

Chapter 11 Basin Plan Fish Monitoring Summary (2014/15 – 2023/24): NSW Murray 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 New South Wales Murray Water Resource Planning Area (WRPA) shown in Figure 11.1.

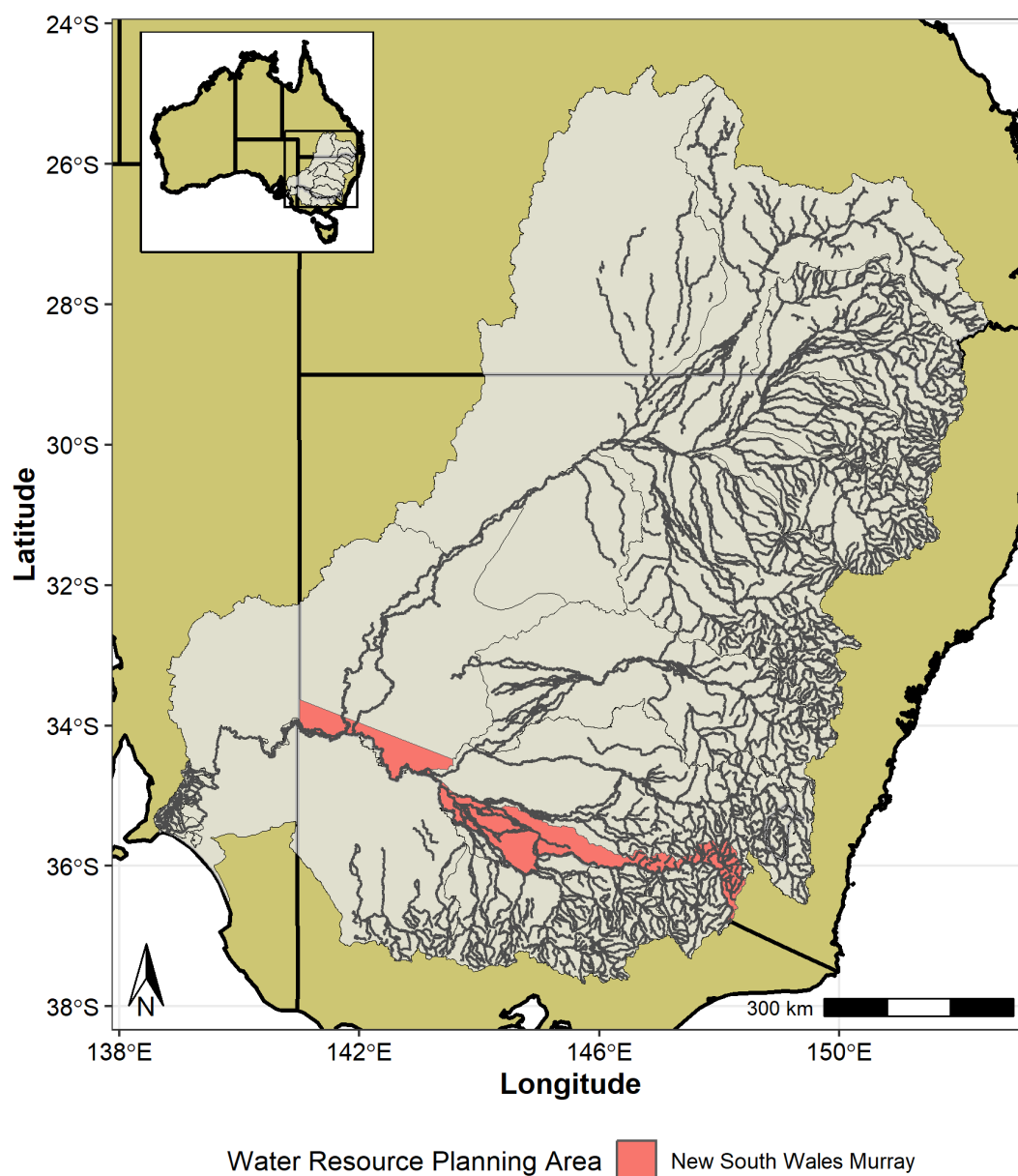


Figure 11.1: Murray-Darling Basin with the key region of this report highlighted. Inset map shows the whole of Australia with a box around the MDB.

What This Report Includes

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

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

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

- Murray cod
- Golden perch
- Freshwater catfish (Very few fish were observed in this WRP during the reporting period)
- Bony herring
- Australian smelt
- Common carp

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

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

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

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

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

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

Sampling Methods

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

As parts of this report compile data from multiple projects, there is some variation in how sites were chosen and the effort of sampling conducted each year (Table 11.1). Details of which projects contributed data to this report can be seen in Table 11.7. At each site, sampling gear was applied as suited to the local conditions with either boat, backpack, or a hybrid of the two, in addition to 10 unbaited bait traps set in edge margins. Most sampling occurred between the months of September and May.

Table 11.1: Sampling effort (Number of sites sampled) each sampling season in the NSW Murray WRPAs. Variation in sampling effort is due to different numbers of projects and interruptions to planned sampling such as flooding, site desiccation, and extreme weather.

Sampling Season	Number of Boat Electrofishing Sites	Number of Backpack Electrofishing Sites	Number of Hybrid Sites	Total
2014/2015	50	25	0	75
2015/2016	56	10	1	67
2016/2017	67	30	0	97
2017/2018	61	29	1	91
2018/2019	76	9	1	86
2019/2020	38	32	0	70
2020/2021	27	5	0	32
2021/2022	51	6	3	60
2022/2023	48	15	0	63
2023/2024	58	7	0	65

The sites sampled during the reporting period are shown in Figure 11.2. A breakdown of sites sampled each sampling season is shown in the Appendix (Figure 11.35).

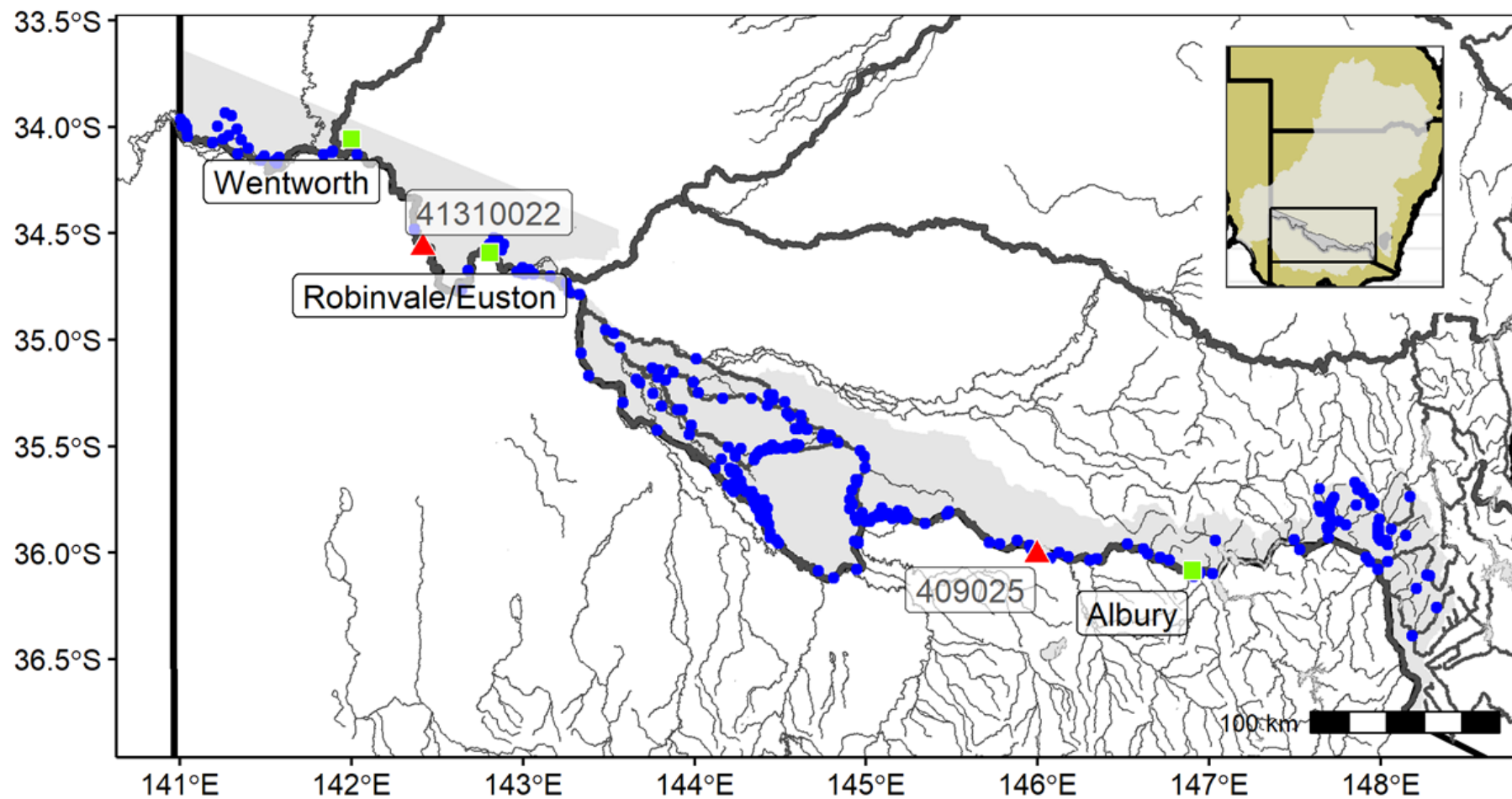


Figure 11.2: Sites (dots) sampled during the reporting period in the NSW Murray WRPA. Triangles show key flow gauges along with their gauge ID number. Green squares show major towns.

Each sampling method has a different effectiveness at sampling each species. Table 11.2 shows the total numbers of each key species caught by each method.

Table 11.2: Number of each key species caught by sample method over the whole program in the NSW Murray WRP. Further data on total catch is provided in the Appendix.

Common name	Boat Electrofishing	Backpack Electrofishing	Bait Trap
Australian smelt	27,221	1,062	35
Bony herring	8,033	17	9
Common carp	27,202	7,436	6,284
Freshwater catfish	5	0	0
Golden perch	1,259	1	1
Murray cod	2,109	23	0

A subset of sampled fish had biological measurements taken during the surveys, including but not limited to length and weight measurements and visual health assessments. Table 11.3 shows the number of biological measurements taken each year for the six key species.

Table 11.3: Number of biological measurements taken for the key species each sampling season in the NSW Murray WRP.

Sampling Season	Australian smelt	Bony herring	Common carp	Freshwater catfish	Golden perch	Murray cod
2014/2015	1,524	444	938	1	198	338
2015/2016	2,035	369	1,046	2	222	510
2016/2017	2,637	582	4,027	0	96	125
2017/2018	1,249	708	1,904	1	133	131
2018/2019	1,682	527	1,471	0	110	187
2019/2020	913	289	385	0	50	82
2020/2021	590	395	765	0	114	328
2021/2022	1,801	967	2,491	0	69	180
2022/2023	2,260	256	3,215	0	140	130
2023/2024	991	452	1,579	1	171	120

Climate Overview

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

2014

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

2015

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

2016

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

2017

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

2018

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

2019

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

2020

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

2021

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

2022

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

2023

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

2024

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

Flow Data

Below shows daily flow data from a flow gauge in the New South Wales Murray WRP (Figure 11.3).

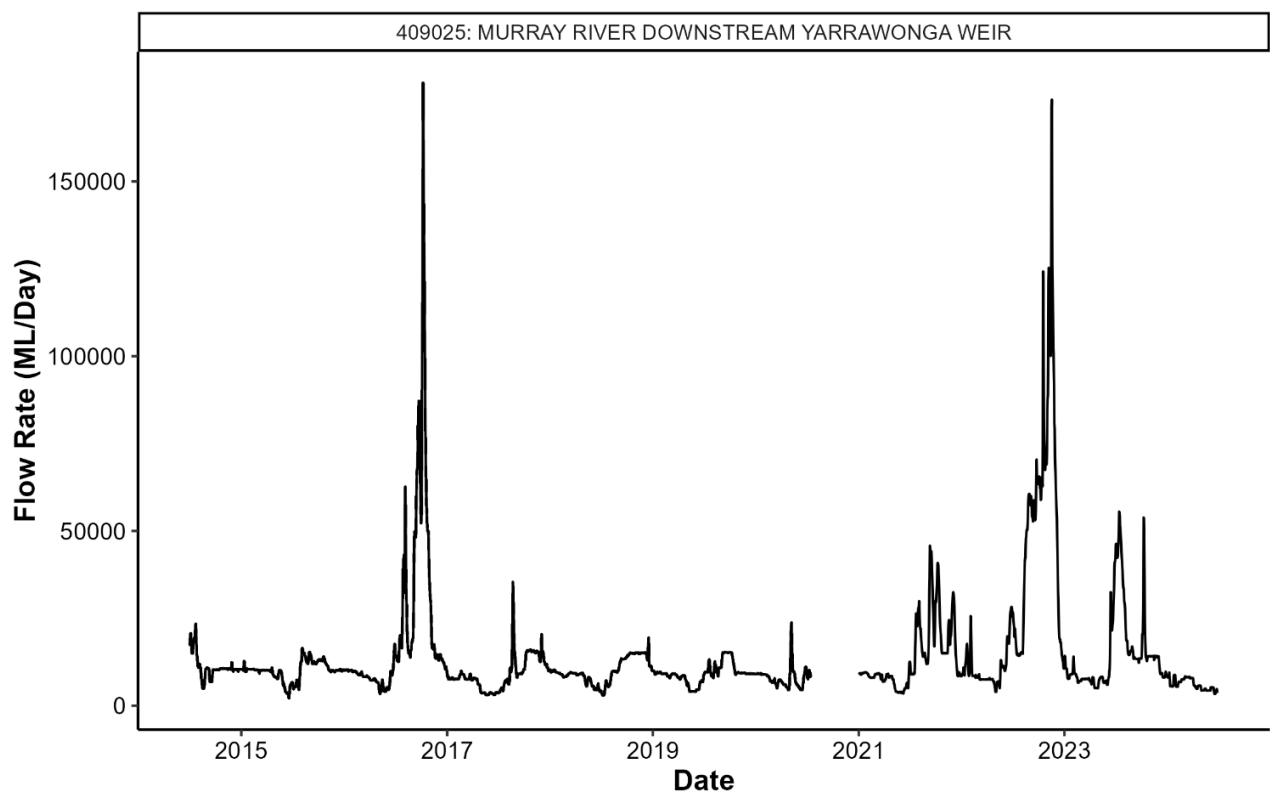


Figure 11.3: Flow data a gauge in the New South Wales Murray WRP over the reporting period. Gauge locations can be seen on Figure 11.2.

Water temperature data, where available, are also shown in Figure 11.4.

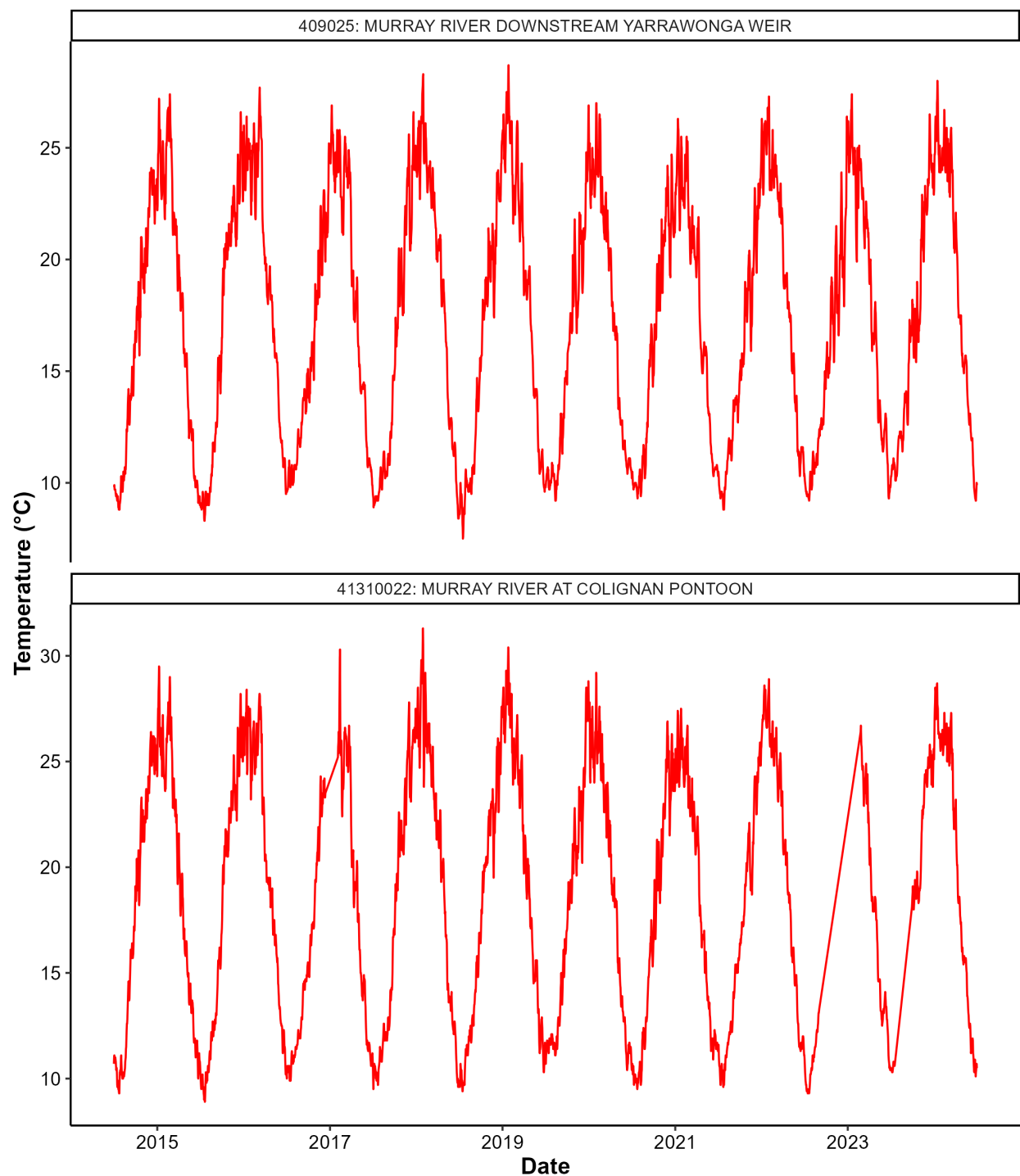


Figure 11.4: Water temperature data from various gauges in the New South Wales Murray WRPAs over the reporting period. Gauge locations can be seen on Figure 11.2. Note the differing scales on the y-axis.

