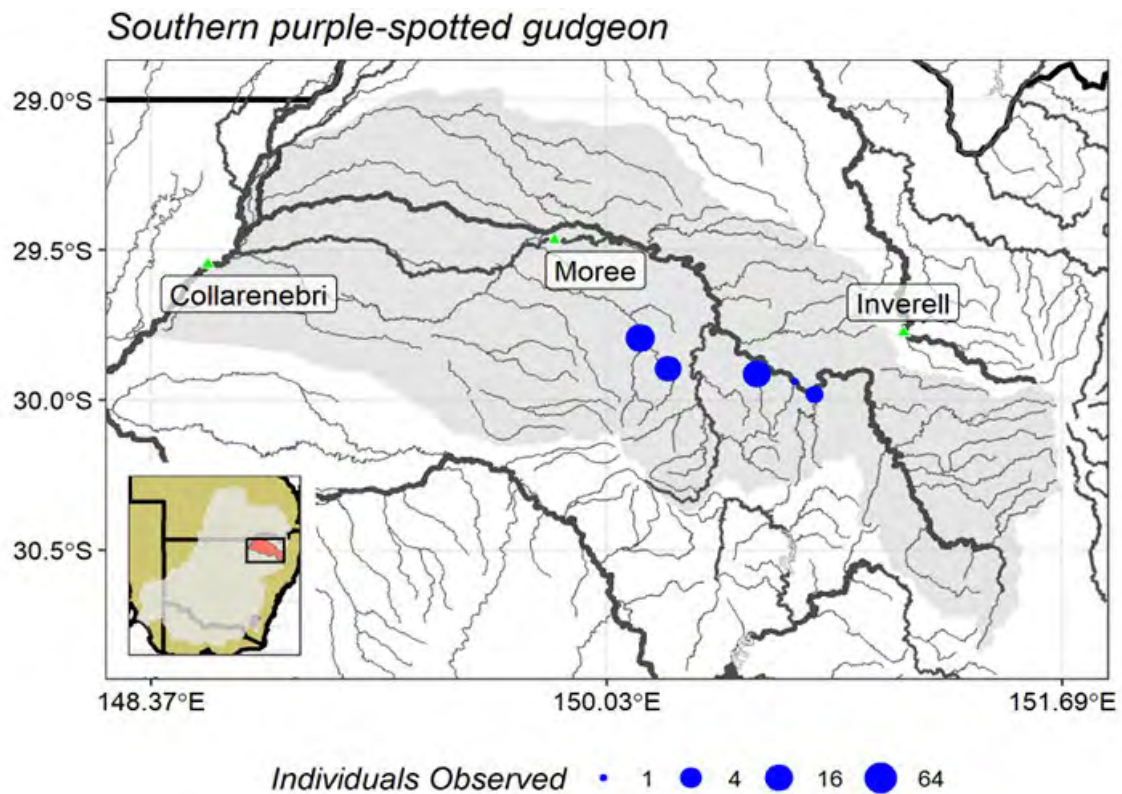


Figure 3.35: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the Gwydir WRPA. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance.

Summary Statement:

A total of 47 Southern purple-spotted gudgeon were captured across 5 sites in the central Gwydir region (2 in 2016/17, 6 in 2017/18, 10 in 2019/20, 19 in 2022/23 and 10 in 2023/24).

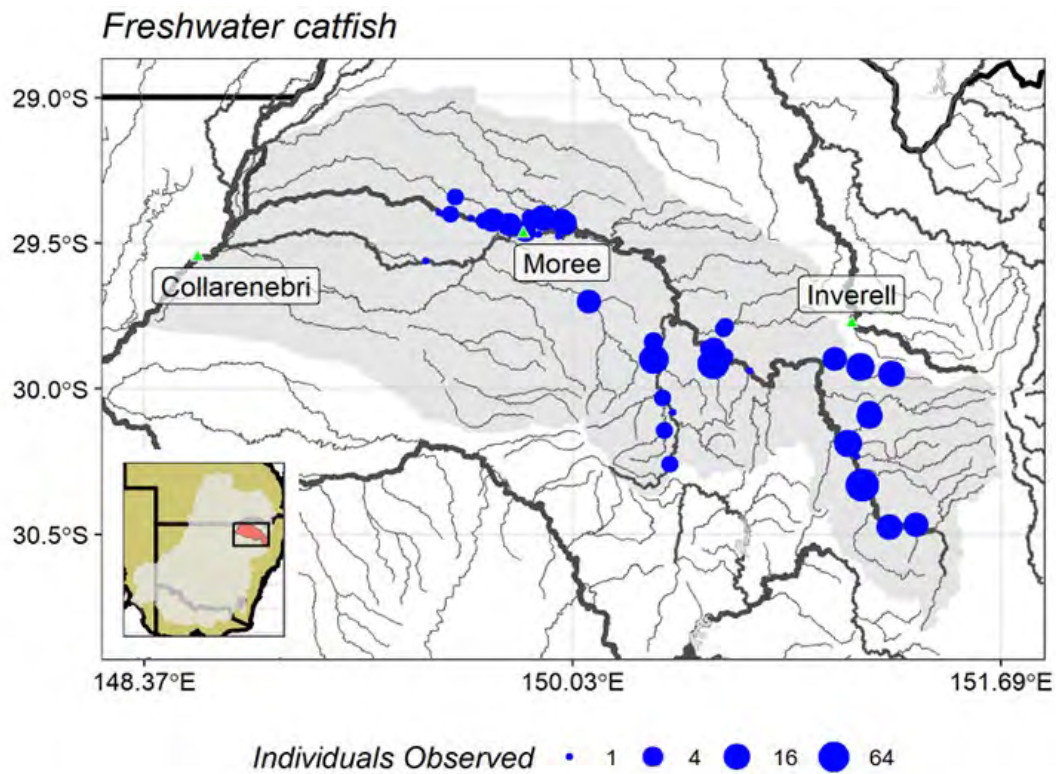


Figure 3.36: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the Gwydir WSPA. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance.

Summary Statement:

A total of 382 Freshwater catfish were captured across 41 sites in the Gwydir region. Individuals were observed in all sampling years.

Appendix

This report contains data from the projects listed in Table 3.7.

Table 3.7: Projects included in this report. Sampling Events show the total number of sampling events included from each project. Sampling Seasons shows which sampling seasons each project contributed data to.

Project Name	Sampling Seasons	Sampling Events
Basin Plan Environmental Outcomes Monitoring	2014/2015, 2015/2016, 2016/2017, 2017/2018, 2018/2019, 2019/2020	126
Basin Plan Environmental Outcomes Monitoring 2	2022/2023, 2023/2024	36
Cold Water Pollution	2022/2023, 2023/2024	17
Gwydir Constraints Project	2023/2024	2
Gwydir Long Term Intervention Monitoring	2014/2015, 2016/2017, 2017/2018, 2018/2019, 2019/2020, 2020/2021, 2021/2022, 2022/2023, 2023/2024	162
Monitoring, Evaluating and Reporting - Inland	2014/2015	1
Murray Cod Slot Limit Assessment	2018/2019	9
Murray-Darling Basin Fish Surveys	2014/2015, 2015/2016, 2016/2017, 2017/2018, 2018/2019, 2020/2021, 2021/2022, 2022/2023, 2023/2024	60

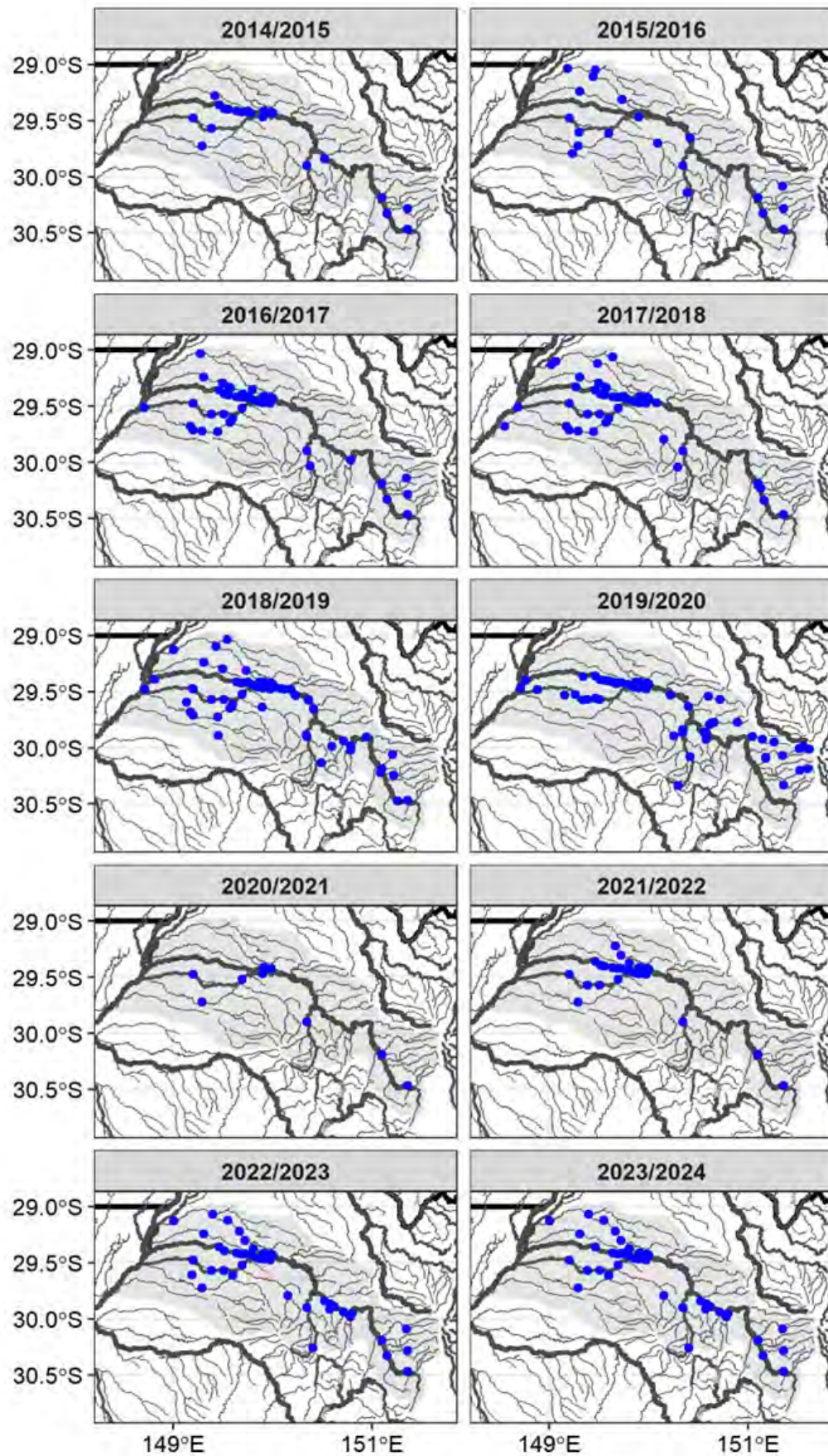


Figure 3.37: Sites sampled and included in this report by sampling season in the Gwydir WRP. Dry sites are not shown.

Table 3.8 shows all species detected during this survey period as part of standardised monitoring projects (see Table 3.7). Note there are variations in effort between sampling seasons so this information should be considered in conjunction with Table 3.1. The Expected from Modelling column identifies species which are possible to occur based upon MaxENT habitat modelling (likelihood threshold > 0.33; NA represents no modelling was undertaken). Species that were possible from the modelling but not observed during standardised sampling in the Gwydir WRPA were: Silver perch and Dwarf flathead gudgeon. It should be noted that the MaxENT modelling models habitat availability and is not always a reliable index of abundance, it merely indicates possible distribution based upon habitat. A full list of species observed during this period across the standardised monitoring protocols and sampling methods is presented in

Table 3.11.

Table 3.8: Total number caught of each species by sampling season in the Gwydir WRPA.

Common name	Expected from modelling	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24
Australian smelt	YES	209	7	280	188	43	205	0	43	49	108
Bony herring	YES	288	279	1,520	1,239	590	298	92	362	603	486
Carp-gudgeon species complex	YES	528	456	1,459	1,497	3,395	1,431	184	84	402	409
Common carp	NA	303	225	981	315	643	1,865	175	682	1,363	558
Darling hardyhead	YES	0	0	0	0	41	0	0	0	15	0
Eastern gambusia	NA	182	2,494	414	2,033	2,937	744	24	46	193	191
Freshwater catfish	YES	5	53	55	14	27	99	2	17	88	22
Galaxias spp	NA	0	0	0	0	0	0	0	0	0	0
Golden perch	YES	33	22	39	29	39	19	7	62	86	121
Goldfish	NA	148	29	410	205	214	161	27	83	361	96
Mountain galaxias	YES	33	64	21	0	0	11	0	0	6	0
Murray cod	YES	103	31	166	145	317	93	5	54	176	162
Murray-Darling rainbowfish	YES	222	7	927	327	249	166	32	414	238	63
River blackfish	NA	0	3	1	0	0	0	0	0	0	0
Olive perchlet	YES	0	0	1	0	0	0	0	0	0	0
Rainbow trout	YES	0	0	2	0	0	0	0	0	4	0
Redfin	YES	134	104	12	294	43	14	0	0	1	188
Southern purple-spotted gudgeon	YES	0	0	2	6	0	10	0	0	19	10
Spangled perch	YES	86	66	166	226	199	275	47	447	152	74
Unspecked hardyhead	YES	291	53	122	150	52	797	3	234	72	210

The following table summarises the sampling methods for each species caught (Table 3.9).

Table 3.9: Total catch of each species by sampling method in the Gwydir WRP.

Common name	Backpack Electrofishing	Bait Trap	Boat Electrofishing
Australian smelt	651	4	477
Bony herring	1,222	16	4,519
Carp-gudgeon species complex	2,368	5,487	1,990
Common carp	3,317	162	3,631
Darling hardyhead	15	0	41
Eastern gambusia	3,189	4,455	1,614
Freshwater catfish	212	11	159
Galaxias spp	0	0	0
Golden perch	24	0	433
Goldfish	1,191	9	534
Mountain galaxias	133	2	0
Murray cod	152	0	1,100
Murray-Darling rainbowfish	1,398	16	1,231
River blackfish	3	0	1
Olive perchlet	0	1	0
Rainbow trout	6	0	0
Redfin	253	4	533
Southern purple-spotted gudgeon	42	2	3
Spangled perch	1,040	32	666
Unspecked hardyhead	409	517	1,058

Table 3.10: Listed threatened species recorded in the Murray-Darling Basin (from the NSW DPIRD Fisheries Freshwater Ecosystem research database). Species are listed under either the NSW Fisheries Management Act 1994 (FMA) or the Commonwealth Environmental Protection and Biodiversity Conservation Act 1999 (EPBC).

Genus, species	Common Name	EPBC Status	FMA Status
<i>Ambassis agassizii</i>	Agassiz's glassfish, olive perchlet, western New South Wales population	NA	Endangered Population
<i>Bidyanus bidyanus</i>	Silver Perch, Bidyan	Endangered	Vulnerable
<i>Craterocephalus fluviatilis</i>	Murray Hardyhead	Endangered	Critically Endangered
<i>Galaxias rostratus</i>	Flathead Galaxias, Beaked Minnow, Flat-headed Galaxias, Flat-headed Jollytail, Flat-headed Minnow	Critically Endangered	Critically Endangered
<i>Galaxias tantangara</i>	Stocky Galaxias	NA	Critically Endangered
<i>Maccullochella macquariensis</i>	Trout Cod	Endangered	Endangered
<i>Maccullochella peelii</i>	Murray Cod	Vulnerable	NA
<i>Macquaria australasica</i>	Macquarie Perch	Endangered	Endangered
<i>Mogurnda adspersa</i>	Southern Purple Spotted Gudgeon	NA	Endangered
<i>Nannoperca australis</i>	Southern Pygmy Perch	Vulnerable	Endangered
<i>Tandanus tandanus</i>	Freshwater catfish, eel tailed catfish, Murray-Darling Basin population	NA	Endangered Population

Table 3.11 shows all species detected during this survey period across all programs and methods. Due to variations in project methods protocols, this data is presented only to give a complete list of species observed in the region. The Expected from Modelling column identifies species which are possible to occur based upon MaxENT habitat modelling (likelihood threshold > 0.33; NA represents no modelling was undertaken). Species that were possible from the modelling but not observed during standardised sampling in the Gwydir WRPAs were: Silver perch and Dwarf flathead gudgeon. It should be noted that the MaxENT modelling actually models habitat availability and is not always a reliable index of abundance, it merely indicates possible distribution based upon habitat. A list of species caught as part of standardised monitoring during this period is in Table 3.8.

Table 3.11: Total catch of each species by all sampling programs and all methods in the Gwydir WRPAs. Note these include projects with sampling not representative of the community and the data should be used with caution.

Common name	Expected from modelling	2014/ 15	2015/ 16	2016/ 17	2017/ 18	2018/ 19	2019/ 20	2020/ 21	2021/ 22	2022/ 23	2023/ 24
Australian smelt	YES	294	7	282	193	45	229	0	54	82	120
Bony herring	YES	603	279	1,728	1,279	595	298	130	532	621	490
Carp gudgeon species complex	YES	2,557	456	2,302	7,649	11,621	4,233	188	958	809	2,379
Common carp	NA	525	225	992	315	643	1,867	179	731	1,383	559
Darling hardyhead	YES	0	0	0	0	41	0	0	0	15	0
Eastern gambusia	NA	280	2,494	547	2,150	3,581	1,031	30	63	264	303
Freshwater catfish	YES	6	53	55	14	27	102	2	26	89	27
Golden perch	YES	48	22	39	29	39	19	8	69	89	124
Goldfish	NA	209	29	410	205	214	161	31	89	366	96
Mountain galaxias	YES	33	64	21	0	0	11	0	0	6	0
Murray cod	YES	139	31	166	145	317	93	5	60	176	163
Murray-Darling rainbowfish	YES	499	7	2,902	477	444	224	45	570	357	316
River blackfish	NA	0	3	1	0	0	0	0	0	0	0
Olive perchlet	YES	0	0	1	0	0	0	0	0	0	0
Rainbow trout	YES	0	0	2	0	0	0	0	0	4	0
Redfin	YES	134	104	12	294	43	14	0	0	1	188
Southern purple-spotted gudgeon	YES	0	0	2	6	0	10	0	0	19	10

Common name	Expected from modelling	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24
Spangled perch	YES	140	66	168	226	205	276	62	499	177	76
Unspecked hardyhead	YES	452	53	254	227	144	812	3	282	86	213

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Chapter 4 Basin Plan Fish Monitoring Summary (2014/15 – 2023/24): Intersecting Streams Water Resource Planning Area

Hayden Schilling & David Crook

March 2025



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Introduction

This report spans 2014/15 to 2023/24 and uses all suitable fish assemblage data collected by NSW DPIRD Fisheries using standardized electrofishing monitoring techniques. The format of the report follows and expands upon the previous reports (Schilling & Crook 2023, 2024). This report focusses on the Intersecting Streams Water Resource Planning Area (WRPA) shown in Figure 4.1.

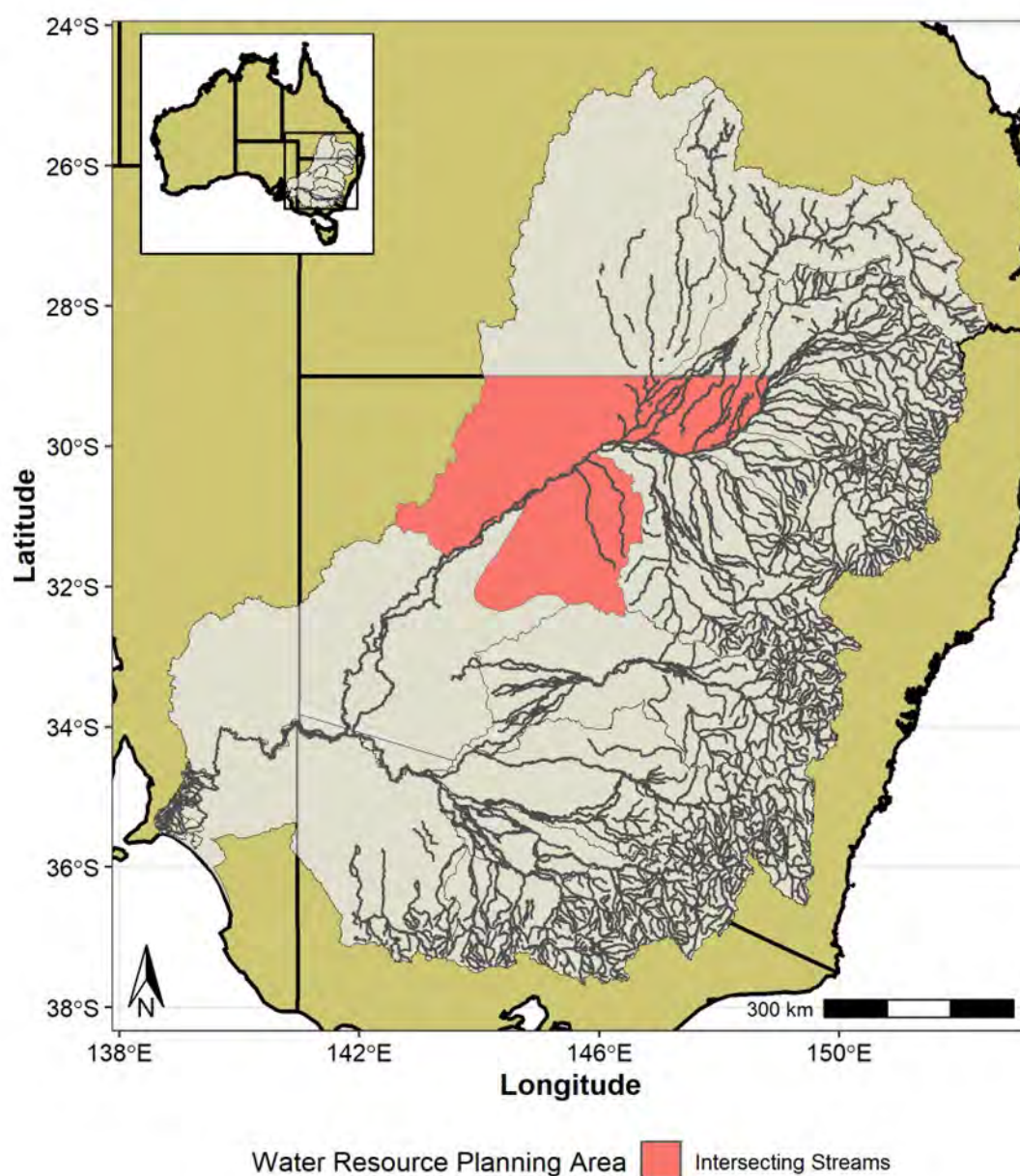


Figure 4.1: Murray-Darling Basin with the key region of this report highlighted. Inset map shows the whole of Australia with a box around the MDB.

What This Report Includes

This report starts with an overview of the standardised monitoring programs including sampling details and statistics. An overview of the hydrological and climatic conditions during the reporting period is also provided as context for interpreting the fish population status data.

Following the introductory sections, we present a summary of *fish diversity* across the Intersecting Streams WRPAs. Separate plots for native and alien species show the total number of unique species observed at each site.

The main body of the report provides detailed information on the *population structure, relative abundance, health, and distribution* of six key fish species:

- Murray cod (not recorded in this WRPAs over the sampling period)
- Golden perch
- Freshwater catfish (not recorded in this WRPAs over the sampling period)
- Bony herring
- Australian smelt (very few recorded in this WRPAs over the sampling period)
- Common carp

Population structure information includes length frequency plots of collected fish and the proportion of fish classified as Young of the Year (YOY). This information can be used to infer the size structure of populations and the level of recruitment each year. For additional context, we provide a summary table showing any stocking which occurred for the species in each year (if relevant).

Relative abundance and *relative biomass* (a unit-less measure representing the number (or biomass) of fish in an area) information is adapted from the modelled outputs from a more in-depth publication (Crook et al. 2023) which considers all available electrofishing data within the NSW Murray-Darling Basin (MDB). The updated analysis uses generalised linear mixed models to generate annual indices of relative abundance and biomass for each WRPAs. In this report we present the modelled time series of relative abundance showing the predicted number (or biomass) of fish observed per 90 second shot of electrofishing. The abundance and biomass trends for the Intersecting Streams WRPAs are contrasted with the overall NSW MDB dataset. It should be noted that these are modelled estimates of relative abundance/biomass, not absolute abundance/biomass as absolute estimates would require extensive calibration surveys that are not included in the monitoring program.

Health information is provided as a summary of any visible health conditions recorded for the key species. The number of health conditions observed in a fish population is generally reflective of water quality, competition, and many other factors. Fewer observations of health conditions indicate healthier populations. The health conditions detailed are any that were observed as part of the biological measurements taken. We provide a comparison of the prevalence of health conditions in the Intersecting Streams WRPAs and greater MDB (excluding the Intersecting Streams WRPAs).

Distribution maps are provided for each species to show the observed distribution of each species from electrofishing samples. The distribution maps also show the relative abundance (number of fish observed per 90 seconds of electrofishing) at each site to give an indication of how the population is spread over the landscape.

Finally, the distributions and numbers of *Threatened species* are reported. The report includes threatened species that were recorded by standardised monitoring programs in the Intersecting Streams WRPAs during the reporting period.

For each section of the report, we provide a *Summary Statement*. This statement provides a very brief overview of the key messages for each section.

Sampling Methods

Three main methods are used during routine fish monitoring surveys: boat electrofishing, backpack electrofishing and bait traps. This report mainly includes the electrofishing data with bait trap samples informing the distribution of small bodied species. The electrofishing was conducted using the standard methodology implemented in the Sustainable Rivers Audit (SRA; Davies et al. 2010). This usually includes 12 shots of 90 seconds “power on” during each sampling event.

As parts of this report compile data from multiple projects, there is some variation in how sites were chosen and the effort of sampling conducted each year (Table 4.1). Details of which projects contributed data to this report can be seen in Table 4.5. At each site, sampling gear was applied as suited to the local conditions with either boat, backpack, or a hybrid of the two, in addition to 10 unbaited bait traps set in edge margins. Most sampling occurred between the months of September and May.

Table 4.1: Sampling effort (Number of sites sampled) each sampling season in the Intersecting Streams WRPA. Variation in sampling effort is due to different numbers of projects and interruptions to planned sampling such as flooding, site desiccation, and extreme weather.

Sampling Season	Number of Boat Electrofishing Sites	Number of Backpack Electrofishing Sites	Number of Hybrid Sites	Total
2014/2015	4	2	0	6
2015/2016	6	3	0	9
2016/2017	10	3	0	13
2017/2018	5	5	1	11
2018/2019	2	1	0	3
2019/2020	7	1	0	8
2020/2021	4	0	2	6
2021/2022	6	0	0	6
2022/2023	7	0	0	7
2023/2024	7	3	0	10

The sites sampled during the reporting period are shown in Figure 4.2. A breakdown of sites sampled each sampling season is shown in the Appendix (Figure 4.20).

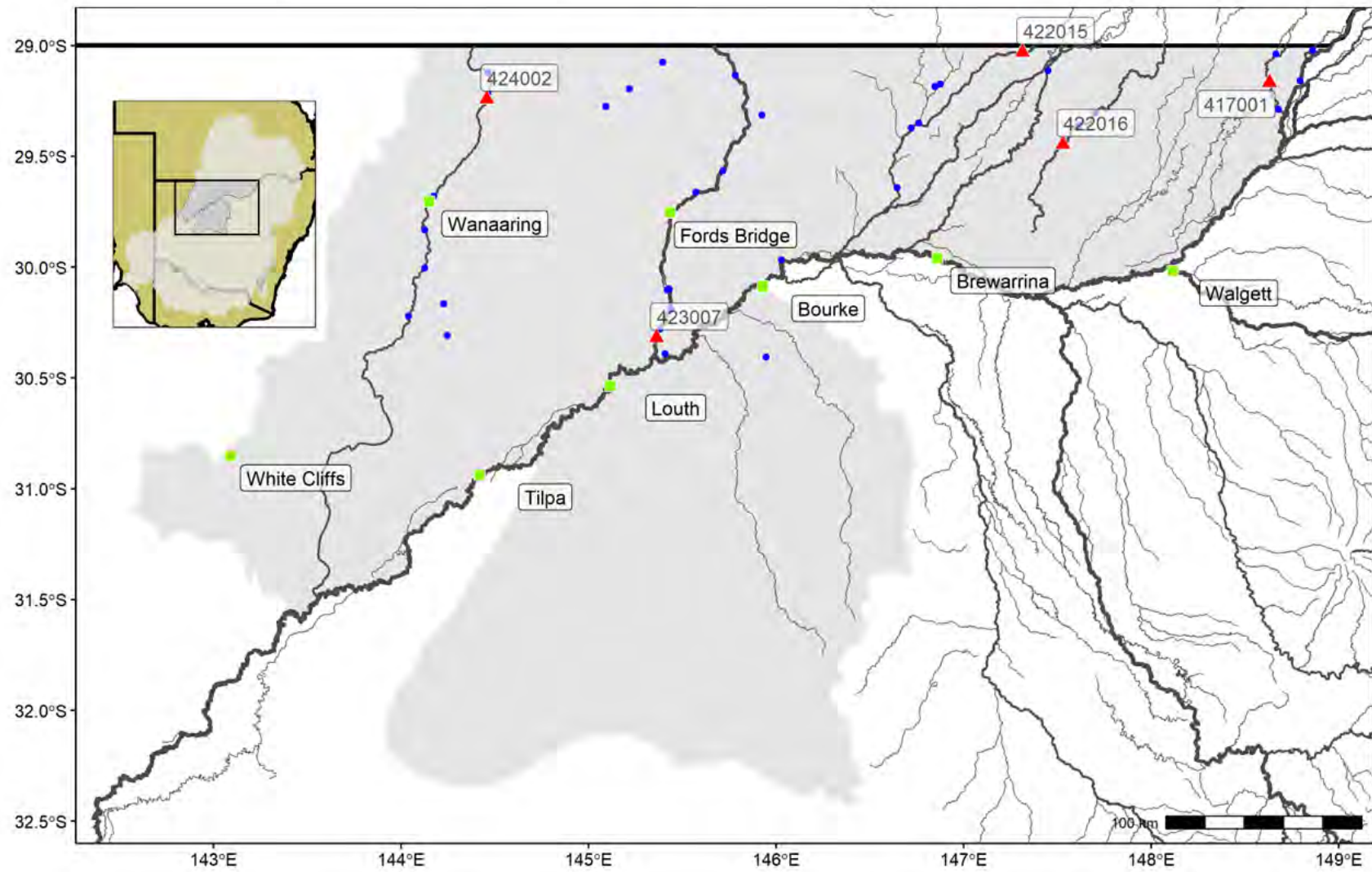


Figure 4.2: Sites (blue dots) sampled during the reporting period in the Intersecting Streams WRP. Red triangles show key flow gauges along with their gauge ID number. Green squares show key towns. The grey shaded area represents the water resource planning area.

Each sampling method has a different effectiveness at sampling each species. Table 4.2 shows the total numbers of each key species caught by each method.

Table 4.2: Number of each key species caught by sample method over the whole program in the Intersecting Streams WRPA. Further data on total catch is provided in the Appendix.

Common name	Boat Electrofishing	Backpack Electrofishing	Bait Trap
Australian smelt	3	0	0
Bony herring	4,841	60	8
Common carp	2,205	141	107
Golden perch	251	25	23

A subset of sampled fish had biological measurements taken during the surveys, including but not limited to length and weight measurements and visual health assessments. Table 4.3 shows the number of biological measurements taken each year for the six key species.

Table 4.3: Number of biological measurements taken for the key species each sampling season in the Intersecting Streams WRPA.

Sampling Season	Australian smelt	Bony herring	Common carp	Golden perch
2014/2015	0	194	32	13
2015/2016	0	136	35	24
2016/2017	2	640	358	69
2017/2018	0	103	74	67
2018/2019	0	1	0	0
2019/2020	0	78	38	35
2020/2021	0	229	288	25
2021/2022	0	413	186	3
2022/2023	1	326	353	42
2023/2024	0	202	325	27

Climate Overview

The following is a summary of the climatic conditions during the reporting period in terms of how the observed conditions compare to long term records. These are direct extracts from the [Australian Bureau of Meteorology climate summaries archive](#) and are written in the given year. To interpret, 2014 states it was the warmest year on record, meaning 2014 was the warmest year on record up to and including 2014 but not including more recent years.

2014

New South Wales experienced its warmest year on record in 2014, with several heatwaves and persistently warm conditions across the State. Rainfall was well below average in the northeast, and close to average elsewhere.

2015

New South Wales recorded well above average temperatures in 2015. Nights were particularly warm, the sixth-warmest on record for the State. Rainfall was close to average for the state as a whole.

2016

2016 was a generally wet, warm year for NSW as a whole, with substantial variability throughout the year and across the state. Following a record-warm start to the year, May to September was the wettest such period on record for NSW, with cooler weather in much of the west of the state. Minimum temperatures were the warmest on record for the State as a whole, with record-warm daytime temperatures on parts of the east coast.

2017

The year 2017 was the warmest on record for New South Wales for both mean and daytime temperatures. It was also the State's driest year since 2006. Following the warmest summer on record for the State, heavy rain in March across the east then made way for a very dry winter and start to spring. Winter overnight temperatures were the lowest since 1997, but daytime temperatures remained above average for most of the year, and were the warmest on record overall.

2018

2018 was the warmest on record for New South Wales for both mean temperature and mean maximum temperature, whilst the mean minimum temperature was fourth-warmest on record. The year was dominated by very dry conditions, with the third-driest January to September on record. October to December saw some relief from the dry, with above average rainfall across parts of the State. Despite this, New South Wales experienced its sixth-lowest annual rainfall on record; its driest year since 2002.

2019

2019 was the driest and warmest year on record for New South Wales. Despite some rain in some months, most of the State received much less rainfall than usual, with the northeast and far west particularly dry. Heatwaves in January brought very high temperatures, and large fires from September onward caused extensive damage and persistent smoke.

2020

2020 saw above average temperature and rainfall in New South Wales. Temperatures were above average across the state in most months except during autumn. There was widespread rain during autumn and spring and in December, but early winter and November rain was below average.

2021

New South Wales had its 6th wettest year on record, with 2021 rainfall 30 % above average. This included significant floods along the east coast in March, and the state's wettest November on record. It was the state's coolest year since 1996, at 0.15 °C above the 1961–1990 average.

2022

2022 was exceptionally wet with the state-averaged annual total being the second-highest on record (since 1900) and many sites recording their highest annual totals on record. Maximum temperatures were lower than average with the state-averaged annual maximum temperature being the coolest since 1992. Minimum temperatures were generally warmer than average with the state-averaged annual minimum temperature being 0.73 °C above the 1961–1990 average.

2023

The state-averaged rainfall was 22.9 % below the 1961–1990 average. Rainfall was above average over small parts of the state's south, west of the Great Dividing Range, while being below average over most of the northern half of the state, especially over parts of the Northern Tablelands, Northern Rivers, Mid-North Coast, and Upper Hunter, where annual rainfall was in the lowest 10 % of historical records (since records began in 1900). State-averaged annual maximum temperature was 1.96 °C above the 1961–1990 average, which is the third highest on record.

2024

Rainfall totals in 2024 were above average to very much above average for the northern and western areas of the state, as well as central parts of the coast. Totals were below average for large parts of the south-east, as well as small parts of the state's north-east and south-west. 2024 was the third-warmest on record for all years since 1910, 1.55 °C above the 1961–1990 average.

Flow Data

Below shows a summary of flow data from a variety of flow gauges in the Intersecting Streams WRPA (Figure 4.3).

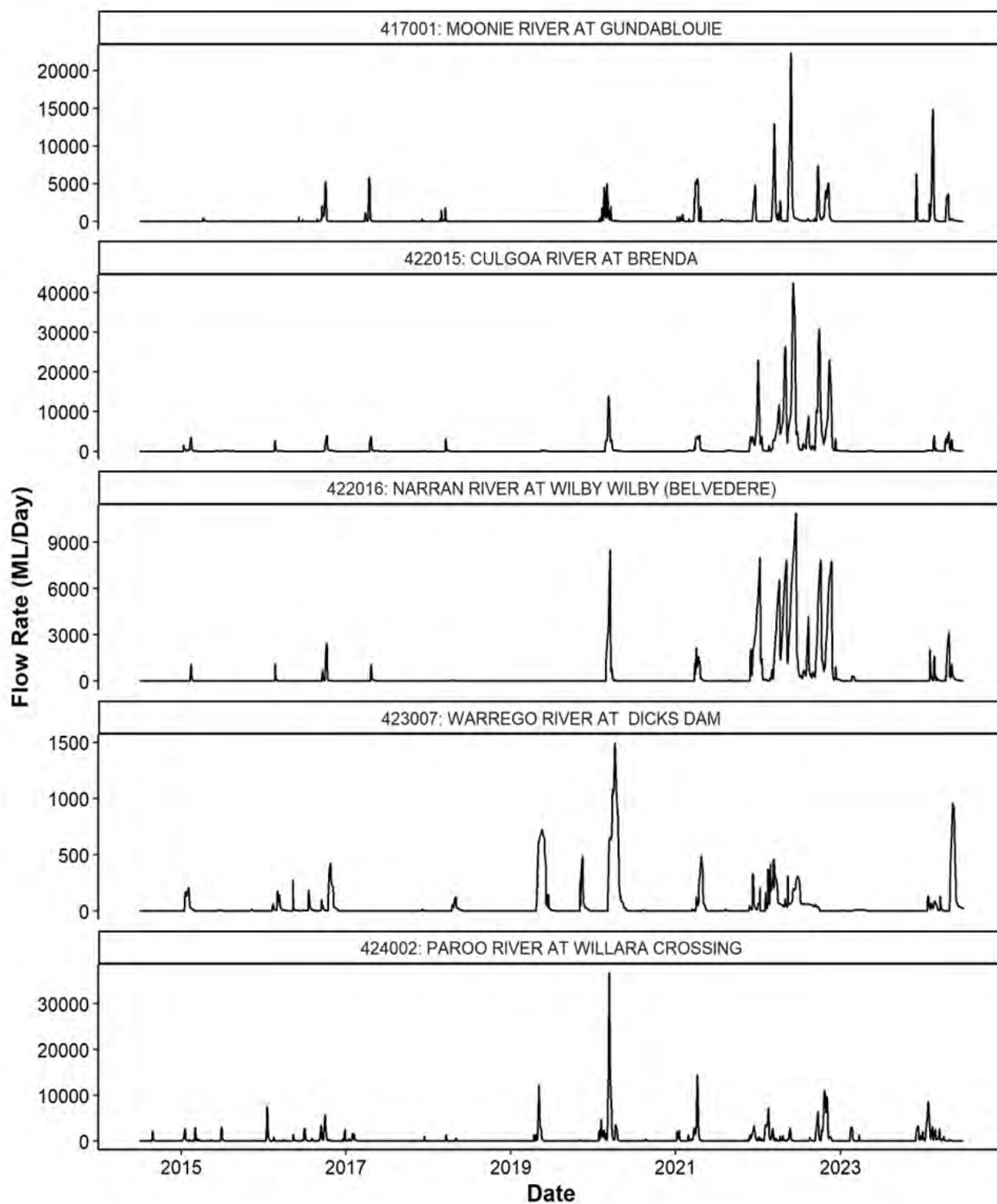


Figure 4.3: Flow data from various gauges in the Intersecting Streams WRPA over the reporting period. Gauge locations can be seen on Figure 4.2. Note the differing scales on the y-axis.

Water temperature data, where available, are also shown in Figure 4.4.

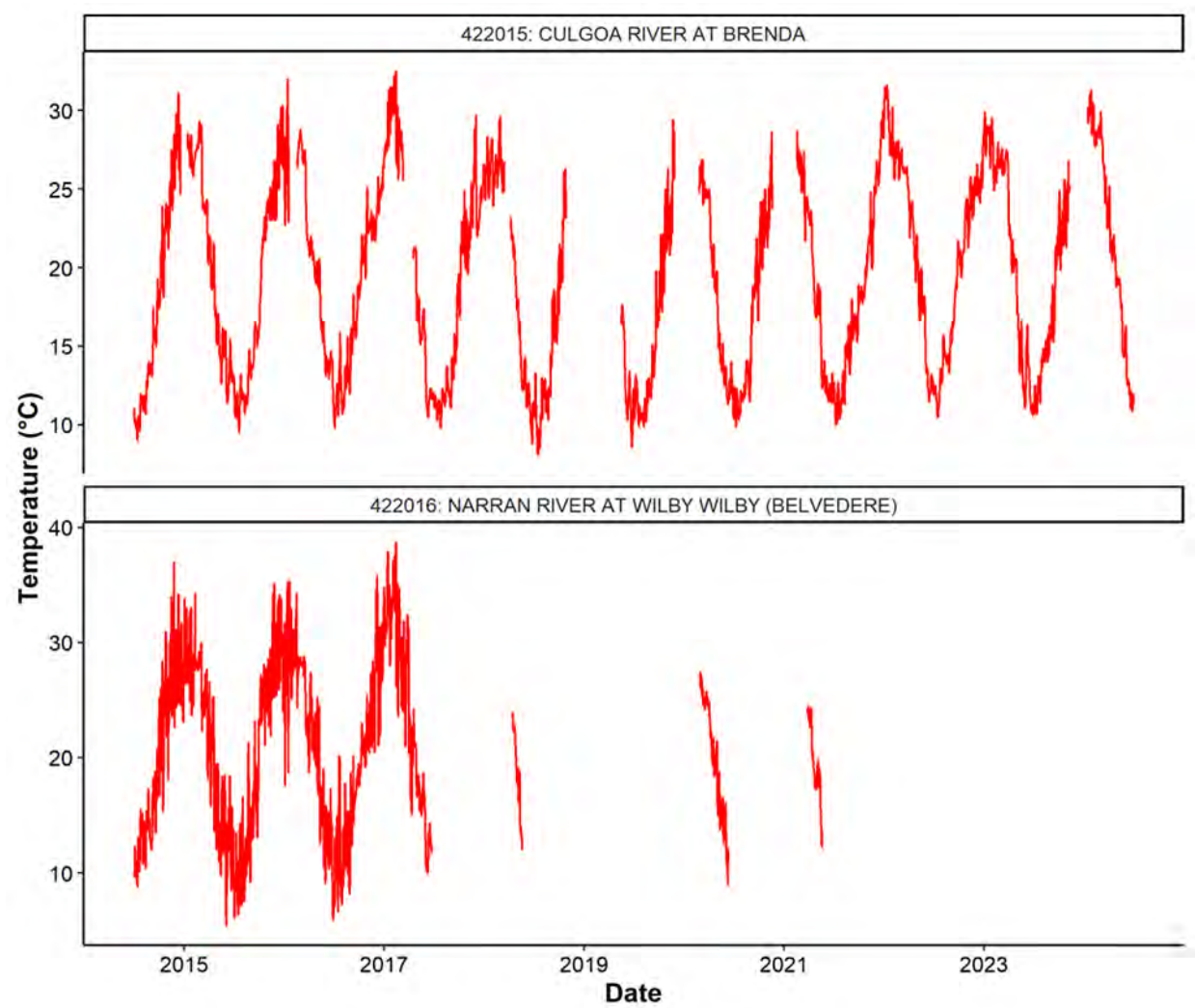


Figure 4.4: Water temperature data from various gauges in the Intersecting Streams WRPA over the reporting period. Gauge locations can be seen on Figure 4.2. Note the differing scales on the y-axis.

Species Diversity

A total of 12 fish species were observed across the Intersecting Streams WRPA including three alien species. Figure 4.5 shows the number of native species found at each site while Figure 4.6 shows the number of alien species found at each site. The full list of species caught and observed is presented in Table 4.6.

Summary Statement:

Native and alien diversity was generally consistent across the region with slight increases in the central area near the lower Warrego River.

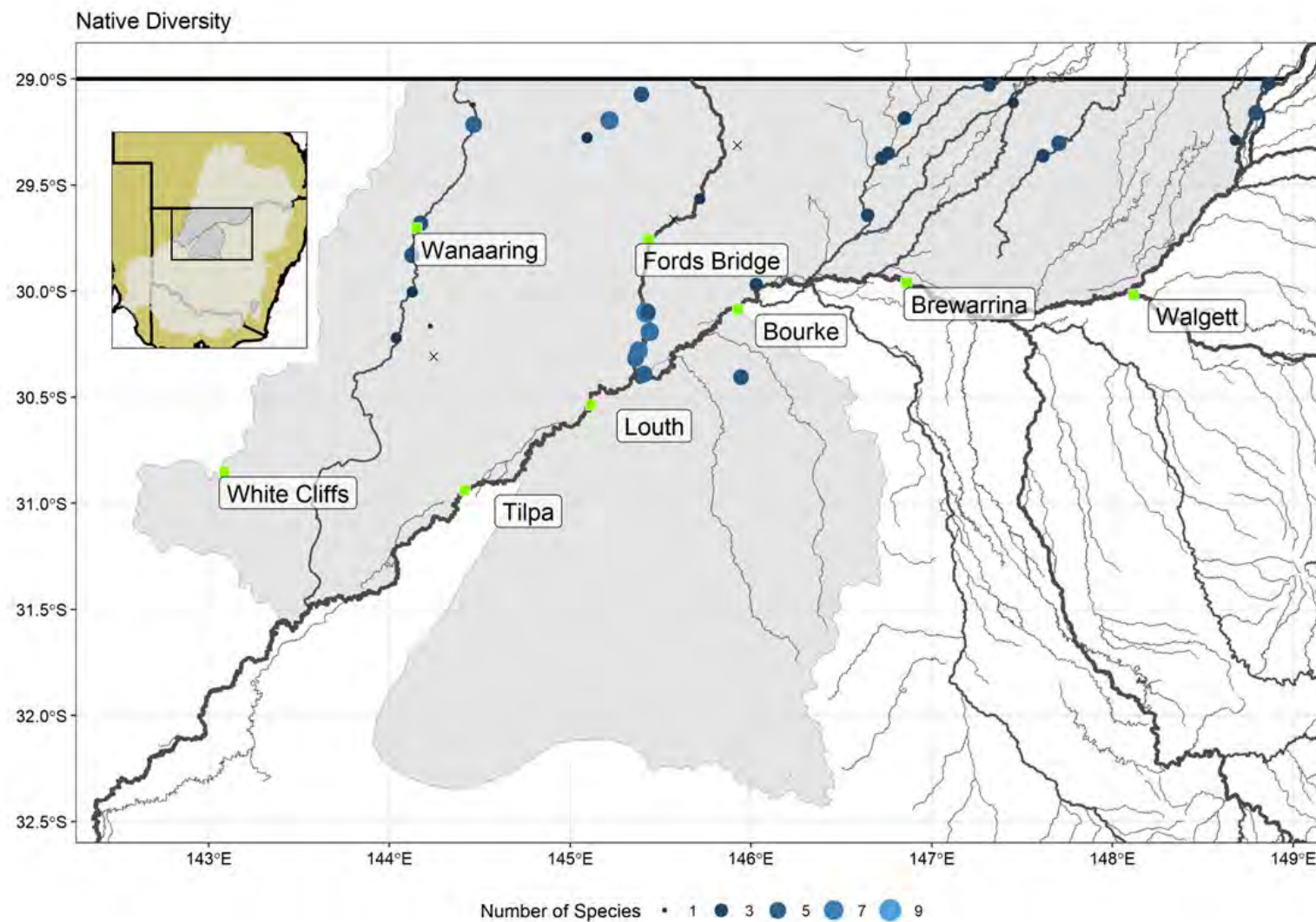


Figure 4.5: Native diversity across all sampling sites in the Intersecting Streams WRP. Bubble size represents the number of unique species observed at each site across all sampling methods and events. X represents a site that had water and was sampled, but no fish species were caught at all. Dry sites are excluded. Green squares represent key towns.

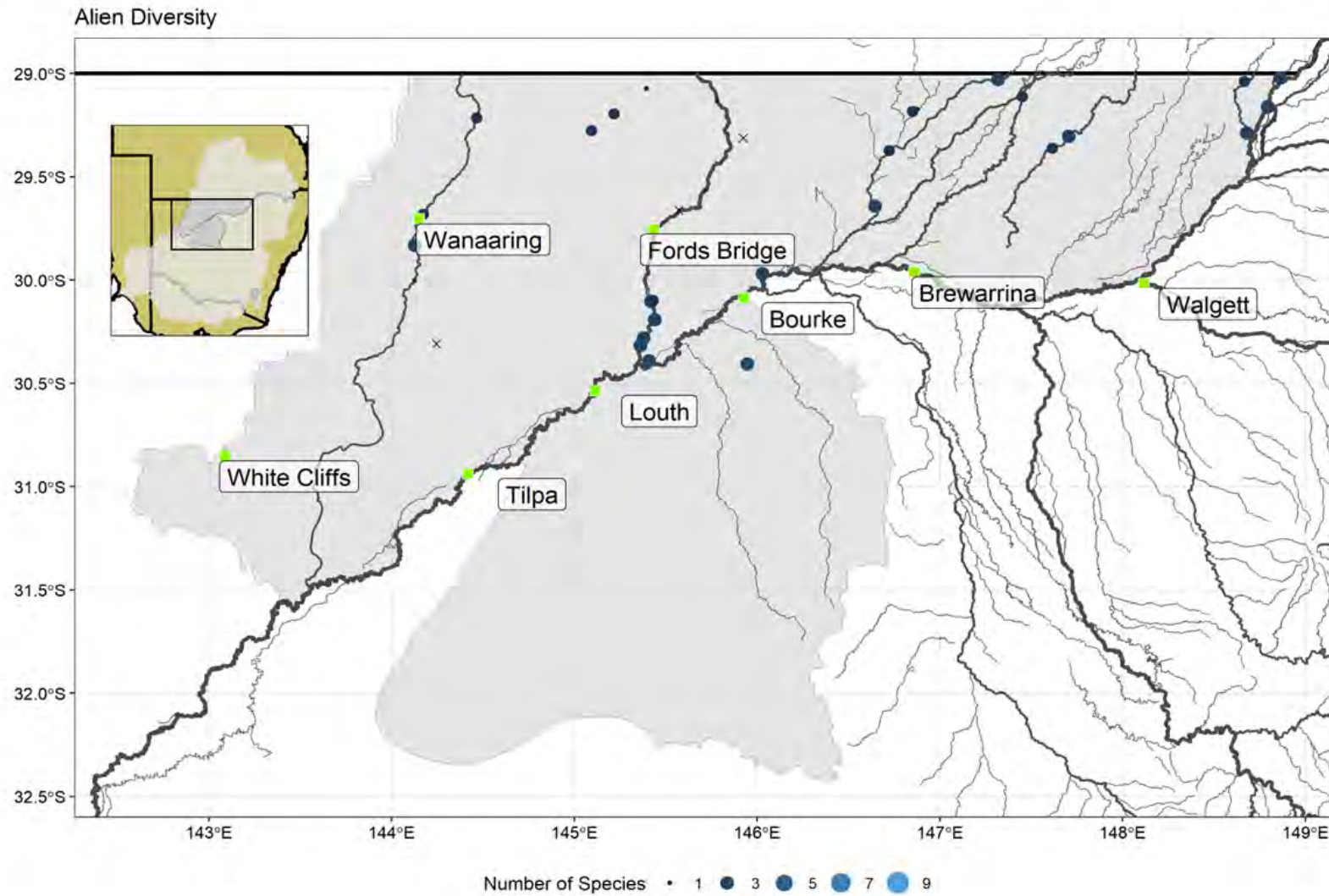


Figure 4.6: Alien diversity across all sampling sites in the Intersecting Streams WRP. Bubble size represents the number of unique species observed at each site across all sampling methods and events. X represents a site that had water and was sampled, but no fish species were caught at all. Dry sites are excluded. Green squares represent key towns.

Murray cod



Summary Statement:

No Murray cod were recorded in the Intersecting Streams WRPA suggesting they are absent or in very low abundances.

Golden perch



Population Structure

Figure 4.7 shows the observed length frequency plot for Golden perch for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 1 to 57, and 7 % to 92 % of measured fish within a season, with a mean percentage YOY of 47 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Golden perch was 6 % (514 out of 7,994).

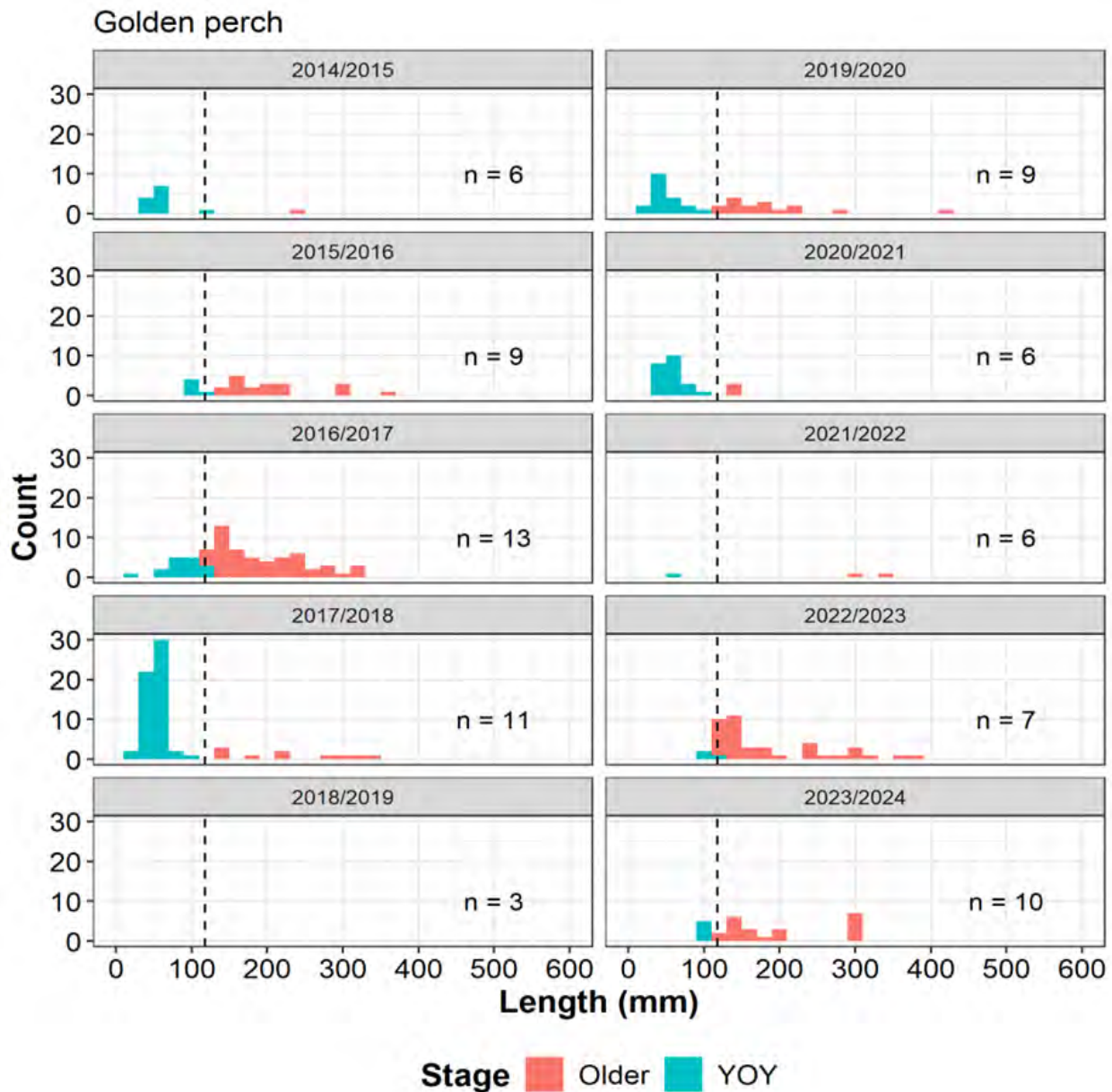


Figure 4.7: Length frequency plots for Golden perch by sampling season in the Intersecting Streams WRPA. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRPA in a sampling season.

Summary Statement:

Sporadic recruitment with possible recruitment failures in 2018/19, 2021/22 and 2022/23. 2023/24 showed some moderate sized fish but very few YOY (note the low sampling effort in many years).

Stocking

No Golden perch were stocked in the Intersecting Streams WRPAs during the reporting period.

Temporal Trends in Abundance

The relative abundance and biomass of Golden perch since the early 2000s was modelled based on all suitable boat electrofishing data. The left-hand panels of Figure 4.8 show the abundance and biomass trends for the Intersecting Streams WRPAs and the right-hand panels show the overall trends across the NSW MDB.

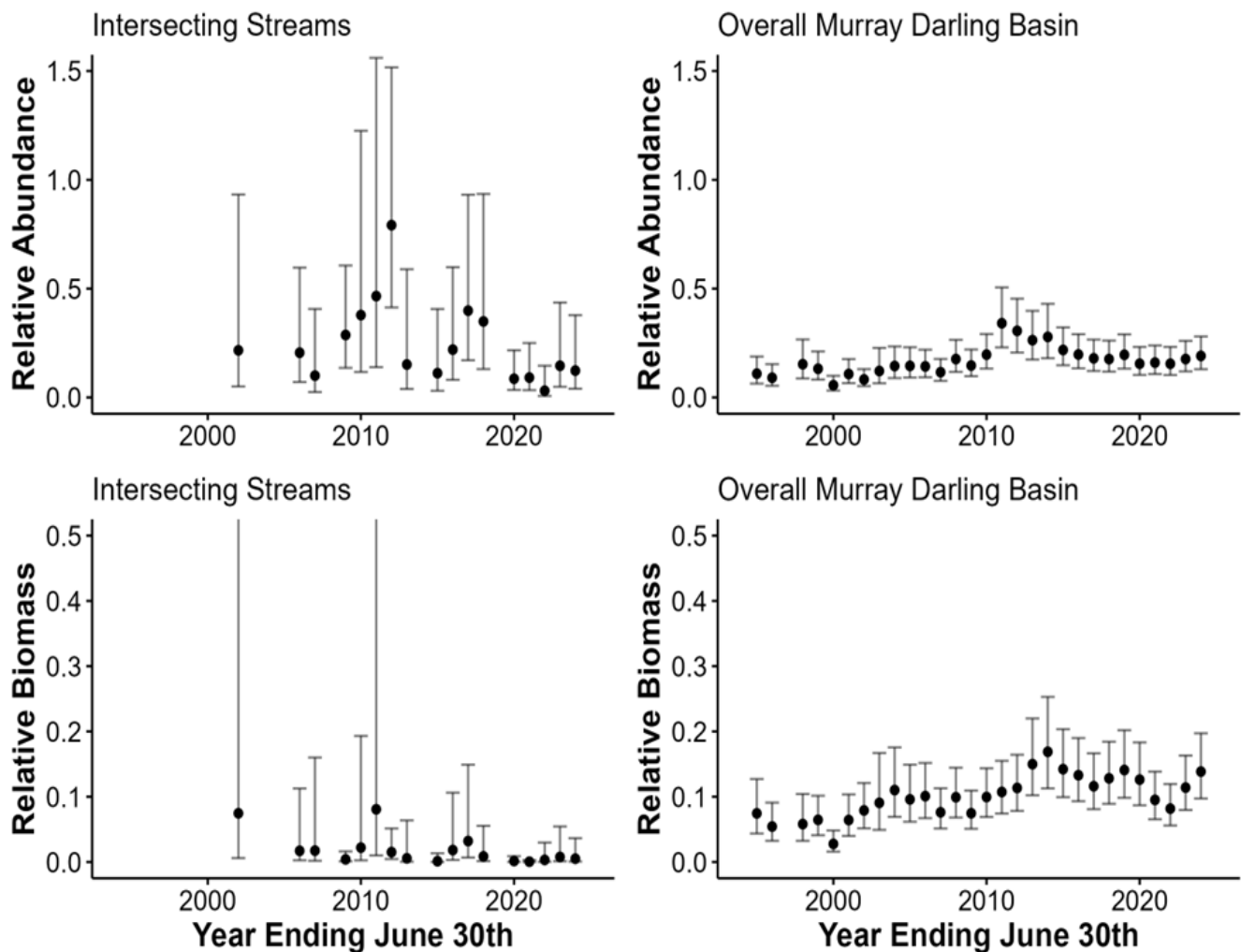


Figure 4.8: Relative abundance and biomass of Golden perch in both this valley and the overall Murray-Darling Basin. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates.

Summary Statement:

Relative abundance has fluctuated since the 2000s but has been trending slightly upwards since 2021 and is likely slightly lower than the overall NSW MDB. Biomass has remained relatively stable since 2020 and is considerably lower than the overall NSW MDB.

Health

The prevalence of any health issues ranged from 0 % of sampled fish in 2014/2015 to 43 % of sampled fish in 2023/2024 (Figure 4.9). The most common health issue for Golden perch in the Intersecting Streams water resource planning area was *Lernaea*, which was observed in a total of 21 fish, corresponding to 7 % of all Golden perch measured.

Across the other WRPA's, 26 % of Golden perch (2,060 out of 7,994 Golden perch) showed a health condition (excludes Intersecting Streams).

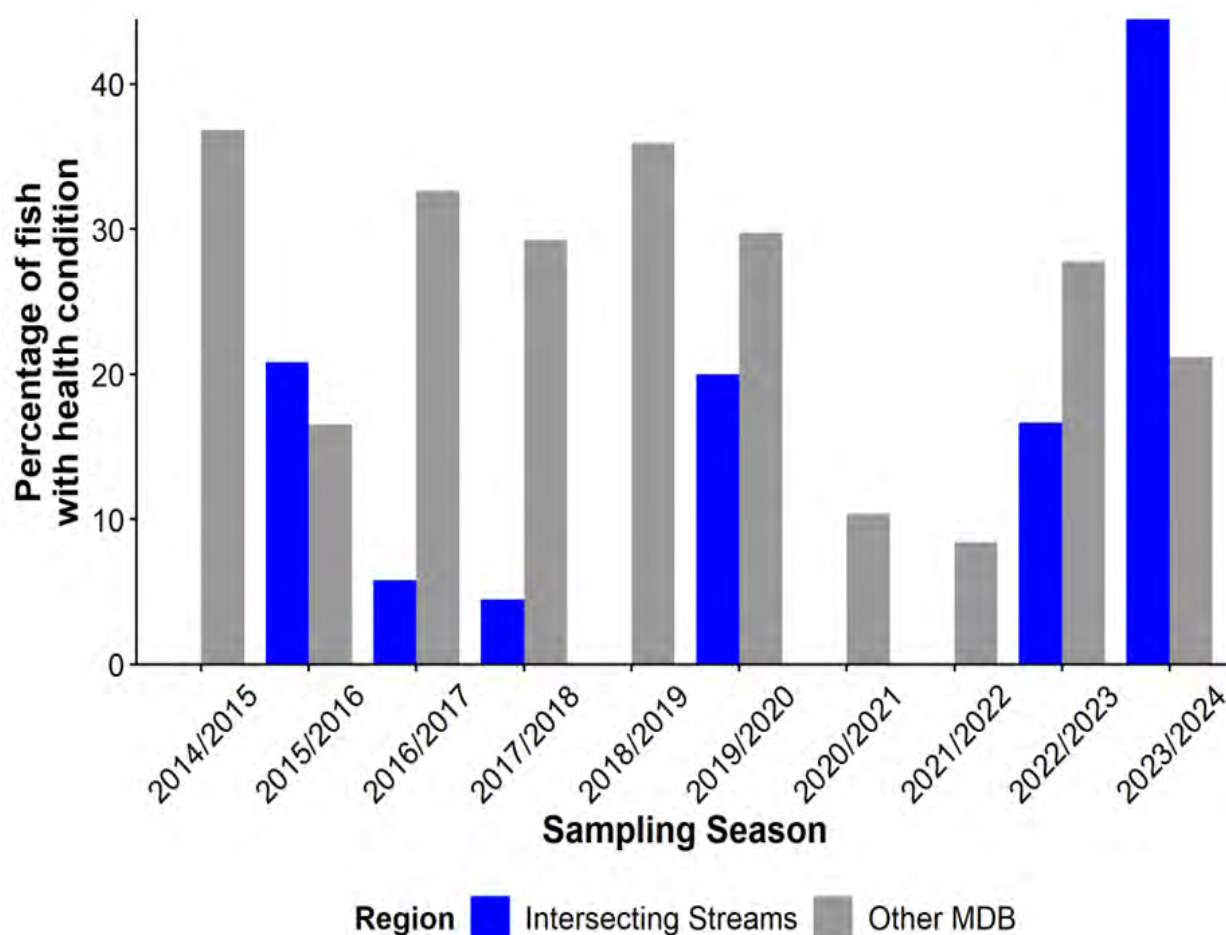


Figure 4.9: Timeseries showing the prevalence of health conditions in Golden perch. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA's.

Summary Statement:

The presence of observable health conditions for Golden perch in the Intersecting Streams was variable and ranged from low to high. While most years showed similar occurrence to the rest of the NSW MDB, no health issues were recorded in 2014/15, 2020/21 and 2021/22. 2023/24 showed a much higher proportion of recorded health conditions than the wider NSW MDB and the highest in the timeseries for the Intersecting Streams WRPA.

Distribution

Golden perch were recorded at 29 out of 37 sites in the Intersecting Streams WRPAs from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 1.2 fish caught per 90 seconds of electrofishing. Figure 4.10 shows the distribution and relative abundance of Golden perch across the Intersecting Streams WRPAs.

Summary Statement:

Golden perch were generally found in the north and western regions of the Intersecting Streams WRPAs.

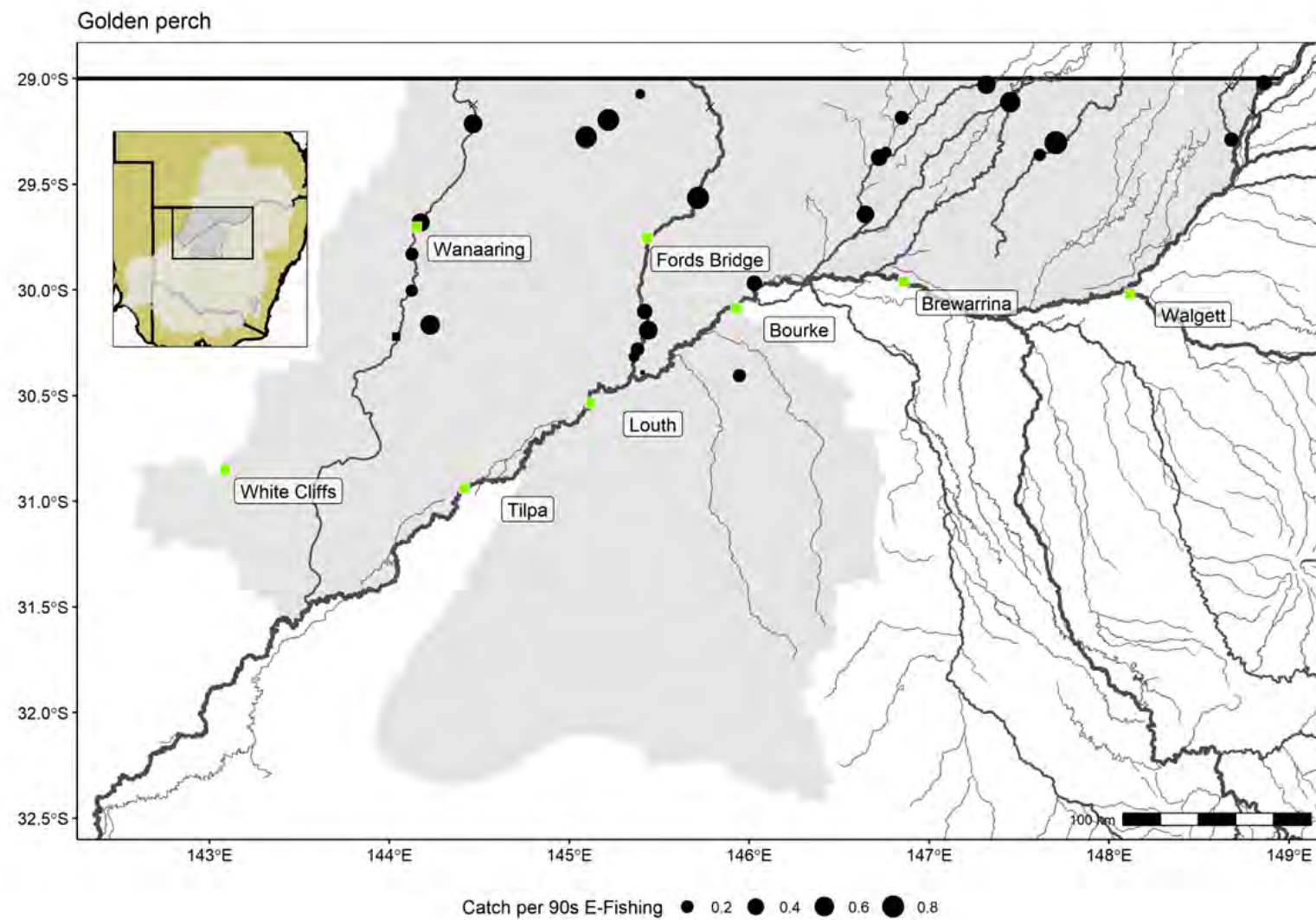


Figure 4.10: Distribution of Golden perch sampled from 2013/14 to 2023/24 in the Intersecting Streams WRPA. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares represent key towns.

Freshwater catfish



Summary Statement:

No Freshwater catfish were recorded in the Intersecting Streams WRPA suggesting they are absent or in very low abundances.

Bony herring



Population Structure

Figure 4.11 shows the observed length frequency plot for Bony herring for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 1 to 235, and 3 % to 100 % of measured fish within a season, with a mean percentage YOY of 44 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Bony herring was 24 % (12,544 out of 51,863). Bony herring are not a stocked species.

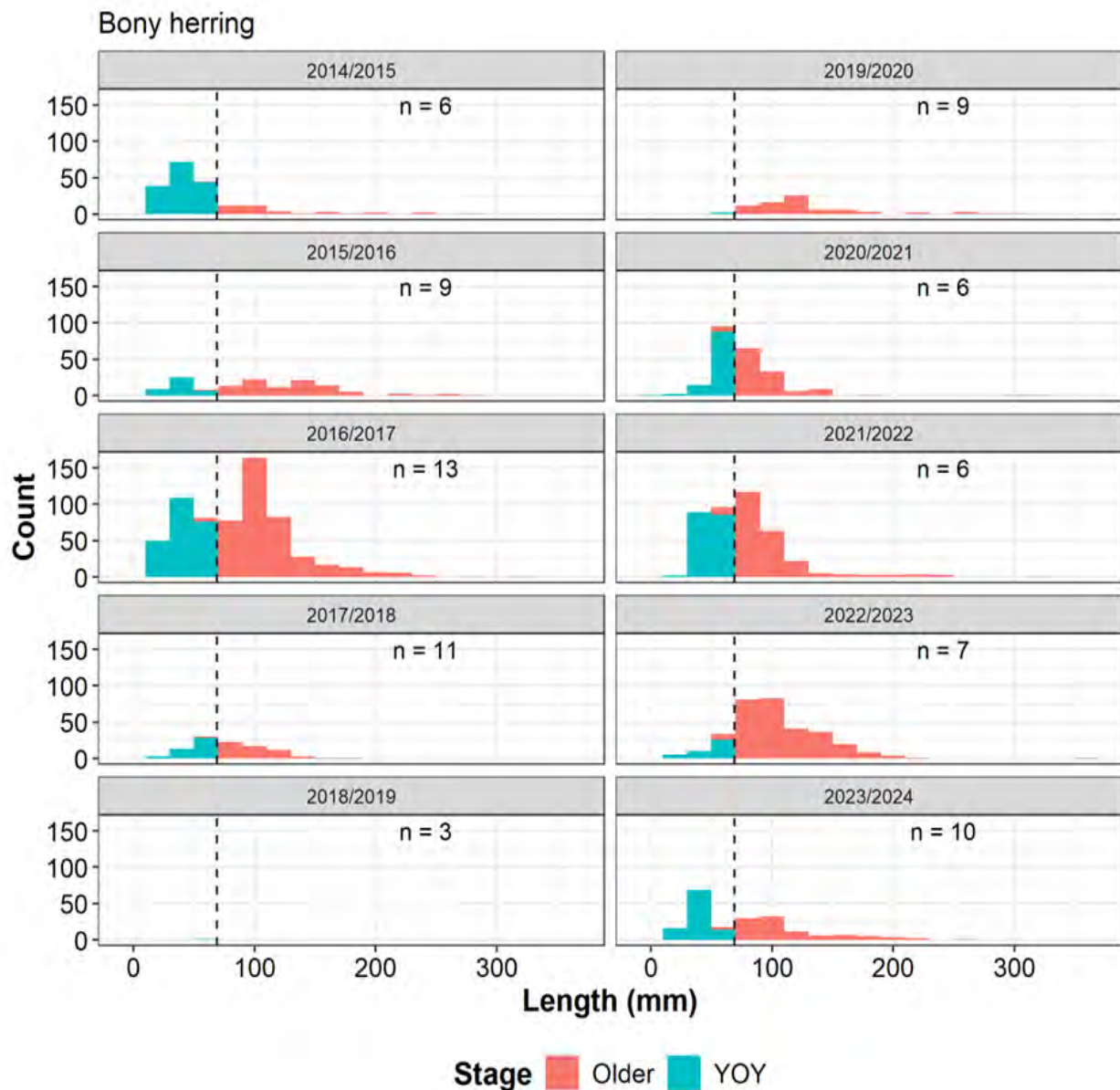


Figure 4.11: Length frequency plots for Bony herring by sampling season in the Intersecting Streams WRPA. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRPA in a sampling season.

Summary Statement:

Regular recruitment in most years except 2018/19 and 2019/20. Note that low sampling effort in some years may limit the ability to detect recruitment in this WRPA.

Temporal Trends in Abundance

The relative abundance and biomass of Bony herring since the early 2000s was modelled based on all suitable boat electrofishing data. The left-hand panels of Figure 4.12 show the abundance and biomass trends for the Intersecting Streams WRPAs and the right-hand panels show the overall trends across the NSW MDB.

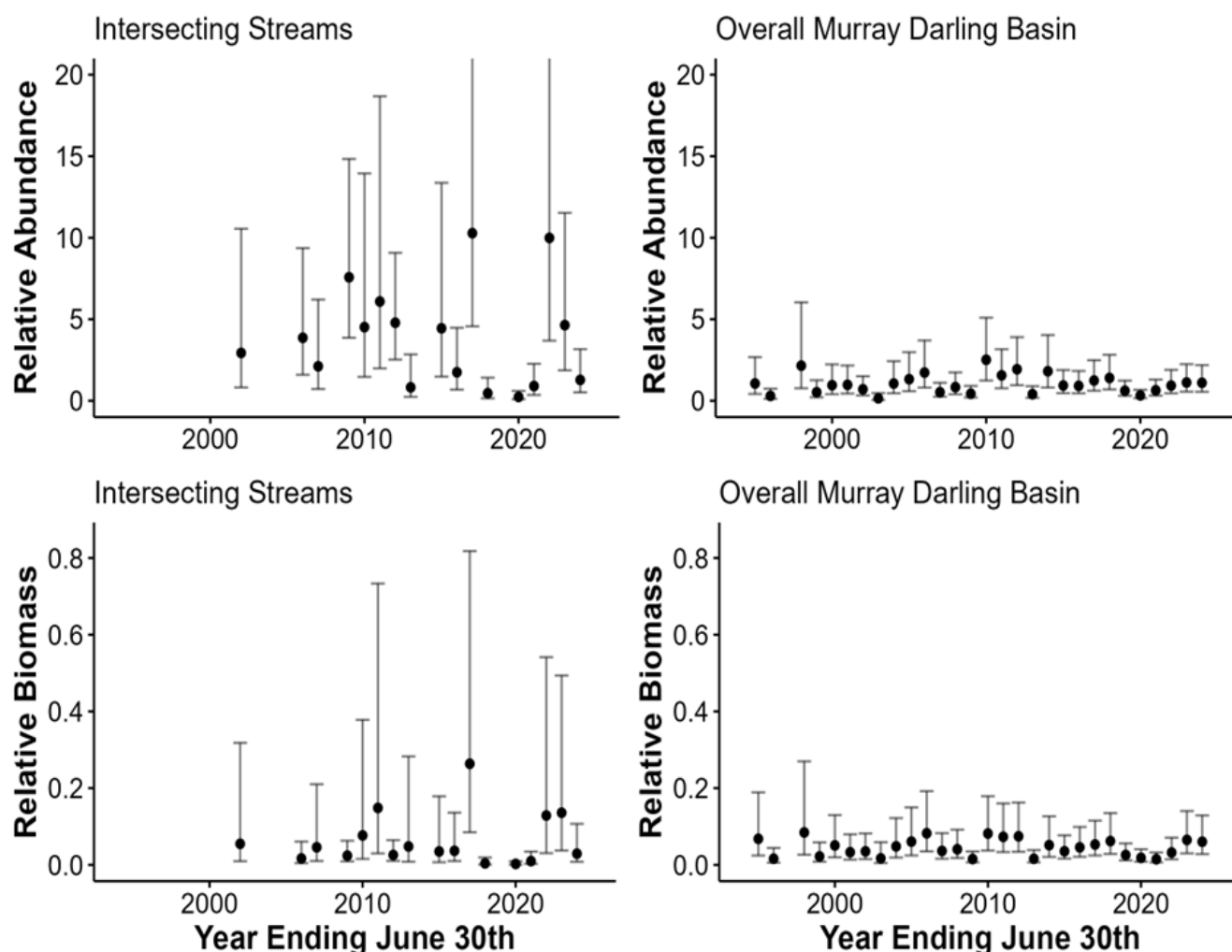


Figure 4.12: Relative abundance and biomass of Bony herring in both the Intersecting Streams WRPAs and the overall NSW MDB. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates.

Summary Statement:

Abundance and biomass both highly variable since the 2000s but both show evidence of a decline over the last 3 years. Abundance and biomass in 2023/24 comparable to the overall NSW MDB.

Health

The prevalence of any health issues ranged from 0 % of sampled fish in 2015/2016 to 8 % of sampled fish in 2023/2024 (Figure 4.13). The most common health issue for Bony herring in the Intersecting Streams WRPAs was Fungus, which was observed in a total of 33 fish, corresponding to 1 % of all Bony herring measured.

Across the other NSW MDB WRPAs, 0.98 % of Bony herring (508 out of 51,864 Bony herring) showed a health condition (excludes the Intersecting Streams WRPAs).

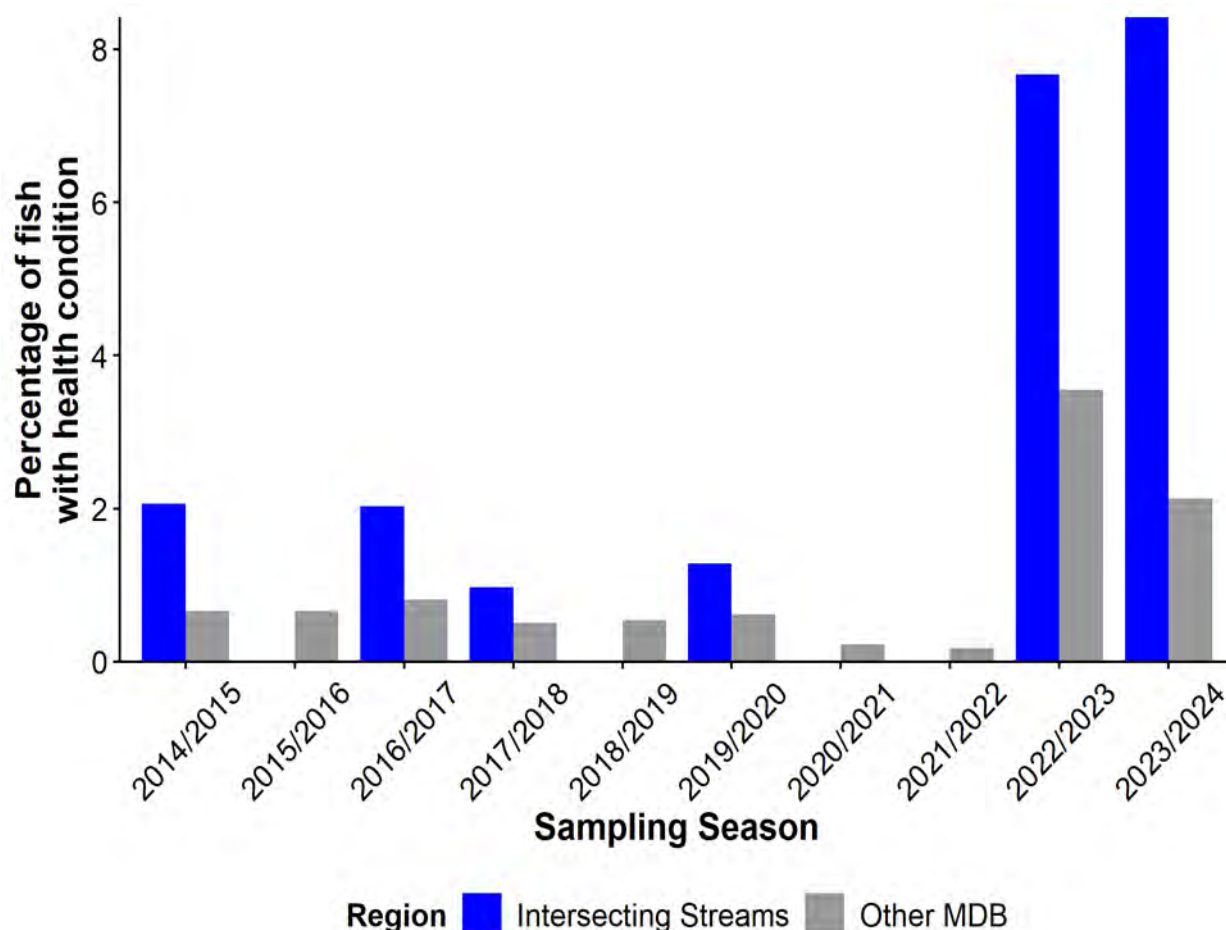


Figure 4.13: Timeseries showing the prevalence of health conditions in Bony herring. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPAs.

Summary Statement:

Presence of observable health conditions was low in all years but 2022/23 and 2023/24 showed a higher level of observed health conditions than other years.

Distribution

Bony herring were recorded at 27 out of 37 sites in the Intersecting Streams WRPA from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 42 fish caught per 90 seconds of electrofishing. Figure 4.14 shows the distribution and relative abundance of Bony herring across the Intersecting Streams WRPA.

Summary Statement:

Bony herring were recorded across the Intersecting Streams WRPA.

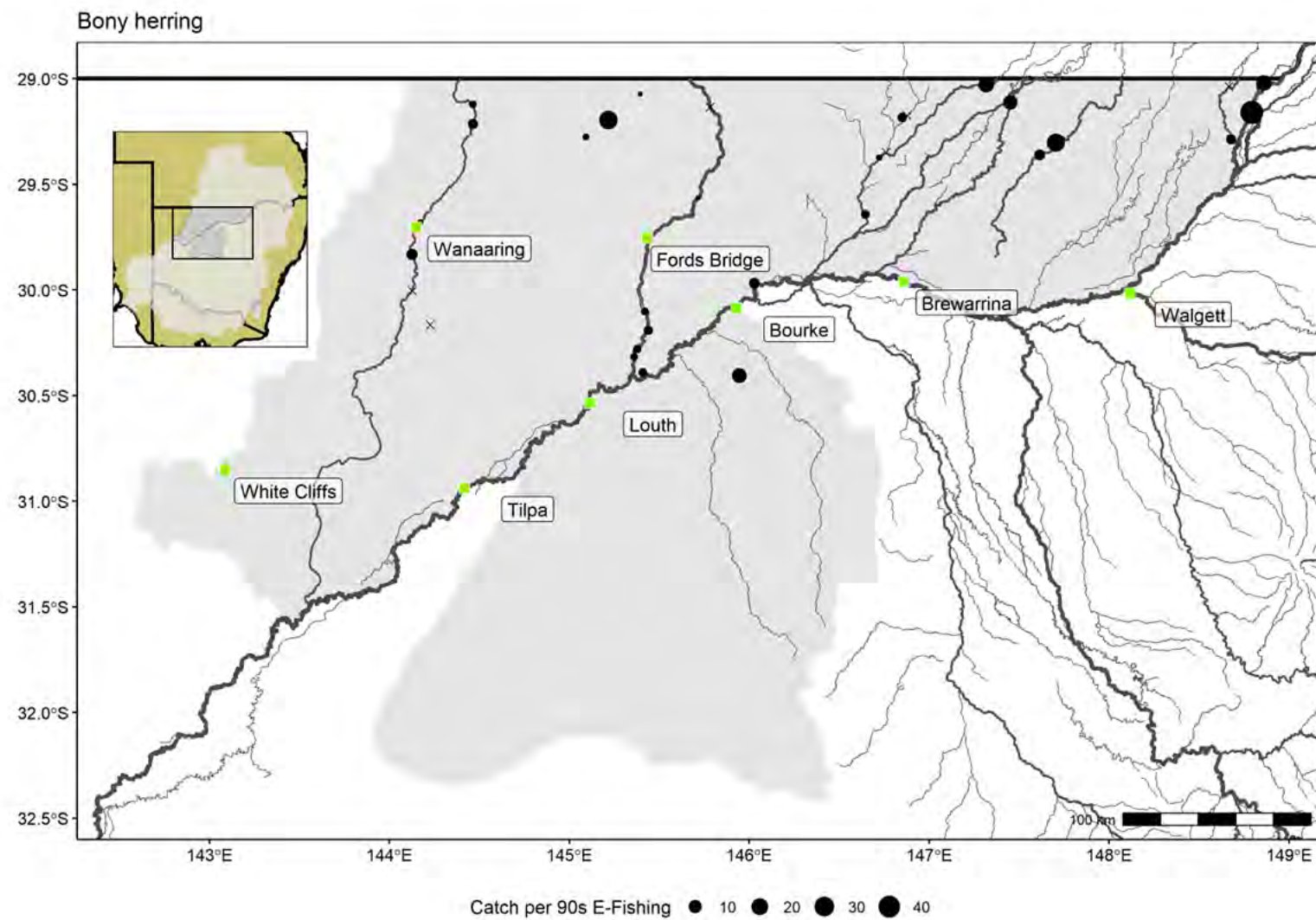


Figure 4.14: Distribution of Bony herring sampled from 2013/14 to 2023/24 in the Intersecting Streams WRP. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares represent key towns.

Australian smelt



Summary Statement:

Only 3 Australian smelt were captured in the Intersecting Streams WRPA during the reporting period (2 in 2016/17 and 1 in 2022; all 3 individuals being Young of the Year). This suggests Australian smelt are in very low abundances across this region. No health issues were observed in these three individuals.

Common carp



Population Structure

Figure 4.15 shows the observed length frequency plot for Common carp for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 17 to 310, and 49 % to 97 % of measured fish within a season, with a mean percentage YOY of 81 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Common carp was 54 % (34,027 out of 62,801). Common carp are not a stocked species.

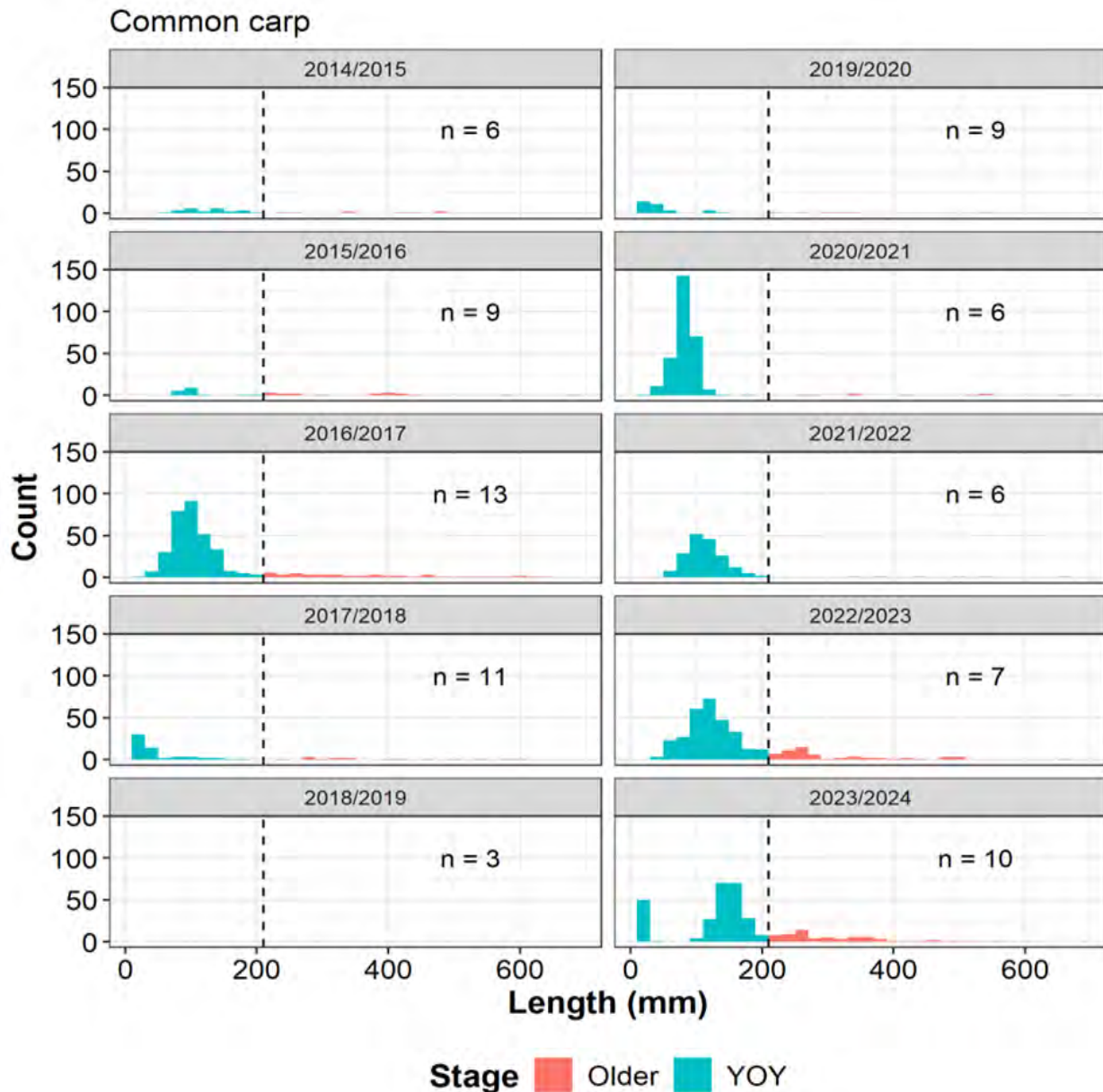


Figure 4.15: Length frequency plots for common carp by sampling season in the Intersecting Streams WRPA. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRPA in a sampling season.

Summary Statement:

Variable recruitment with very strong peaks in 2016/17, 2021/22, 2022/23 and 2023/24. Large fish (>500 mm) present in low abundance in most years compared to other WRPAs. Note low sampling effort in some years.

Temporal Trends in Abundance

The relative abundance and biomass of Common carp since the early 2000s was modelled based on all suitable boat electrofishing data. The left-hand panels of Figure 4.16 show the abundance and biomass trends for the Intersecting Streams WRP and the right-hand panels show the overall trends across the NSW MDB.

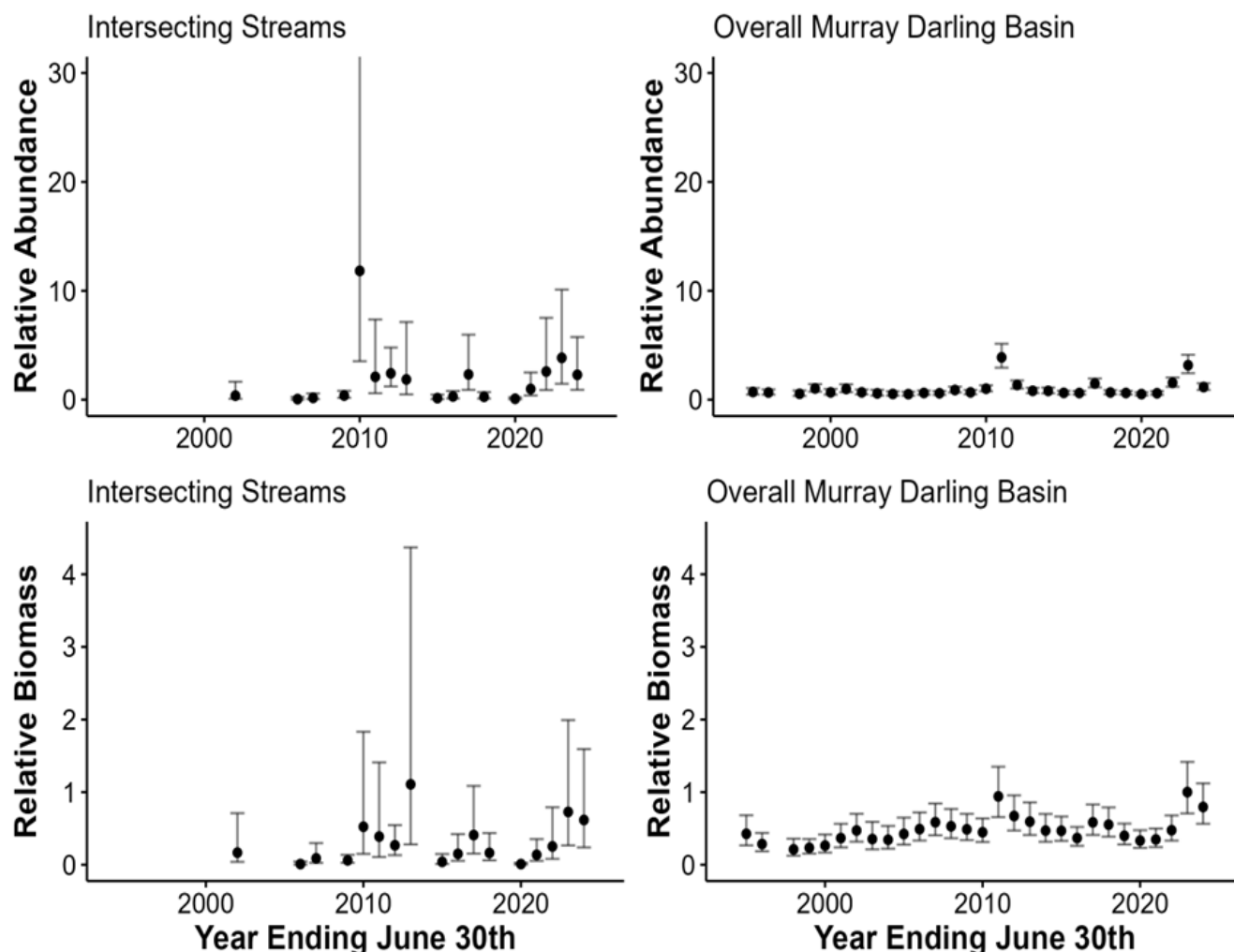


Figure 4.16: Relative abundance and biomass of Common carp in both this valley and the overall Murray-Darling Basin. These are model estimates based upon all electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates.

Summary Statement:

Abundance and biomass show evidence of an increase from the early 2000s and are comparable to the wider NSW MDB. Both abundance and biomass appear to have increased since 2020 when both were at very low levels.

Health

The prevalence of any health issues ranged from 0 % of sampled fish in 2015/2016 to 13 % of sampled fish in 2023/2024 (Figure 4.17). The most common health issue for Common carp in the Intersecting Streams water resource planning area was Lesions, which was observed in a total of 45 fish, corresponding to 3 % of all Common carp measured.

Across the other WRPA's, 4 % of Common carp (2,353 out of 62,803 Common carp) showed a health condition (excludes Intersecting Streams).

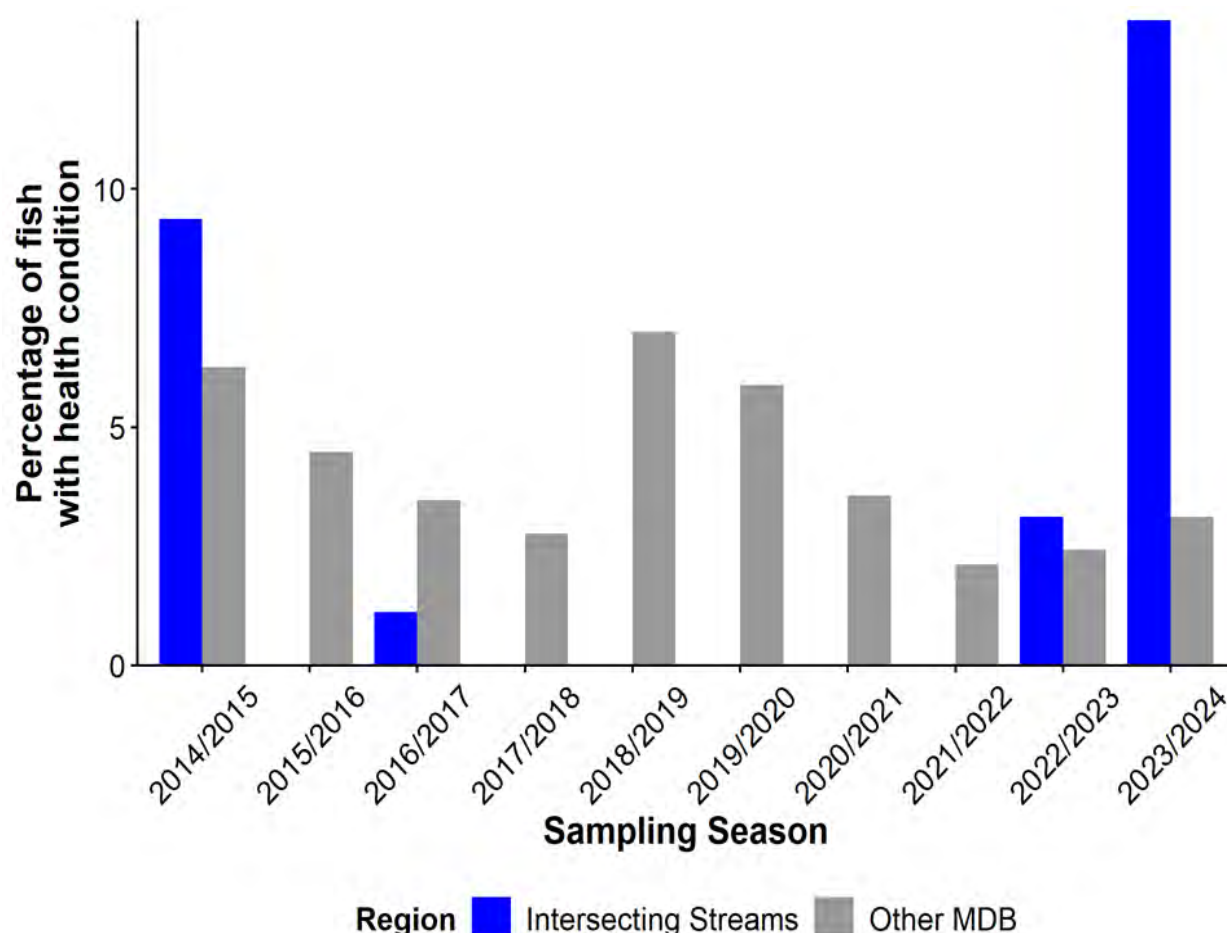


Figure 4.17: Timeseries showing the prevalence of health conditions in Common carp. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA's.

Summary Statement:

The presence of observable health conditions for Common carp in the Intersecting Streams was low with small increases over time. The overall Murray-Darling Basin had higher rates of health conditions compared to the Intersecting Streams.

Distribution

Common carp were recorded at 26 out of 37 sites in the Intersecting Streams WRPA from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 15 fish caught per 90 seconds of electrofishing. Figure 4.18 shows the distribution and relative abundance of Common carp across the Intersecting Streams WRPA.

Summary Statement:

Common carp were found across the Intersecting Streams region.

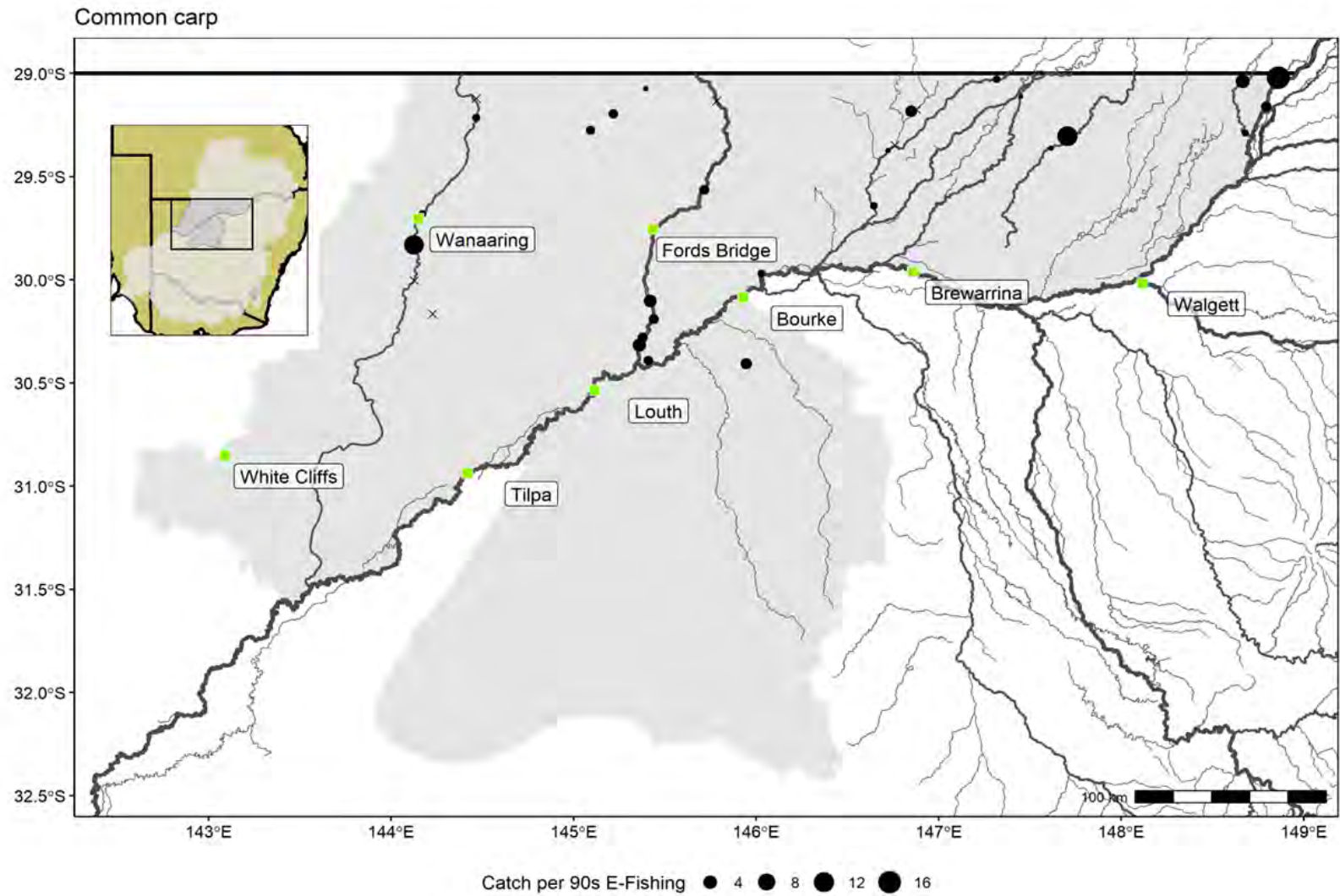


Figure 4.18: Distribution of Common carp sampled from 2013/14 to 2023/24 in the Intersecting Streams WRPA. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares represent key towns.

Threatened Species

The following table (Table 4.4) shows the fish species listed under either the *NSW Fisheries Management Act 1994* (FMA) or the *Commonwealth Environmental Protection and Biodiversity Conservation Act 1999* (EPBC) which were observed during standardised electrofishing surveys in the Intersecting Streams Water Resource Planning Area during the reporting period. A list of all threatened fish species observed by NSW DPIRD Fisheries (as part of any sampling program in any area) is provided in Table 4.8.

Table 4.4: Listed species which were observed in this region during the sampling period. (* = FMA, # = EPBC)

Species	Common name	Total caught (observed)
<i>Ambassis agassizii</i>	Olive perchlet*	25 (1)

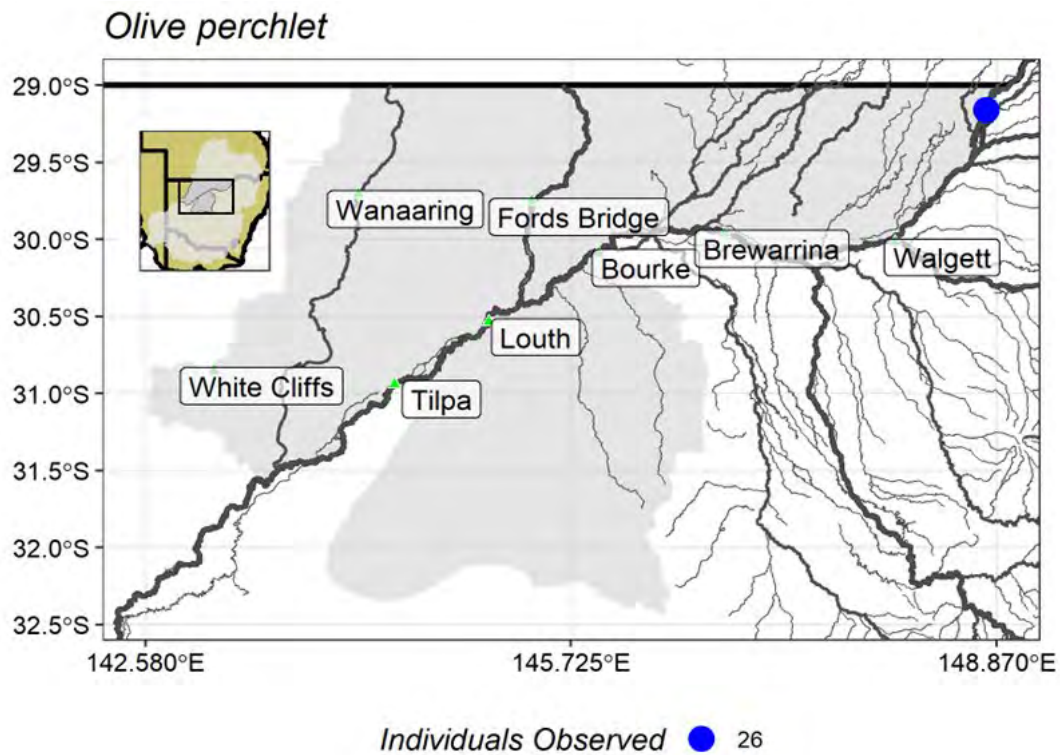


Figure 4.19: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the Intersecting Streams WRPA. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance.

Summary Statement:

25 Olive perchlet were caught and one was observed at Cubberoo Lagoon in 2016/17. This site has not been sampled since.

Appendix

This report contains data from the projects listed in Table 4.5.

Table 4.5: Projects included in this report. Sampling Events show the total number of sampling events included from each project. Sampling Seasons shows which sampling seasons each project contributed data to.

Project Name	Sampling Seasons	Sampling Events
Basin Plan Environmental Outcomes Monitoring	2014/2015, 2015/2016, 2016/2017, 2017/2018, 2018/2019, 2019/2020	33
Basin Plan Environmental Outcomes Monitoring 2	2022/2023, 2023/2024	8
Monitoring, Evaluating and Reporting - Inland	2014/2015	3
Murray-Darling Basin Fish Surveys	2014/2015	2
Toorale Long Term Intervention Monitoring	2015/2016, 2016/2017, 2017/2018, 2019/2020, 2020/2021, 2021/2022, 2022/2023, 2023/2024	61

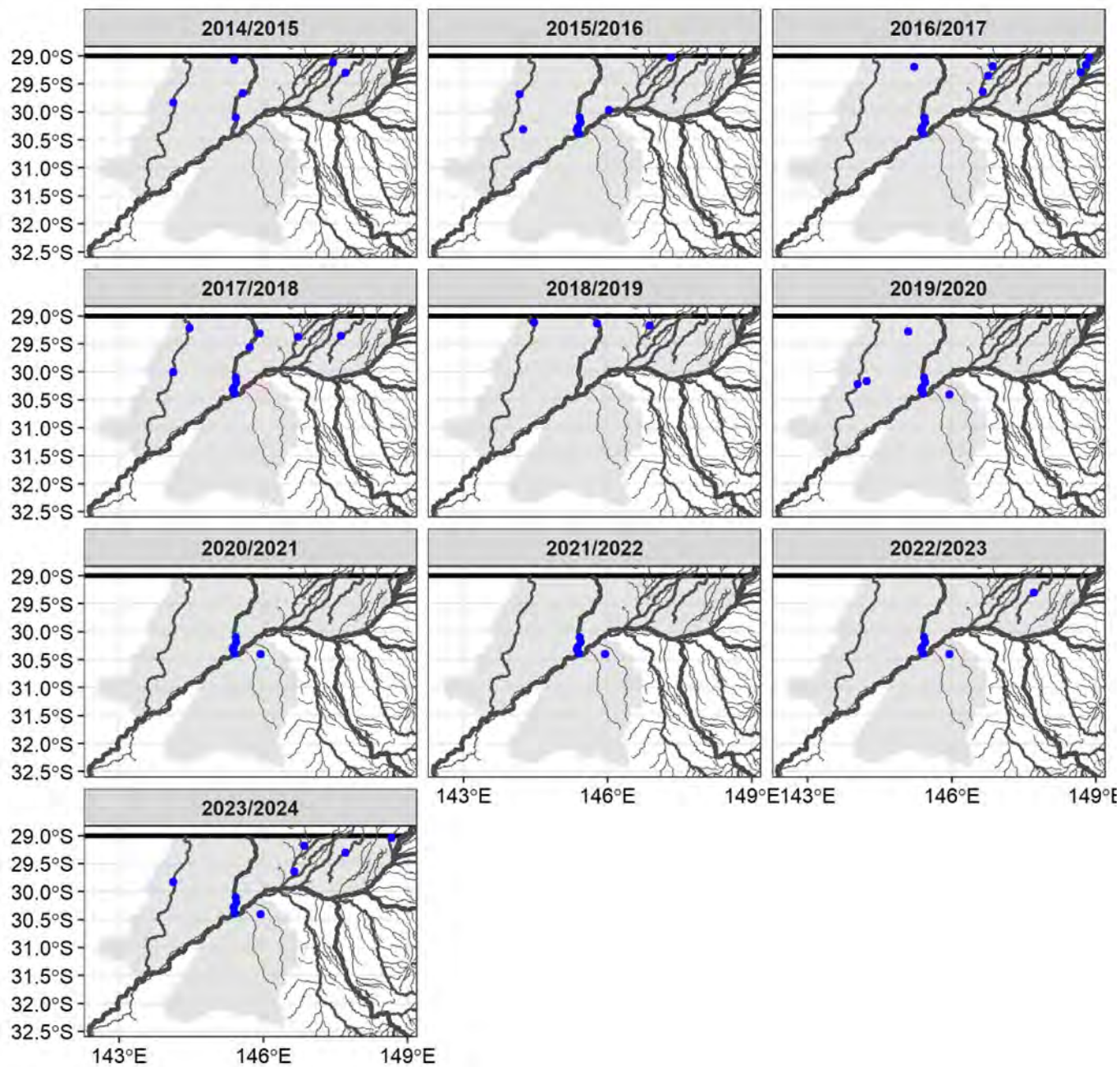


Figure 4.20: Sites sampled and included in this report by sampling season in the Intersecting Streams WRP. Dry sites are not shown.

Table 4.6 shows all species detected during this survey period as part of standardised monitoring projects (see Table 4.5). Note there are variations in effort between sampling seasons so this information should be considered in conjunction with Table 4.1. The Expected from Modelling column identifies species which are possible to occur based upon MaxENT habitat modelling (likelihood threshold > 0.33; NA represents no modelling was undertaken). Species that were possible from the modelling but not observed during standardised sampling in the Intersecting Streams WSPA were: Silver perch, Murray hardyhead, Unspecked hardyhead, Murray cod, Southern purple-spotted gudgeon, Freshwater catfish, Redfin. It should be noted that the MaxENT modelling models habitat availability and is not always a reliable index of abundance, it merely indicates possible distribution based upon habitat. A full list of species observed during this period across the standardised monitoring protocols and sampling methods is presented in Table 4.9.

Table 4.6: Total number caught of each species by sampling season in the Intersecting Streams WSPA.

Common name	Expected from modelling	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24
Australian smelt	YES	0	0	2	0	0	0	0	0	1	0
Bony herring	YES	676	275	1,827	103	1	78	392	648	467	442
Carp-gudgeon species complex	YES	9	6	2	0	0	37	5	1	0	0
Common carp	NA	32	35	465	74	0	38	383	186	725	515
Desert rainbowfish	NA	0	0	0	0	0	0	0	0	5	0
Eastern gambusia	NA	2	11	120	10	1	1	24	14	7	2
Golden perch	YES	13	23	69	67	0	35	25	3	41	23
Goldfish	NA	2	2	199	7	1	3	3	3	29	20
Hyrtl's catfish	YES	1	6	24	2	0	0	0	0	1	4
Murray-Darling rainbowfish	YES	0	5	24	3	0	0	2	2	0	1
Olive perchlet	YES	0	0	25	0	0	0	0	0	0	0
Spangled perch	YES	26	15	183	23	0	3	18	84	60	30

The following table summarises the sampling methods for each species caught (Table 4.7).

Table 4.7: Total catch of each species by sampling method in the Intersecting Streams WRP.

Common name	Backpack Electrofishing	Bait Trap	Boat Electrofishing
Australian smelt	0	0	3
Bony herring	60	8	4,841
Carp-gudgeon species complex	9	47	4
Common carp	141	107	2,205
Desert rainbowfish	0	0	5
Eastern gambusia	16	1	175
Golden perch	25	23	251
Goldfish	3	3	263
Hyrtil's catfish	7	14	17
Murray-Darling rainbowfish	5	0	32
Olive perchlet	0	2	23
Spangled perch	38	120	284

Table 4.8: Listed threatened species recorded in the Murray-Darling Basin (from the NSW DPIRD Fisheries Freshwater Ecosystem research database). Species are listed under either the NSW Fisheries Management Act 1994 (FMA) or the Commonwealth Environmental Protection and Biodiversity Conservation Act 1999 (EPBC).

Genus, species	Common Name	EPBC Status	FMA Status
<i>Ambassis agassizii</i>	Agassiz's glassfish, olive perchlet, western New South Wales population	NA	Endangered Population
<i>Bidyanus bidyanus</i>	Silver Perch, Bidyan	Endangered	Vulnerable
<i>Craterocephalus fluviatilis</i>	Murray Hardyhead	Endangered	Critically Endangered
<i>Galaxias rostratus</i>	Flathead Galaxias, Beaked Minnow, Flat-headed Galaxias, Flat-headed Jollytail, Flat-headed Minnow	Critically Endangered	Critically Endangered
<i>Galaxias tantangara</i>	Stocky Galaxias	NA	Critically Endangered
<i>Maccullochella macquariensis</i>	Trout Cod	Endangered	Endangered
<i>Maccullochella peelii</i>	Murray Cod	Vulnerable	NA
<i>Macquaria australasica</i>	Macquarie Perch	Endangered	Endangered
<i>Mogurnda adspersa</i>	Southern Purple Spotted Gudgeon	NA	Endangered
<i>Nannoperca australis</i>	Southern Pygmy Perch	Vulnerable	Endangered
<i>Tandanus tandanus</i>	Freshwater catfish, eel tailed catfish, Murray-Darling Basin population	NA	Endangered Population

Table 4.9 shows all species detected during this survey period across all programs and methods. Due to variations in project methods protocols, this data is presented only to give a complete list of species observed in the region. The Expected from Modelling column identifies species which are possible to occur based upon MaxENT habitat modelling (likelihood threshold > 0.33; NA represents no modelling was undertaken). Species that were possible from the modelling but not observed during standardised sampling in the Intersecting Streams WSPA were: Silver perch, Murray hardyhead, Unspecked hardyhead, Murray cod, Southern purple-spotted gudgeon, Freshwater catfish, Redfin. It should be noted that the MaxENT modelling actually models habitat availability and is not always a reliable index of abundance, it merely indicates possible distribution based upon habitat. A list of species caught as part of standardised monitoring during this period is in Table 4.6.

Table 4.9: Total catch of each species by all sampling programs and all methods in the Intersecting Streams WSPA. Note these include projects with sampling not representative of the community and the data should be used with caution.

Common name	Expected from modelling	2014/ 15	2015/ 16	2016/ 17	2017/ 18	2018/ 19	2019/ 20	2020/ 21	2021/ 22	2022/ 23	2023/ 24
Australian smelt	YES	0	0	16	0	0	29	0	0	1	0
Bony herring	YES	676	292	2,726	122	1	130	532	830	539	455
Carp gudgeon species complex	YES	9	59	12	0	0	1,518	22	1	0	3
Common carp	NA	32	50	803	503	0	660	1,039	2,814	5,960	809
Desert rainbowfish	NA	0	0	0	0	0	0	0	0	5	1
Eastern gambusia	NA	2	12	447	29	1	13	42	17	9	3
Golden perch	YES	13	54	131	359	0	1,067	95	81	75	44
Goldfish	NA	2	4	402	7	1	13	133	18	147	58
Hyrtl's catfish	YES	1	171	892	5	0	4	3	370	991	583
Murray-Darling rainbowfish	YES	0	5	86	4	0	0	3	3	1	1
Olive perchlet	YES	0	0	25	0	0	0	0	0	0	0
Spangled perch	YES	26	262	857	40	0	22	574	3,392	2,931	176

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Chapter 5 Basin Plan Fish Monitoring Summary (2014/15 – 2023/24): Lachlan Water Resource Planning Area

Hayden Schilling & David Crook

March 2025



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Chapter cover image credit: Jason Thiem (NSW DPIRD); Fish images credit: Gunther Schmida

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Introduction

This report spans 2014/15 to 2023/24 and uses all suitable fish assemblage data collected by NSW DPIRD Fisheries using standardized electrofishing monitoring techniques. The format of the report follows and expands upon the previous reports (Schilling & Crook 2023, 2024). This report focusses on the Lachlan Water Resource Planning Area (WRPA) shown in Figure 5.1.

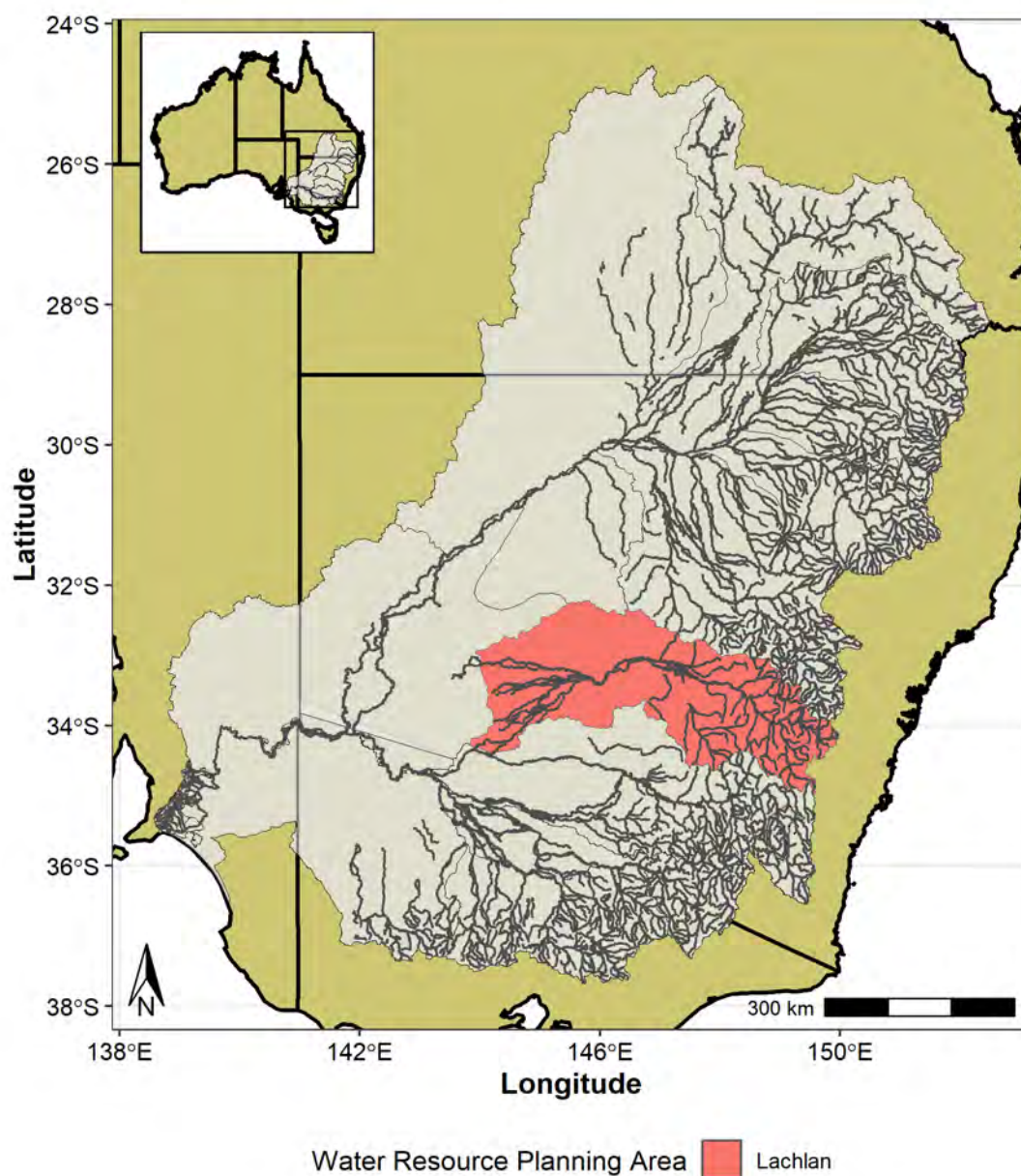


Figure 5.1: Murray-Darling Basin with the key region of this report highlighted. Inset map shows the whole of Australia with a box around the MDB.

What This Report Includes

This report starts with an overview of the standardised monitoring programs including sampling details and statistics. An overview of the hydrological and climatic conditions during the reporting period is also provided as context for interpreting the fish population status data.

Following the introductory sections, we present a summary of *fish diversity* across the Lachlan WRPA. Separate plots for native and alien species show the total number of unique species observed at each site.

The main body of the report provides detailed information on the *population structure, relative abundance, health, and distribution* of six key fish species:

- Murray cod
- Golden perch
- Freshwater catfish (very few were caught in this WRPA during the reporting period)
- Bony herring
- Australian smelt
- Common carp

Population structure information includes length frequency plots of collected fish and the proportion of fish classified as Young of the Year (YOY). This information can be used to infer the size structure of populations and the level of recruitment each year. For additional context, we provide a summary table showing any stocking which occurred for the species in each year (if relevant).

Relative abundance and *relative biomass* (a unit-less measure representing the number (or biomass) of fish in an area) information is adapted from the modelled outputs from a more in-depth publication (Crook et al. 2023) which considers all available electrofishing data within the NSW Murray-Darling Basin (MDB). The updated analysis uses generalised linear mixed models to generate annual indices of relative abundance and biomass for each WRPA. In this report we present the modelled time series of relative abundance showing the predicted number (or biomass) of fish observed per 90 second shot of electrofishing. The abundance and biomass trends for the Lachlan WRPA are contrasted with the overall NSW MDB dataset. It should be noted that these are modelled estimates of relative abundance/biomass, not absolute abundance/biomass as absolute estimates would require extensive calibration surveys that are not included in the monitoring program.

Health information is provided as a summary of any visible health conditions recorded for the key species. The number of health conditions observed in a fish population is generally reflective of water quality, competition, and many other factors. Fewer observations of health conditions indicate healthier populations. The health conditions detailed are any that were observed as part of the biological measurements taken. We provide a comparison of the prevalence of health conditions in the Lachlan WRPA and greater MDB (excluding the Lachlan WRPA).

Distribution maps are provided for each species to show the observed distribution of each species from electrofishing samples. The distribution maps also show the relative abundance (number of fish observed per 90 seconds of electrofishing) at each site to give an indication of how the population is spread over the landscape.

Finally, the distributions and numbers of *Threatened species* are reported. The report includes threatened species that were recorded by standardised monitoring programs in the Lachlan WRPA during the reporting period.

For each section of the report, we provide a *Summary Statement*. This statement provides a very brief overview of the key messages for each section.

Sampling Methods

Three main methods are used during routine fish monitoring surveys: boat electrofishing, backpack electrofishing and bait traps. This report mainly includes the electrofishing data with bait trap samples informing the distribution of small bodied species. The electrofishing was conducted using the standard methodology implemented in the Sustainable Rivers Audit (SRA; Davies et al. 2010). This usually includes 12 shots of 90 seconds “power on” during each sampling event.

As parts of this report compile data from multiple projects, there is some variation in how sites were chosen and the effort of sampling conducted each year (Table 5.1). Details of which projects contributed data to this report can be seen in Table 5.7. At each site, sampling gear was applied as suited to the local conditions with either boat, backpack, or a hybrid of the two, in addition to 10 unbaited bait traps set in edge margins. Most sampling occurred between the months of September and May.

Table 5.1: Sampling effort (Number of sites sampled) each sampling season in the Lachlan WRPA. Variation in sampling effort is due to different numbers of projects and interruptions to planned sampling such as flooding, site desiccation, and extreme weather.

Sampling Season	Number of Boat Electrofishing Sites	Number of Backpack Electrofishing Sites	Number of Hybrid Sites	Total
2014/2015	21	18	1	40
2015/2016	25	11	0	36
2016/2017	26	18	0	44
2017/2018	25	21	1	47
2018/2019	24	18	2	44
2019/2020	29	15	0	44
2020/2021	20	9	1	30
2021/2022	14	1	0	15
2022/2023	17	3	1	21
2023/2024	19	5	0	24

The sites sampled during the reporting period are shown in Figure 5.2. A breakdown of sites sampled each sampling season is shown in the Appendix (Figure 5.33).

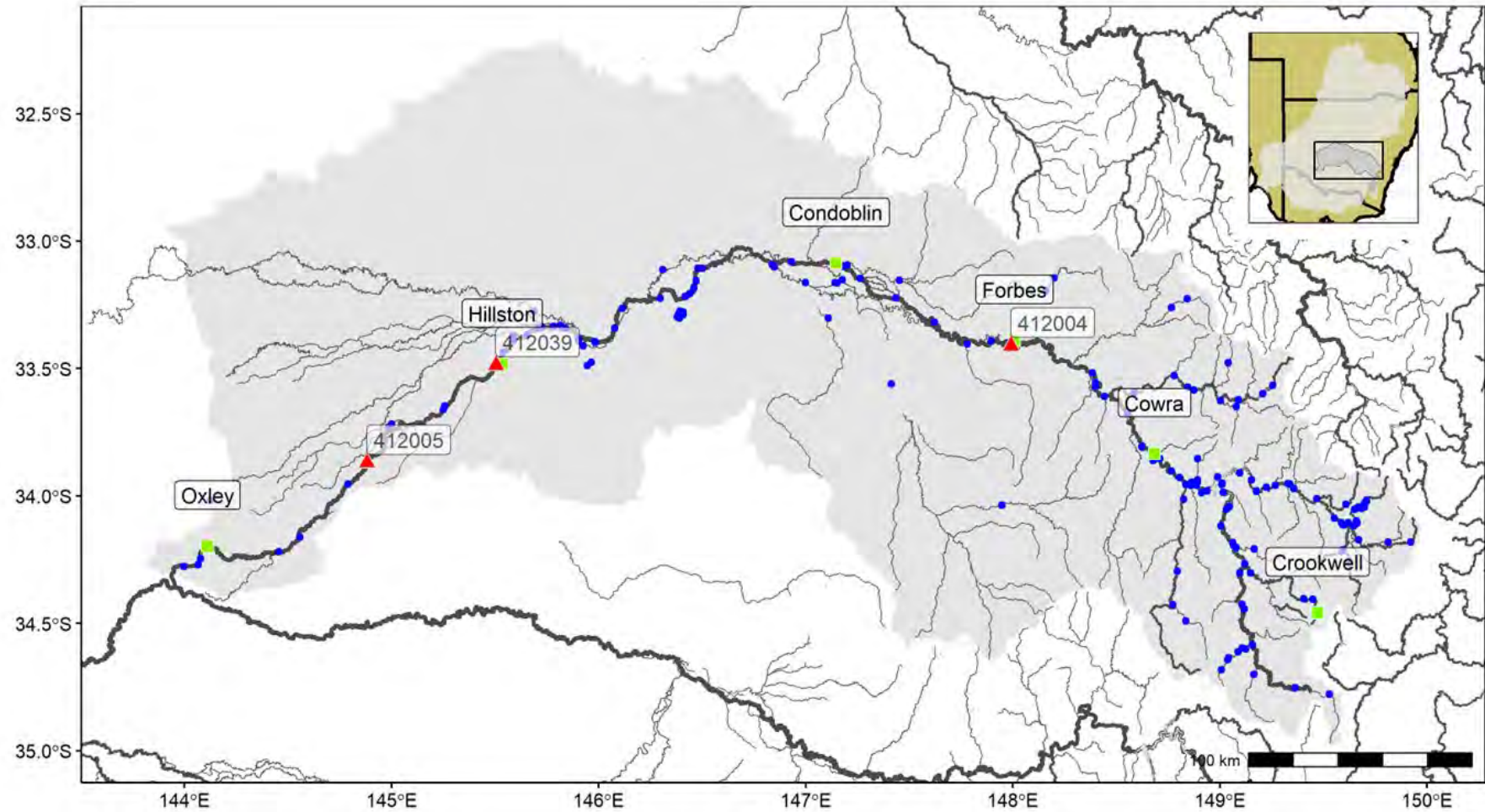


Figure 5.2: Sites (blue dots) sampled during the reporting period in the Lachlan WRPA. Red triangles show key flow gauges along with their gauge ID number. Green squares show key towns. The grey shaded area represents the water resource planning area.

Each sampling method has a different effectiveness at sampling each species. Table 5.2 shows the total numbers of each key species caught by each method.

Table 5.2: Number of each key species caught by sample method over the whole program in the Lachlan WRP. Further data on total catch is provided in the Appendix.

Common name	Boat Electrofishing	Backpack Electrofishing	Bait Trap
Australian smelt	1,872	108	1
Bony herring	21,036	30	3
Common carp	15,933	687	990
Freshwater catfish	3	0	0
Golden perch	1,057	0	0
Murray cod	1,032	16	0

A subset of sampled fish had biological measurements taken during the surveys, including but not limited to length and weight measurements and visual health assessments. Table 5.3 shows the number of biological measurements taken each year for the six key species.

Table 5.3: Number of biological measurements taken for the key species each sampling season in the Lachlan WRP.

Sampling Season	Australian smelt	Bony herring	Common carp	Freshwater catfish	Golden perch	Murray cod
2014/2015	95	1,648	415	1	186	198
2015/2016	67	2,466	591	0	129	123
2016/2017	170	2,264	1,931	0	94	37
2017/2018	249	3,877	591	0	98	38
2018/2019	38	2,171	489	1	131	56
2019/2020	34	353	474	0	154	151
2020/2021	94	684	729	0	141	248
2021/2022	381	790	810	0	26	50
2022/2023	123	571	1,038	0	68	78
2023/2024	32	1,034	876	1	43	76

Climate Overview

The following is a summary of the climatic conditions during the reporting period in terms of how the observed conditions compare to long term records. These are direct extracts from the [Australian Bureau of Meteorology climate summaries archive](#) and are written in the given year. To interpret, 2014 states it was the warmest year on record, meaning 2014 was the warmest year on record up to and including 2014 but not including more recent years.

2014

New South Wales experienced its warmest year on record in 2014, with several heatwaves and persistently warm conditions across the State. Rainfall was well below average in the northeast, and close to average elsewhere.

2015

New South Wales recorded well above average temperatures in 2015. Nights were particularly warm, the sixth-warmest on record for the State. Rainfall was close to average for the state as a whole.

2016

2016 was a generally wet, warm year for NSW as a whole, with substantial variability throughout the year and across the state. Following a record-warm start to the year, May to September was the wettest such period on record for NSW, with cooler weather in much of the west of the state. Minimum temperatures were the warmest on record for the State as a whole, with record-warm daytime temperatures on parts of the east coast.

2017

The year 2017 was the warmest on record for New South Wales for both mean and daytime temperatures. It was also the State's driest year since 2006. Following the warmest summer on record for the State, heavy rain in March across the east then made way for a very dry winter and start to spring. Winter overnight temperatures were the lowest since 1997, but daytime temperatures remained above average for most of the year, and were the warmest on record overall.

2018

2018 was the warmest on record for New South Wales for both mean temperature and mean maximum temperature, whilst the mean minimum temperature was fourth-warmest on record. The year was dominated by very dry conditions, with the third-driest January to September on record. October to December saw some relief from the dry, with above average rainfall across parts of the State. Despite this, New South Wales experienced its sixth-lowest annual rainfall on record; its driest year since 2002.

2019

2019 was the driest and warmest year on record for New South Wales. Despite some rain in some months, most of the State received much less rainfall than usual, with the northeast and far west particularly dry. Heatwaves in January brought very high temperatures, and large fires from September onward caused extensive damage and persistent smoke.

2020

2020 saw above average temperature and rainfall in New South Wales. Temperatures were above average across the state in most months except during autumn. There was widespread rain during autumn and spring and in December, but early winter and November rain was below average.

2021

New South Wales had its 6th wettest year on record, with 2021 rainfall 30 % above average. This included significant floods along the east coast in March, and the state's wettest November on record. It was the state's coolest year since 1996, at 0.15 °C above the 1961–1990 average.

2022

2022 was exceptionally wet with the state-averaged annual total being the second-highest on record (since 1900) and many sites recording their highest annual totals on record. Maximum temperatures were lower than average with the state-averaged annual maximum temperature being the coolest since 1992. Minimum temperatures were generally warmer than average with the state-averaged annual minimum temperature being 0.73 °C above the 1961–1990 average.

2023

The state-averaged rainfall was 22.9 % below the 1961–1990 average. Rainfall was above average over small parts of the state's south, west of the Great Dividing Range, while being below average over most of the northern half of the state, especially over parts of the Northern Tablelands, Northern Rivers, Mid-North Coast, and Upper Hunter, where annual rainfall was in the lowest 10 % of historical records (since records began in 1900). State-averaged annual maximum temperature was 1.96 °C above the 1961–1990 average, which is the third highest on record.

2024

Rainfall totals in 2024 were above average to very much above average for the northern and western areas of the state, as well as central parts of the coast. Totals were below average for large parts of the south-east, as well as small parts of the state's north-east and south-west. 2024 was the third-warmest on record for all years since 1910, 1.55 °C above the 1961–1990 average.

Flow Data

Below shows a summary of flow data from a variety of flow gauges in the Lachlan WRP (Figure 5.3).

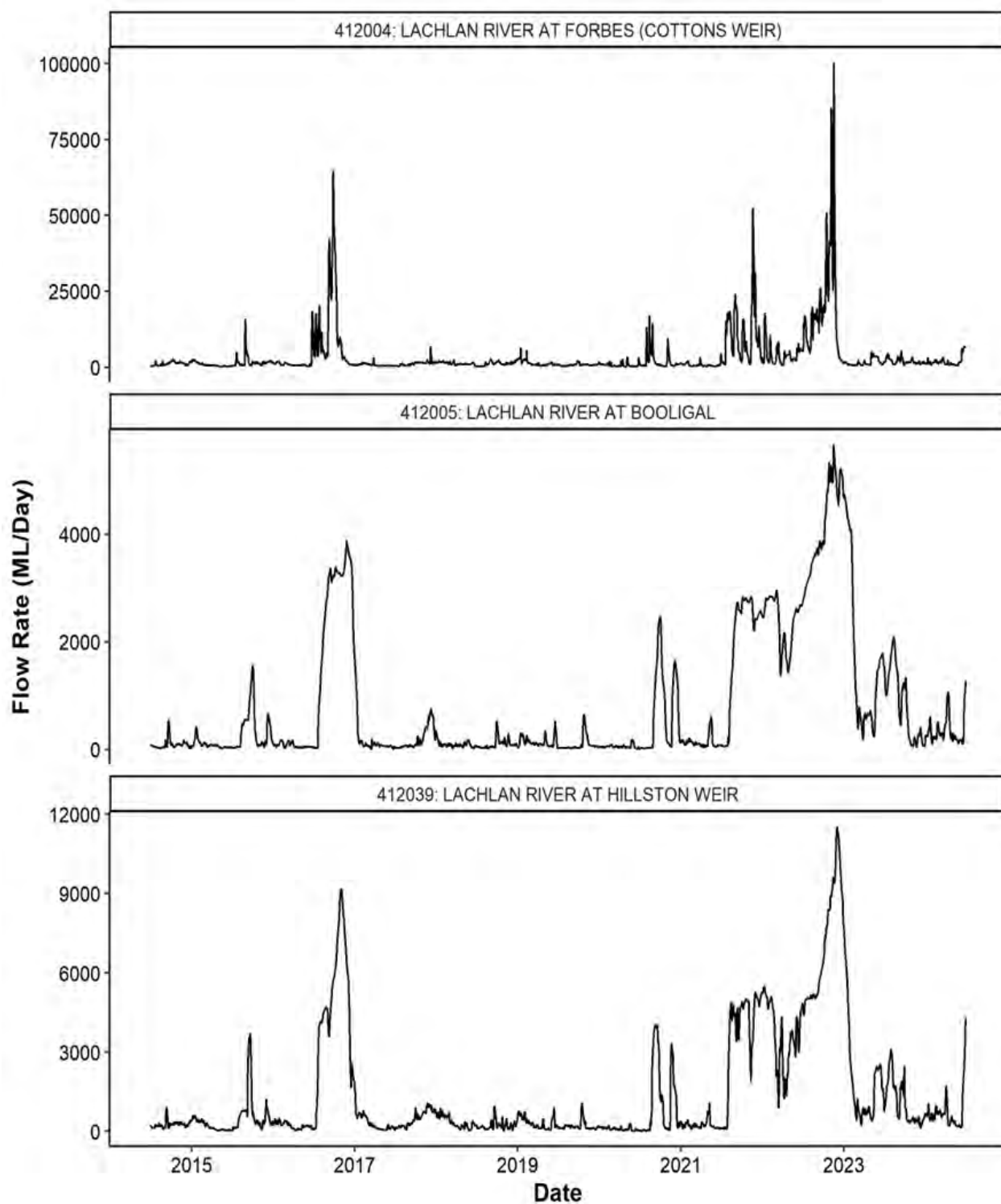


Figure 5.3: Flow data from various gauges in the Lachlan WRP over the reporting period. Gauge locations can be seen on Figure 5.2. Note the differing scales on the y-axis.

Water temperature data, where available, are also shown in Figure 5.4.

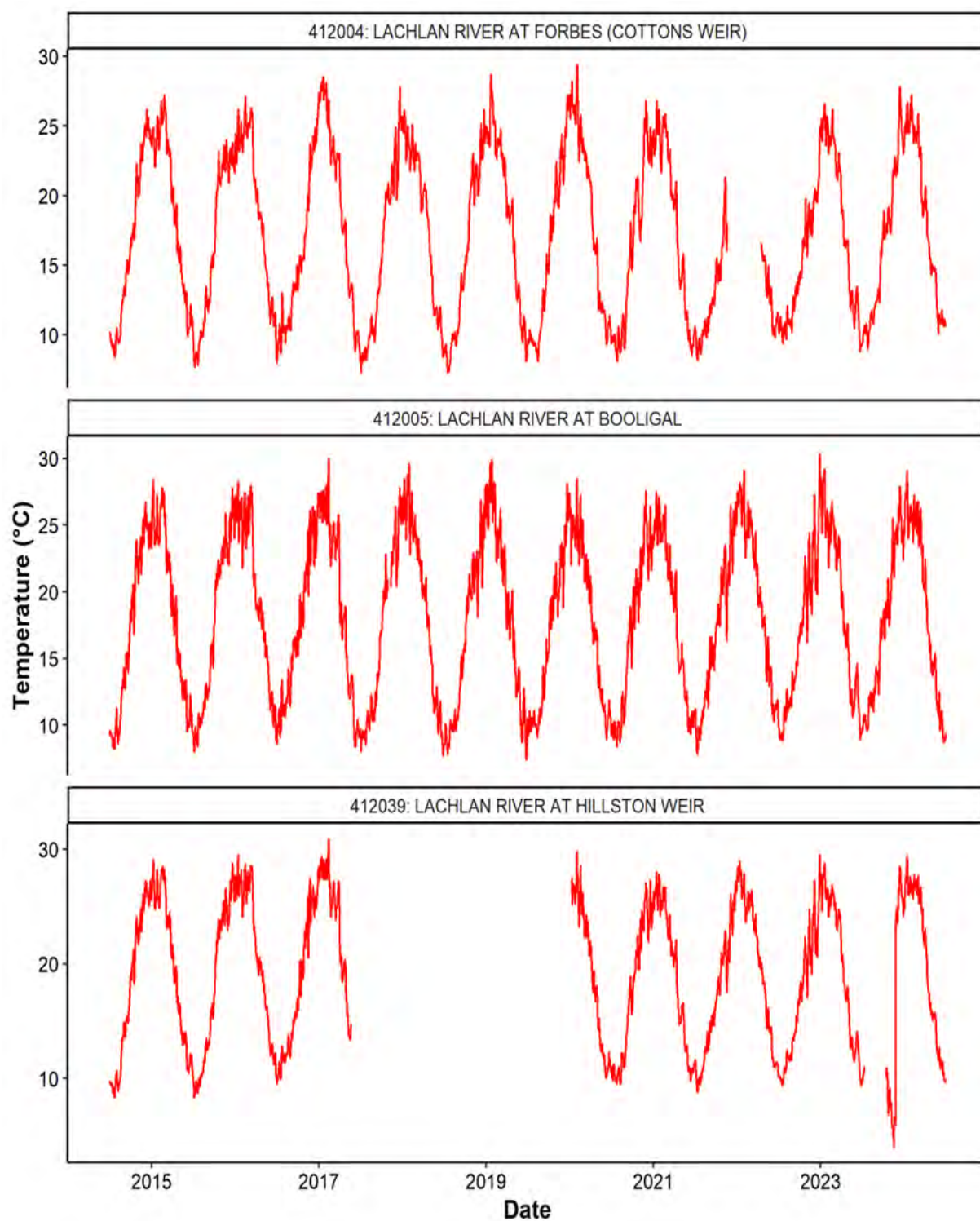


Figure 5.4: Water temperature data from various gauges in the Lachlan WRPA over the reporting period. Gauge locations can be seen on Figure 5.2. Note the differing scales on the y-axis.

Species Diversity

A total of 20 fish species were observed across the Lachlan WRPAs including seven alien species. Figure 5.5 shows the number of native species found at each site while Figure 5.6 shows the number of alien species found at each site. The full list of species caught and observed is presented in Table 5.8.

Summary Statement:

Diversity was highest in the central area of the Lachlan region while the alien diversity was generally consistent across the region.

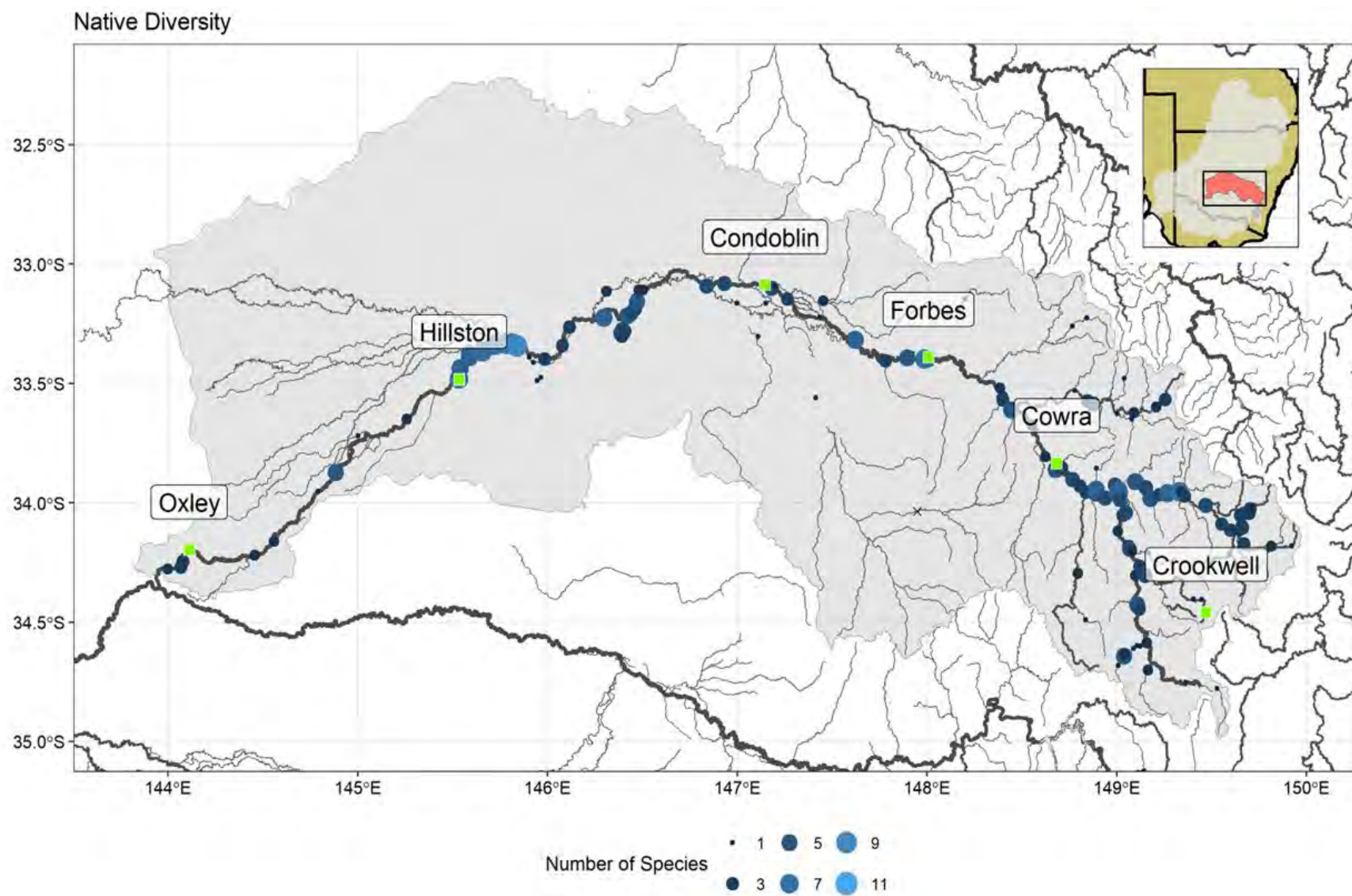


Figure 5.5: Native diversity across all sampling sites in the Lachlan WRPA. Bubble size represents the number of unique species observed at each site across all sampling methods and events. X represents a site that had water and was sampled, but no fish species were caught at all. Dry sites are excluded. Green squares represent key towns.

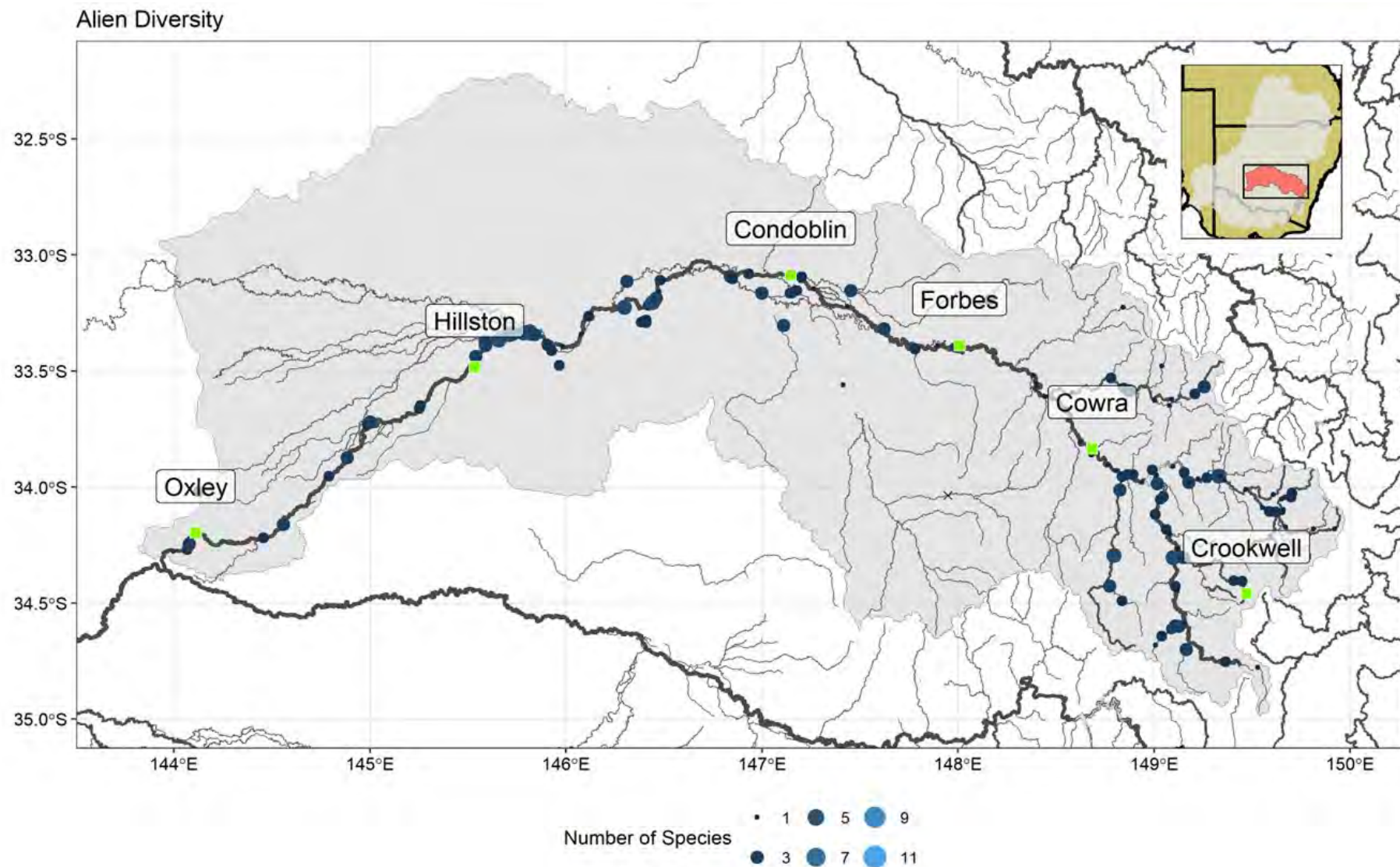


Figure 5.6: Alien diversity across all sampling sites in the Lachlan WRP. Bubble size represents the number of unique species observed at each site across all sampling methods and events. X represents a site that had water and was sampled, but no fish species were caught at all. Dry sites are excluded. Green squares represent key towns.

Murray cod



Population Structure

Figure 5.7 shows the observed length frequency plot for Murray cod for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 0 to 69, and 0 % to 28 % of measured fish within a season, with a mean percentage YOY of 9 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Murray cod was 12 % (1,310 out of 10,496).

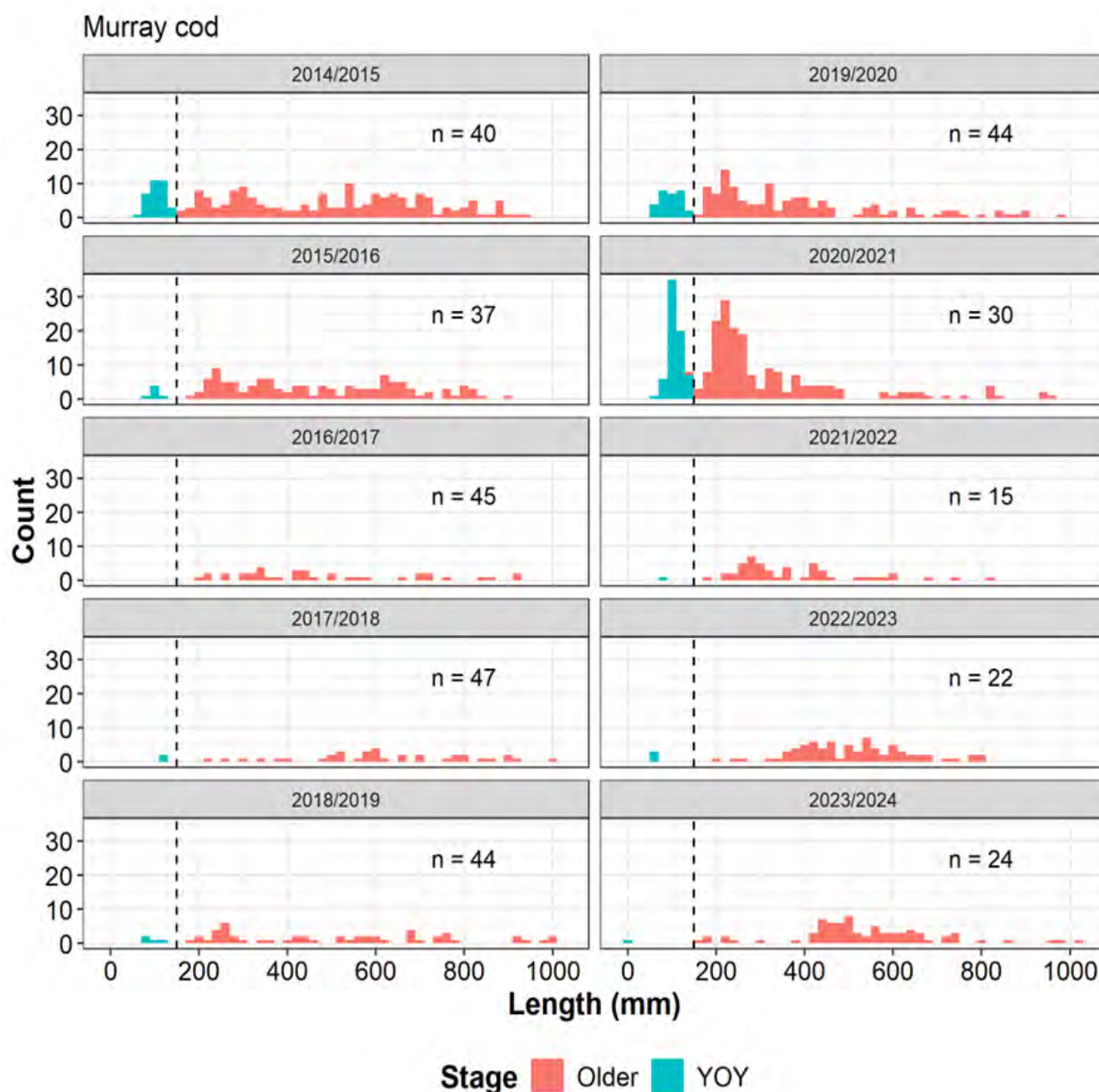


Figure 5.7: Length frequency plots for Murray cod by sampling season in the Lachlan WRPA. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRPA in a sampling season.

Summary Statement:

Sporadic recruitment. A good range of larger fish in all years but very limited evidence of recruitment from 2021/22 onwards.

Stocking

A total of 943,531 Murray cod were stocked into the waterways of the Lachlan WRPA during the reporting period. Of these fish, 839,609 (89 %) were stocked into impoundments while 103,922 (11 %) were stocked into rivers or creeks. Table 5.4 shows the detailed breakdown of stocking by season, location and life stage while Figure 5.8 shows the locations of stocking.

Table 5.4: Number and life stage of stocked Murray cod each sampling season in the Lachlan WRPA.

