

Chapter 9 Basin Plan Fish Monitoring Summary (2014/15 – 2023/24): NSW Border Rivers Water Resource Planning Area

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March 2025



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Citation Details

Please cite the overall report when referring to this chapter:

Schilling, H., Crook, D. 2025. Basin Plan Fish Monitoring Summary (2014/15 – 2023/24): Water Resource Planning Area Reports. NSW Department of Primary Industries and Regional Development. Port Stephens Fisheries Institute. 625pp. (PUB25/277)

Chapter 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.

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.

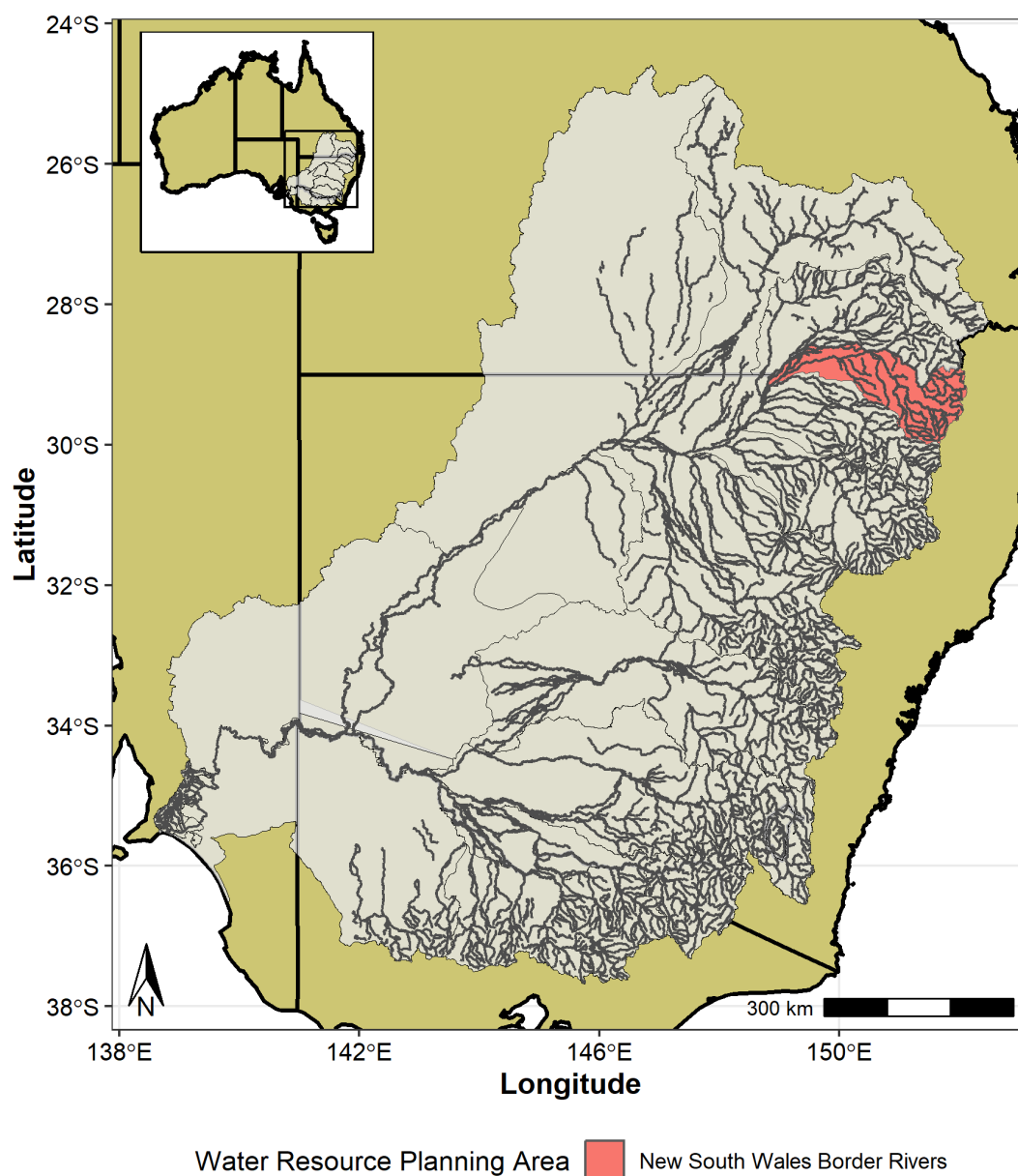


Figure 9.1: Murray-Darling Basin with the key region of this report highlighted. Inset map shows the whole of Australia with a box around the MDB.

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).

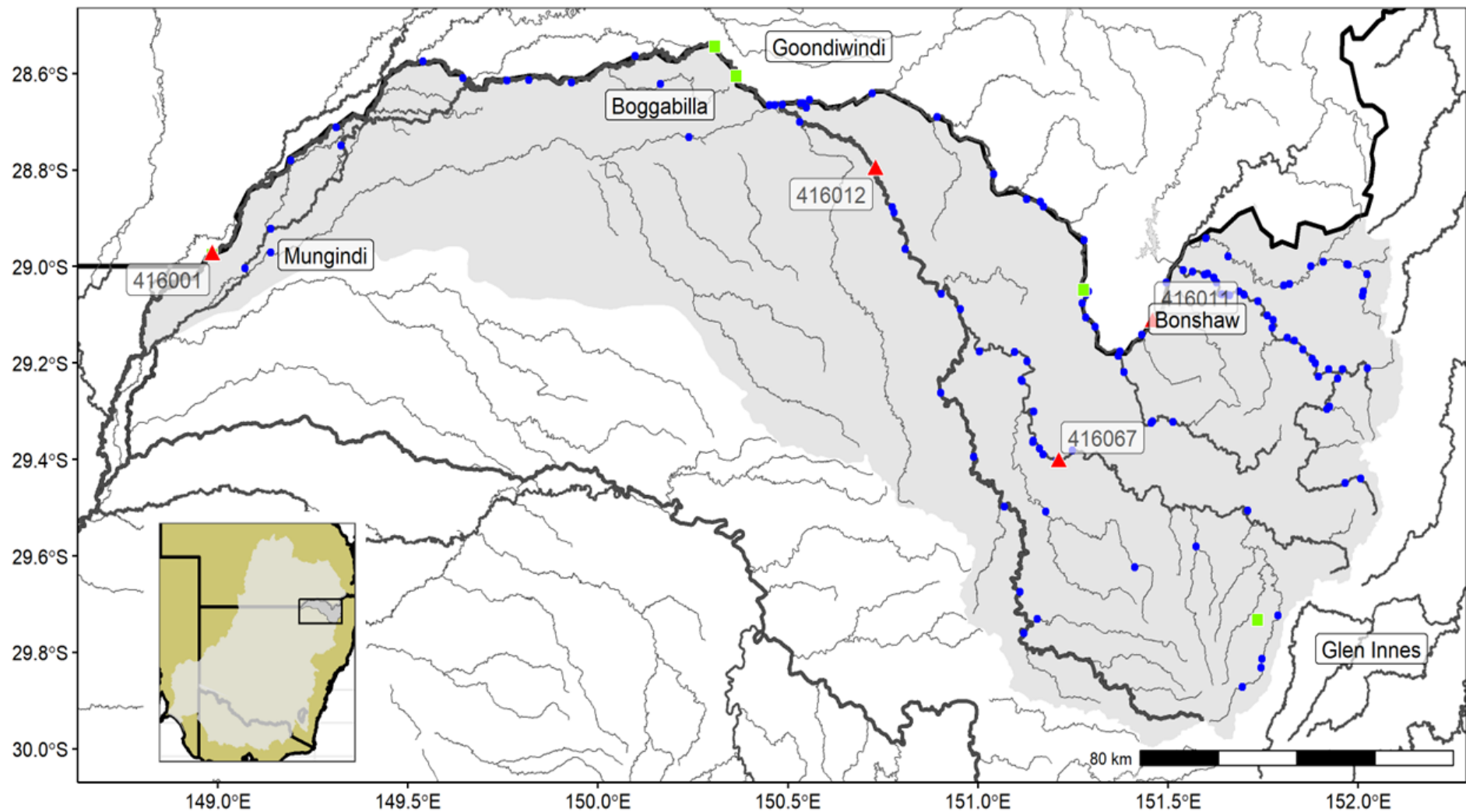


Figure 9.2: Sites (dots) sampled during the reporting period in the NSW Border Rivers WRPA. Triangles show key flow gauges along with their gauge ID number. Green squares show major towns.

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).

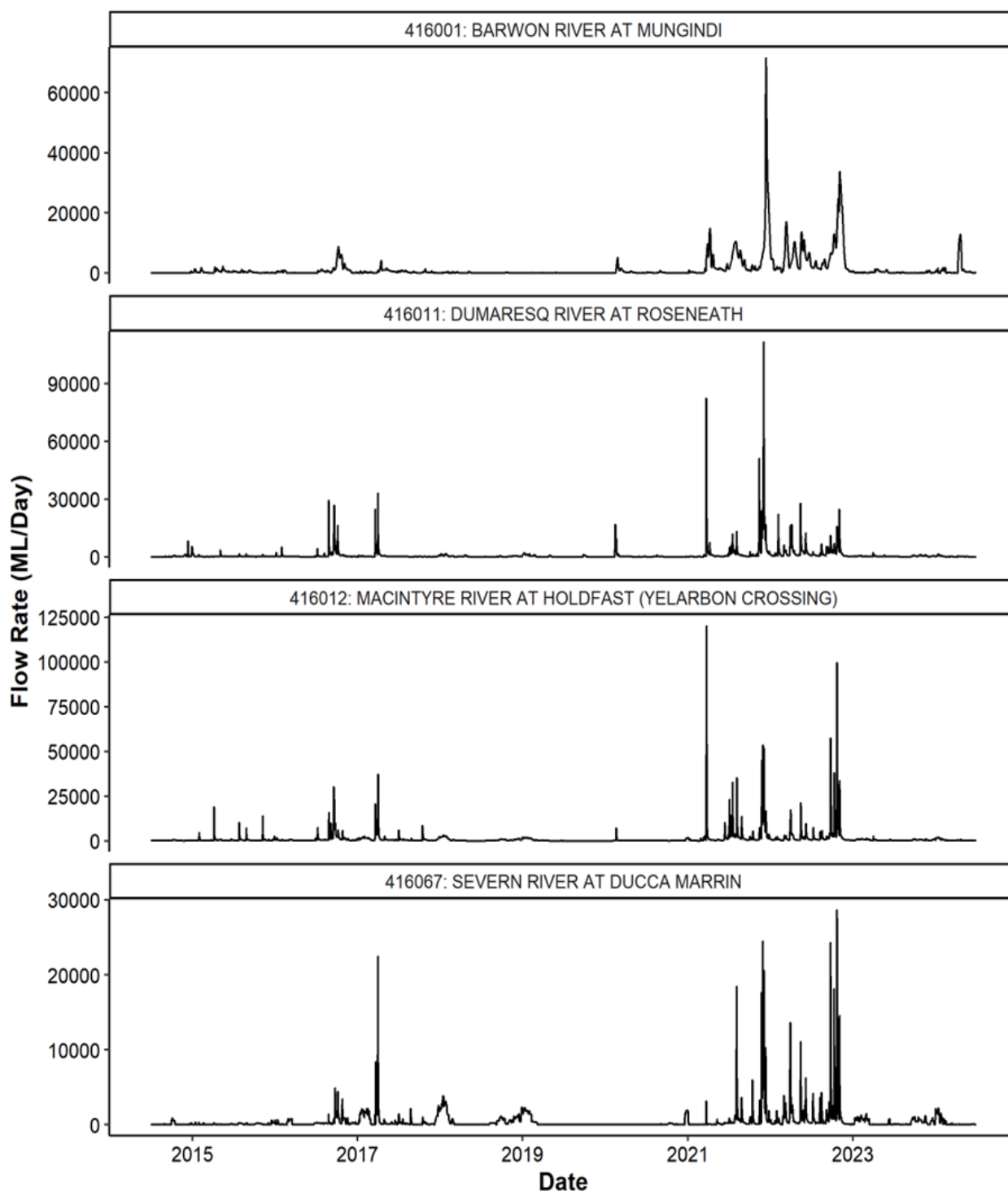


Figure 9.3: Flow data from various gauges in the New South Wales Border Rivers WRPA over the reporting period. Gauge locations can be seen on Figure 9.2. Note the differing scales on the y-axis.

Water temperature data, where available, are also shown in Figure 9.4.

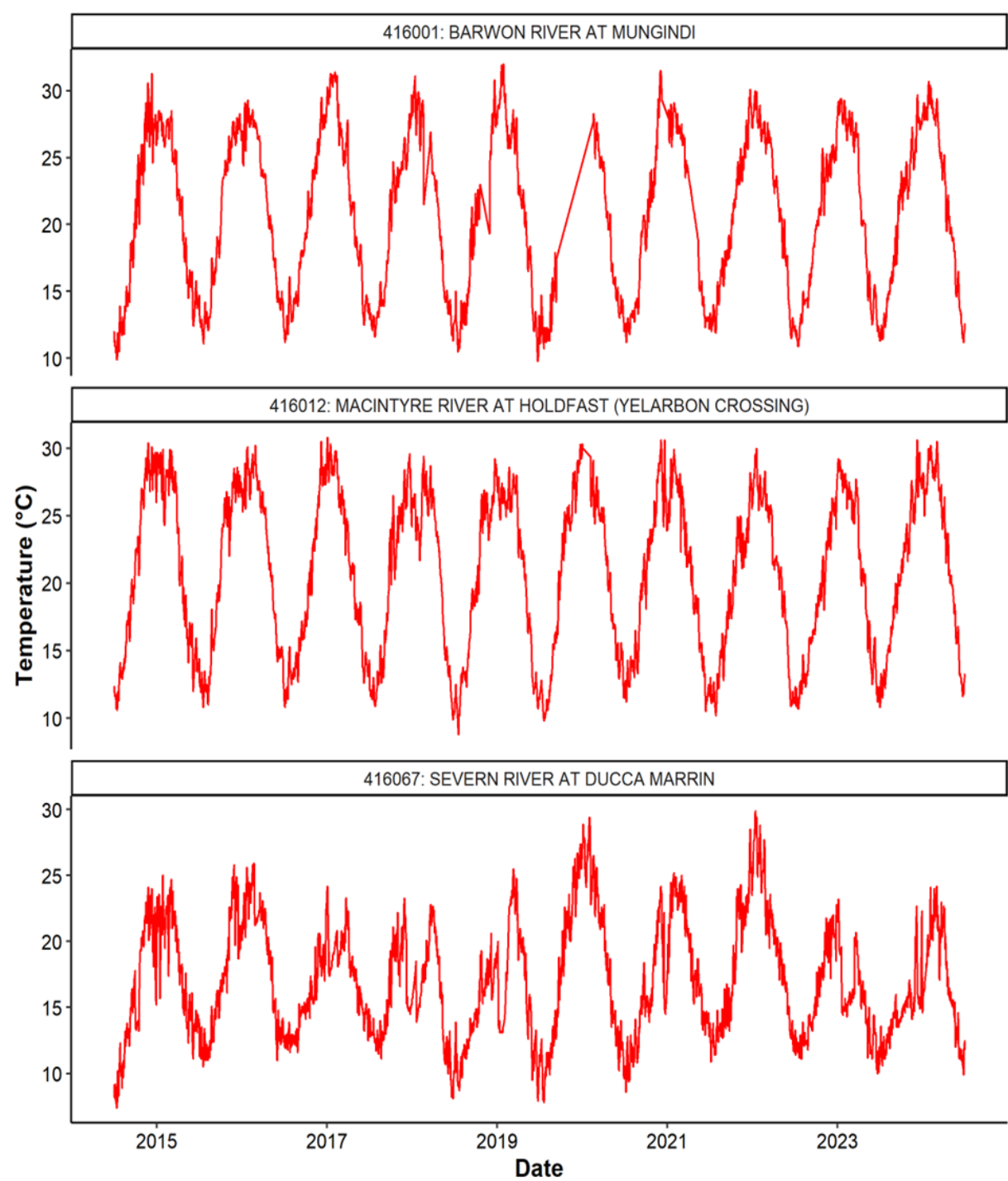


Figure 9.4: Water temperature data from various gauges in the New South Wales Border Rivers WRPA over the reporting period. Gauge locations can be seen on Figure 9.2. Note the differing scales on the y-axis.

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.