Species Diversity

A total of 30 fish species were observed across the New South Wales Murray WRPAs including nine alien species. Figure 11.5 shows the number of native species found at each site while Figure 11.6 shows the number of alien species found at each site. The full list of species caught and observed is presented in Table 11.8.

Summary Statement:

Native diversity was highest in the central and western areas of the New South Wales Murray region while the alien diversity was generally consistent across the region.

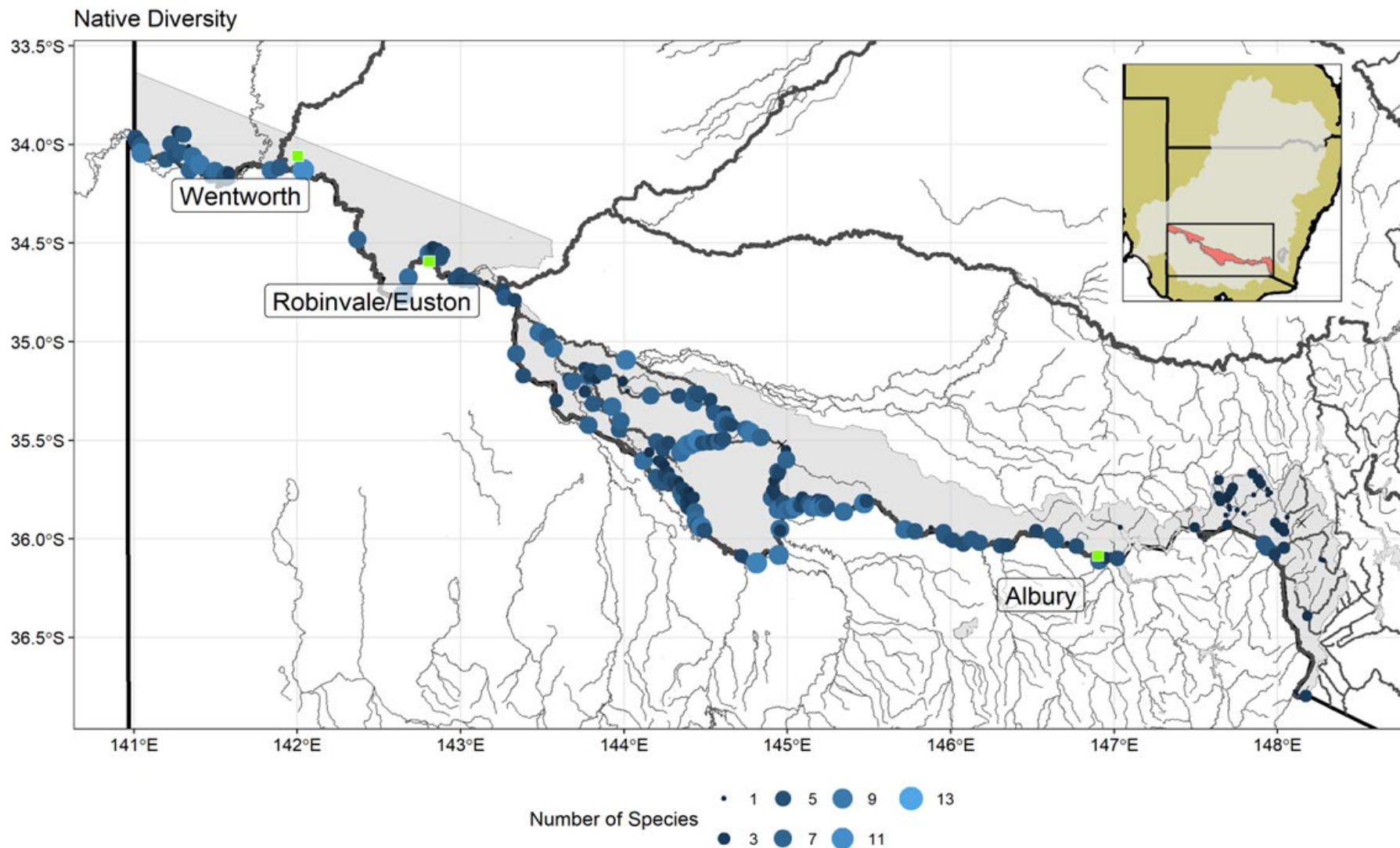


Figure 11.5: Native diversity across all sampling sites in the NSW Murray WRP. Bubble size represents the number of unique species observed at each site across all sampling methods and events. X represents a site that had water and was sampled, but no fish species were caught at all. Dry sites are excluded. Green squares represent key towns.

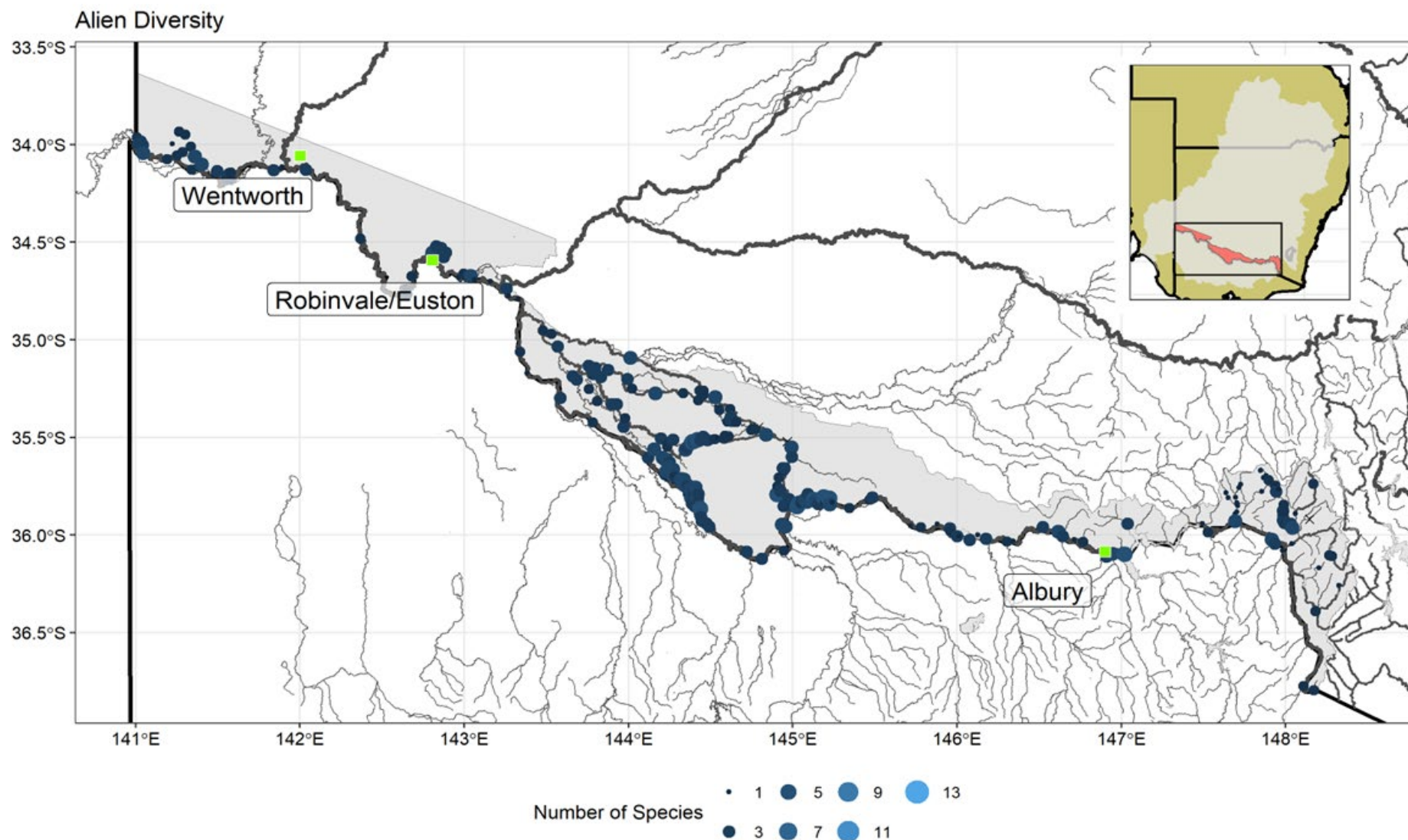


Figure 11.6: Alien diversity across all sampling sites in the NSW Murray WRP. Bubble size represents the number of unique species observed at each site across all sampling methods and events. X represents a site that had water and was sampled, but no fish species were caught at all. Dry sites are excluded. Green squares represent key towns.

Murray cod



Population Structure

Figure 11.7 shows the observed length frequency plot for Murray cod for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 0 to 89, and 0 % to 27 % of measured fish within a season, with a mean percentage YOY of 13 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Murray cod was 12 % (1,142 out of 9,420).

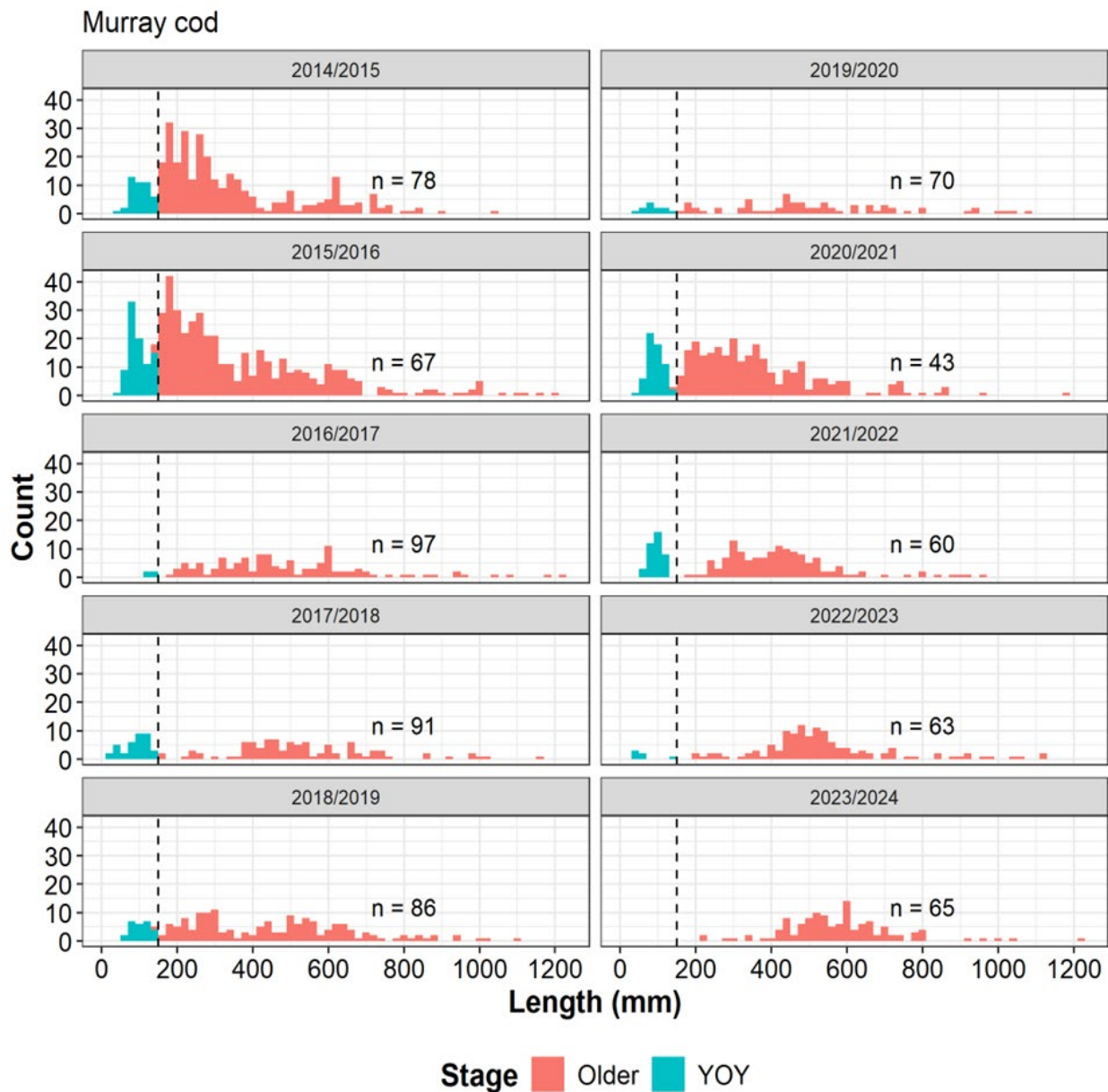


Figure 11.7: Length frequency plots for Murray cod by sampling season in the NSW Murray WRP. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRP in a sampling season.

Summary Statement:

Usually regular recruitment of Murray cod but no evidence of recruitment in 2023/24 which followed likely poor recruitment in 2022/23.

Stocking

A total of 660,302 Murray cod were stocked into the waterways of the New South Wales Murray WRPAs during the reporting period. Of these fish, 82,120 (12 %) were stocked into impoundments while 578,182 (88 %) were stocked into rivers or creeks. Table 11.4 shows the detailed breakdown of stocking by season, location and life stage while Figure 11.8 shows the locations of stocking.

Table 11.4: Number and life stage of stocked Murray cod each sampling season in the NSW Murray WRPAs.

Sampling Season	River/Creek or Impoundment	Life Stage	Number Stocked
2014/2015	Impoundment	Fry	2,000
2014/2015	River/Creek	Fry	80,741
2015/2016	Impoundment	Fry	1,000
2015/2016	River/Creek	Fry	67,532
2016/2017	Impoundment	Fingerling	12,120
2016/2017	Impoundment	Fry	8,000
2016/2017	River/Creek	Fingerling	111,068
2017/2018	River/Creek	Fry	38,797
2018/2019	Impoundment	Fry	9,000
2018/2019	River/Creek	Fry	54,131
2019/2020	Impoundment	Fry	5,000
2019/2020	River/Creek	Fry	42,033
2020/2021	Impoundment	Fry	10,000
2020/2021	River/Creek	Fry	35,868
2021/2022	Impoundment	Fry	16,000
2021/2022	River/Creek	Fry	10,050
2022/2023	Impoundment	Fry	19,000
2022/2023	River/Creek	Fingerling	71,000
2022/2023	River/Creek	Fry	19,600
2023/2024	River/Creek	Fingerling	47,362

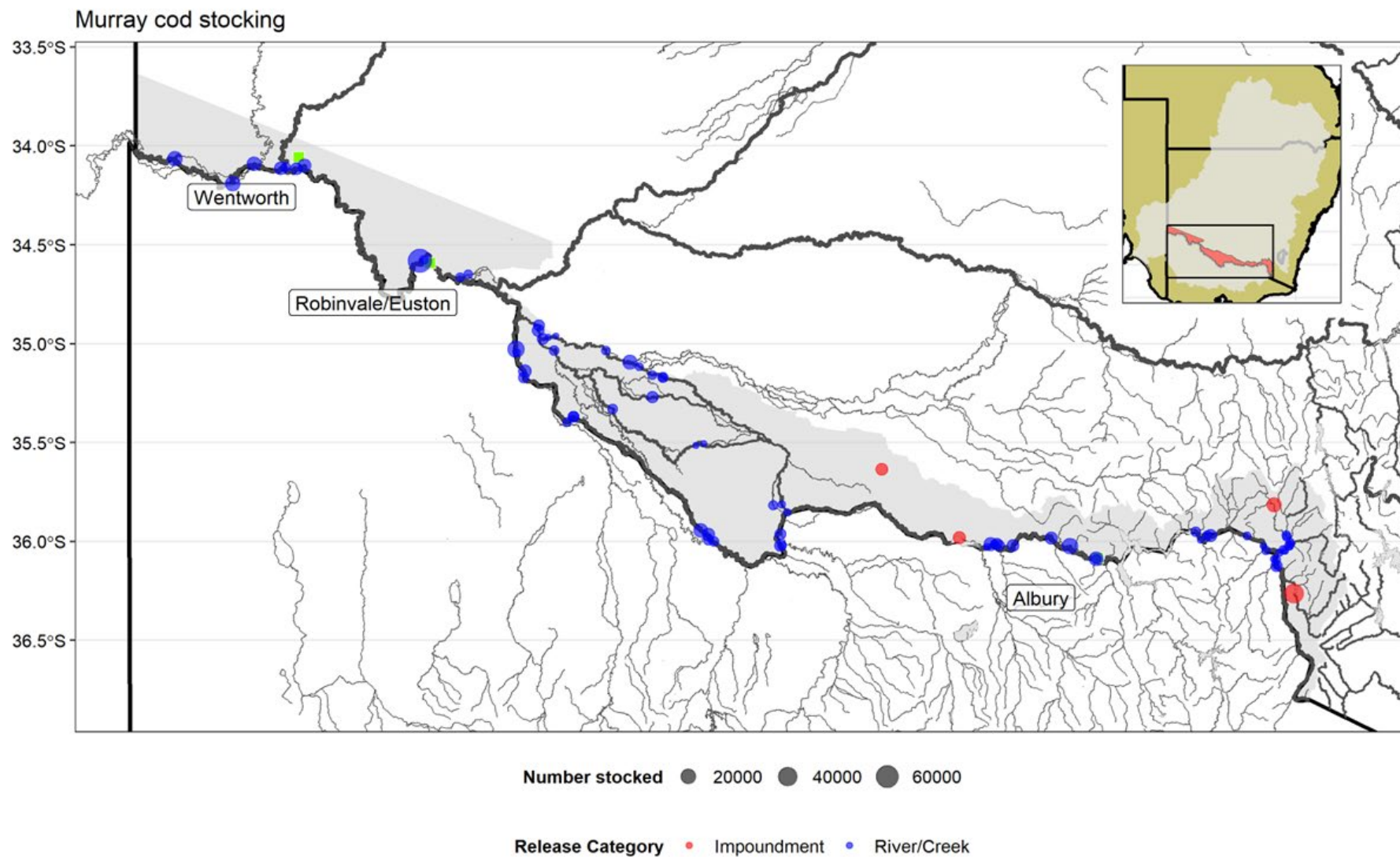


Figure 11.8: Locations of Murray cod stocking in the NSW Murray WRP. Colours show whether a site was a river/creek site or an impoundment, while the size of the point reflects the total number of fish stocked over the reporting period. Green squares represent key towns.