Sampling Season	River/Creek or Impoundment	Life Stage	Number Stocked
2014/2015	Impoundment	Fry	43,085
2014/2015	River/Creek	Fry	2,171
2015/2016	Impoundment	Fry	125,000
2015/2016	River/Creek	Fry	9,090
2016/2017	Impoundment	Fry	10,000
2016/2017	River/Creek	Fingerling	13,772
2017/2018	Impoundment	Fry	27,000
2017/2018	River/Creek	Fry	6,000
2018/2019	Impoundment	Fry	33,500
2018/2019	River/Creek	Fry	13,500
2019/2020	Impoundment	Fry	31,688
2019/2020	River/Creek	Fry	20,000
2020/2021	Impoundment	Fry	57,000
2020/2021	River/Creek	Fry	12,000
2021/2022	Impoundment	Fry	194,900
2021/2022	River/Creek	Fry	6,935
2022/2023	Impoundment	Fry	249,500
2023/2024	Impoundment	Fingerling	67,936
2023/2024	River/Creek	Fingerling	20,454

Murray cod stocking

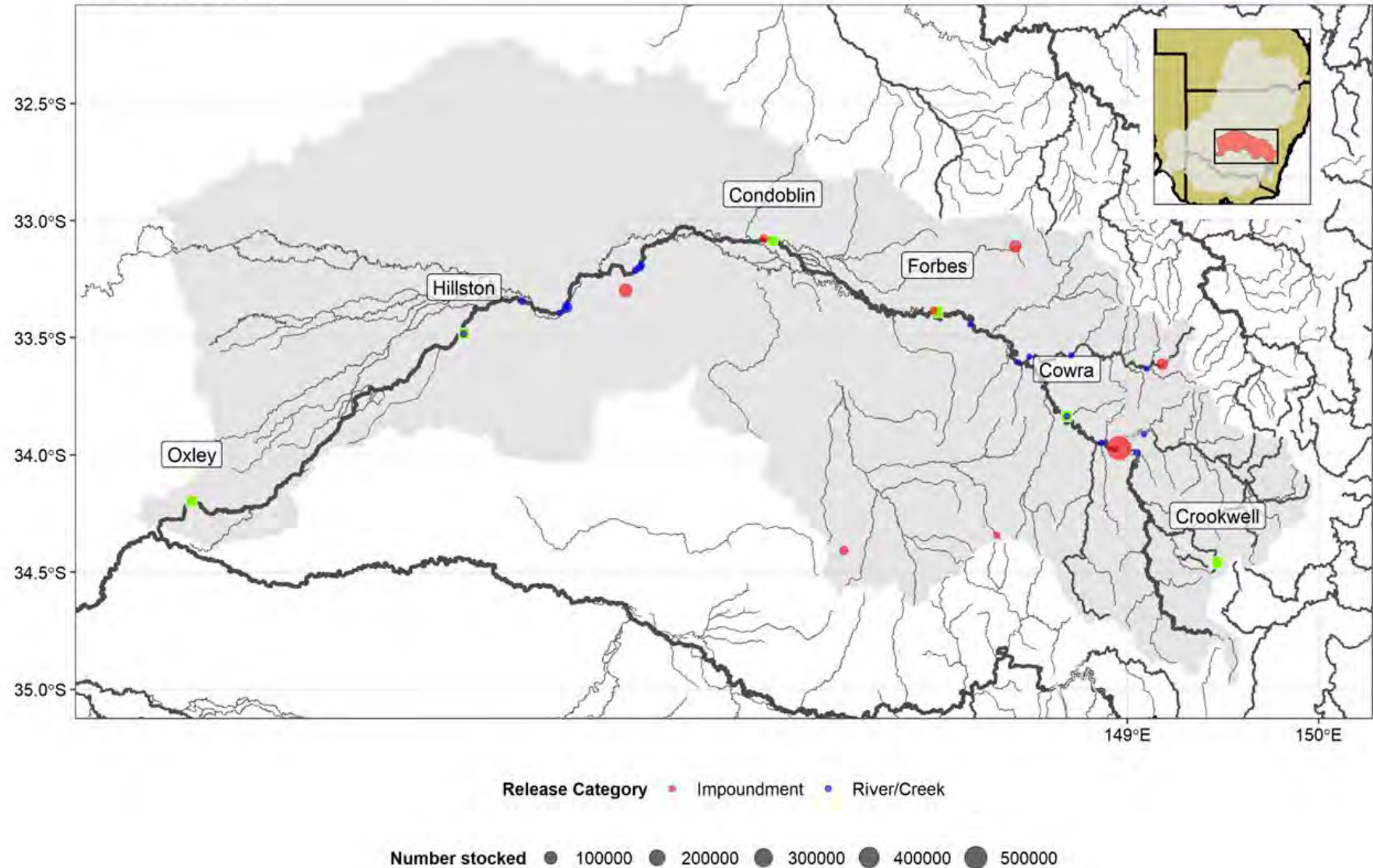


Figure 5.8: Locations of Murray cod stocking in the Lachlan WRPA. Colours show whether a site was a river/creek site or an impoundment, while the size of the point reflects the total number of fish stocked over the reporting period. Green squares represent key towns.

Temporal Trends in Abundance

The relative abundance and biomass of Murray cod since 1994 was modelled based on all suitable boat electrofishing data. The left-hand panels of Figure 5.9 show the abundance and biomass trends for the Lachlan WRPA and the right-hand panels show the overall trends across the NSW MDB.

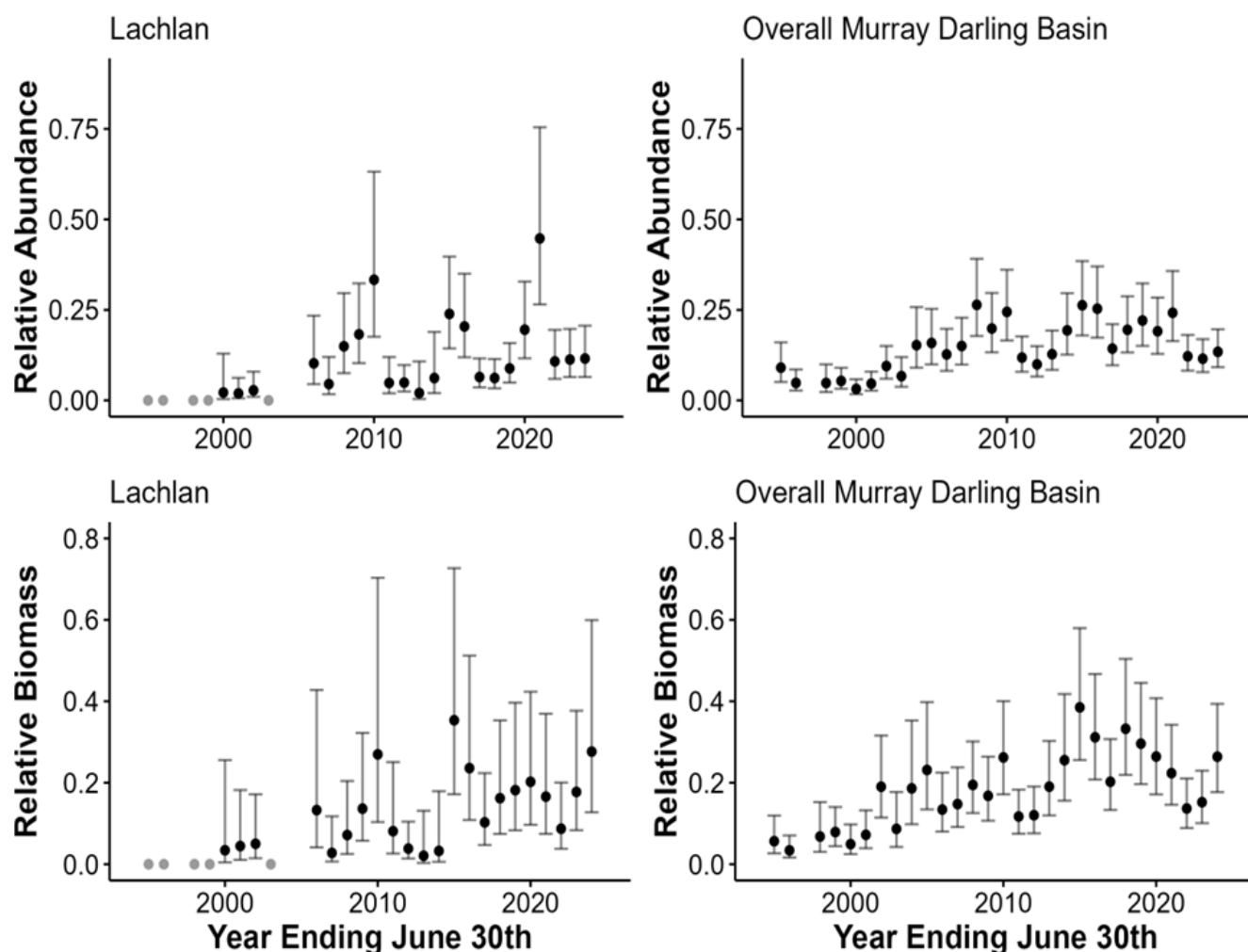


Figure 5.9: Relative abundance and biomass of Murray cod in both the Lachlan WRPA and the overall NSW MDB. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates. Grey dots show years where sampling was conducted but no Murray cod was caught and therefore there is no estimate of error around the index.

Summary Statement:

An overall increase in abundance since the 1990s. Abundance has declined recently from a peak in 2020/21 but biomass appears to be increasing. Relative abundance and biomass similar to the overall NSW MDB.

Health

The prevalence of any health issues ranged from 2 % of sampled fish in 2020/2021 to 62 % of sampled fish in 2022/2023 (Figure 5.10). The most common health issue for Murray cod in the Lachlan WRPAs was *Lernaea*, which was observed in a total of 151 fish, corresponding to 14 % of all Murray cod measured.

Across the other NSW MDB WRPA, 16 % of Murray cod (1,645 out of 10,496 Murray cod) showed a health condition (excludes the Lachlan WRPAs).

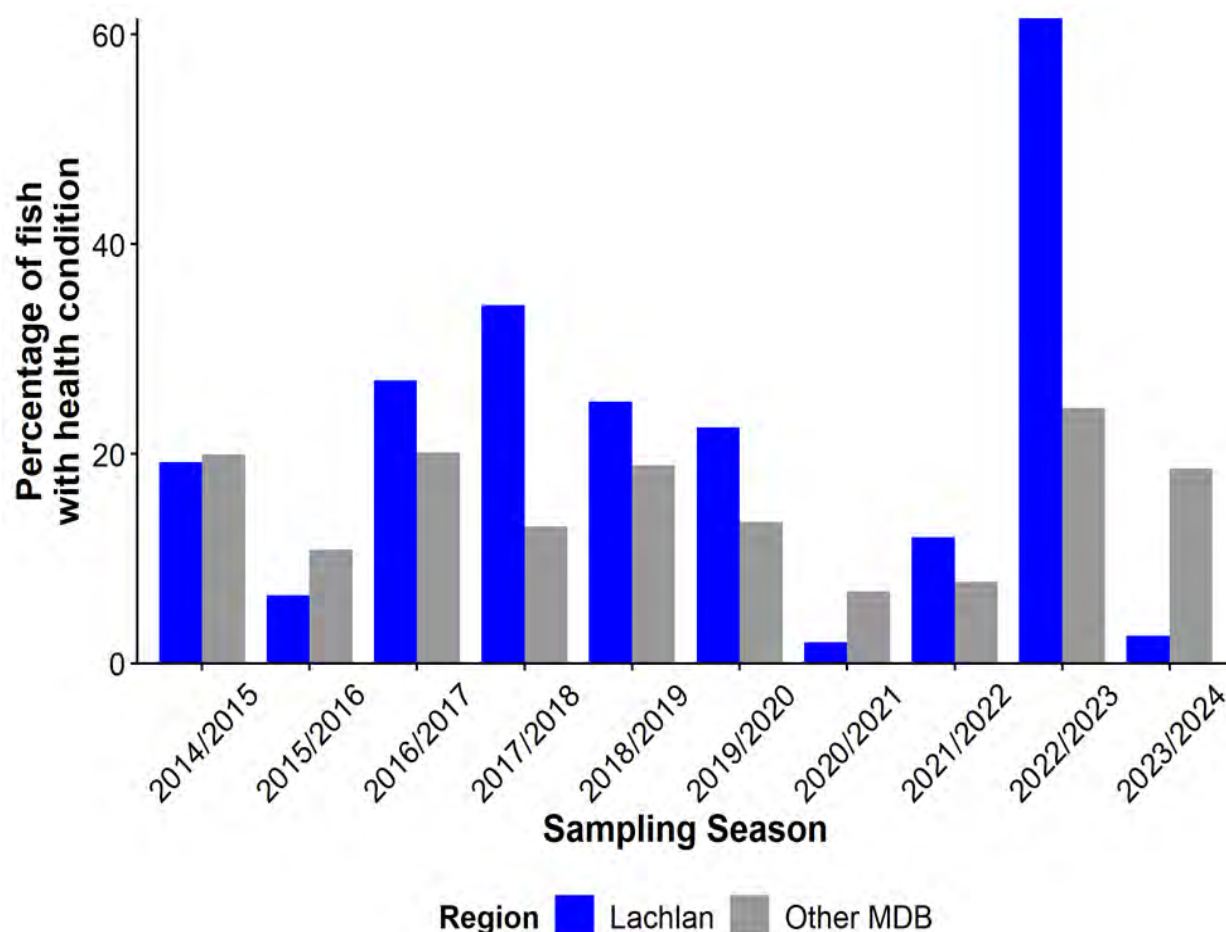


Figure 5.10: Timeseries showing the prevalence of health conditions in Murray cod. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA.

Summary Statement:

Presence of observable health conditions was moderate to high across most years and higher than the overall Murray-Darling Basin in most years. There was a low level of observed health issues in 2023/24.

Distribution

Murray cod were recorded at 52 out of 168 sites in the Lachlan WRPA from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 1.3 fish caught per 90 seconds of electrofishing. Figure 5.11 shows the distribution and relative abundance of Murray cod across the Lachlan WRPA.

Summary Statement:

Murray cod were recorded across the Lachlan WRPA but less abundant or absent in west of Hillston.

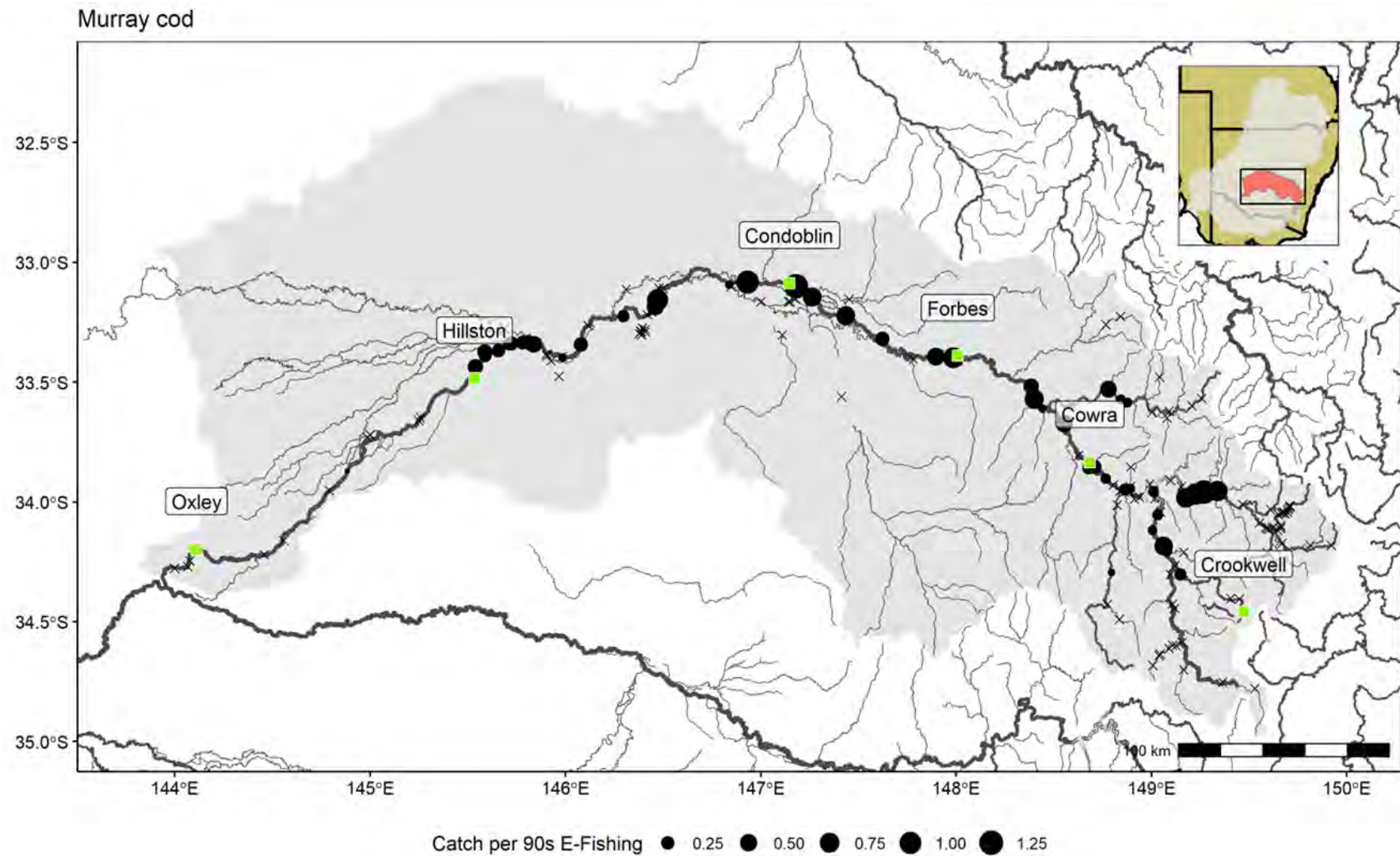


Figure 5.11: Distribution of Murray cod sampled from 2013/14 to 2023/24 in the Lachlan WRPA. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares represent key towns.

Golden perch



Population Structure

Figure 5.12 shows the observed length frequency plot for Golden perch for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 0 to 4, and 0 % to 12 % of measured fish within a season, with a mean percentage YOY of 2 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Golden perch was 9 % (641 out of 7,229).

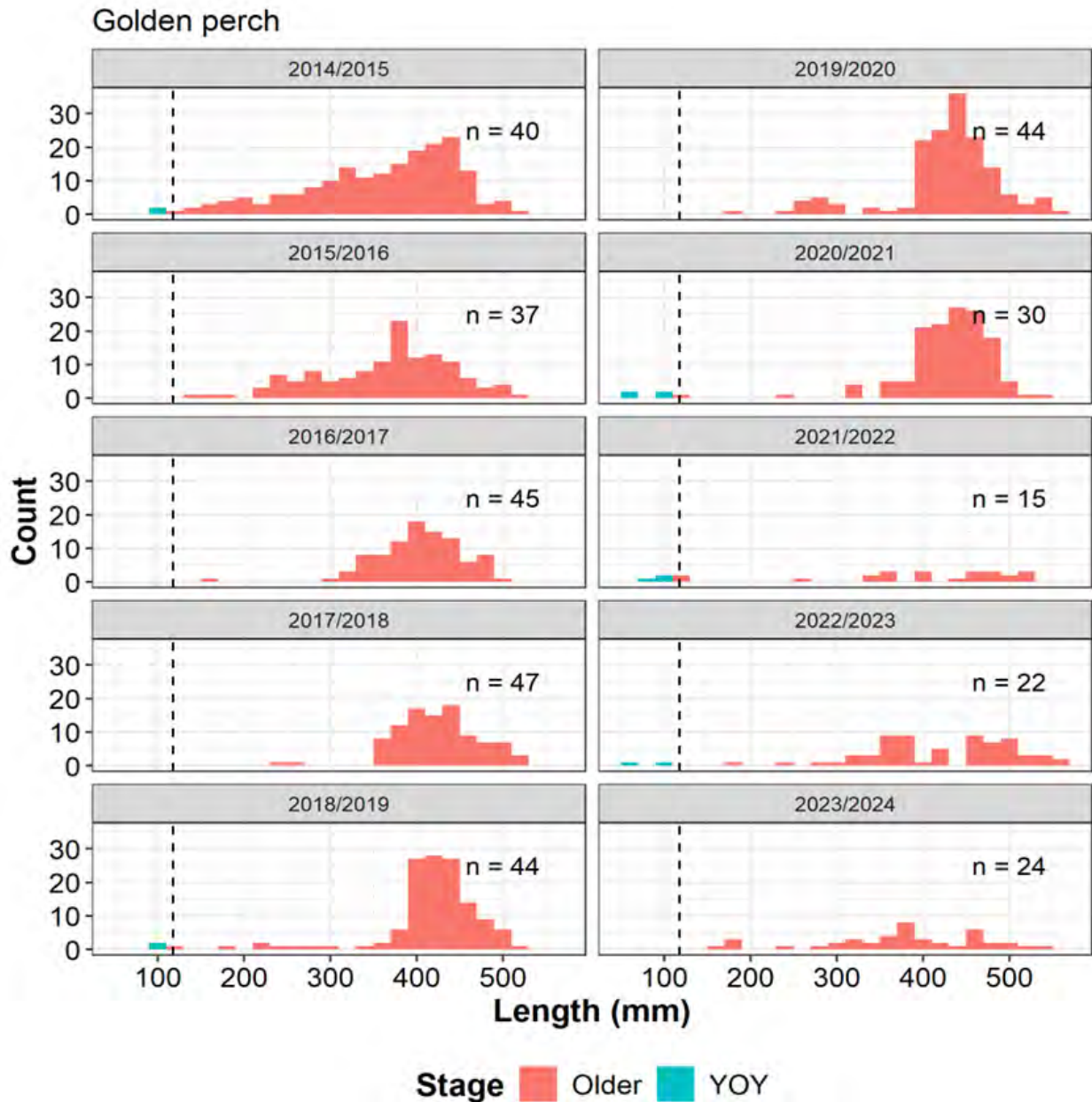


Figure 5.12: Length frequency plots for Golden perch by sampling season in the Lachlan WRPA. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRPA in a sampling season.

Summary Statement:

The population consistently has a high proportion of large fish. Recruitment appears to be limited with only very small numbers of YOY collected. Small numbers of YOY were observed from 2020/21 to 2022/23 but no YOY were collected in 2023/24.

Stocking

A total of 1,051,492 Golden perch were stocked into the waterways of the Lachlan WRPAs during the reporting period. Of these fish, 865,374 (82.3 %) were stocked into impoundments while 186,118 (17.7 %) were stocked into rivers or creeks. Table 5.5 shows the detailed breakdown of stocking by season, location and life stage while Figure 5.13 shows the locations of stocking.

Table 5.5: Number and life stage of stocked Golden perch each sampling season in the Lachlan WRPAs.

Sampling Season	River/Creek or Impoundment	Life Stage	Number Stocked
2014/2015	Impoundment	Fry	41,629
2014/2015	River/Creek	Fry	84,167
2015/2016	Impoundment	Fry	41,000
2016/2017	Impoundment	Fry	140,000
2016/2017	River/Creek	Fingerling	45,452
2017/2018	Impoundment	Fry	158,200
2017/2018	River/Creek	Fry	26,999
2018/2019	Impoundment	Fry	85,000
2019/2020	Impoundment	Fry	74,545
2019/2020	River/Creek	Fry	10,000
2020/2021	Impoundment	Fry	103,000
2020/2021	River/Creek	Fry	12,000
2021/2022	Impoundment	Fry	11,200
2022/2023	Impoundment	Fry	94,860
2023/2024	Impoundment	Fingerling	115,940

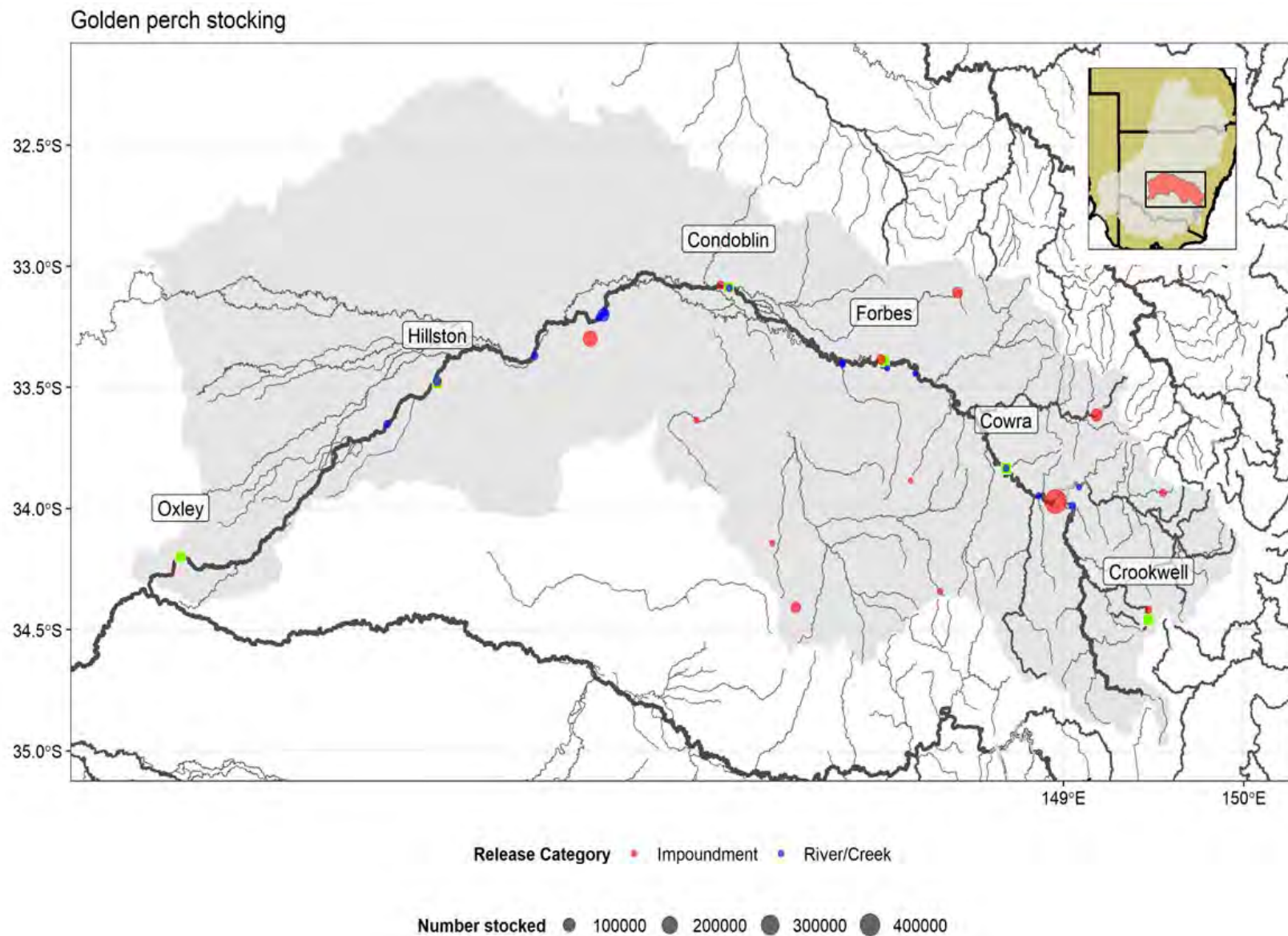


Figure 5.13: Locations of Golden perch stocking in the Lachlan WRPA. Colours show whether a site was a river/creek site or an impoundment, while the size of the point reflects the total number of fish stocked over the reporting period. Green squares represent key towns.

Temporal Trends in Abundance

The relative abundance and biomass of Golden perch since 1994 was modelled based on all suitable boat electrofishing data. The left-hand panels of Figure 5.14 show the abundance and biomass trends for the Lachlan WRPA and the right-hand panels show the overall trends across the NSW MDB.

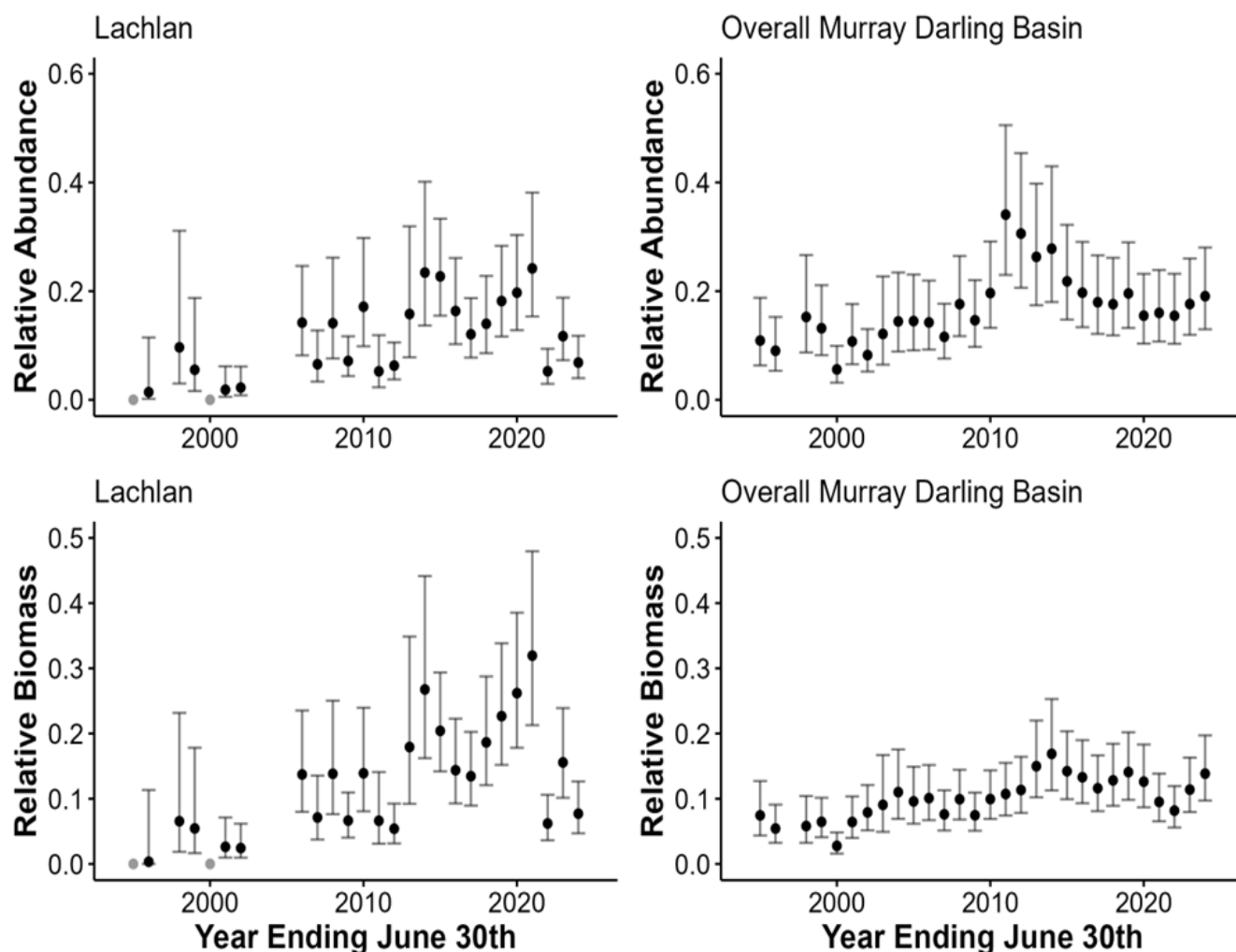


Figure 5.14: Relative abundance and biomass of Golden perch in both the Lachlan WRPA and the overall NSW MDB. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates. Grey dots show years where sampling was conducted by no Golden perch caught and therefore there is no estimate of error around the index.

Summary Statement:

Abundance and biomass likely higher than the mid-1990s but both have declined sharply since 2020/21 and are currently lower than the overall Murray-Darling Basin.

Health

The prevalence of any health issues ranged from 1 % of sampled fish in 2020/2021 to 65 % of sampled fish in 2017/2018 (Figure 5.15). The most common health issue for Golden perch in the Lachlan water resource planning area was *Lernaea*, which was observed in a total of 278 fish, corresponding to 26 % of all Golden perch measured.

Across the other WRPAs, 25 % of Golden perch (1,792 out of 7,229 Golden perch) showed a health condition (excludes Lachlan).

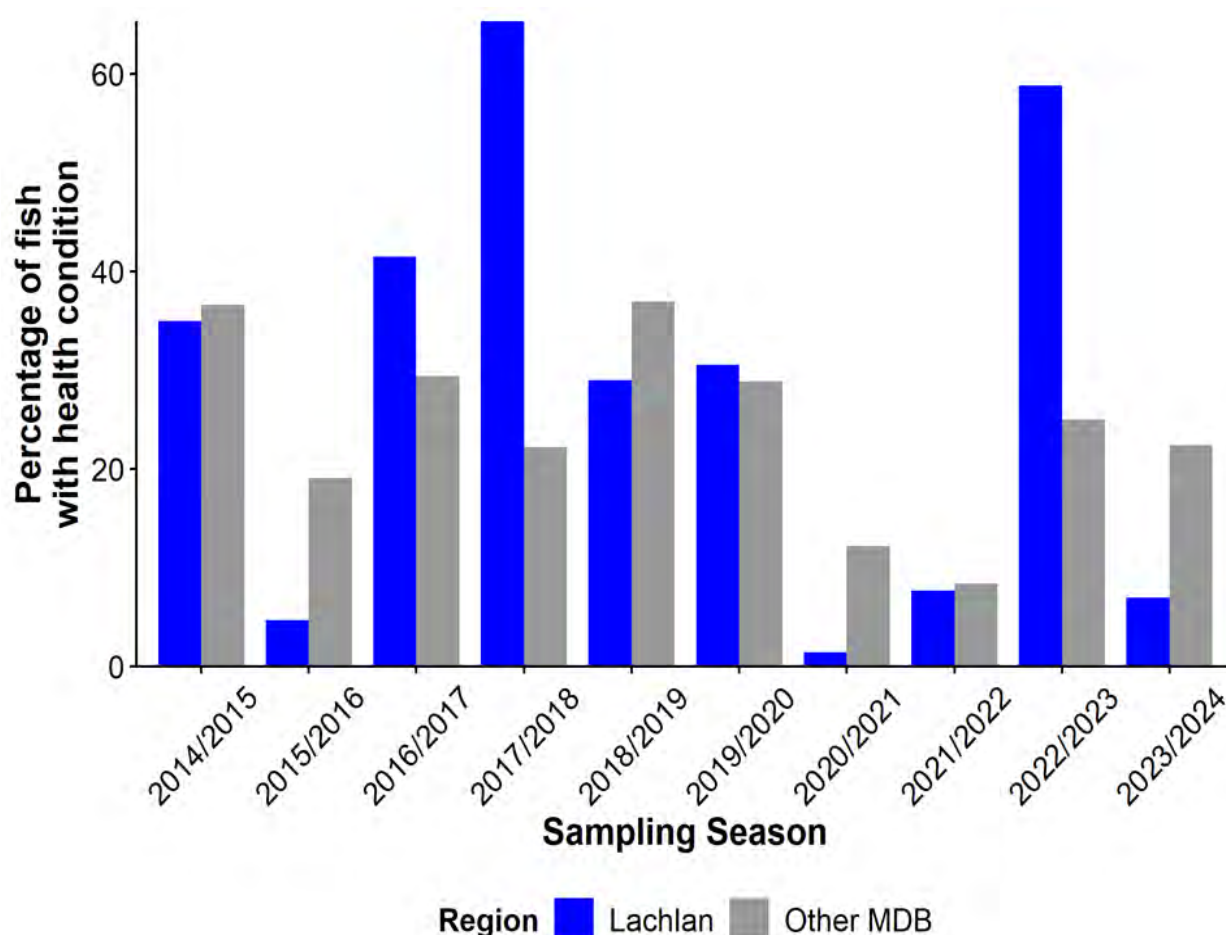


Figure 5.15: Timeseries showing the prevalence of health conditions in Golden perch. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPAs.

Summary Statement:

The presence of observable health conditions for Golden perch in the Lachlan was variable but generally tracked the average across the rest of the NSW Murray-Darling Basin except for 2017/18 and 2022/23 when it was significantly higher.

Distribution

Golden perch were recorded at 50 out of 168 sites in the Lachlan WRPA from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 1.3 fish caught per 90 seconds of electrofishing. Figure 5.16 shows the distribution and relative abundance of Golden perch across the Lachlan WRPA.

Summary Statement:

Golden perch were generally present across the Lachlan region.

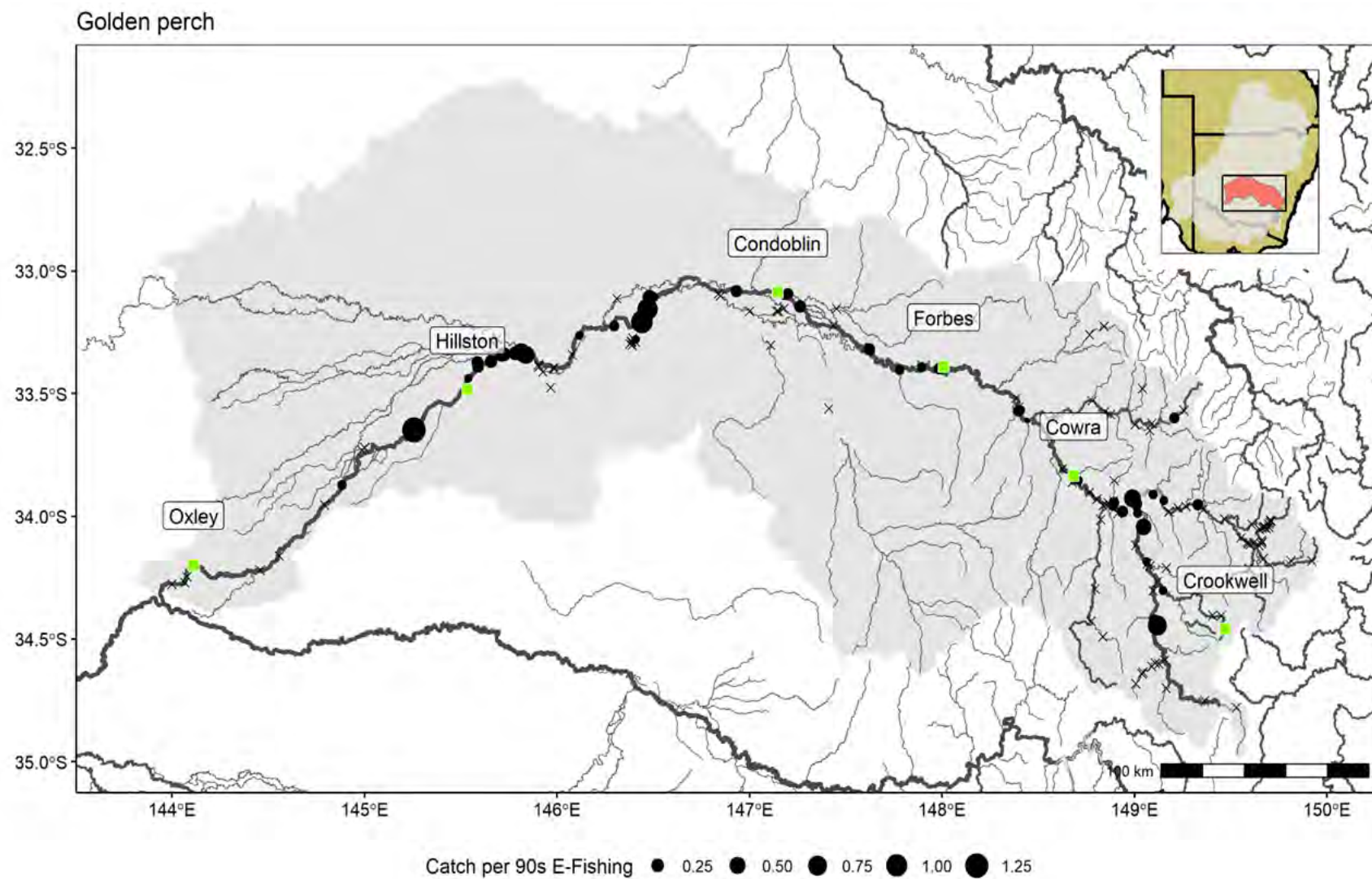


Figure 5.16: Distribution of Golden perch sampled from 2013/14 to 2023/24 in the Lachlan WRPA. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares represent key towns.

Freshwater catfish



Summary Statement:

Only three Freshwater catfish were caught in the Lachlan WRPA during the reporting period. Two fish were caught in Lake Wyangala. A 39 cm individual in 2014/15 and a 25 cm individual in 2018/19. A 56 cm individual was caught in 2023/24 at Wallanthery in the Lachlan River. None of the fish showed any health conditions. Overall, Freshwater catfish in the Lachlan WRPA are likely severely restricted in abundance and distribution.

Bony herring



Population Structure

Figure 5.17 shows the observed length frequency plot for Bony herring for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 8 to 1,327, and 1 % to 43 % of measured fish within a season, with a mean percentage YOY of 19 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Bony herring was 26 % (9,926 out of 38,327). Bony herring are not a stocked species.

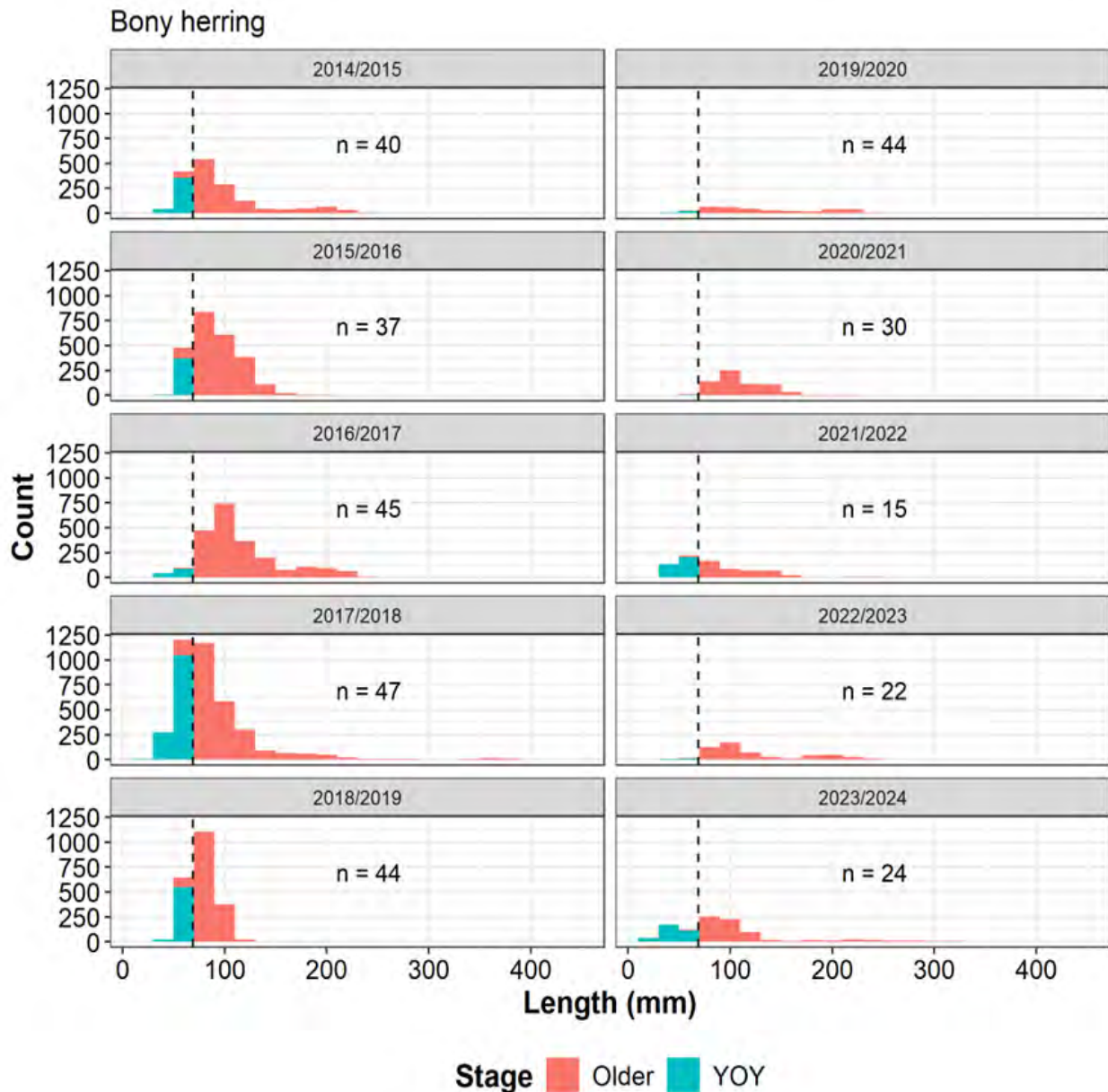


Figure 5.17: Length frequency plots for Bony herring by sampling season in the Lachlan WRPA. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRPA in a sampling season.

Summary Statement:

Regular recruitment prior to 2019/20 with good recruitment only observed in 2021/22 and 2023/24 since. Some larger individuals evident in both 2022/23 and 2023/24.

Temporal Trends in Abundance

The relative abundance and biomass of Bony herring since 1994 was modelled based on all suitable boat electrofishing data. The left-hand panels of Figure 5.18 show the abundance and biomass trends for the Lachlan WRPA and the right-hand panels show the overall trends across the NSW MDB.

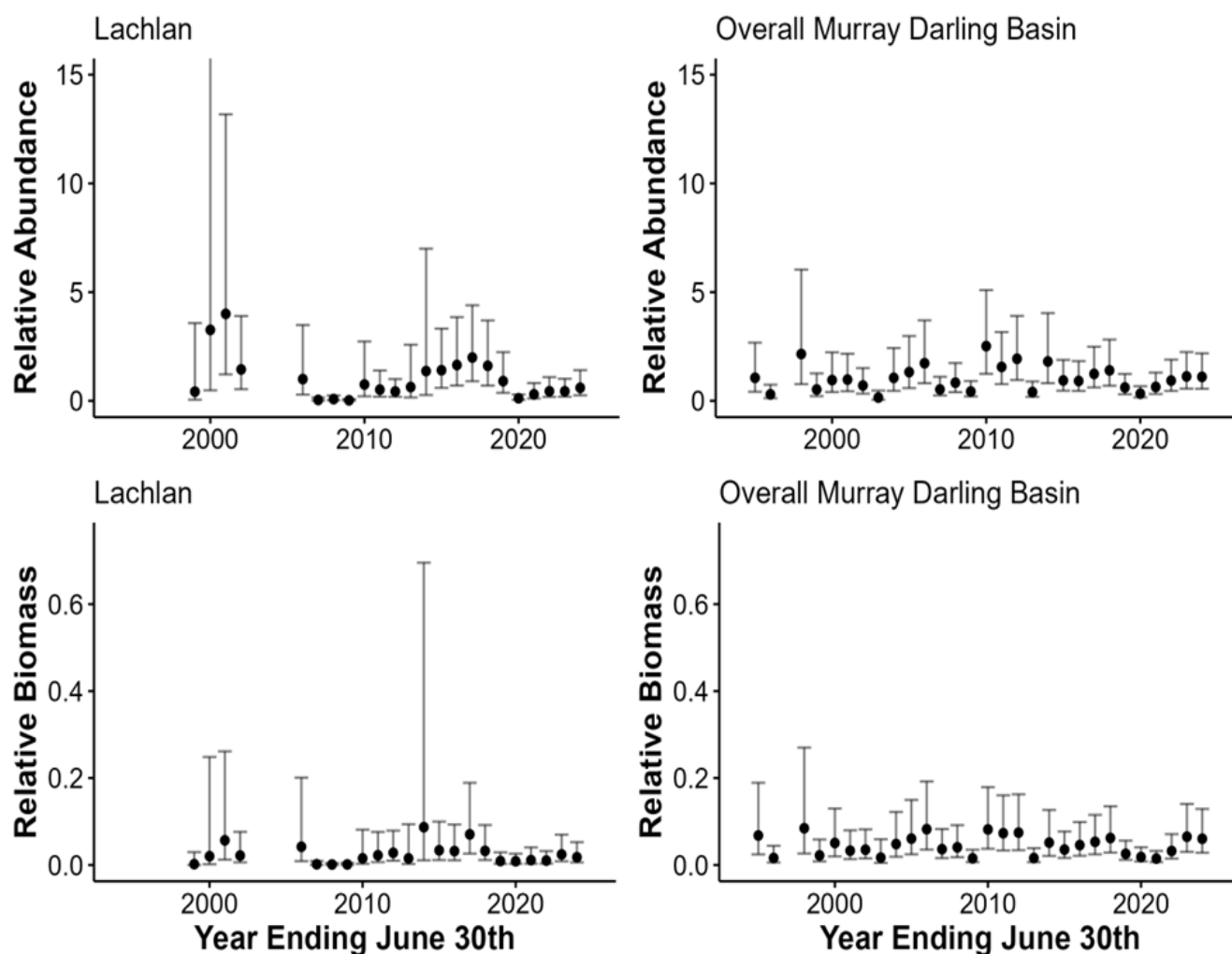


Figure 5.18: Relative abundance and biomass of Bony herring in both the Lachlan WRPA and the overall NSW MDB. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates.

Summary Statement:

Fluctuations in both abundance and biomass but both have likely declined from peaks in 2000/01 and 2017/18. Abundance and biomass are slightly lower than the overall NSW MDB.

Health

The prevalence of any health issues ranged from 0 % of sampled fish in 2020/2021 to 4 % of sampled fish in 2022/2023 (Figure 5.19). The most common health issue for Bony herring in the Lachlan WRPAs was Wounds, which was observed in a total of 28 fish, corresponding to <1 % of all Bony herring measured.

Across the other NSW MDB WRPA, 1.35 % of Bony herring (517 out of 38,328 Bony herring) showed a health condition (excludes the Lachlan WRPA).

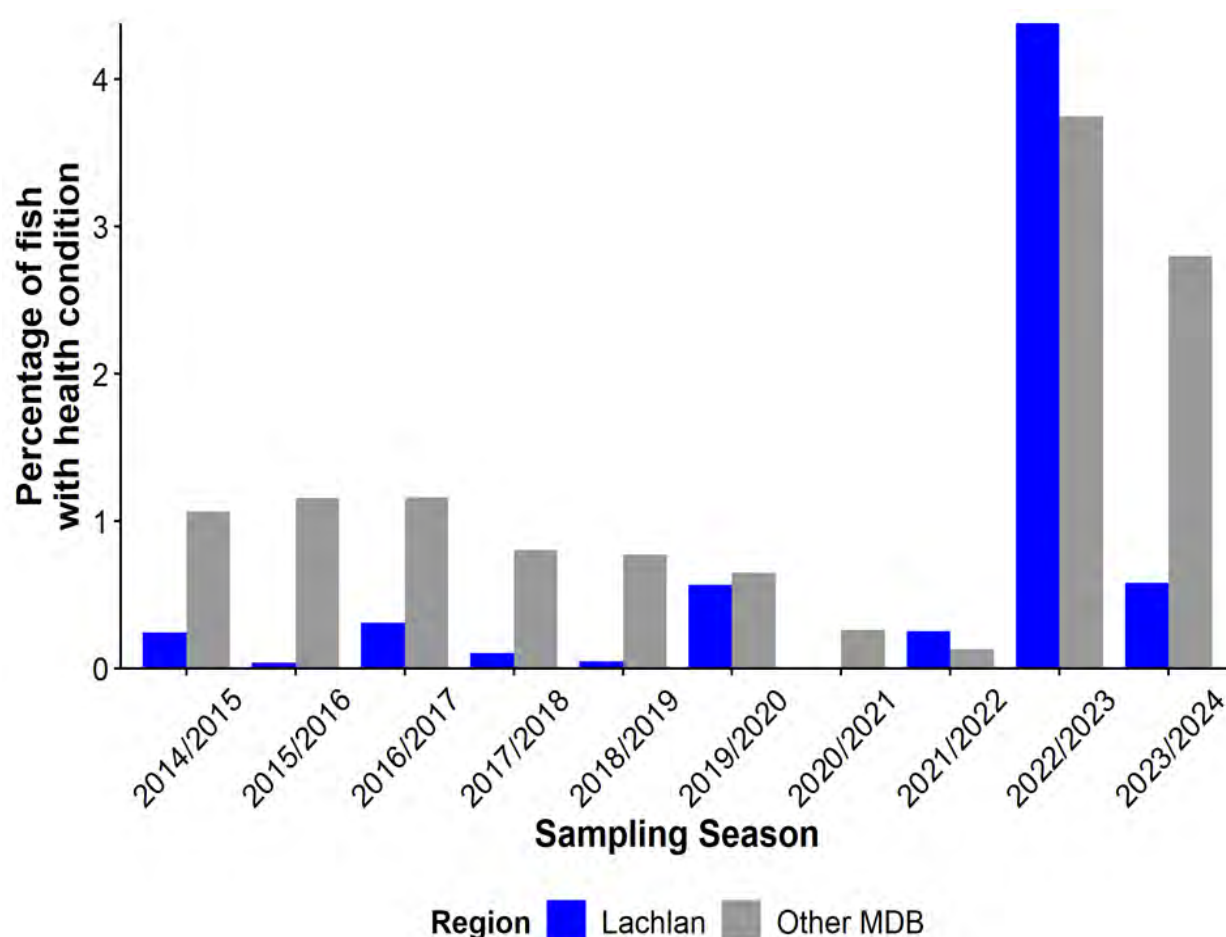


Figure 5.19: Timeseries showing the prevalence of health conditions in Bony herring. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA.

Summary Statement:

Presence of observable health conditions was generally very low but much higher in 2022/23 reflecting an increase across the NSW MDB. The proportion of observed health issues was lower in the Lachlan compared to the rest of the NSW MDB in 2023/24.

Distribution

Bony herring were recorded at 38 out of 168 sites in the Lachlan WRP from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 25.7 fish caught per 90 seconds of electrofishing. Figure 5.20 shows the distribution and relative abundance of Bony herring across the Lachlan WRP.

Summary Statement:

Bony herring appear to be largely restricted to the western Lachlan WRP with very few occurrences east of Condobolin.

Bony herring

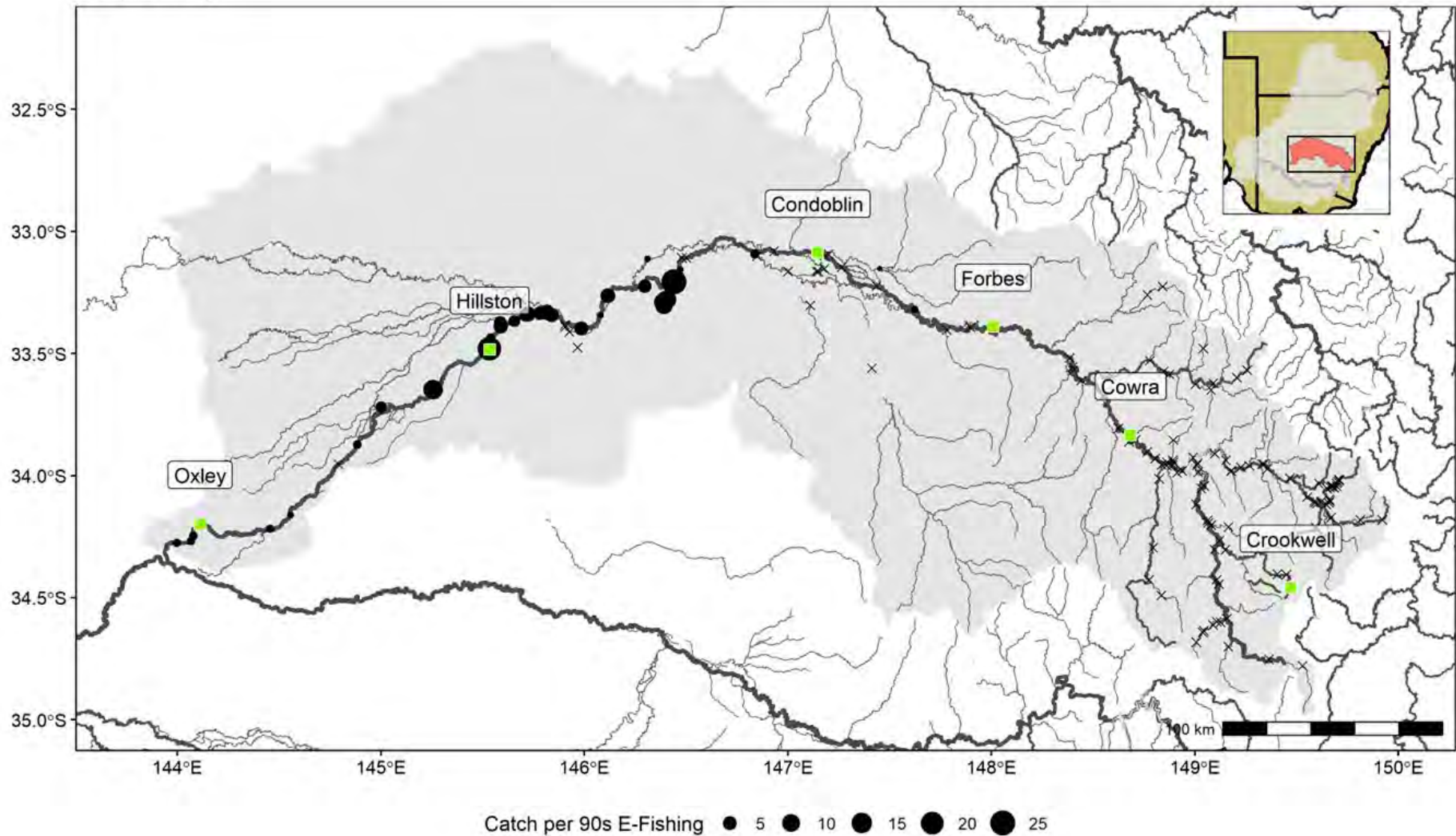


Figure 5.20: Distribution of Bony herring sampled from 2013/14 to 2023/24 in the Lachlan WRP. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares represent key towns.

Australian smelt



Population Structure

Figure 5.21 shows the observed length frequency plot for Australian smelt for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 0 to 206, and 0 % to 83 % of measured fish within a season, with a mean percentage YOY of 22 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Australian smelt was 42 % (11,165 out of 26,645). Australian smelt are not a stocked species.

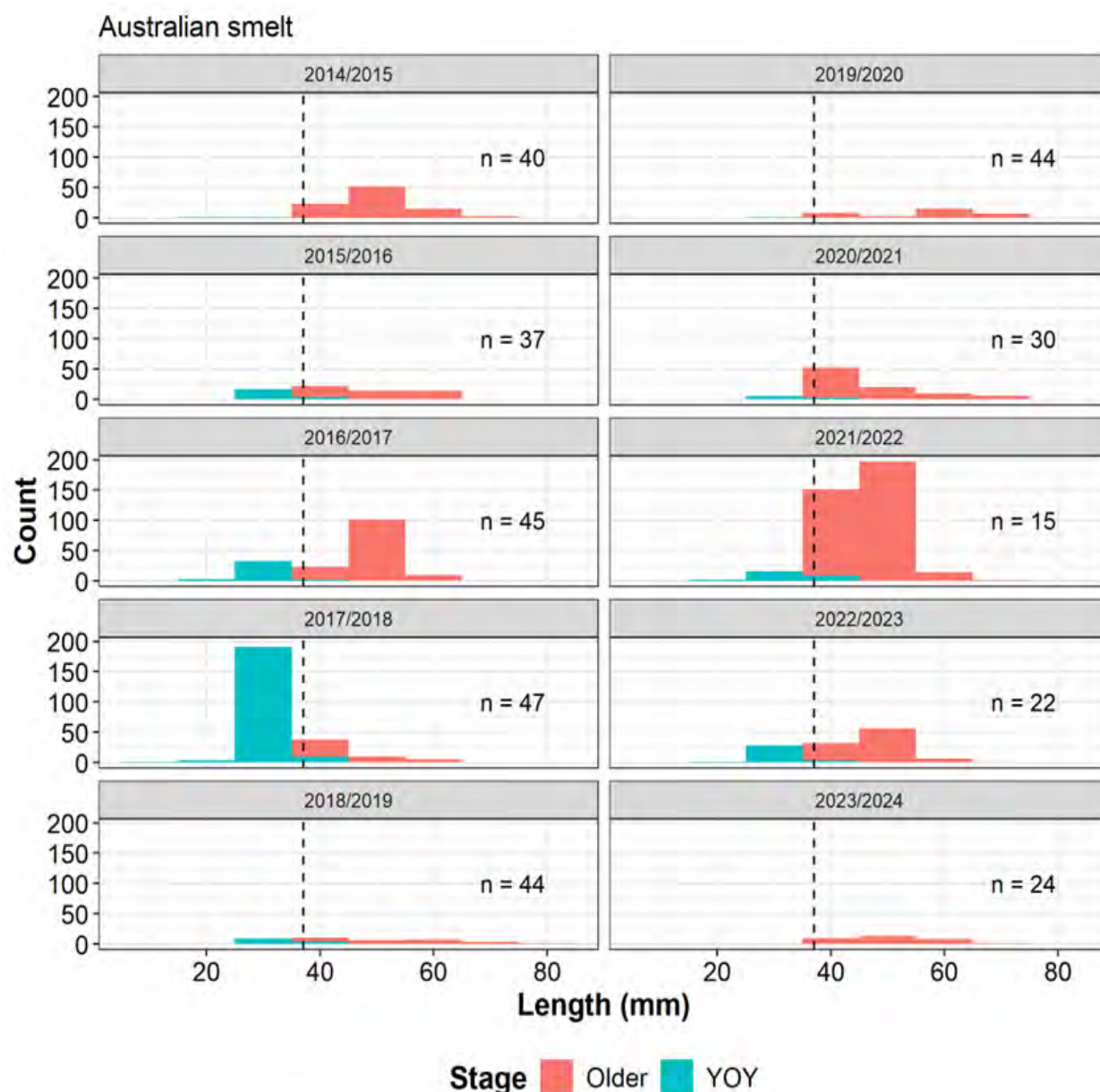


Figure 5.21: Length frequency plots for Australian smelt by sampling season in the Lachlan WRPA. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRPA in a sampling season.

Summary Statement:

Low levels of recruitment in most years but evidence of a large recruitment event in 2017/18. No observed YOY in 2023/24 suggesting poor recruitment.

Temporal Trends in Abundance

The relative abundance of Australian smelt since 1994 was modelled based on all suitable boat electrofishing data. The left-hand panel of Figure 5.22 show the abundance trends for the Lachlan WRPA and the right-hand panel show the overall trend across the NSW MDB.

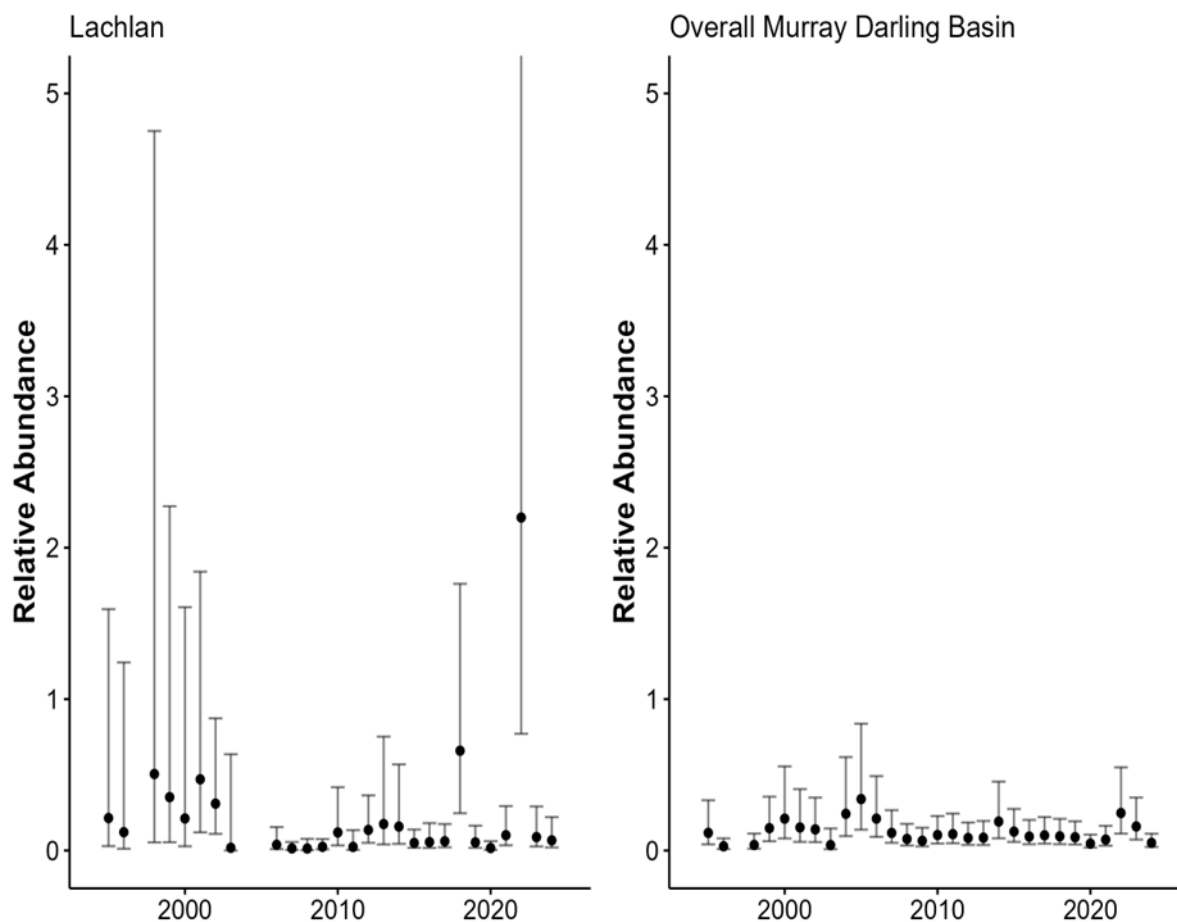


Figure 5.22: Relative abundance of Australian smelt in both the Lachlan WRPA and the overall NSW MDB. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates. No modelling of biomass was done for Australian smelt.

Summary Statement:

Large fluctuations in relative abundance with recent peaks in 2017/18 and 2021/22. Current abundance is low and similar to overall abundance across the NSW MDB.

Health

The prevalence of any health issues ranged from 0 % of sampled fish in 2014/2015 to 6 % of sampled fish to 2019/2020 (Figure 5.23). The most common health issue for Australian smelt in the Lachlan WRPAs was *Lernaea*, which was observed in a total of 5 fish, corresponding to <1 % of all Australian smelt measured.

Across the other NSW MDB WRPA, 1 % of Australian smelt (168 out of 26,646 Australian smelt) showed a health condition (excludes the Lachlan WRPAs).

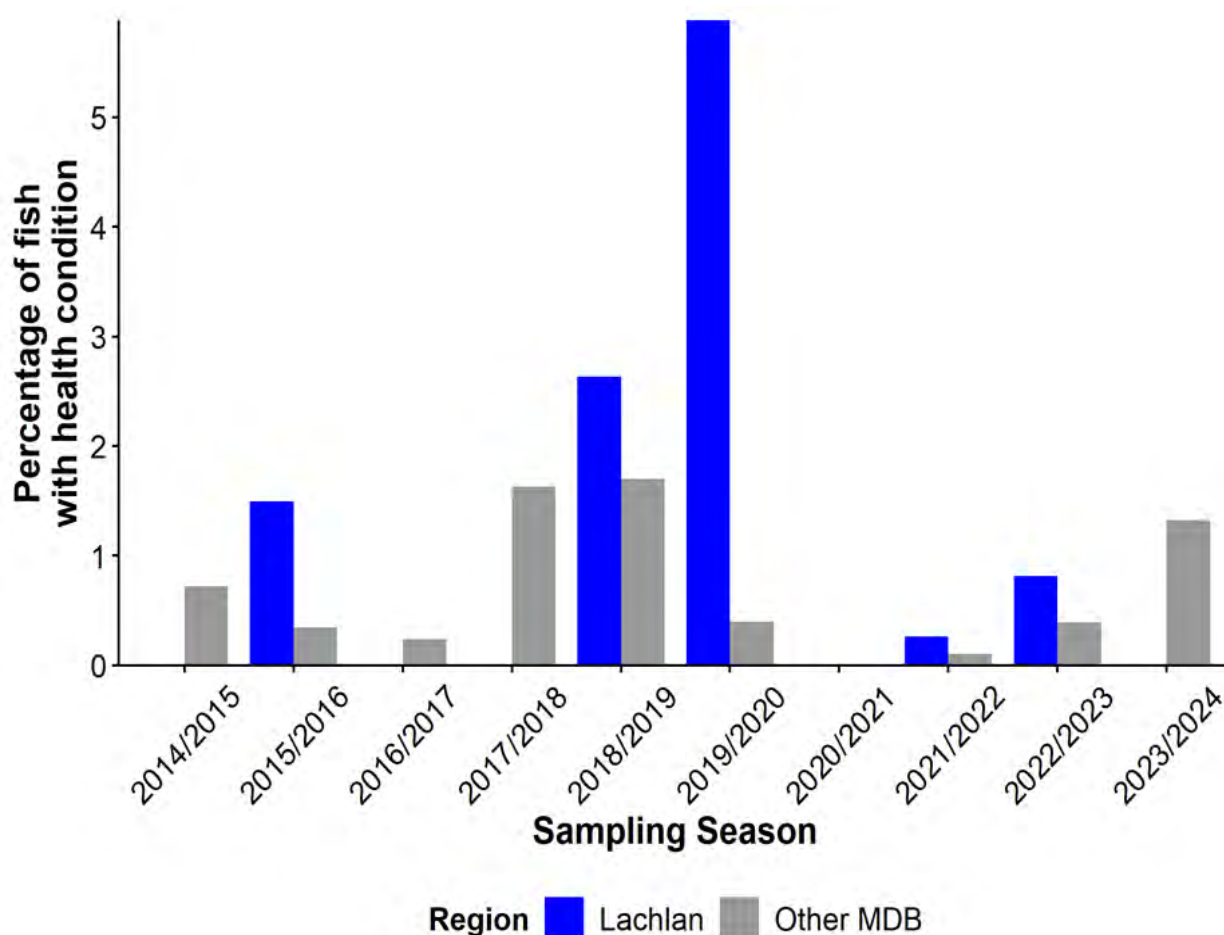


Figure 5.23: Timeseries showing the prevalence of health conditions in Australian smelt. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA.

Summary Statement:

Australian smelt in the Lachlan WRPAs generally had very low levels of observable health issues except for 2019/20 where levels were moderate.

Distribution

Australian smelt were recorded at 65 out of 168 sites in the Lachlan WRPA from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 47.7 fish caught per 90 seconds of electrofishing. Figure 5.24 shows the distribution and relative abundance of Australian smelt across the Lachlan WRPA.

Summary Statement:

Australian smelt were across the Lachlan WRPA with highest densities observed in the eastern upland area.

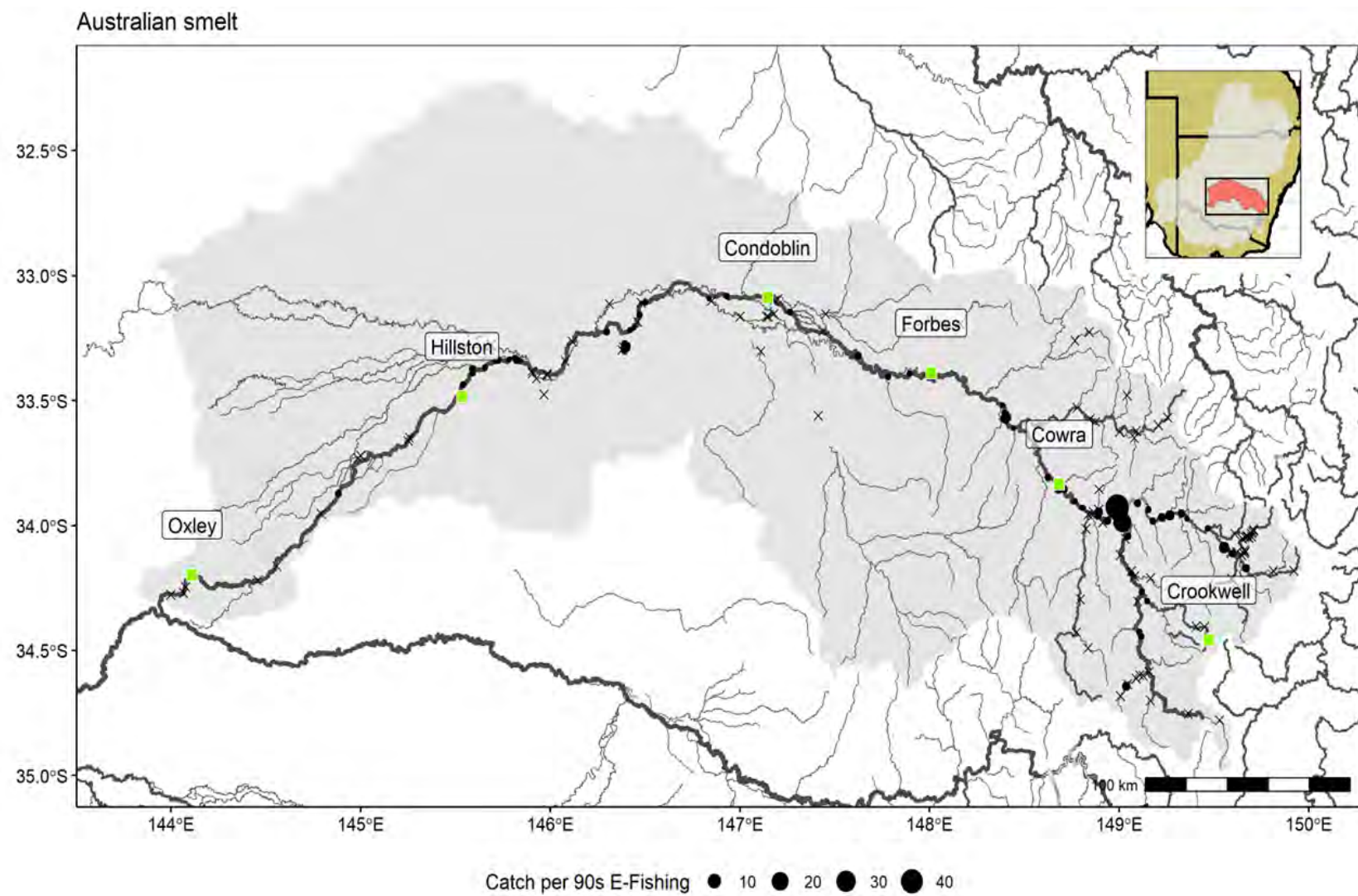


Figure 5.24: Distribution of Australian smelt sampled from 2013/14 to 2023/24 in the Lachlan WRPA. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares represent key towns.

Common carp



Population Structure

Figure 5.25 shows the observed length frequency plot for Common carp for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 27 to 1,682, and 7 % to 87 % of measured fish within a season, with a mean percentage YOY of 46 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Common carp was 55 % (31,195 out of 56,546). Common carp are not a stocked species.

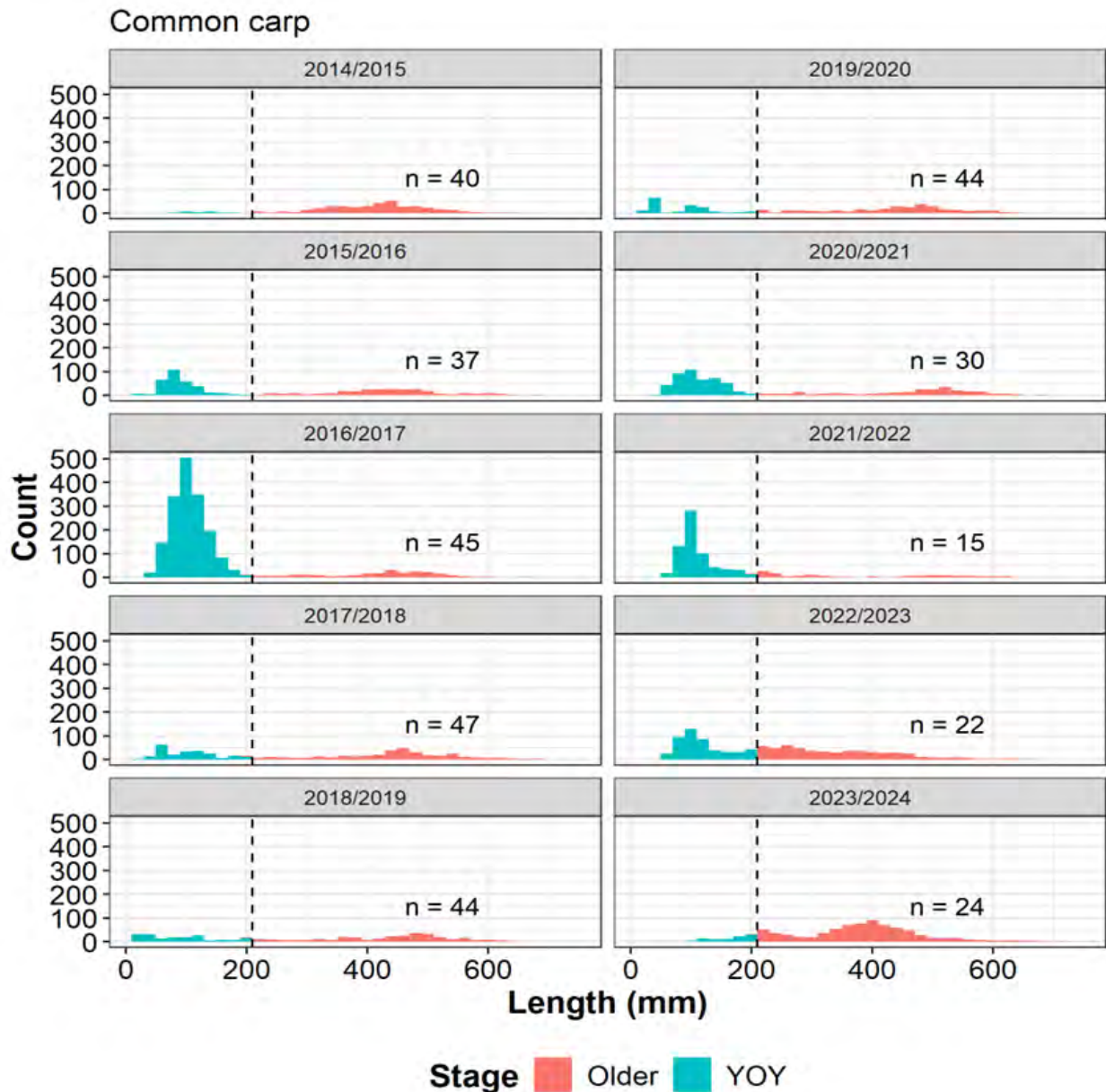


Figure 5.25: Length frequency plots for common carp by sampling season in the Lachlan WRPA. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRPA in a sampling season.

Summary Statement:

Variable recruitment a strong peak in 2016/17 and moderate recruitment in 2020/21, 2021/22, and 2022/23. Large fish (>500 mm) present in all years. Low recruitment in 2023/24 with evidence of multiple year classes in the population.

Temporal Trends in Abundance

The relative abundance and biomass of Common carp since 1994 was modelled based on all suitable boat electrofishing data. The left-hand panels of Figure 5.26 show the abundance and biomass trends for the Lachlan WRPA and the right-hand panels show the overall trends across the NSW MDB.

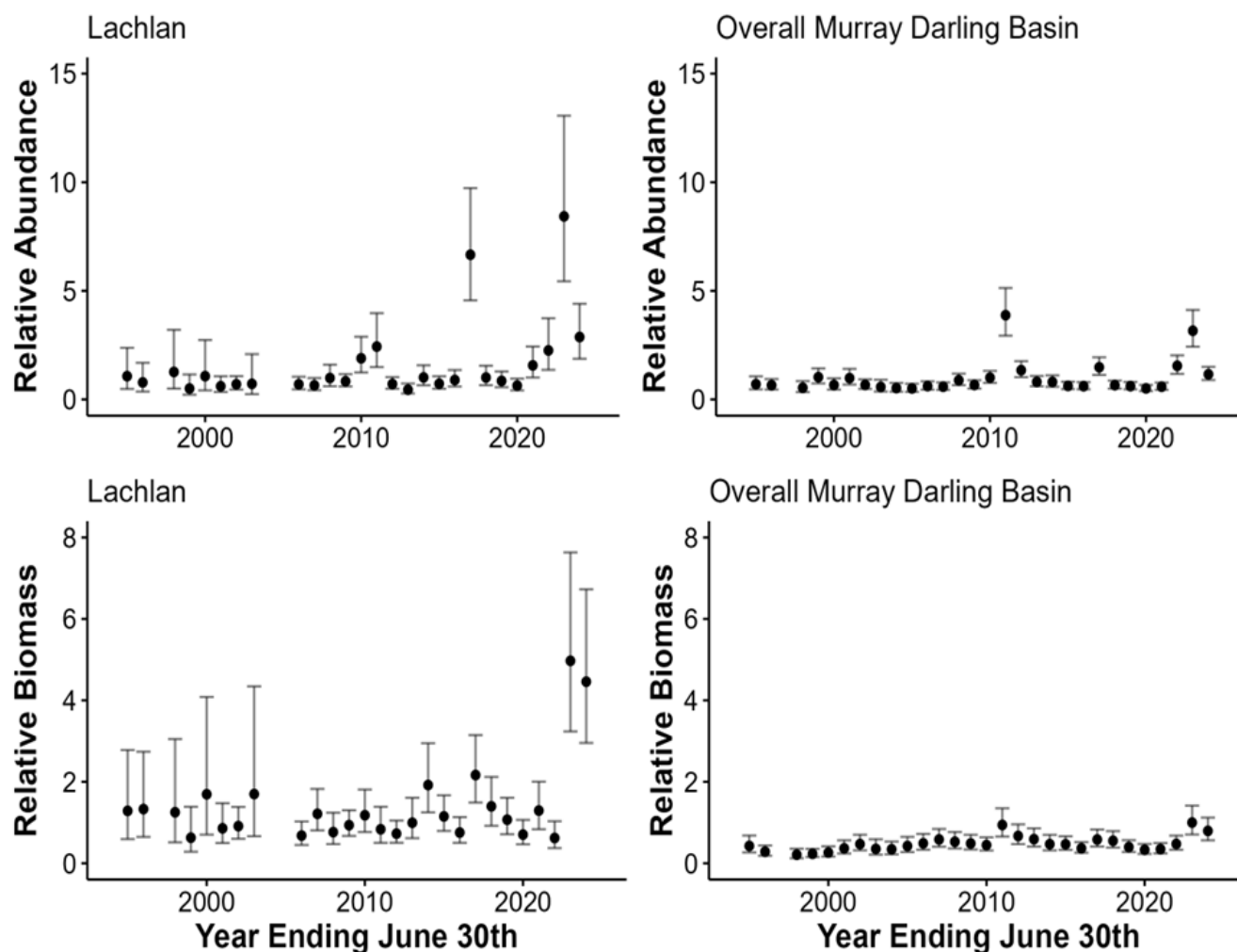


Figure 5.26: Relative abundance and biomass of Common carp in both this valley and the overall Murray-Darling Basin. These are model estimates based upon all electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates.

Summary Statement:

For Common carp in the Lachlan, there is evidence of an increase since the mid 1990s. Recent years of strong recruitment have seen increases in both abundance and biomass. Abundance is now falling to pre-increase level but biomass has not fallen. Relative abundance and biomass is higher compared to the overall abundance across the NSW Murray-Darling Basin.

Health

The prevalence of any health issues ranged from 1 % of sampled fish in 2021/2022 to 8 % of sampled fish in 2014/2015 (Figure 5.27). The most common health issue for Common carp in the Lachlan water resource planning area was *Lernaea*, which was observed in a total of 128 fish, corresponding to 2 % of all Common carp measured.

Across the other WRPA's, 4 % of Common carp (2,141 out of 56,546 Common carp) showed a health condition (excludes Lachlan).

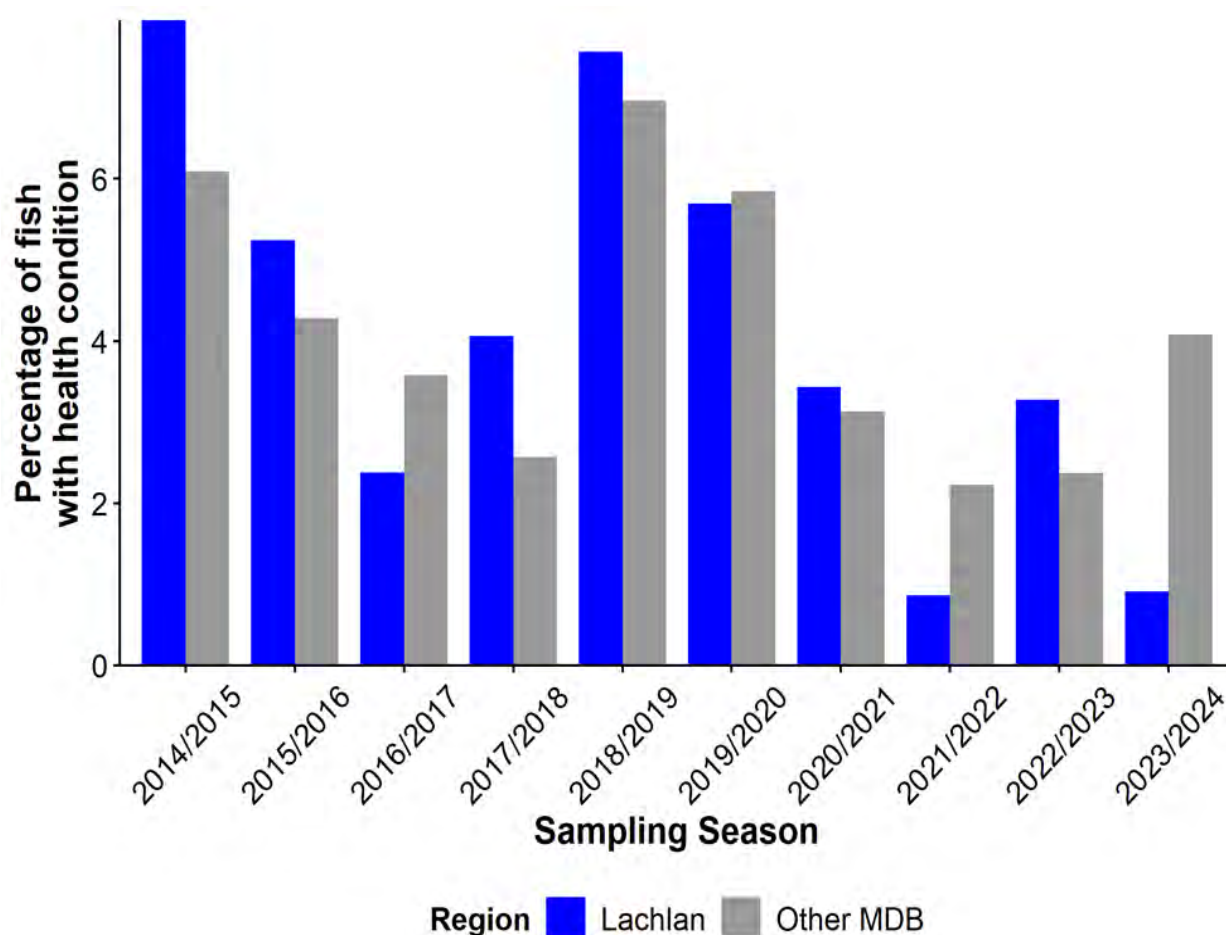


Figure 5.27: Timeseries showing the prevalence of health conditions in Common carp. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA's.

Summary Statement:

The presence of observable health conditions for Common carp in the Lachlan was low and generally tracked the wider NSW MDB. 2023/24 showed a low level of health issues.

Distribution

Common carp were recorded at 120 out of 168 sites in the Lachlan WRPA from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 23.1 fish caught per 90 seconds of electrofishing. Figure 5.28 shows the distribution and relative abundance of Common carp across the Lachlan WRPA.

Summary Statement:

Common carp were found in relatively high abundance across the Lachlan region.

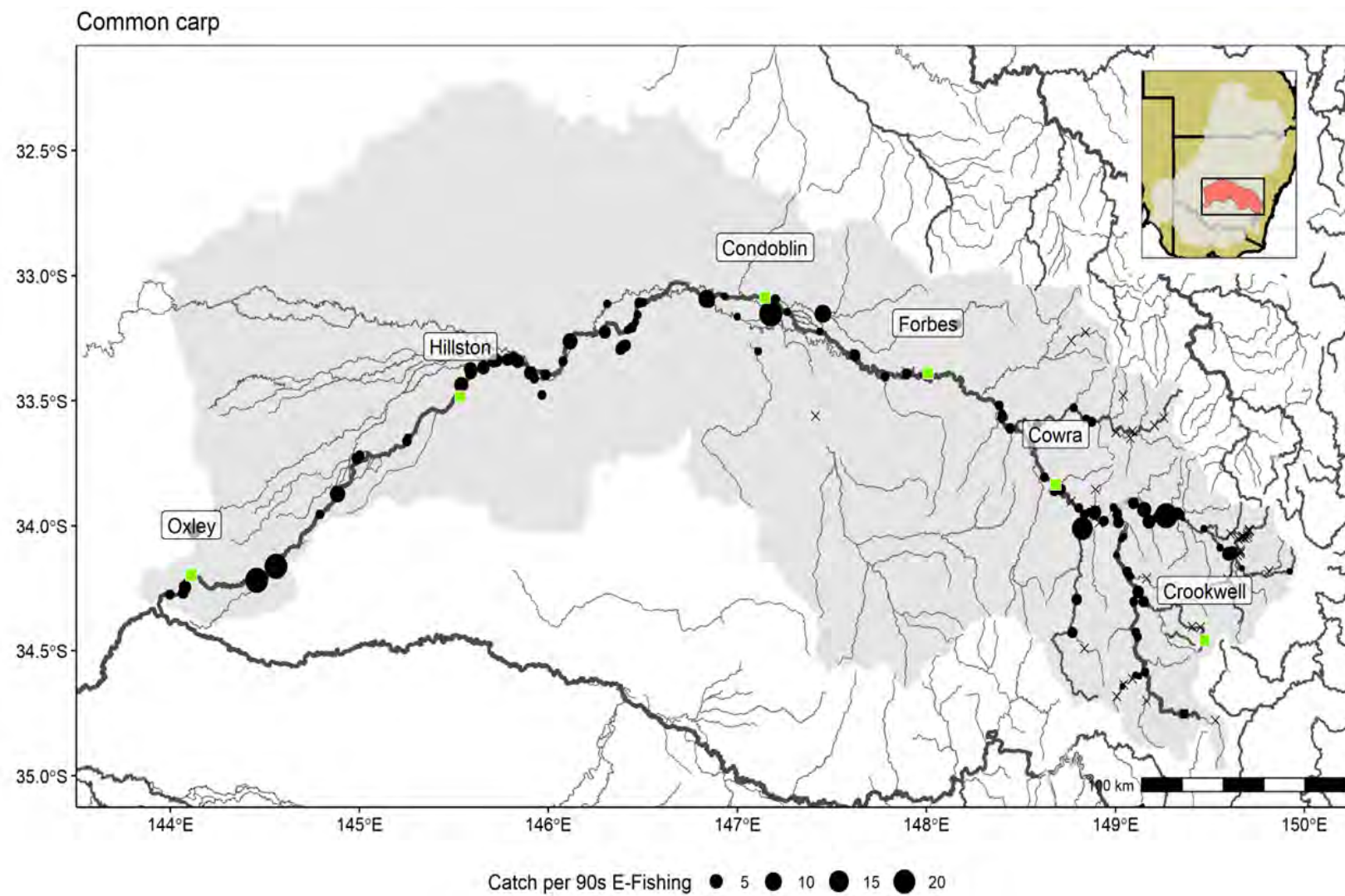


Figure 5.28: Distribution of Common carp sampled from 2013/14 to 2023/24 in the Lachlan WRPA. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares represent key towns.

Threatened Species

The following table (Table 5.6) shows the fish species listed under either the *NSW Fisheries Management Act 1994* (FMA) or the *Commonwealth Environmental Protection and Biodiversity Conservation Act 1999* (EPBC) which were observed during standardised electrofishing surveys in the Lachlan Water Resource Planning Area during the reporting period. A list of all threatened fish species observed by NSW DPIRD Fisheries (as part of any sampling program in any area) is provided in Table 5.10.

Table 5.6: Listed species which were observed in this region during the sampling period. (* = FMA, # = EPBC)

Species	Common name	Total caught (observed)
<i>Bidyanus bidyanus</i>	Silver perch ^{*#}	24 (2)
<i>Maccullochella peelii</i>	Murray cod [#]	1,048 (285)
<i>Macquaria australasica</i>	Macquarie perch ^{*#}	111 (14)
<i>Tandanus tandanus</i>	Freshwater catfish [*]	3 (0)

Note: Olive perchlet have been observed in and near Lake Brewster via other sampling methods.

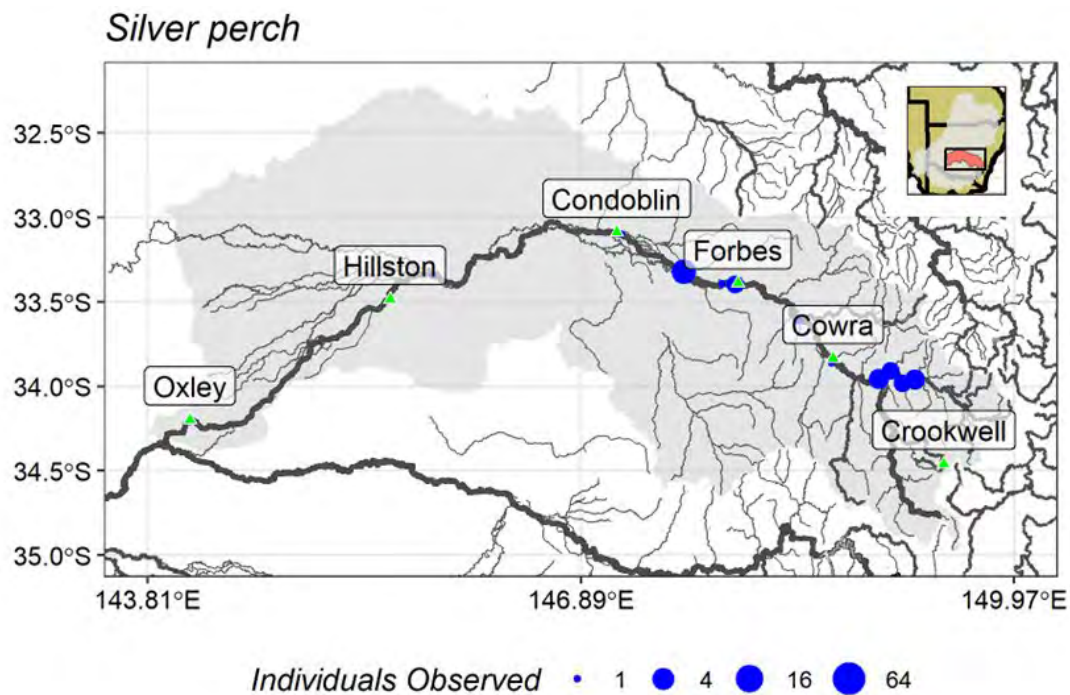


Figure 5.29: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the Lachlan WRP. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance.

Summary Statement:

24 Silver perch were caught during the reporting period across 12 sites in the Lachlan and Abercrombie Rivers. Individuals were observed in all sampling years except 2023/24.

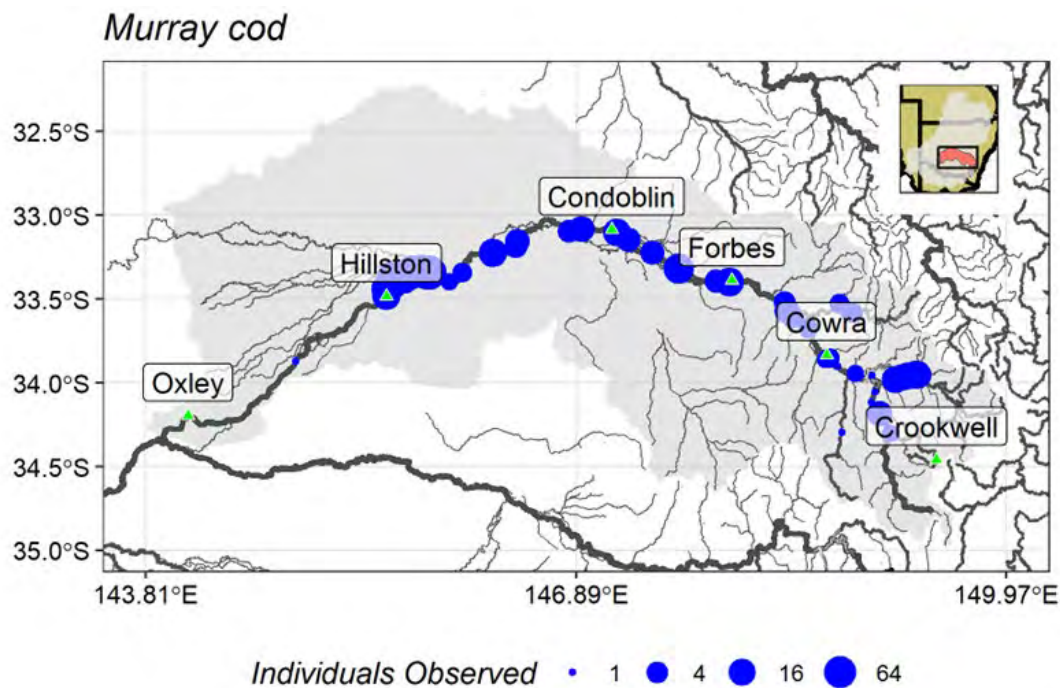


Figure 5.30 Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the Lachlan WRP. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance. Note the lower image shows a juvenile Murray cod.

Summary Statement:

Murray cod were widespread across the Lachlan WRP and were particularly common in the Lachlan River. A total of 1,048 individuals were caught over the reporting period with individuals observed in each sampling season.

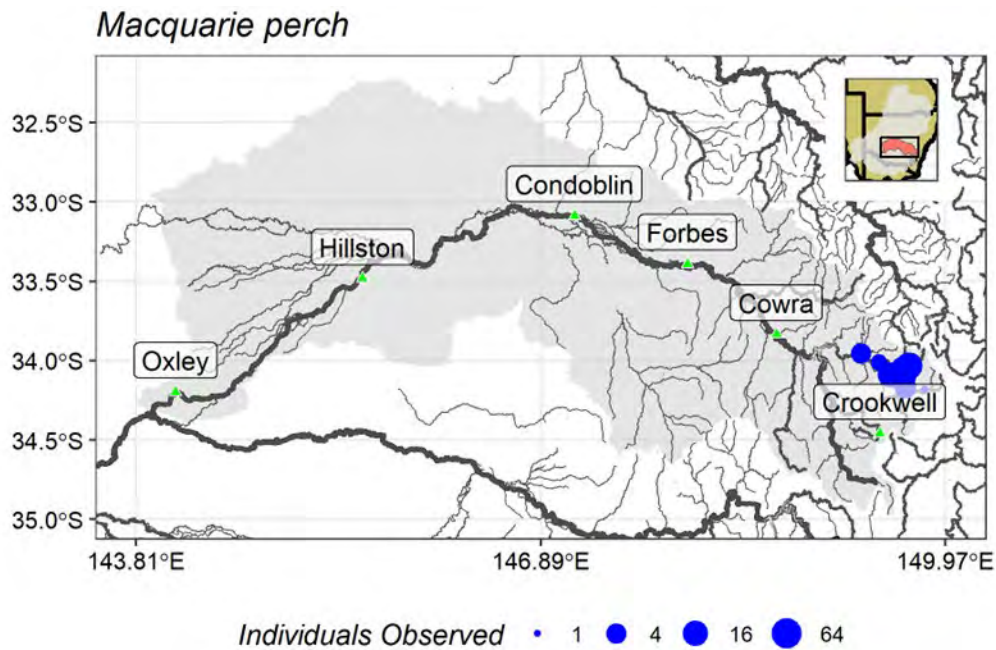


Figure 5.31: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the Lachlan WRP. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance.

Summary Statement:

111 Macquarie perch were caught during the reporting period across 19 sites in the eastern upland area (Abercrombie and Retreat Rivers). No Macquarie perch were caught after 2019/20. Macquarie perch were stocked in the Lachlan WRP from 2010/11 – 2014/15. Sampling effort has decreased with only four samples (across two of the sites where Macquarie perch were observed) have been taken since 2019/2020.

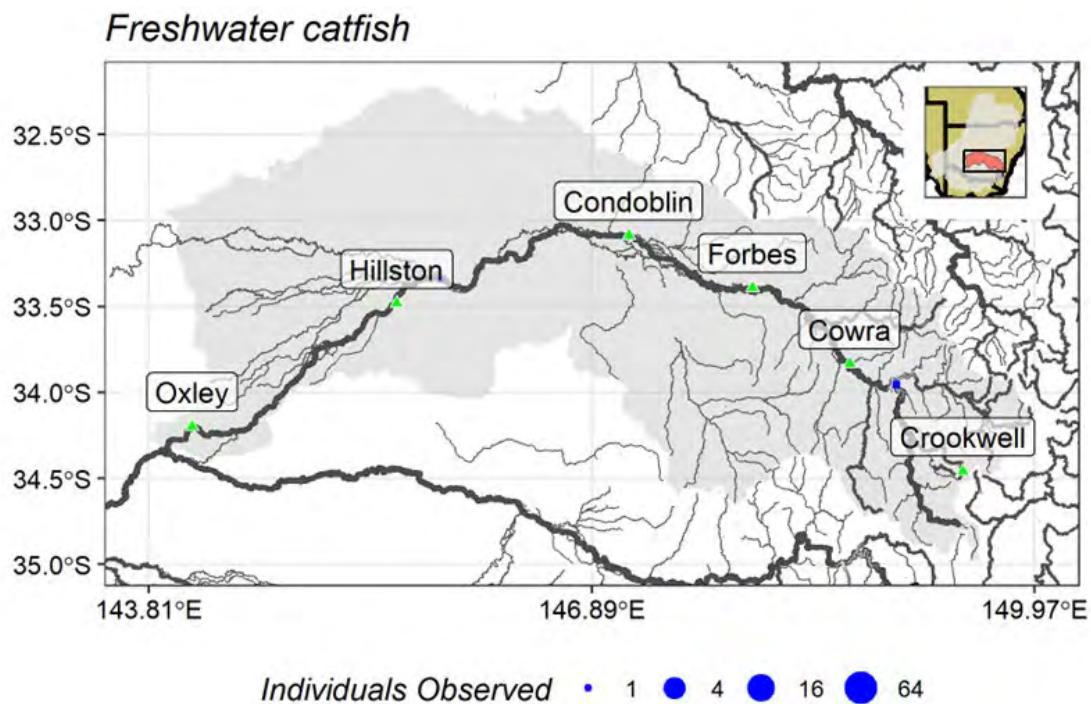


Figure 5.32: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the Lachlan WRPA. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance.

Summary Statement:

Only three Freshwater catfish were caught in the Lachlan WRPA during the reporting period. Further details are given in the Freshwater catfish section of the report.

Appendix

This report contains data from the projects listed in Table 5.7.

Table 5.7: Projects included in this report. Sampling Events show the total number of sampling events included from each project. Sampling Seasons shows which sampling seasons each project contributed data to.

Project Name	Sampling Seasons	Sampling Events
Basin Plan Environmental Outcomes Monitoring	2014/2015, 2015/2016, 2016/2017, 2017/2018, 2018/2019, 2019/2020	109
Basin Plan Environmental Outcomes Monitoring 2	2022/2023, 2023/2024	28
Carp Biomass Project (NCCP)	2017/2018	6
Carp herpes virus investigation	2015/2016, 2016/2017	11
Lachlan Long Term Intervention Monitoring	2014/2015, 2015/2016, 2016/2017, 2017/2018, 2018/2019, 2019/2020, 2020/2021, 2021/2022, 2022/2023, 2023/2024	100
Lachlan Macquarie Perch Rescue	2014/2015, 2015/2016, 2016/2017, 2017/2018, 2019/2020	59
Macquarie perch surveys	2018/2019, 2020/2021	10
Monitoring, Evaluating and Reporting - Inland	2014/2015	1
Murray-Darling Basin Fish Surveys	2014/2015, 2015/2016, 2016/2017, 2017/2018, 2018/2019, 2019/2020, 2021/2022, 2022/2023, 2023/2024	53
Olive perchlet surveys	2015/2016	3
Three Dams	2020/2021	19

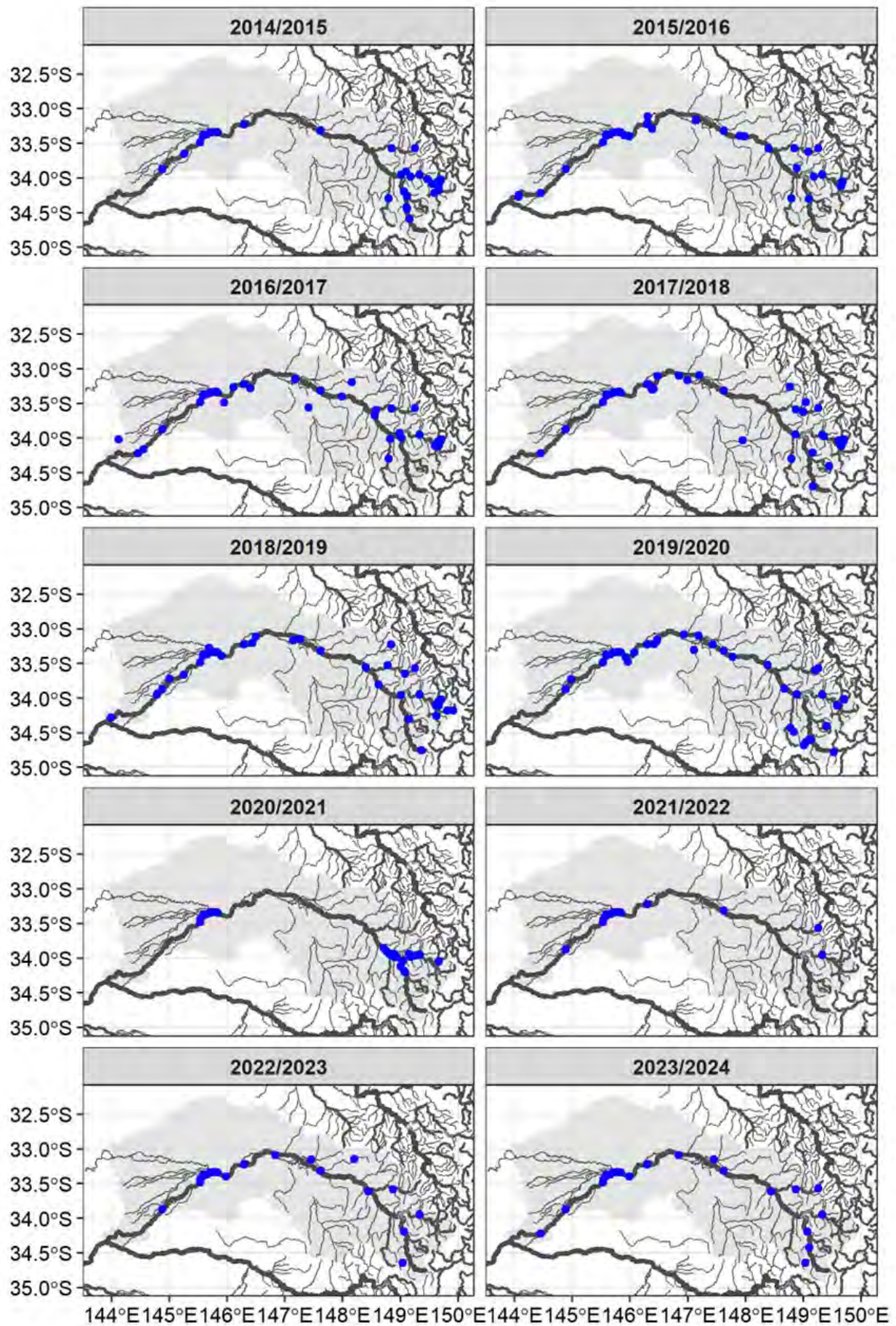


Figure 5.33: Sites sampled and included in this report by sampling season in the Lachlan WRPA. Dry sites are not shown.

Table 5.8 shows all species detected during this survey period as part of standardised monitoring projects (see Table 5.7). Note there are variations in effort between sampling seasons so this information should be considered in conjunction with Table 5.1. The Expected from Modelling column identifies species which are possible to occur based upon MaxENT habitat modelling (likelihood threshold > 0.33; NA represents no modelling was undertaken). Species that were possible from the modelling but not observed during standardised sampling in the Lachlan WRPA were: Olive perchlet, Darling hardyhead, Murray hardyhead, Flat-headed galaxias, Spangled perch, Trout cod, Murray-Darling rainbowfish, Southern purple-spotted gudgeon, Southern pygmy perch and Dwarf flathead gudgeon. It should be noted that the MaxENT modelling models habitat availability and is not always a reliable index of abundance, it merely indicates possible distribution based upon habitat. A full list of species observed during this period across the standardised monitoring protocols and sampling methods is presented in Table 5.11.

Table 5.8: Total number caught of each species by sampling season in the Lachlan WRPA.

Common name	Expected from modelling	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24
Australian smelt	YES	95	67	805	249	38	34	94	444	123	32
Bony herring	YES	1,815	3,820	2,442	6,667	2,837	353	686	837	574	1,038
Brown trout	YES	5	0	19	38	0	30	0	0	0	0
Carp-gudgeon species complex	YES	897	796	253	265	263	292	231	213	53	269
Common carp	NA	415	599	7,085	590	487	474	940	1,108	4,306	1,606
Common carp - Goldfish hybrid	NA	0	0	15	0	0	0	0	0	0	0
Eastern gambusia	NA	210	104	490	641	662	519	40	233	15	7
Flathead gudgeon	YES	57	21	94	9	10	71	46	23	5	4
Freshwater catfish	YES	1	0	0	0	1	0	0	0	0	1
Galaxias spp	NA	0	0	258	1,221	78	16	0	0	5	0
Golden perch	YES	183	124	94	98	130	152	141	26	66	43
Goldfish	NA	13	85	89	44	103	116	37	60	224	248
Macquarie perch	YES	62	4	24	13	1	7	0	0	0	0
Mountain galaxias	YES	2,603	477	397	404	847	129	95	0	2	14
Murray cod	YES	198	124	36	36	55	149	247	50	77	76
River blackfish	NA	0	0	0	0	16	0	0	0	2	0
Rainbow trout	YES	3	1	1	4	2	0	0	0	0	0
Redfin	YES	2	1	32	85	100	11	0	2	6	6
Silver perch	YES	4	3	2	1	3	2	6	1	2	0
Unspecked hardyhead	YES	7	19	15	18	0	5	5	105	1	7

The following table summarises the sampling methods for each species caught (Table 5.9).

Table 5.9: Total catch of each species by sampling method in the Lachlan WRPA.

Common name	Backpack Electrofishing	Bait Trap	Boat Electrofishing
Australian smelt	108	1	1,872
Bony herring	30	3	21,036
Brown trout	91	0	1
Carp-gudgeon species complex	182	2,993	357
Common carp	687	990	15,933
Common carp - Goldfish hybrid	0	0	15
Eastern gambusia	1,471	641	809
Flathead gudgeon	19	112	209
Freshwater catfish	0	0	3
Galaxias spp	1,244	318	16
Golden perch	0	0	1,057
Goldfish	78	1	940
Macquarie perch	108	0	3
Mountain galaxias	4,265	689	14
Murray cod	16	0	1,032
River blackfish	18	0	0
Rainbow trout	10	0	1
Redfin	29	3	213
Silver perch	0	0	24
Unspecked hardyhead	0	0	182

Table 5.10: Listed threatened species recorded in the Murray-Darling Basin (from the NSW DPIRD Fisheries Freshwater Ecosystem research database). Species are listed under either the NSW Fisheries Management Act 1994 (FMA) or the Commonwealth Environmental Protection and Biodiversity Conservation Act 1999 (EPBC).

Genus, species	Common Name	EPBC Status	FMA Status
<i>Ambassis agassizii</i>	Agassiz's glassfish, olive perchlet, western New South Wales population	NA	Endangered Population
<i>Bidyanus bidyanus</i>	Silver Perch, Bidyan	Endangered	Vulnerable
<i>Craterocephalus fluviatilis</i>	Murray Hardyhead	Endangered	Critically Endangered
<i>Galaxias rostratus</i>	Flathead Galaxias, Beaked Minnow, Flat-headed Galaxias, Flat-headed Jollytail, Flat-headed Minnow	Critically Endangered	Critically Endangered
<i>Galaxias tantangara</i>	Stocky Galaxias	NA	Critically Endangered
<i>Maccullochella macquariensis</i>	Trout Cod	Endangered	Endangered
<i>Maccullochella peelii</i>	Murray Cod	Vulnerable	NA
<i>Macquaria australasica</i>	Macquarie Perch	Endangered	Endangered
<i>Mogurnda adspersa</i>	Southern Purple Spotted Gudgeon	NA	Endangered
<i>Nannoperca australis</i>	Southern Pygmy Perch	Vulnerable	Endangered
<i>Tandanus tandanus</i>	Freshwater catfish, eel tailed catfish, Murray-Darling Basin population	NA	Endangered Population

Table 5.11 shows all species detected during this survey period across all programs and methods. Due to variations in project methods protocols, this data is presented only to give a complete list of species observed in the region. The Expected from Modelling column identifies species which are possible to occur based upon MaxENT habitat modelling (likelihood threshold > 0.33; NA represents no modelling was undertaken). Species that were possible from the modelling but not observed during standardised sampling in the Lachlan WRPAs were: Darling hardyhead, Murray hardyhead, Flat-headed galaxias, Spangled perch, Trout cod, Murray-Darling rainbowfish, Southern purple-spotted gudgeon, Southern pygmy perch and Dwarf flathead gudgeon. It should be noted that the MaxENT modelling actually models habitat availability and is not always a reliable index of abundance, it merely indicates possible distribution based upon habitat. A list of species caught as part of standardised monitoring during this period is in Table 5.8.

Table 5.11: Total catch of each species by all sampling programs and all methods in the Lachlan WRPAs. Note these include projects with sampling not representative of the community and the data should be used with caution.

Common name	Expected from modelling	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24
Australian smelt	YES	96	67	806	279	38	44	94	566	146	32
Bony herring	YES	1,855	3,853	2,463	8,455	2,865	353	689	852	575	1,071
Brown trout	YES	9	0	19	38	0	30	0	0	0	0
Carp gudgeon species complex	YES	957	6,397	596	4,482	627	3,116	453	6,458	414	335
Common carp	NA	416	650	8,156	802	508	479	946	1,125	4,521	1,609
Common carp - Goldfish hybrid	NA	0	0	15	0	0	0	0	0	0	0
Eastern gambusia	NA	481	717	1,468	1,201	854	1,700	270	315	544	22
Flathead gudgeon	YES	57	33	95	9	15	84	83	1,588	10	4
Freshwater catfish	YES	2	0	0	0	1	0	0	0	0	1
Galaxia spp	NA	0	0	272	1,221	78	16	0	0	5	0
Golden perch	YES	201	135	108	291	135	152	142	26	66	43
Goldfish	NA	13	86	92	56	103	119	37	62	231	248
Macquarie perch	YES	109	16	36	45	12	74	0	0	0	0
Mountain galaxias	YES	2,705	544	397	404	847	129	96	0	2	14
Murray cod	YES	198	127	36	41	55	149	247	50	77	76
River blackfish	NA	0	0	0	0	42	0	0	0	2	0
Olive perchlet	YES	0	126	0	0	0	0	0	0	0	0
Rainbow trout	YES	3	1	1	4	2	0	0	0	0	0

Common name	Expected from modelling	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24
Redfin	YES	2	2	33	142	135	19	0	2	11	6
Silver perch	YES	4	3	2	1	3	2	6	1	2	0
Unspecked hardyhead	YES	7	22	15	18	0	6	6	111	3	7

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Chapter 6 Basin Plan Fish Monitoring Summary (2014/15 – 2023/24): Macquarie-Castlereagh Water Resource Planning Area

Hayden Schilling & David Crook

March 2025



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Chapter cover image credit: NSW DPIRD FER; Fish images credit: Gunther Schmida

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Introduction

This report spans 2014/15 to 2023/24 and uses all suitable fish assemblage data collected by NSW DPIRD Fisheries using standardized electrofishing monitoring techniques. The format of the report follows and expands upon the previous reports (Schilling & Crook 2023, 2024). This report focusses on the Macquarie-Castlereagh Water Resource Planning Area (WRPA) shown in Figure 6.1.

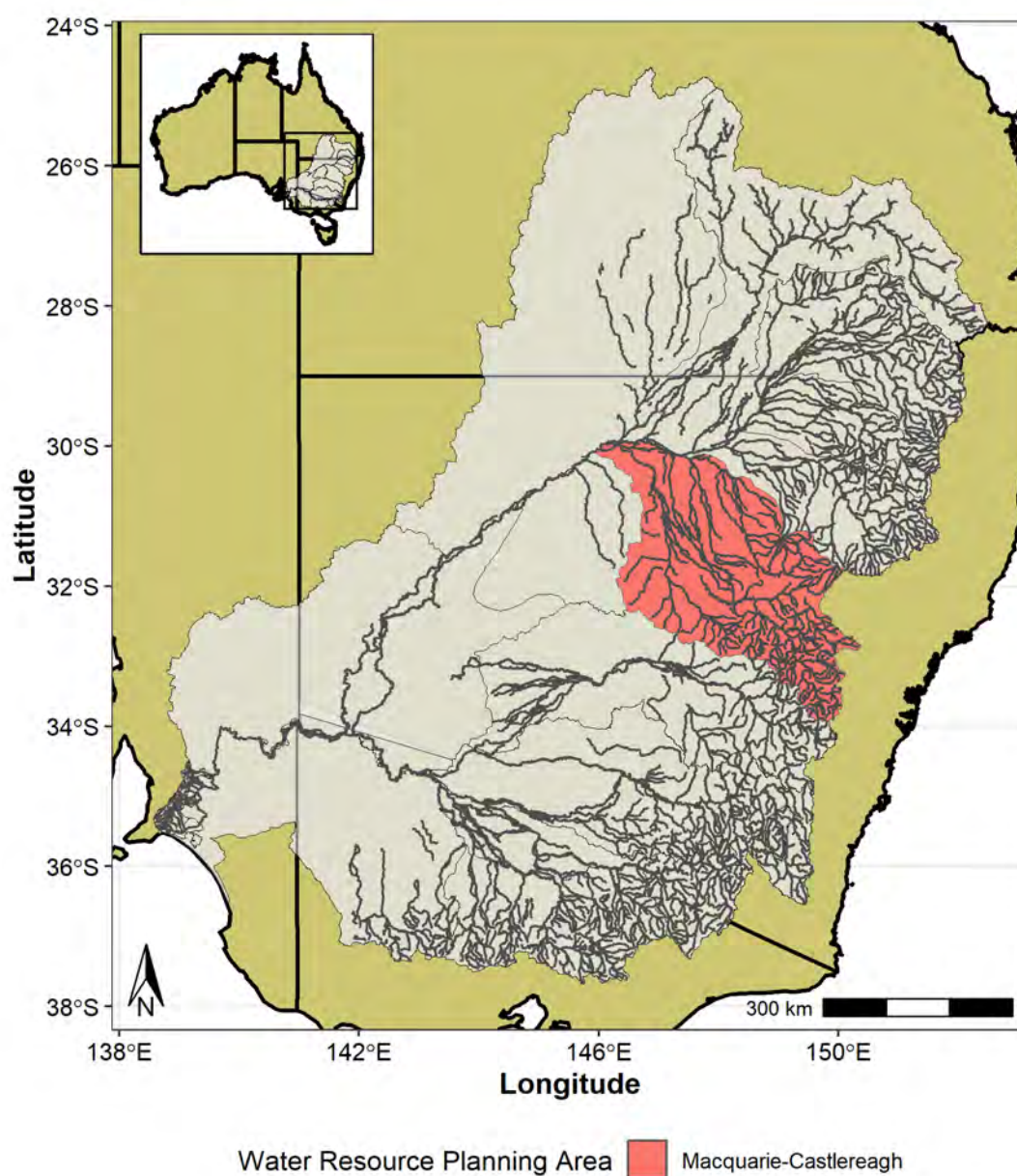


Figure 6.1: Murray-Darling Basin with the key region of this report highlighted. Inset map shows the whole of Australia with a box around the MDB.

What This Report Includes

This report starts with an overview of the standardised monitoring programs including sampling details and statistics. An overview of the hydrological and climatic conditions during the reporting period is also provided as context for interpreting the fish population status data.

Following the introductory sections, we present a summary of *fish diversity* across the Macquarie-Castlereagh WRP. Separate plots for native and alien species show the total number of unique species observed at each site.

The main body of the report provides detailed information on the *population structure, relative abundance, health, and distribution* of six key fish species:

- Murray cod
- Golden perch
- Freshwater catfish
- Bony herring
- Australian smelt
- Common carp

Population structure information includes length frequency plots of collected fish and the proportion of fish classified as Young of the Year (YOY). This information can be used to infer the size structure of populations and the level of recruitment each year. For additional context, we provide a summary table showing any stocking which occurred for the species in each year (if relevant).

Relative abundance and *relative biomass* (a unit-less measure representing the number (or biomass) of fish in an area) information is adapted from the modelled outputs from a more in-depth publication (Crook et al. 2023) which considers all available electrofishing data within the NSW Murray-Darling Basin (MDB). The updated analysis uses generalised linear mixed models to generate annual indices of relative abundance and biomass for each WRP. In this report we present the modelled time series of relative abundance showing the predicted number (or biomass) of fish observed per 90 second shot of electrofishing. The abundance and biomass trends for the Macquarie-Castlereagh WRP are contrasted with the overall NSW MDB dataset. It should be noted that these are modelled estimates of relative abundance/biomass, not absolute abundance/biomass as absolute estimates would require extensive calibration surveys that are not included in the monitoring program.

Health information is provided as a summary of any visible health conditions recorded for the key species. The number of health conditions observed in a fish population is generally reflective of water quality, competition, and many other factors. Fewer observations of health conditions indicate healthier populations. The health conditions detailed are any that were observed as part of the biological measurements taken. We provide a comparison of the prevalence of health conditions in the Macquarie-Castlereagh WRP and greater MDB (excluding the Macquarie-Castlereagh WRP).

Distribution maps are provided for each species to show the observed distribution of each species from electrofishing samples. The distribution maps also show the relative abundance (number of fish observed per 90 seconds of electrofishing) at each site to give an indication of how the population is spread over the landscape.

Finally, the distributions and numbers of *Threatened species* are reported. The report includes threatened species that were recorded by standardised monitoring programs in the Macquarie-Castlereagh WRP during the reporting period.

For each section of the report, we provide a *Summary Statement*. This statement provides a very brief overview of the key messages for each section.

Sampling Methods

Three main methods are used during routine fish monitoring surveys: boat electrofishing, backpack electrofishing and bait traps. This report mainly includes the electrofishing data with bait trap samples informing the distribution of small bodied species. The electrofishing was conducted using the standard methodology implemented in the Sustainable Rivers Audit (SRA; Davies et al. 2010). This usually includes 12 shots of 90 seconds “power on” during each sampling event.

As parts of this report compile data from multiple projects, there is some variation in how sites were chosen and the effort of sampling conducted each year (Table 6.1). Details of which projects contributed data to this report can be seen in Table 6.7. At each site, sampling gear was applied as suited to the local conditions with either boat, backpack, or a hybrid of the two, in addition to 10 unbaited bait traps set in edge margins. Most sampling occurred between the months of September and May.

Table 6.1: Sampling effort (Number of sites sampled) each sampling season in the Macquarie-Castlereagh WRPA. Variation in sampling effort is due to different numbers of projects and interruptions to planned sampling such as flooding, site desiccation, and extreme weather.

Sampling Season	Number of Boat Electrofishing Sites	Number of Backpack Electrofishing Sites	Number of Hybrid Sites	Total
2014/2015	24	7	9	40
2015/2016	27	11	6	44
2016/2017	35	16	15	66
2017/2018	11	15	13	39
2018/2019	14	9	13	36
2019/2020	5	8	13	26
2020/2021	13	3	1	17
2021/2022	13	7	10	30
2022/2023	17	9	13	39
2023/2024	13	8	12	33

The sites sampled during the reporting period are shown in Figure 6.2. A breakdown of sites sampled each sampling season is shown in the Appendix (Figure 6.39).

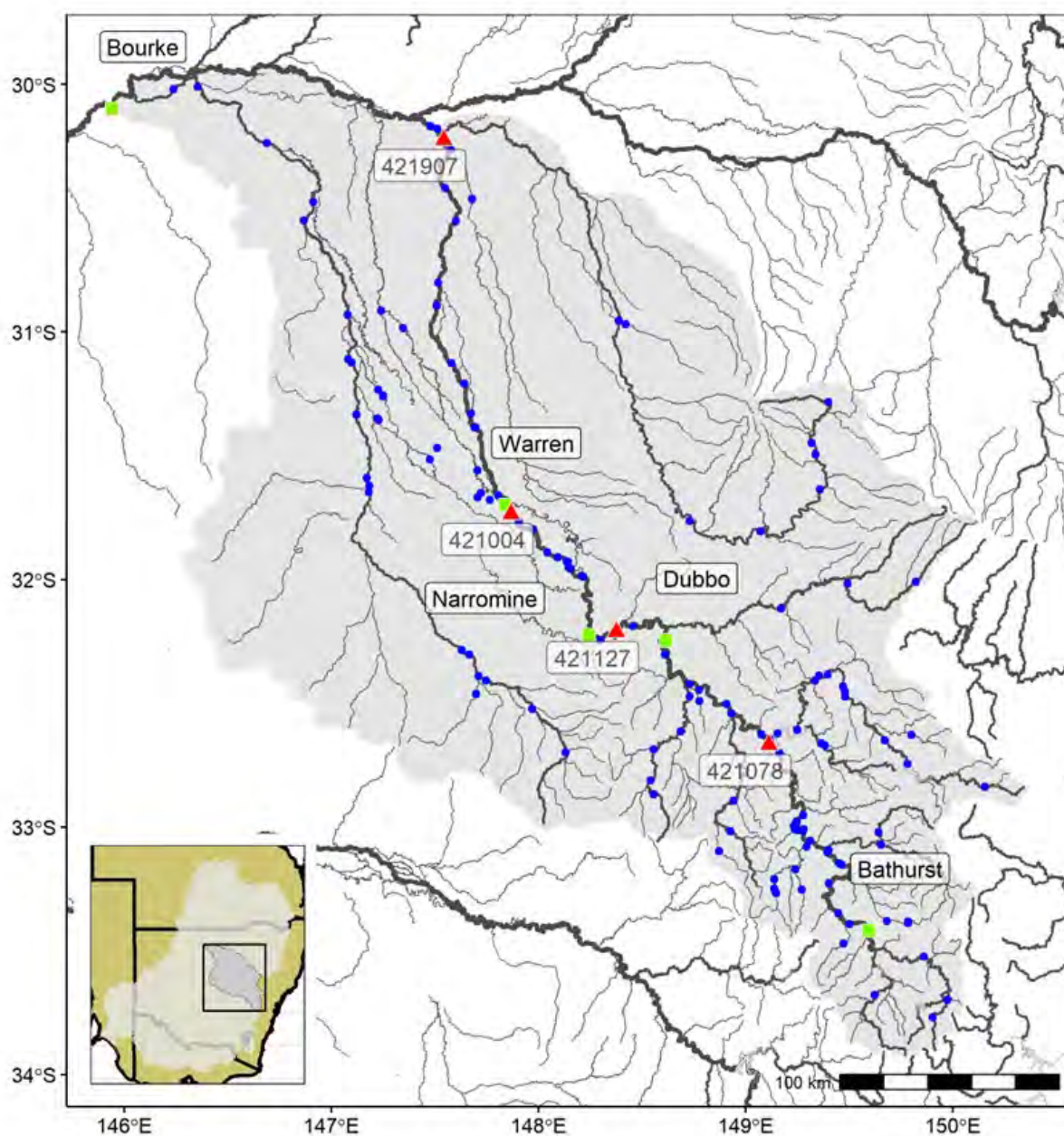


Figure 6.2: Sites (dots) sampled during the reporting period in the Macquarie-Castlereagh WRP. Triangles show key flow gauges along with their gauge ID number. Green squares show major towns.

Each sampling method has a different effectiveness at sampling each species. Table 6.2 shows the total numbers of each key species caught by each method.

Table 6.2: Number of each key species caught by sample method over the whole program in the Macquarie-Castlereagh WRPA. Further data on total catch is provided in the Appendix.

Common name	Boat Electrofishing	Backpack Electrofishing	Bait Trap
Australian smelt	2,542	276	1
Bony herring	2,695	112	11
Common carp	9,110	1,022	723
Freshwater catfish	101	19	0
Golden perch	845	10	3
Murray cod	1,434	18	1

A subset of sampled fish had biological measurements taken during the surveys, including but not limited to length and weight measurements and visual health assessments. Table 6.3 shows the number of biological measurements taken each year for the six key species.

Table 6.3: Number of biological measurements taken for the key species each sampling season in the Macquarie-Castlereagh WRPA.

Sampling Season	Australian smelt	Bony herring	Common carp	Freshwater catfish	Golden perch	Murray cod
2014/2015	567	211	1,183	32	172	299
2015/2016	274	104	722	8	93	187
2016/2017	389	455	2,595	19	235	203
2017/2018	51	127	629	6	39	101
2018/2019	56	44	642	10	38	98
2019/2020	42	26	451	2	12	39
2020/2021	100	60	142	4	25	176
2021/2022	77	119	546	4	111	114
2022/2023	73	257	1,017	11	83	129
2023/2024	77	174	590	4	69	116

Climate Overview

The following is a summary of the climatic conditions during the reporting period in terms of how the observed conditions compare to long term records. These are direct extracts from the [Australian Bureau of Meteorology climate summaries archive](#) and are written in the given year. To interpret, 2014 states it was the warmest year on record, meaning 2014 was the warmest year on record up to and including 2014 but not including more recent years.

2014

New South Wales experienced its warmest year on record in 2014, with several heatwaves and persistently warm conditions across the State. Rainfall was well below average in the northeast, and close to average elsewhere.

2015

New South Wales recorded well above average temperatures in 2015. Nights were particularly warm, the sixth-warmest on record for the State. Rainfall was close to average for the state as a whole.

2016

2016 was a generally wet, warm year for NSW as a whole, with substantial variability throughout the year and across the state. Following a record-warm start to the year, May to September was the wettest such period on record for NSW, with cooler weather in much of the west of the state. Minimum temperatures were the warmest on record for the State as a whole, with record-warm daytime temperatures on parts of the east coast.

2017

The year 2017 was the warmest on record for New South Wales for both mean and daytime temperatures. It was also the State's driest year since 2006. Following the warmest summer on record for the State, heavy rain in March across the east then made way for a very dry winter and start to spring. Winter overnight temperatures were the lowest since 1997, but daytime temperatures remained above average for most of the year, and were the warmest on record overall.

2018

2018 was the warmest on record for New South Wales for both mean temperature and mean maximum temperature, whilst the mean minimum temperature was fourth-warmest on record. The year was dominated by very dry conditions, with the third-driest January to September on record. October to December saw some relief from the dry, with above average rainfall across parts of the State. Despite this, New South Wales experienced its sixth-lowest annual rainfall on record; its driest year since 2002.

2019

2019 was the driest and warmest year on record for New South Wales. Despite some rain in some months, most of the State received much less rainfall than usual, with the northeast and far west particularly dry. Heatwaves in January brought very high temperatures, and large fires from September onward caused extensive damage and persistent smoke.

2020

2020 saw above average temperature and rainfall in New South Wales. Temperatures were above average across the state in most months except during autumn. There was widespread rain during autumn and spring and in December, but early winter and November rain was below average.

2021

New South Wales had its 6th wettest year on record, with 2021 rainfall 30 % above average. This included significant floods along the east coast in March, and the state's wettest November on record. It was the state's coolest year since 1996, at 0.15 °C above the 1961–1990 average.

2022

2022 was exceptionally wet with the state-averaged annual total being the second-highest on record (since 1900) and many sites recording their highest annual totals on record. Maximum temperatures were lower than average with the state-averaged annual maximum temperature being the coolest since 1992. Minimum temperatures were generally warmer than average with the state-averaged annual minimum temperature being 0.73 °C above the 1961–1990 average.

2023

The state-averaged rainfall was 22.9 % below the 1961–1990 average. Rainfall was above average over small parts of the state's south, west of the Great Dividing Range, while being below average over most of the northern half of the state, especially over parts of the Northern Tablelands, Northern Rivers, Mid-North Coast, and Upper Hunter, where annual rainfall was in the lowest 10 % of historical records (since records began in 1900). State-averaged annual maximum temperature was 1.96 °C above the 1961–1990 average, which is the third highest on record.

2024

Rainfall totals in 2024 were above average to very much above average for the northern and western areas of the state, as well as central parts of the coast. Totals were below average for large parts of the south-east, as well as small parts of the state's north-east and south-west. 2024 was the third-warmest on record for all years since 1910, 1.55 °C above the 1961–1990 average.

Flow Data

Below shows a summary of flow data from a variety of flow gauges in the Macquarie-Castlereagh WRP (Figure 6.3).

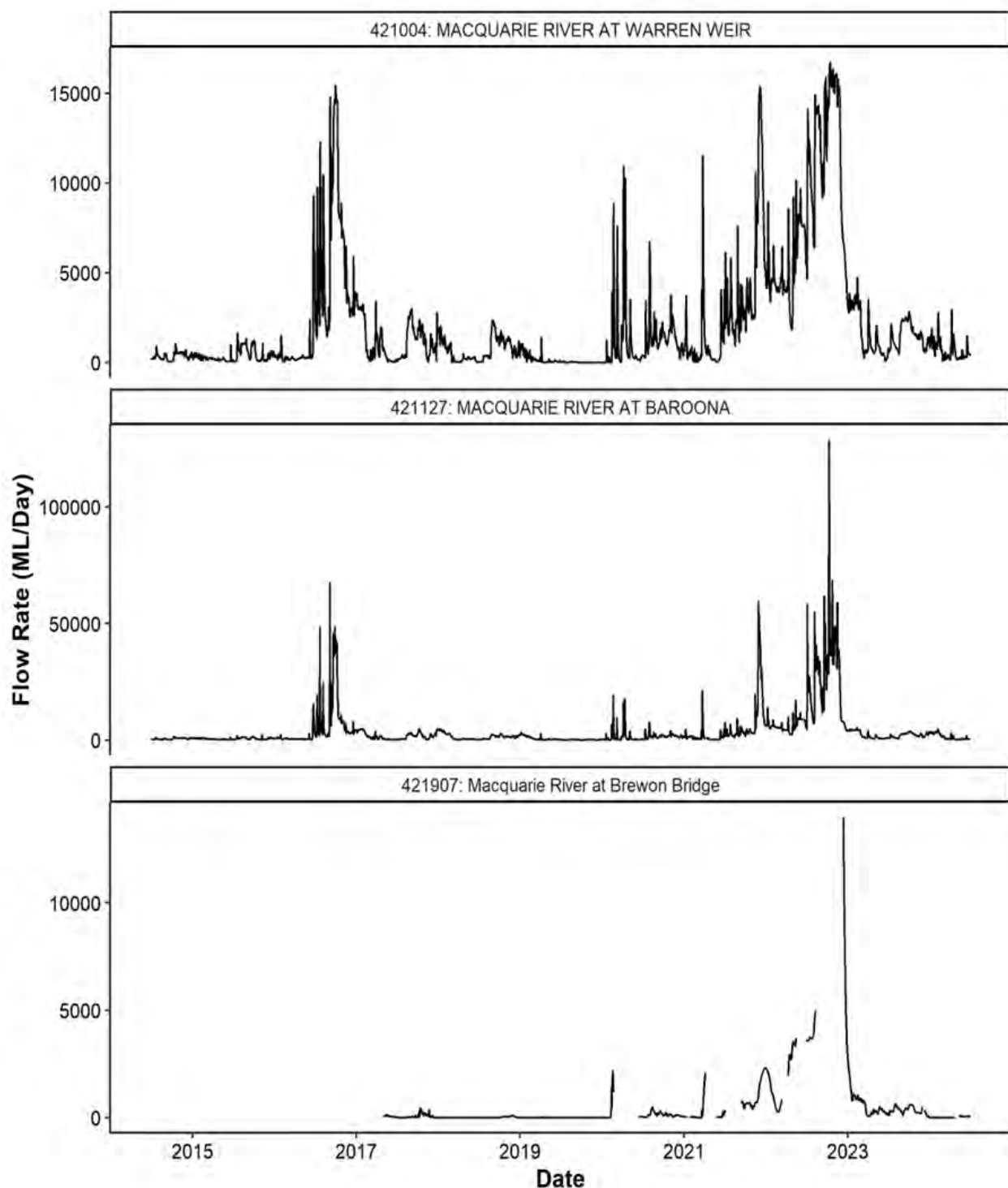


Figure 6.3: Flow data from various gauges in the Macquarie-Castlereagh WRP over the reporting period. Gauge locations can be seen on Figure 6.2. Note the differing scales on the y-axis.

Water temperature data, where available, are also shown in Figure 6.4.

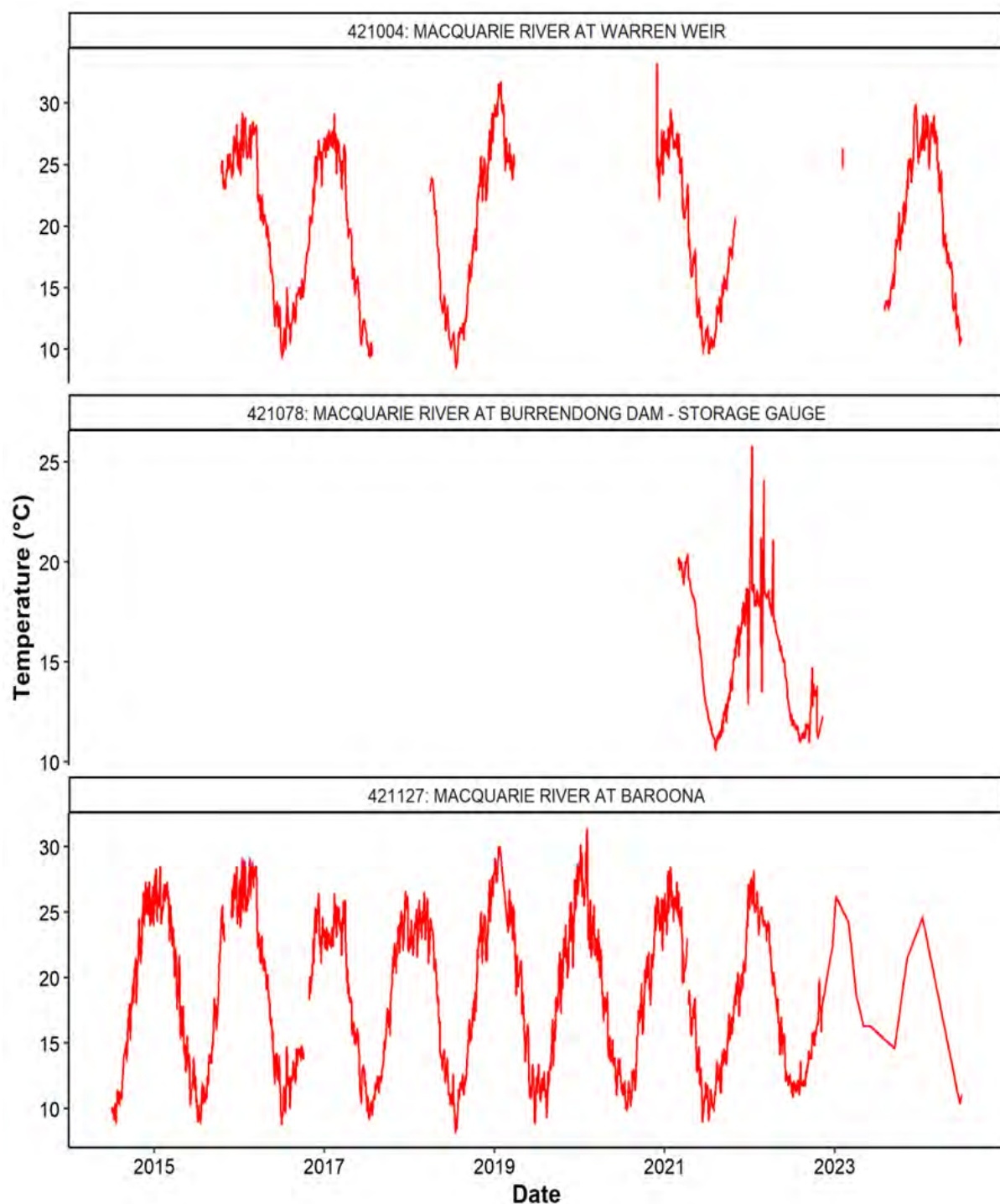


Figure 6.4: Water temperature data from various gauges in the Macquarie-Castlereagh WRPA over the reporting period. Gauge locations can be seen on Figure 6.2. Note the differing scales on the y-axis.

Species Diversity

A total of 24 fish species were observed across the Macquarie-Castlereagh WRPA including seven alien species. Figure 6.5 shows the number of native species found at each site while Figure 6.6 shows the number of alien species found at each site. The full list of species caught and observed is presented in Table 6.8.

Summary Statement:

Native diversity was highest in the central area of the Macquarie-Castlereagh region while the alien diversity was generally consistent across the region.

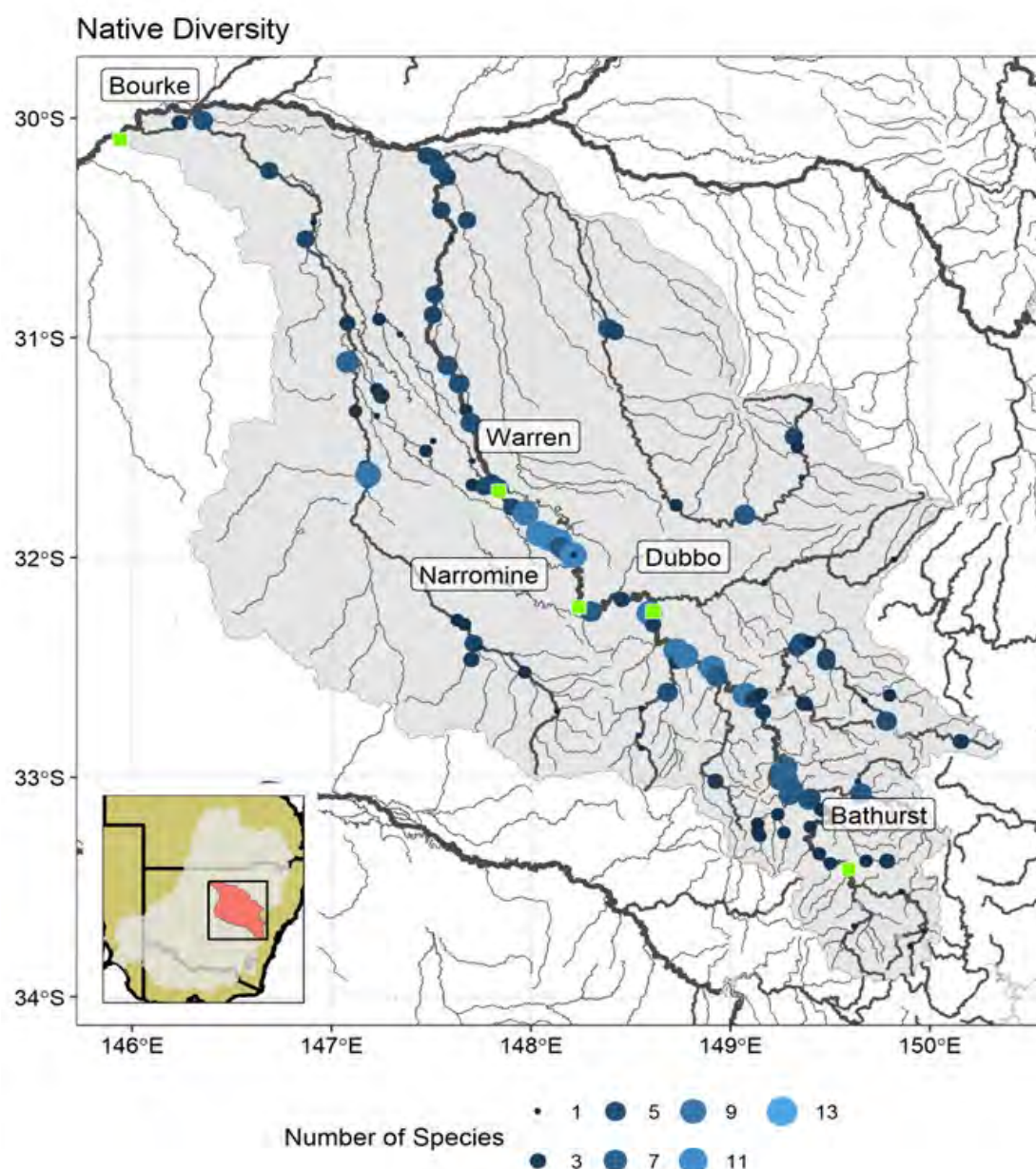


Figure 6.5: Native diversity across all sampling sites in the Macquarie-Castlereagh WRPA. Bubble size represents the number of unique species observed at each site across all sampling methods and events. X represents a site that had water and was sampled, but no fish species were caught at all. Dry sites are excluded. Green squares represent key towns.

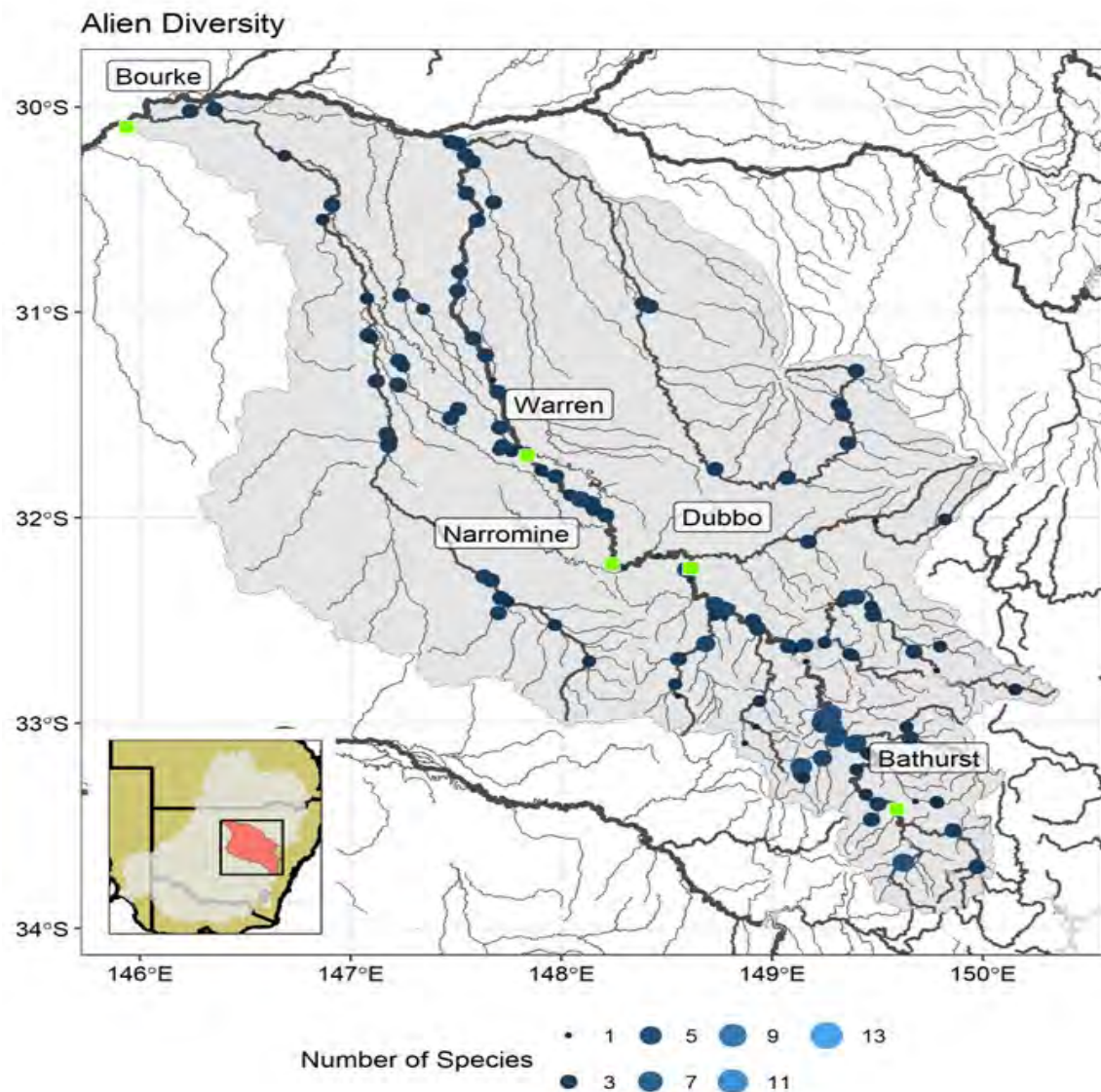


Figure 6.6: Alien diversity across all sampling sites in the Macquarie-Castlereagh WRP. Bubble size represents the number of unique species observed at each site across all sampling methods and events. X represents a site that had water and was sampled, but no fish species were caught at all. Dry sites are excluded. Green squares represent key towns.

Murray cod



Population Structure

Figure 6.7 shows the observed length frequency plot for Murray cod for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 2 to 55, and 1 % to 31 % of measured fish within a season, with a mean percentage YOY of 11 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Murray cod was 13 % (1,282 out of 10,089).

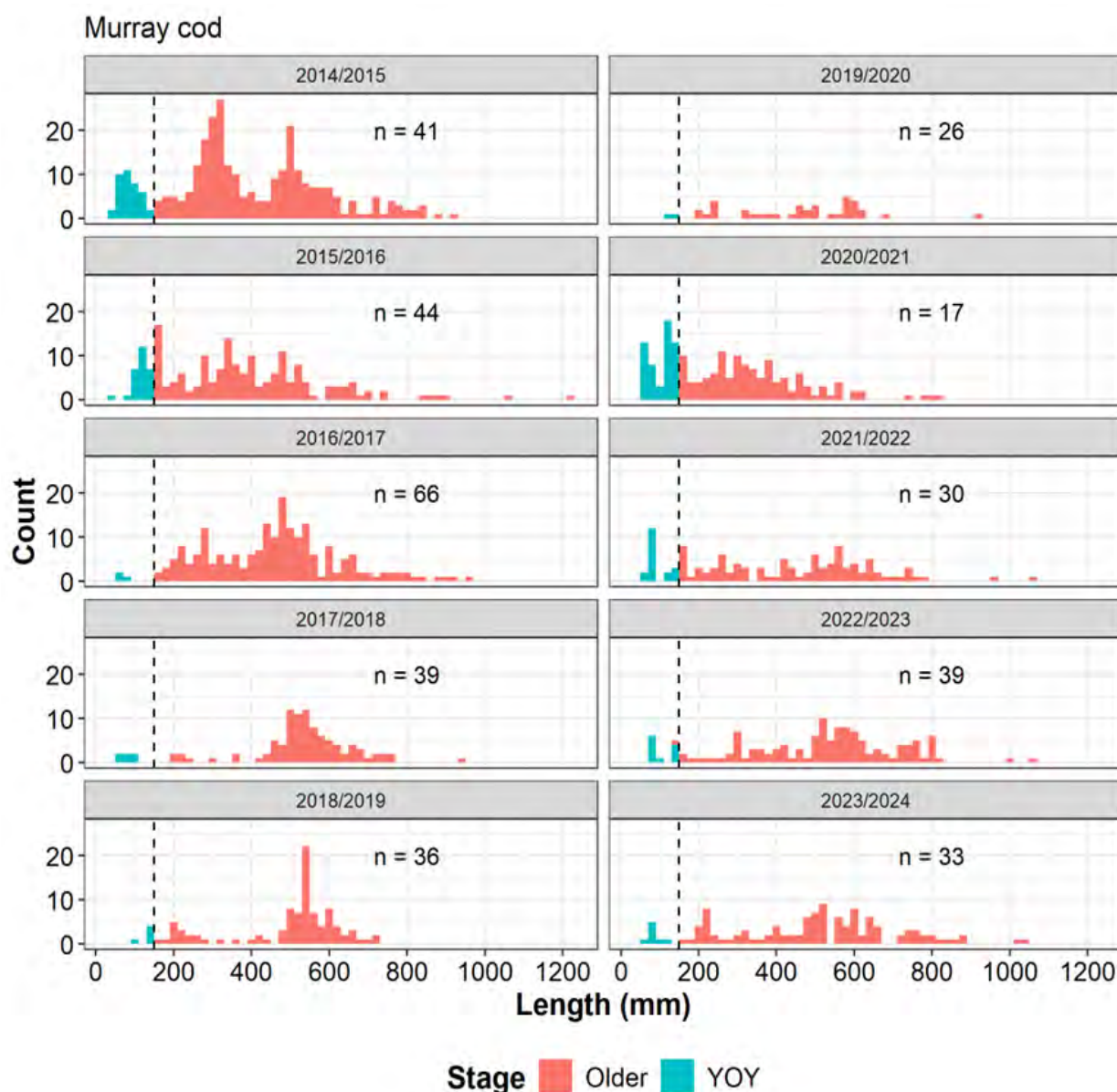


Figure 6.7: Length frequency plots for Murray cod by sampling season in the Macquarie-Castlereagh WRPA. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRPA in a sampling season.

Summary Statement:

Low levels of recruitment evident in most years with stronger recruitment in 2014/15, 2015/16 and 2020/21. A good range of size classes in most years. A few YOY and a wide range of size classes in 2023/24.

Stocking

A total of 1,571,813 Murray cod were stocked into the waterways of the Macquarie-Castlereagh WRPAs during the reporting period. Of these fish, 999,731 (64 %) were stocked into impoundments while 572,082 (36 %) were stocked into rivers or creeks. Table 6.4 shows the detailed breakdown of stocking by season, location and life stage while Figure 6.8 shows the locations of stocking.

Table 6.4: Number and life stage of stocked Murray cod each sampling season in the Macquarie-Castlereagh WRPAs.

Sampling Season	River/Creek or Impoundment	Life Stage	Number Stocked
2014/2015	Impoundment	Fry	83,000
2014/2015	River/Creek	Fry	30,709
2015/2016	Impoundment	Fry	59,000
2015/2016	River/Creek	Fry	35,621
2016/2017	Impoundment	Fingerling	48,957
2016/2017	Impoundment	Fry	197,000
2016/2017	River/Creek	Fingerling	30,229
2016/2017	River/Creek	Fry	10,000
2017/2018	Impoundment	Fry	14,274
2017/2018	River/Creek	Fry	37,629
2018/2019	Impoundment	Fry	47,000
2018/2019	River/Creek	Fry	26,583
2019/2020	Impoundment	Fry	60,000
2019/2020	River/Creek	Fry	13,792
2020/2021	Impoundment	Fry	57,600
2020/2021	River/Creek	Fry	85,160
2021/2022	Impoundment	Fry	204,400
2021/2022	River/Creek	Fry	109,000
2022/2023	Impoundment	Fry	176,500
2022/2023	River/Creek	Fingerling	109,000
2022/2023	River/Creek	Fry	48,466
2023/2024	Impoundment	Fingerling	52,000
2023/2024	River/Creek	Fingerling	35,893

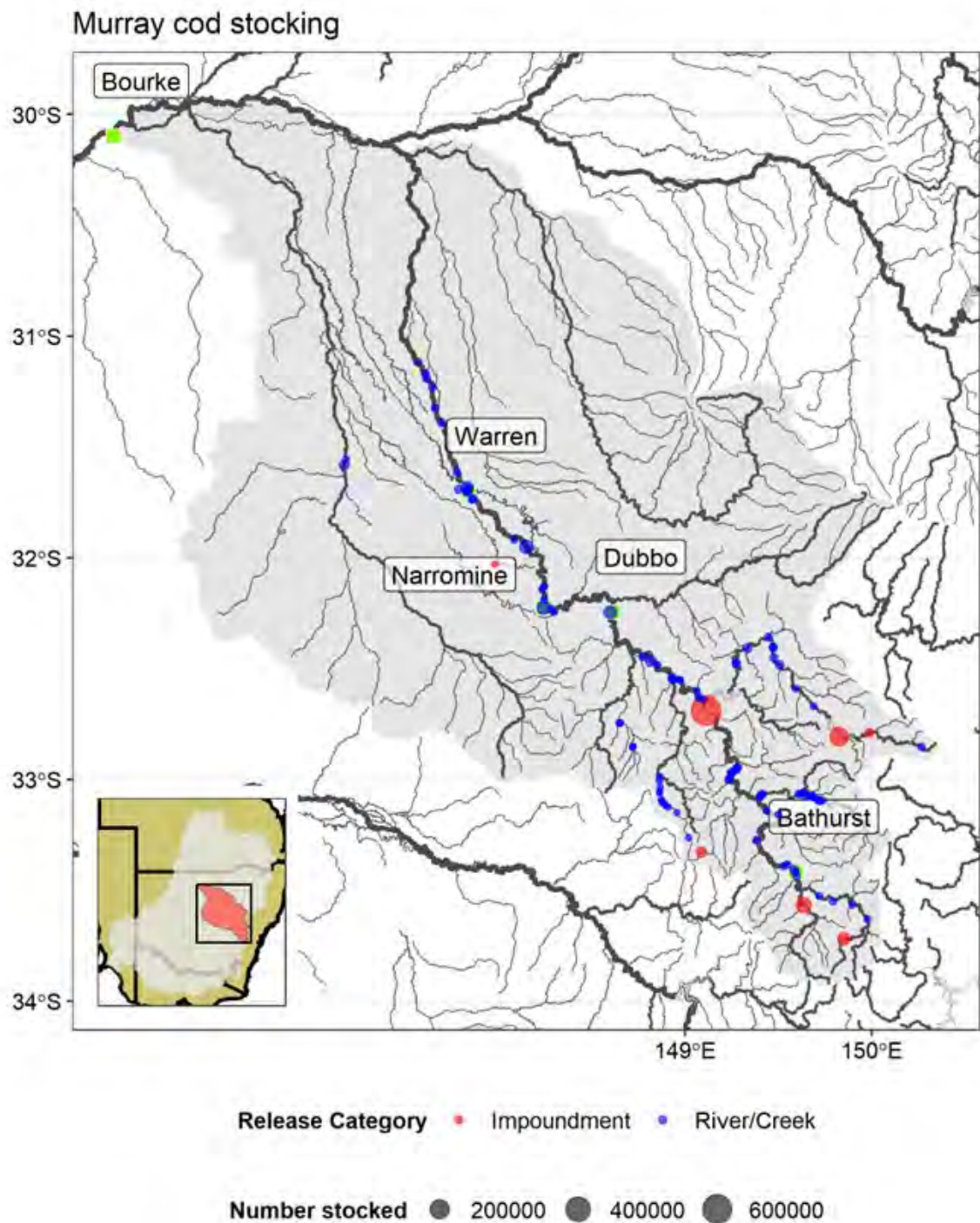


Figure 6.8: Locations of Murray cod stocking in the Macquarie-Castlereagh WRP. Colours show whether a site was a river/creek site or an impoundment, while the size of the point reflects the total number of fish stocked over the reporting period. Green squares represent key towns.