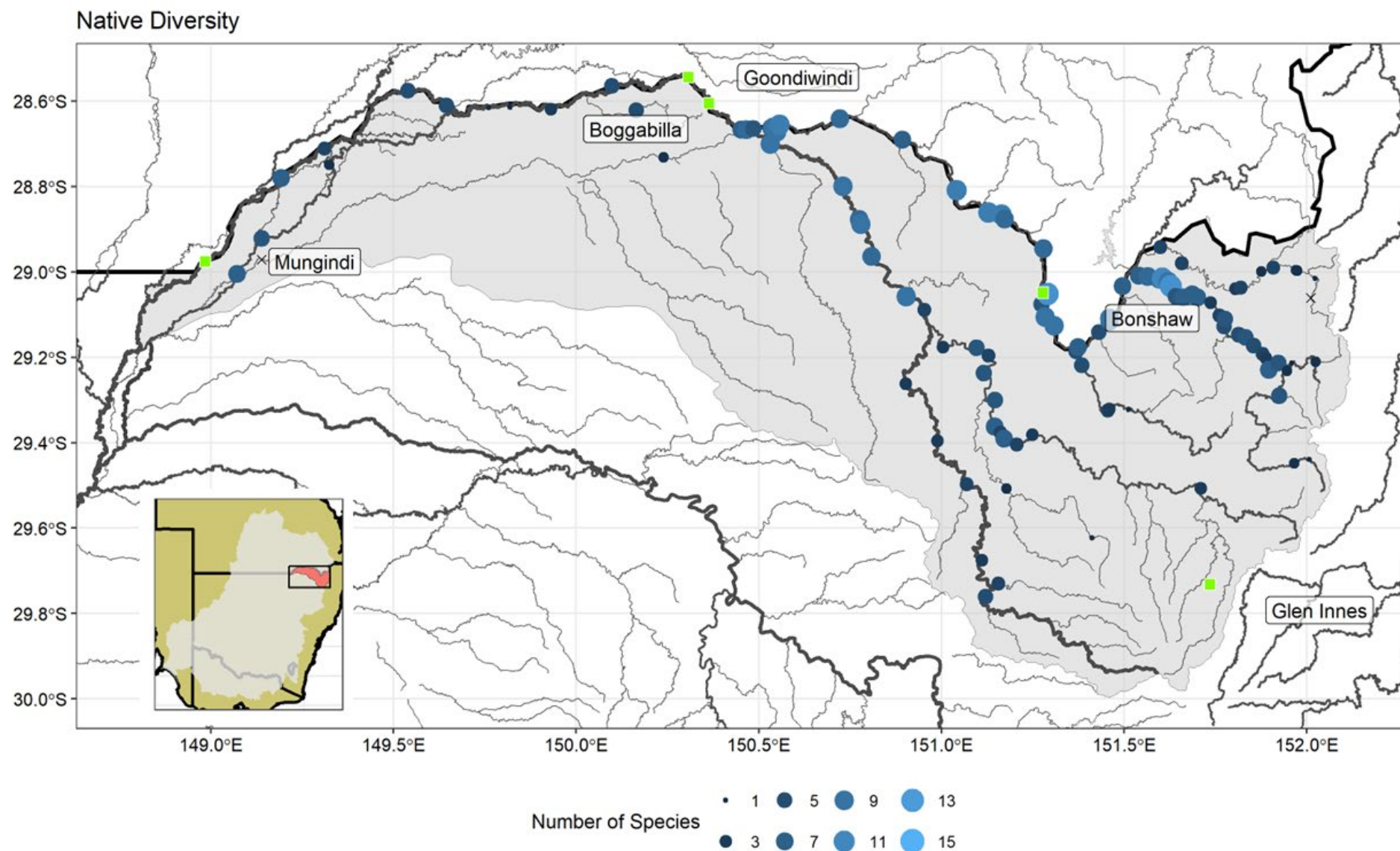


Figure 9.5: Native diversity across all sampling sites in the NSW Border Rivers WRPA. Bubble size represents the number of unique species observed at each site across all sampling methods and events. X represents a site that had water and was sampled, but no fish species were caught at all. Dry sites are excluded. Green squares represent key towns.

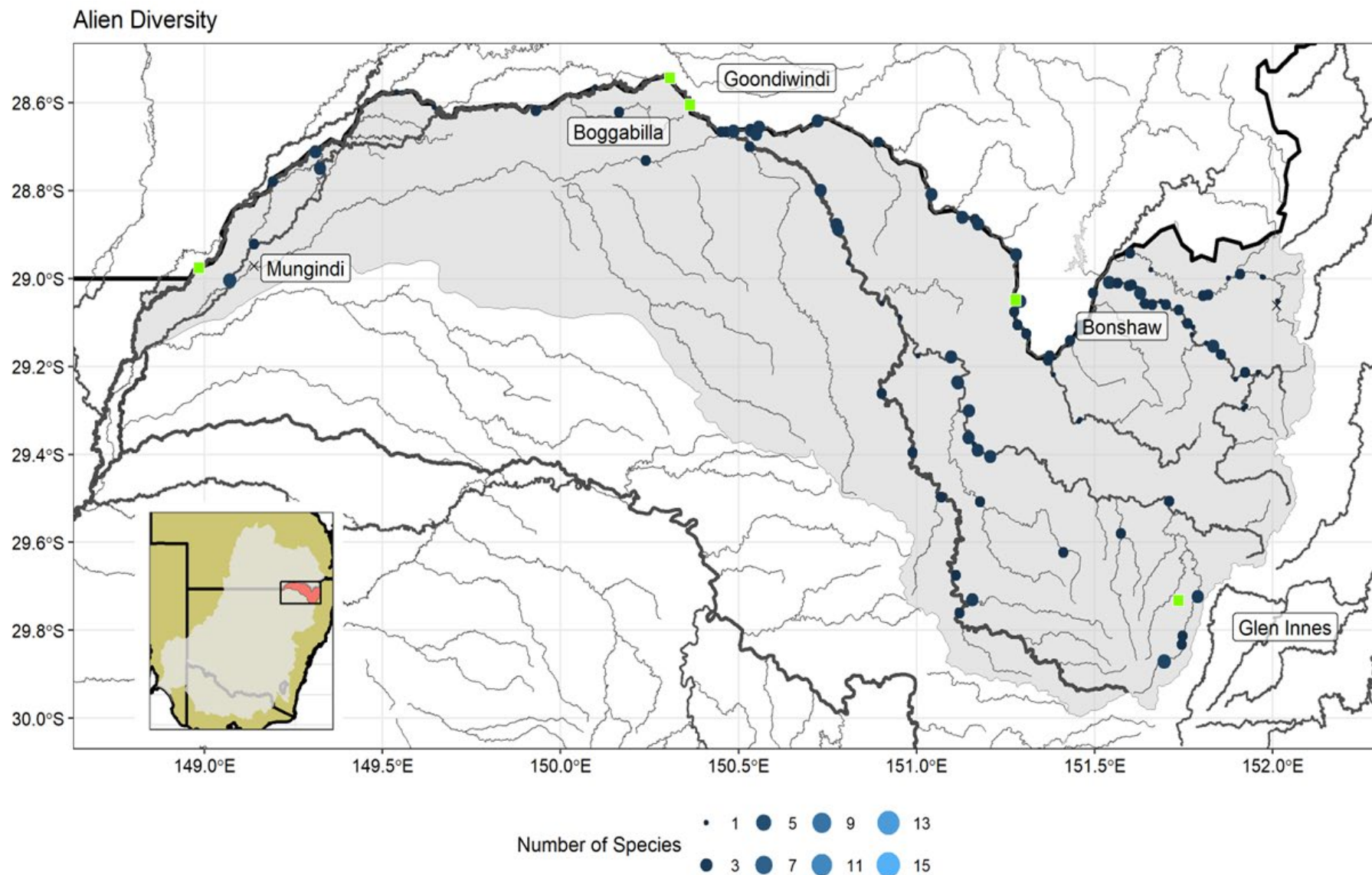


Figure 9.6: Alien diversity across all sampling sites in the NSW Border Rivers WRPA. Bubble size represents the number of unique species observed at each site across all sampling methods and events. X represents a site that had water and was sampled, but no fish species were caught at all. Dry sites 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).

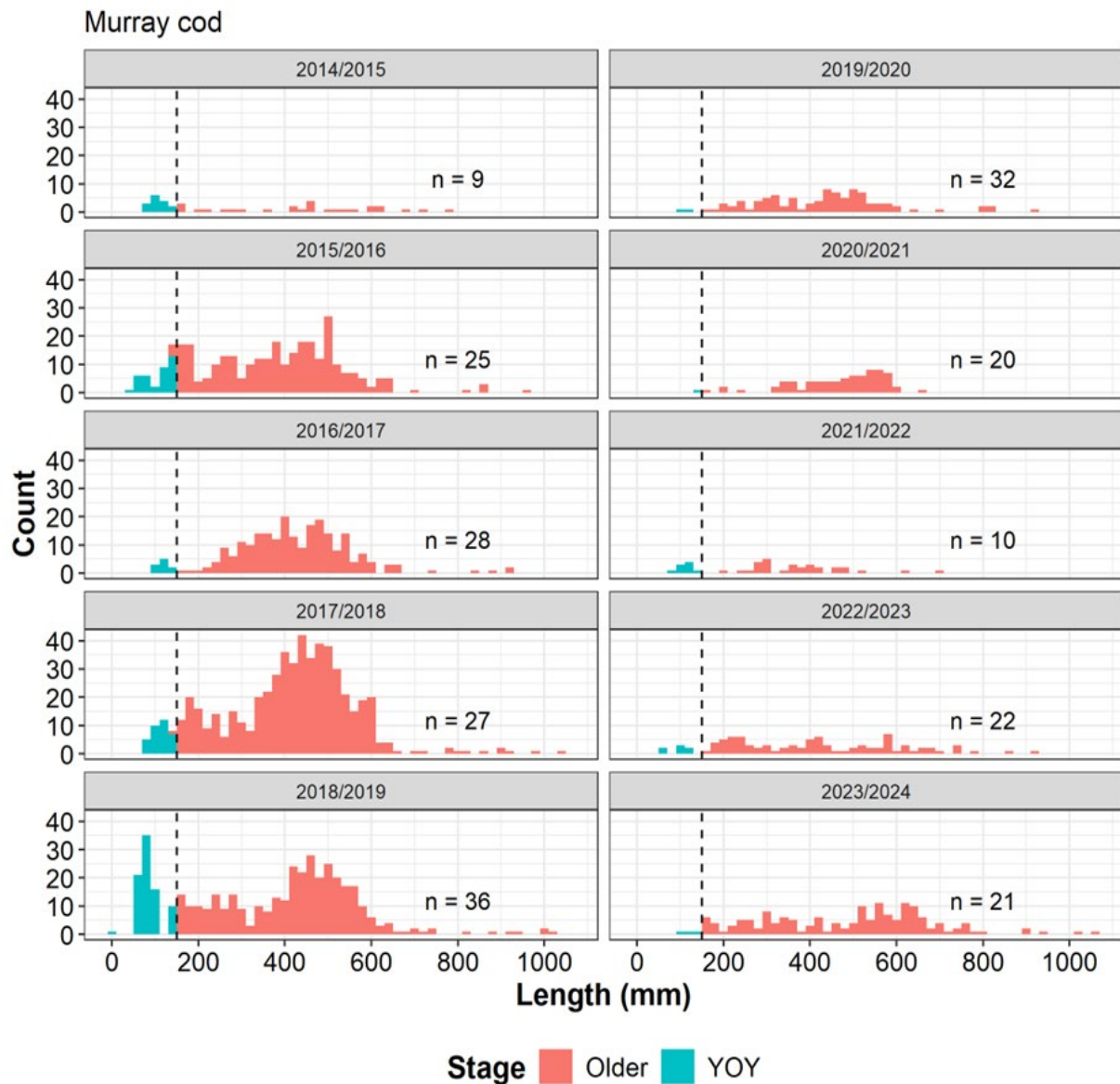


Figure 9.7: Length frequency plots for Murray cod by sampling season in the NSW Border Rivers WRP. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRP in a sampling season.

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

Murray cod stocking

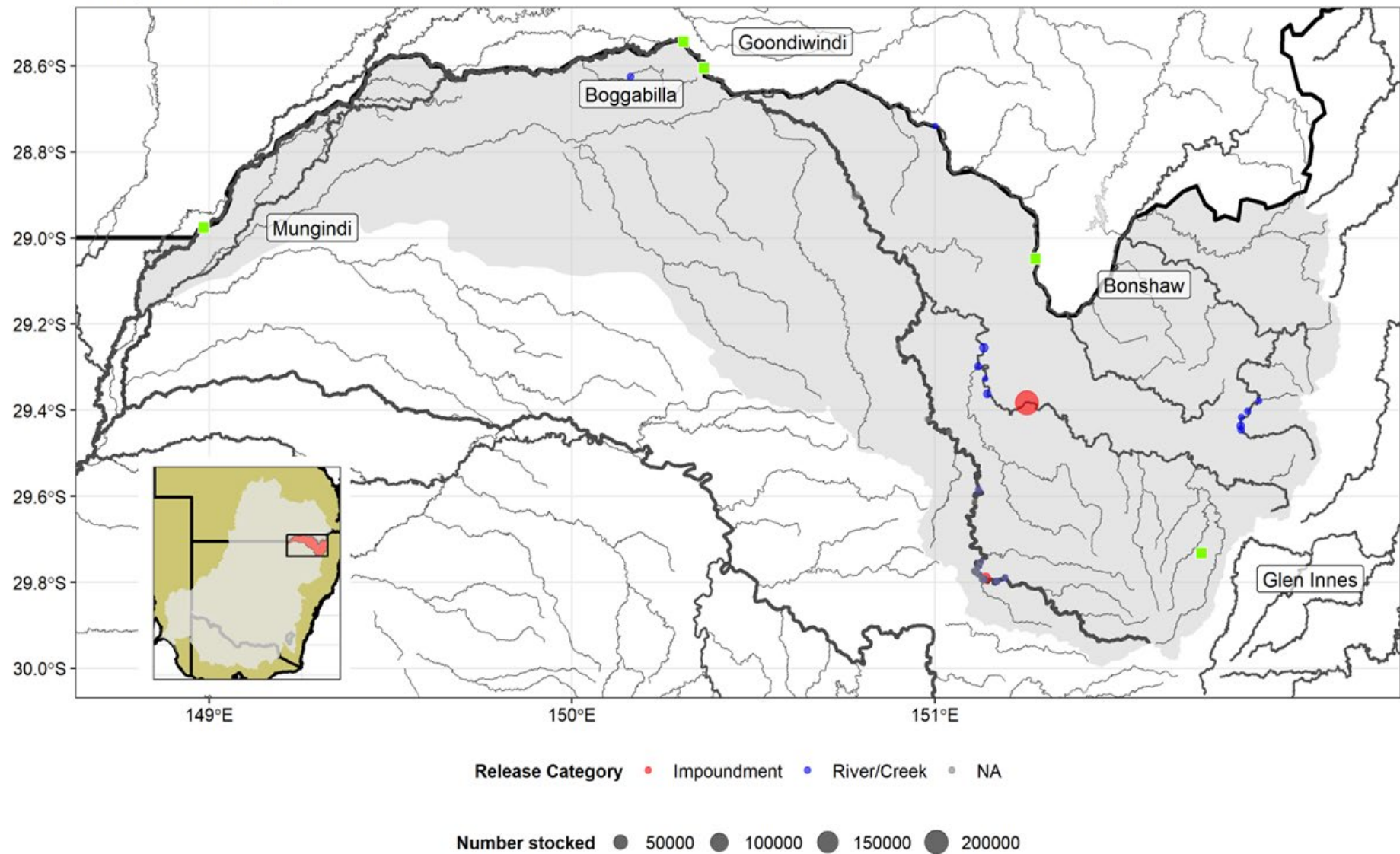


Figure 9.8: Locations of Murray cod stocking in the NSW Border Rivers WRPA. Colours show whether a site was a river/creek site or an impoundment, while the size of the point reflects the total number of fish stocked over the reporting period. Green squares represent key towns.

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.

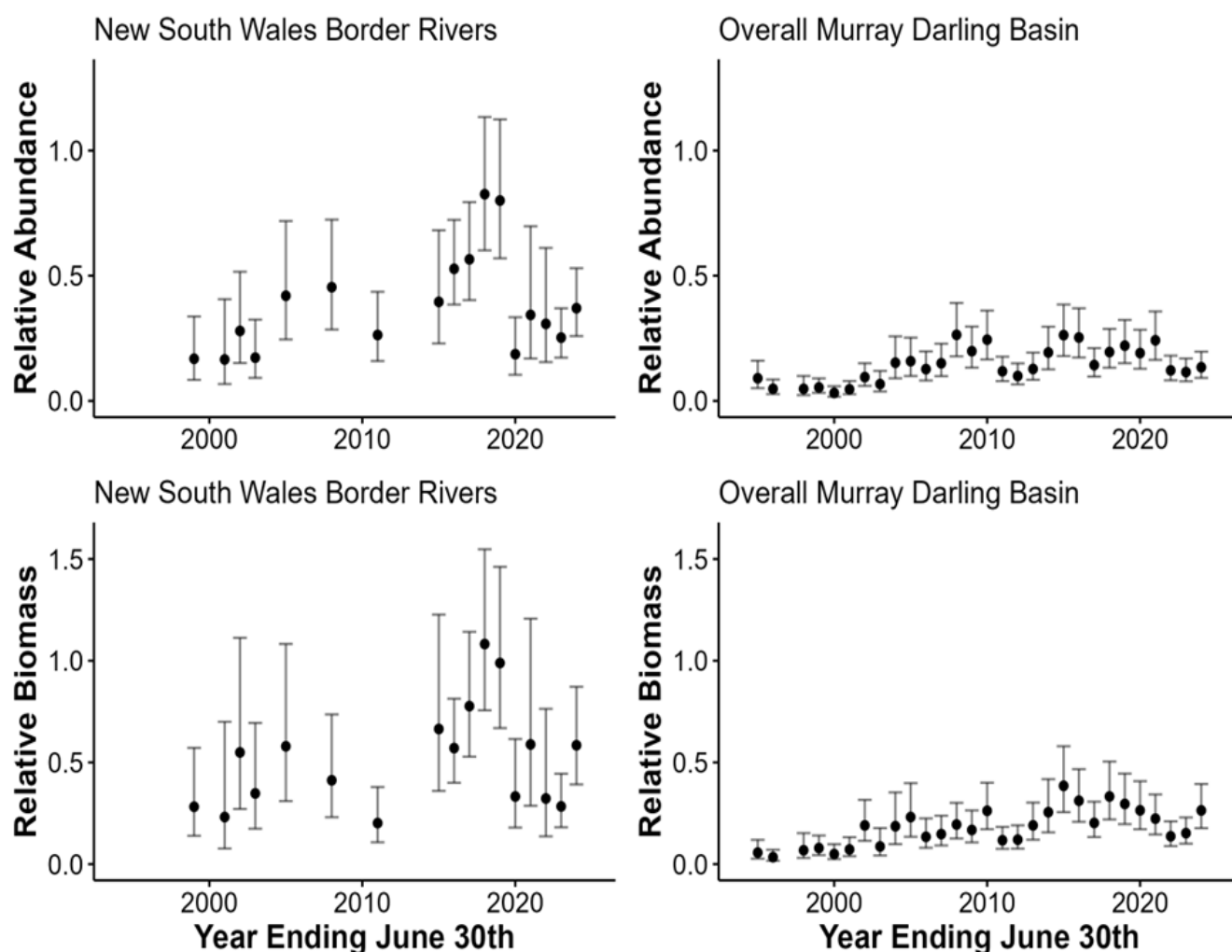


Figure 9.9: Relative abundance and biomass of Murray cod in both the NSW Border Rivers WRPA and the overall NSW MDB. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show 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).