Temporal Trends in Abundance

The relative abundance and biomass of Murray cod since 1994 was modelled based on all suitable boat electrofishing data. The left-hand panels of Figure 11.9 show the abundance and biomass trends for the New South Wales Murray WRP and the right-hand panels show the overall trends across the NSW MDB.

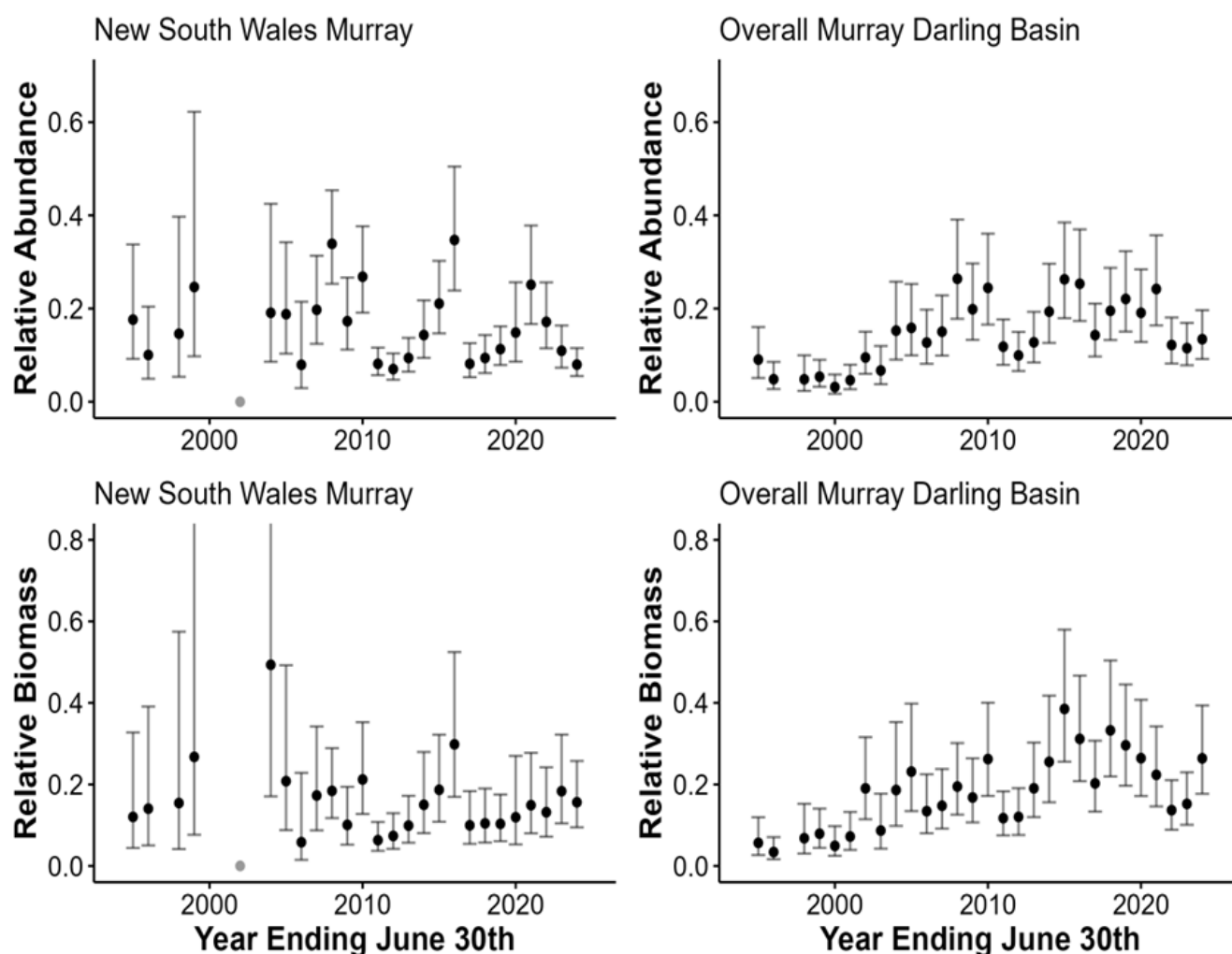


Figure 11.9: Relative abundance and biomass of Murray cod in both the New South Wales Murray WRP and the overall NSW MDB. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates.

Summary Statement:

Abundance of Murray cod has declined since 2021 and is likely to be less than the overall NSW MDB. Biomass appears relatively stable. This suggests a lack of recruitment with larger fish maintaining the population biomass.

Health

The prevalence of any health issues ranged from 2 % of sampled fish in 2020/2021 to 38 % of sampled fish in 2022/2023 (Figure 11.10). The most common health issue for Murray cod in the New South Wales Murray WRPAs was *Lernaea*, which was observed in a total of 152 fish, corresponding to 7 % of all Murray cod measured.

Across the other NSW MDB WRPA, 17 % of Murray cod (1,603 out of 9,420 Murray cod) showed a health condition (excludes the New South Wales Murray WRPAs).

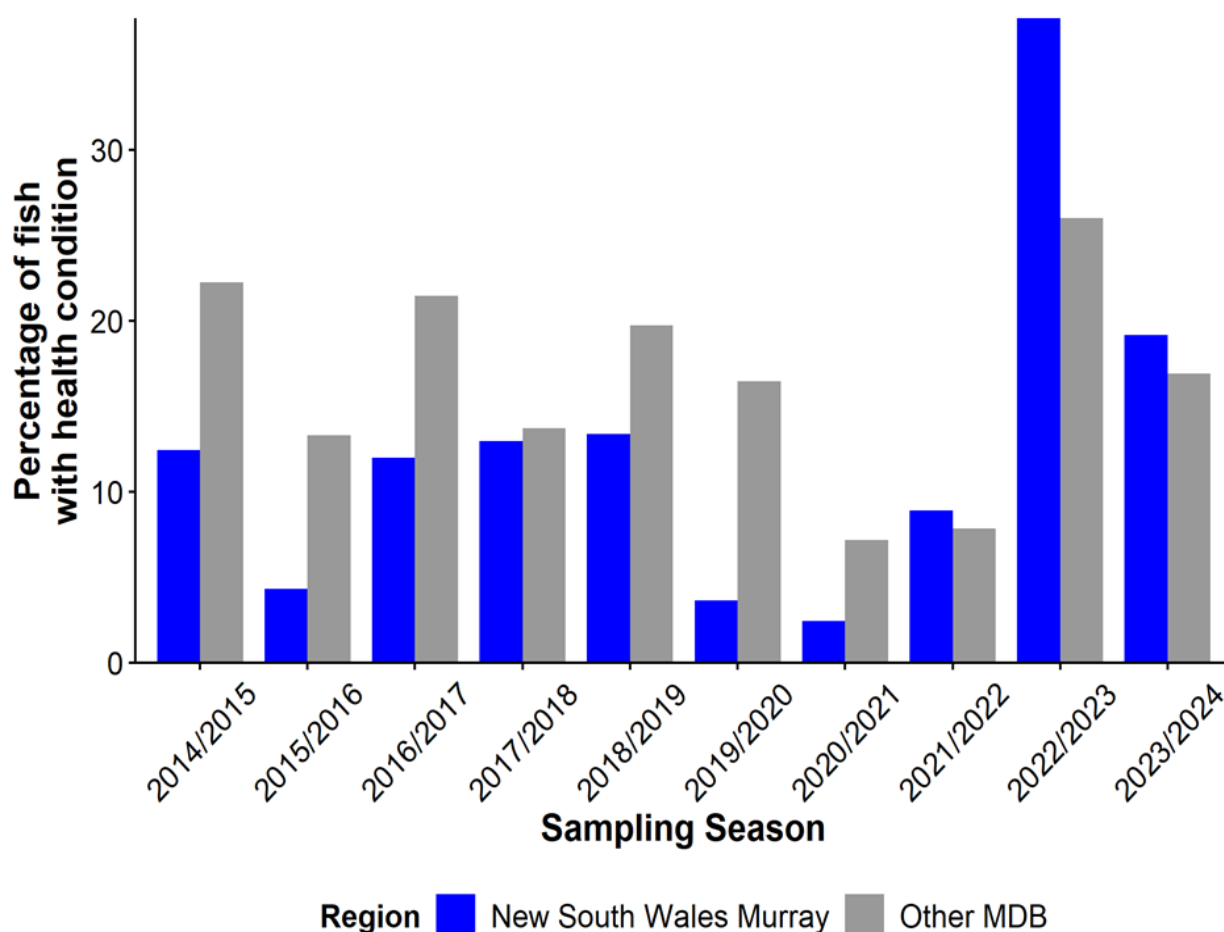


Figure 11.10: Timeseries showing the prevalence of health conditions in Murray cod. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA.

Summary Statement:

Presence of observable health conditions was variable across years but has been higher than the rest of the NSW MDB in the last three seasons (particularly 2022/23).

Distribution

Murray cod were recorded at 115 out of 274 sites in the New South Wales Murray WRPA from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 2.18 fish caught per 90 seconds of electrofishing. Figure 11.11 shows the distribution and relative abundance of Murray cod across the New South Wales Murray WRPA.

Summary Statement:

Murray cod were recorded across the NSW Murray WRPA but most abundant in the mid-reaches.

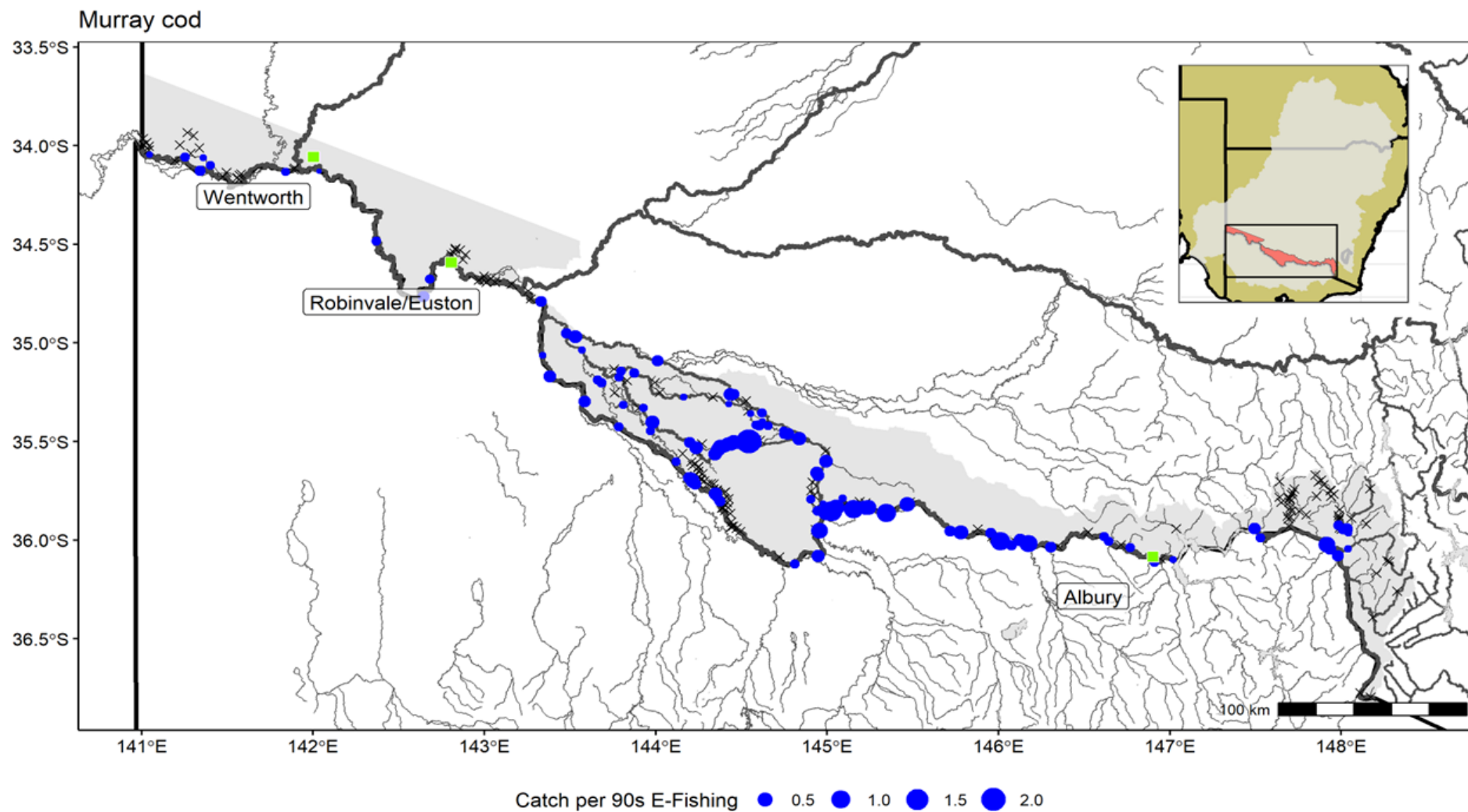


Figure 11.11: Distribution of Murray cod sampled from 2013/14 to 2023/24 in the NSW Murray WRP. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares represent key towns.

Golden perch



Population Structure

Figure 11.12 shows the observed length frequency plot for Golden perch for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 0 to 7, and 0 % to 10 % of measured fish within a season, with a mean percentage YOY of 2 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Golden perch was 9 % (639 out of 6,996).

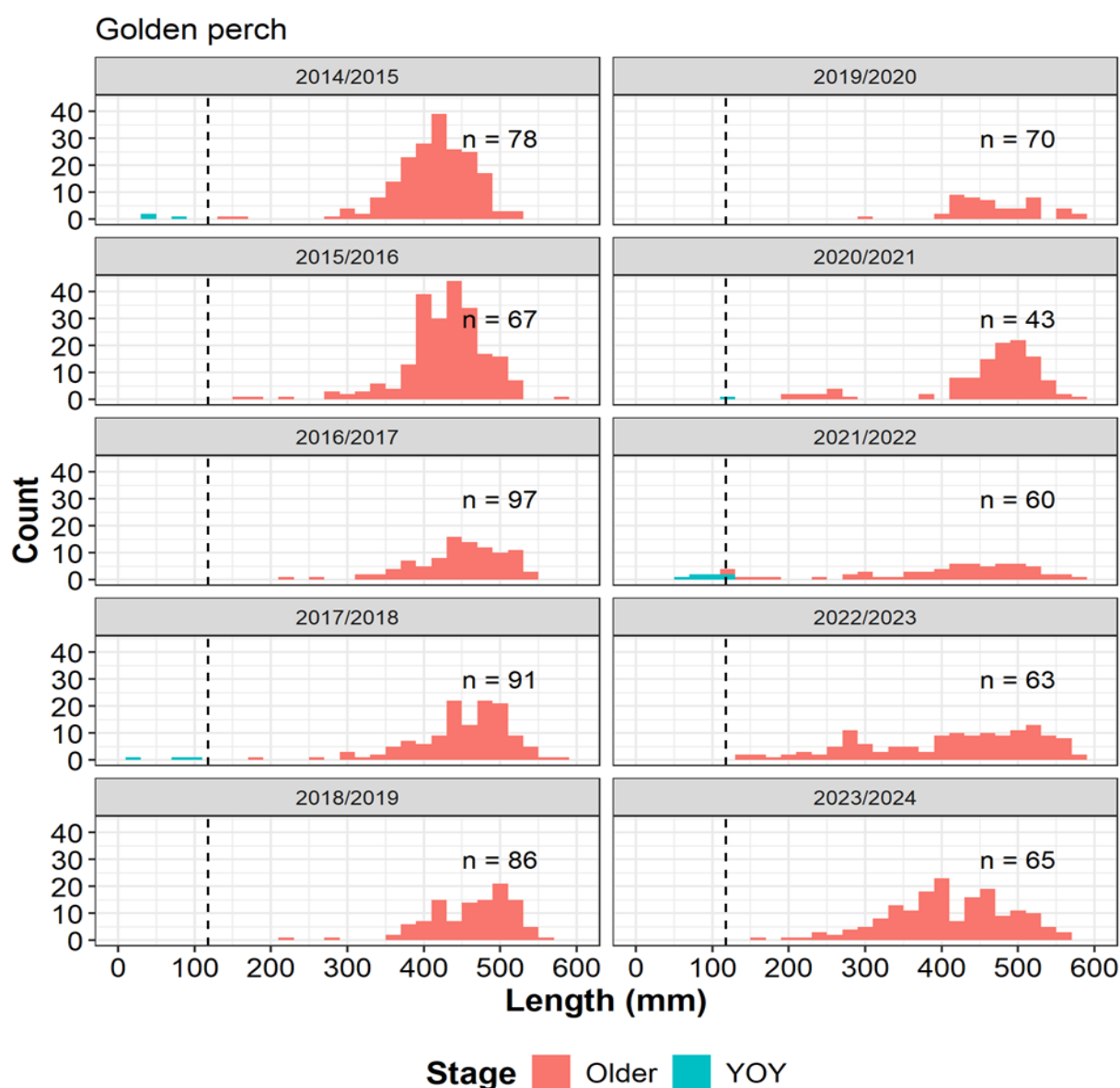


Figure 11.12: Length frequency plots for Golden perch by sampling season in the NSW Murray WRP. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRP in a sampling season.

