

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

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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.

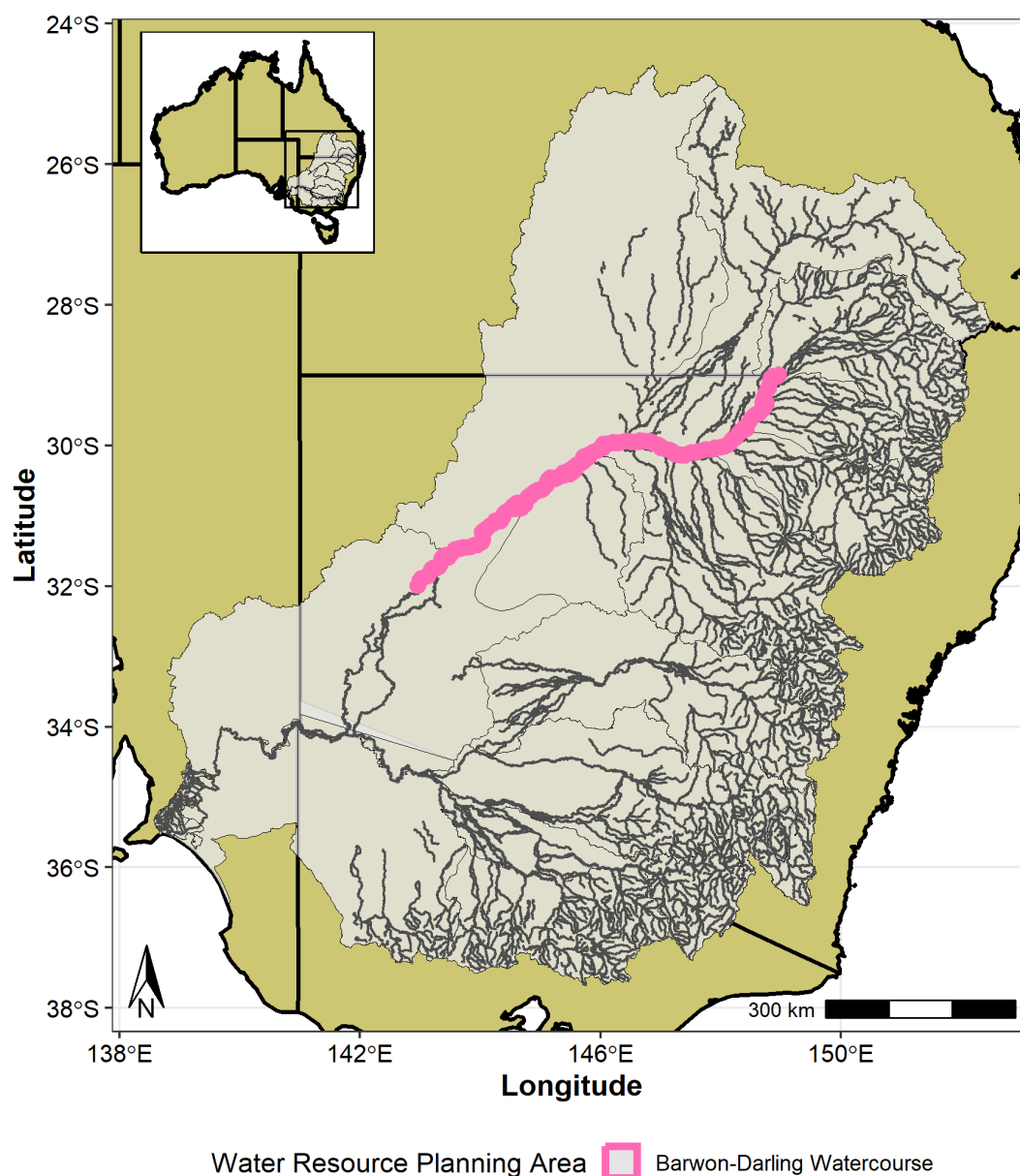


Figure 2.1: Murray-Darling Basin with the key region of this report highlighted. Inset map shows the whole of Australia with a box around the MDB.

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).

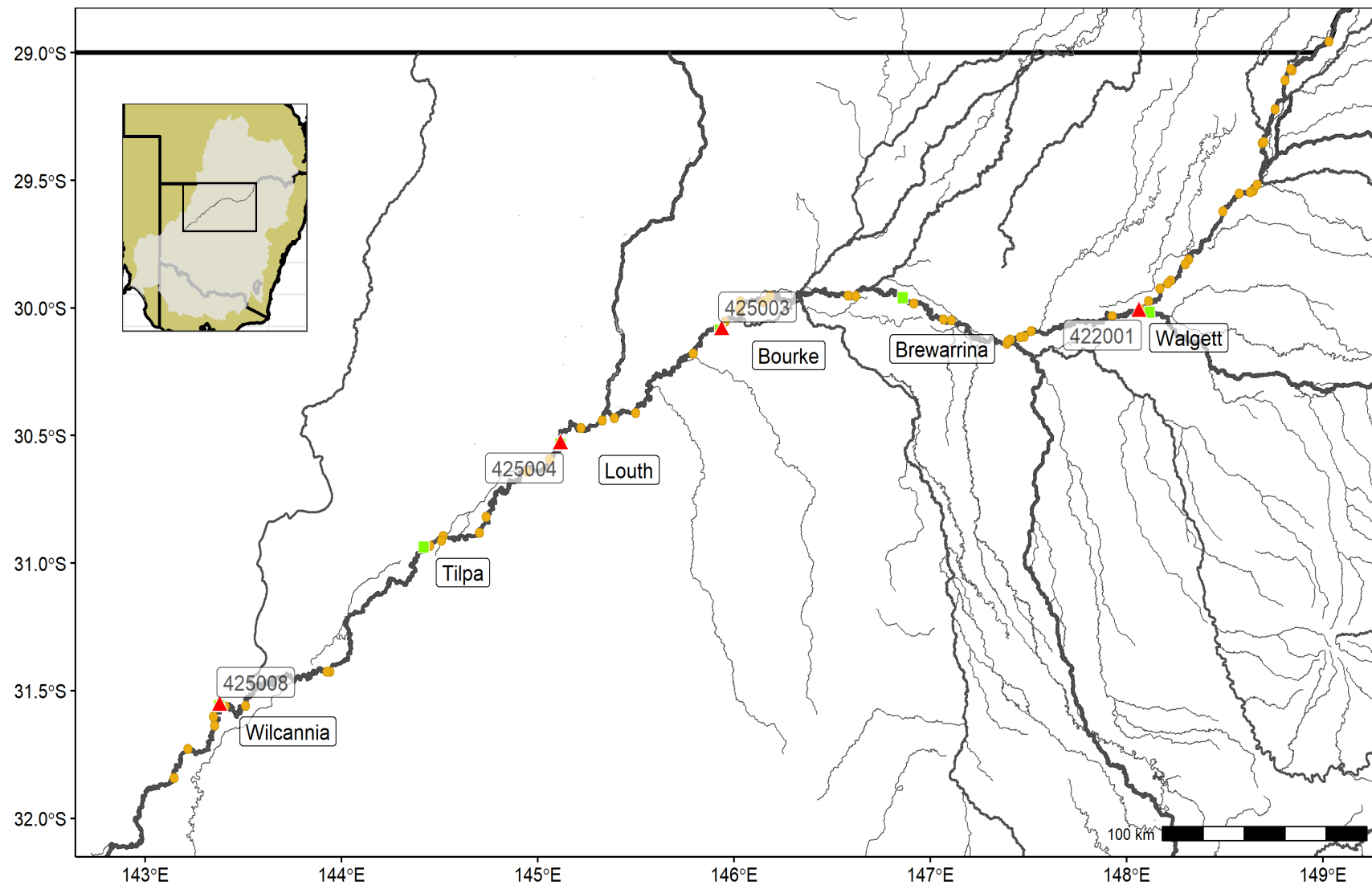


Figure 2.2: Sites (orange dots) sampled during the reporting period in the Barwon-Darling Watercourse. Triangles show key flow gauges along with their gauge ID number. Green squares show major towns.

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).

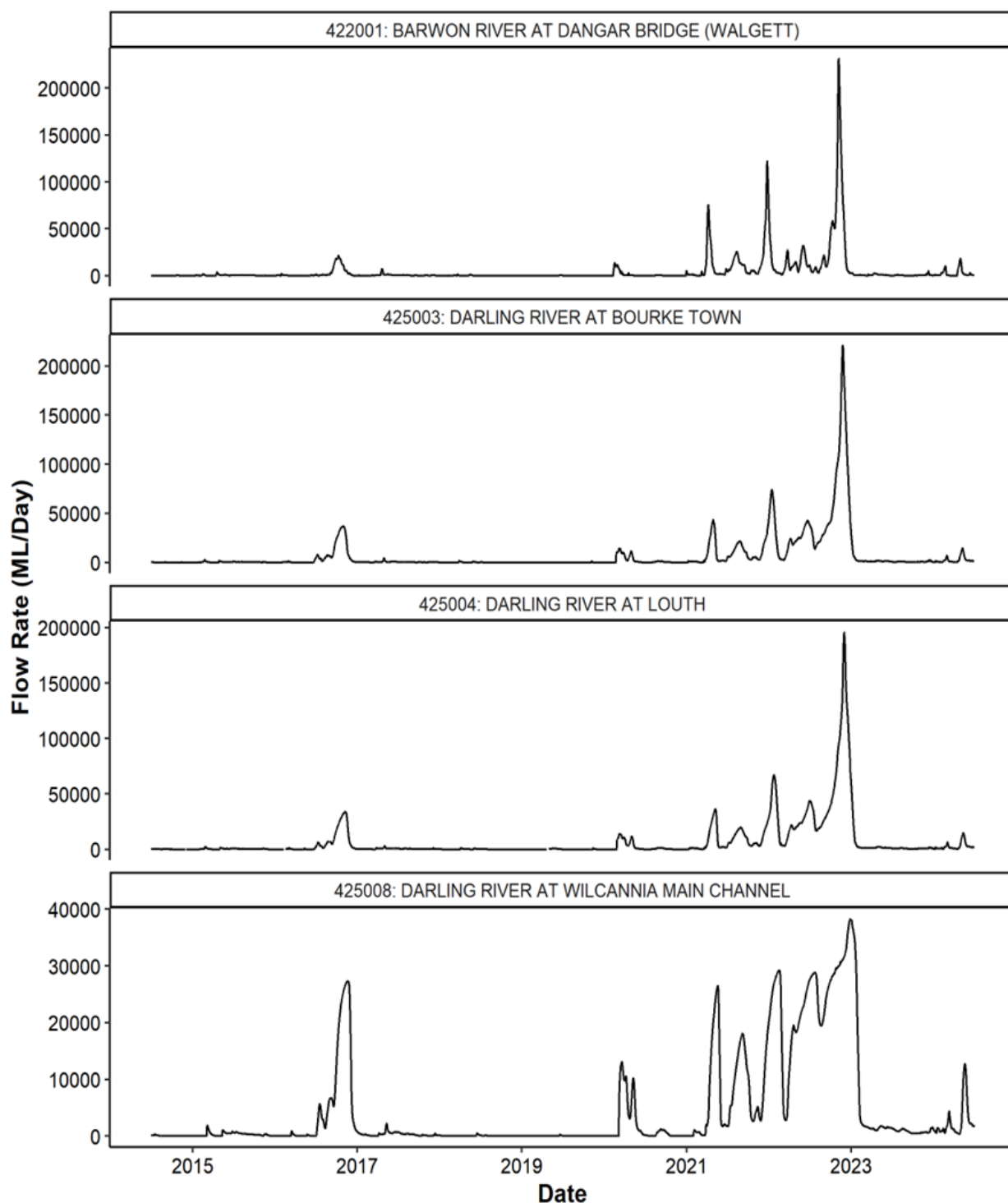


Figure 2.3: Flow data from various gauges in the Barwon-Darling Watercourse WRPAs over the reporting period. Gauge locations can be seen on Figure 2.2. Note the differing scales on the y-axis.

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

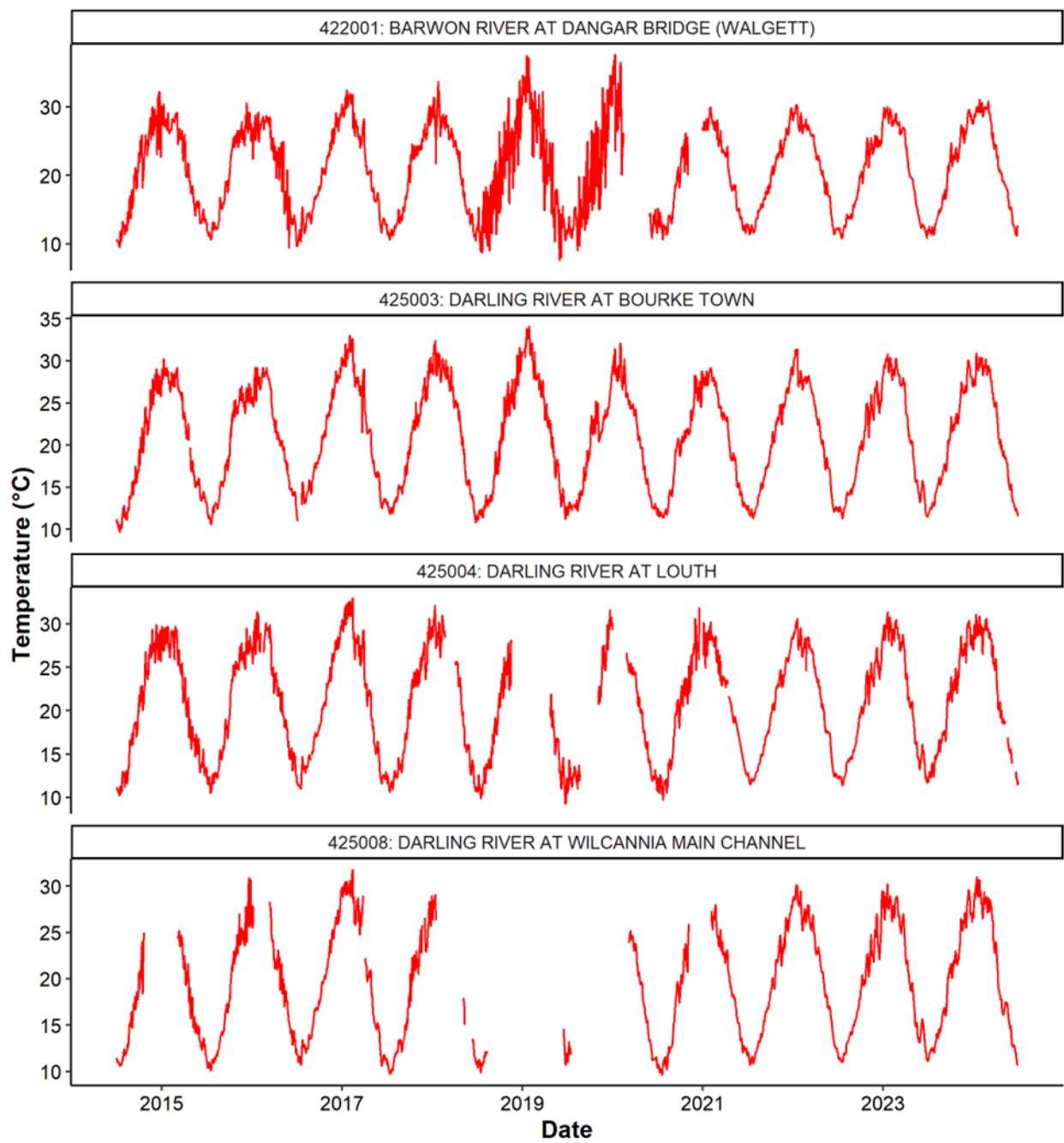


Figure 2.4: Water temperature data from various gauges in the Barwon-Darling Watercourse WRPA over the reporting period. Gauge locations can be seen on Figure 2.2. Note the differing scales on the y-axis.