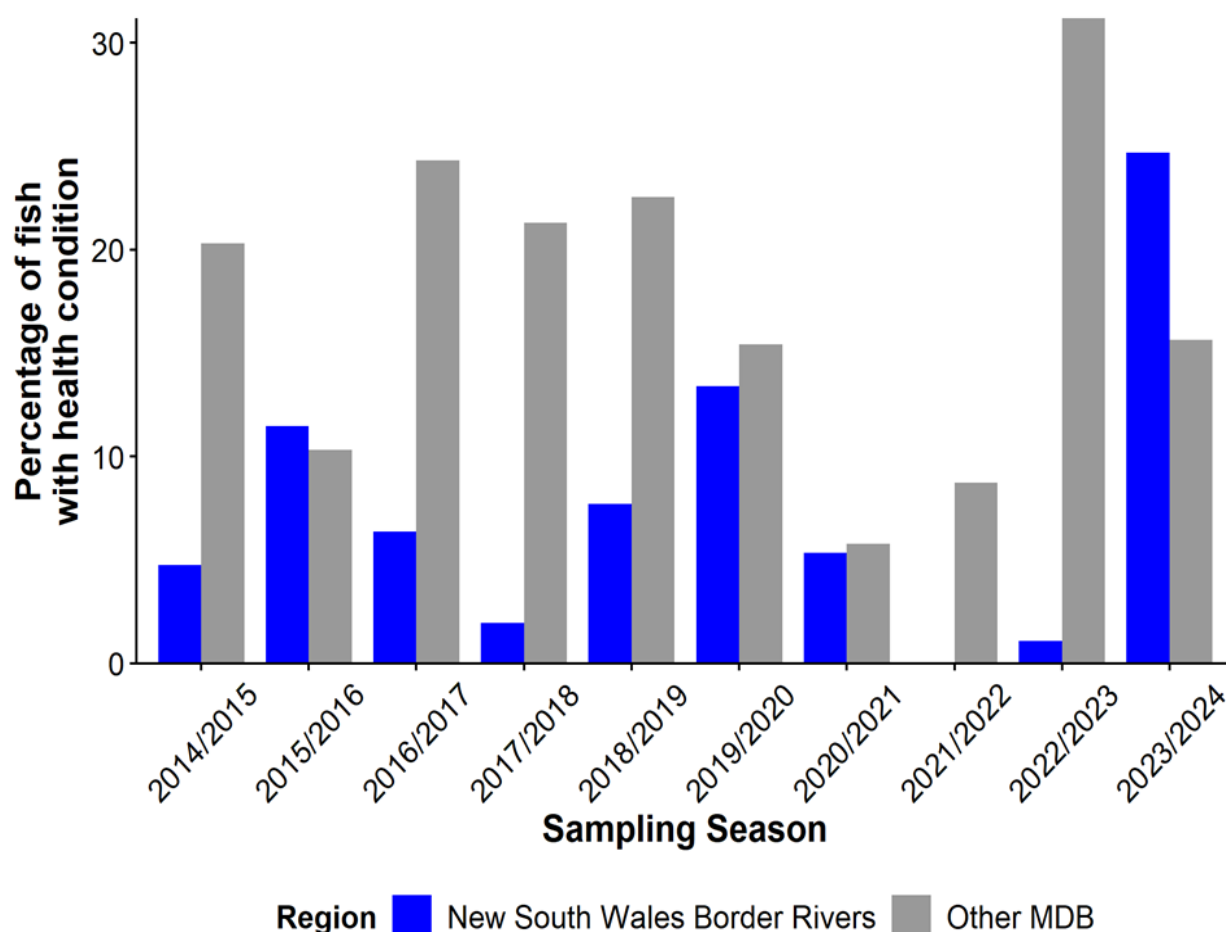


Figure 9.10: Timeseries showing the prevalence of health conditions in Murray cod. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA.

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.

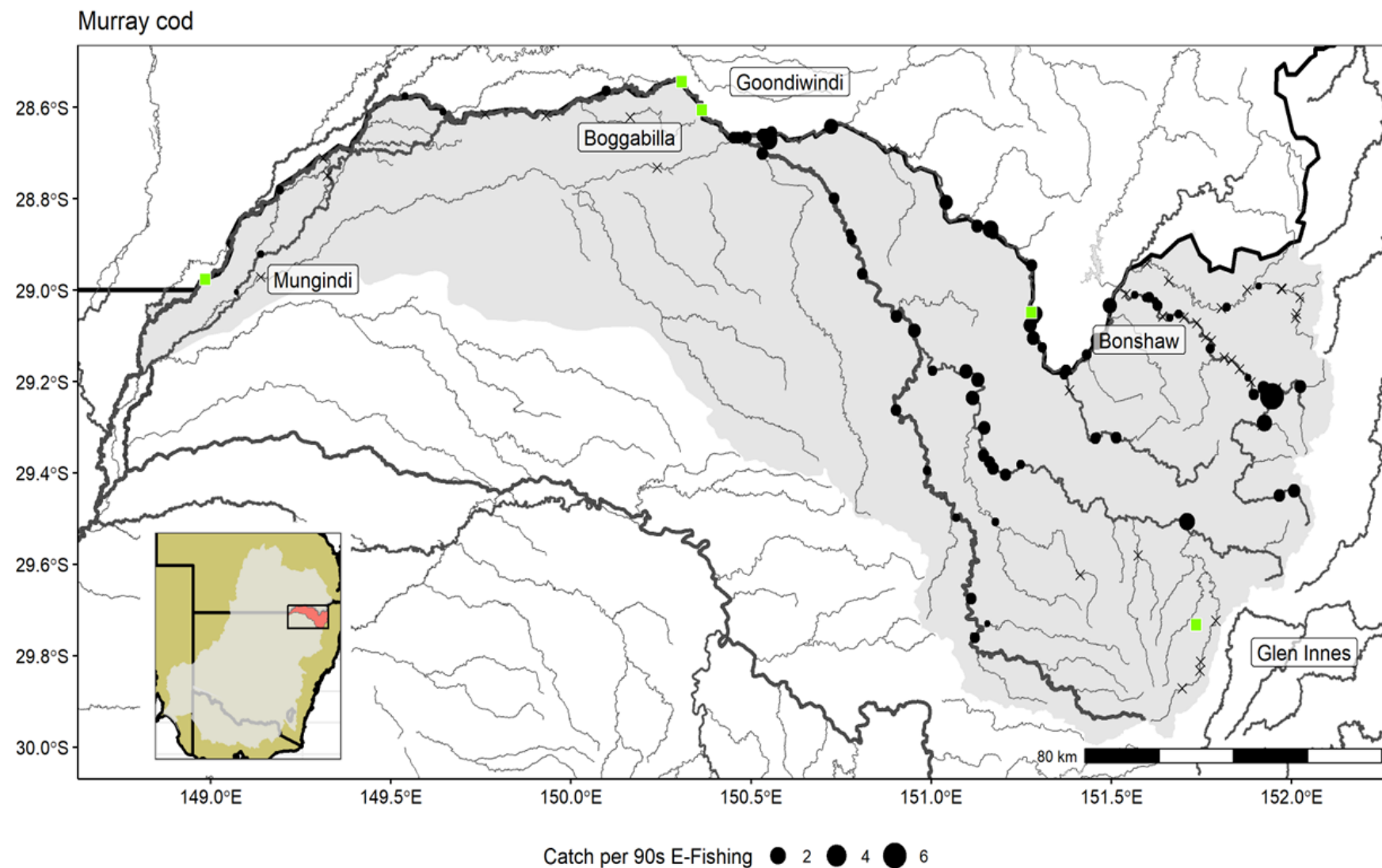


Figure 9.11: Distribution of Murray cod sampled from 2013/14 to 2023/24 in the NSW Border Rivers WRPA. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown 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).

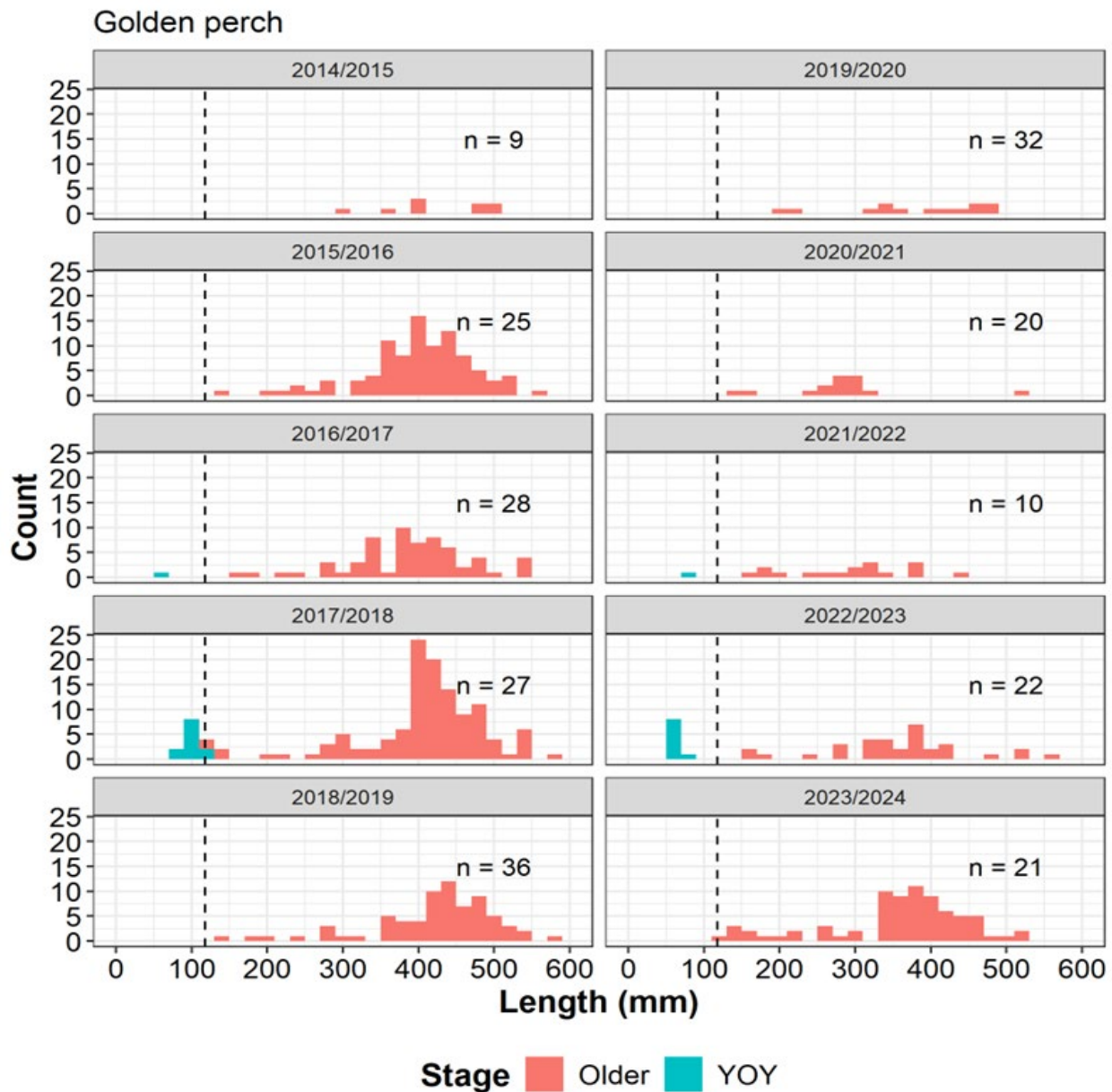


Figure 9.12: Length frequency plots for Golden perch by sampling season in the NSW Border Rivers WRPA. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRPA in a sampling season.

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 WRPAs 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 WRPAs.

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

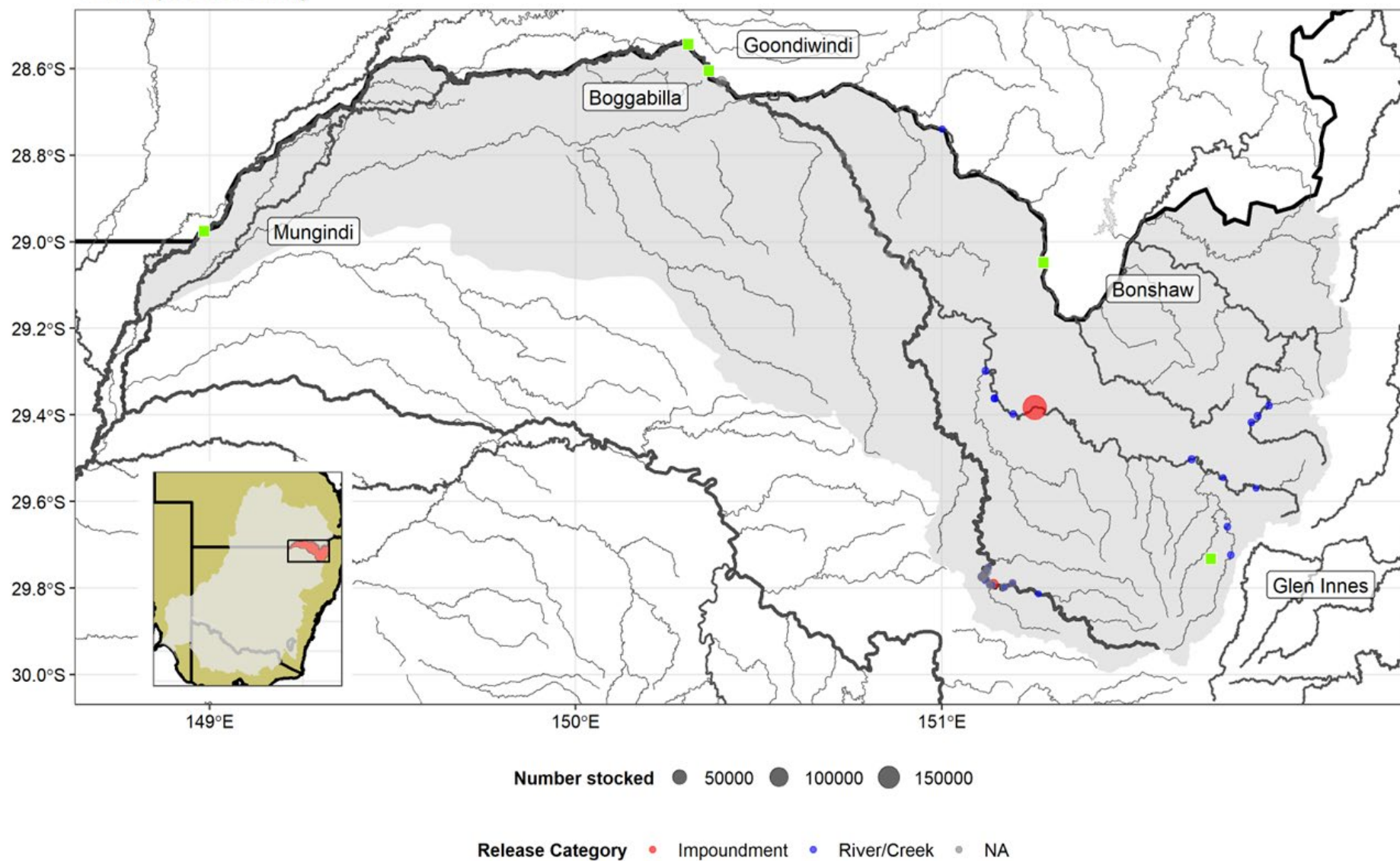


Figure 9.13: Locations of Golden perch stocking in the NSW Border Rivers WRPA. Colours show whether a site was a river/creek site or an impoundment, while the size of the point reflects the total number of fish stocked over the reporting period. Green squares represent key towns.

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 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.