Temporal Trends in Abundance

The relative abundance and biomass of Murray cod since 1994 was modelled based on all suitable boat electrofishing data. The left-hand panels of Figure 6.9 show the abundance and biomass trends for the Macquarie-Castlereagh WRPAs and the right-hand panels show the overall trends across the NSW MDB.

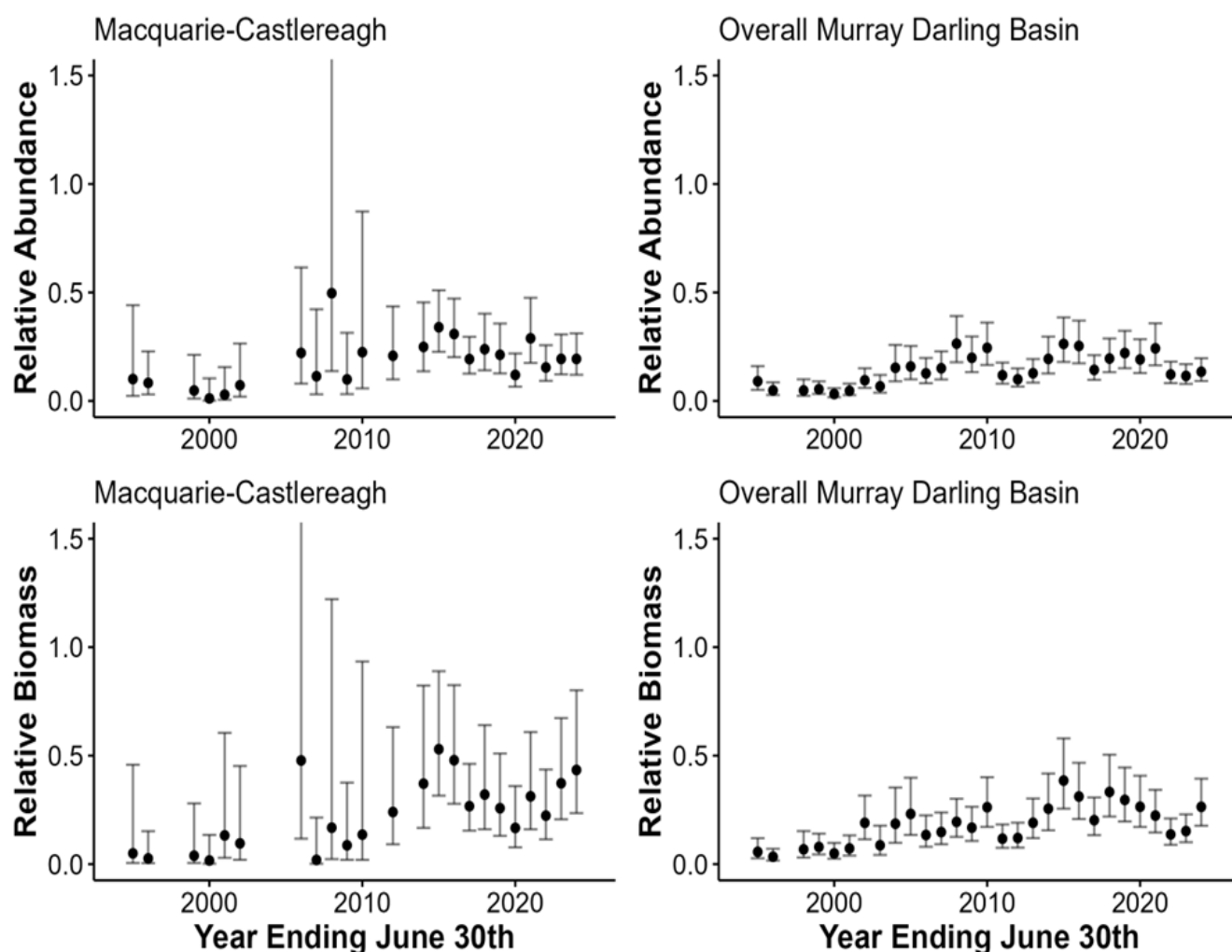


Figure 6.9: Relative abundance and biomass of Murray cod in this WRPAs and the overall NSW MDB. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates.

Summary Statement:

An overall increase in abundance and biomass since the 1990s. Both abundance and biomass have been relatively stable since the mid 2010s, although biomass is currently trending upwards.

Health

The prevalence of any health issues ranged from 10 % of sampled fish in 2020/2021 to 71 % of sampled fish in 2018/2019 (Figure 6.10). The most common health issue for Murray cod in the Macquarie-Castlereagh WRPAs was *Lernaea*, which was observed in a total of 489 fish, corresponding to 33 % of all Murray cod measured.

Across the other NSW MDB WRPA, 13 % of Murray cod (1,292 out of 10,089 Murray cod) showed a health condition (excludes the Macquarie-Castlereagh WRPAs).

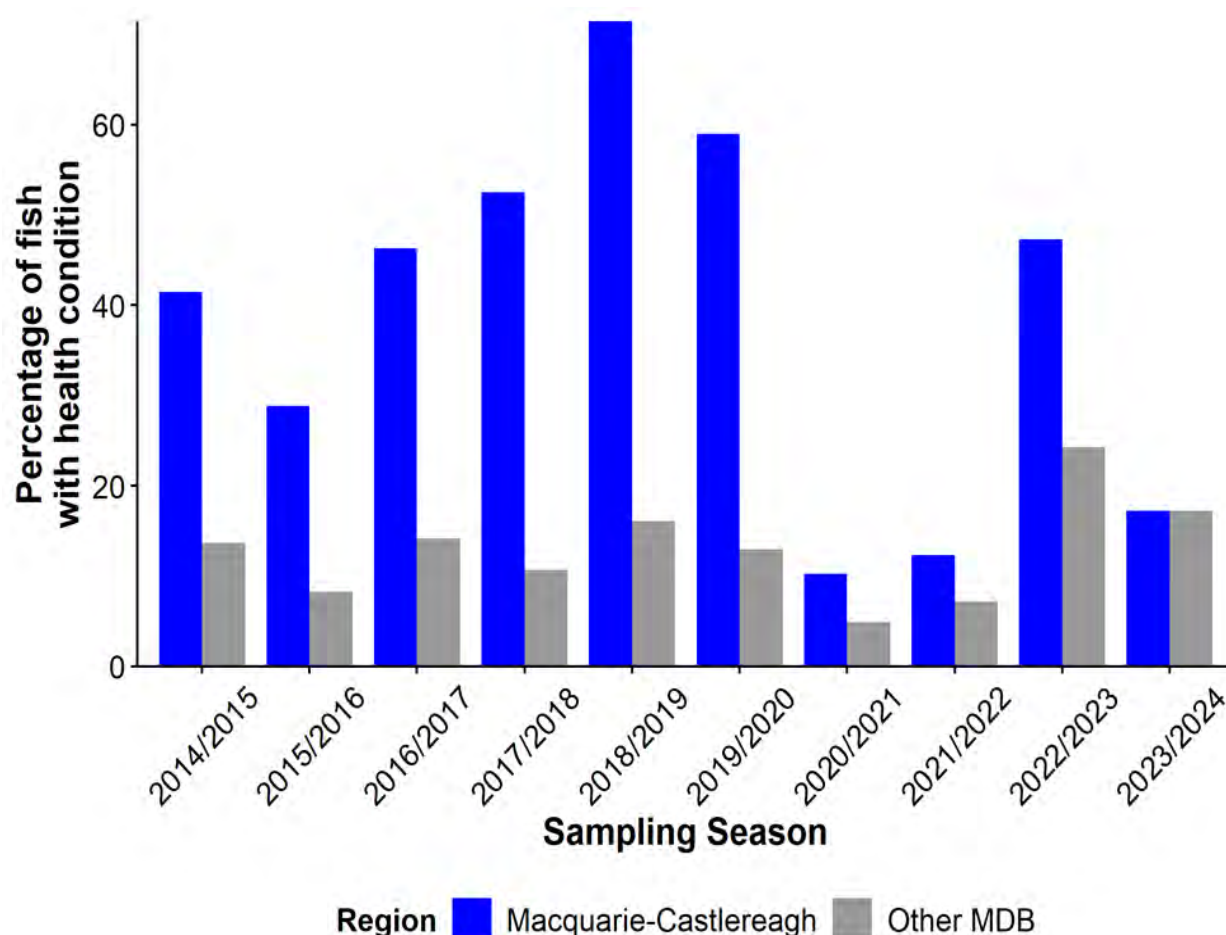


Figure 6.10: Timeseries showing the prevalence of health conditions in Murray cod. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA.

Summary Statement:

Presence of observable health conditions was moderate to high across most years and higher than or equal to the overall Murray-Darling Basin in all years. There was a moderate level of observed health issues in 2023/24.

Distribution

Murray cod were recorded at 50 out of 141 sites in the Macquarie-Castlereagh WRPA from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 1.4 fish caught per 90 seconds of electrofishing. Figure 6.11 shows the distribution and relative abundance of Murray cod across the Macquarie-Castlereagh WRPA.

Summary Statement:

Murray cod were recorded across the central and southern portion of the Macquarie-Castlereagh WRPA but less abundant or absent in northern and south-western sites.

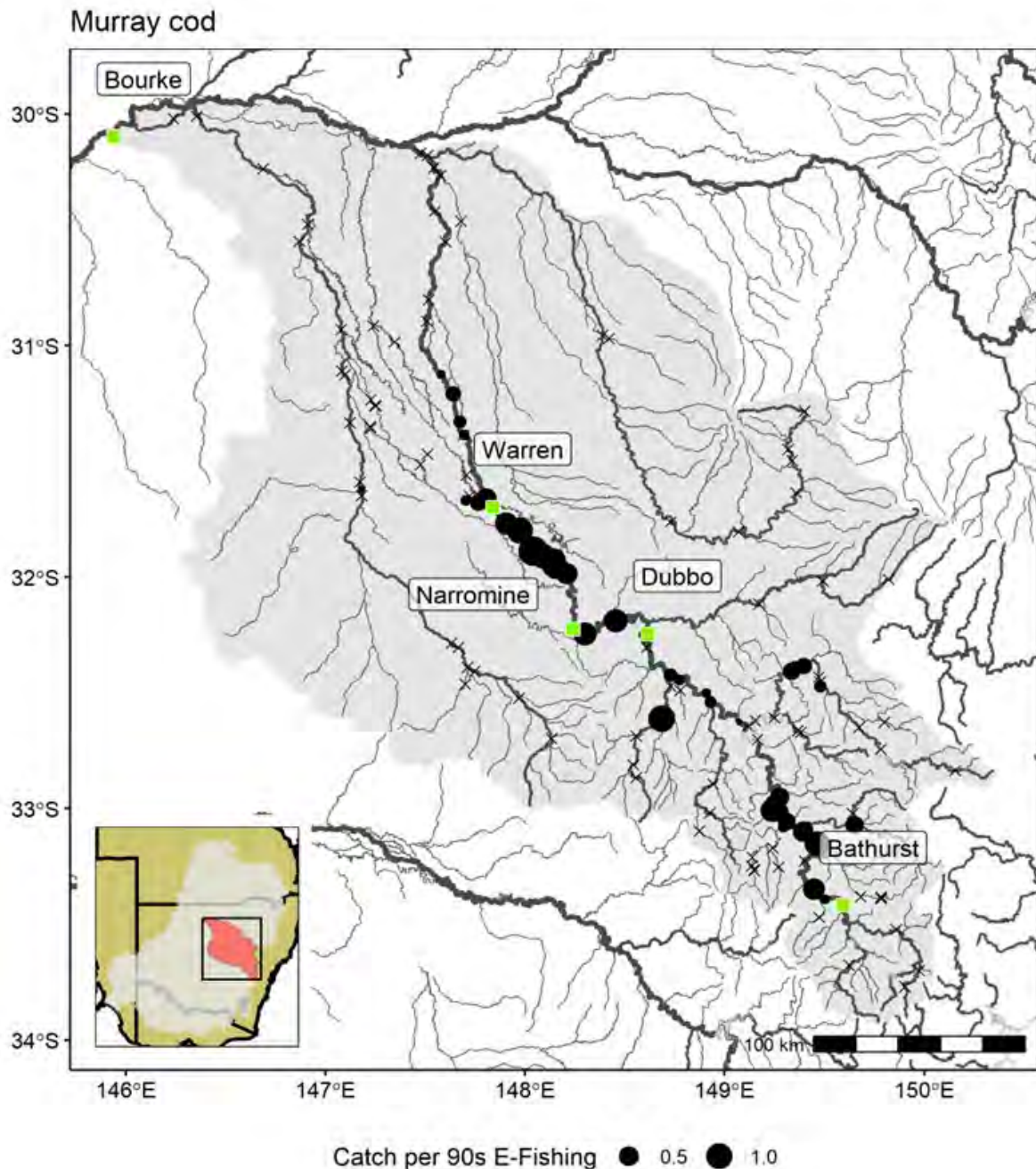


Figure 6.11: Distribution of Murray cod sampled from 2013/14 to 2023/24 in the Macquarie-Castlereagh WRPA. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares represent key towns.

Golden perch



Population Structure

Figure 6.12 shows the observed length frequency plot for Golden perch for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 0 to 72, and 0 % to 31 % of measured fish within a season, with a mean percentage YOY of 6 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Golden perch was 8 % (564 out of 7,422).

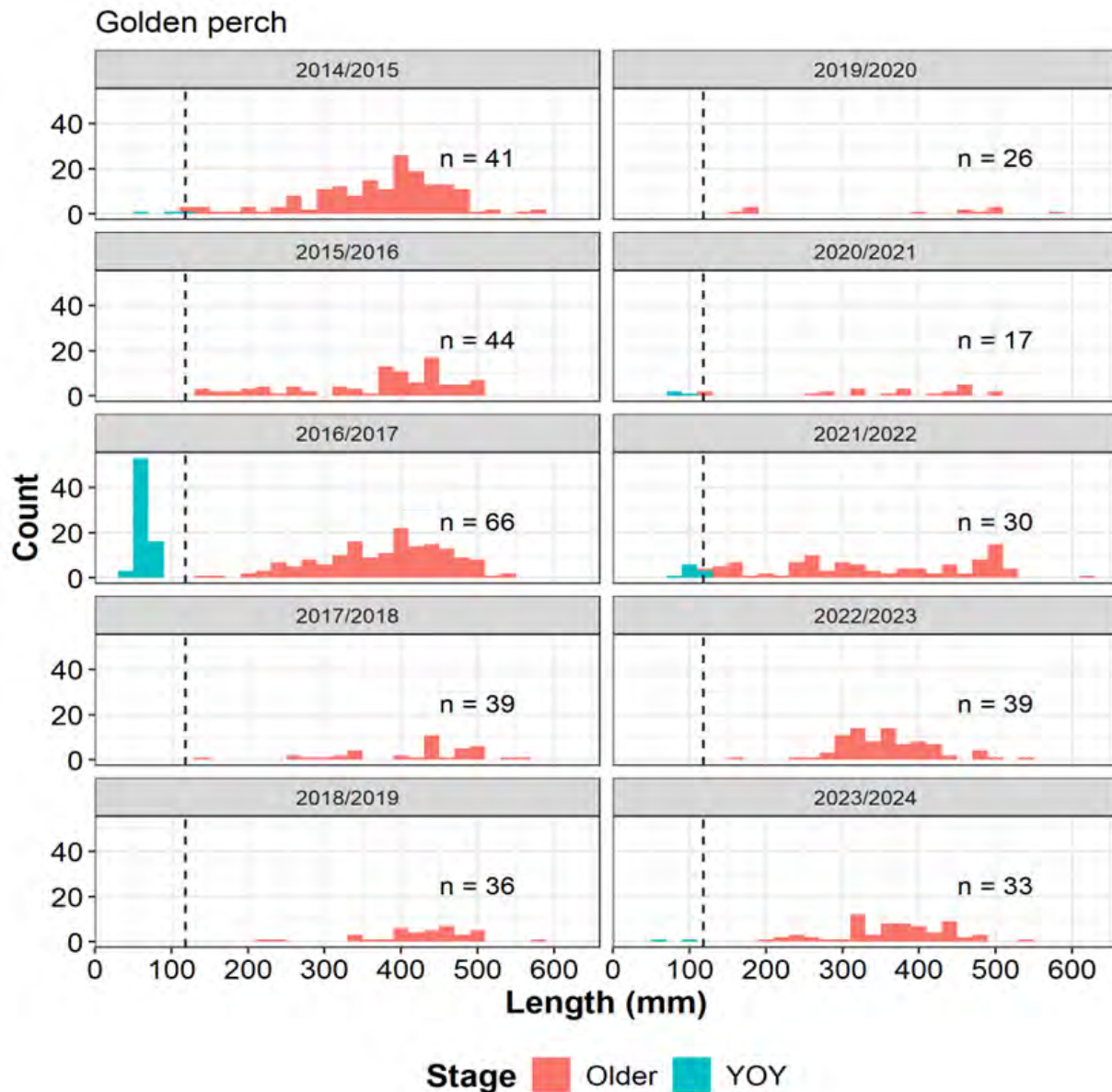


Figure 6.12: Length frequency plots for Golden perch by sampling season in the Macquarie-Castlereagh WRPA. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRPA in a sampling season.

Summary Statement:

The population consistently showed larger fish but recruitment appears to be sporadic with multiple years of recruitment failure including 2015/16, 2017/18 – 2019-2020 and 2022/23. Very few YOY were observed in 2023/24 suggesting poor recruitment.

Stocking

A total of 1,738,199 Golden perch were stocked into the waterways of the Macquarie-Castlereagh WRPAs during the reporting period. Of these fish, 1,190,921 (68.5 %) were stocked into impoundments while 547,278 (31.5 %) were stocked into rivers or creeks. Table 6.5 shows the detailed breakdown of stocking by season, location and life stage while Figure 6.13 shows the locations of stocking.

Table 6.5: Number and life stage of stocked Golden perch each sampling season in the Macquarie-Castlereagh WRPAs.

Sampling Season	River/Creek or Impoundment	Life Stage	Number Stocked
2014/2015	Impoundment	Fry	162,363
2014/2015	River/Creek	Fry	50,963
2015/2016	Impoundment	Fry	104,058
2015/2016	River/Creek	Fry	64,807
2016/2017	Impoundment	Fry	103,500
2016/2017	River/Creek	Fingerling	26,393
2017/2018	Impoundment	Fry	135,000
2017/2018	River/Creek	Fry	5,000
2018/2019	Impoundment	Fry	91,000
2018/2019	River/Creek	Fry	9,375
2019/2020	River/Creek	Fry	63,666
2020/2021	Impoundment	Fry	180,000
2020/2021	River/Creek	Fry	118,188
2021/2022	Impoundment	Fry	112,000
2021/2022	River/Creek	Fry	64,396
2022/2023	Impoundment	Fry	164,000
2022/2023	River/Creek	Fry	61,682
2023/2024	Impoundment	Fingerling	139,000
2023/2024	River/Creek	Fingerling	82,808

Golden perch stocking

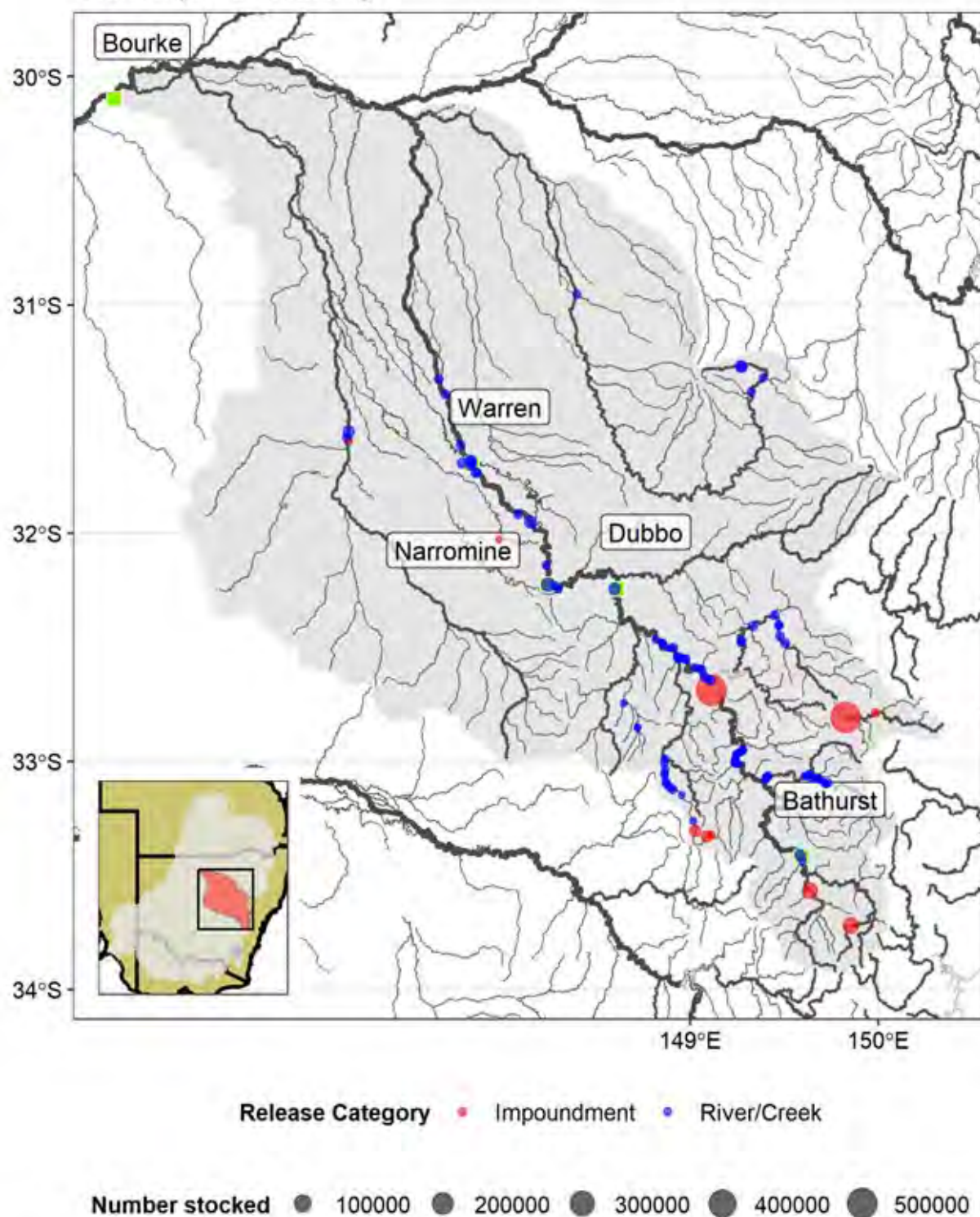


Figure 6.13: Locations of Golden perch stocking in the Macquarie-Castlereagh WRP. Colours show whether a site was a river/creek site or an impoundment, while the size of the point reflects the total number of fish stocked over the reporting period. Green squares represent key towns.

Temporal Trends in Abundance

The relative abundance and biomass of Golden perch since 1994 was modelled based on all suitable boat electrofishing data. The left-hand panels of Figure 6.14 show the abundance and biomass trends for the Macquarie-Castlereagh WRPAs and the right-hand panels show the overall trends across the NSW MDB.

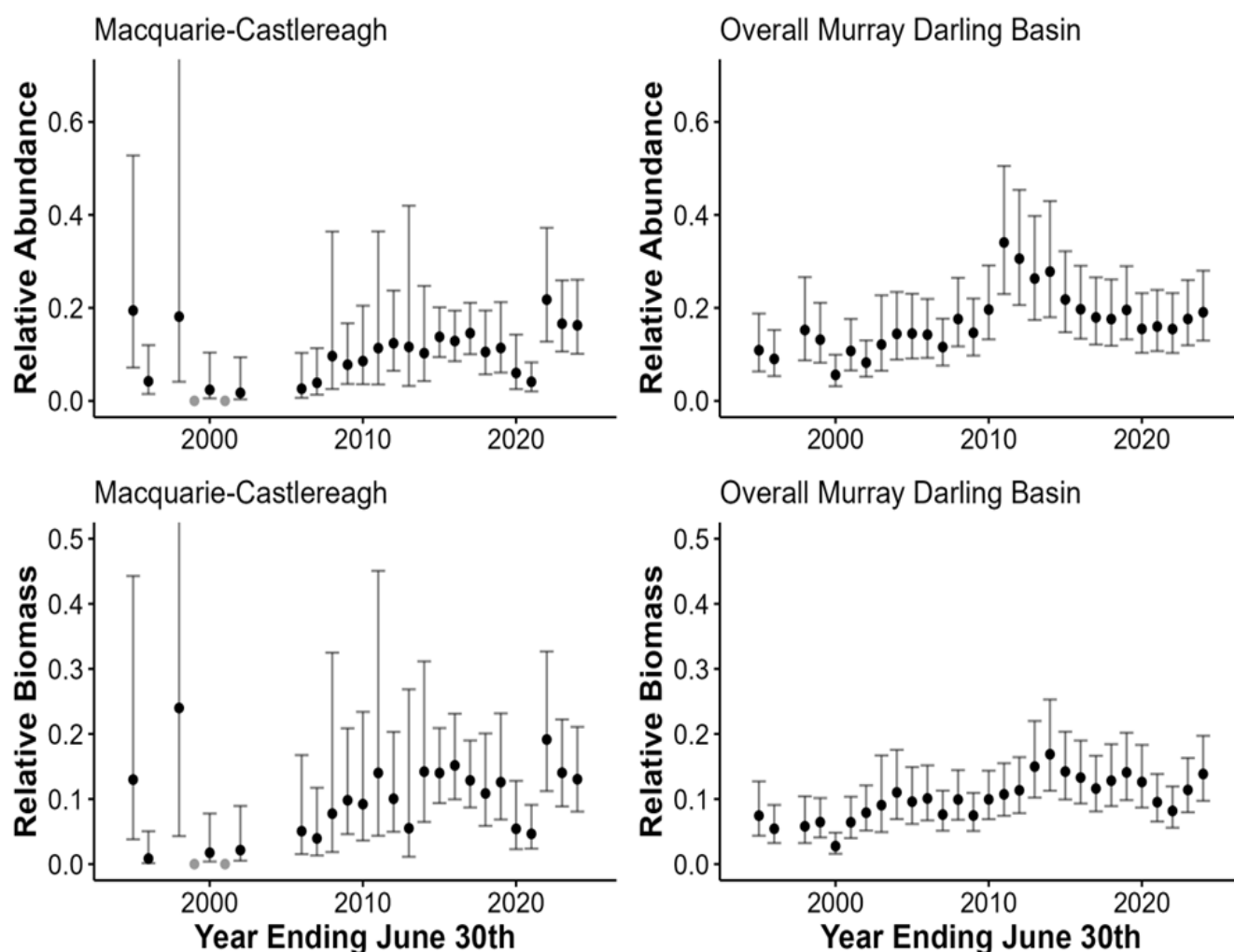


Figure 6.14: Relative abundance and biomass of Golden perch in both this WRPAs and the overall Murray-Darling Basin. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates.

Summary Statement:

For Golden perch in the Macquarie-Castlereagh, there is evidence of an overall increase in abundance and biomass since the early 2000s. Both abundance and biomass increased from low levels since 2021. Relative abundance and biomass are approximately equal to the overall NSW Murray-Darling Basin.

Health

The prevalence of any health issues ranged from 10 % of sampled fish in 2021/2022 to 83 % of sampled fish in 2019/2020 (Figure 6.15). The most common health issue for Golden perch in the Macquarie-Castlereagh water resource planning area was *Lernaea*, which was observed in a total of 181 fish, corresponding to 21 % of all Golden perch measured.

Across the other WRPA's, 25 % of Golden perch (1,823 out of 7,422 Golden perch) showed a health condition (excludes Macquarie-Castlereagh).

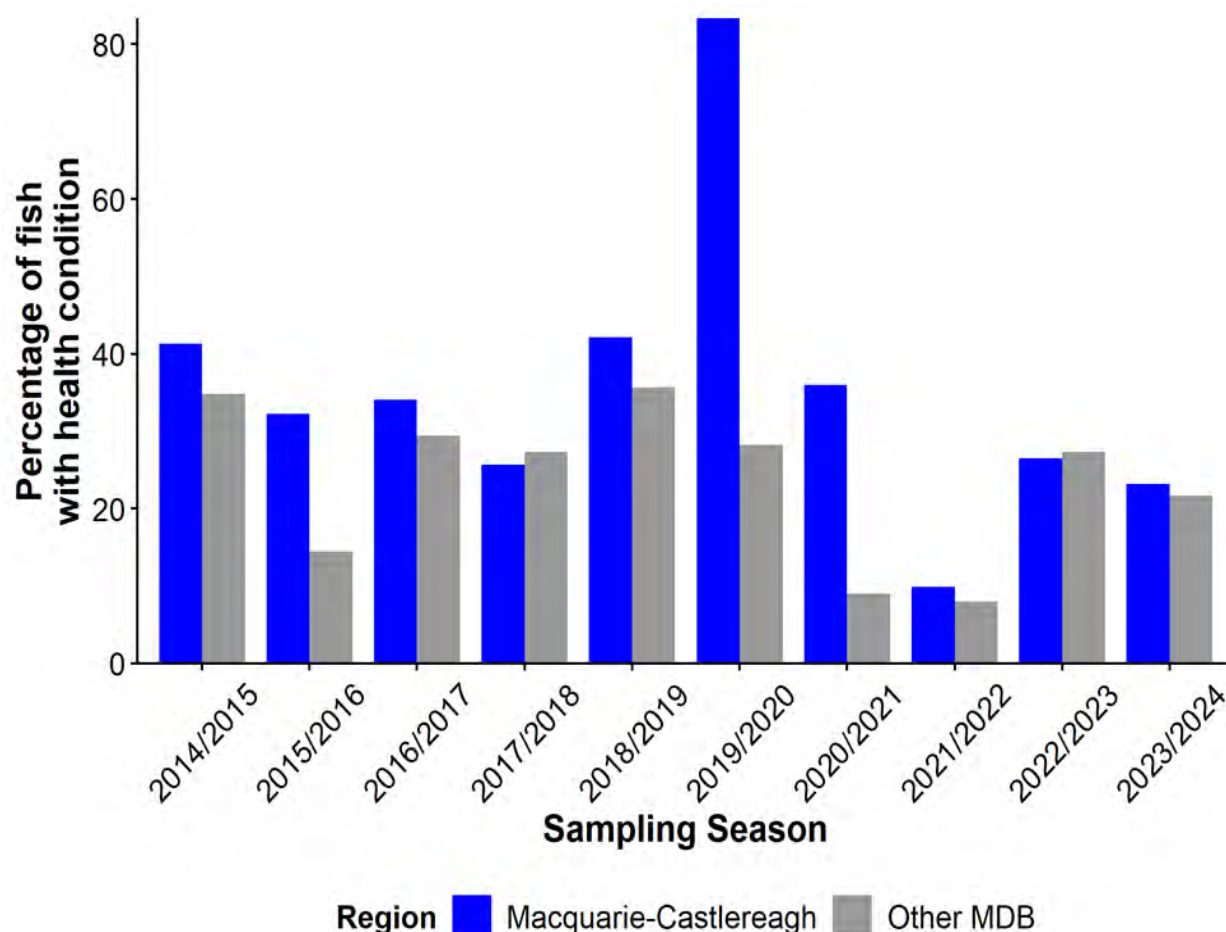


Figure 6.15: Timeseries showing the prevalence of health conditions in Golden perch. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA's.

Summary Statement:

The presence of observable health conditions for Golden perch in the Macquarie-Castlereagh was moderate to high and generally tracked the average across the rest of the NSW Murray-Darling Basin except for 2019/20 when it was significantly higher.

Distribution

Golden perch were recorded at 64 out of 141 sites in the Macquarie-Castlereagh WRP from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 1.15 fish caught per 90 seconds of electrofishing. Figure 6.16 shows the distribution and relative abundance of Golden perch across the Macquarie-Castlereagh WRP.

Summary Statement:

Golden perch were generally present across the Macquarie-Castlereagh region.

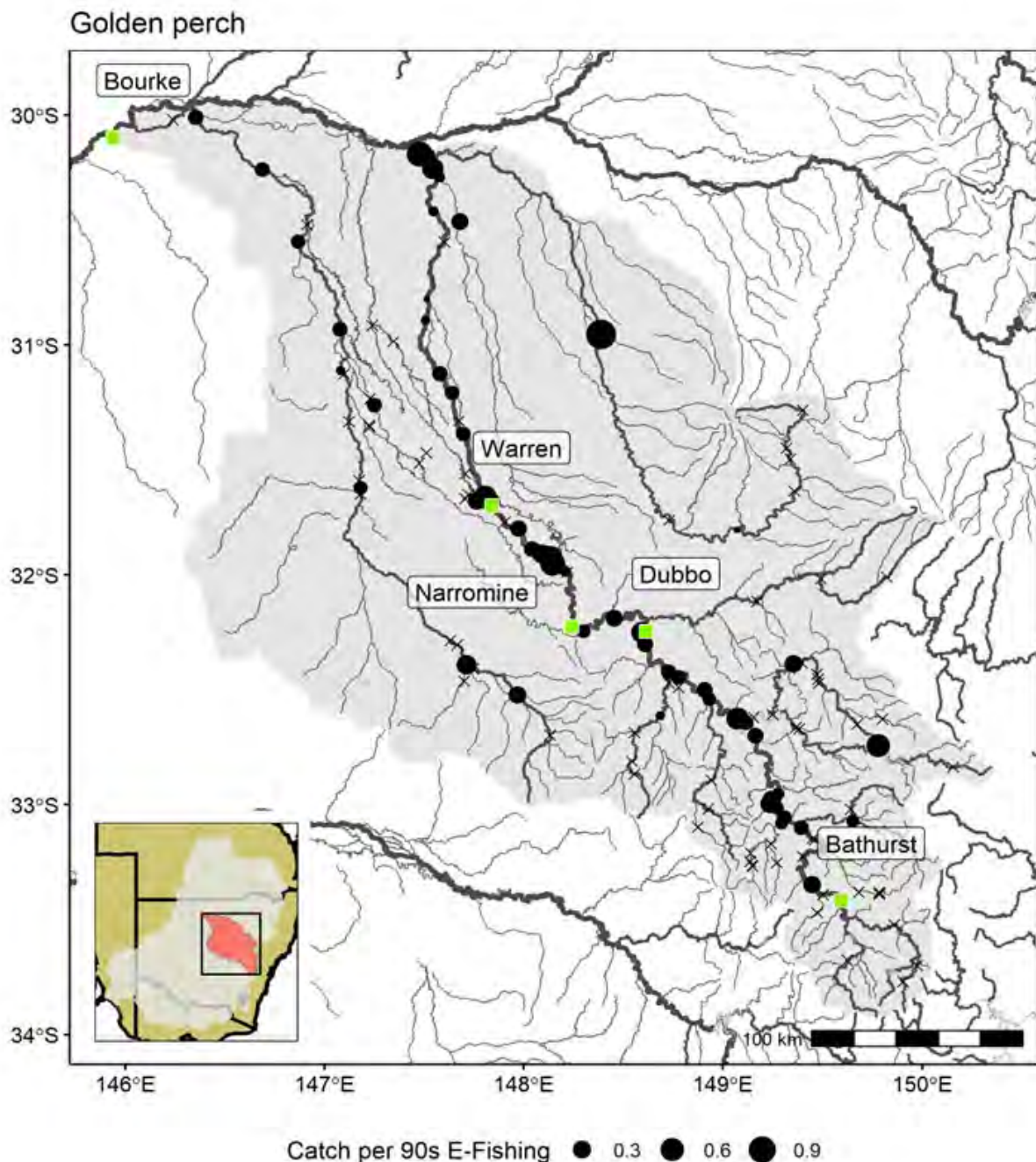


Figure 6.16: Distribution of Golden perch sampled from 2013/14 to 2023/24 in the Macquarie-Castlereagh WRP. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares represent key towns.

Freshwater catfish



Population Structure

Figure 6.17 shows the observed length frequency plot for Freshwater catfish for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 0 to 9, and 0 % to 64 % of measured fish within a season, with a mean percentage YOY of 20 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Freshwater catfish was 40 % (390 out of 976).

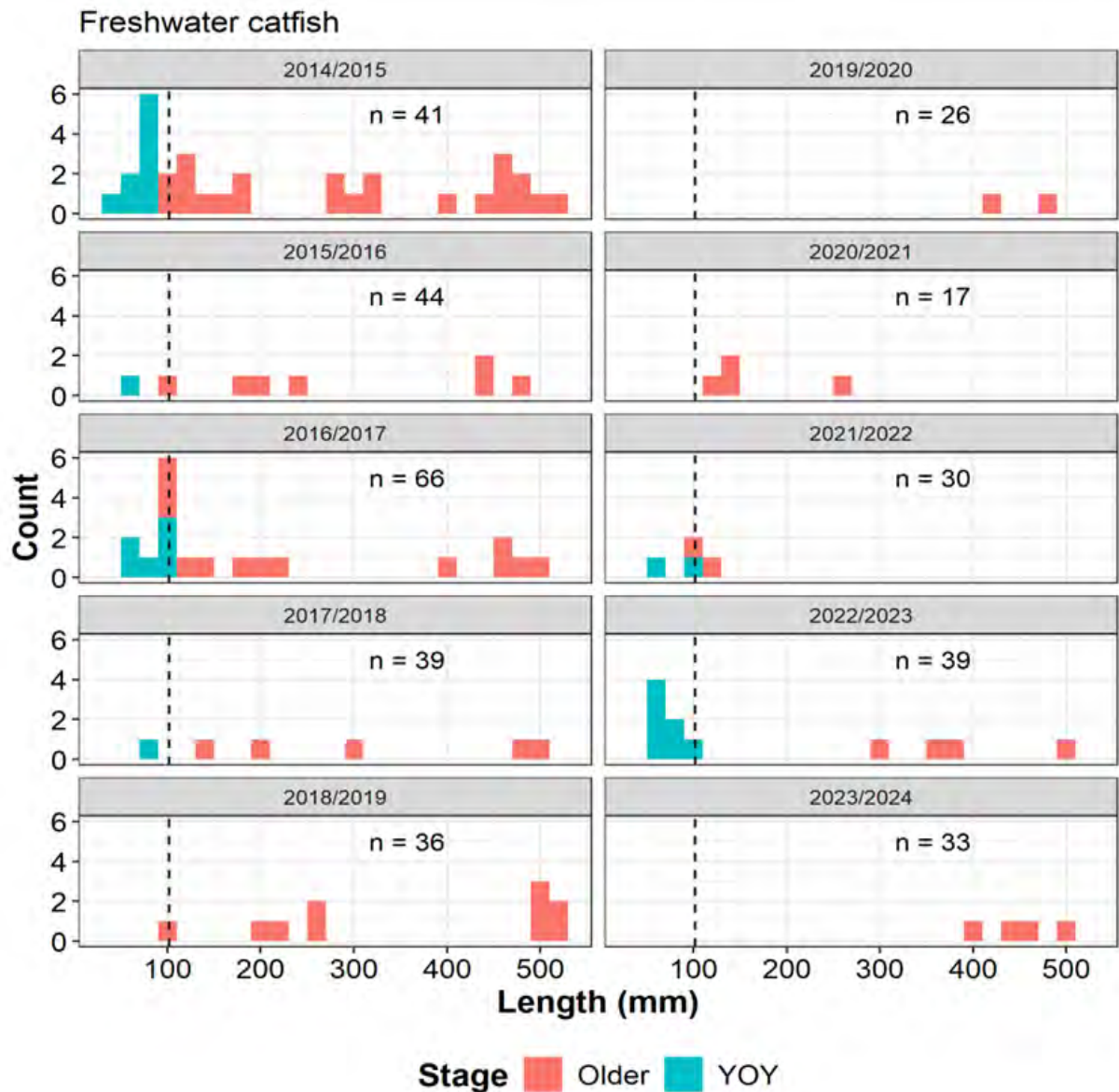


Figure 6.17: Length frequency plots for Freshwater catfish by sampling season in the Macquarie-Castlereagh WRP. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRP in a sampling season.

Summary Statement:

Sporadic recruitment with possible recruitment failure from 2018/19 – 2020/21 and in 2023/24. Despite relatively strong recruitment of YOY in 2022/23, there were very low numbers of Freshwater catfish and no evidence of recruitment in 2023/24.

Temporal Trends in Abundance

The relative abundance and biomass of Freshwater catfish since 1994 was modelled based on all suitable boat electrofishing data. The left-hand panels of Figure 6.18 show the abundance and biomass trends for the Macquarie-Castlereagh WRPA and the right-hand panels show the overall trends across the NSW MDB.

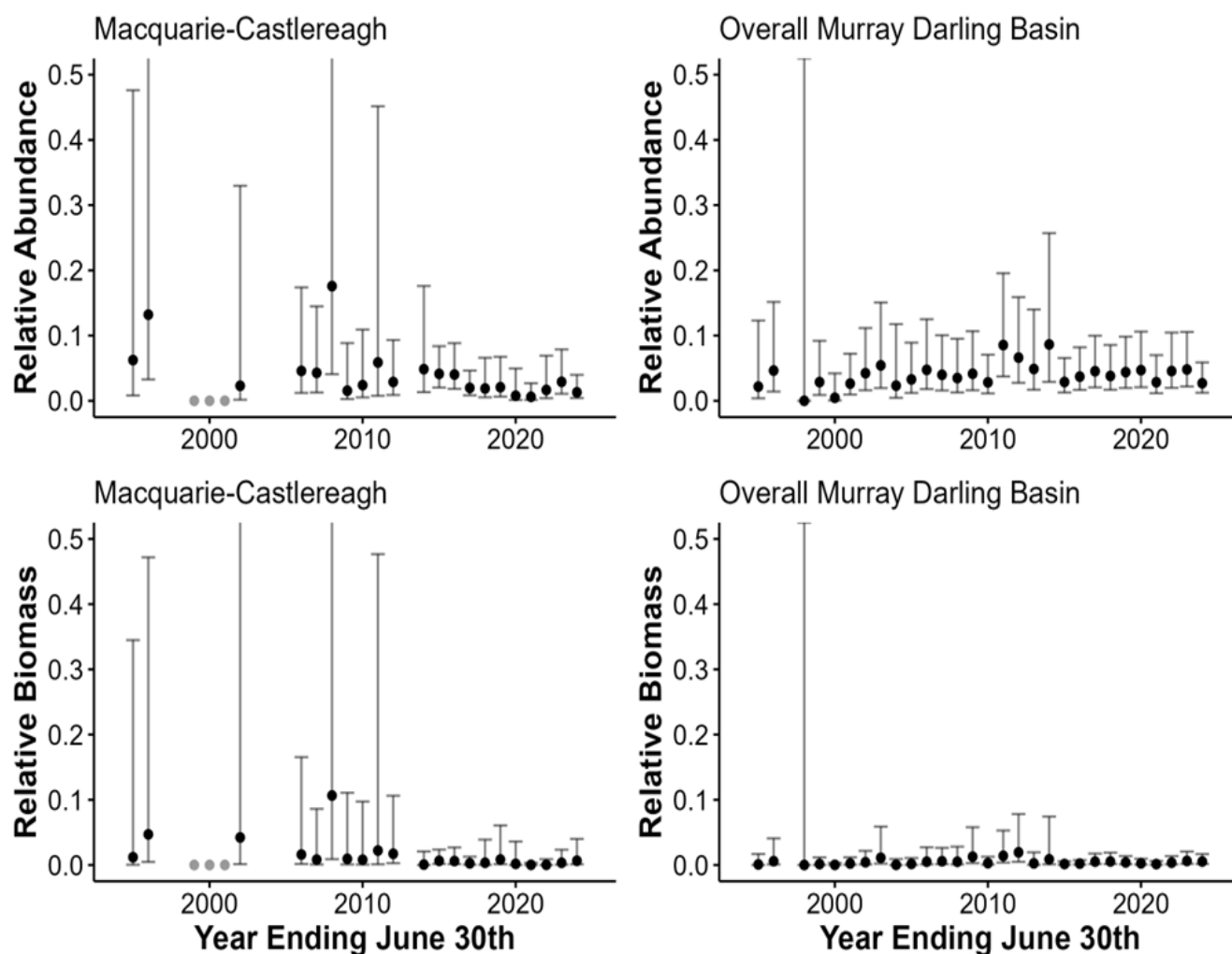


Figure 6.18: Relative abundance and biomass of Freshwater catfish in both this WRPA and the overall Murray-Darling Basin. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates.

Summary Statement:

Abundance and biomass are both low in the Macquarie-Castlereagh WRPA and have likely declined since the 2000s. Abundance and biomass are comparable to the overall NSW MDB.

Health

The prevalence of any health issues ranged from 0 % of sampled fish in multiple years to 17 % of sampled fish in 2017/2018 (Figure 6.19). The most common health issue for Freshwater catfish in the Macquarie-Castlereagh water resource planning area was *Lernaea*, which was observed in a total of 6 fish, corresponding to 6 % of all Freshwater catfish measured.

Across the other WRPA's, 1 % of Freshwater catfish (12 out of 976 Freshwater catfish) showed a health condition (excludes Macquarie-Castlereagh).

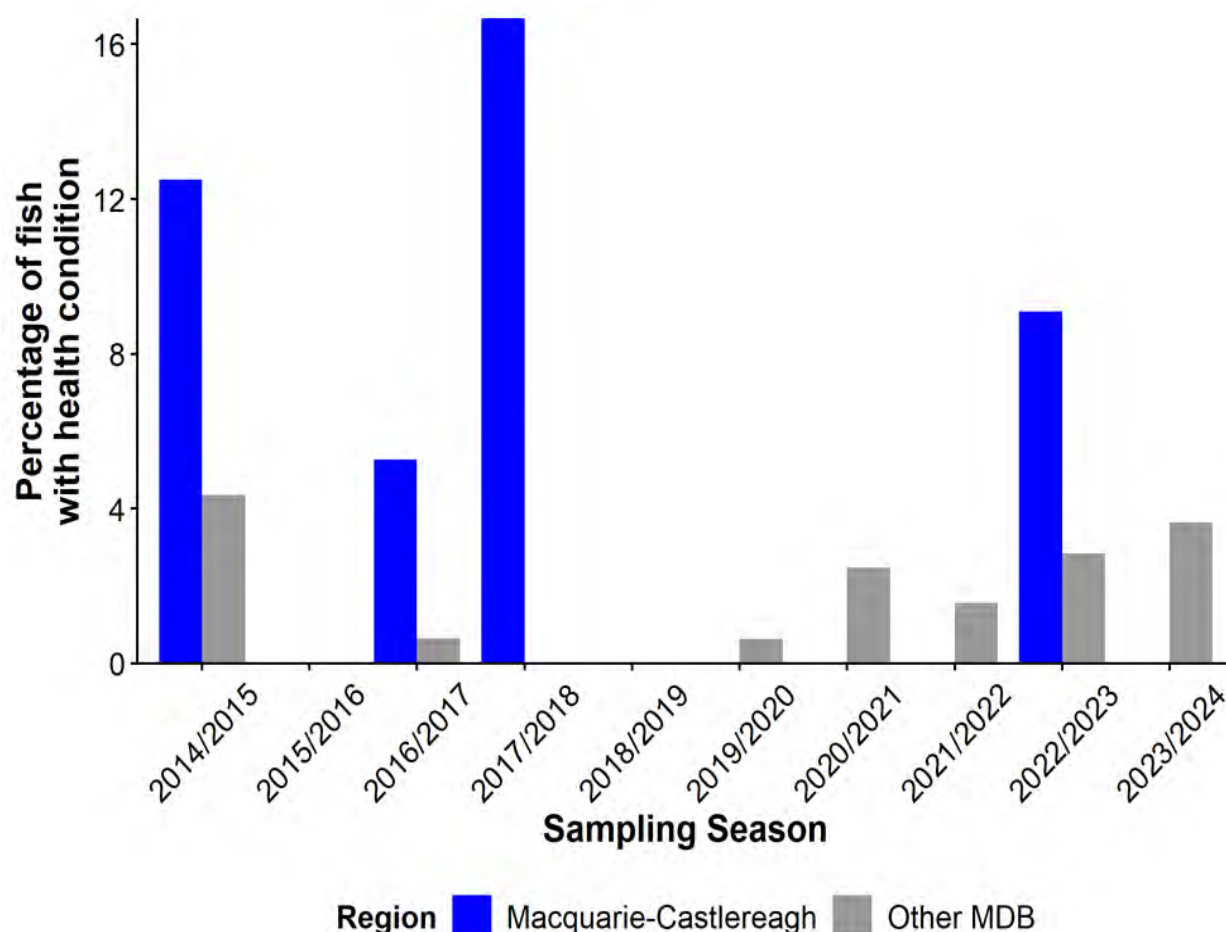


Figure 6.19: Timeseries showing the prevalence of health conditions in Freshwater catfish. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA's.

Summary Statement:

The presence of observable health conditions for Freshwater catfish in the Macquarie-Castlereagh was overall low – moderate and above the level observed in the other areas of the NSW MDB (when health issues were observed). No health issues were observed in 2023/24 but limited fish were sampled.

Distribution

Freshwater catfish were recorded at 25 out of 141 sites in the Macquarie-Castlereagh WRPA from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 0.7 fish caught per 90 seconds of electrofishing. Figure 6.20 shows the distribution and relative abundance of Freshwater catfish across the Macquarie-Castlereagh WRPA.

Summary Statement:

Freshwater catfish were generally restricted to the central and upland areas of the Macquarie-Castlereagh WRPA.

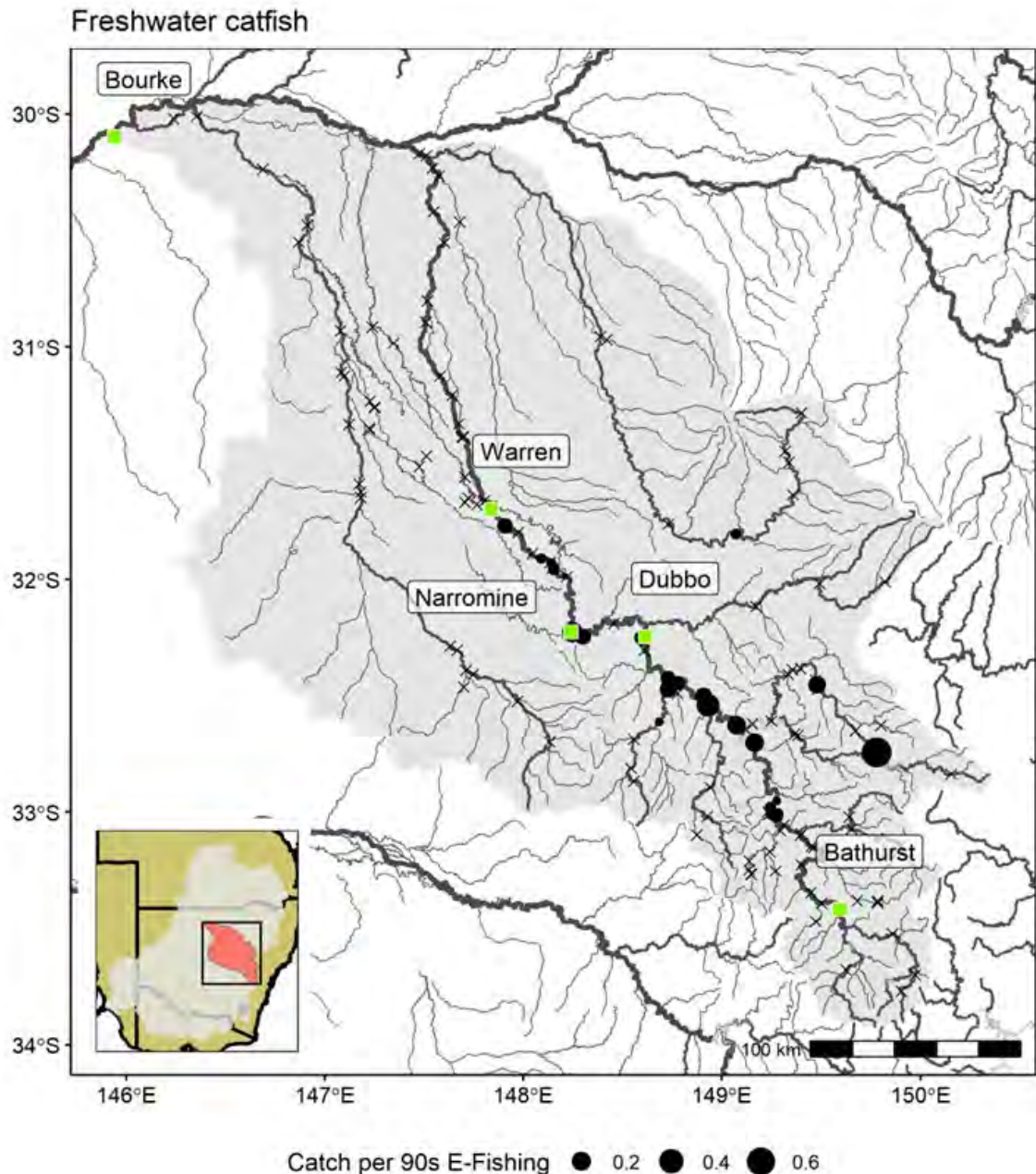


Figure 6.20: Distribution of Freshwater catfish sampled from 2013/14 to 2023/24 in the Macquarie-Castlereagh WRPA. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares represent key towns.

Bony herring



Population Structure

Figure 6.21 shows the observed length frequency plot for Bony herring for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 11 to 73, and 5 % to 65 % of measured fish within a season, with a mean percentage YOY of 25 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Bony herring was 25 % (13,207 out of 52,608). Bony herring are not a stocked species.

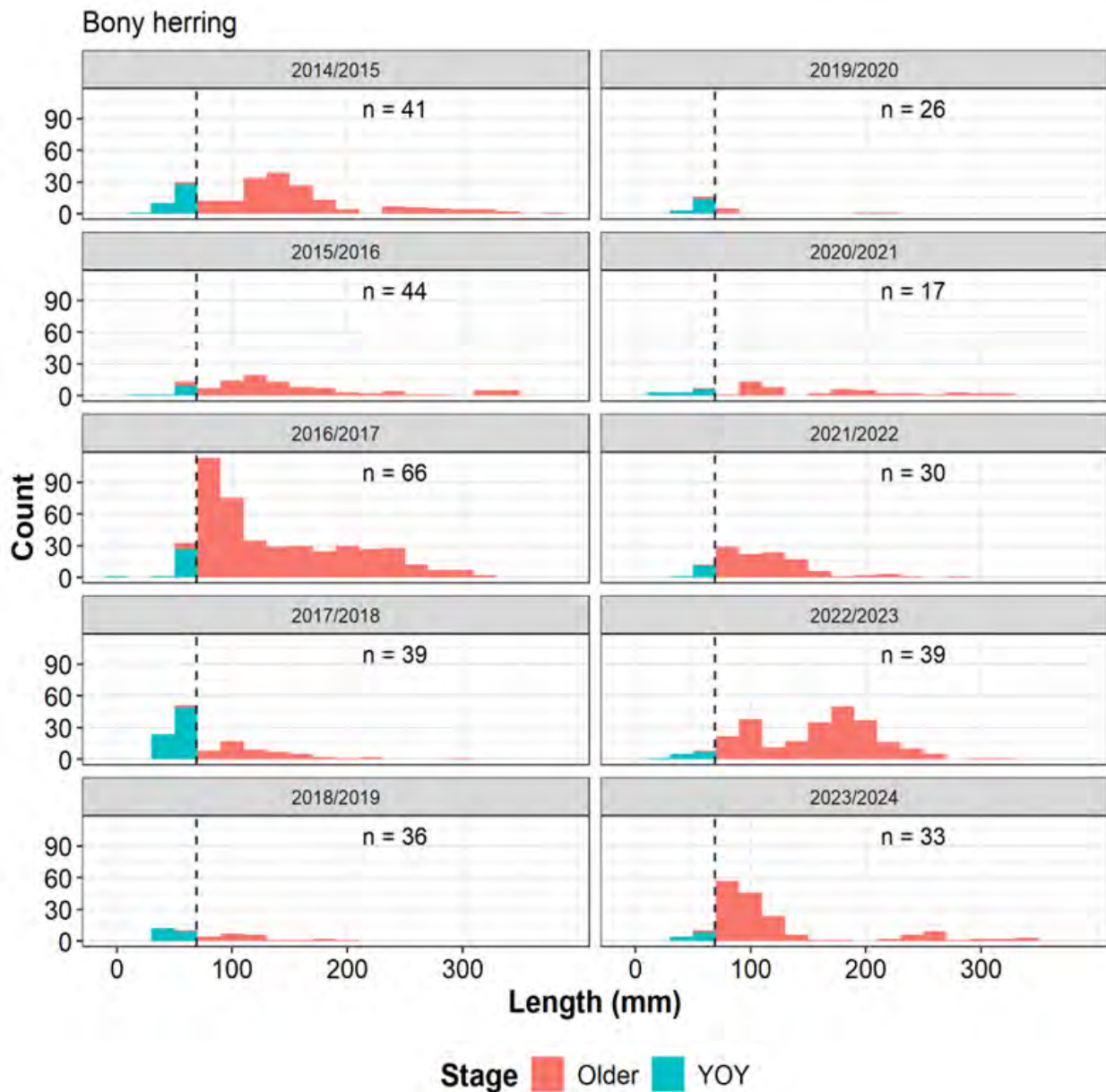


Figure 6.21: Length frequency plots for Bony herring by sampling season in the Macquarie-Castlereagh WRPA. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRPA in a sampling season.

Summary Statement:

Regular recruitment with variable numbers of YOY. Some evidence of recruitment in 2023/24 with multiple size classes evident.

Temporal Trends in Abundance

The relative abundance and biomass of Bony herring since 1994 was modelled based on all suitable boat electrofishing data. The left-hand panels of Figure 6.22 show the abundance and biomass trends for the Macquarie-Castlereagh WRPA and the right-hand panels show the overall trends across the NSW MDB.

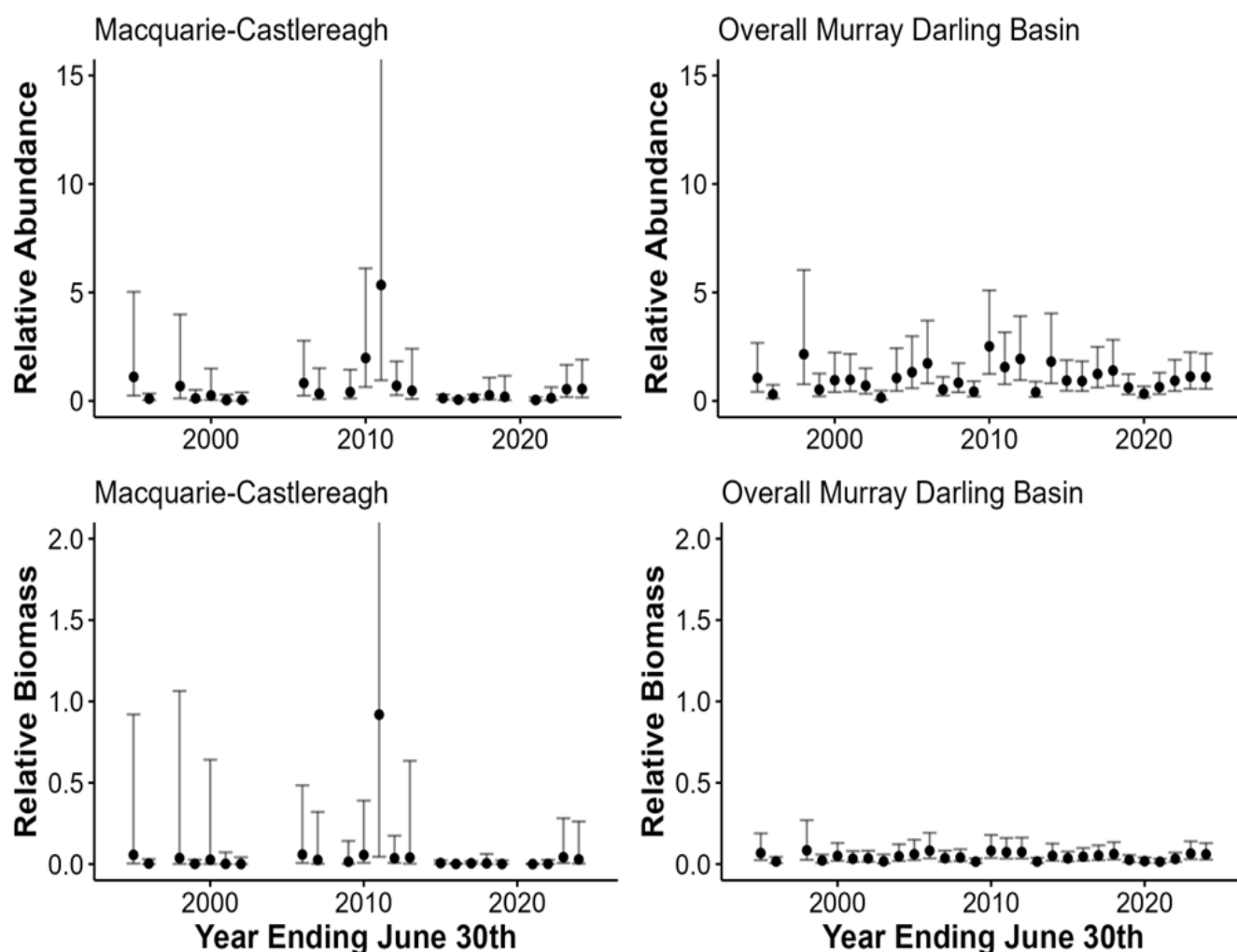


Figure 6.22: Relative abundance and biomass of Bony herring in both this WRPA and the overall NSW MDB. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates. Note some error bars have been truncated for clarity.

Summary Statement:

Variable abundance and biomass but both appear to have increased slightly since 2020 and 2021 and are comparable to the wider NSW MDB.

Health

The prevalence of any health issues ranged from 0 % of sampled fish in multiple years to 6 % of sampled fish in 2016/2017 (Figure 6.23). The most common health issue for Bony herring in the Macquarie-Castlereagh WRPAs was Wounds, which was observed in a total of 11 fish, corresponding to 1 % of all Bony herring measured.

Across the other NSW MDB WRPA, 1 % of Bony herring (526 out of 52,609 Bony herring) showed a health condition (excludes the Macquarie-Castlereagh WRPAs).

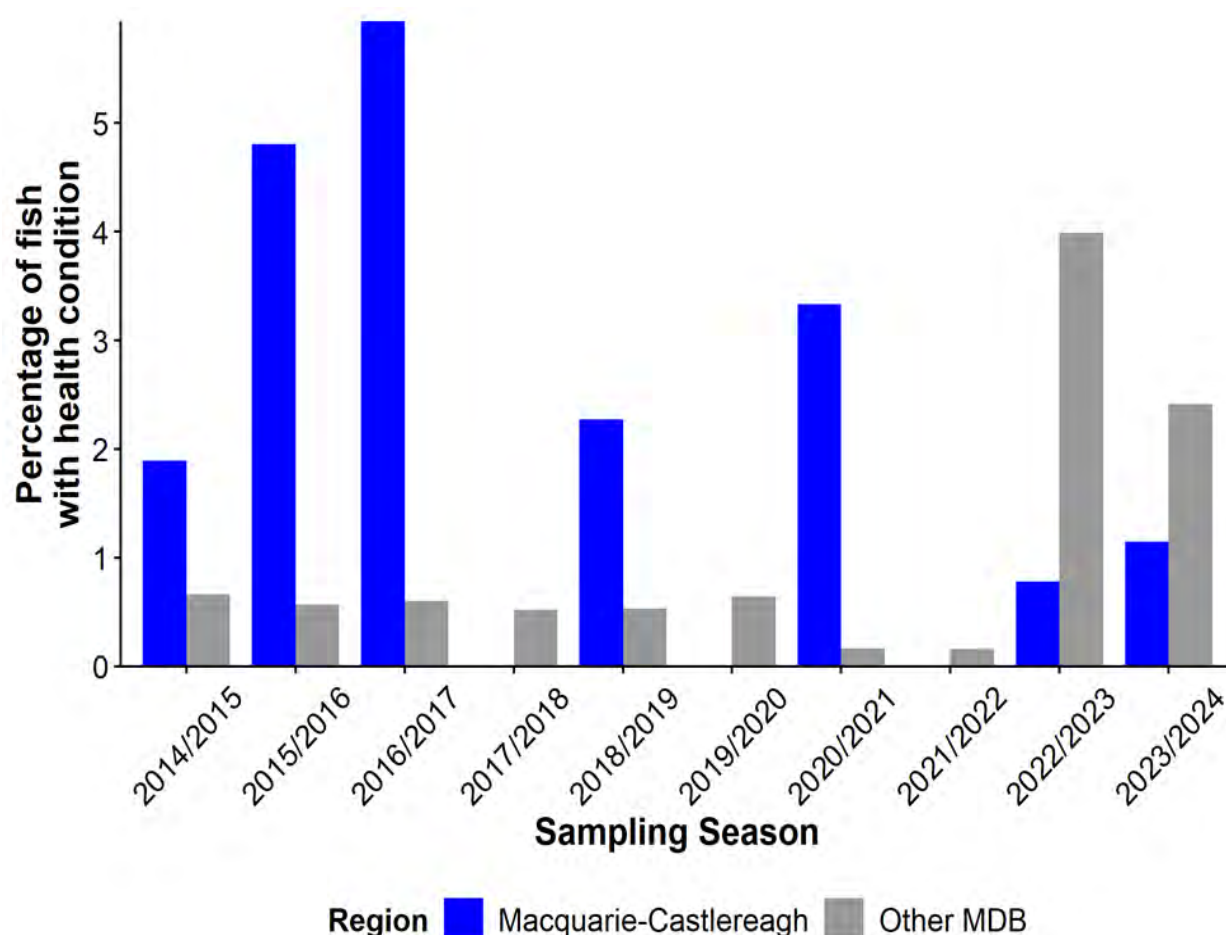


Figure 6.23: Timeseries showing the prevalence of health conditions in Bony herring. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA.

Summary Statement:

Presence of observable health conditions was generally low but often at higher levels than the rest of the NSW MDB. Low proportion of health issues in 2022/23 compared to the rest of the NSW MDB.

Distribution

Bony herring were recorded at 37 out of 141 sites in the Macquarie-Castlereagh WRP from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 14.1 fish caught per 90 seconds of electrofishing. Figure 6.24 shows the distribution and relative abundance of Bony herring across the Macquarie-Castlereagh WRP.

Summary Statement:

Bony herring appear to be mainly restricted to the northern Macquarie-Castlereagh WRP with very few occurrences south of Dubbo.

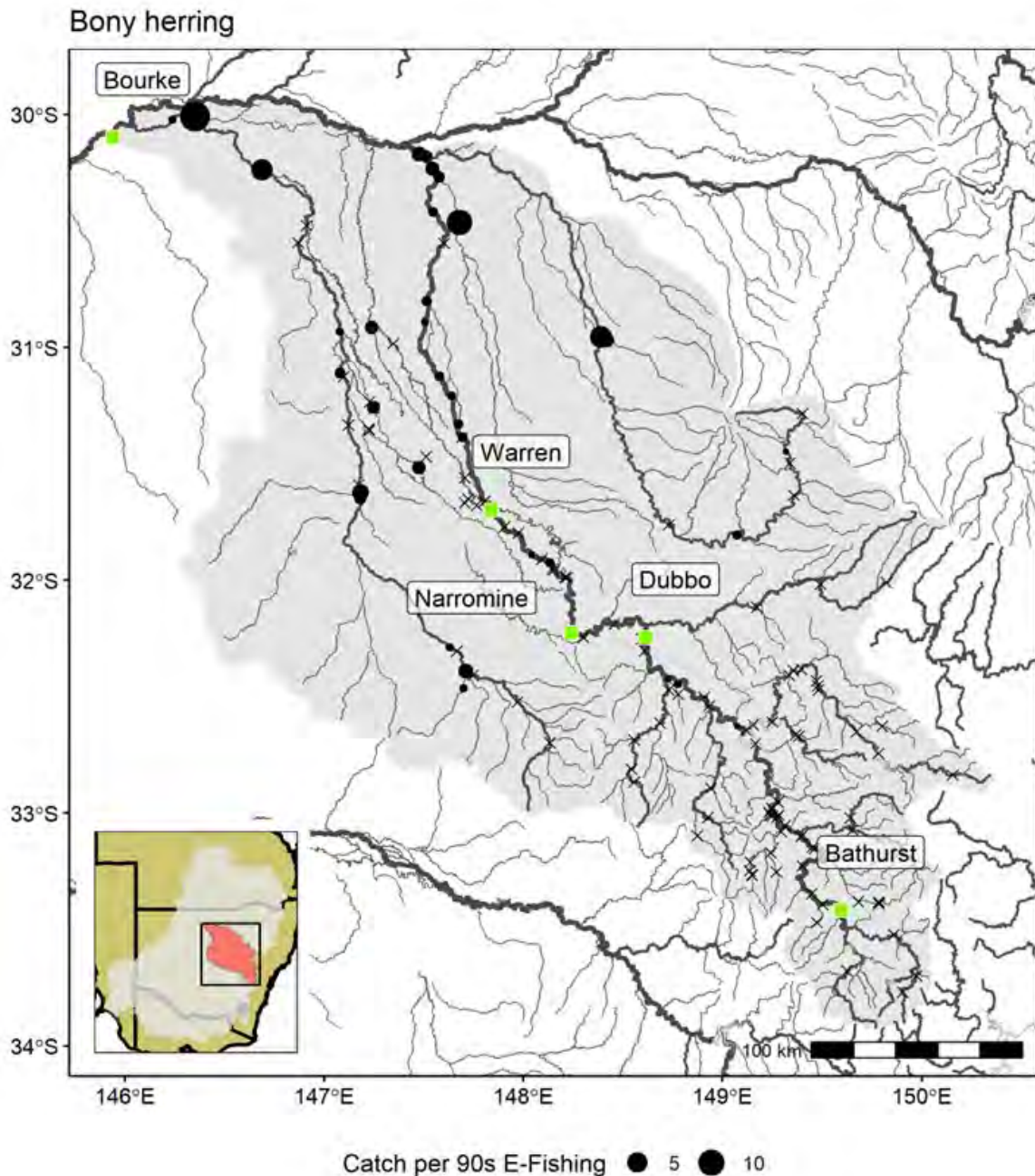


Figure 6.24: Distribution of Bony herring sampled from 2013/14 to 2023/24 in the Macquarie-Castlereagh WRP. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares represent key towns.

Australian smelt



Population Structure

Figure 6.25 shows the observed length frequency plot for Australian smelt for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 2 to 211, and 4 % to 64 % of measured fish within a season, with a mean percentage YOY of 30 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Australian smelt was 42 % (10,896 out of 26,222). Australian smelt are not a stocked species.

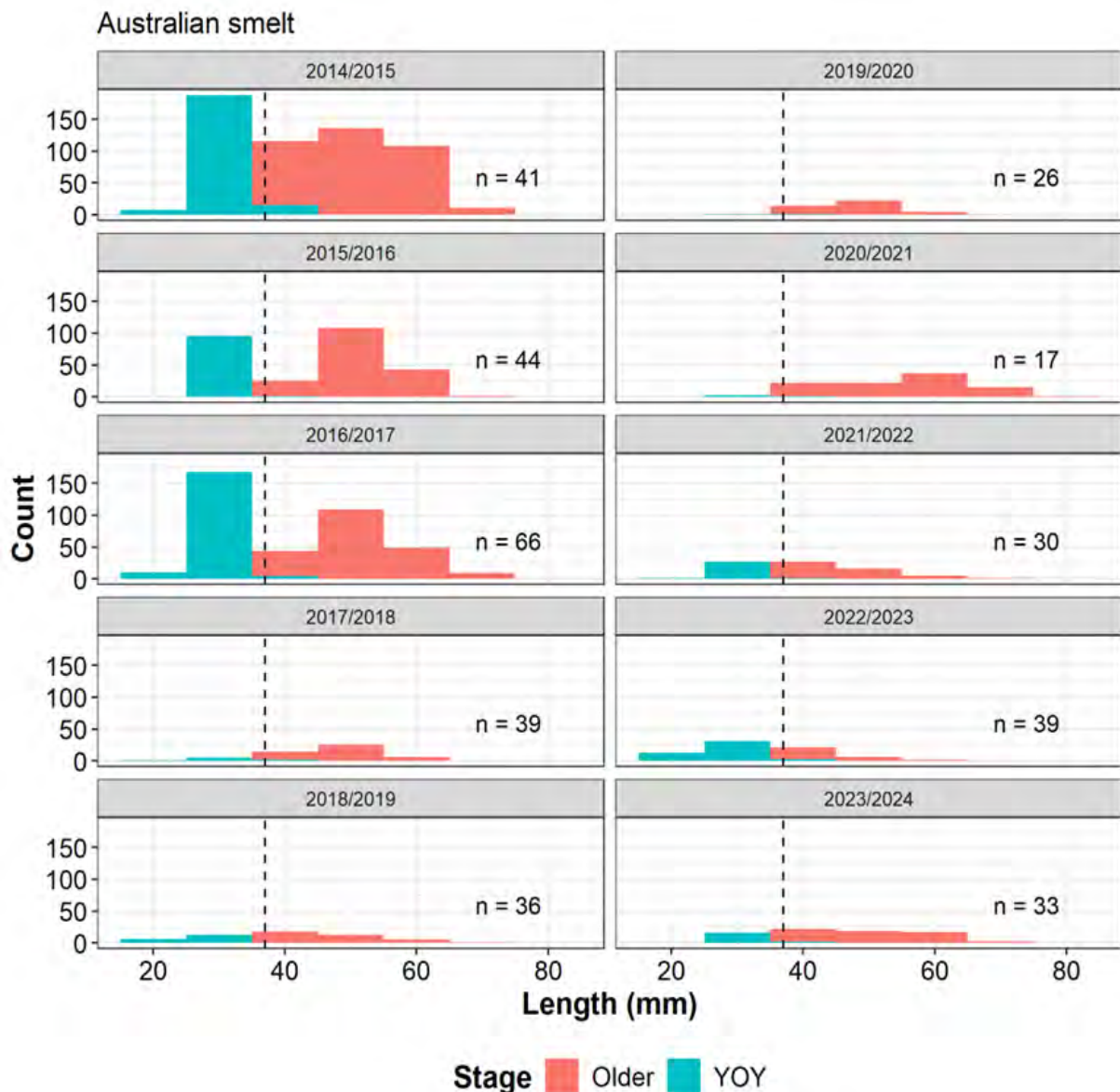


Figure 6.25: Length frequency plots for Australian smelt by sampling season in the Macquarie-Castlereagh WRPA. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRPA in a sampling season.

Summary Statement:

Regular recruitment but evidence of large recruitment events from 2014/15 – 2016/17. Lower recruitment in following years including 2023/24.

Temporal Trends in Abundance

The relative abundance of Australian smelt since 1994 was modelled based on all suitable boat electrofishing data. The left-hand panel of Figure 6.26 show the abundance trends for the Macquarie-Castlereagh WRPAs and the right-hand panel show the overall trend across the NSW MDB.

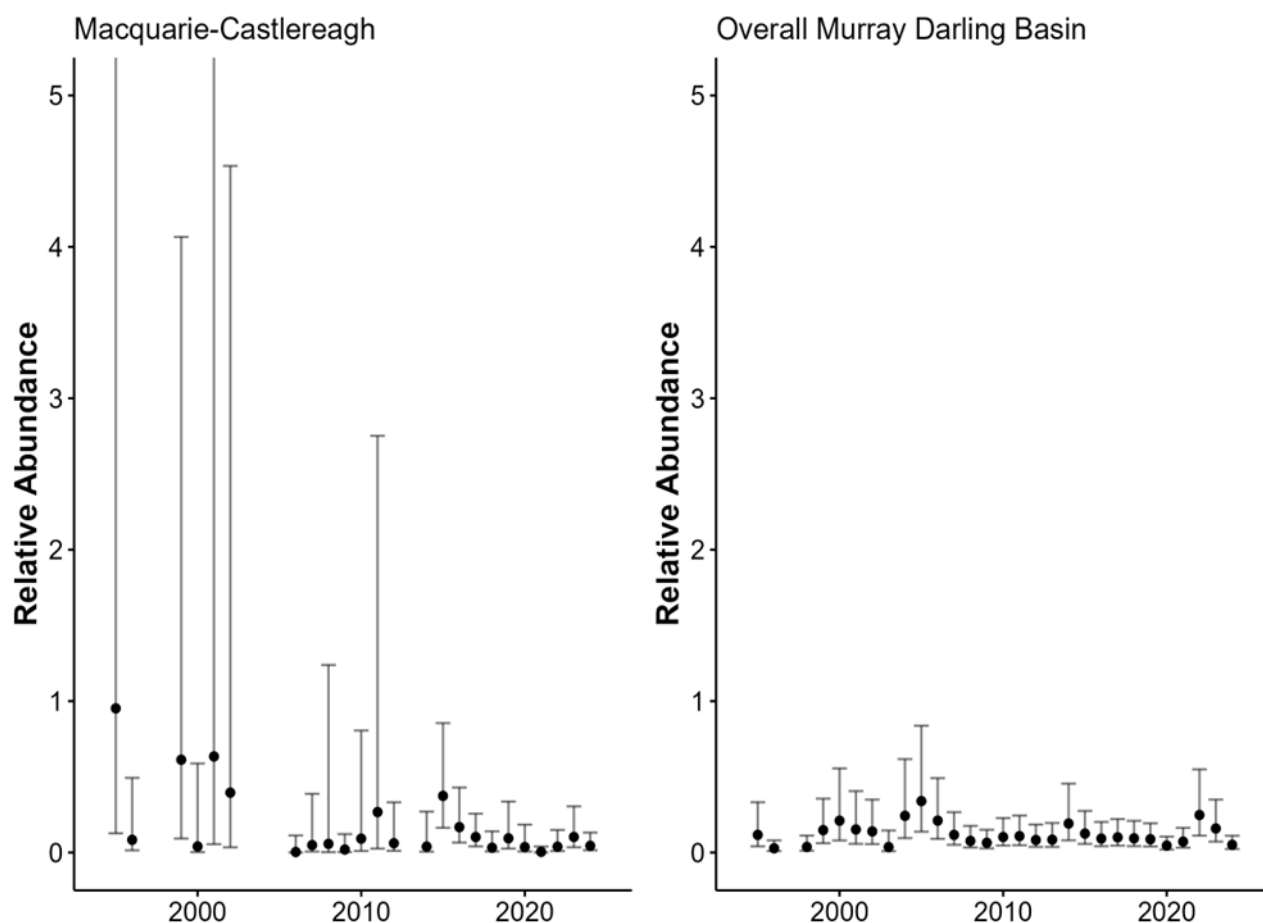


Figure 6.26: Relative abundance of Australian smelt in both this WRPAs and the overall NSW MDB. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates. No modelling of biomass was done for Australian smelt.

Summary Statement:

Highly variable abundance but there is some evidence that abundance has declined since 2015. Abundance is similar to the overall NSW MDB.

Health

The prevalence of any health issues ranged from 0 % of sampled fish in all years since 2016/17 to 1 % of sampled fish to 2016/2017 (Figure 6.27). The most common health issue for Australian smelt in the Macquarie-Castlereagh WRPAs was Lesions, which was observed in a total of 3 fish, corresponding to <1 % of all Australian smelt measured.

Across the other NSW MDB WRPA, 1 % of Australian smelt (168 out of 26,224 Australian smelt) showed a health condition (excludes the Macquarie-Castlereagh WRPAs).

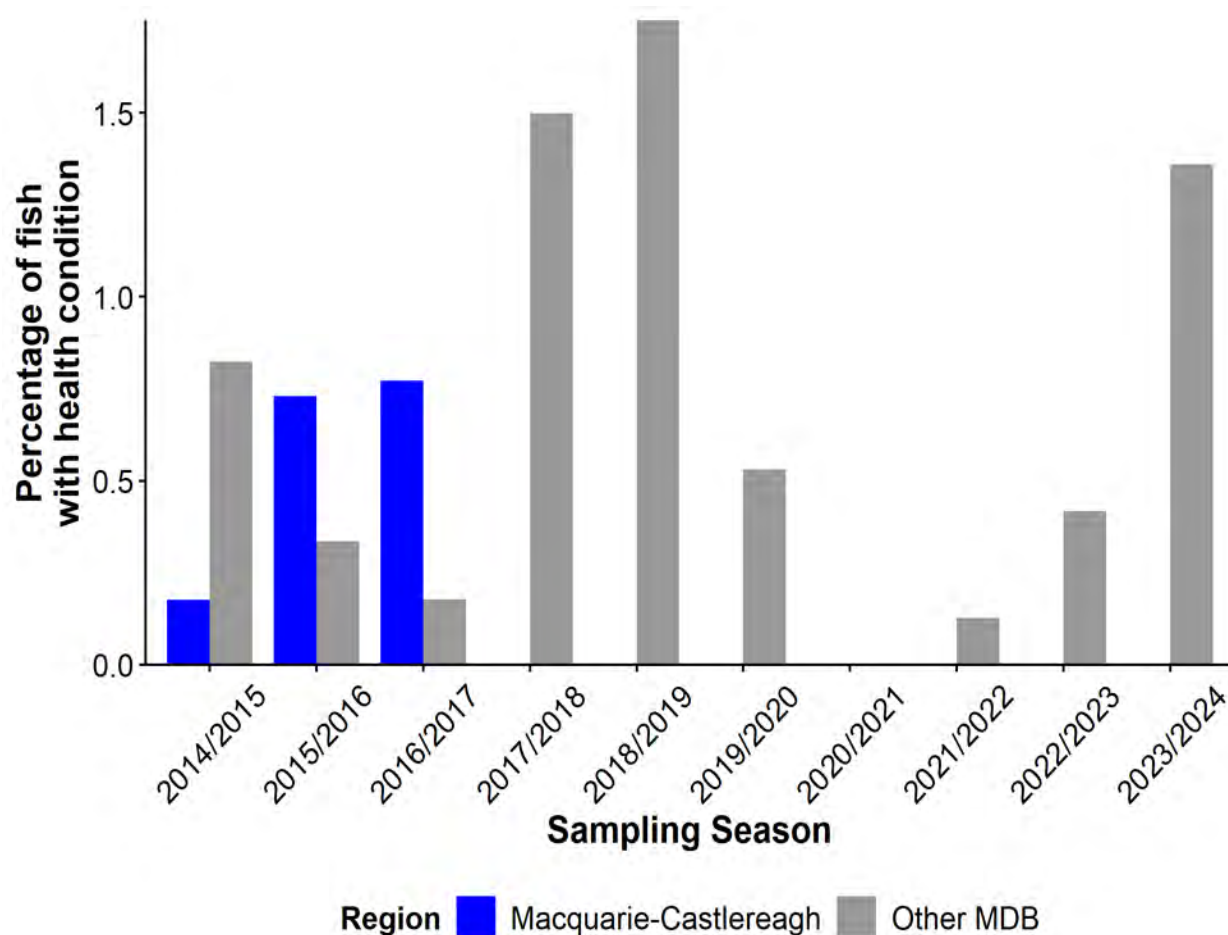


Figure 6.27: Timeseries showing the prevalence of health conditions in Australian smelt. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA.

Summary Statement:

Very few health issues were recorded in Australian smelt in the Macquarie-Castlereagh and none in recent years.

Distribution

Australian smelt were recorded at 51 out of 141 sites in the Macquarie-Castlereagh WRP from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 8.3 fish caught per 90 seconds of electrofishing. Figure 6.28 shows the distribution and relative abundance of Australian smelt across the Macquarie-Castlereagh WRP.

Summary Statement:

Australian smelt were mostly observed across the southern half of the Macquarie-Castlereagh WRP with very few observations in the northern region.

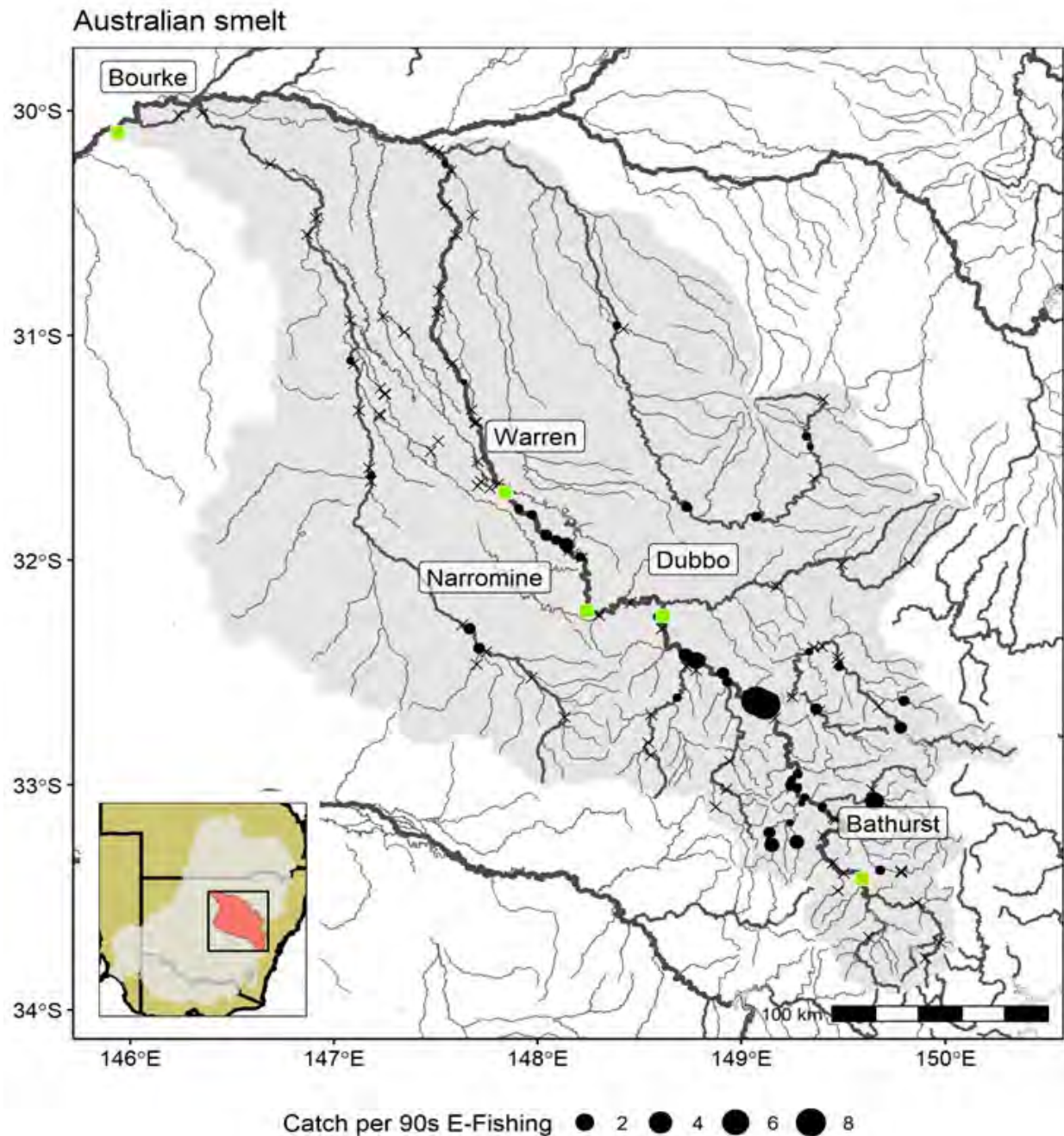


Figure 6.28: Distribution of Australian smelt sampled from 2013/14 to 2023/24 in the Macquarie-Castlereagh WRP. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares represent key towns.

Common carp



Population Structure

Figure 6.29 shows the observed length frequency plot for Common carp for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 54 to 1925, and 9 % to 74 % of measured fish within a season, with a mean percentage YOY of 36 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Common carp was 57 % (31,755 out of 55,973).

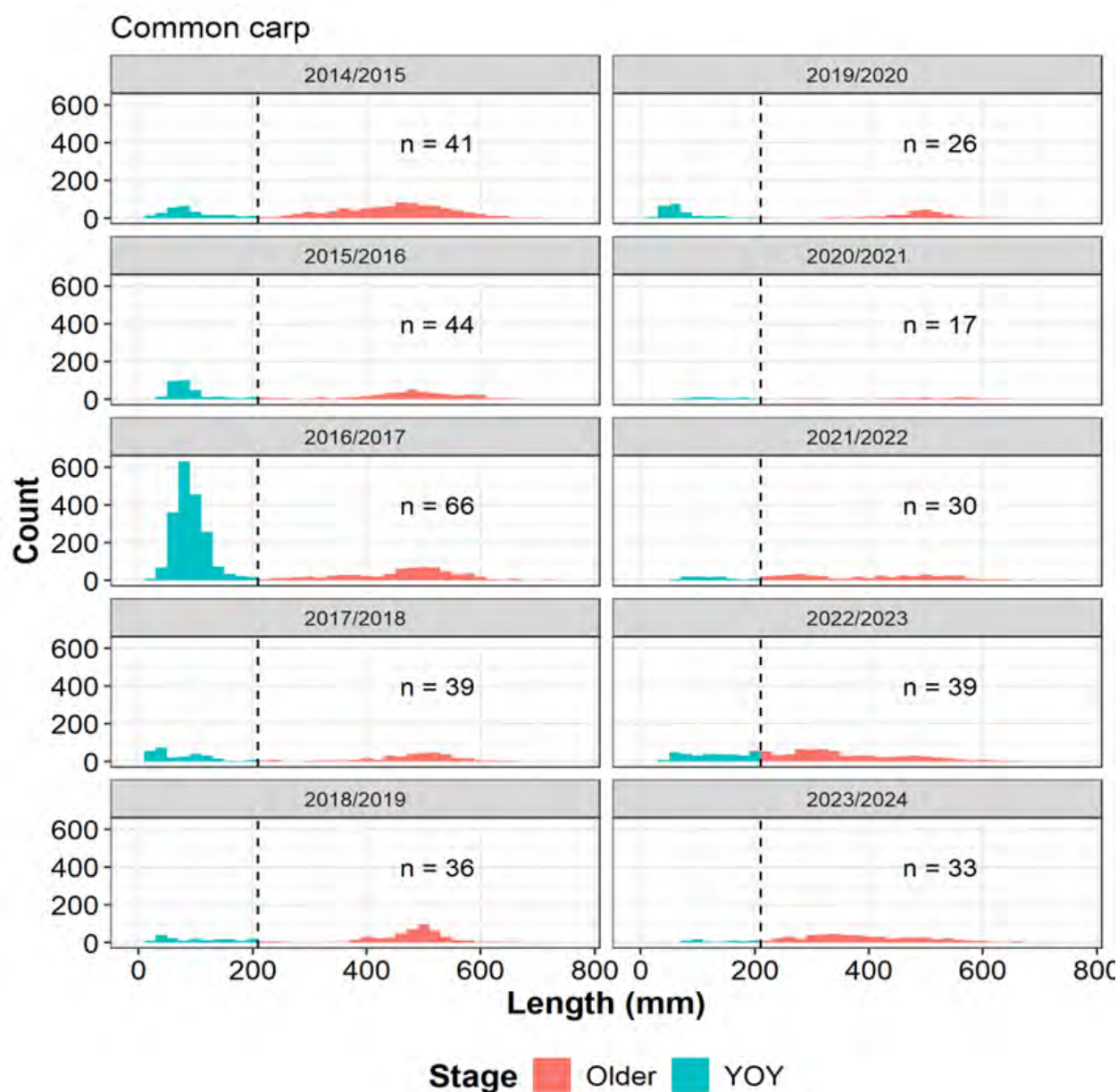


Figure 6.29: Length frequency plots for common carp by sampling season in the Macquarie-Castlereagh WRP. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRP in a sampling season.

Summary Statement:

Variable recruitment with a very strong peak in 2016/17. Large fish (>500 mm) present in all years. Low recruitment in 2023/24 with evidence of multiple year classes in the population.

Temporal Trends in Abundance

The relative abundance and biomass of Common carp since 1994 was modelled based on all suitable boat electrofishing data. The left-hand panels of Figure 6.30 show the abundance and biomass trends for the Macquarie-Castlereagh WRPA and the right-hand panels show the overall trends across the NSW MDB.

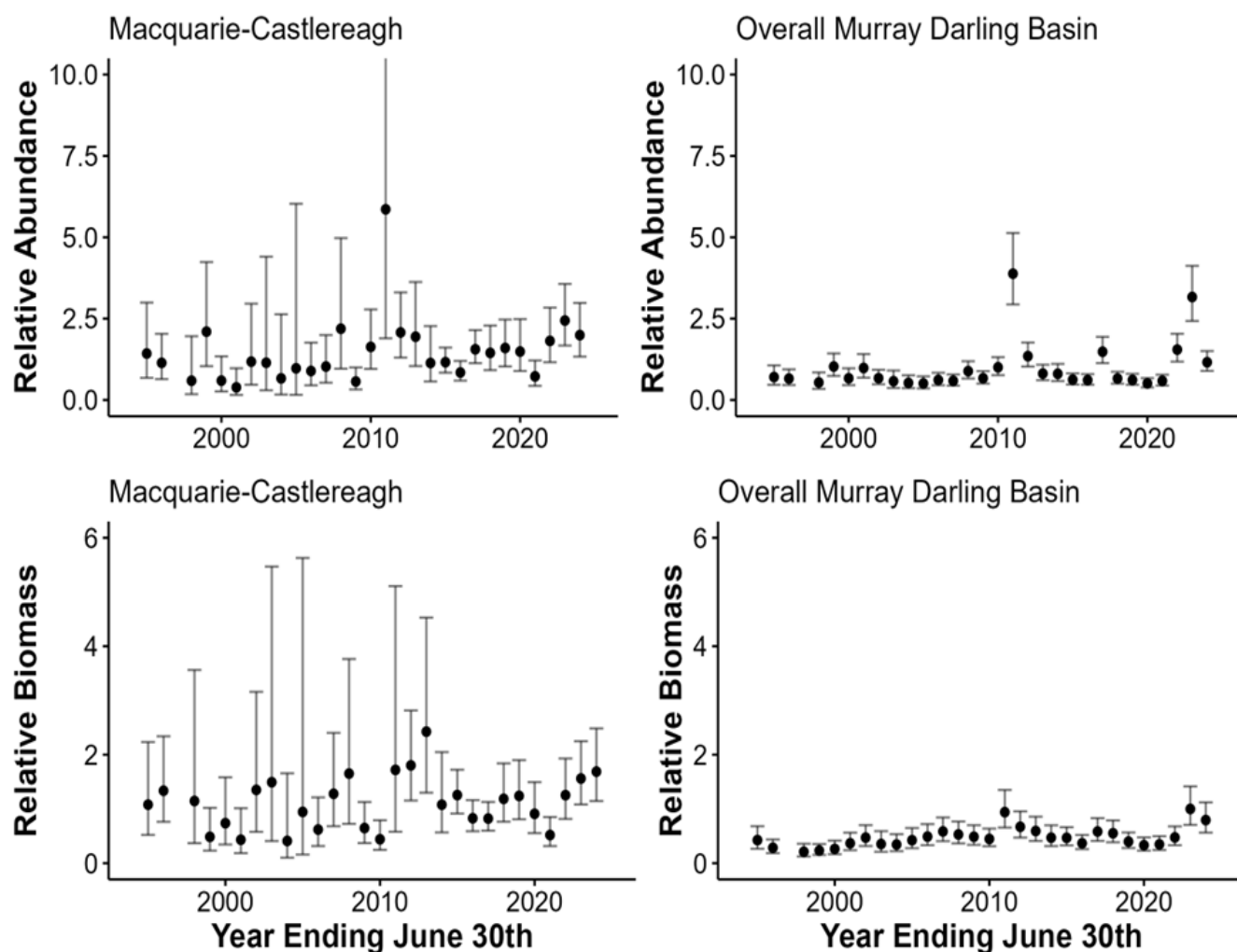


Figure 6.30: Relative abundance and biomass of Common carp in both this valley and the overall Murray-Darling Basin. These are model estimates based upon all electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates.

Summary Statement:

Abundance and biomass are likely both slightly higher than the 1990s following strong recruitment in recent years. Recent abundance similar to, or slightly higher, than overall NSW MDB. Recent biomass higher than overall NSW MDB and trending upwards.

Health

The prevalence of any health issues ranged from 3 % of sampled fish in 2017/2018 to 18 % of sampled fish in 2018/2019 (Figure 6.31). The most common health issue for Common carp in the Macquarie-Castlereagh water resource planning area was *Lernaea*, which was observed in a total of 480 fish, corresponding to 6 % of all Common carp measured.

Across the other WRPA's, 3 % of Common carp (1,680 out of 55,975 Common carp) showed a health condition (excludes Macquarie-Castlereagh).

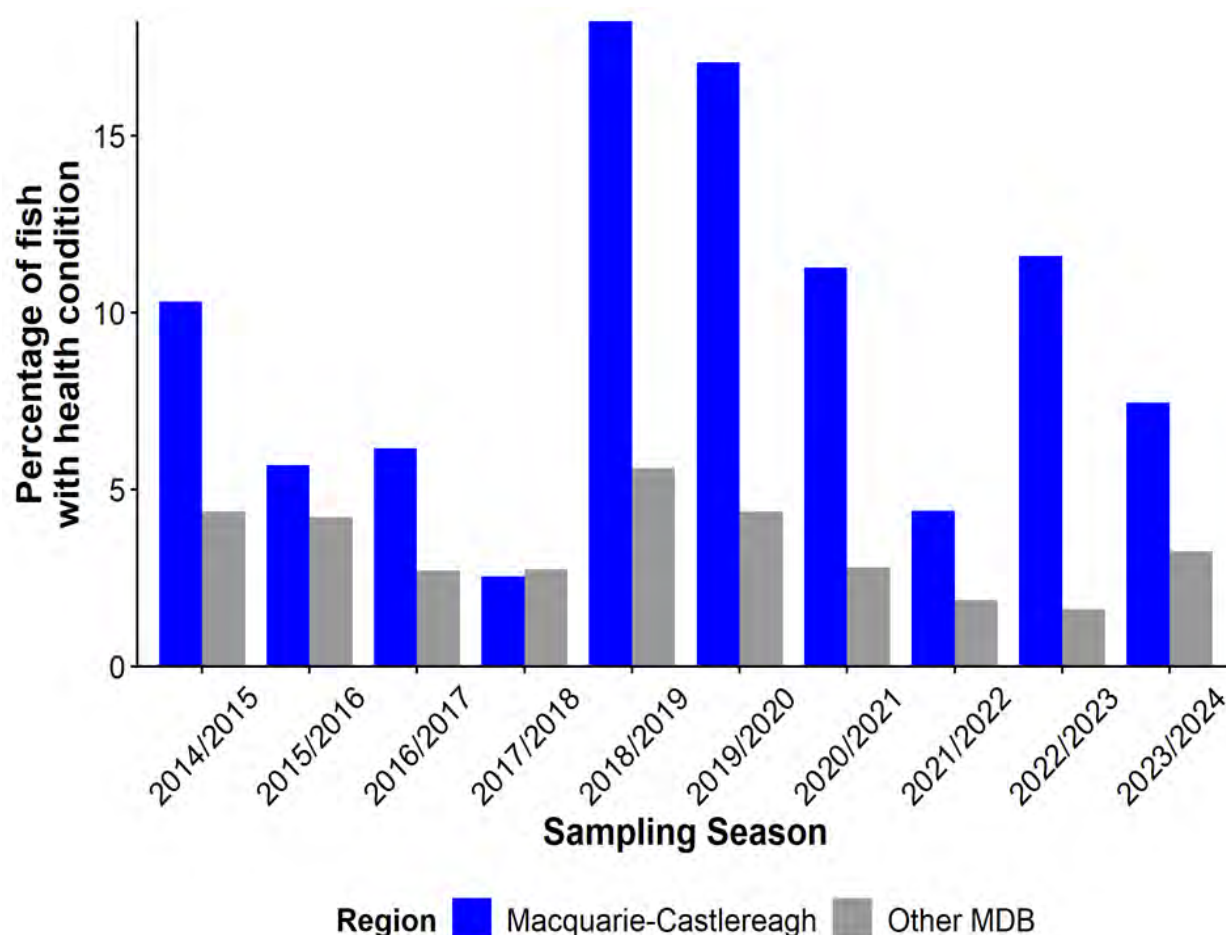


Figure 6.31: Timeseries showing the prevalence of health conditions in Common carp. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA's.

Summary Statement:

The presence of observable health conditions for Common carp in the Macquarie-Castlereagh was low to moderate and but consistently higher than the wider NSW MDB. 2023/24 showed a moderate level of health issues.

Distribution

Common carp were recorded at 121 out of 141 sites in the Macquarie-Castlereagh WRP from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 26.8 fish caught per 90 seconds of electrofishing. Figure 6.32 shows the distribution and relative abundance of Common carp across the Macquarie-Castlereagh WRP.

Summary Statement:

Common carp were found in relatively high abundance across the Macquarie-Castlereagh region.

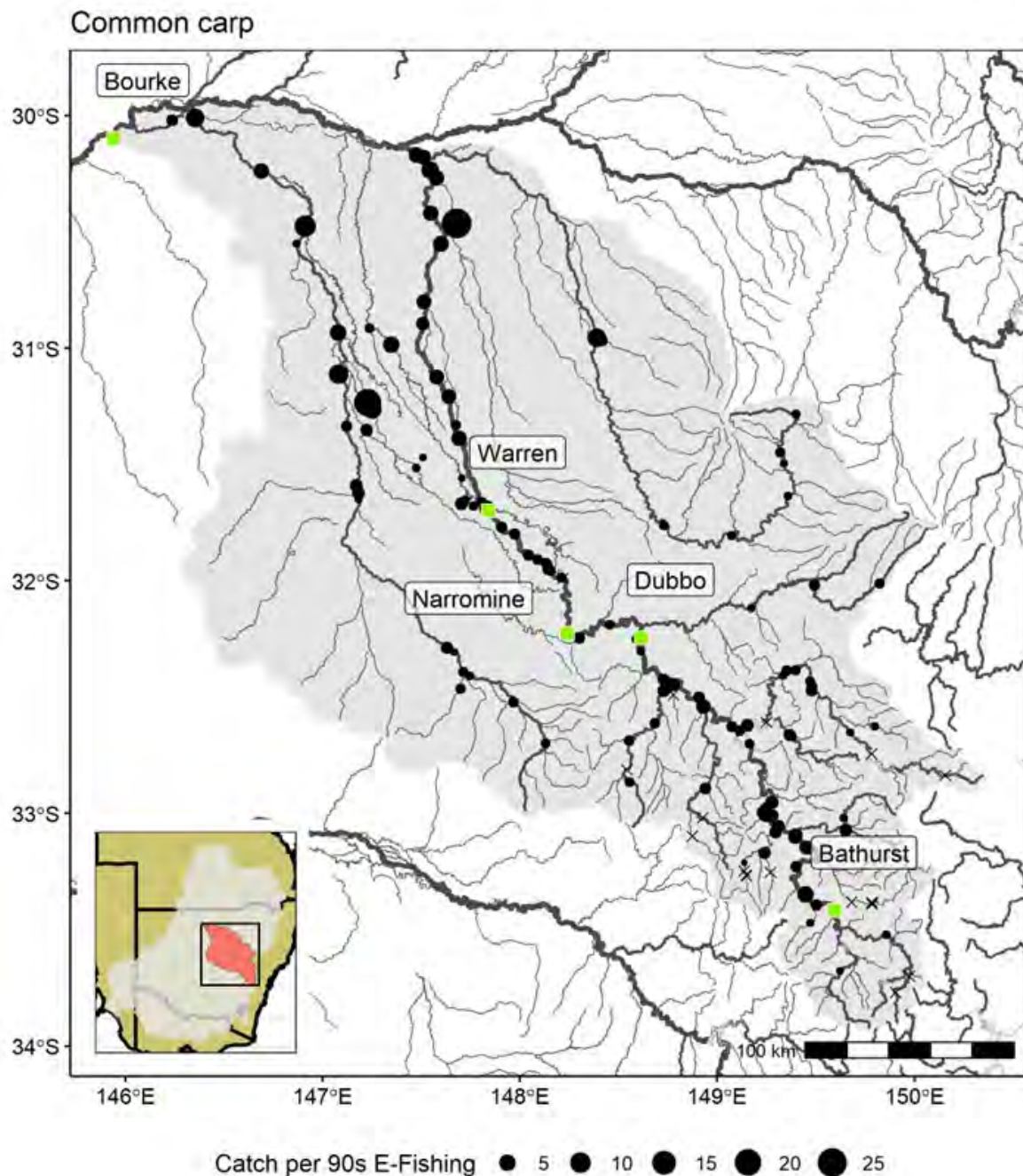


Figure 6.32: Distribution of Common carp sampled from 2013/14 to 2023/24 in the Macquarie-Castlereagh WRP. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares represent key towns.

Threatened Species

The following table (Table 6.6) shows the fish species listed under either the *NSW Fisheries Management Act 1994* (FMA) or the *Commonwealth Environmental Protection and Biodiversity Conservation Act 1999* (EPBC) which were observed during standardised electrofishing surveys in the Macquarie-Castlereagh Water Resource Planning Area during the reporting period. A list of all threatened fish species observed by NSW DPIRD Fisheries (as part of any sampling program in any area) is provided in Table 6.10.

Table 6.6: Listed species which were observed in this region during the sampling period. (* = FMA, # = EPBC)

Species	Common name	Total caught (observed)
<i>Ambassis agassizii</i>	Olive perchlet*	41 (3)
<i>Bidyanus bidyanus</i>	Silver perch*#	14 (6)
<i>Maccullochella macquariensis</i>	Trout cod*#	7 (0)
<i>Maccullochella peelii</i>	Murray cod#	1,453 (481)
<i>Macquaria australasica</i>	Macquarie perch*#	3 (0)
<i>Tandanus tandanus</i>	Freshwater catfish*	120 (16)

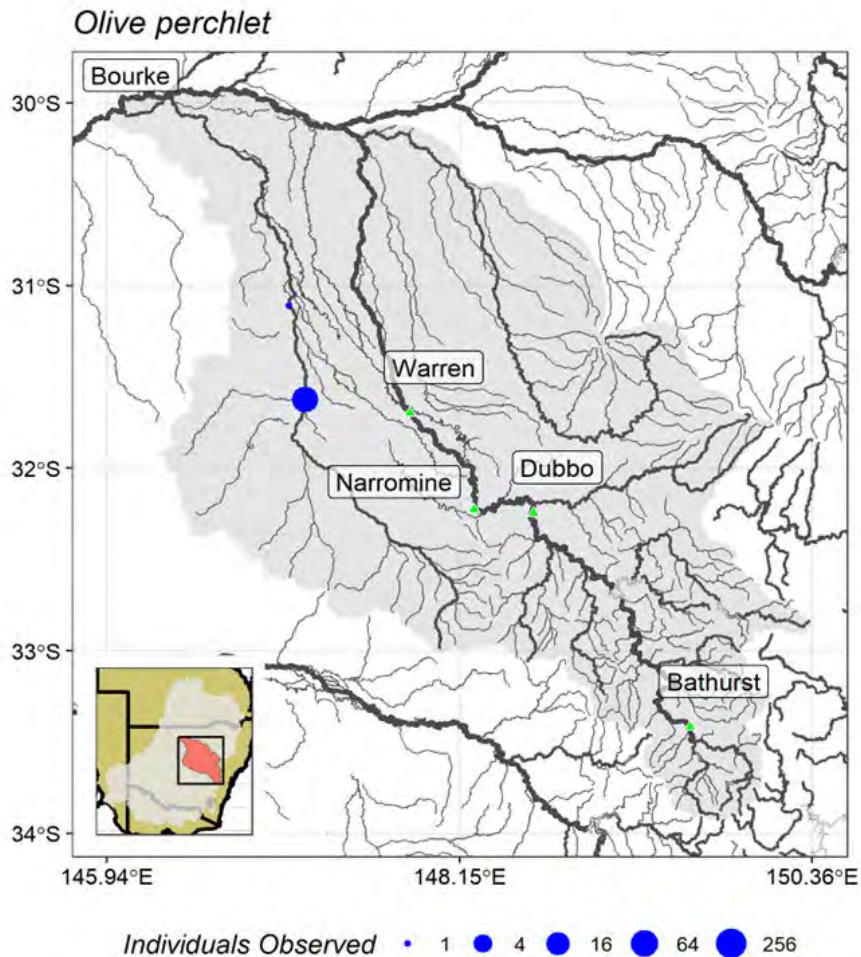


Figure 6.33: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the Macquarie-Castlereagh WRPA. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance.

Summary Statement:

A total of 41 Olive perchlet were caught across two sites in the Bogan River. Individuals were observed in all sampling years except 2021/22. Olive perchlet were stocked in the Macquarie-Castlereagh WRPA in 2020/21 and 2021/22 (n= 35,000).

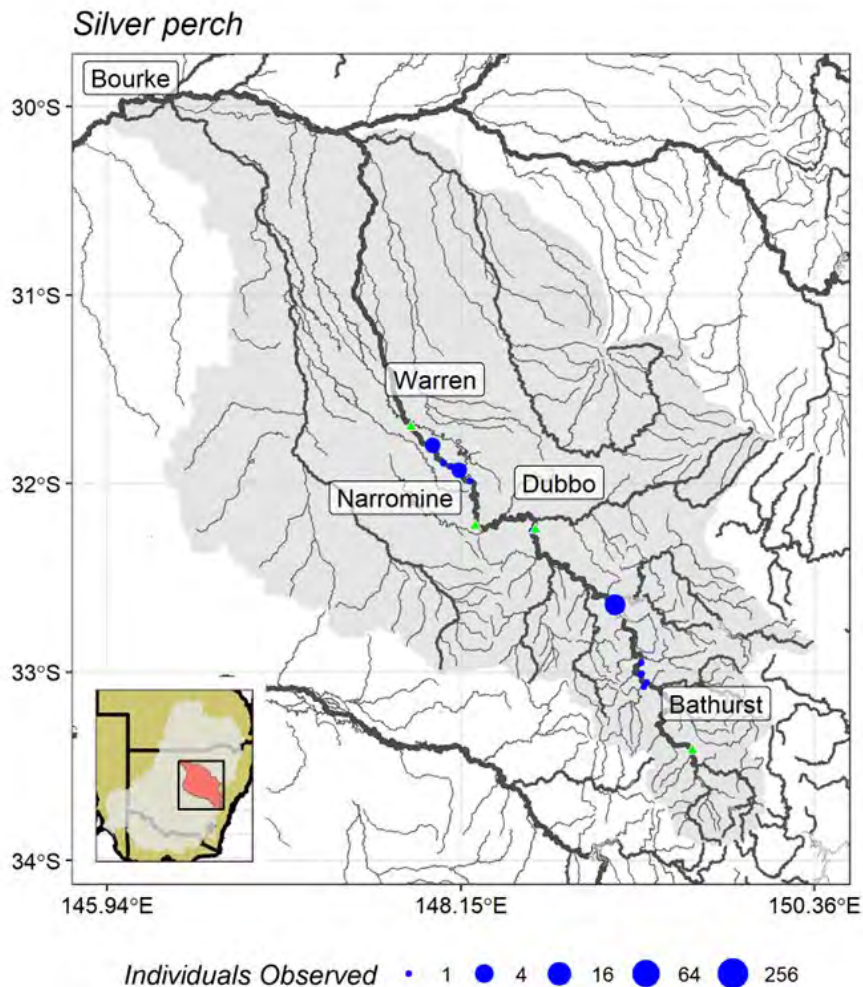


Figure 6.34: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the Macquarie-Castlereagh WRPA. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance.

Summary Statement:

14 Silver perch were caught across the reporting period across 10 sites in the Macquarie River and Little Bald Creek. Individuals were observed in all years except 2019/2020 and 2023/24.

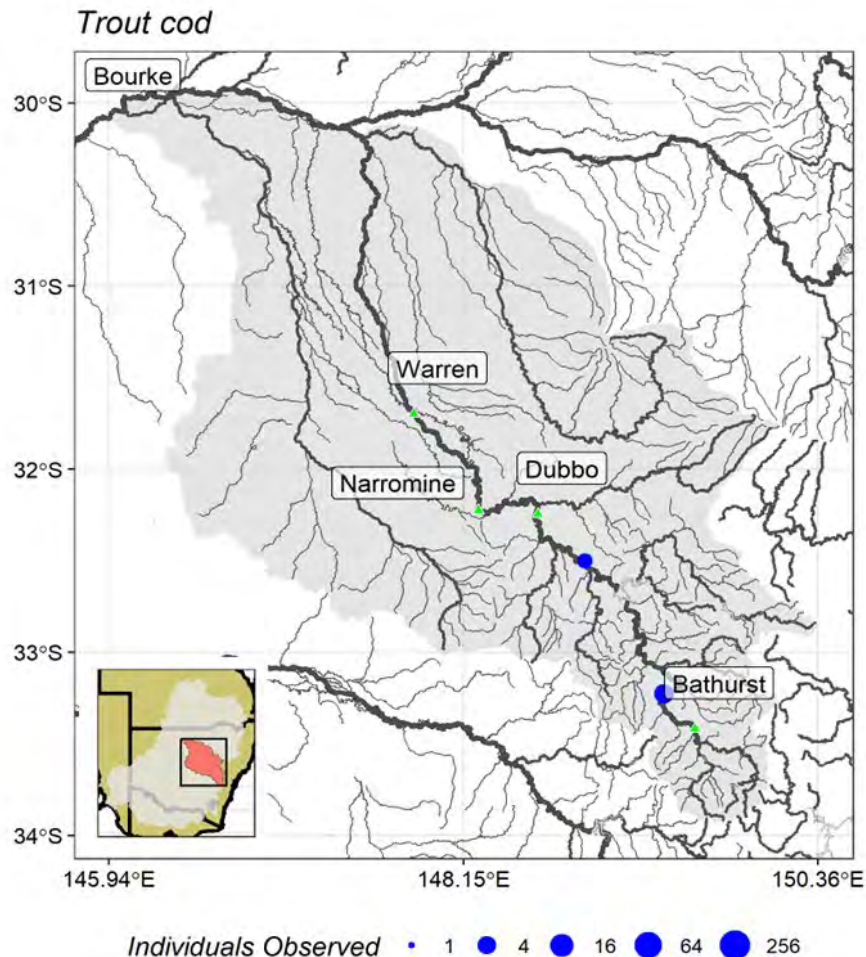


Figure 6.35: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the Macquarie-Castlereagh WRPA. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance.

Summary Statement:

Trout cod were observed in 2014/15 ($n=2$) and 2015/16 ($n=5$) in the Macquarie River. Trout cod have been stocked in this WRPA since 1992, most recently in 2018. Trout cod have not been recorded in this WRPA since 2016.

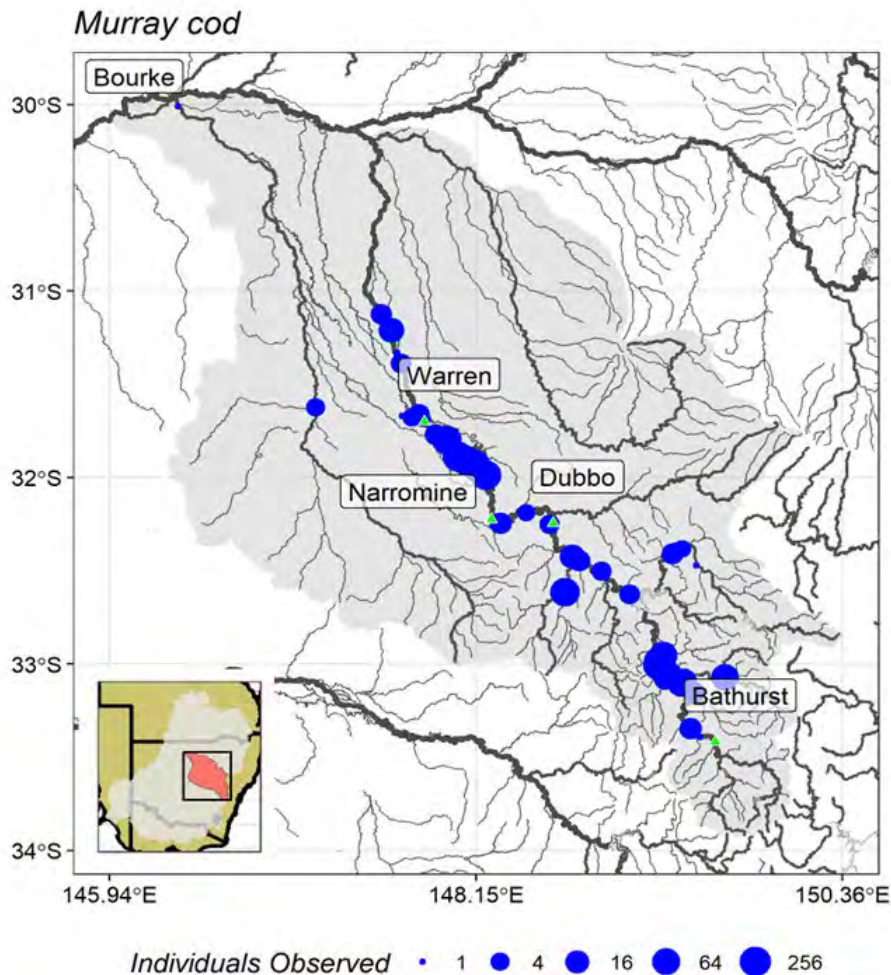


Figure 6.36: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the Macquarie-Castlereagh WRP. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance. Note the lower image shows a juvenile Murray cod.

Summary Statement:

Murray cod were widespread across the Macquarie-Castlereagh WRP, and were particularly common in the Macquarie River. A total of 1,453 individuals were caught over the reporting period with individuals observed in each sampling season.

Macquarie perch

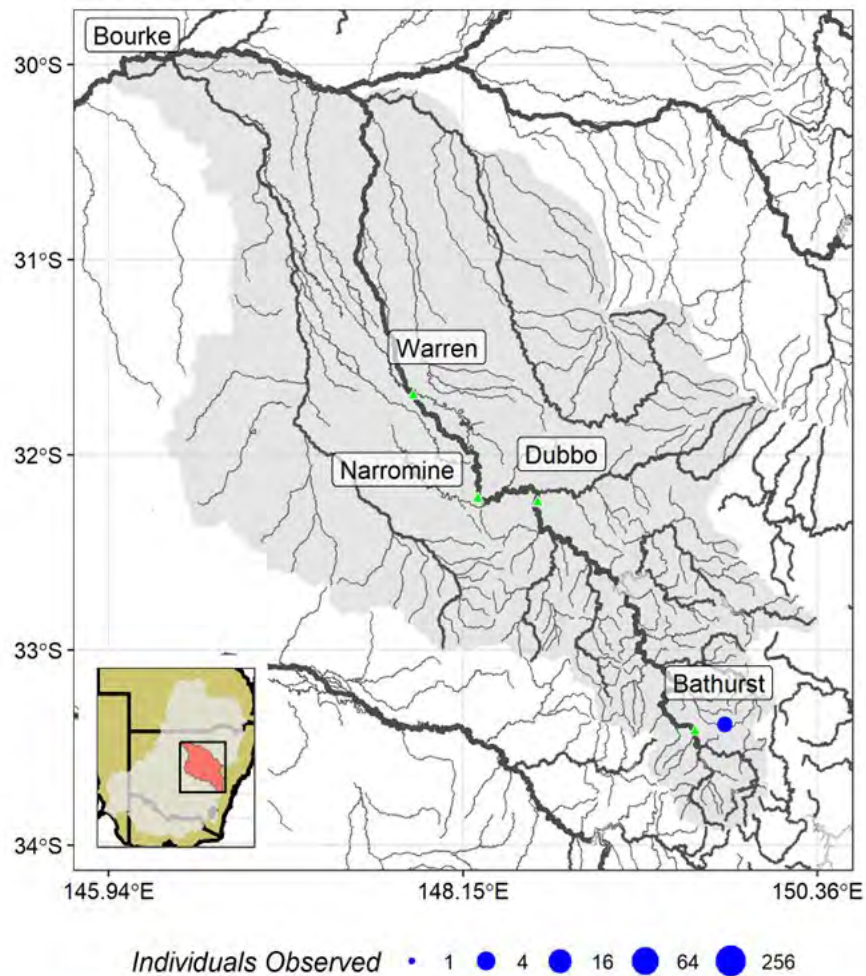


Figure 6.37: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the Macquarie-Castlereagh WRPA. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance.

Summary Statement:

One Macquarie perch was caught in 2020/21 and two Macquarie perch were caught in 2021/22.

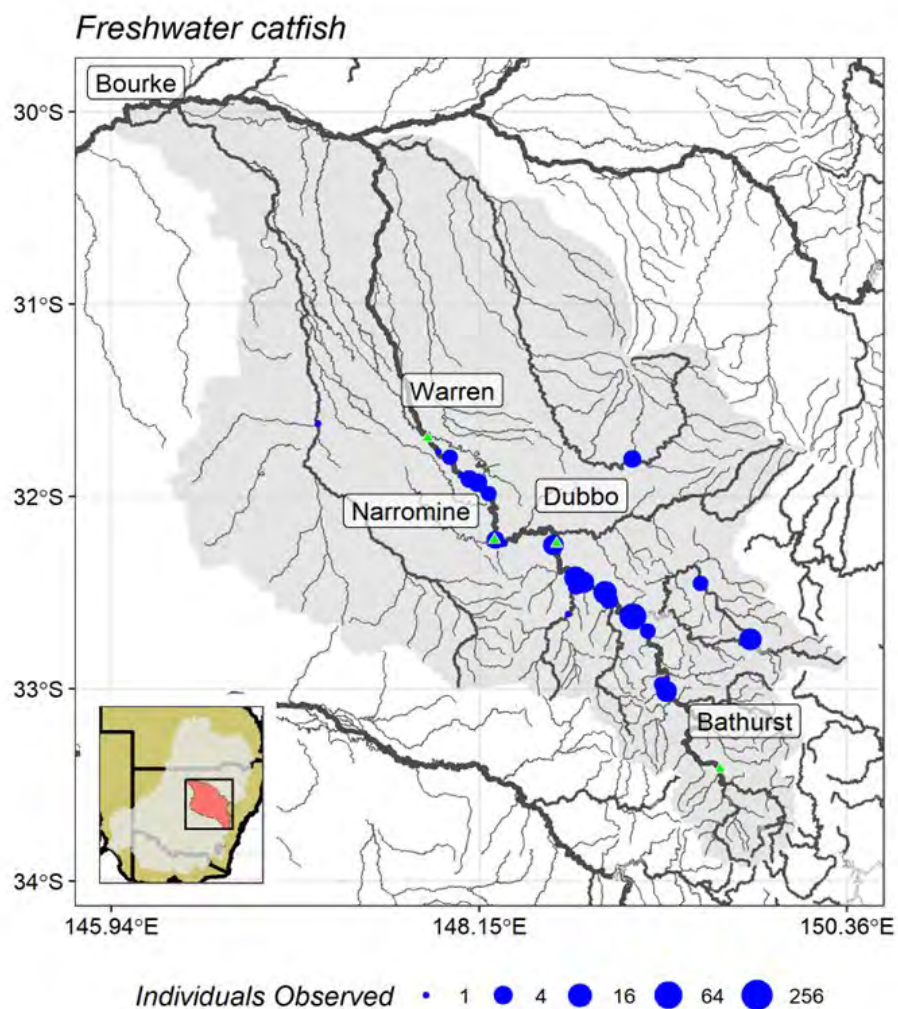


Figure 6.38: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the Macquarie-Castlereagh WRPA. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance.

Summary Statement:

Freshwater catfish were caught in all sampling years (total= 120) across the central and southern half of the Macquarie-Castlereagh WRPA. Most individuals were in the Macquarie River.

Appendix

This report contains data from the projects listed in Table 6.7.

Table 6.7: Projects included in this report. Sampling Events show the total number of sampling events included from each project. Sampling Seasons shows which sampling seasons each project contributed data to.

Project Name	Sampling Seasons	Sampling Events
Basin Plan Environmental Outcomes Monitoring	2014/2015, 2015/2016, 2016/2017, 2017/2018, 2018/2019, 2019/2020, 2020/2021	259
Basin Plan Environmental Outcomes Monitoring 2	2022/2023, 2023/2024	37
Carp Biomass Project (NCCP)	2017/2018	1
Carp herpes virus investigation	2015/2016, 2016/2017	11
Golden perch Macquarie migration pathways	2022/2023	4
Macquarie River eflow response monitoring	2020/2021, 2021/2022, 2022/2023, 2023/2024	33
Macquarie perch surveys	2020/2021, 2021/2022, 2022/2023	5
Monitoring, Evaluating and Reporting - Inland	2014/2015, 2015/2016, 2016/2017	17
Murray-Darling Basin Fish Surveys	2014/2015, 2015/2016, 2016/2017, 2017/2018, 2018/2019, 2019/2020, 2020/2021, 2021/2022, 2022/2023, 2023/2024	84
Orange Pipeline assessment	2014/2015, 2016/2017, 2017/2018, 2018/2019, 2019/2020, 2021/2022, 2022/2023, 2023/2024	97

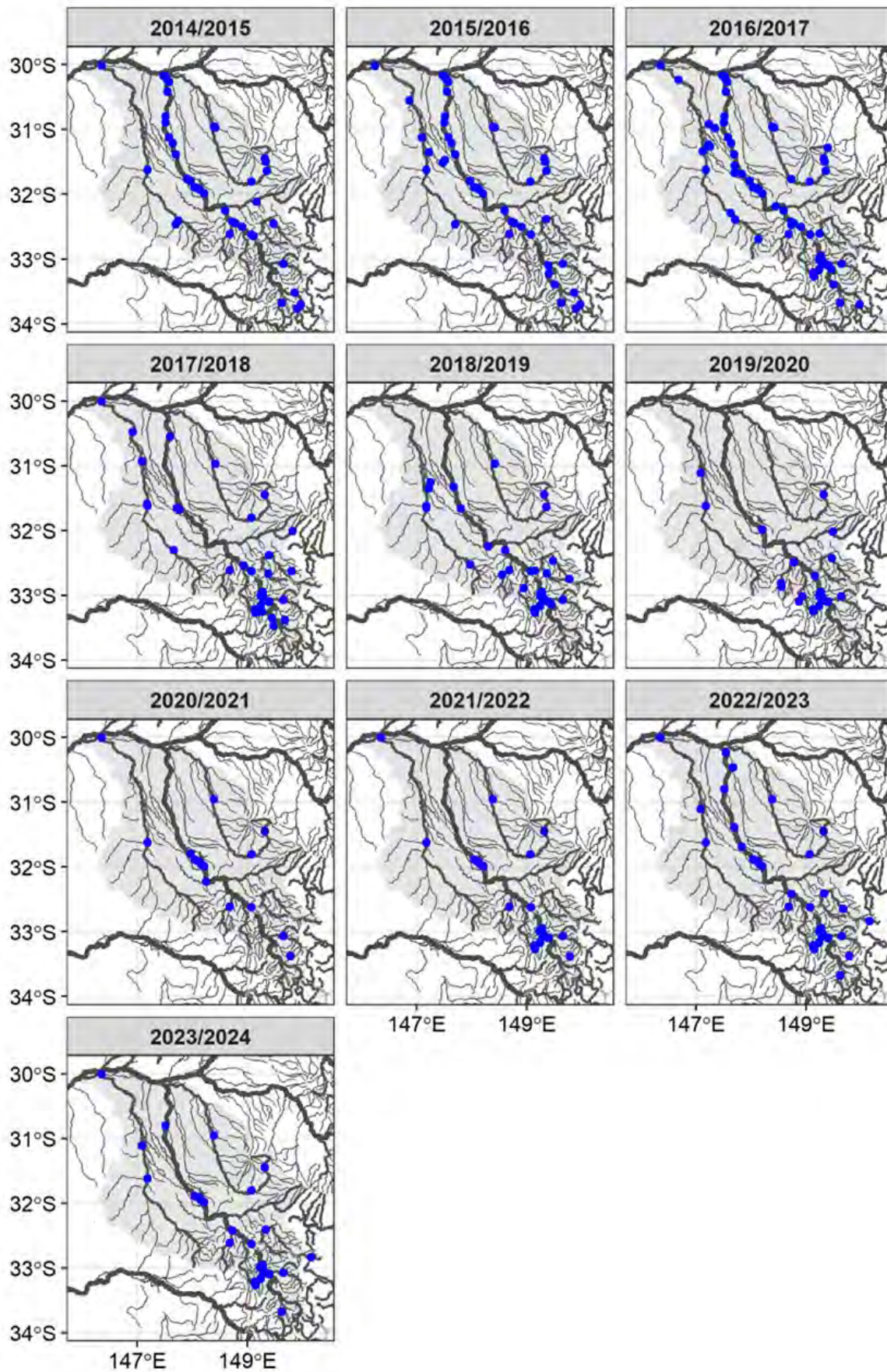


Figure 6.39: Sites sampled and included in this report by sampling season in the Macquarie-Castlereagh WRP. Dry sites are not shown.

Table 6.8 shows all species detected during this survey period as part of standardised monitoring projects (see Table 6.7). Note there are variations in effort between sampling seasons so this information should be considered in conjunction with Table 6.1. The Expected from Modelling column identifies species which are possible to occur based upon MaxENT habitat modelling (likelihood threshold > 0.33; NA represents no modelling was undertaken). Species that were possible from the modelling but not observed during standardised sampling in the Macquarie-Castlereagh WRPAs were: Darling hardyhead, Flat-headed galaxias, Southern purple-spotted gudgeon, Southern pygmy perch and Hyrtl's catfish. It should be noted that the MaxENT modelling models habitat availability and is not always a reliable index of abundance, it merely indicates possible distribution based upon habitat. A full list of species observed during this period across the standardised monitoring protocols and sampling methods is presented in Table 6.11.

Table 6.8: Total number caught of each species by sampling season in the Macquarie-Castlereagh WRPAs.

Common name	Expected from modelling	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24
Australian smelt	YES	1,017	370	985	51	56	42	101	84	153	79
Bony herring	YES	240	103	1,179	153	44	26	60	155	483	375
Brown trout	YES	4	3	12	0	0	0	18	102	55	0
Carp-gudgeon species complex	YES	2,502	1,222	1,295	1,061	1,020	389	1,198	66	78	109
Common carp	NA	1,412	722	3,638	712	638	634	149	594	1,746	803
Common carp - Goldfish hybrid	NA	2	1	2	3	7	0	0	3	4	13
Dwarf flathead gudgeon	YES	0	1	0	2	0	0	0	0	0	0
Eastern gambusia	NA	2,445	2,777	4,758	1,518	1,322	696	247	59	699	383
Flathead gudgeon	YES	784	116	244	192	120	87	4	3	10	53
Freshwater catfish	YES	54	8	19	6	10	2	4	4	11	4
Golden perch	YES	185	90	229	39	37	12	24	109	81	67
Goldfish	NA	130	147	4,391	239	61	72	13	80	446	138
Macquarie perch	YES	0	0	0	0	0	0	1	2	0	0
Mountain galaxias	YES	93	114	39	130	16	7	64	148	85	44
Murray cod	YES	432	188	198	101	97	39	329	114	128	114
Murray-Darling rainbowfish	YES	738	169	135	3	1	0	10	4	0	13
River blackfish	NA	0	0	0	0	0	5	2	0	5	3
Olive perchlet	YES	0	7	2	1	1	15	13	0	2	0
Rainbow trout	YES	4	27	13	4	0	7	0	40	64	4

Common name	Expected from modelling	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24
Redfin	YES	222	18	840	67	110	47	0	346	89	55
Silver perch	YES	6	2	2	2	0	0	1	1	0	1
Spangled perch	YES	35	21	80	9	2	0	14	54	78	10
Trout cod	YES	3	5	0	0	0	0	0	0	0	0
Unspecked hardyhead	YES	192	112	228	16	15	53	28	32	105	44

The following table summarises the sampling methods for each species caught (Table 6.9).

Table 6.9: Total catch of each species by sampling method in the Macquarie-Castlereagh WRPA.

Common name	Backpack Electrofishing	Bait Trap	Boat Electrofishing
Australian smelt	276	1	2,542
Bony herring	112	11	2,695
Brown trout	129	0	65
Carp gudgeon species complex	2,239	4,525	852
Common carp	1,022	723	9,110
Common carp - Goldfish hybrid	0	0	34
Dwarf flathead gudgeon	2	0	1
Eastern gambusia	8,882	4,061	1,686
Flathead gudgeon	179	145	1,216
Freshwater catfish	19	0	101
Golden perch	10	3	845
Goldfish	411	53	5,253
Macquarie perch	3	0	0
Mountain galaxias	679	12	13
Murray cod	18	1	1,434
Murray-Darling rainbowfish	19	1	1,049
River blackfish	12	0	3
Olive perchlet	0	8	33
Rainbow trout	140	0	23
Redfin	182	106	1,287
Silver perch	1	0	13
Spangled perch	64	26	213
Trout cod	5	0	2
Unspecked hardyhead	29	5	789

Table 6.10: Listed threatened species recorded in the Murray-Darling Basin (from the NSW DPIRD Fisheries Freshwater Ecosystem research database). Species are listed under either the NSW Fisheries Management Act 1994 (FMA) or the Commonwealth Environmental Protection and Biodiversity Conservation Act 1999 (EPBC).

Genus, species	Common Name	EPBC Status	FMA Status
<i>Ambassis agassizii</i>	Agassiz's glassfish, olive perchlet, western New South Wales population	NA	Endangered Population
<i>Bidyanus bidyanus</i>	Silver Perch, Bidyan	Endangered	Vulnerable
<i>Craterocephalus fluviatilis</i>	Murray Hardyhead	Endangered	Critically Endangered
<i>Galaxias rostratus</i>	Flathead Galaxias, Beaked Minnow, Flat-headed Galaxias, Flat-headed Jollytail, Flat-headed Minnow	Critically Endangered	Critically Endangered
<i>Galaxias tantangara</i>	Stocky Galaxias	NA	Critically Endangered
<i>Maccullochella macquariensis</i>	Trout Cod	Endangered	Endangered
<i>Maccullochella peelii</i>	Murray Cod	Vulnerable	NA
<i>Macquaria australasica</i>	Macquarie Perch	Endangered	Endangered
<i>Mogurnda adspersa</i>	Southern Purple Spotted Gudgeon	NA	Endangered
<i>Nannoperca australis</i>	Southern Pygmy Perch	Vulnerable	Endangered
<i>Tandanus tandanus</i>	Freshwater catfish, eel tailed catfish, Murray-Darling Basin population	NA	Endangered Population

Table 6.11 shows all species detected during this survey period across all programs and methods. Due to variations in project methods protocols, this data is presented only to give a complete list of species observed in the region. The Expected from Modelling column identifies species which are possible to occur based upon MaxENT habitat modelling (likelihood threshold > 0.33; NA represents no modelling was undertaken). Species that were possible from the modelling but not observed during standardised sampling in the Macquarie-Castlereagh WRPAs were: Darling hardyhead, Flat-headed galaxias, Southern purple-spotted gudgeon and Southern pygmy perch. It should be noted that the MaxENT modelling actually models habitat availability and is not always a reliable index of abundance, it merely indicates possible distribution based upon habitat. A list of species caught as part of standardised monitoring during this period is in Table 6.8.

Table 6.11: Total catch of each species by all sampling programs and all methods in the Macquarie-Castlereagh WRPAs. Note these include projects with sampling not representative of the community and the data should be used with caution.

Common name	Expected from modelling	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24
Australian smelt	YES	1,017	511	995	51	56	42	110	84	396	82
Bony herring	YES	240	103	1,349	153	44	26	194	155	510	375
Brown trout	YES	4	3	12	0	14	32	60	132	102	0
Carp gudgeon species complex	YES	2,502	1,511	1,660	1,061	1,021	389	2,710	66	82	112
Common carp	NA	1,564	914	3,689	712	639	636	331	649	2,498	1,063
Common carp - Goldfish hybrid	NA	2	5	2	3	7	0	0	3	4	13
Dwarf flathead gudgeon	YES	0	1	0	2	0	0	0	0	0	0
Eastern gambusia	NA	2,445	3,169	5,273	1,518	1,335	701	2,535	59	729	384
Flathead gudgeon	YES	784	228	260	192	127	90	33	4	218	53
Freshwater catfish	YES	57	27	26	6	10	2	241	20	15	5
Golden perch	YES	185	129	245	39	37	12	29	115	229	147
Goldfish	NA	130	147	4,760	239	61	72	327	80	469	146
Hyrtl's catfish	YES	0	0	1	0	0	0	0	0	3	0
Macquarie perch	YES	0	0	0	0	0	0	1	2	0	0
Mountain galaxias	YES	93	126	40	130	148	348	151	234	181	44
Murray cod	YES	432	286	199	101	97	39	1,051	148	157	132
Murray-Darling rainbowfish	YES	758	176	136	3	1	0	48	4	0	13

Common name	Expected from modelling	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24
River blackfish	NA	0	0	0	0	0	5	2	0	5	3
Olive perchlet	YES	0	7	2	1	1	15	13	0	2	0
Rainbow trout	YES	4	27	13	4	117	67	121	138	181	4
Redfin	YES	222	156	840	67	111	49	2	355	163	62
Silver perch	YES	6	4	2	2	0	0	1	1	7	1
Spangled perch	YES	35	21	119	9	2	0	14	54	256	10
Trout cod	YES	3	5	0	0	0	0	0	0	0	0
Unspecked hardyhead	YES	212	230	234	16	15	53	280	32	4	0

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Chapter 7 Basin Plan Fish Monitoring Summary (2014/15 – 2023/24): Murrumbidgee Water Resource Planning Area

Hayden Schilling & David Crook

March 2025



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Chapter cover image credit: Samuel Nolan (UNSW); Fish images credit: Gunther Schmida

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Introduction

This report spans 2014/15 to 2023/24 and uses all suitable fish assemblage data collected by NSW DPIRD Fisheries using standardized electrofishing monitoring techniques. The format of the report follows and expands upon the previous reports (Schilling & Crook 2023, 2024). This report focusses on the Murrumbidgee Water Resource Planning Area (WRPA) shown in Figure 7.1.

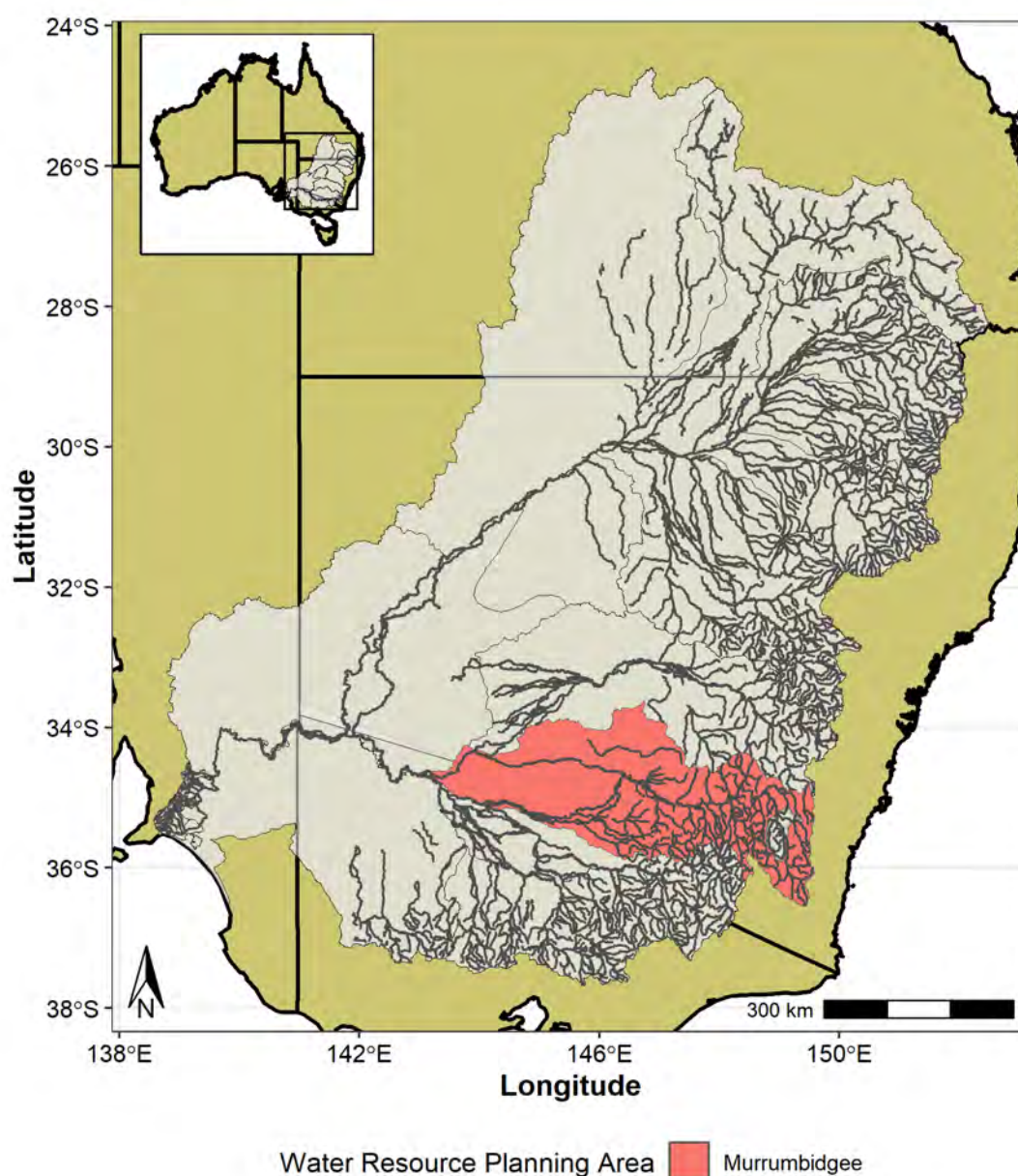


Figure 7.1: Murray-Darling Basin with the key region of this report highlighted. Inset map shows the whole of Australia with a box around the MDB.

What This Report Includes

This report starts with an overview of the standardised monitoring programs including sampling details and statistics. An overview of the hydrological and climatic conditions during the reporting period is also provided as context for interpreting the fish population status data.

Following the introductory sections, we present a summary of *fish diversity* across the Murrumbidgee WRPAs. Separate plots for native and alien species show the total number of unique species observed at each site.

The main body of the report provides detailed information on the *population structure, relative abundance, health, and distribution* of six key fish species:

- Murray cod
- Golden perch
- Freshwater catfish (very few were caught in this WRPAs during the reporting period)
- Bony herring
- Australian smelt
- Common carp

Population structure information includes length frequency plots of collected fish and the proportion of fish classified as Young of the Year (YOY). This information can be used to infer the size structure of populations and the level of recruitment each year. For additional context, we provide a summary table showing any stocking which occurred for the species in each year (if relevant).

Relative abundance and *relative biomass* (a unit-less measure representing the number (or biomass) of fish in an area) information is adapted from the modelled outputs from a more in-depth publication (Crook et al. 2023) which considers all available electrofishing data within the NSW Murray-Darling Basin (MDB). The updated analysis uses generalised linear mixed models to generate annual indices of relative abundance and biomass for each WRPAs. In this report we present the modelled time series of relative abundance showing the predicted number (or biomass) of fish observed per 90 second shot of electrofishing. The abundance and biomass trends for the Murrumbidgee WRPAs are contrasted with the overall NSW MDB dataset. It should be noted that these are modelled estimates of relative abundance/biomass, not absolute abundance/biomass as absolute estimates would require extensive calibration surveys that are not included in the monitoring program.

Health information is provided as a summary of any visible health conditions recorded for the key species. The number of health conditions observed in a fish population is generally reflective of water quality, competition, and many other factors. Fewer observations of health conditions indicate healthier populations. The health conditions detailed are any that were observed as part of the biological measurements taken. We provide a comparison of the prevalence of health conditions in the Murrumbidgee WRPAs and greater MDB (excluding the Murrumbidgee WRPAs).

Distribution maps are provided for each species to show the observed distribution of each species from electrofishing samples. The distribution maps also show the relative abundance (number of fish observed per 90 seconds of electrofishing) at each site to give an indication of how the population is spread over the landscape.

Finally, the distributions and numbers of *Threatened species* are reported. The report includes threatened species that were recorded by standardised monitoring programs in the Murrumbidgee WRPAs during the reporting period.

For each section of the report, we provide a *Summary Statement*. This statement provides a very brief overview of the key messages for each section.

Sampling Methods

Three main methods are used during routine fish monitoring surveys: boat electrofishing, backpack electrofishing and bait traps. This report mainly includes the electrofishing data with bait trap samples informing the distribution of small bodied species. The electrofishing was conducted using the standard methodology implemented in the Sustainable Rivers Audit (SRA; Davies et al. 2010). This usually includes 12 shots of 90 seconds “power on” during each sampling event.

As parts of this report compile data from multiple projects, there is some variation in how sites were chosen and the effort of sampling conducted each year (Table 7.1). Details of which projects contributed data to this report can be seen in Table 7.7. At each site, sampling gear was applied as suited to the local conditions with either boat, backpack, or a hybrid of the two, in addition to 10 unbaited bait traps set in edge margins. Most sampling occurred between the months of September and May.

Table 7.1: Sampling effort (Number of sites sampled) each sampling season in the Murrumbidgee WRPAs. Variation in sampling effort is due to different numbers of projects and interruptions to planned sampling such as flooding, site desiccation, and extreme weather.

Sampling Season	Number of Boat Electrofishing Sites	Number of Backpack Electrofishing Sites	Number of Hybrid Sites	Total
2014/2015	36	11	2	49
2015/2016	43	14	0	57
2016/2017	41	9	1	51
2017/2018	49	30	1	80
2018/2019	48	9	2	59
2019/2020	30	11	3	44
2020/2021	10	0	0	10
2021/2022	18	0	0	18
2022/2023	22	4	1	27
2023/2024	23	4	1	28

The sites sampled during the reporting period are shown in Figure 7.2. A breakdown of sites sampled each sampling season is shown in the Appendix (Figure 7.35).

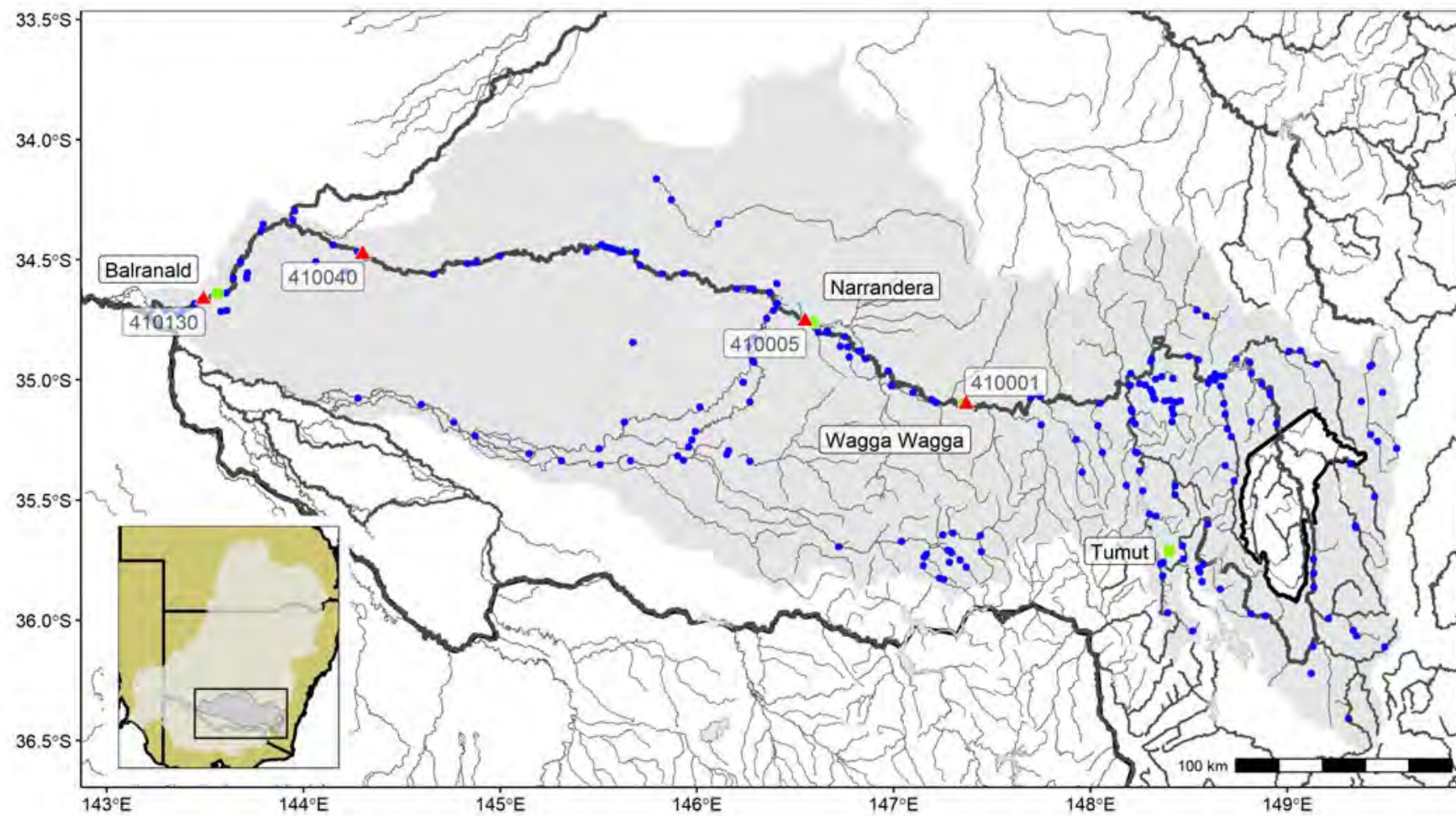


Figure 7.2: Sites (blue dots) sampled during the reporting period in the Murrumbidgee WRPA. Red triangles show key flow gauges along with their gauge ID number. Green squares show key towns. The grey shaded area represents the water resource planning area.

Each sampling method has a different effectiveness at sampling each species. Table 7.2 shows the total numbers of each key species caught by each method.

Table 7.2: Number of each key species caught by sample method over the whole program in the Murrumbidgee WRPA. Further data on total catch is provided in the Appendix.

Common name	Boat Electrofishing	Backpack Electrofishing	Bait Trap
Australian smelt	7,721	30	6
Bony herring	4,714	0	0
Common carp	6,918	633	182
Freshwater catfish	4	0	0
Golden perch	749	1	3
Murray cod	2,090	6	0

A subset of sampled fish had biological measurements taken during the surveys, including but not limited to length and weight measurements and visual health assessments. Table 7.3 shows the number of biological measurements taken each year for the six key species.

Table 7.3: Number of biological measurements taken for the key species each sampling season in the Murrumbidgee WRPA.

Sampling Season	Australian smelt	Bony herring	Common carp	Freshwater catfish	Golden perch	Murray cod
2014/2015	462	635	534	0	102	314
2015/2016	644	470	552	0	78	317
2016/2017	642	247	1,397	0	76	161
2017/2018	324	809	689	0	107	270
2018/2019	368	717	645	0	137	433
2019/2020	86	85	579	1	83	284
2020/2021	662	526	144	0	19	109
2021/2022	602	78	720	0	23	62
2022/2023	964	425	747	1	45	52
2023/2024	248	624	414	2	92	117

Climate Overview

The following is a summary of the climatic conditions during the reporting period in terms of how the observed conditions compare to long term records. These are direct extracts from the [Australian Bureau of Meteorology climate summaries archive](#) and are written in the given year. To interpret, 2014 states it was the warmest year on record, meaning 2014 was the warmest year on record up to and including 2014 but not including more recent years.

2014

New South Wales experienced its warmest year on record in 2014, with several heatwaves and persistently warm conditions across the State. Rainfall was well below average in the northeast, and close to average elsewhere.

2015

New South Wales recorded well above average temperatures in 2015. Nights were particularly warm, the sixth-warmest on record for the State. Rainfall was close to average for the state as a whole.

2016

2016 was a generally wet, warm year for NSW as a whole, with substantial variability throughout the year and across the state. Following a record-warm start to the year, May to September was the wettest such period on record for NSW, with cooler weather in much of the west of the state. Minimum temperatures were the warmest on record for the State as a whole, with record-warm daytime temperatures on parts of the east coast.

2017

The year 2017 was the warmest on record for New South Wales for both mean and daytime temperatures. It was also the State's driest year since 2006. Following the warmest summer on record for the State, heavy rain in March across the east then made way for a very dry winter and start to spring. Winter overnight temperatures were the lowest since 1997, but daytime temperatures remained above average for most of the year, and were the warmest on record overall.

2018

2018 was the warmest on record for New South Wales for both mean temperature and mean maximum temperature, whilst the mean minimum temperature was fourth-warmest on record. The year was dominated by very dry conditions, with the third-driest January to September on record. October to December saw some relief from the dry, with above average rainfall across parts of the State. Despite this, New South Wales experienced its sixth-lowest annual rainfall on record; its driest year since 2002.

2019

2019 was the driest and warmest year on record for New South Wales. Despite some rain in some months, most of the State received much less rainfall than usual, with the northeast and far west particularly dry. Heatwaves in January brought very high temperatures, and large fires from September onward caused extensive damage and persistent smoke.

2020

2020 saw above average temperature and rainfall in New South Wales. Temperatures were above average across the state in most months except during autumn. There was widespread rain during autumn and spring and in December, but early winter and November rain was below average.

2021

New South Wales had its 6th wettest year on record, with 2021 rainfall 30 % above average. This included significant floods along the east coast in March, and the state's wettest November on record. It was the state's coolest year since 1996, at 0.15 °C above the 1961–1990 average.

2022

2022 was exceptionally wet with the state-averaged annual total being the second-highest on record (since 1900) and many sites recording their highest annual totals on record. Maximum temperatures were lower than average with the state-averaged annual maximum temperature being the coolest since 1992. Minimum temperatures were generally warmer than average with the state-averaged annual minimum temperature being 0.73 °C above the 1961–1990 average.

2023

The state-averaged rainfall was 22.9 % below the 1961–1990 average. Rainfall was above average over small parts of the state's south, west of the Great Dividing Range, while being below average over most of the northern half of the state, especially over parts of the Northern Tablelands, Northern Rivers, Mid-North Coast, and Upper Hunter, where annual rainfall was in the lowest 10 % of historical records (since records began in 1900). State-averaged annual maximum temperature was 1.96 °C above the 1961–1990 average, which is the third highest on record.

2024

Rainfall totals in 2024 were above average to very much above average for the northern and western areas of the state, as well as central parts of the coast. Totals were below average for large parts of the south-east, as well as small parts of the state's north-east and south-west. 2024 was the third-warmest on record for all years since 1910, 1.55 °C above the 1961–1990 average.

Flow Data

Below shows a summary of flow data from a variety of flow gauges in the Murrumbidgee WRP (Figure 7.3).

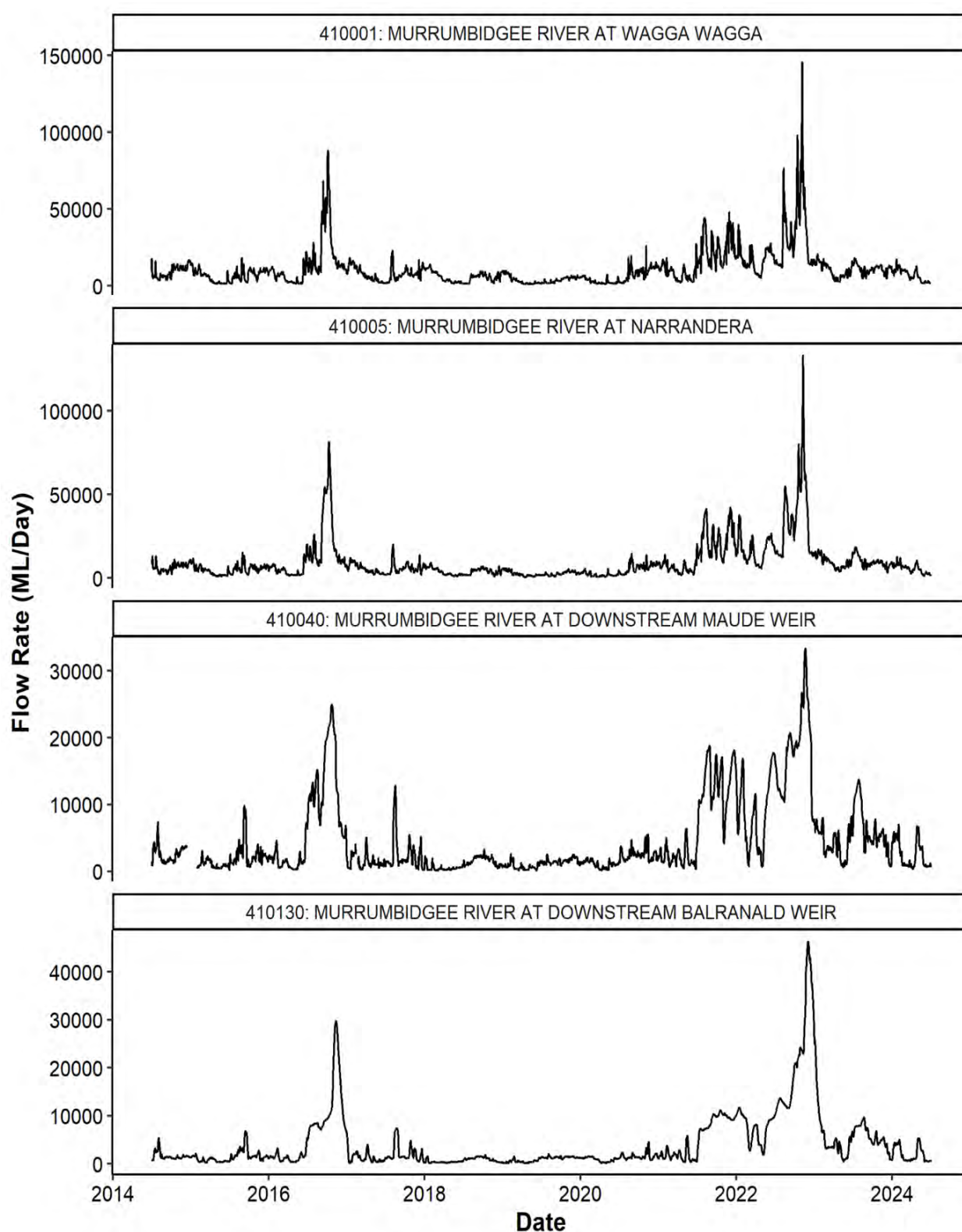


Figure 7.3: Flow data from various gauges in the Murrumbidgee WRP over the reporting period. Gauge locations can be seen on Figure 7.2. Note the differing scales on the y-axis.