Species Diversity

A total of 12 fish species were observed across the Barwon-Darling Watercourse WRPA 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 WRPA region while the alien diversity was generally consistent across the region.

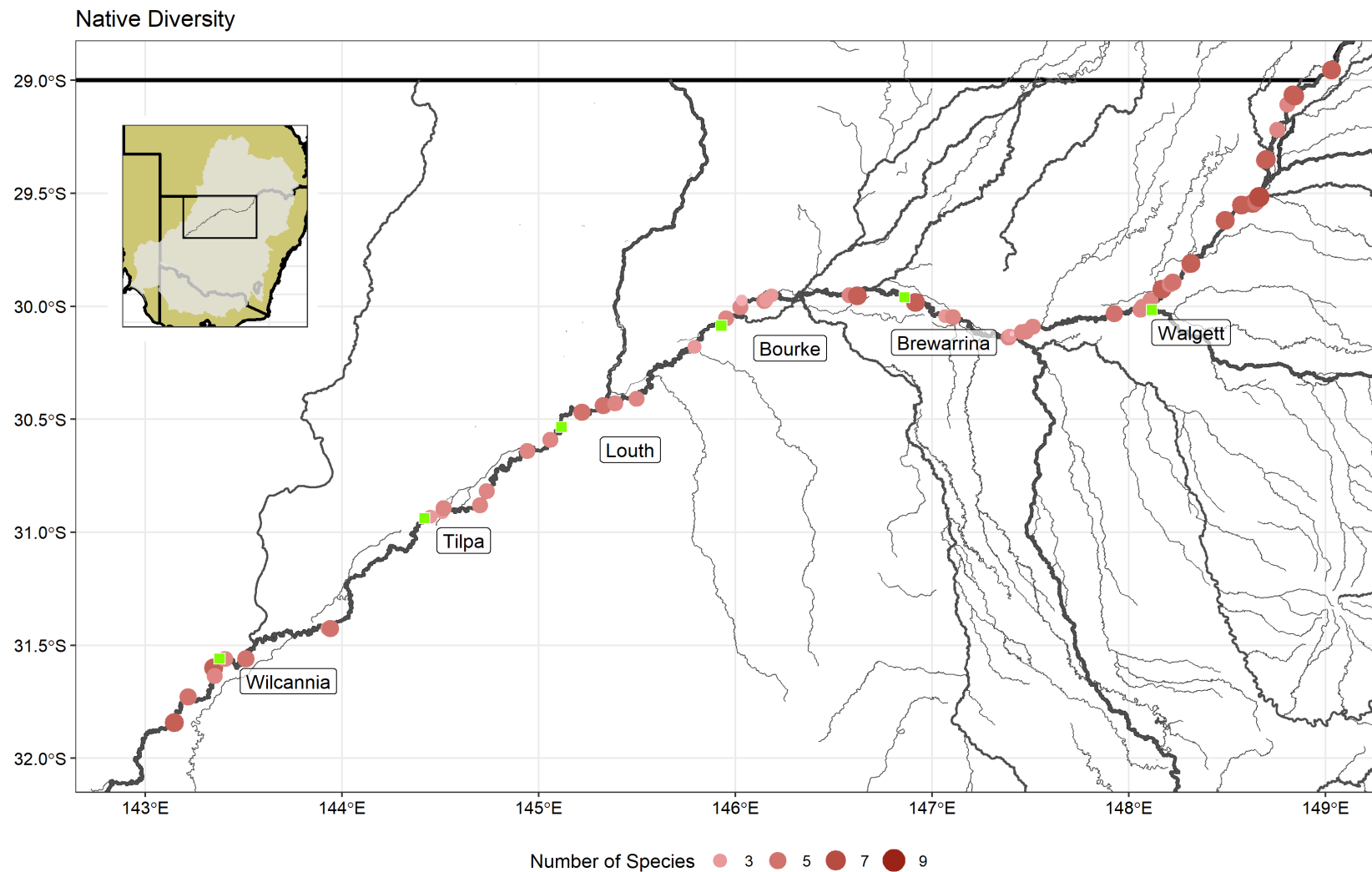


Figure 2.5: Native diversity across all sampling sites in the Barwon-Darling Watercourse. Bubble size represents the number of unique species observed at each site across all sampling methods and events. Dry sites are excluded. Green squares show major towns.

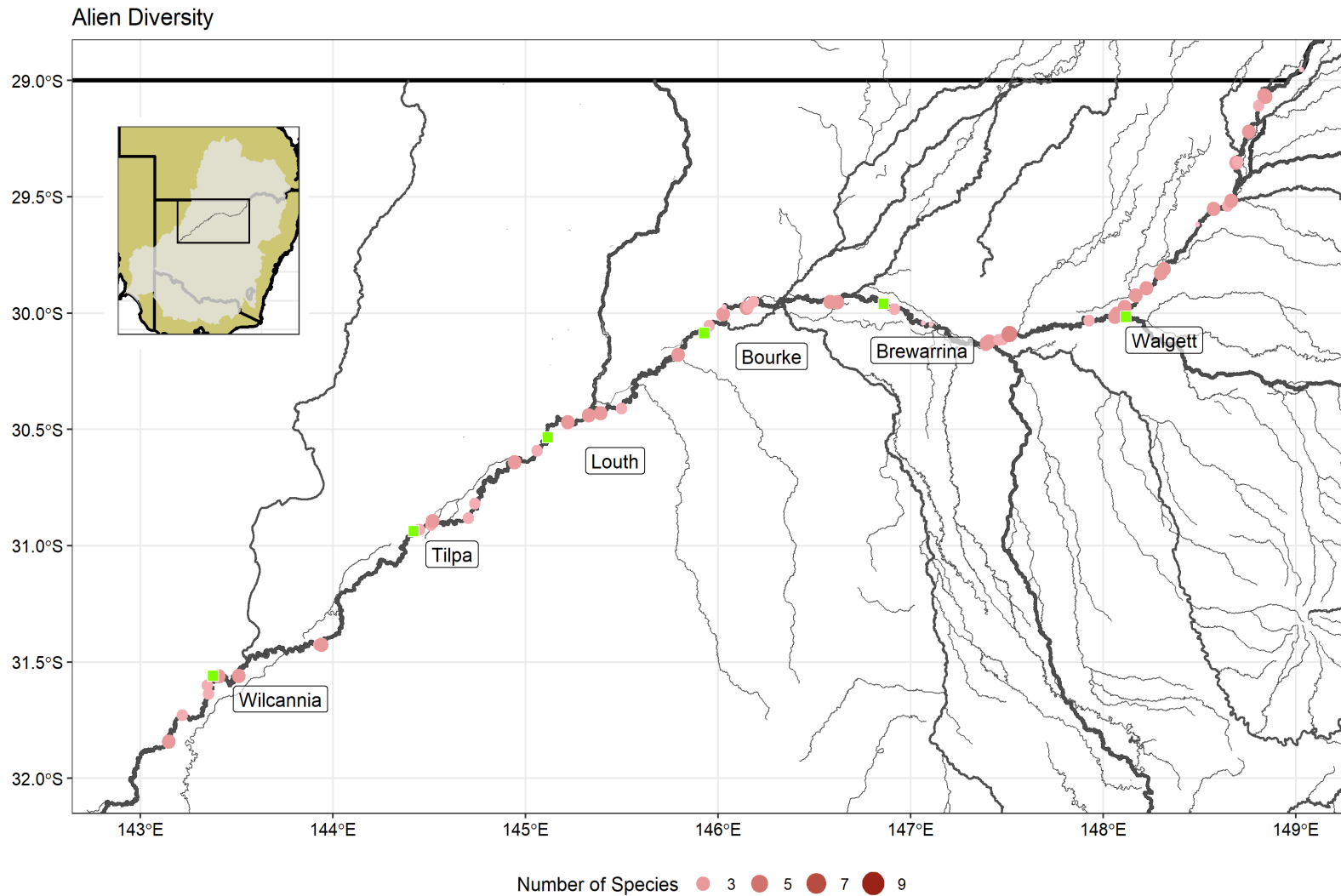


Figure 2.6: Alien diversity across all sampling sites in the Barwon-Darling Watercourse. Bubble size represents the number of unique species observed at each site across all sampling methods and events. Dry sites are excluded. Green squares show major towns.

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).

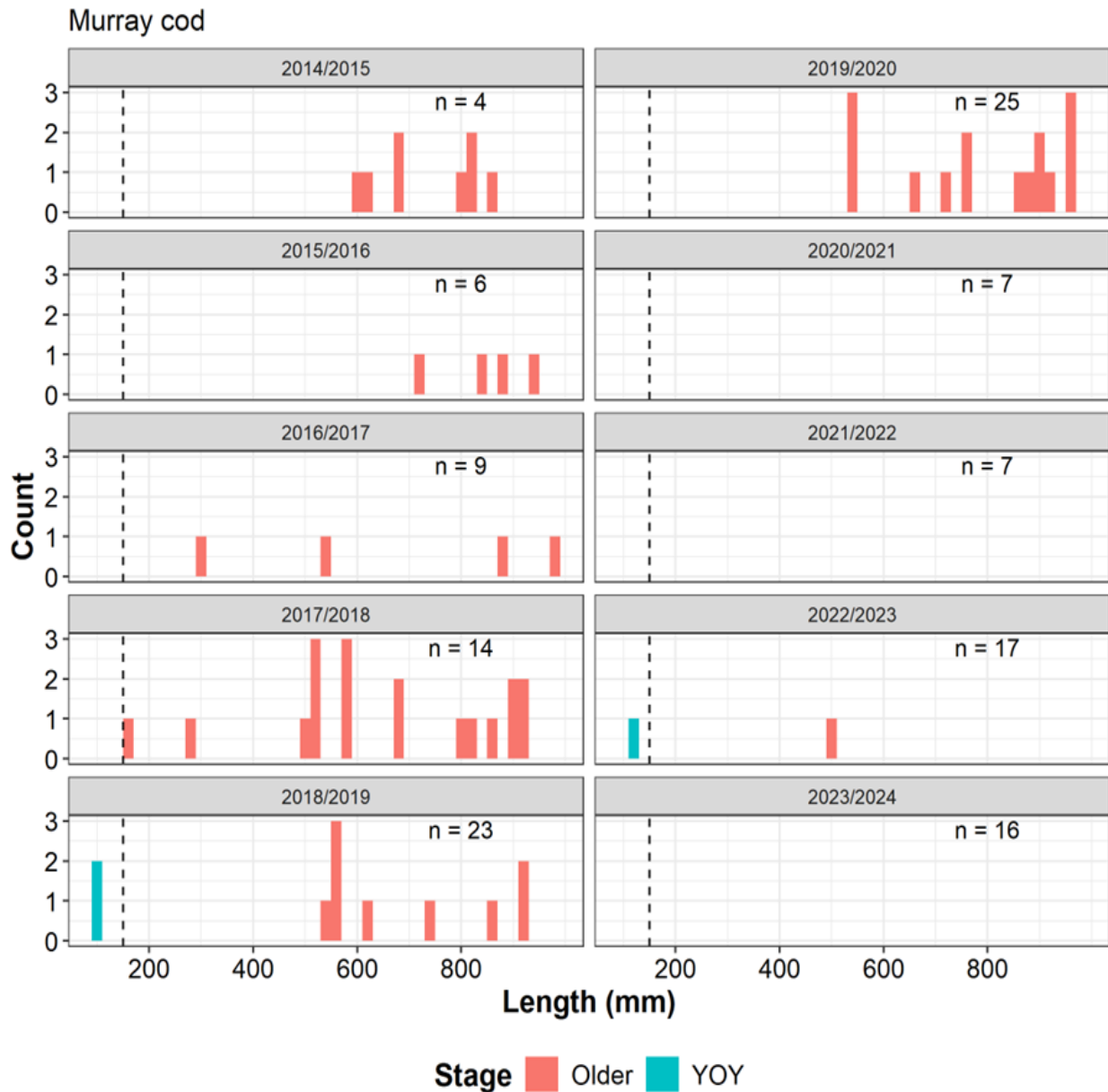


Figure 2.7: Length frequency plots for Murray cod by sampling season in the Barwon-Darling Watercourse. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRPAs in a sampling season.