Summary Statement:

High proportion of large fish in all sampling years. Limited or poor recruitment in most years with young of the year only observed in 2014/15, 2017/18 and 2021/22 suggesting recruitment limitation in most years.

Stocking

A total of 1,214,566 Golden perch were stocked into the waterways of the New South Wales Murray WRPAs during the reporting period. Of these fish, 487,800 (40.2 %) were stocked into impoundments while 726,766 (59.8 %) were stocked into rivers or creeks. Table 11.5 shows the detailed breakdown of stocking by season, location and life stage while Figure 11.13 shows the locations of stocking.

Table 11.5: Number and life stage of stocked Golden perch each sampling season in the NSW Murray WRPAs.

Sampling Season	River/Creek or Impoundment	Life Stage	Number Stocked
2014/2015	Impoundment	Fry	27,000
2014/2015	River/Creek	Fry	159,723
2015/2016	Impoundment	Fry	46,000
2015/2016	River/Creek	Fry	59,107
2016/2017	Impoundment	Fingerling	500
2016/2017	Impoundment	Fry	87,000
2016/2017	River/Creek	Fingerling	76,992
2017/2018	Impoundment	Fry	65,000
2017/2018	River/Creek	Fry	130,949
2018/2019	Impoundment	Fry	60,000
2018/2019	River/Creek	Fry	43,031
2019/2020	Impoundment	Fry	5,000
2019/2020	River/Creek	Fry	65,991
2020/2021	Impoundment	Fry	51,000
2020/2021	River/Creek	Fry	34,857
2021/2022	River/Creek	Fry	14,935
2022/2023	Impoundment	Fry	49,000
2022/2023	River/Creek	Fingerling	6,000
2022/2023	River/Creek	Fry	3,750
2023/2024	Impoundment	Fingerling	97,300
2023/2024	River/Creek	Fingerling	131,431

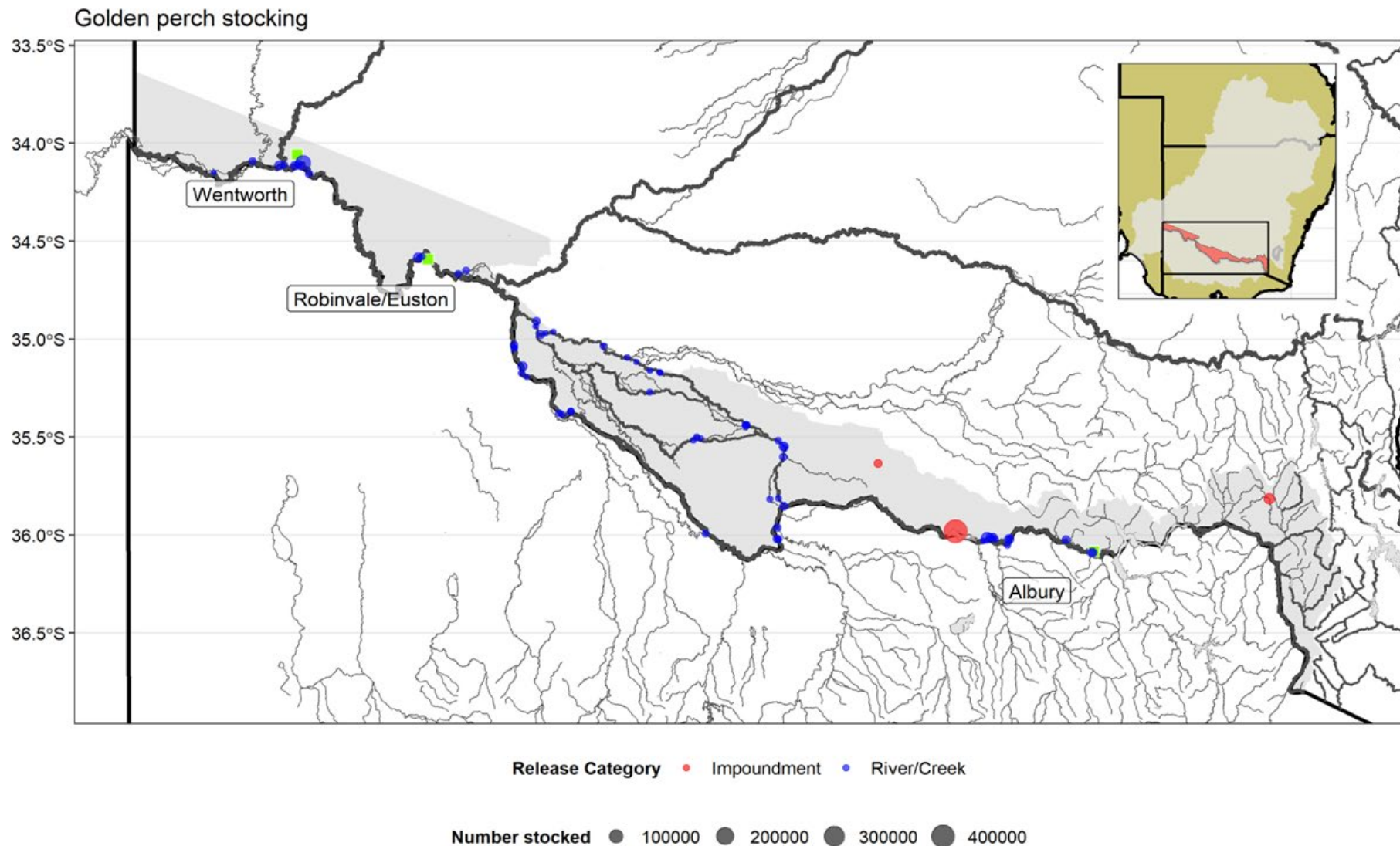


Figure 11.13: Locations of Golden perch stocking in the NSW Murray WRP. Colours show whether a site was a river/creek site or an impoundment, while the size of the point reflects the total number of fish stocked over the reporting period. Green squares represent key towns.

Temporal Trends in Abundance

The relative abundance and biomass of Golden perch since 1994 was modelled based on all suitable boat electrofishing data. The left-hand panels of Figure 11.14 show the abundance and biomass trends for the New South Wales Murray WRP and the right-hand panels show the overall trends across the NSW MDB.

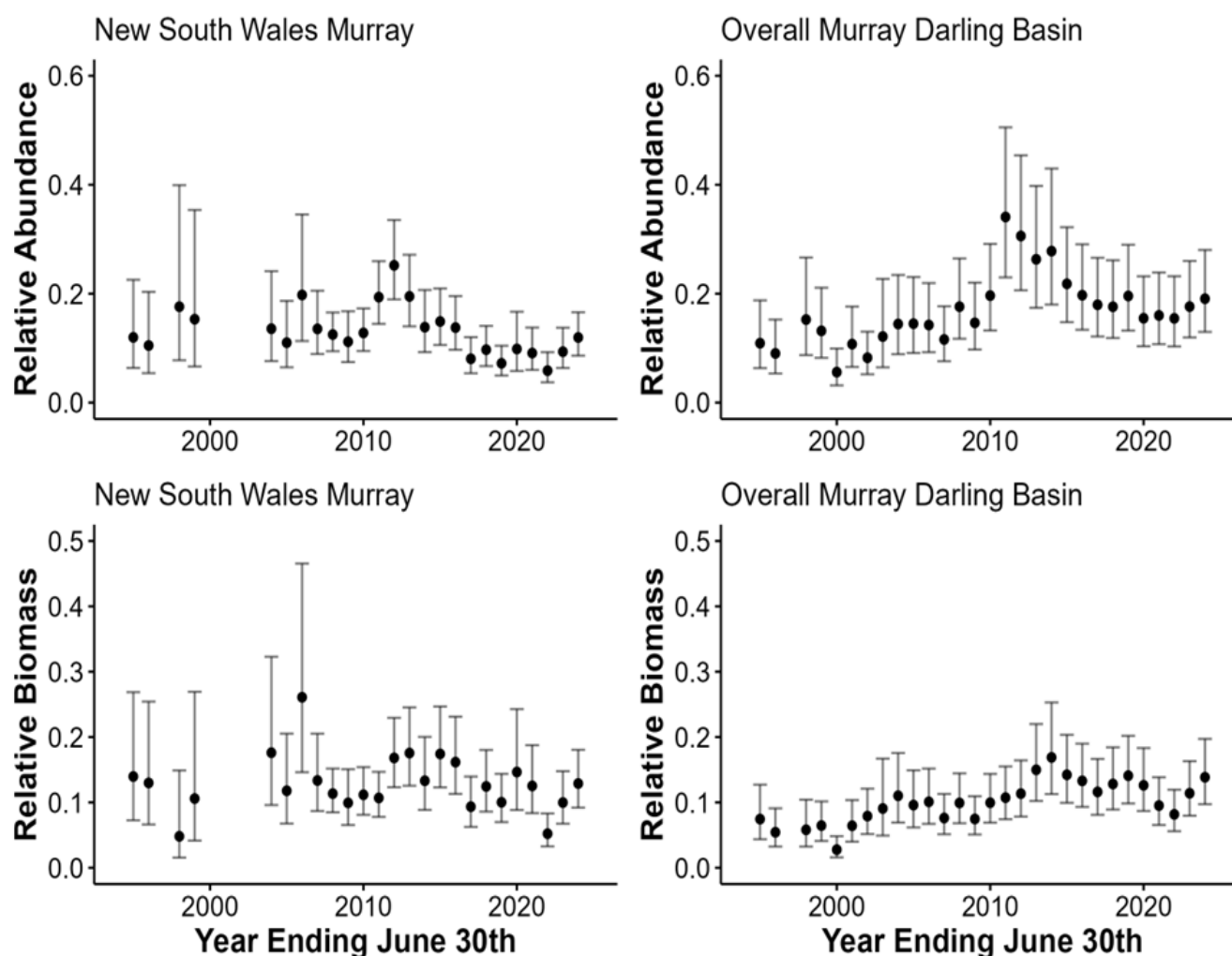


Figure 11.14: Relative abundance and biomass of Golden perch in both this valley and the overall Murray-Darling Basin. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates.

Summary Statement:

Similar abundance and biomass to the late 1990s with an upwards trend in both since 2021/22. Abundance currently slightly lower than the overall NSW MDB but biomass is approximately equal to the overall NSW MDB.

Health

The prevalence of any health issues ranged from 3 % of sampled fish in 2020/2021 to 51 % of sampled fish in 2022/2023 (Figure 11.15). The most common health issue for Golden perch in the New South Wales Murray water resource planning area was *Lernaea*, which was observed in a total of 131 fish, corresponding to 10 % of all Golden perch measured.

Across the other WRPA's, 26 % of Golden perch (1,811 out of 6,996 Golden perch) showed a health condition (excludes New South Wales Murray).

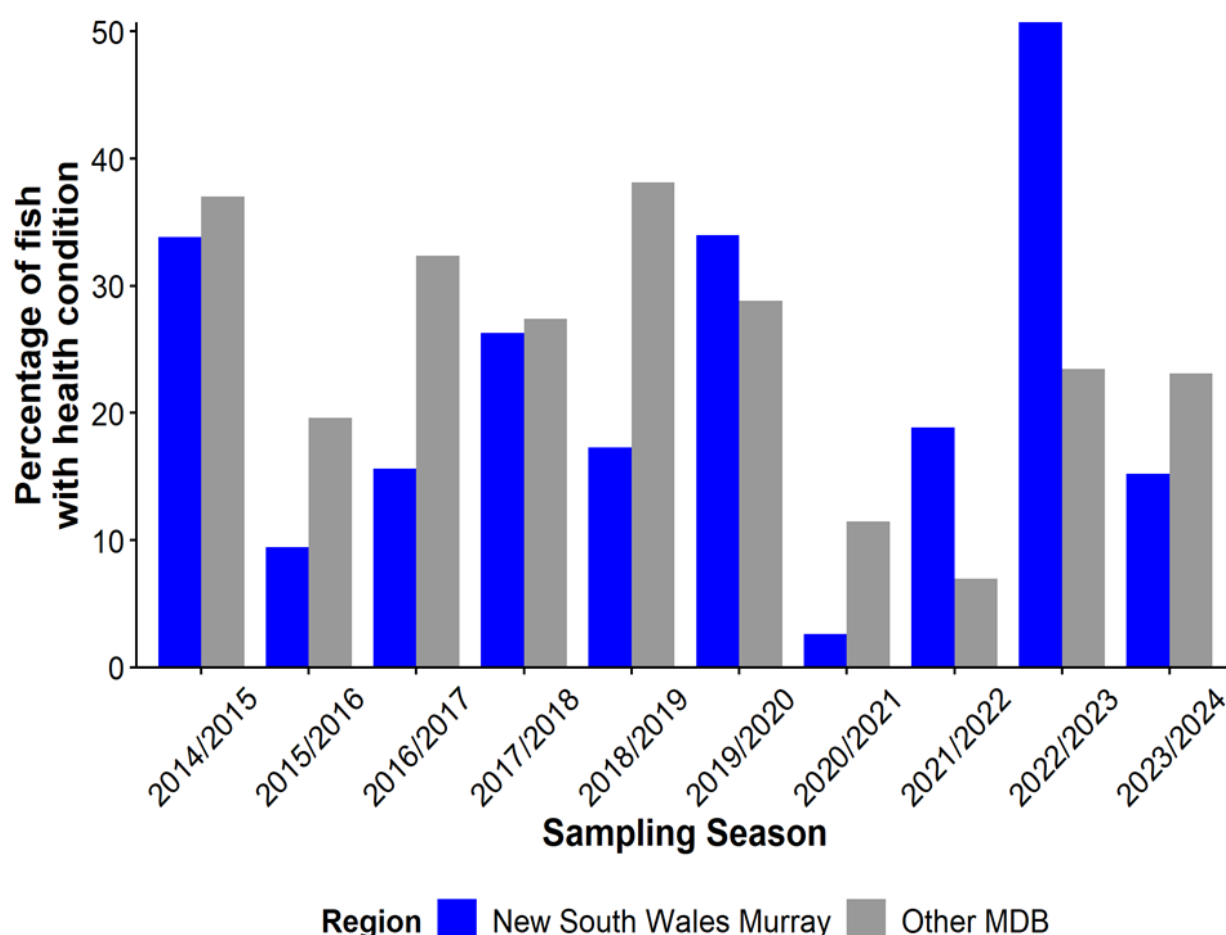


Figure 11.15: Timeseries showing the prevalence of health conditions in Golden perch. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA's.

Summary Statement:

The presence of observable health conditions for Golden perch in the NSW Murray was variable and ranged from low to high. While most years showed similar trends to the rest of the NSW MDB, in 2022/23 the NSW Murray showed a much greater proportion of Golden perch with observable health issues.

Distribution

Golden perch were recorded at 102 out of 274 sites in the New South Wales Murray WRPAs from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 1.3 fish caught per 90 seconds of electrofishing. Figure 11.16 shows the distribution and relative abundance of Golden perch across the New South Wales Murray WRPAs.

Summary Statement:

Golden perch were distributed across the NSW Murray WRPAs with the exception of upland areas in the east.

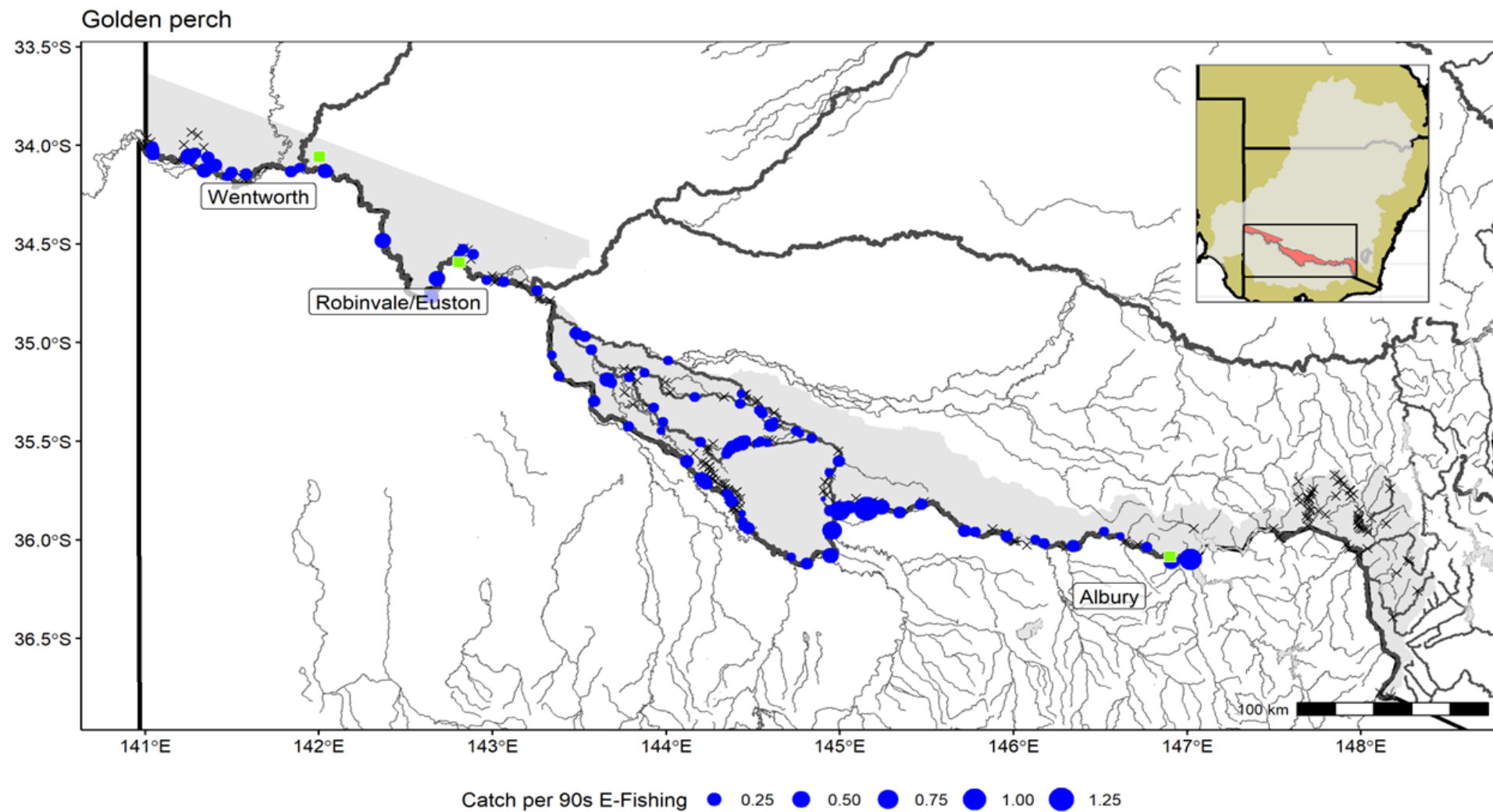


Figure 11.16: Distribution of Golden perch sampled from 2013/14 to 2023/24 in the NSW Murray WRP. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares represent key towns.