Water temperature data, where available, are also shown in Figure 7.4.

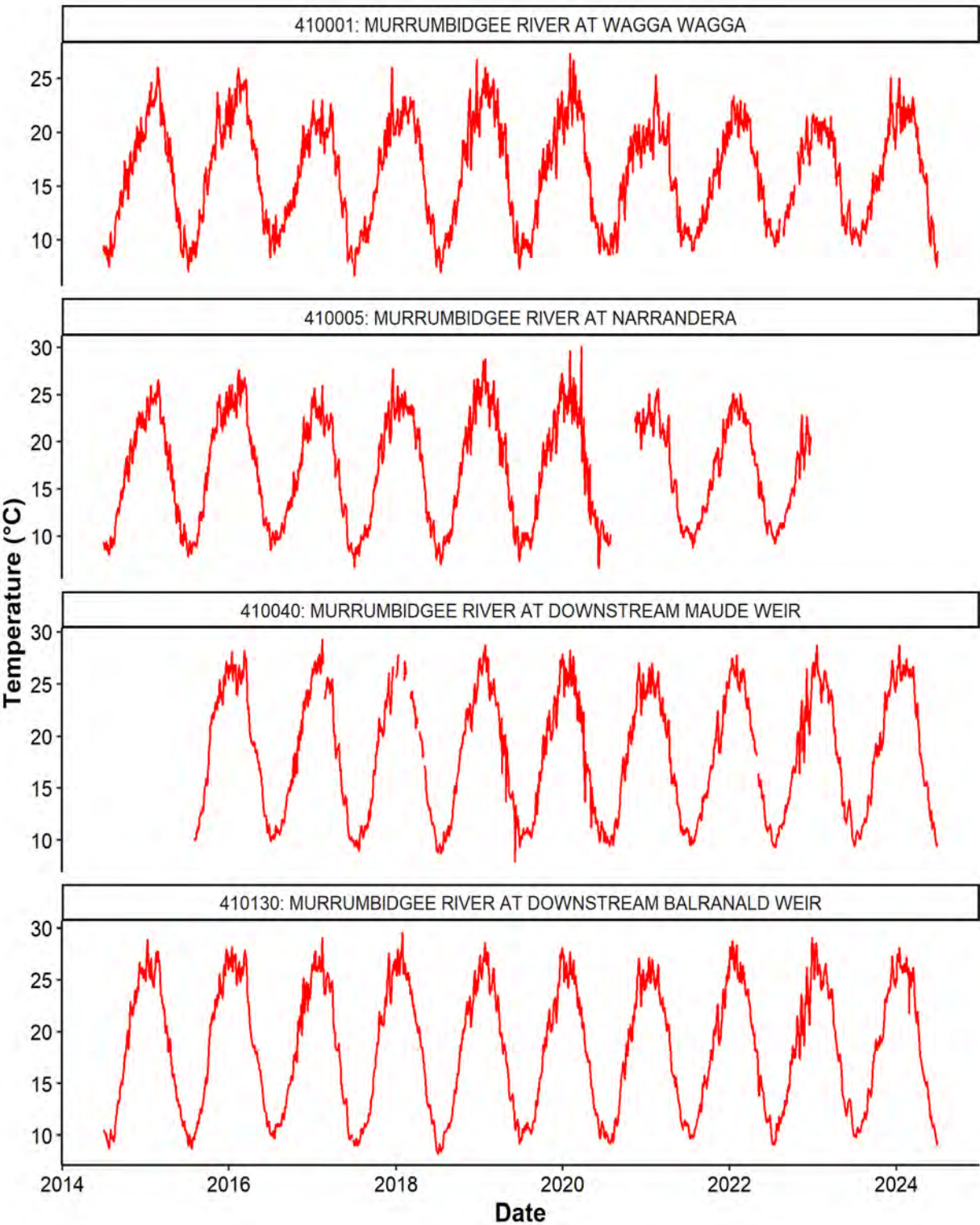


Figure 7.4: Water temperature data from various gauges in the Murrumbidgee WRPA over the reporting period. Gauge locations can be seen on Figure 7.2. Note the differing scales on the y-axis.

Species Diversity

A total of 27 fish species were observed across the Murrumbidgee WRPAs including eight alien species. Figure 7.5 shows the number of native species found at each site while Figure 7.6 shows the number of alien species found at each site. The full list of species caught and observed is presented in Table 7.8.

Summary Statement:

Diversity was highest in the central area of the Murrumbidgee region while the alien diversity was generally consistent across the region.

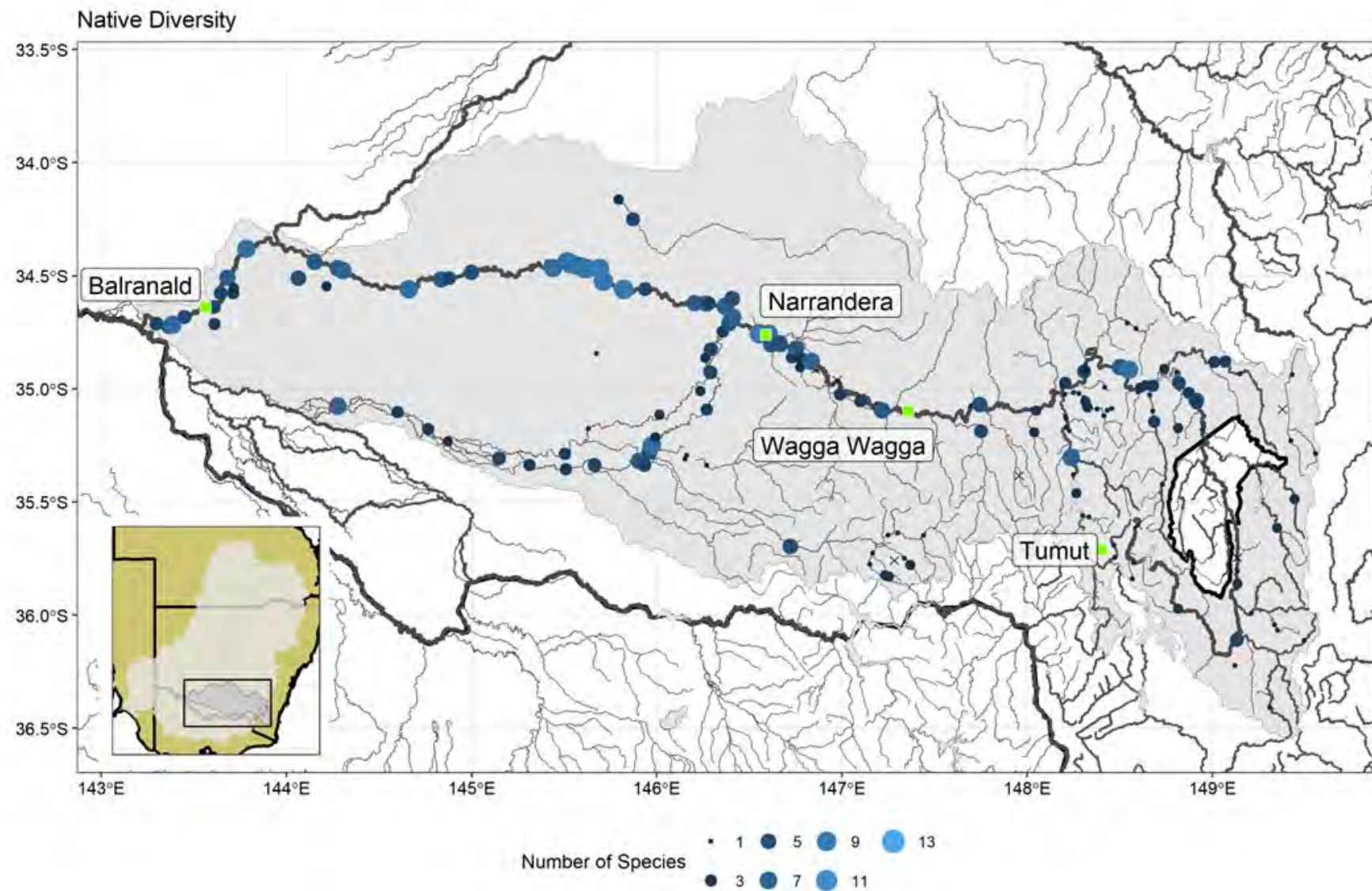


Figure 7.5: Native diversity across all sampling sites in the Murrumbidgee WRPA. Bubble size represents the number of unique species observed at each site across all sampling methods and events. X represents a site that had water and was sampled, but no fish species were caught at all. Dry sites are excluded. Green squares represent key towns.

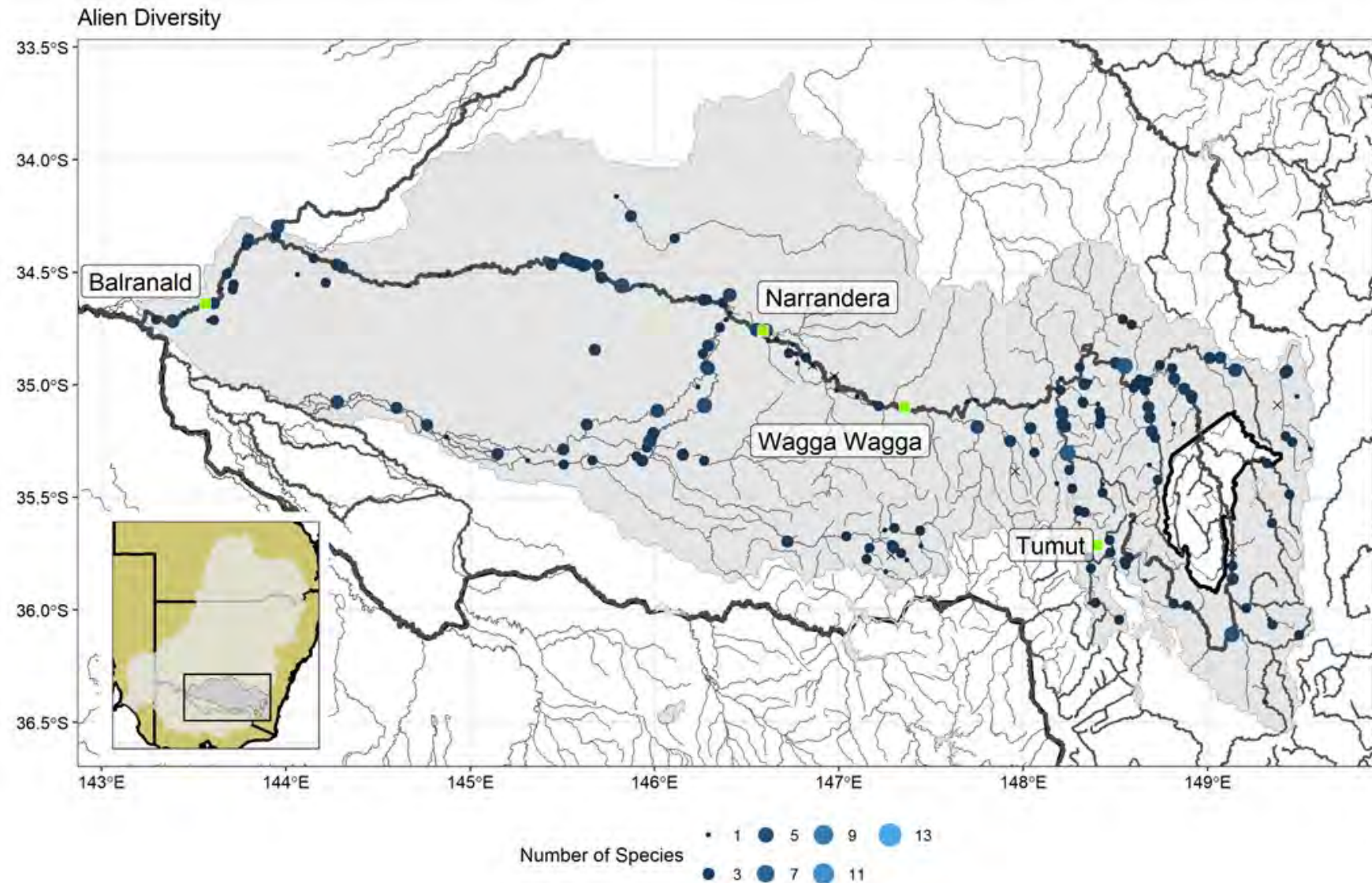


Figure 7.6: Alien diversity across all sampling sites in the Murrumbidgee WRPA. Bubble size represents the number of unique species observed at each site across all sampling methods and events. X represents a site that had water and was sampled, but no fish species were caught at all. Dry sites are excluded. Green squares represent key towns.

Murray cod



Population Structure

Figure 7.7 shows the observed length frequency plot for Murray cod for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 0 to 86, and 0 % to 39 % of measured fish within a season, with a mean percentage YOY of 13 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Murray cod was 13 % (1,186 out of 9,432).

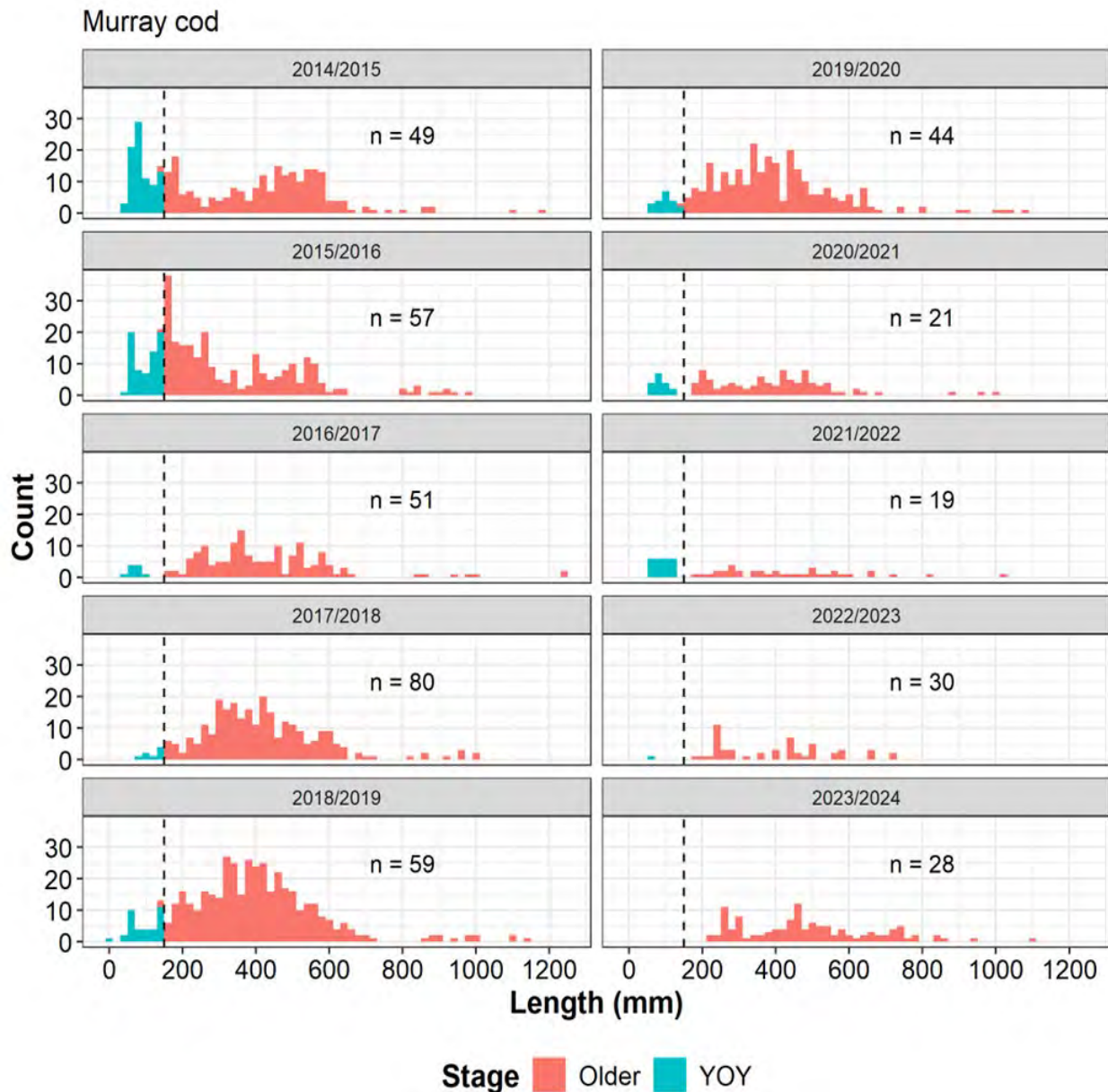


Figure 7.7: Length frequency plots for Murray cod by sampling season in the Murrumbidgee WRPA. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRPA in a sampling season.

Summary Statement:

Low to moderate levels of recruitment evident in most years. Possible recruitment failures in 2022/23 and 2023/24. Multiple cohorts appear evident in the size distribution.

Stocking

A total of 1,728,118 Murray cod were stocked into the waterways of the Murrumbidgee WRPAs during the reporting period. Of these fish, 1,306,247 (76 %) were stocked into impoundments while 421,871 (24 %) were stocked into rivers or creeks. Table 7.4 shows the detailed breakdown of stocking by season, location and life stage while Figure 7.8 shows the locations of stocking.

Table 7.4: Number and life stage of stocked Murray cod each sampling season in the Murrumbidgee WRPAs.

Sampling Season	River/Creek or Impoundment	Life Stage	Number Stocked
2014/2015	Impoundment	Fry	96,776
2014/2015	River/Creek	Fry	68,267
2015/2016	Impoundment	Fry	91,300
2015/2016	River/Creek	Fry	71,757
2016/2017	Impoundment	Fingerling	6,198
2016/2017	Impoundment	Fry	104,788
2016/2017	River/Creek	Fingerling	61,348
2016/2017	River/Creek	Fry	4,000
2017/2018	Impoundment	Fry	3,444
2017/2018	River/Creek	Fry	28,322
2018/2019	Impoundment	Fry	64,670
2018/2019	River/Creek	Fry	46,178
2019/2020	Impoundment	Fry	208,410
2019/2020	River/Creek	Fry	21,441
2020/2021	Impoundment	Fry	124,609
2020/2021	River/Creek	Fingerling	500
2020/2021	River/Creek	Fry	31,991
2021/2022	Impoundment	Fry	240,200
2021/2022	River/Creek	Fingerling	5,000
2021/2022	River/Creek	Fry	12,565
2022/2023	Impoundment	Fry	295,032
2022/2023	River/Creek	Fry	16,300
2023/2024	Impoundment	Fingerling	70,820
2023/2024	River/Creek	Fingerling	54,202

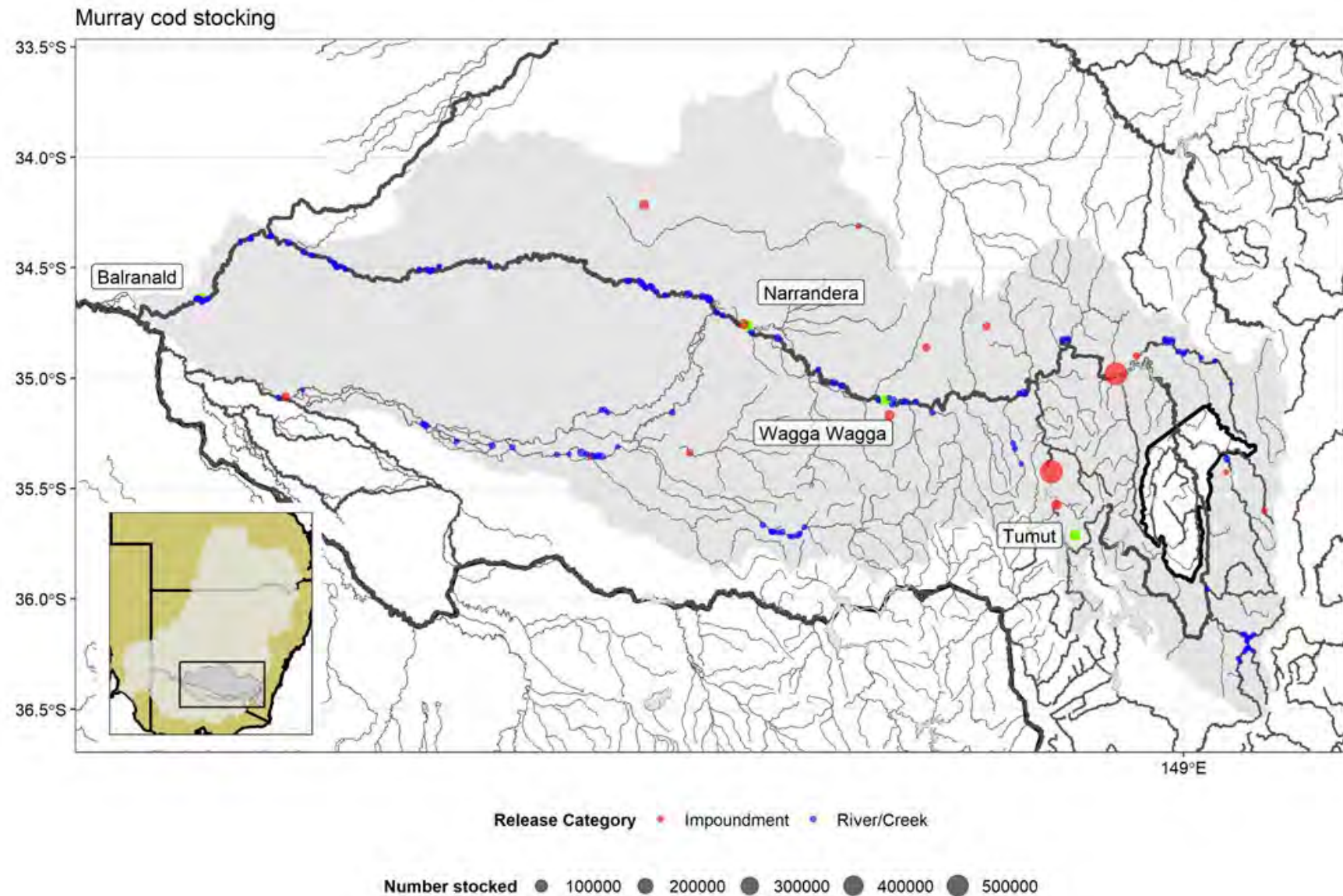


Figure 7.8: Locations of Murray cod stocking in the Murrumbidgee WRPA. Colours show whether a site was a river/creek site or an impoundment, while the size of the point reflects the total number of fish stocked over the reporting period. Green squares represent key towns.

Temporal Trends in Abundance

The relative abundance and biomass of Murray cod since 1994 was modelled based on all suitable boat electrofishing data. The left-hand panels of Figure 7.9 show the abundance and biomass trends for the Murrumbidgee WRPA and the right-hand panels show the overall trends across the NSW MDB.

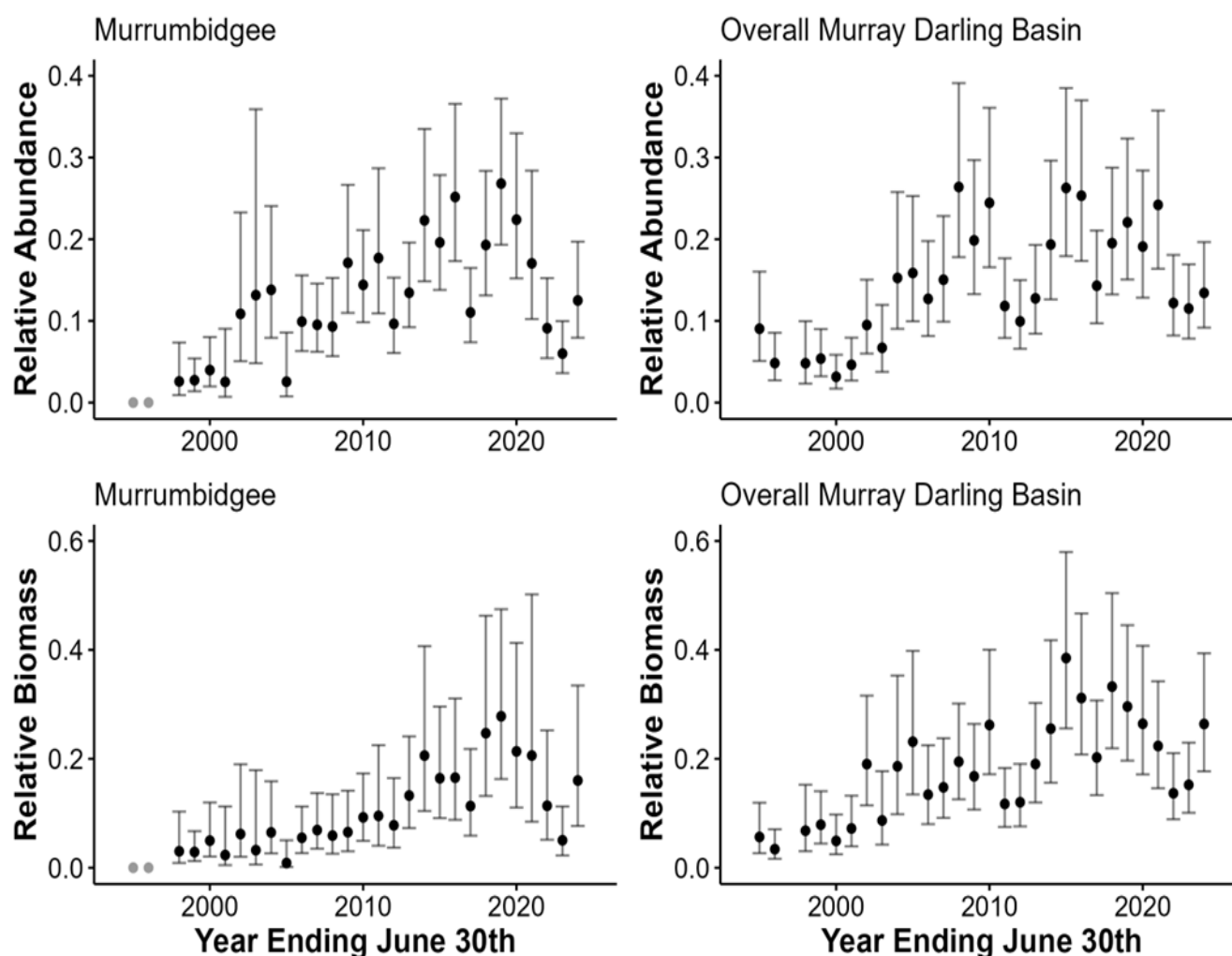


Figure 7.9: Relative abundance and biomass of Murray cod in both the Murrumbidgee WRPA and the overall NSW MDB. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates.

Summary Statement:

Relative abundance and biomass have both increased in the Murrumbidgee since the 1990s but have declined slightly since 2020. Abundance and biomass both similar to the overall NSW MDB.

Health

The prevalence of any health issues ranged from 2 % of sampled fish in 2021/2022 to 32 % of sampled fish in 2016/2017 (Figure 7.10). The most common health issue for Murray cod in the Murrumbidgee WRPAs was *Lernaea*, which was observed in a total of 210 fish, corresponding to 10 % of all Murray cod measured.

Across the other NSW MDB WRPA, 16 % of Murray cod (1,552 out of 9,432 Murray cod) showed a health condition (excludes the Murrumbidgee WRPAs).

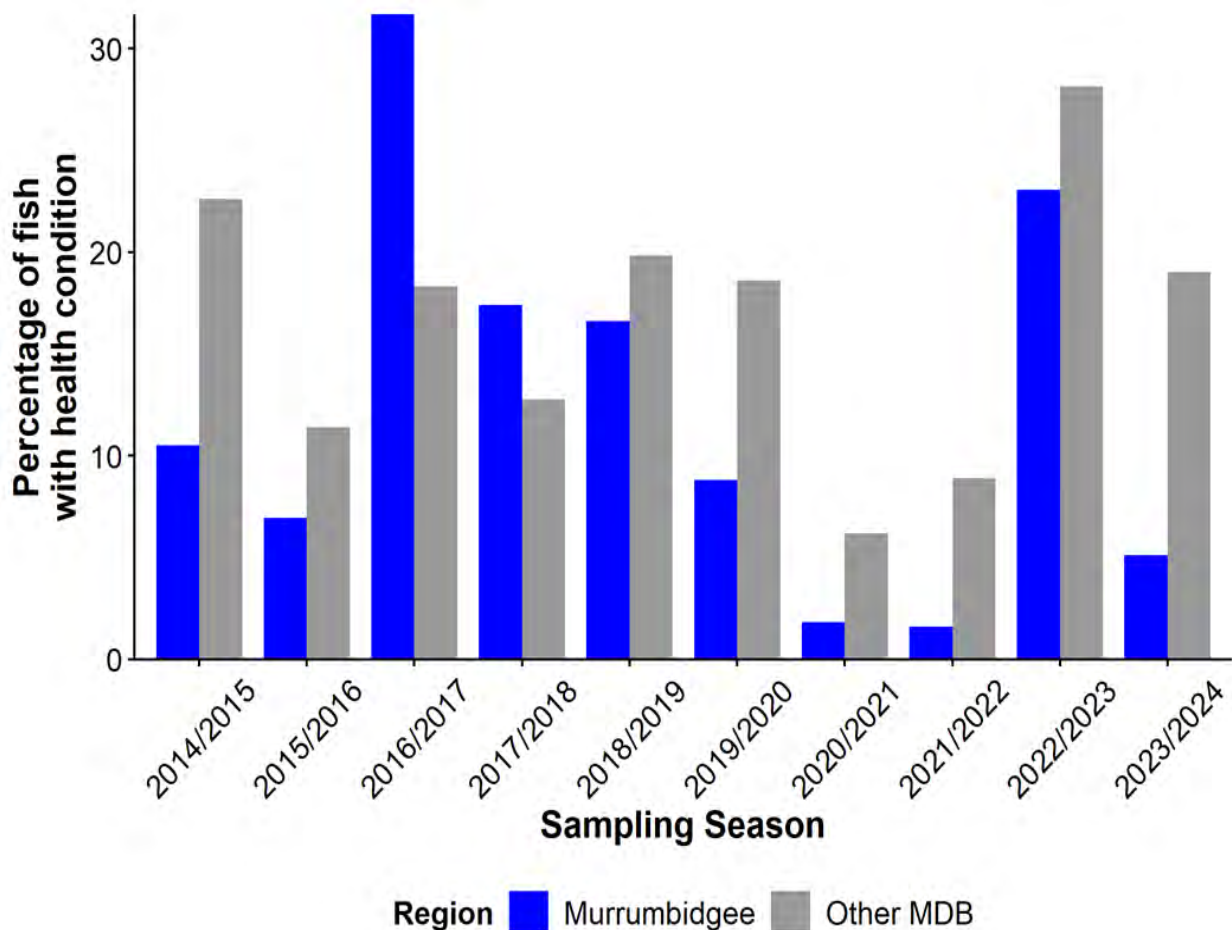


Figure 7.10: Timeseries showing the prevalence of health conditions in Murray cod. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA.

Summary Statement:

Presence of observable health conditions was variable across most years. There was a low level of observed health issues in 2023/24, lower than the rest of the NSW MDB.

Distribution

Murray cod were recorded at 69 out of 215 sites in the Murrumbidgee WRPAs from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 1.5 fish caught per 90 seconds of electrofishing. Figure 7.11 shows the distribution and relative abundance of Murray cod across the Murrumbidgee WRPAs.

Summary Statement:

Murray cod were recorded across the central and western portion of the Murrumbidgee WRPAs but less abundant or absent in south-east and eastern upland sites.

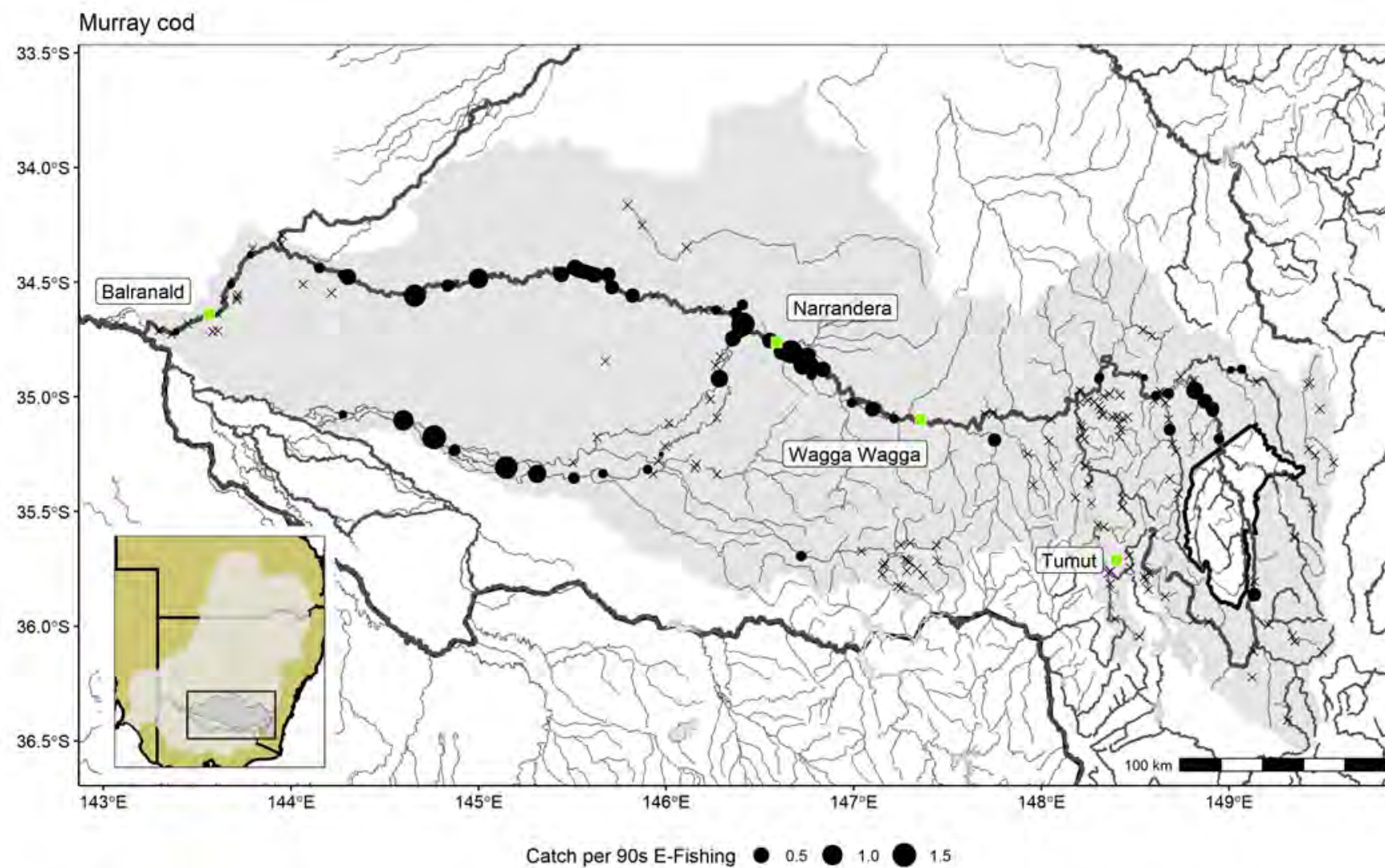


Figure 7.11: Distribution of Murray cod sampled from 2013/14 to 2023/24 in the Murrumbidgee WRPA. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares represent key towns.

Golden perch



Population Structure

Figure 7.12 shows the observed length frequency plot for Golden perch for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 0 to 3, and 0 % to 5 % of measured fish within a season, with a mean percentage YOY of 1 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Golden perch was 9 % (648 out of 7,537).

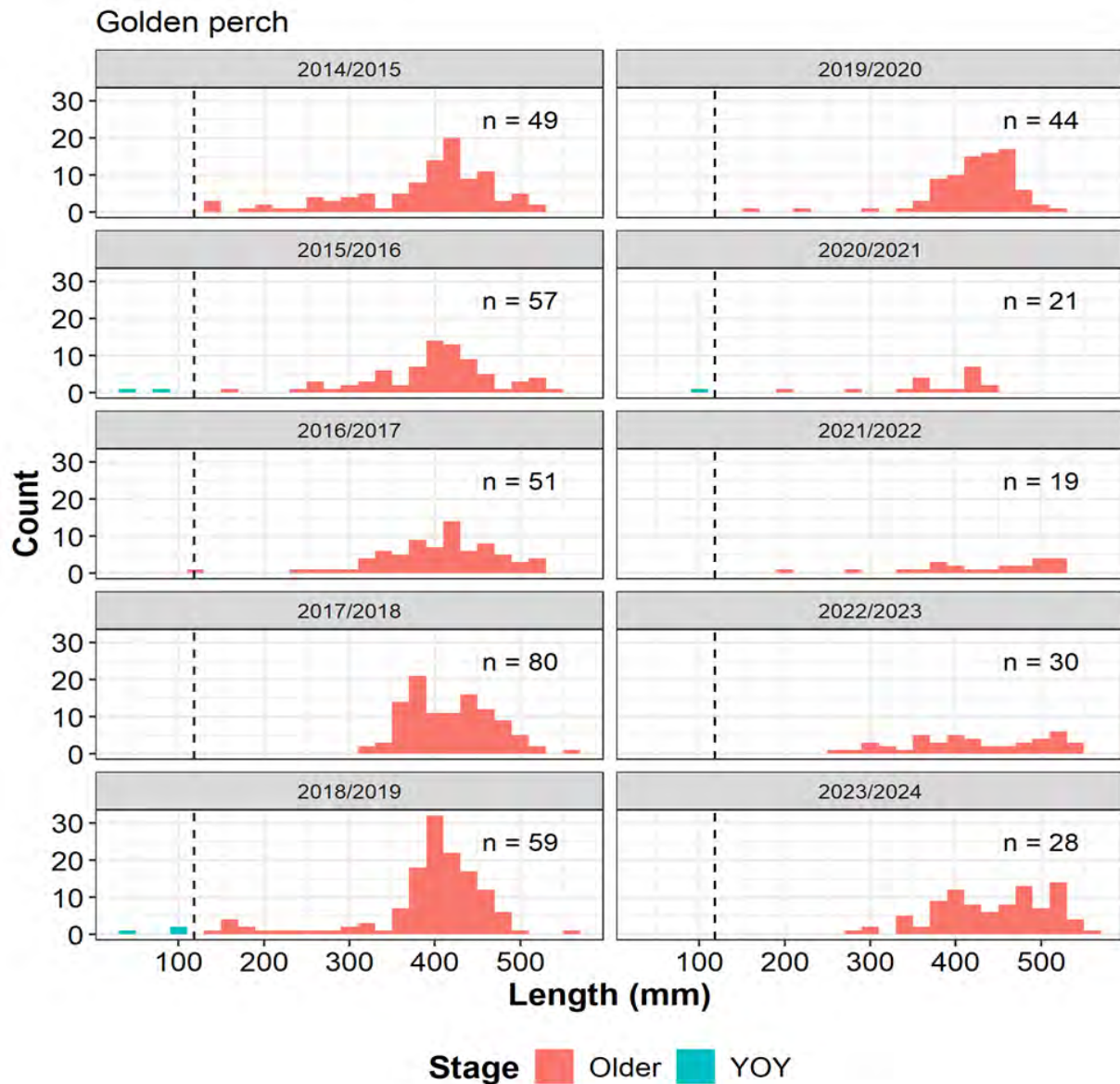


Figure 7.12: Length frequency plots for Golden perch by sampling season in the Murrumbidgee WRPA. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRPA in a sampling season.

Summary Statement:

Larger fish were consistently collected across years but recruitment appears to be extremely limited. Young of the year were only observed in very small numbers in 2015/16, 2018/19 and 2020/21.

Stocking

A total of 2,513,377 Golden perch were stocked into the waterways of the Murrumbidgee WRP during the reporting period. Of these fish, 1,590,596 (63.3 %) were stocked into impoundments while 922,781 (36.7 %) were stocked into rivers or creeks. Table 7.5 shows the detailed breakdown of stocking by season, location and life stage while Figure 7.13 shows the locations of stocking.

Table 7.5: Number and life stage of stocked Golden perch each sampling season in the Murrumbidgee WRP.

Sampling Season	River/Creek or Impoundment	Life Stage	Number Stocked
2014/2015	Impoundment	Fry	154,261
2014/2015	River/Creek	Fry	110,971
2015/2016	Impoundment	Fry	136,000
2015/2016	River/Creek	Fry	140,290
2016/2017	Impoundment	Fingerling	5,682
2016/2017	Impoundment	Fry	235,576
2016/2017	River/Creek	Fingerling	167,515
2016/2017	River/Creek	Fry	5,000
2017/2018	Impoundment	Fry	222,071
2017/2018	River/Creek	Fry	154,936
2018/2019	Impoundment	Fry	130,000
2018/2019	River/Creek	Fry	68,838
2019/2020	Impoundment	Fry	123,756
2019/2020	River/Creek	Fry	45,455
2020/2021	Impoundment	Fry	174,990
2020/2021	River/Creek	Fry	67,548
2021/2022	Impoundment	Fry	99,670
2021/2022	River/Creek	Fry	17,147
2022/2023	Impoundment	Fry	138,500
2022/2023	River/Creek	Fry	7,750
2023/2024	Impoundment	Fingerling	170,090
2023/2024	River/Creek	Fingerling	137,331

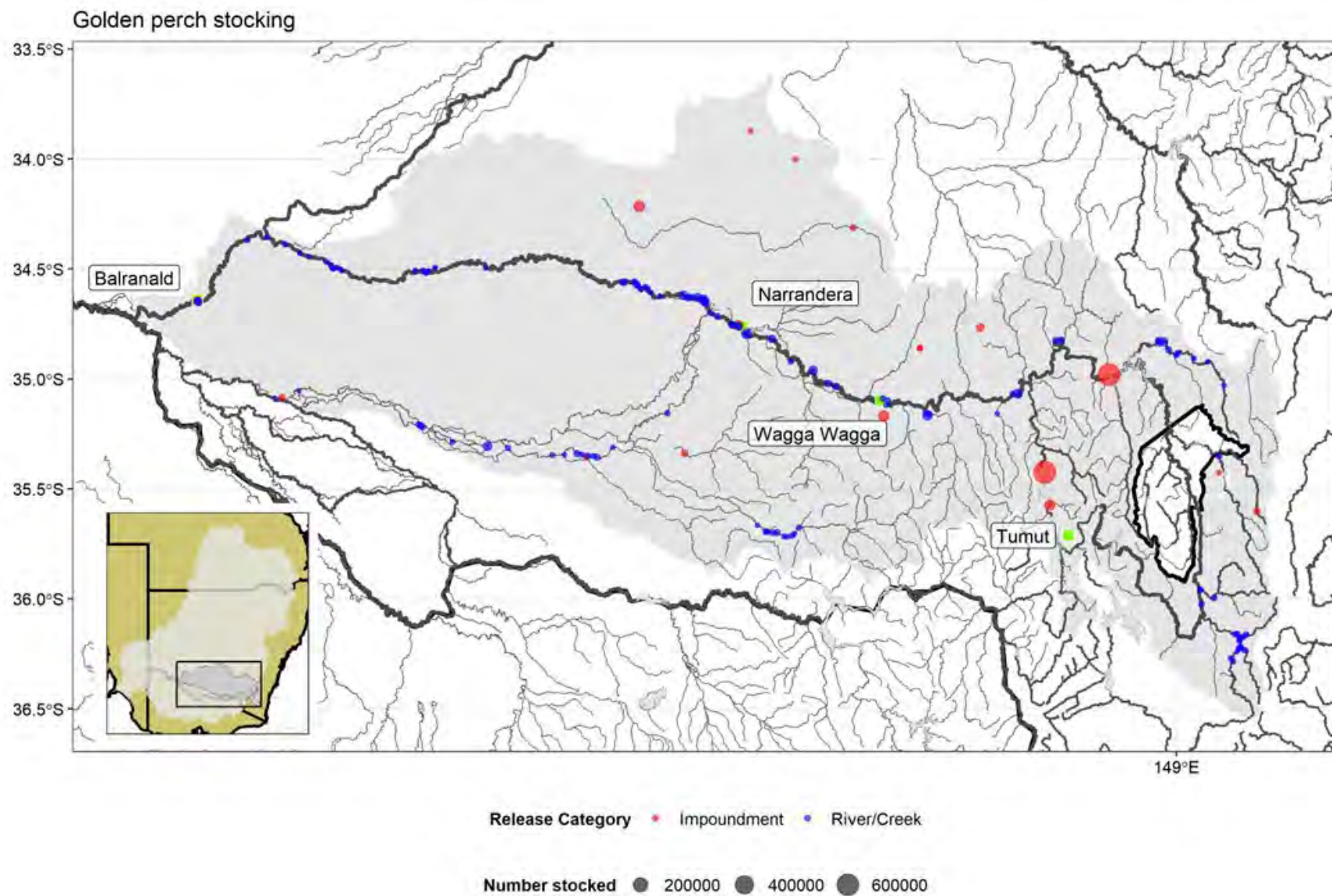


Figure 7.13: Locations of Golden perch stocking in the Murrumbidgee WRP. Colours show whether a site was a river/creek site or an impoundment, while the size of the point reflects the total number of fish stocked over the reporting period. Green squares represent key towns.

Temporal Trends in Abundance

The relative abundance and biomass of Golden perch since 1994 was modelled based on all suitable boat electrofishing data. The left-hand panels of Figure 7.14 show the abundance and biomass trends for the Murrumbidgee WRPA and the right-hand panels show the overall trends across the NSW MDB.

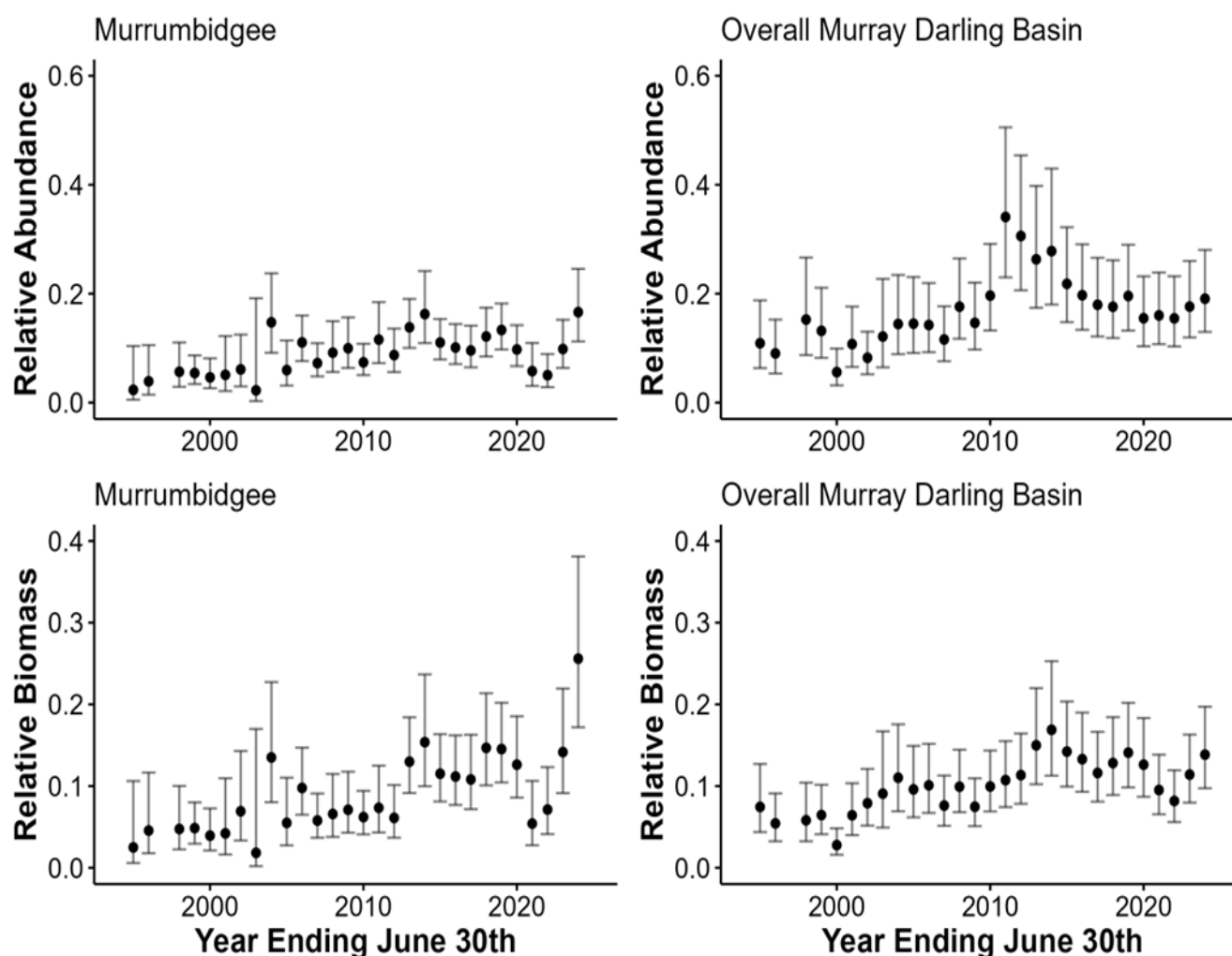


Figure 7.14: Relative abundance and biomass of Golden perch in both this valley and the overall Murray-Darling Basin. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates.

Summary Statement:

Evidence of an overall increase in both abundance and biomass since the 1990's with a particularly strong increase in 2023/24. Relative abundance is approximately equal to the overall abundance across the NSW MDB which peaked in approximately 2012 and biomass is currently higher than the overall NSW MDB.

Health

The prevalence of any health issues ranged from 0 % of sampled fish in 2020/2021 to 46 % of sampled fish in 2016/2017 (Figure 7.15). The most common health issue for Golden perch in the Murrumbidgee water resource planning area was *Lernaea*, which was observed in a total of 118 fish, corresponding to 15 % of all Golden perch measured.

Across the other WRPA's, 25 % of Golden perch (1,921 out of 7,537 Golden perch) showed a health condition (excludes Murrumbidgee).

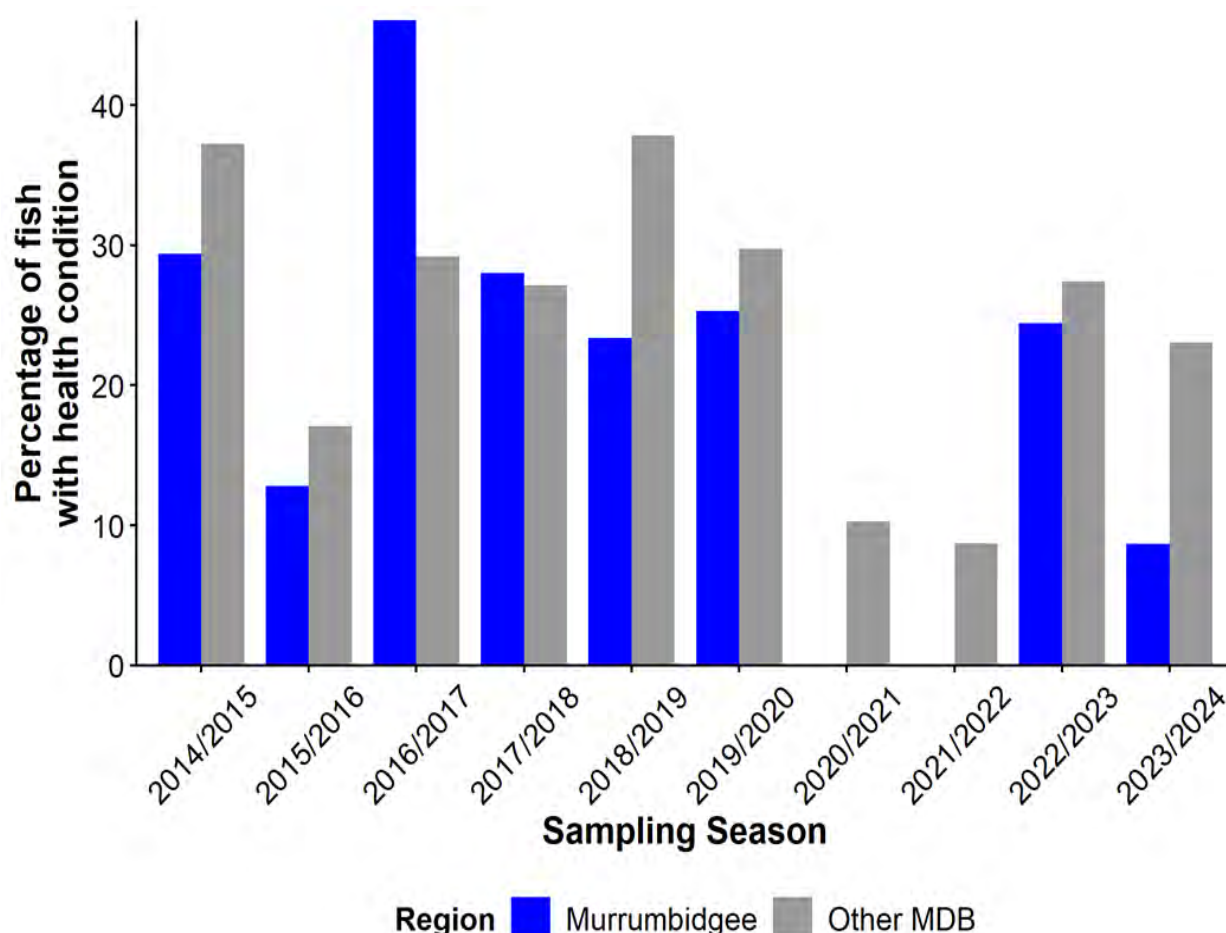


Figure 7.15: Timeseries showing the prevalence of health conditions in Golden perch. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA's.

Summary Statement:

The presence of observable health conditions for Golden perch in the Murrumbidgee was moderate to high and generally tracked the average across the rest of the NSW Murray-Darling Basin except for 2016/17 when it was significantly higher.

Distribution

Golden perch were recorded at 72 out of 215 sites in the Murrumbidgee WRPAs from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 1.08 fish caught per 90 seconds of electrofishing. Figure 7.16 shows the distribution and relative abundance of Golden perch across the Murrumbidgee WRPAs.

Summary Statement:

Golden perch were generally present across the Murrumbidgee region with the exception of the eastern upland region.

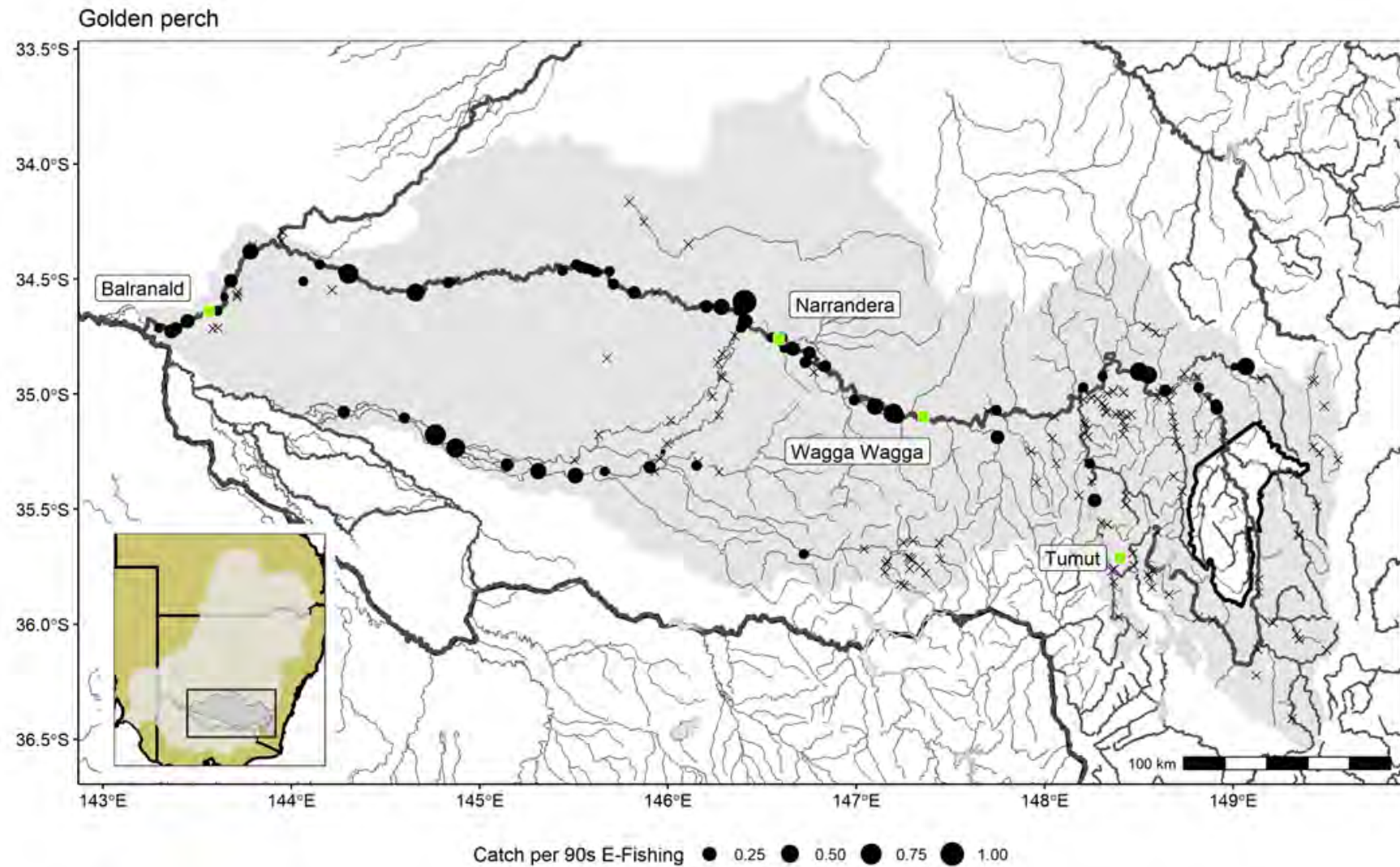


Figure 7.16: Distribution of Golden perch sampled from 2013/14 to 2023/24 in the Murrumbidgee WRPA. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares represent key towns.

Freshwater catfish



Summary Statement:

Over the reporting period only four Freshwater catfish were caught in the Murrumbidgee WRPA during standardised sampling. Two of these occurred in 2023/24.

Overall, this suggests that Freshwater catfish only occur in very low abundances in the Murrumbidgee WRPA.

Bony herring



Population Structure

Figure 7.17 shows the observed length frequency plot for Bony herring for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 2 to 331, and 3 % to 53 % of measured fish within a season, with a mean percentage YOY of 26 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Bony herring was 25 % (12,170 out of 49,569). Bony herring are not a stocked species.

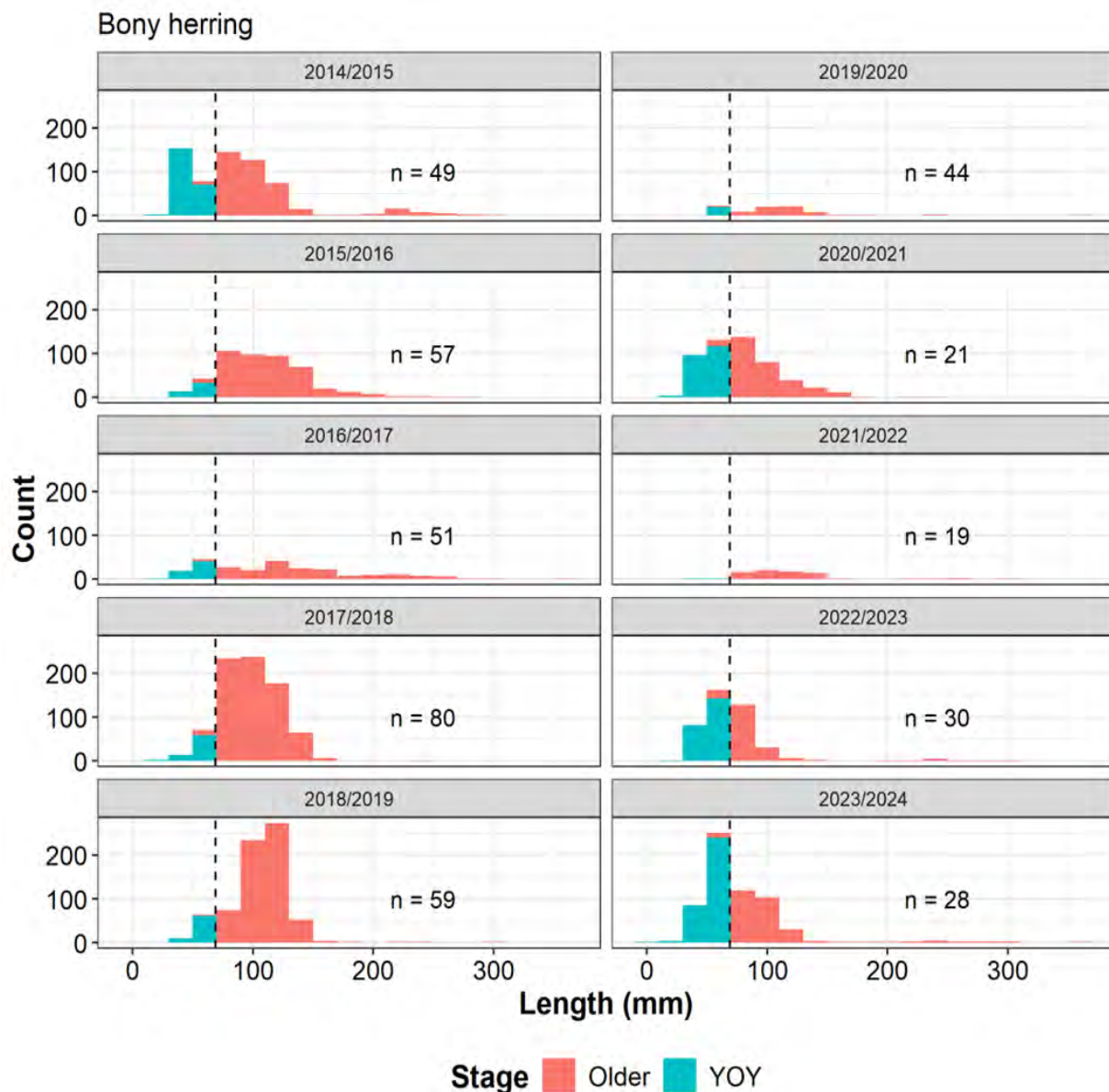


Figure 7.17: Length frequency plots for Bony herring by sampling season in the Murrumbidgee WRPA. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRPA in a sampling season.

Summary Statement:

Regular recruitment with variable numbers of young-of-year. Evidence of good recruitment in both 2022/23 and 2023/24.

Temporal Trends in Abundance

The relative abundance and biomass of Bony herring since 1994 was modelled based on all suitable boat electrofishing data. The left-hand panels of Figure 7.18 show the abundance and biomass trends for the Murrumbidgee WRP and the right-hand panels show the overall trends across the NSW MDB.

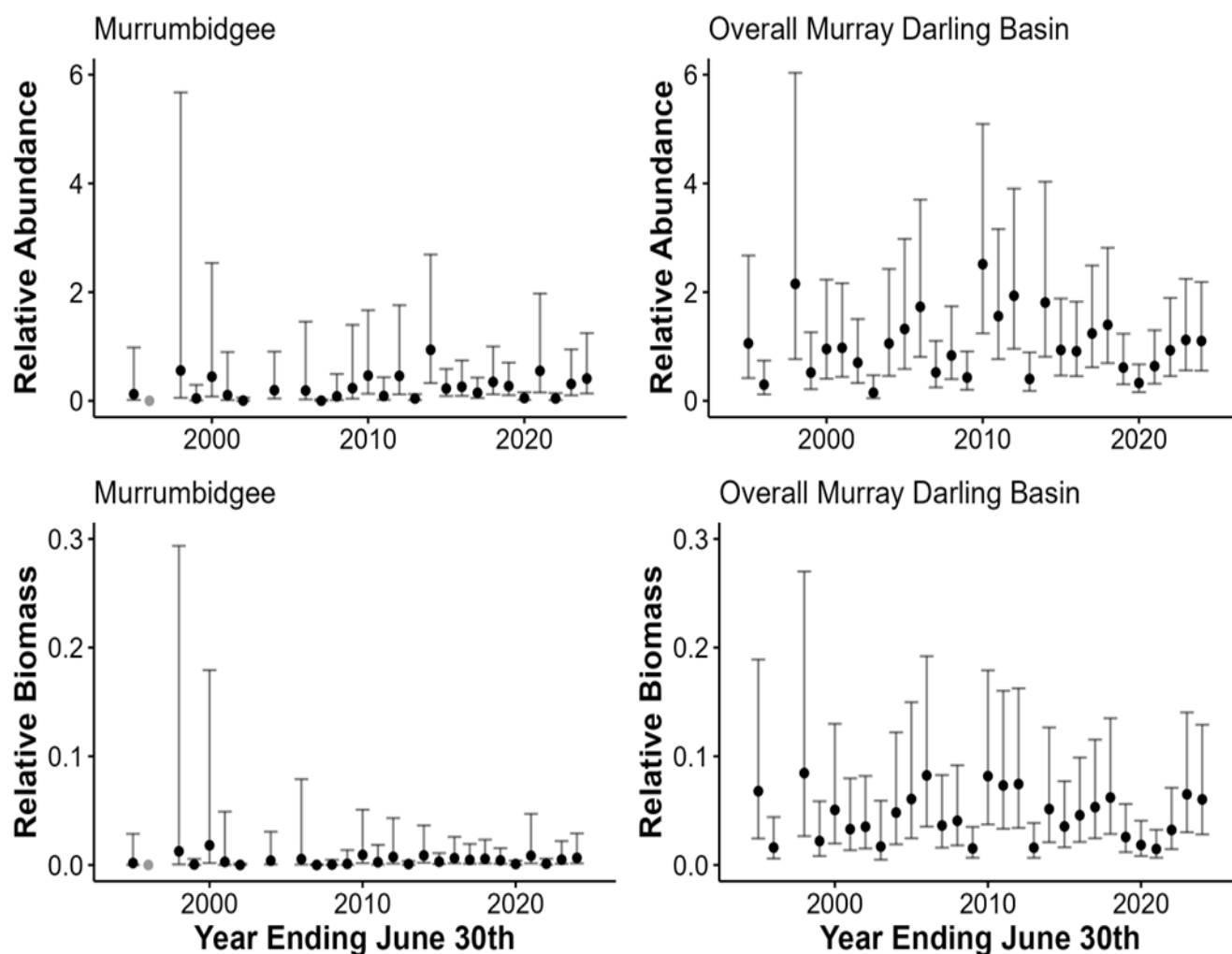


Figure 7.18: Relative abundance and biomass of Bony herring in both the Murrumbidgee WRP and the overall NSW MDB. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates.

Summary Statement:

Relative abundance has fluctuated but is likely to be trending up slightly in recent years. Biomass has shown high variability over time and is likely low overall. Current levels of abundance and biomass are lower than the overall NSW MDB.

Health

The prevalence of any health issues was <1 % in all years (Figure 7.19). The most common health issue for Bony herring in the Murrumbidgee WRPAs was Deformity, which was observed in a total of 3 fish, corresponding to 0 % of all Bony herring measured.

Across the other NSW MDB WRPA, 1.13 % of Bony herring (561 out of 49,570 Bony herring) showed a health condition (excludes the Murrumbidgee WRPAs).

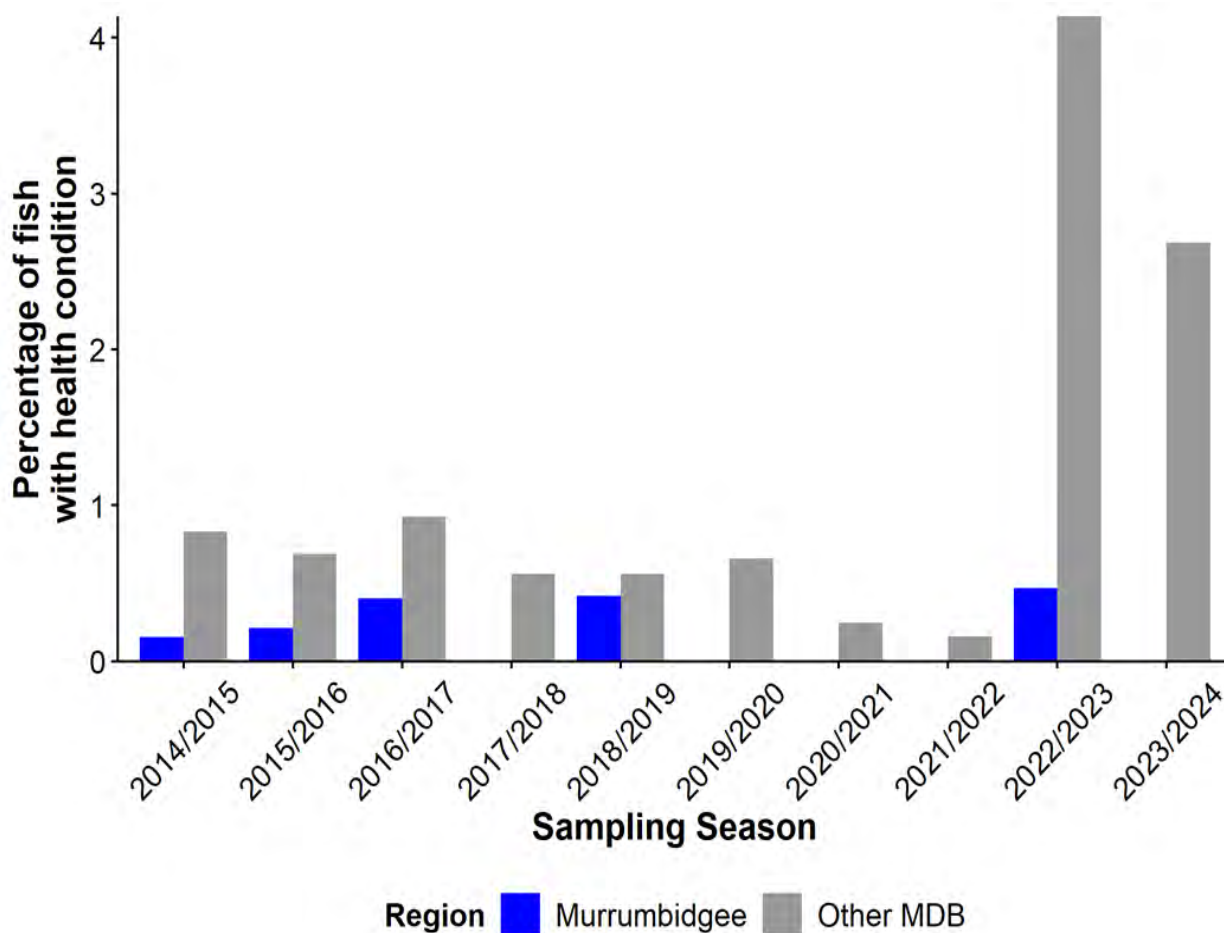


Figure 7.19: Timeseries showing the prevalence of health conditions in Bony herring. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA.

Summary Statement:

Presence of observable health conditions low across all years. No health conditions were recorded in 2023/24 in the Murrumbidgee WRPAs.

Distribution

Bony herring were recorded at 38 out of 215 sites in the Murrumbidgee WRPAs from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 4.75 fish caught per 90 seconds of electrofishing. Figure 7.20 shows the distribution and relative abundance of Bony herring across the Murrumbidgee WRPAs.

Summary Statement:

Bony herring appear to be restricted to the western Murrumbidgee WRPAs.

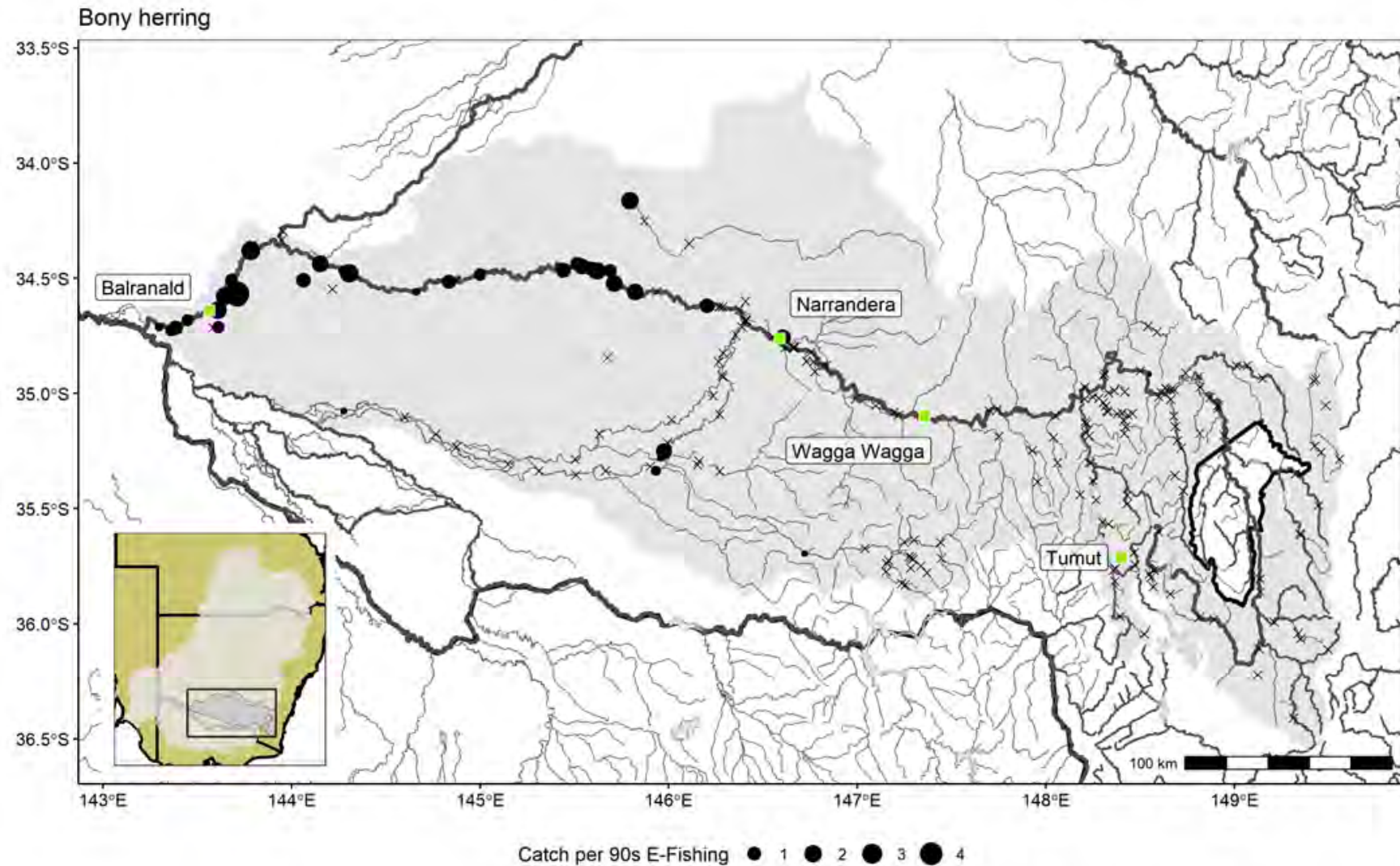


Figure 7.20: Distribution of Bony herring sampled from 2013/14 to 2023/24 in the Murrumbidgee WRPA. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares represent key towns.

Australian smelt



Population Structure

Figure 7.21 shows the observed length frequency plot for Australian smelt for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 18 to 657, and 14 % to 68 % of measured fish within a season, with a mean percentage YOY of 33 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Australian smelt was 42 % (9,596 out of 22,926). Australian smelt are not a stocked species.

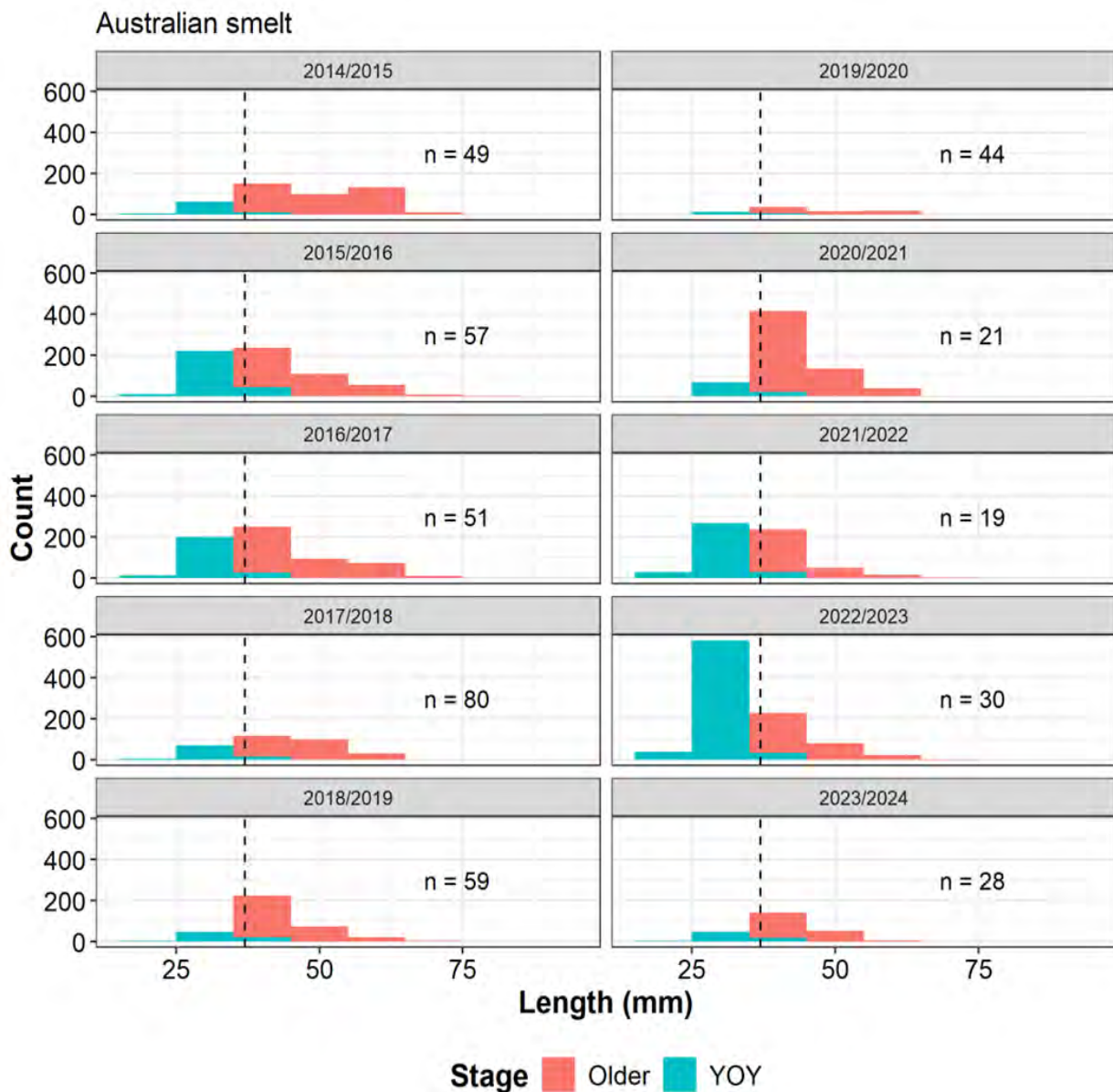


Figure 7.21: Length frequency plots for Australian smelt by sampling season in the Murrumbidgee WRPA. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRPA in a sampling season.

Summary Statement:

Regular recruitment with evidence of strong recruitment in 2021/22 and 2022/23. Recruitment in 2023/24 possibly lower than recent years.

Temporal Trends in Abundance

The relative abundance of Australian smelt since 1994 was modelled based on all suitable boat electrofishing data. The left-hand panel of Figure 7.22 show the abundance trends for the Murrumbidgee WRP and the right-hand panel show the overall trend across the NSW MDB.

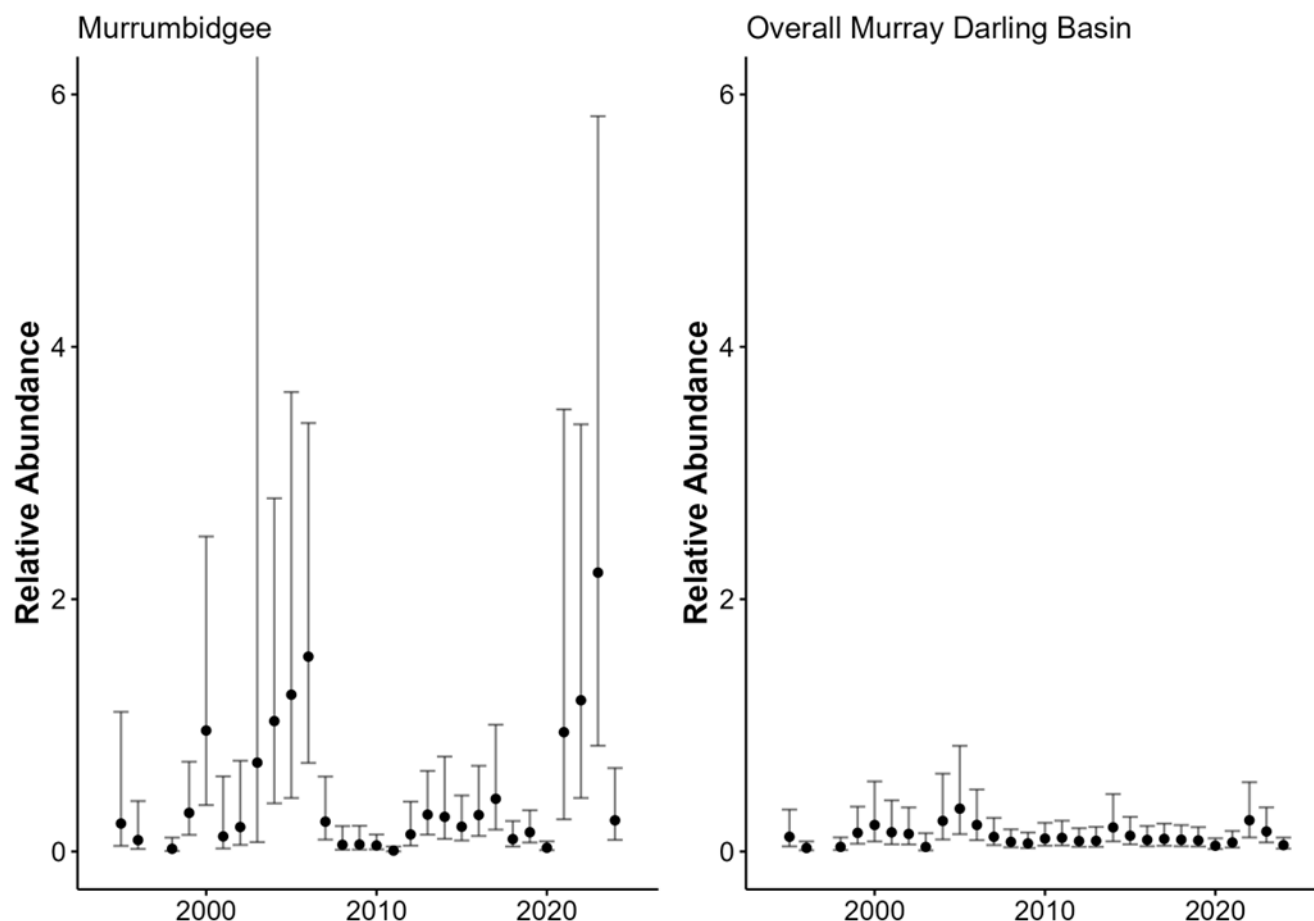


Figure 7.22: Relative abundance of Australian smelt in both the Murrumbidgee WRP and the overall NSW MDB. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates. No modelling of biomass was done for Australian smelt. The y-axis has been slightly truncated for visibility.

Summary Statement:

An overall increase in abundance since the 1990's followed by a recent decline in 2023/24. Relative abundance generally higher than overall abundance across the NSW MDB.

Health

The prevalence of any health issues ranged from 0 % of sampled fish in most years to 2 % of sampled fish to 2019/2020 (Figure 7.23). The most common health issue for Australian smelt in the Murrumbidgee WRPAs was Deformity, which was observed in a total of 4 fish, corresponding to 0 % of all Australian smelt measured.

Across the other NSW MDB WRPA, 1 % of Australian smelt (166 out of 22,927 Australian smelt) showed a health condition (excludes the Murrumbidgee WRPAs).

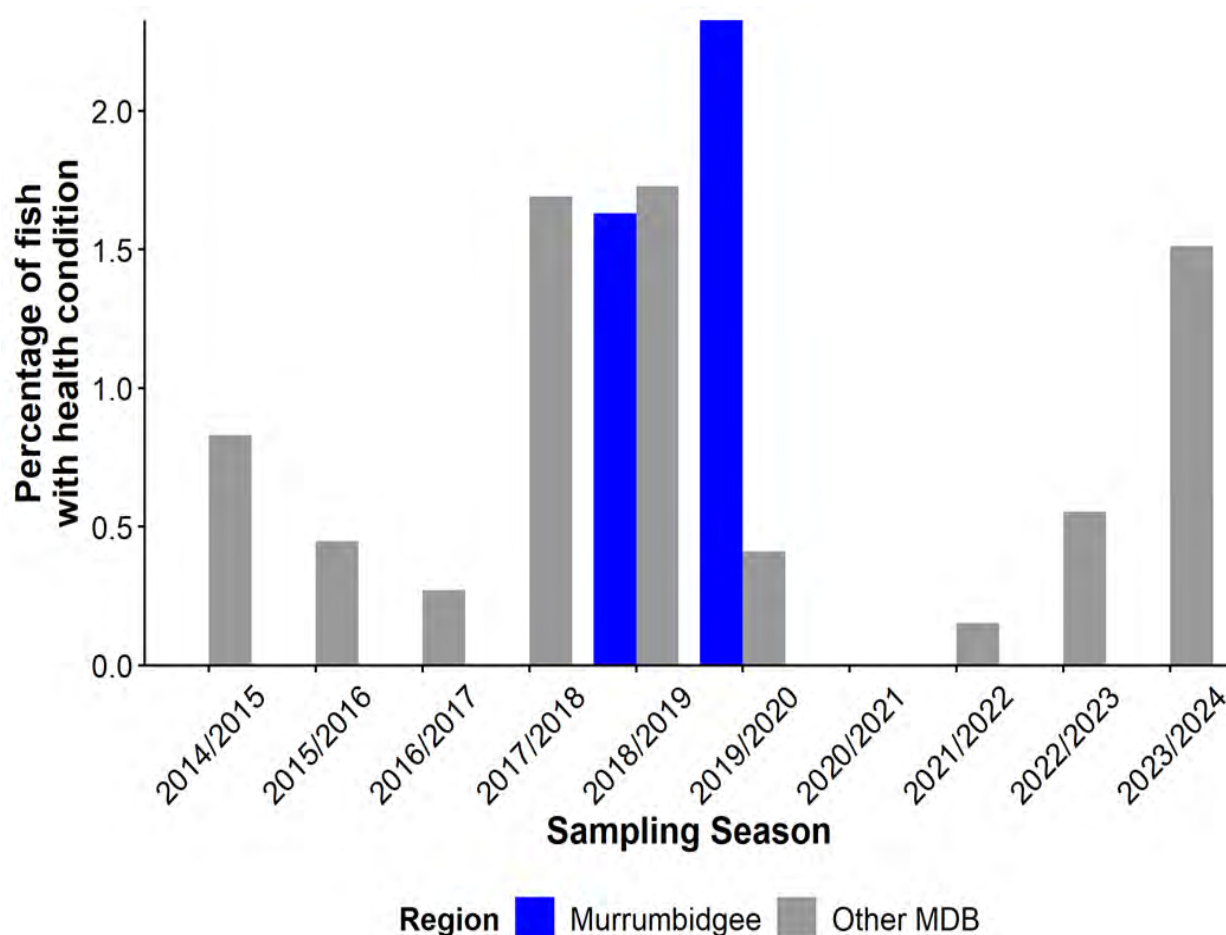


Figure 7.23: Timeseries showing the prevalence of health conditions in Australian smelt. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA.

Summary Statement:

Very few health issues were observed in Australian smelt in the Murrumbidgee WRPAs and none in recent years.

Distribution

Australian smelt were recorded at 78 out of 215 sites in the Murrumbidgee WRPA from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 12.25 fish caught per 90 seconds of electrofishing. Figure 7.24 shows the distribution and relative abundance of Australian smelt across the Murrumbidgee WRPA.

Summary Statement:

Australian smelt were recorded across the Murrumbidgee WRPA except in upland areas in the south-east.

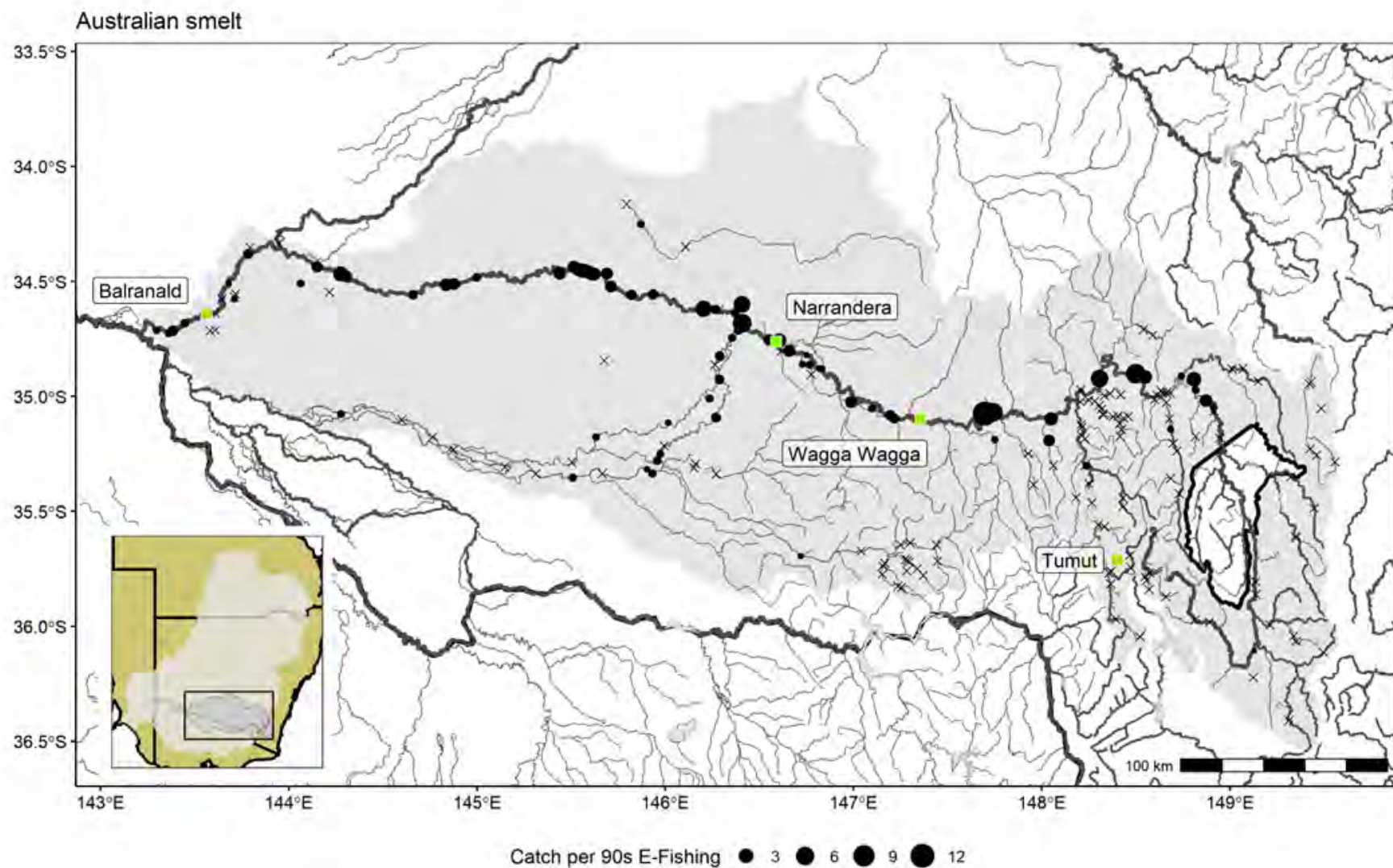


Figure 7.24: Distribution of Australian smelt sampled from 2013/14 to 2023/24 in the Murrumbidgee WRP. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares represent key towns.

Common carp



Population Structure

Figure 7.25 shows the observed length frequency plot for Common carp for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 62 to 771, and 14 % to 61 % of measured fish within a season, with a mean percentage YOY of 34 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Common carp was 57 % (33,139 out of 58,069). Common carp are not a stocked species.

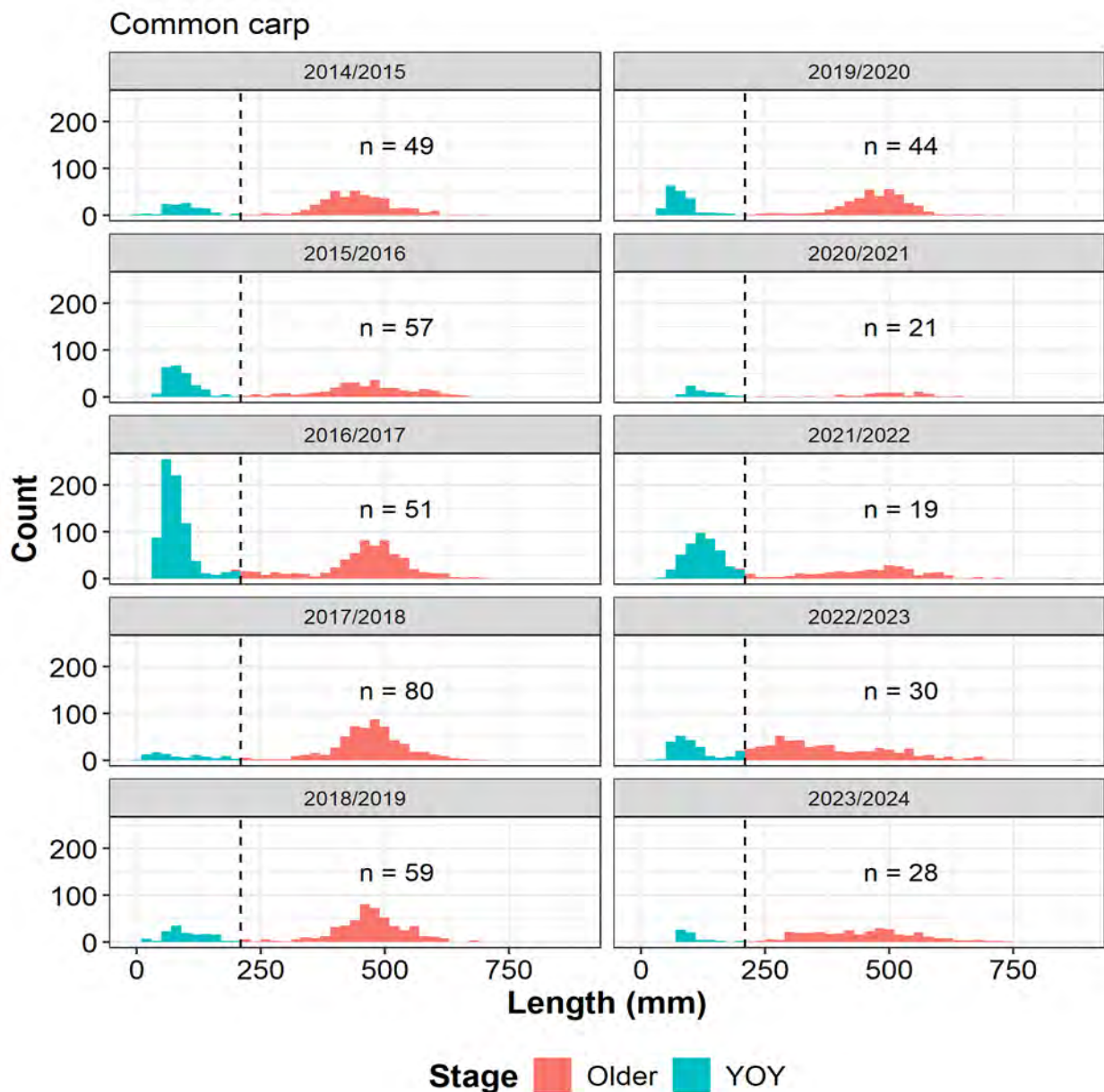


Figure 7.25: Length frequency plots for common carp by sampling season in the Murrumbidgee WRPA. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRPA in a sampling season.

Summary Statement:

Variable recruitment with strong peaks in 2016/17 and 2021/22. Large fish (>500 mm) present in all years. Low recruitment in 2023/24 with evidence of multiple year classes.

Temporal Trends in Abundance

The relative abundance and biomass of Common carp since 1994 was modelled based on all suitable boat electrofishing data. The left-hand panels of Figure 7.26 show the abundance and biomass trends for the Murrumbidgee WRPA and the right-hand panels show the overall trends across the NSW MDB.

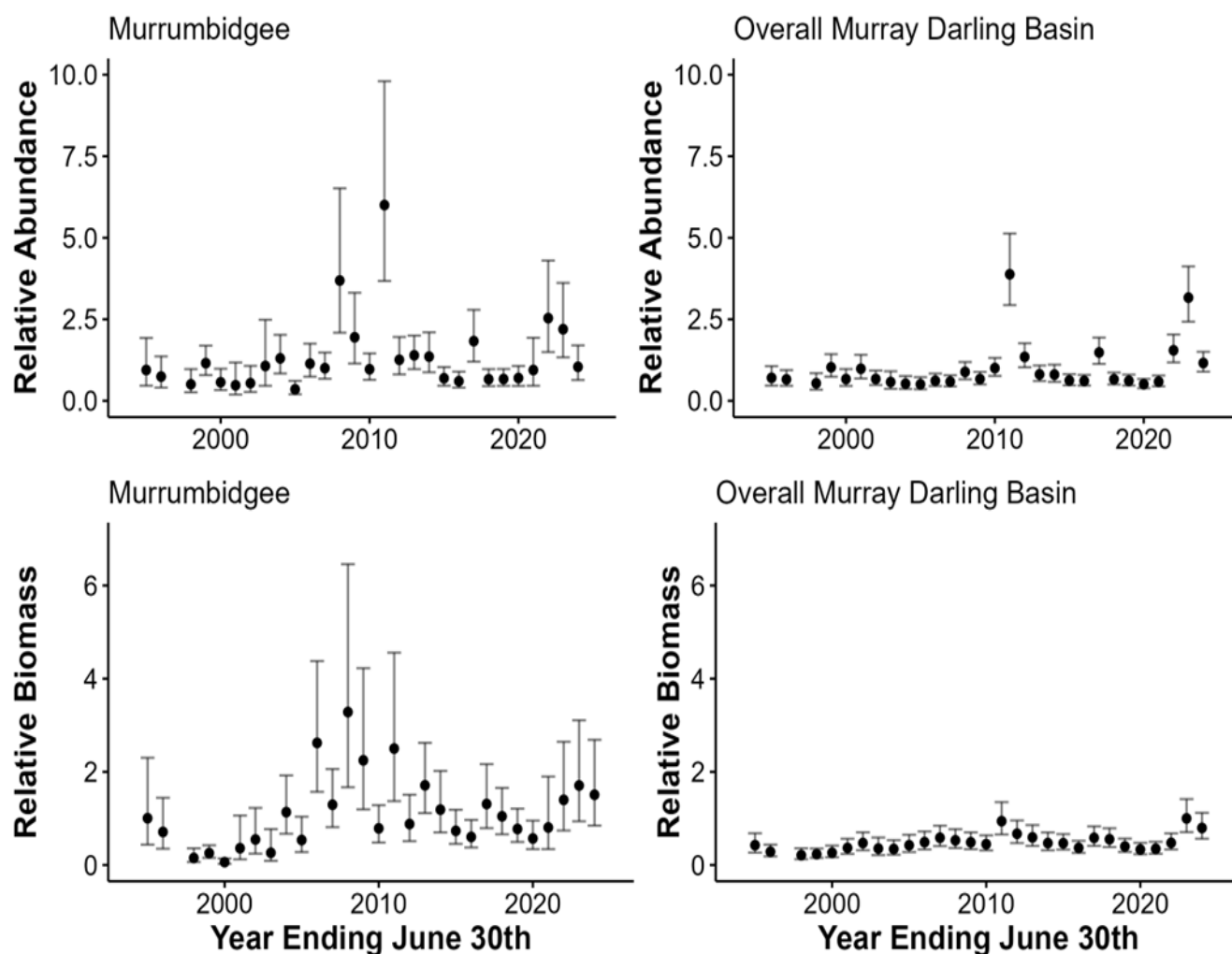


Figure 7.26: Relative abundance and biomass of Common carp in both this valley and the overall Murray-Darling Basin. These are model estimates based upon all electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates.

Summary Statement:

Relative abundance and biomass have slightly increased since the 1990s. Both abundance and biomass show large fluctuations, but abundance declined in 2023/24 after two previous years of high recruitment. Abundance and biomass are both comparable to the wider NSW MDB.

Health

The prevalence of any health issues ranged from 0 % of sampled fish in 2020/2021 to 11 % of sampled fish in 2018/2019 (Figure 7.27). The most common health issue for Common carp in the Murrumbidgee water resource planning area was *Lernaea*, which was observed in a total of 187 fish, corresponding to 3 % of all Common carp measured.

Across the other WRPAs, 4 % of Common carp (2,051 out of 58,071 Common carp) showed a health condition (excludes Murrumbidgee).

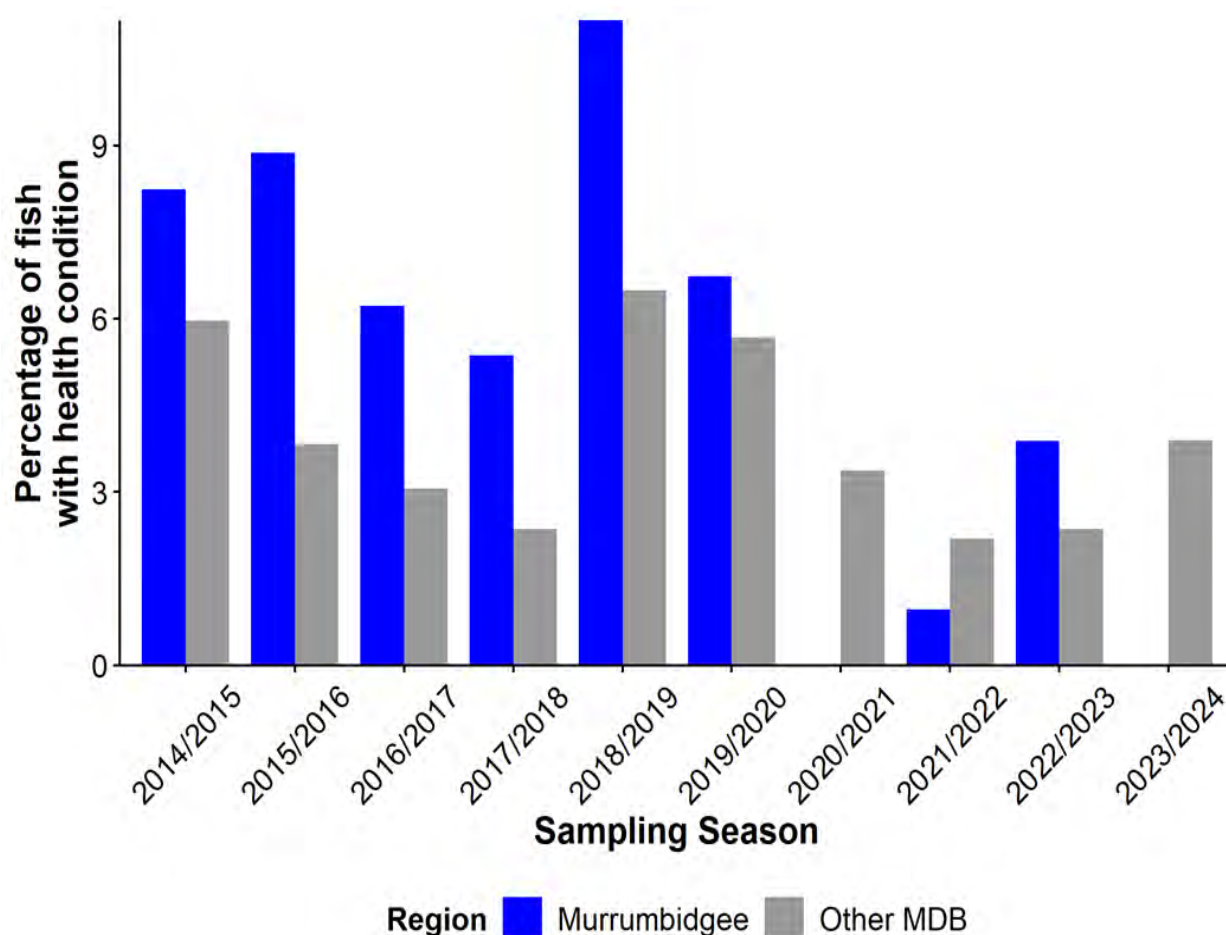


Figure 7.27: Timeseries showing the prevalence of health conditions in Common carp. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPAs.

Summary Statement:

The presence of observable health conditions for Common carp in the Murrumbidgee was low to moderate and but was slightly higher than the wider NSW MDB in most years. No health issues were recorded in the Murrumbidgee in 2023/24 for Common carp.

Distribution

Common carp were recorded at 150 out of 215 sites in the Murrumbidgee WRPA from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 26.32 fish caught per 90 seconds of electrofishing. Figure 7.28 shows the distribution and relative abundance of Common carp across the Murrumbidgee WRPA.

Summary Statement:

Common carp were found in relatively high abundance across the Murrumbidgee region.

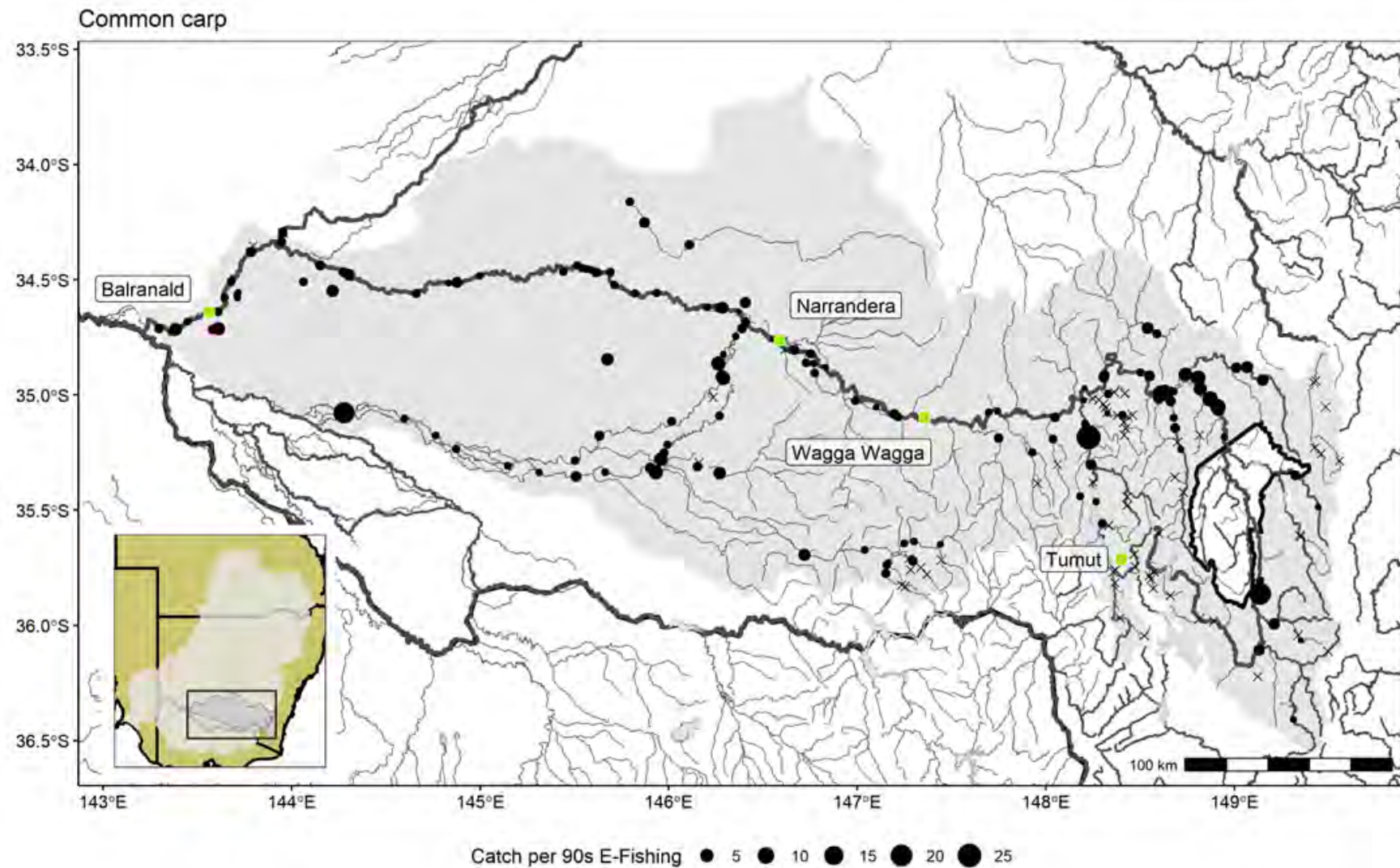


Figure 7.28: Distribution of Common carp sampled from 2013/14 to 2023/24 in the Murrumbidgee WRPA. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares represent key towns.

Threatened Species

The following table (Table 7.6) shows the fish species listed under either the *NSW Fisheries Management Act 1994* (FMA) or the *Commonwealth Environmental Protection and Biodiversity Conservation Act 1999* (EPBC) which were observed during standardised electrofishing surveys in the Murrumbidgee Water Resource Planning Area during the reporting period. A list of all threatened fish species observed by NSW DPIRD Fisheries (as part of any sampling program in any area) is provided in Table 7.10.

Table 7.6: Listed species which were observed in this region during the sampling period. (* = FMA, # = EPBC)

Species	Common name	Total caught (observed)
<i>Bidyanus bidyanus</i>	Silver perch ^{#*}	53 (11)
<i>Maccullochella macquariensis</i>	Trout cod ^{#*}	100 (7)
<i>Maccullochella peelii</i>	Murray cod [#]	2,096 (637)
<i>Macquaria australasica</i>	Macquarie perch ^{#*}	78 (9)
<i>Nannoperca australis</i>	Southern pygmy perch ^{#*}	49 (0)
<i>Tandanus tandanus</i>	Freshwater catfish [*]	4 (1)

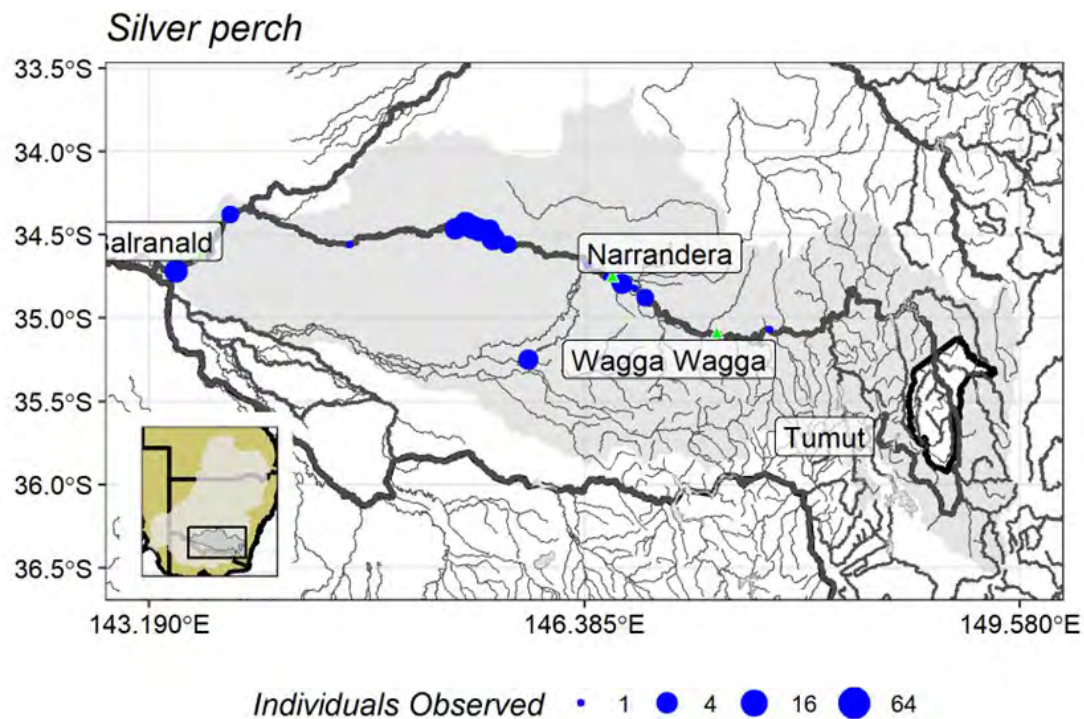


Figure 7.29: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the Murrumbidgee WRP. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance.

Summary Statement:

A total of 64 Silver perch were observed in 21 sites across the Murrumbidgee River and Columbo Creek. Individuals were observed in all sampling years with 10 individuals caught in 2023/24.

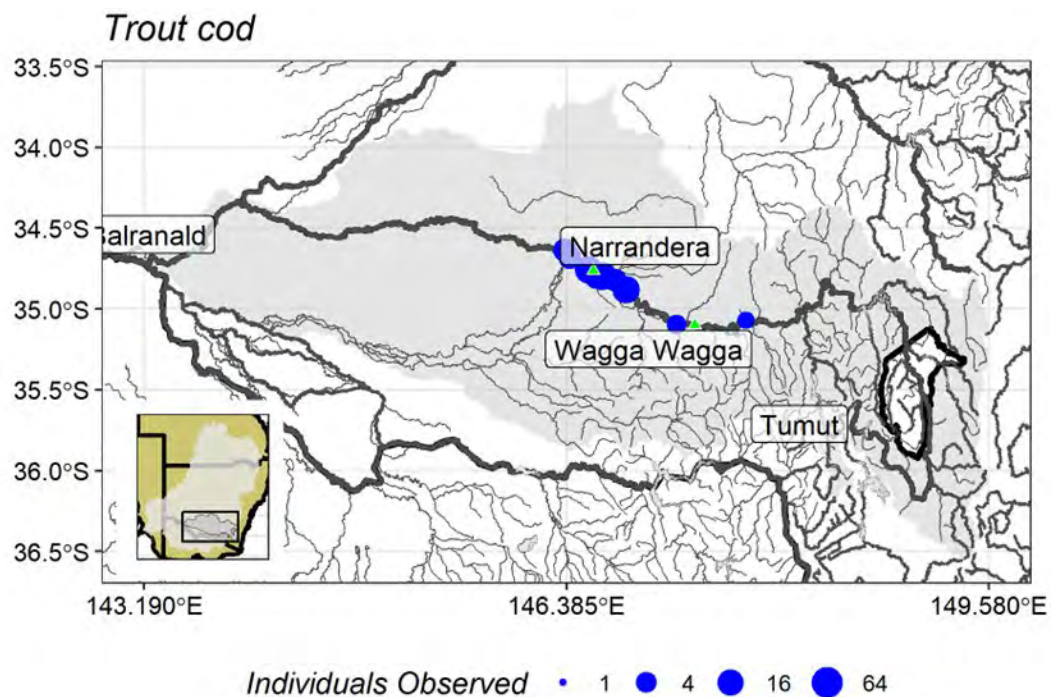


Figure 7.30: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the Murrumbidgee WRP. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance.

Summary Statement:

A total of 107 Trout cod were observed at 11 sites in the Murrumbidgee region. One individual was observed during standardized monitoring in 2023/24 (in the Murrumbidgee River), the first since 2019/20.

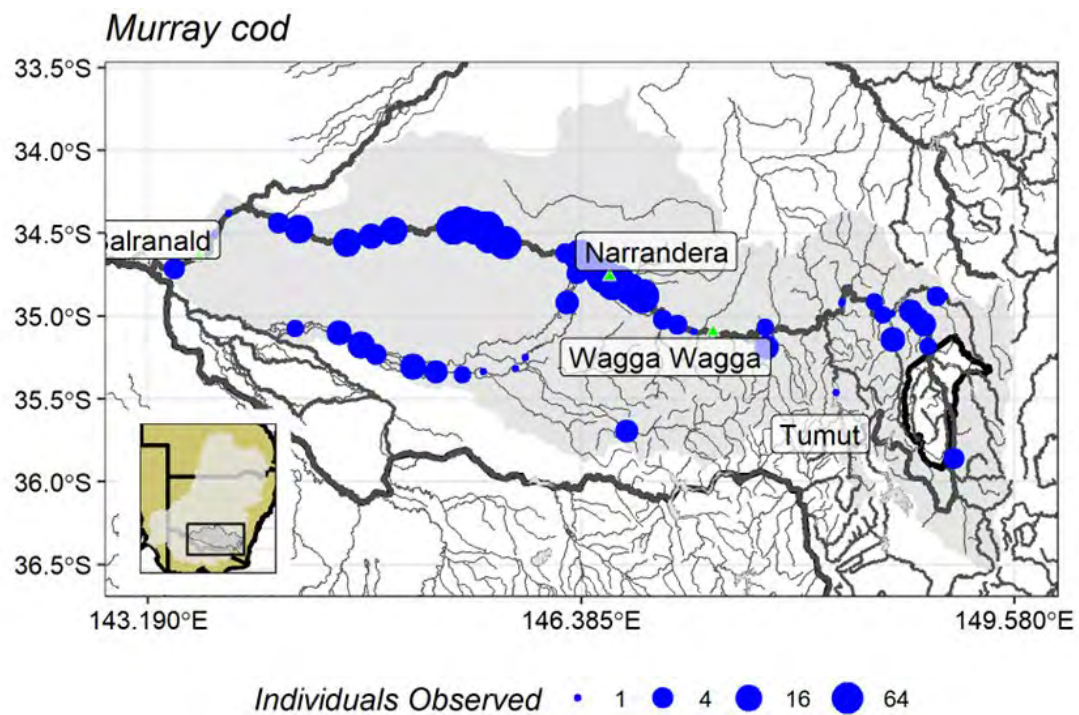


Figure 7.31: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the Murrumbidgee WRPA. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance. Note the image shows a juvenile Murray cod.

Summary Statement:

A total of 2,733 Murray cod were observed at 72 sites across the Murrumbidgee region with individuals observed in all years.

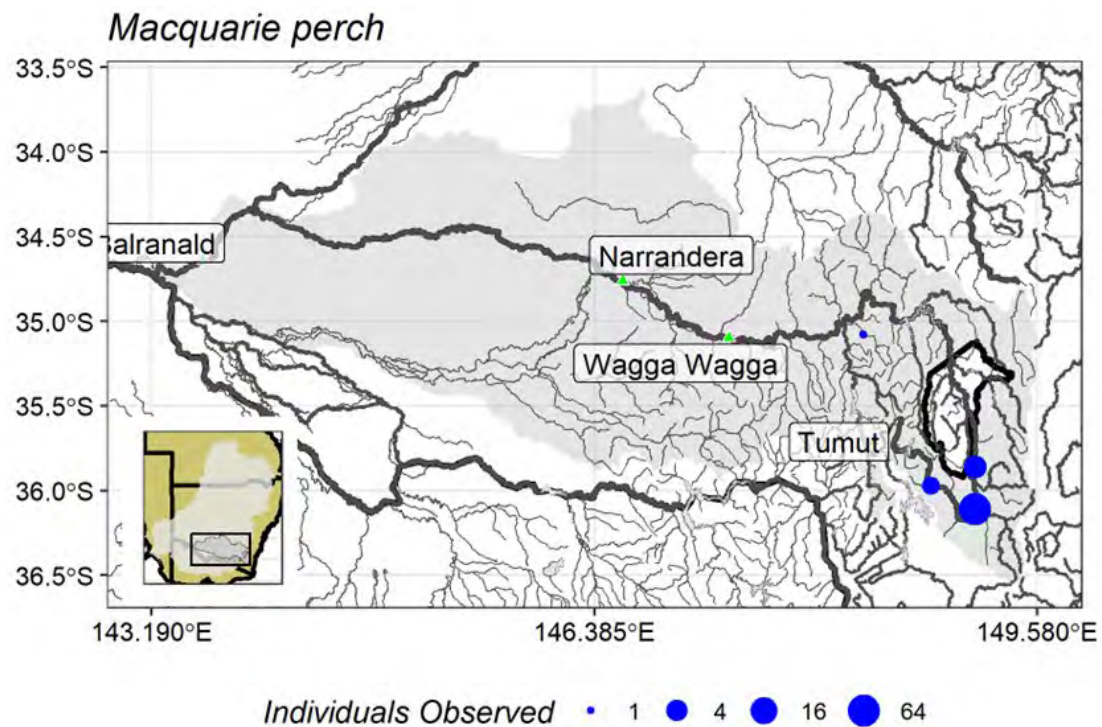


Figure 7.32: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the Murrumbidgee WRP. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance.

Summary Statement:

87 Macquarie perch were caught across 5 sites in the upland reaches of the Murrumbidgee river during the reporting period. Individuals were caught in all sampling years except 2020/21.

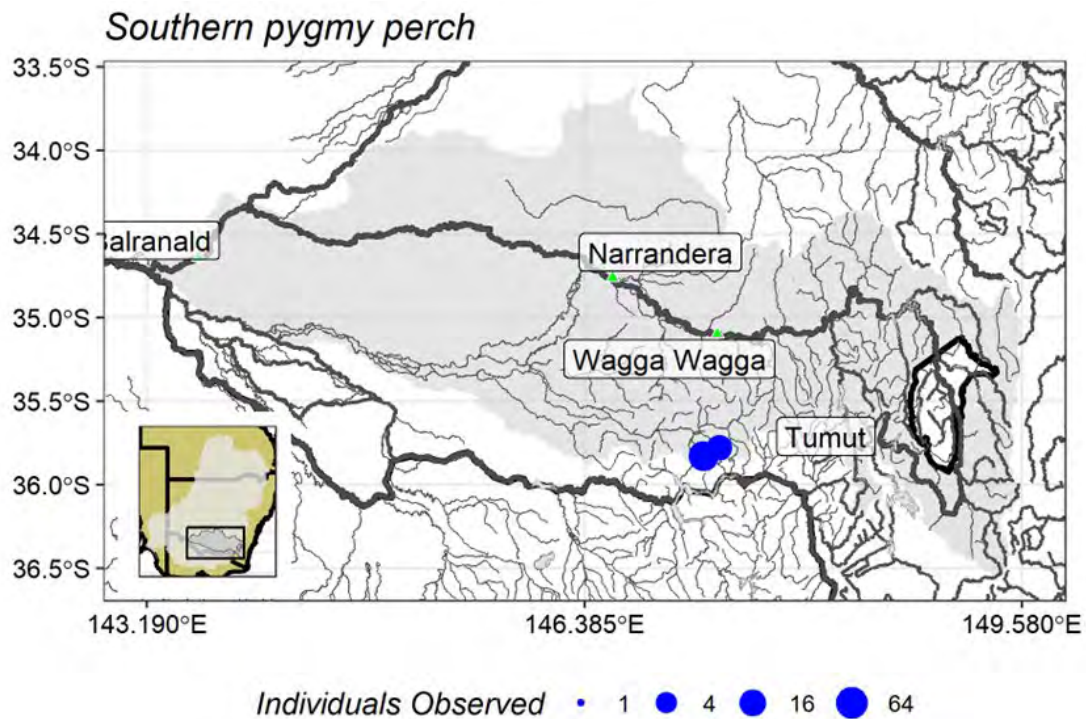


Figure 7.33: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the Murrumbidgee WRP. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance.

Summary Statement:

49 Southern pygmy perch were caught during the reporting period across three sites. 23 individuals were caught in 2023/24, 14 in 2022/23 and 12 in 2014/15.

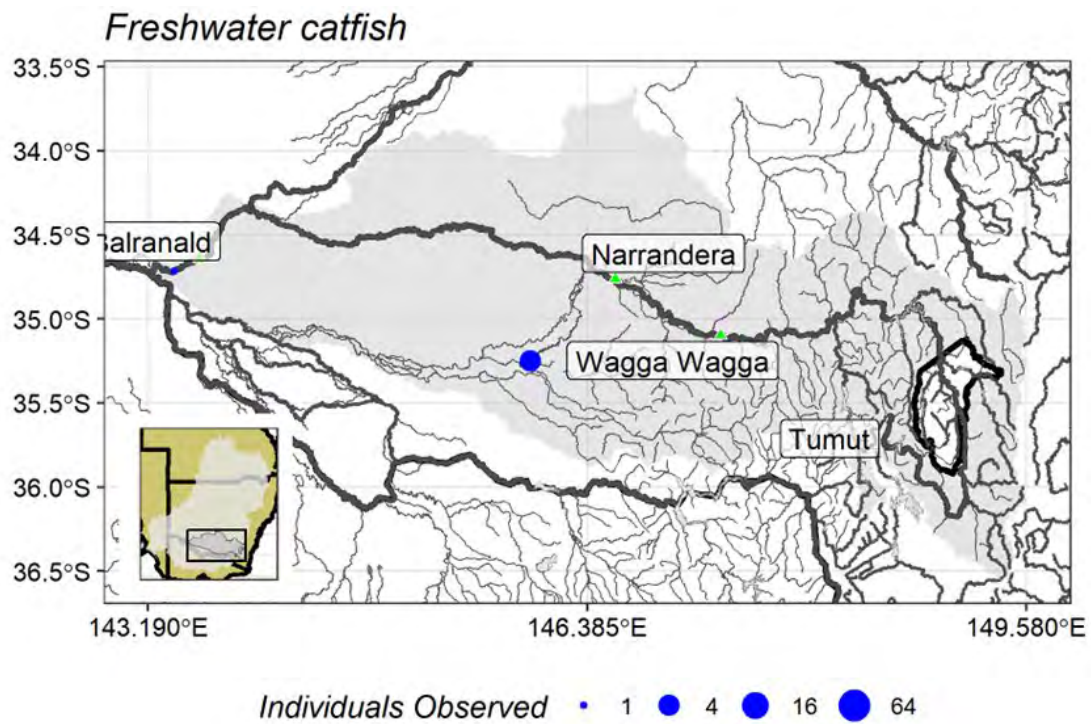


Figure 7.34: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the Murrumbidgee WRPA. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance.

Summary Statement:

A total of 4 catfish have been caught (1 more observed) at two sites in the Murrumbidgee region. Two of these catfish were caught in 2023/24.

Appendix

This report contains data from the projects listed in Table 7.7.

Table 7.7 Projects included in this report. Sampling Events show the total number of sampling events included from each project. Sampling Seasons shows which sampling seasons each project contributed data to.

Project Name	Sampling Seasons	Sampling Events
Basin Plan Environmental Outcomes Monitoring	2014/2015, 2015/2016, 2016/2017, 2017/2018, 2018/2019, 2019/2020	175
Basin Plan Environmental Outcomes Monitoring 2	2022/2023, 2023/2024	37
Carp Biomass Project (NCCP)	2017/2018	8
Carp herpes virus investigation	2015/2016, 2016/2017	10
Discrimination of Hatchery Produced Fish	2014/2015, 2015/2016, 2016/2017, 2017/2018, 2018/2019, 2019/2020	24
Hume Highway Duplication-Threatened Species	2014/2015	6
Macquarie perch surveys	2017/2018	12
Monitoring, Evaluating and Reporting - Inland	2014/2015, 2015/2016	10
Murray Crayfish	2020/2021, 2021/2022, 2022/2023	15
Murray-Darling Basin Fish Surveys	2014/2015, 2015/2016, 2016/2017, 2017/2018, 2018/2019, 2019/2020, 2021/2022, 2022/2023, 2023/2024	72
Murrumbidgee Long Term Intervention Monitoring	2014/2015, 2015/2016, 2016/2017, 2017/2018, 2018/2019, 2019/2020, 2020/2021, 2021/2022, 2022/2023, 2023/2024	134

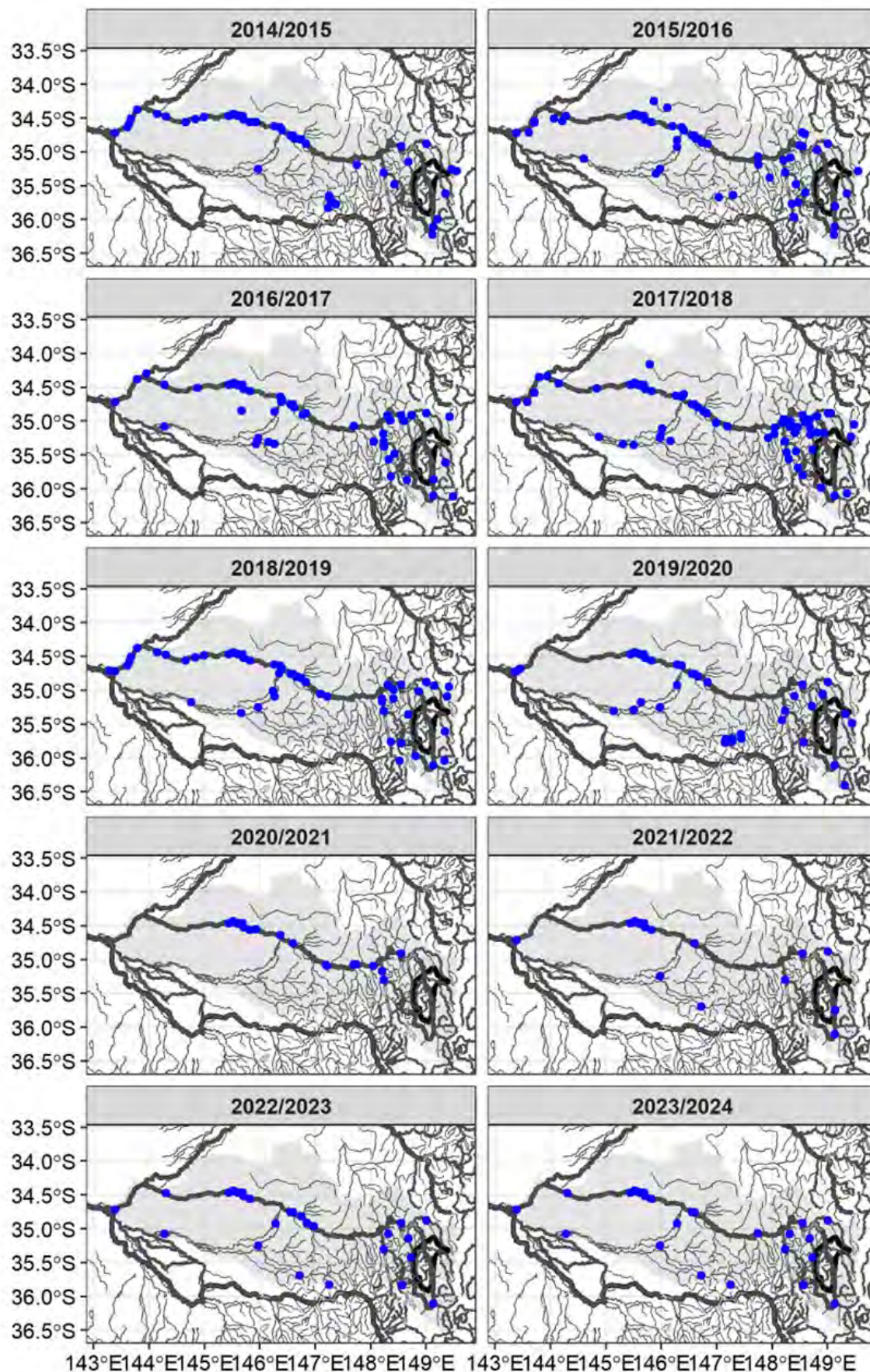


Figure 7.35: Sites sampled and included in this report by sampling season in the Murrumbidgee WRP. Dry sites are not shown.

Table 7.8 shows all species detected during this survey period as part of standardised monitoring projects (see Table 7.7). Note there are variations in effort between sampling seasons so this information should be considered in conjunction with Table 7.1. The Expected from Modelling column identifies species which are possible to occur based upon MaxENT habitat modelling (likelihood threshold > 0.33; NA represents no modelling was undertaken). Species that were possible from the modelling but not observed during standardised sampling in the Murrumbidgee WRPAs were: Olive perchlet, Darling hardyhead, Murray hardyhead, Riffle galaxias, Obscure galaxias, Flat-headed galaxias, Carp-gudgeon species complex, Spangled perch, Southern purple-spotted gudgeon. It should be noted that the MaxENT modelling models habitat availability and is not always a reliable index of abundance, it merely indicates possible distribution based upon habitat. A full list of species observed during this period across the standardised monitoring protocols and sampling methods is presented in Table 7.11.

Table 7.8: Total number caught of each species by sampling season in the Murrumbidgee WRPAs.

Common name	Expected from modelling	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24
Australian smelt	YES	473	808	706	325	409	86	662	1,335	2,705	248
Bony herring	YES	635	466	247	814	718	85	562	79	480	628
Brown trout	YES	5	23	17	109	71	14	0	26	14	9
Carp-gudgeon species complex	YES	256	615	244	235	166	221	48	302	85	32
Common carp	NA	531	550	2,123	709	682	626	147	728	1,208	429
Common carp - Goldfish hybrid	NA	0	0	0	0	0	1	0	0	0	0
Dwarf flathead gudgeon	YES	0	1	0	32	1	0	0	0	0	0
Eastern gambusia	NA	329	272	659	568	84	193	3	125	119	10
Flathead gudgeon	YES	3	45	55	308	98	102	0	12	13	50
Freshwater catfish	YES	0	0	0	0	0	1	0	0	1	2
Galaxias spp	NA	0	0	46	0	0	18	0	0	0	0
Golden perch	YES	101	78	72	107	137	79	19	23	45	92
Goldfish	NA	48	122	188	78	36	98	8	29	72	7
Macquarie perch	YES	24	6	27	1	5	9	0	3	1	2
Mountain galaxias	YES	285	75	10	193	33	18	0	1	0	1
Murray cod	YES	312	316	150	266	431	283	109	62	50	117
Murray-Darling rainbowfish	YES	253	212	143	43	131	15	172	357	178	19
River blackfish	NA	35	76	1	118	13	10	0	1	61	23
Oriental weatherloach	NA	0	1	8	148	1	1	0	2	1	2
Rainbow trout	YES	7	24	29	171	61	14	0	9	44	37
Redfin	YES	43	83	277	133	347	17	0	20	103	17
Silver perch	YES	5	1	4	3	9	8	4	1	10	8
Southern pygmy perch	YES	12	0	0	0	0	0	0	0	14	23

Common name	Expected from modelling	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24
Stocky galaxias	NA	0	0	0	0	0	0	0	0	22	7
Trout cod	YES	9	13	8	19	25	25	0	0	0	1
Two-spined blackfish	YES	0	33	1	3	0	0	0	0	0	5
Unidentified Maccullochella cod	NA	1	0	0	0	0	0	0	0	0	0
Unspecked hardyhead	YES	52	143	44	13	101	114	2	136	7	48

The following table summarises the sampling methods for each species caught (Table 7.9).

Table 7.9: Total catch of each species by sampling method in the Murrumbidgee WRPA.

Common name	Backpack Electrofishing	Bait Trap	Boat Electrofishing
Australian smelt	30	6	7,721
Bony herring	0	0	4,714
Brown trout	164	1	123
Carp-gudgeon species complex	65	1,394	745
Common carp	633	182	6,918
Common carp - Goldfish hybrid	0	0	1
Dwarf flathead gudgeon	0	6	28
Eastern gambusia	894	361	1,107
Flathead gudgeon	206	120	360
Freshwater catfish	0	0	4
Galaxias spp	61	2	1
Golden perch	1	3	749
Goldfish	129	8	549
Macquarie perch	3	10	65
Mountain galaxias	483	118	15
Murray cod	6	0	2,090
Murray-Darling rainbowfish	6	3	1,514
River blackfish	286	17	35
Oriental weatherloach	156	0	8
Rainbow trout	252	3	141
Redfin	47	46	947
Silver perch	0	0	53
Southern pygmy perch	45	4	0
Stocky galaxias	29	0	0
Trout cod	0	0	100
Two-spined blackfish	42	0	0
Unidentified Maccullochella cod	0	0	1
Unspecked hardyhead	3	1	656

Table 7.10: Listed threatened species recorded in the Murray-Darling Basin (from the NSW DPIRD Fisheries Freshwater Ecosystem research database). Species are listed under either the NSW Fisheries Management Act 1994 (FMA) or the Commonwealth Environmental Protection and Biodiversity Conservation Act 1999 (EPBC).

Genus, species	Common Name	EPBC Status	FMA Status
<i>Ambassis agassizii</i>	Agassiz's glassfish, olive perchlet, western New South Wales population	NA	Endangered Population
<i>Bidyanus bidyanus</i>	Silver Perch, Bidyan	Endangered	Vulnerable
<i>Craterocephalus fluviatilis</i>	Murray Hardyhead	Endangered	Critically Endangered
<i>Galaxias rostratus</i>	Flathead Galaxias, Beaked Minnow, Flat-headed Galaxias, Flat-headed Jollytail, Flat-headed Minnow	Critically Endangered	Critically Endangered
<i>Galaxias tantangara</i>	Stocky Galaxias	NA	Critically Endangered
<i>Maccullochella macquariensis</i>	Trout Cod	Endangered	Endangered
<i>Maccullochella peelii</i>	Murray Cod	Vulnerable	NA
<i>Macquaria australasica</i>	Macquarie Perch	Endangered	Endangered
<i>Mogurnda adspersa</i>	Southern Purple Spotted Gudgeon	NA	Endangered
<i>Nannoperca australis</i>	Southern Pygmy Perch	Vulnerable	Endangered
<i>Tandanus tandanus</i>	Freshwater catfish, eel tailed catfish, Murray-Darling Basin population	NA	Endangered Population

Table 7.11 shows all species detected during this survey period across all programs and methods. Due to variations in project methods protocols, this data is presented only to give a complete list of species observed in the region. The Expected from Modelling column identifies species which are possible to occur based upon MaxENT habitat modelling (likelihood threshold > 0.33; NA represents no modelling was undertaken). Species that were possible from the modelling but not observed during sampling in the Murrumbidgee WRPAs were: Olive perchlet, Darling hardyhead, Murray hardyhead, Riffle galaxias, Obscure galaxias, Flat-headed galaxias, Carp-gudgeon species complex, Spangled perch and Southern purple-spotted gudgeon. It should be noted that the MaxENT modelling actually models habitat availability and is not always a reliable index of abundance, it merely indicates possible distribution based upon habitat. A list of species caught as part of standardised monitoring during this period is in Table 7.8.

Table 7.11: Total catch of each species by all sampling programs and all methods in the Murrumbidgee WRPAs. Note these include projects with sampling not representative of the community and the data should be used with caution.

Common name	Expected from modelling	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24
Australian smelt	YES	499	812	809	328	409	87	708	2174	17,697	1,295
Bony herring	YES	637	466	249	816	718	85	564	79	482	629
Brown trout	YES	5	23	17	112	91	64	28	47	80	9
Carp gudgeon species complex	YES	465	1,685	1,017	1,656	609	652	598	1,043	1,880	500
Common carp	NA	532	550	2,124	741	719	637	209	751	1,478	435
Common carp - Goldfish hybrid	NA	0	0	0	0	0	1	0	0	0	0
Dwarf flathead gudgeon	YES	0	1	0	32	1	0	0	0	0	0
Eastern gambusia	NA	1,064	765	1,030	1,008	249	420	26	787	489	1,311
Flathead gudgeon	YES	3	45	57	330	98	102	2	60	75	435
Freshwater catfish	YES	0	0	0	0	0	1	0	0	1	2
Galaxia spp	NA	0	0	46	0	0	18	10	1	0	0
Golden perch	YES	101	78	72	140	137	80	19	23	45	92
Goldfish	NA	48	122	188	79	40	100	13	29	74	7
Macquarie perch	YES	24	6	27	8	5	9	0	3	1	2
Mountain galaxias	YES	285	75	10	193	65	33	6	7	3	1
Murray cod	YES	317	316	151	267	431	284	109	62	50	117
Murray-Darling rainbowfish	YES	654	348	204	176	160	55	313	551	183	82
River blackfish	NA	35	76	1	148	13	10	0	1	61	23
Oriental weatherloach	NA	0	1	8	148	1	1	0	31	139	2
Rainbow trout	YES	7	24	29	172	98	30	20	15	109	37
Redfin	YES	45	83	277	192	360	18	3	20	103	17
Silver perch	YES	5	1	4	5	9	8	4	1	10	8

Common name	Expected from modelling	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24
Southern pygmy perch	YES	12	0	0	0	0	0	0	0	14	23
Stocky galaxias	NA	0	0	0	0	0	0	0	0	22	7
Trout cod	YES	10	13	8	19	25	25	0	0	2	1
Two-spined blackfish	YES	0	33	1	3	2	10	3	6	8	5
Unidentified Maccullochella cod	NA	1	0	0	0	0	0	0	0	0	0
Unspecked hardyhead	YES	54	143	46	13	101	114	4	136	7	48

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Chapter 8 Basin Plan Fish Monitoring Summary (2014/15 – 2023/24): Namoi Water Resource Planning Area

Hayden Schilling & David Crook

March 2025



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Introduction

This report spans 2014/15 to 2023/24 and uses all suitable fish assemblage data collected by NSW DPIRD Fisheries using standardized electrofishing monitoring techniques. The format of the report follows and expands upon the previous reports (Schilling & Crook 2023, 2024). This report focusses on the Namoi Water Resource Planning Area (WRPA) shown in Figure 2.1.

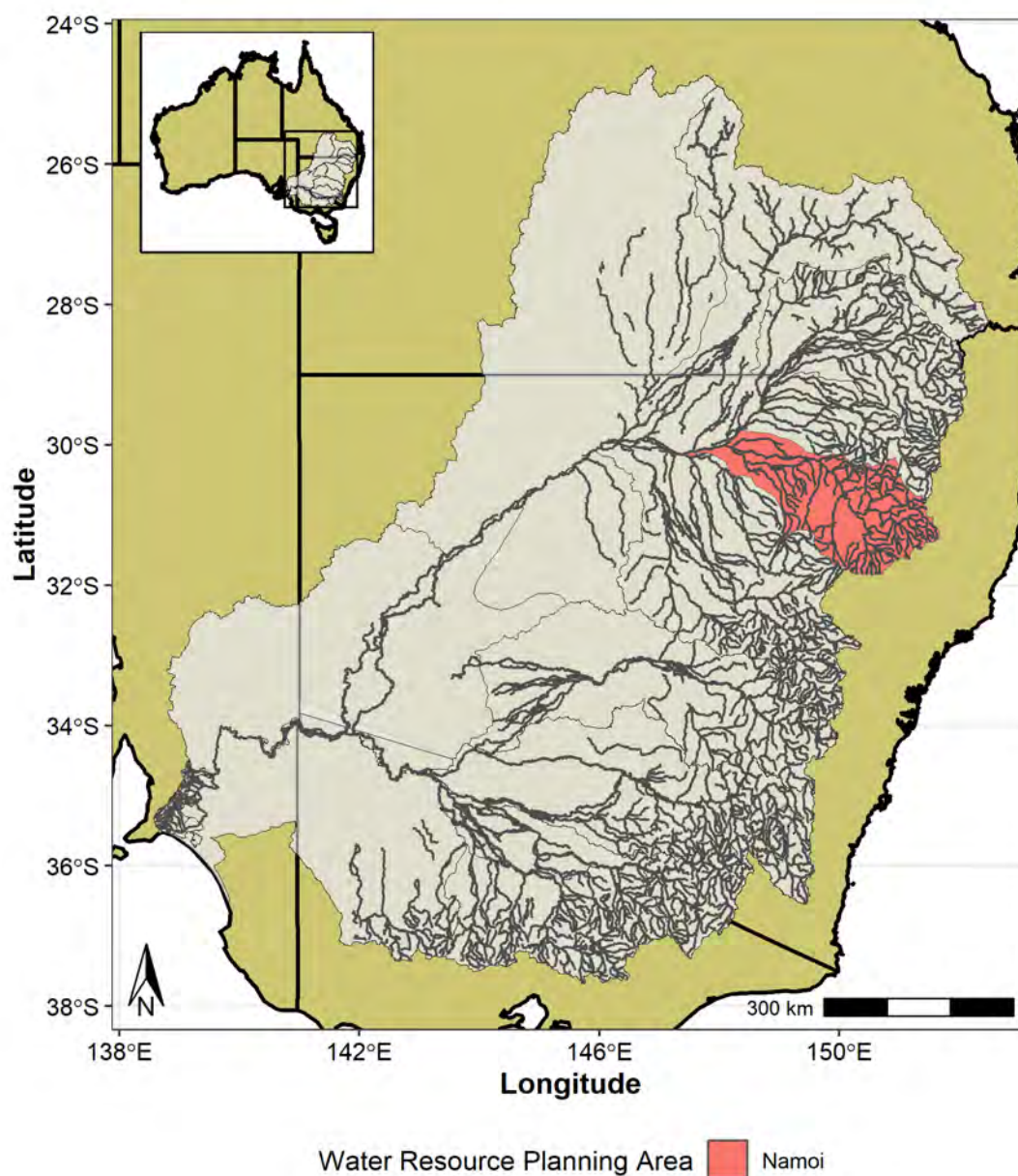


Figure 8.1: Murray-Darling Basin with the key region of this report highlighted. Inset map shows the whole of Australia with a box around the MDB.

What This Report Includes

This report starts with an overview of the standardised monitoring programs including sampling details and statistics. An overview of the hydrological and climatic conditions during the reporting period is also provided as context for interpreting the fish population status data.

Following the introductory sections, we present a summary of *fish diversity* across the Namoi WRP. Separate plots for native and alien species show the total number of unique species observed at each site.

The main body of the report provides detailed information on the *population structure, relative abundance, health, and distribution* of six key fish species:

- Murray cod
- Golden perch
- Freshwater catfish
- Bony herring
- Australian smelt
- Common carp

Population structure information includes length frequency plots of collected fish and the proportion of fish classified as Young of the Year (YOY). This information can be used to infer the size structure of populations and the level of recruitment each year. For additional context, we provide a summary table showing any stocking which occurred for the species in each year (if relevant).

Relative abundance and *relative biomass* (a unit-less measure representing the number (or biomass) of fish in an area) information is adapted from the modelled outputs from a more in-depth publication (Crook et al. 2023) which considers all available electrofishing data within the NSW Murray-Darling Basin (MDB). The updated analysis uses generalised linear mixed models to generate annual indices of relative abundance and biomass for each WRP. In this report we present the modelled time series of relative abundance showing the predicted number (or biomass) of fish observed per 90 second shot of electrofishing. The abundance and biomass trends for the Namoi WRP are contrasted with the overall NSW MDB dataset. It should be noted that these are modelled estimates of relative abundance/biomass, not absolute abundance/biomass as absolute estimates would require extensive calibration surveys that are not included in the monitoring program.

Health information is provided as a summary of any visible health conditions recorded for the key species. The number of health conditions observed in a fish population is generally reflective of water quality, competition, and many other factors. Fewer observations of health conditions indicate healthier populations. The health conditions detailed are any that were observed as part of the biological measurements taken. We provide a comparison of the prevalence of health conditions in the Namoi WRP and greater MDB (excluding the Namoi WRP).

Distribution maps are provided for each species to show the observed distribution of each species from electrofishing samples. The distribution maps also show the relative abundance (number of fish observed per 90 seconds of electrofishing) at each site to give an indication of how the population is spread over the landscape.

Finally, the distributions and numbers of *Threatened species* are reported. The report includes threatened species that were recorded by standardised monitoring programs in the Namoi WRP during the reporting period.

For each section of the report, we provide a *Summary Statement*. This statement provides a very brief overview of the key messages for each section.

Sampling Methods

Three main methods are used during routine fish monitoring surveys: boat electrofishing, backpack electrofishing and bait traps. This report mainly includes the electrofishing data with bait trap samples informing the distribution of small bodied species. The electrofishing was conducted using the standard methodology implemented in the Sustainable Rivers Audit (SRA; Davies et al. 2010). This usually includes 12 shots of 90 seconds “power on” during each sampling event.

As parts of this report compile data from multiple projects, there is some variation in how sites were chosen and the effort of sampling conducted each year (Table 8.1). Details of which projects contributed data to this report can be seen in Table 8.7. At each site, sampling gear was applied as suited to the local conditions with either boat, backpack, or a hybrid of the two, in addition to 10 unbaited bait traps set in edge margins. Most sampling occurred between the months of September and May.

Table 8.1: Sampling effort (Number of sites sampled) each sampling season in the Namoi WRPA. Variation in sampling effort is due to different numbers of projects and interruptions to planned sampling such as flooding, site desiccation, and extreme weather.

Sampling Season	Number of Boat Electrofishing Sites	Number of Backpack Electrofishing Sites	Number of Hybrid Sites	Total
2014/2015	4	3	2	9
2015/2016	15	12	3	30
2016/2017	17	6	9	32
2017/2018	18	3	5	26
2018/2019	19	10	3	32
2019/2020	6	6	4	16
2020/2021	4	9	0	13
2021/2022	15	11	0	26
2022/2023	19	12	2	33
2023/2024	18	12	1	31

The sites sampled during the reporting period are shown in Figure 8.2. A breakdown of sites sampled each sampling season is shown in the Appendix (Figure 8.36).

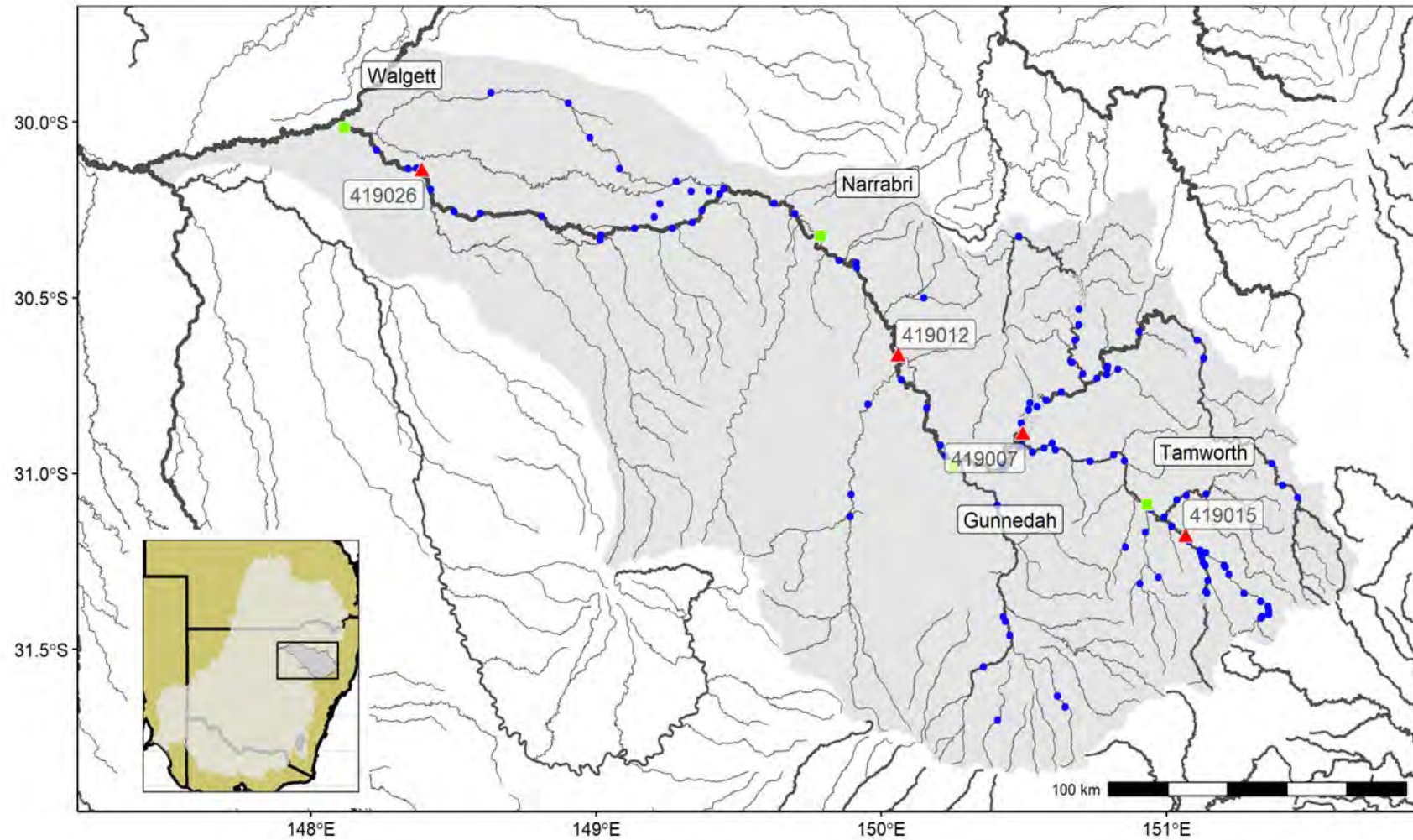


Figure 8.2: Sites (dots) sampled during the reporting period in the Namoi WRPA. Triangles show key flow gauges along with their gauge ID number. Green squares show major towns.

Each sampling method has a different effectiveness at sampling each species. Table 8.2 shows the total numbers of each key species caught by each method.

Table 8.2: Number of each key species caught by sample method over the whole program in the Namoi WRP. Further data on total catch is provided in the Appendix.

Common name	Boat Electrofishing	Backpack Electrofishing	Bait Trap
Australian smelt	175	378	1
Bony herring	4,780	624	7
Common carp	3,385	1,332	201
Freshwater catfish	29	105	0
Golden perch	641	15	0
Murray cod	903	121	0

A subset of sampled fish had biological measurements taken during the surveys, including but not limited to length and weight measurements and visual health assessments. Table 8.3 shows the number of biological measurements taken each year for the six key species.

Table 8.3: Number of biological measurements taken for the key species each sampling season in the Namoi WRP.

Sampling Season	Australian smelt	Bony herring	Common carp	Freshwater catfish	Golden perch	Murray cod
2014/2015	3	77	154	0	6	38
2015/2016	315	680	704	8	62	146
2016/2017	28	911	672	35	136	120
2017/2018	42	447	377	2	114	144
2018/2019	1	235	508	6	69	202
2019/2020	28	79	214	22	33	35
2020/2021	0	11	80	1	13	9
2021/2022	81	47	320	26	43	84
2022/2023	12	368	593	24	108	152
2023/2024	24	141	300	10	92	108

Climate Overview

The following is a summary of the climatic conditions during the reporting period in terms of how the observed conditions compare to long term records. These are direct extracts from the [Australian Bureau of Meteorology climate summaries archive](#) and are written in the given year. To interpret, 2014 states it was the warmest year on record, meaning 2014 was the warmest year on record up to and including 2014 but not including more recent years.

2014

New South Wales experienced its warmest year on record in 2014, with several heatwaves and persistently warm conditions across the State. Rainfall was well below average in the northeast, and close to average elsewhere.

2015

New South Wales recorded well above average temperatures in 2015. Nights were particularly warm, the sixth-warmest on record for the State. Rainfall was close to average for the state as a whole.

2016

2016 was a generally wet, warm year for NSW as a whole, with substantial variability throughout the year and across the state. Following a record-warm start to the year, May to September was the wettest such period on record for NSW, with cooler weather in much of the west of the state. Minimum temperatures were the warmest on record for the State as a whole, with record-warm daytime temperatures on parts of the east coast.

2017

The year 2017 was the warmest on record for New South Wales for both mean and daytime temperatures. It was also the State's driest year since 2006. Following the warmest summer on record for the State, heavy rain in March across the east then made way for a very dry winter and start to spring. Winter overnight temperatures were the lowest since 1997, but daytime temperatures remained above average for most of the year, and were the warmest on record overall.

2018

2018 was the warmest on record for New South Wales for both mean temperature and mean maximum temperature, whilst the mean minimum temperature was fourth-warmest on record. The year was dominated by very dry conditions, with the third-driest January to September on record. October to December saw some relief from the dry, with above average rainfall across parts of the State. Despite this, New South Wales experienced its sixth-lowest annual rainfall on record; its driest year since 2002.

2019

2019 was the driest and warmest year on record for New South Wales. Despite some rain in some months, most of the State received much less rainfall than usual, with the northeast and far west particularly dry. Heatwaves in January brought very high temperatures, and large fires from September onward caused extensive damage and persistent smoke.

2020

2020 saw above average temperature and rainfall in New South Wales. Temperatures were above average across the state in most months except during autumn. There was widespread rain during autumn and spring and in December, but early winter and November rain was below average.

2021

New South Wales had its 6th wettest year on record, with 2021 rainfall 30 % above average. This included significant floods along the east coast in March, and the state's wettest November on record. It was the state's coolest year since 1996, at 0.15 °C above the 1961–1990 average.