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

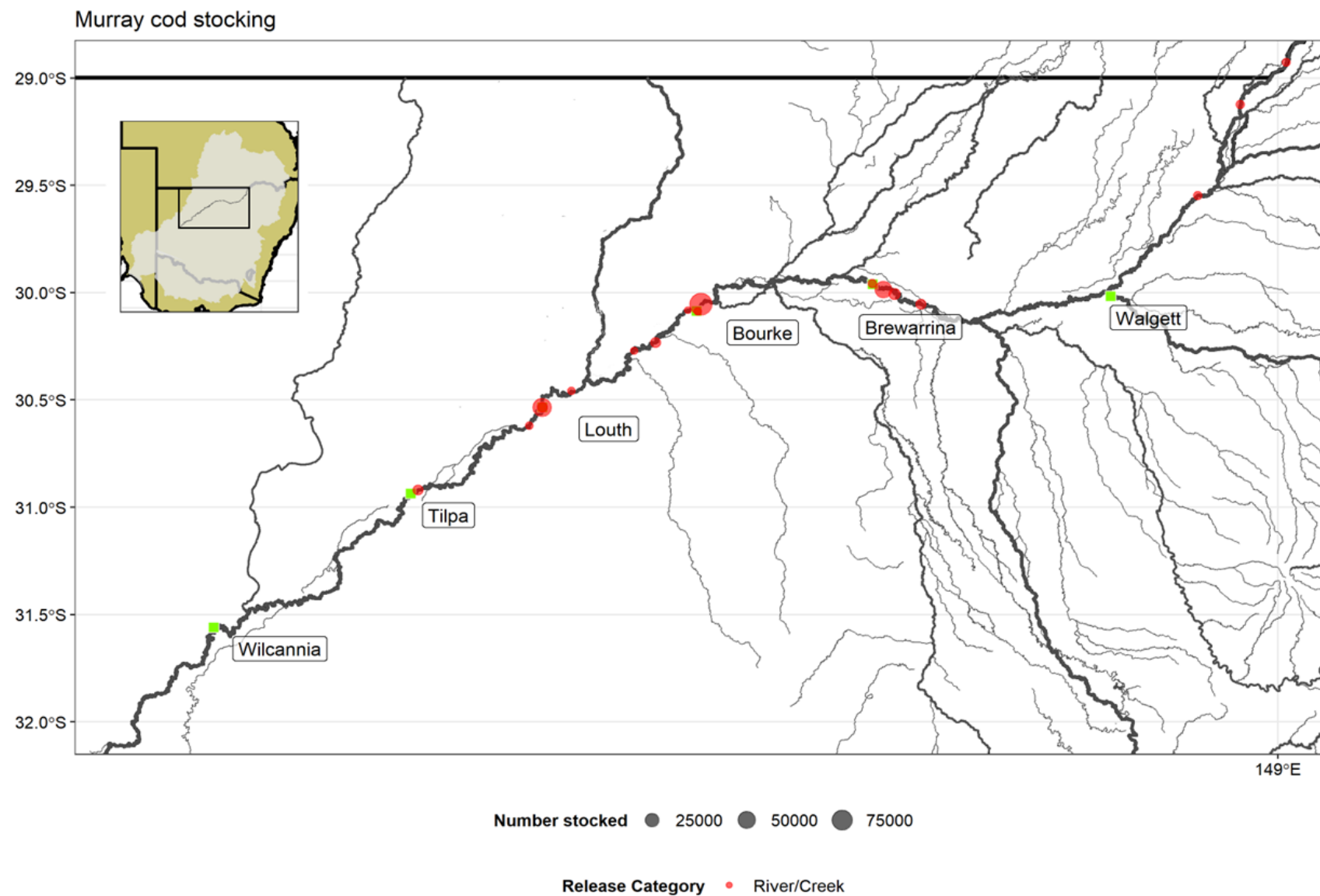


Figure 2.8: Locations of Murray cod stocking in the Barwon-Darling Watercourse. Colours show whether a site was a river/creek site or an impoundment, while the size of the point reflects the total number of fish stocked over the reporting period. Green squares show major towns.

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.

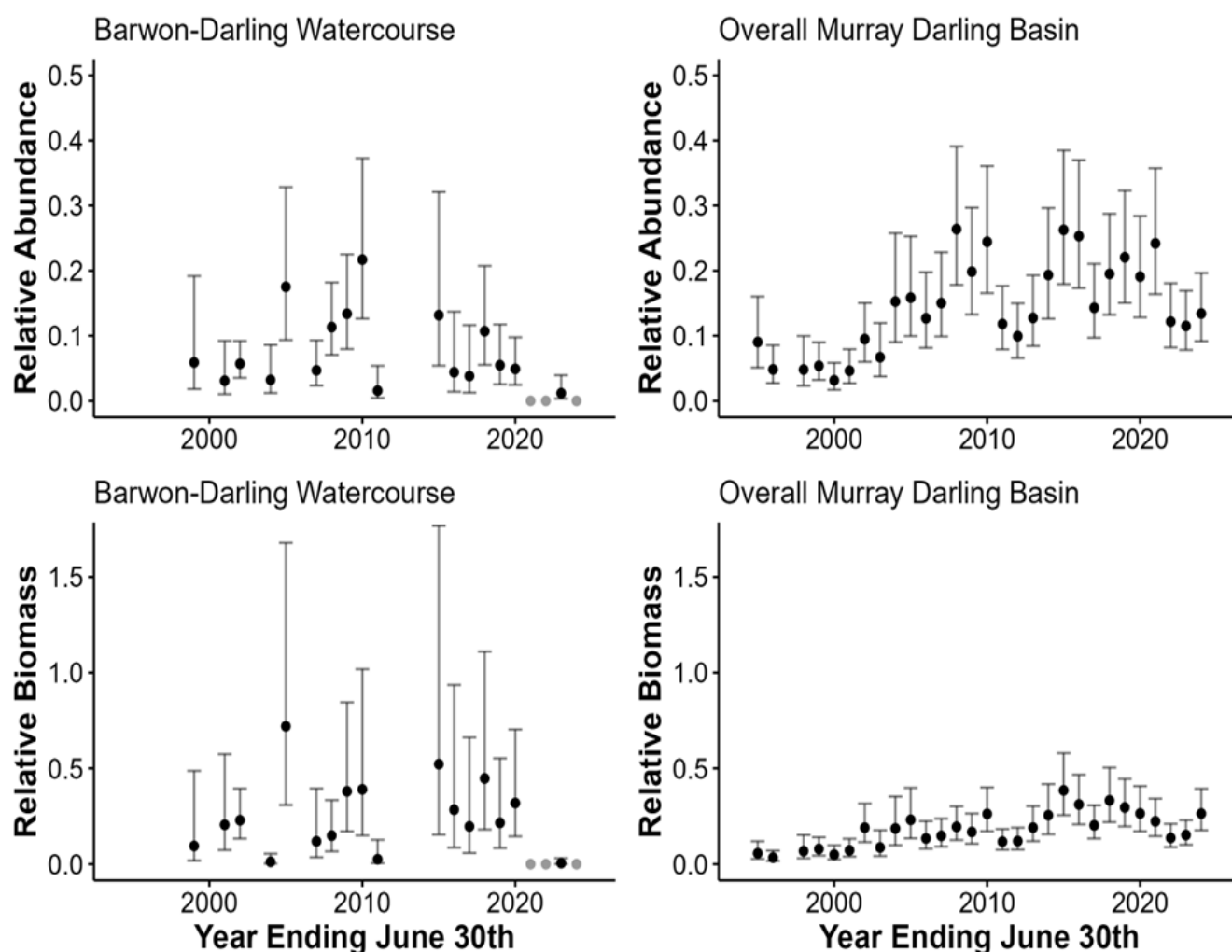


Figure 2.9: Relative abundance and biomass of Murray cod in this WRPA and the overall NSW MDB. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates. Grey dots represents years where sampling was conducted by 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).

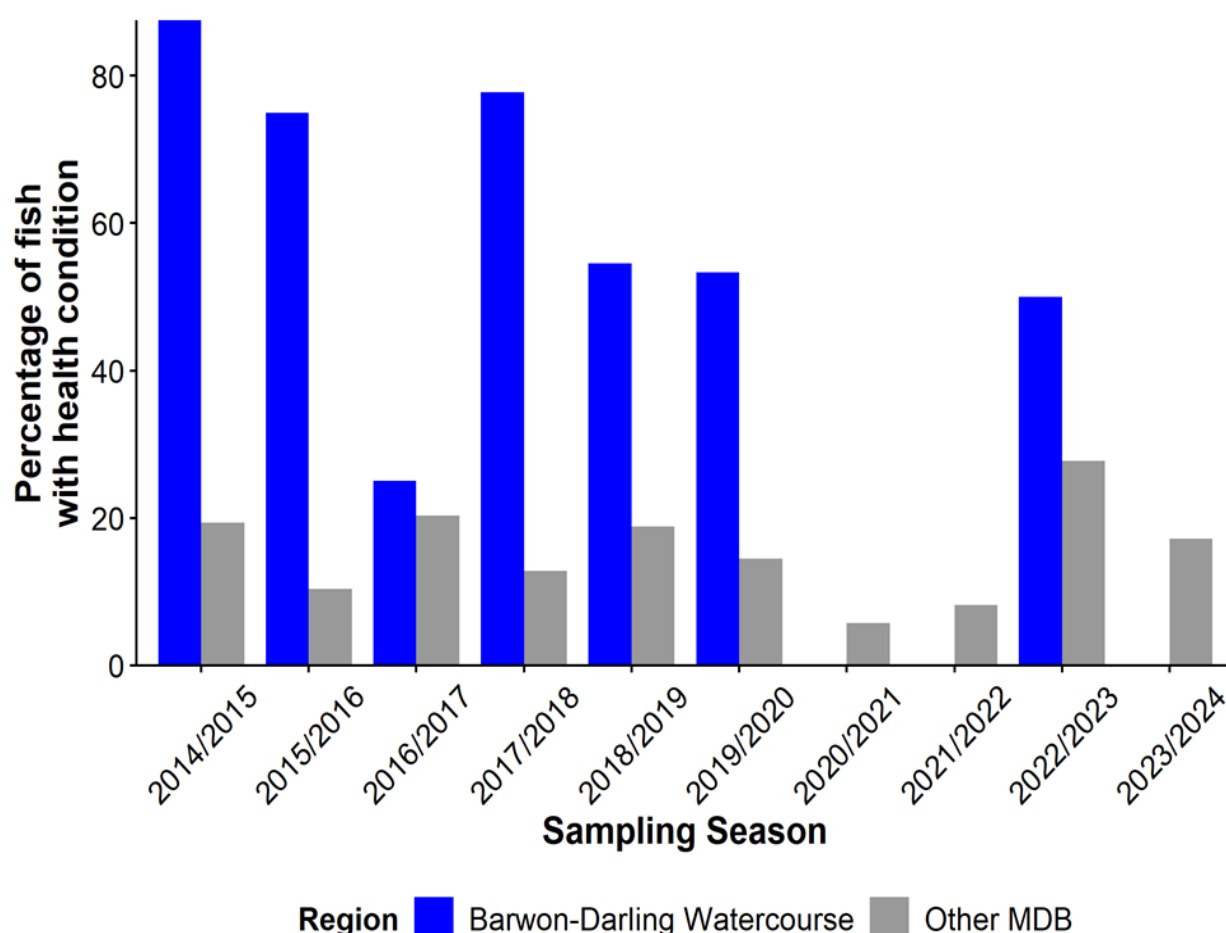


Figure 2.10: Timeseries showing the prevalence of health conditions in Murray cod. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA.

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).

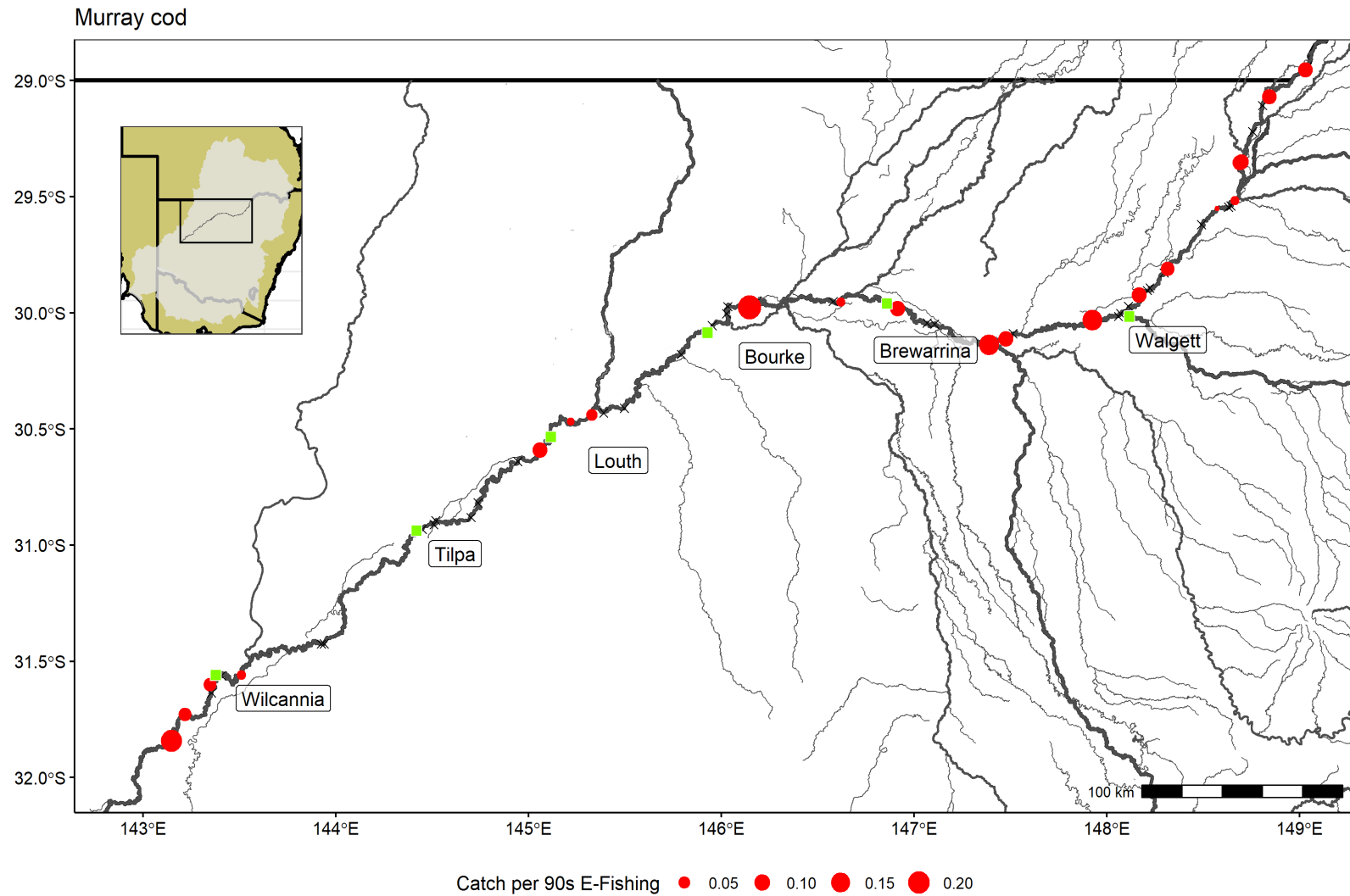


Figure 2.11: Distribution of Murray cod sampled from 2013/14 to 2023/24 in the Barwon-Darling Watercourse. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are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