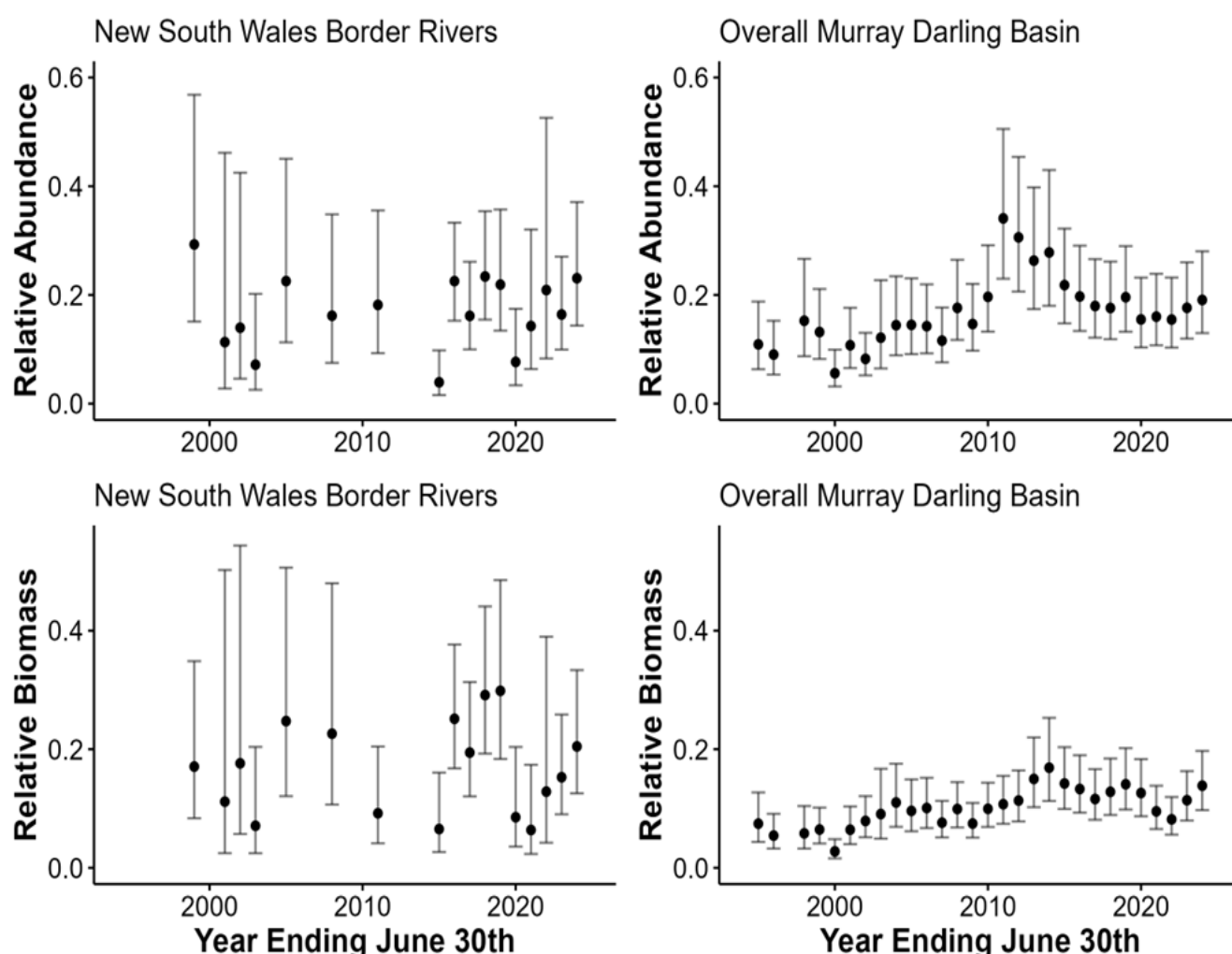


Figure 9.14: Relative abundance and biomass of Golden perch in both this valley and the overall Murray-Darling Basin. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show 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).

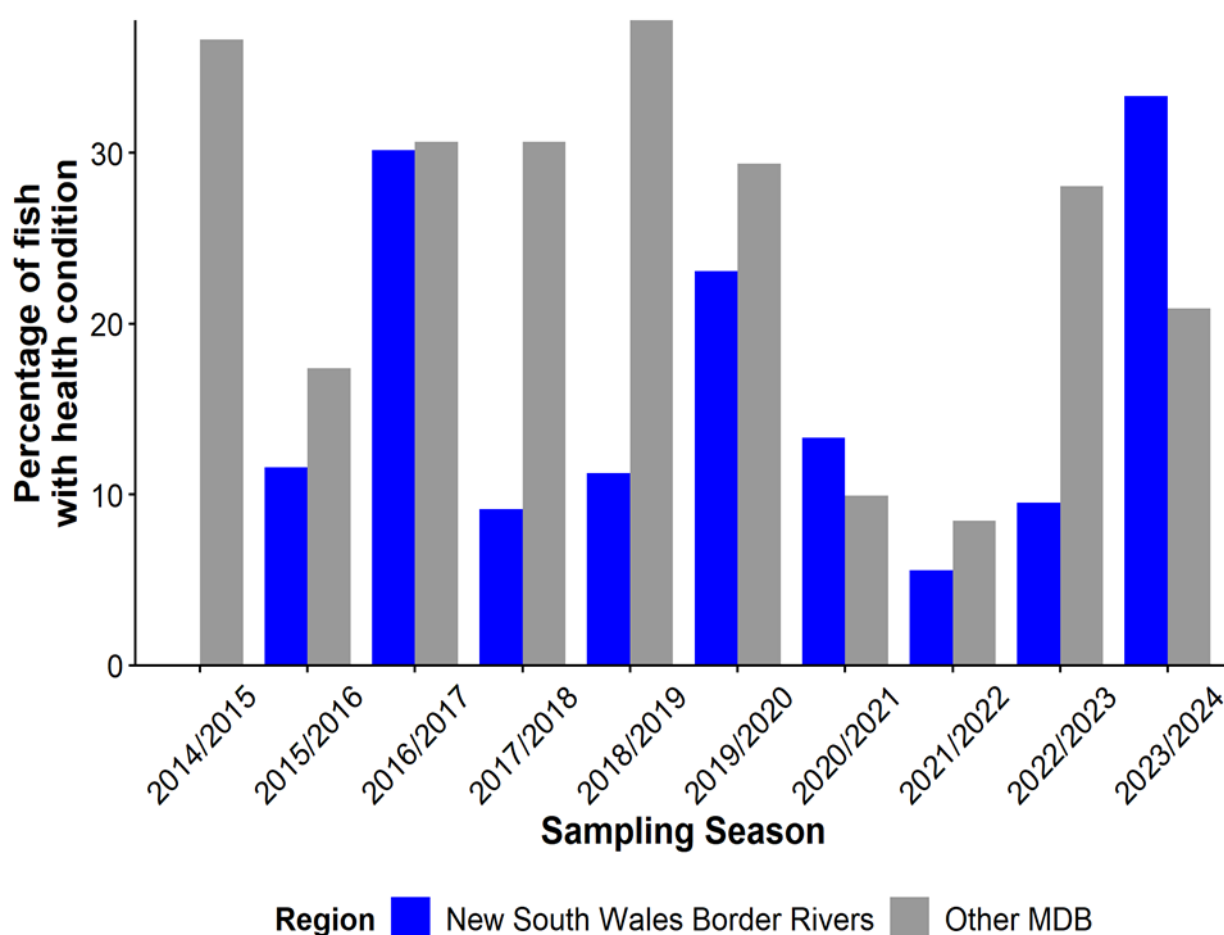


Figure 9.15: Timeseries showing the prevalence of health conditions in Golden perch. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA's.

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.

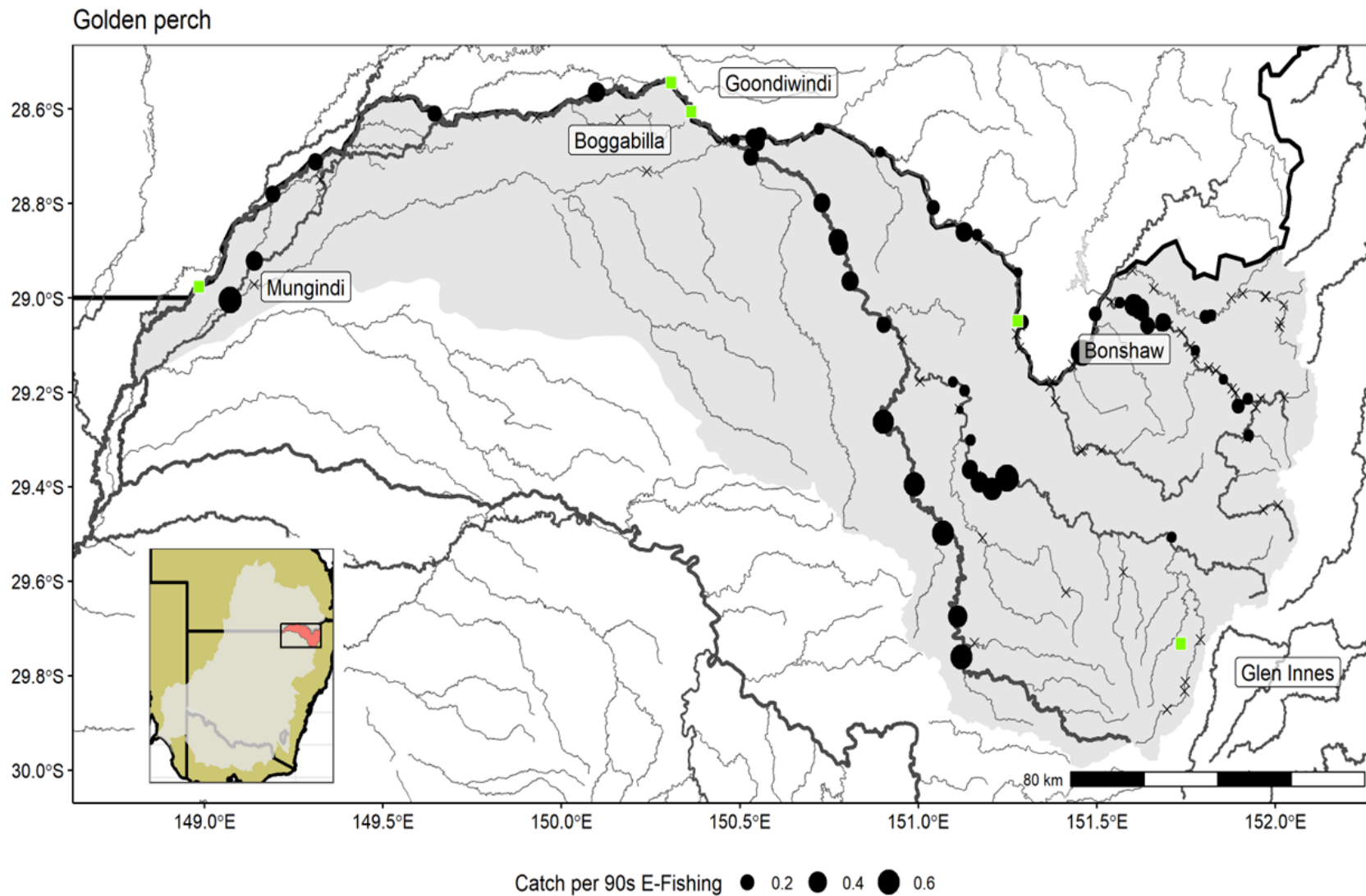


Figure 9.16: Distribution of Golden perch sampled from 2013/14 to 2023/24 in the NSW Border Rivers WRP. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown 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).

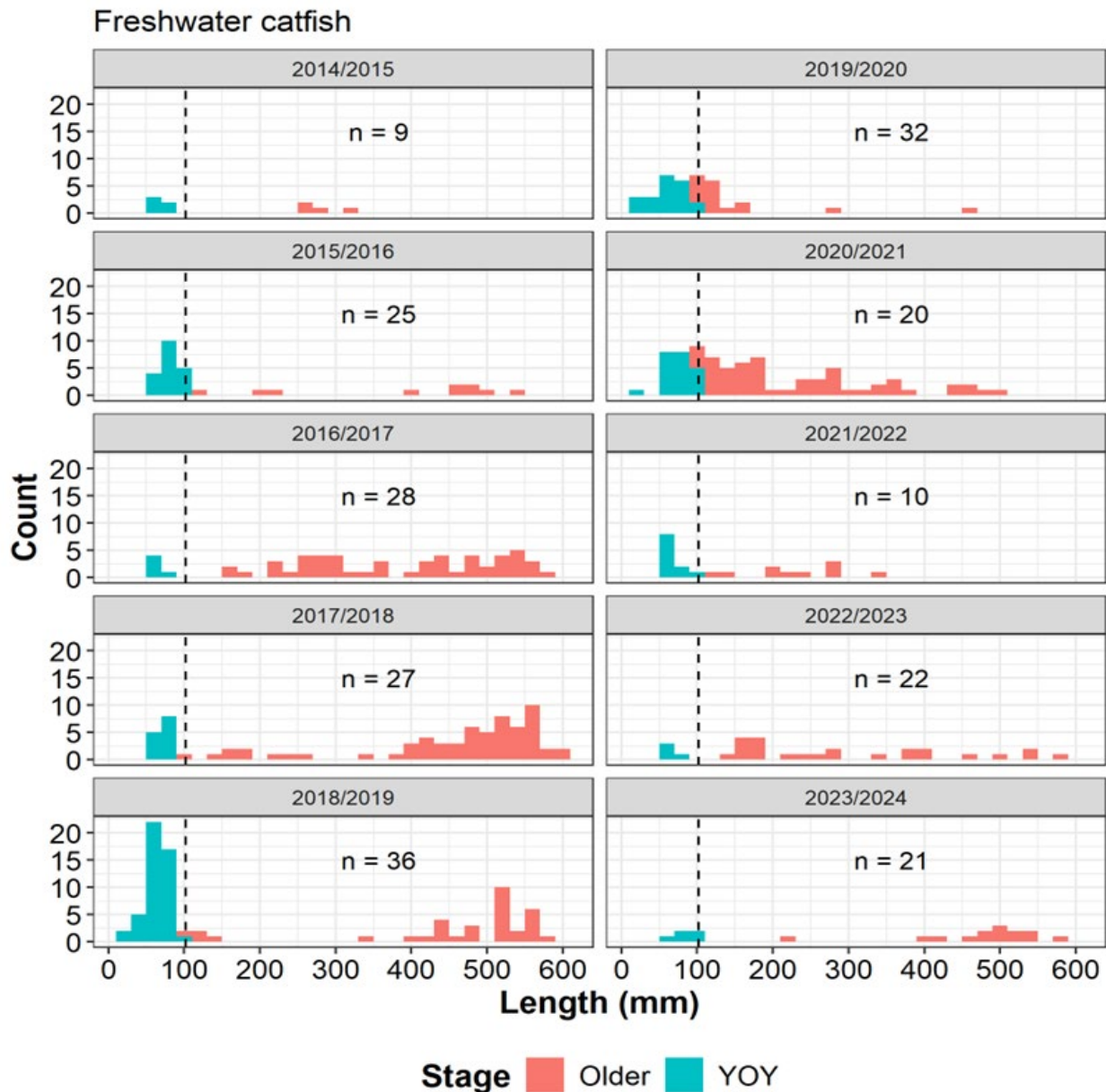


Figure 9.17: Length frequency plots for Freshwater catfish by sampling season in the NSW Border Rivers WRPA. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRPA in a sampling season.

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.

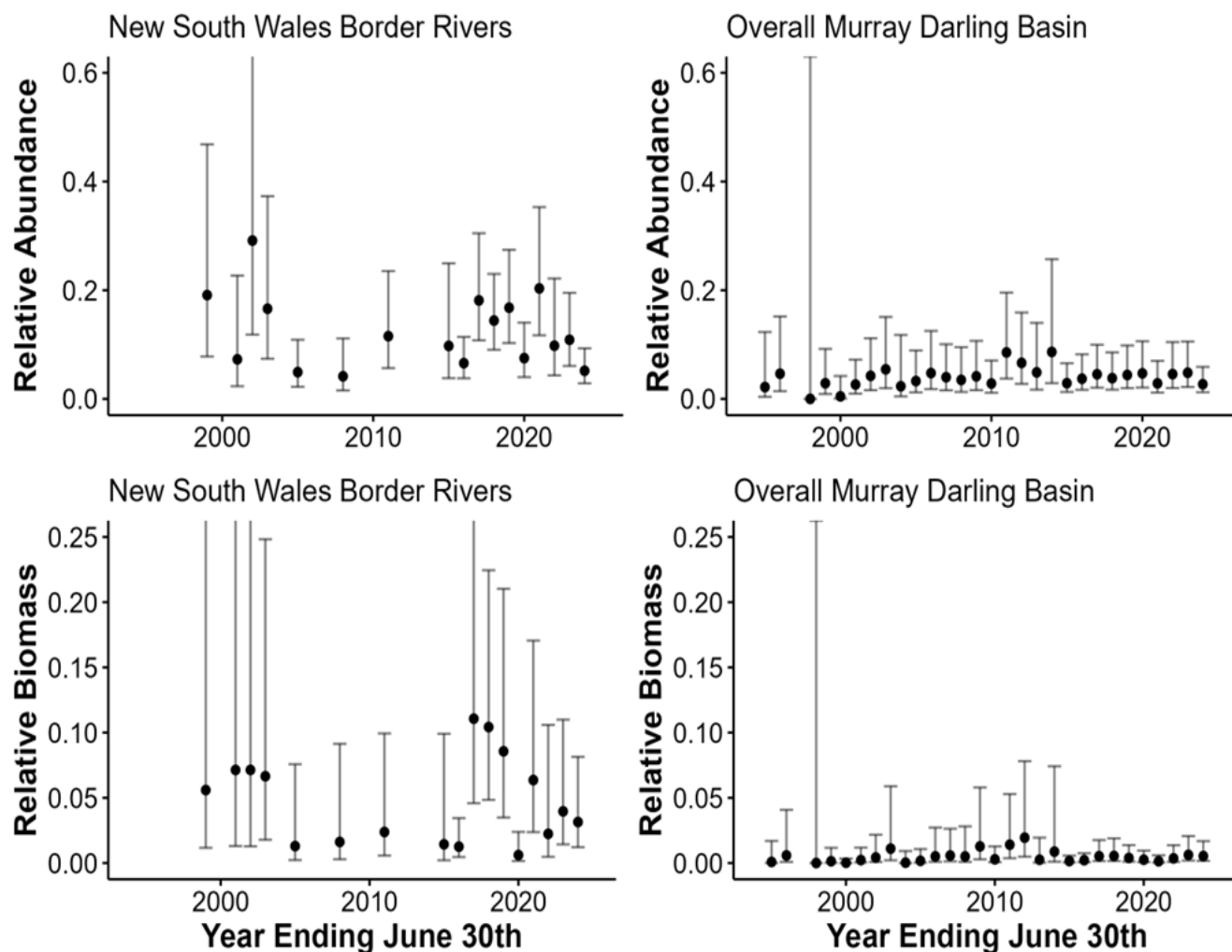


Figure 9.18: Relative abundance and biomass of Freshwater catfish in both this valley and the overall Murray-Darling Basin. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars 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).