Freshwater catfish



Summary Statement:

Very few Freshwater catfish ($n=6$) were caught or observed during standardised monitoring in the reporting period. These included one individual was observed in 2014/15, three in 2015/16, one in 2017/18 and one in 2023/24. All individuals were of mature size. This suggests very low abundance in this area.

Bony herring



Population Structure

Figure 11.17 shows the observed length frequency plot for Bony herring for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 17 to 231, and 7 % to 49 % of measured fish within a season, with a mean percentage YOY of 28 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Bony herring was 25 % (12,108 out of 49,196). Bony herring are not a stocked species.

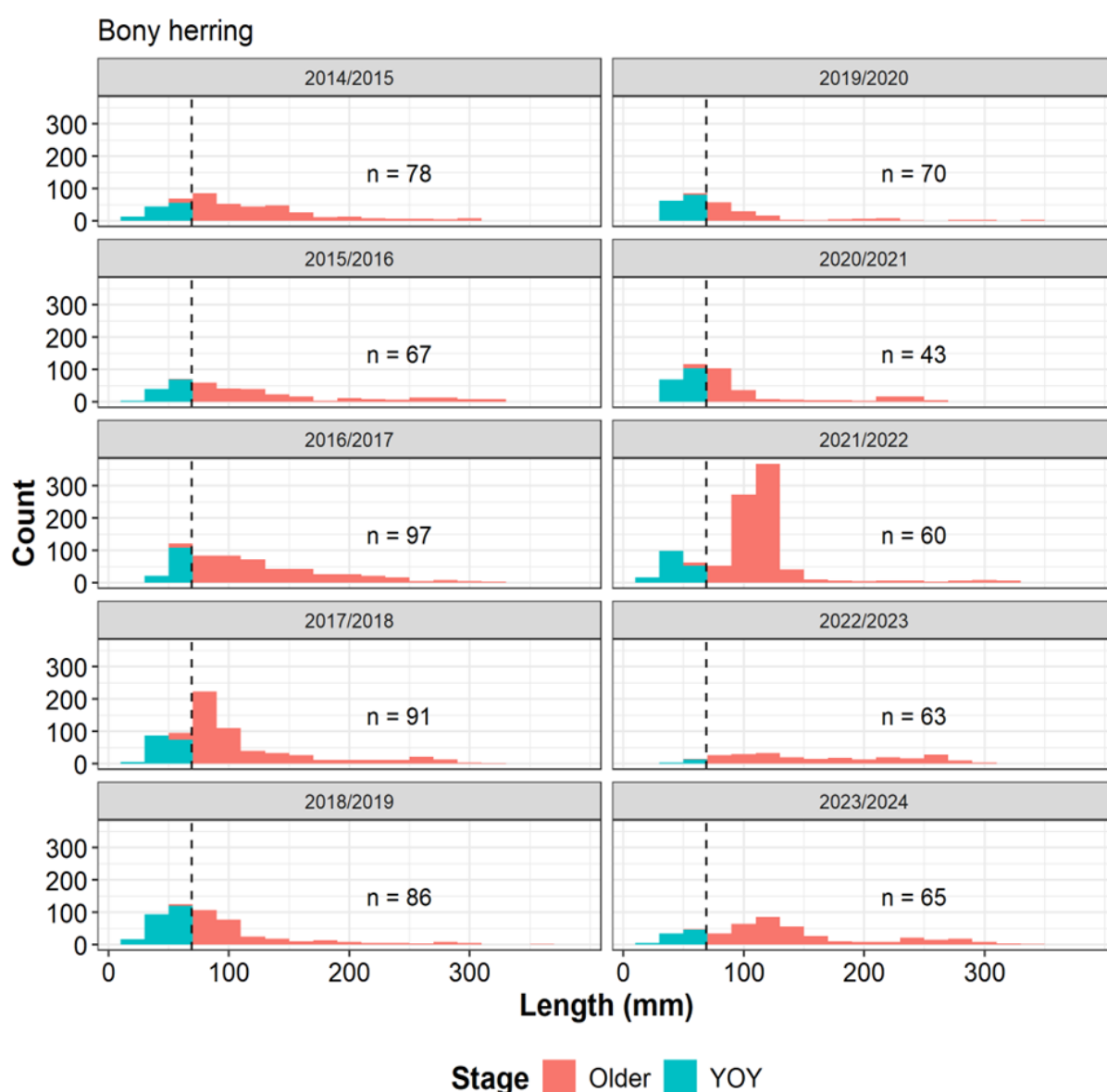


Figure 11.17: Length frequency plots for Bony herring by sampling season in the NSW Murray WRP. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRP in a sampling season.

Summary Statement:

Regular recruitment in most years except 2022/23 which appears to have had possible recruitment failure compared to the other years.

Temporal Trends in Abundance

The relative abundance and biomass of Bony herring since 1994 was modelled based on all suitable boat electrofishing data. The left-hand panels of Figure 11.18 show the abundance and biomass trends for the New South Wales Murray WRPA and the right-hand panels show the overall trends across the NSW MDB.

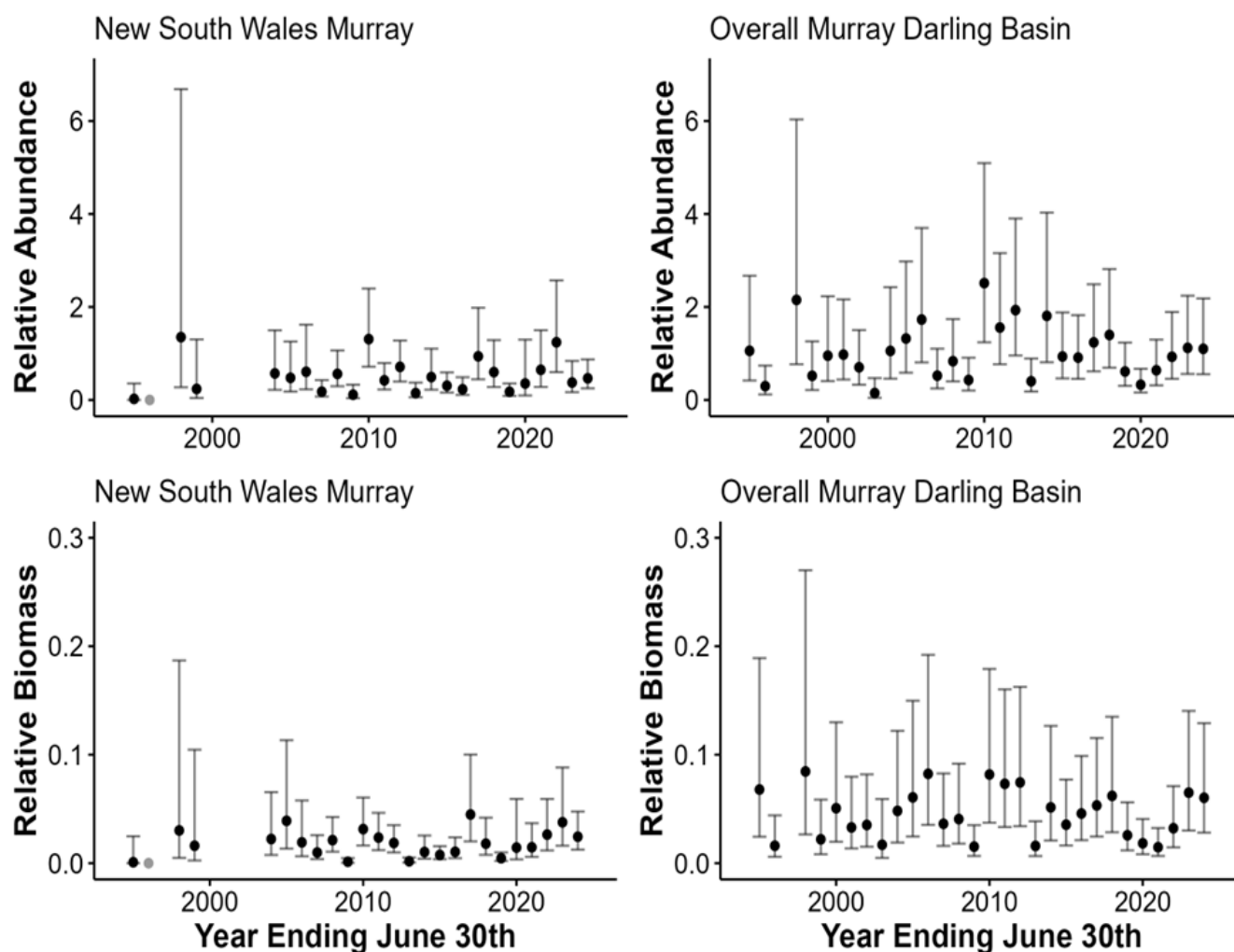


Figure 11.18: Relative abundance and biomass of Bony herring in both the New South Wales Murray WRPA and the overall NSW MDB. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates.

Summary Statement:

Abundance and biomass have fluctuated but are generally lower than the overall NSW MDB.

Health

The prevalence of any health issues ranged from 0 % of sampled fish in multiple years to 2 % of sampled fish in 2023/2024 (Figure 11.19). The most common health issue for Bony herring in the New South Wales Murray WRPAs was Fungus, which was observed in a total of 9 fish, corresponding to 0 % of all Bony herring measured.

Across the other NSW MDB WRPA's, 1.1 % of Bony herring (543 out of 49,197 Bony herring) showed a health condition (excludes the New South Wales Murray WRPA).

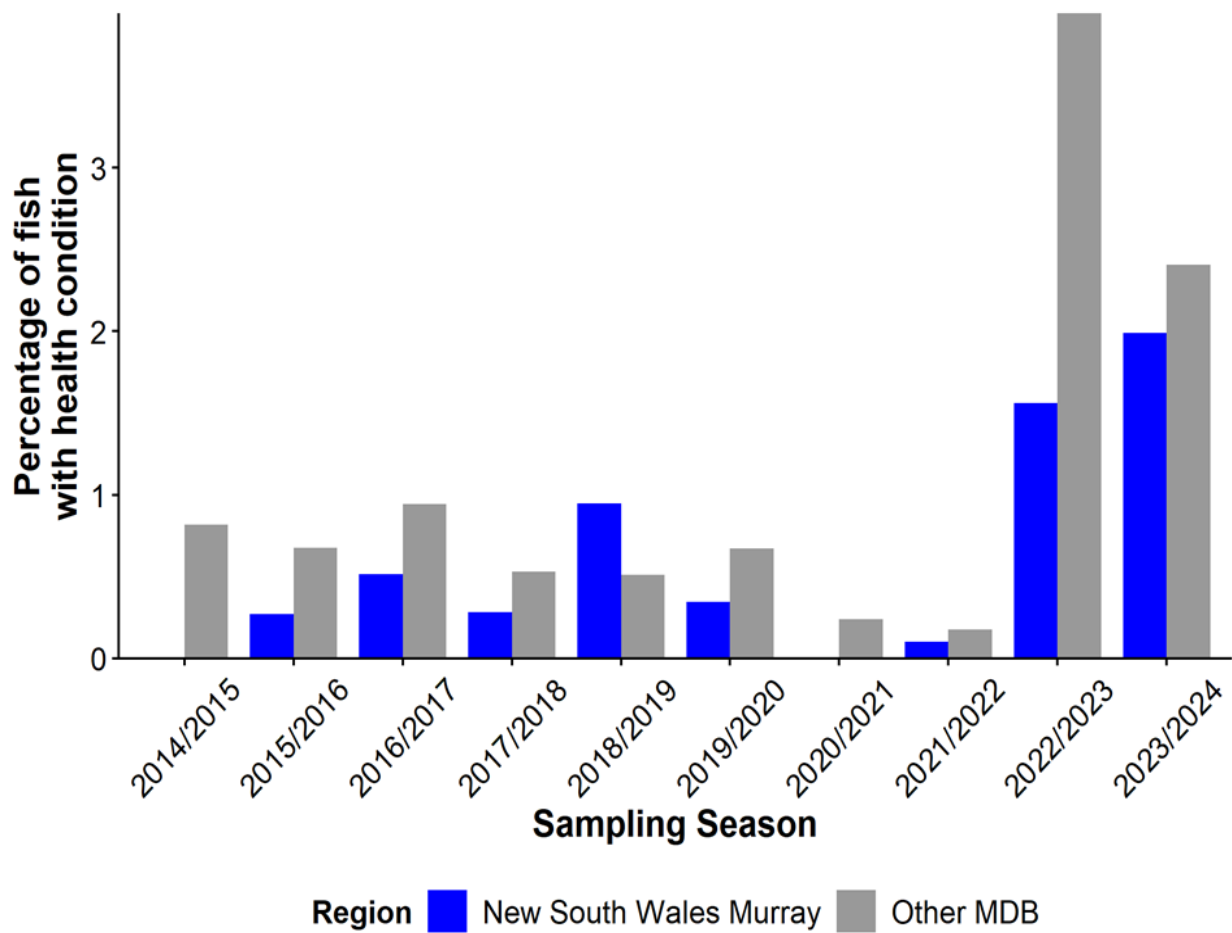


Figure 11.19: Timeseries showing the prevalence of health conditions in Bony herring. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA's.

Summary Statement:

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

Distribution

Bony herring were recorded at 96 out of 274 sites in the New South Wales Murray WRP from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 31.83 fish caught per 90 seconds of electrofishing. Figure 11.20 shows the distribution and relative abundance of Bony herring across the New South Wales Murray WRP.

Summary Statement:

Bony herring were recorded across the western half NSW Murray WRP and appear to be absent or in very low abundance in the eastern region.

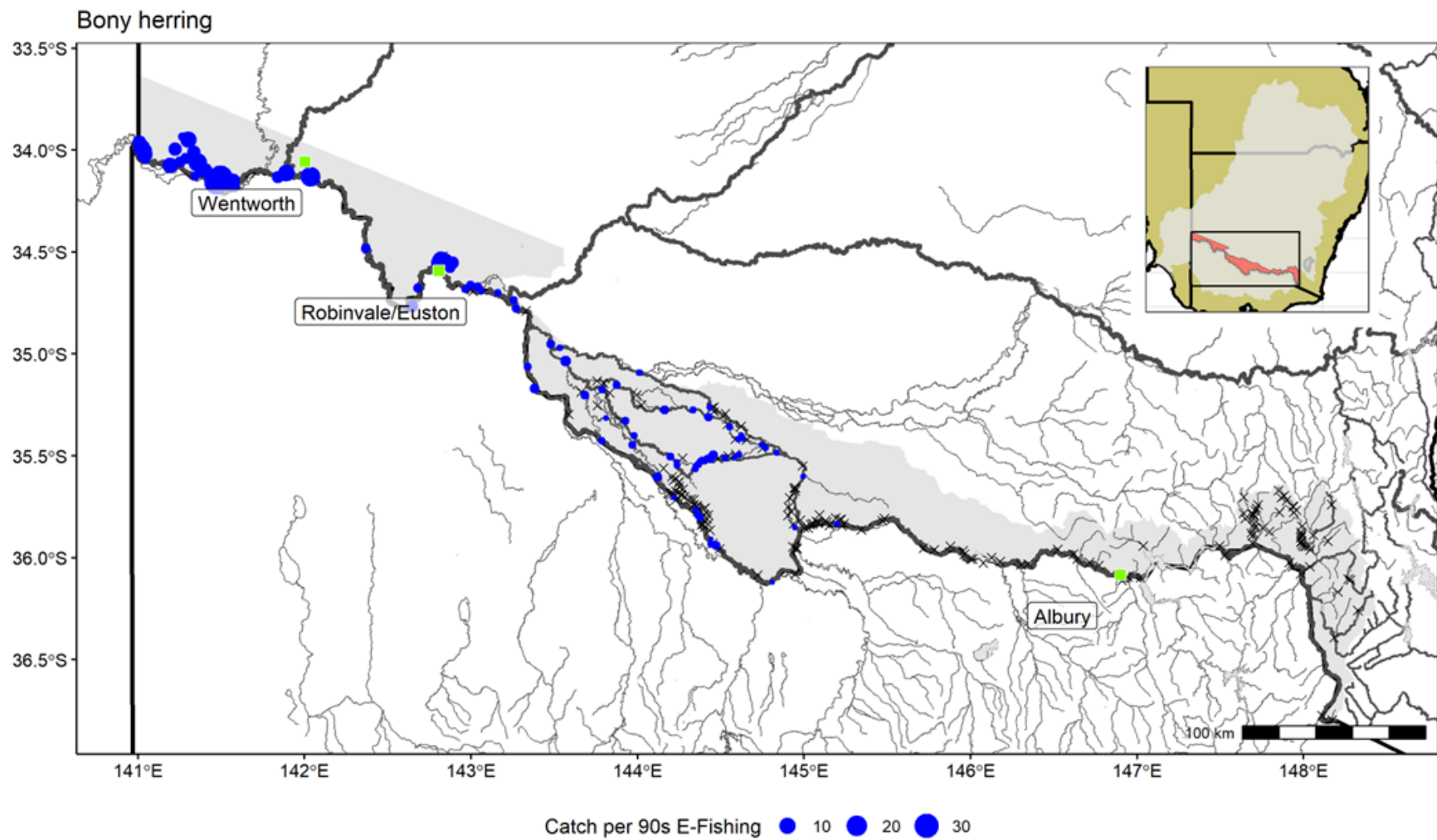


Figure 11.20: Distribution of Bony herring sampled from 2013/14 to 2023/24 in the NSW Murray WRP. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares represent key towns.