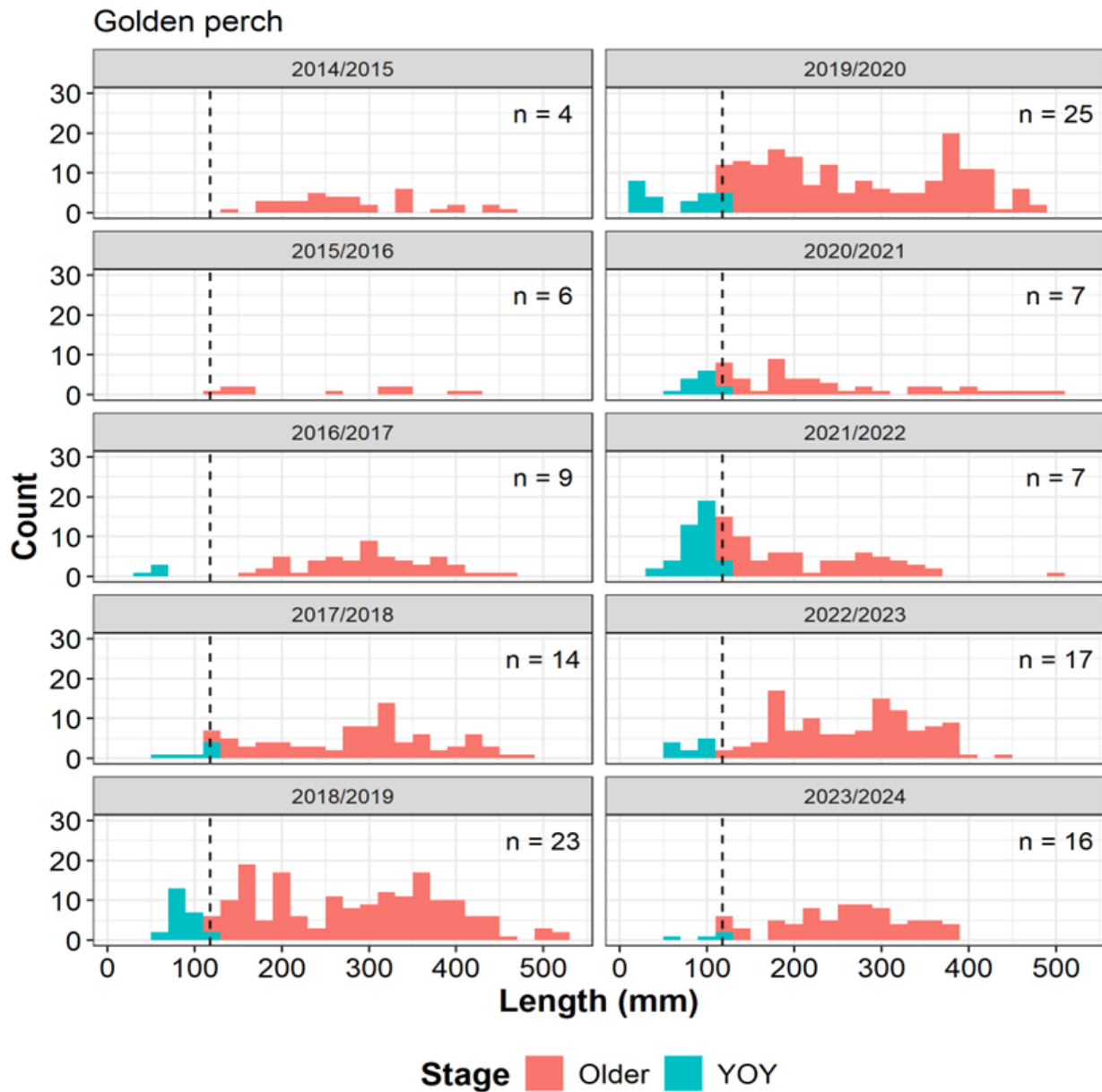


Figure 2.12: Length frequency plots for Golden perch by sampling season in the Barwon-Darling Watercourse. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRPA in a sampling season.

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

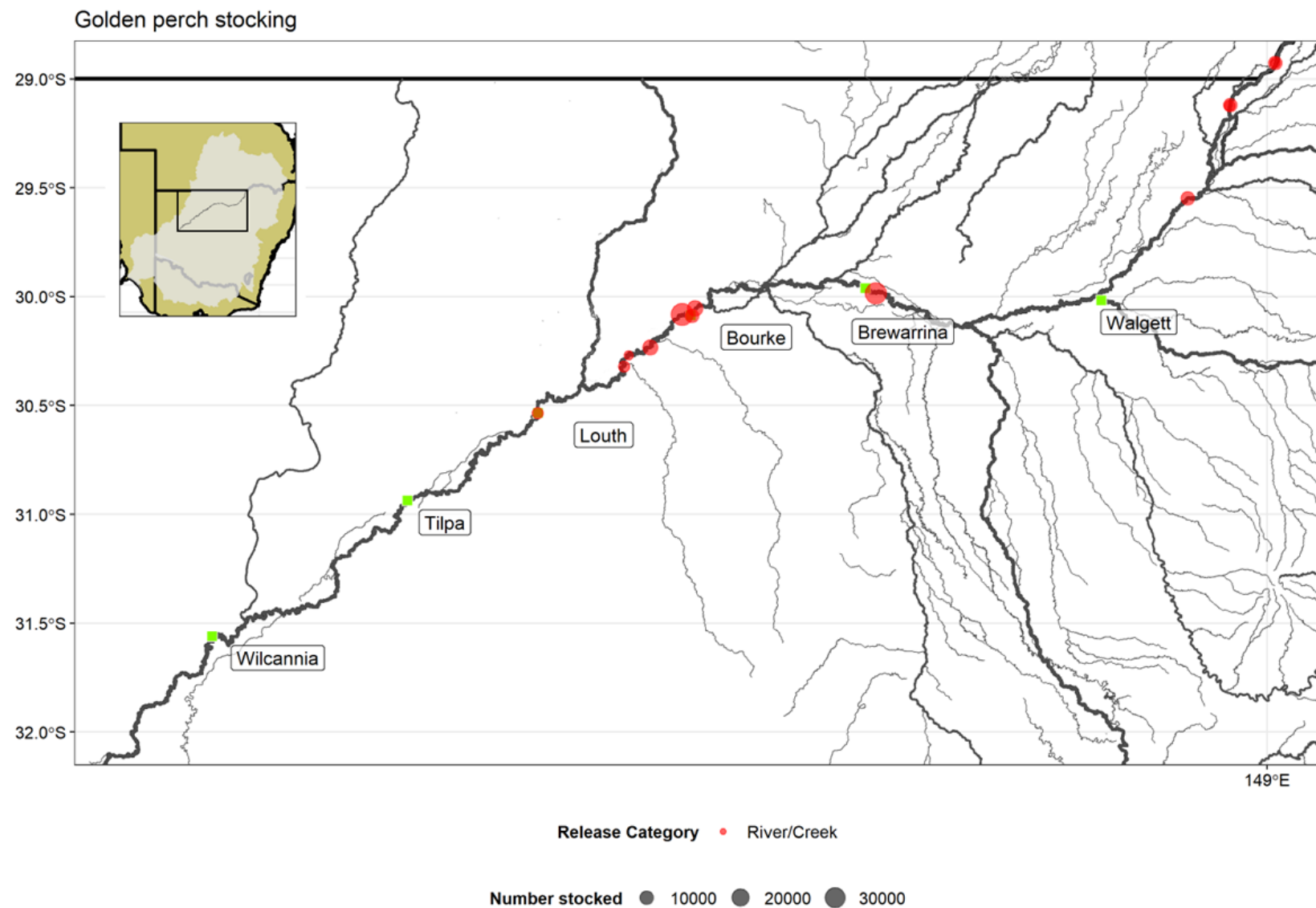


Figure 2.13: Locations of Golden perch stocking in the Barwon-Darling Watercourse. Colours show whether a site was a river/creek site or an impoundment, while the size of the point reflects the total number of fish stocked over the reporting period. Green squares show major towns.

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 WRPAs and the right-hand panels show the overall trends across the NSW MDB.

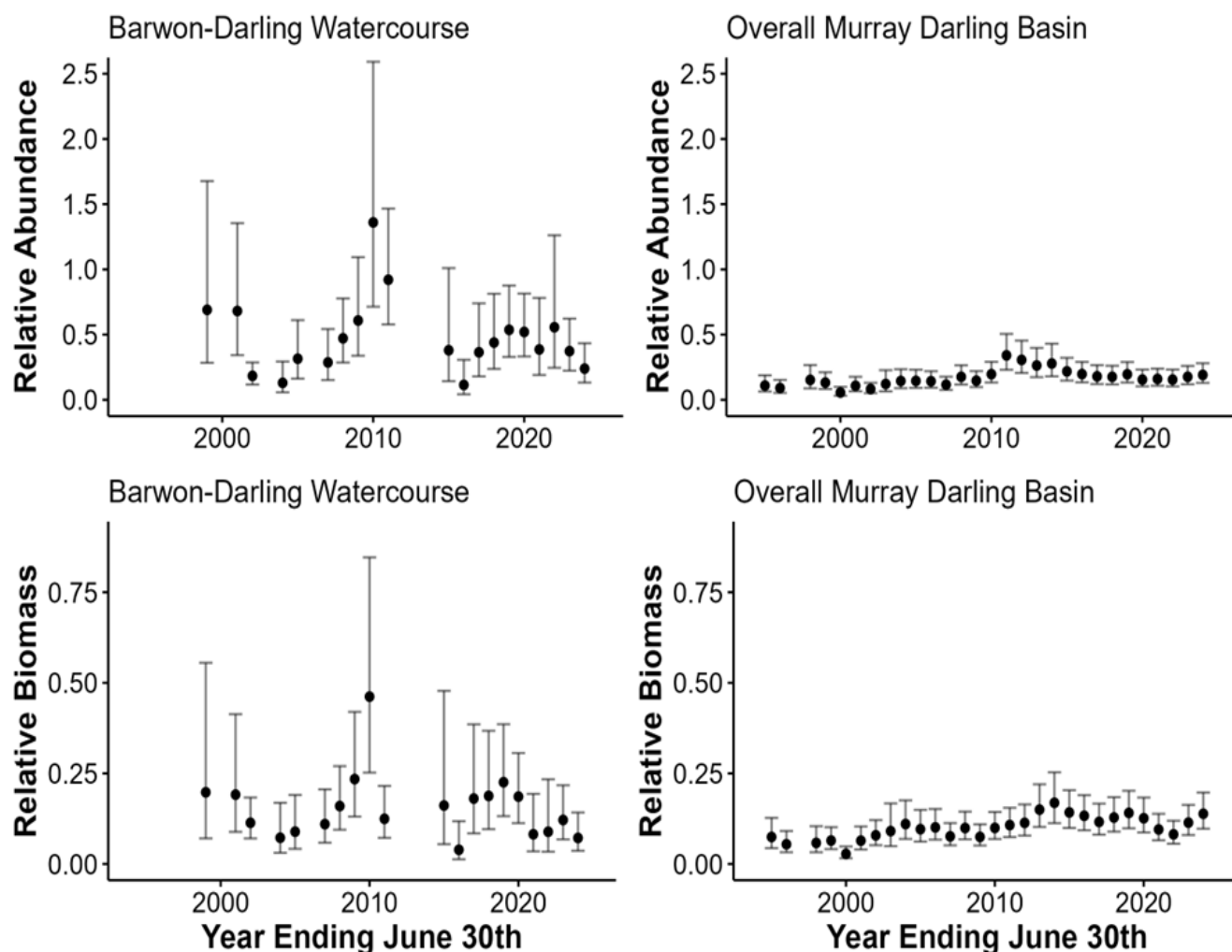


Figure 2.14: Relative abundance and biomass of Golden perch in both this WRPAs and the overall Murray-Darling Basin. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show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

Summary Statement:

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).

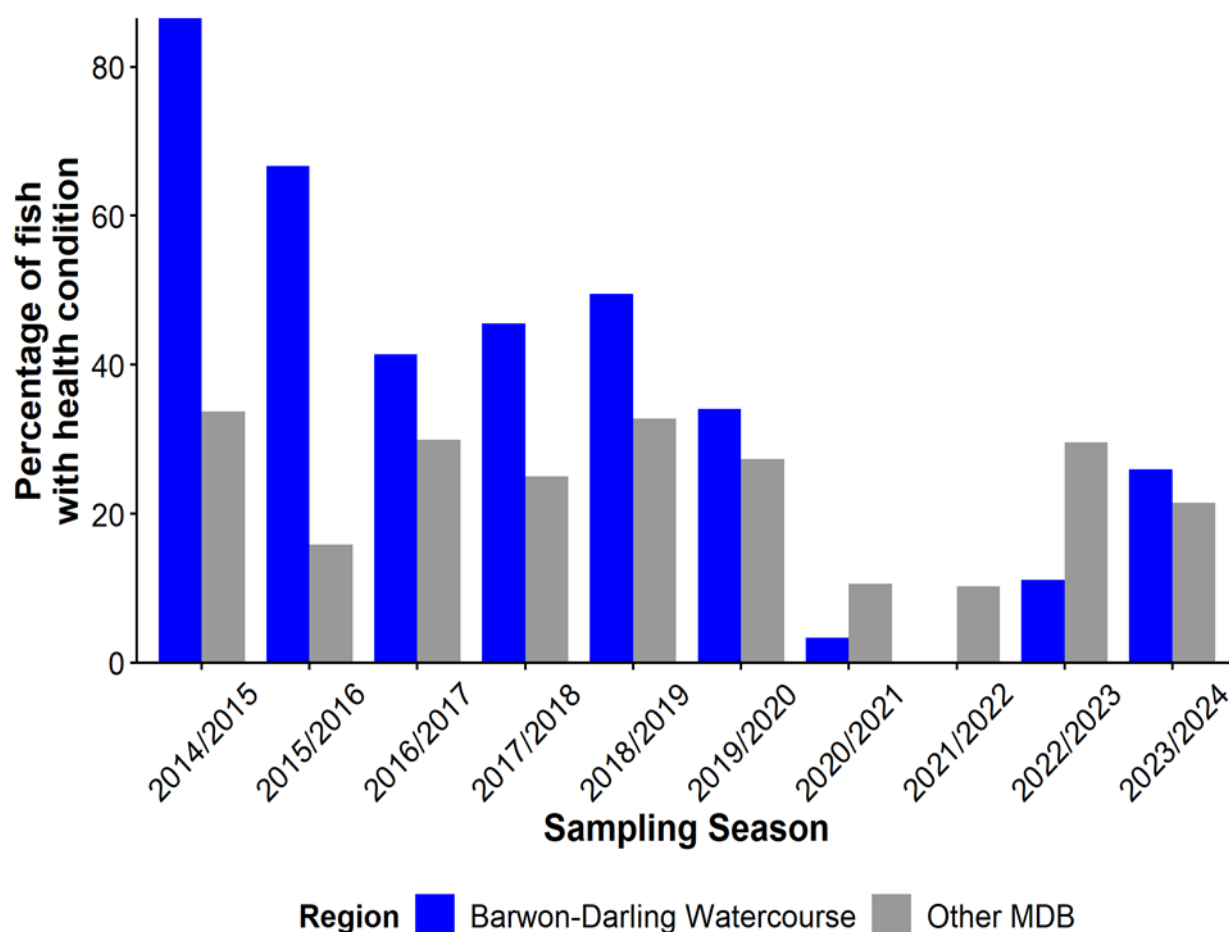


Figure 2.15: Timeseries showing the prevalence of health conditions in Golden perch. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA's.