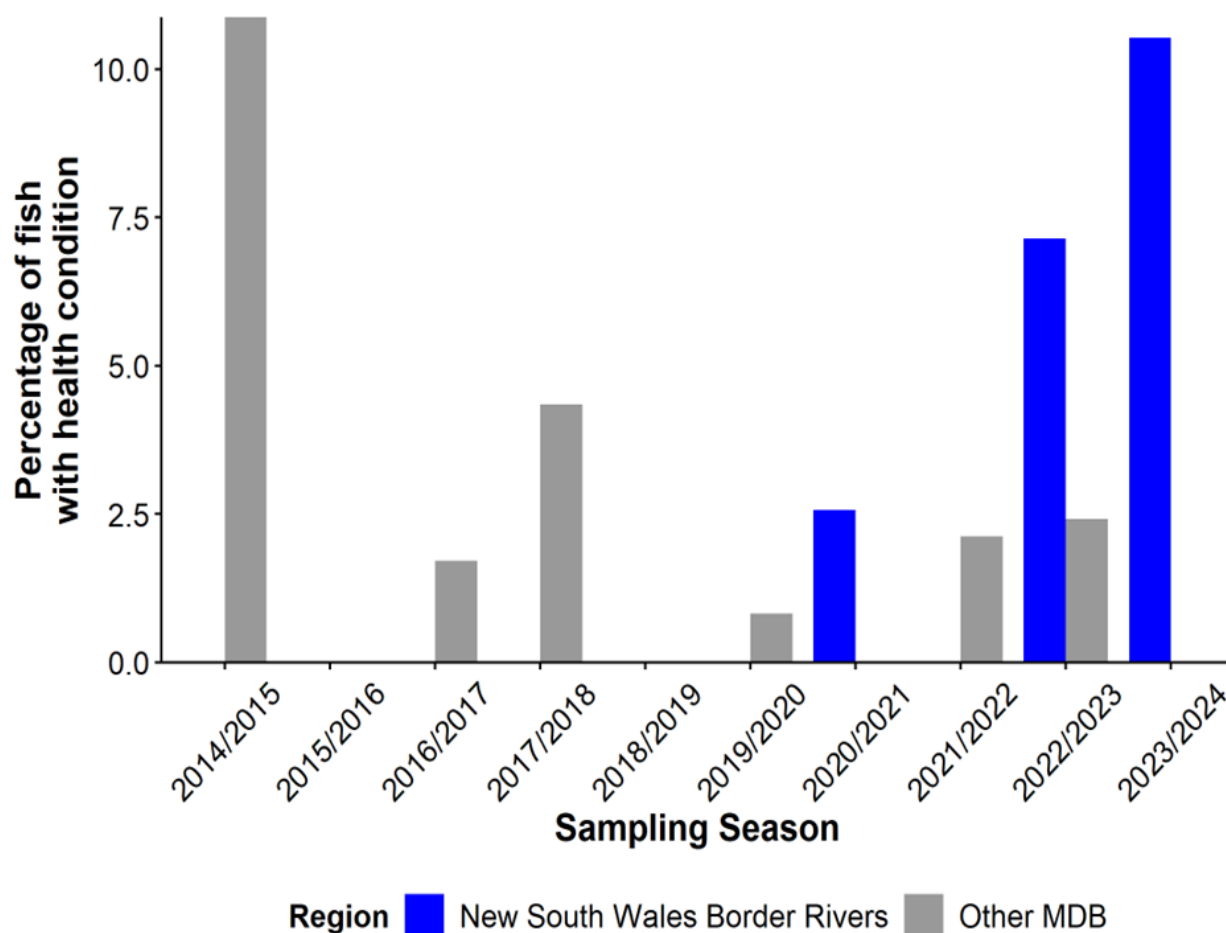


Figure 9.19: Timeseries showing the prevalence of health conditions in Freshwater catfish. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPAs.

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.

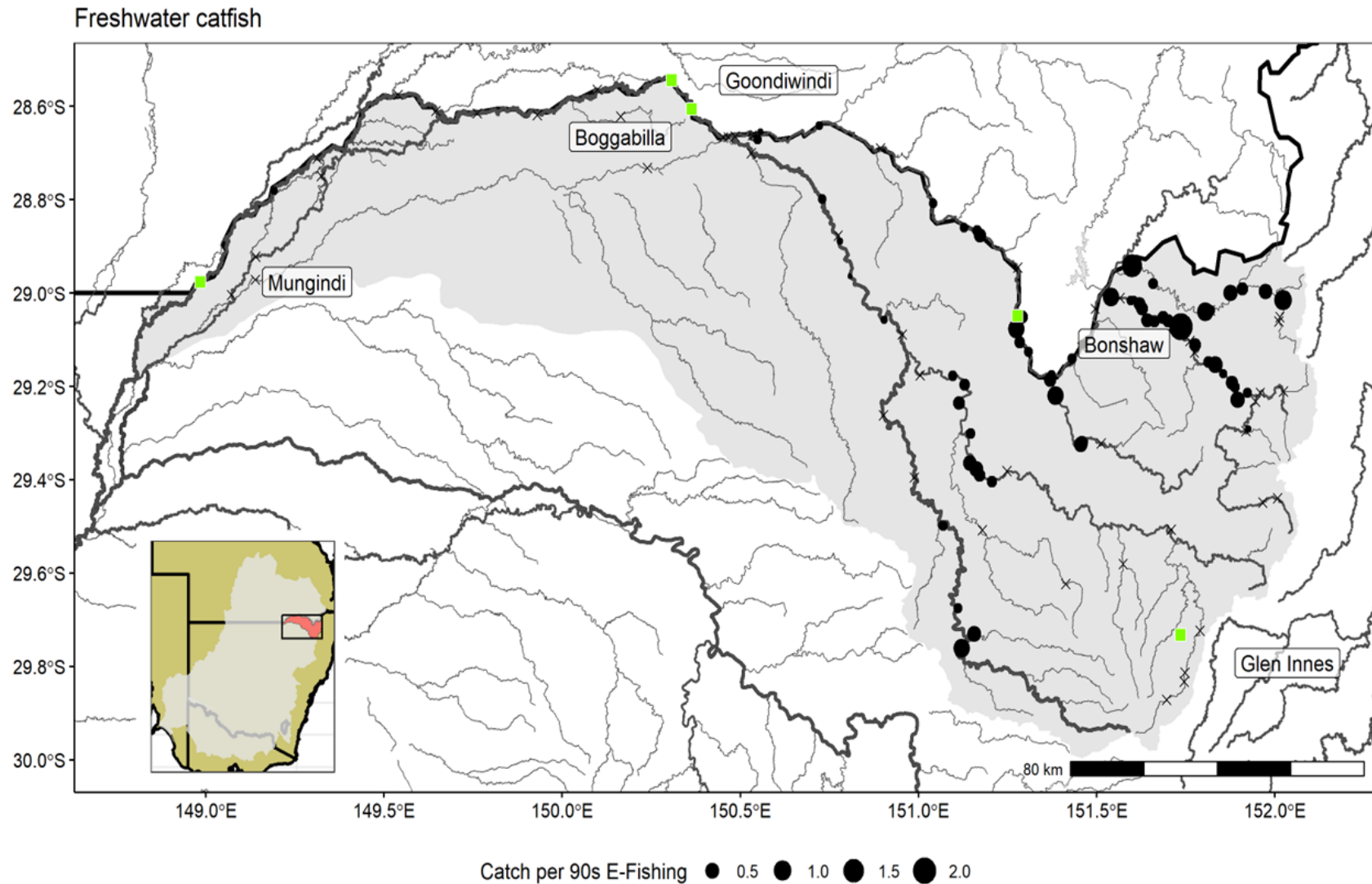


Figure 9.20: Distribution of Freshwater catfish sampled from 2013/14 to 2023/24 in the NSW Border Rivers WRPA. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares represent key towns.

Bony herring



Population Structure

Figure 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.

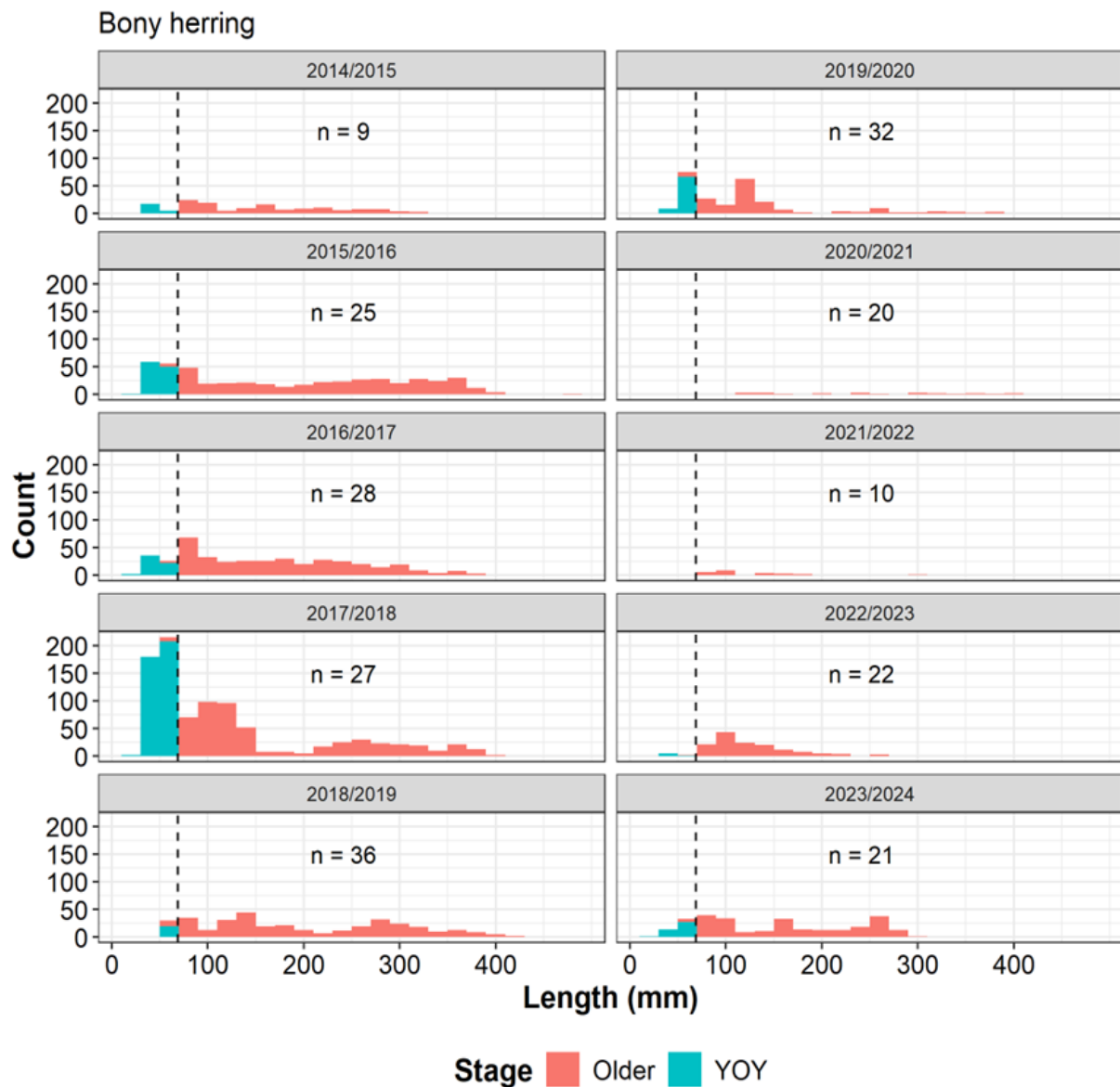


Figure 9.21: Length frequency plots for Bony herring by sampling season in the NSW Border Rivers WRPA. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRPA in a sampling season.

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.

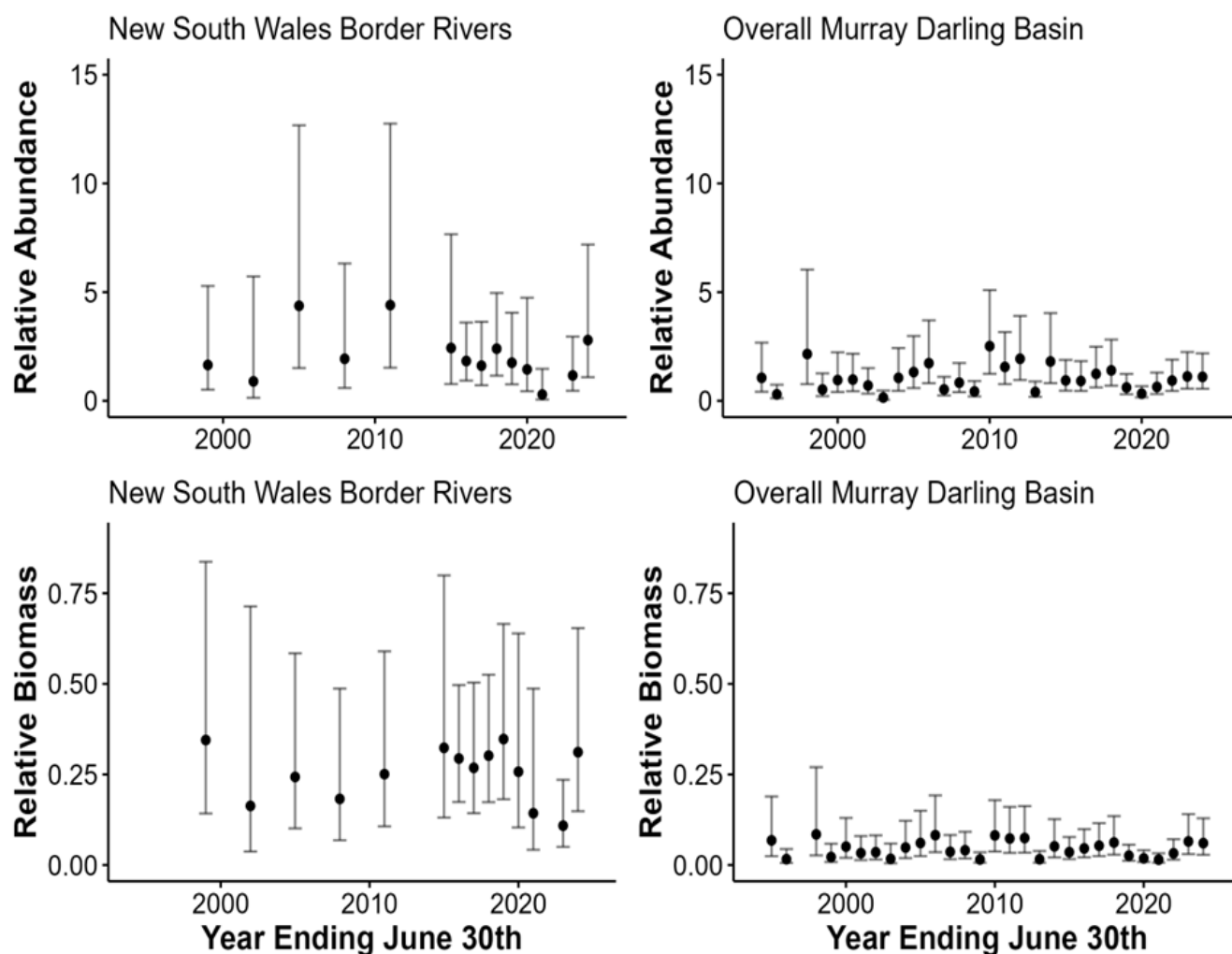


Figure 9.22: Relative abundance and biomass of Bony herring in both the NSW Border Rivers and the overall NSW MDB. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 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).

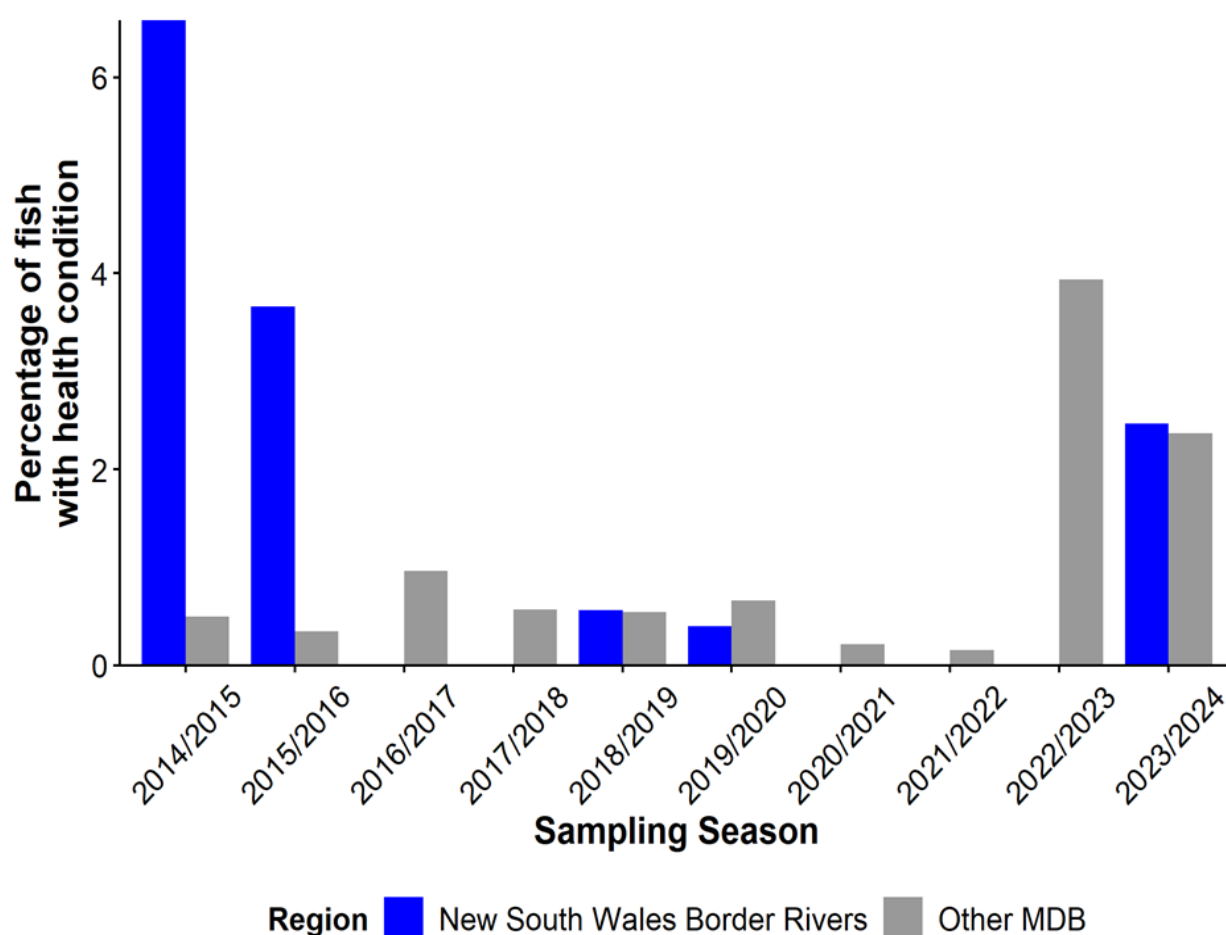


Figure 9.23: Timeseries showing the prevalence of health conditions in Bony herring. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA.