2022

2022 was exceptionally wet with the state-averaged annual total being the second-highest on record (since 1900) and many sites recording their highest annual totals on record. Maximum temperatures were lower than average with the state-averaged annual maximum temperature being the coolest since 1992. Minimum temperatures were generally warmer than average with the state-averaged annual minimum temperature being 0.73 °C above the 1961–1990 average.

2023

The state-averaged rainfall was 22.9 % below the 1961–1990 average. Rainfall was above average over small parts of the state's south, west of the Great Dividing Range, while being below average over most of the northern half of the state, especially over parts of the Northern Tablelands, Northern Rivers, Mid-North Coast, and Upper Hunter, where annual rainfall was in the lowest 10 % of historical records (since records began in 1900). State-averaged annual maximum temperature was 1.96 °C above the 1961–1990 average, which is the third highest on record.

2024

Rainfall totals in 2024 were above average to very much above average for the northern and western areas of the state, as well as central parts of the coast. Totals were below average for large parts of the south-east, as well as small parts of the state's north-east and south-west. 2024 was the third-warmest on record for all years since 1910, 1.55 °C above the 1961–1990 average.

Flow Data

Below shows a summary of flow data from a variety of flow gauges in the Namoi WRPA (Figure 8.3).

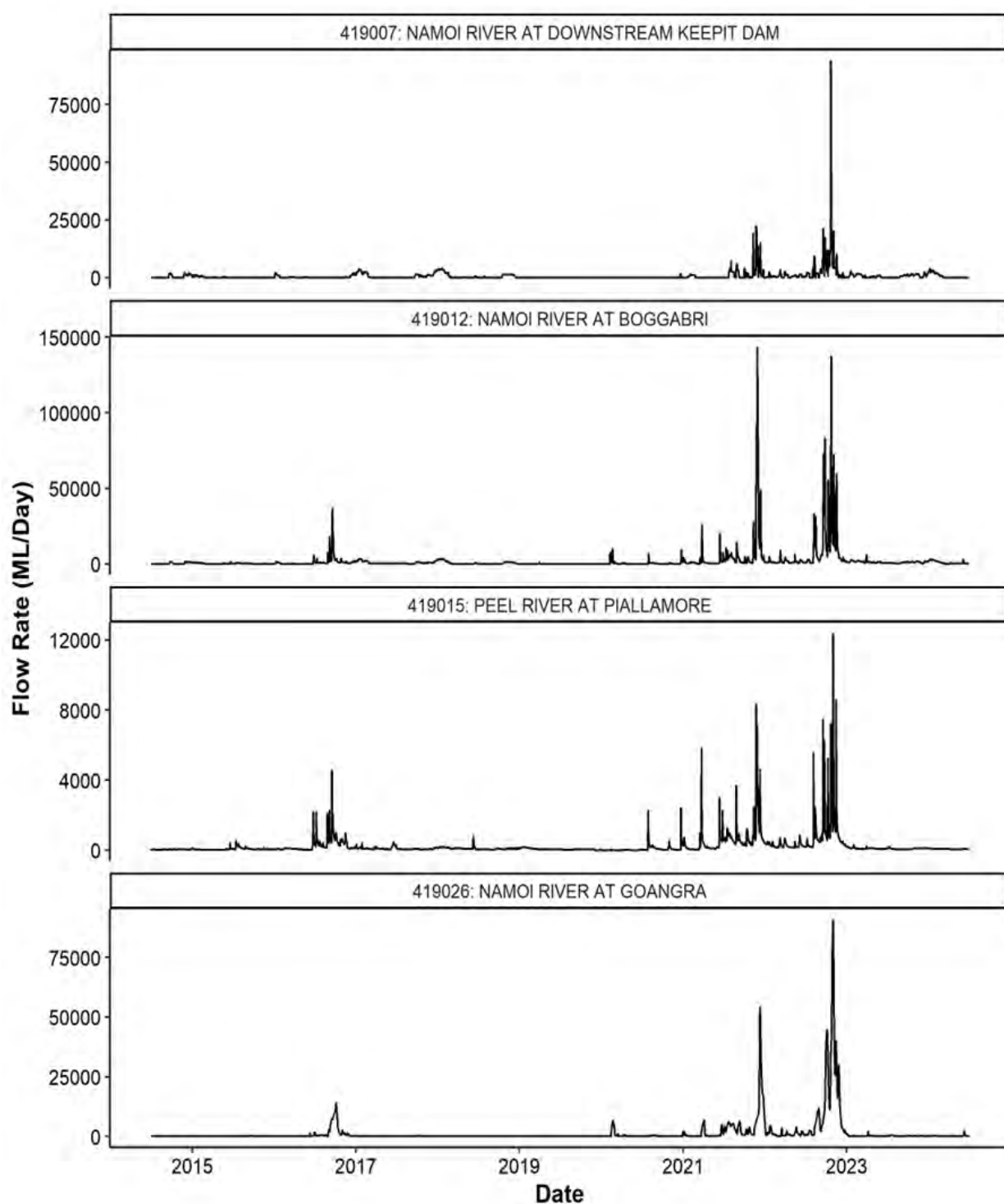


Figure 8.3: Flow data from various gauges in the Namoi WRPA over the reporting period. Gauge locations can be seen on Figure 8.2. Note the differing scales on the y-axis.

Water temperature data, where available, are also shown in Figure 8.4.

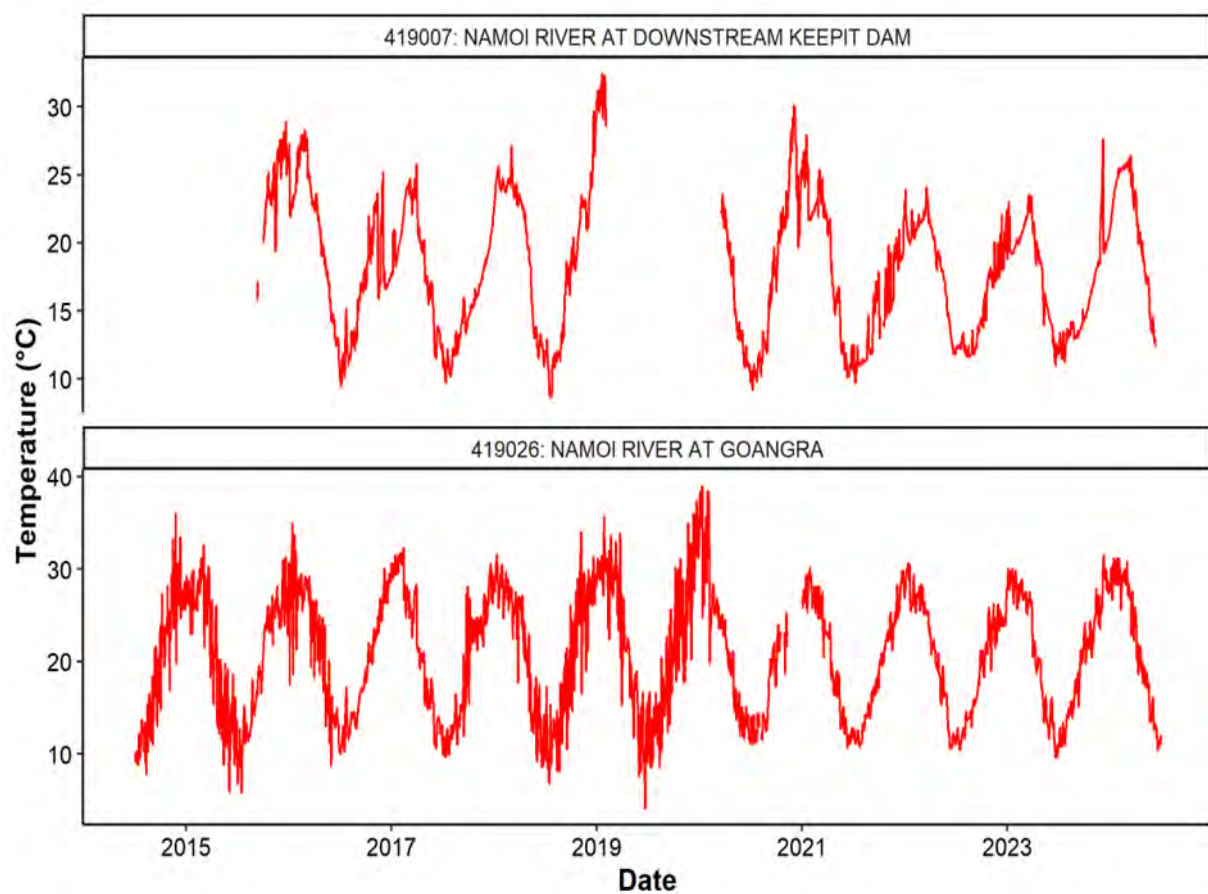


Figure 8.4: Water temperature data from various gauges in the Namoi WRPA over the reporting period. Gauge locations can be seen on Figure 8.2. Note the differing scales on the y-axis.

Species Diversity

A total of 18 fish species were observed across the Namoi WRPA including four alien species. Figure 8.5 shows the number of native species found at each site while Figure 8.6 shows the number of alien species found at each site. The full list of species caught and observed is presented in Table 8.8.

Summary Statement:

Native and alien diversity were generally consistent across Namoi region.

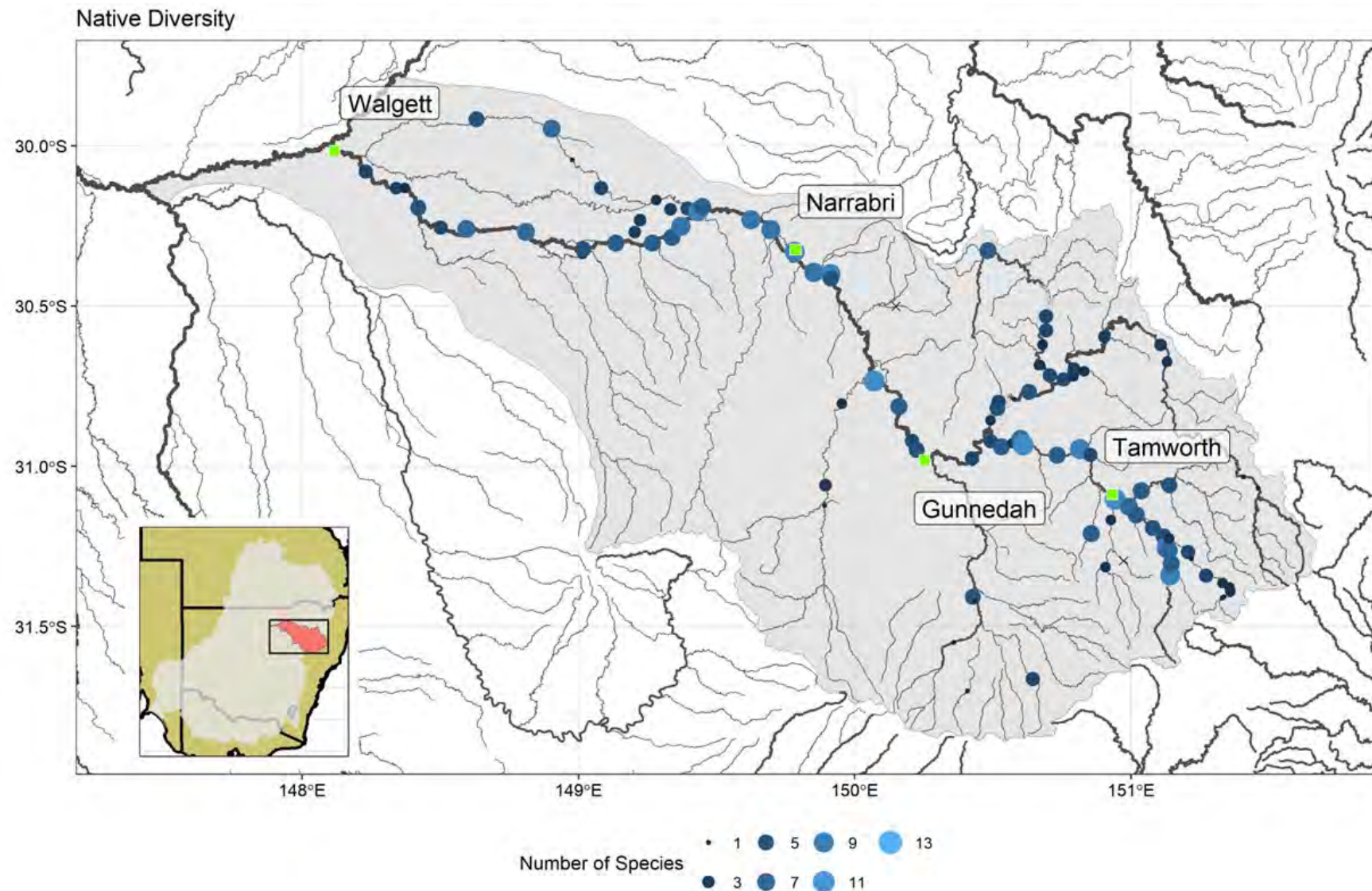


Figure 8.5: Native diversity across all sampling sites in the Namoi WRPA. Bubble size represents the number of unique species observed at each site across all sampling methods and events. X represents a site that had water and was sampled, but no fish species were caught at all. Dry sites are excluded. Green squares represent key towns.

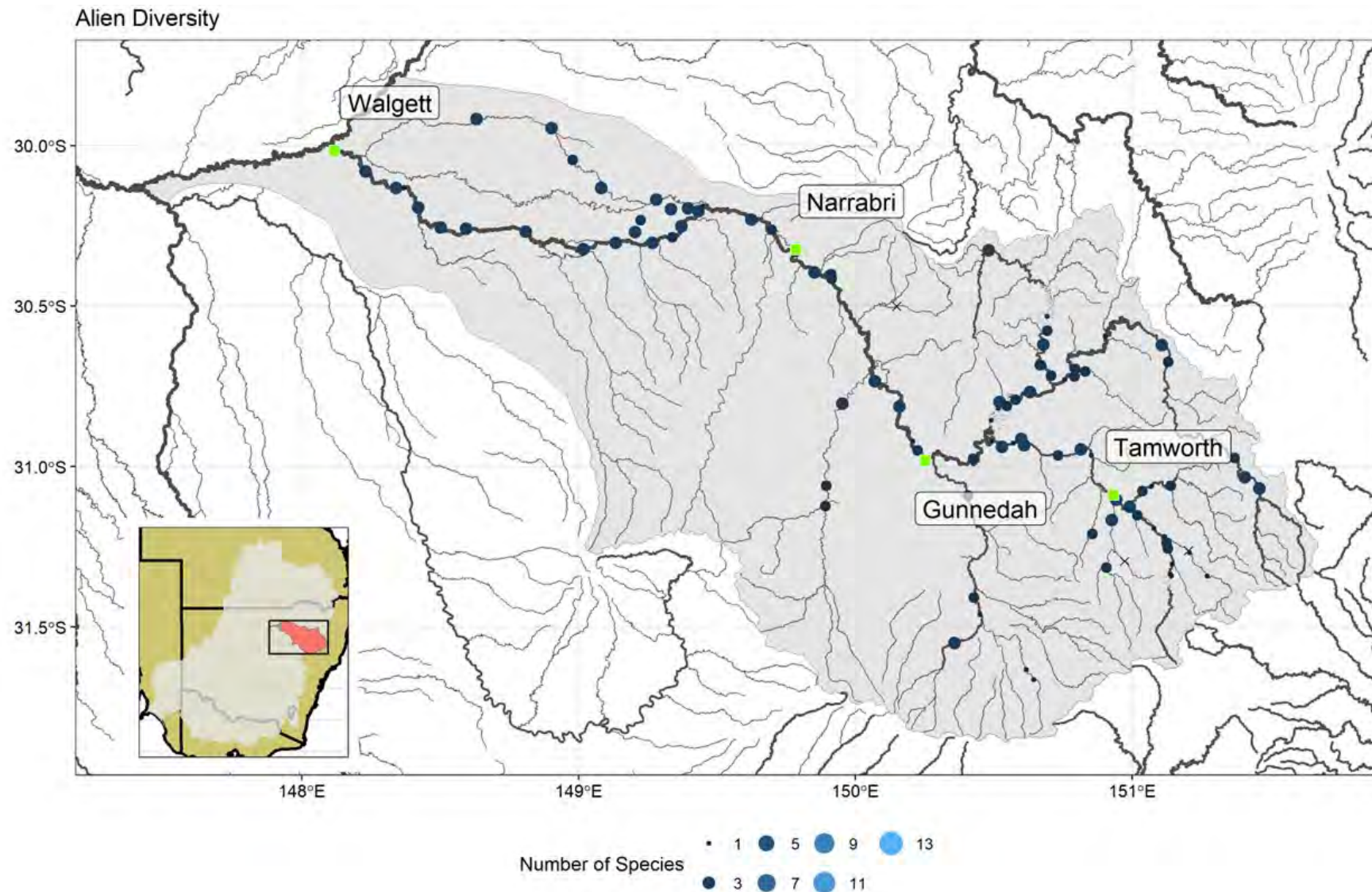


Figure 8.6: Alien diversity across all sampling sites in the Namoi WRPA. Bubble size represents the number of unique species observed at each site across all sampling methods and events. X represents a site that had water and was sampled, but no fish species were caught at all. Dry sites are excluded. Green squares represent key towns.

Murray cod



Population Structure

Figure 8.7 shows the observed length frequency plot for Murray cod for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 0 to 27, and 0 % to 22 % of measured fish within a season, with a mean percentage YOY of 10 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Murray cod was 13 % (1,360 out of 10,513).

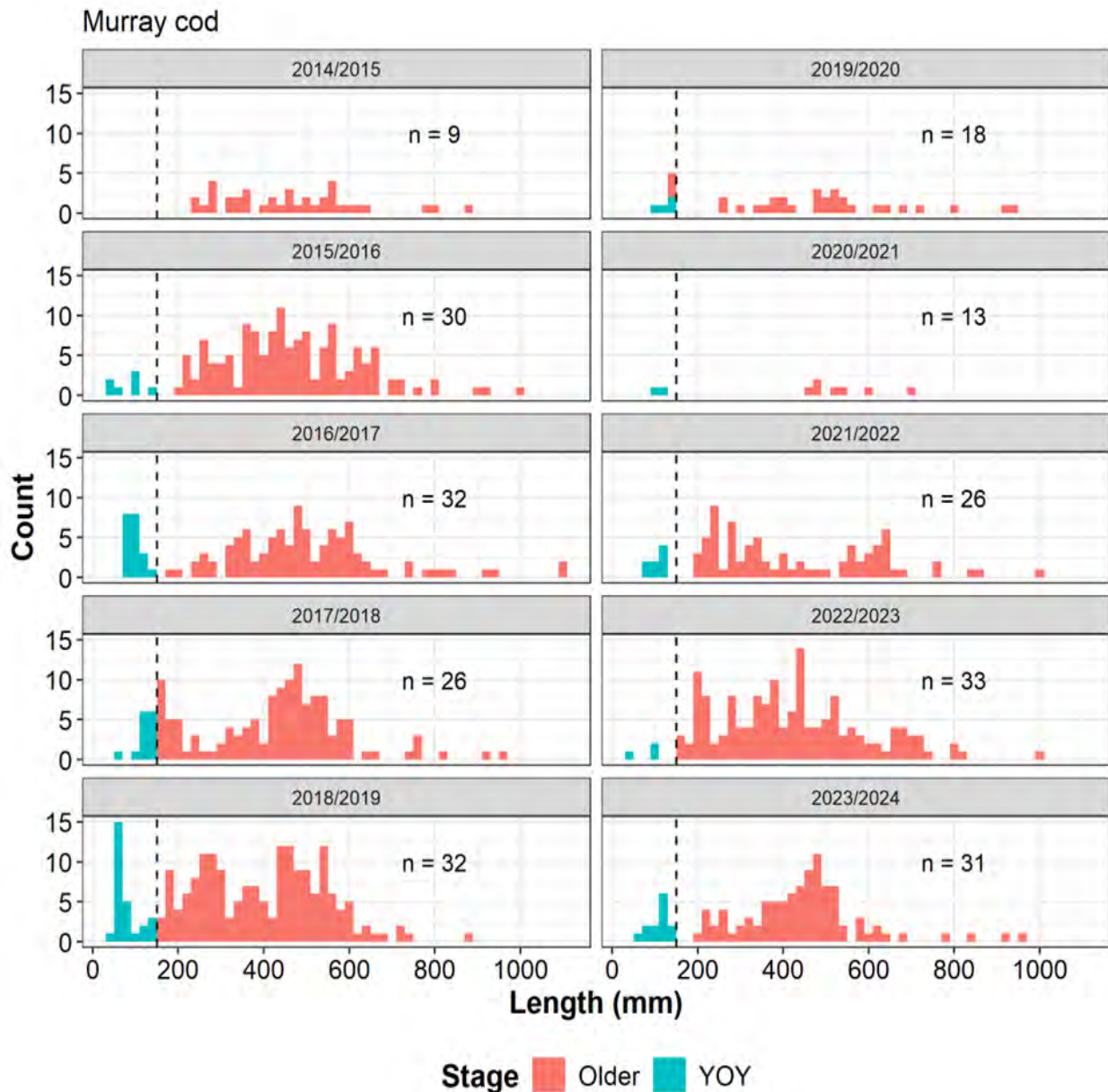


Figure 8.7: Length frequency plots for Murray cod by sampling season in the Namoi WRPA. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRPA in a sampling season.

Summary Statement:

Recruitment evident in most years with variable numbers of young-of-year. A good range of size classes in most years with YOY and larger fish observed in 2023/24.

Stocking

A total of 672,925 Murray cod were stocked into the waterways of the Namoi WRPA during the reporting period. Of these fish, 541,794 (80 %) were stocked into impoundments while 131,131 (20 %) were stocked into rivers or creeks. Table 8.4 shows the detailed breakdown of stocking by season, location and life stage while Figure 8.8 shows the locations of stocking.

Table 8.4: Number and life stage of stocked Murray cod each sampling season in the Namoi WRPA.

Sampling Season	River/Creek or Impoundment	Life Stage	Number Stocked
2014/2015	Impoundment	Fry	2,000
2014/2015	River/Creek	Fry	14,858
2015/2016	Impoundment	Fry	30,000
2015/2016	River/Creek	Fry	6,494
2015/2016	River/Creek	Sub Adult	100
2016/2017	Impoundment	Fry	117,000
2016/2017	River/Creek	Fingerling	17,494
2018/2019	Impoundment	Fry	20,000
2018/2019	River/Creek	Fry	6,493
2019/2020	River/Creek	Fry	13,333
2020/2021	Impoundment	Fry	30,000
2020/2021	River/Creek	Fry	34,200
2021/2022	Impoundment	Fry	144,544
2021/2022	River/Creek	Fry	14,722
2022/2023	Impoundment	Fry	140,000
2022/2023	River/Creek	Fingerling	3,000
2022/2023	River/Creek	Fry	11,437
2023/2024	Impoundment	Fingerling	57,750
2023/2024	River/Creek	Fingerling	9,500

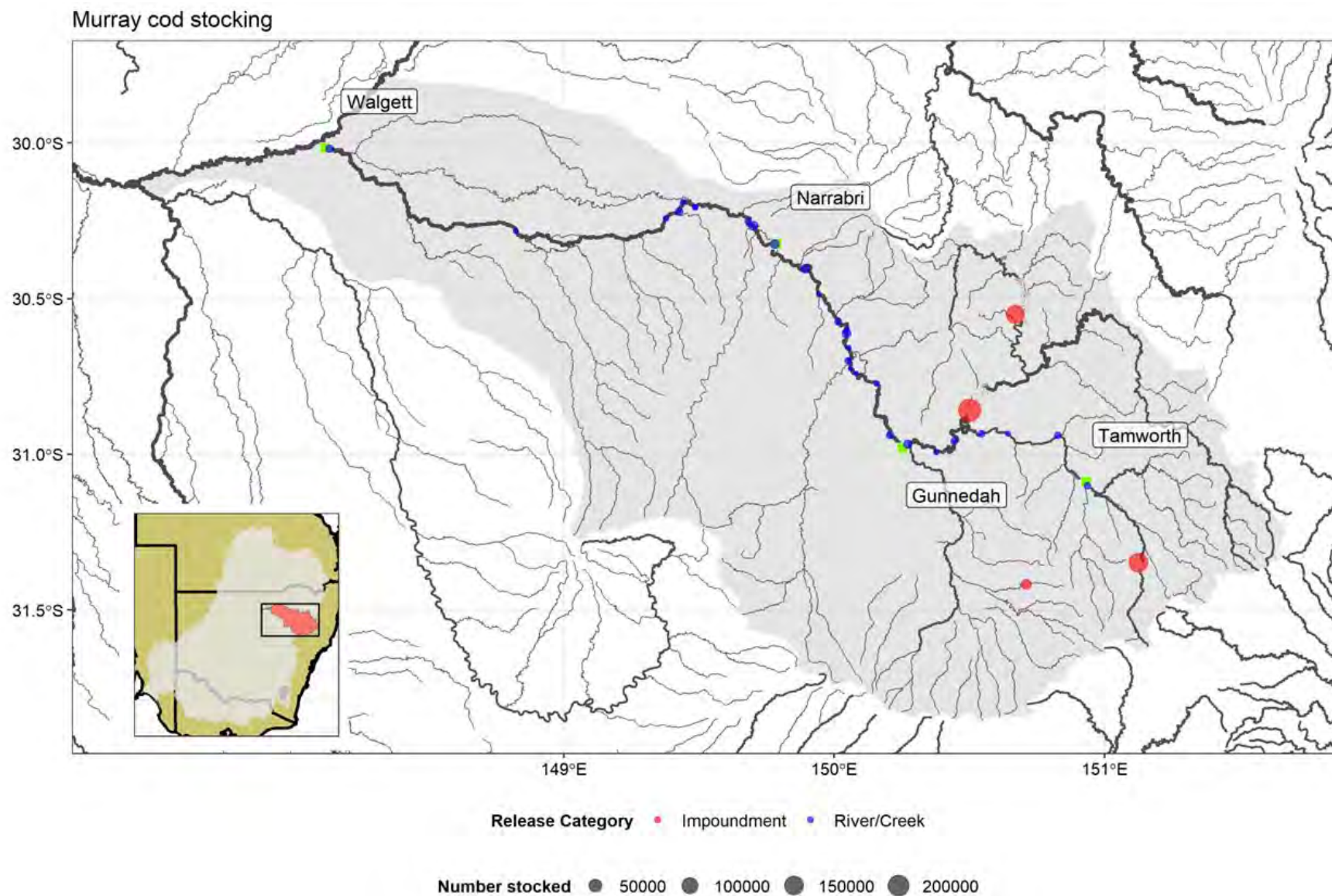


Figure 8.8: Locations of Murray cod stocking in the Namoi WRPA. Colours show whether a site was a river/creek site or an impoundment, while the size of the point reflects the total number of fish stocked over the reporting period. Green squares represent key towns.

Temporal Trends in Abundance

The relative abundance and biomass of Murray cod since 1994 was modelled based on all suitable boat electrofishing data. The left-hand panels of Figure 8.9 show the abundance and biomass trends for the Namoi WRP and the right-hand panels show the overall trends across the NSW MDB.

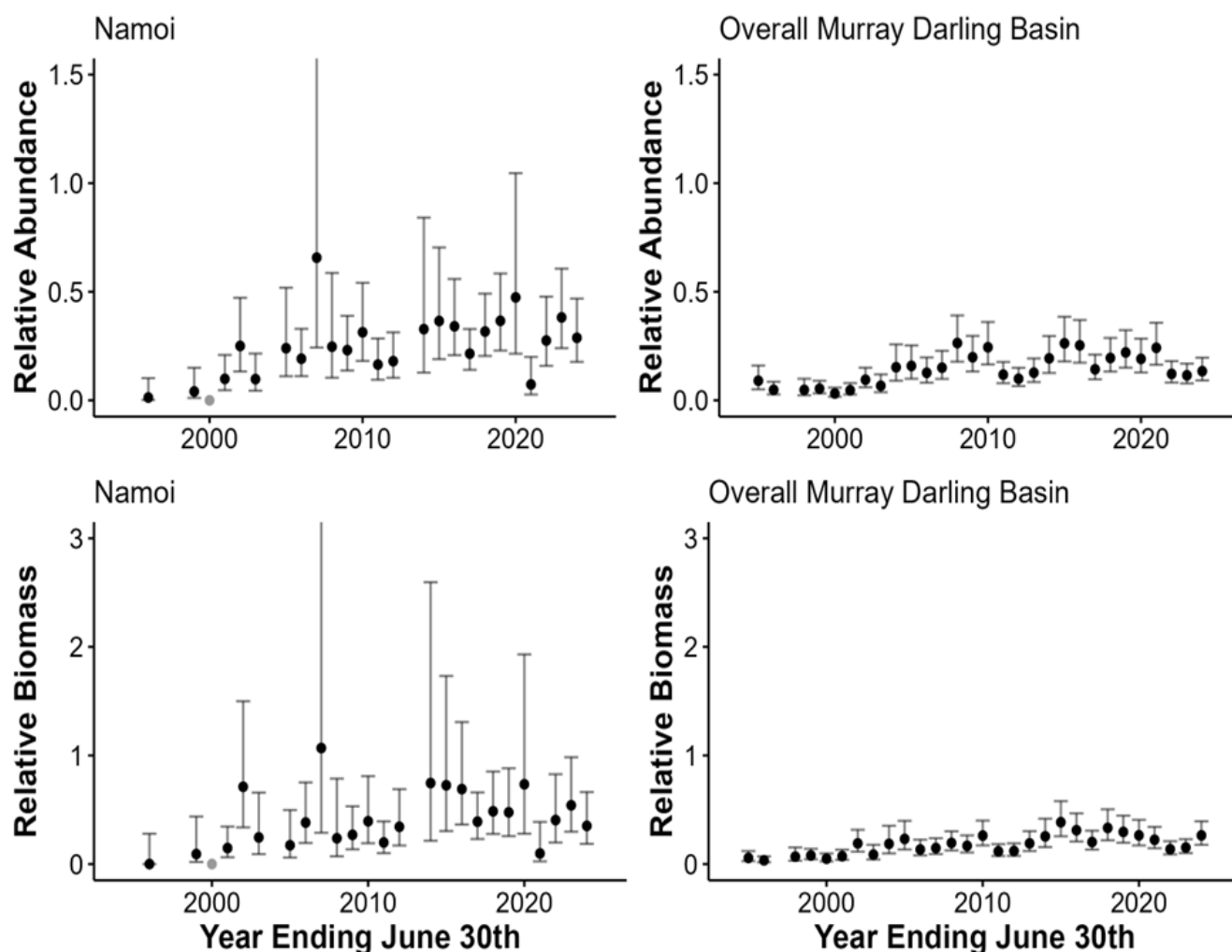


Figure 8.9: Relative abundance and biomass of Murray cod in both the Namoi WRP and the overall NSW MDB. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates.

Summary Statement:

An overall increase in abundance and biomass since the 1990s. Both abundance and biomass appear stable since 2021 and are comparable or slightly higher than the overall NSW MDB.

Health

The prevalence of any health issues ranged from 11 % of sampled fish in 2020/2021 to 42 % of sampled fish in 2018/2019 (Figure 8.10). The most common health issue for Murray cod in the Namoi WRPAs was *Lernaea*, which was observed in a total of 196 fish, corresponding to 19 % of all Murray cod measured.

Across the other NSW MDB WRPA, 15 % of Murray cod (1,578 out of 10,513 Murray cod) showed a health condition (excludes the Namoi WRPAs).

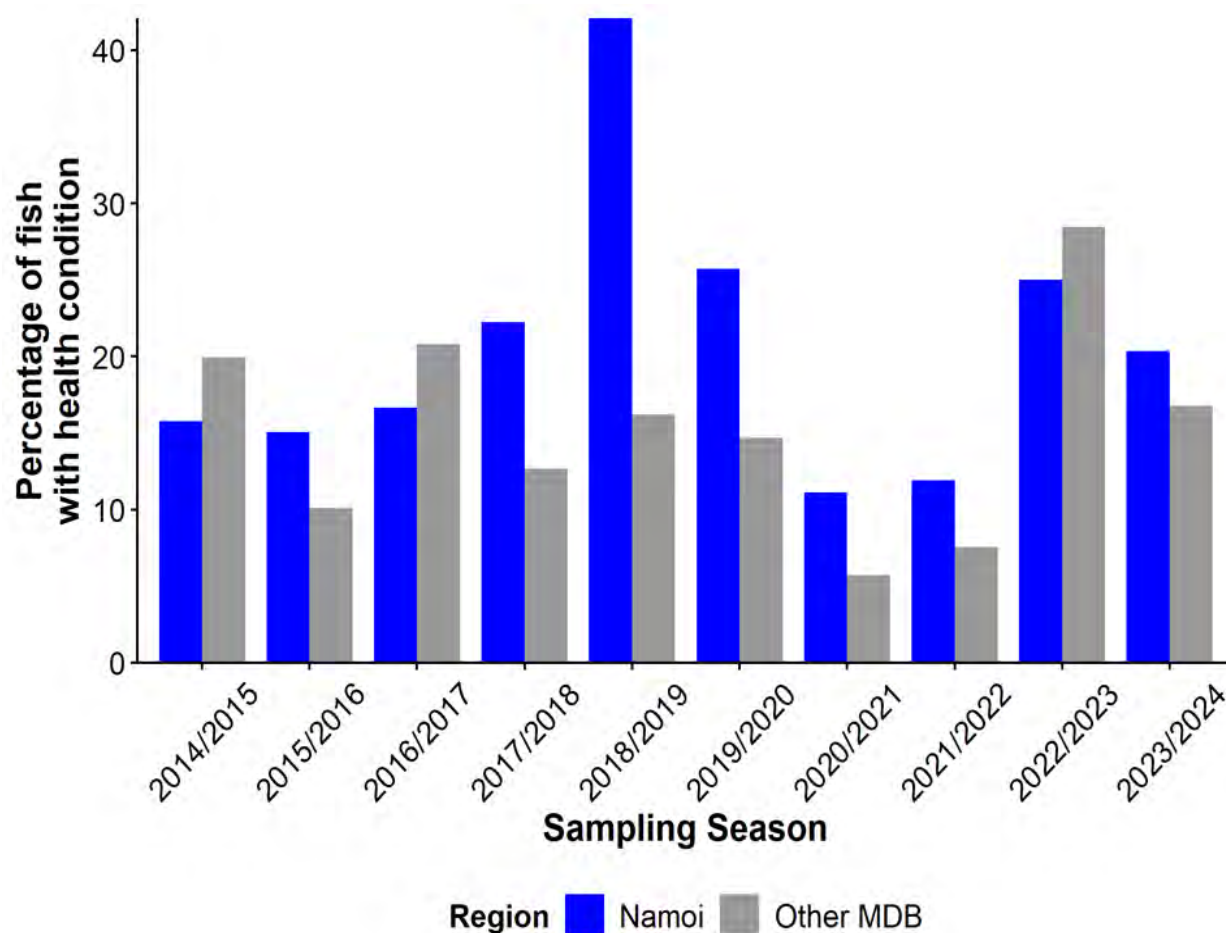


Figure 8.10: Timeseries showing the prevalence of health conditions in Murray cod. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA.

Summary Statement:

Presence of observable health conditions was variable across years and generally similar to the overall Murray-Darling Basin. There were a moderately high level of observed health issues in 2023/24.

Distribution

Murray cod were recorded at 58 out of 108 sites in the Namoi WRP from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 2.2 fish caught per 90 seconds of electrofishing. Figure 8.11 shows the distribution and relative abundance of Murray cod across the Namoi WRP.

Summary Statement:

Murray cod were recorded across the Namoi WRP but less abundant or absent in western sites.

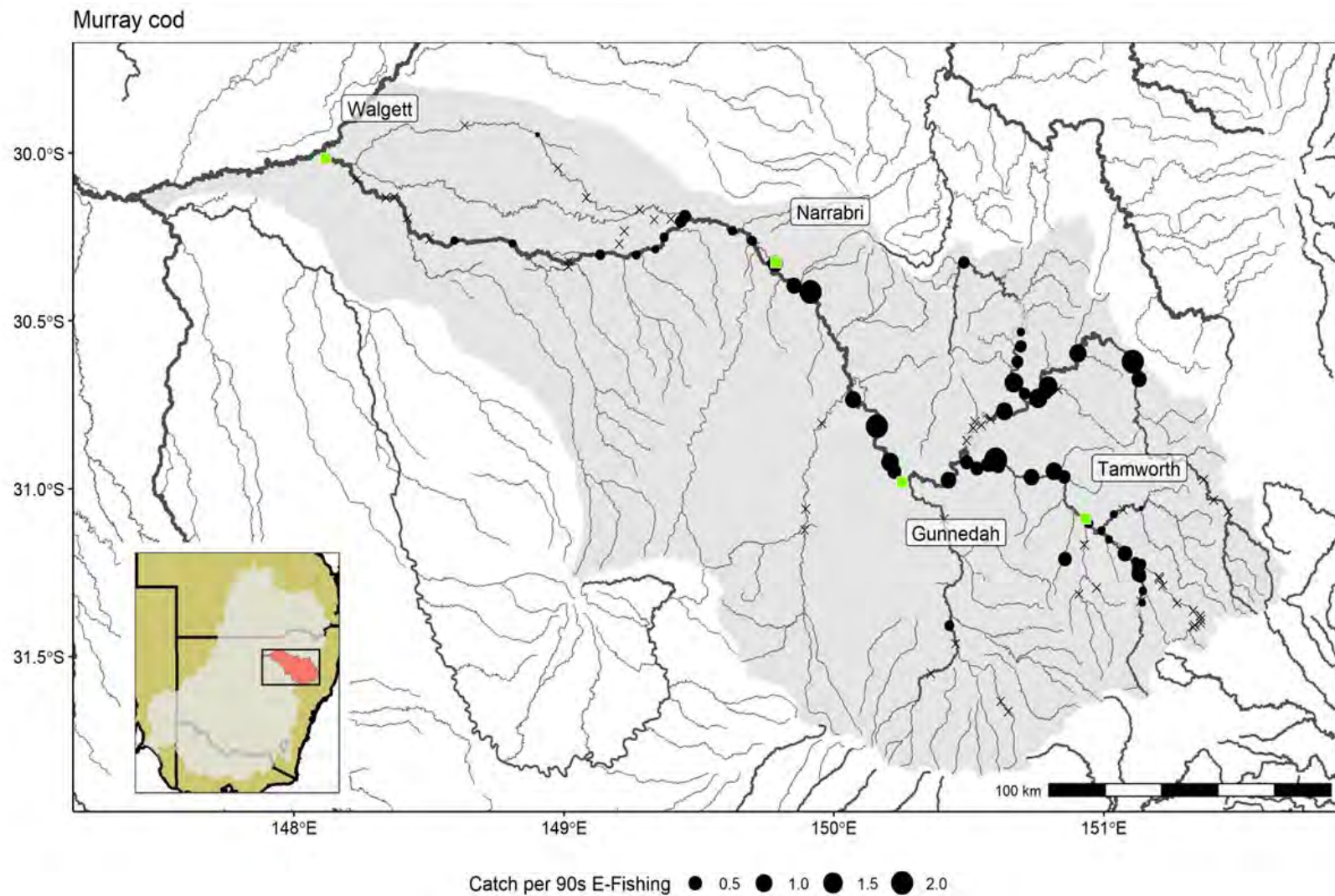


Figure 8.11: Distribution of Murray cod sampled from 2013/14 to 2023/24 in the Namoi WRPA. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares represent key towns.

Golden perch



Population Structure

Figure 8.12 shows the observed length frequency plot for Golden perch for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 0 to 8, and 0 % to 62 % of measured fish within a season, with a mean percentage YOY of 7 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Golden perch was 8 % (641 out of 7,623).

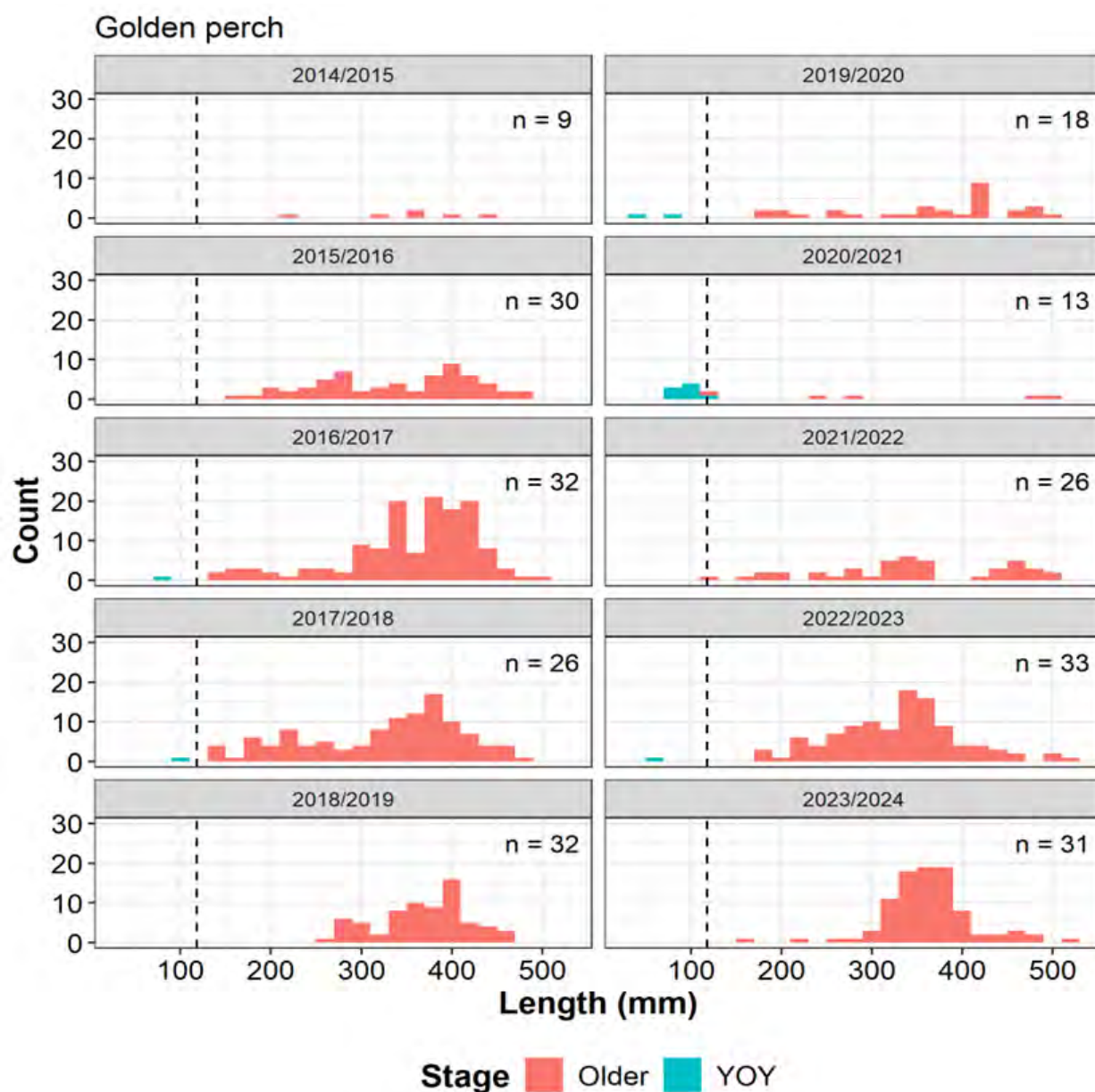


Figure 8.12: Length frequency plots for Golden perch by sampling season in the Namoi WRPA. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRPA in a sampling season.

Summary Statement:

Larger fish were consistently recorded across years but recruitment appears to be rare with many years of recruitment failure. Likely poor recruitment since 2021/22.

Stocking

A total of 786,277 Golden perch were stocked into the waterways of the Namoi WRP during the reporting period. Of these fish, 493,386 (62.8 %) were stocked into impoundments while 292,891 (37.2 %) were stocked into rivers or creeks. Table 8.5 shows the detailed breakdown of stocking by season, location and life stage while Figure 8.13 shows the locations of stocking.

Table 8.5: Number and life stage of stocked Golden perch each sampling season in the Namoi WRP.

Sampling Season	River/Creek or Impoundment	Life Stage	Number Stocked
2014/2015	Impoundment	Fry	3,000
2014/2015	River/Creek	Fry	18,181
2015/2016	Impoundment	Fry	1,000
2015/2016	River/Creek	Fry	58,320
2016/2017	Impoundment	Fry	87,000
2016/2017	River/Creek	Fingerling	35,723
2017/2018	Impoundment	Fry	47,000
2017/2018	River/Creek	Fry	14,363
2018/2019	Impoundment	Fry	30,000
2018/2019	River/Creek	Fry	22,000
2020/2021	Impoundment	Fry	106,000
2020/2021	River/Creek	Fry	24,000
2021/2022	Impoundment	Fry	7,273
2021/2022	River/Creek	Fry	10,923
2022/2023	Impoundment	Fry	90,000
2022/2023	River/Creek	Fry	40,703
2023/2024	Impoundment	Fingerling	122,113
2023/2024	River/Creek	Fingerling	68,678

Golden perch stocking

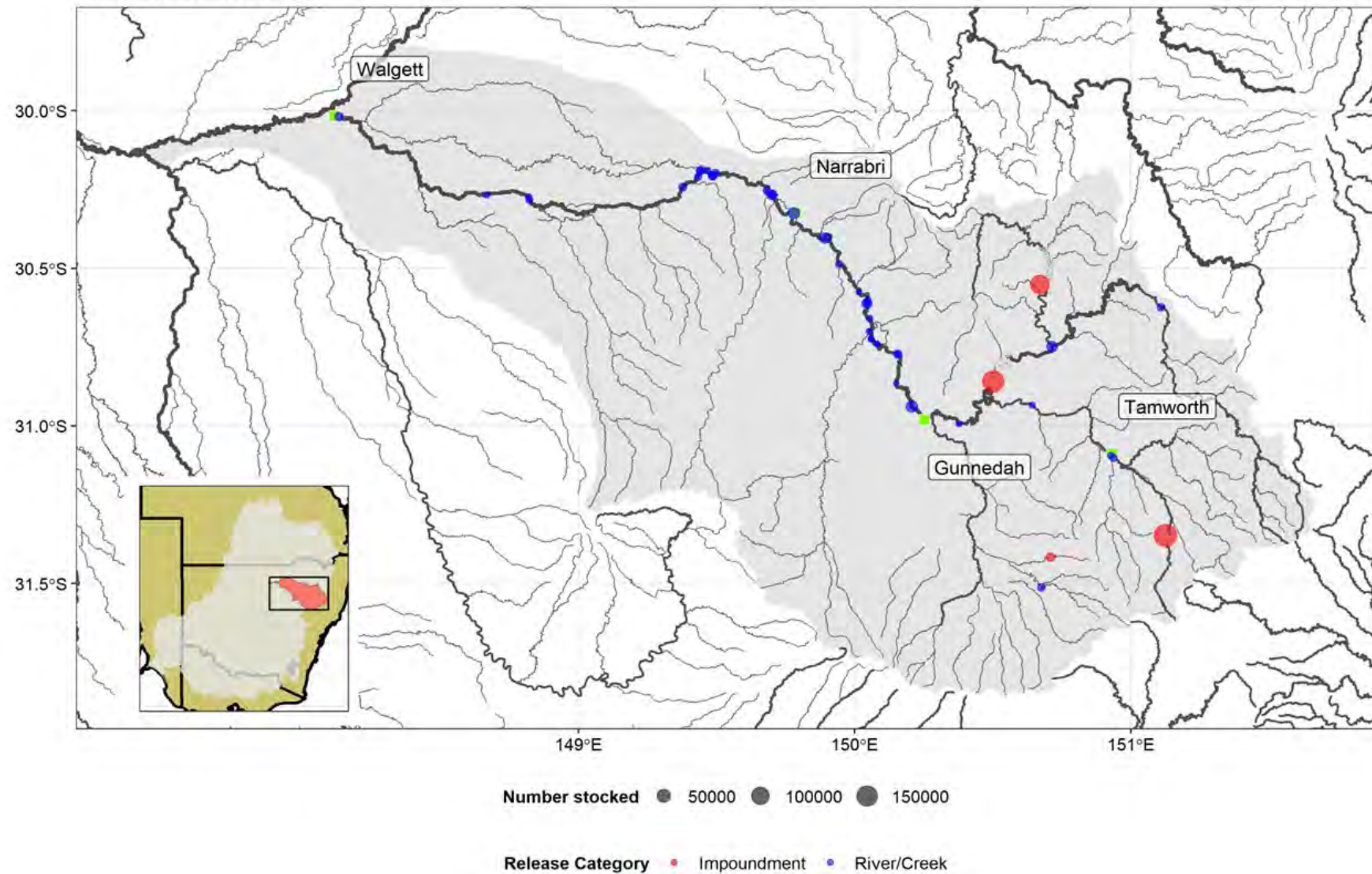


Figure 8.13: Locations of Golden perch stocking in the Namoi WRPA. Colours show whether a site was a river/creek site or an impoundment, while the size of the point reflects the total number of fish stocked over the reporting period. Green squares represent key towns.

Temporal Trends in Abundance

The relative abundance and biomass of Golden perch since 1994 was modelled based on all suitable boat electrofishing data. The left-hand panels of Figure 8.14 show the abundance and biomass trends for the Namoi WRP and the right-hand panels show the overall trends across the NSW MDB.

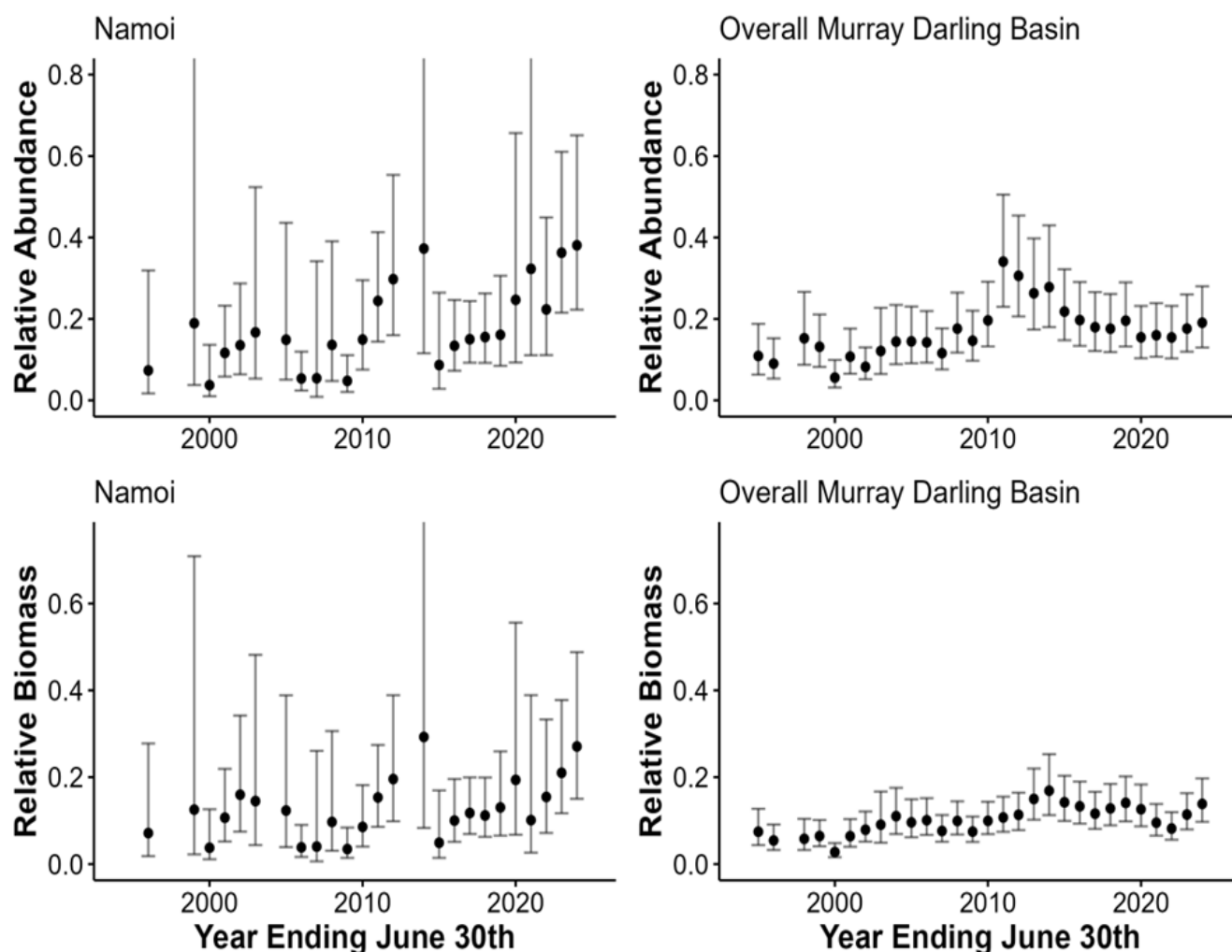


Figure 8.14: Relative abundance and biomass of Golden perch in both this valley and the overall Murray-Darling Basin. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates. Note some error bars have been truncated for clarity.

Summary Statement:

Clear increases in abundance and biomass since the 1990s. Recent increases evident since 2022 and both abundance and biomass are higher than the overall NSW MDB.

Health

The prevalence of any health issues ranged from 14 % of sampled fish in 2021/2022 to 71 % of sampled fish in 2018/2019 (Figure 8.15). The most common health issue for Golden perch in the Namoi water resource planning area was *Lernaea*, which was observed in a total of 151 fish, corresponding to 22 % of all Golden perch measured.

Across the other WRPAs, 25 % of Golden perch (1,875 out of 7,623 Golden perch) showed a health condition (excludes Namoi).

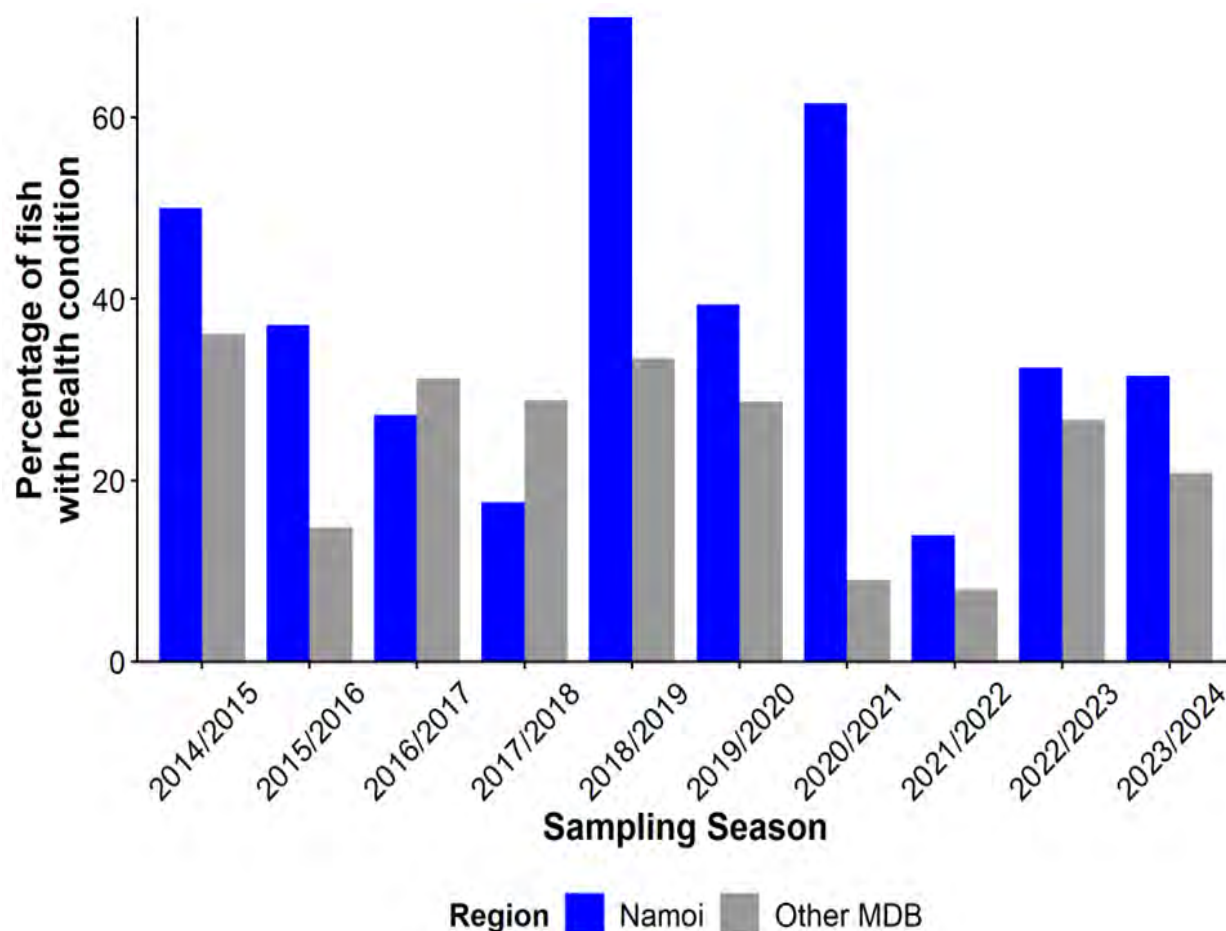


Figure 8.15: Timeseries showing the prevalence of health conditions in Golden perch. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPAs.

Summary Statement:

The presence of observable health conditions for Golden perch in the Namoi WRPAs was variable and generally tracked the average across the rest of the NSW Murray-Darling Basin except for 2018/19 and 2020/21 when it was considerably higher.

Distribution

Golden perch were recorded at 45 out of 108 sites in the Namoi WRPA from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 1.8 fish caught per 90 seconds of electrofishing. Figure 8.16 shows the distribution and relative abundance of Golden perch across the Namoi WRPA.

Summary Statement:

Golden perch were generally present across the Namoi region.

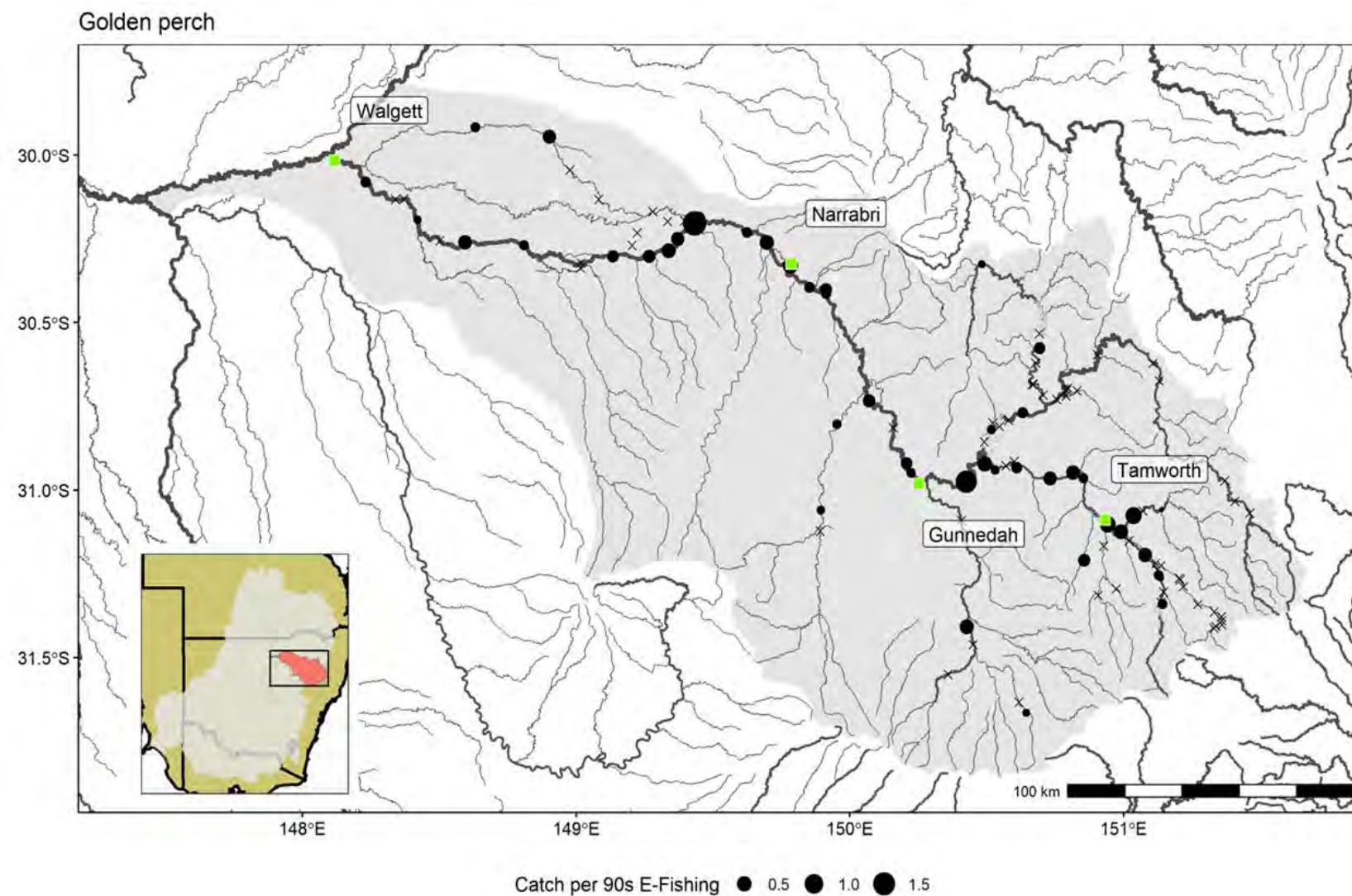


Figure 8.16: Distribution of Golden perch sampled from 2013/14 to 2023/24 in the Namoi WRPA. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares represent key towns.

Freshwater catfish



Population Structure

Figure 8.17 shows the observed length frequency plot for Freshwater catfish for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 0 to 31, and 0 % to 100 % of measured fish within a season, with a mean percentage YOY of 44 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Freshwater catfish was 37 % (348 out of 942).

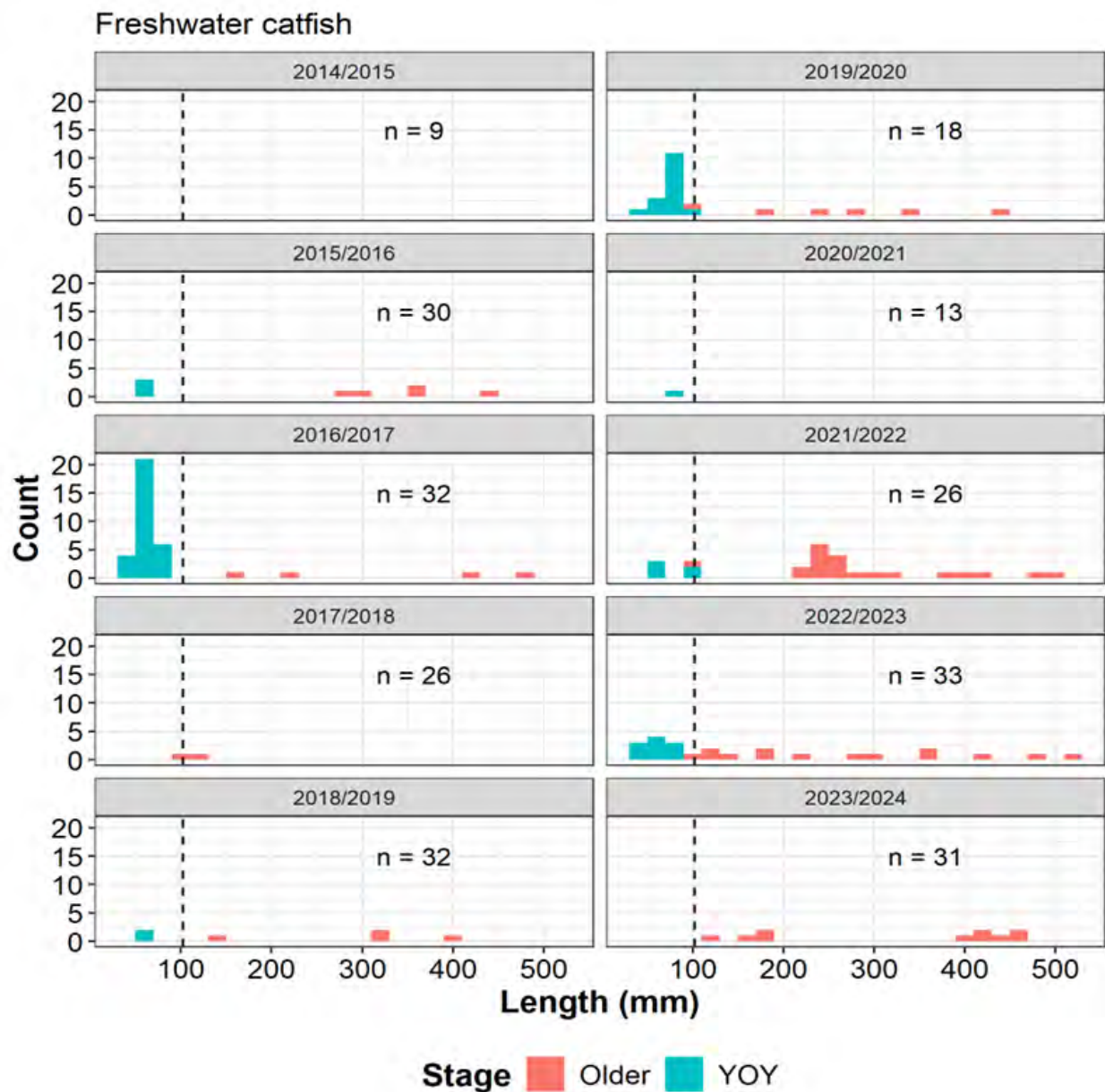


Figure 8.17: Length frequency plots for Freshwater catfish by sampling season in the Namoi WRPA. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRPA in a sampling season.

Summary Statement:

Sporadic recruitment with good recruitment events evident in 2016/17, 2019/20 and 2022/23. Possible recruitment failure in 2023/24.

Temporal Trends in Abundance

The relative abundance and biomass of Freshwater catfish since 1994 was modelled based on all suitable boat electrofishing data. The left-hand panels of Figure 8.18 show the abundance and biomass trends for the Namoi WRPA and the right-hand panels show the overall trends across the NSW MDB.

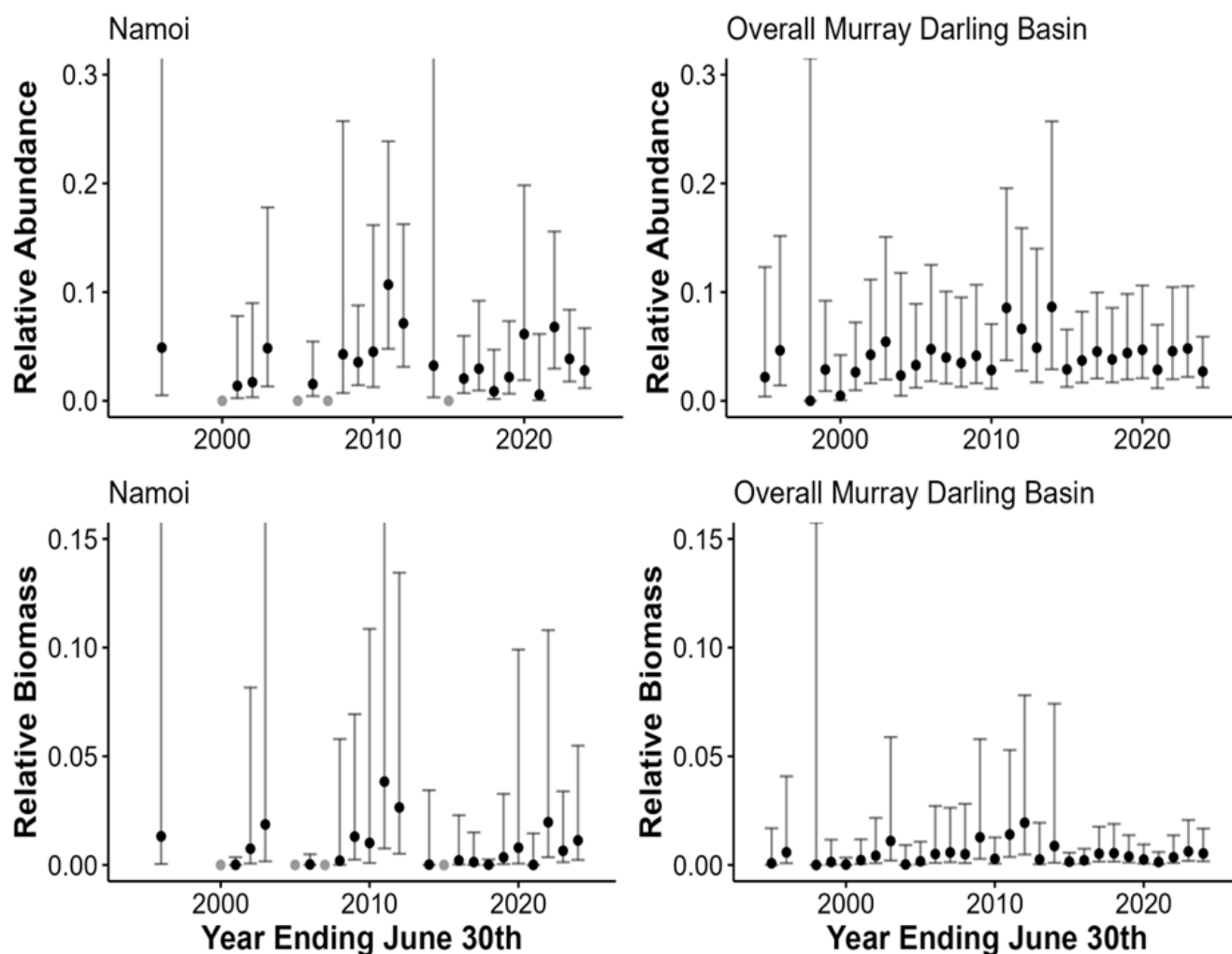


Figure 8.18: Relative abundance and biomass of Freshwater catfish in both this valley and the overall Murray-Darling Basin. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates. Note some error bars have been truncated for clarity. Grey dots represent years where sampling was conducted but no fish were caught and error estimates were therefore not available.

Summary Statement:

Likely increase in abundance in the Namoi WRPA since the 1990s, matching the wider NSW MDB. Both abundance and biomass are stable over the last few years.

Health

The prevalence of any health issues ranged from 0 % of sampled fish in most years to 4 % of sampled fish in 2023/2024 (Figure 8.19). The most common health issue for Freshwater catfish in the Namoi water resource planning area was *Lernaea*, which was observed in a total of 1 fish, corresponding to 1 % of all Freshwater catfish measured.

Across the other WRPA's, 2 % of Freshwater catfish (17 out of 942 Freshwater catfish) showed a health condition (excludes Namoi).

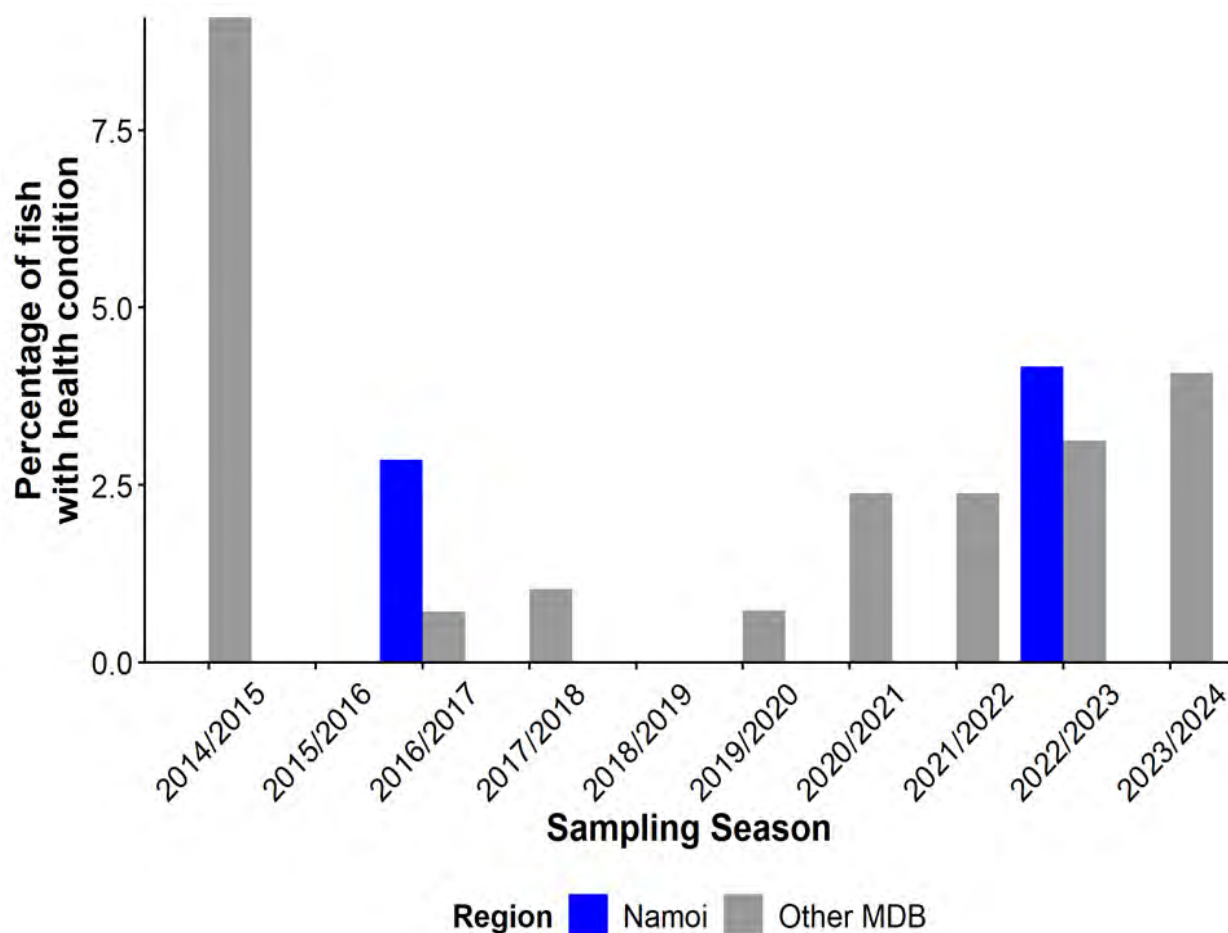


Figure 8.19: Timeseries showing the prevalence of health conditions in Freshwater catfish. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA's.

Summary Statement:

The presence of observable health conditions for Freshwater catfish in the Namoi was overall low.

Distribution

Freshwater catfish were recorded at 29 out of 108 sites in the Namoi WRP from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 1.6 fish caught per 90 seconds of electrofishing. Figure 8.20 shows the distribution and relative abundance of Freshwater catfish across the Namoi WRP.

Summary Statement:

Freshwater catfish were generally present across the eastern Namoi region but absent or in very low abundances across the central and western areas.

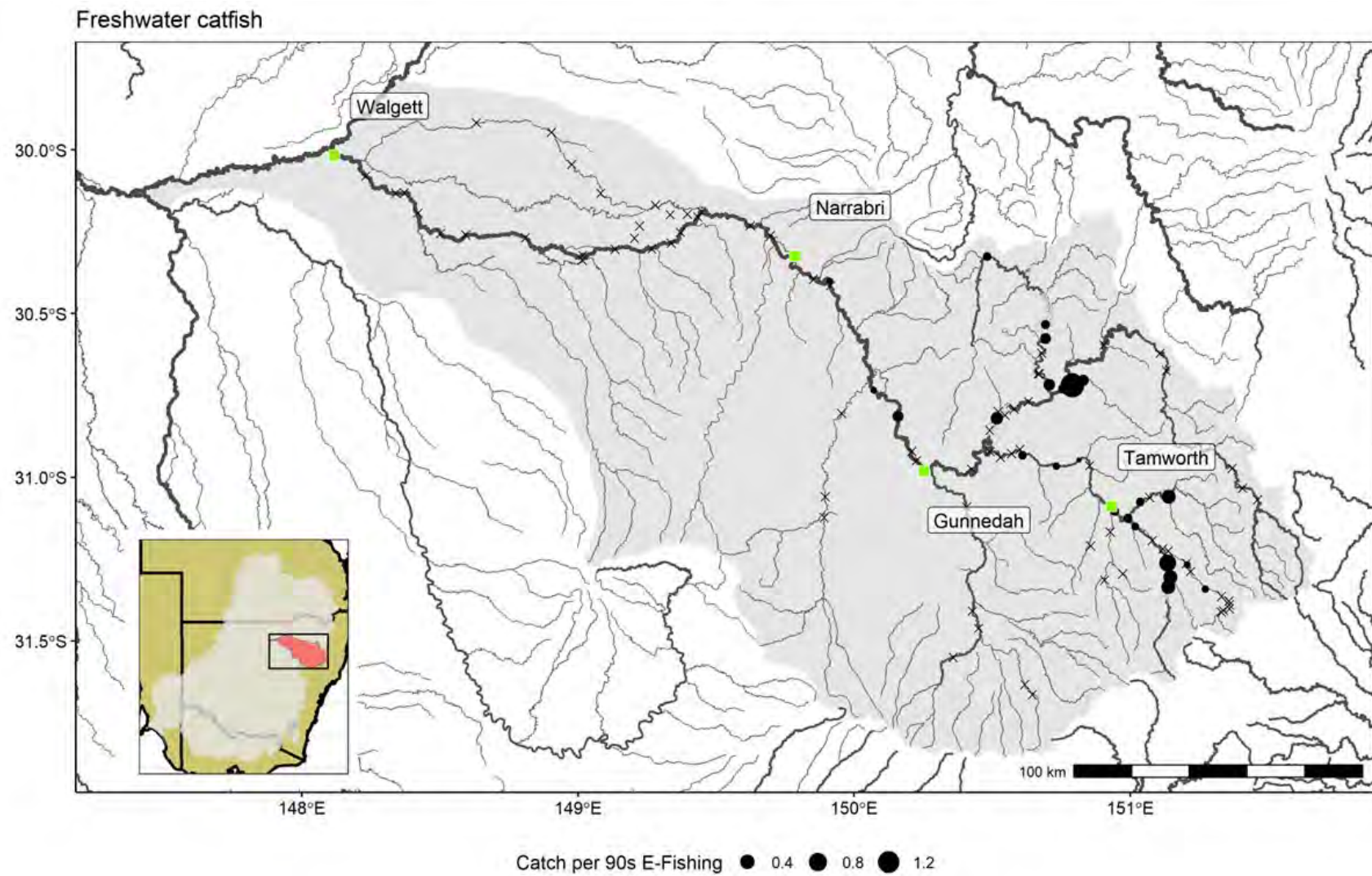


Figure 8.20: Distribution of Freshwater catfish sampled from 2013/14 to 2023/24 in the Namoi WRPA. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares represent key towns.

Bony herring



Population Structure

Figure 8.21 shows the observed length frequency plot for Bony herring for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 0 to 187, and 0 % to 49 % of measured fish within a season, with a mean percentage YOY of 19 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Bony herring was 25 % (12,865 out of 51,189). Bony herring are not a stocked species.

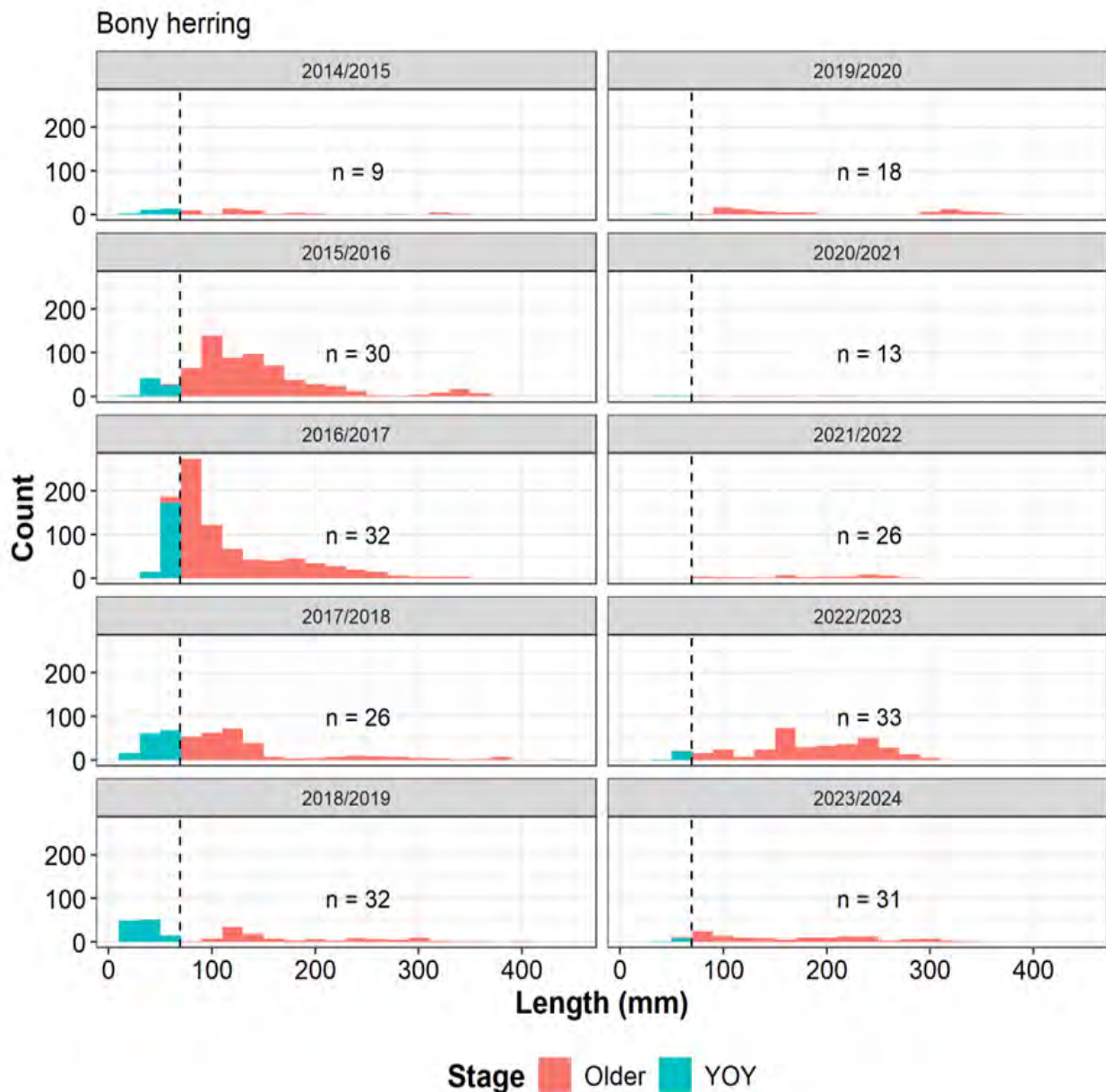


Figure 8.21: Length frequency plots for Bony herring by sampling season in the Namoi WRPA. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRPA in a sampling season.

Summary Statement:

Sporadic recruitment with variable numbers of young-of-year. Strong recruitment evident in 2015/16 – 2018/19. Low recruitment evident in 2023/24 but a range of larger sizes.

Temporal Trends in Abundance

The relative abundance and biomass of Bony herring since 1994 was modelled based on all suitable boat electrofishing data. The left-hand panels of Figure 8.22 show the abundance and biomass trends for the Namoi WRP and the right-hand panels show the overall trends across the NSW MDB.

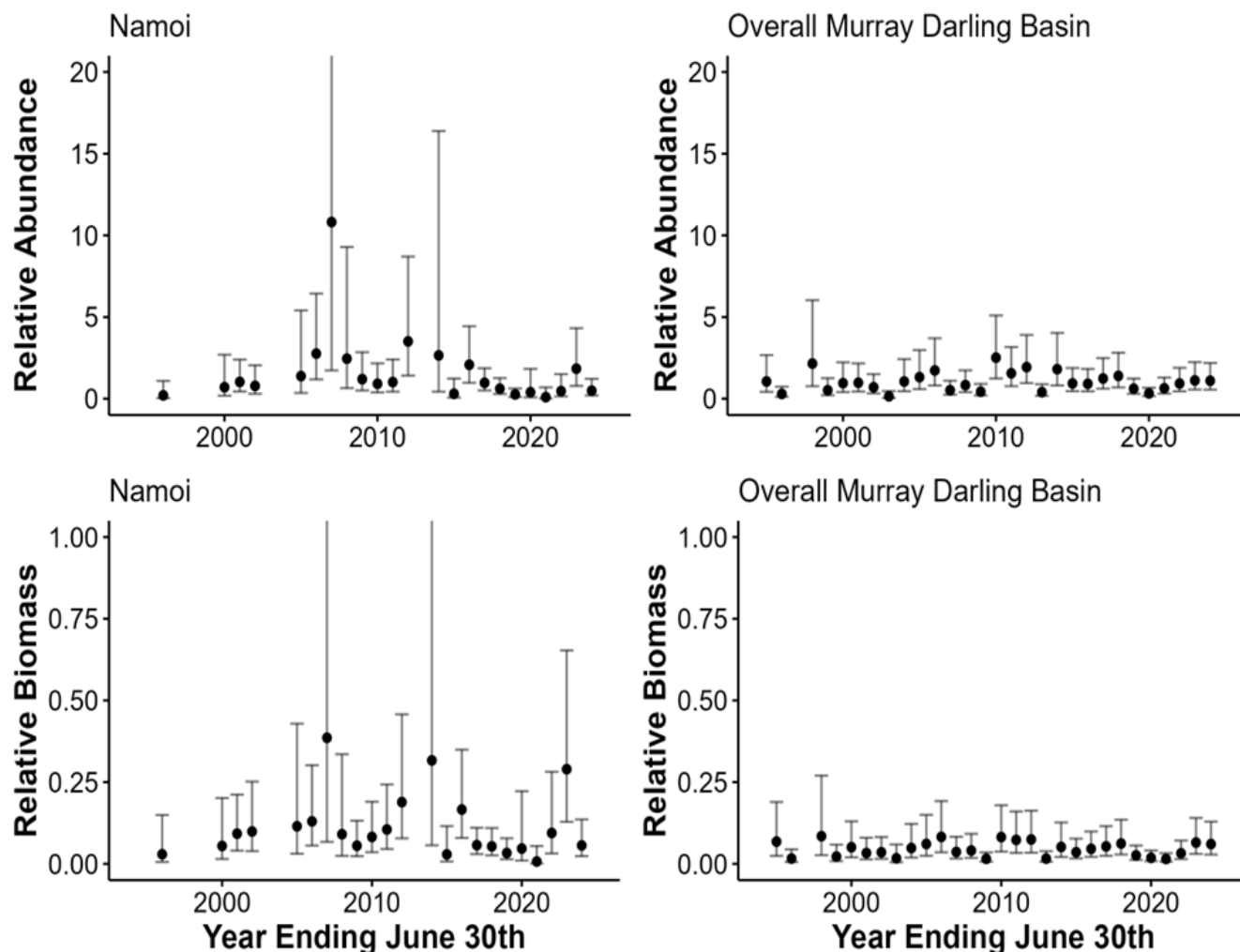


Figure 8.22: Relative abundance and biomass of Bony herring in both the Namoi and the overall NSW MDB. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates. Note some error bars have been truncated for clarity.

Summary Statement:

Likely increases in abundance and biomass since the 1990s but both abundance and biomass appear to have declined since 2022/23. Relative abundance and biomass similar to the overall NSW MDB.

Health

The prevalence of any health issues ranged from 0 % of sampled fish in 2014/2015 and 2023/24 to 18 % of sampled fish in 2020/2021 (Figure 8.23). The most common health issue for Bony herring in the Namoi WRPA was *Lernaea*, which was observed in a total of 14 fish, corresponding to <1 % of all Bony herring measured.

Across the other NSW MDB WRPA's, 1 % of Bony herring (535 out of 51,189 Bony herring) showed a health condition (excludes the Namoi WRPA).

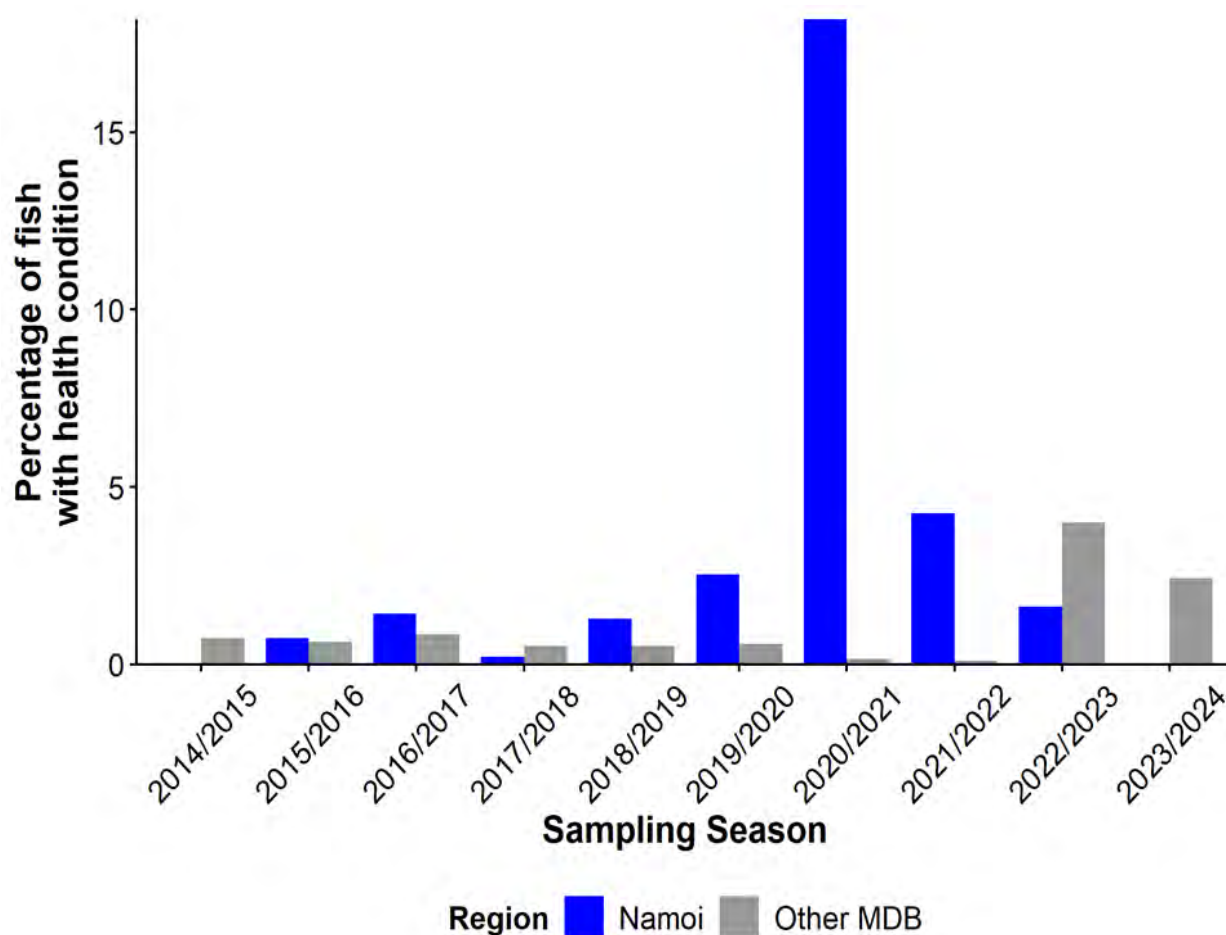


Figure 8.23: Timeseries showing the prevalence of health conditions in Bony herring. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA's.

Summary Statement:

Presence of observable health conditions was generally very low except for 2020/21 where a moderate proportion of fish showed health issues.

Distribution

Bony herring were recorded at 48 out of 108 sites in the Namoi WRPA from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 27 fish caught per 90 seconds of electrofishing. Figure 8.24 shows the distribution and relative abundance of Bony herring across the Namoi WRPA.

Summary Statement:

Bony herring were recorded across the Namoi WRPA but appear to be absent or in low abundances in the upper catchment (east of Tamworth).

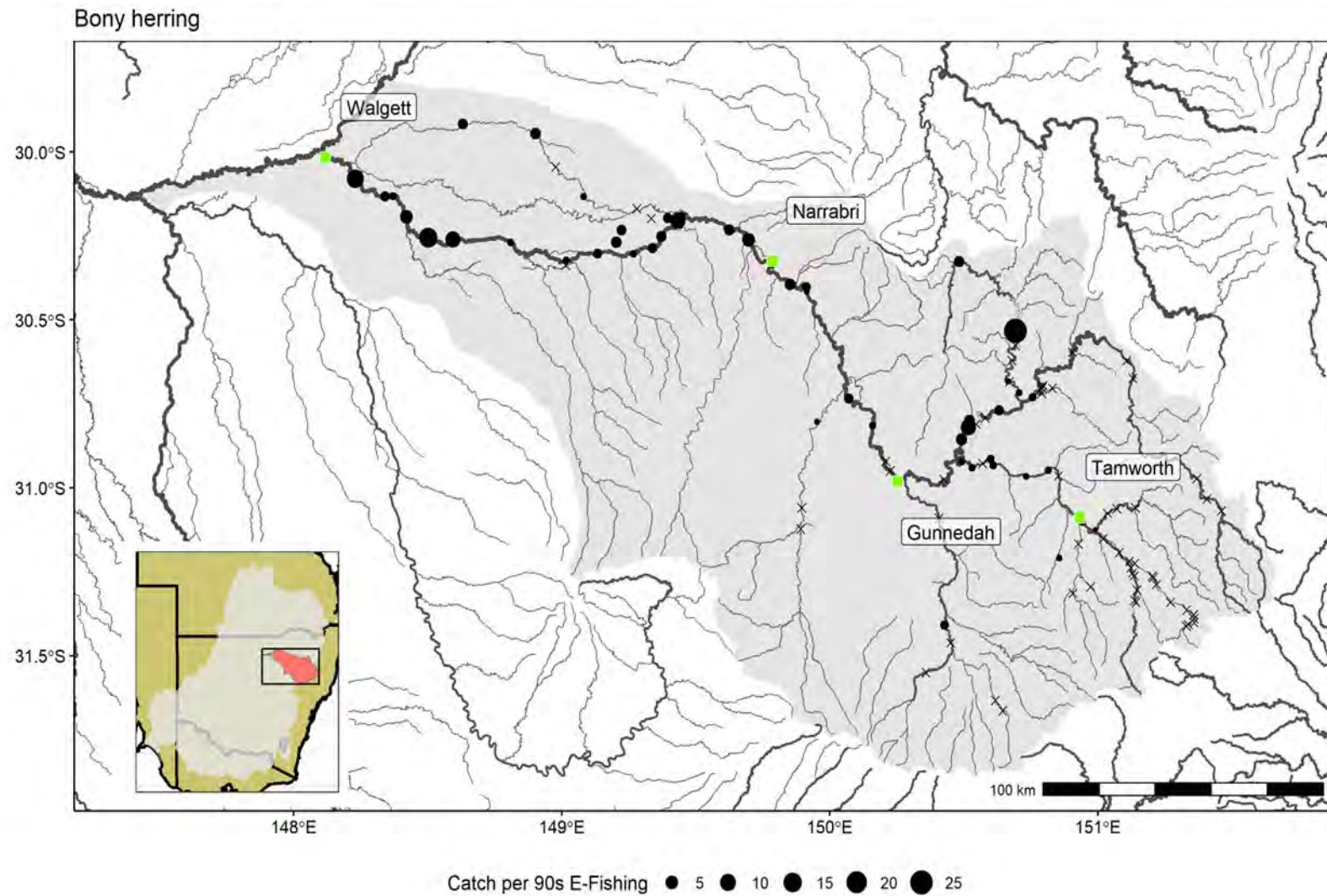


Figure 8.24: Distribution of Bony herring sampled from 2013/14 to 2023/24 in the Namoi WRPA. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares represent key towns.

Australian smelt



Population Structure

Figure 8.25 shows the observed length frequency plot for Australian smelt for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 1 to 249, and 7 % to 100 % of measured fish within a season, with a mean percentage YOY of 49 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Australian smelt was 41 % (11,207 out of 27,394). Australian smelt are not a stocked species.

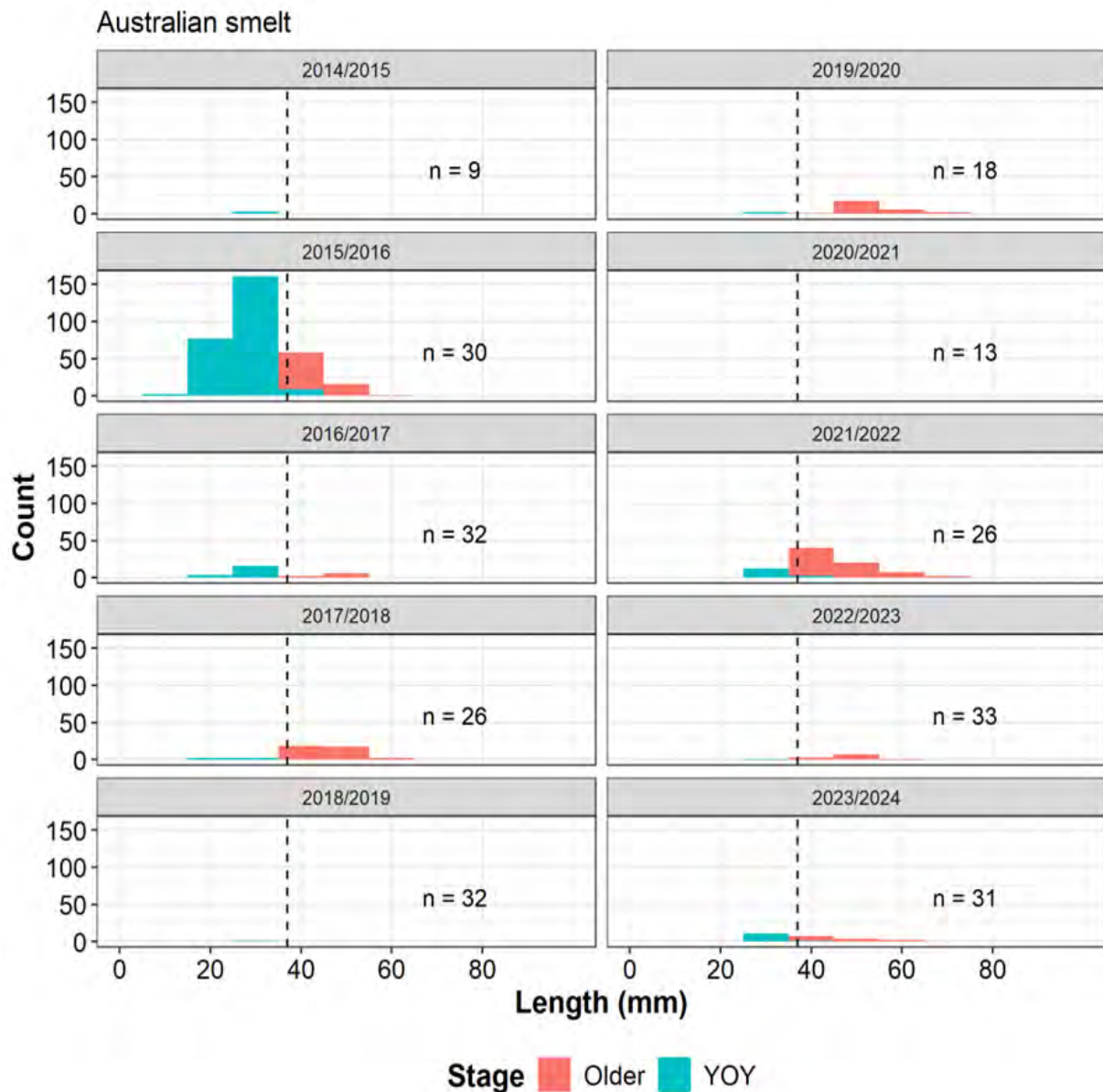


Figure 8.25 Length frequency plots for Australian smelt by sampling season in the Namoi WRPA. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRPA in a sampling season.

Summary Statement:

Sporadic recruitment with a strong recruitment pulse in 2015/16 and possible recruitment failures in 2014/15, 2018/19, 2020/21 and 2022/23. Low recruitment in 2023/24.

Temporal Trends in Abundance

The relative abundance of Australian smelt since 1994 was modelled based on all suitable boat electrofishing data. The left-hand panel of Figure 8.26 show the abundance trends for the Namoi WRPA and the right-hand panel show the overall trend across the NSW MDB.

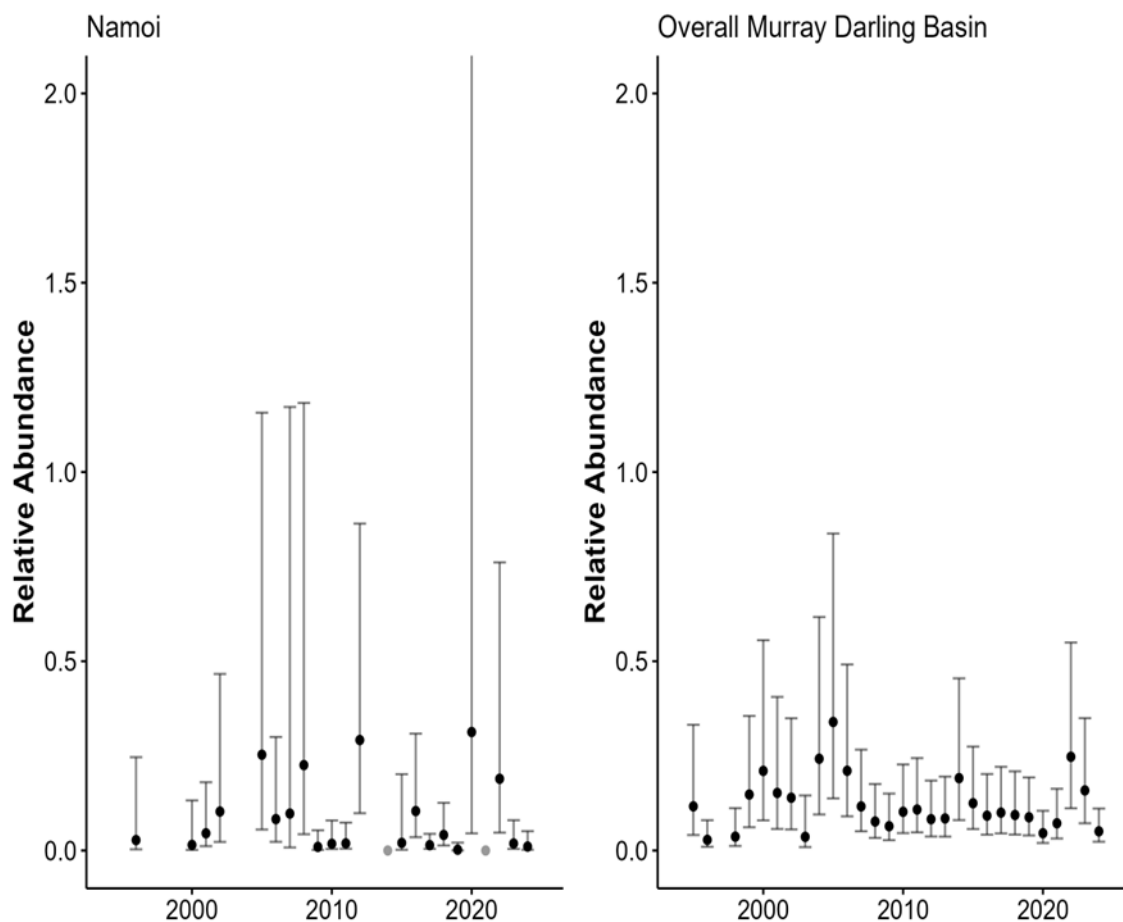


Figure 8.26: Relative abundance of Australian smelt in both the Namoi WRPA and the overall NSW MDB. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates. No modelling of biomass was done for Australian smelt. Note some error bars have been truncated for clarity.

Summary Statement:

Highly variable abundance with high certainty across the time series. Recent abundance lower than the overall NSW MDB.

Health

The prevalence of any health issues ranged from 0 % of sampled fish in most years to 2 % of sampled fish to 2015/2016 (Figure 8.27). The most common health issue for Australian smelt in the Namoi WRPAs was *Lernaea*, which was observed in a total of 6 fish, corresponding to <1 % of all Australian smelt measured.

Across the other NSW MDB WRPA's, <1 % of Australian smelt (168 out of 27,396 Australian smelt) showed a health condition (excludes the Namoi WRPAs).

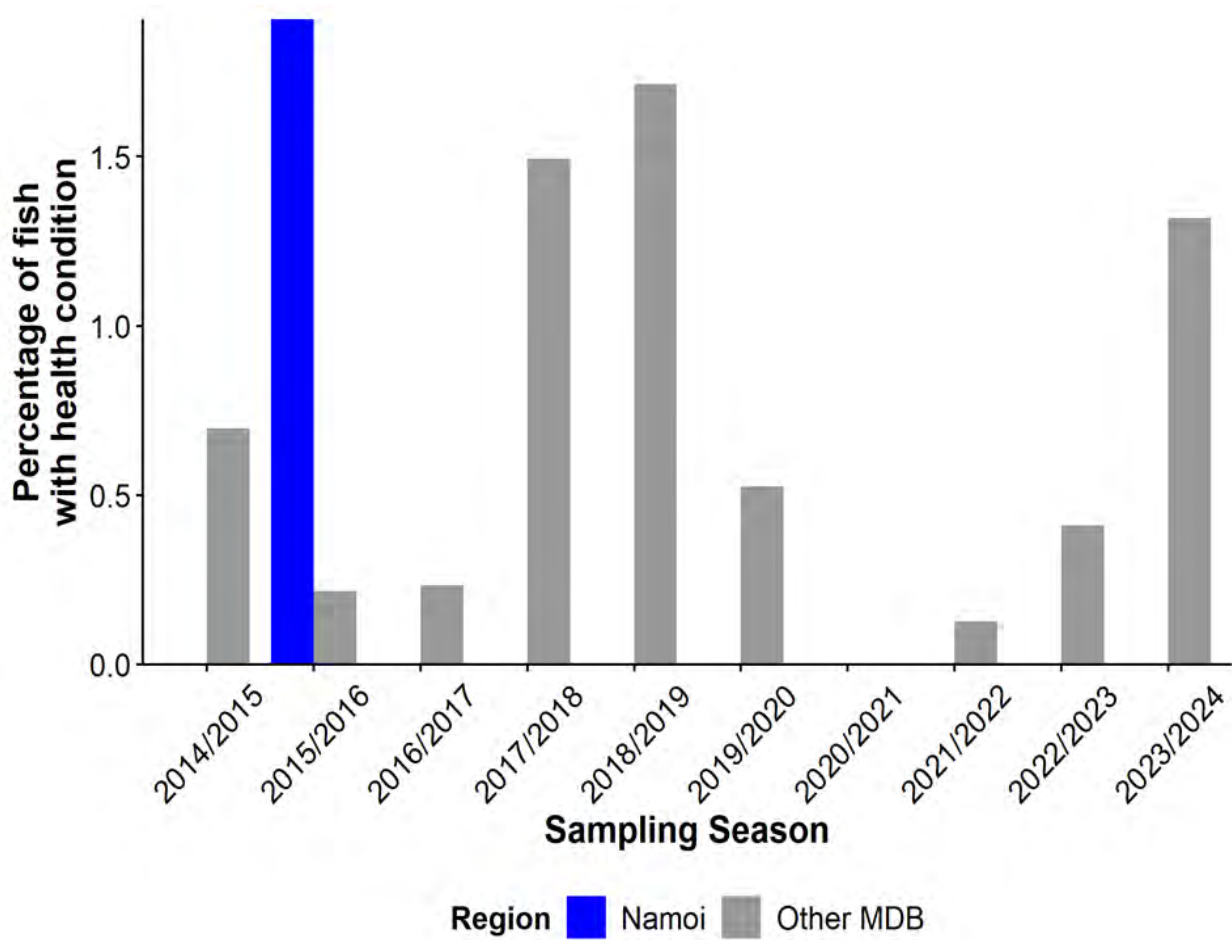


Figure 8.27: Timeseries showing the prevalence of health conditions in Australian smelt. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA's.

Summary Statement:

Very few health issues were observed in Australian smelt in the Namoi.

Distribution

Australian smelt were recorded at 37 out of 108 sites in the Namoi WRP from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 2.8 fish caught per 90 seconds of electrofishing. Figure 8.28 shows the distribution and relative abundance of Australian smelt across the Namoi WRP.

Summary Statement:

Australian smelt were recorded across the Namoi WRP.

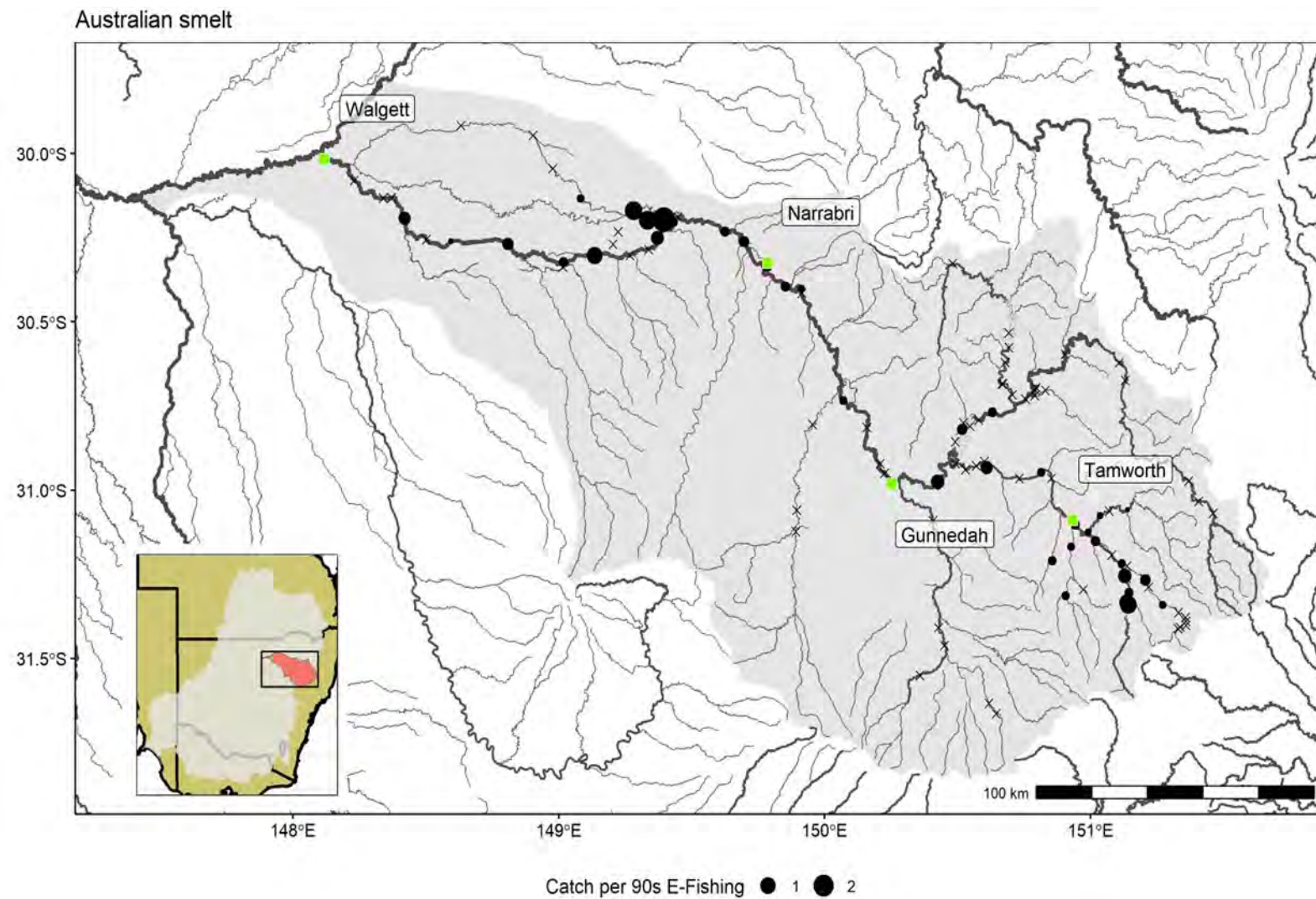


Figure 8.28: Distribution of Australian smelt sampled from 2013/14 to 2023/24 in the Namoi WRPA. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares represent key towns.

Common carp



Population Structure

Figure 8.29 shows the observed length frequency plot for Common carp for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 23 to 478, and 8 % to 78 % of measured fish within a season, with a mean percentage YOY of 46 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Common carp was 56 % (33,727 out of 60,568). Common carp are not a stocked species.

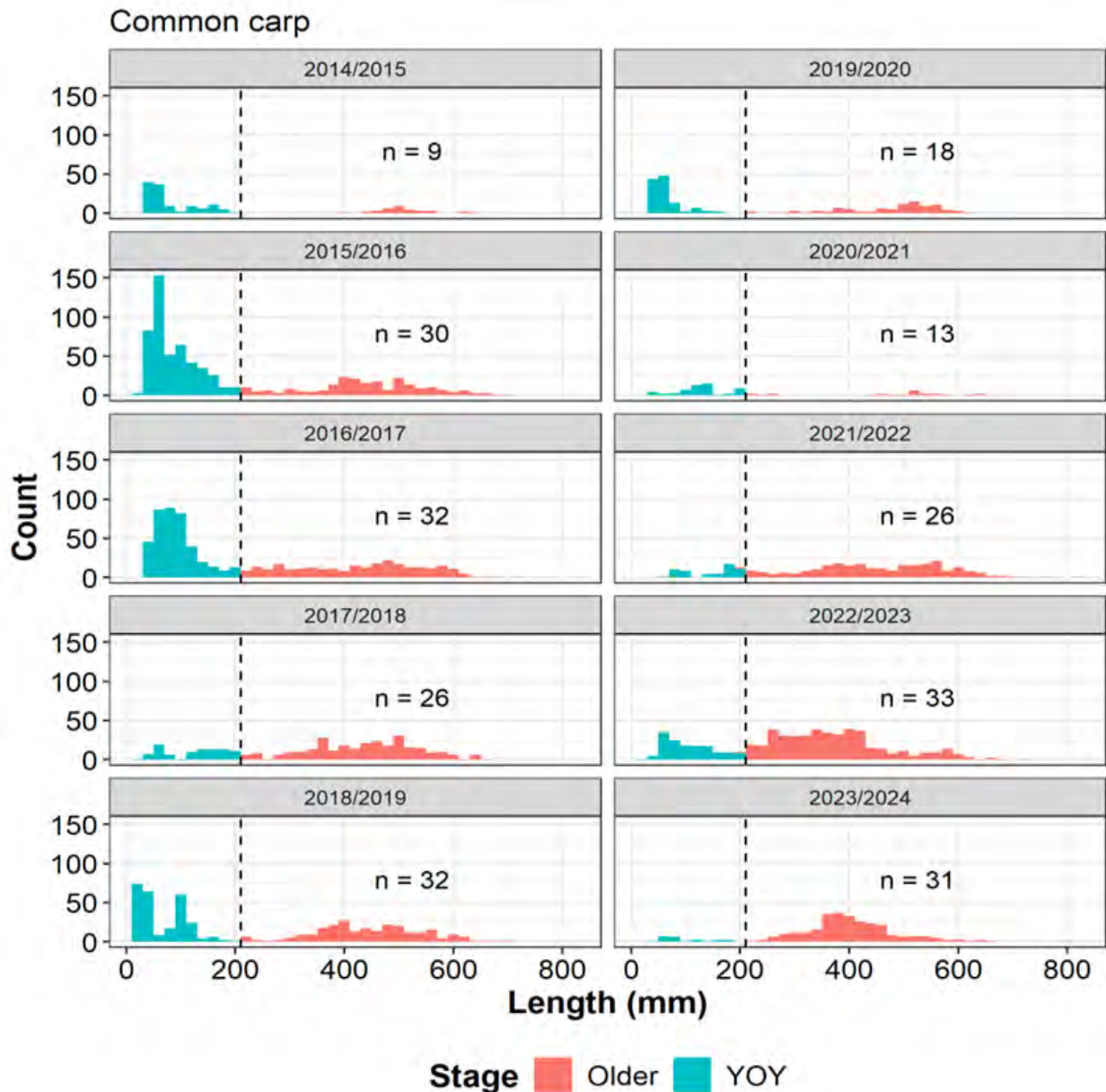


Figure 8.29: Length frequency plots for common carp by sampling season in the Namoi WRPA. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRPA in a sampling season.

Summary Statement:

Variable recruitment with very strong peaks in 2015/16, 2016/17 and 2018/19. Large fish (>500 mm) present in all years. Low recruitment in 2023/24 following moderately strong recruitment in 2022/23.

Temporal Trends in Abundance

The relative abundance and biomass of Common carp since 1994 was modelled based on all suitable boat electrofishing data. The left-hand panels of Figure 8.30 show the abundance and biomass trends for the Namoi WRP and the right-hand panels show the overall trends across the NSW MDB.

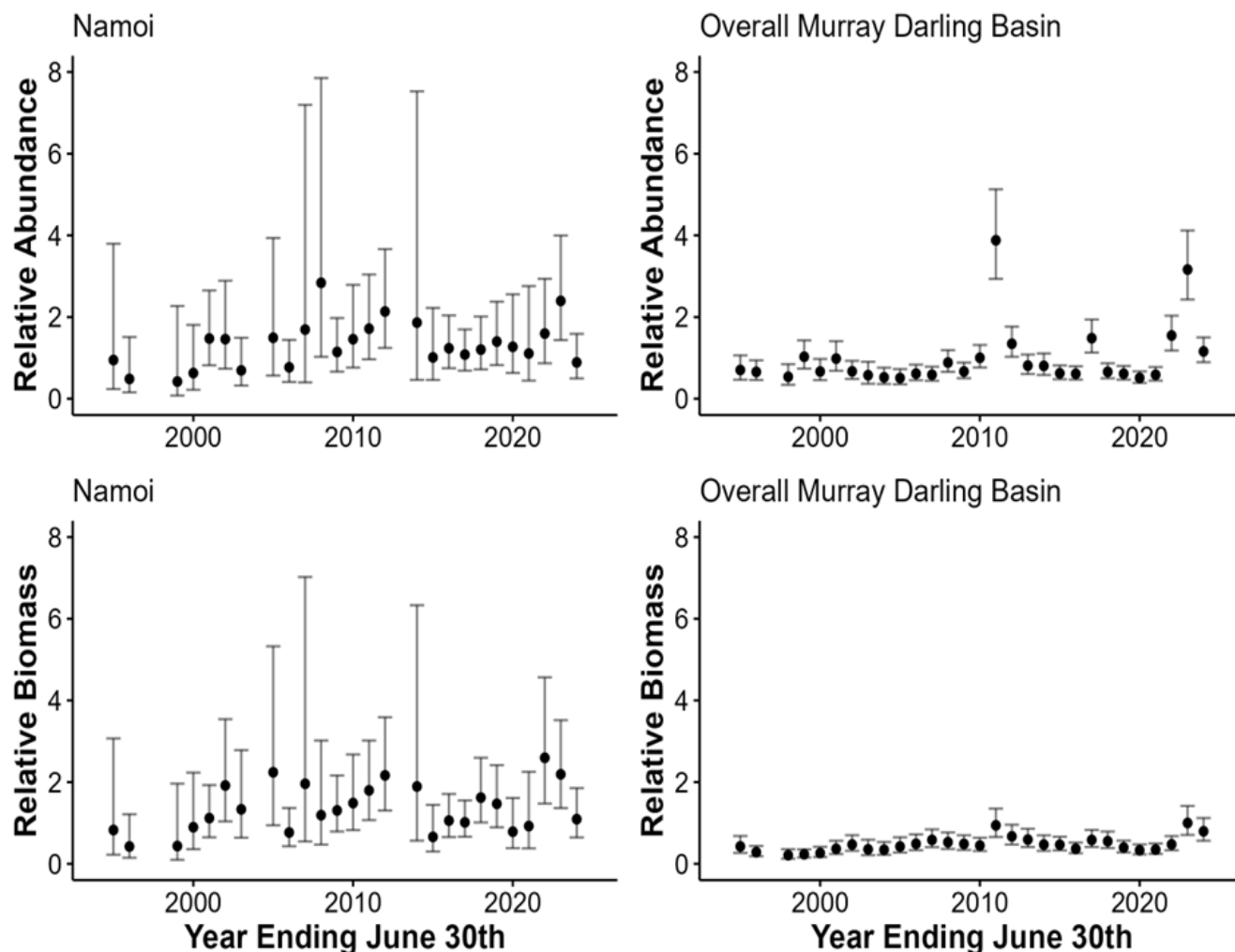


Figure 8.30: Relative abundance and biomass of Common carp in both this valley and the overall Murray-Darling Basin. These are model estimates based upon all electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates.

Summary Statement:

For Common carp in the Namoi, likely increase in biomass and abundance since the 1990s but there is evidence that both abundance and biomass have declined since 2022/23. Both abundance and biomass are similar to the overall NSW MDB.

Health

The prevalence of any health issues ranged from 2 % of sampled fish in 2023/2024 to 31 % of sampled fish in 2020/2021 (Figure 8.31). The most common health issue for Common carp in the Namoi water resource planning area was *Lernaea*, which was observed in a total of 141 fish, corresponding to 4 % of all Common carp measured.

Across the other WRPAs, 4 % of Common carp (2,207 out of 60,570 Common carp) showed a health condition (excludes Namoi).

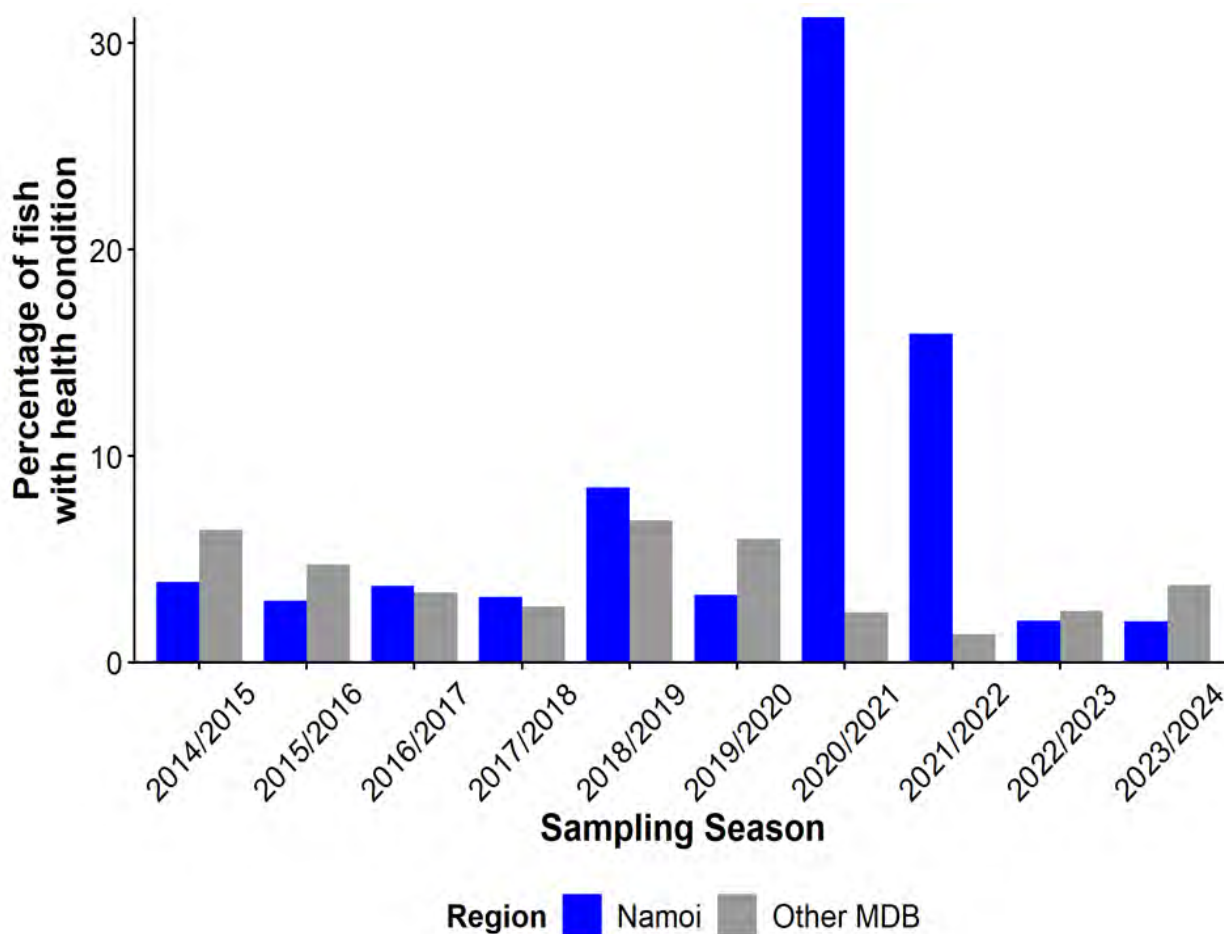


Figure 8.31: Timeseries showing the prevalence of health conditions in Common carp. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPAs.

Summary Statement:

The presence of observable health conditions for Common carp in the Namoi was low to moderate and generally similar to the wider NSW MDB except for 2020/21 when the Namoi showed a high proportion of health issues.

Distribution

Common carp were recorded at 80 out of 108 sites in the Namoi WRPA from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 15.8 fish caught per 90 seconds of electrofishing. Figure 8.32 shows the distribution and relative abundance of Common carp across the Namoi WRPA.

Summary Statement:

Common carp were found in relatively high abundance across the Namoi region.

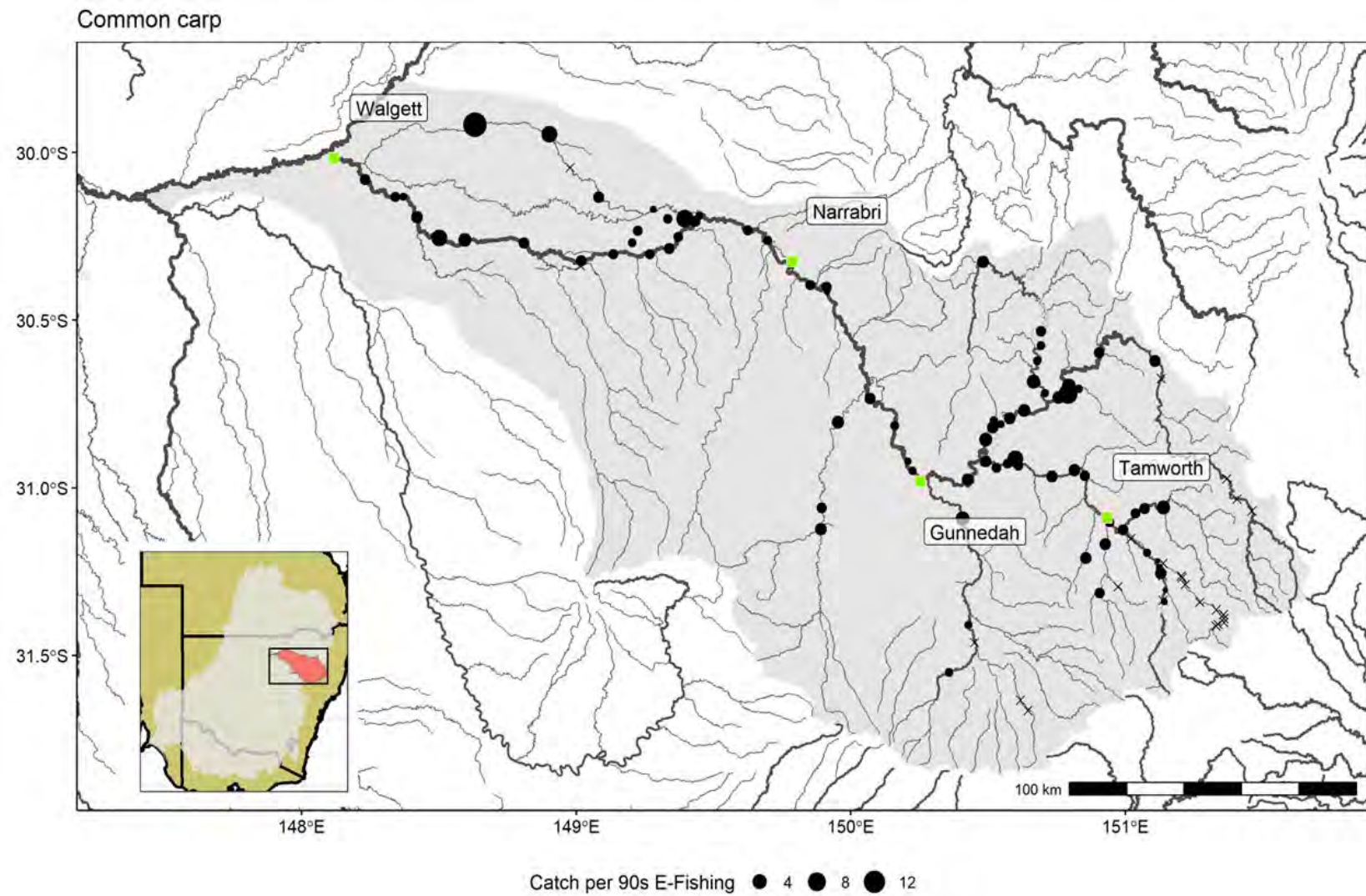


Figure 8.32: Distribution of Common carp sampled from 2013/14 to 2023/24 in the Namoi WRPA. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares represent key towns.

Threatened Species

The following table (Table 8.6) shows the fish species listed under either the *NSW Fisheries Management Act 1994* (FMA) or the *Commonwealth Environmental Protection and Biodiversity Conservation Act 1999* (EPBC) which were observed during standardised electrofishing surveys in the Namoi Water Resource Planning Area during the reporting period. A list of all threatened fish species observed by NSW DPIRD Fisheries (as part of any sampling program in any area) is provided in Table 8.10.

Table 8.6: Listed species which were observed in this region during the sampling period. (* = FMA, # = EPBC)

Species	Common name	Total caught (observed)
<i>Bidyanus bidyanus</i>	Silver perch ^{*#}	20 (7)
<i>Maccullochella peelii</i>	Murray cod [#]	1,024 (373)
<i>Tandanus tandanus</i>	Freshwater catfish [*]	134 (32)

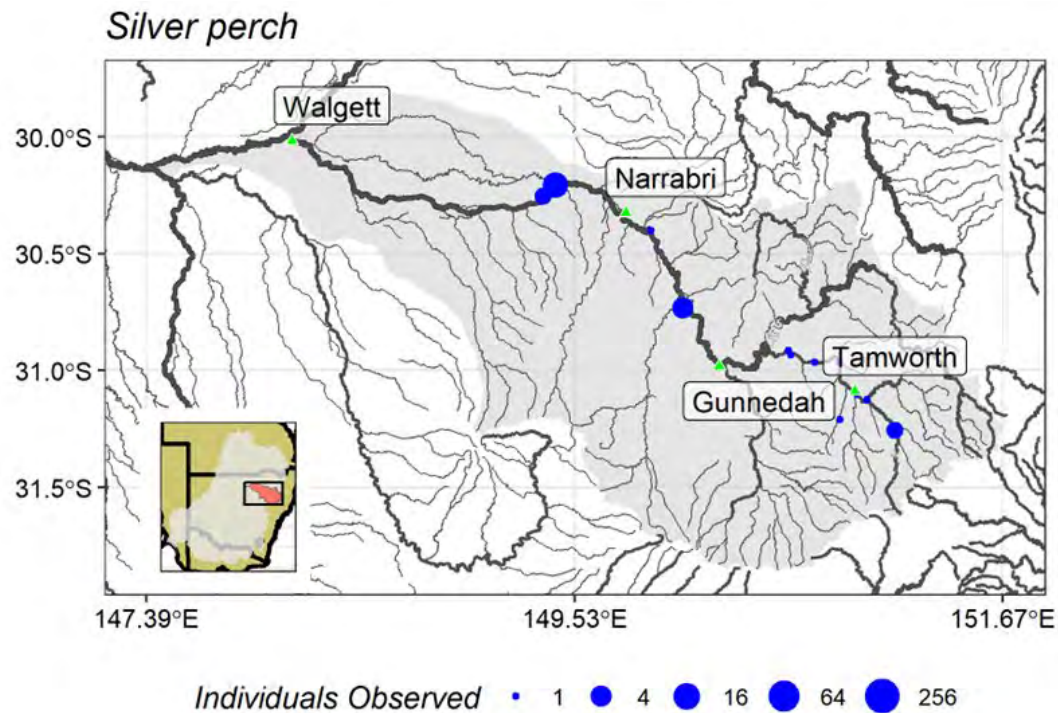


Figure 8.33: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the Namoi WRPA. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance.

Summary Statement:

A total of 20 Silver perch were caught across 9 sites in the Namoi region, including 2 caught in 2023/24.

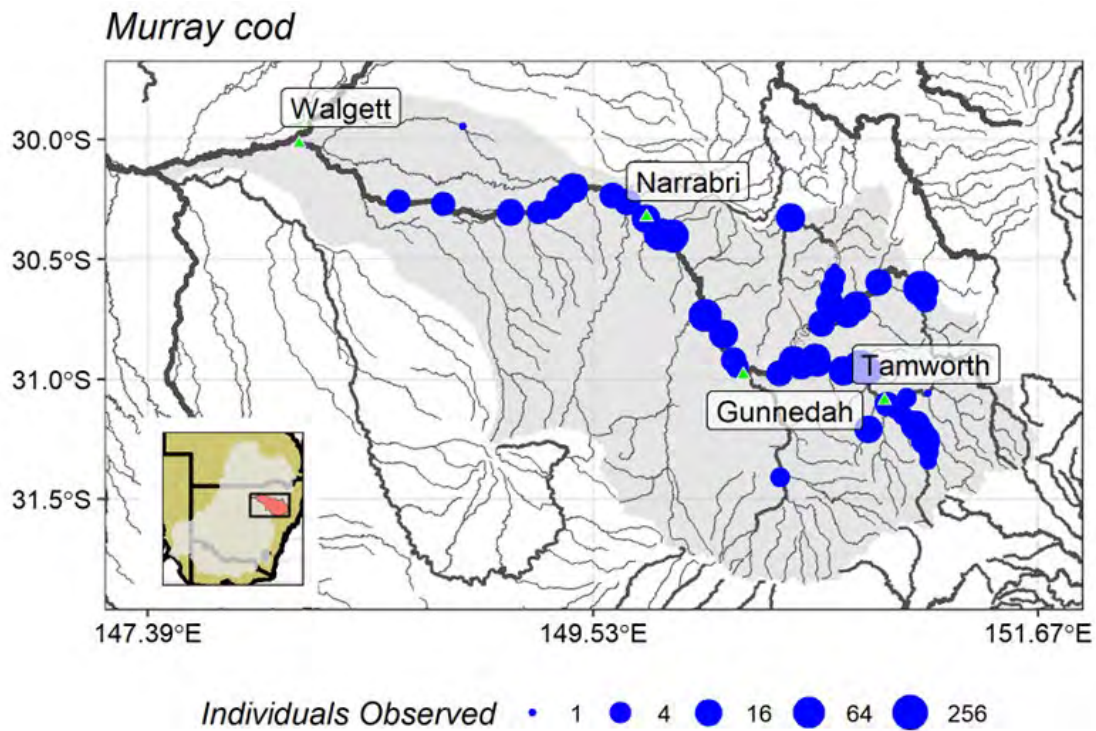


Figure 8.34: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the Namoi WRPA. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance. Note the lower image shows a juvenile Murray cod.

Summary Statement:

Murray cod are widespread across the Namoi WRPA with 1024 being caught over the reporting period. For more details see the Murray cod section of this chapter.

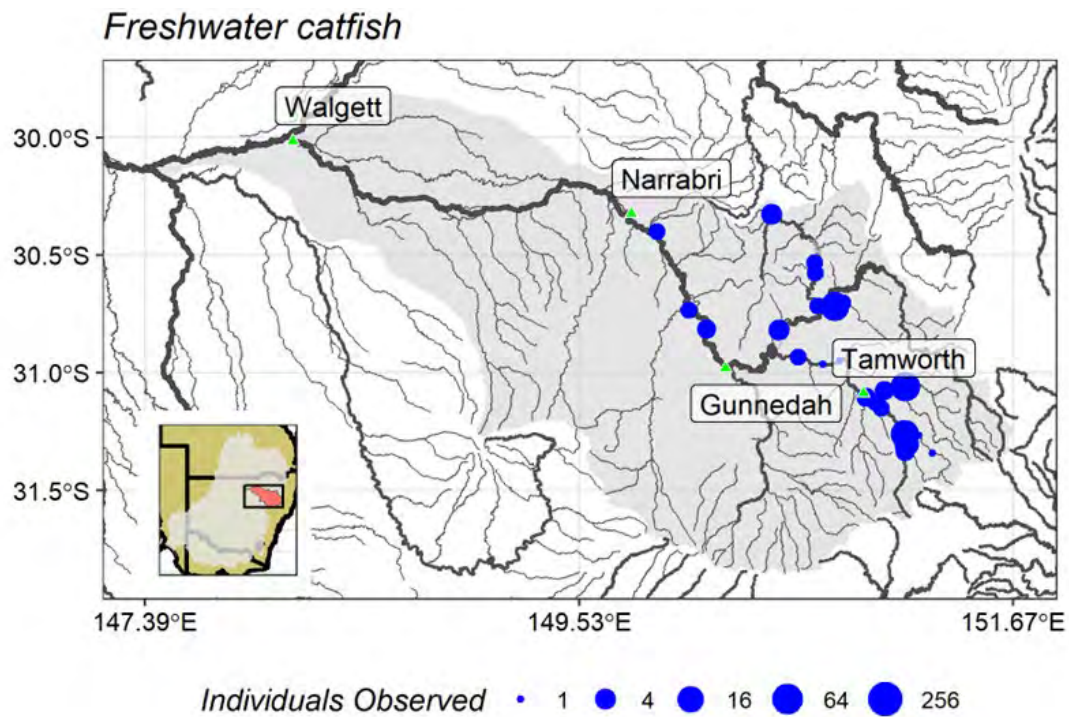


Figure 8.35: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the Namoi WRP. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance.

Summary Statement:

A total of 134 Freshwater catfish were captured across 29 sites in the Namoi region, although they are restricted to the eastern region. For more details see the Freshwater catfish section of this chapter.

Appendix

This report contains data from the projects listed in Table 8.7.

Table 8.7: Projects included in this report. Sampling Events show the total number of sampling events included from each project. Sampling Seasons shows which sampling seasons each project contributed data to.

Project Name	Sampling Seasons	Sampling Events
Basin Plan Environmental Outcomes Monitoring	2014/2015, 2015/2016, 2016/2017, 2017/2018, 2018/2019, 2019/2020	68
Basin Plan Environmental Outcomes Monitoring 2	2022/2023, 2023/2024	30
Fish & Flows Intervention Monitoring - Peel	2021/2022, 2022/2023, 2023/2024	54
Murray-Darling Basin Fish Surveys	2014/2015, 2015/2016, 2016/2017, 2017/2018, 2018/2019, 2020/2021, 2021/2022, 2022/2023, 2023/2024	61
Namoi Fish and Flows	2015/2016, 2016/2017, 2017/2018, 2018/2019	92
Three Dams	2020/2021, 2021/2022	9

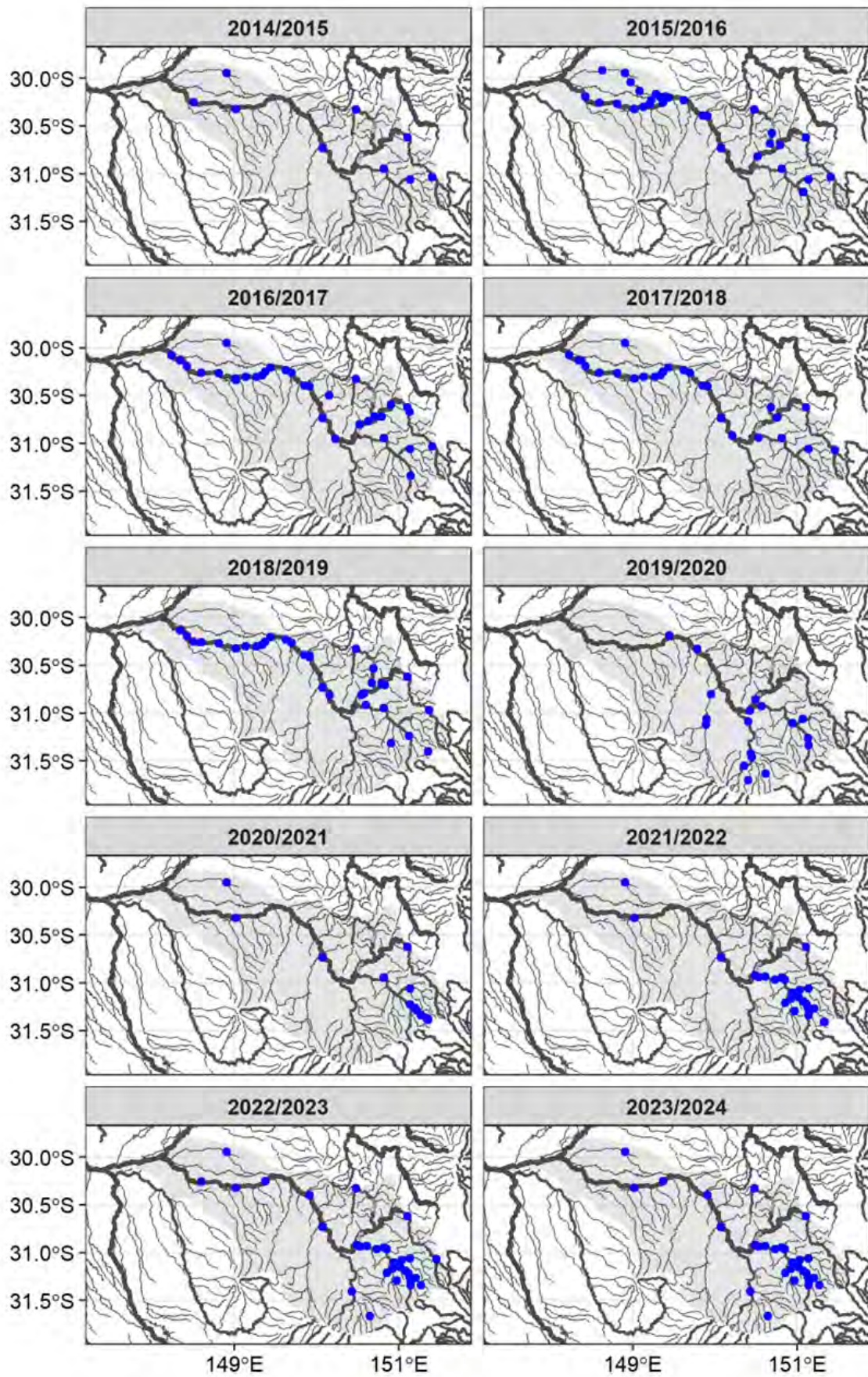


Figure 8.36: Sites sampled and included in this report by sampling season in the Namoi WRPA. Dry sites are not shown.

Table 8.8 shows all species detected during this survey period as part of standardised monitoring projects (see Table 8.7). Note there are variations in effort between sampling seasons so this information should be considered in conjunction with Table 8.1. The Expected from Modelling column identifies species which are possible to occur based upon MaxENT habitat modelling (likelihood threshold > 0.33; NA represents no modelling was undertaken). Species that were possible from the modelling but not observed during standardised sampling in the Namoi WRP were: Olive perchlet, Macquarie perch, Southern purple-spotted gudgeon, Dwarf flathead gudgeon, Redfin and Brown trout. It should be noted that the MaxENT modelling models habitat availability and is not always a reliable index of abundance, it merely indicates possible distribution based upon habitat. A full list of species observed during this period across all protocols and sampling methods is presented in Table 8.11.

Table 8.8: Total number caught of each species by sampling season in the Namoi WRP.

Common name	Expected from modelling	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24
Australian smelt	YES	3	335	28	42	1	28	0	81	12	24
Bony herring	YES	77	1,021	1,639	1,026	777	79	12	47	592	141
Carp-gudgeon species complex	YES	933	5,742	2,877	149	3,714	576	68	1,115	1,356	399
Common carp	NA	211	918	895	374	657	214	74	503	772	300
Darling hardyhead	YES	0	0	3	0	0	0	0	0	2	1
Eastern gambusia	NA	552	2,592	1,076	264	1,481	109	62	40	36	691
Flathead gudgeon	NO	0	0	0	0	0	0	0	0		1
Freshwater catfish	YES	0	8	35	2	6	22	1	26	24	10
Golden perch	YES	5	59	129	114	68	31	13	43	102	92
Goldfish	NA	62	484	96	37	177	21	0	74	51	24
Mountain galaxias	YES	0	0	0	1	0	0	13	433	43	31
Murray cod	YES	38	146	118	141	194	35	9	84	151	108
Murray-Darling rainbowfish	YES	3	111	65	117	20	6	1	36	178	41
River blackfish	NA	35	41	3	1	7	0	136	68	138	73
Rainbow trout	YES	2	3	0	0	0	0	0	1	17	0
Silver perch	YES	0	0	3	8	2	0	0	3	2	2
Spangled perch	YES	14	131	52	39	32	27	11	11	35	15
Unspecked hardyhead	YES	7	5	29	34	20	6	0	3	15	54

The following table summarises the sampling methods for each species (Table 8.9).

Table 8.9: Total catch of each species by sampling method in the Namoi WRP.

Common name	Backpack Electrofishing	Bait Trap	Boat Electrofishing
Australian smelt	378	1	175
Bony herring	624	7	4,780
Carp-gudgeon species complex	4,345	12,240	344
Common carp	1,332	201	3,385
Darling hardyhead	1	0	5
Eastern gambusia	3,693	2,324	886
Flathead gudgeon	1	0	0
Freshwater catfish	105	0	29
Golden perch	15	0	641
Goldfish	566	9	451
Mountain galaxias	239	282	0
Murray cod	121	0	903
Murray-Darling rainbowfish	86	11	481
Northern river blackfish	405	6	91
Rainbow trout	3	0	20
Silver perch	0	0	20
Spangled perch	123	20	224
Unspecked hardyhead	23	58	92

Table 8.10: Listed threatened species recorded in the Murray-Darling Basin (from the NSW DPIRD Fisheries Freshwater Ecosystem research database). Species are listed under either the NSW Fisheries Management Act 1994 (FMA) or the Commonwealth Environmental Protection and Biodiversity Conservation Act 1999 (EPBC).

Genus, species	Common Name	EPBC Status	FMA Status
<i>Ambassis agassizii</i>	Agassiz's glassfish, olive perchlet, western New South Wales population	NA	Endangered Population
<i>Bidyanus bidyanus</i>	Silver Perch, Bidyan	Endangered	Vulnerable
<i>Craterocephalus fluviatilis</i>	Murray Hardyhead	Endangered	Critically Endangered
<i>Galaxias rostratus</i>	Flathead Galaxias, Beaked Minnow, Flat-headed Galaxias, Flat-headed Jollytail, Flat-headed Minnow	Critically Endangered	Critically Endangered
<i>Galaxias tantangara</i>	Stocky Galaxias	NA	Critically Endangered
<i>Maccullochella macquariensis</i>	Trout Cod	Endangered	Endangered
<i>Maccullochella peelii</i>	Murray Cod	Vulnerable	NA
<i>Macquaria australasica</i>	Macquarie Perch	Endangered	Endangered
<i>Mogurnda adspersa</i>	Southern Purple Spotted Gudgeon	NA	Endangered
<i>Nannoperca australis</i>	Southern Pygmy Perch	Vulnerable	Endangered
<i>Tandanus tandanus</i>	Freshwater catfish, eel tailed catfish, Murray-Darling Basin population	NA	Endangered Population

Table 8.11 shows all species detected during this survey period across all programs and methods. Due to variations in project methods protocols, this data is presented only to give a complete list of species observed in the region. The Expected from Modelling column identifies species which are possible to occur based upon MaxENT habitat modelling (likelihood threshold > 0.33; NA represents no modelling was undertaken). Species that were possible from the modelling but not observed during standardised sampling in the Namoi WRPAs were: Olive perchlet, Macquarie perch, Southern purple-spotted gudgeon, Dwarf flathead gudgeon, Redfin and Brown trout. It should be noted that the MaxENT modelling actually models habitat availability and is not always a reliable index of abundance, it merely indicates possible distribution based upon habitat. A list of species caught as part of standardised monitoring during this period is in Table 8.8.

Table 8.11: Total catch of each species by all sampling programs and all methods in the Namoi WRPAs. Note these include projects with sampling not representative of the community and the data should be used with caution.

Common name	Expected from modelling	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24
Australian smelt	YES	3	335	28	42	1	28	0	81	12	24
Bony herring	YES	77	1,021	1,639	1,026	777	79	12	47	592	141
Carp gudgeon species complex	YES	933	5,742	2,877	149	3,714	576	68	1,115	1,356	399
Common carp	NA	212	918	895	374	657	214	74	503	772	300
Darling hardyhead	YES	0	0	3	0	0	0	0	0	2	1
Eastern gambusia	NA	552	2,592	1,076	264	1,481	109	62	40	36	691
Flathead gudgeon	NO	0	0	0	0	0	0	0	0	0	1
Freshwater catfish	YES	0	8	35	2	6	22	1	26	24	10
Golden perch	YES	5	59	129	114	68	31	13	43	112	92
Goldfish	NA	62	484	96	37	177	21	0	74	51	24
Mountain galaxias	YES	0	0	0	1	0	0	13	433	43	31
Murray cod	YES	38	146	118	141	194	35	9	84	151	108
Murray-Darling rainbowfish	YES	3	111	65	117	20	6	1	36	178	41
River blackfish	NA	35	41	3	1	7	0	136	68	138	73
Rainbow trout	YES	2	3	0	0	0	0	0	1	17	0
Silver perch	YES	0	0	3	8	2	0	0	3	2	2
Spangled perch	YES	14	131	52	39	32	27	11	11	35	15
Unspecked hardyhead	YES	7	5	29	34	20	6	0	3	15	54

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Chapter 9 Basin Plan Fish Monitoring Summary (2014/15 – 2023/24): NSW Border Rivers Water Resource Planning Area

Hayden Schilling & David Crook

March 2025



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Chapter cover image credit: NSW DPIRD FER Staff; Fish images credit: Gunther Schmida

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Introduction

This report spans 2014/15 to 2023/24 and uses all suitable fish assemblage data collected by NSW DPIRD Fisheries using standardized electrofishing monitoring techniques. The format of the report follows and expands upon the previous reports (Schilling & Crook 2023, 2024). This report focusses on the New South Wales Border Rivers Water Resource Planning Area (WRPA) shown in Figure 9.1.

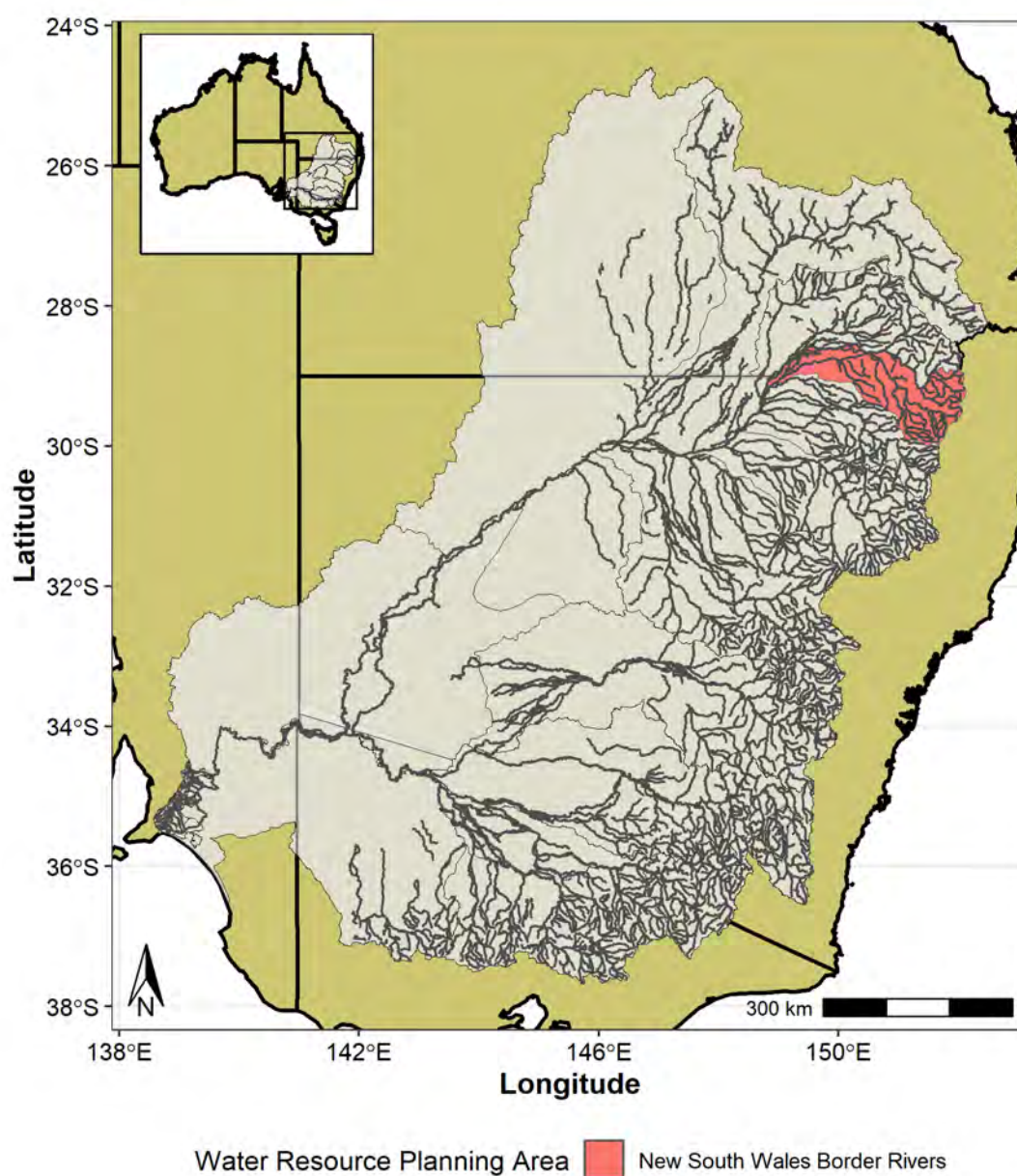


Figure 9.1: Murray-Darling Basin with the key region of this report highlighted. Inset map shows the whole of Australia with a box around the MDB.

What This Report Includes

This report starts with an overview of the standardised monitoring programs including sampling details and statistics. An overview of the hydrological and climatic conditions during the reporting period is also provided as context for interpreting the fish population status data.

Following the introductory sections, we present a summary of *fish diversity* across the New South Wales Border Rivers WRPAs. Separate plots for native and alien species show the total number of unique species observed at each site.

The main body of the report provides detailed information on the *population structure, relative abundance, health, and distribution* of six key fish species:

- Murray cod
- Golden perch
- Freshwater catfish
- Bony herring
- Australian smelt
- Common carp

Population structure information includes length frequency plots of collected fish and the proportion of fish classified as Young of the Year (YOY). This information can be used to infer the size structure of populations and the level of recruitment each year. For additional context, we provide a summary table showing any stocking which occurred for the species in each year (if relevant).

Relative abundance and *relative biomass* (a unit-less measure representing the number (or biomass) of fish in an area) information is adapted from the modelled outputs from a more in-depth publication (Crook et al. 2023) which considers all available electrofishing data within the NSW Murray-Darling Basin (MDB). The updated analysis uses generalised linear mixed models to generate annual indices of relative abundance and biomass for each WRPAs. In this report we present the modelled time series of relative abundance showing the predicted number (or biomass) of fish observed per 90 second shot of electrofishing. The abundance and biomass trends for the New South Wales Border Rivers WRPAs are contrasted with the overall NSW MDB dataset. It should be noted that these are modelled estimates of relative abundance/biomass, not absolute abundance/biomass as absolute estimates would require extensive calibration surveys that are not included in the monitoring program.

Health information is provided as a summary of any visible health conditions recorded for the key species. The number of health conditions observed in a fish population is generally reflective of water quality, competition, and many other factors. Fewer observations of health conditions indicate healthier populations. The health conditions detailed are any that were observed as part of the biological measurements taken. We provide a comparison of the prevalence of health conditions in the New South Wales Border Rivers WRPAs and greater MDB (excluding the New South Wales Border Rivers WRPAs).

Distribution maps are provided for each species to show the observed distribution of each species from electrofishing samples. The distribution maps also show the relative abundance (number of fish observed per 90 seconds of electrofishing) at each site to give an indication of how the population is spread over the landscape.

Finally, the distributions and numbers of *Threatened species* are reported. The report includes threatened species that were recorded by standardised monitoring programs in the New South Wales Border Rivers WRPAs during the reporting period.

For each section of the report, we provide a *Summary Statement*. This statement provides a very brief overview of the key messages for each section.

Sampling Methods

Three main methods are used during routine fish monitoring surveys: boat electrofishing, backpack electrofishing and bait traps. This report mainly includes the electrofishing data with bait trap samples informing the distribution of small bodied species. The electrofishing was conducted using the standard methodology implemented in the Sustainable Rivers Audit (SRA; Davies et al. 2010). This usually includes 12 shots of 90 seconds “power on” during each sampling event.

As parts of this report compile data from multiple projects, there is some variation in how sites were chosen and the effort of sampling conducted each year (Table 9.1). Details of which projects contributed data to this report can be seen in Table 9.7. At each site, sampling gear was applied as suited to the local conditions with either boat, backpack, or a hybrid of the two, in addition to 10 unbaited bait traps set in edge margins. Most sampling occurred between the months of September and May.