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.

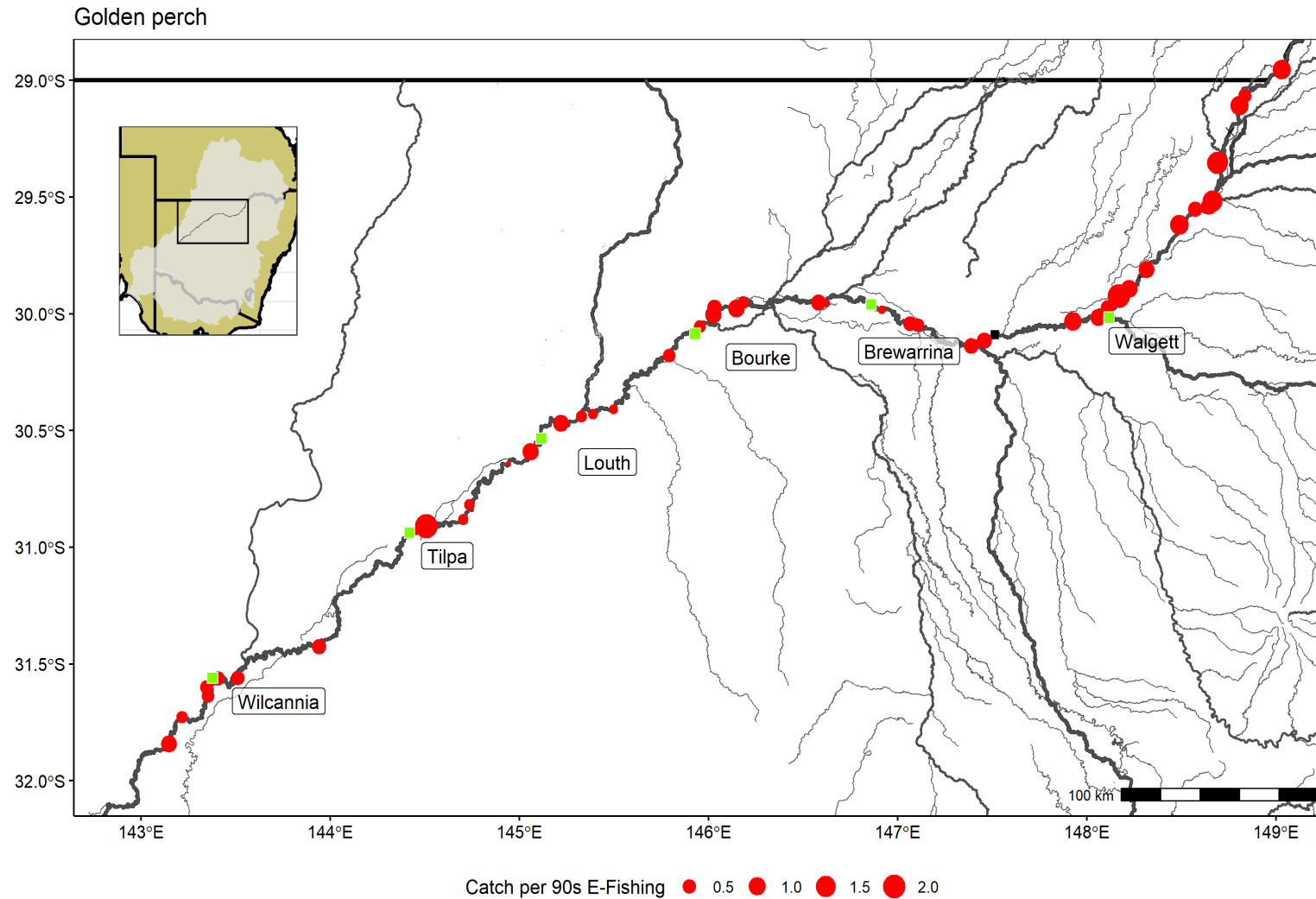


Figure 2.16: Distribution of Golden perch sampled from 2013/14 to 2023/24 in the Barwon-Darling Watercourse. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are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

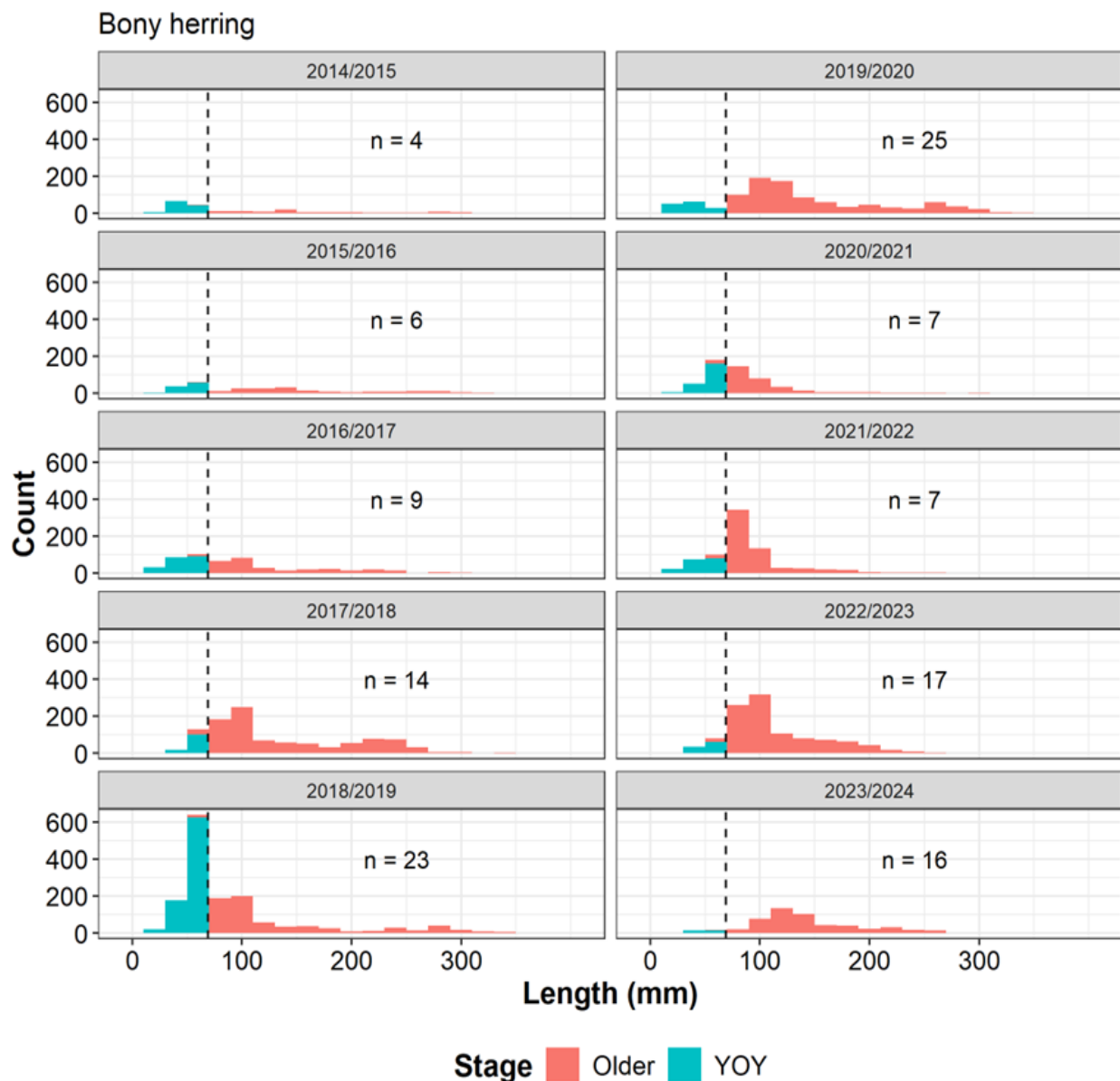


Figure 2.17: Length frequency plots for Bony herring by sampling season in the Barwon-Darling Watercourse. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRPAs in a sampling season.

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.

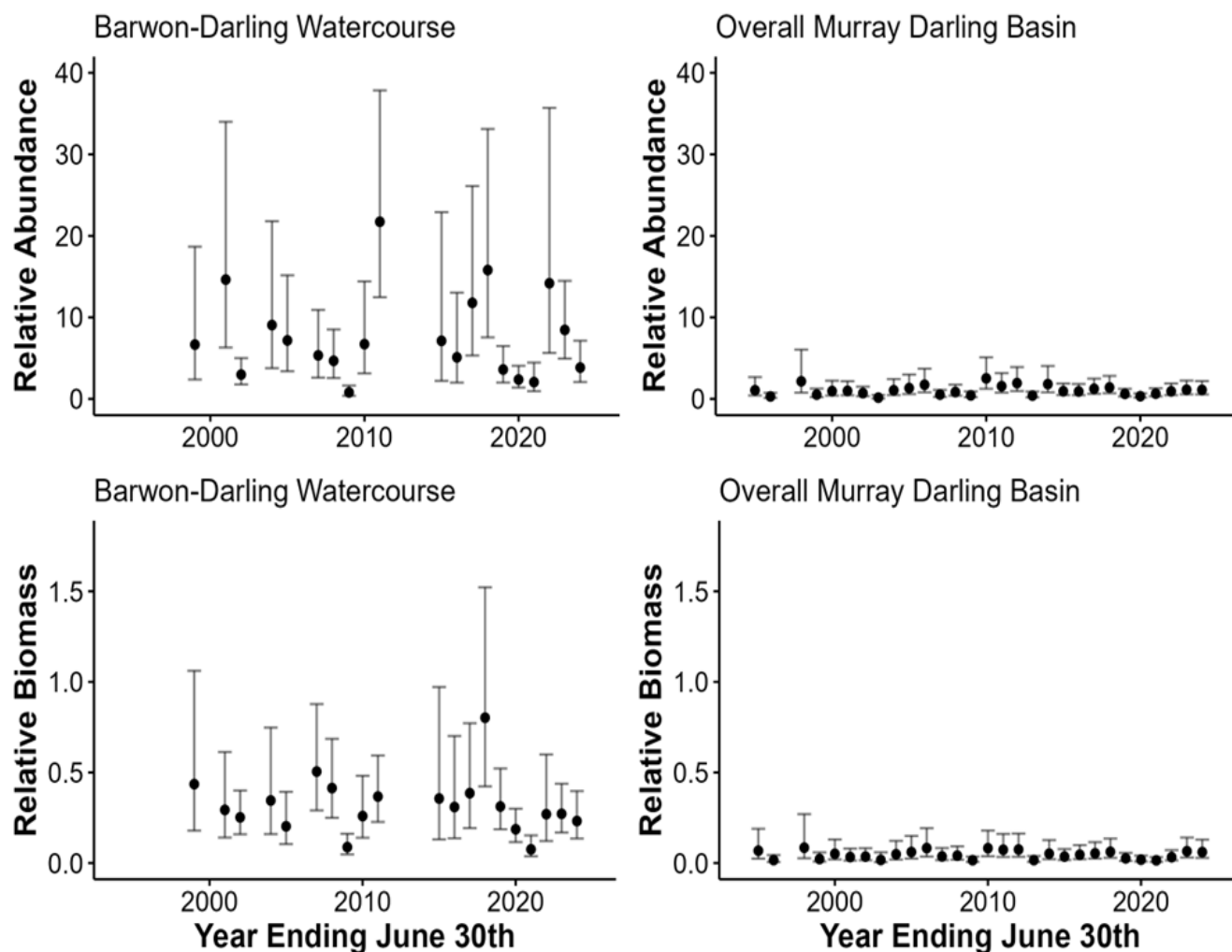


Figure 2.18: Relative abundance and biomass of Bony herring in both this WRPA and the overall NSW MDB. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence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

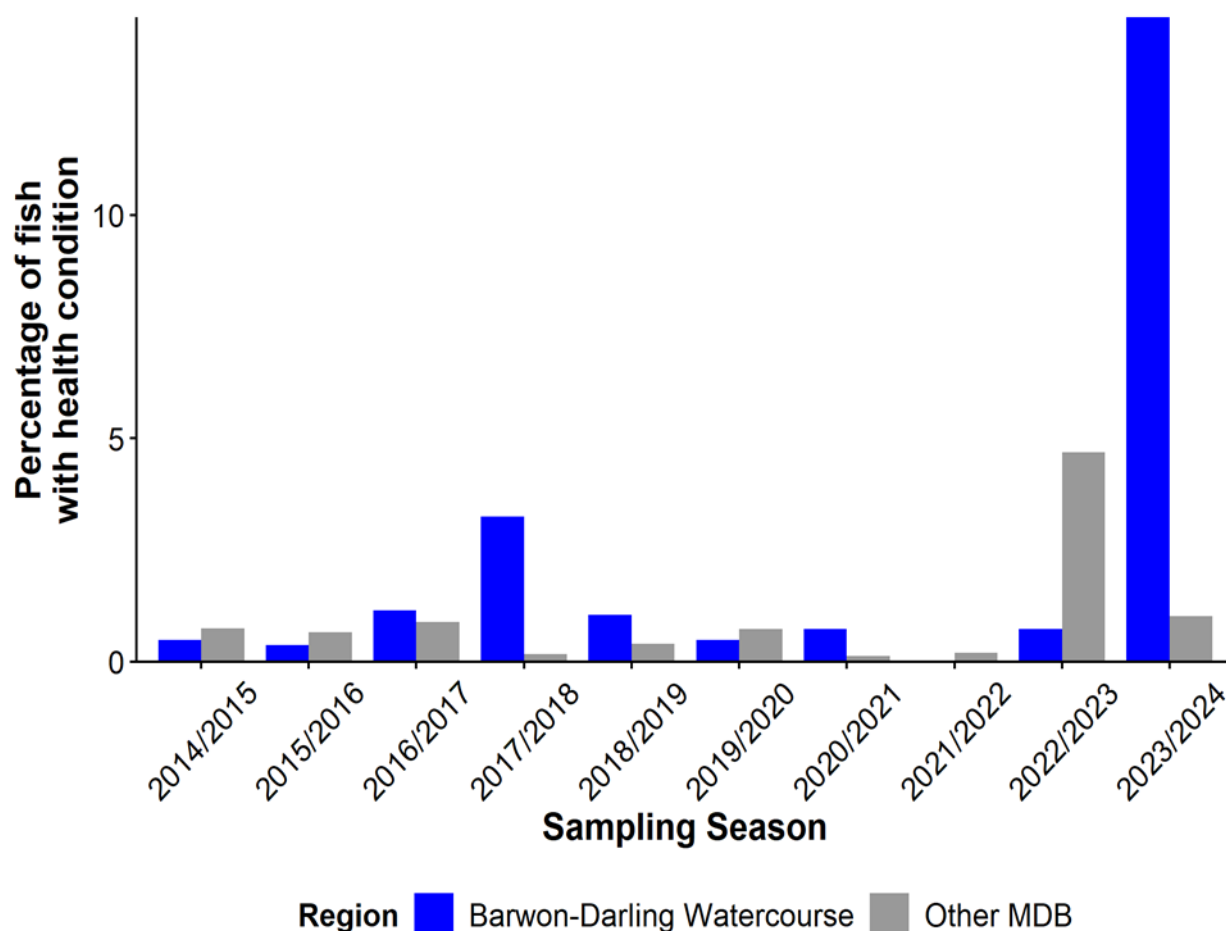


Figure 2.19: Timeseries showing the prevalence of health conditions in Bony herring. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA.