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).

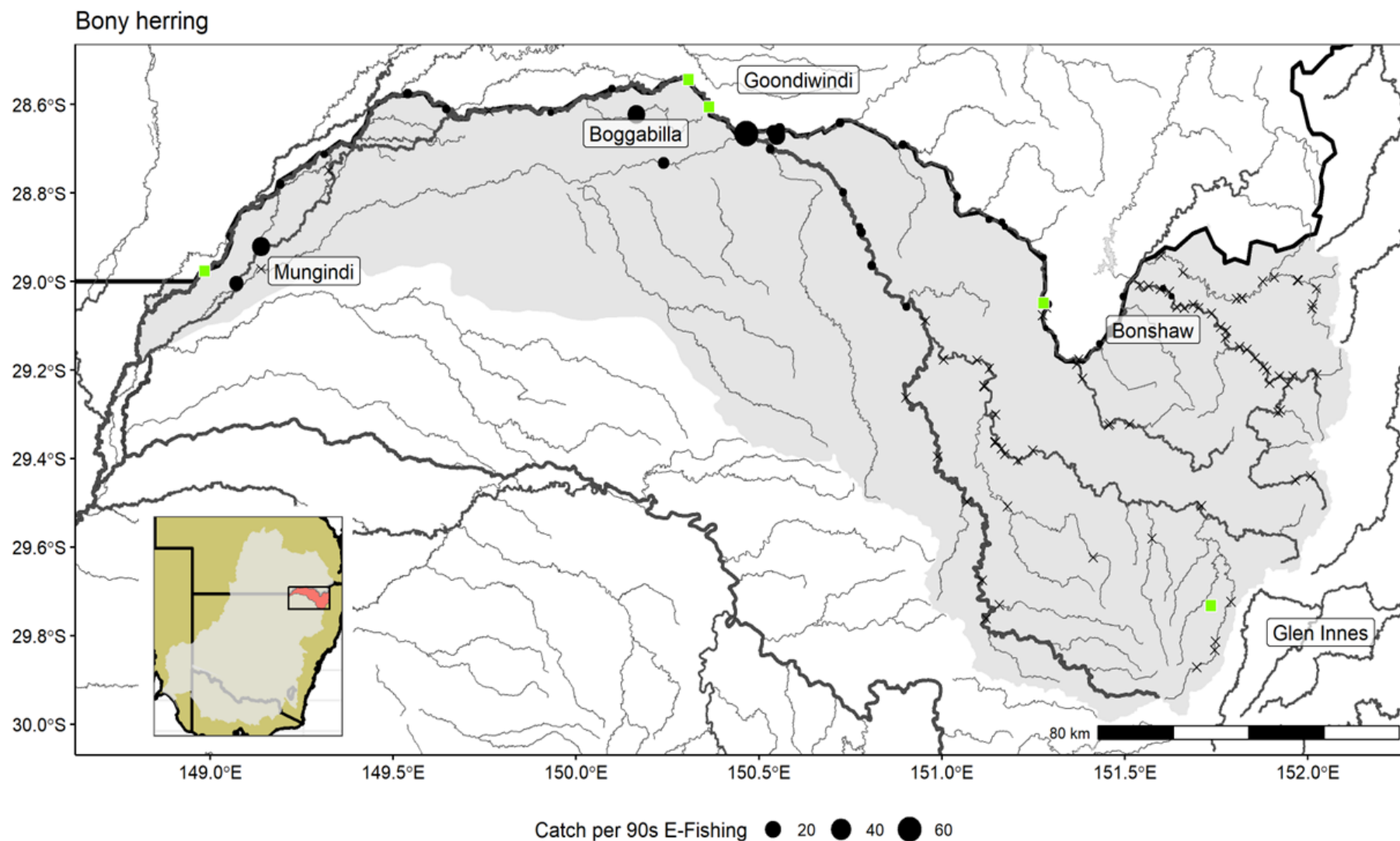


Figure 9.24: Distribution of Bony herring sampled from 2013/14 to 2023/24 in the NSW Border Rivers WRPA. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown 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.

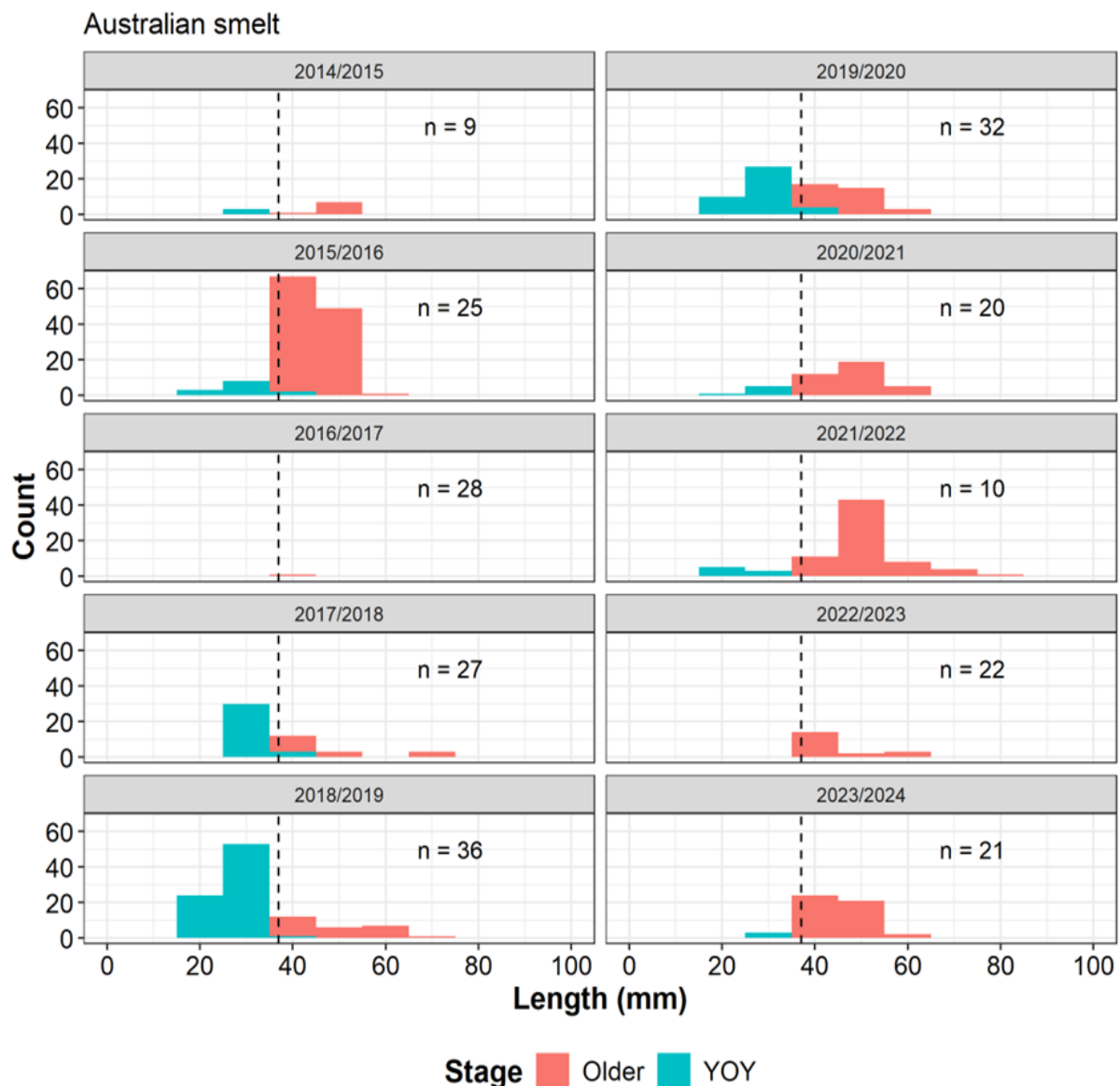


Figure 9.25: Length frequency plots for Australian smelt by sampling season in the NSW Border Rivers WRPA. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRPA in a sampling season.

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.

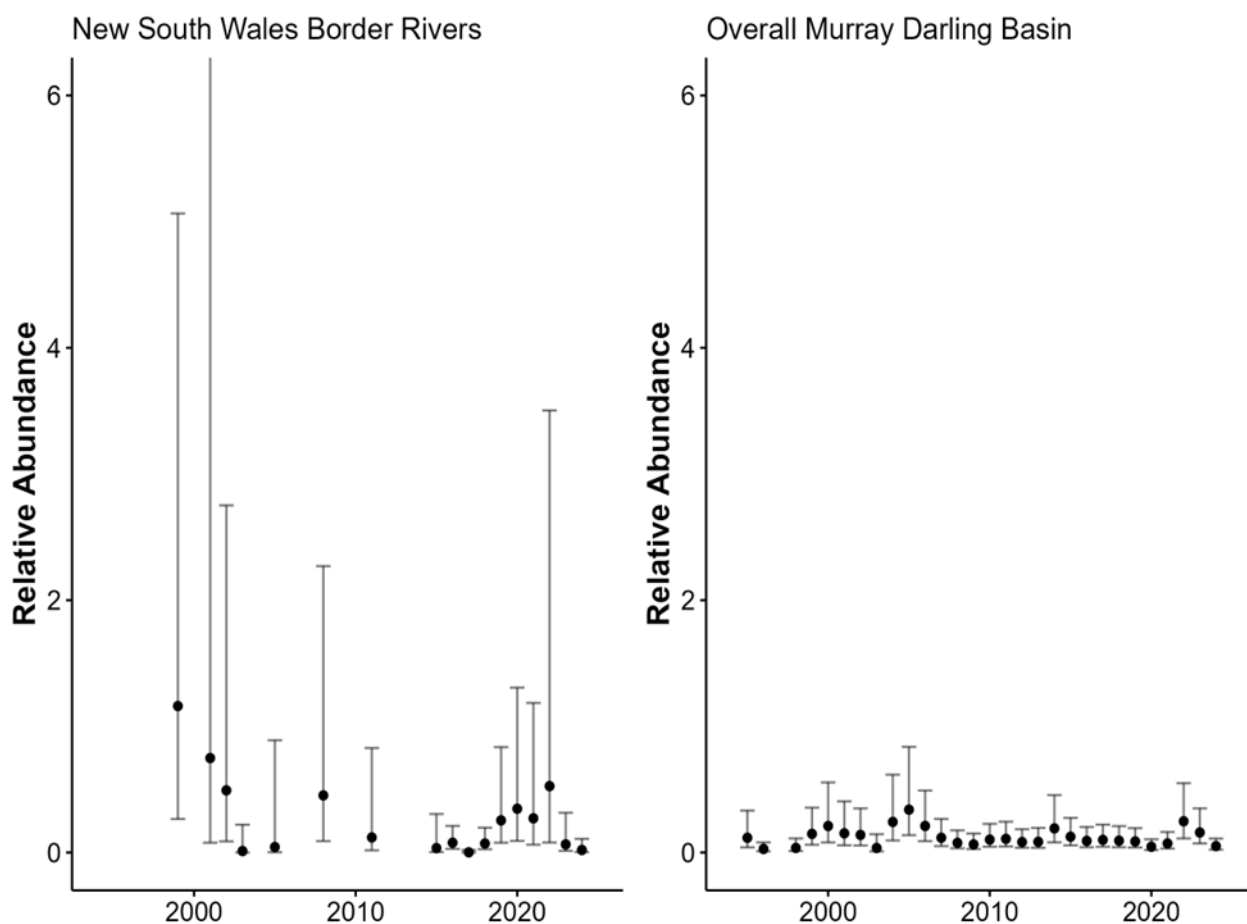


Figure 9.26: Relative abundance of Australian smelt in both the NSW Border Rivers WRPA and the overall NSW MDB. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % 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, 1 % of Australian smelt (173 out of 27,381 Australian smelt) showed a health condition (excludes the New South Wales Border Rivers WRPAs).

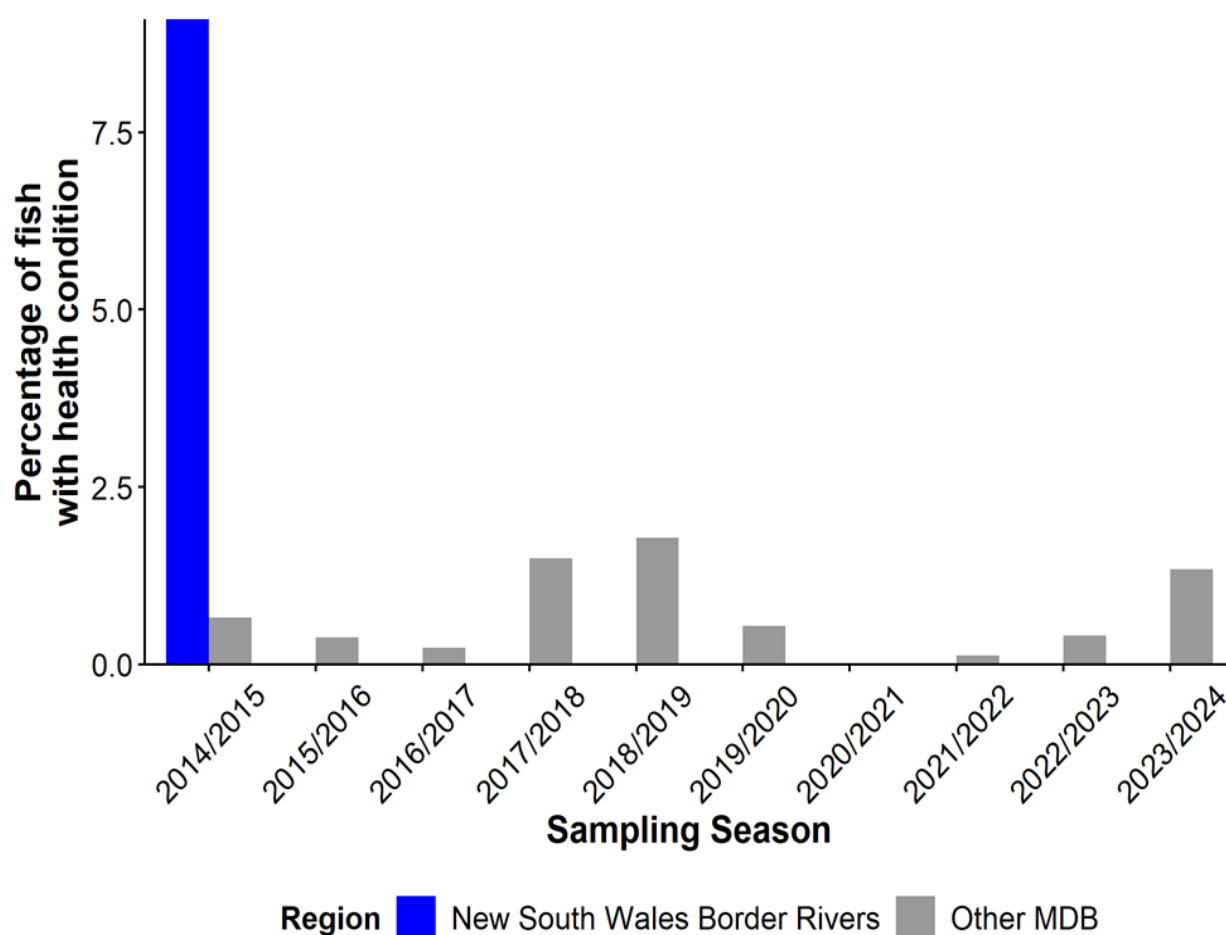


Figure 9.27: Timeseries showing the prevalence of health conditions in Australian smelt. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA.

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 WRPAs 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 WRPAs.

Summary Statement:

Australian smelt were recorded across the eastern and central region of the NSW Border Rivers WRPAs.