Table 9.1: Sampling effort (Number of sites sampled) each sampling season in the NSW Border Rivers WRPAs. Variation in sampling effort is due to different numbers of projects and interruptions to planned sampling such as flooding, site desiccation, and extreme weather.

Sampling Season	Number of Boat Electrofishing Sites	Number of Backpack Electrofishing Sites	Number of Hybrid Sites	Total
2014/2015	7	1	1	9
2015/2016	20	3	2	25
2016/2017	27	1	NA	0
2017/2018	23	3	1	27
2018/2019	27	5	3	35
2019/2020	11	12	8	31
2020/2021	15	4	1	20
2021/2022	6	3	1	10
2022/2023	17	4	1	22
2023/2024	16	4	1	21

The sites sampled during the reporting period are shown in Figure 9.2. A breakdown of sites sampled each sampling season is shown in the Appendix (Figure 9.38).

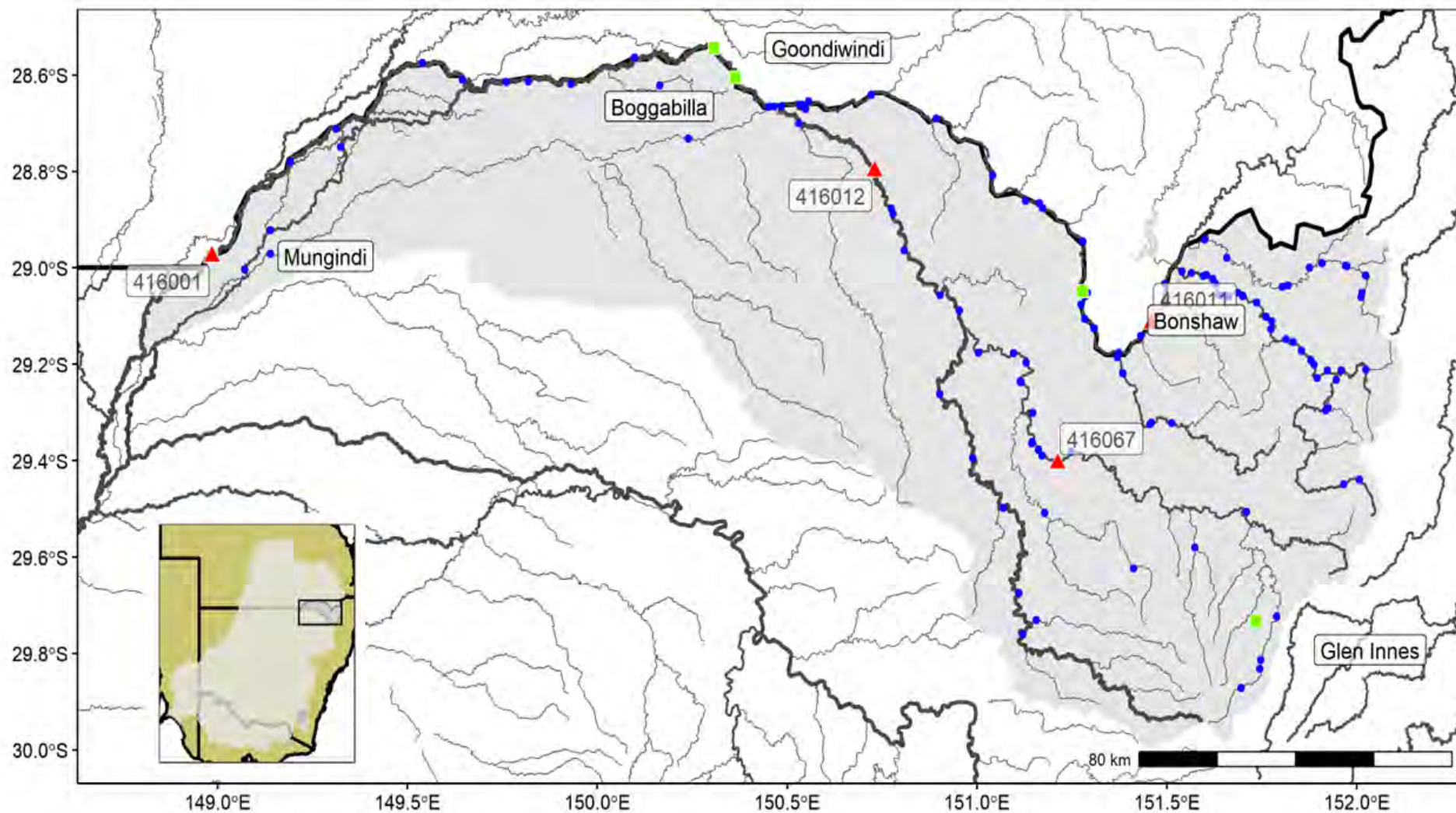


Figure 9.2: Sites (dots) sampled during the reporting period in the NSW Border Rivers WRPA. Triangles show key flow gauges along with their gauge ID number. Green squares show major towns.

Each sampling method has a different effectiveness at sampling each species. Table 9.2 shows the total numbers of each key species caught by each method.

Table 9.2: Number of each key species caught by sample method over the whole program in the NSW Border Rivers WRPA. Further data on total catch is provided in the Appendix.

Common name	Boat Electrofishing	Backpack Electrofishing	Bait Trap
Australian smelt	795	13	0
Bony herring	5,952	7	1
Common carp	1,921	78	4
Freshwater catfish	279	155	1
Golden perch	522	3	4
Murray cod	1,883	187	0

A subset of sampled fish had biological measurements taken during the surveys, including but not limited to length and weight measurements and visual health assessments. Table 9.3 shows the number of biological measurements taken each year for the six key species.

Table 9.3: Number of biological measurements taken for the key species each sampling season in the NSW Border Rivers WRPA.

Sampling Season	Australian smelt	Bony herring	Common carp	Freshwater catfish	Golden perch	Murray cod
2014/2015	11	152	32	9	9	42
2015/2016	128	492	241	29	95	323
2016/2017	1	422	223	57	63	235
2017/2018	48	914	337	76	131	563
2018/2019	103	357	261	81	71	428
2019/2020	72	250	112	37	13	97
2020/2021	42	24	135	78	15	75
2021/2022	75	25	97	21	18	39
2022/2023	19	147	246	28	42	93
2023/2024	50	284	289	19	75	158

Climate Overview

The following is a summary of the climatic conditions during the reporting period in terms of how the observed conditions compare to long term records. These are direct extracts from the [Australian Bureau of Meteorology climate summaries archive](#) and are written in the given year. To interpret, 2014 states it was the warmest year on record, meaning 2014 was the warmest year on record up to and including 2014 but not including more recent years.

2014

New South Wales experienced its warmest year on record in 2014, with several heatwaves and persistently warm conditions across the State. Rainfall was well below average in the northeast, and close to average elsewhere.

2015

New South Wales recorded well above average temperatures in 2015. Nights were particularly warm, the sixth-warmest on record for the State. Rainfall was close to average for the state as a whole.

2016

2016 was a generally wet, warm year for NSW as a whole, with substantial variability throughout the year and across the state. Following a record-warm start to the year, May to September was the wettest such period on record for NSW, with cooler weather in much of the west of the state. Minimum temperatures were the warmest on record for the State as a whole, with record-warm daytime temperatures on parts of the east coast.

2017

The year 2017 was the warmest on record for New South Wales for both mean and daytime temperatures. It was also the State's driest year since 2006. Following the warmest summer on record for the State, heavy rain in March across the east then made way for a very dry winter and start to spring. Winter overnight temperatures were the lowest since 1997, but daytime temperatures remained above average for most of the year, and were the warmest on record overall.

2018

2018 was the warmest on record for New South Wales for both mean temperature and mean maximum temperature, whilst the mean minimum temperature was fourth-warmest on record. The year was dominated by very dry conditions, with the third-driest January to September on record. October to December saw some relief from the dry, with above average rainfall across parts of the State. Despite this, New South Wales experienced its sixth-lowest annual rainfall on record; its driest year since 2002.

2019

2019 was the driest and warmest year on record for New South Wales. Despite some rain in some months, most of the State received much less rainfall than usual, with the northeast and far west particularly dry. Heatwaves in January brought very high temperatures, and large fires from September onward caused extensive damage and persistent smoke.

2020

2020 saw above average temperature and rainfall in New South Wales. Temperatures were above average across the state in most months except during autumn. There was widespread rain during autumn and spring and in December, but early winter and November rain was below average.

2021

New South Wales had its 6th wettest year on record, with 2021 rainfall 30 % above average. This included significant floods along the east coast in March, and the state's wettest November on record. It was the state's coolest year since 1996, at 0.15 °C above the 1961–1990 average.

2022

2022 was exceptionally wet with the state-averaged annual total being the second-highest on record (since 1900) and many sites recording their highest annual totals on record. Maximum temperatures were lower than average with the state-averaged annual maximum temperature being the coolest since 1992. Minimum temperatures were generally warmer than average with the state-averaged annual minimum temperature being 0.73 °C above the 1961–1990 average.

2023

The state-averaged rainfall was 22.9 % below the 1961–1990 average. Rainfall was above average over small parts of the state's south, west of the Great Dividing Range, while being below average over most of the northern half of the state, especially over parts of the Northern Tablelands, Northern Rivers, Mid-North Coast, and Upper Hunter, where annual rainfall was in the lowest 10 % of historical records (since records began in 1900). State-averaged annual maximum temperature was 1.96 °C above the 1961–1990 average, which is the third highest on record.

2024

Rainfall totals in 2024 were above average to very much above average for the northern and western areas of the state, as well as central parts of the coast. Totals were below average for large parts of the south-east, as well as small parts of the state's north-east and south-west. 2024 was the third-warmest on record for all years since 1910, 1.55 °C above the 1961–1990 average.

Flow Data

Below shows a summary of flow data from a variety of flow gauges in the New South Wales Border Rivers WRPA (Figure 9.3).

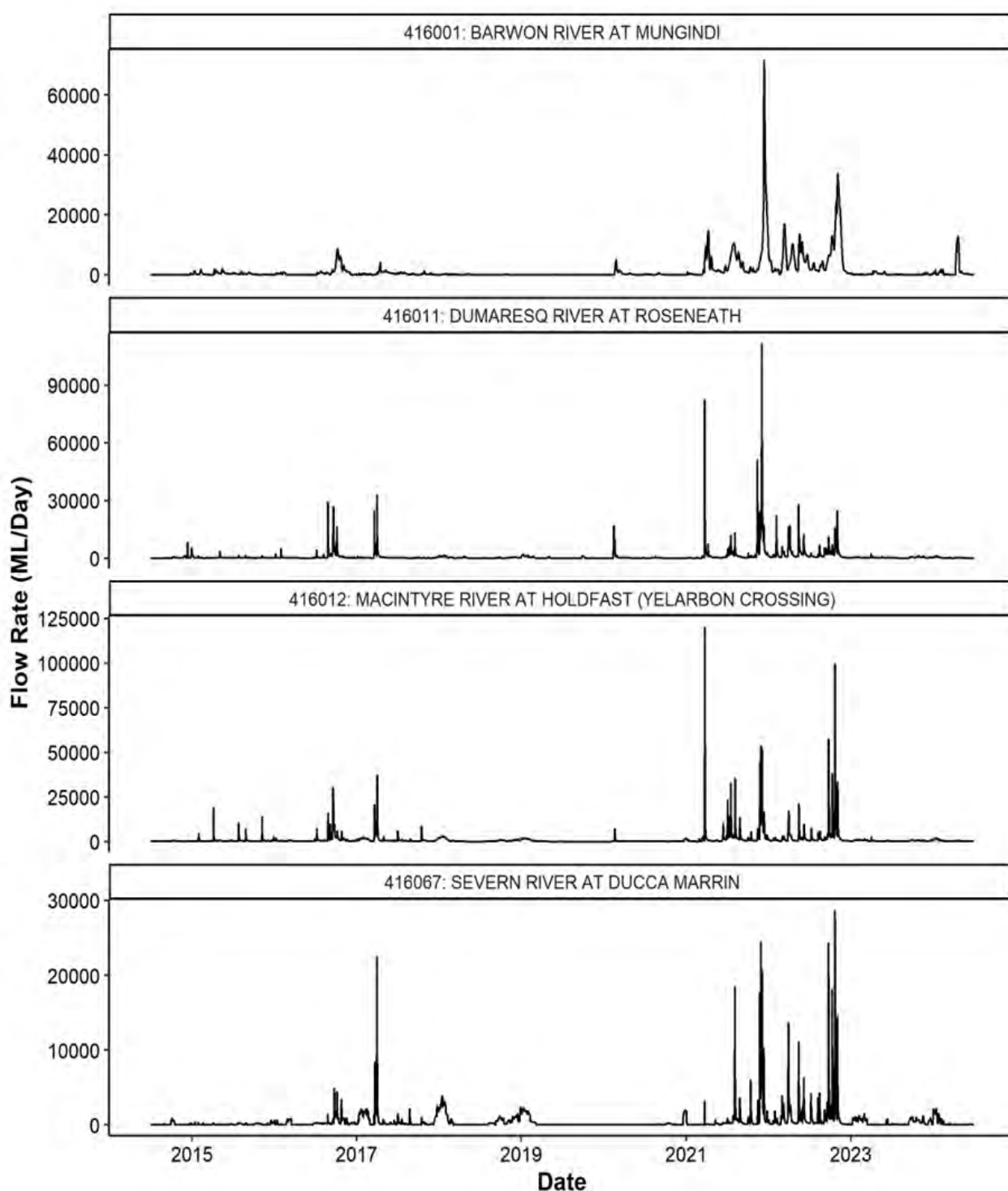


Figure 9.3: Flow data from various gauges in the New South Wales Border Rivers WRPA over the reporting period. Gauge locations can be seen on Figure 9.2. Note the differing scales on the y-axis.

Water temperature data, where available, are also shown in Figure 9.4.

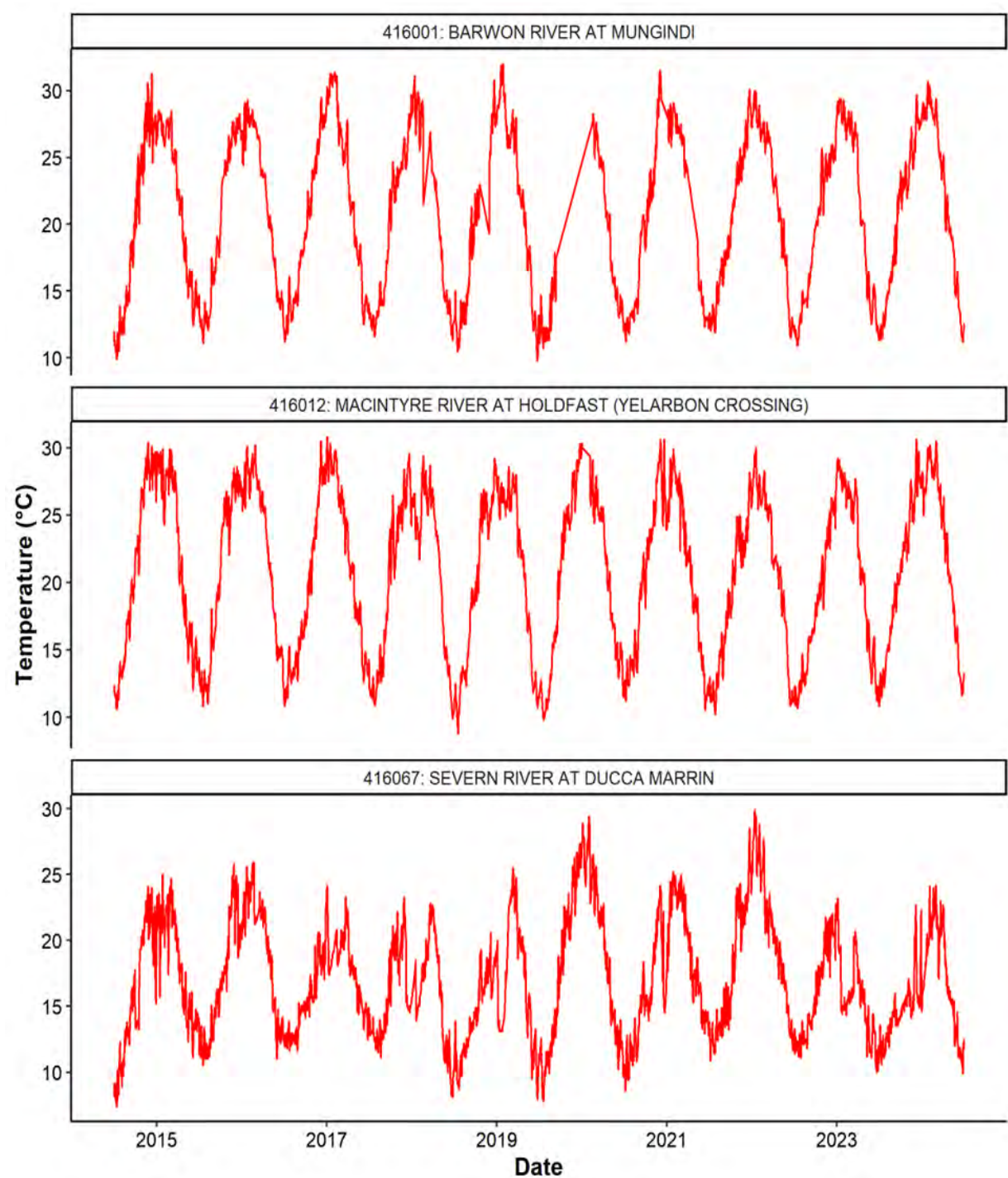


Figure 9.4: Water temperature data from various gauges in the New South Wales Border Rivers WRPA over the reporting period. Gauge locations can be seen on Figure 9.2. Note the differing scales on the y-axis.

Species Diversity

A total of 19 fish species were observed across the New South Wales Border Rivers WRPAs including five alien species. Figure 9.5 shows the number of native species found at each site while Figure 9.6 shows the number of alien species found at each site. The full list of species caught and observed is presented in Table 9.8.

Summary Statement:

Native diversity was slightly higher in the central area of the NSW Border Rivers compared to other areas. Alien diversity was generally consistent across the region.

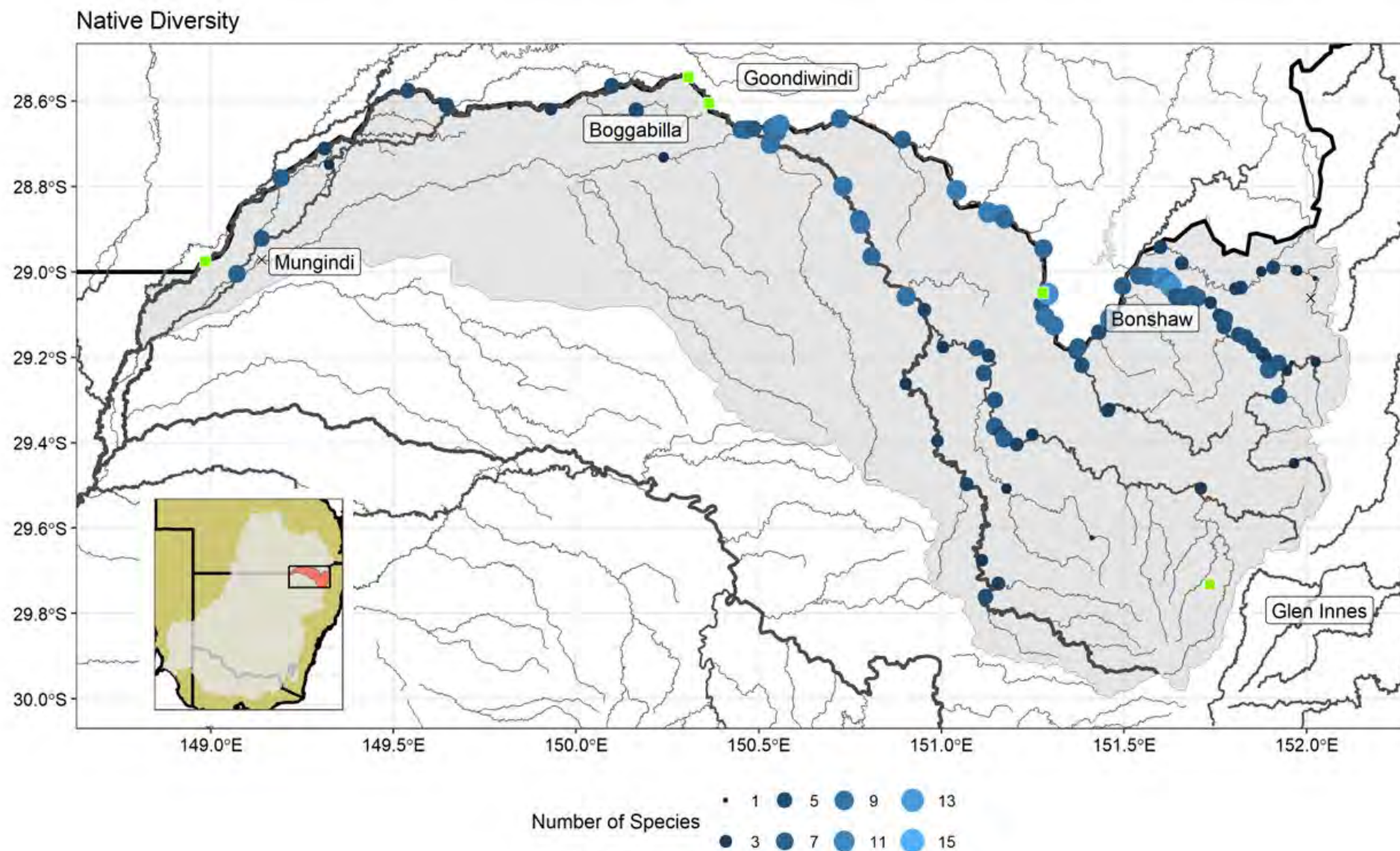


Figure 9.5: Native diversity across all sampling sites in the NSW Border Rivers WRPA. Bubble size represents the number of unique species observed at each site across all sampling methods and events. X represents a site that had water and was sampled, but no fish species were caught at all. Dry sites are excluded. Green squares represent key towns.

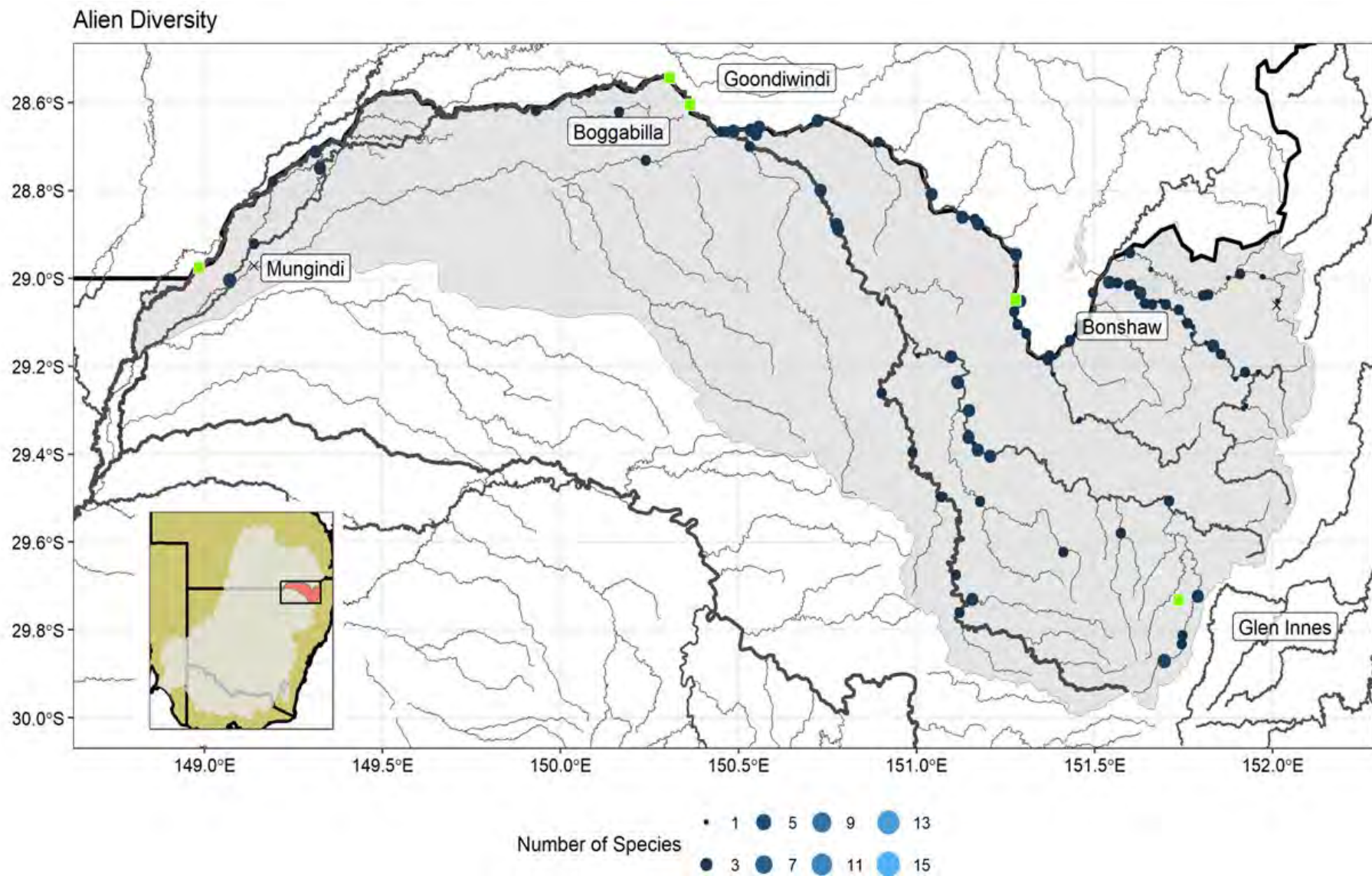


Figure 9.6: Alien diversity across all sampling sites in the NSW Border Rivers WRPA. Bubble size represents the number of unique species observed at each site across all sampling methods and events. X represents a site that had water and was sampled, but no fish species were caught at all. Dry sites are excluded. Green squares represent key towns.

Murray cod



Population Structure

Figure 9.7 shows the observed length frequency plot for Murray cod for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 1 to 83, and 1 % to 36 % of measured fish within a season, with a mean percentage YOY of 11 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Murray cod was 13 % (1,257 out of 9,498).

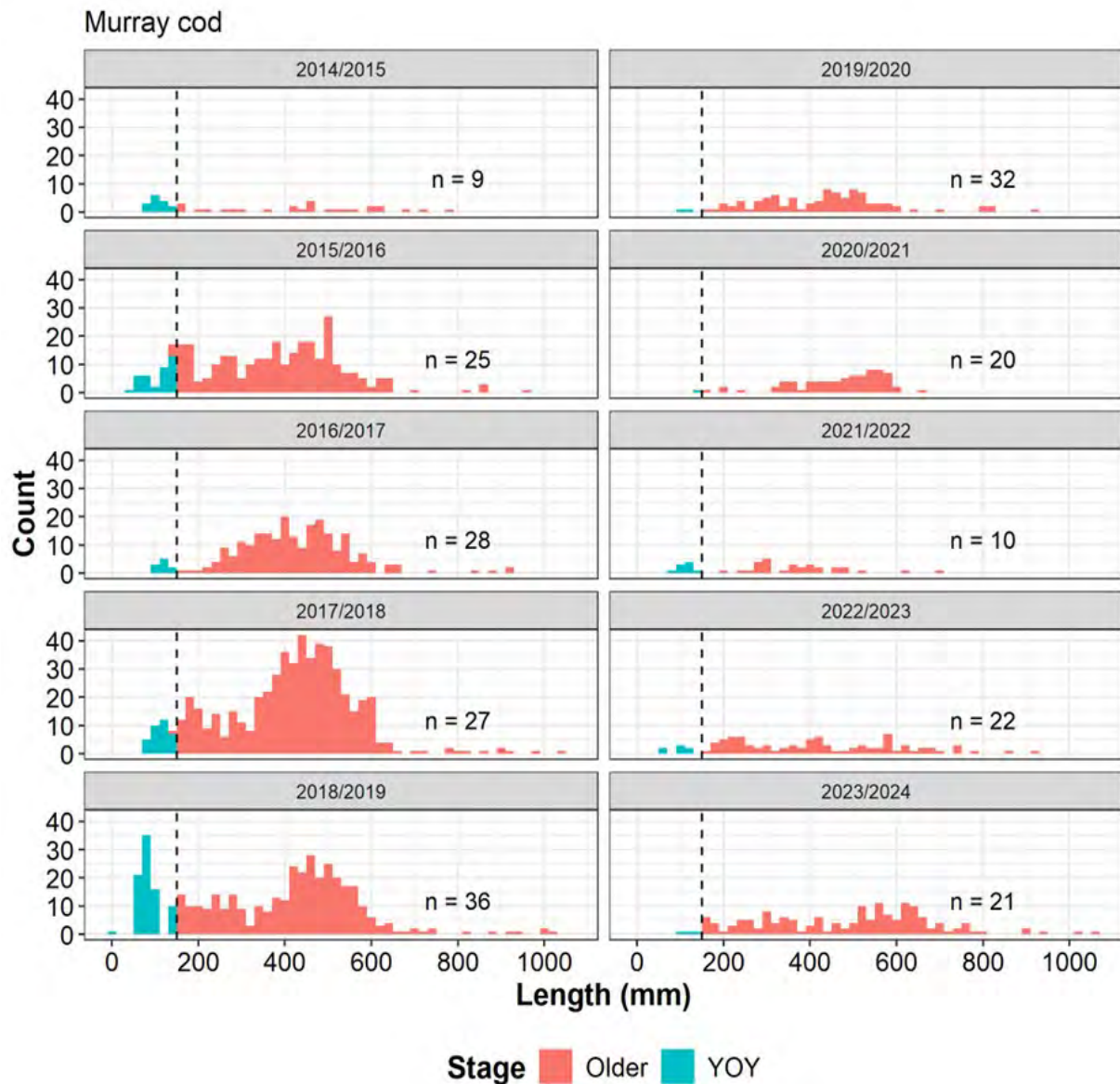


Figure 9.7: Length frequency plots for Murray cod by sampling season in the NSW Border Rivers WRP. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRP in a sampling season.

Summary Statement:

Recruitment evident in most years with possible recruitment failures in 2019/20 and 2020/21. A good range of size classes including YOY were observed in both 2023/24 but recruitment appears to have been low since 2018/19.

Stocking

A total of 295,383 Murray cod were stocked into the waterways of the New South Wales Border Rivers WRPA during the reporting period. Of these fish, 223,182 (76 %) were stocked into impoundments while 72,201 (24 %) were stocked into rivers or creeks. Table 9.4 shows the detailed breakdown of stocking by season, location and life stage while Figure 9.8 shows the locations of stocking.

Table 9.4: Number and life stage of stocked Murray cod each sampling season in the NSW Border Rivers WRPA.

Sampling Season	River/Creek or Impoundment	Life Stage	Number Stocked
2014/2015	Impoundment	Fry	1,649
2014/2015	River/Creek	Fry	7,121
2015/2016	Impoundment	Fry	20,950
2015/2016	River/Creek	Fry	11,070
2016/2017	Impoundment	Fingerling	3,898
2016/2017	Impoundment	Fry	47,000
2016/2017	River/Creek	Fingerling	7,360
2016/2017	River/Creek	Fry	3,000
2018/2019	Impoundment	Fry	20,000
2018/2019	River/Creek	Fry	18,000
2019/2020	Impoundment	Fry	500
2019/2020	River/Creek	Fry	6,318
2020/2021	Impoundment	Fry	185
2020/2021	River/Creek	Fry	2,037
2021/2022	Impoundment	Fry	39,000
2021/2022	River/Creek	Fry	2,195
2022/2023	Impoundment	Fry	70,000
2022/2023	River/Creek	Fingerling	100
2022/2023	River/Creek	Fry	15,000
2023/2024	Impoundment	Fingerling	20,000

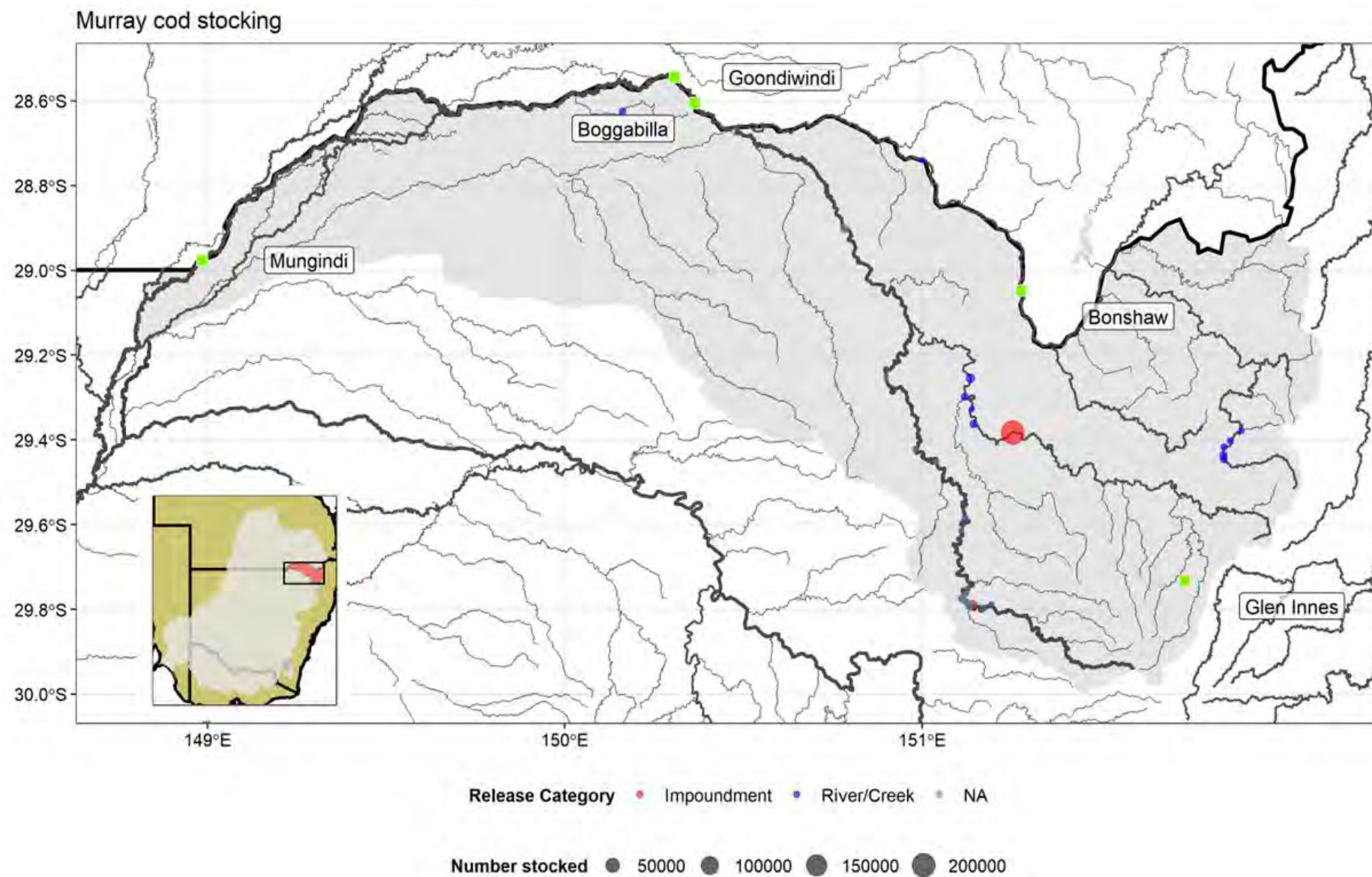


Figure 9.8: Locations of Murray cod stocking in the NSW Border Rivers WRPA. Colours show whether a site was a river/creek site or an impoundment, while the size of the point reflects the total number of fish stocked over the reporting period. Green squares represent key towns.

Temporal Trends in Abundance

The relative abundance and biomass of Murray cod since 1994 was modelled based on all suitable boat electrofishing data. The left-hand panels of Figure 9.9 show the abundance and biomass trends for the New South Wales Border Rivers WRPA and the right-hand panels show the overall trends across the NSW MDB.

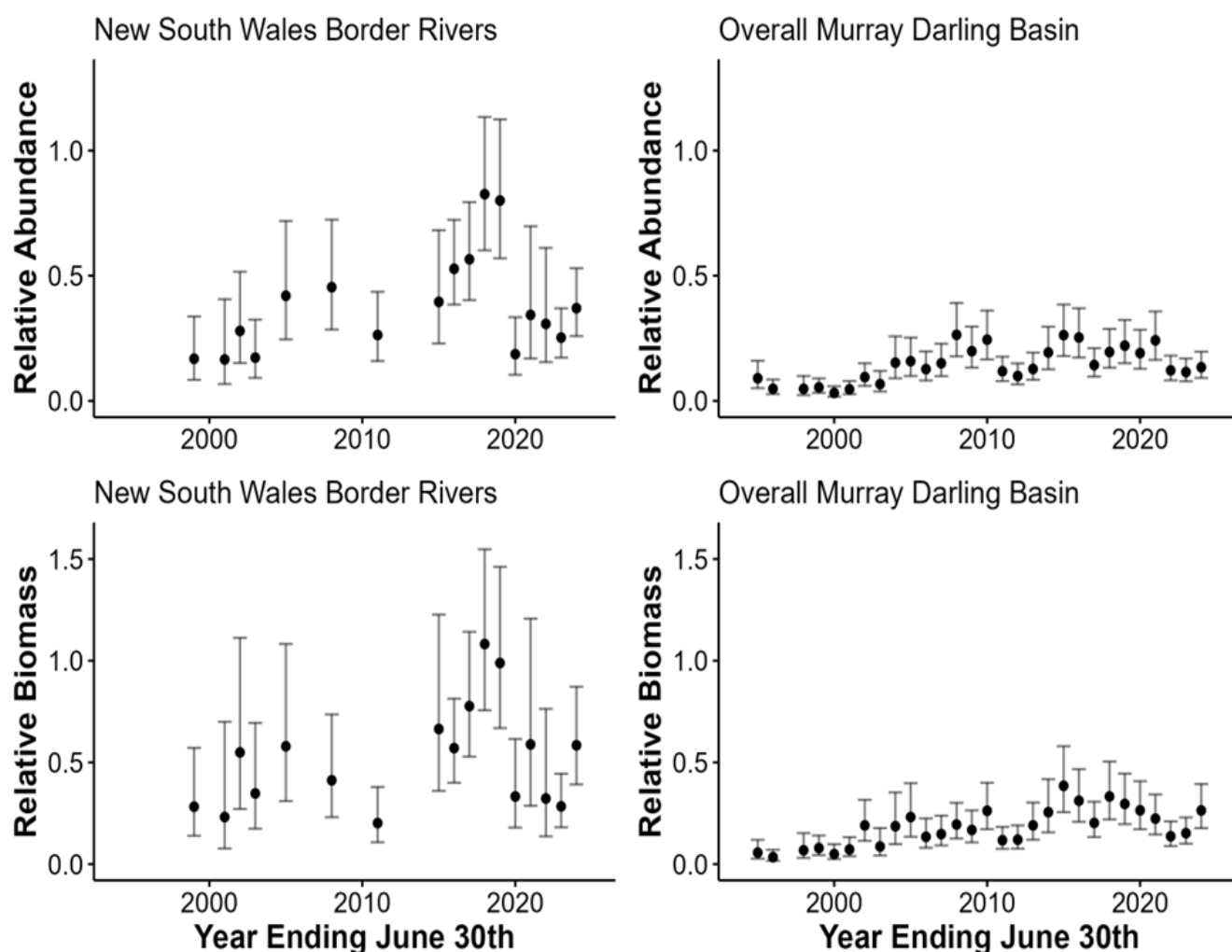


Figure 9.9: Relative abundance and biomass of Murray cod in both the NSW Border Rivers WRPA and the overall NSW MDB. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates.

Summary Statement:

An overall likely increase in abundance and biomass since the 1990s followed by a recent decline since 2019. Both abundance and biomass appear to have increased between 2023 and 2024. Relative abundance and biomass higher than the overall NSW MDB.

Health

The prevalence of any health issues ranged from 0 % of sampled fish in 2021/2022 to 25 % of sampled fish in 2023/2024 (Figure 9.10). The most common health issue for Murray cod in the New South Wales Border Rivers WRPAs was *Lernaea*, which was observed in a total of 103 fish, corresponding to 5 % of all Murray cod measured.

Across the other NSW MDB WRPA, 18 % of Murray cod (1,668 out of 9,498 Murray cod) showed a health condition (excludes the New South Wales Border Rivers WRPAs).

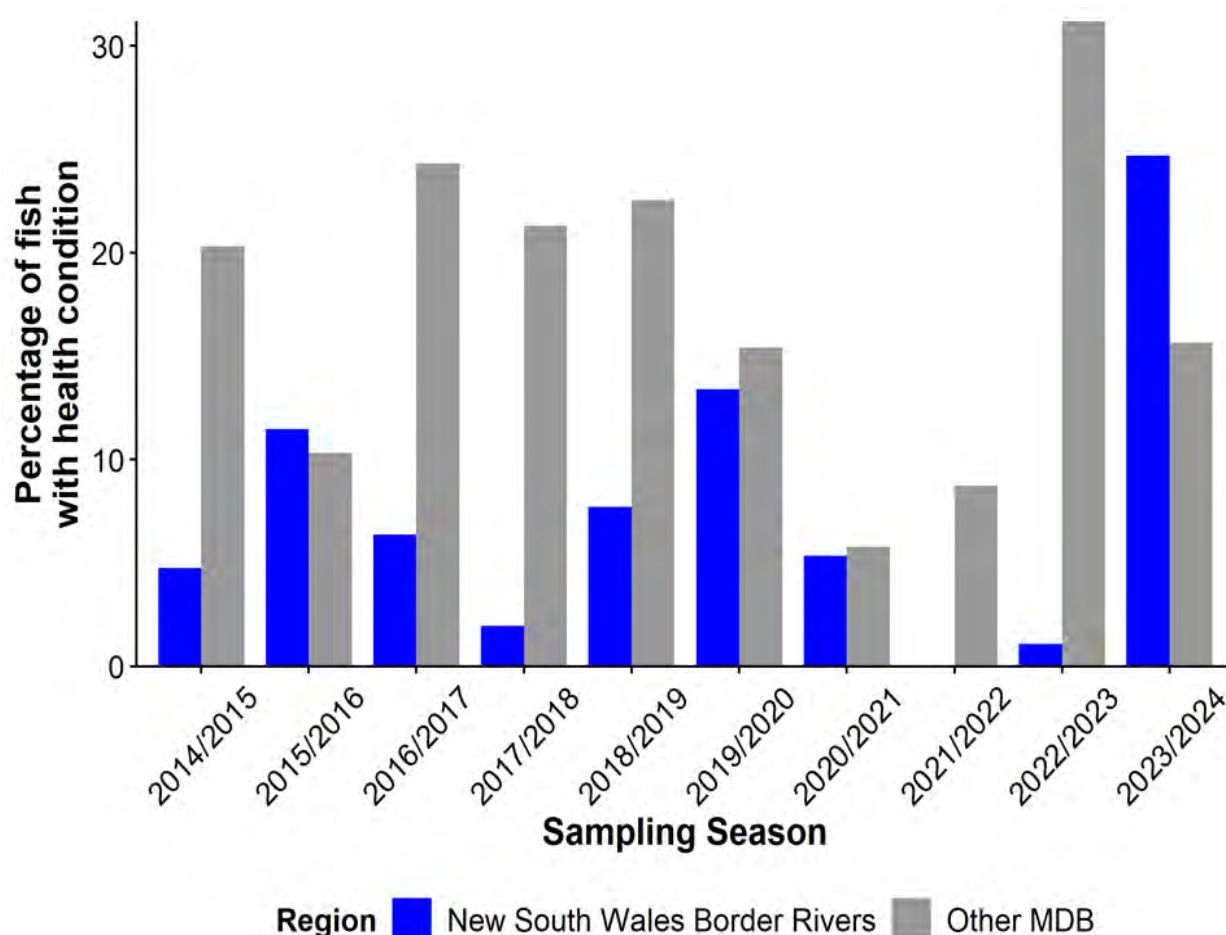


Figure 9.10: Timeseries showing the prevalence of health conditions in Murray cod. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA.

Summary Statement:

Presence of observable health conditions was variable across years with a moderate level of issues observed in 2023/24, the highest in the reporting period.

Distribution

Murray cod were recorded at 80 out of 117 sites in the New South Wales Border Rivers WRPAs from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 6.4 fish caught per 90 seconds of electrofishing. Figure 9.11 shows the distribution and relative abundance of Murray cod across the New South Wales Border Rivers WRPAs.

Summary Statement:

Murray cod were recorded across the eastern portion of the NSW Border Rivers WRPAs but less abundant or absent in western sites.

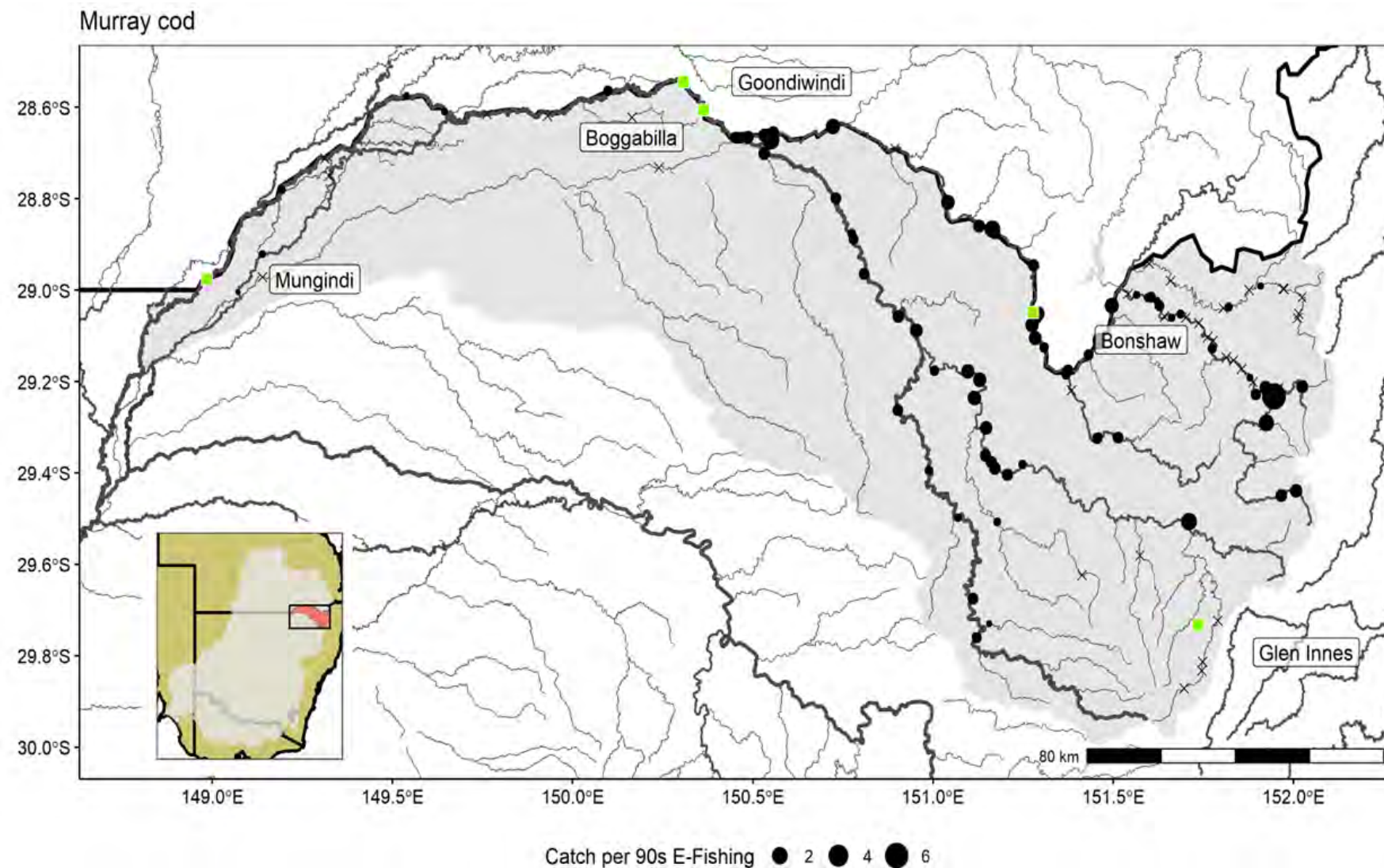


Figure 9.11: Distribution of Murray cod sampled from 2013/14 to 2023/24 in the NSW Border Rivers WRPA. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares represent key towns.

Golden perch



Population Structure

Figure 9.12 shows the observed length frequency plot for Golden perch for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 0 to 12, and 0 % to 21 % of measured fish within a season, with a mean percentage YOY of 4 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Golden perch was 8 % (631 out of 7,767).

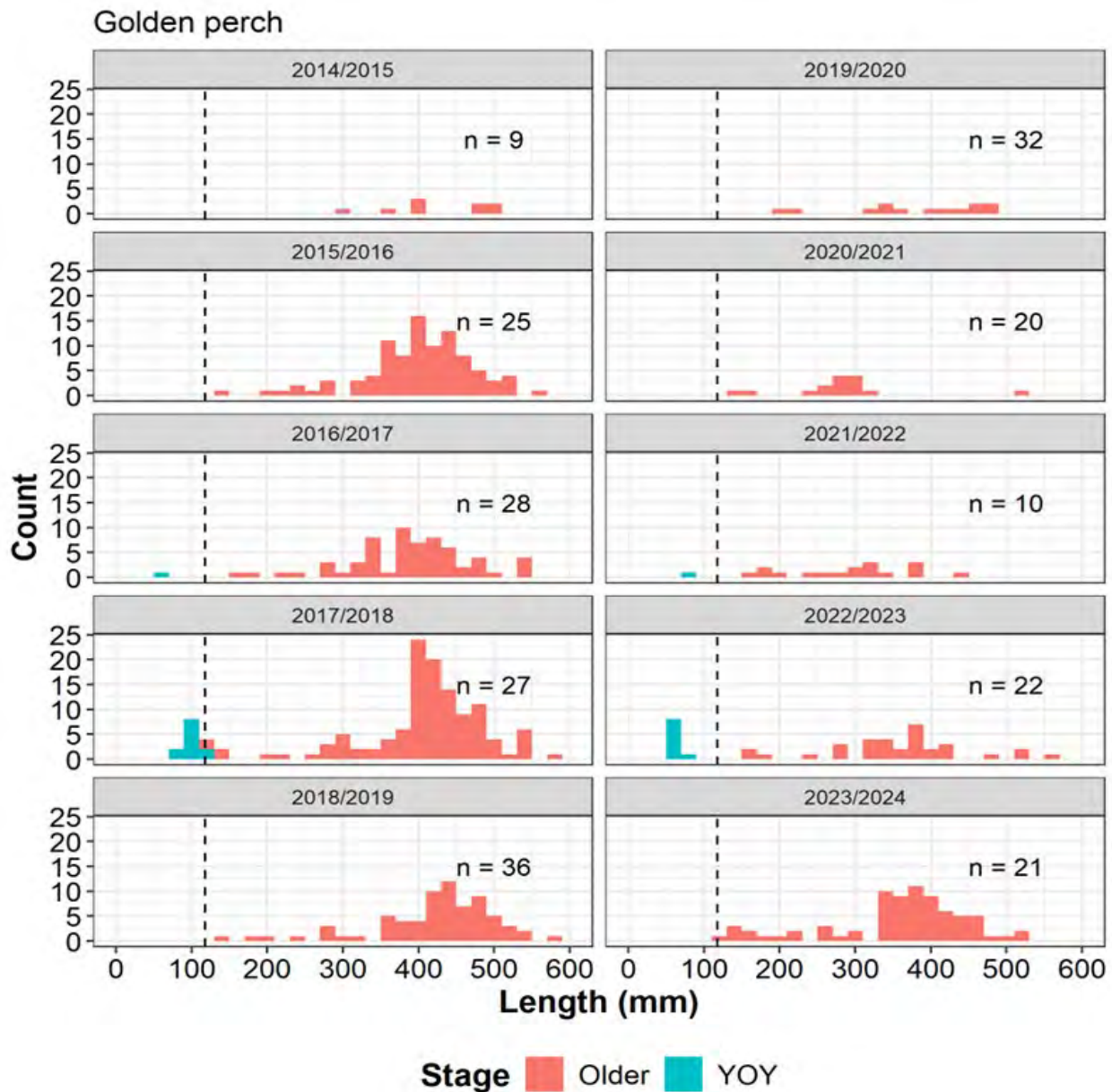


Figure 9.12: Length frequency plots for Golden perch by sampling season in the NSW Border Rivers WRP. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRP in a sampling season.

Summary Statement:

Limited recruitment with Young of the Year fish only evident in 2017/18 and 2022/23. A good range of size fish were observed in 2023/24 but no evidence of recruitment.

Stocking

A total of 343,950 Golden perch were stocked into the waterways of the New South Wales Border Rivers WRPA during the reporting period. Of these fish, 208,297 (60.6 %) were stocked into impoundments while 135,653 (39.4 %) were stocked into rivers or creeks. Table 9.5 shows the detailed breakdown of stocking by season, location and life stage while Figure 9.13 shows the locations of stocking. Details on annual stocking locations are provided in the Appendix (**Error! Reference source not found.**).

Table 9.5: Number and life stage of stocked Golden perch each sampling season in the NSW Border Rivers WRPA.

Sampling Season	River/Creek or Impoundment	Life Stage	Number Stocked
2014/2015	Impoundment	Fry	5,273
2014/2015	River/Creek	Fry	37,919
2015/2016	Impoundment	Fry	1,906
2015/2016	River/Creek	Fry	39,638
2016/2017	Impoundment	Fingerling	1,285
2016/2017	Impoundment	Fry	30,000
2016/2017	River/Creek	Fingerling	15,612
2017/2018	Impoundment	Fry	41,000
2017/2018	River/Creek	Fry	5,000
2020/2021	Impoundment	Fry	32,555
2020/2021	River/Creek	Fry	20,012
2022/2023	Impoundment	Fry	50,000
2023/2024	Impoundment	Fingerling	46,278
2023/2024	River/Creek	Fingerling	17,472

Golden perch stocking

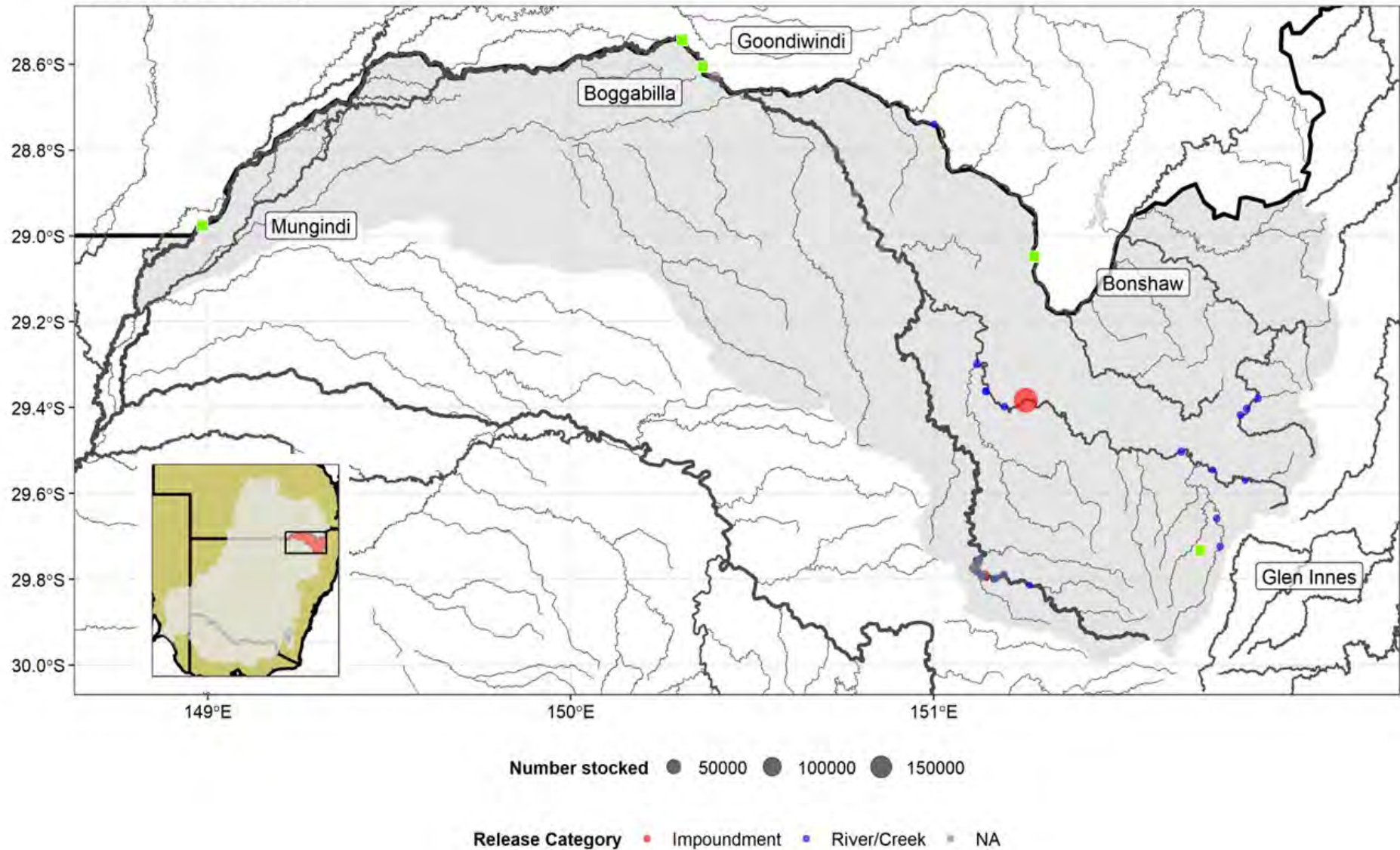


Figure 9.13: Locations of Golden perch stocking in the NSW Border Rivers WRP. Colours show whether a site was a river/creek site or an impoundment, while the size of the point reflects the total number of fish stocked over the reporting period. Green squares represent key towns.

Temporal Trends in Abundance

The relative abundance and biomass of Golden perch since 1994 was modelled based on all suitable boat electrofishing data. The left-hand panels of Figure 9.14 show the abundance and biomass trends for the New South Wales Border Rivers WRP and the right-hand panels show the overall trends across the NSW MDB.

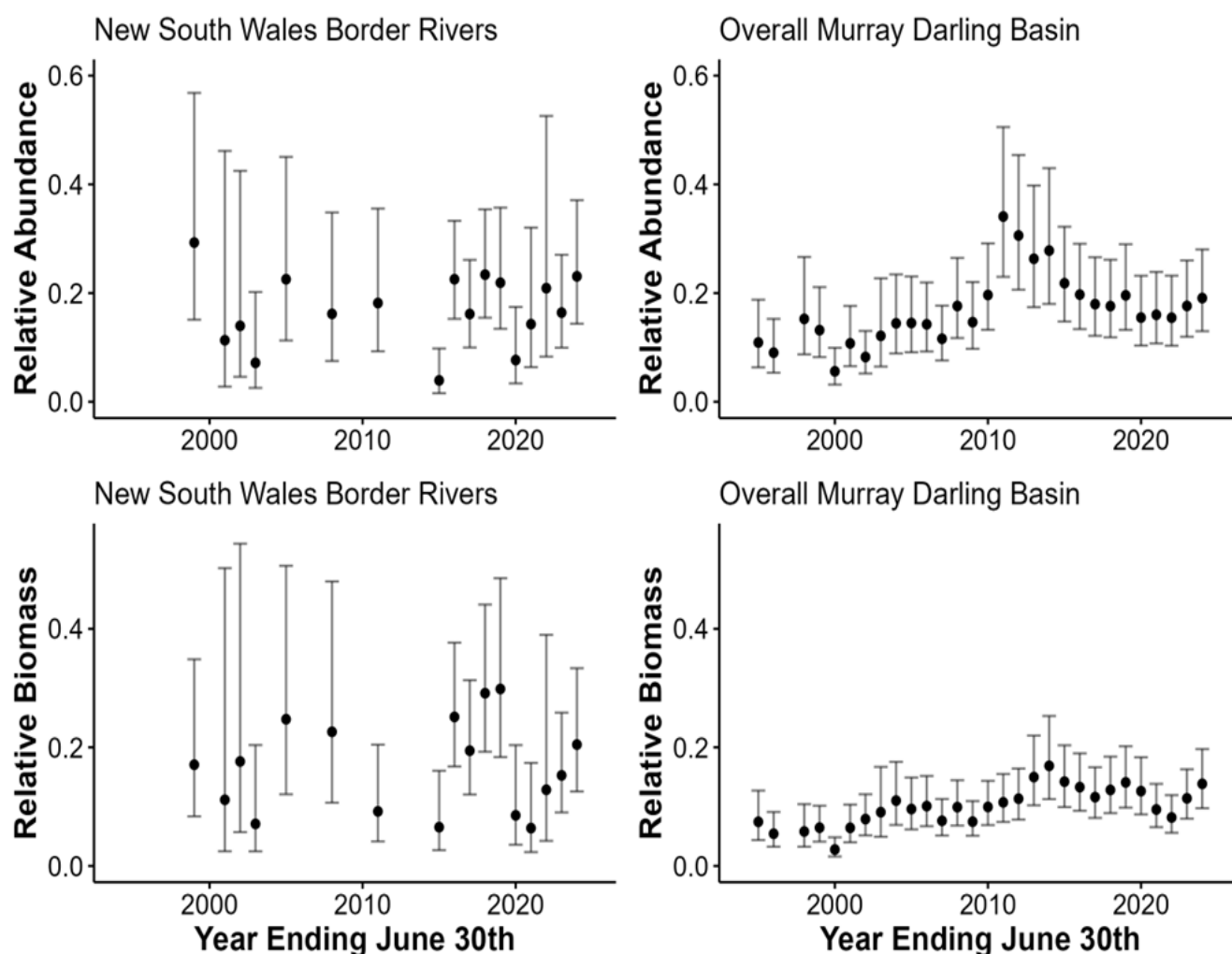


Figure 9.14: Relative abundance and biomass of Golden perch in both this valley and the overall Murray-Darling Basin. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates.

Summary Statement:

For Golden perch in the New South Wales Border Rivers, abundance and biomass appear to have been variable over the past 25 years. Abundance and biomass are both currently trending upwards and are likely slightly higher than the overall NSW MDB.

Health

The prevalence of any health issues ranged from 0 % of sampled fish in 2014/2015 to 33 % of sampled fish in 2023/2024 (Figure 9.15). The most common health issue for Golden perch in the New South Wales Border Rivers water resource planning area was *Lernaea*, which was observed in a total of 60 fish, corresponding to 11% of all Golden perch measured.

Across the other WRPA's, 26 % of Golden perch (2,013 out of 7,767 Golden perch) showed a health condition (excludes New South Wales Border Rivers).

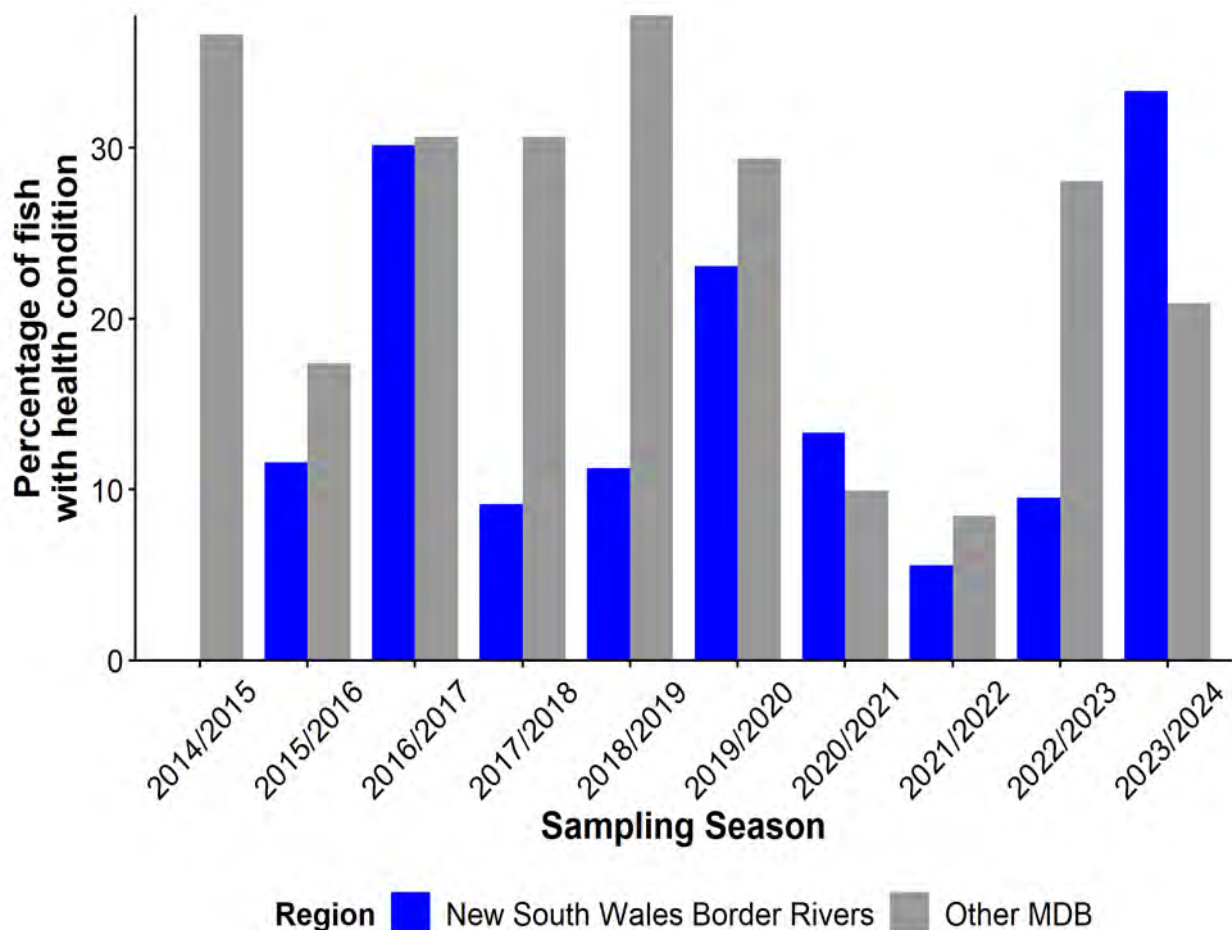


Figure 9.15: Timeseries showing the prevalence of health conditions in Golden perch. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA's.

Summary Statement:

The presence of observable health conditions for Golden perch in the NSW Border Rivers was variable and ranged from none to moderate. 2023/24 showed the highest proportion of reported health issues in the reporting period.

Distribution

Golden perch were recorded at 56 out of 117 sites in the New South Wales Border Rivers WRPA from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 0.7 fish caught per 90 seconds of electrofishing. Figure 9.16 shows the distribution and relative abundance of Golden perch across the New South Wales Border Rivers WRPA.

Summary Statement:

Golden perch were generally present across the NSW Border Rivers region.

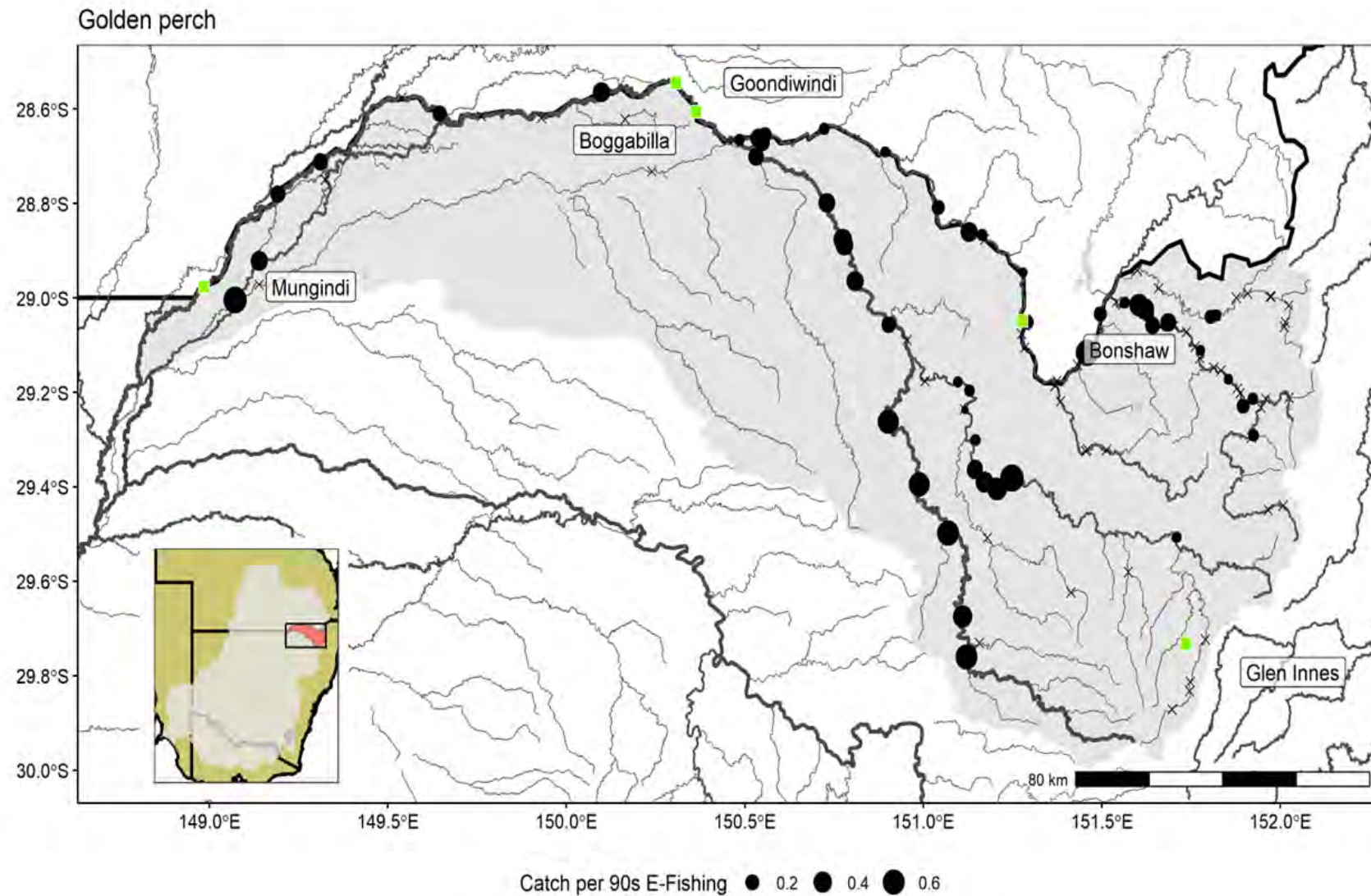


Figure 9.16: Distribution of Golden perch sampled from 2013/14 to 2023/24 in the NSW Border Rivers WRP. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares represent key towns.

Freshwater catfish



Population Structure

Figure 9.17 shows the observed length frequency plot for Freshwater catfish for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 4 to 47, and 9 % to 66 % of measured fish within a season, with a mean percentage YOY of 38 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Freshwater catfish was 41 % (264 out of 641).

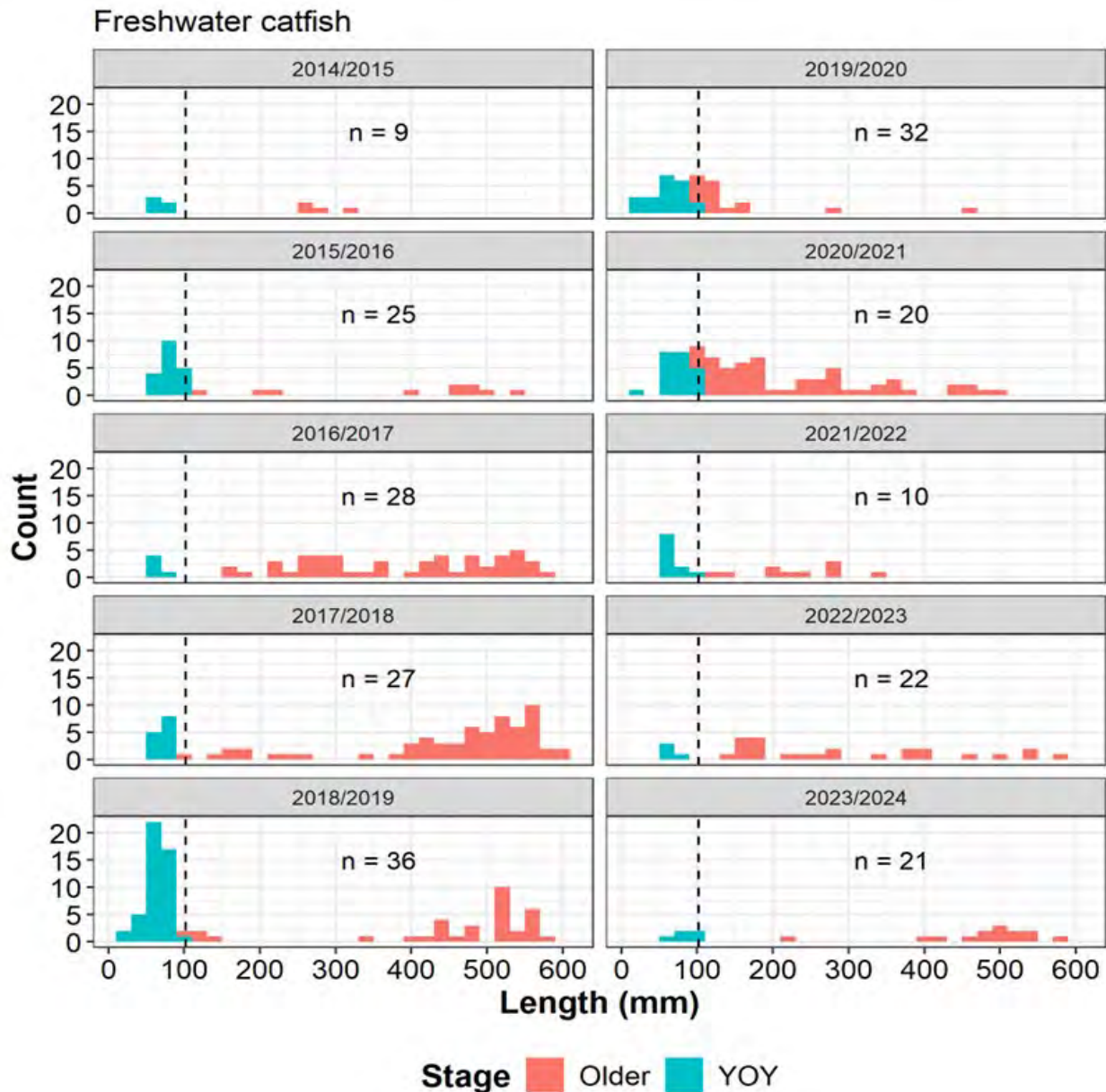


Figure 9.17: Length frequency plots for Freshwater catfish by sampling season in the NSW Border Rivers WRPA. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRPA in a sampling season.

Summary Statement:

Regular recruitment with YOY observed in all years. Strong recruitment was evident from 2018/19 – 2020/21. 2022/23 and 2023/24 both show a range of size classes but possible weak recruitment.

Temporal Trends in Abundance

The relative abundance and biomass of Freshwater catfish since 1994 was modelled based on all suitable boat electrofishing data. The left-hand panels of Figure 9.18 show the abundance and biomass trends for the New South Wales Border Rivers WRPA and the right-hand panels show the overall trends across the NSW MDB.

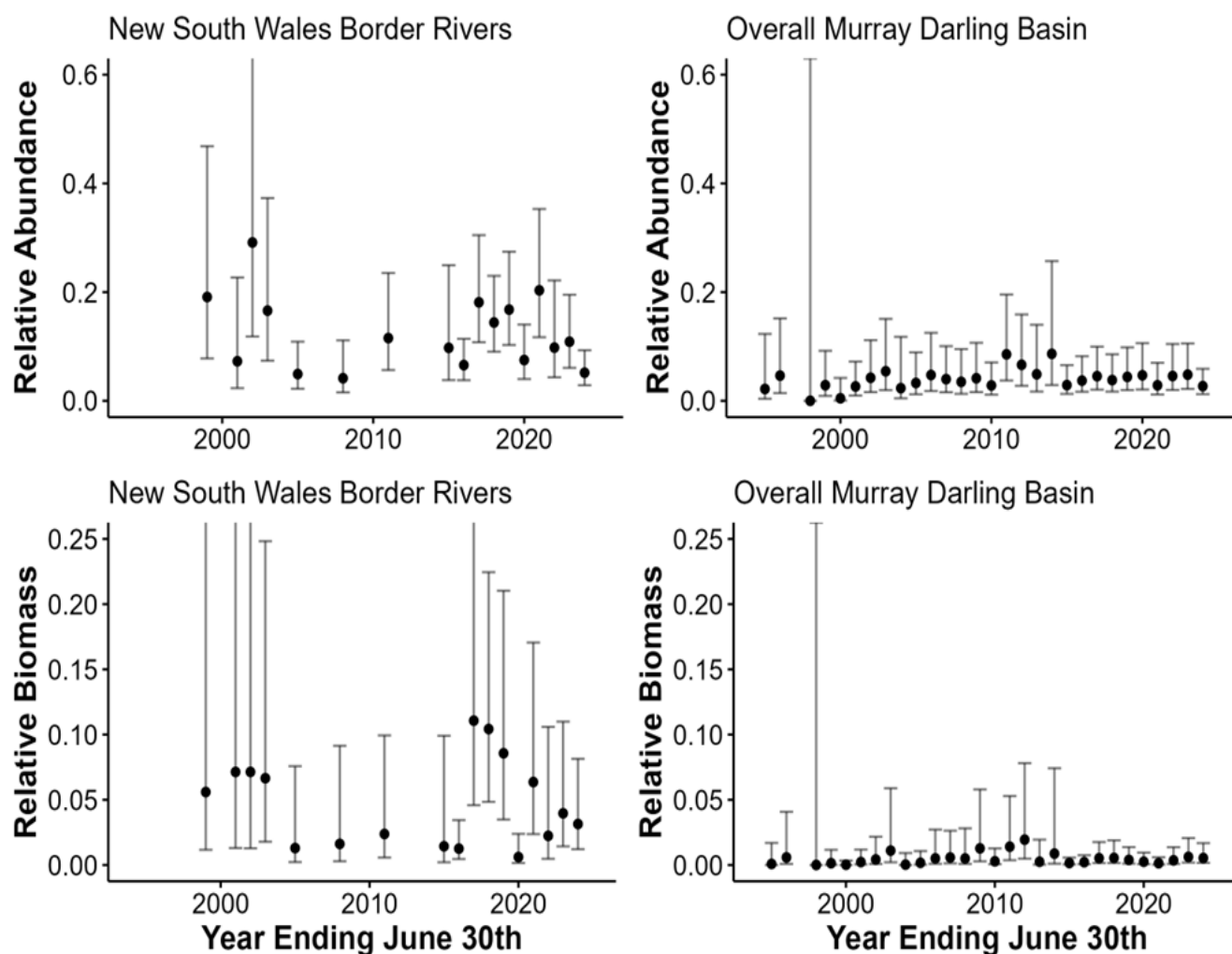


Figure 9.18: Relative abundance and biomass of Freshwater catfish in both this valley and the overall Murray-Darling Basin. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates.

Summary Statement:

Abundance of Freshwater catfish is at a low level compared to recent history but biomass appears stable. Recent abundance and biomass are slightly higher than the overall NSW MDB.

Health

The prevalence of any health issues ranged from 0 % of sampled fish in most years to 11 % of sampled fish in 2023/2024 (Figure 9.19). The most common health issue for Freshwater catfish in the New South Wales Border Rivers water resource planning area was *Lernaea*, which was observed in a total of 3 fish, corresponding to 1 % of all Freshwater catfish measured.

Across the other WRPAs, 2 % of Freshwater catfish (13 out of 641 Freshwater catfish) showed a health condition (excludes New South Wales Border Rivers).

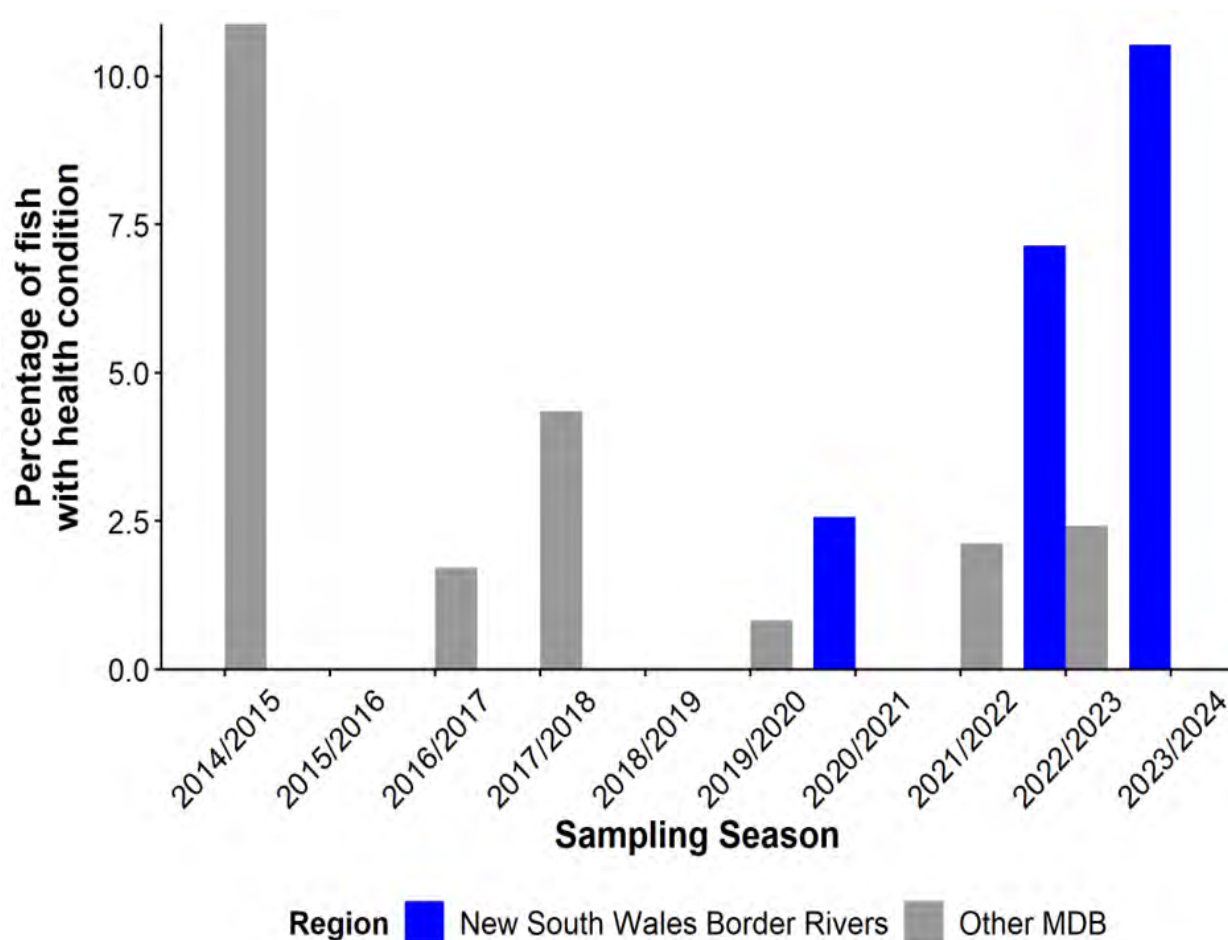


Figure 9.19: Timeseries showing the prevalence of health conditions in Freshwater catfish. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPAs.

Summary Statement:

The presence of observable health conditions for Freshwater catfish in the NSW Border Rivers was overall low except for 2022/23 and 2023/24 where the NSW Border Rivers showed a higher amount of health issues than the wider NSW MDB.

Distribution

Freshwater catfish were recorded at 67 out of 117 sites in the New South Wales Border Rivers WRPAs from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 2.1 fish caught per 90 seconds of electrofishing. Figure 9.20 shows the distribution and relative abundance of Freshwater catfish across the New South Wales Border Rivers WRPAs.

Summary Statement:

Freshwater catfish were generally recorded in the eastern NSW Border Rivers region.

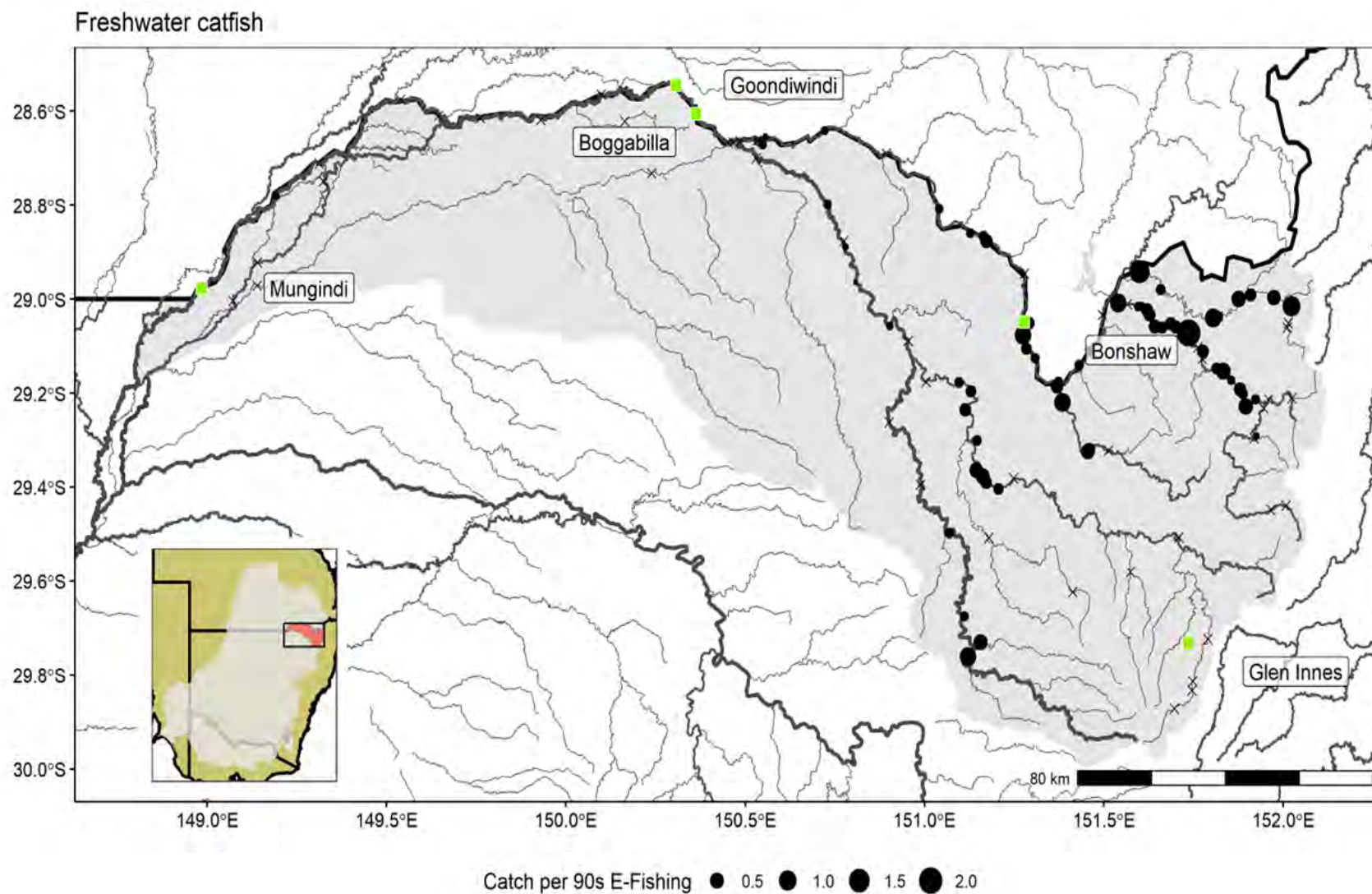


Figure 9.20: Distribution of Freshwater catfish sampled from 2013/14 to 2023/24 in the NSW Border Rivers WRP. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares represent key towns.

Bony herring



Population Structure

Figure 9.21 shows the observed length frequency plot for Bony herring for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 0 to 388, and 0 % to 42 % of measured fish within a season, with a mean percentage YOY of 15 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Bony herring was 25 % (12,724 out of 51,118). Bony herring are not a stocked species.

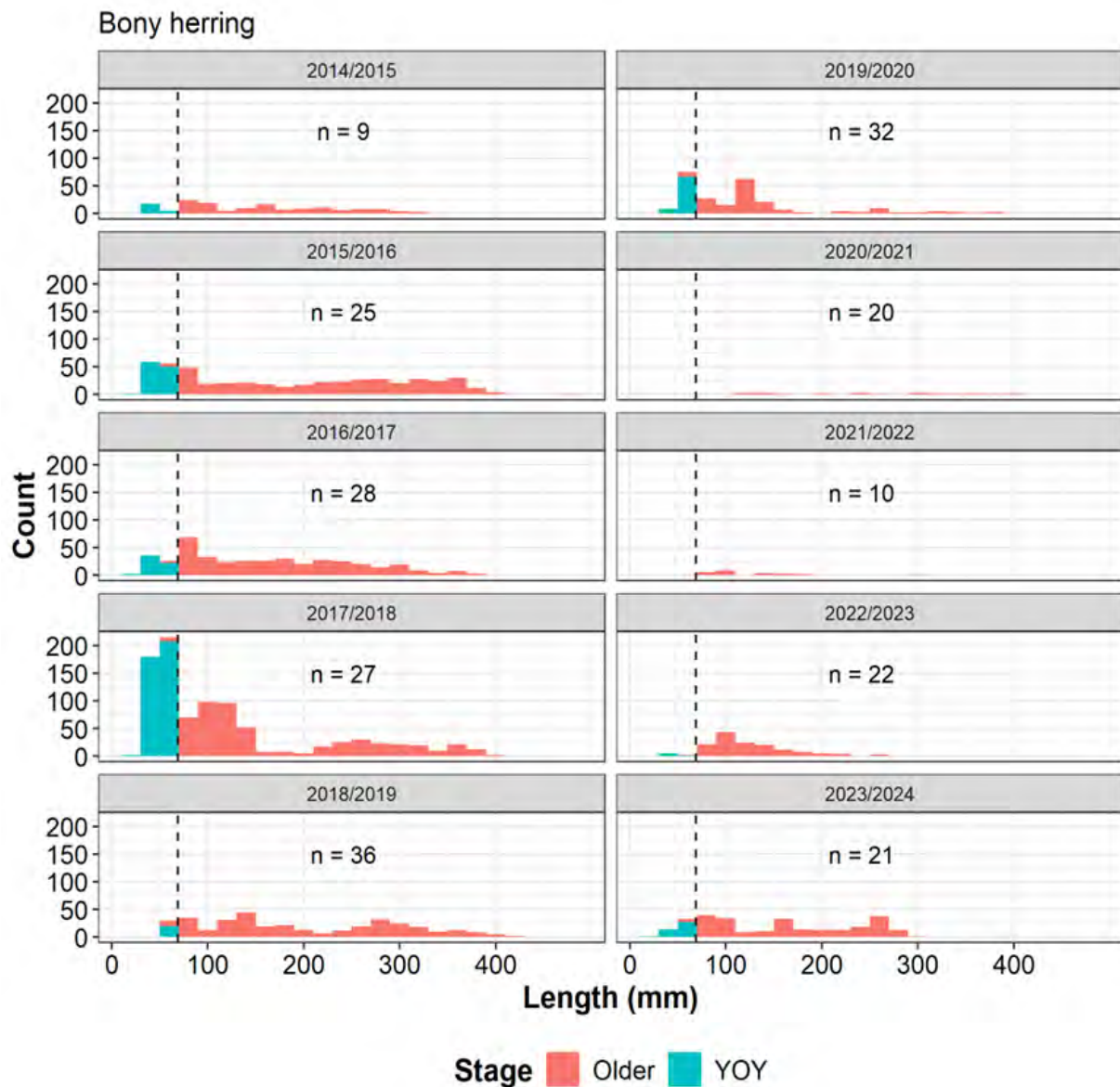


Figure 9.21: Length frequency plots for Bony herring by sampling season in the NSW Border Rivers WRPA. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRPA in a sampling season.

Summary Statement:

Sporadic recruitment with a small amount of recruitment evident in 2023/24 following 3 years of low/no recruitment. A good range of size classes were observed in 2023/24.

Temporal Trends in Abundance

The relative abundance and biomass of Bony herring since 1994 was modelled based on all suitable boat electrofishing data. The left-hand panels of Figure 9.22 show the abundance and biomass trends for the New South Wales Border Rivers WRPA and the right-hand panels show the overall trends across the NSW MDB.

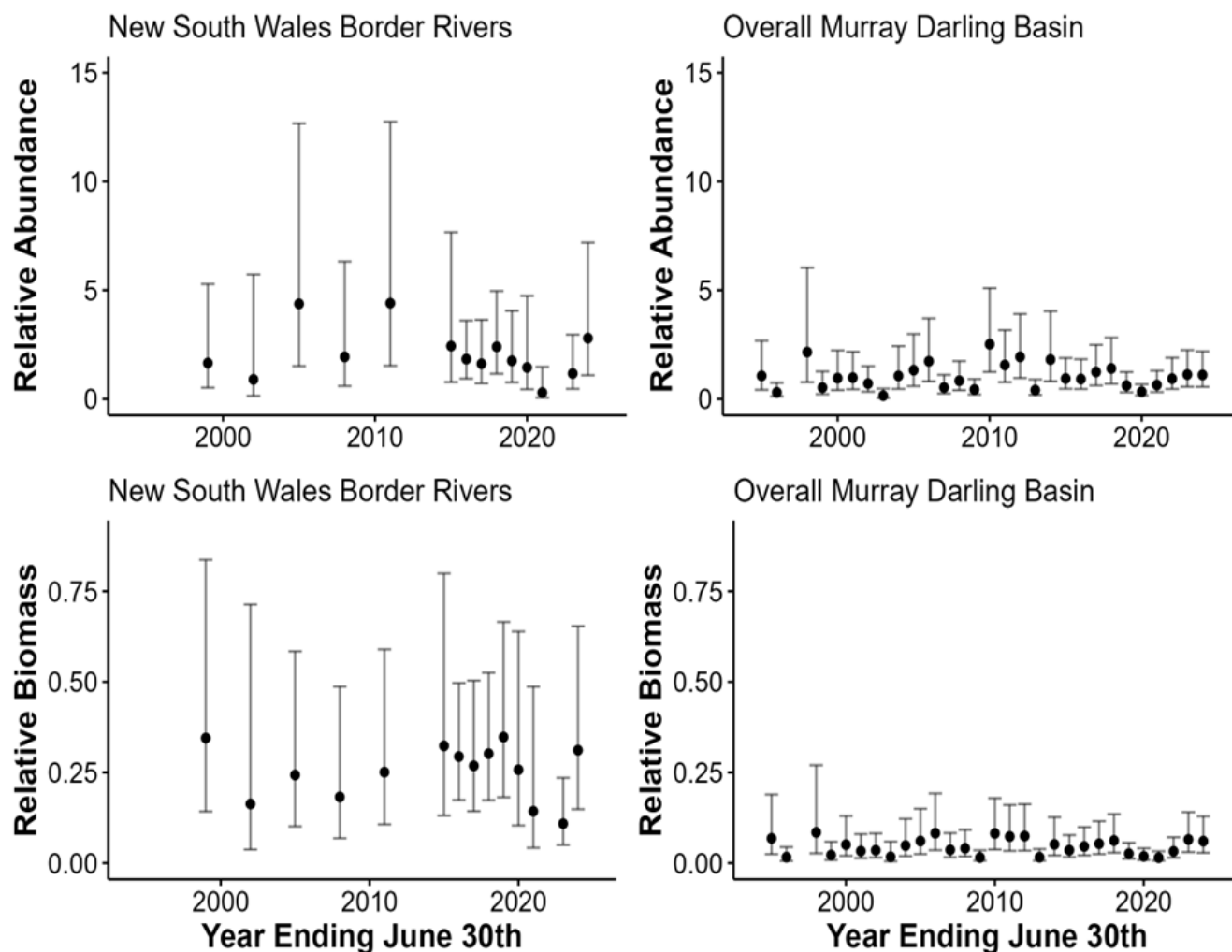


Figure 9.22: Relative abundance and biomass of Bony herring in both the NSW Border Rivers and the overall NSW MDB. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates.

Summary Statement:

Abundance and biomass have been relatively stable since the early 2000s but abundance is currently trending upwards since 2021. Recent abundance and biomass are higher than the overall NSW MDB.

Health

The prevalence of any health issues ranged from 0 % of sampled fish in most years to 7 % of sampled fish in 2014/2015 (Figure 9.23). The most common health issue for Bony herring in the New South Wales Border Rivers WRPAs was Ulcers, which was observed in a total of 9 fish, corresponding to <1 % of all Bony herring measured.

Across the other NSW MDB WRPA, 1 % of Bony herring (531 out of 51,119 Bony herring) showed a health condition (excludes the New South Wales Border Rivers WRPAs).

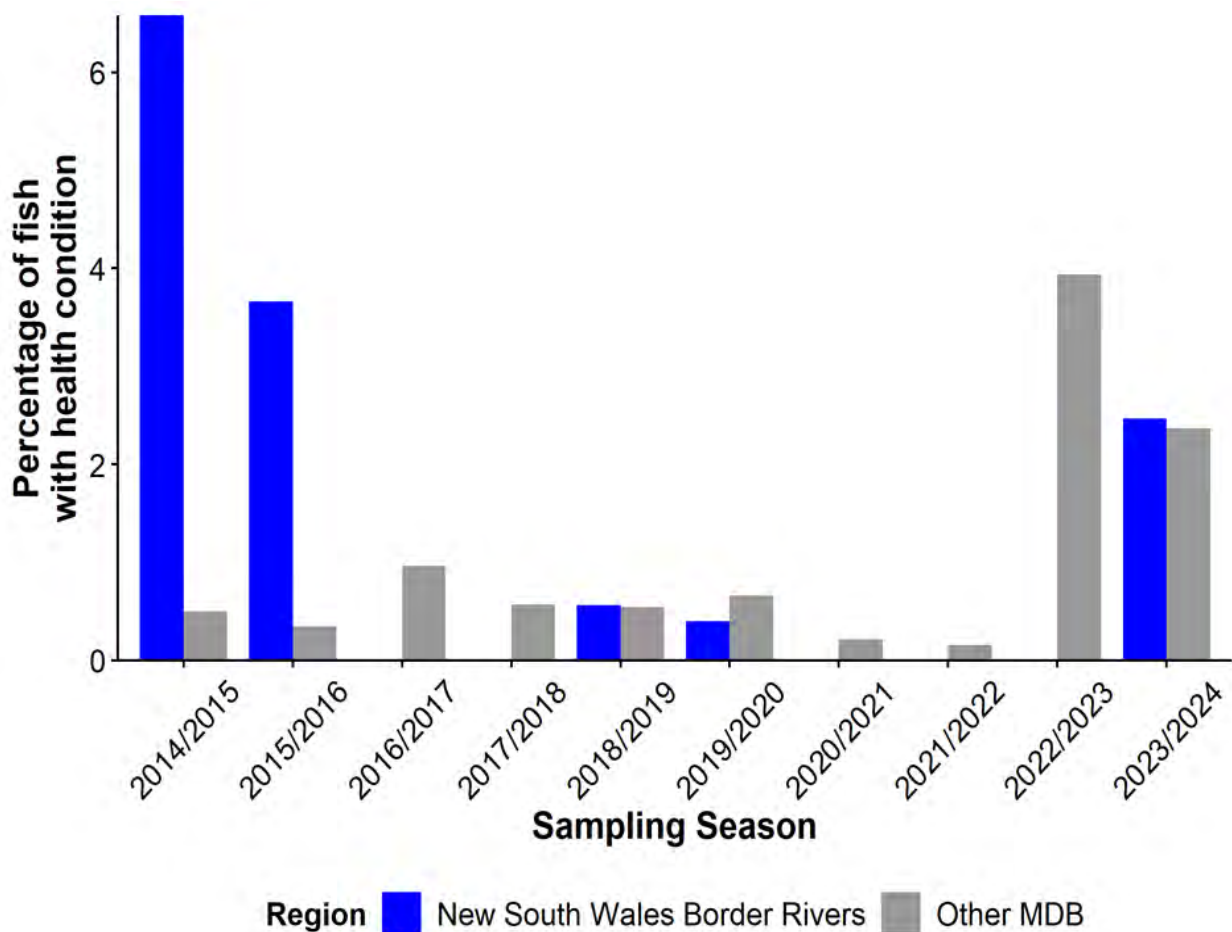


Figure 9.23: Timeseries showing the prevalence of health conditions in Bony herring. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA.

Summary Statement:

Presence of observable health conditions was low or absent in all years. A low number of health conditions were observed in 2023/24.

Distribution

Bony herring were recorded at 39 out of 117 sites in the New South Wales Border Rivers WRPAs from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 64.9 fish caught per 90 seconds of electrofishing. Figure 9.24 shows the distribution and relative abundance of Bony herring across the New South Wales Border Rivers WRPAs.

Summary Statement:

Bony herring were recorded across the western half NSW Border Rivers WRPAs but appear to be absent or in low eastern region (except the Dumaresq River).

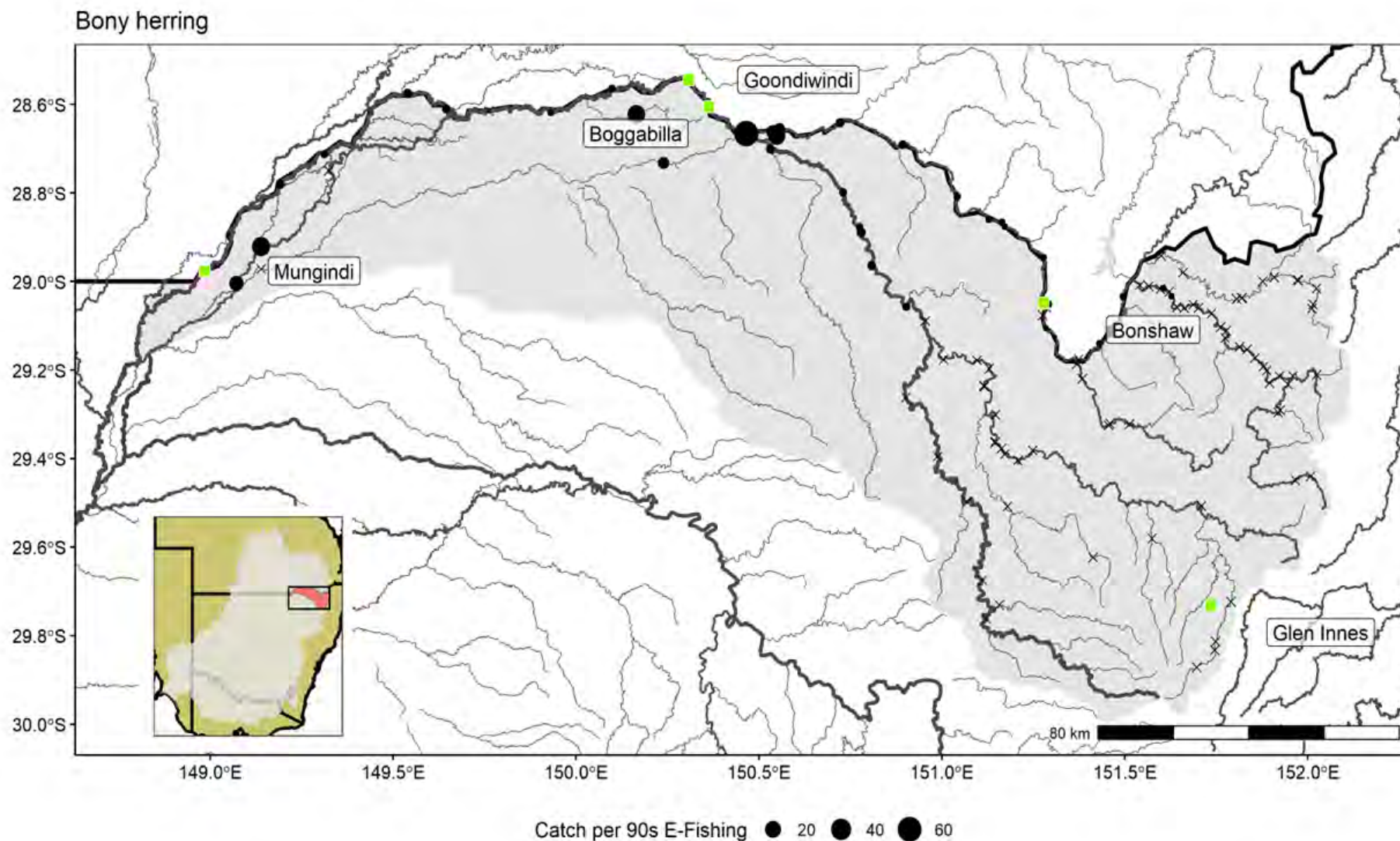


Figure 9.24: Distribution of Bony herring sampled from 2013/14 to 2023/24 in the NSW Border Rivers WRPA. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares represent key towns.

Australian smelt



Population Structure

Figure 9.25 shows the observed length frequency plot for Australian smelt for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 0 to 78, and 0 % to 76 % of measured fish within a season, with a mean percentage YOY of 27 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Australian smelt was 41 % (11,328 out of 27,379). Australian smelt are not a stocked species.

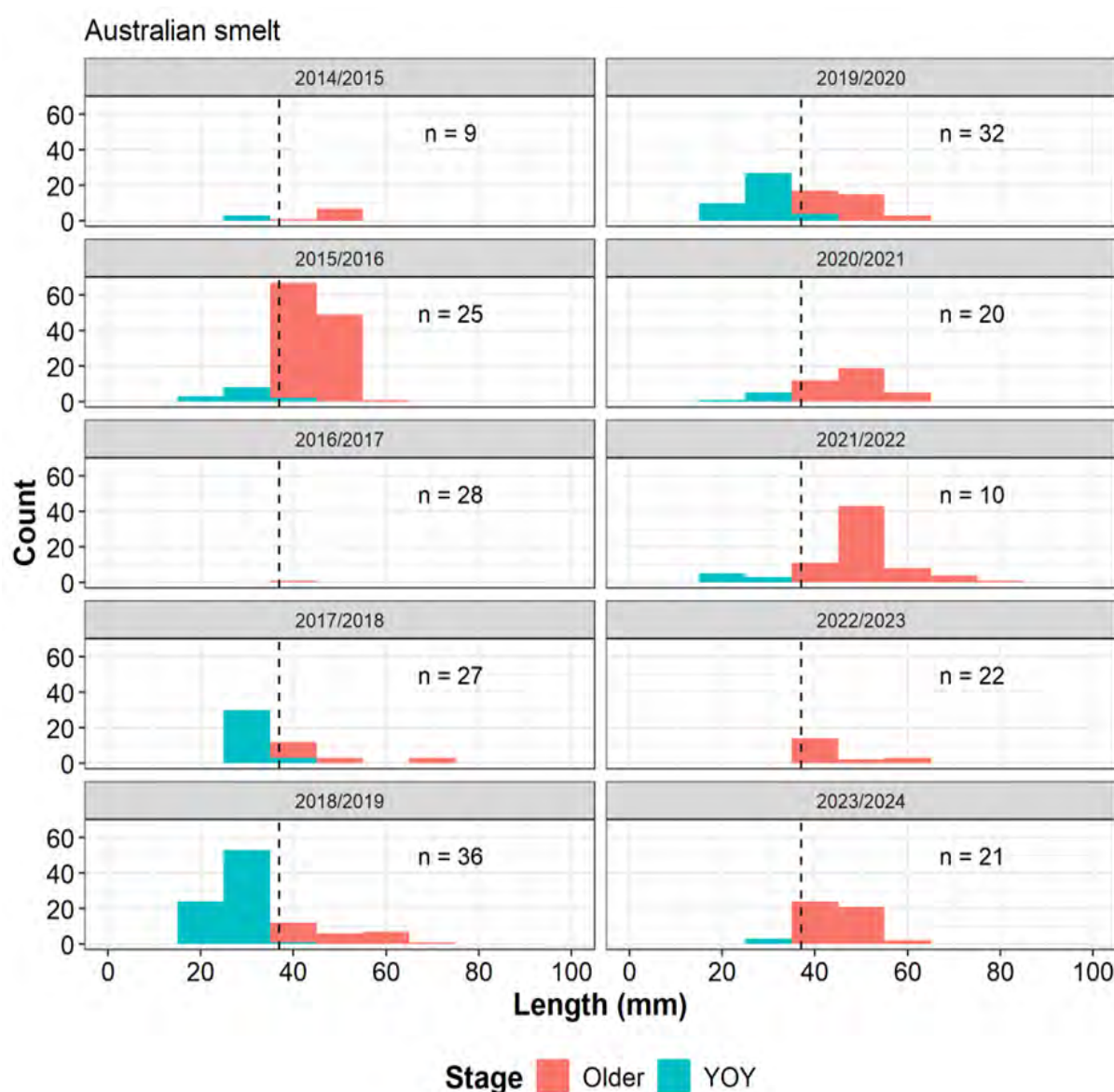


Figure 9.25: Length frequency plots for Australian smelt by sampling season in the NSW Border Rivers WRPA. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRPA in a sampling season.

Summary Statement:

Variable numbers of YOY with likely recruitment failure in 2016/17 and 2022/23. Low recruitment in 2023/24.

Temporal Trends in Abundance

The relative abundance of Australian smelt since 1994 was modelled based on all suitable boat electrofishing data. The left-hand panel of Figure 9.26 show the abundance trends for the New South Wales Border Rivers WRPA and the right-hand panel show the overall trend across the NSW MDB.

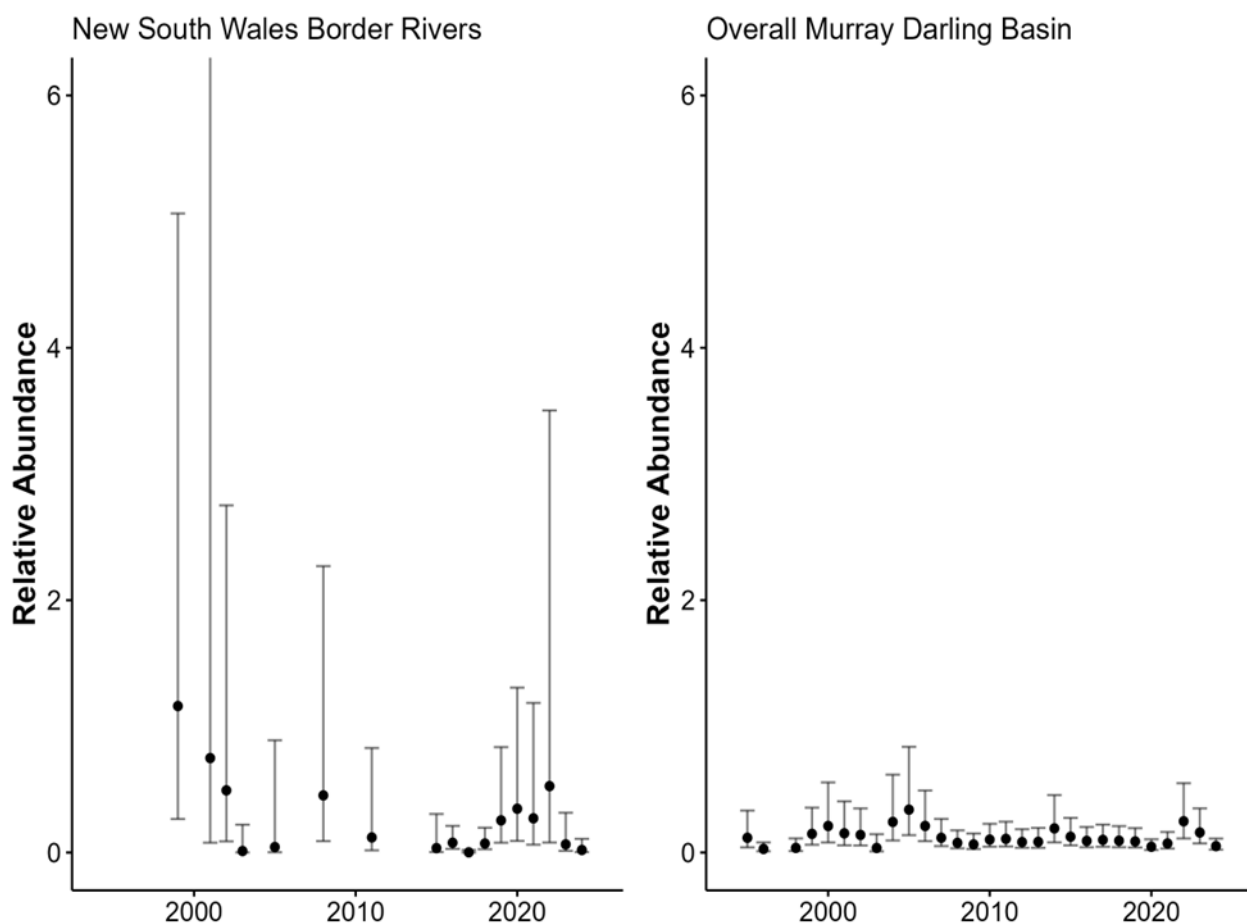


Figure 9.26: Relative abundance of Australian smelt in both the NSW Border Rivers WRPA and the overall NSW MDB. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates. No modelling of biomass was done for Australian smelt.

Summary Statement:

While the data is variable, there is evidence of a likely decline in abundance since the early 2000s. Abundance is likely similar to the overall NSW MDB.

Health

The prevalence of any health issues ranged from 0 % of sampled fish in most years to 9 % of sampled fish to 2014/2015 (Figure 9.27). The most common health issue for Australian smelt in the New South Wales Border Rivers WRPAs was *Lernaea*, which was observed in a total of 1 fish, corresponding to <1 % of all Australian smelt measured.

Across the other NSW MDB WRPA's, 1 % of Australian smelt (173 out of 27,381 Australian smelt) showed a health condition (excludes the New South Wales Border Rivers WRPAs).

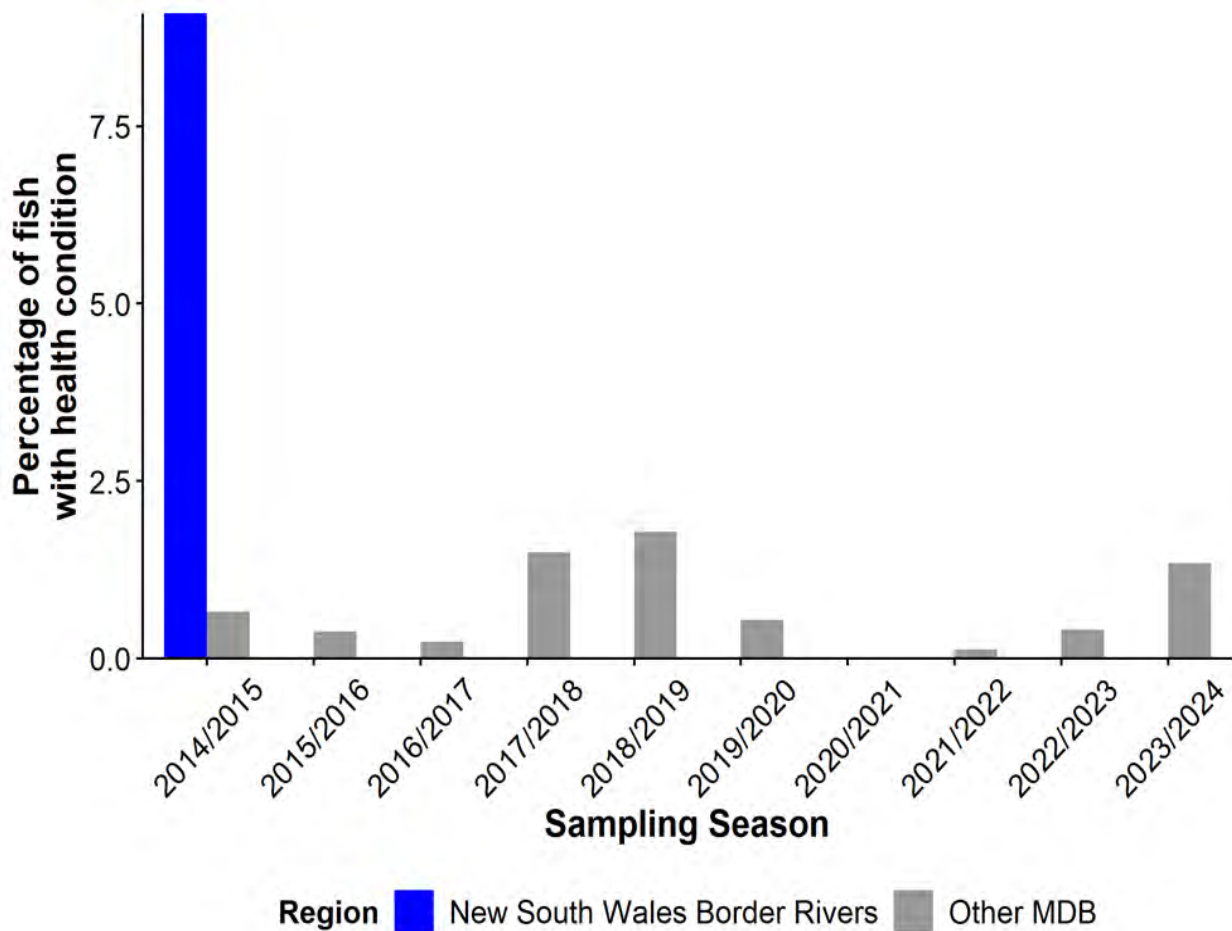


Figure 9.27: Timeseries showing the prevalence of health conditions in Australian smelt. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA's.

Summary Statement:

No health issues have been reported for Australian smelt in the NSW Border Rivers since 2014/15.

Distribution

Australian smelt were recorded at 39 out of 117 sites in the New South Wales Border Rivers WRPA from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 4.9 fish caught per 90 seconds of electrofishing. Figure 9.28 shows the distribution and relative abundance of Australian smelt across the New South Wales Border Rivers WRPA.

Summary Statement:

Australian smelt were recorded across the eastern and central region of the NSW Border Rivers WRPA.

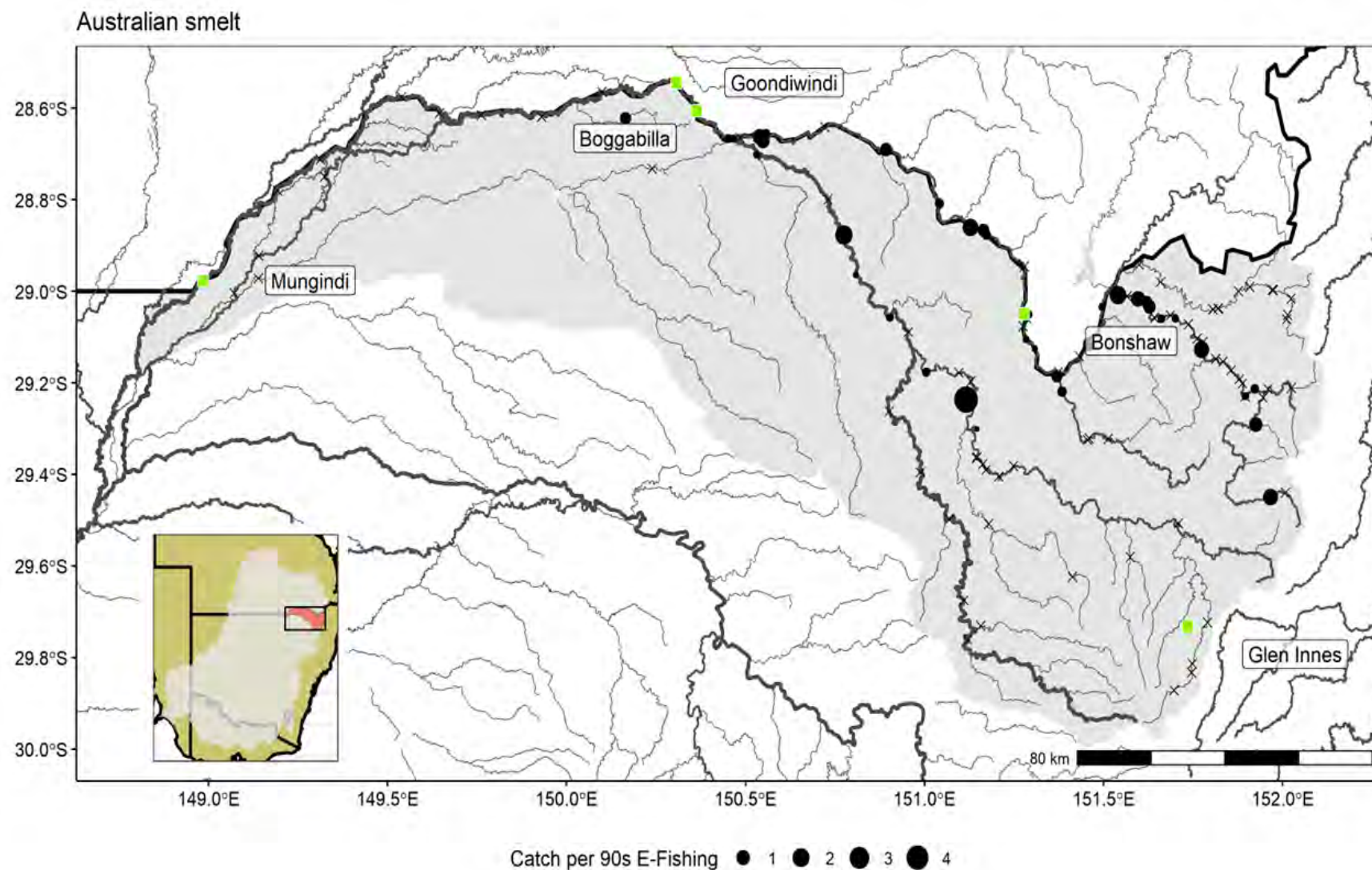


Figure 9.28: Distribution of Australian smelt sampled from 2013/14 to 2023/24 in the NSW Border Rivers WRPA. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares represent key towns.

Common carp



Population Structure

Figure 9.29 shows the observed length frequency plot for Common carp for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 6 to 88, and 4 % to 62 % of measured fish within a season, with a mean percentage YOY of 21 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Common carp was 56 % (35,112 out of 62,517). Common carp are not a stocked species.

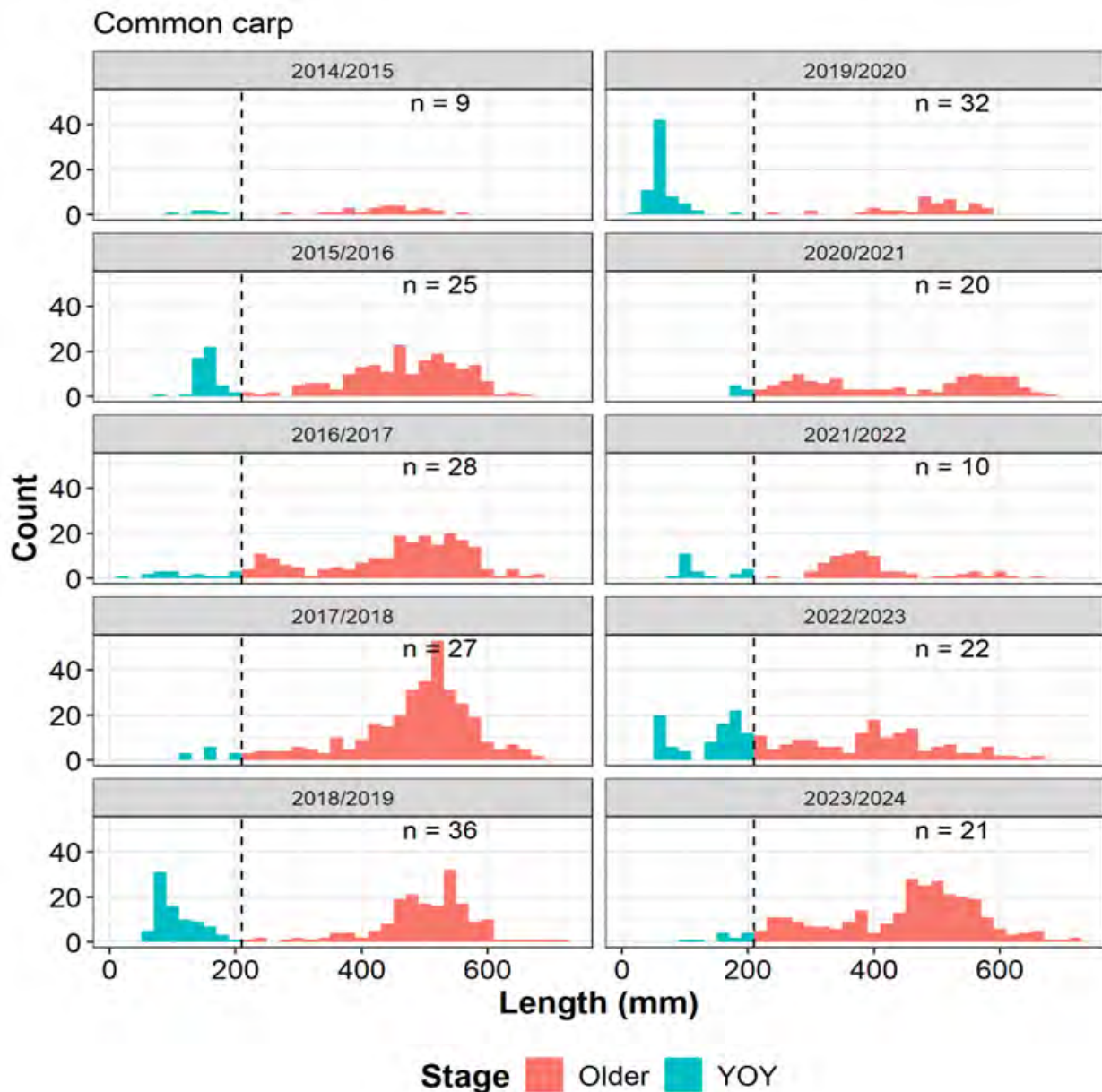


Figure 9.29: Length frequency plots for common carp by sampling season in the NSW Border Rivers WRPA. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRPA in a sampling season.

Summary Statement:

Variable recruitment with very strong peaks in 2015/16, 2018/19, 2019/20 and 2022/23. Large fish (>500 mm) present in all years. Low recruitment in 2023/24 with evidence of multiple cohorts.

Temporal Trends in Abundance

The relative abundance and biomass of Common carp since 1994 was modelled based on all suitable boat electrofishing data. The left-hand panels of Figure 9.30 show the abundance and biomass trends for the New South Wales Border Rivers WRPA and the right-hand panels show the overall trends across the NSW MDB.

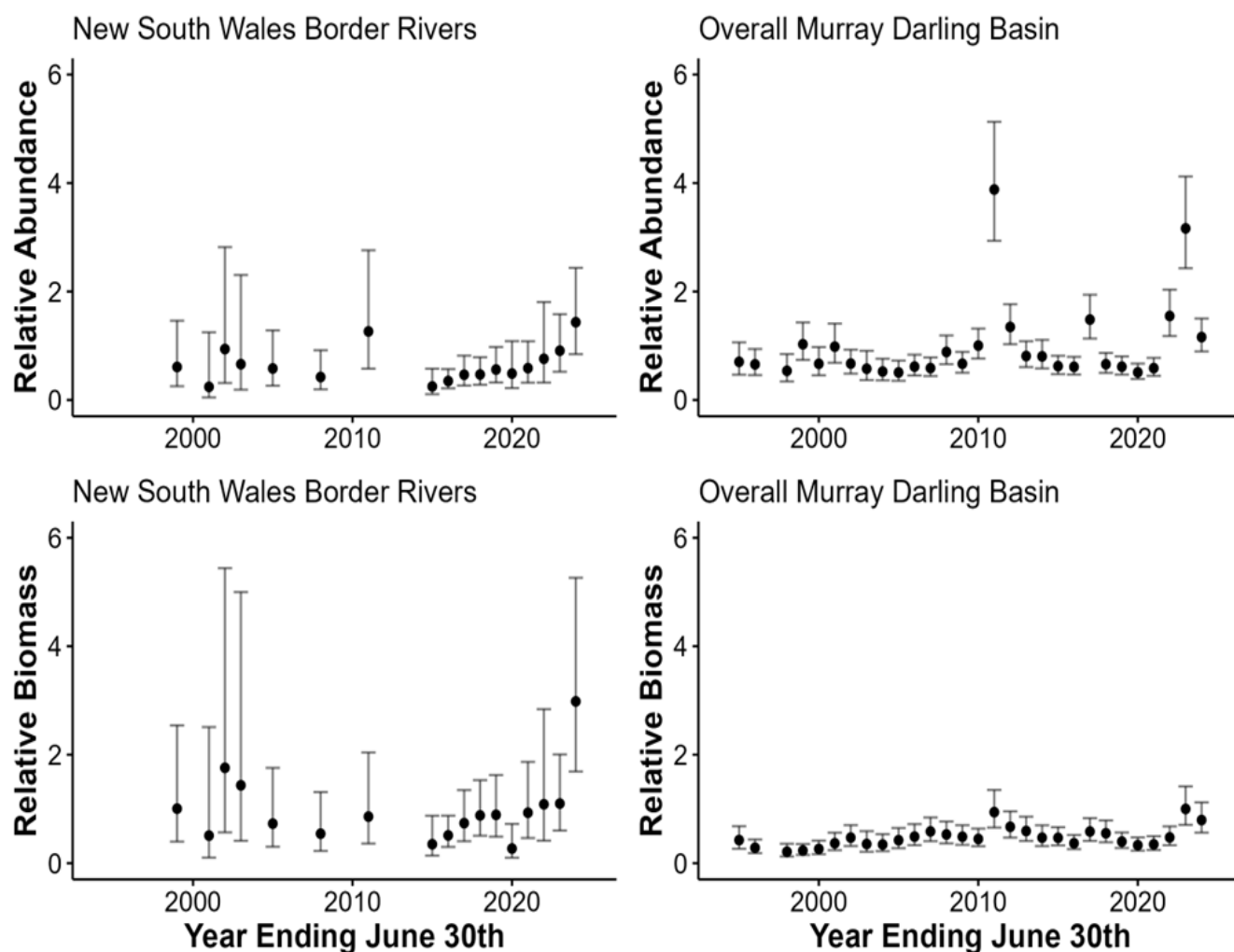


Figure 9.30: Relative abundance and biomass of Common carp in both this valley and the overall Murray-Darling Basin. These are model estimates based upon all electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates.

Summary Statement:

Abundance and Biomass both appear to be currently higher than levels in the early 2000s following recent strong recruitment. Unlike most other WRPAs, abundance and biomass of carp did not decline in 2023/24.

Health

The prevalence of any health issues ranged from 0 % of sampled fish in 2021/2022 to 5 % of sampled fish in 2018/2019 (Figure 9.31). The most common health issue for Common carp in the New South Wales Border Rivers water resource planning area was *Lernaea*, which was observed in a total of 18 fish, corresponding to 1 % of all Common carp measured.

Across the other WRPA's, 4 % of Common carp (2,375 out of 62,519 Common carp) showed a health condition (excludes New South Wales Border Rivers).

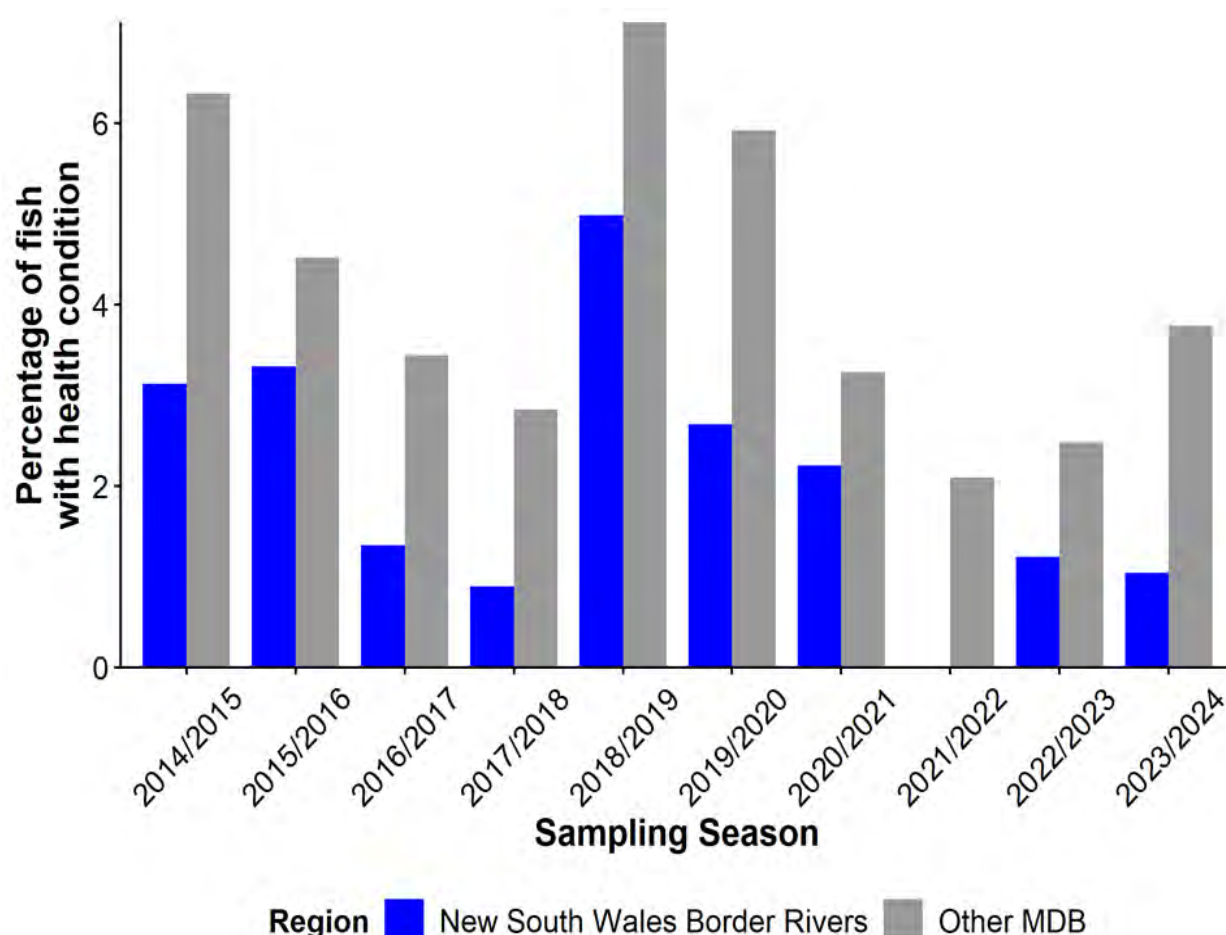


Figure 9.31: Timeseries showing the prevalence of health conditions in Common carp. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA's.

Summary Statement:

The presence of observable health conditions for Common carp in the NSW Border Rivers was very low to low in all years and generally similar to the wider NSW MDB.

Distribution

Common carp were recorded at 70 out of 117 sites in the New South Wales Border Rivers WRP from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 3.9 fish caught per 90 seconds of electrofishing. Figure 9.32 shows the distribution and relative abundance of Common carp across the New South Wales Border Rivers WRP.

Summary Statement:

Common carp were found across the NSW Border Rivers region except for some areas of the eastern upland region.

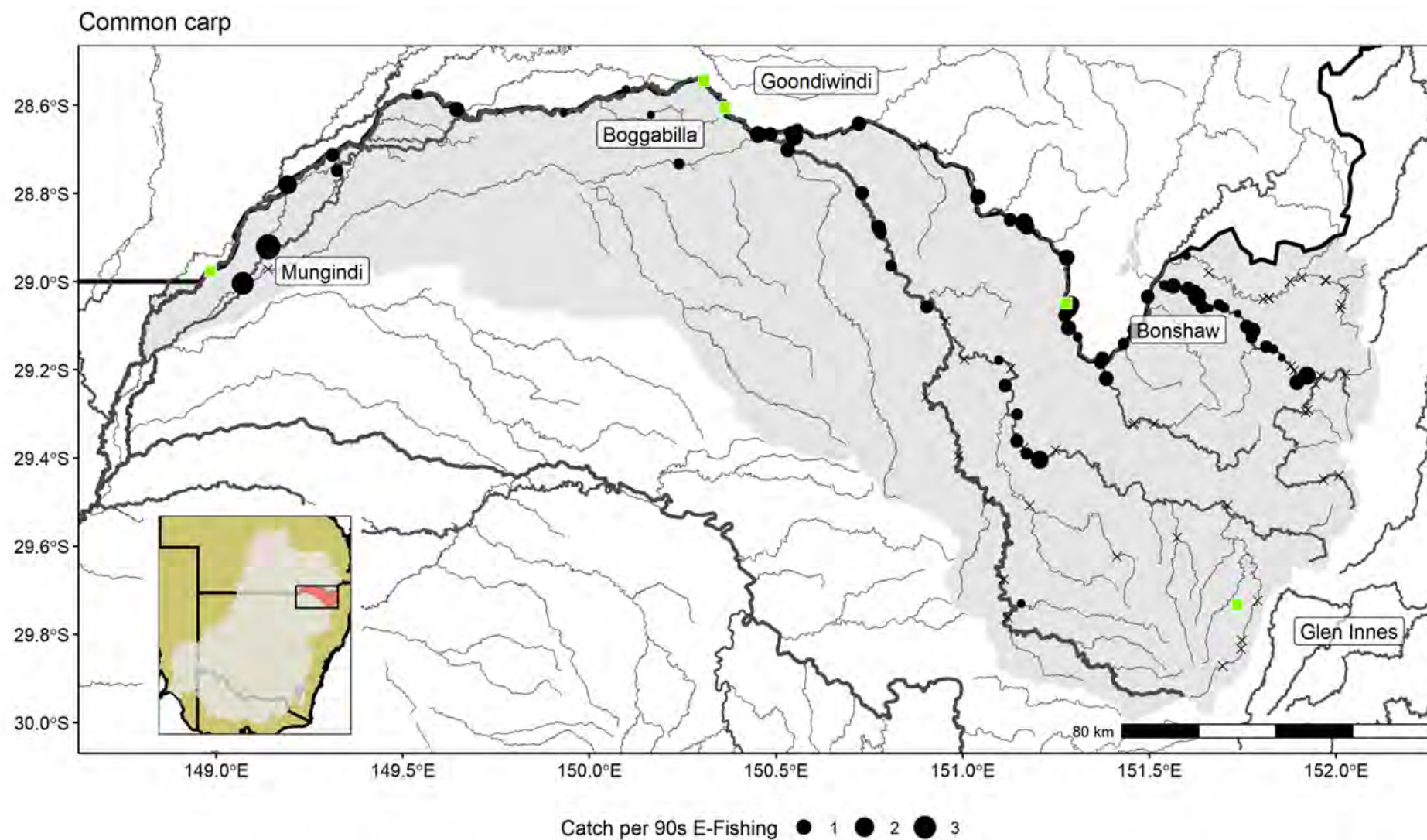


Figure 9.32: Distribution of Common carp sampled from 2013/14 to 2023/24 in the NSW Border Rivers WRPA. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares represent key towns.

Threatened Species

The following table (Table 9.6) shows the fish species listed under either the *NSW Fisheries Management Act 1994* (FMA) or the *Commonwealth Environmental Protection and Biodiversity Conservation Act 1999* (EPBC) which were observed during standardised electrofishing surveys in the New South Wales Border Rivers Water Resource Planning Area during the reporting period. A list of all threatened fish species observed by NSW DPIRD Fisheries (as part of any sampling program in any area) is provided in Table 9.10.

Table 9.6: Listed species which were observed in this region during the sampling period. (* = FMA, # = EPBC)

Species	Common name	Total caught (observed)
<i>Ambassis agassizii</i>	Olive perchlet*	159 (8)
<i>Bidyanus bidyanus</i>	Silver perch*#	38 (7)
<i>Maccullochella peelii</i>	Murray cod#	2,070 (1,059)
<i>Mogurnda adspersa</i>	Southern purple-spotted gudgeon*	86 (6)
<i>Tandanus tandanus</i>	Freshwater catfish*	435 (107)

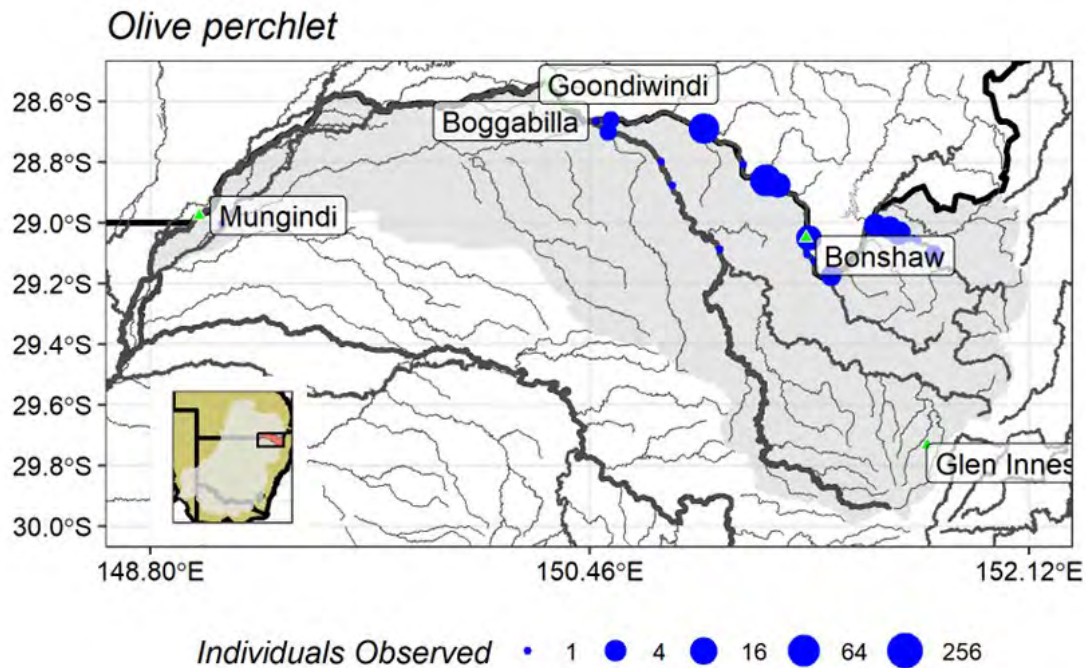


Figure 9.33: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the NSW Border Rivers WRP. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance.

Summary Statement:

A total of 159 Olive perchlet were captured in across 25 sites during the reporting period. Individuals were caught in all years except 2021/22. 7 individuals were caught in 2023/24.

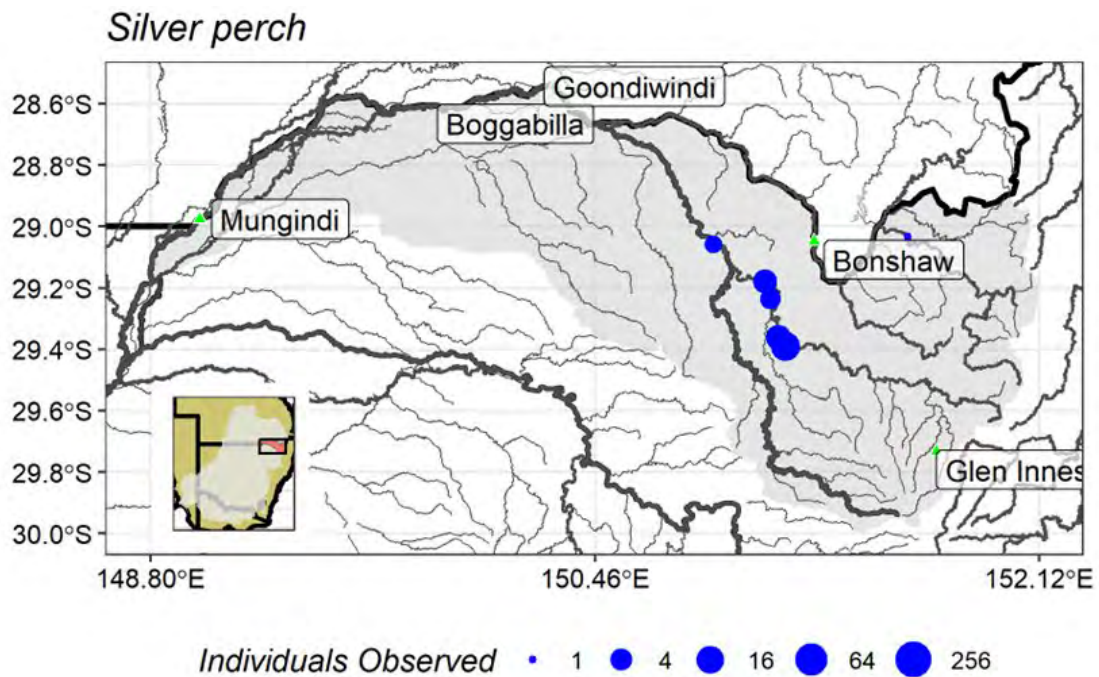


Figure 9.34: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the NSW Border Rivers WRPA. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance.

Summary Statement:

A total of 38 Silver perch were captured in across 8 during the reporting period. No individuals were caught in 2014/15, 2019/20, 2020/21 and 2021/22. Four individuals were caught in 2023/24.

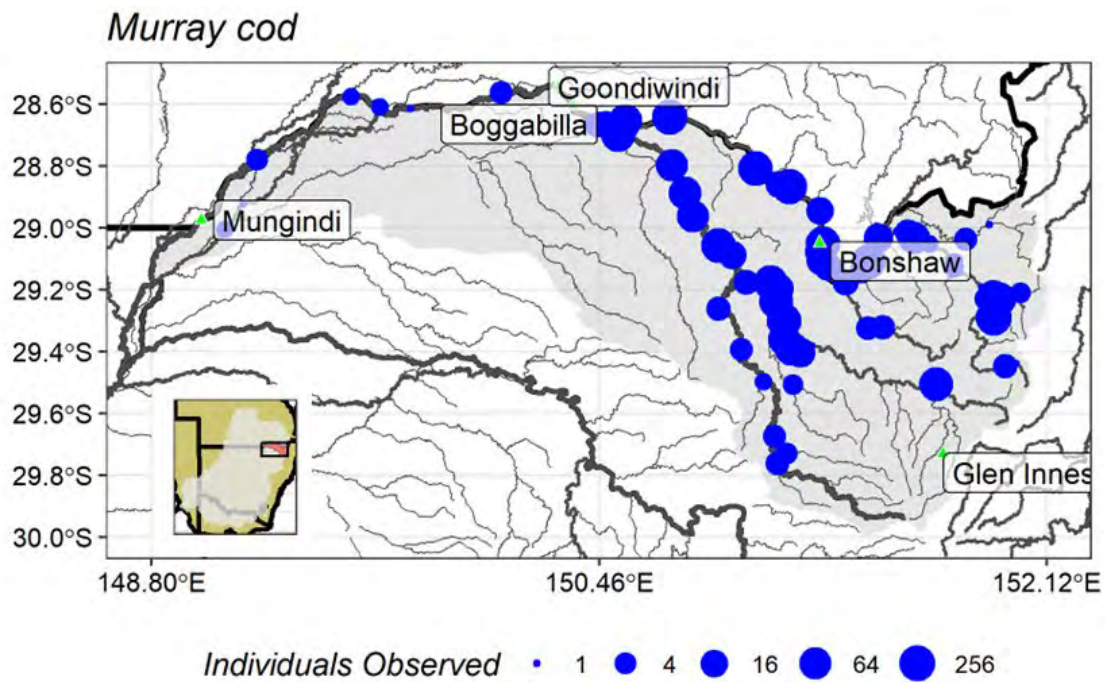


Figure 9.35: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the NSW Border Rivers WRPA. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance. Note the lower image shows a juvenile Murray cod.

Summary Statement:

A total of 2,070 Murray cod were captured across the NSW Border Rivers during the reporting period. For more details see the Murray cod section.

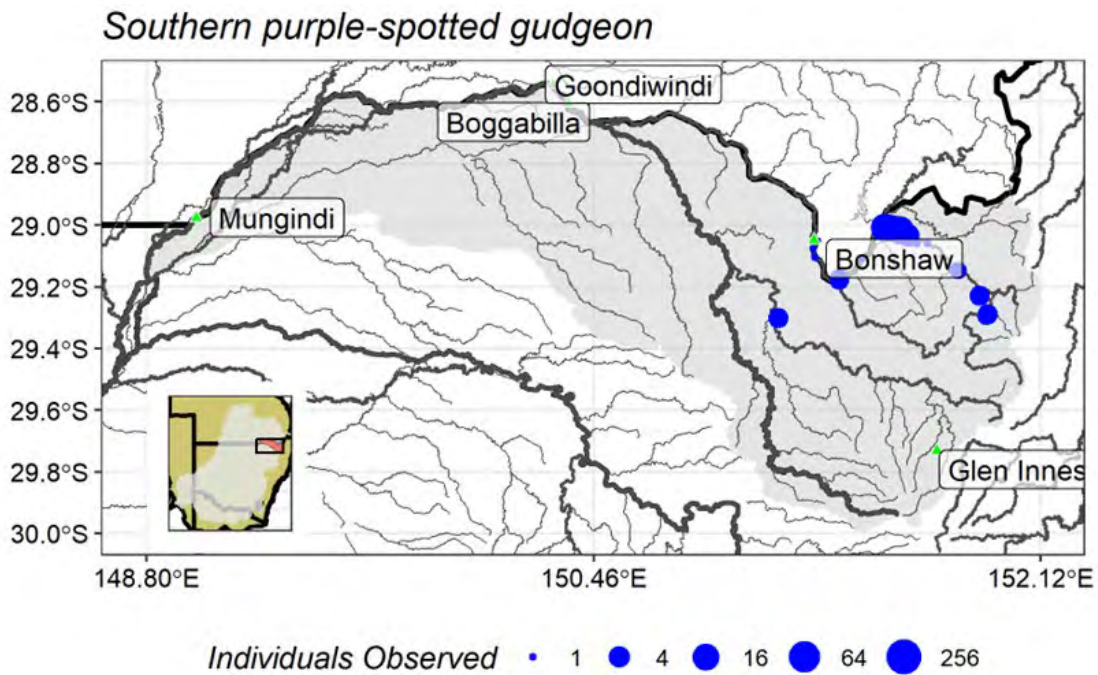


Figure 9.36: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the NSW Border Rivers WRPA. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance.

Summary Statement:

A total of 86 Southern purple-spotted gudgeon were captured across 17 sites in the eastern NSW Border Rivers region. Individuals were captured in all years except 2015/16, 2017/18 and 2023/24. Southern purple-spotted gudgeon have been stocked in this WRPA annual since 2020/21.

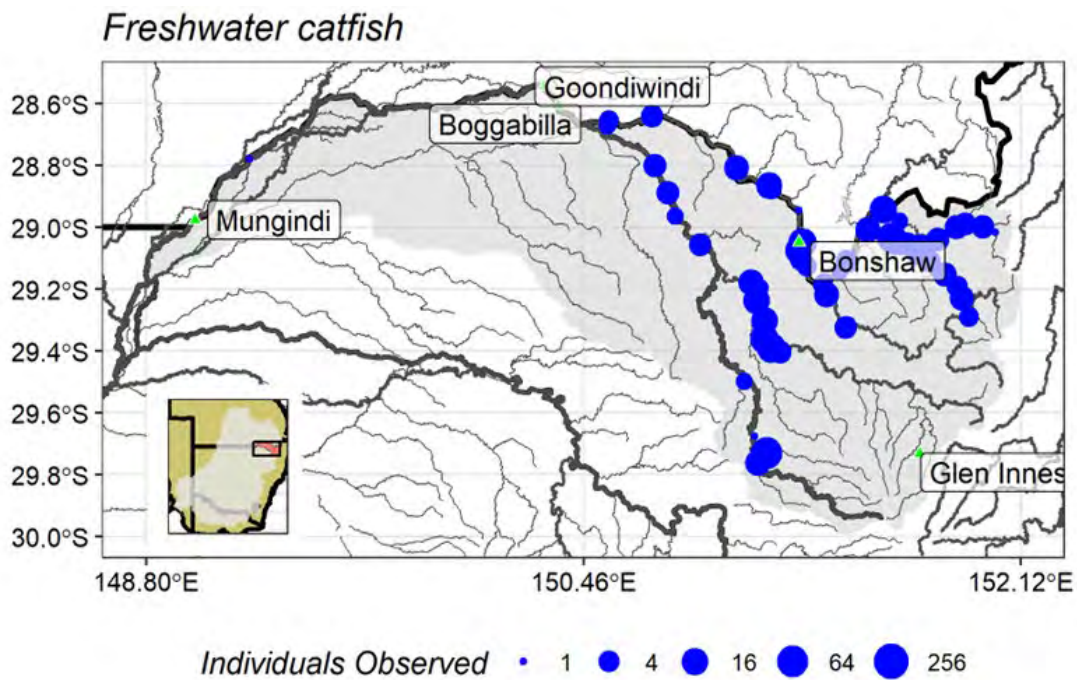


Figure 9.37: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the NSW Border Rivers WRPA. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance.

Summary Statement:

A total of 435 Freshwater catfish were captured across the eastern half of the NSW Border Rivers region. Individuals were observed in all sampling years.

Appendix

This report contains data from the projects listed in Table 9.7.

Table 9.7: Projects included in this report. Sampling Events show the total number of sampling events included from each project. Sampling Seasons shows which sampling seasons each project contributed data to.

Project Name	Sampling Seasons	Sampling Events
Basin Plan Environmental Outcomes Monitoring	2014/2015, 2015/2016, 2016/2017, 2017/2018, 2018/2019, 2019/2020	169
Basin Plan Environmental Outcomes Monitoring 2	2022/2023, 2023/2024	34
Cold Water Pollution	2022/2023, 2023/2024	18
Monitoring, Evaluating and Reporting - Inland	2014/2015, 2015/2016	4
Murray Cod Slot Limit Assessment	2020/2021	10
Murray-Darling Basin Fish Surveys	2014/2015, 2015/2016, 2016/2017, 2017/2018, 2018/2019, 2019/2020, 2021/2022, 2022/2023, 2023/2024	42
Three Dams	2020/2021, 2021/2022	20

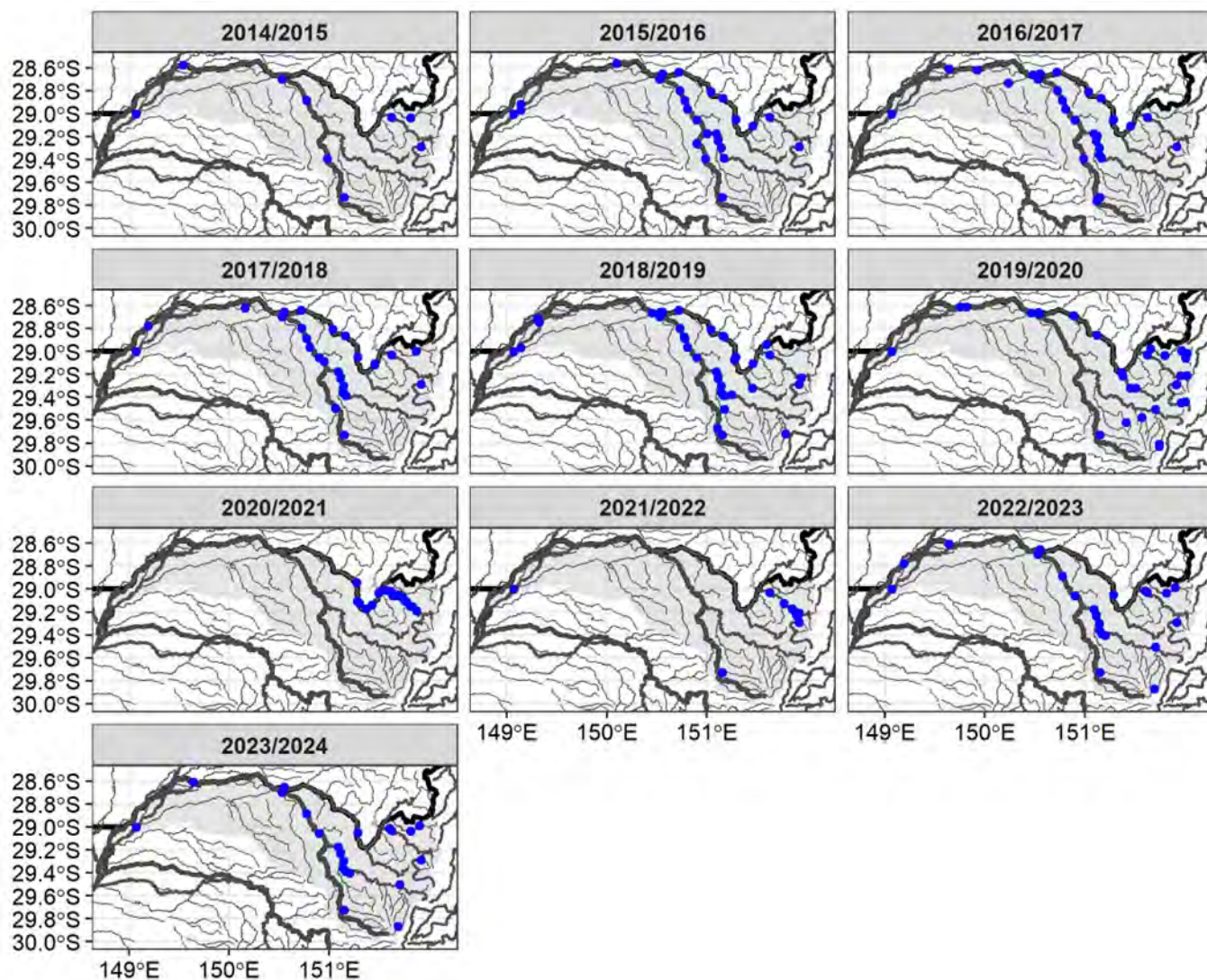


Figure 9.38: Sites sampled and included in this report by sampling season in the NSW Border Rivers WRPAs. Dry sites are not shown.