Australian smelt



Population Structure

Figure 11.21 shows the observed length frequency plot for Australian smelt for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 146 to 1,369, and 25 % to 61 % of measured fish within a season, with a mean percentage YOY of 39 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Australian smelt was 41 % (4,982 out of 12,246). Australian smelt are not a stocked species.

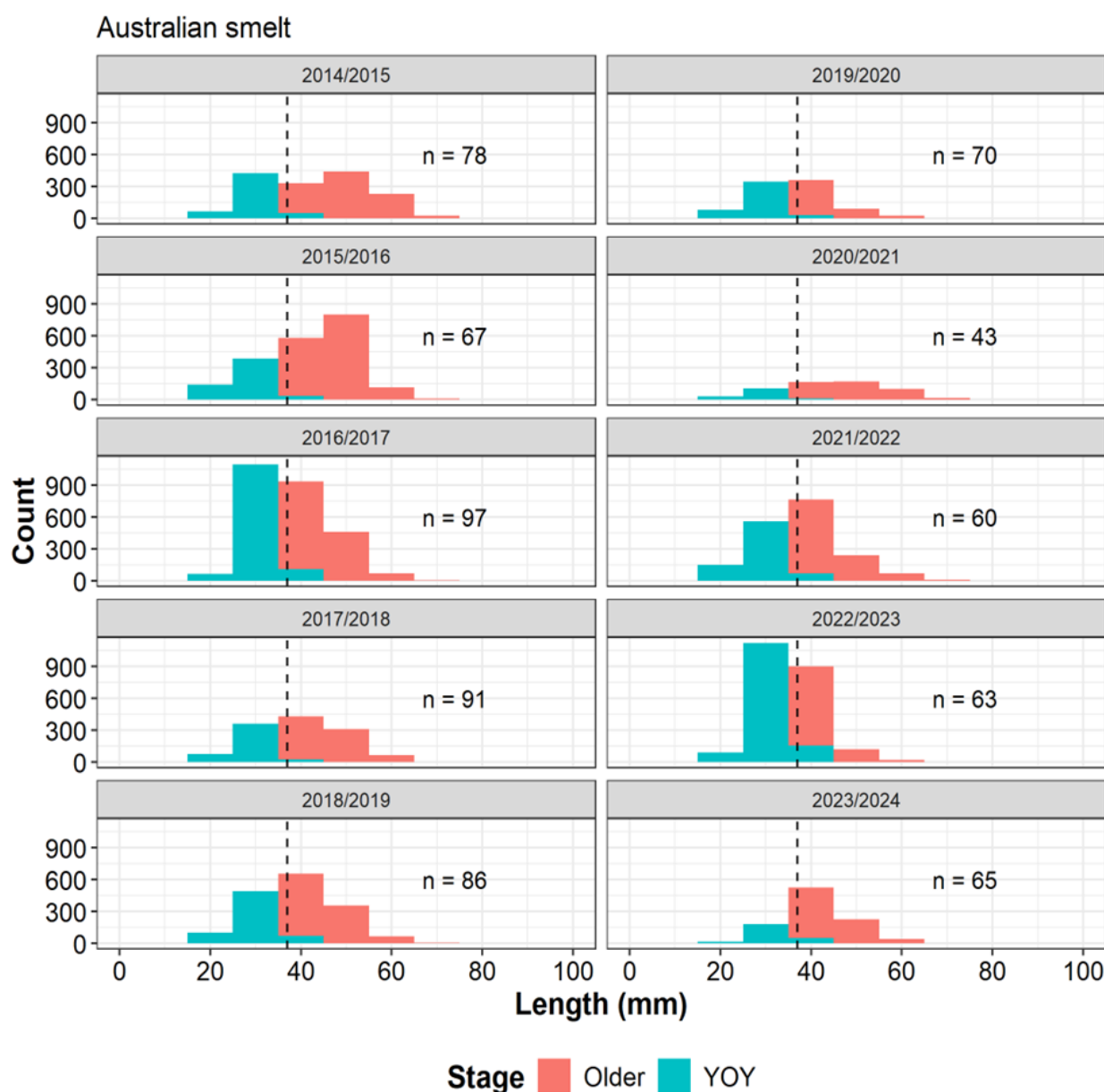


Figure 11.21: Length frequency plots for Australian smelt by sampling season in the NSW Murray WRP. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRP in a sampling season.

Summary Statement:

Recruitment evident in all years, weaker than usual recruitment in 2020/21 and 2023/24.

Temporal Trends in Abundance

The relative abundance of Australian smelt since 1994 was modelled based on all suitable boat electrofishing data. The left-hand panel of Figure 11.22 show the abundance trends for the New South Wales Murray WRPA and the right-hand panel show the overall trend across the NSW MDB.

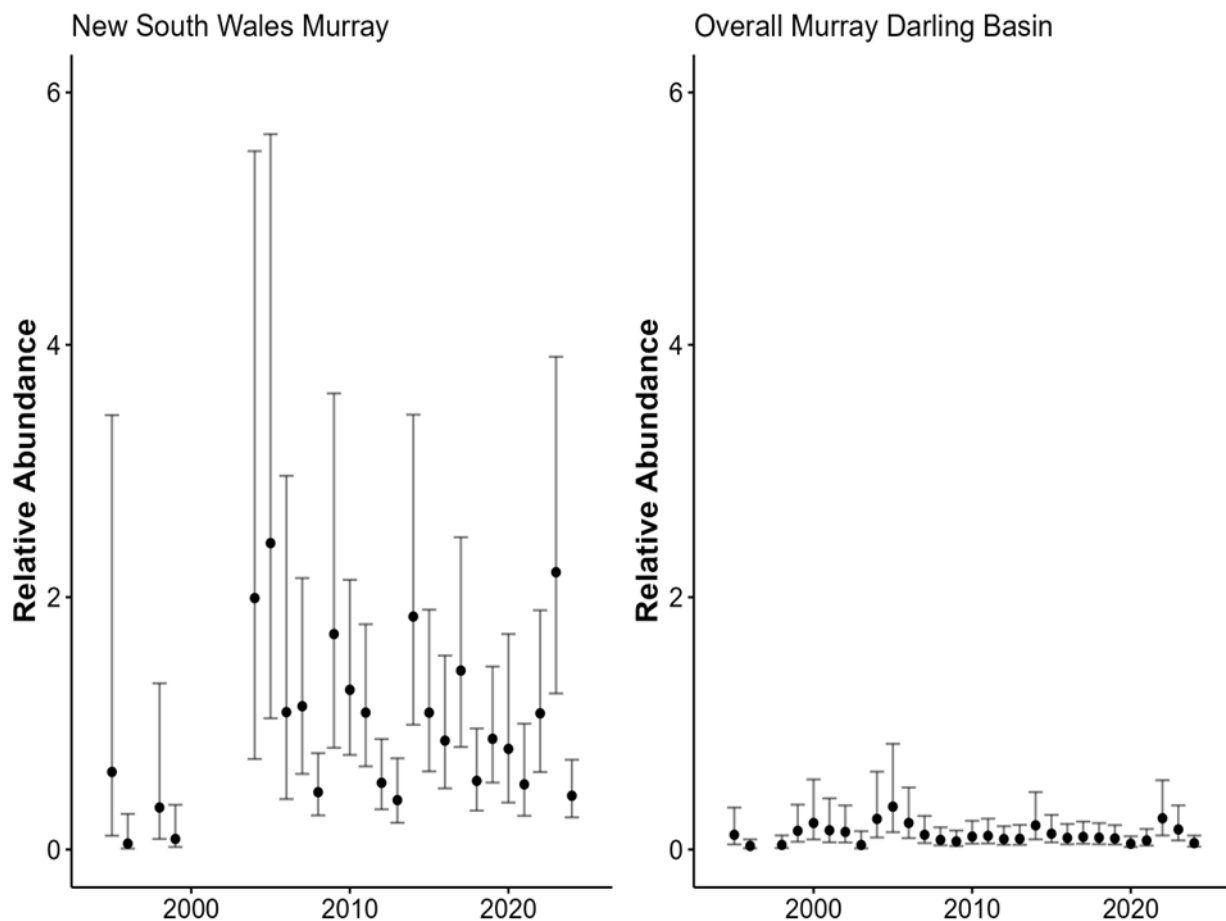


Figure 11.22: Relative abundance of Australian smelt in both the New South Wales Murray WRPA and the overall NSW MDB. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates. No modelling of biomass was done for Australian smelt.

Summary Statement:

Decline in abundance in 2023/24 compared to most years since 2005 but abundance is still higher than the overall NSW MDB.

Health

The prevalence of any health issues ranged from 0 % of sampled fish in 2020/2021 to 3 % of sampled fish to 2017/2018 (Figure 11.23). The most common health issue for Australian smelt in the New South Wales Murray WRPAs was *Lernaea*, which was observed in a total of 128 fish, corresponding to 1 % of all Australian smelt measured.

Across the other NSW MDB WRPA, <1 % of Australian smelt (32 out of 12,248 Australian smelt) showed a health condition (excludes the New South Wales Murray WRPAs).

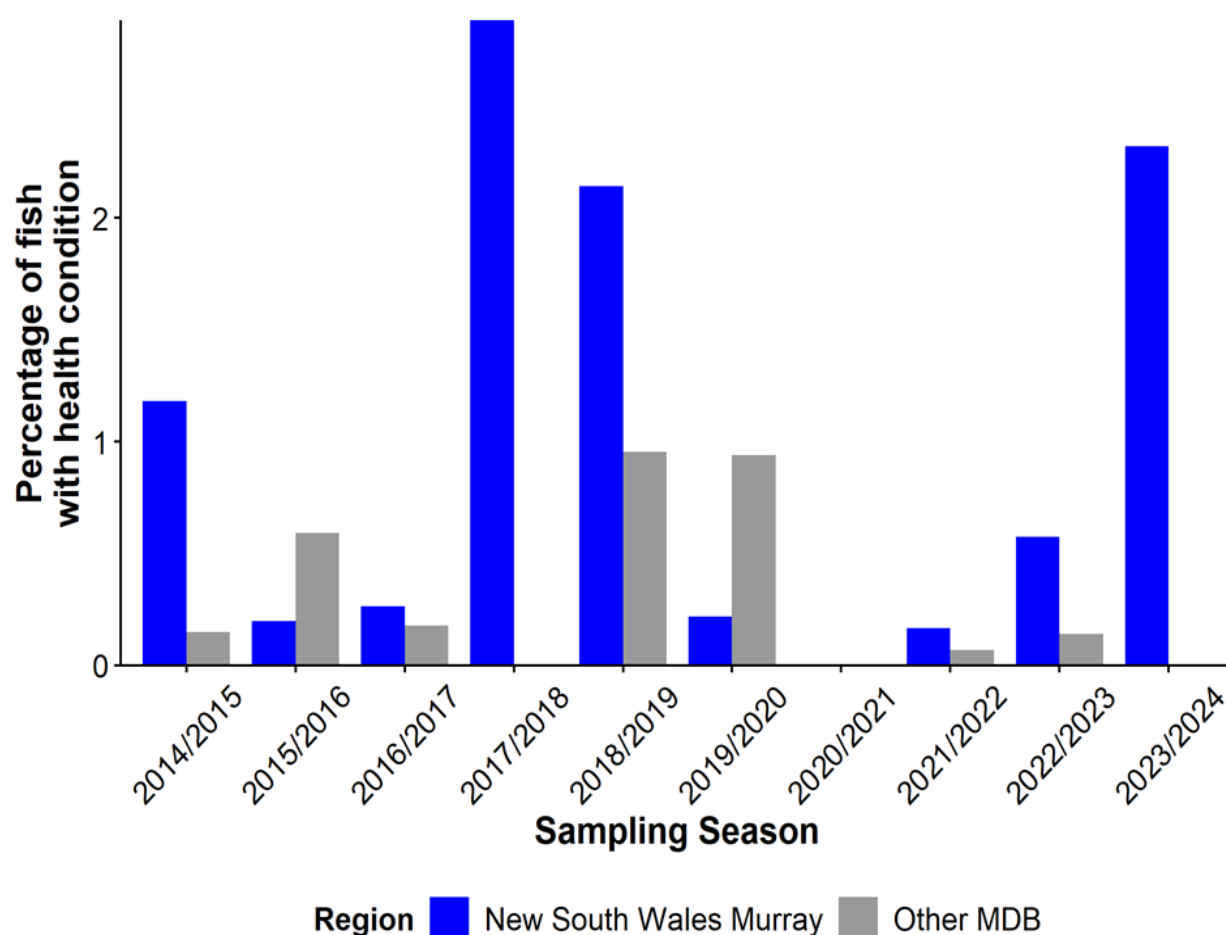


Figure 11.23: Timeseries showing the prevalence of health conditions in Australian smelt. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA.

Summary Statement:

Very few health issues were observed in Australian smelt in the NSW Murray overall (<3 % in all years) but a higher proportion of health issues compared to the rest of the NSW MDB in multiple years including 2023/24.

Distribution

Australian smelt were recorded at 201 out of 274 sites in the New South Wales Murray WRP from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 71.7 fish caught per 90 seconds of electrofishing. Figure 11.24 shows the distribution and relative abundance of Australian smelt across the New South Wales Murray WRP.

Summary Statement:

Australian smelt were recorded across the New South Wales Murray WRP.

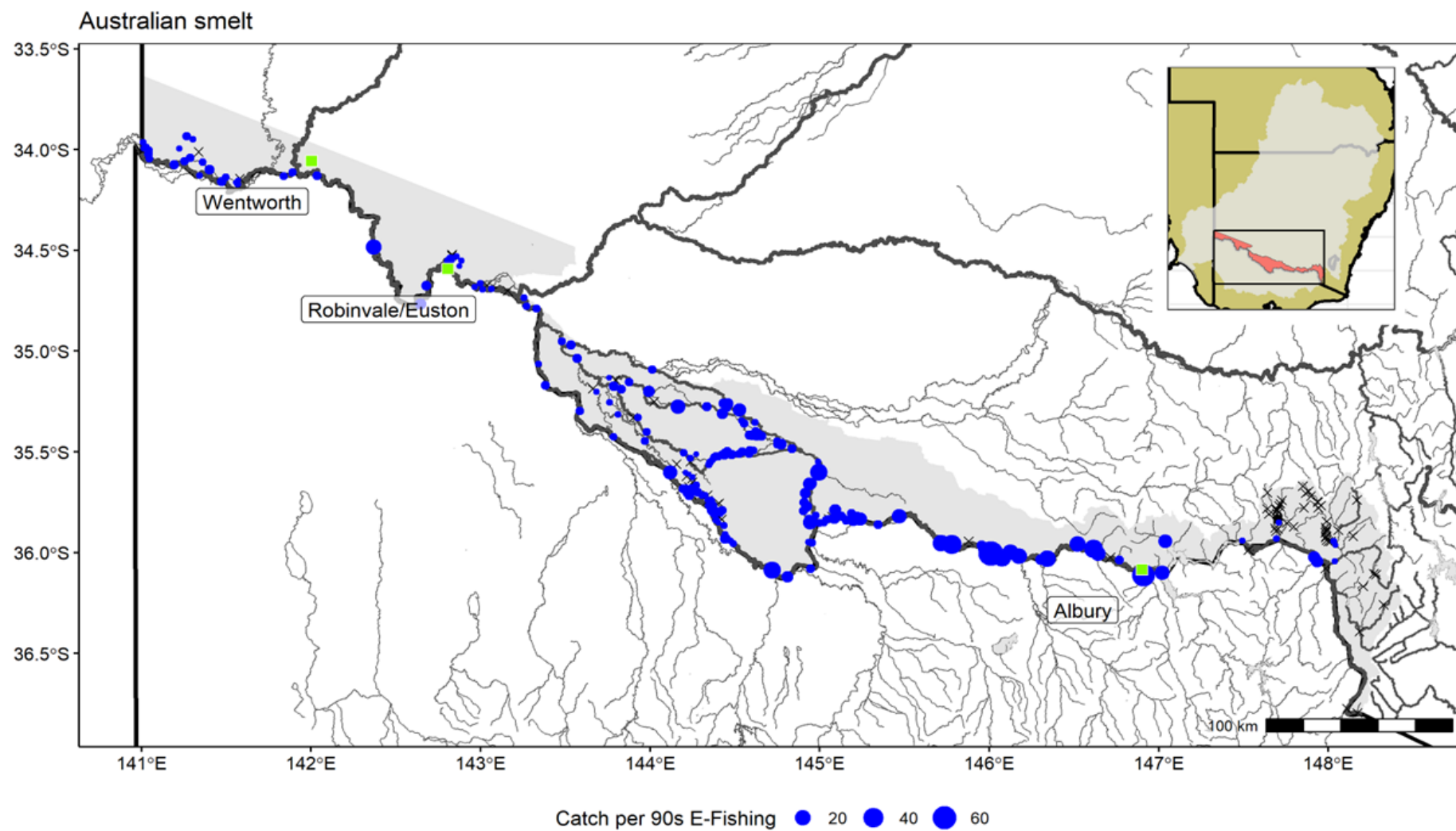


Figure 11.24: Distribution of Australian smelt sampled from 2013/14 to 2023/24 in the NSW Murray WRPA. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares represent key towns.

Common carp



Population Structure

Figure 11.25 shows the observed length frequency plot for Common carp for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 151 to 3,366, and 18 % to 89 % of measured fish within a season, with a mean percentage YOY of 57 %.