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 WSPA 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 WSPA.

Summary Statement:

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

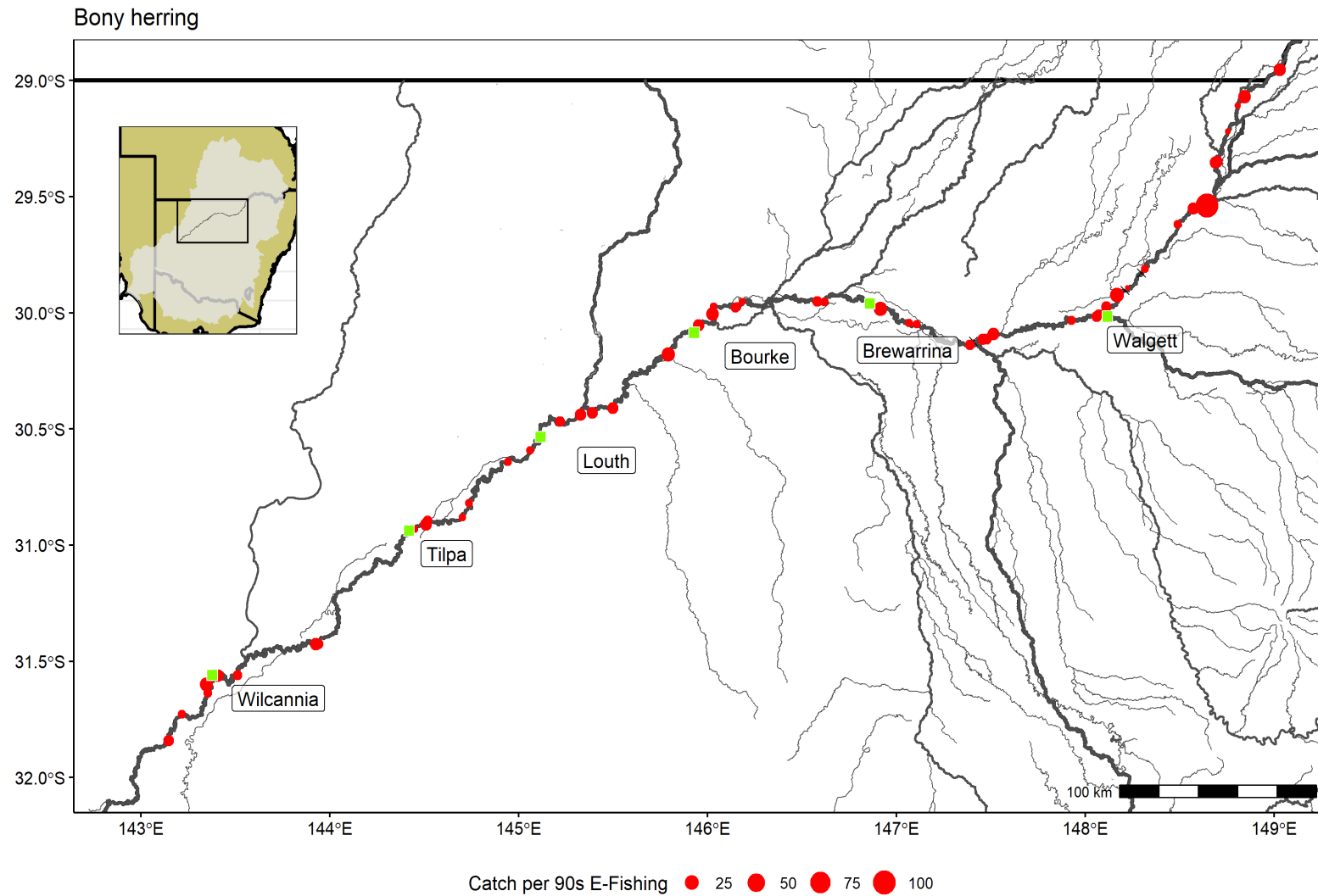


Figure 2.20: Distribution of Bony herring sampled from 2013/14 to 2023/24 in the Barwon-Darling Watercourse. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are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

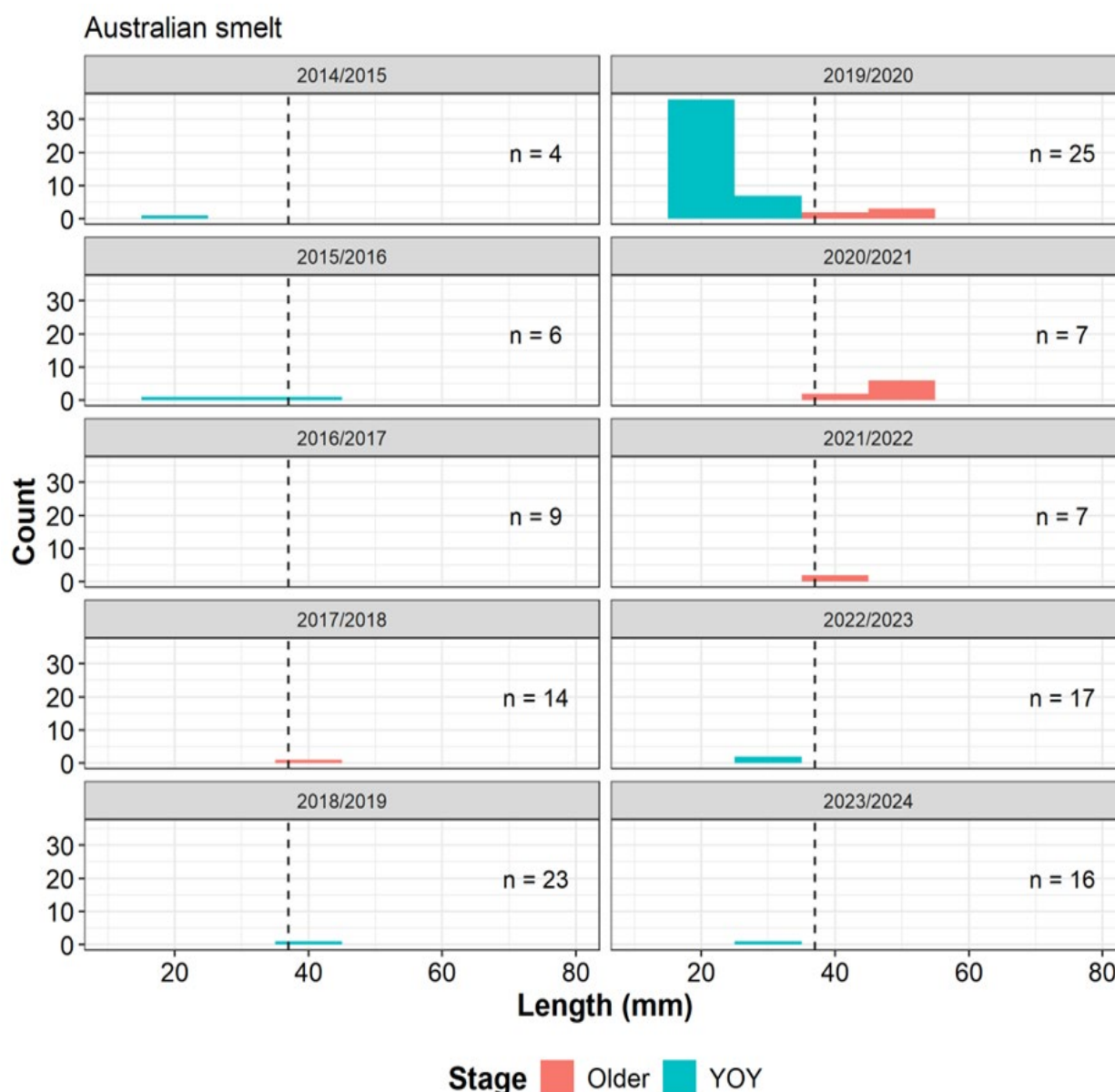


Figure 2.21: Length frequency plots for Australian smelt by sampling season in the Barwon-Darling Watercourse. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRPA in a sampling season.

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.

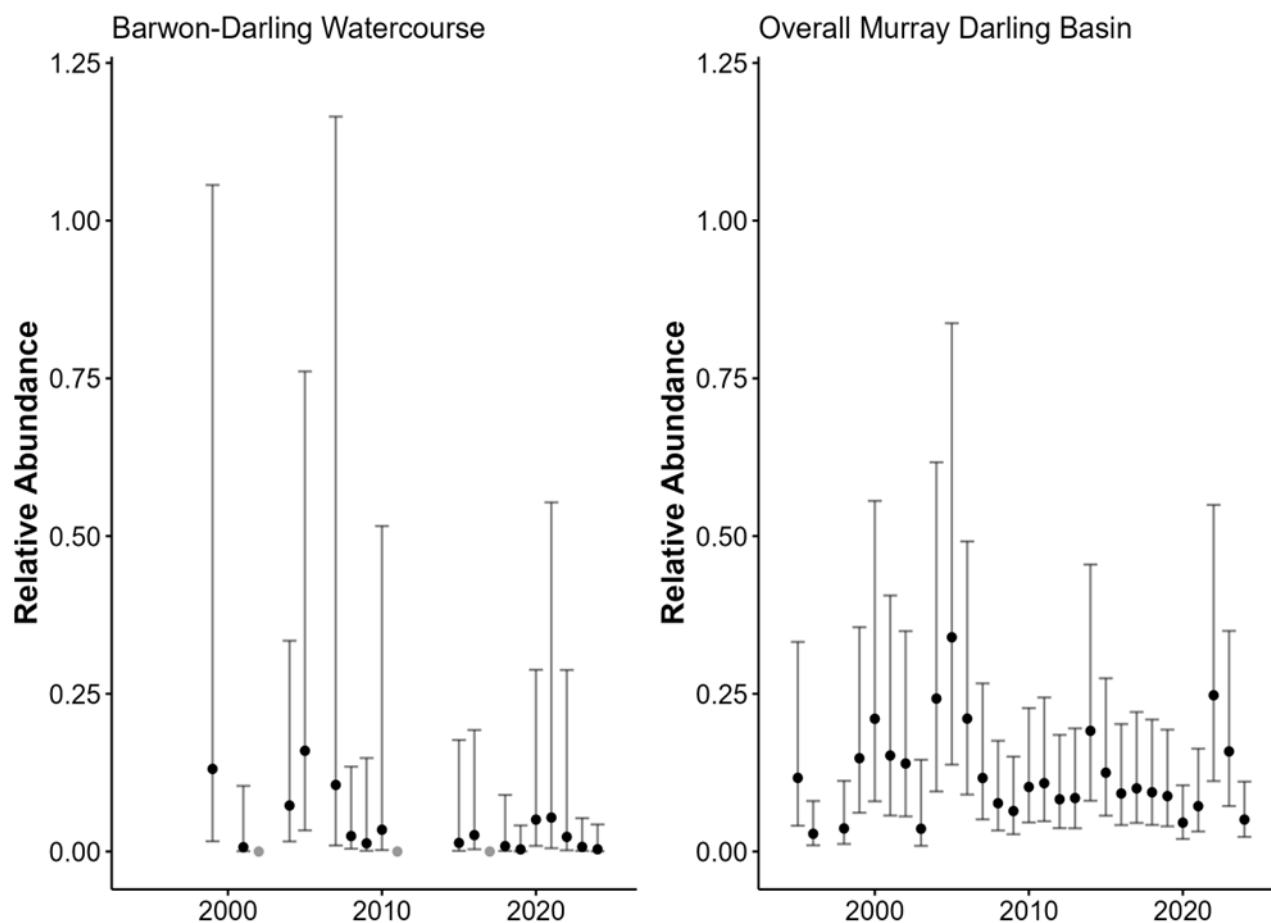


Figure 2.22: Relative abundance of Australian smelt in both this WRPAs and the overall NSW MDB. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals 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).

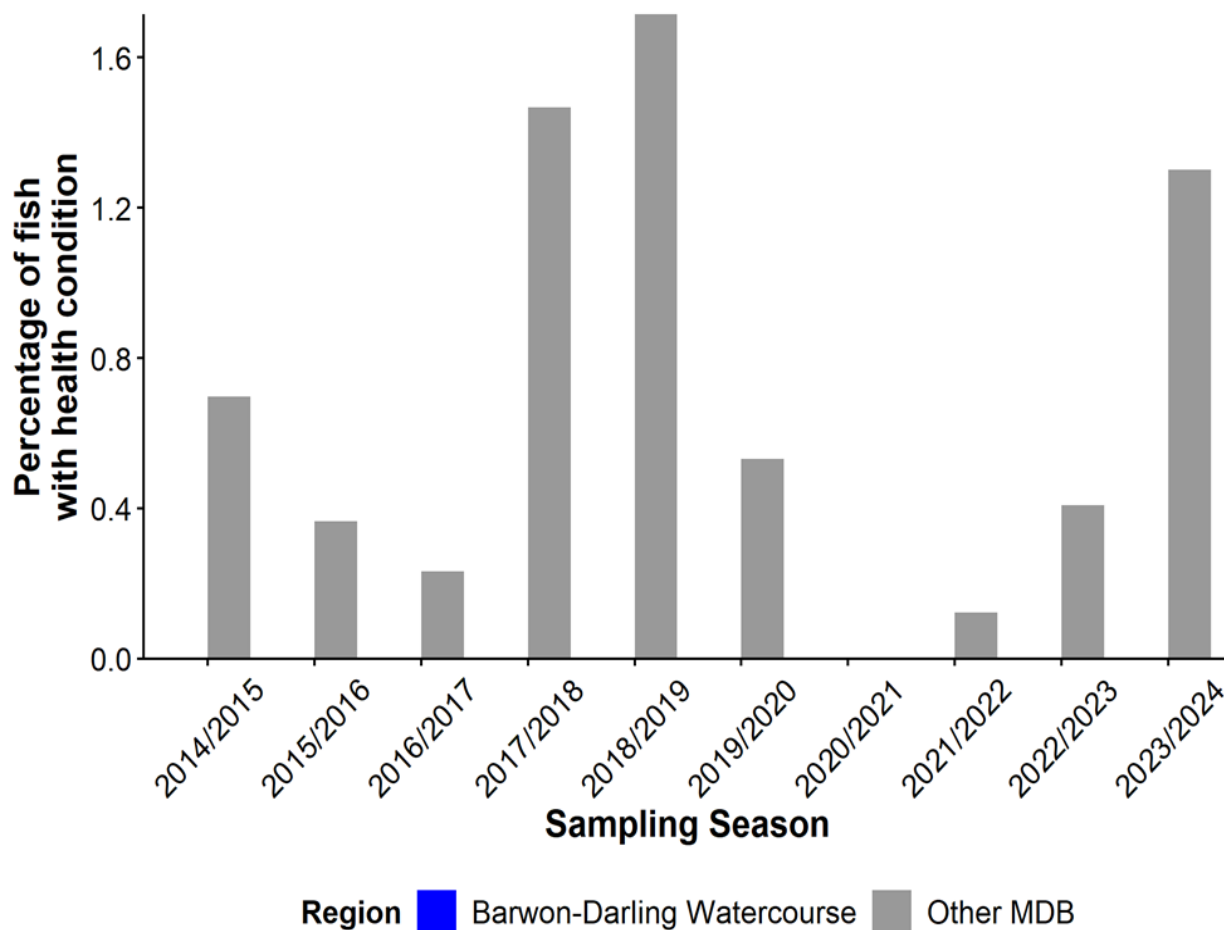


Figure 2.23: Timeseries showing the prevalence of health conditions in Australian smelt. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA.