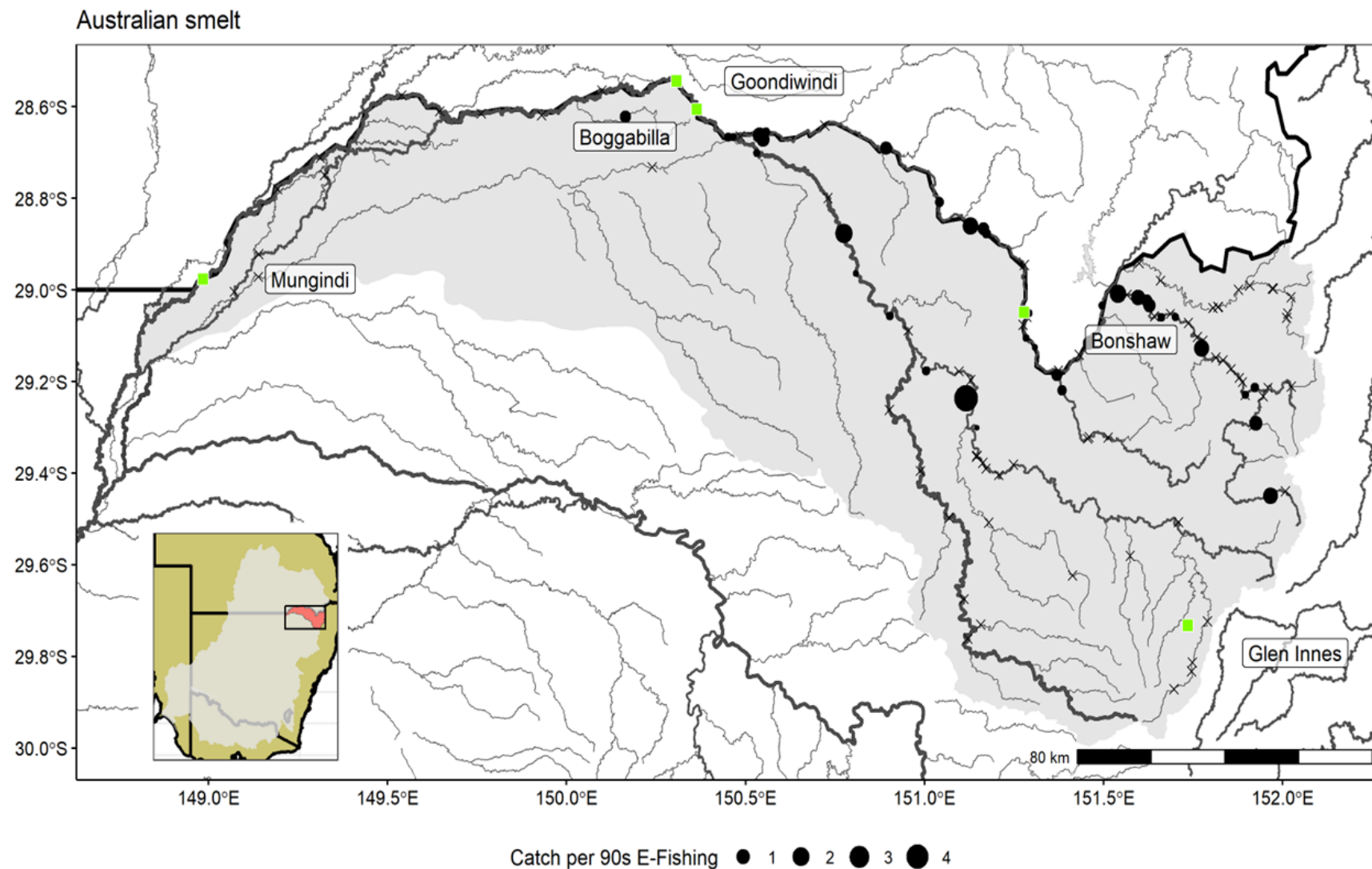


Figure 9.28: Distribution of Australian smelt sampled from 2013/14 to 2023/24 in the NSW Border Rivers WRPA. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are 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.

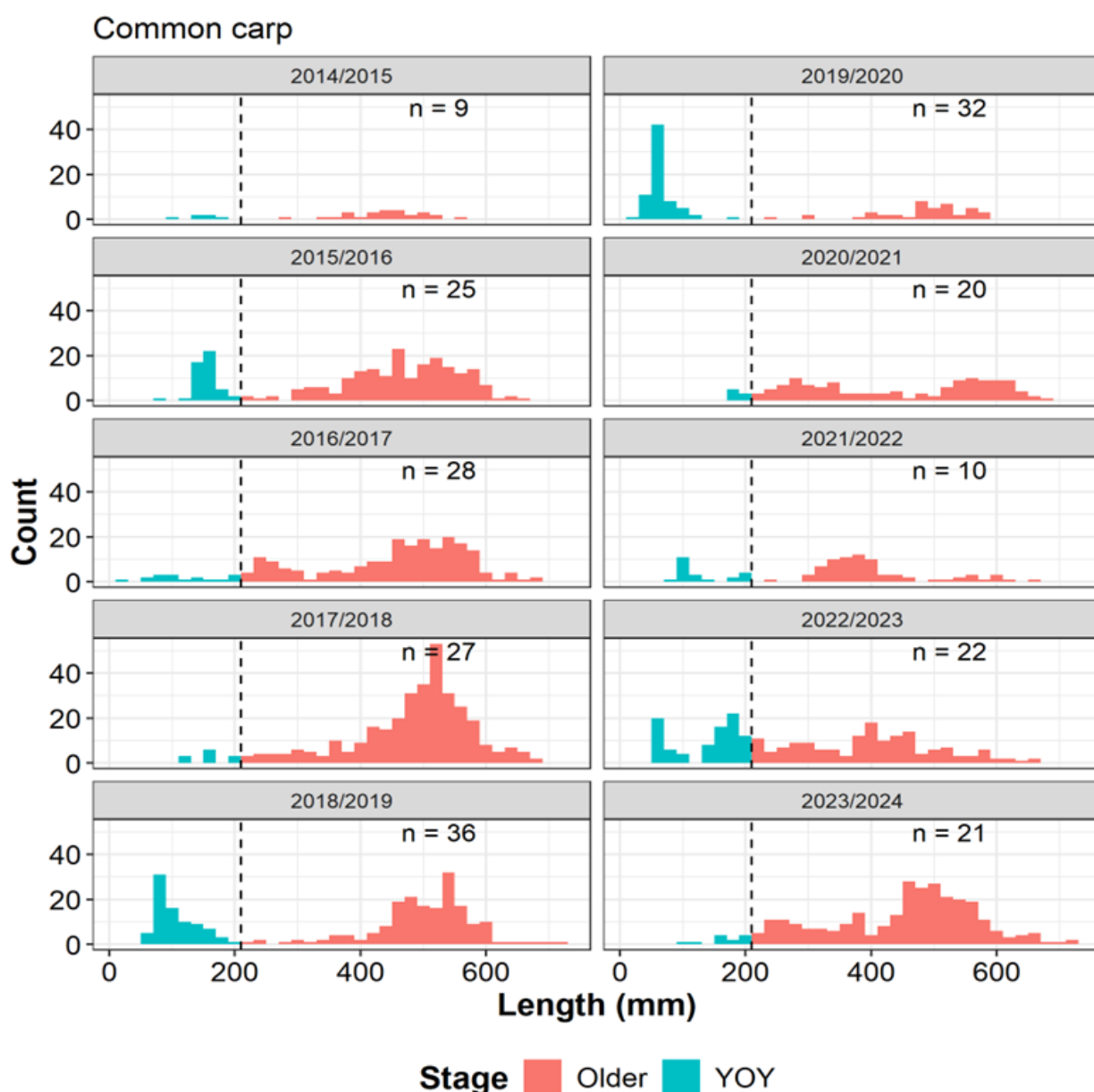


Figure 9.29: Length frequency plots for common carp by sampling season in the NSW Border Rivers WRPA. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRPA in a sampling season.

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.

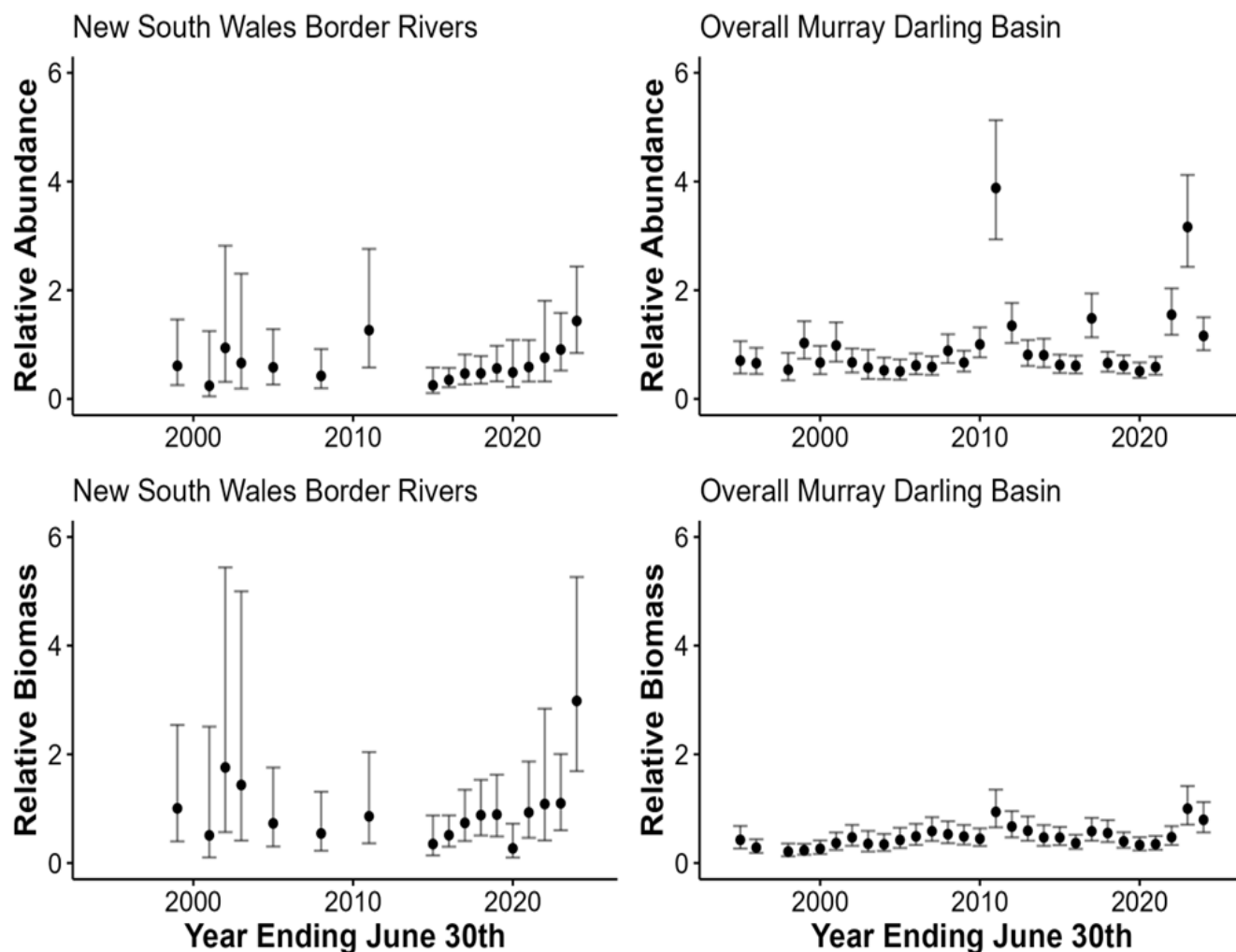


Figure 9.30: Relative abundance and biomass of Common carp in both this valley and the overall Murray-Darling Basin. These are model estimates based upon all electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % 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).

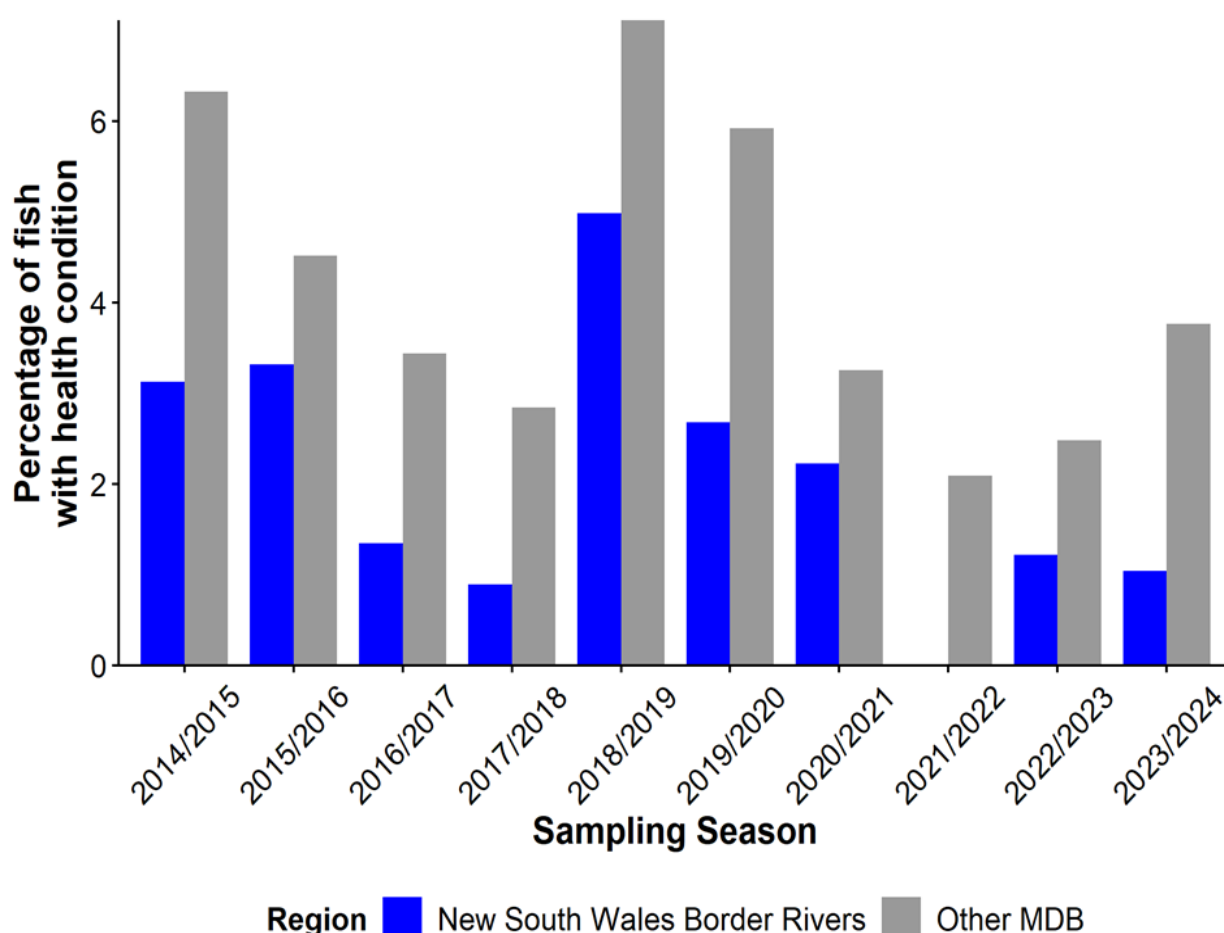


Figure 9.31: Timeseries showing the prevalence of health conditions in Common carp. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA's.

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.