Table 9.8 shows all species detected during this survey period as part of standardised monitoring projects (see Table 9.7). Note there are variations in effort between sampling seasons so this information should be considered in conjunction with Table 9.1. The Expected from Modelling column identifies species which are possible to occur based upon MaxENT habitat modelling (likelihood threshold > 0.33; NA represents no modelling was undertaken). Species that were possible from the modelling but not observed during standardised sampling in the New South Wales Border Rivers WRPAs were: River Blackfish, Mountain galaxias, Macquarie perch, Dwarf flathead gudgeon and Brown trout. It should be noted that the MaxENT modelling models habitat availability and is not always a reliable index of abundance, it merely indicates possible distribution based upon habitat. A full list of species observed during this period across the standardised monitoring protocols and sampling methods is presented in Table 9.11.

Table 9.8: Total number caught of each species by sampling season in the NSW Border Rivers WRPAs.

Common name	Expected from modelling	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24
Australian smelt	YES	11	387	1	48	103	72	42	75	19	50
Bony herring	YES	417	919	499	1,909	387	1,295	24	25	159	326
Carp-gudgeon species complex	YES	661	2,685	851	4,841	5,848	3,974	1,839	487	298	1,911
Common carp	NA	32	241	222	337	260	112	135	97	244	323
Darling hardyhead	YES	0	11	4	2	5	7	0	0	187	40
Eastern gambusia	NA	74	253	69	307	1,498	446	48	14	342	177
Freshwater catfish	YES	9	29	57	76	81	37	78	21	28	19
Golden perch	YES	9	97	61	132	69	13	15	18	42	73
Goldfish	NA	45	13	31	58	115	44	9	20	272	83
Murray cod	YES	42	323	234	561	450	96	75	39	93	157
Murray-Darling carp-gudgeon	NA	0	0	13	0	0	0	0	0	0	0
Murray-Darling rainbowfish	YES	30	183	285	420	226	57	223	60	84	30
Olive perchlet	YES	2	3	4	2	13	105	22	0	1	7
Rainbow trout	YES	0	0	0	0	0	0	0	0	28	0
Redfin	YES	0	0	0	0	38	3	0	0	0	48
Silver perch	YES	0	6	7	12	4	0	0	0	5	4
Southern purple-spotted gudgeon	YES	3	0	1	0	4	3	71	3	1	0
Spangled perch	YES	8	11	13	19	152	37	6	21	40	3
Unspecked hardyhead	YES	43	59	55	227	938	659	608	10	70	113

The following table summarises the sampling methods for each species caught (Table 9.9).

Table 9.9: Total catch of each species by sampling method in the NSW Border Rivers WRPA.

Common name	Backpack Electrofishing	Bait Trap	Boat Electrofishing
Australian smelt	13	0	795
Bony herring	7	1	5,952
Carp-gudgeon species complex	1,987	15,303	6,105
Common carp	78	4	1,921
Darling hardyhead	25	1	230
Eastern gambusia	1,542	719	967
Freshwater catfish	155	1	279
Golden perch	3	4	522
Goldfish	147	16	527
Murray cod	187	0	1,883
Murray-Darling carp-gudgeon	0	13	0
Murray-Darling rainbowfish	140	22	1,436
Olive perchlet	0	79	80
Rainbow trout	28	0	0
Redfin	48	0	41
Silver perch	1	0	37
Southern purple-spotted gudgeon	11	2	73
Spangled perch	23	21	266
Unspecked hardyhead	168	17	2,597

Table 9.10: Listed threatened species recorded in the Murray-Darling Basin (from the NSW DPIRD Fisheries Freshwater Ecosystem research database). Species are listed under either the NSW Fisheries Management Act 1994 (FMA) or the Commonwealth Environmental Protection and Biodiversity Conservation Act 1999 (EPBC).

Genus, species	Common Name	EPBC Status	FMA Status
<i>Ambassis agassizii</i>	Agassiz's glassfish, olive perchlet, western New South Wales population	NA	Endangered Population
<i>Bidyanus bidyanus</i>	Silver Perch, Bidyan	Endangered	Vulnerable
<i>Craterocephalus fluviatilis</i>	Murray Hardyhead	Endangered	Critically Endangered
<i>Galaxias rostratus</i>	Flathead Galaxias, Beaked Minnow, Flat-headed Galaxias, Flat-headed Jollytail, Flat-headed Minnow	Critically Endangered	Critically Endangered
<i>Galaxias tantangara</i>	Stocky Galaxias	NA	Critically Endangered
<i>Maccullochella macquariensis</i>	Trout Cod	Endangered	Endangered
<i>Maccullochella peelii</i>	Murray Cod	Vulnerable	NA
<i>Macquaria australasica</i>	Macquarie Perch	Endangered	Endangered
<i>Mogurnda adspersa</i>	Southern Purple Spotted Gudgeon	NA	Endangered
<i>Nannoperca australis</i>	Southern Pygmy Perch	Vulnerable	Endangered
<i>Tandanus tandanus</i>	Freshwater catfish, eel tailed catfish, Murray-Darling Basin population	NA	Endangered Population

Table 9.11 shows all species detected during this survey period across all programs and methods. Due to variations in project methods protocols, this data is presented only to give a complete list of species observed in the region. The Expected from Modelling column identifies species which are possible to occur based upon MaxENT habitat modelling (likelihood threshold > 0.33; NA represents no modelling was undertaken). Species that were possible from the modelling but not observed during sampling in the New South Wales Border Rivers WRPA were: River Blackfish, Mountain galaxias, Macquarie perch, Dwarf flathead gudgeon, Brown trout. It should be noted that the MaxENT modelling actually models habitat availability and is not always a reliable index of abundance, it merely indicates possible distribution based upon habitat. A list of species caught as part of standardised monitoring during this period is in Table 9.8.

Table 9.11: Total catch of each species by all sampling programs and all methods in the NSW Border Rivers WRPA. Note these include projects with sampling not representative of the community and the data should be used with caution.

Common name	Expected from modelling	2014/ 15	2015/ 16	2016/ 17	2017/ 18	2018/ 19	2019/ 20	2020/ 21	2021/ 22	2022/ 23	2023/ 24
Australian smelt	YES	11	575	1	48	103	822	42	75	19	50
Bony herring	YES	417	936	499	1,909	387	1,295	24	25	159	326
Carp gudgeon species complex	YES	661	3,725	851	4,841	5,848	7,648	1,839	487	298	1,911
Common carp	NA	32	241	222	337	260	150	135	97	244	325
Darling hardyhead	YES	0	11	4	2	5	7	0	0	187	40
Eastern gambusia	NA	74	625	69	307	1,498	649	48	14	342	177
Freshwater catfish	YES	9	30	57	76	81	39	78	21	28	27
Golden perch	YES	9	97	61	132	69	13	15	18	42	73
Goldfish	NA	45	13	31	58	115	50	9	20	272	85
Murray cod	YES	42	323	234	561	450	96	75	39	93	161
Murray-Darling carp-gudgeon	NA	0	0	13	0	0	0	0	0	0	0
Murray-Darling rainbowfish	YES	30	314	285	420	226	71	223	60	84	30
Olive perchlet	YES	2	7	4	2	13	352	22	0	1	7
Rainbow trout	YES	0	0	0	0	0	0	0	0	28	0
Redfin	YES	0	0	0	0	38	3	0	0	0	48
Silver perch	YES	0	6	7	12	4	0	0	0	5	4
Southern purple-spotted gudgeon	YES	3	0	1	0	4	3	71	3	1	0

Common name	Expected from modelling	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24
Spangled perch	YES	8	12	13	19	152	37	6	21	40	3
Unspecked hardyhead	YES	43	258	55	227	938	2,333	608	10	70	113

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Chapter 10 Basin Plan Fish Monitoring Summary (2014/15 – 2023/24): NSW Lower Darling (Baaka) Water Resource Planning Area

Hayden Schilling & David Crook

March 2025



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Chapter cover image credit (Juvenile Murray cod): Jason Thiem (NSW DPIRD); Fish images credit: Gunther Schmida

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Introduction

This report spans 2014/15 to 2023/24 and uses all suitable fish assemblage data collected by NSW DPIRD Fisheries using standardized electrofishing monitoring techniques. The format of the report follows and expands upon the previous reports (Schilling & Crook 2023, 2024). This report focusses on the New South Wales Lower Darling (Baaka) Water Resource Planning Area (WRPA) shown in Figure 10.1.

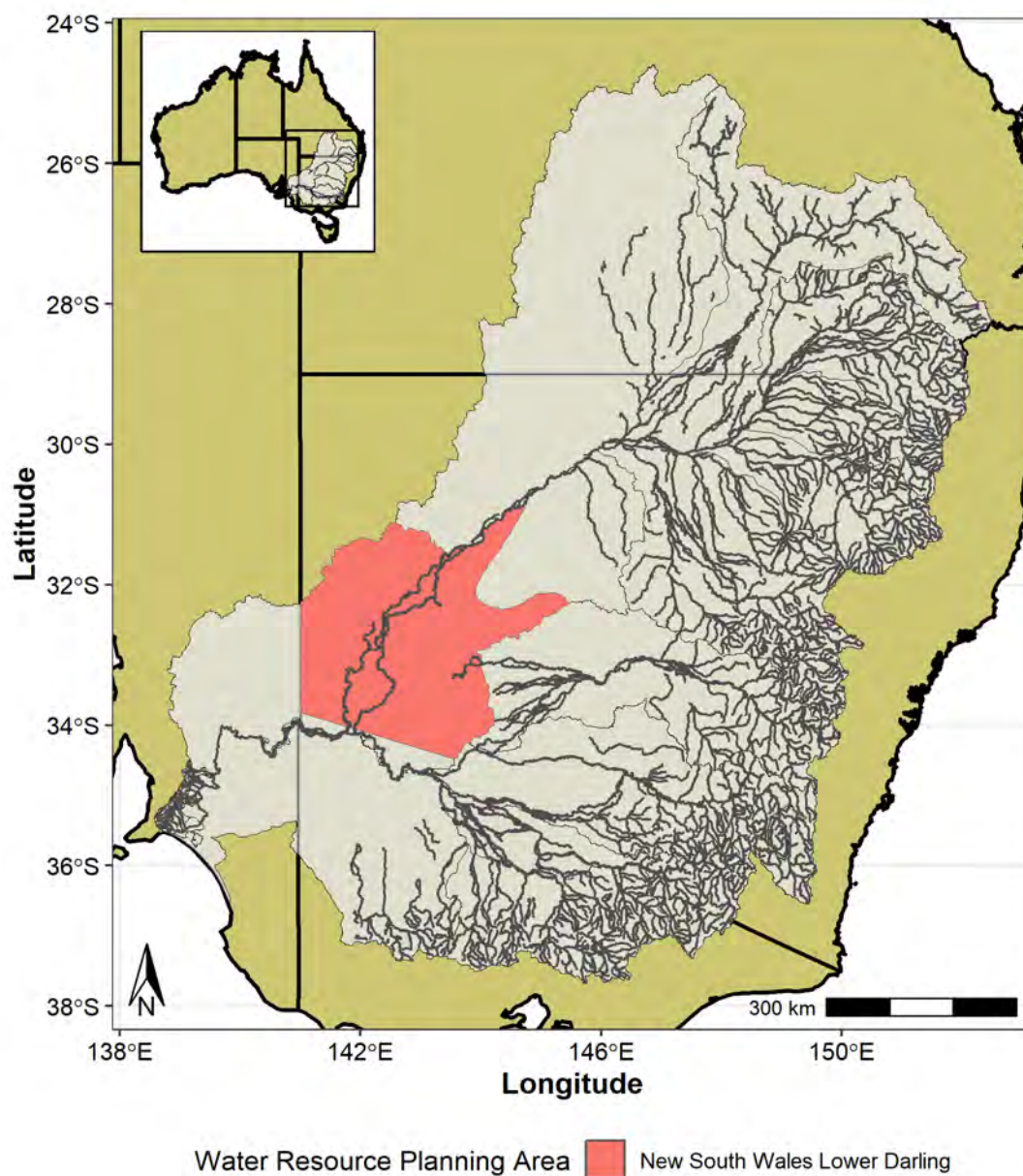


Figure 10.1: Murray-Darling Basin with the key region of this report highlighted. Inset map shows the whole of Australia with a box around the MDB.

What This Report Includes

This report starts with an overview of the standardised monitoring programs including sampling details and statistics. An overview of the hydrological and climatic conditions during the reporting period is also provided as context for interpreting the fish population status data.

Following the introductory sections, we present a summary of *fish diversity* across the New South Wales Lower Darling (Baaka) WRP. Separate plots for native and alien species show the total number of unique species observed at each site.

The main body of the report provides detailed information on the *population structure, relative abundance, health, and distribution* of six key fish species:

- Murray cod
- Golden perch
- Freshwater catfish (No fish were observed in this WRP during the reporting period)
- Bony herring
- Australian smelt
- Common carp

Population structure information includes length frequency plots of collected fish and the proportion of fish classified as Young of the Year (YOY). This information can be used to infer the size structure of populations and the level of recruitment each year. For additional context, we provide a summary table showing any stocking which occurred for the species in each year (if relevant).

Relative abundance and *relative biomass* (a unit-less measure representing the number (or biomass) of fish in an area) information is adapted from the modelled outputs from a more in-depth publication (Crook et al. 2023) which considers all available electrofishing data within the NSW Murray-Darling Basin (MDB). The updated analysis uses generalised linear mixed models to generate annual indices of relative abundance and biomass for each WRP. In this report we present the modelled time series of relative abundance showing the predicted number (or biomass) of fish observed per 90 second shot of electrofishing. The abundance and biomass trends for the New South Wales Lower Darling WRP are contrasted with the overall NSW MDB dataset. It should be noted that these are modelled estimates of relative abundance/biomass, not absolute abundance/biomass as absolute estimates would require extensive calibration surveys that are not included in the monitoring program.

Health information is provided as a summary of any visible health conditions recorded for the key species. The number of health conditions observed in a fish population is generally reflective of water quality, competition, and many other factors. Fewer observations of health conditions indicate healthier populations. The health conditions detailed are any that were observed as part of the biological measurements taken. We provide a comparison of the prevalence of health conditions in the New South Wales Lower Darling WRP and greater MDB (excluding the New South Wales Lower Darling WRP).

Distribution maps are provided for each species to show the observed distribution of each species from electrofishing samples. The distribution maps also show the relative abundance (number of fish observed per 90 seconds of electrofishing) at each site to give an indication of how the population is spread over the landscape.

Finally, the distributions and numbers of *Threatened species* are reported. The report includes threatened species that were recorded by standardised monitoring programs in the New South Wales Lower Darling WRPAs during the reporting period.

For each section of the report, we provide a *Summary Statement*. This statement provides a very brief overview of the key messages for each section.

Sampling Methods

Three main methods are used during routine fish monitoring surveys: boat electrofishing, backpack electrofishing and bait traps. This report mainly includes the electrofishing data with bait trap samples informing the distribution of small bodied species. The electrofishing was conducted using the standard methodology implemented in the Sustainable Rivers Audit (SRA; Davies et al. 2010). This usually includes 12 shots of 90 seconds “power on” during each sampling event.

As parts of this report compile data from multiple projects, there is some variation in how sites were chosen and the effort of sampling conducted each year (Table 10.1). Details of which projects contributed data to this report can be seen in Table 10.7. At each site, sampling gear was applied as suited to the local conditions with either boat, backpack, or a hybrid of the two, in addition to 10 unbaited bait traps set in edge margins. Most sampling occurred between the months of September and May.

Table 10.1: Sampling effort (Number of sites sampled) each sampling season in the Lower Darling WRPAs. Variation in sampling effort is due to different numbers of projects and interruptions to planned sampling such as flooding, site desiccation, and extreme weather.

Sampling Season	Number of Boat Electrofishing Sites	Number of Backpack Electrofishing Sites	Total
2014/2015	2	0	2
2015/2016	5	0	5
2016/2017	10	2	12
2017/2018	8	0	8
2018/2019	20	0	20
2019/2020	22	0	22
2020/2021	23	0	23
2021/2022	10	0	10
2022/2023	24	0	24
2023/2024	29	0	29

The sites sampled during the reporting period are shown in

Figure 10.2. A breakdown of sites sampled each sampling season is shown in the Appendix (Figure 10.32).

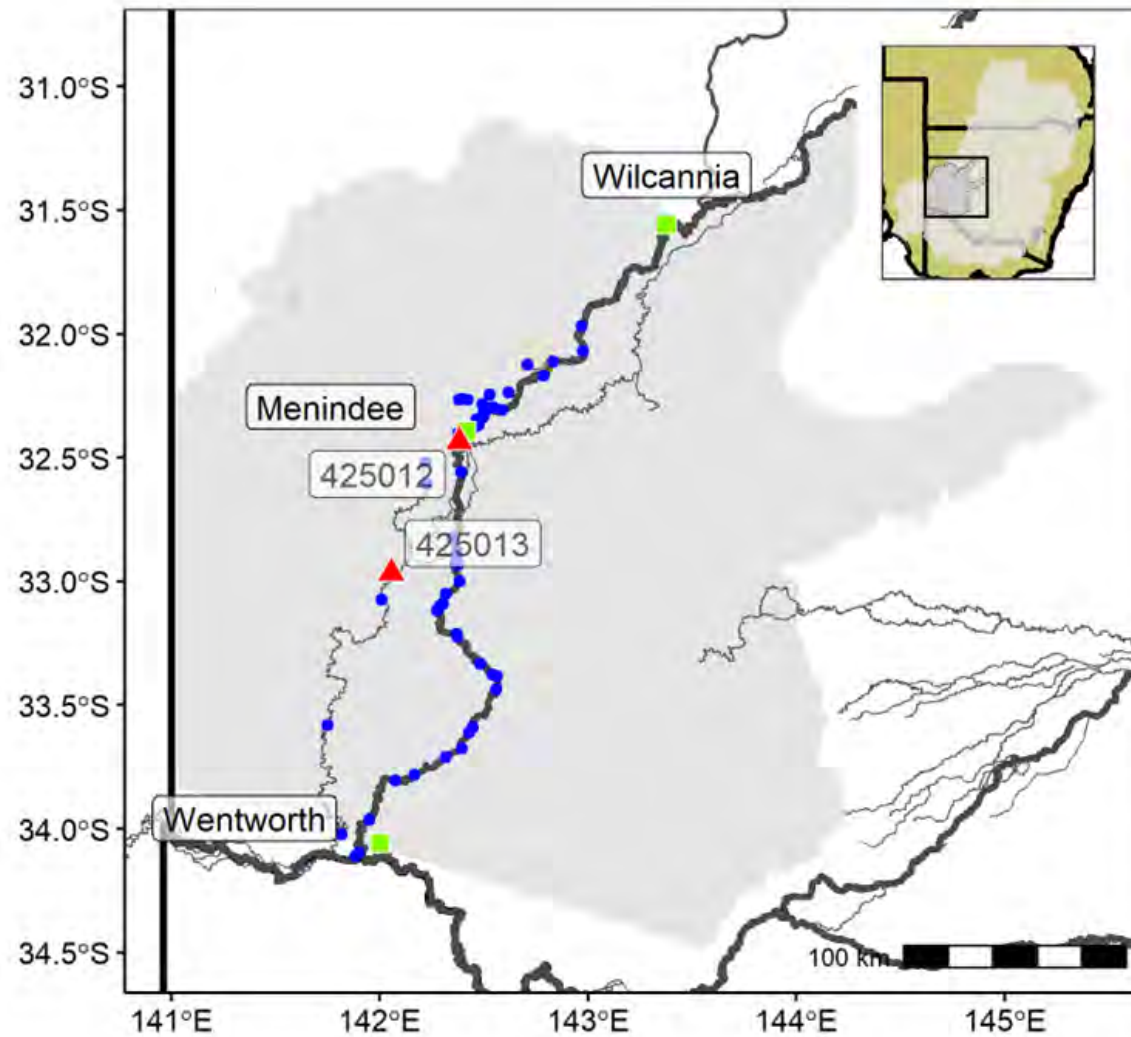


Figure 10.2: Sites (blue dots) sampled during the reporting period in the Lower Darling WRP. Red triangles show key flow gauges along with their gauge ID number. Green squares show key towns.

Each sampling method has a different effectiveness at sampling each species. Table 10.2 shows the total numbers of each key species caught by each method.

Table 10.2: Number of each key species caught by sample method over the whole program in the Lower Darling WRP. Further data on total catch is provided in the Appendix.

Common name	Boat Electrofishing	Backpack Electrofishing	Bait Trap
Australian smelt	660	0	2
Bony herring	11,505	4	1
Common carp	19,225	10	385
Golden perch	1,280	0	4
Murray cod	349	0	0

A subset of sampled fish had biological measurements taken during the surveys, including but not limited to length and weight measurements and visual health assessments. Table 10.3 shows the number of biological measurements taken each year for the key species.

Table 10.3: Number of biological measurements taken for the key species each sampling season in the Lower Darling WRP.

Sampling Season	Australian smelt	Bony herring	Common carp	Golden perch	Murray cod
2014/2015	0	104	21	4	12
2015/2016	8	153	60	14	12
2016/2017	50	524	253	44	5
2017/2018	6	400	148	25	9
2018/2019	172	812	733	240	97
2019/2020	57	394	237	80	20
2020/2021	166	1,178	246	269	122
2021/2022	39	245	203	122	17
2022/2023	77	908	2,303	257	17
2023/2024	71	1,418	927	259	41

Climate Overview

The following is a summary of the climatic conditions during the reporting period in terms of how the observed conditions compare to long term records. These are direct extracts from the [Australian Bureau of Meteorology climate summaries archive](#) and are written in the given year. To interpret, 2014 states it was the warmest year on record, meaning 2014 was the warmest year on record up to and including 2014 but not including more recent years.

2014

New South Wales experienced its warmest year on record in 2014, with several heatwaves and persistently warm conditions across the State. Rainfall was well below average in the northeast, and close to average elsewhere.

2015

New South Wales recorded well above average temperatures in 2015. Nights were particularly warm, the sixth-warmest on record for the State. Rainfall was close to average for the state as a whole.

2016

2016 was a generally wet, warm year for NSW as a whole, with substantial variability throughout the year and across the state. Following a record-warm start to the year, May to September was the wettest such period on record for NSW, with cooler weather in much of the west of the state. Minimum temperatures were the warmest on record for the State as a whole, with record-warm daytime temperatures on parts of the east coast.

2017

The year 2017 was the warmest on record for New South Wales for both mean and daytime temperatures. It was also the State's driest year since 2006. Following the warmest summer on record for the State, heavy rain in March across the east then made way for a very dry winter and start to spring. Winter overnight temperatures were the lowest since 1997, but daytime temperatures remained above average for most of the year, and were the warmest on record overall.

2018

2018 was the warmest on record for New South Wales for both mean temperature and mean maximum temperature, whilst the mean minimum temperature was fourth-warmest on record. The year was dominated by very dry conditions, with the third-driest January to September on record. October to December saw some relief from the dry, with above average rainfall across parts of the State. Despite this, New South Wales experienced its sixth-lowest annual rainfall on record; its driest year since 2002.

2019

2019 was the driest and warmest year on record for New South Wales. Despite some rain in some months, most of the State received much less rainfall than usual, with the northeast and far west particularly dry. Heatwaves in January brought very high temperatures, and large fires from September onward caused extensive damage and persistent smoke.

2020

2020 saw above average temperature and rainfall in New South Wales. Temperatures were above average across the state in most months except during autumn. There was widespread rain during autumn and spring and in December, but early winter and November rain was below average.

2021

New South Wales had its 6th wettest year on record, with 2021 rainfall 30 % above average. This included significant floods along the east coast in March, and the state's wettest November on record. It was the state's coolest year since 1996, at 0.15 °C above the 1961–1990 average.

2022

2022 was exceptionally wet with the state-averaged annual total being the second-highest on record (since 1900) and many sites recording their highest annual totals on record. Maximum temperatures were lower than average with the state-averaged annual maximum temperature being the coolest since 1992. Minimum temperatures were generally warmer than average with the state-averaged annual minimum temperature being 0.73 °C above the 1961–1990 average.

2023

The state-averaged rainfall was 22.9 % below the 1961–1990 average. Rainfall was above average over small parts of the state's south, west of the Great Dividing Range, while being below average over most of the northern half of the state, especially over parts of the Northern Tablelands, Northern Rivers, Mid-North Coast, and Upper Hunter, where annual rainfall was in the lowest 10 % of historical records (since records began in 1900). State-averaged annual maximum temperature was 1.96 °C above the 1961–1990 average, which is the third highest on record.

2024

Rainfall totals in 2024 were above average to very much above average for the northern and western areas of the state, as well as central parts of the coast. Totals were below average for large parts of the south-east, as well as small parts of the state's north-east and south-west. 2024 was the third-warmest on record for all years since 1910, 1.55 °C above the 1961–1990 average.

Flow Data

Below shows a summary of flow data from a variety of flow gauges in the New South Wales Lower Darling WRP (Figure 10.3).

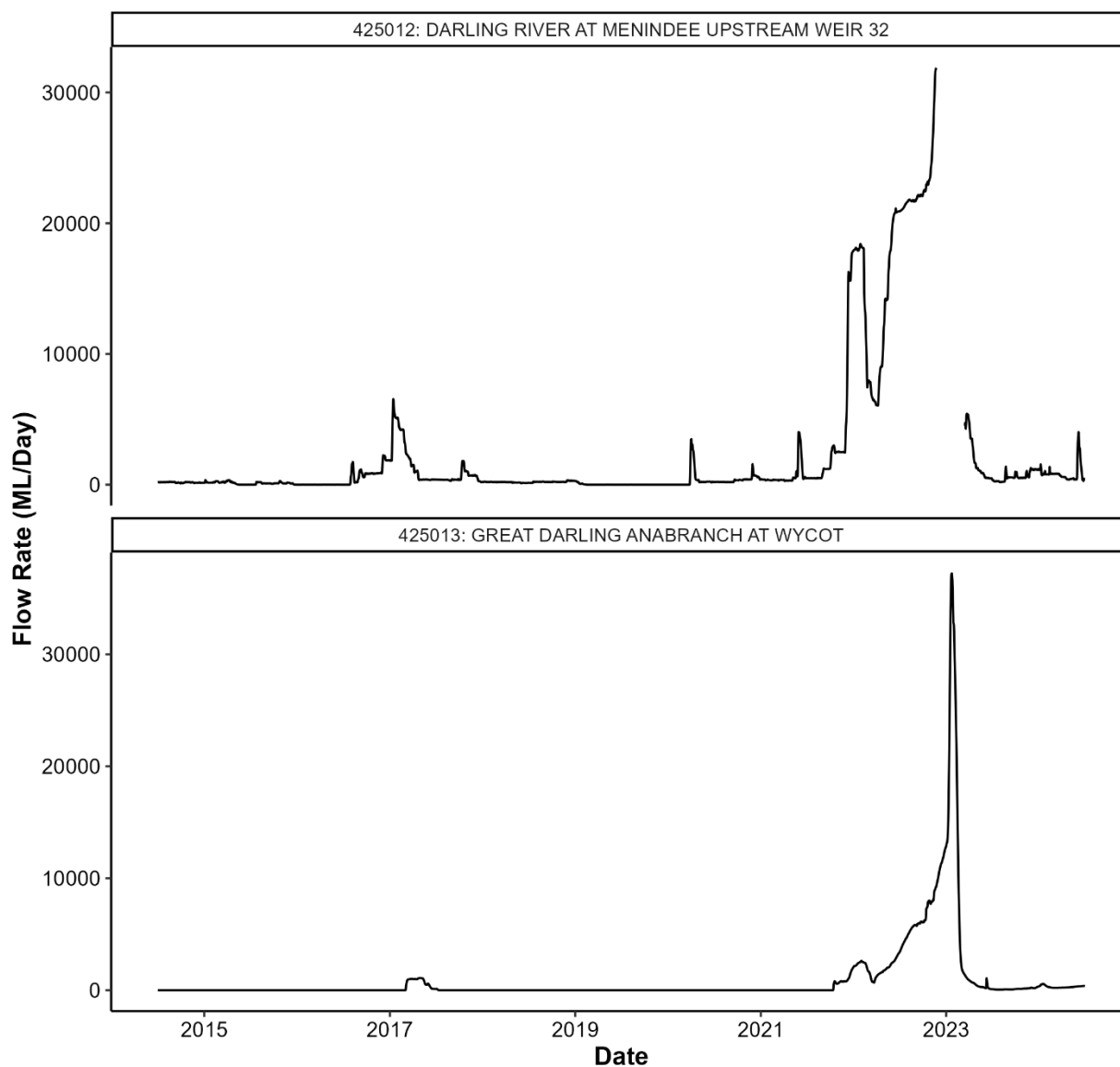


Figure 10.3: Flow data from various gauges in the New South Wales Lower Darling WRP over the reporting period. Gauge locations can be seen on Figure 10.2. Note the differing scales on the y-axis.

Water temperature data, where available, are also shown in Figure 10.4.

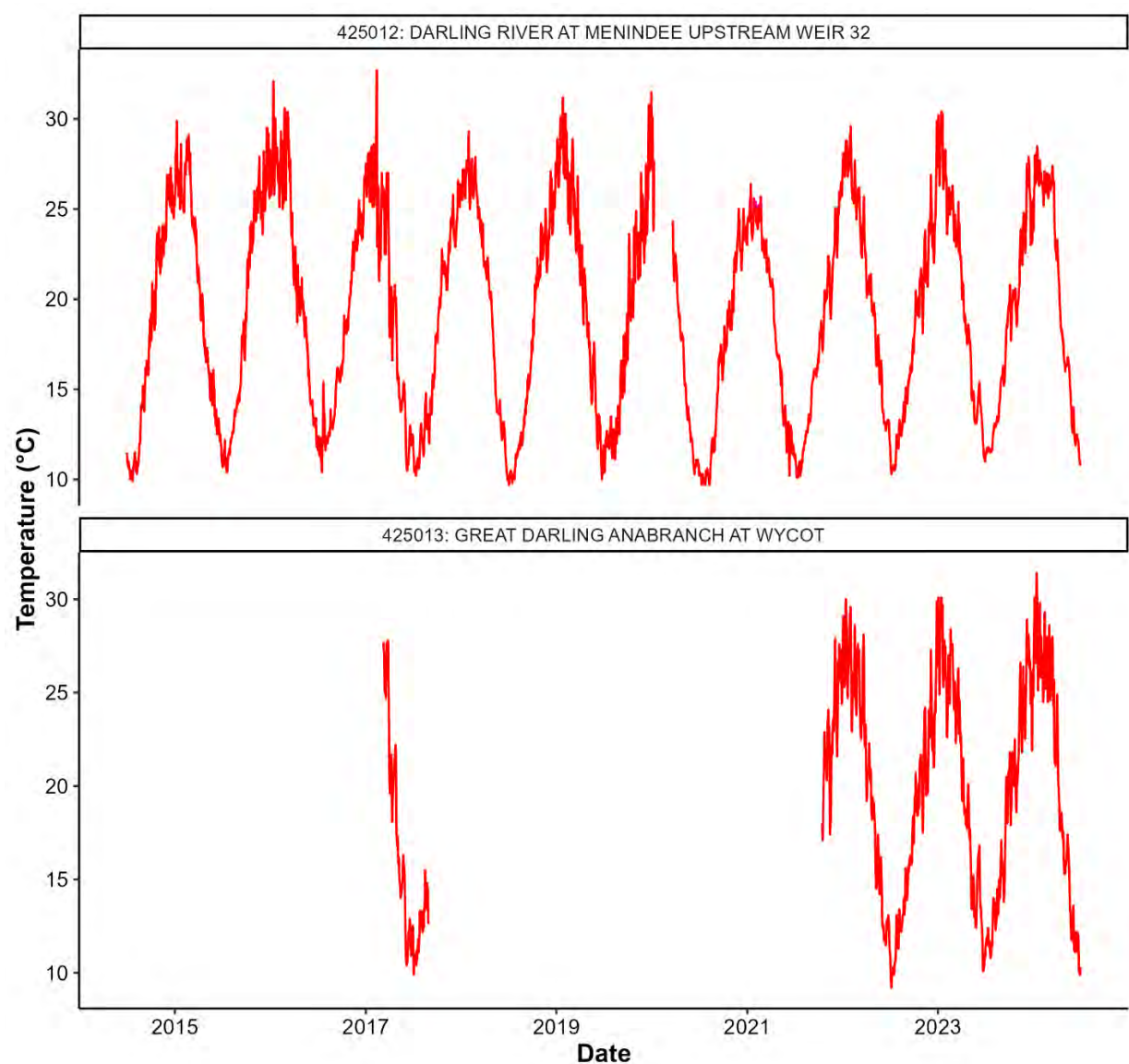


Figure 10.4: Water temperature data from various gauges in the New South Wales Lower Darling WRPA over the reporting period. Gauge locations can be seen on Figure 10.2. Note the differing scales on the y-axis.

Species Diversity

A total of 15 fish species were observed across the New South Wales Lower Darling WRPAs including five alien species. Figure 10.5 shows the number of native species found at each site while Figure 10.6 shows the number of alien species found at each site. The full list of species caught and observed is presented in Table 10.8.

Summary Statement:

Native diversity was highest in the central area of the New South Wales Lower Darling region while the alien diversity was generally consistent across the region.

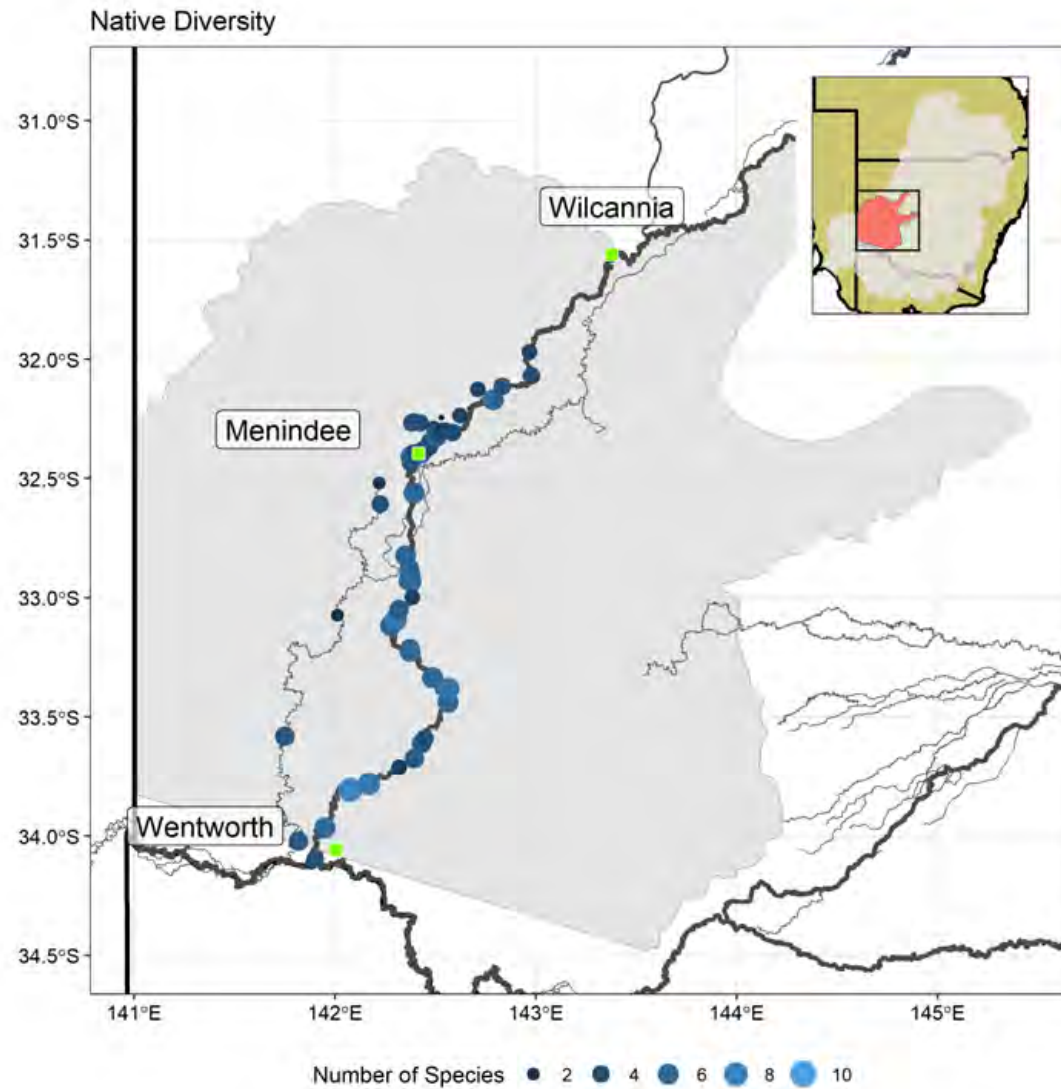


Figure 10.5: Native diversity across all sampling sites in the Lower Darling WRP. Bubble size represents the number of unique species observed at each site across all sampling methods and events. X represents a site that had water and was sampled, but no fish species were caught at all. Dry sites are excluded. Green squares represent key towns.

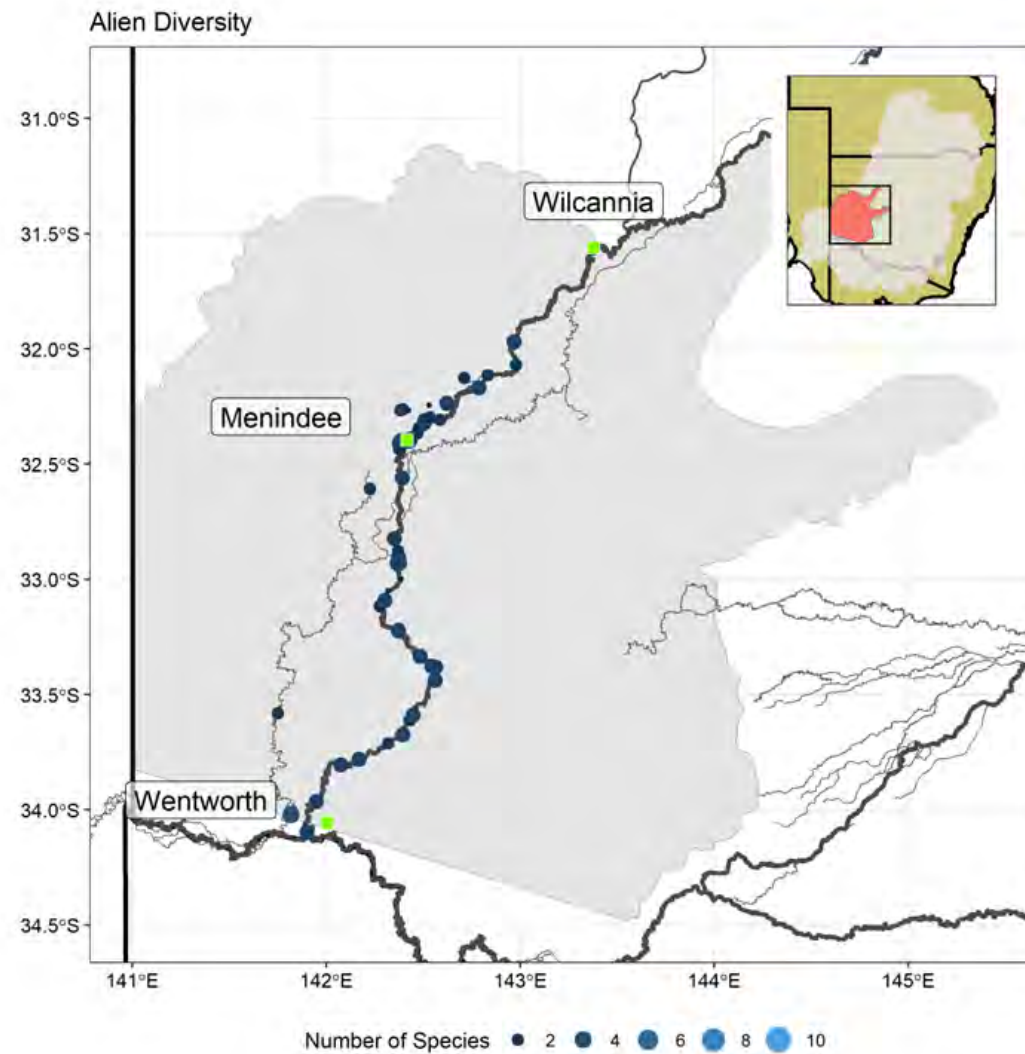


Figure 10.6: Alien diversity across all sampling sites in the Lower Darling WRP. Bubble size represents the number of unique species observed at each site across all sampling methods and events. X represents a site that had water and was sampled, but no fish species were caught at all. Dry sites are excluded. Green squares represent key towns.

Murray cod



Population Structure

Figure 10.7 shows the observed length frequency plot for Murray cod for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 0 to 42, and 0 % to 34 % of measured fish within a season, with a mean percentage YOY of 12 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Murray cod was 12 % (1,375 out of 11,199).

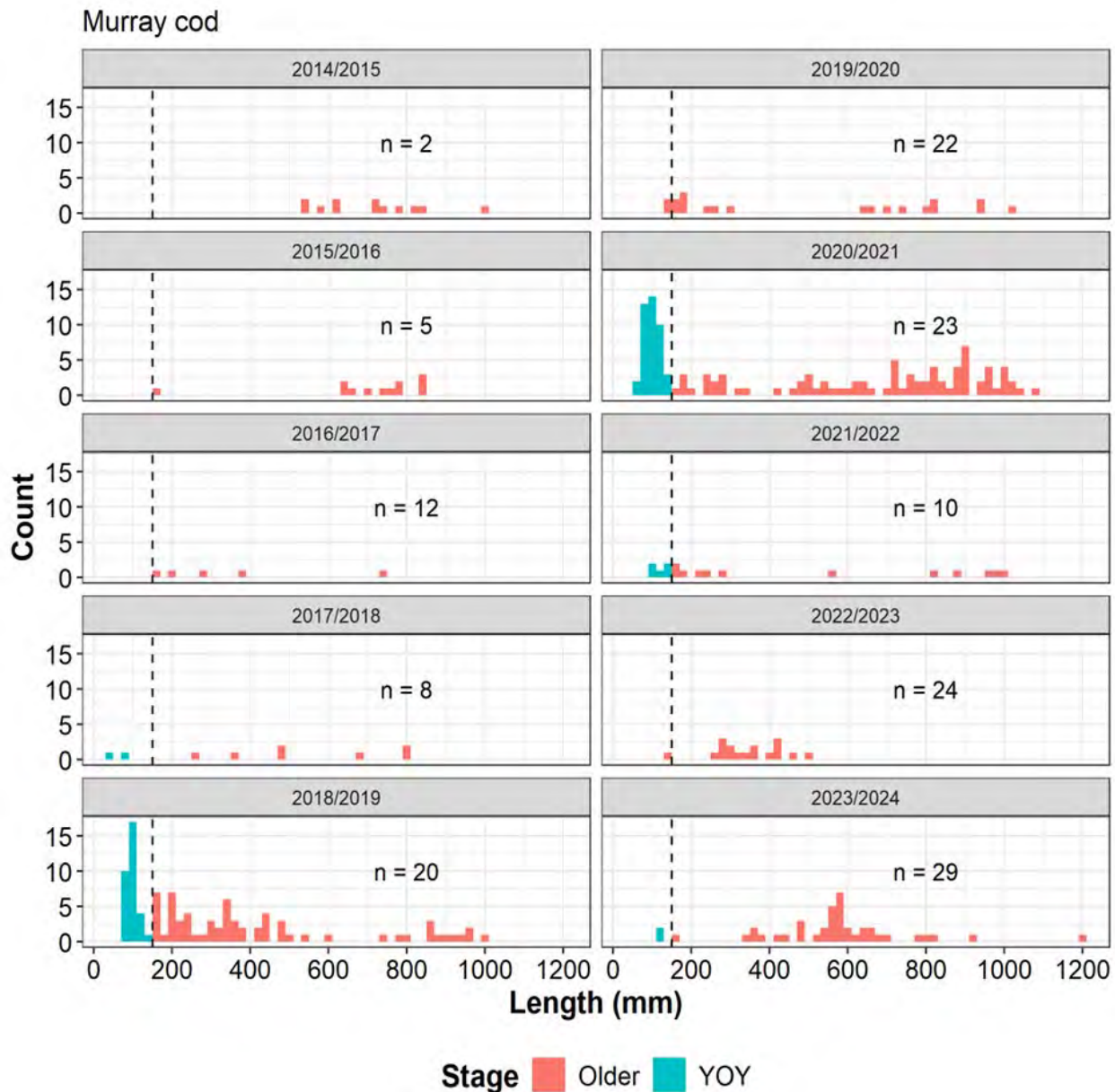


Figure 10.7: Length frequency plots for Murray cod by sampling season in the Lower Darling WRPA. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRPA in a sampling season.

Summary Statement:

Irregular recruitment with only 2 YOY observed in 2023/24 despite a range of larger sized Murray cod observed.

Stocking

A total of 119,000 Murray cod were stocked into the waterways of the New South Wales Lower Darling WRPA during the reporting period. Of these fish, 0 (0 %) were stocked into impoundments while 119,000 (100 %) were stocked into rivers or creeks. Table 10.4 shows the detailed breakdown of stocking by season, location and life stage while Figure 10.8 shows the locations of stocking.

Table 10.4: Number and life stage of stocked Murray cod each sampling season in the Lower Darling WRPA.

Sampling Season	River/Creek or Impoundment	Life Stage	Number Stocked
2020/2021	River/Creek	Fry	60,000
2021/2022	River/Creek	Fry	59,000

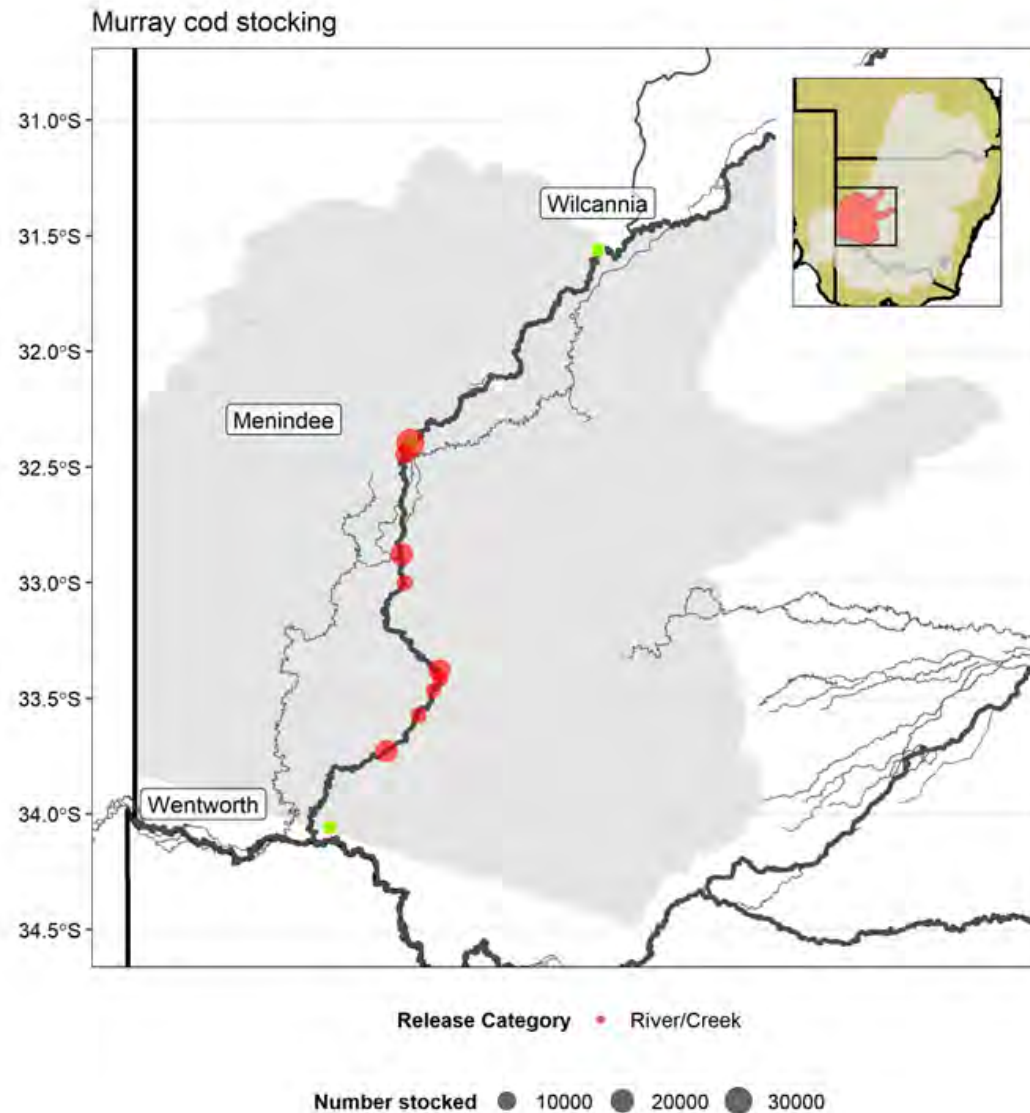


Figure 10.8: Locations of Murray cod stocking in the Lower Darling WRP. Colours show whether a site was a river/creek site or an impoundment, while the size of the point reflects the total number of fish stocked over the reporting period. Green squares represent key towns.

Temporal Trends in Abundance

The relative abundance and biomass of Murray cod since 1994 was modelled based on all suitable boat electrofishing data. The left-hand panels of Figure 10.9 show the abundance and biomass trends for the New South Wales Lower Darling WRPA and the right-hand panels show the overall trends across the NSW MDB.

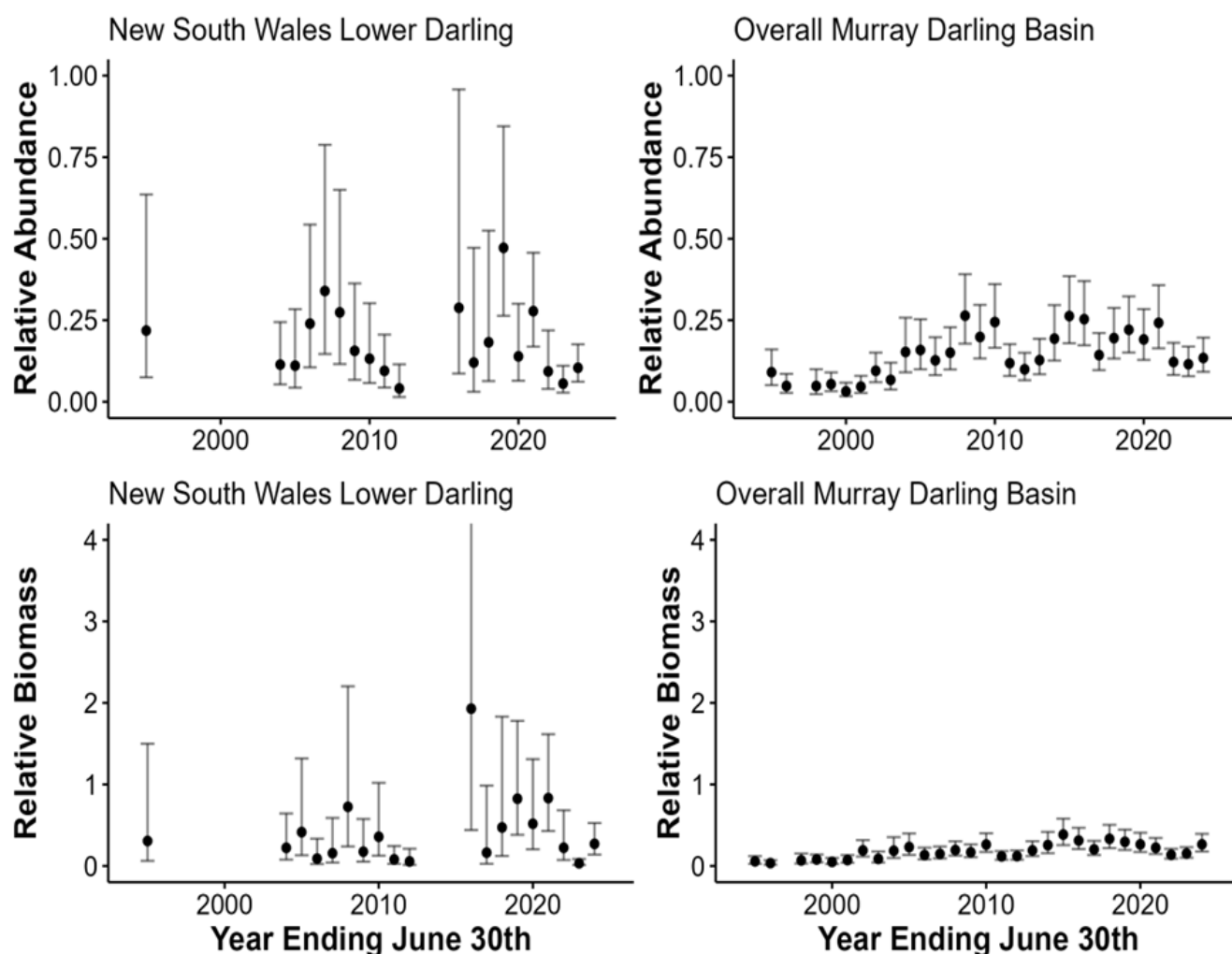


Figure 10.9: Relative abundance and biomass of Murray cod in both the New South Wales Lower Darling WRPA and the overall NSW MDB. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates.

Summary Statement:

Abundance and biomass variable since the 1990s. A decreasing trend in abundance and biomass since 2021/22. Recent abundance and biomass comparable to the wider NSW MDB.

Health

The prevalence of any health issues ranged from 0 % of sampled fish in 2015/2016 to 60 % of sampled fish in 2016/2017 (Figure 10.10). The most common health issue for Murray cod in the New South Wales Lower Darling WRPAs was *Lernaea*, which was observed in a total of 72 fish, corresponding to 20 % of all Murray cod measured.

Across the other NSW MDB WRPA, 16 % of Murray cod (1,738 out of 11,199 Murray cod) showed a health condition (excludes the New South Wales Lower Darling WRPAs).

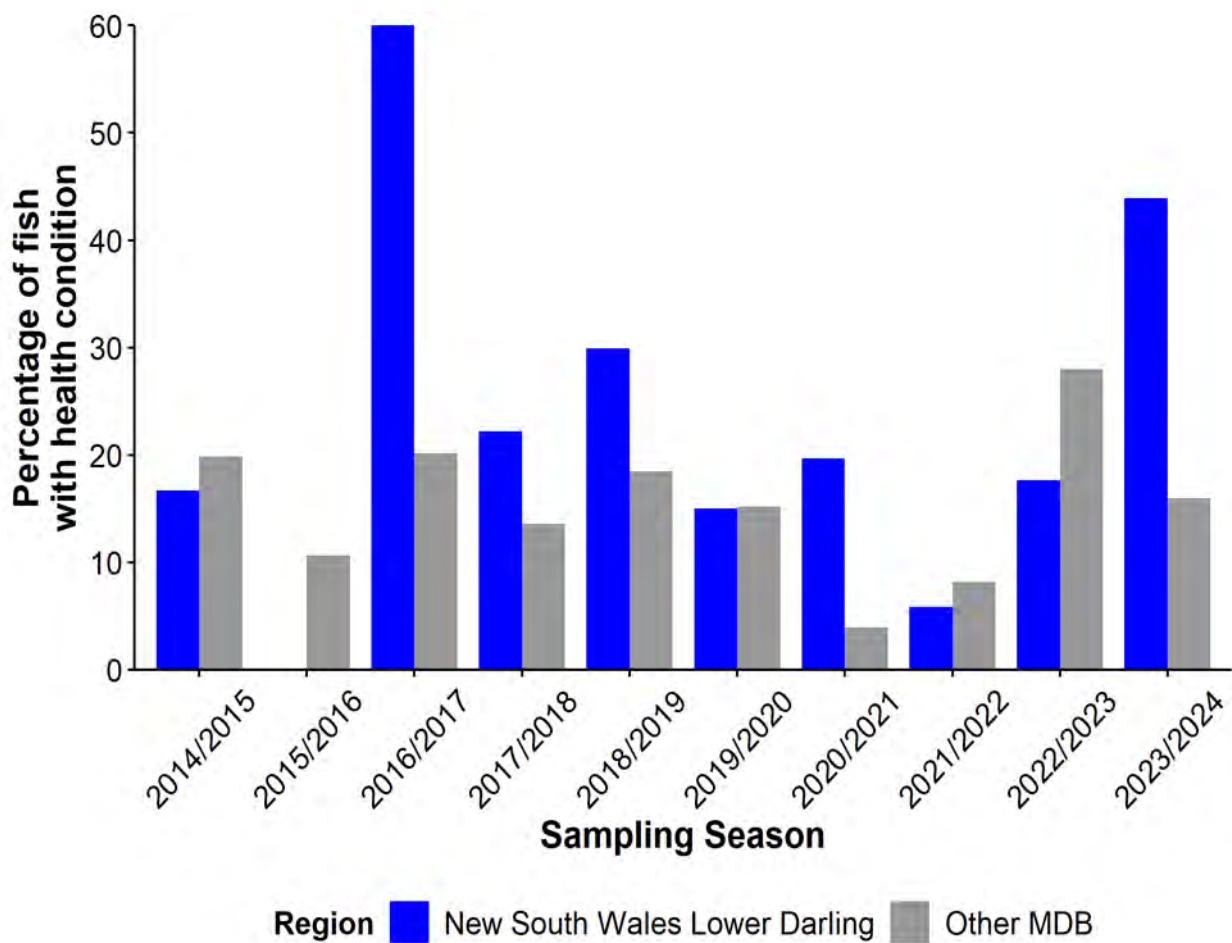


Figure 10.10: Timeseries showing the prevalence of health conditions in Murray cod. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA.

Summary Statement:

Presence of observable health conditions was variable across years but higher than the rest of the NSW MDB in 2023/24.

Distribution

Murray cod were recorded at 29 out of 77 sites in the New South Wales Lower Darling WRP from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 0.97 fish caught per 90 seconds of electrofishing. Figure 10.11 shows the distribution and relative abundance of Murray cod across the New South Wales Lower Darling WRP.

Summary Statement:

Murray cod were recorded across the New South Wales Lower Darling WRP but less abundant or absent north of Menindee and the Great Darling Anabranch.

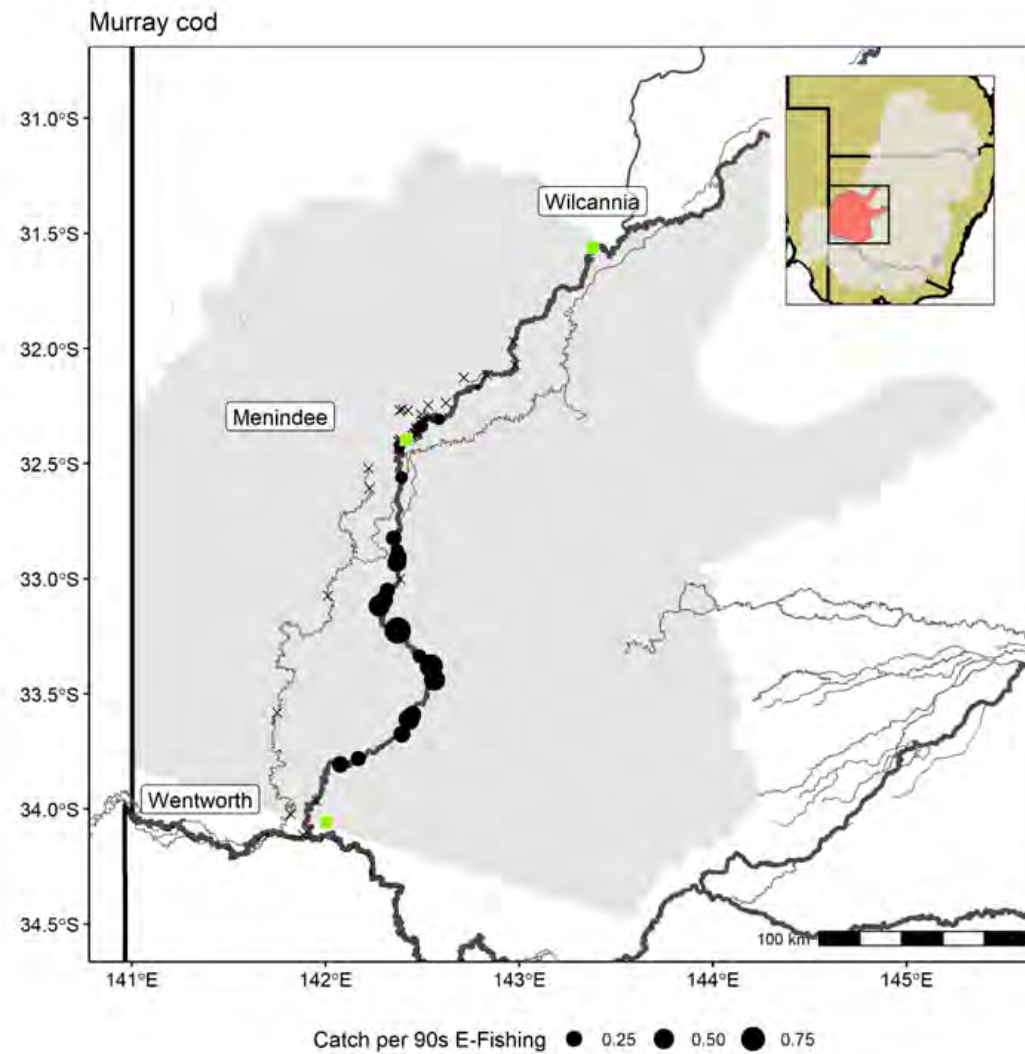


Figure 10.11: Distribution of Murray cod sampled from 2013/14 to 2023/24 in the Lower Darling WRPA. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares represent key towns.

Golden perch



Population Structure

Figure 10.12 shows the observed length frequency plot for Golden perch for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 0 to 118, and 0 % to 55 % of measured fish within a season, with a mean percentage YOY of 15 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Golden perch was 6 % (449 out of 6,985).

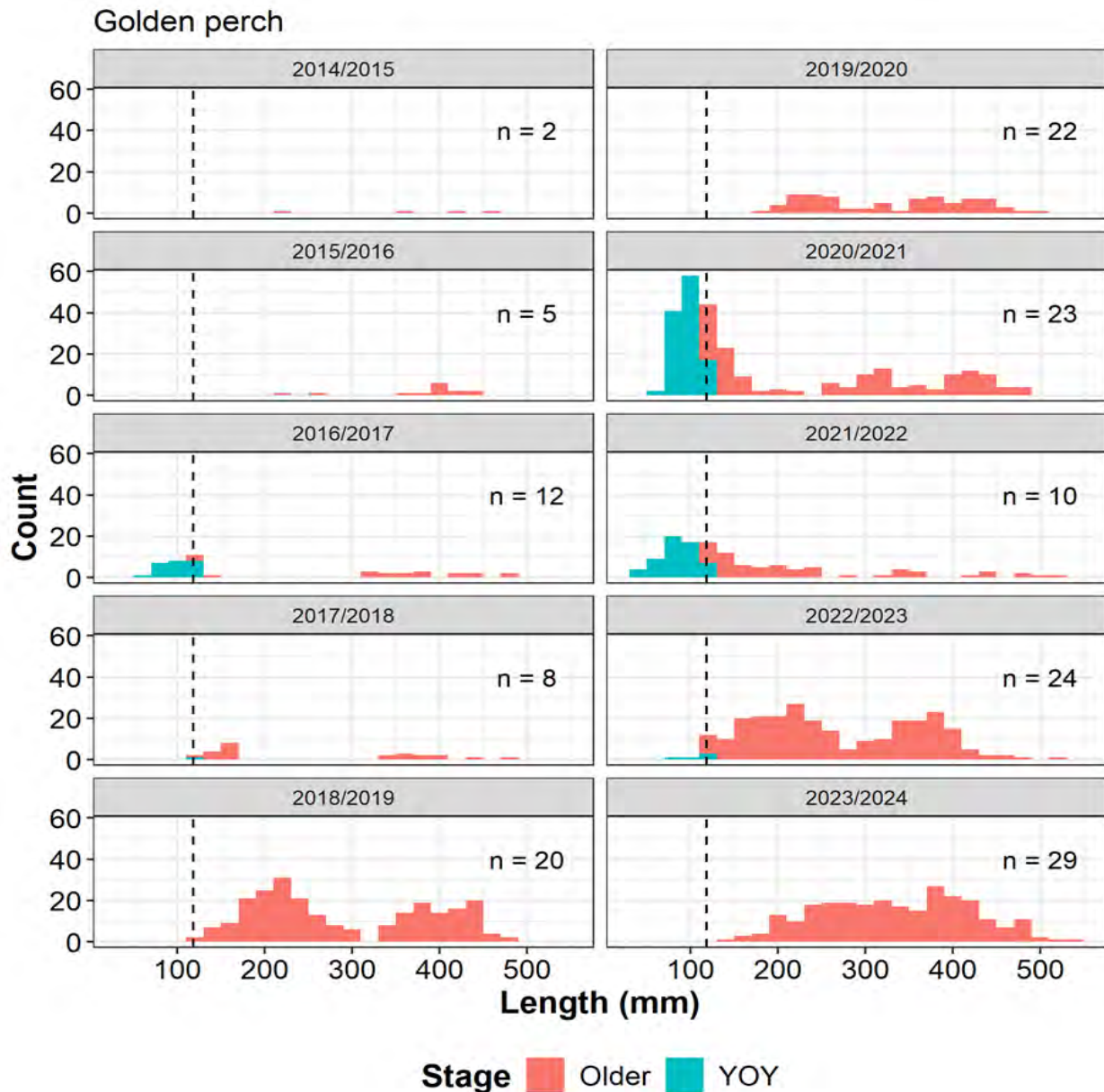


Figure 10.12: Length frequency plots for Golden perch by sampling season in the Lower Darling WRPA. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRPA in a sampling season.

Summary Statement:

Irregular recruitment with no evidence of recruitment in 2023/24 (following very limited recruitment in 2022/23). A range of larger Golden perch were observed.

Stocking

A total of 60,000 Golden perch were stocked into the waterways of the New South Wales Lower Darling WRPAs during the reporting period. Of these fish, 0 (0 %) were stocked into impoundments while 60,000 (100 %) were stocked into rivers or creeks. Table 10.5 shows the detailed breakdown of stocking by season, location and life stage while Figure 10.13 shows the locations of stocking.

Table 10.5: Number and life stage of stocked Golden perch each sampling season in the Lower Darling WRPAs.

Sampling Season	River/Creek or Impoundment	Life Stage	Number Stocked
2020/2021	River/Creek	Fry	60,000

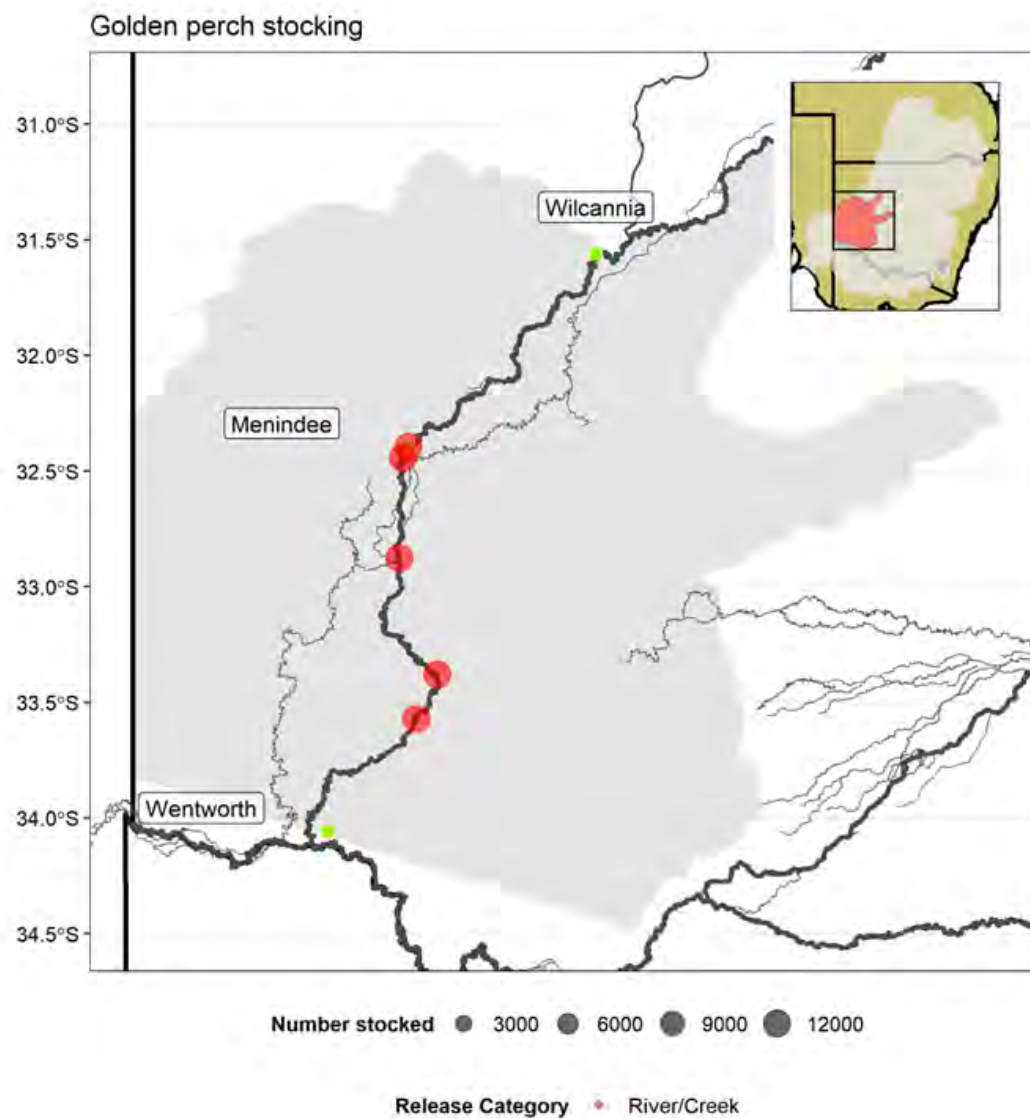


Figure 10.13: Locations of Golden perch stocking in the Lower Darling WRPA. Colours show whether a site was a river/creek site or an impoundment, while the size of the point reflects the total number of fish stocked over the reporting period. Green squares represent key towns.

Temporal Trends in Abundance

The relative abundance and biomass of Golden perch since 1994 was modelled based on all suitable boat electrofishing data. The left-hand panels of Figure 10.14 show the abundance and biomass trends for the New South Wales Lower Darling WRP and the right-hand panels show the overall trends across the NSW MDB.

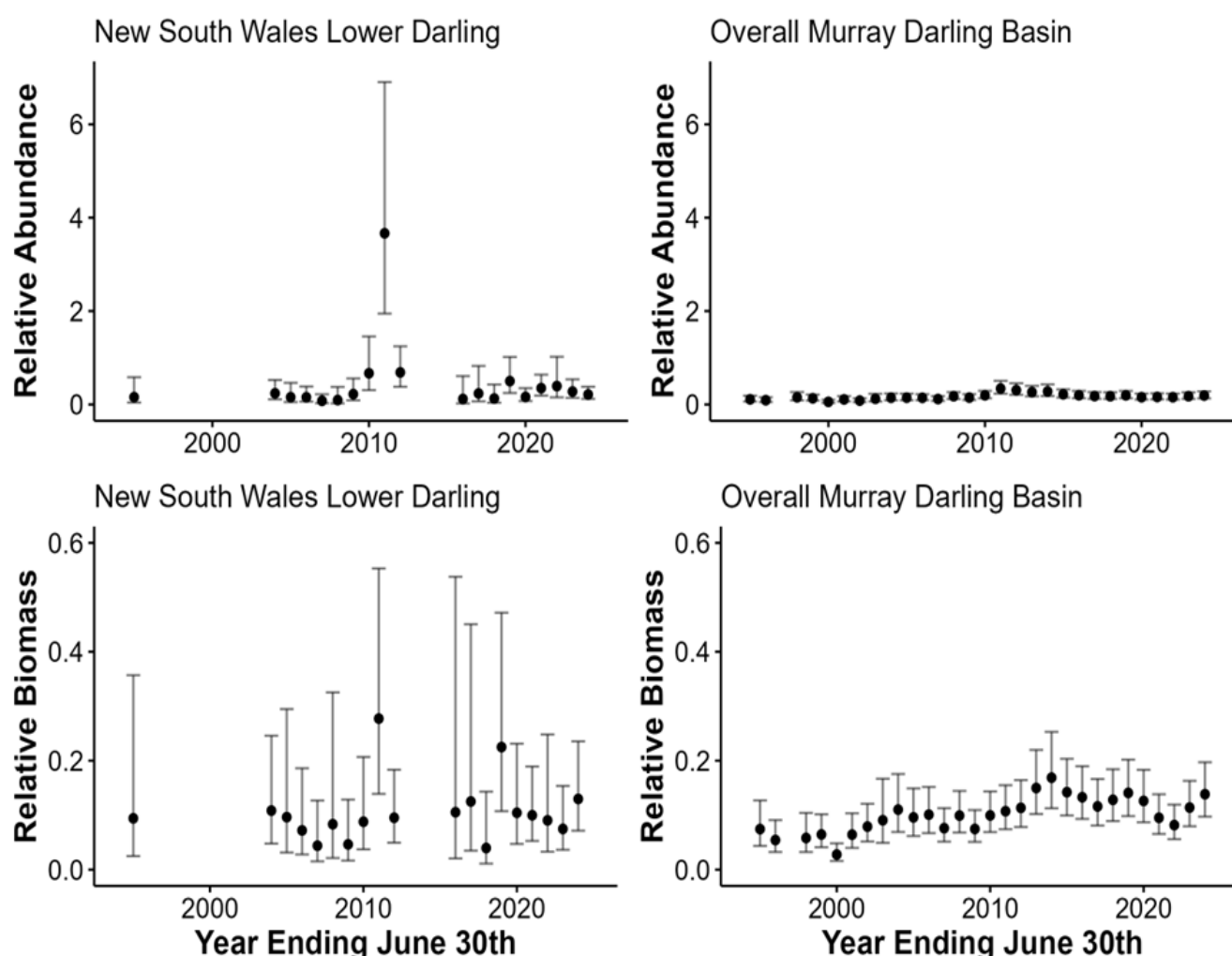


Figure 10.14: Relative abundance and biomass of Golden perch in both this valley and the overall Murray-Darling Basin. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates.

Summary Statement:

Golden perch abundance and biomass in the NSW Lower Darling WRP declined sharply after a large peak in 2010/11 and have been relatively stable at lower levels in recent years. Recent abundance and biomass are similar to the wider MDB.

Health

The prevalence of any health issues ranged from 4 % of sampled fish in 2021/2022 to 48 % of sampled fish in 2016/2017 (Figure 10.15). The most common health issue for Golden perch in the New South Wales Lower Darling water resource planning area was *Lernaea*, which was observed in a total of 215 fish, corresponding to 16 % of all Golden perch measured.

Across the other WRPAs, 26 % of Golden perch (1,787 out of 6,985 Golden perch) showed a health condition (excludes New South Wales Lower Darling).

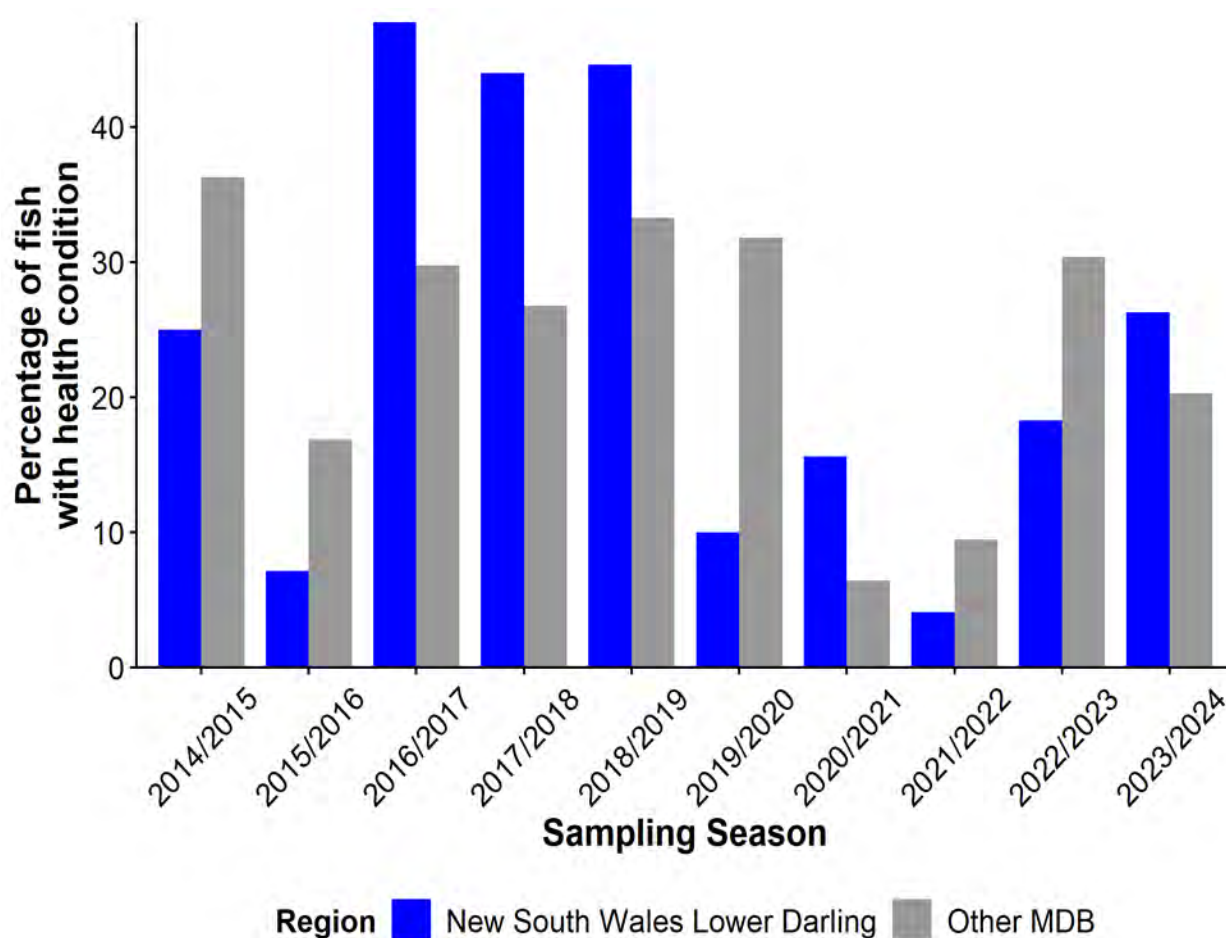


Figure 10.15: Timeseries showing the prevalence of health conditions in Golden perch. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPAs.

Summary Statement:

The presence of observable health conditions for Golden perch in the New South Wales Lower Darling was variable and generally tracked the average across the rest of the Murray-Darling Basin.

Distribution

Golden perch were recorded at 65 out of 77 sites in the New South Wales Lower Darling WRP from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 2.58 fish caught per 90 seconds of electrofishing. Figure 10.16 shows the distribution and relative abundance of Golden perch across the New South Wales Lower Darling WRP.

Summary Statement:

Golden perch were generally present across the New South Wales Lower Darling region.

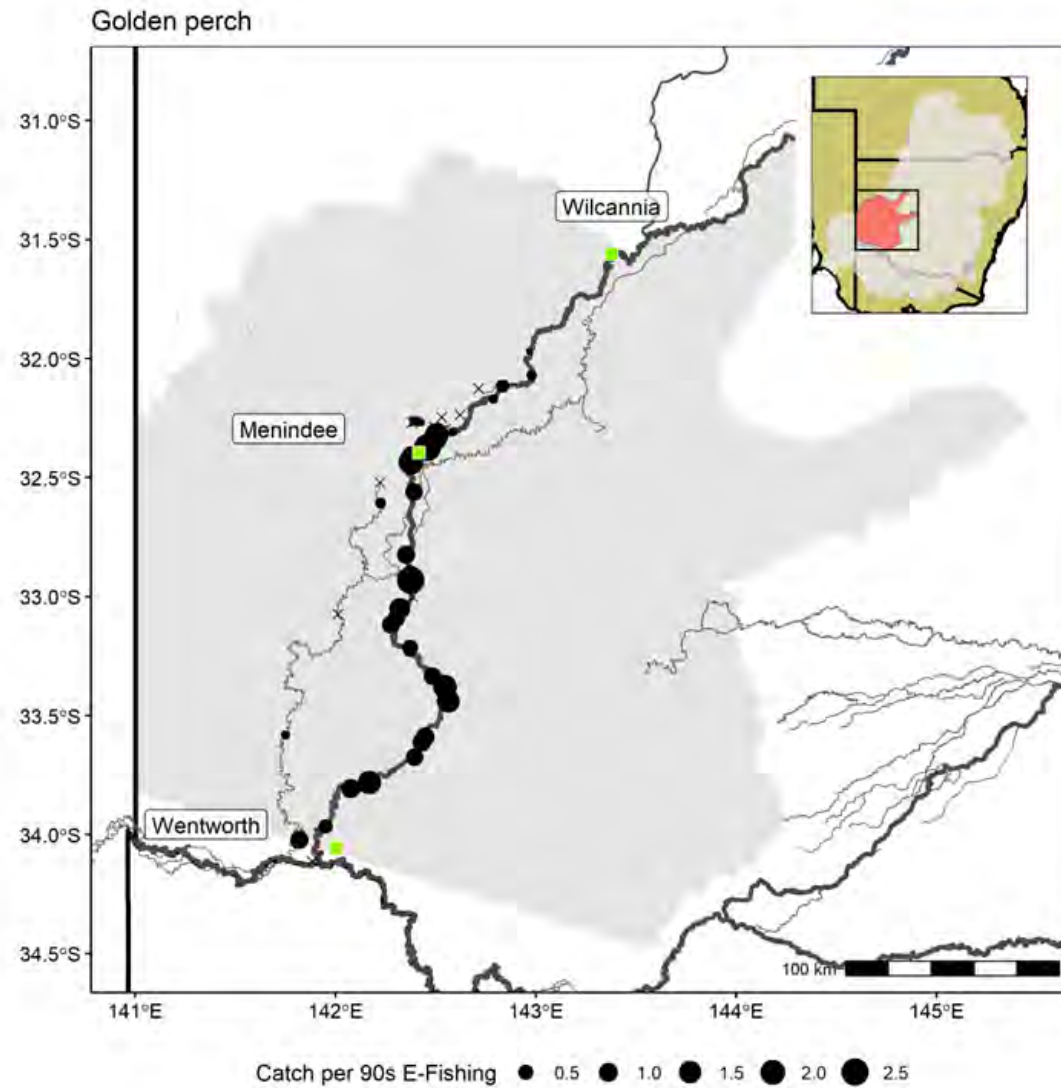


Figure 10.16: Distribution of Golden perch sampled from 2013/14 to 2023/24 in the Lower Darling WRPA. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares represent key towns.

Freshwater catfish



Summary Statement:

No Freshwater catfish were observed in the NSW Lower Darling WRPA during the reporting period. This suggests that Freshwater catfish are absent or in very low abundances in this region.

Bony herring



Population Structure

Figure 10.17 shows the observed length frequency plot for Bony herring for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 4 to 733, and 4 % to 73 % of measured fish within a season, with a mean percentage YOY of 28 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Bony herring was 24 % (11,512 out of 48,049). Bony herring are not a stocked species.

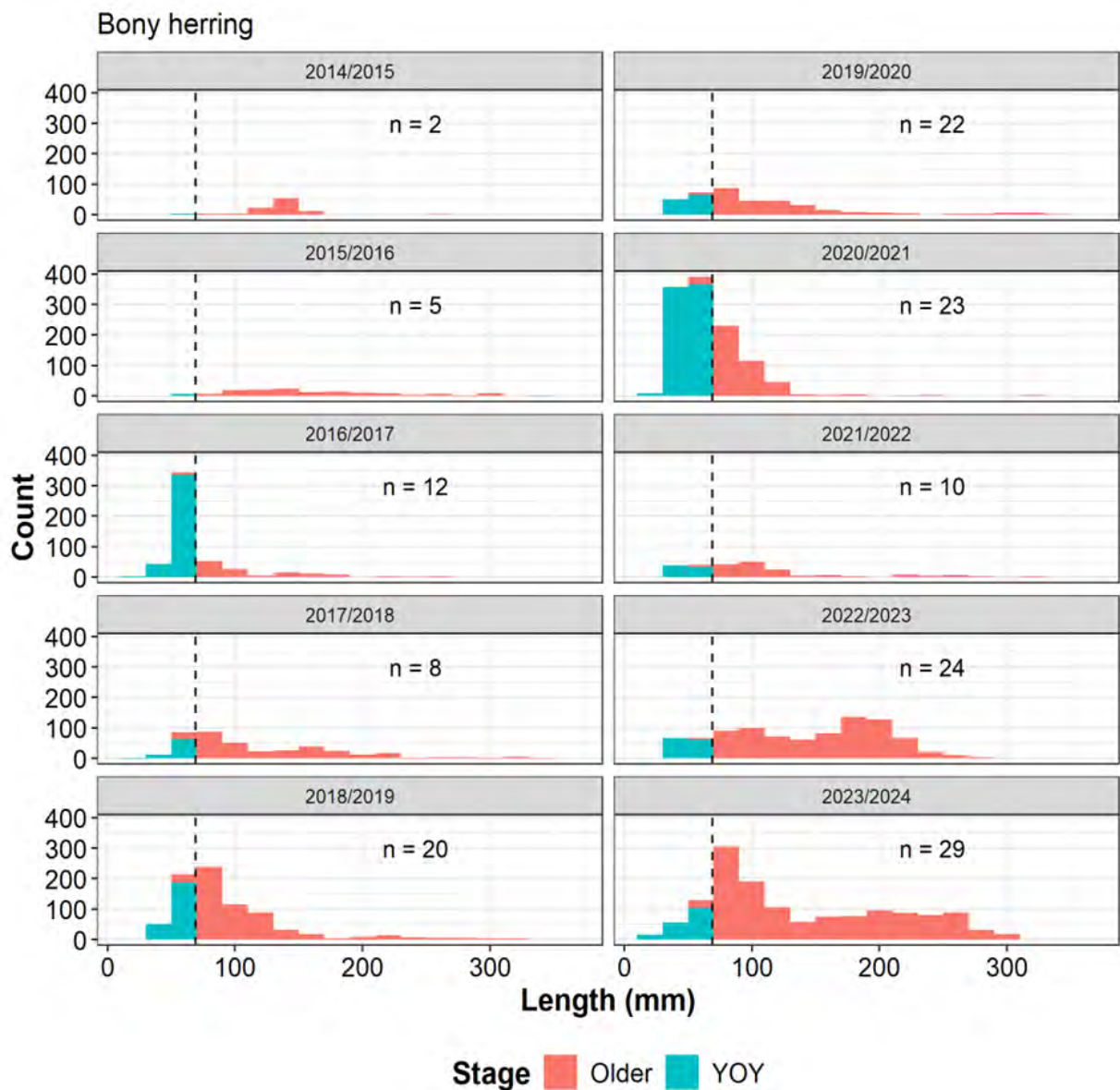


Figure 10.17: Length frequency plots for Bony herring by sampling season in the Lower Darling WRPA. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRPA in a sampling season.

Summary Statement:

Regular recruitment since 2016/17 but variable numbers of young-of-year and few large fish in most years. Higher proportions of large fish in 2022/23 and 2023/24 than previous years.

Temporal Trends in Abundance

The relative abundance and biomass of Bony herring since 1994 was modelled based on all suitable boat electrofishing data. The left-hand panels of Figure 10.18 show the abundance and biomass trends for the New South Wales Lower Darling WRPA and the right-hand panels show the overall trends across the NSW MDB.

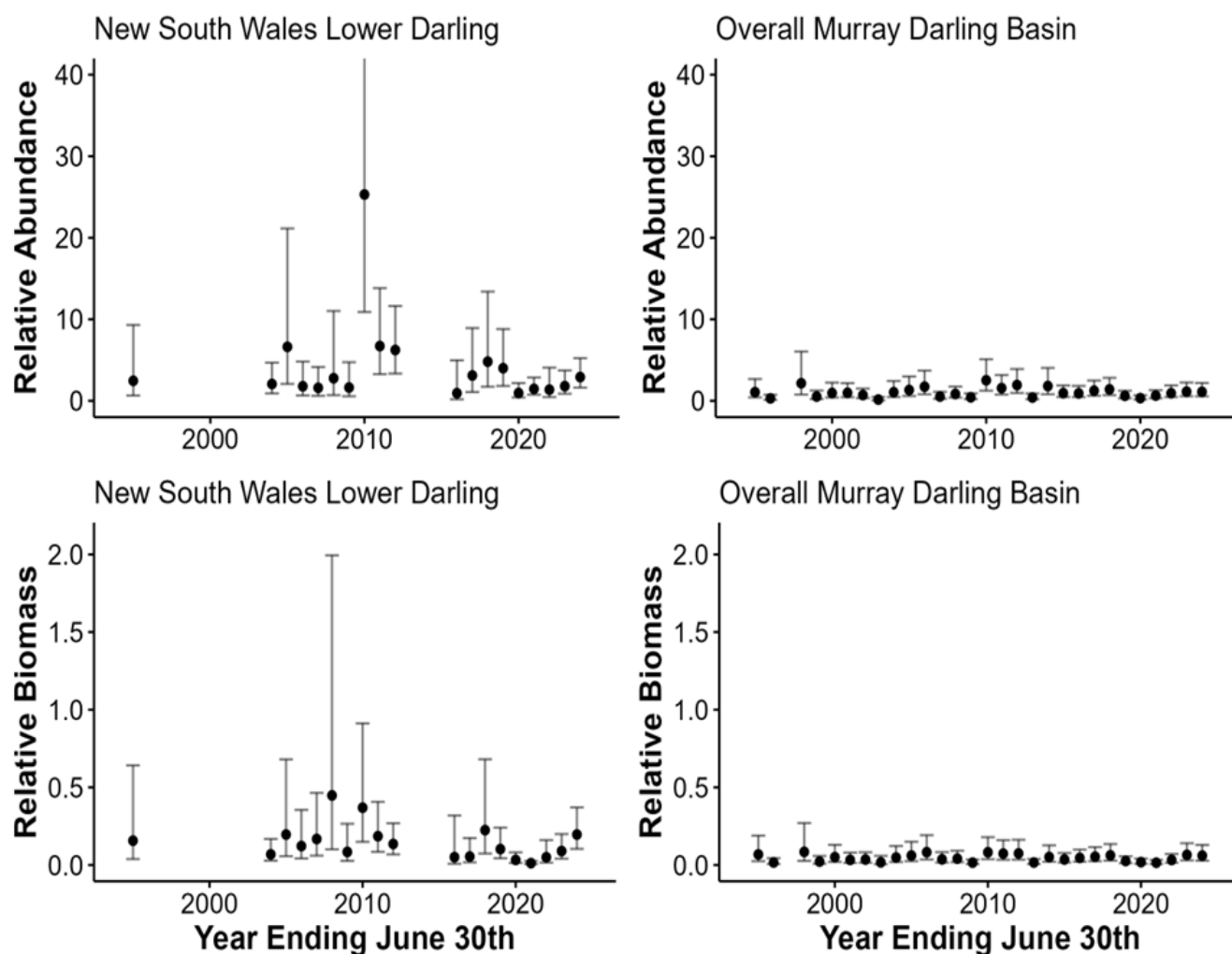


Figure 10.18: Relative abundance and biomass of Bony herring in both the New South Wales Lower Darling WRPA and the overall NSW MDB. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates. Note some error bars are truncated for clarity.

Summary Statement:

Fluctuations in abundance and biomass with peaks around 2010 and low values in 2019/20 and 2020/21. Abundance and biomass are trending upwards in recent years and are slightly higher than the overall NSW MDB.

Health

The prevalence of any health issues ranged from 0 % of sampled fish in multiple years to 13 % of sampled fish in 2022/2023 (Figure 10.19). The most common health issue for Bony herring in the New South Wales Lower Darling WRPAs was Fungus, which was observed in a total of 92 fish, corresponding to 1 % of all Bony herring measured.

Across the other NSW MDB WRPA, 0.7 % of Bony herring (313 out of 44,515 Bony herring) showed a health condition (excludes the New South Wales Lower Darling WRPAs).

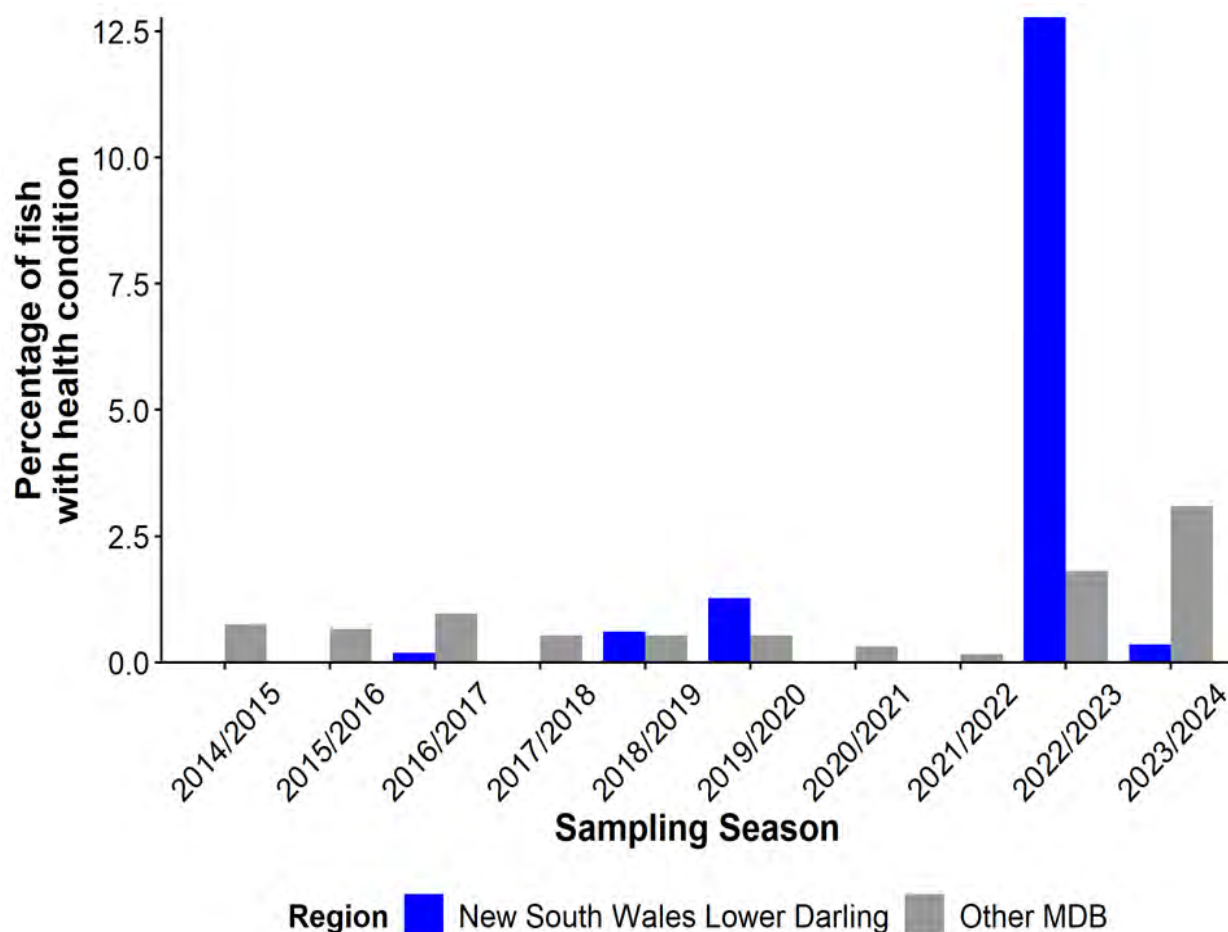


Figure 10.19: Timeseries showing the prevalence of health conditions in Bony herring. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA.

Summary Statement:

Presence of observable health conditions was lower than or similar to the rest of the Murray-Darling Basin in all years except 2022/23 when the proportion was much higher.

Distribution

Bony herring were recorded at 75 out of 77 sites in the New South Wales Lower Darling WRP from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 64.5 fish caught per 90 seconds of electrofishing. Figure 10.20 shows the distribution and relative abundance of Bony herring across the New South Wales Lower Darling WRP.

Summary Statement:

Bony herring were recorded across the New South Wales Lower Darling WRP.

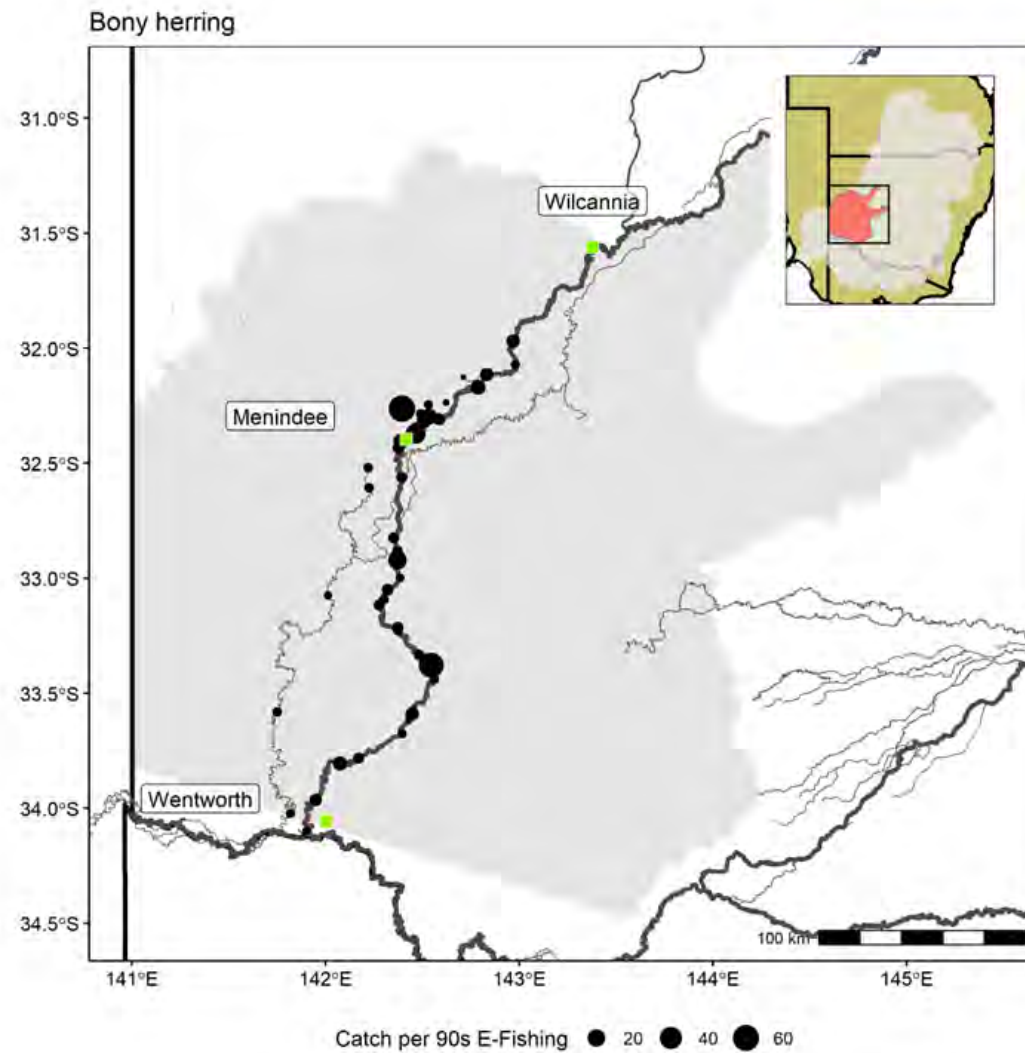


Figure 10.20: Distribution of Bony herring sampled from 2013/14 to 2023/24 in the Lower Darling WRPA. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares represent key towns.

Australian smelt



Population Structure

Figure 10.21 shows the observed length frequency plot for Australian smelt for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 2 to 31, and 4 % to 88 % of measured fish within a season, with a mean percentage YOY of 31 %.

Across all MDB water resource planning areas during the reporting period, the percentage YOY for Australian smelt was 42 % (10,875 out of 25,783). Australian smelt are not a stocked species.

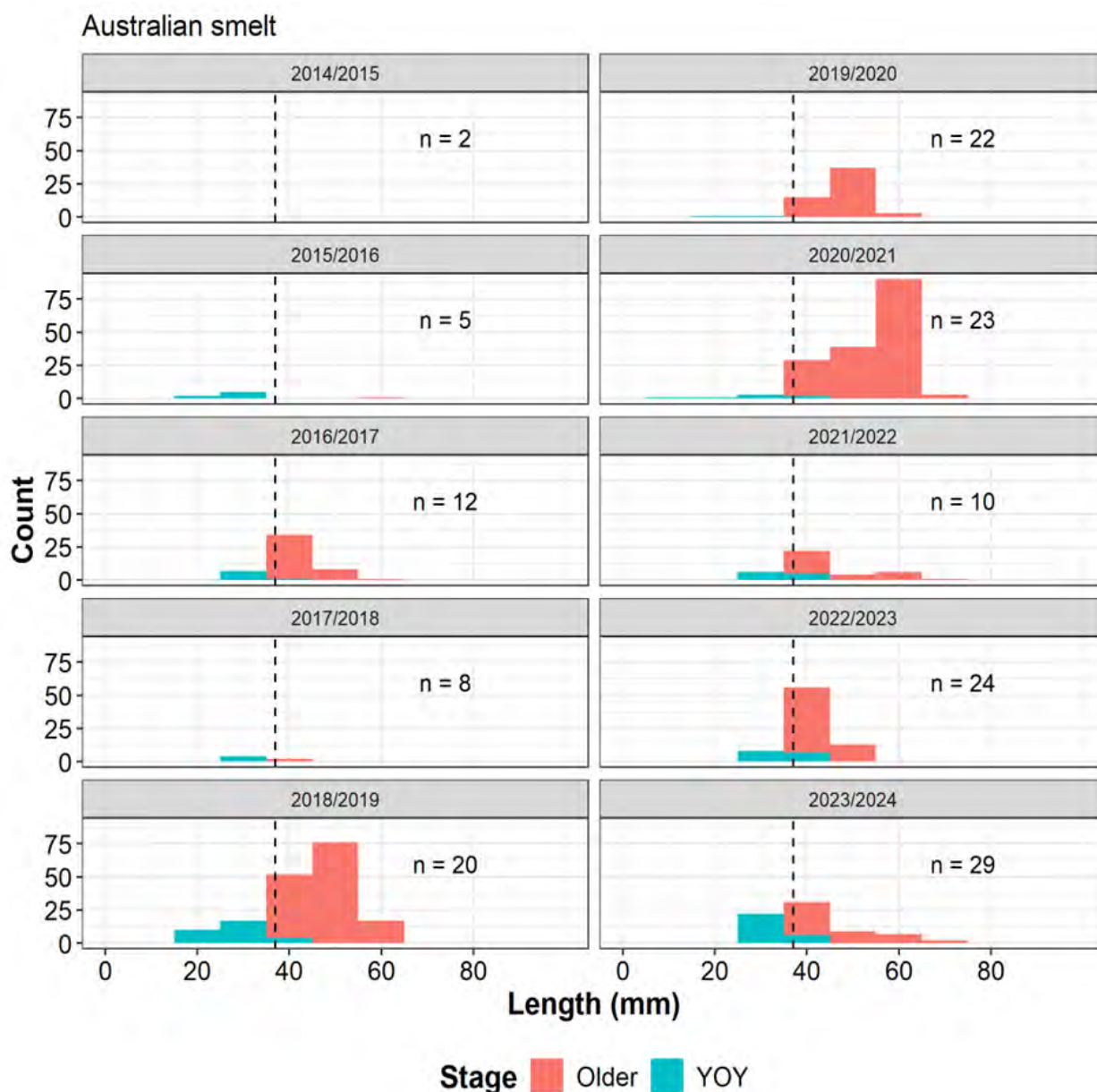


Figure 10.21: Length frequency plots for Australian smelt by sampling season in the Lower Darling WRP. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRP in a sampling season.

Summary Statement:

Evidence of regular recruitment with YOY and adult size ranges in most years. No Australian smelt were detected in 2014/15. There was reasonable recruitment and a range of size classes in 2023/24.

Temporal Trends in Abundance

The relative abundance of Australian smelt since 1994 was modelled based on all suitable boat electrofishing data. The left-hand panel of Figure 10.22 show the abundance trends for the New South Wales Lower Darling WRPA and the right-hand panel show the overall trend across the NSW MDB.

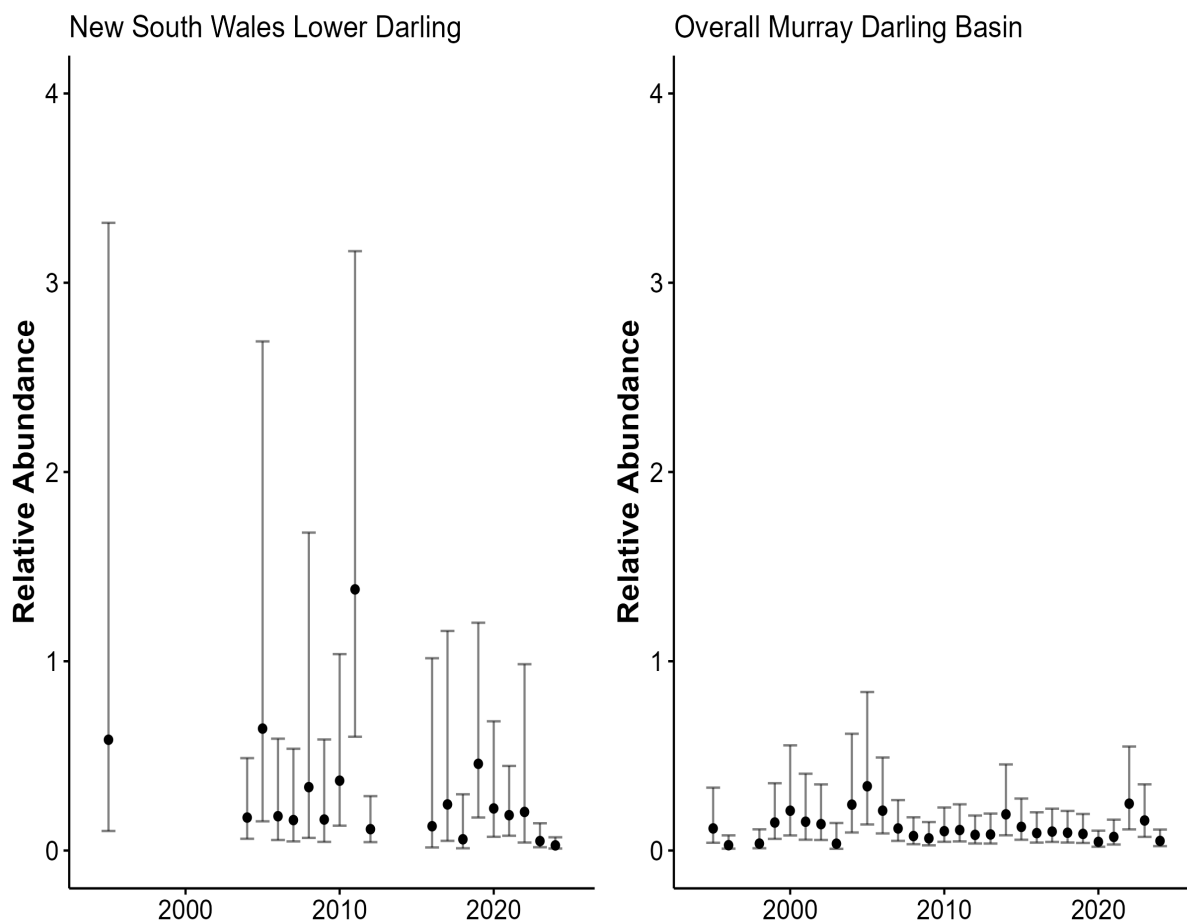


Figure 10.22: Relative abundance of Australian smelt in both the New South Wales Lower Darling WRPA and the overall NSW MDB. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates. No modelling of biomass was done for Australian smelt.

Summary Statement:

Abundance is currently very low in the NSW Lower Darling and this is comparable to the wider NSW MDB. High abundances of Australian smelt were observed in this WRPA in previous years.

Health

The prevalence of any health issues ranged from 0 % of sampled fish in most years to 1.1 % of sampled fish to 2018/19 (Figure 10.23). The most common health issue for Australian smelt in the New South Wales Lower Darling WRPAs was Lesions, which was observed in a total of 1 fish, corresponding to <1 % of all Australian smelt measured.

Across the other NSW MDB WRPA, <1 % of Australian smelt (172 out of 27,284 Australian smelt) showed a health condition (excludes the New South Wales Lower Darling WRPAs).

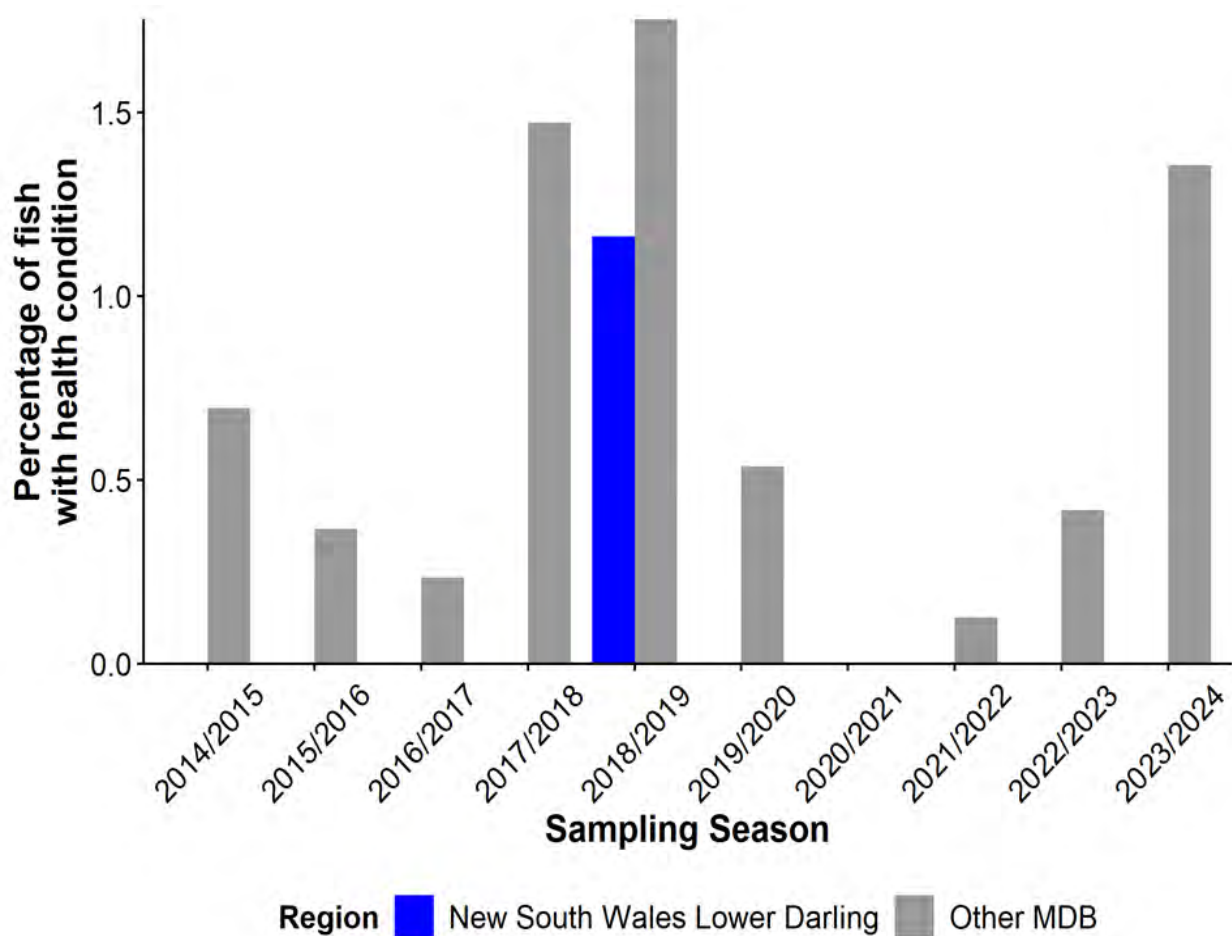


Figure 10.23: Timeseries showing the prevalence of health conditions in Australian smelt. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA.

Summary Statement:

Very few health issues were observed in Australian smelt in the NSW Lower Darling.

Distribution

Australian smelt were recorded at 53 out of 77 sites in the New South Wales Lower Darling WRP from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 4.58 fish caught per 90 seconds of electrofishing. Figure 10.24 shows the distribution and relative abundance of Australian smelt across the New South Wales Lower Darling WRP.

Summary Statement:

Australian smelt were recorded across the NSW Lower Darling.

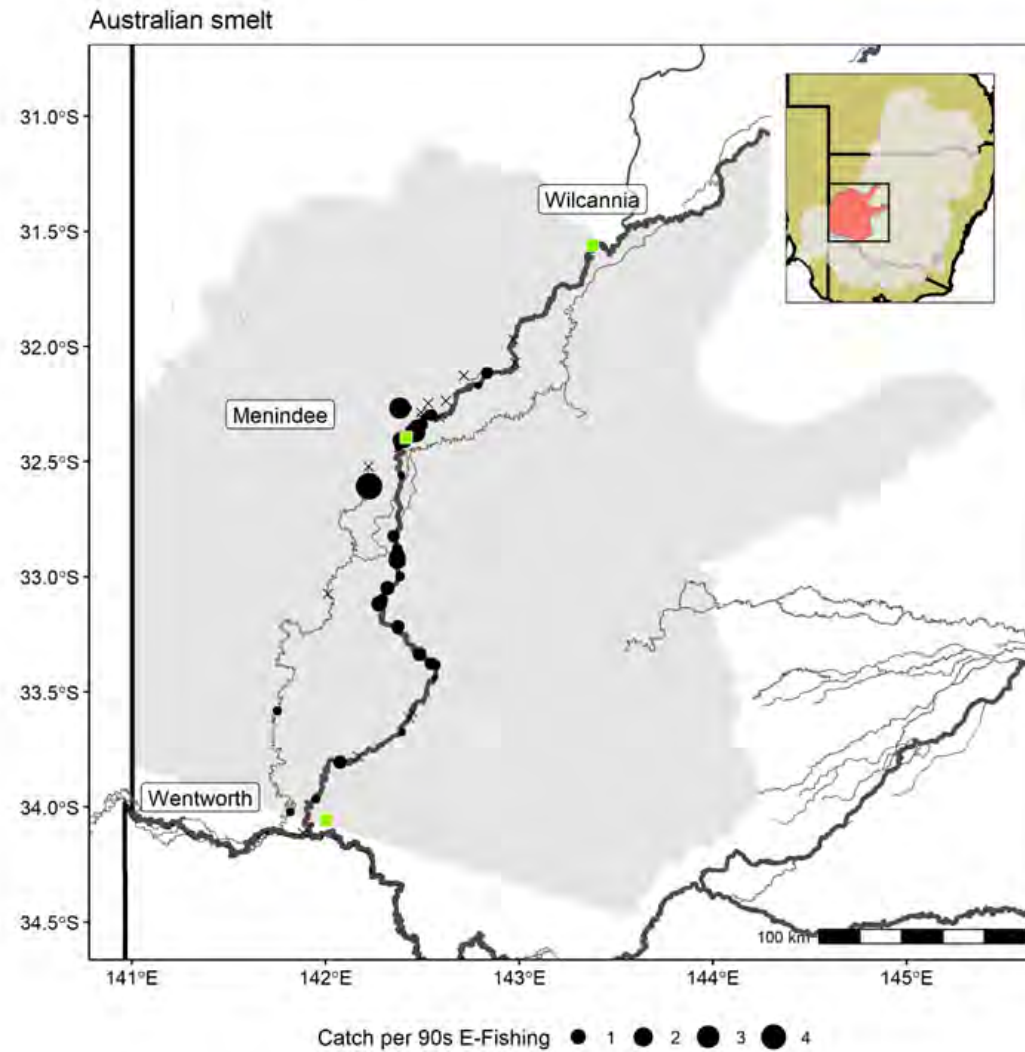


Figure 10.24: Distribution of Australian smelt sampled from 2013/14 to 2023/24 in the Lower Darling WRPA. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares represent key towns.

Common carp



Population Structure

Figure 10.25 shows the observed length frequency plot for Common carp for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 1 to 1,844, and 2 % to 90 % of measured fish within a season, with a mean percentage YOY of 39 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Common carp was 55 % (32,632 out of 59,358). Common carp are not a stocked species.

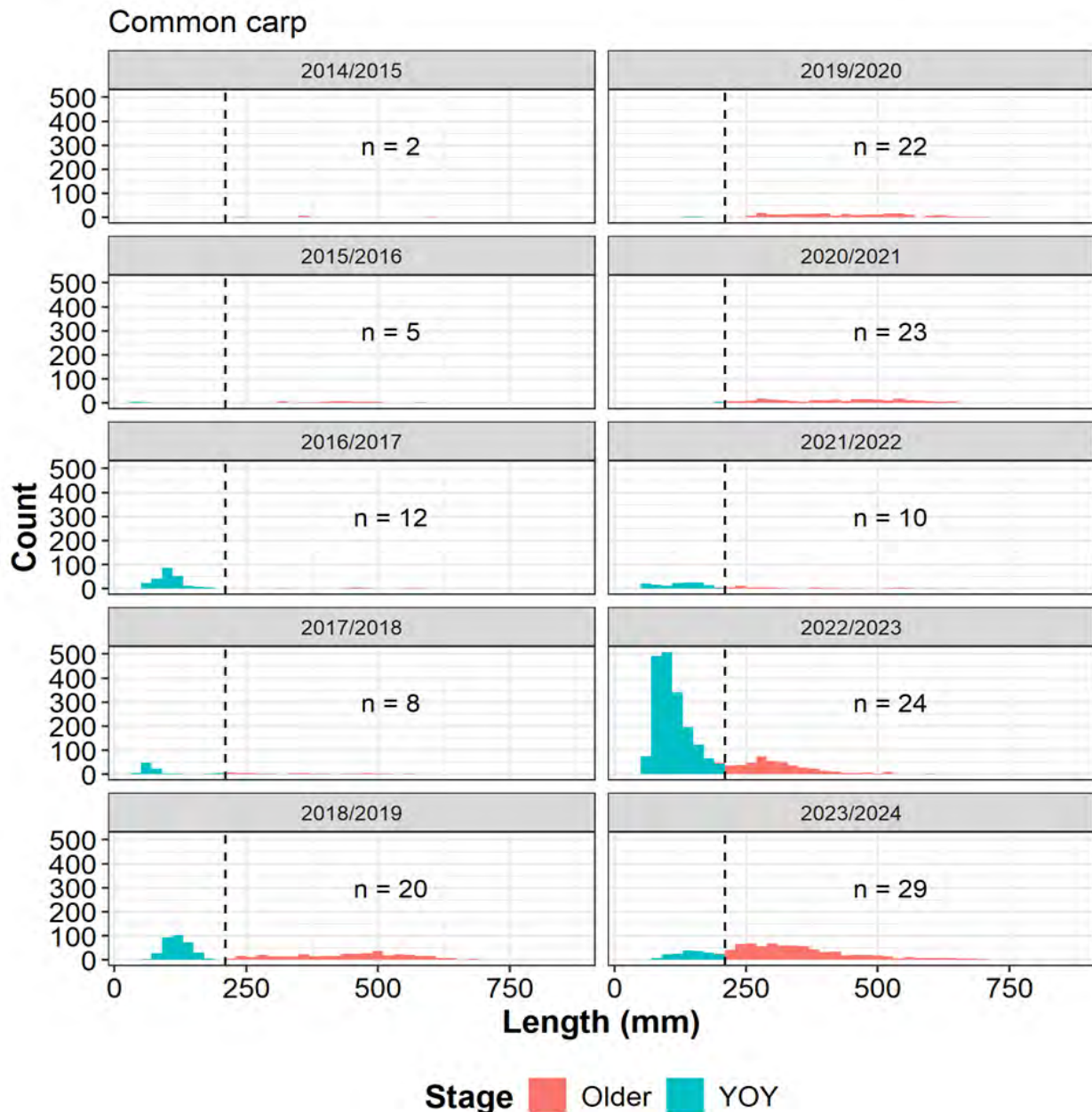


Figure 10.25: Length frequency plots for common carp by sampling season in the Lower Darling WRPA. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRPA in a sampling season.

Summary Statement:

Moderate recruitment of in 2023/24, following very strong recruitment in 2022/23. A higher proportion of moderate size fish following the previous recruitment.

Temporal Trends in Abundance

The relative abundance and biomass of Common carp since 1994 was modelled based on all suitable boat electrofishing data. The left-hand panels of Figure 10.26 show the abundance and biomass trends for the New South Wales Lower Darling WRP and the right-hand panels show the overall trends across the NSW MDB.

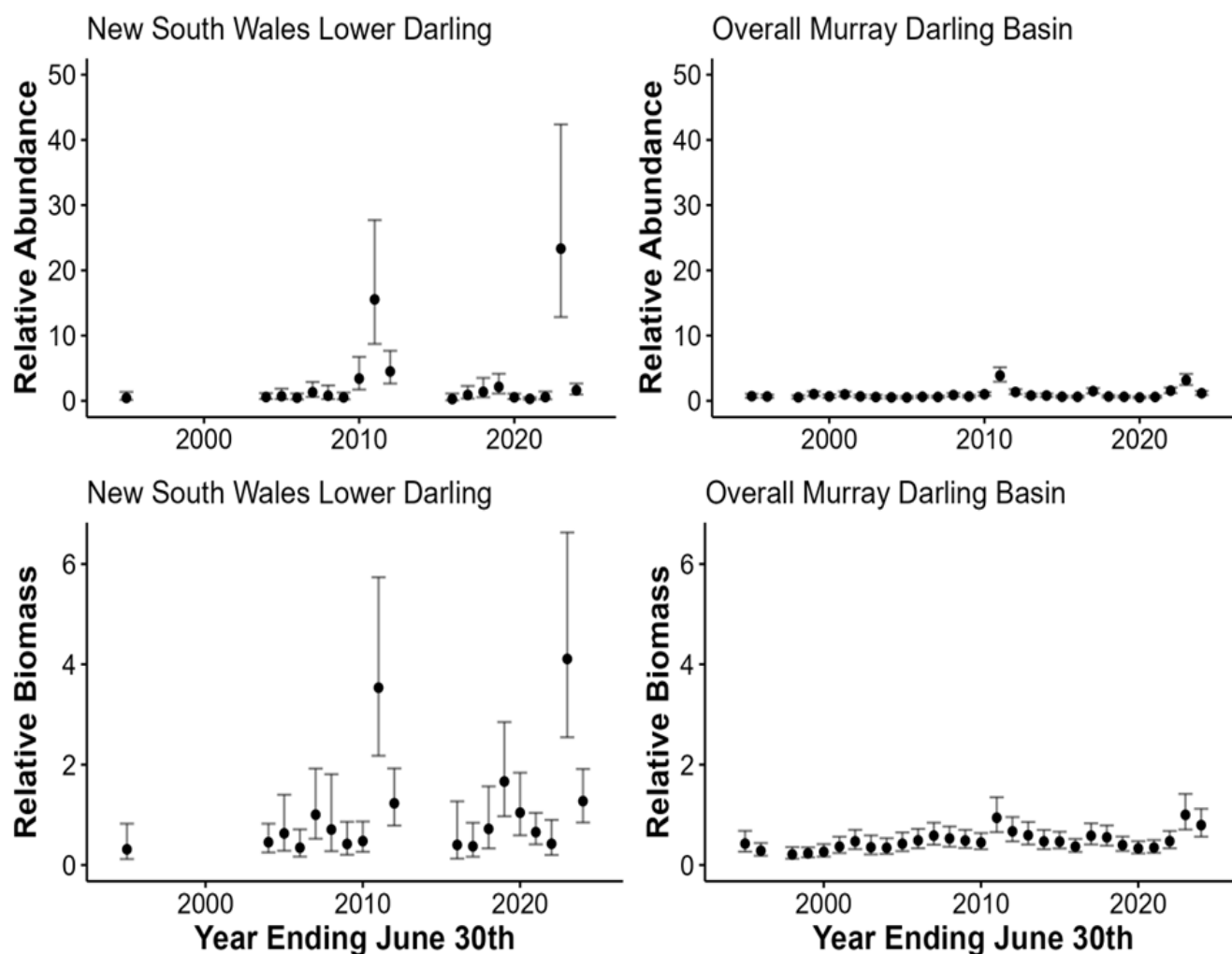


Figure 10.26: Relative abundance and biomass of Common carp in both this valley and the overall Murray-Darling Basin. These are model estimates based upon all electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates.

Summary Statement:

Large increases in abundance and biomass after strong recruitment in 2022/23 have been followed by sharp declines. Abundance appears to be back at long term average but biomass remains slightly elevated.

Health

The prevalence of any health issues ranged from 0 % of sampled fish in 2014/2015 to 7 % of sampled fish in 2020/2021 (Figure 10.27). The most common health issue for Common carp in the New South Wales Lower Darling water resource planning area was *Lernaea*, which was observed in a total of 59 fish, corresponding to 1 % of all Common carp measured.

Across the other WRPA's, 4 % of Common carp (2,307 out of 59,360 Common carp) showed a health condition (excludes New South Wales Lower Darling).

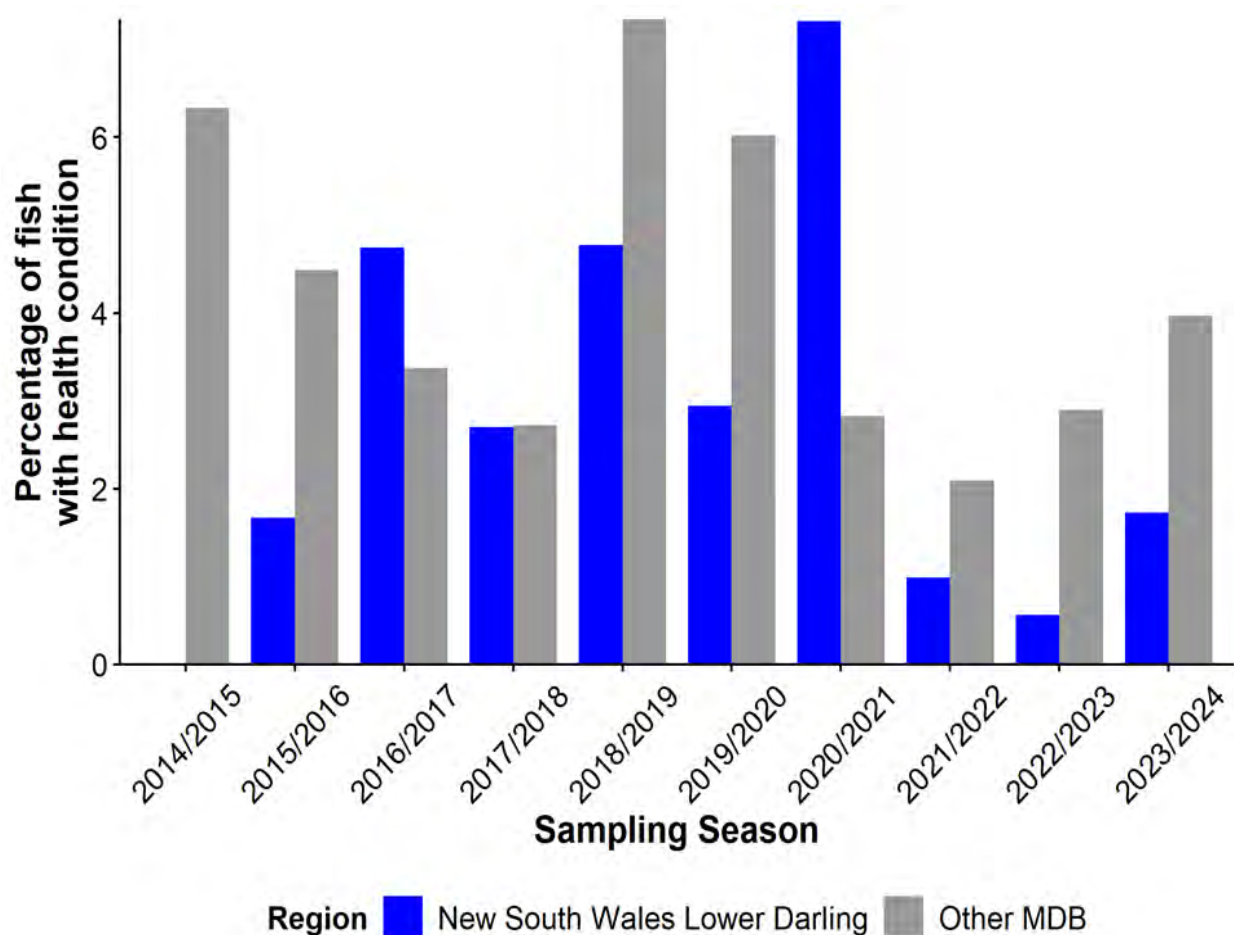


Figure 10.27: Timeseries showing the prevalence of health conditions in Common carp. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA's.

Summary Statement:

The presence of observable health conditions for Common carp in the NSW Lower Darling was low to moderate and generally similar to the wider NSW MDB.

Distribution

Common carp were recorded at 73 out of 77 sites in the New South Wales Lower Darling WRP from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 55.41 fish caught per 90 seconds of electrofishing. Figure 10.28 shows the distribution and relative abundance of Common carp across the New South Wales Lower Darling WRP

Summary Statement:

Common carp were found in relatively high abundance across the NSW Lower Darling region.

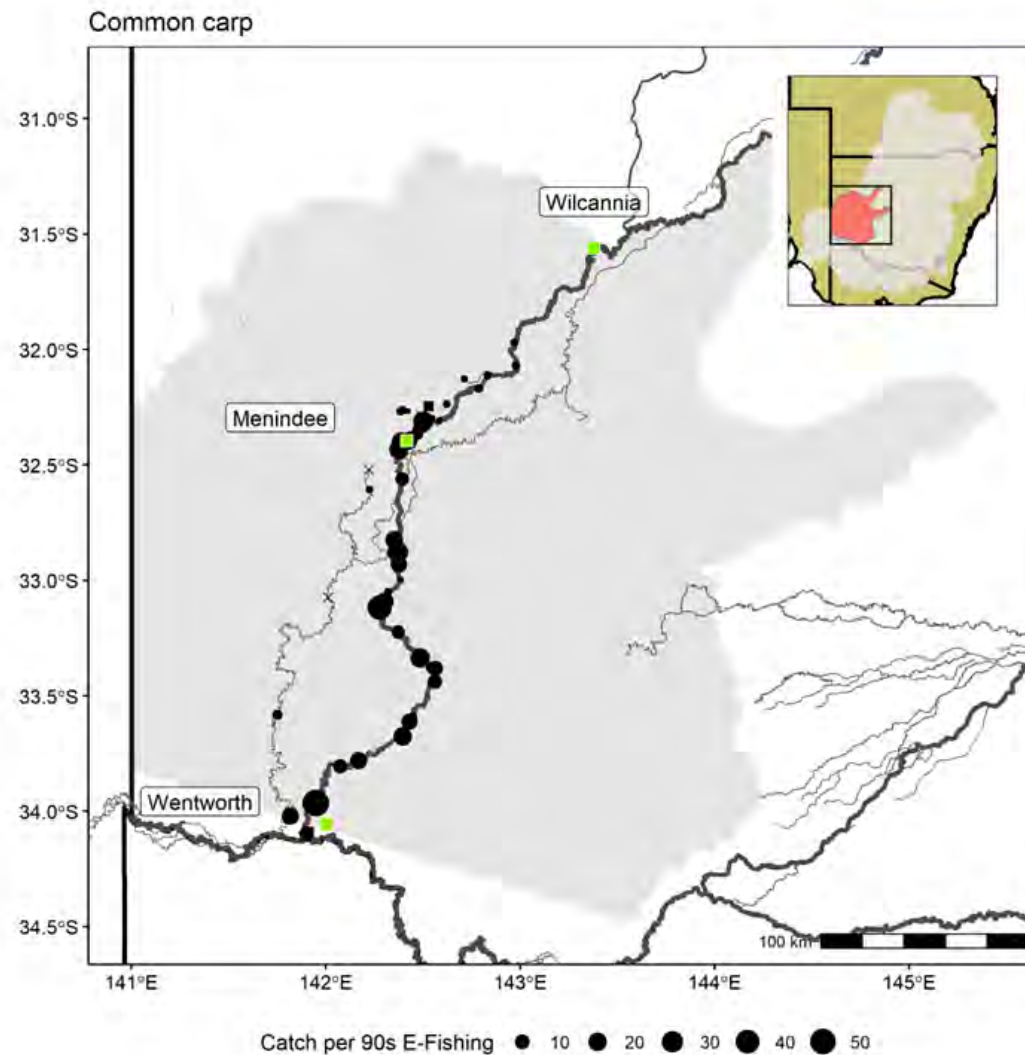


Figure 10.28: Distribution of Common carp sampled from 2013/14 to 2023/24 in the Lower Darling WRPA. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X Green squares represent key towns..

Threatened Species

The following table (Table 10.6) shows the fish species listed under either the *NSW Fisheries Management Act 1994* (FMA) or the *Commonwealth Environmental Protection and Biodiversity Conservation Act 1999* (EPBC) which were observed during standardised electrofishing surveys in the New South Wales Lower Darling Water Resource Planning Area during the reporting period. A list of all threatened fish species observed by NSW DPIRD Fisheries (as part of any sampling program in any area) is provided in Table 10.10.

Table 10.6: Listed species which were observed in this region during the sampling period. (* = FMA, # = EPBC)

Species	Common name	Total caught (observed)
<i>Ambassis agassizii</i>	Olive perchlet*	1 (0)
<i>Bidyanus bidyanus</i>	Silver perch*#	18 (0)
<i>Maccullochella peelii</i>	Murray cod#	349 (115)

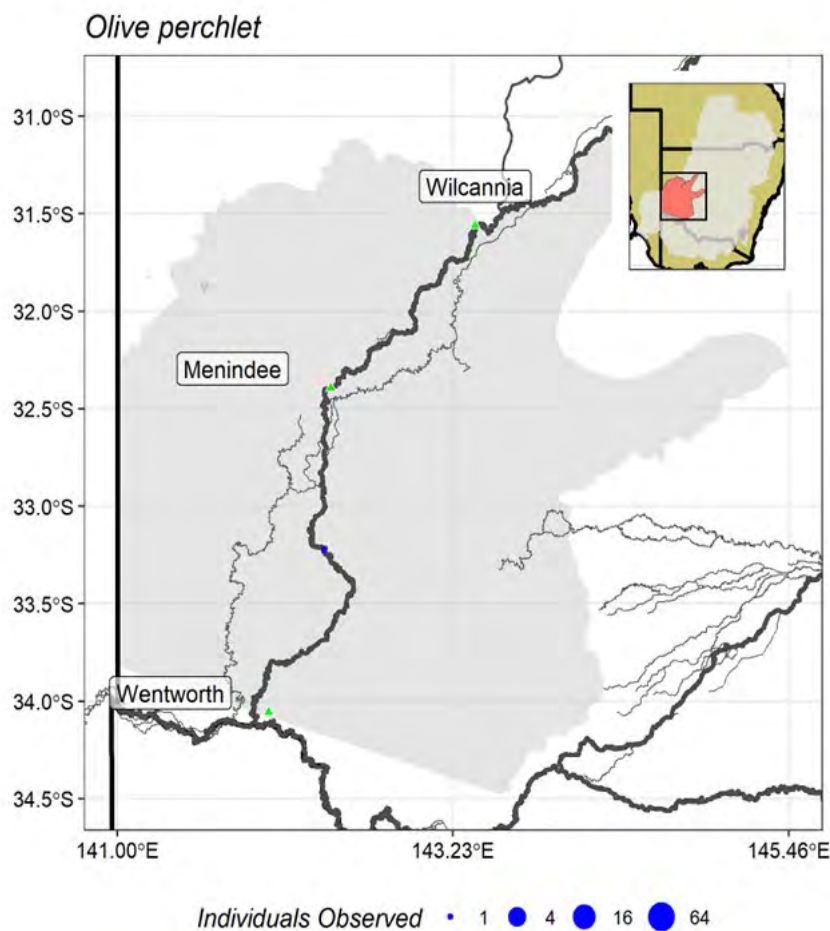


Figure 10.29: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the Lower Darling WRP. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals.

Summary Statement:

One Olive perchlet was caught in the Lower Darling near Moorara in 2023 during electrofishing sampling. Another Olive perchlet was observed in 2022 in a fyke net in Balaka Lake (fyke net data is not included in most of this report but see Table 10.11).

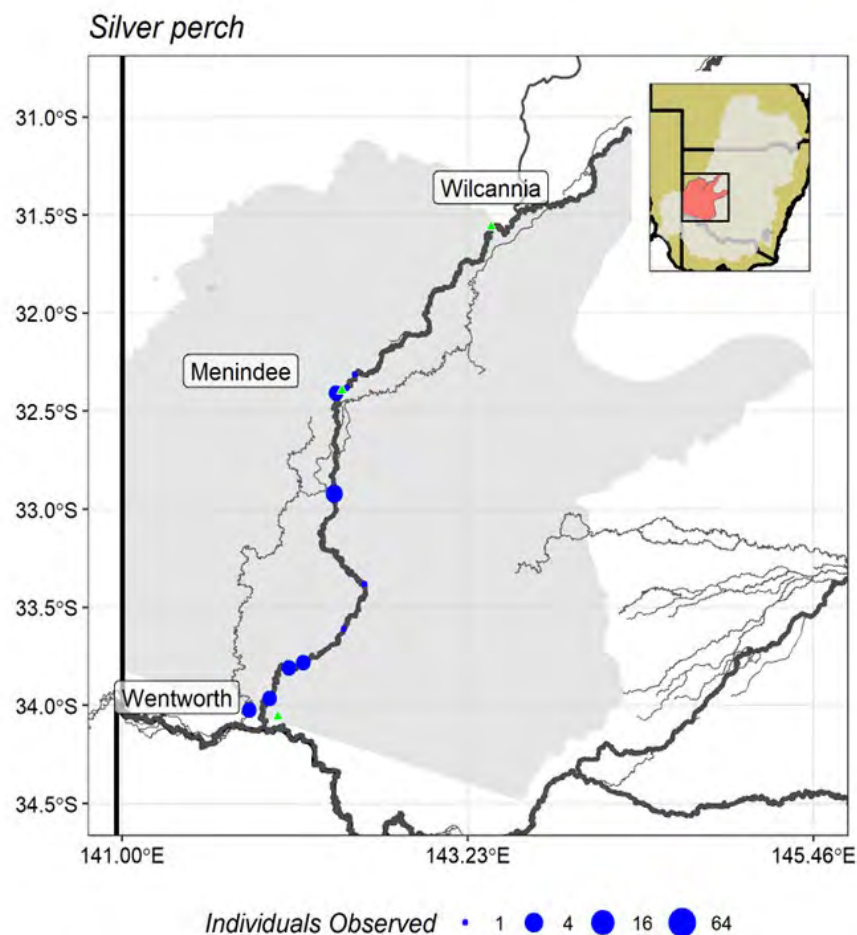


Figure 10.30: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the Lower Darling WRP. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals.

Summary Statement:

A total of 13 Silver perch were caught at 7 sites in the New South Wales Lower Darling region. This includes 1 in 2016/17, 5 in 2018/19, 1 in 2019/20, 2 in 2020/21, 2 in 2021/22, 2 in 2022/23 and 5 in 2023/24.

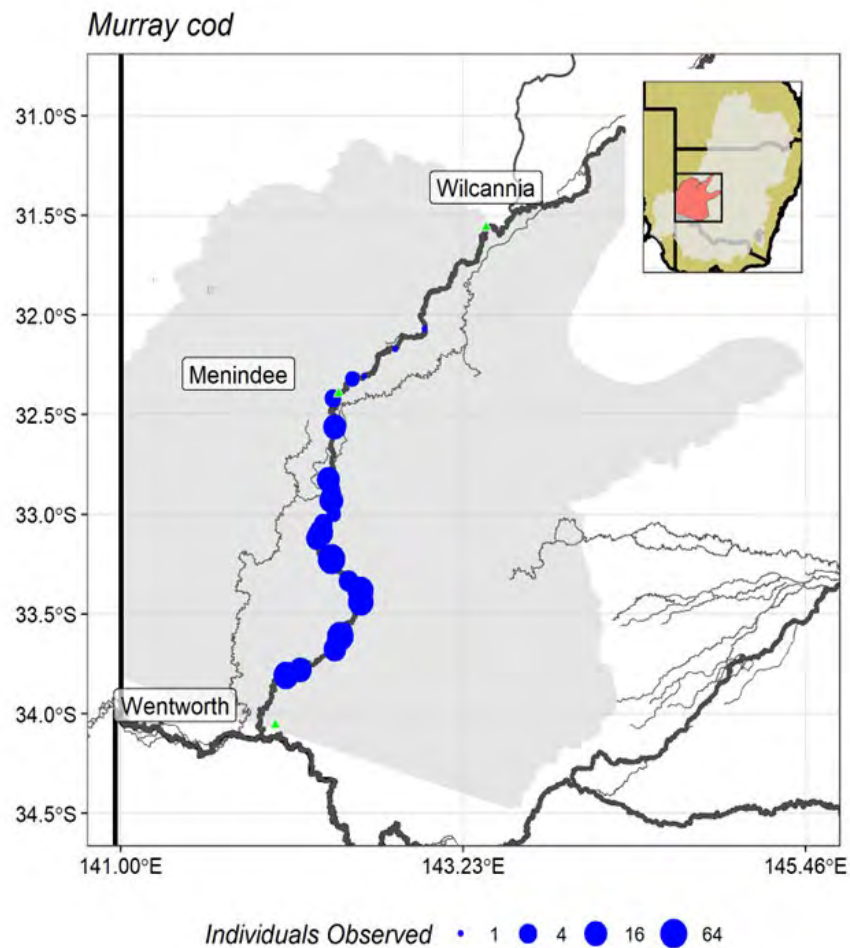


Figure 10.31: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the Lower Darling WRPA. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals. Note the lower image shows a juvenile Murray cod.

Summary Statement:

A total of 464 Murray cod were observed at 33 sites in the New South Wales Lower Darling region, mostly in the southern region.

Appendix

This report contains data from the projects listed in Table 10.7.

Table 10.7 Projects included in this report. Sampling Events show the total number of sampling events included from each project. Sampling Seasons shows which sampling seasons each project contributed data to.

Project Name	Sampling Seasons	Sampling Events
Basin Plan Environmental Outcomes Monitoring	2014/2015, 2015/2016, 2016/2017, 2017/2018, 2018/2019, 2019/2020	33
Basin Plan Environmental Outcomes Monitoring 2	2022/2023, 2023/2024	24
Darling E flows	2020/2021, 2021/2022, 2022/2023, 2023/2024	42
Darling River Health	2023/2024	16
Lower Darling Recovery	2018/2019, 2019/2020, 2020/2021, 2022/2023, 2023/2024	76
Murray-Darling Basin Fish Surveys	2014/2015, 2015/2016, 2016/2017, 2017/2018, 2018/2019, 2020/2021, 2021/2022, 2022/2023, 2023/2024	18

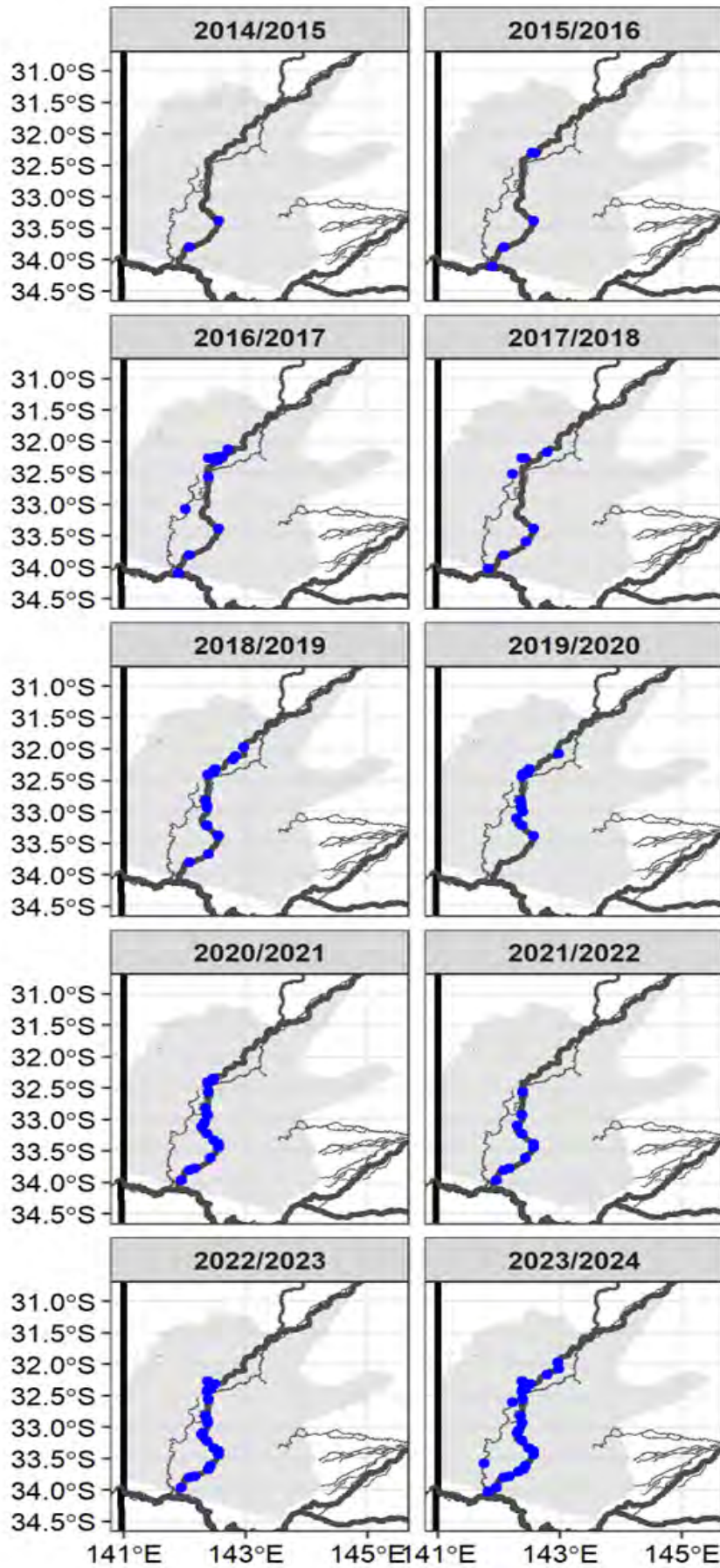


Figure 10.32: Sites sampled and included in this report by sampling season in the Lower Darling WRP. Dry sites are not shown.

Table 10.8 shows all species detected during this survey period as part of standardised monitoring projects (see Table 10.7). Note there are variations in effort between sampling seasons so this information should be considered in conjunction with Table 10.1. The Expected from Modelling column identifies species which are possible to occur based upon MaxENT habitat modelling (likelihood threshold > 0.33; NA represents no modelling was undertaken). Species that were possible from the modelling but not observed during standardised sampling in the New South Wales Lower Darling WRPAs were: Murray hardyhead, Flat-headed galaxias, Macquarie perch, Trout cod, Southern purple-spotted gudgeon, Flathead gudgeon, Dwarf flathead gudgeon, Freshwater catfish. It should be noted that the MaxENT modelling models habitat availability and is not always a reliable index of abundance, it merely indicates possible distribution based upon habitat. A full list of species observed during this period across the standardised monitoring protocols and sampling methods is presented in Table 10.11.

Table 10.8: Total number caught of each species by sampling season in the Lower Darling WRPAs.

Common name	Expected from modelling	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24
Australian smelt	YES	0	8	50	6	172	58	166	39	93	71
Bony herring	YES	272	160	1,665	858	2,431	393	1,902	490	1,263	2,078
Carp-gudgeon species complex	YES	36	621	225	1,380	1,898	204	266	28	1	181
Common carp	NA	21	60	311	239	796	237	245	318	16,108	1,258
Common carp - Goldfish hybrid	NA	0	0	0	0	0	0	0	0	1	0
Eastern gambusia	NA	1	16	159	71	88	4	21	7	20	3
Golden perch	YES	4	14	42	23	233	78	265	122	246	257
Goldfish	NA	1	48	16	10	137	5	9	16	592	44
Murray cod	YES	12	12	5	11	96	20	119	17	17	40
Murray-Darling rainbowfish	YES	0	0	6	0	0	0	9	3	1	1
Olive perchlet	YES	0	0	0	0	0	0	0	0	1	0
Redfin	YES	0	0	0	0	0	0	0	0	0	2
Silver perch	YES	0	0	1	0	5	1	2	2	2	5
Spangled perch	YES	0	0	2	0	0	0	0	3	185	19
Unspecked hardyhead	YES	0	1	4	0	0	0	1	0	0	0

The following table summarises the sampling methods for each species caught (Table 10.9).

Table 10.9: Total catch of each species by sampling method in the Lower Darling WRP.

Common name	Backpack Electrofishing	Bait Trap	Boat Electrofishing
Australian smelt	0	2	660
Bony herring	4	1	11,505
Carp-gudgeon species complex	7	4,213	620
Common carp	10	385	19,225
Common carp - Goldfish hybrid	0	0	1
Eastern gambusia	2	13	375
Golden perch	0	4	1,280
Goldfish	1	6	872
Murray cod	0	0	349
Murray-Darling rainbowfish	0	0	20
Olive perchlet	0	0	1
Redfin	0	0	2
Silver perch	0	0	18
Spangled perch	2	11	196
Unspecked hardyhead	0	0	6

Table 10.10: Listed threatened species recorded in the Murray-Darling Basin (from the NSW DPIRD Fisheries Freshwater Ecosystem research database). Species are listed under either the NSW Fisheries Management Act 1994 (FMA) or the Commonwealth Environmental Protection and Biodiversity Conservation Act 1999 (EPBC).

Genus, species	Common Name	EPBC Status	FMA Status
<i>Ambassis agassizii</i>	Agassiz's glassfish, olive perchlet, western New South Wales population	NA	Endangered Population
<i>Bidyanus bidyanus</i>	Silver Perch, Bidyan	Endangered	Vulnerable
<i>Craterocephalus fluviatilis</i>	Murray Hardyhead	Endangered	Critically Endangered
<i>Galaxias rostratus</i>	Flathead Galaxias, Beaked Minnow, Flat-headed Galaxias, Flat-headed Jollytail, Flat-headed Minnow	Critically Endangered	Critically Endangered
<i>Galaxias tantangara</i>	Stocky Galaxias	NA	Critically Endangered
<i>Maccullochella macquariensis</i>	Trout Cod	Endangered	Endangered
<i>Maccullochella peelii</i>	Murray Cod	Vulnerable	NA
<i>Macquaria australasica</i>	Macquarie Perch	Endangered	Endangered
<i>Mogurnda adspersa</i>	Southern Purple Spotted Gudgeon	NA	Endangered
<i>Nannoperca australis</i>	Southern Pygmy Perch	Vulnerable	Endangered
<i>Tandanus tandanus</i>	Freshwater catfish, eel tailed catfish, Murray-Darling Basin population	NA	Endangered Population

Table 10.11 shows all species detected during this survey period across all programs and methods. Due to variations in project methods protocols, this data is presented only to give a complete list of species observed in the region. The Expected from Modelling column identifies species which are possible to occur based upon MaxENT habitat modelling (likelihood threshold > 0.33; NA represents no modelling was undertaken). Species that were possible from the modelling but not observed during standardised sampling in the New South Wales Lower Darling WRPAs were: Murray hardyhead, Flat-headed galaxias, Macquarie perch, Trout cod, Southern purple-spotted gudgeon, Flathead gudgeon, Dwarf flathead gudgeon, Freshwater catfish. It should be noted that the MaxENT modelling actually models habitat availability and is not always a reliable index of abundance, it merely indicates possible distribution based upon habitat. A list of species caught as part of standardised monitoring during this period is in Table 10.8.

Table 10.11: Total catch of each species by all sampling programs and all methods in the Lower Darling WRPAs. Note these include projects with sampling not representative of the community and the data should be used with caution.

Common name	Expected from modelling	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24
Australian smelt	YES	0	8	50	6	172	58	352	2113	975	555
Bony herring	YES	272	160	1,701	858	2,431	393	3,140	2,244	1,611	2,214
Carp gudgeon species complex	YES	36	621	225	1,380	1,898	204	2,015	2,580	983	840
Common carp	NA	21	60	313	239	796	237	751	25,722	19,299	3,406
Common carp - Goldfish hybrid	NA	0	0	0	0	0	0	0	0	1	0
Eastern gambusia	NA	1	16	159	71	88	4	287	651	73	543
Golden perch	YES	4	14	42	23	233	78	714	574	419	271
Goldfish	NA	1	48	17	10	137	5	9	19	594	511
Murray cod	YES	12	12	5	11	96	20	119	17	17	40
Murray-Darling rainbowfish	YES	0	0	6	0	0	0	9	3	1	1
Olive perchlet	YES	0	0	0	0	0	0	0	1	1	0
Redfin	YES	0	0	0	0	0	0	0	0	0	2
Silver perch	YES	0	0	1	0	5	1	2	2	2	5
Spangled perch	YES	0	0	2	0	0	0	13	11	186	28
Unspecked hardyhead	YES	0	1	4	0	0	0	1	0	0	0

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Chapter 11 Basin Plan Fish Monitoring Summary (2014/15 – 2023/24): NSW Murray Water Resource Planning Area

Hayden Schilling & David Crook

March 2025



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Chapter cover image credit: David Crook (NSW DPIRD); Fish images credit: Gunther Schmida

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Introduction

This report spans 2014/15 to 2023/24 and uses all suitable fish assemblage data collected by NSW DPIRD Fisheries using standardized electrofishing monitoring techniques. The format of the report follows and expands upon the previous reports (Schilling & Crook 2023, 2024). This report focusses on the New South Wales Murray Water Resource Planning Area (WRPA) shown in Figure 11.1.

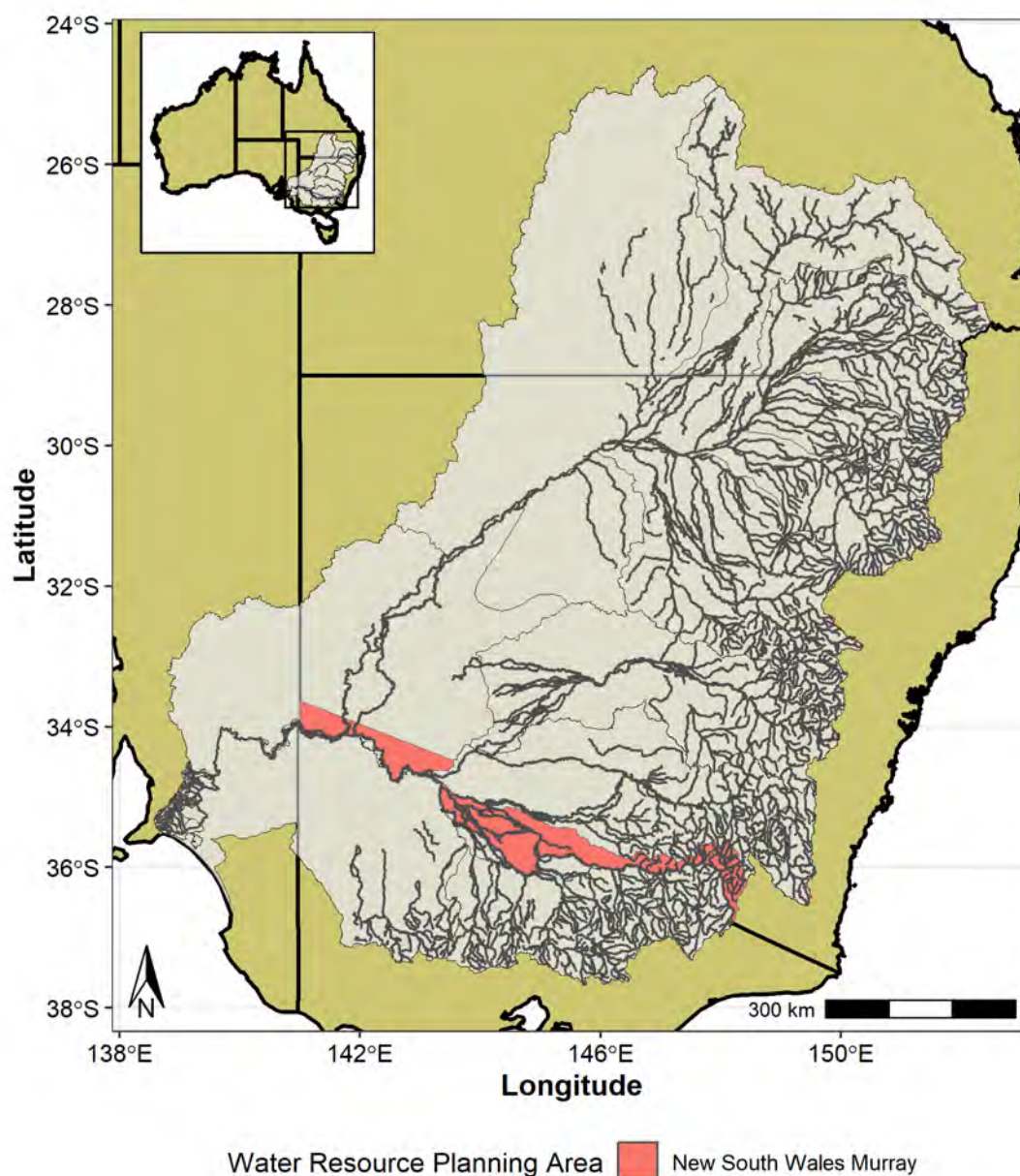


Figure 11.1: Murray-Darling Basin with the key region of this report highlighted. Inset map shows the whole of Australia with a box around the MDB.