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.

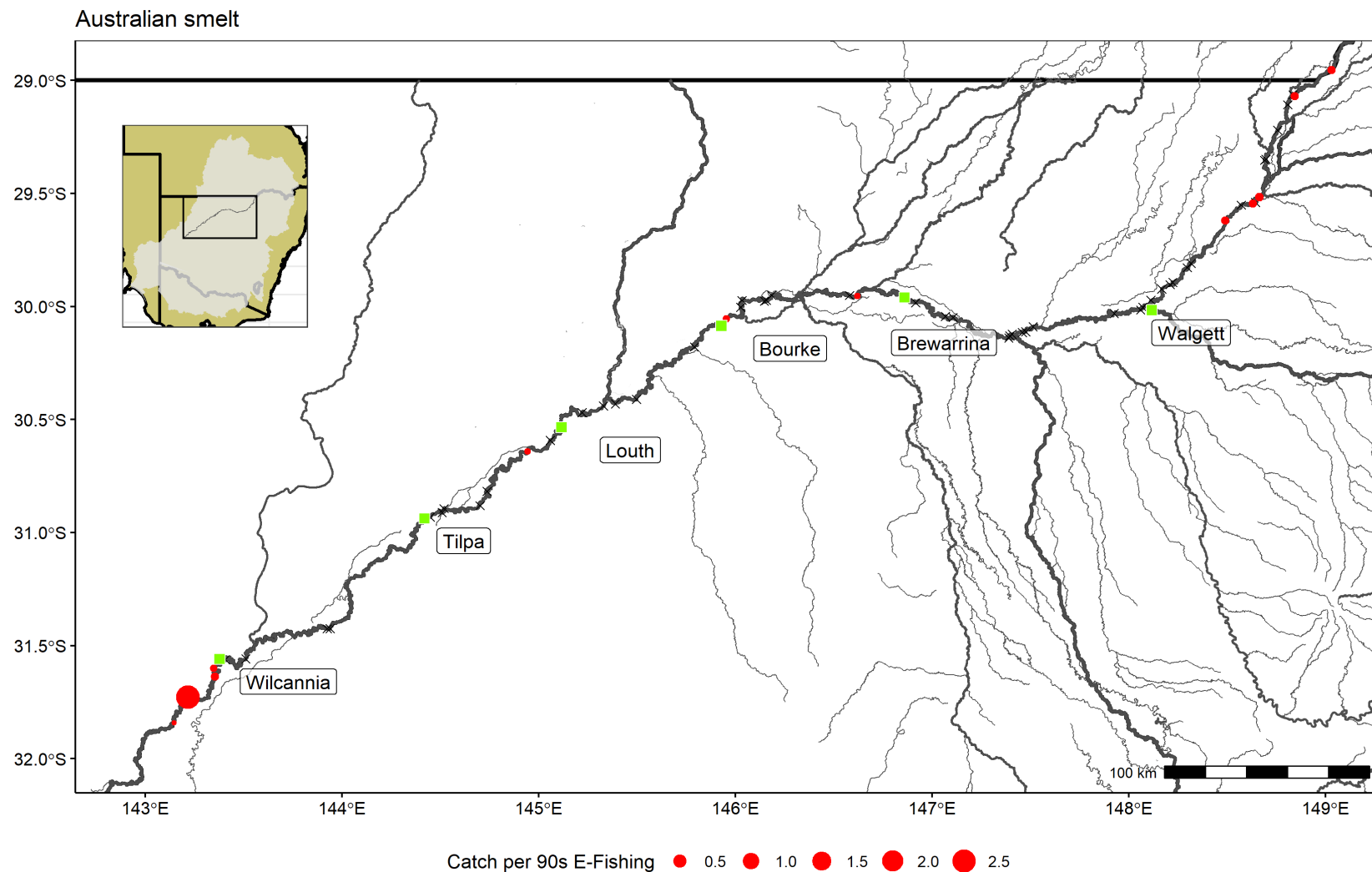


Figure 2.24: Distribution of Australian smelt sampled from 2013/14 to 2023/24 in the Barwon-Darling Watercourse. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species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

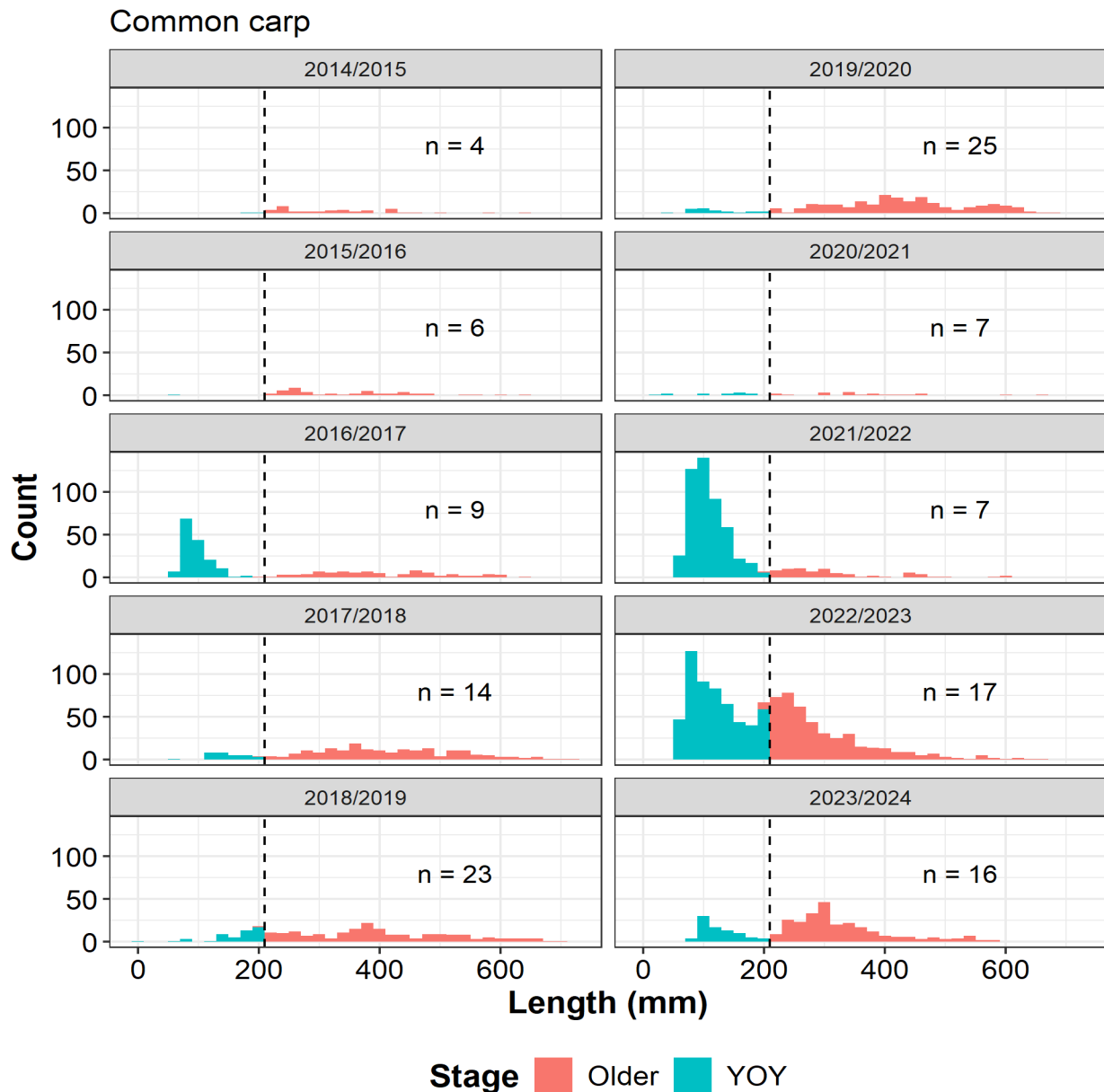


Figure 2.25: Length frequency plots for common carp by sampling season in the Barwon-Darling Watercourse. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRPA in a sampling season.

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.

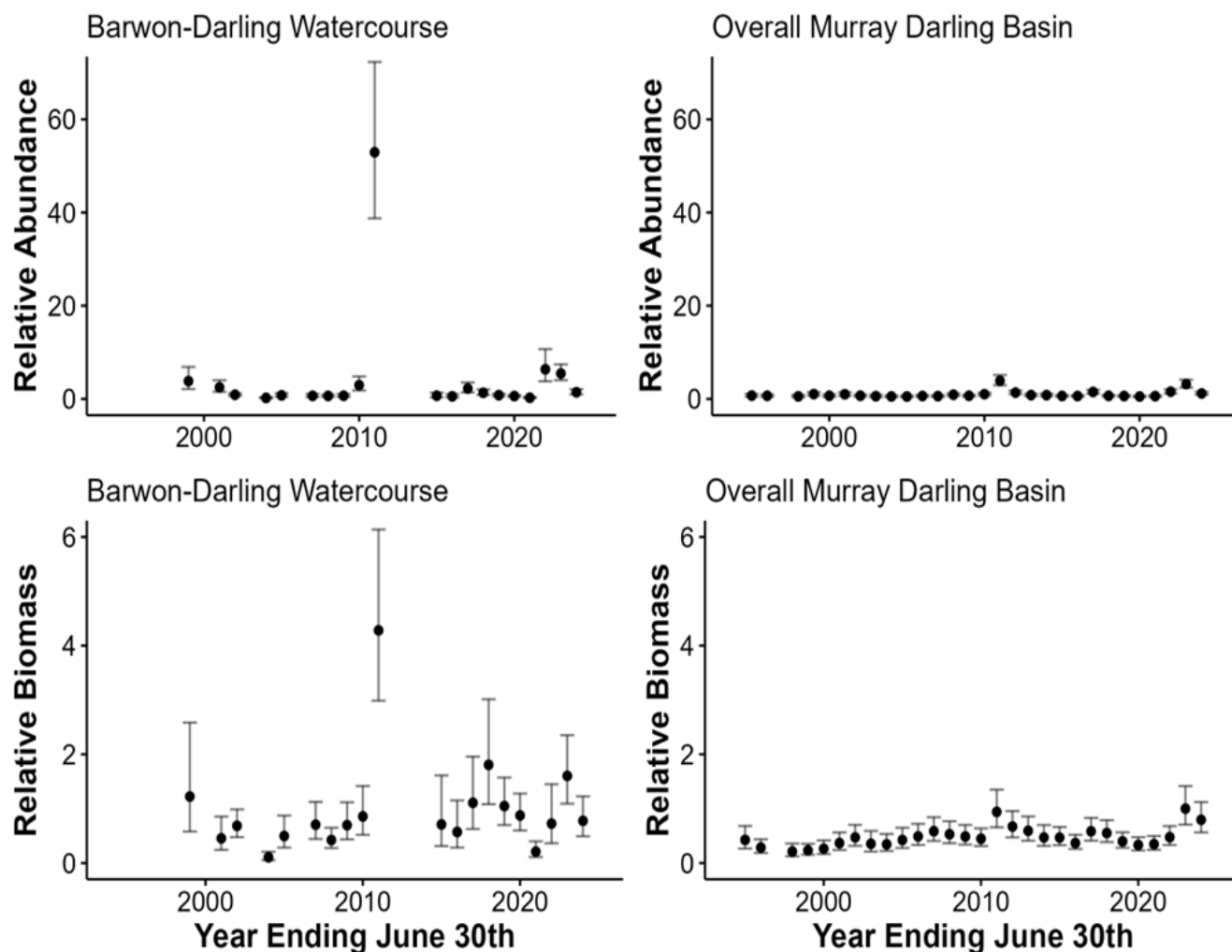


Figure 2.26: Relative abundance and biomass of Common carp in both this valley and the overall Murray-Darling Basin. These are model estimates based upon all electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95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

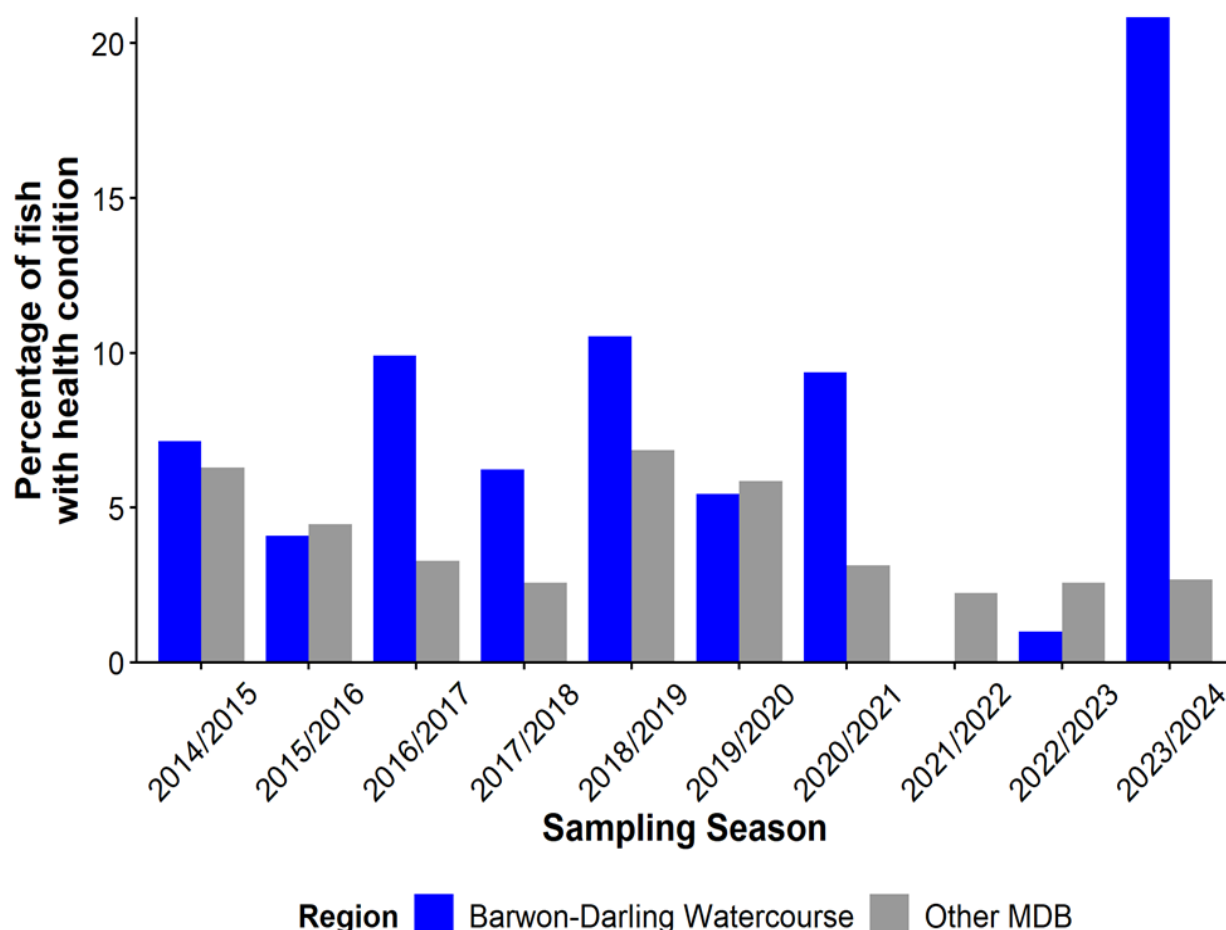


Figure 2.27: Timeseries showing the prevalence of health conditions in Common carp. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA's.