Overall, during the reporting period, across all the MDB water resource planning areas, the percentage YOY for Common carp was 50 % (23,339 out of 46,669). Common carp are not a stocked species.

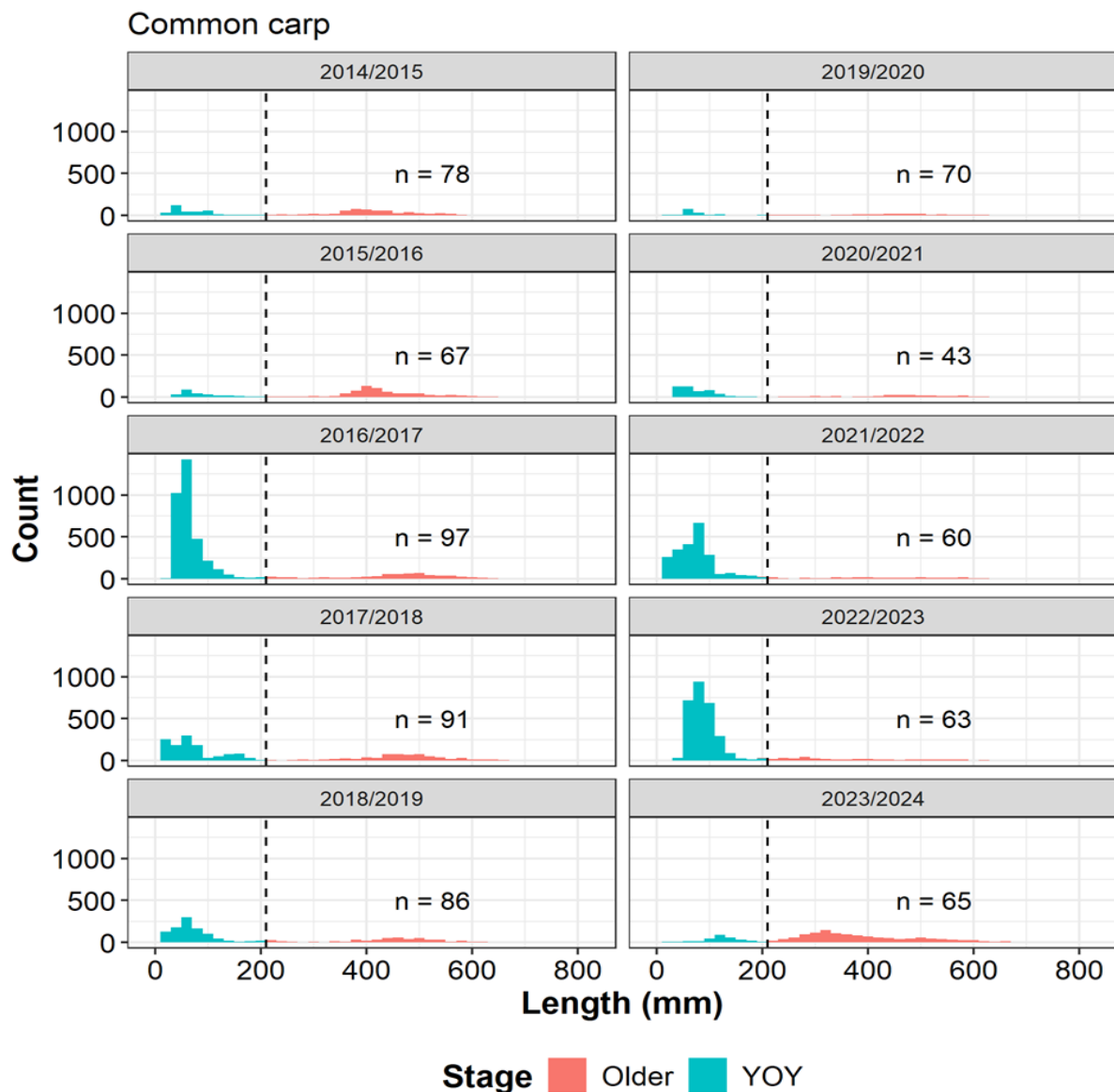


Figure 11.25: Length frequency plots for common carp by sampling season in the NSW Murray WRP. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRP in a sampling season.

Summary Statement:

Variable recruitment with very strong peaks in 2016/17, 2021/22 and 2022/23. Large fish (>500 mm) present in all years. Low recruitment in 2023/24.

Temporal Trends in Abundance

The relative abundance and biomass of Common carp since 1994 was modelled based on all suitable boat electrofishing data. The left-hand panels of Figure 11.26 show the abundance and biomass trends for the New South Wales Murray WRPA and the right-hand panels show the overall trends across the NSW MDB.

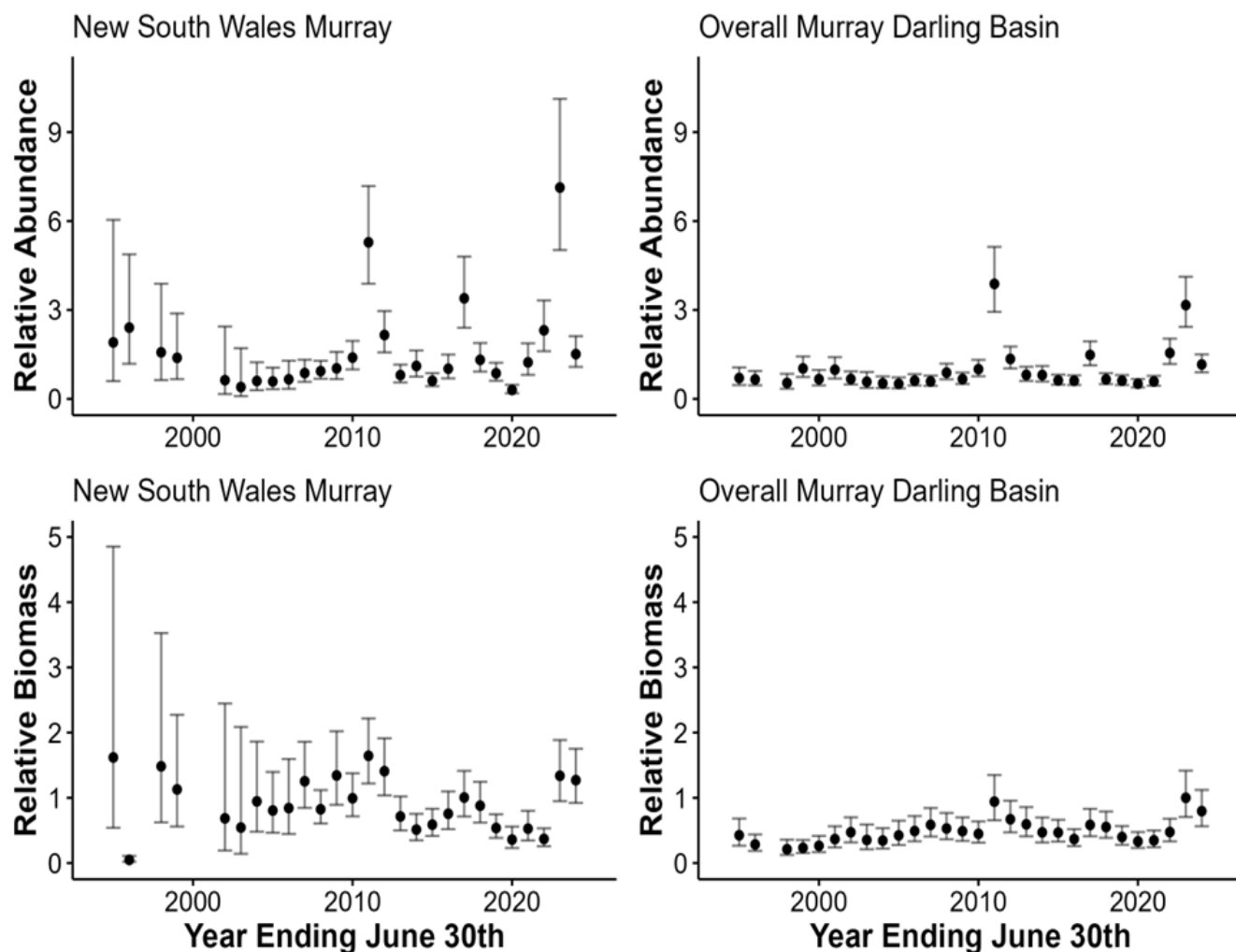


Figure 11.26: Relative abundance and biomass of Common carp in both this valley and the overall Murray-Darling Basin. These are model estimates based upon all electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence intervals around the estimates.

Summary Statement:

Abundance has declined sharply following strong recruitment pulse in 2022/23 but biomass remains elevated. Abundance and biomass slightly higher than the overall NSW MDB.

Health

The prevalence of any health issues ranged from 0 % of sampled fish in 2020/2021 to 4 % of sampled fish in 2019/2020 (Figure 11.27). The most common health issue for Common carp in the New South Wales Murray water resource planning area was *Lernaea*, which was observed in a total of 175 fish, corresponding to 1 % of all Common carp measured.

Across the other WRPA's, 4 % of Common carp (2,082 out of 46,671 Common carp) showed a health condition (excludes New South Wales Murray).

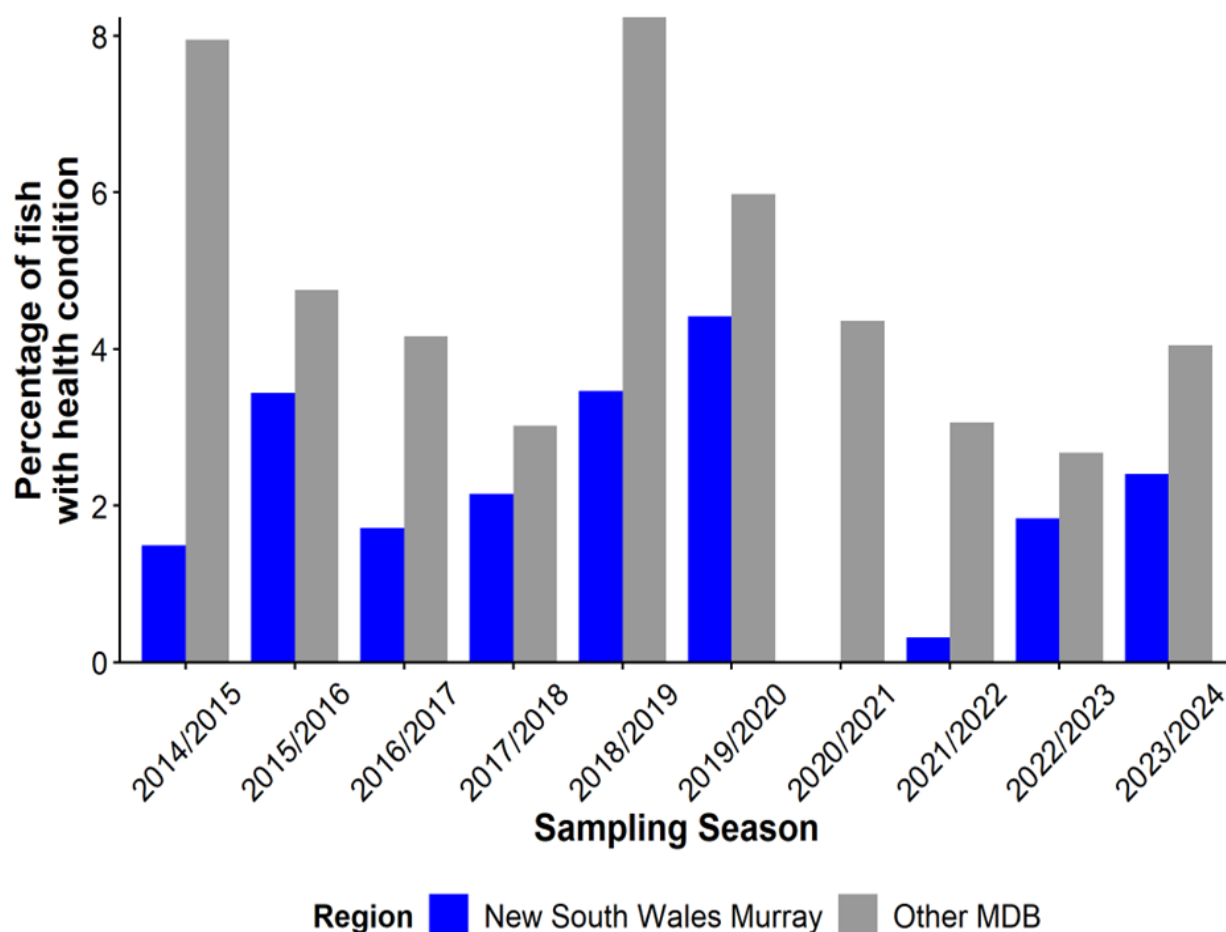


Figure 11.27: Timeseries showing the prevalence of health conditions in Common carp. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA's.

Summary Statement:

The presence of observable health conditions for Common carp in the NSW Murray was very low to low in all years and generally similar to the wider NSW MDB except for 2014/15 and 2020/21 when the NSW Murray showed a substantially lower proportion of health issues.

Distribution

Common carp were recorded at 231 out of 274 sites in the New South Wales Murray WRP from 2013/14 to 2023/24. The maximum observed relative abundance at a site was 53.7 fish caught per 90 seconds of electrofishing. Figure 11.28 shows the distribution and relative abundance of Common carp across the New South Wales Murray WRP.

Summary Statement:

Common carp were generally found across the New South Wales Murray region.

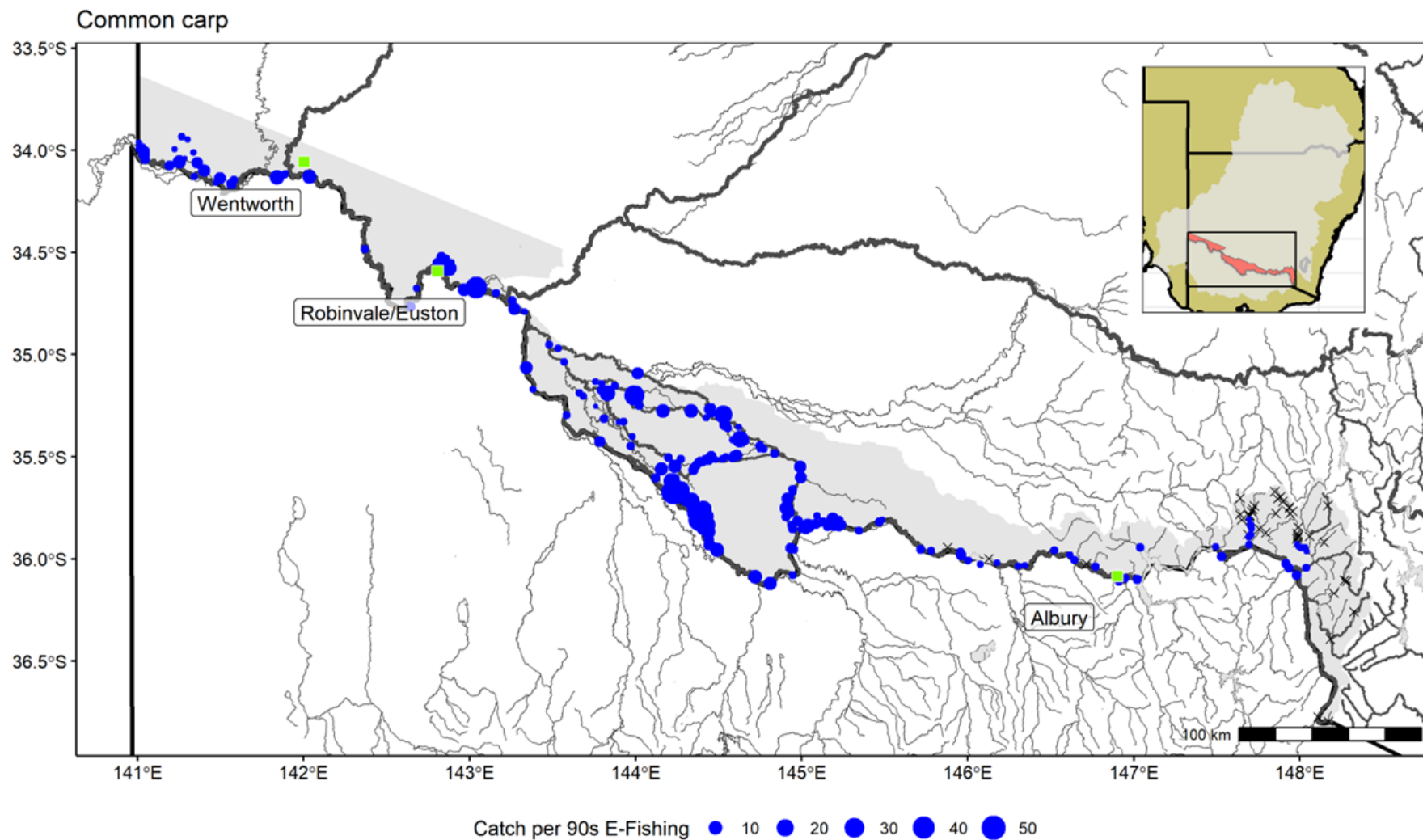


Figure 11.28: Distribution of Common carp sampled from 2013/14 to 2023/24 in the NSW Murray WRPA. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green squares represent key towns.

Threatened Species

The following table (Table 11.6) shows the fish species listed under either the *NSW Fisheries Management Act 1994* (FMA) or the *Commonwealth Environmental Protection and Biodiversity Conservation Act 1999* (EPBC) which were observed during standardised electrofishing surveys in the New South Wales Murray Water Resource Planning Area during the reporting period. A list of all threatened fish species observed by NSW DPIRD Fisheries (as part of any sampling program in any area) is provided in Table 11.10.