What This Report Includes

This report starts with an overview of the standardised monitoring programs including sampling details and statistics. An overview of the hydrological and climatic conditions during the reporting period is also provided as context for interpreting the fish population status data.

Following the introductory sections, we present a summary of *fish diversity* across the New South Wales Murray WRP. Separate plots for native and alien species show the total number of unique species observed at each site.

The main body of the report provides detailed information on the *population structure, relative abundance, health, and distribution* of six key fish species:

- Murray cod
- Golden perch
- Freshwater catfish (Very few fish were observed in this WRP during the reporting period)
- Bony herring
- Australian smelt
- Common carp

Population structure information includes length frequency plots of collected fish and the proportion of fish classified as Young of the Year (YOY). This information can be used to infer the size structure of populations and the level of recruitment each year. For additional context, we provide a summary table showing any stocking which occurred for the species in each year (if relevant).

Relative abundance and *relative biomass* (a unit-less measure representing the number (or biomass) of fish in an area) information is adapted from the modelled outputs from a more in-depth publication (Crook et al. 2023) which considers all available electrofishing data within the NSW Murray-Darling Basin (MDB). The updated analysis uses generalised linear mixed models to generate annual indices of relative abundance and biomass for each WRP. In this report we present the modelled time series of relative abundance showing the predicted number (or biomass) of fish observed per 90 second shot of electrofishing. The abundance and biomass trends for the New South Wales Murray WRP are contrasted with the overall NSW MDB dataset. It should be noted that these are modelled estimates of relative abundance/biomass, not absolute abundance/biomass as absolute estimates would require extensive calibration surveys that are not included in the monitoring program.

Health information is provided as a summary of any visible health conditions recorded for the key species. The number of health conditions observed in a fish population is generally reflective of water quality, competition, and many other factors. Fewer observations of health conditions indicate healthier populations. The health conditions detailed are any that were observed as part of the biological measurements taken. We provide a comparison of the prevalence of health conditions in the New South Wales Murray WRP and greater MDB (excluding the New South Wales Murray WRP).

Distribution maps are provided for each species to show the observed distribution of each species from electrofishing samples. The distribution maps also show the relative abundance (number of fish observed per 90 seconds of electrofishing) at each site to give an indication of how the population is spread over the landscape.

Finally, the distributions and numbers of *Threatened species* are reported. The report includes threatened species that were recorded by standardised monitoring programs in the New South Wales Murray WRPAs during the reporting period.

For each section of the report, we provide a *Summary Statement*. This statement provides a very brief overview of the key messages for each section.

Sampling Methods

Three main methods are used during routine fish monitoring surveys: boat electrofishing, backpack electrofishing and bait traps. This report mainly includes the electrofishing data with bait trap samples informing the distribution of small bodied species. The electrofishing was conducted using the standard methodology implemented in the Sustainable Rivers Audit (SRA; Davies et al. 2010). This usually includes 12 shots of 90 seconds “power on” during each sampling event.

As parts of this report compile data from multiple projects, there is some variation in how sites were chosen and the effort of sampling conducted each year (Table 11.1). Details of which projects contributed data to this report can be seen in Table 11.7. At each site, sampling gear was applied as suited to the local conditions with either boat, backpack, or a hybrid of the two, in addition to 10 unbaited bait traps set in edge margins. Most sampling occurred between the months of September and May.

Table 11.1: Sampling effort (Number of sites sampled) each sampling season in the NSW Murray WRPAs. Variation in sampling effort is due to different numbers of projects and interruptions to planned sampling such as flooding, site desiccation, and extreme weather.

Sampling Season	Number of Boat Electrofishing Sites	Number of Backpack Electrofishing Sites	Number of Hybrid Sites	Total
2014/2015	50	25	0	75
2015/2016	56	10	1	67
2016/2017	67	30	0	97
2017/2018	61	29	1	91
2018/2019	76	9	1	86
2019/2020	38	32	0	70
2020/2021	27	5	0	32
2021/2022	51	6	3	60
2022/2023	48	15	0	63
2023/2024	58	7	0	65

The sites sampled during the reporting period are shown in Figure 11.2. A breakdown of sites sampled each sampling season is shown in the Appendix (Figure 11.35).

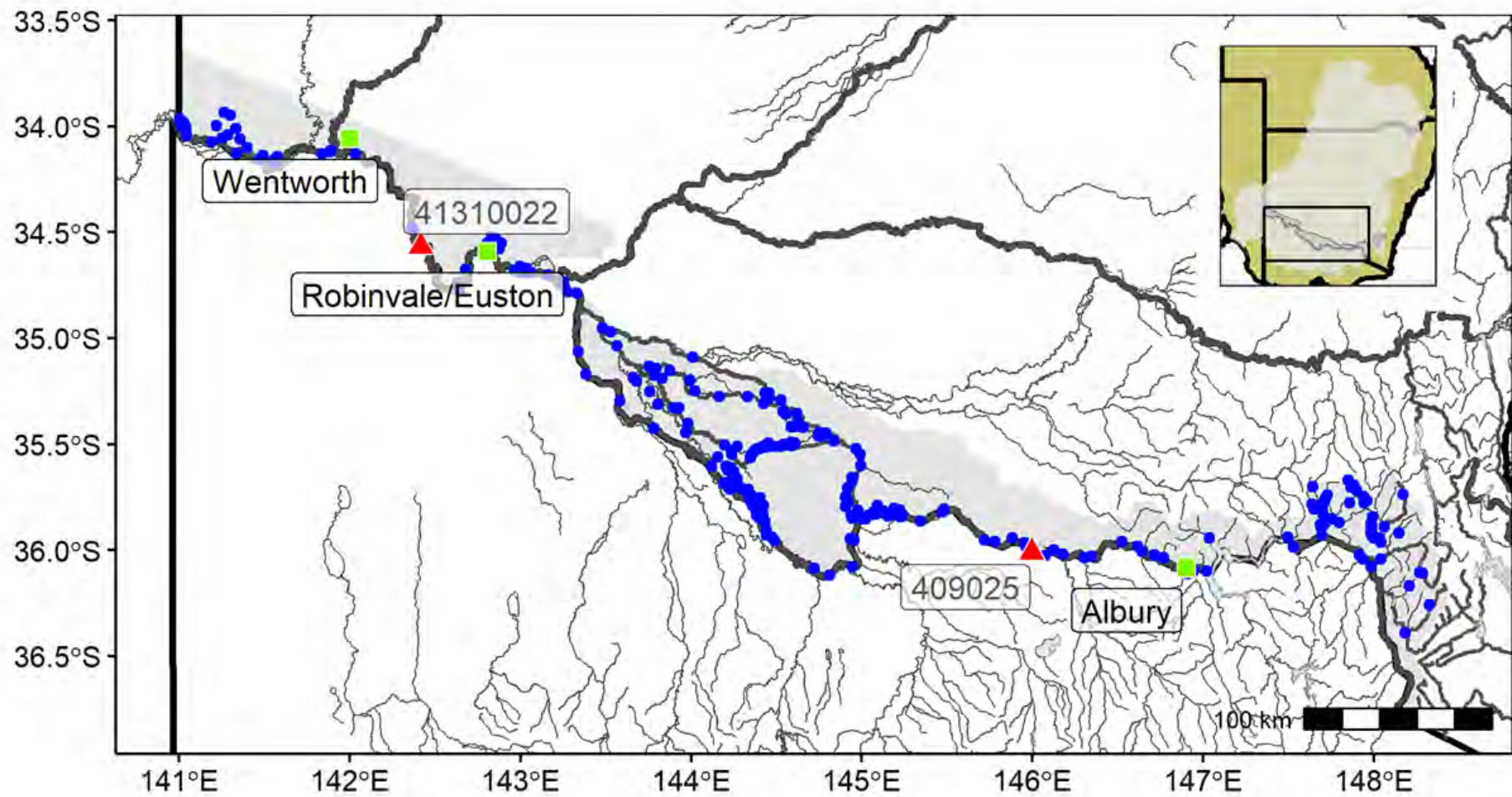


Figure 11.2: Sites (dots) sampled during the reporting period in the NSW Murray WRPA. Triangles show key flow gauges along with their gauge ID number. Green squares show major towns.

Each sampling method has a different effectiveness at sampling each species. Table 11.2 shows the total numbers of each key species caught by each method.

Table 11.2: Number of each key species caught by sample method over the whole program in the NSW Murray WRP. Further data on total catch is provided in the Appendix.

Common name	Boat Electrofishing	Backpack Electrofishing	Bait Trap
Australian smelt	27,221	1,062	35
Bony herring	8,033	17	9
Common carp	27,202	7,436	6,284
Freshwater catfish	5	0	0
Golden perch	1,259	1	1
Murray cod	2,109	23	0

A subset of sampled fish had biological measurements taken during the surveys, including but not limited to length and weight measurements and visual health assessments. Table 11.3 shows the number of biological measurements taken each year for the six key species.

Table 11.3: Number of biological measurements taken for the key species each sampling season in the NSW Murray WRP.

Sampling Season	Australian smelt	Bony herring	Common carp	Freshwater catfish	Golden perch	Murray cod
2014/2015	1,524	444	938	1	198	338
2015/2016	2,035	369	1,046	2	222	510
2016/2017	2,637	582	4,027	0	96	125
2017/2018	1,249	708	1,904	1	133	131
2018/2019	1,682	527	1,471	0	110	187
2019/2020	913	289	385	0	50	82
2020/2021	590	395	765	0	114	328
2021/2022	1,801	967	2,491	0	69	180
2022/2023	2,260	256	3,215	0	140	130
2023/2024	991	452	1,579	1	171	120

Climate Overview

The following is a summary of the climatic conditions during the reporting period in terms of how the observed conditions compare to long term records. These are direct extracts from the [Australian Bureau of Meteorology climate summaries archive](#) and are written in the given year. To interpret, 2014 states it was the warmest year on record, meaning 2014 was the warmest year on record up to and including 2014 but not including more recent years.

2014

New South Wales experienced its warmest year on record in 2014, with several heatwaves and persistently warm conditions across the State. Rainfall was well below average in the northeast, and close to average elsewhere.

2015

New South Wales recorded well above average temperatures in 2015. Nights were particularly warm, the sixth-warmest on record for the State. Rainfall was close to average for the state as a whole.

2016

2016 was a generally wet, warm year for NSW as a whole, with substantial variability throughout the year and across the state. Following a record-warm start to the year, May to September was the wettest such period on record for NSW, with cooler weather in much of the west of the state. Minimum temperatures were the warmest on record for the State as a whole, with record-warm daytime temperatures on parts of the east coast.

2017

The year 2017 was the warmest on record for New South Wales for both mean and daytime temperatures. It was also the State's driest year since 2006. Following the warmest summer on record for the State, heavy rain in March across the east then made way for a very dry winter and start to spring. Winter overnight temperatures were the lowest since 1997, but daytime temperatures remained above average for most of the year, and were the warmest on record overall.

2018

2018 was the warmest on record for New South Wales for both mean temperature and mean maximum temperature, whilst the mean minimum temperature was fourth-warmest on record. The year was dominated by very dry conditions, with the third-driest January to September on record. October to December saw some relief from the dry, with above average rainfall across parts of the State. Despite this, New South Wales experienced its sixth-lowest annual rainfall on record; its driest year since 2002.

2019

2019 was the driest and warmest year on record for New South Wales. Despite some rain in some months, most of the State received much less rainfall than usual, with the northeast and far west particularly dry. Heatwaves in January brought very high temperatures, and large fires from September onward caused extensive damage and persistent smoke.

2020

2020 saw above average temperature and rainfall in New South Wales. Temperatures were above average across the state in most months except during autumn. There was widespread rain during autumn and spring and in December, but early winter and November rain was below average.

2021

New South Wales had its 6th wettest year on record, with 2021 rainfall 30 % above average. This included significant floods along the east coast in March, and the state's wettest November on record. It was the state's coolest year since 1996, at 0.15 °C above the 1961–1990 average.

2022

2022 was exceptionally wet with the state-averaged annual total being the second-highest on record (since 1900) and many sites recording their highest annual totals on record. Maximum temperatures were lower than average with the state-averaged annual maximum temperature being the coolest since 1992. Minimum temperatures were generally warmer than average with the state-averaged annual minimum temperature being 0.73 °C above the 1961–1990 average.

2023

The state-averaged rainfall was 22.9 % below the 1961–1990 average. Rainfall was above average over small parts of the state's south, west of the Great Dividing Range, while being below average over most of the northern half of the state, especially over parts of the Northern Tablelands, Northern Rivers, Mid-North Coast, and Upper Hunter, where annual rainfall was in the lowest 10 % of historical records (since records began in 1900). State-averaged annual maximum temperature was 1.96 °C above the 1961–1990 average, which is the third highest on record.

2024

Rainfall totals in 2024 were above average to very much above average for the northern and western areas of the state, as well as central parts of the coast. Totals were below average for large parts of the south-east, as well as small parts of the state's north-east and south-west. 2024 was the third-warmest on record for all years since 1910, 1.55 °C above the 1961–1990 average.

Flow Data

Below shows daily flow data from a flow gauge in the New South Wales Murray WRP (Figure 11.3).

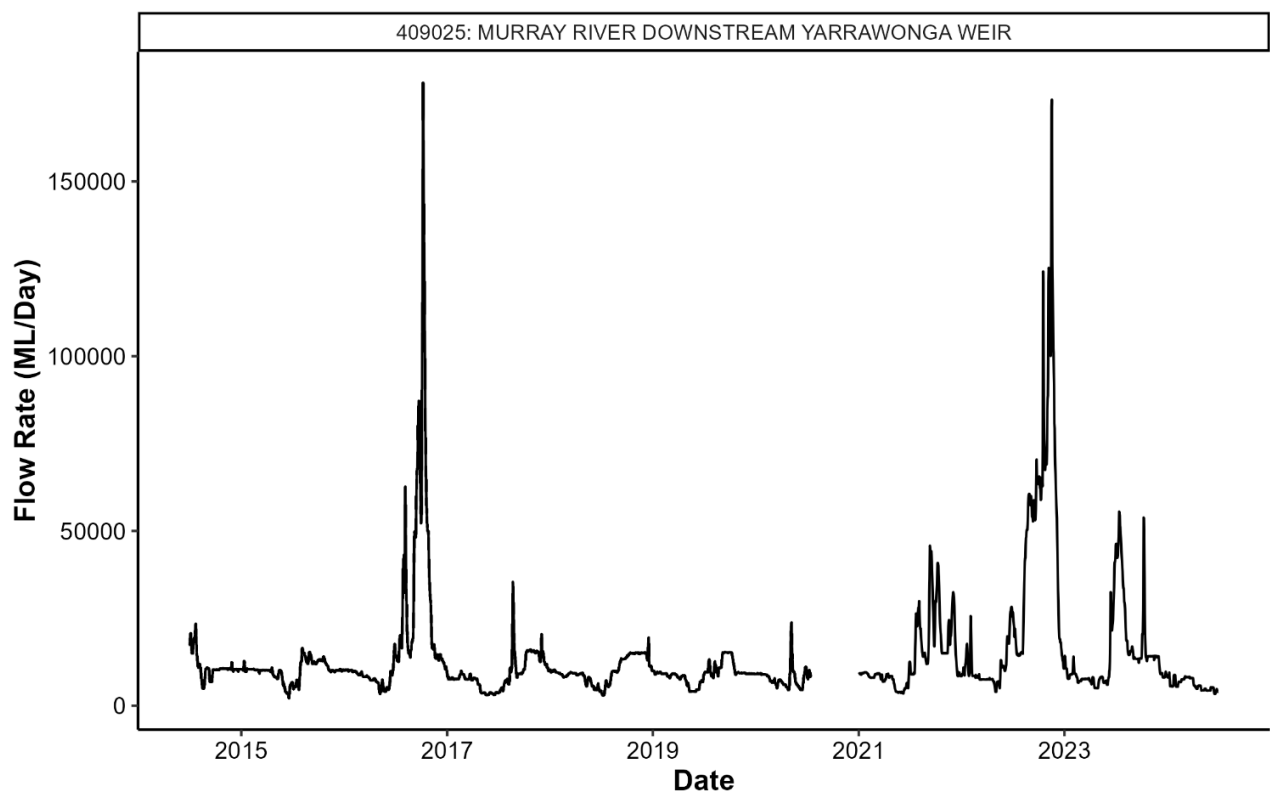


Figure 11.3: Flow data a gauge in the New South Wales Murray WRP over the reporting period. Gauge locations can be seen on Figure 11.2.

Water temperature data, where available, are also shown in Figure 11.4.

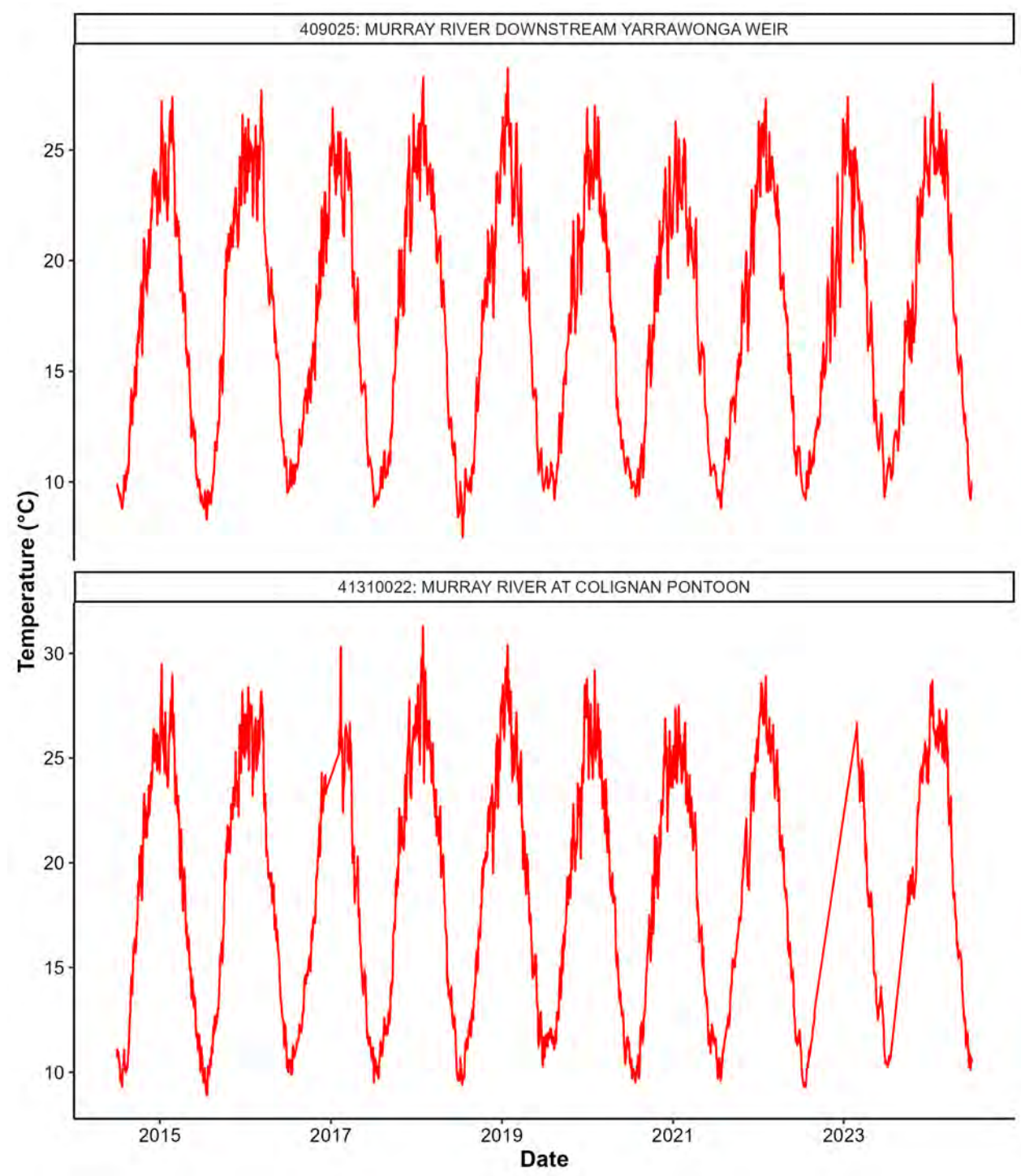


Figure 11.4: Water temperature data from various gauges in the New South Wales Murray WRPA over the reporting period. Gauge locations can be seen on Figure 11.2. Note the differing scales on the y-axis.

Species Diversity

A total of 30 fish species were observed across the New South Wales Murray WRPAs including nine alien species. Figure 11.5 shows the number of native species found at each site while Figure 11.6 shows the number of alien species found at each site. The full list of species caught and observed is presented in Table 11.8.

Summary Statement:

Native diversity was highest in the central and western areas of the New South Wales Murray region while the alien diversity was generally consistent across the region.

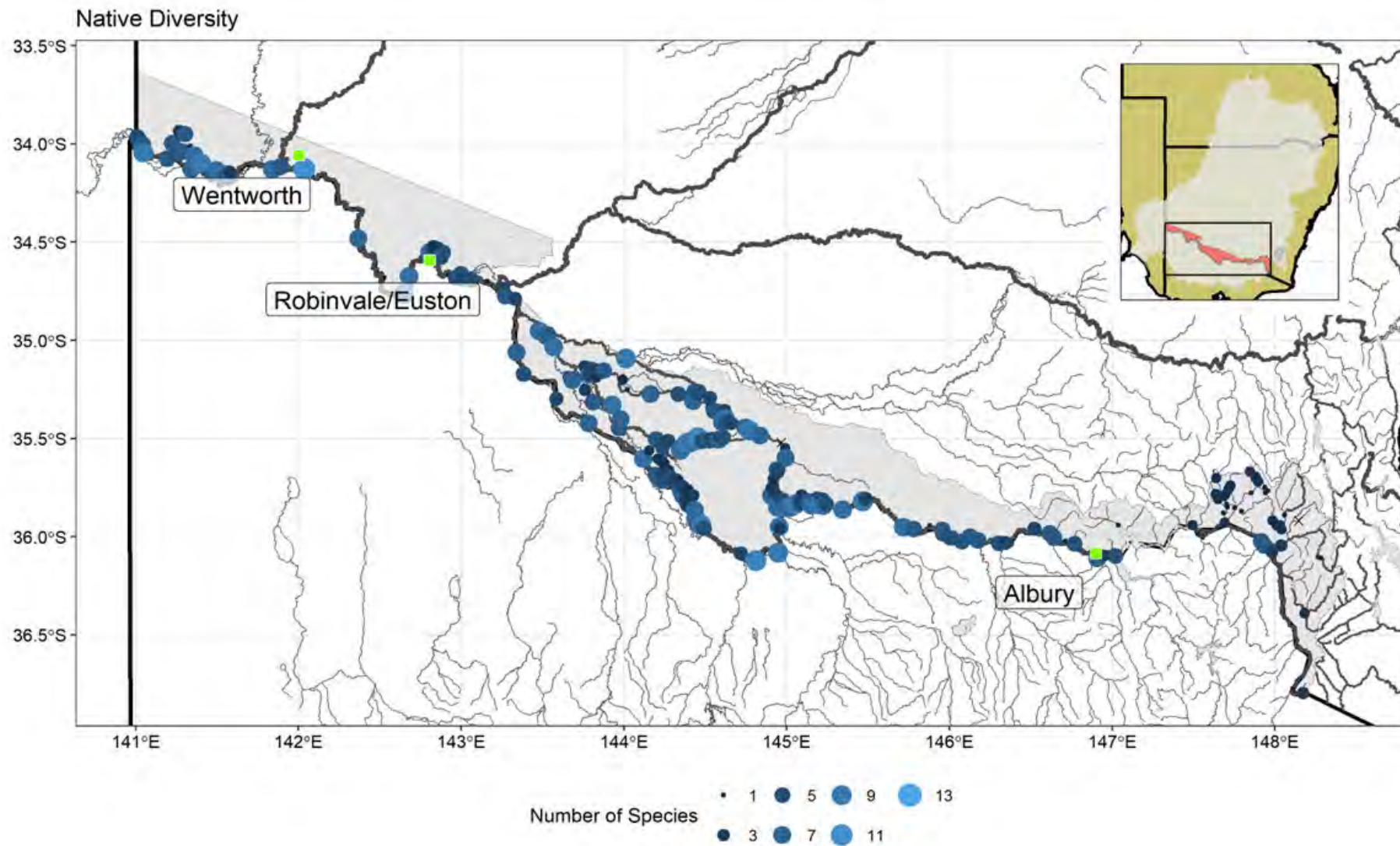


Figure 11.5: Native diversity across all sampling sites in the NSW Murray WRP. Bubble size represents the number of unique species observed at each site across all sampling methods and events. X represents a site that had water and was sampled, but no fish species were caught at all. Dry sites are excluded. Green squares represent key towns.

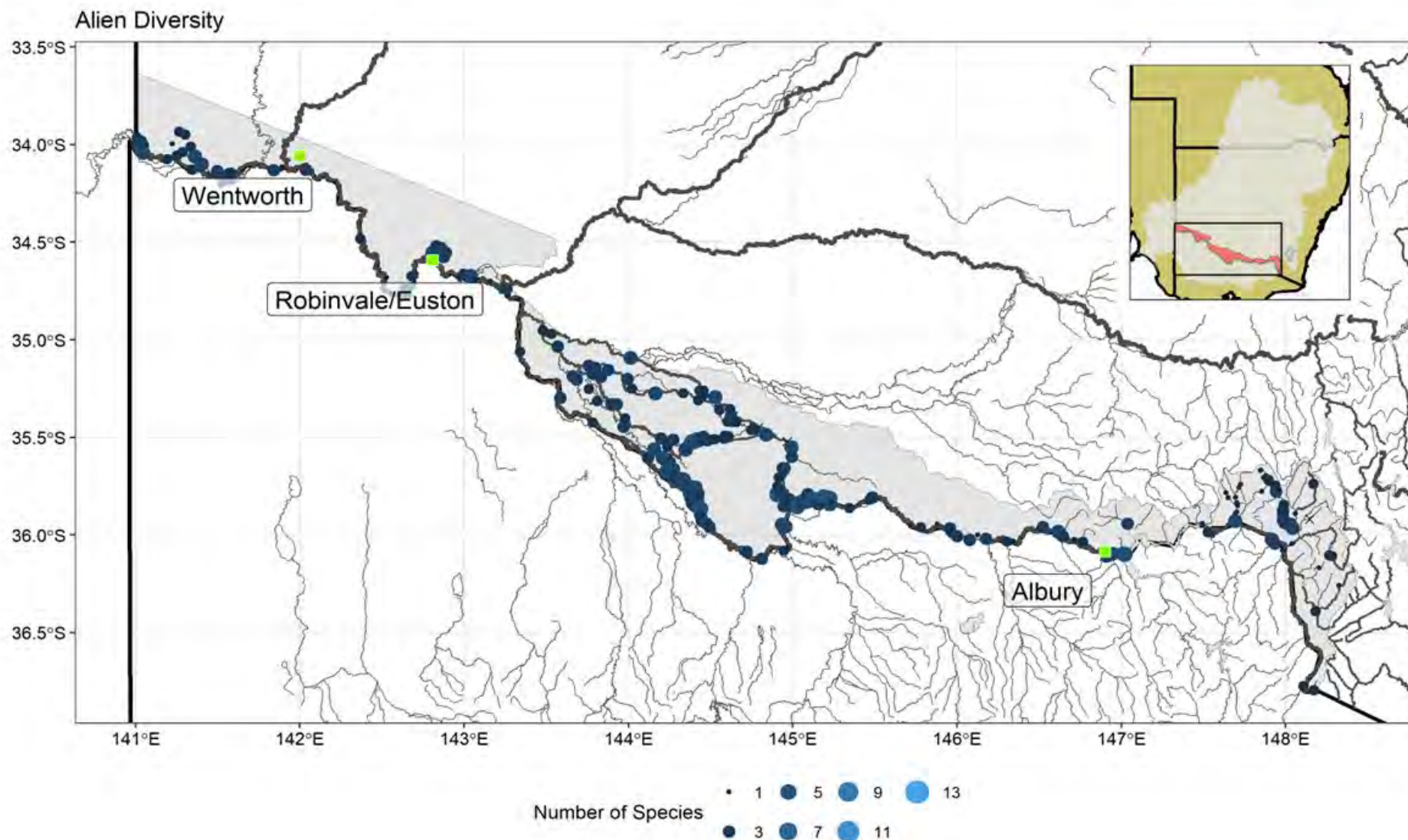


Figure 11.6: Alien diversity across all sampling sites in the NSW Murray WRP. Bubble size represents the number of unique species observed at each site across all sampling methods and events. X represents a site that had water and was sampled, but no fish species were caught at all. Dry sites are excluded. Green squares represent key towns.

Murray cod



Population Structure

Figure 11.7 shows the observed length frequency plot for Murray cod for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 0 to 89, and 0 % to 27 % of measured fish within a season, with a mean percentage YOY of 13 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Murray cod was 12 % (1,142 out of 9,420).

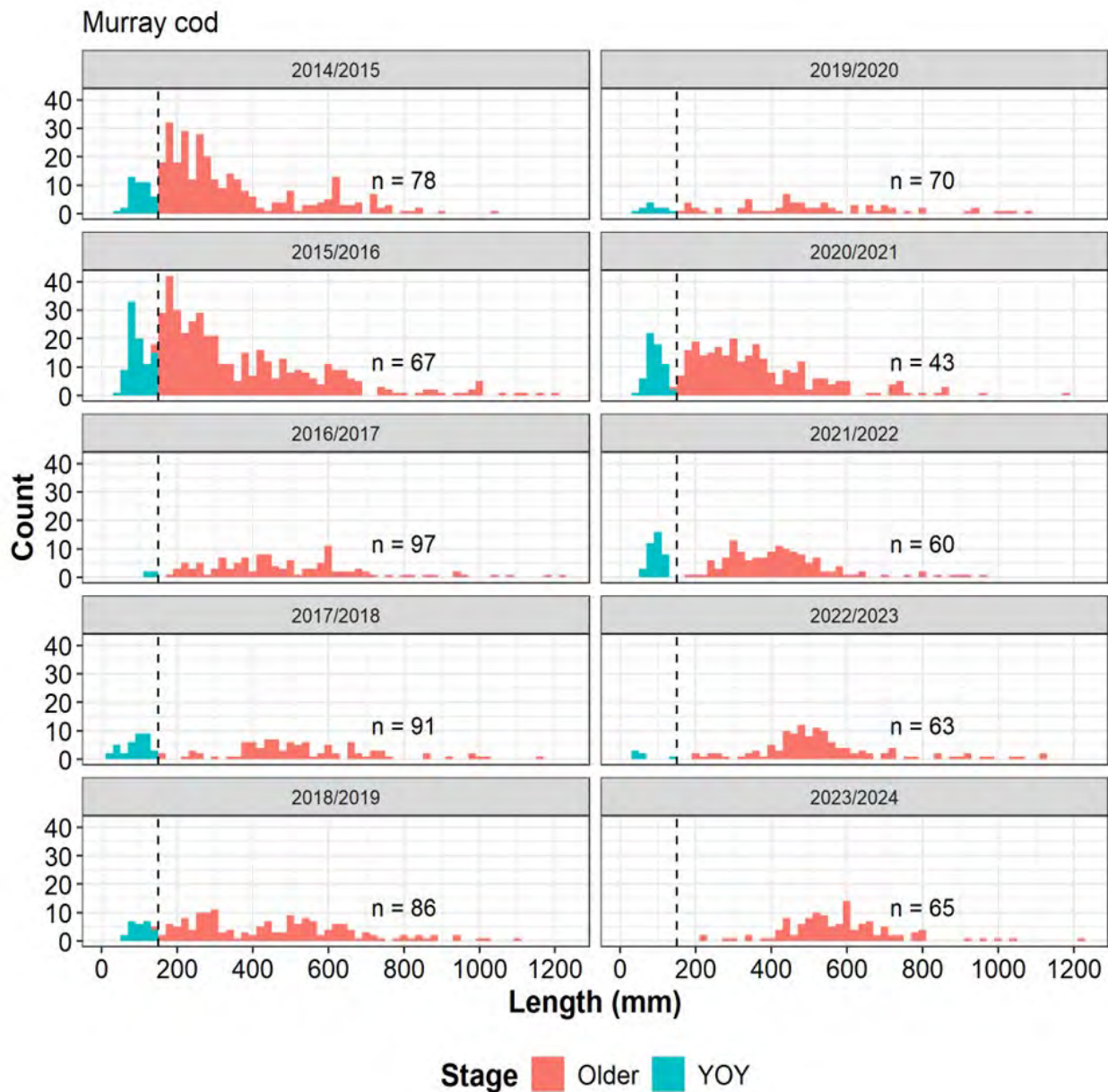


Figure 11.7: Length frequency plots for Murray cod by sampling season in the NSW Murray WRP. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRP in a sampling season.

Summary Statement:

Usually regular recruitment of Murray cod but no evidence of recruitment in 2023/24 which followed likely poor recruitment in 2022/23.

Stocking

A total of 660,302 Murray cod were stocked into the waterways of the New South Wales Murray WRP during the reporting period. Of these fish, 82,120 (12 %) were stocked into impoundments while 578,182 (88 %) were stocked into rivers or creeks. Table 11.4 shows the detailed breakdown of stocking by season, location and life stage while Figure 11.8 shows the locations of stocking.

Table 11.4: Number and life stage of stocked Murray cod each sampling season in the NSW Murray WRP.

Sampling Season	River/Creek or Impoundment	Life Stage	Number Stocked
2014/2015	Impoundment	Fry	2,000
2014/2015	River/Creek	Fry	80,741
2015/2016	Impoundment	Fry	1,000
2015/2016	River/Creek	Fry	67,532
2016/2017	Impoundment	Fingerling	12,120
2016/2017	Impoundment	Fry	8,000
2016/2017	River/Creek	Fingerling	111,068
2017/2018	River/Creek	Fry	38,797
2018/2019	Impoundment	Fry	9,000
2018/2019	River/Creek	Fry	54,131
2019/2020	Impoundment	Fry	5,000
2019/2020	River/Creek	Fry	42,033
2020/2021	Impoundment	Fry	10,000
2020/2021	River/Creek	Fry	35,868
2021/2022	Impoundment	Fry	16,000
2021/2022	River/Creek	Fry	10,050
2022/2023	Impoundment	Fry	19,000
2022/2023	River/Creek	Fingerling	71,000
2022/2023	River/Creek	Fry	19,600
2023/2024	River/Creek	Fingerling	47,362

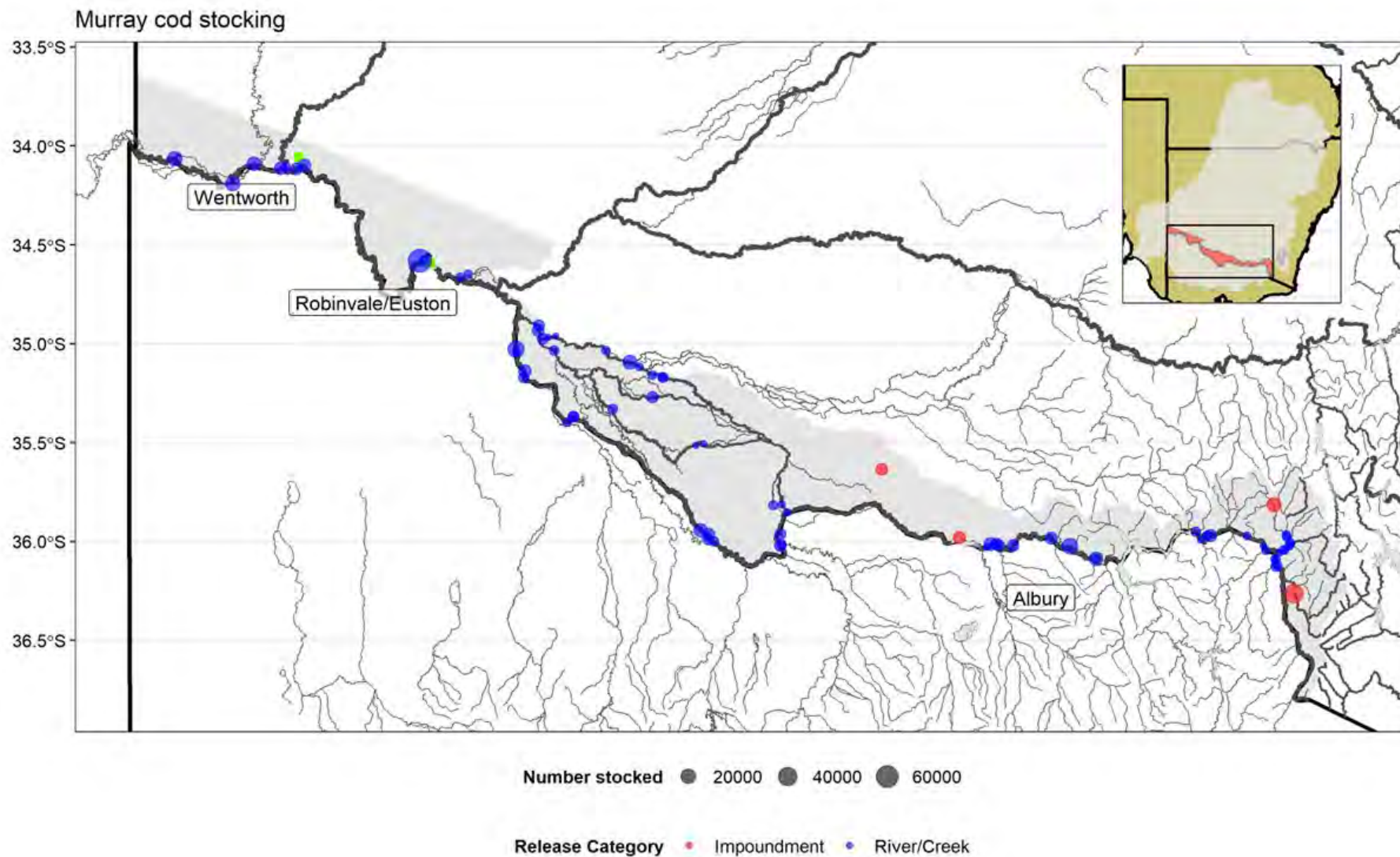


Figure 11.8: Locations of Murray cod stocking in the NSW Murray WRP. Colours show whether a site was a river/creek site or an impoundment, while the size of the point reflects the total number of fish stocked over the reporting period. Green squares represent key towns.

Temporal Trends in Abundance

The relative abundance and biomass of Murray cod since 1994 was modelled based on all suitable boat electrofishing data. The left-hand panels of Figure 11.9 show the abundance and biomass trends for the New South Wales Murray WRP and the right-hand panels show the overall trends across the NSW MDB.

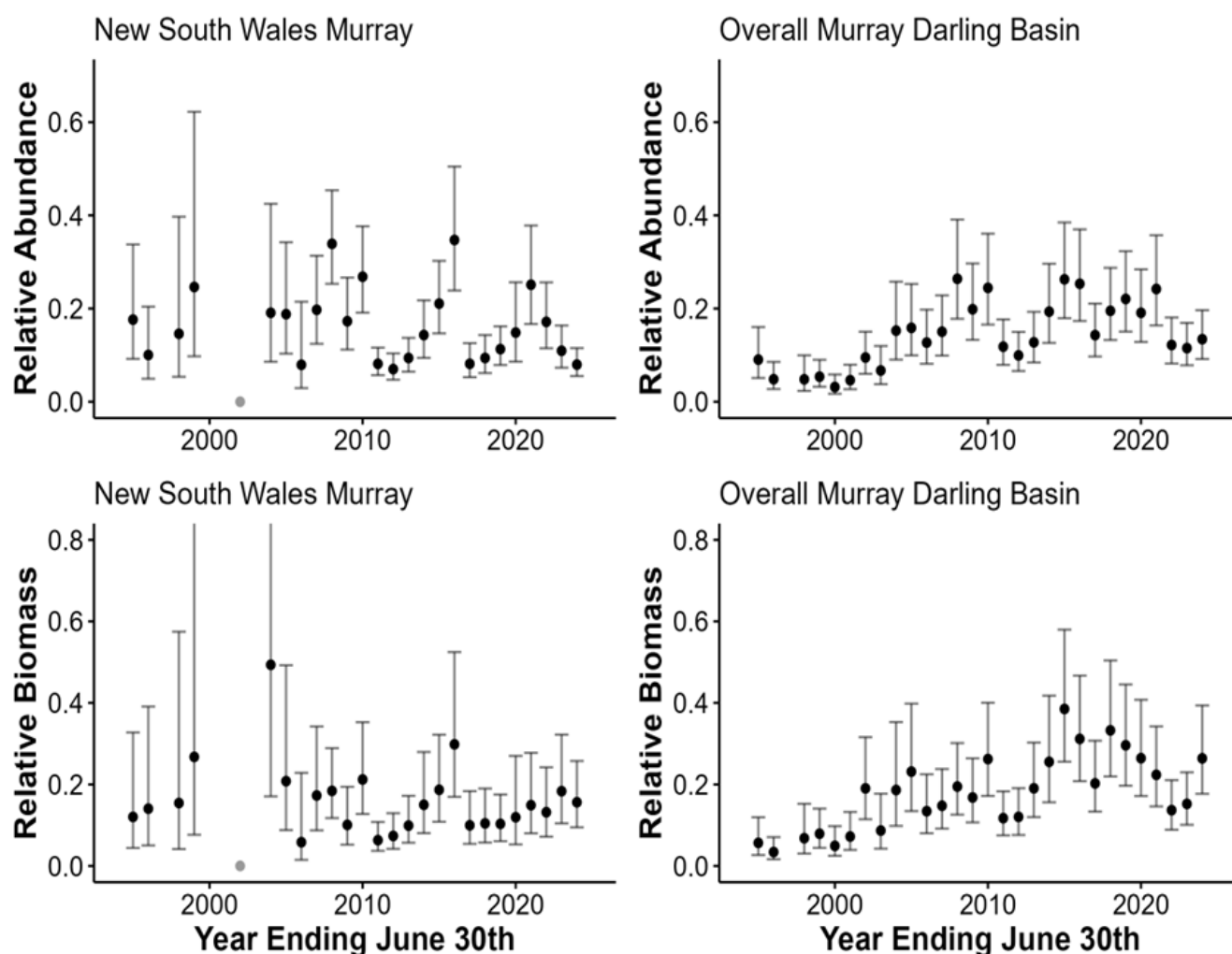


Figure 11.9: Relative abundance and biomass of Murray cod in both the New South Wales Murray WRP and the overall NSW MDB. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates.

Summary Statement:

Abundance of Murray cod has declined since 2021 and is likely to be less than the overall NSW MDB. Biomass appears relatively stable. This suggests a lack of recruitment with larger fish maintaining the population biomass.

Health

The prevalence of any health issues ranged from 2 % of sampled fish in 2020/2021 to 38 % of sampled fish in 2022/2023 (Figure 11.10). The most common health issue for Murray cod in the New South Wales Murray WRPAs was *Lernaea*, which was observed in a total of 152 fish, corresponding to 7 % of all Murray cod measured.

Across the other NSW MDB WRPA, 17 % of Murray cod (1,603 out of 9,420 Murray cod) showed a health condition (excludes the New South Wales Murray WRPAs).

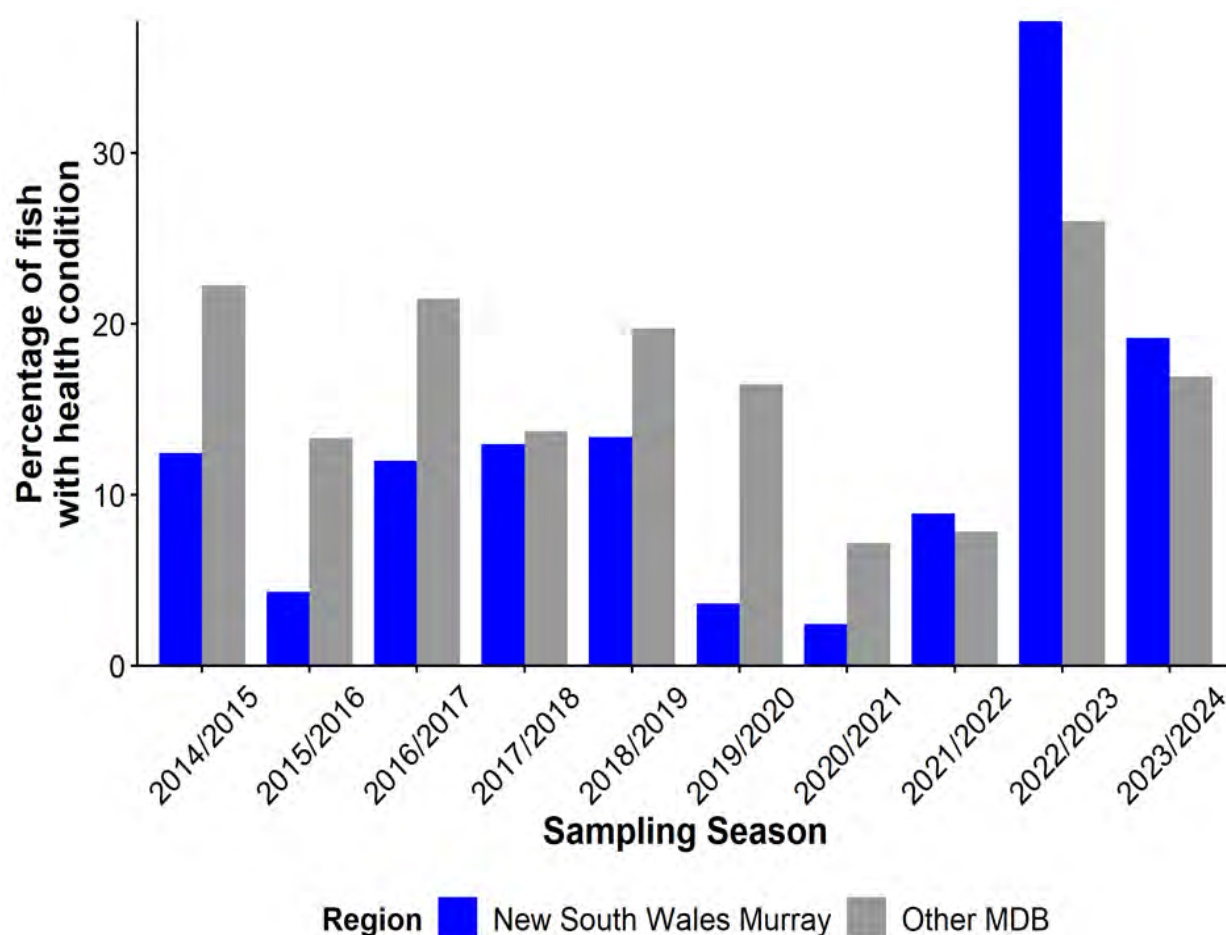


Figure 11.10: Timeseries showing the prevalence of health conditions in Murray cod. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA.

Summary Statement:

Presence of observable health conditions was variable across years but has been higher than the rest of the NSW MDB in the last three seasons (particularly 2022/23).

Distribution

Murray cod were recorded at 115 out of 274 sites in the New South Wales Murray WRPA from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 2.18 fish caught per 90 seconds of electrofishing. Figure 11.11 shows the distribution and relative abundance of Murray cod across the New South Wales Murray WRPA.

Summary Statement:

Murray cod were recorded across the NSW Murray WRPA but most abundant in the mid-reaches.

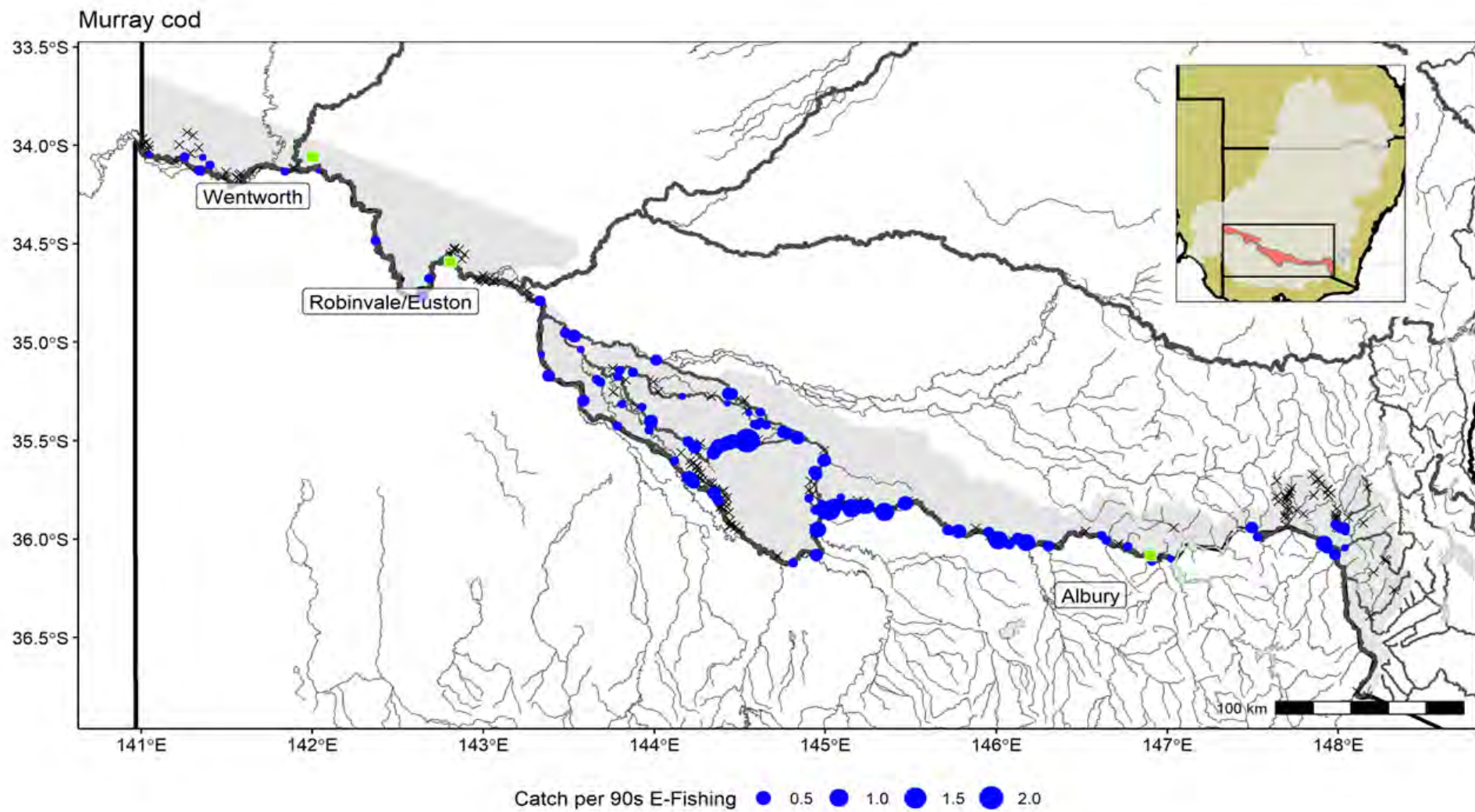


Figure 11.11: Distribution of Murray cod sampled from 2013/14 to 2023/24 in the NSW Murray WRP. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares represent key towns.

Golden perch



Population Structure

Figure 11.12 shows the observed length frequency plot for Golden perch for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 0 to 7, and 0 % to 10 % of measured fish within a season, with a mean percentage YOY of 2 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Golden perch was 9 % (639 out of 6,996).

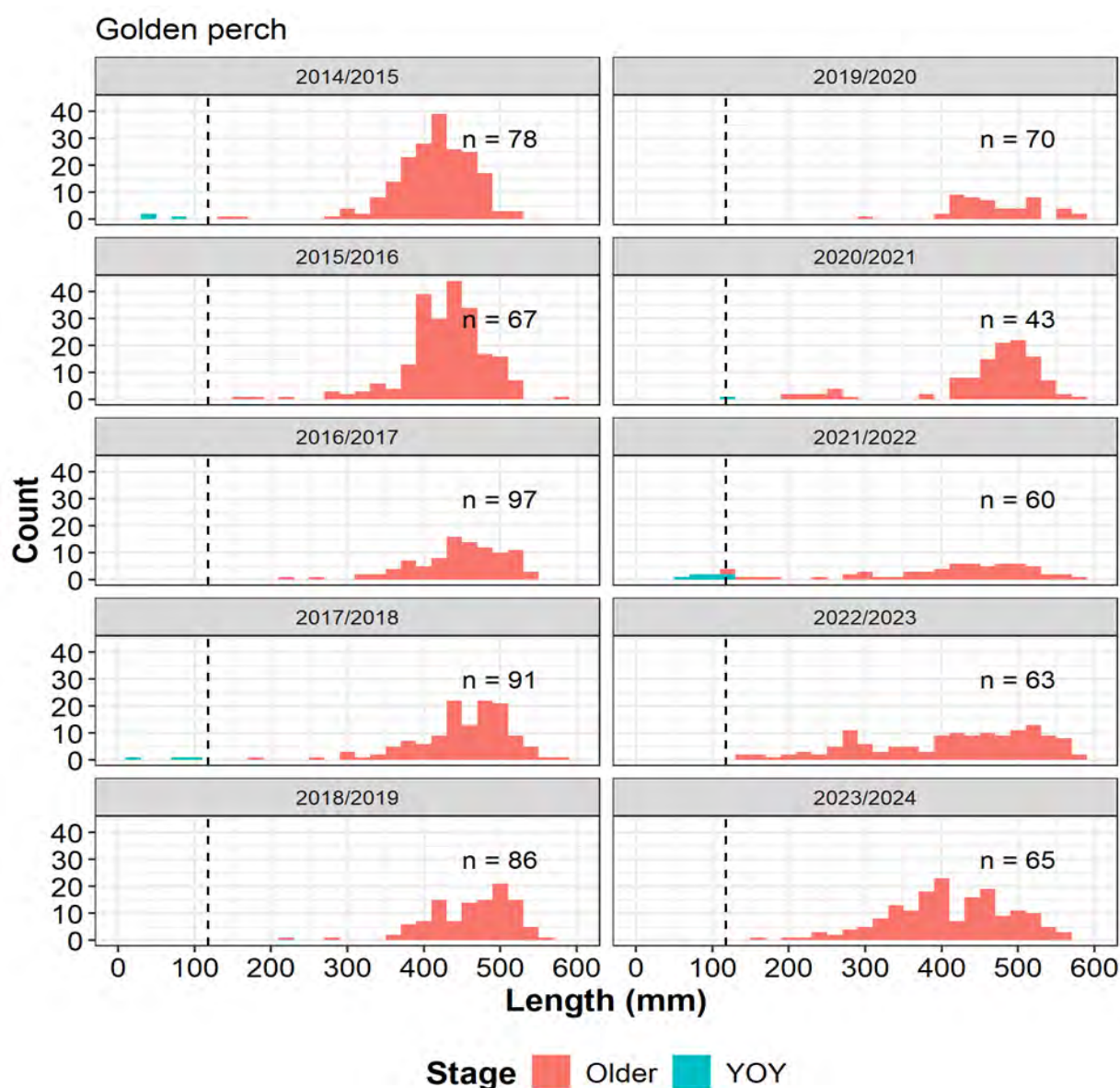


Figure 11.12: Length frequency plots for Golden perch by sampling season in the NSW Murray WRP. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRP in a sampling season.

Summary Statement:

High proportion of large fish in all sampling years. Limited or poor recruitment in most years with young of the year only observed in 2014/15, 2017/18 and 2021/22 suggesting recruitment limitation in most years.

Stocking

A total of 1,214,566 Golden perch were stocked into the waterways of the New South Wales Murray WRPAs during the reporting period. Of these fish, 487,800 (40.2 %) were stocked into impoundments while 726,766 (59.8 %) were stocked into rivers or creeks. Table 11.5 shows the detailed breakdown of stocking by season, location and life stage while Figure 11.13 shows the locations of stocking.

Table 11.5: Number and life stage of stocked Golden perch each sampling season in the NSW Murray WRPAs.

Sampling Season	River/Creek or Impoundment	Life Stage	Number Stocked
2014/2015	Impoundment	Fry	27,000
2014/2015	River/Creek	Fry	159,723
2015/2016	Impoundment	Fry	46,000
2015/2016	River/Creek	Fry	59,107
2016/2017	Impoundment	Fingerling	500
2016/2017	Impoundment	Fry	87,000
2016/2017	River/Creek	Fingerling	76,992
2017/2018	Impoundment	Fry	65,000
2017/2018	River/Creek	Fry	130,949
2018/2019	Impoundment	Fry	60,000
2018/2019	River/Creek	Fry	43,031
2019/2020	Impoundment	Fry	5,000
2019/2020	River/Creek	Fry	65,991
2020/2021	Impoundment	Fry	51,000
2020/2021	River/Creek	Fry	34,857
2021/2022	River/Creek	Fry	14,935
2022/2023	Impoundment	Fry	49,000
2022/2023	River/Creek	Fingerling	6,000
2022/2023	River/Creek	Fry	3,750
2023/2024	Impoundment	Fingerling	97,300
2023/2024	River/Creek	Fingerling	131,431

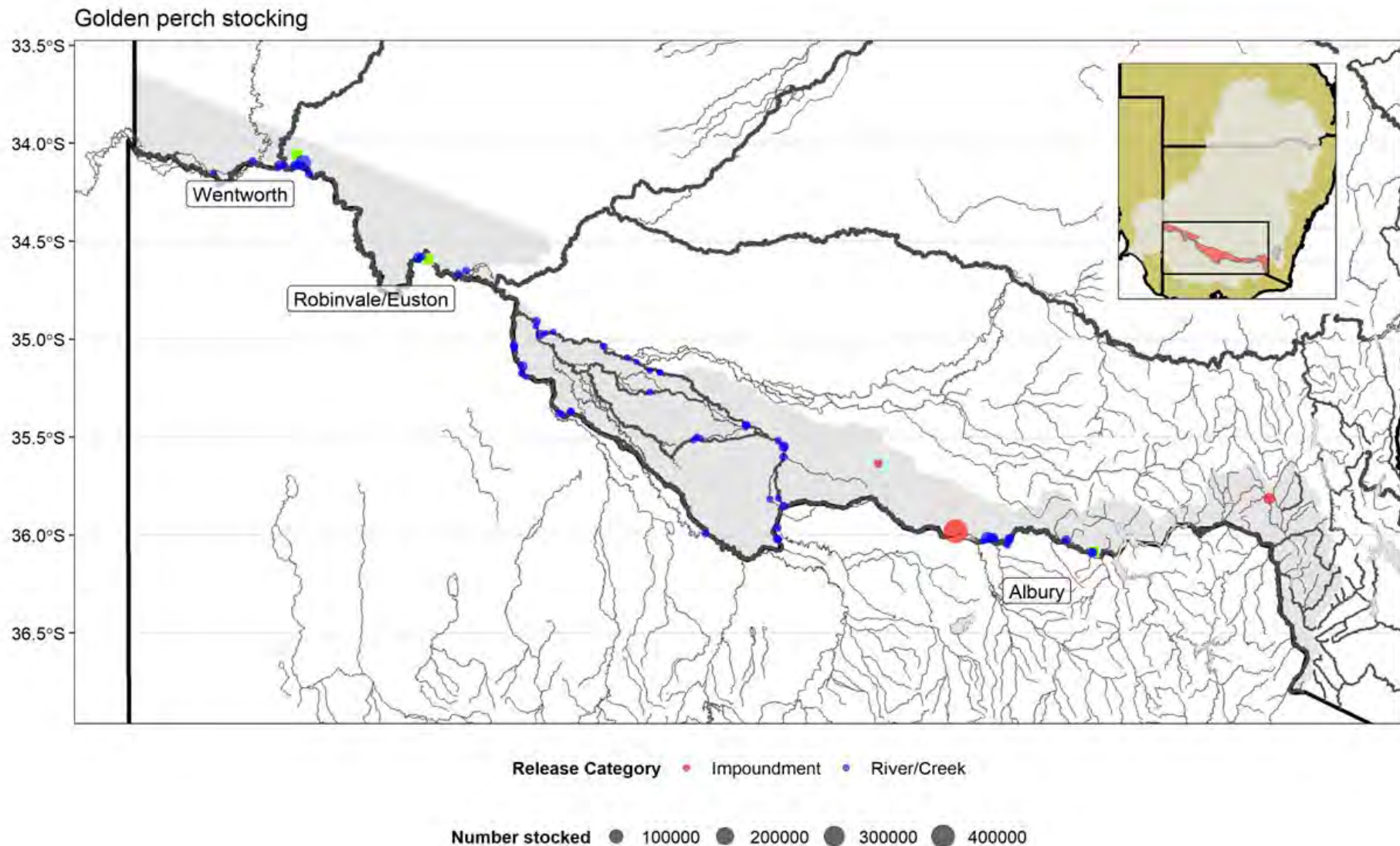


Figure 11.13: Locations of Golden perch stocking in the NSW Murray WRP. Colours show whether a site was a river/creek site or an impoundment, while the size of the point reflects the total number of fish stocked over the reporting period. Green squares represent key towns.

Temporal Trends in Abundance

The relative abundance and biomass of Golden perch since 1994 was modelled based on all suitable boat electrofishing data. The left-hand panels of Figure 11.14 show the abundance and biomass trends for the New South Wales Murray WRP and the right-hand panels show the overall trends across the NSW MDB.

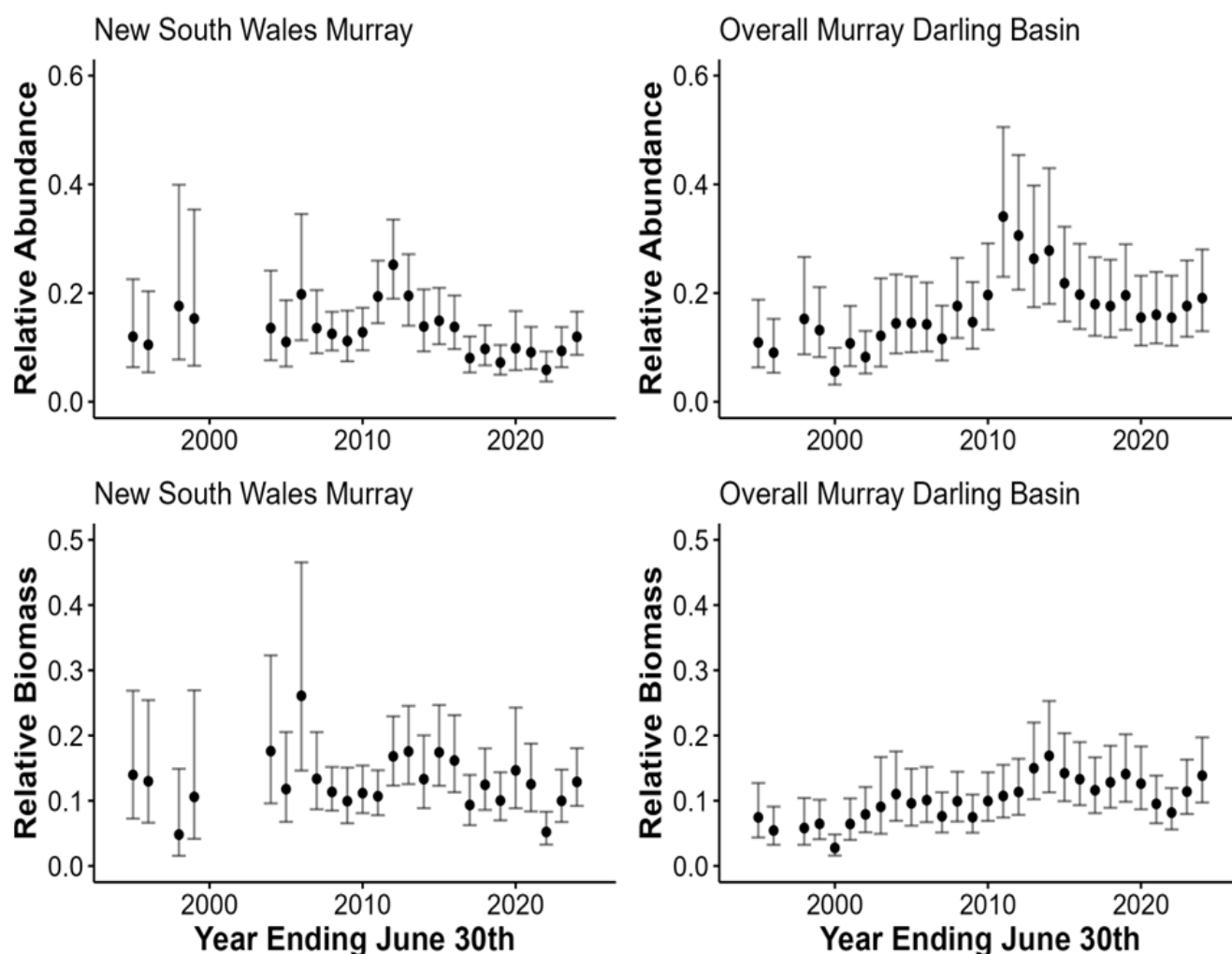


Figure 11.14: Relative abundance and biomass of Golden perch in both this valley and the overall Murray-Darling Basin. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates.

Summary Statement:

Similar abundance and biomass to the late 1990s with an upwards trend in both since 2021/22. Abundance currently slightly lower than the overall NSW MDB but biomass is approximately equal to the overall NSW MDB.

Health

The prevalence of any health issues ranged from 3 % of sampled fish in 2020/2021 to 51 % of sampled fish in 2022/2023 (Figure 11.15). The most common health issue for Golden perch in the New South Wales Murray water resource planning area was *Lernaea*, which was observed in a total of 131 fish, corresponding to 10 % of all Golden perch measured.

Across the other WRPAs, 26 % of Golden perch (1,811 out of 6,996 Golden perch) showed a health condition (excludes New South Wales Murray).

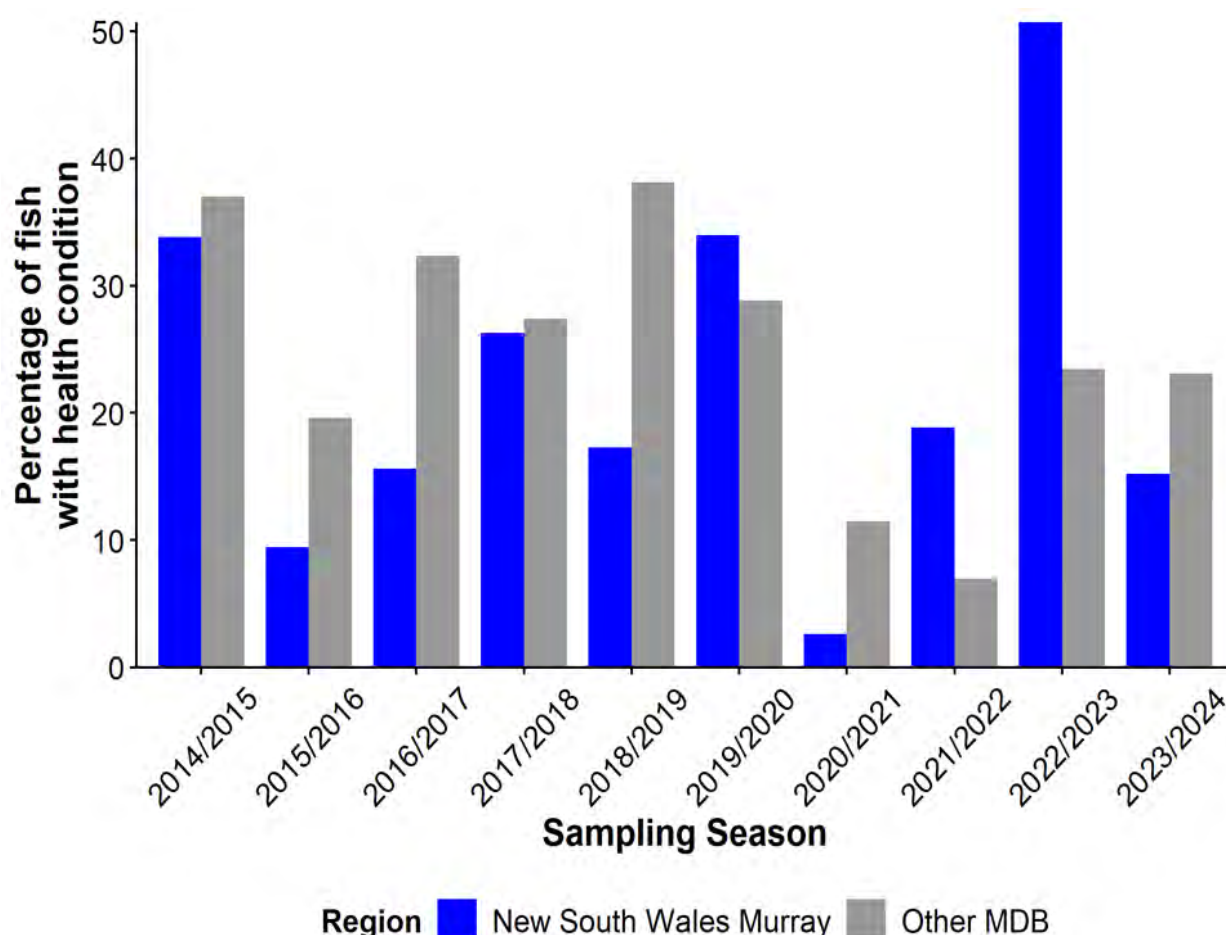


Figure 11.15: Timeseries showing the prevalence of health conditions in Golden perch. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPAs.

Summary Statement:

The presence of observable health conditions for Golden perch in the NSW Murray was variable and ranged from low to high. While most years showed similar trends to the rest of the NSW MDB, in 2022/23 the NSW Murray showed a much greater proportion of Golden perch with observable health issues.

Distribution

Golden perch were recorded at 102 out of 274 sites in the New South Wales Murray WRPAs from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 1.3 fish caught per 90 seconds of electrofishing. Figure 11.16 shows the distribution and relative abundance of Golden perch across the New South Wales Murray WRPAs.

Summary Statement:

Golden perch were distributed across the NSW Murray WRPAs with the exception of upland areas in the east.

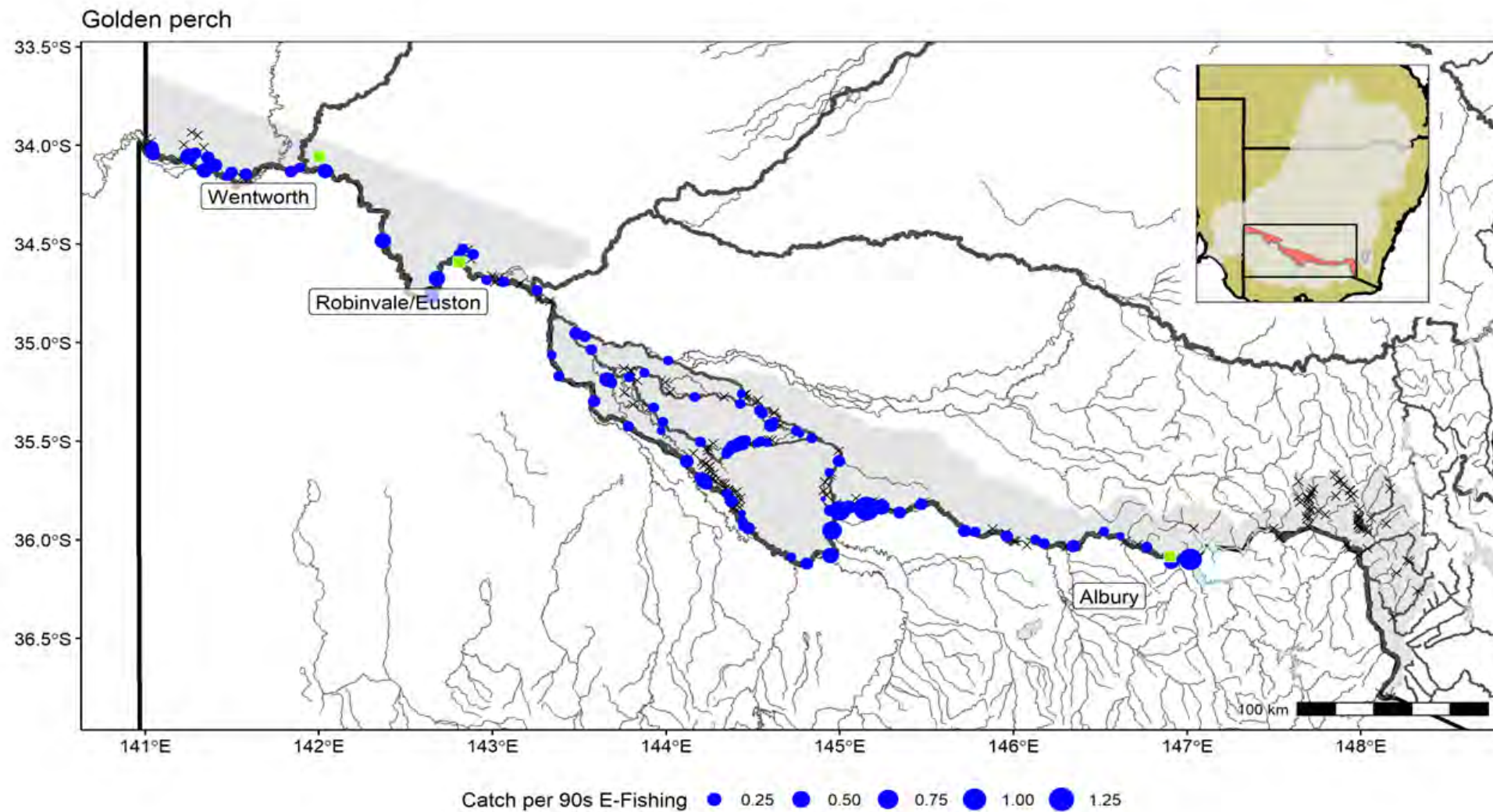


Figure 11.16: Distribution of Golden perch sampled from 2013/14 to 2023/24 in the NSW Murray WRP. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares represent key towns.

Freshwater catfish



Summary Statement:

Very few Freshwater catfish ($n=6$) were caught or observed during standardised monitoring in the reporting period. These included one individual was observed in 2014/15, three in 2015/16, one in 2017/18 and one in 2023/24. All individuals were of mature size. This suggests very low abundance in this area.

Bony herring



Population Structure

Figure 11.17 shows the observed length frequency plot for Bony herring for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 17 to 231, and 7 % to 49 % of measured fish within a season, with a mean percentage YOY of 28 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Bony herring was 25 % (12,108 out of 49,196). Bony herring are not a stocked species.

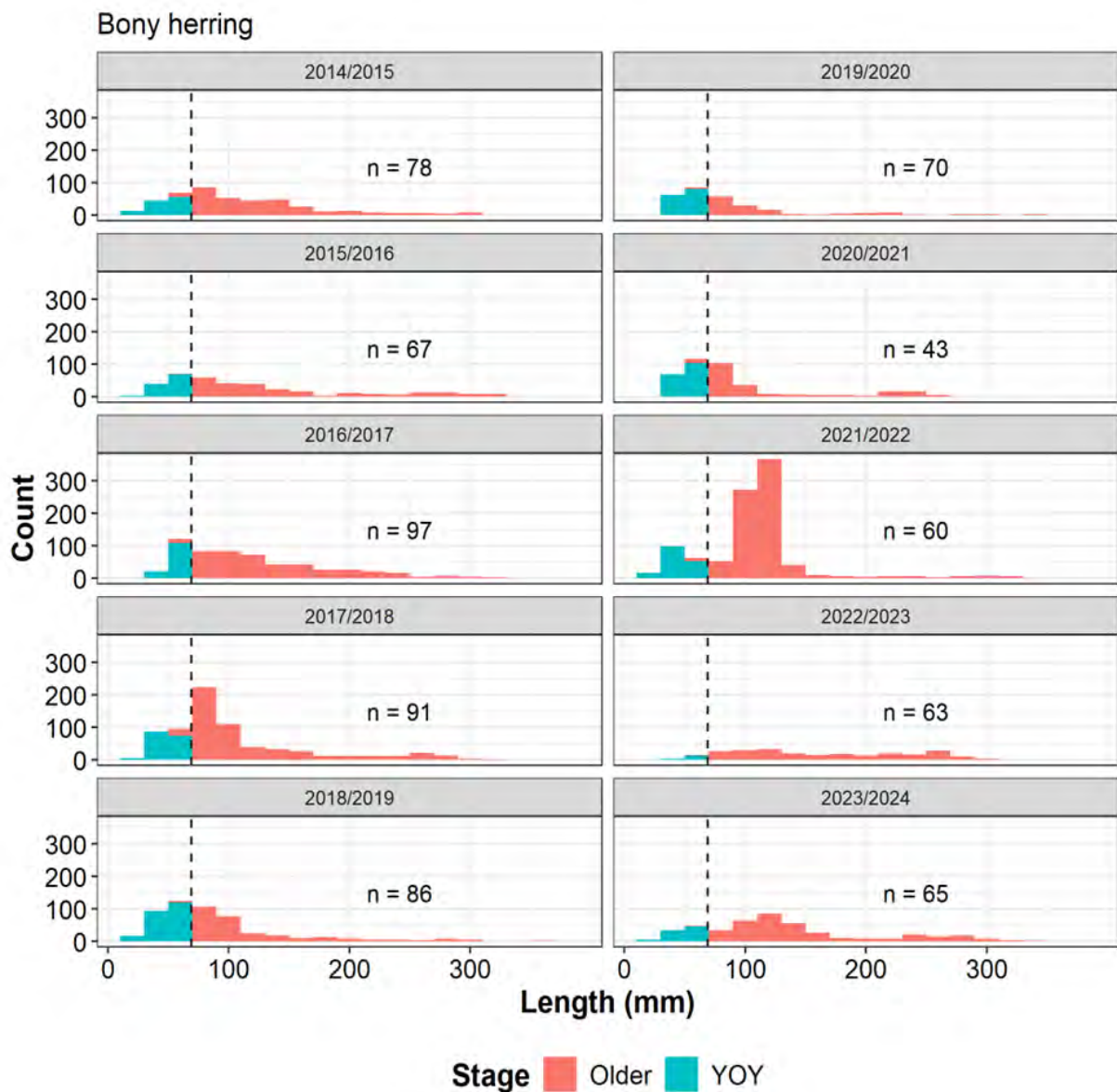


Figure 11.17: Length frequency plots for Bony herring by sampling season in the NSW Murray WRP. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRP in a sampling season.

Summary Statement:

Regular recruitment in most years except 2022/23 which appears to have had possible recruitment failure compared to the other years.

Temporal Trends in Abundance

The relative abundance and biomass of Bony herring since 1994 was modelled based on all suitable boat electrofishing data. The left-hand panels of Figure 11.18 show the abundance and biomass trends for the New South Wales Murray WRPA and the right-hand panels show the overall trends across the NSW MDB.

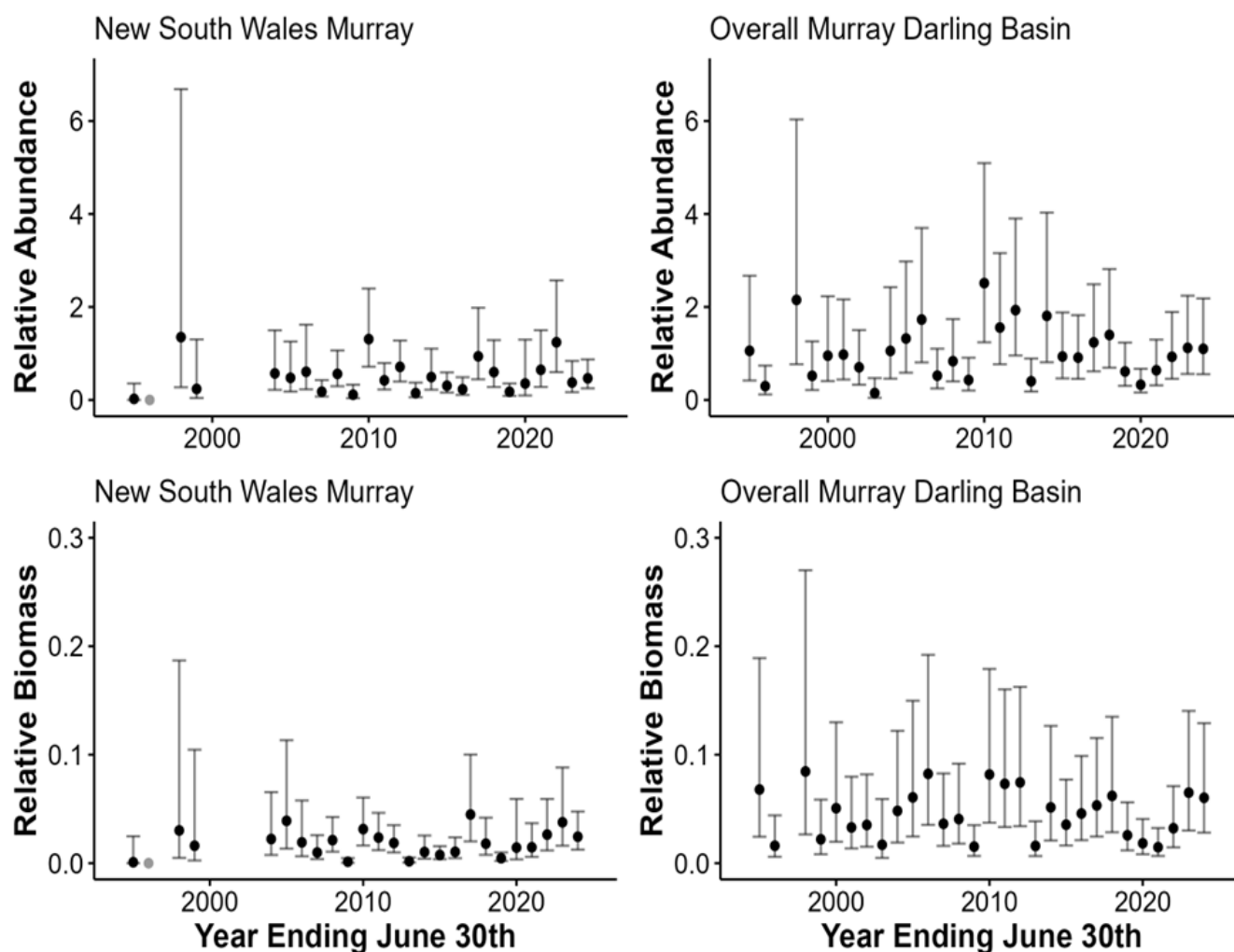


Figure 11.18: Relative abundance and biomass of Bony herring in both the New South Wales Murray WRPA and the overall NSW MDB. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates.

Summary Statement:

Abundance and biomass have fluctuated but are generally lower than the overall NSW MDB.

Health

The prevalence of any health issues ranged from 0 % of sampled fish in multiple years to 2 % of sampled fish in 2023/2024 (Figure 11.19). The most common health issue for Bony herring in the New South Wales Murray WRPAs was Fungus, which was observed in a total of 9 fish, corresponding to 0 % of all Bony herring measured.

Across the other NSW MDB WRPA, 1.1 % of Bony herring (543 out of 49,197 Bony herring) showed a health condition (excludes the New South Wales Murray WRPAs).

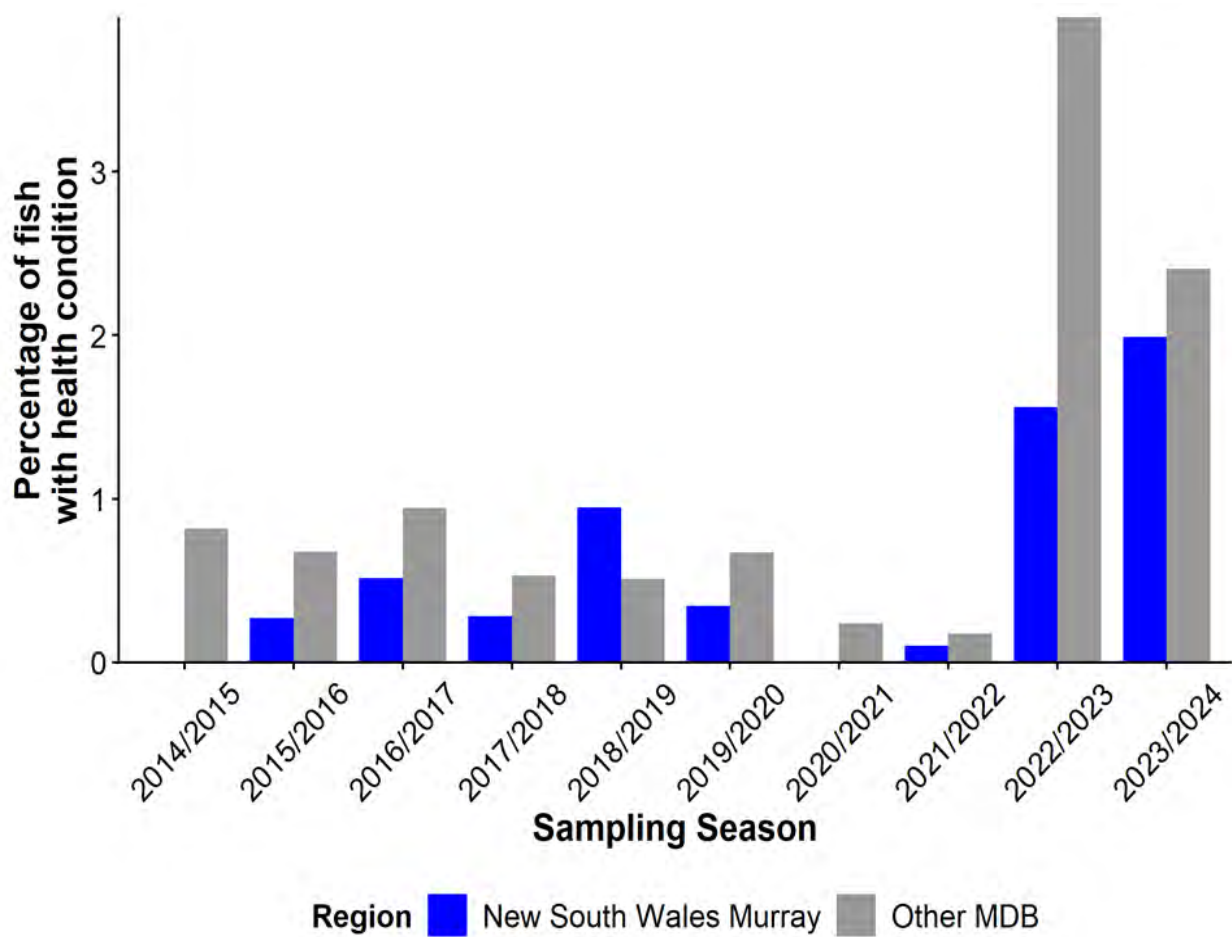


Figure 11.19: Timeseries showing the prevalence of health conditions in Bony herring. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA.

Summary Statement:

Presence of observable health conditions was very low in all years.

Distribution

Bony herring were recorded at 96 out of 274 sites in the New South Wales Murray WRP from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 31.83 fish caught per 90 seconds of electrofishing. Figure 11.20 shows the distribution and relative abundance of Bony herring across the New South Wales Murray WRP.

Summary Statement:

Bony herring were recorded across the western half NSW Murray WRP and appear to be absent or in very low abundance in the eastern region.

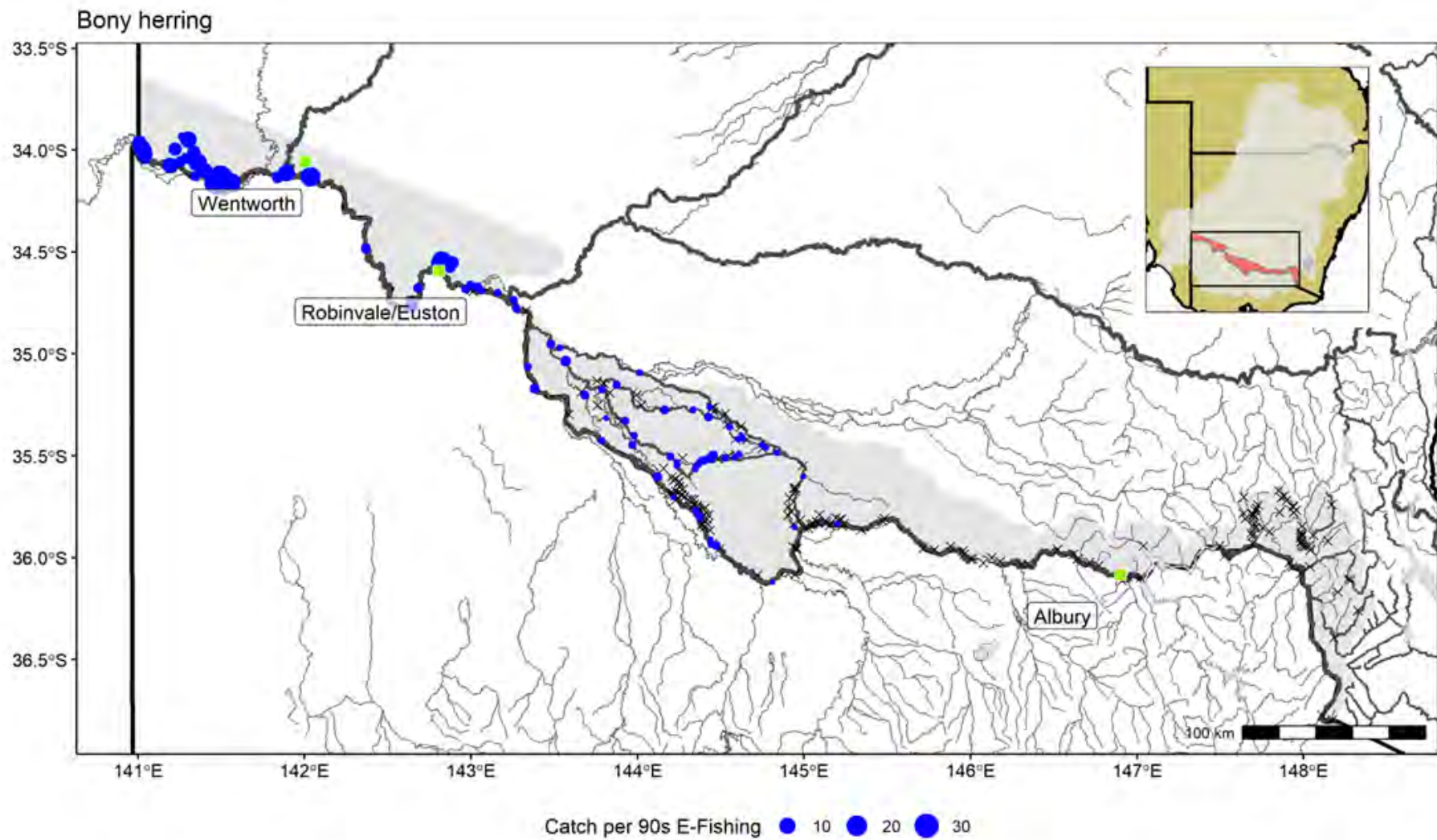


Figure 11.20: Distribution of Bony herring sampled from 2013/14 to 2023/24 in the NSW Murray WRPA. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares represent key towns.

Australian smelt



Population Structure

Figure 11.21 shows the observed length frequency plot for Australian smelt for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 146 to 1,369, and 25 % to 61 % of measured fish within a season, with a mean percentage YOY of 39 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Australian smelt was 41 % (4,982 out of 12,246). Australian smelt are not a stocked species.

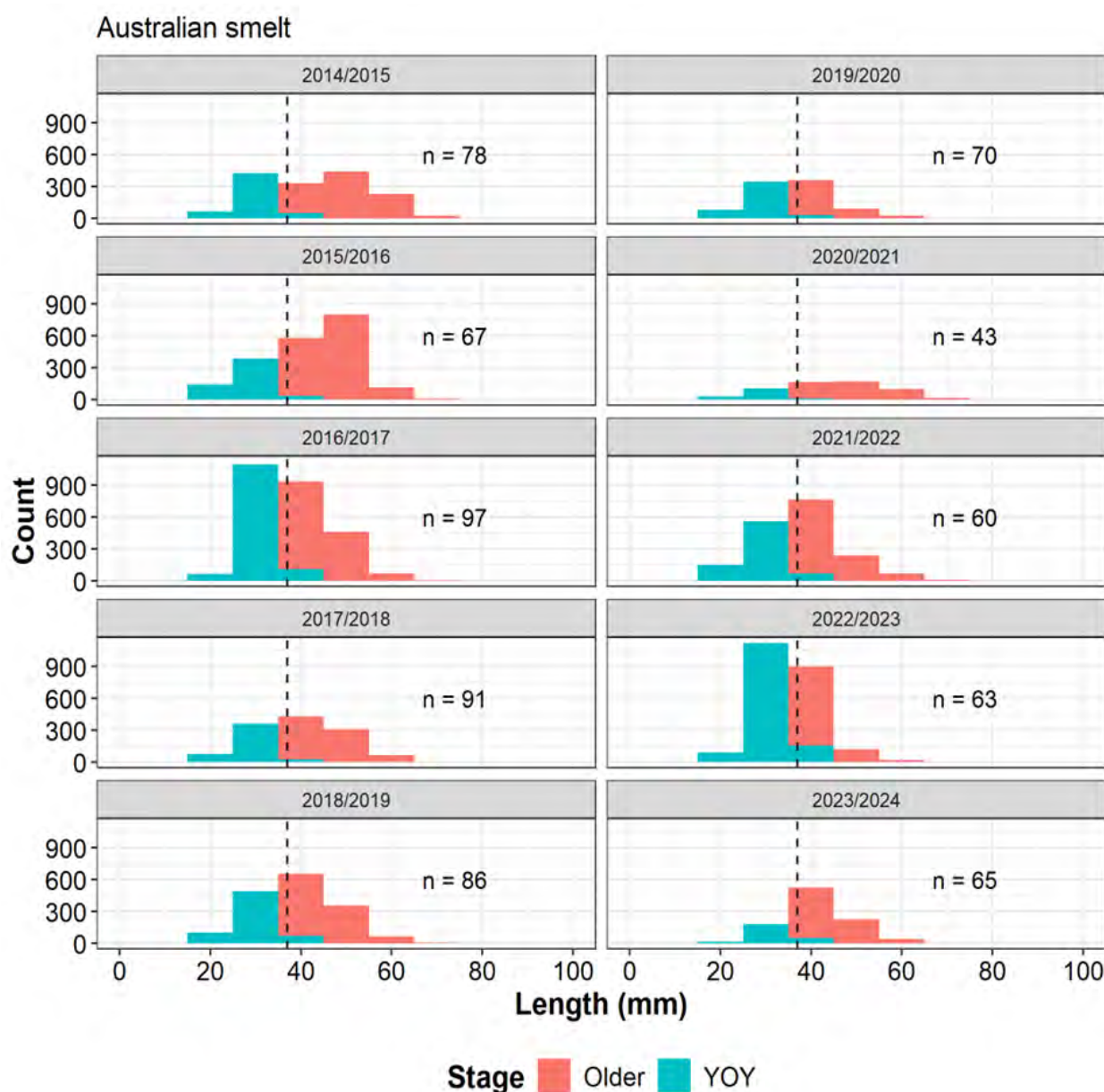


Figure 11.21: Length frequency plots for Australian smelt by sampling season in the NSW Murray WRP. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRP in a sampling season.

Summary Statement:

Recruitment evident in all years, weaker than usual recruitment in 2020/21 and 2023/24.

Temporal Trends in Abundance

The relative abundance of Australian smelt since 1994 was modelled based on all suitable boat electrofishing data. The left-hand panel of Figure 11.22 show the abundance trends for the New South Wales Murray WRPA and the right-hand panel show the overall trend across the NSW MDB.

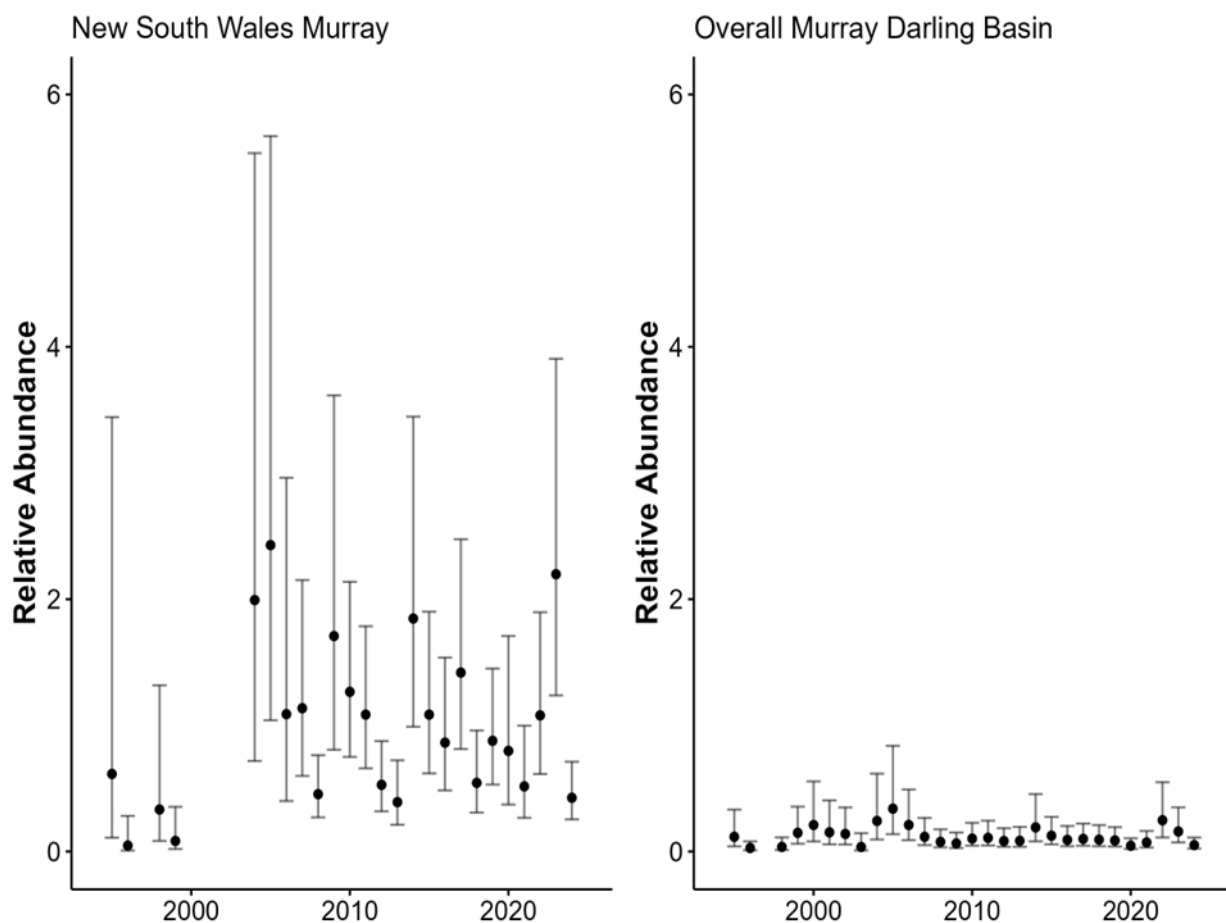


Figure 11.22: Relative abundance of Australian smelt in both the New South Wales Murray WRPA and the overall NSW MDB. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates. No modelling of biomass was done for Australian smelt.

Summary Statement:

Decline in abundance in 2023/24 compared to most years since 2005 but abundance is still higher than the overall NSW MDB.

Health

The prevalence of any health issues ranged from 0 % of sampled fish in 2020/2021 to 3 % of sampled fish to 2017/2018 (Figure 11.23). The most common health issue for Australian smelt in the New South Wales Murray WRPAs was *Lernaea*, which was observed in a total of 128 fish, corresponding to 1 % of all Australian smelt measured.

Across the other NSW MDB WRPA, <1 % of Australian smelt (32 out of 12,248 Australian smelt) showed a health condition (excludes the New South Wales Murray WRPAs).

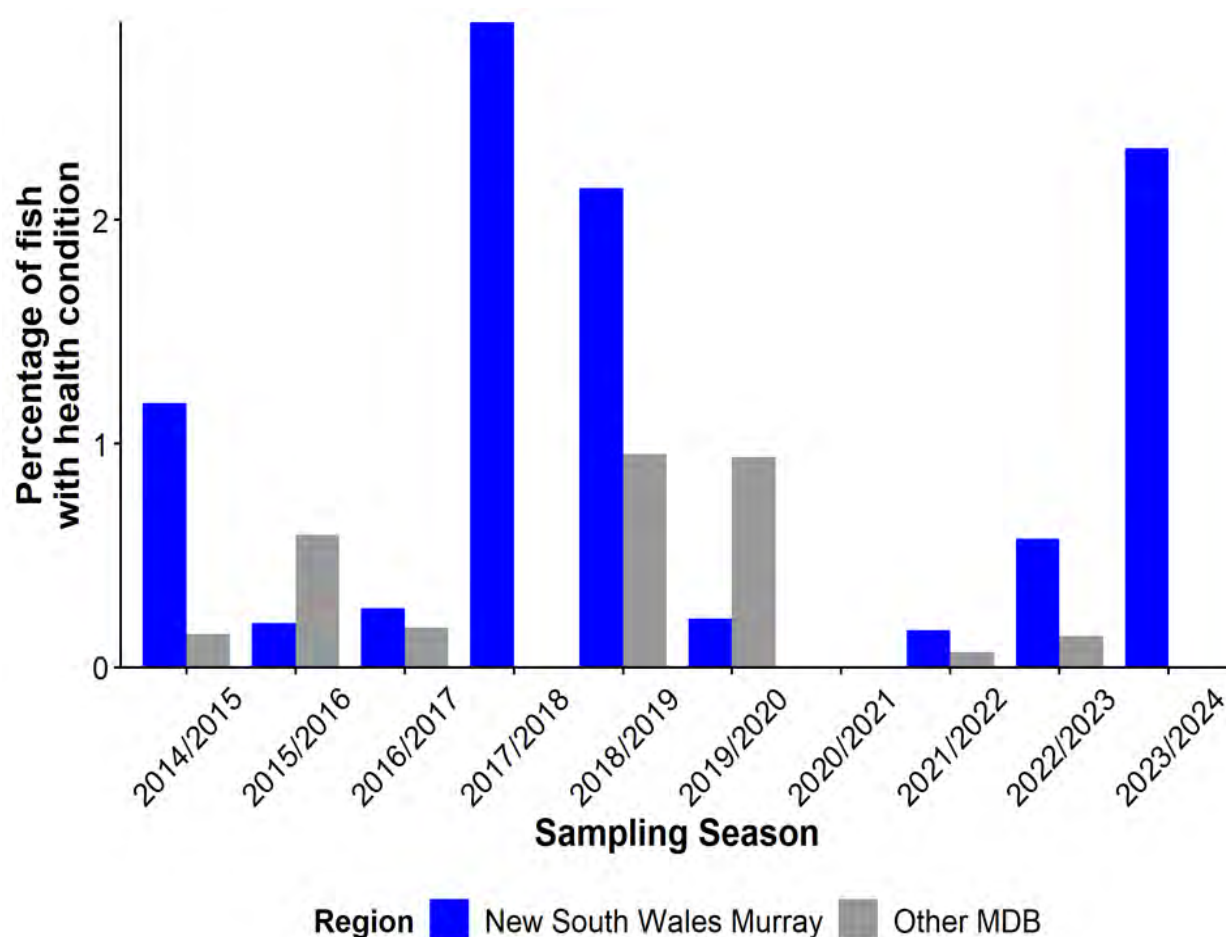


Figure 11.23: Timeseries showing the prevalence of health conditions in Australian smelt. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA.

Summary Statement:

Very few health issues were observed in Australian smelt in the NSW Murray overall (<3 % in all years) but a higher proportion of health issues compared to the rest of the NSW MDB in multiple years including 2023/24.

Distribution

Australian smelt were recorded at 201 out of 274 sites in the New South Wales Murray WRP from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 71.7 fish caught per 90 seconds of electrofishing. Figure 11.24 shows the distribution and relative abundance of Australian smelt across the New South Wales Murray WRP.

Summary Statement:

Australian smelt were recorded across the New South Wales Murray WRP.

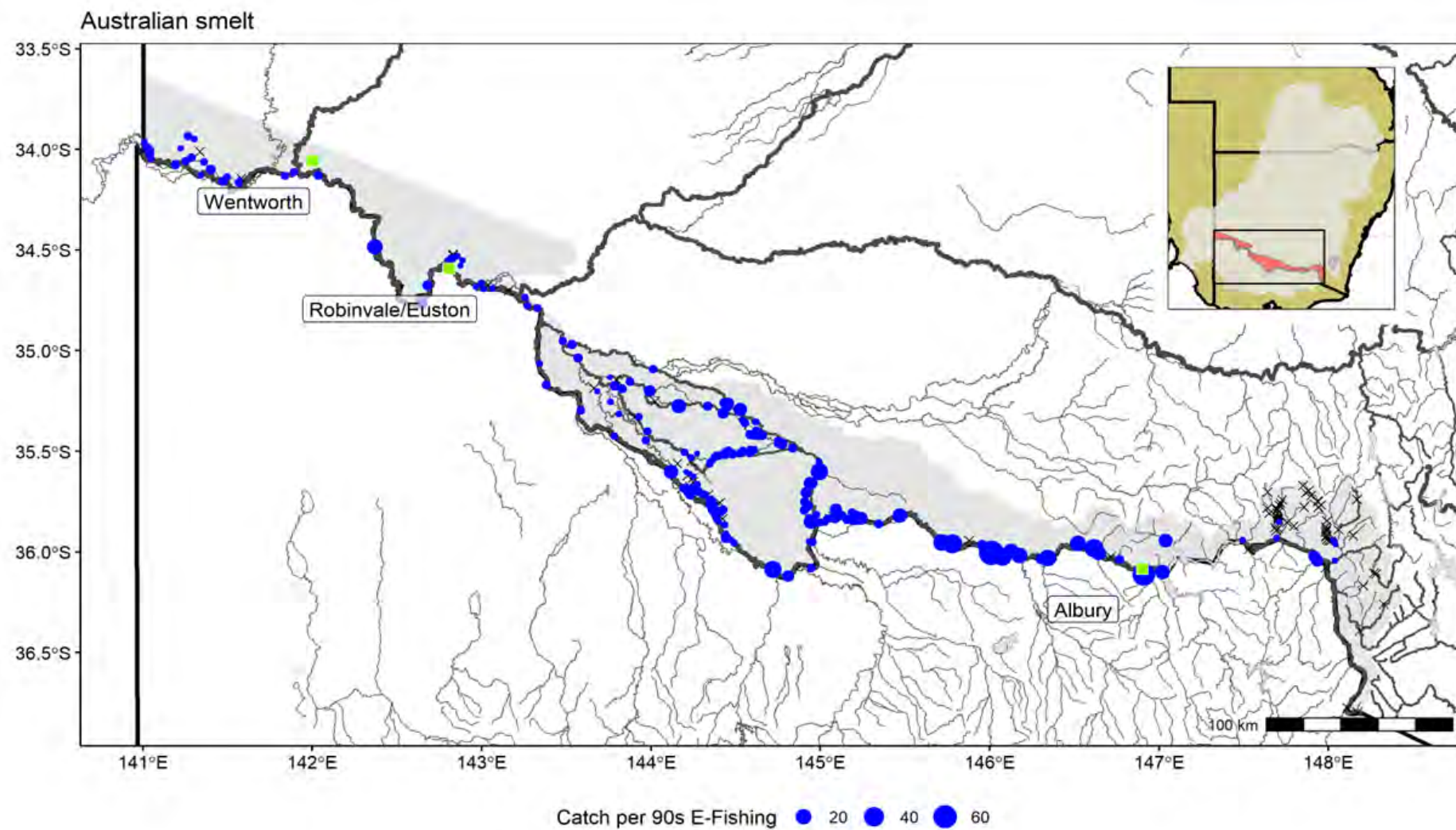


Figure 11.24: Distribution of Australian smelt sampled from 2013/14 to 2023/24 in the NSW Murray WRPA. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares represent key towns.

Common carp



Population Structure

Figure 11.25 shows the observed length frequency plot for Common carp for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 151 to 3,366, and 18 % to 89 % of measured fish within a season, with a mean percentage YOY of 57 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Common carp was 50 % (23,339 out of 46,669). Common carp are not a stocked species.

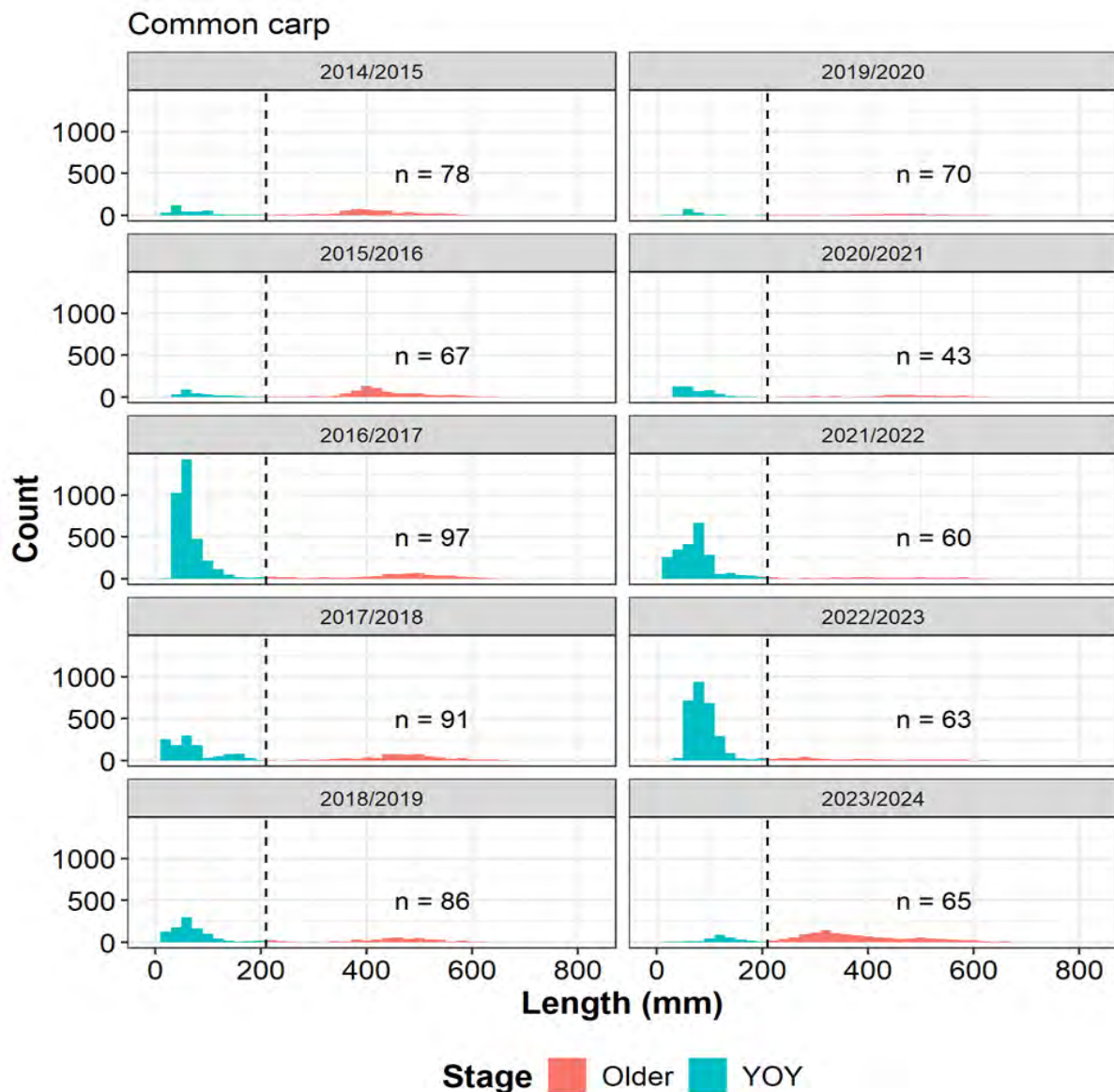


Figure 11.25: Length frequency plots for common carp by sampling season in the NSW Murray WRP. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRP in a sampling season.

Summary Statement:

Variable recruitment with very strong peaks in 2016/17, 2021/22 and 2022/23. Large fish (>500 mm) present in all years. Low recruitment in 2023/24.

Temporal Trends in Abundance

The relative abundance and biomass of Common carp since 1994 was modelled based on all suitable boat electrofishing data. The left-hand panels of Figure 11.26 show the abundance and biomass trends for the New South Wales Murray WRPA and the right-hand panels show the overall trends across the NSW MDB.

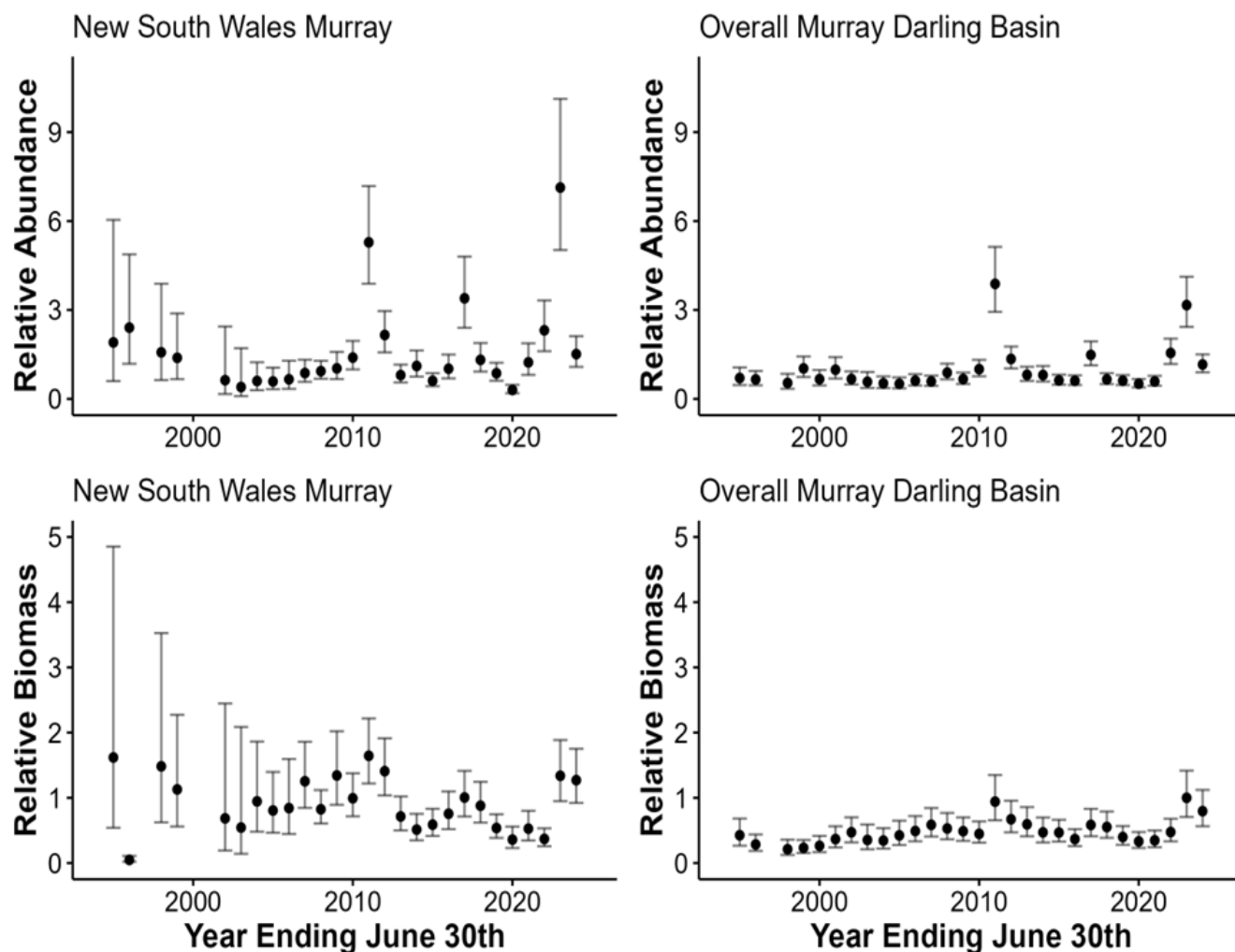


Figure 11.26: Relative abundance and biomass of Common carp in both this valley and the overall Murray-Darling Basin. These are model estimates based upon all electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates.

Summary Statement:

Abundance has declined sharply following strong recruitment pulse in 2022/23 but biomass remains elevated. Abundance and biomass slightly higher than the overall NSW MDB.

Health

The prevalence of any health issues ranged from 0 % of sampled fish in 2020/2021 to 4 % of sampled fish in 2019/2020 (Figure 11.27). The most common health issue for Common carp in the New South Wales Murray water resource planning area was *Lernaea*, which was observed in a total of 175 fish, corresponding to 1 % of all Common carp measured.

Across the other WRPA's, 4 % of Common carp (2,082 out of 46,671 Common carp) showed a health condition (excludes New South Wales Murray).

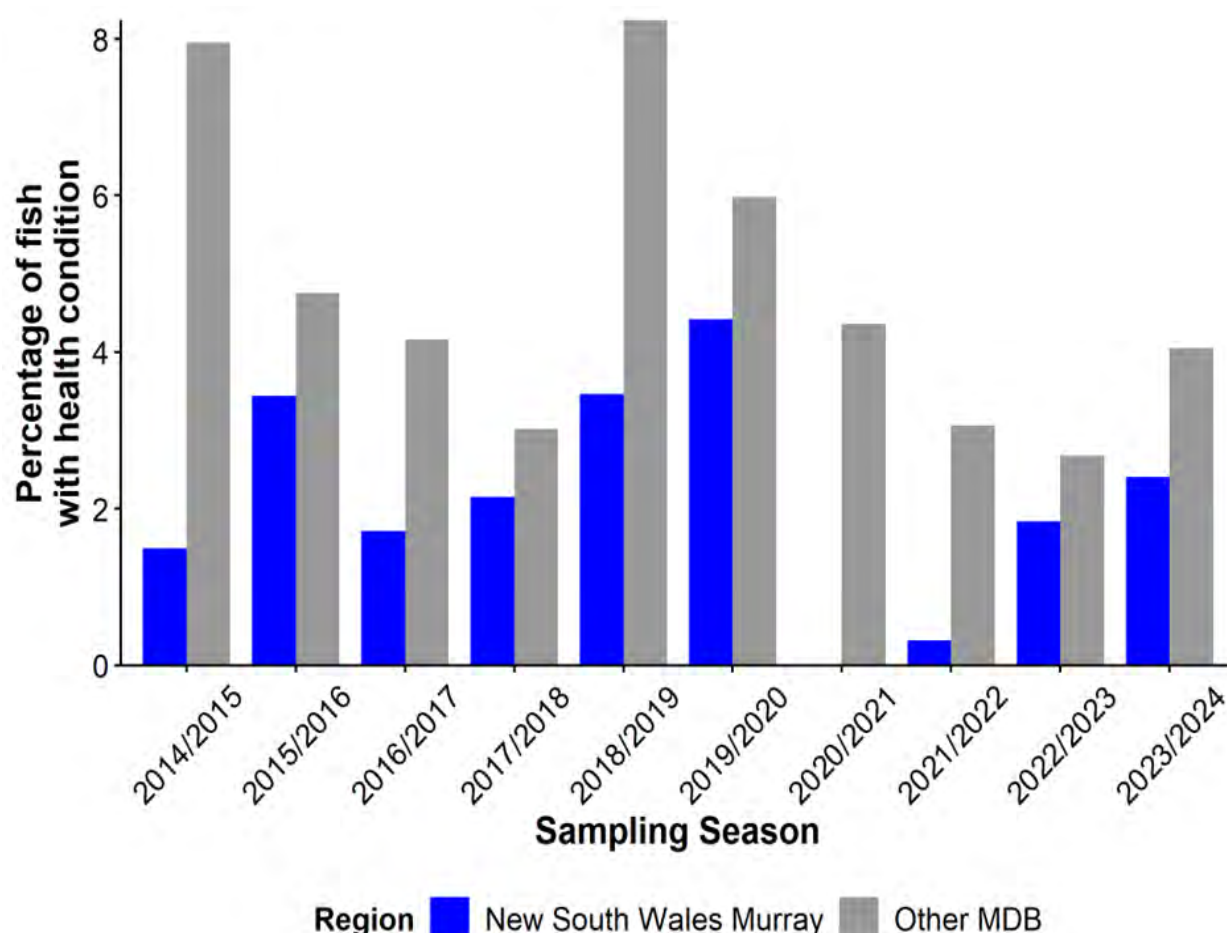


Figure 11.27: Timeseries showing the prevalence of health conditions in Common carp. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA's.

Summary Statement:

The presence of observable health conditions for Common carp in the NSW Murray was very low to low in all years and generally similar to the wider NSW MDB except for 2014/15 and 2020/21 when the NSW Murray showed a substantially lower proportion of health issues.

Distribution

Common carp were recorded at 231 out of 274 sites in the New South Wales Murray WRP from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 53.7 fish caught per 90 seconds of electrofishing. Figure 11.28 shows the distribution and relative abundance of Common carp across the New South Wales Murray WRP.

Summary Statement:

Common carp were generally found across the New South Wales Murray region.

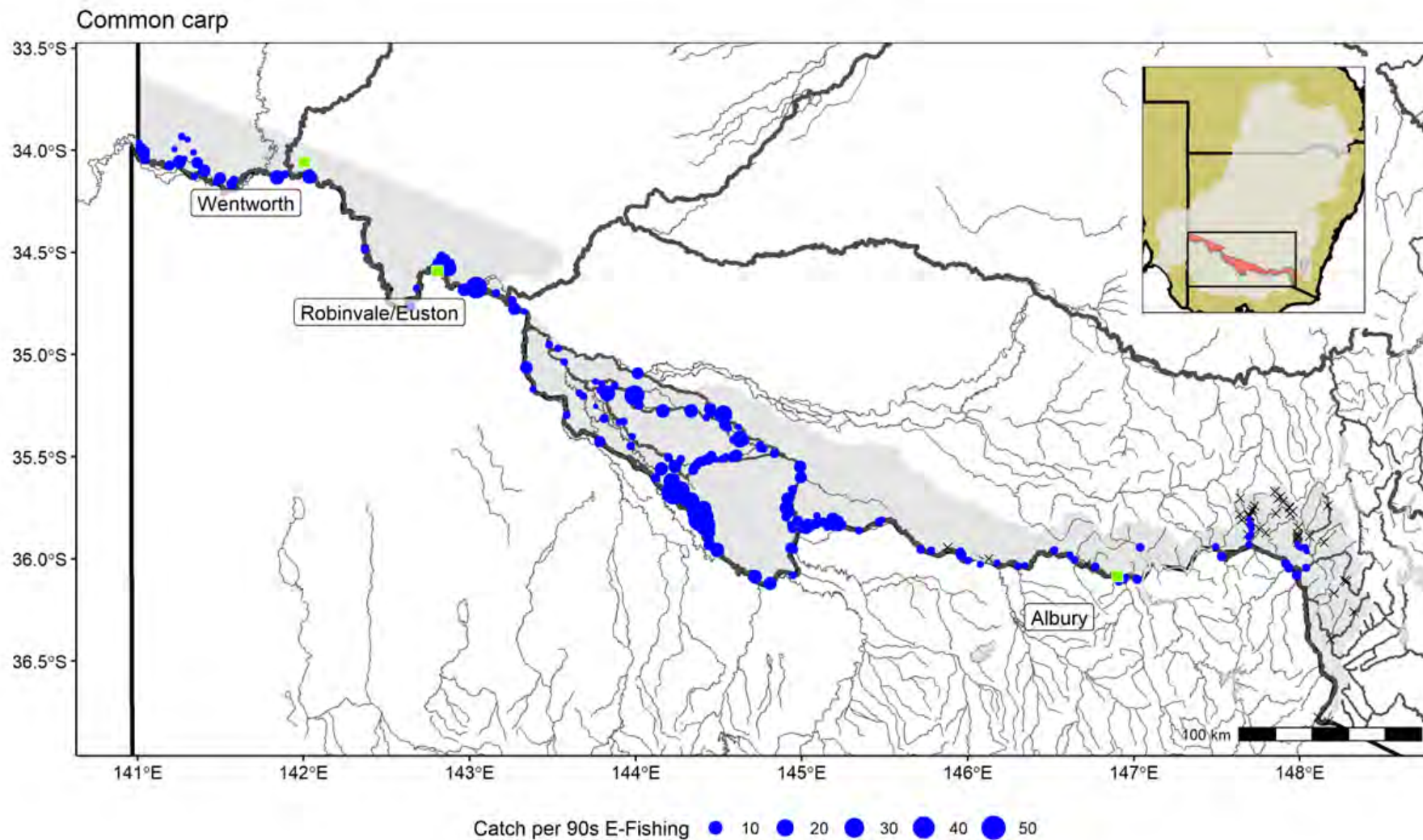


Figure 11.28: Distribution of Common carp sampled from 2013/14 to 2023/24 in the NSW Murray WRPA. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares represent key towns.

Threatened Species

The following table (Table 11.6) shows the fish species listed under either the *NSW Fisheries Management Act 1994* (FMA) or the *Commonwealth Environmental Protection and Biodiversity Conservation Act 1999* (EPBC) which were observed during standardised electrofishing surveys in the New South Wales Murray Water Resource Planning Area during the reporting period. A list of all threatened fish species observed by NSW DPIRD Fisheries (as part of any sampling program in any area) is provided in Table 11.10.

Table 11.6: Listed species which were observed in this region during the sampling period. (* = FMA, # = EPBC)

Species	Common name	Total caught (observed)
<i>Bidyanus bidyanus</i>	Silver perch ^{#*}	159 (10)
<i>Maccullochella macquariensis</i>	Trout cod ^{#*}	411 (30)
<i>Maccullochella peelii</i>	Murray cod [#]	2,132 (383)
<i>Macquaria australasica</i>	Macquarie perch ^{#*}	12 (3)
<i>Nannoperca australis</i>	Southern pygmy perch ^{#*}	602 (197)
<i>Tandanus tandanus</i>	Freshwater catfish [*]	5 (1)

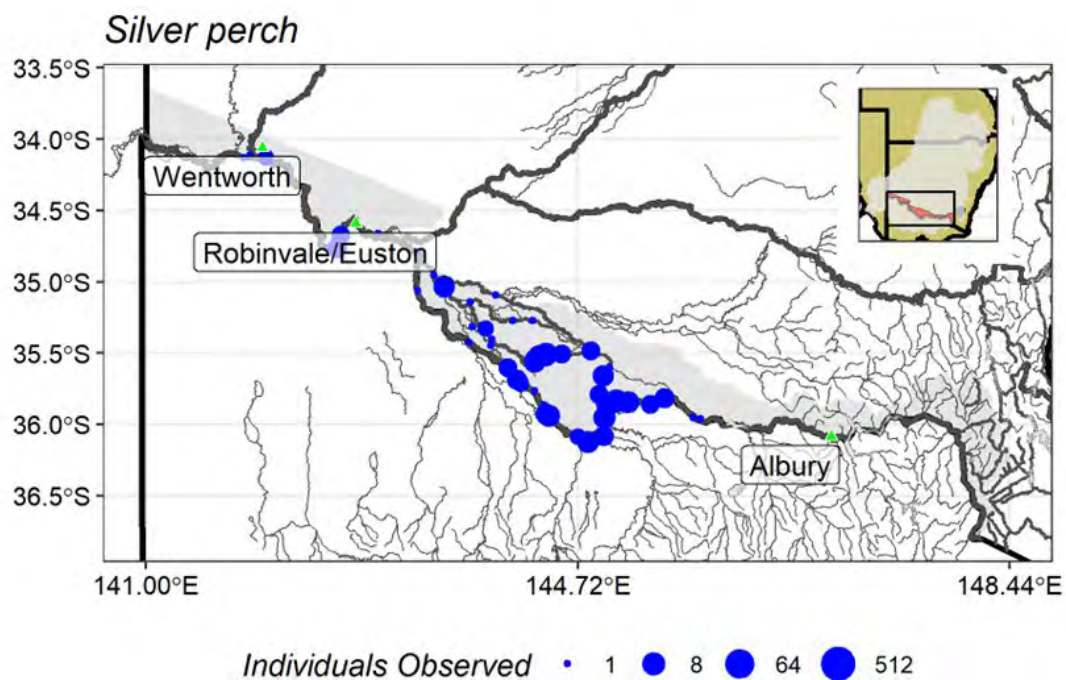


Figure 11.29: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the NSW Murray WRP. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance.

Summary Statement:

159 Silver perch were captured across 60 sites in the central and western areas with individuals observed in all sampling years. 13 individuals were caught across 11 sites in 2023/24.

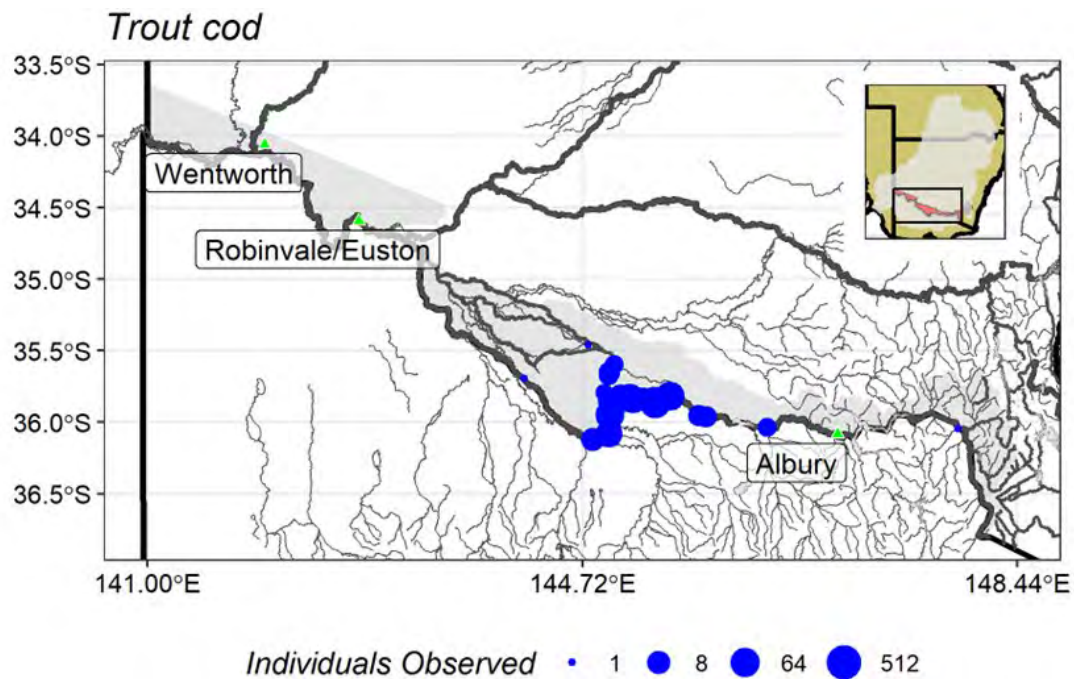


Figure 11.30: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the NSW Murray WRP. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance.

Summary Statement:

411 Trout cod were captured across 25 sites in the central area with individuals observed in all sampling seasons.

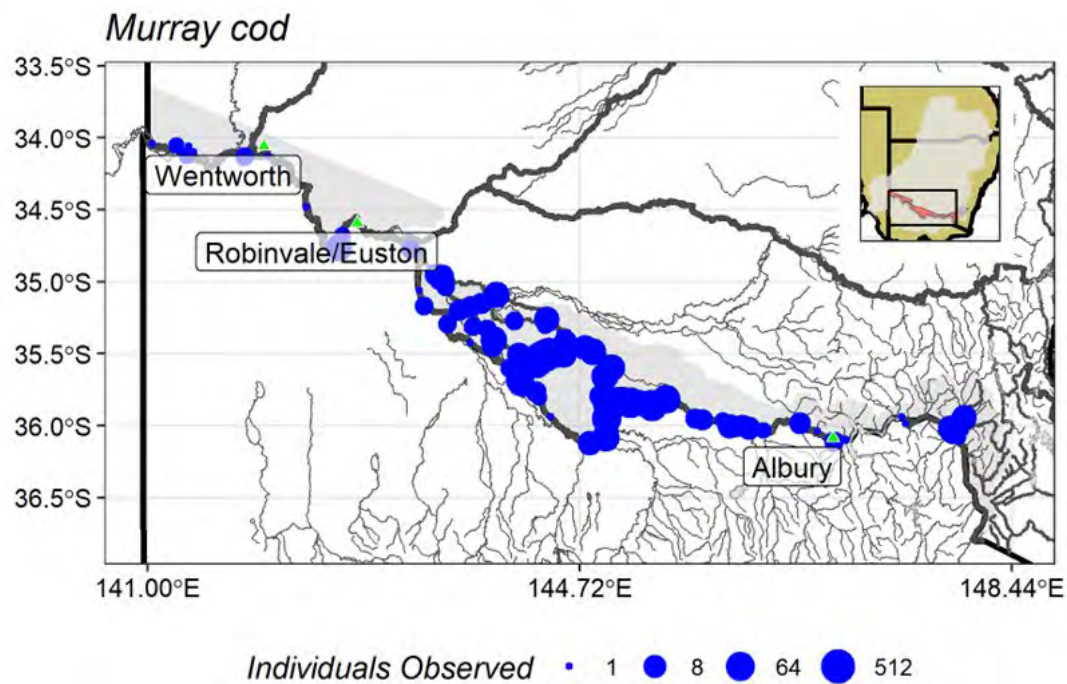


Figure 11.31: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the NSW Murray WRP. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance. Note lower image shows a juvenile Murray cod.

Summary Statement:

Murray cod are widespread across the NSW Murray WRP with 2,132 being caught over the reporting period.

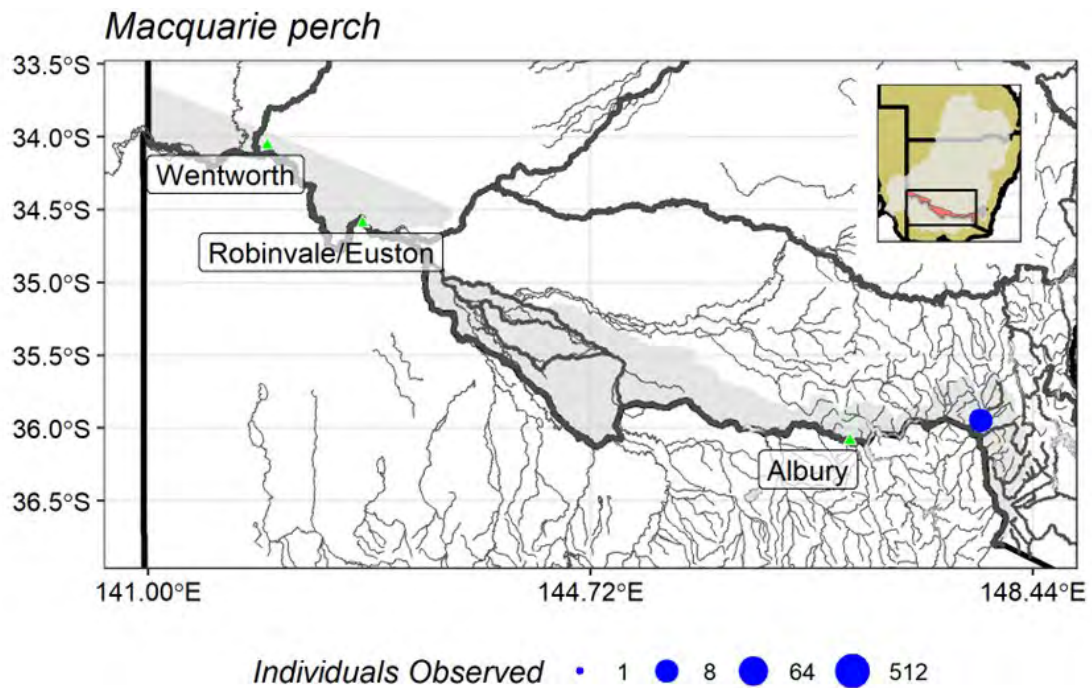


Figure 11.32: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the NSW Murray WRP. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance.

Summary Statement:

Twelve Macquarie perch were captured across 3 sites in the upper NSW Murray region (9 in 2016/17 and 3 in 2017/18). Macquarie perch were stocked into Mannus Creek in 2020/21 (n= 4,500).

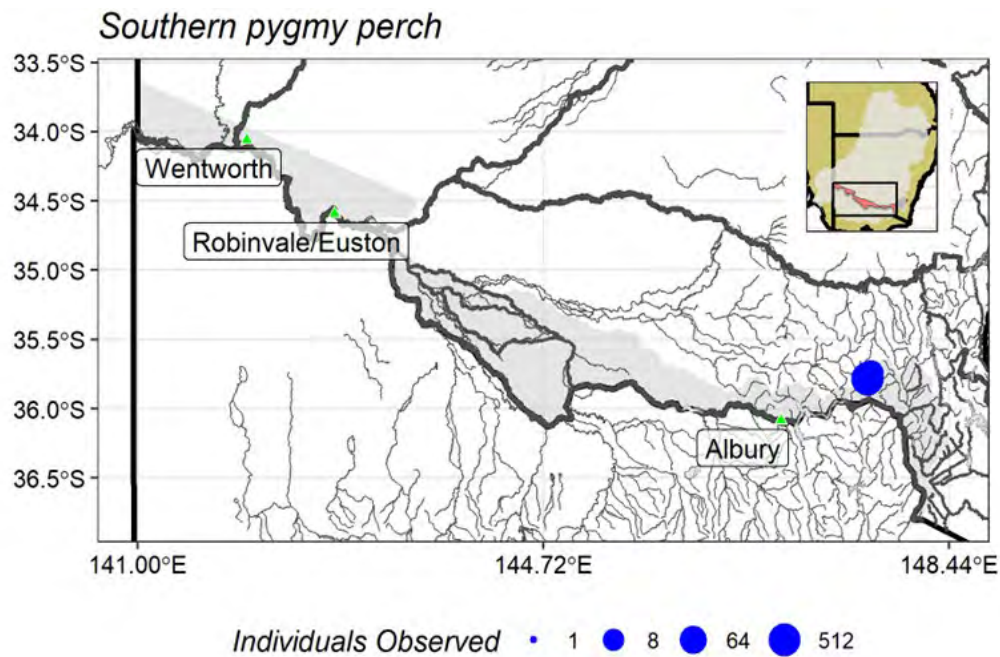


Figure 11.33: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the NSW Murray WRP. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance.

Summary Statement:

A total of 602 Southern pygmy perch were captured across 3 sites in the upper NSW Murray region. Individuals were observed in 2014/15 (n= 3), 2019/20 (n= 595) and 2022/23 (n= 4). Southern pygmy perch have been stocked historically in this WRP (prior to 2012) and there have been some recent translocations into the area.

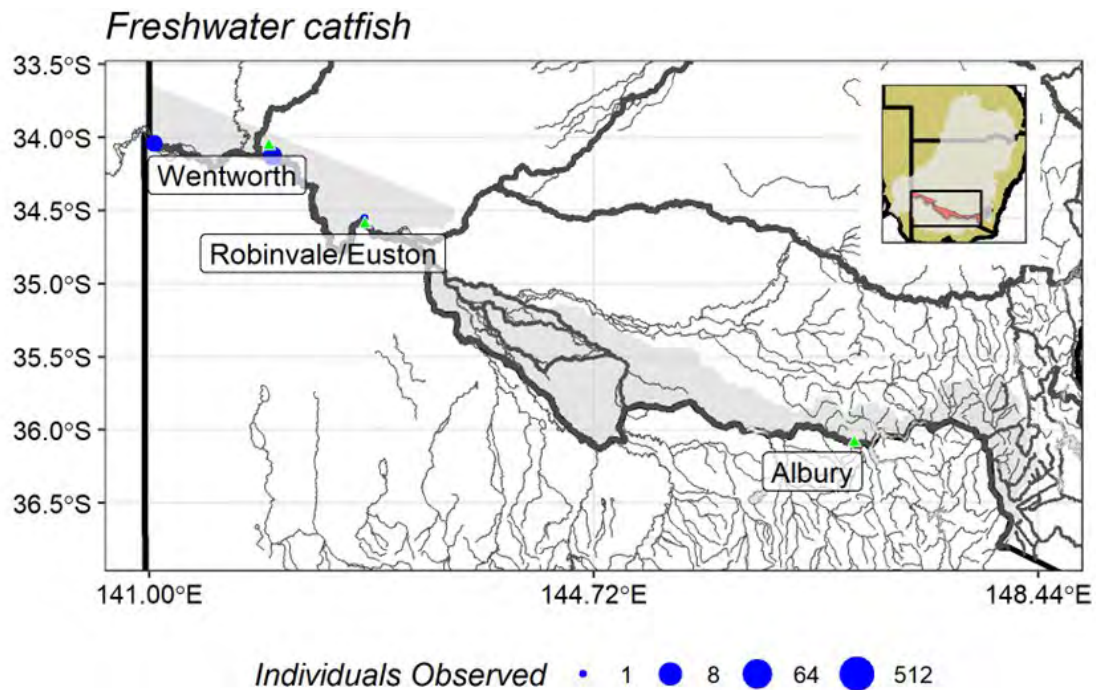


Figure 11.34: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the NSW Murray WRP. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance.

Summary Statement:

Five Freshwater catfish were captured across 3 sites in the western NSW Murray region. Individuals were observed in 2014/15 (n= 1), 2015/16 (n= 2), 2017/18 (n= 1) and 2023/24 (n= 1).

Appendix

This report contains data from the projects listed in Table 11.7.

Table 11.7: Projects included in this report. Sampling Events show the total number of sampling events included from each project. Sampling Seasons shows which sampling seasons each project contributed data to.

Project Name	Sampling Seasons	Sampling Events
Barmah-Millewa Fish Condition Monitoring	2015/2016, 2016/2017, 2017/2018, 2018/2019, 2019/2020, 2020/2021, 2021/2022, 2022/2023, 2023/2024	157
Basin Plan Environmental Outcomes Monitoring	2014/2015, 2015/2016, 2016/2017, 2017/2018, 2018/2019, 2019/2020	171
Basin Plan Environmental Outcomes Monitoring 2	2022/2023, 2023/2024	43
Carp Biomass Project (NCCP)	2017/2018	3
Carp herpes virus investigation	2015/2016, 2016/2017	12
Edward-Wakool Blackwater restocking	2014/2015	5
Edward-Wakool CMA surveys	2014/2015	1
Edward-Wakool Long Term Intervention Monitoring	2014/2015, 2015/2016, 2016/2017, 2017/2018, 2018/2019, 2020/2021, 2021/2022, 2022/2023, 2023/2024	180
Koondrook Perricoota Accumulation Sites	2014/2015, 2015/2016, 2016/2017	15
Koondrook-Perricoota Fish Condition Monitoring	2014/2015, 2015/2016, 2016/2017, 2017/2018, 2018/2019, 2019/2020, 2020/2021, 2021/2022, 2022/2023	105
Macquarie perch surveys	2016/2017, 2017/2018, 2019/2020	35
Monitoring, Evaluating and Reporting - Inland	2014/2015, 2015/2016	14
Murray Crayfish	2014/2015, 2020/2021	14
Murray-Darling Basin Fish Surveys	2014/2015, 2015/2016, 2016/2017, 2017/2018, 2018/2019, 2019/2020, 2021/2022, 2022/2023, 2023/2024	41
Southern pygmy perch surveys	2014/2015	10

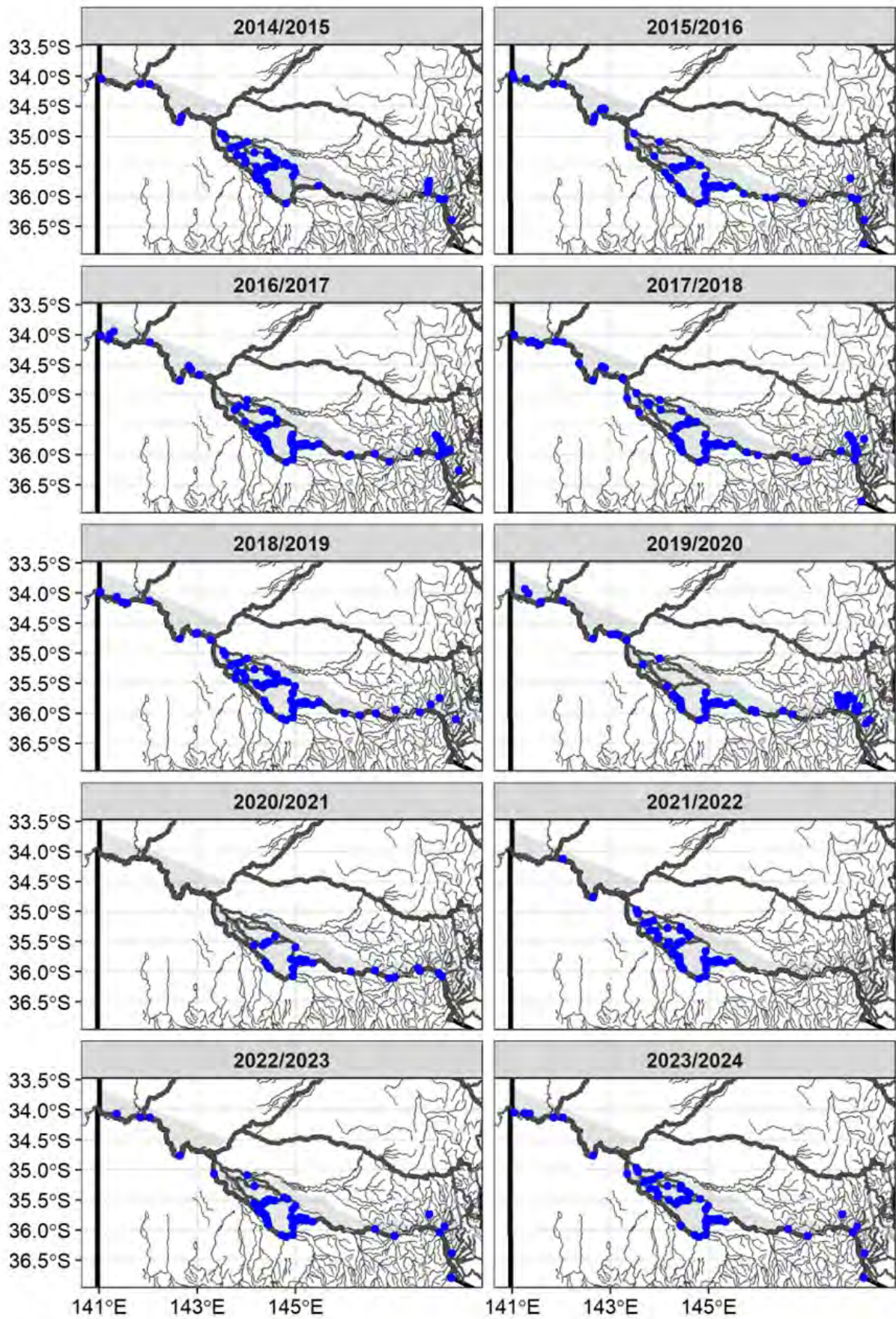


Figure 11.35: Sites sampled and included in this report by sampling season in the NSW Murray WRP. Dry sites are not shown.

Table 11.8 shows all species detected during this survey period as part of standardised monitoring projects (see Table 11.7). Note there are variations in effort between sampling seasons so this information should be considered in conjunction with Table 11.1. The Expected from Modelling column identifies species which are possible to occur based upon MaxENT habitat modelling (likelihood threshold > 0.33; NA represents no modelling was undertaken). Species that were possible from the modelling but not observed during standardised sampling in the New South Wales Murray WRPAs were: Olive perchlet, Darling hardyhead, Murray hardyhead, Flat-headed galaxias, Southern purple-spotted gudgeon. It should be noted that the MaxENT modelling models habitat availability and is not always a reliable index of abundance, it merely indicates possible distribution based upon habitat. A full list of species observed during this period across the standardised monitoring protocols and sampling methods is presented in Table 11.11.

Table 11.8: Total number caught of each species by sampling season in the NSW Murray WRPAs.

Common name	Expected from modelling	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24
Australian smelt	YES	1,680	3,177	5,121	2,625	2,244	1,657	643	2,539	7,460	1,172
Bony herring	YES	486	592	946	1,222	1,166	670	395	1,553	538	492
Brook trout	NA	0	0	0	0	0	0	0	0	6	1
Brown trout	YES	4	0	1	44	2	9	0	0	9	11
Carp-gudgeon species complex	YES	7,471	4,038	3,279	3,321	3,501	3,054	1,299	2,680	377	614
Common carp	NA	974	1,044	8,381	2,445	1,563	391	1,256	8,777	14,348	1,743
Common carp - Goldfish hybrid	NA	1	0	0	0	0	0	0	0	3	1
Dwarf flathead gudgeon	YES	22	49	1	19	6	26	32	2	0	0
Eastern gambusia	NA	2,020	824	1,585	1,171	615	388	504	829	680	88
Flathead gudgeon	YES	38	364	62	55	89	188	250	36	44	23
Freshwater catfish	YES	1	2	0	1	0	0	0	0	0	1
Galaxias spp	NA	0	0	0	0	0	7	0	0	26	30
Golden perch	YES	189	224	95	127	108	45	117	66	119	171
Goldfish	NA	261	173	1,163	469	497	61	102	589	5,243	377
Macquarie perch	YES	0	0	9	3	0	0	0	0	0	0
Mountain galaxias	YES	2	246	47	10	73	160	0	0	0	0
Murray cod	YES	335	510	125	130	186	82	331	180	133	120
Murray-Darling rainbowfish	YES	521	673	776	763	777	93	963	309	153	47
River blackfish	NA	42	3	11	33	6	59	0	0	22	2

Common name	Expected from modelling	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24
Obscure galaxias	YES	0	0	0	0	1	0	0	0	0	0
Oriental weatherloach	NA	54	1	7	13	5	2	6	7	179	7
Rainbow trout	YES	0	0	3	7	5	21	0	0	2	5
Redfin	YES	0	33	39	157	72	59	0	64	114	18
Riffle galaxias	YES	0	0	0	0	0	0	0	0	22	0
Silver perch	YES	22	20	19	20	14	8	20	12	11	13
Southern pygmy perch	YES	3	0	0	0	0	595	0	0	4	0
Spangled perch	NO	0	0	0	0	0	0	0	0	1	0
Trout cod	YES	7	75	37	25	60	45	67	56	17	22
Two-spined blackfish	YES	15	15	3	1	0	0	0	0	6	11
Unspecked hardyhead	YES	130	1,146	625	1,131	397	214	240	190	133	0

The following table summarises the sampling methods for each species (Table 11.9).

Table 11.9: Total catch of each species by sampling method in the NSW Murray WRP.

Common name	Backpack Electrofishing	Bait Trap	Boat Electrofishing
Australian smelt	1,062	35	27,221
Bony herring	17	9	8,033
Brook trout	7	0	0
Brown trout	75	0	5
Carp-gudgeon species complex	10,163	12,884	6,587
Common carp	7,436	6,284	27,202
Common carp - Goldfish hybrid	0	0	5
Dwarf flathead gudgeon	126	5	26
Eastern gambusia	4,282	2,087	2,335
Flathead gudgeon	264	122	763
Freshwater catfish	0	0	5
Galaxias spp	28	1	34
Golden perch	1	1	1,259
Goldfish	2,515	31	6,389
Macquarie perch	11	1	0
Mountain galaxias	500	26	12
Murray cod	23	0	2,109
Murray-Darling rainbowfish	68	48	4,959
River blackfish	157	0	21
Obscure galaxias	0	0	1
Oriental weatherloach	245	4	32
Rainbow trout	43	0	0
Redfin	139	11	406
Riffle galaxias	22	0	0
Silver perch	2	0	157
Southern pygmy perch	588	14	0
Spangled perch	0	0	1
Trout cod	16	0	395
Two-spined blackfish	45	2	4
Unspecked hardyhead	11	37	4,158

Table 11.10: Listed threatened species recorded in the Murray-Darling Basin (from the NSW DPIRD Fisheries Freshwater Ecosystem research database). Species are listed under either the NSW Fisheries Management Act 1994 (FMA) or the Commonwealth Environmental Protection and Biodiversity Conservation Act 1999 (EPBC).

Genus, species	Common Name	EPBC Status	FMA Status
<i>Ambassis agassizii</i>	Agassiz's glassfish, olive perchlet, western New South Wales population	NA	Endangered Population
<i>Bidyanus bidyanus</i>	Silver Perch, Bidyan	Endangered	Vulnerable
<i>Craterocephalus fluviatilis</i>	Murray Hardyhead	Endangered	Critically Endangered
<i>Galaxias rostratus</i>	Flathead Galaxias, Beaked Minnow, Flat-headed Galaxias, Flat-headed Jollytail, Flat-headed Minnow	Critically Endangered	Critically Endangered
<i>Galaxias tantangara</i>	Stocky Galaxias	NA	Critically Endangered
<i>Maccullochella macquariensis</i>	Trout Cod	Endangered	Endangered
<i>Maccullochella peelii</i>	Murray Cod	Vulnerable	NA
<i>Macquaria australasica</i>	Macquarie Perch	Endangered	Endangered
<i>Mogurnda adspersa</i>	Southern Purple Spotted Gudgeon	NA	Endangered
<i>Nannoperca australis</i>	Southern Pygmy Perch	Vulnerable	Endangered
<i>Tandanus tandanus</i>	Freshwater catfish, eel tailed catfish, Murray-Darling Basin population	NA	Endangered Population

Table 11.11 shows all species detected during this survey period across all programs and methods. Due to variations in project methods protocols, this data is presented only to give a complete list of species observed in the region. The Expected from Modelling column identifies species which are possible to occur based upon MaxENT habitat modelling (likelihood threshold > 0.33; NA represents no modelling was undertaken). Species that were possible from the modelling but not observed during standardised sampling in the New South Wales Murray WRPAs were: Olive perchlet, Darling hardyhead, Murray hardyhead, Flat-headed galaxias and Southern purple-spotted gudgeon. It should be noted that the MaxENT modelling actually models habitat availability and is not always a reliable index of abundance, it merely indicates possible distribution based upon habitat. A list of species caught as part of standardised monitoring during this period is in Table 11.8.

Table 11.11: Total catch of each species by all sampling programs and all methods in the NSW Murray WRPAs. Note these include projects with sampling not representative of the community and the data should be used with caution.

Common name	Expected from modelling	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24
Australian smelt	YES	1,682	3,178	5,131	2,629	2,270	1,702	644	2,540	7,553	1,175
Bony herring	YES	507	592	946	1,222	1,166	675	395	1,553	538	492
Brook trout	NA	0	0	0	0	0	0	0	0	6	1
Brown trout	YES	4	0	3	44	2	9	0	0	9	11
Carp gudgeon species complex	YES	11,773	6,405	10,093	11,125	5,897	7,927	4,594	10,468	556	3,637
Common carp	NA	1,002	1,044	8,421	2,447	1,564	391	1,257	8,782	14,431	1,745
Common carp - Goldfish hybrid	NA	1	0	0	0	0	0	0	0	3	1
Dwarf flathead gudgeon	YES	22	49	1	19	6	26	32	2	0	0
Eastern gambusia	NA	2,195	1,190	1,710	1,226	625	388	508	1,475	680	635
Flathead gudgeon	YES	38	367	62	55	89	188	255	43	44	23
Freshwater catfish	YES	1	2	0	1	0	0	0	0	0	1
Galaxia spp	NA	0	0	0	0	0	7	0	0	26	30
Golden perch	YES	267	224	95	127	108	45	117	66	119	171
Goldfish	NA	264	173	1,165	470	497	61	103	589	5,332	377
Macquarie perch	YES	0	0	33	28	0	2	0	0	0	0
Mountain galaxias	YES	2	246	49	10	73	160	0	0	0	0
Murray cod	YES	448	511	126	130	186	82	331	180	133	120

Common name	Expected from modelling	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24
Murray-Darling rainbowfish	YES	689	750	795	782	860	176	996	327	153	47
River blackfish	NA	42	3	60	37	6	59	0	0	22	2
Obscure galaxias	YES	0	0	0	0	1	0	0	0	0	0
Oriental weatherloach	NA	54	1	7	13	5	2	6	7	184	8
Rainbow trout	YES	0	0	3	7	5	21	0	0	2	5
Redfin	YES	0	33	48	285	72	62	0	64	114	18
Riffle galaxias	YES	0	0	0	0	0	0	0	0	22	0
Silver perch	YES	28	20	19	20	14	8	20	12	11	13
Southern pygmy perch	YES	3	0	0	0	0	595	0	0	4	0
Spangled perch	NO	0	0	0	0	0	0	0	0	1	0
Trout cod	YES	7	75	37	25	60	45	67	56	17	22
Two-spined blackfish	YES	15	15	3	1	0	0	0	0	6	11
Unspecked hardyhead	YES	194	1,181	697	1,138	406	239	245	198	133	0

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