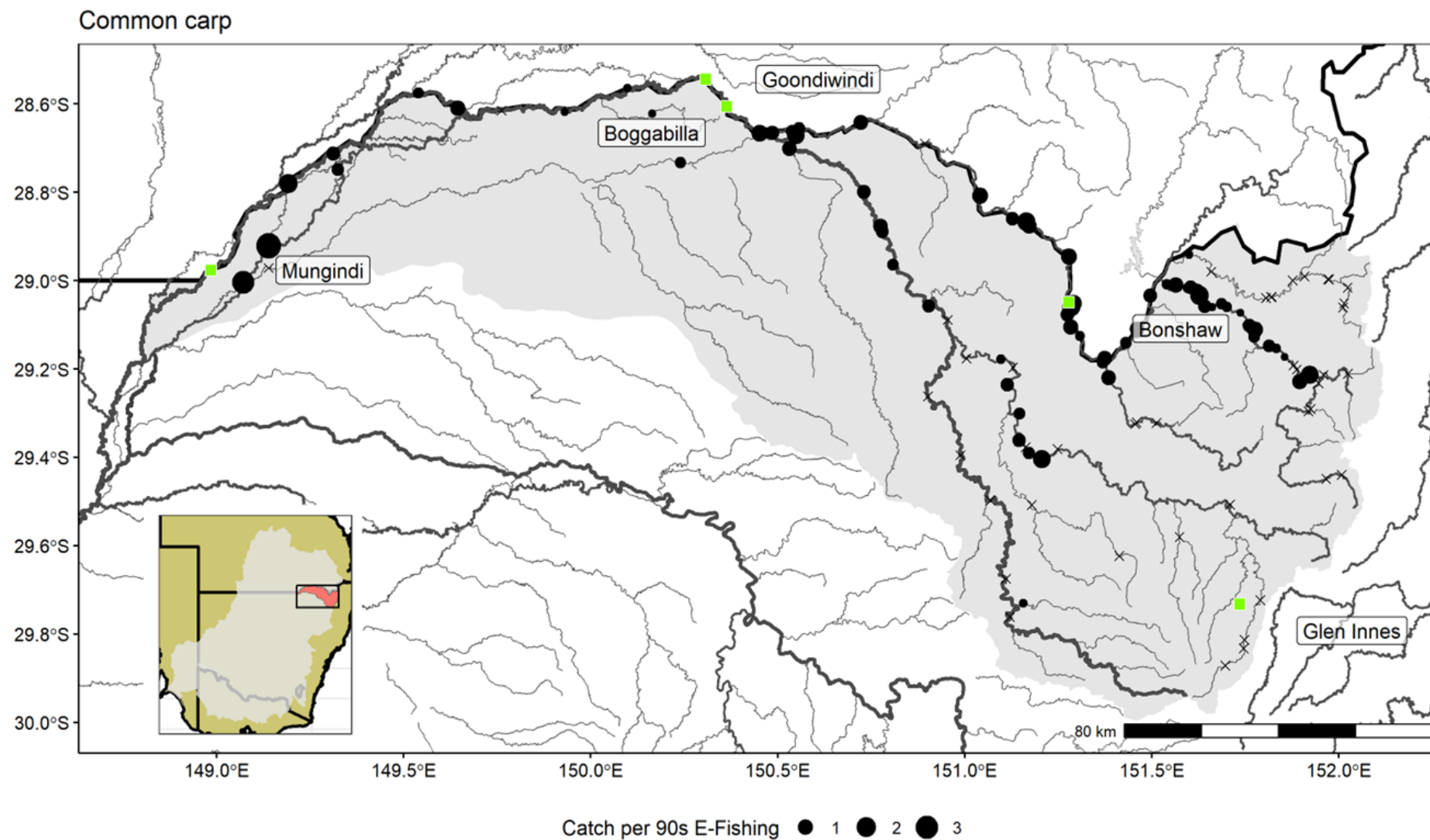


Figure 9.32: Distribution of Common carp sampled from 2013/14 to 2023/24 in the NSW Border Rivers WRPA. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown 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)

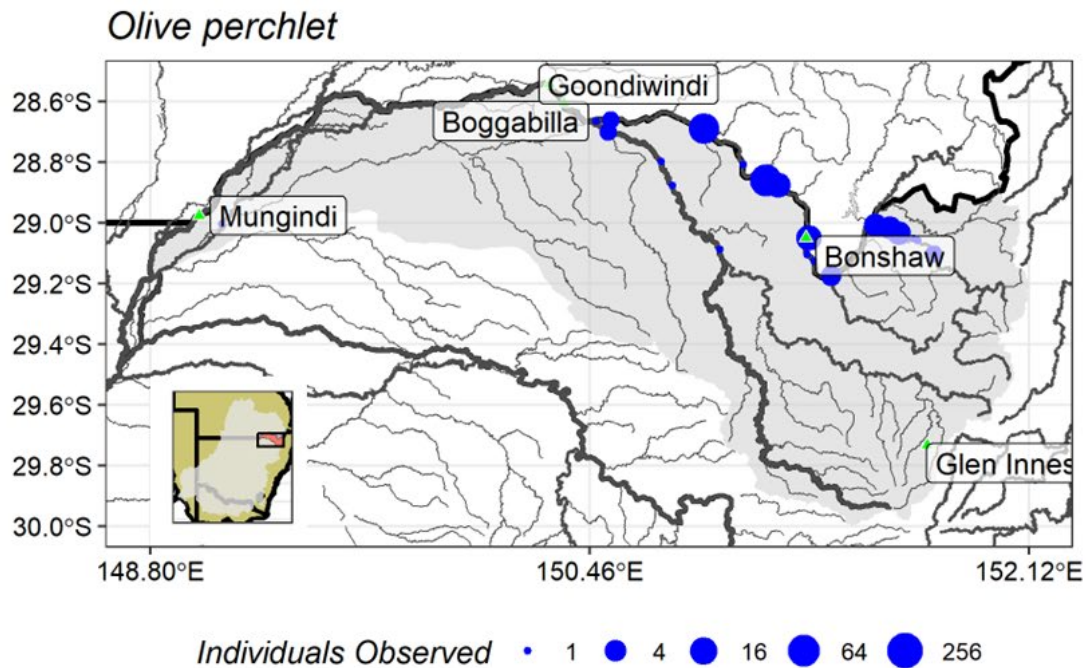


Figure 9.33: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the NSW Border Rivers WRPA. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance.

Summary Statement:

A total of 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.

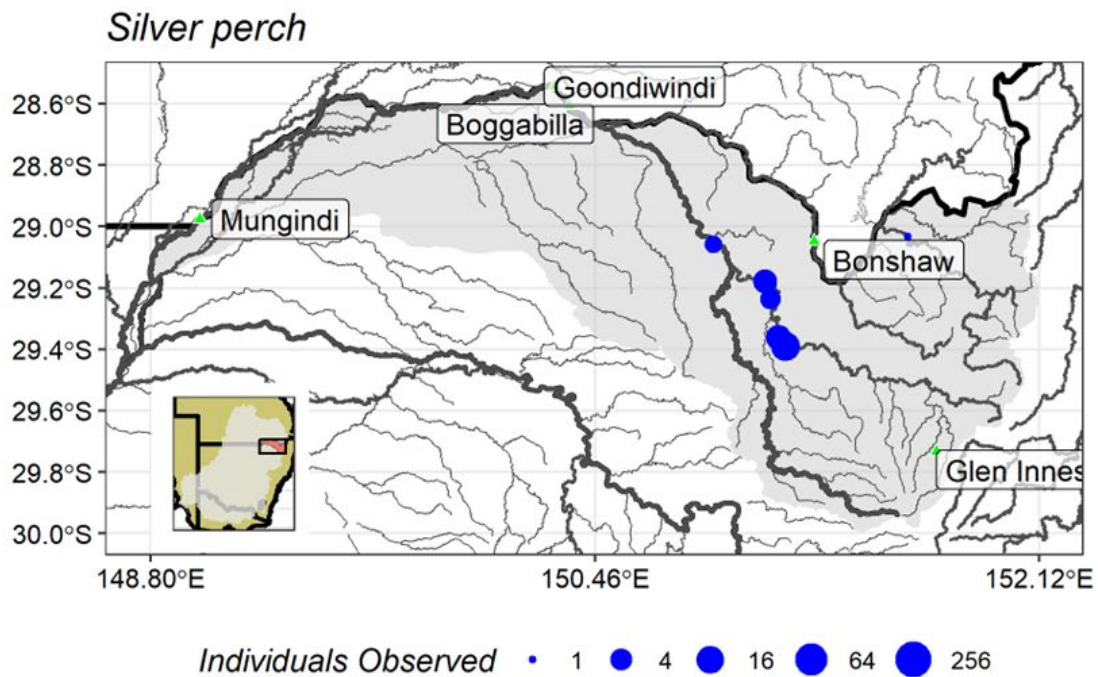


Figure 9.34: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the NSW Border Rivers WRPA. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance.

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.

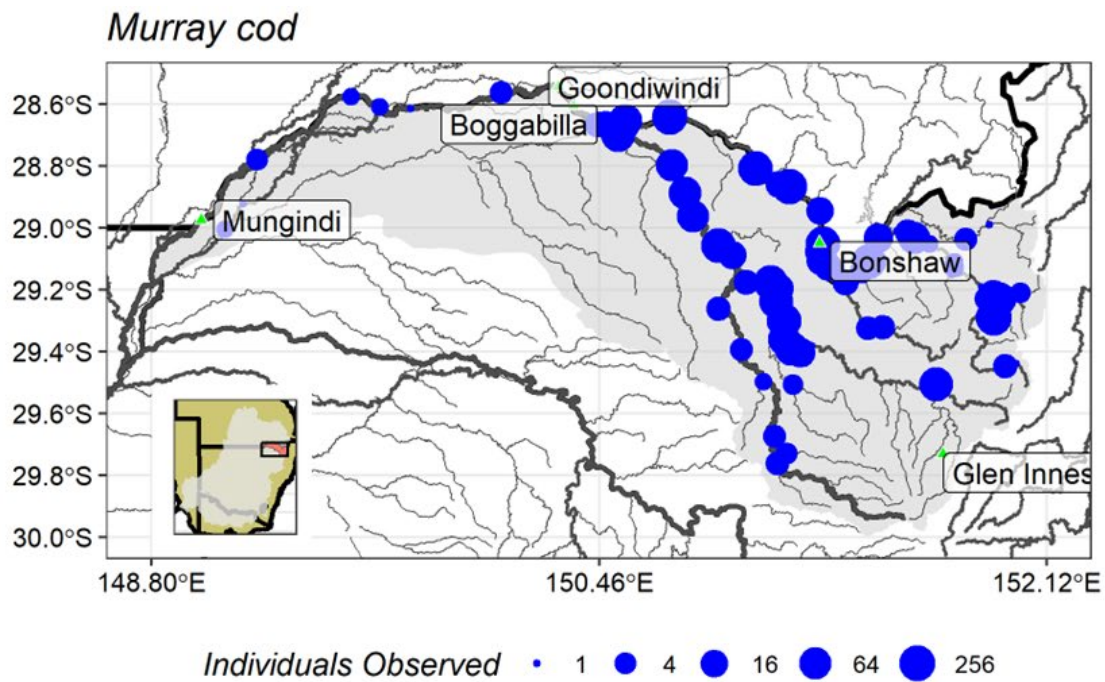


Figure 9.35: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the NSW Border Rivers WRPA. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance. Note the lower image shows a juvenile Murray 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.

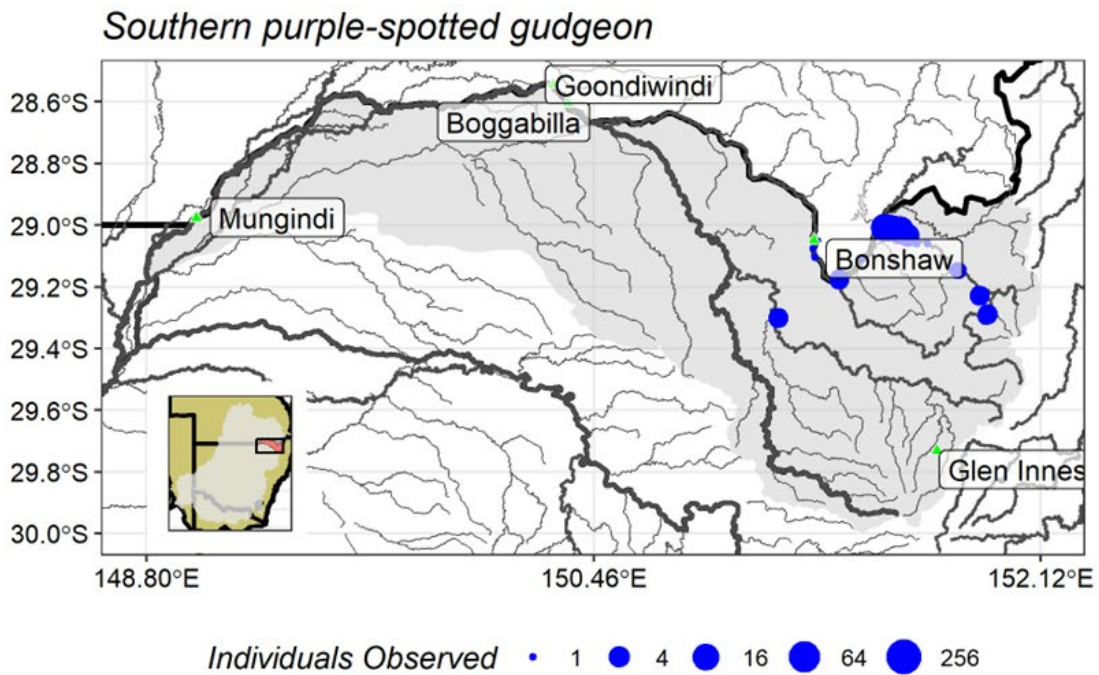


Figure 9.36: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the NSW Border Rivers WRPA. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance.

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.

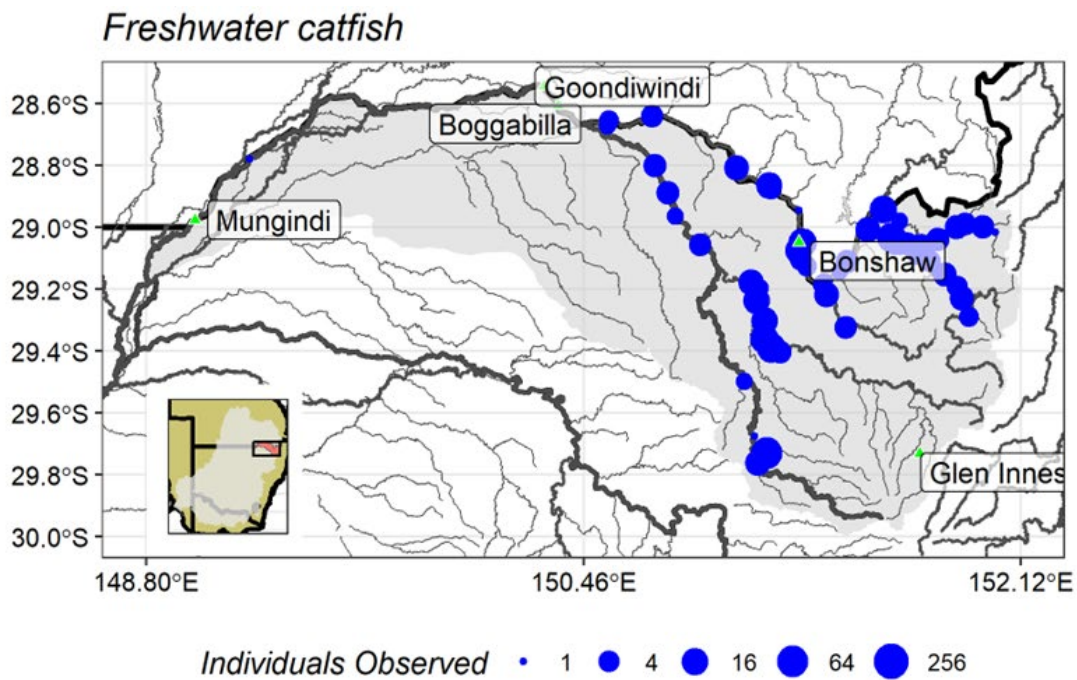


Figure 9.37: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the NSW Border Rivers WRPA. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance.

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

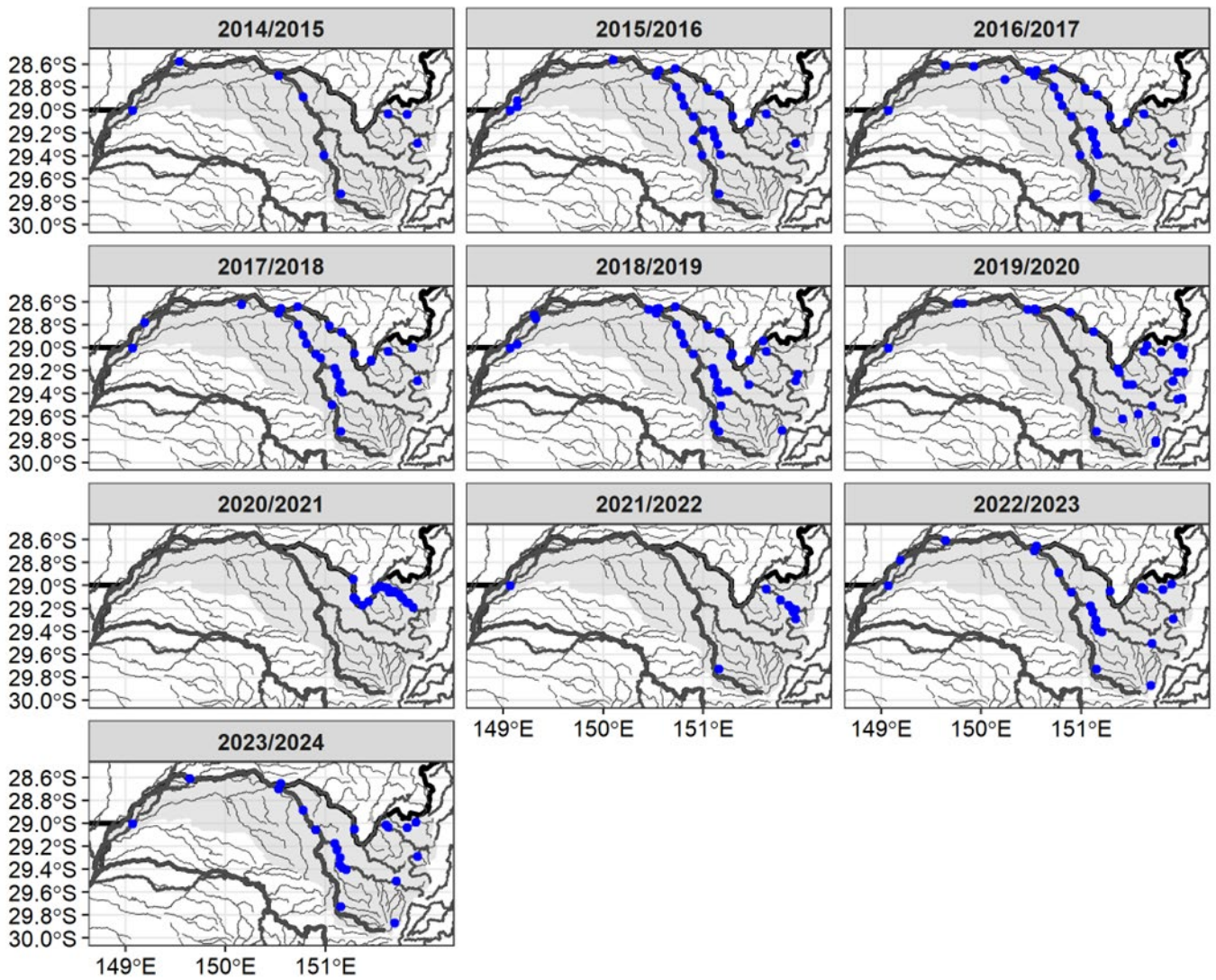


Figure 9.38: Sites sampled and included in this report by sampling season in the NSW Border Rivers WRPA. Dry sites are not shown.

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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