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.

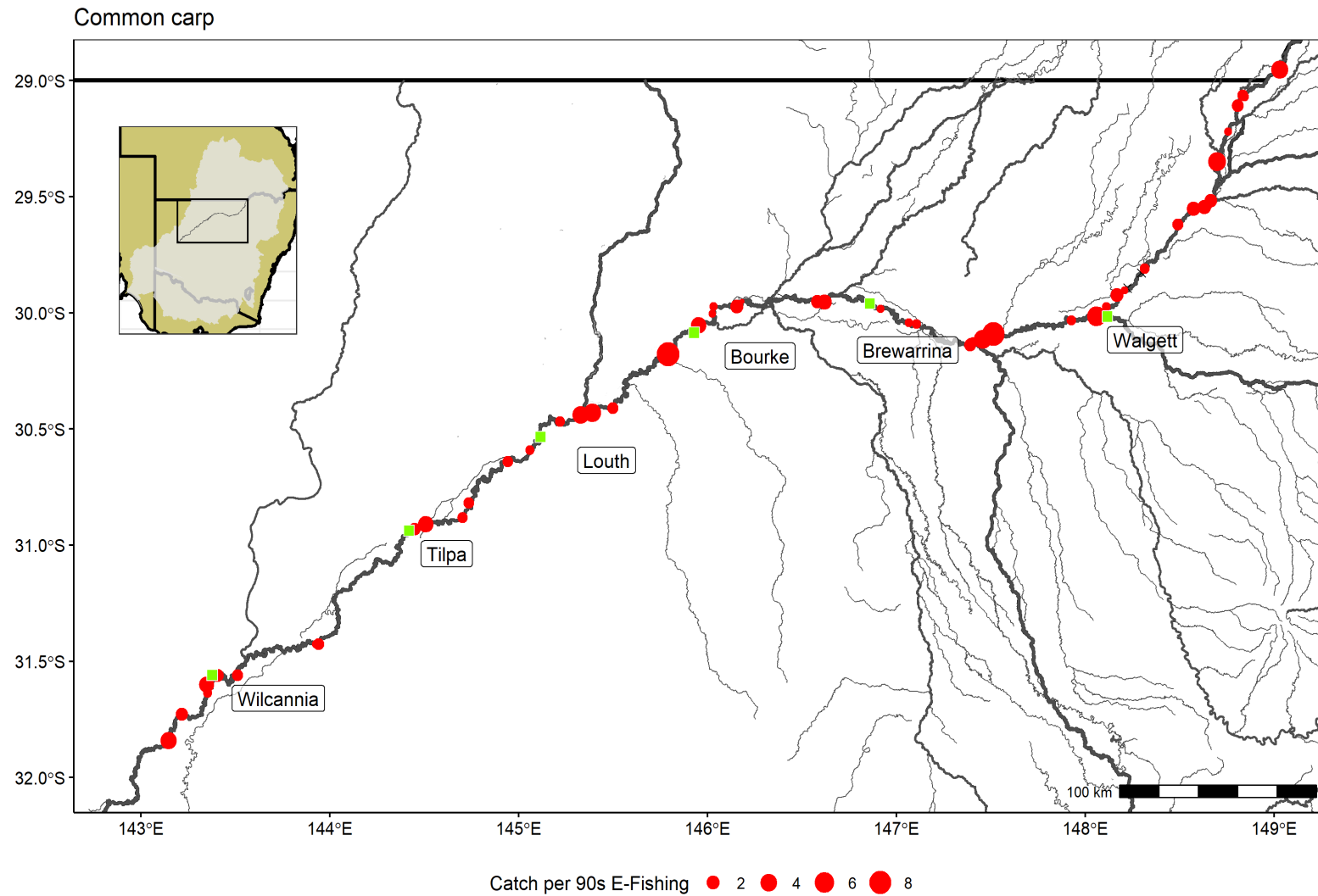


Figure 2.28: Distribution of Common carp sampled from 2013/14 to 2023/24 in the Barwon-Darling Watercourse. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are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

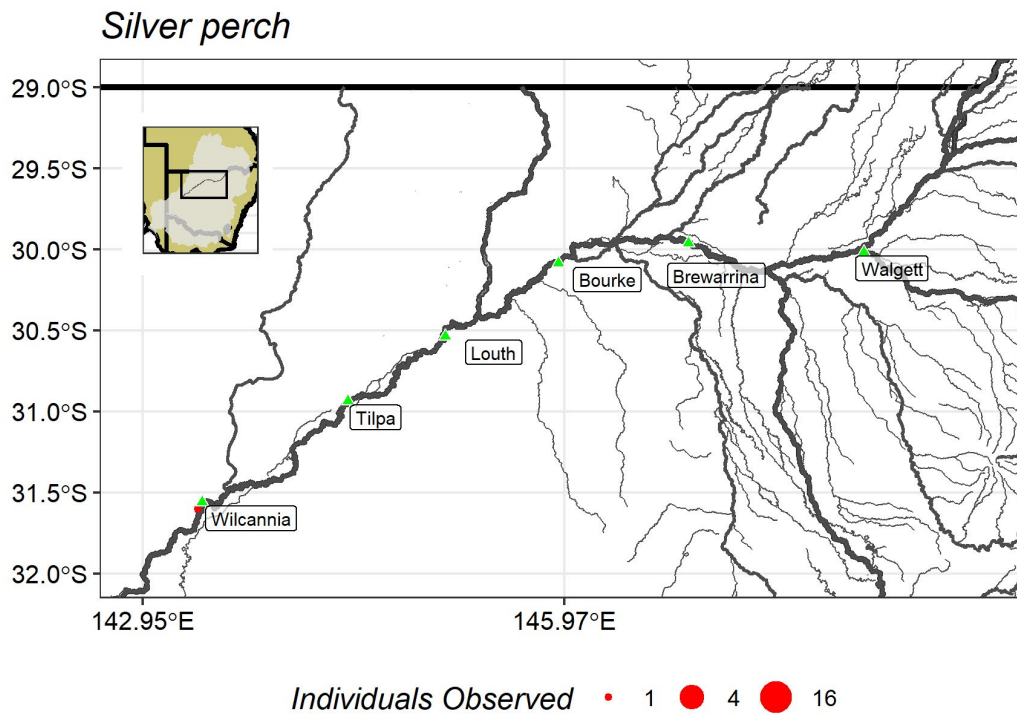


Figure 2.29: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the Barwon-Darling Watercourse. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance.

Summary Statement:

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

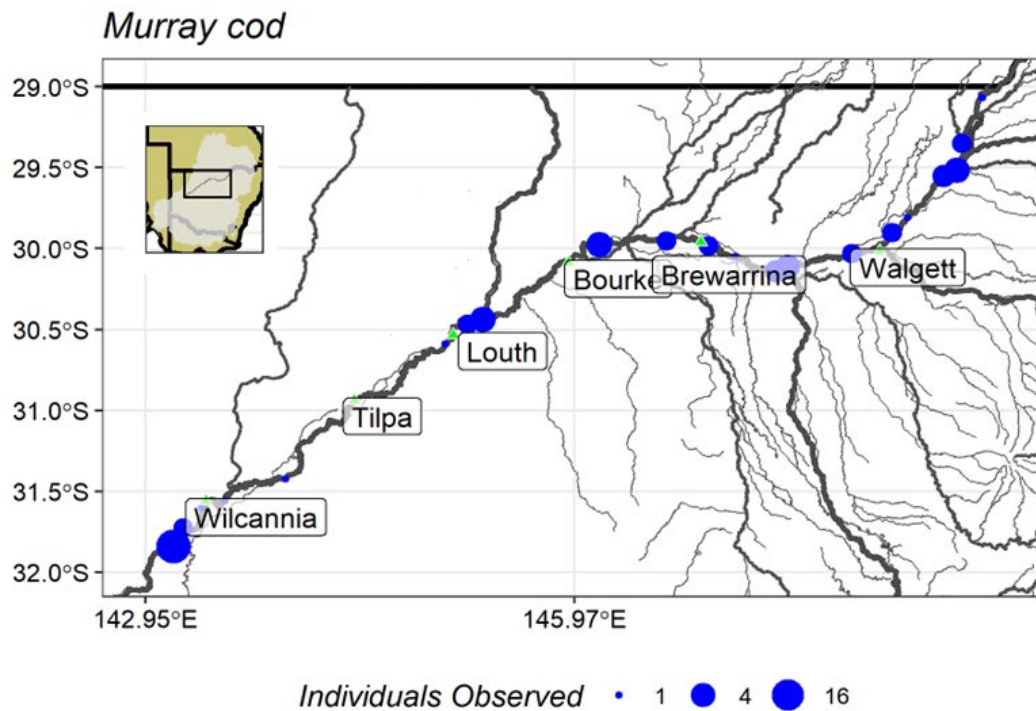


Figure 2.30: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the Barwon-Darling Watercourse. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance. Note the lower image shows a juvenile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

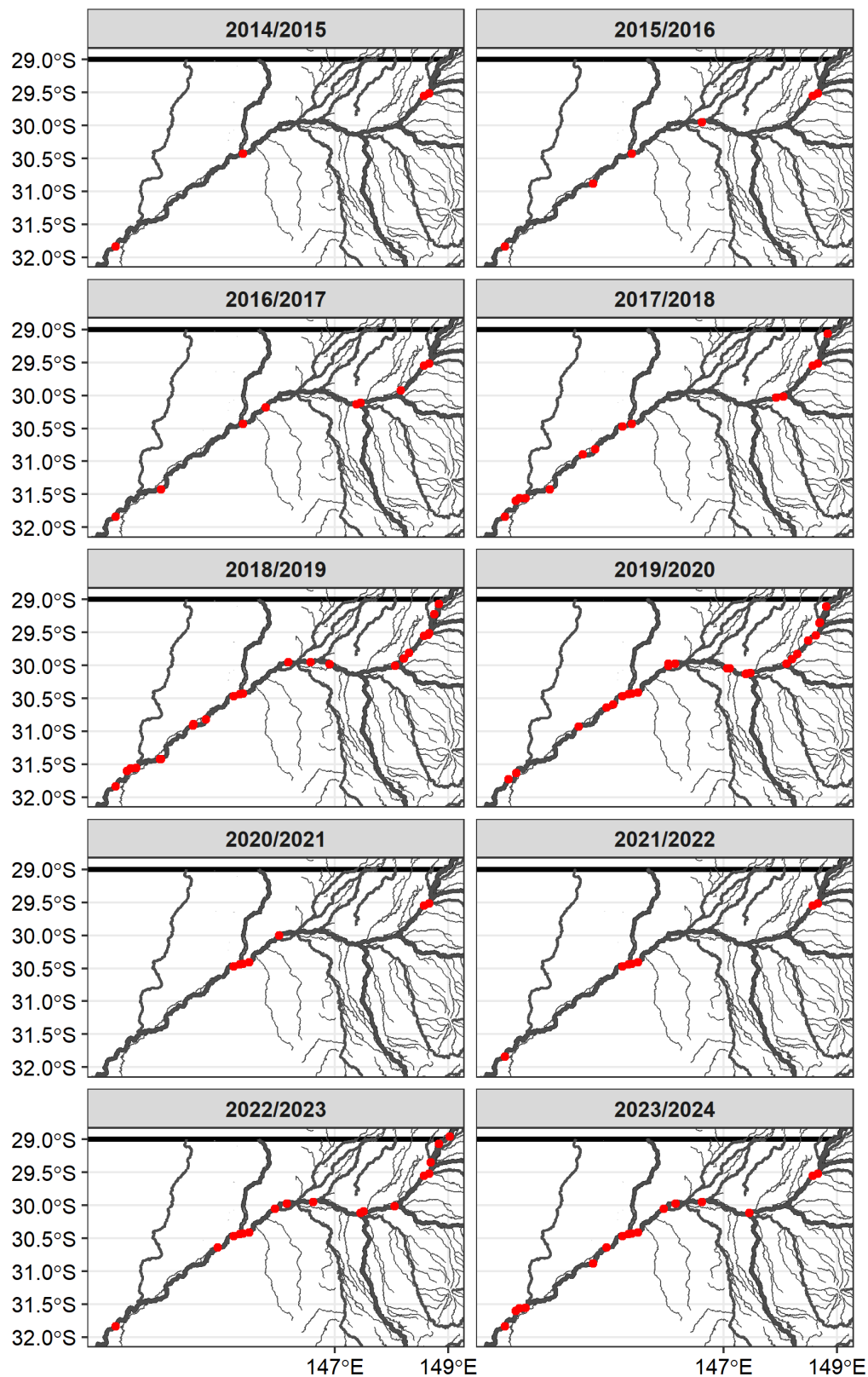


Figure 2.31: Sites sampled and included in this report by sampling season. Dry sites are not shown.

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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