Table 11.6: Listed species which were observed in this region during the sampling period. (* = FMA, # = EPBC)

Species	Common name	Total caught (observed)
<i>Bidyanus bidyanus</i>	Silver perch ^{#*}	159 (10)
<i>Maccullochella macquariensis</i>	Trout cod ^{#*}	411 (30)
<i>Maccullochella peelii</i>	Murray cod [#]	2,132 (383)
<i>Macquaria australasica</i>	Macquarie perch ^{#*}	12 (3)
<i>Nannoperca australis</i>	Southern pygmy perch ^{#*}	602 (197)
<i>Tandanus tandanus</i>	Freshwater catfish [*]	5 (1)

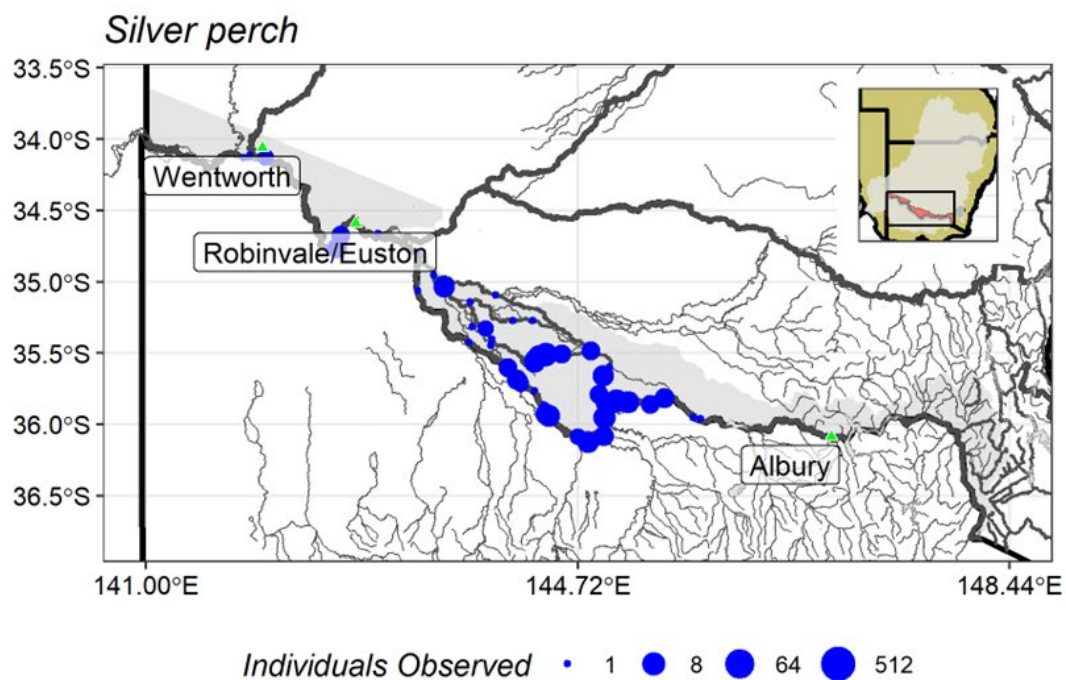


Figure 11.29: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the NSW Murray WRP. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance.

Summary Statement:

159 Silver perch were captured across 60 sites in the central and western areas with individuals observed in all sampling years. 13 individuals were caught across 11 sites in 2023/24.

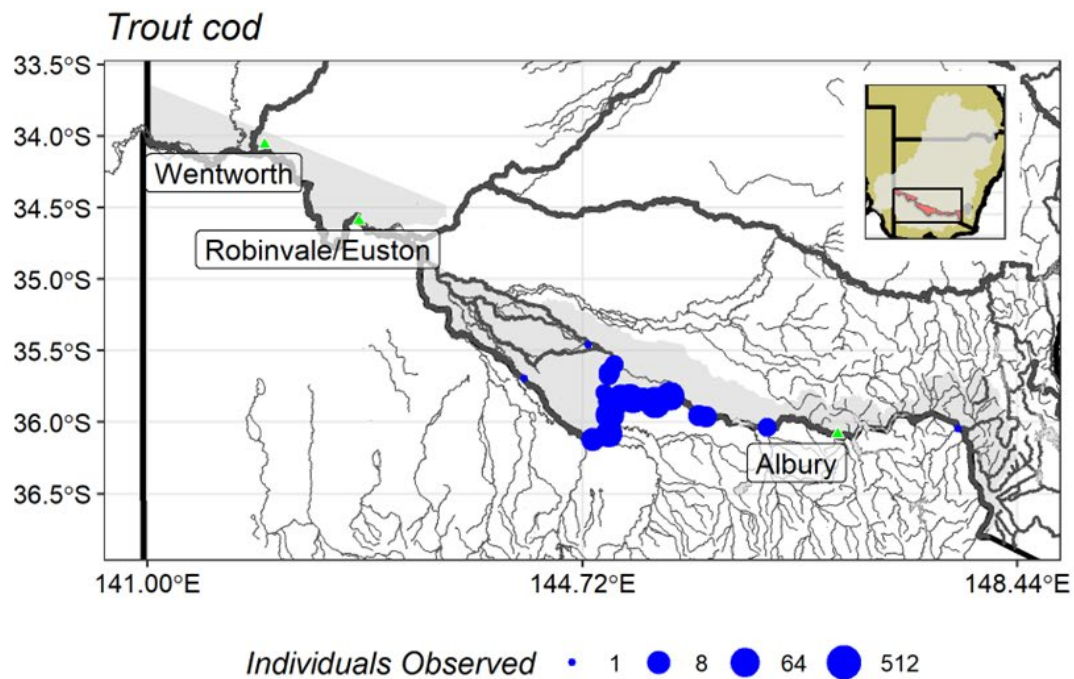


Figure 11.30: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the NSW Murray WRP. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance.

Summary Statement:

411 Trout cod were captured across 25 sites in the central area with individuals observed in all sampling seasons.

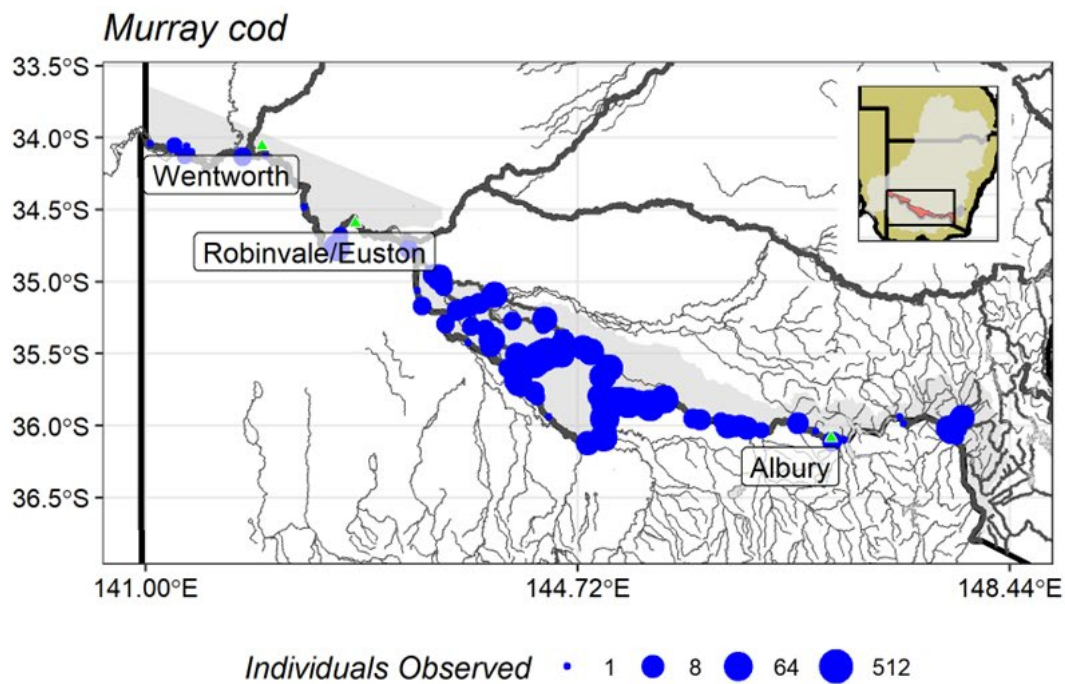


Figure 11.31: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the NSW Murray WRP. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance. Note lower image shows a juvenile Murray cod.

Summary Statement:

Murray cod are widespread across the NSW Murray WRP with 2,132 being caught over the reporting period.

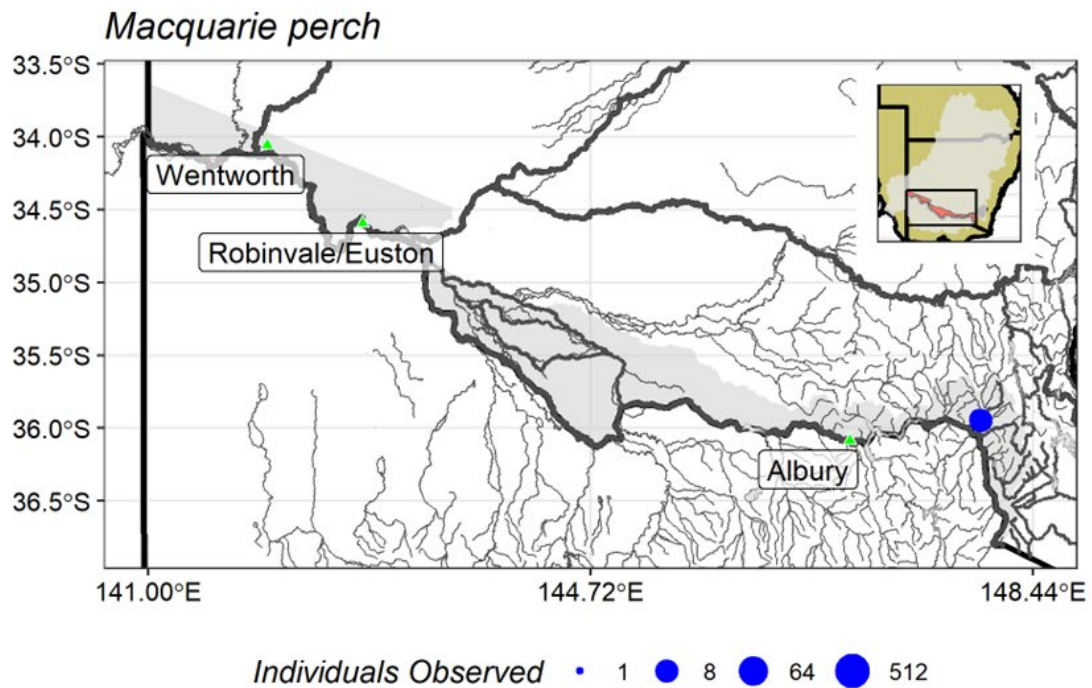


Figure 11.32: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the NSW Murray WRP. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance.

Summary Statement:

Twelve Macquarie perch were captured across 3 sites in the upper NSW Murray region (9 in 2016/17 and 3 in 2017/18). Macquarie perch were stocked into Mannus Creek in 2020/21 (n= 4,500).

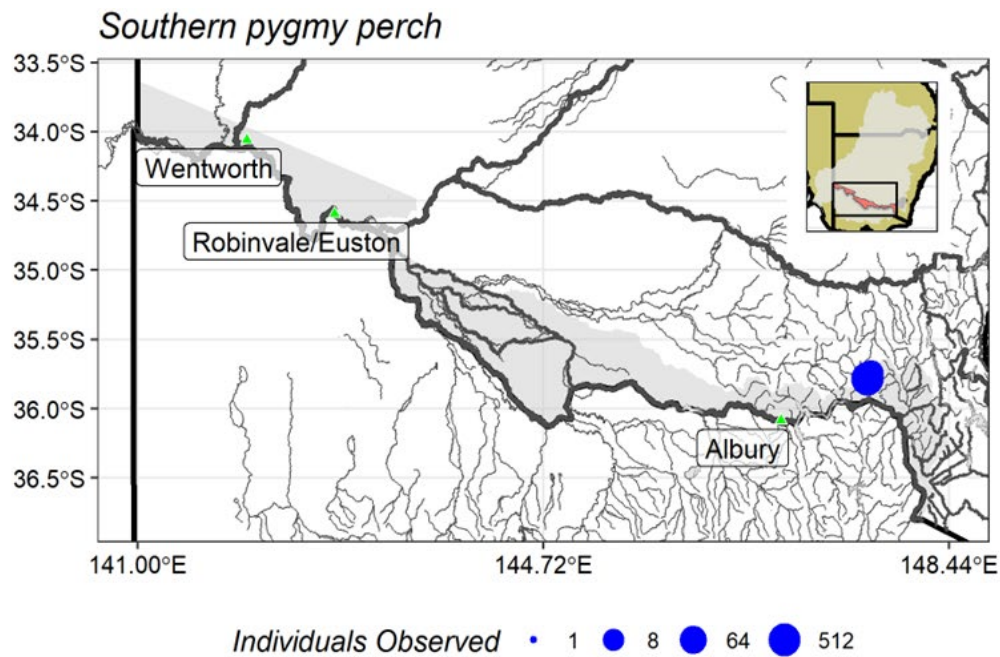


Figure 11.33: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the NSW Murray WRP. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance.

Summary Statement:

A total of 602 Southern pygmy perch were captured across 3 sites in the upper NSW Murray region. Individuals were observed in 2014/15 (n= 3), 2019/20 (n= 595) and 2022/23 (n= 4). Southern pygmy perch have been stocked historically in this WRP (prior to 2012) and there have been some recent translocations into the area.

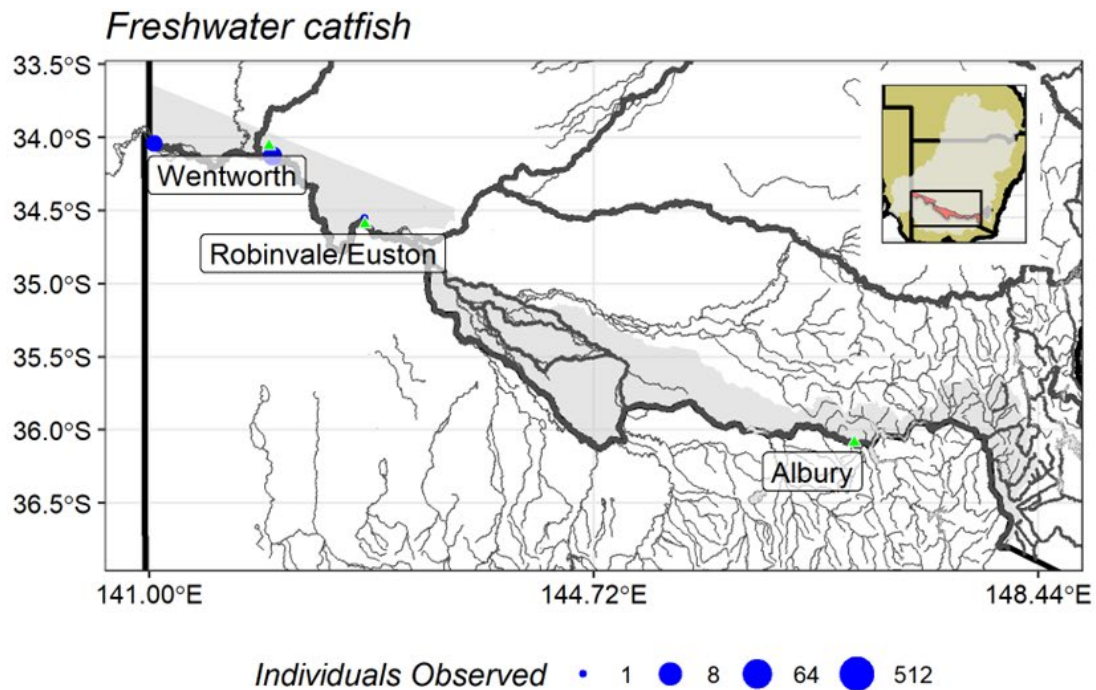


Figure 11.34: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the NSW Murray WRP. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance.

Summary Statement:

Five Freshwater catfish were captured across 3 sites in the western NSW Murray region. Individuals were observed in 2014/15 (n= 1), 2015/16 (n= 2), 2017/18 (n= 1) and 2023/24 (n= 1).

Appendix

This report contains data from the projects listed in Table 11.7.

Table 11.7: Projects included in this report. Sampling Events show the total number of sampling events included from each project. Sampling Seasons shows which sampling seasons each project contributed data to.

Project Name	Sampling Seasons	Sampling Events
Barmah-Millewa Fish Condition Monitoring	2015/2016, 2016/2017, 2017/2018, 2018/2019, 2019/2020, 2020/2021, 2021/2022, 2022/2023, 2023/2024	157
Basin Plan Environmental Outcomes Monitoring	2014/2015, 2015/2016, 2016/2017, 2017/2018, 2018/2019, 2019/2020	171
Basin Plan Environmental Outcomes Monitoring 2	2022/2023, 2023/2024	43
Carp Biomass Project (NCCP)	2017/2018	3
Carp herpes virus investigation	2015/2016, 2016/2017	12
Edward-Wakool Blackwater restocking	2014/2015	5
Edward-Wakool CMA surveys	2014/2015	1
Edward-Wakool Long Term Intervention Monitoring	2014/2015, 2015/2016, 2016/2017, 2017/2018, 2018/2019, 2020/2021, 2021/2022, 2022/2023, 2023/2024	180
Koondrook Perricoota Accumulation Sites	2014/2015, 2015/2016, 2016/2017	15
Koondrook-Perricoota Fish Condition Monitoring	2014/2015, 2015/2016, 2016/2017, 2017/2018, 2018/2019, 2019/2020, 2020/2021, 2021/2022, 2022/2023	105
Macquarie perch surveys	2016/2017, 2017/2018, 2019/2020	35
Monitoring, Evaluating and Reporting - Inland	2014/2015, 2015/2016	14
Murray Crayfish	2014/2015, 2020/2021	14
Murray-Darling Basin Fish Surveys	2014/2015, 2015/2016, 2016/2017, 2017/2018, 2018/2019, 2019/2020, 2021/2022, 2022/2023, 2023/2024	41
Southern pygmy perch surveys	2014/2015	10

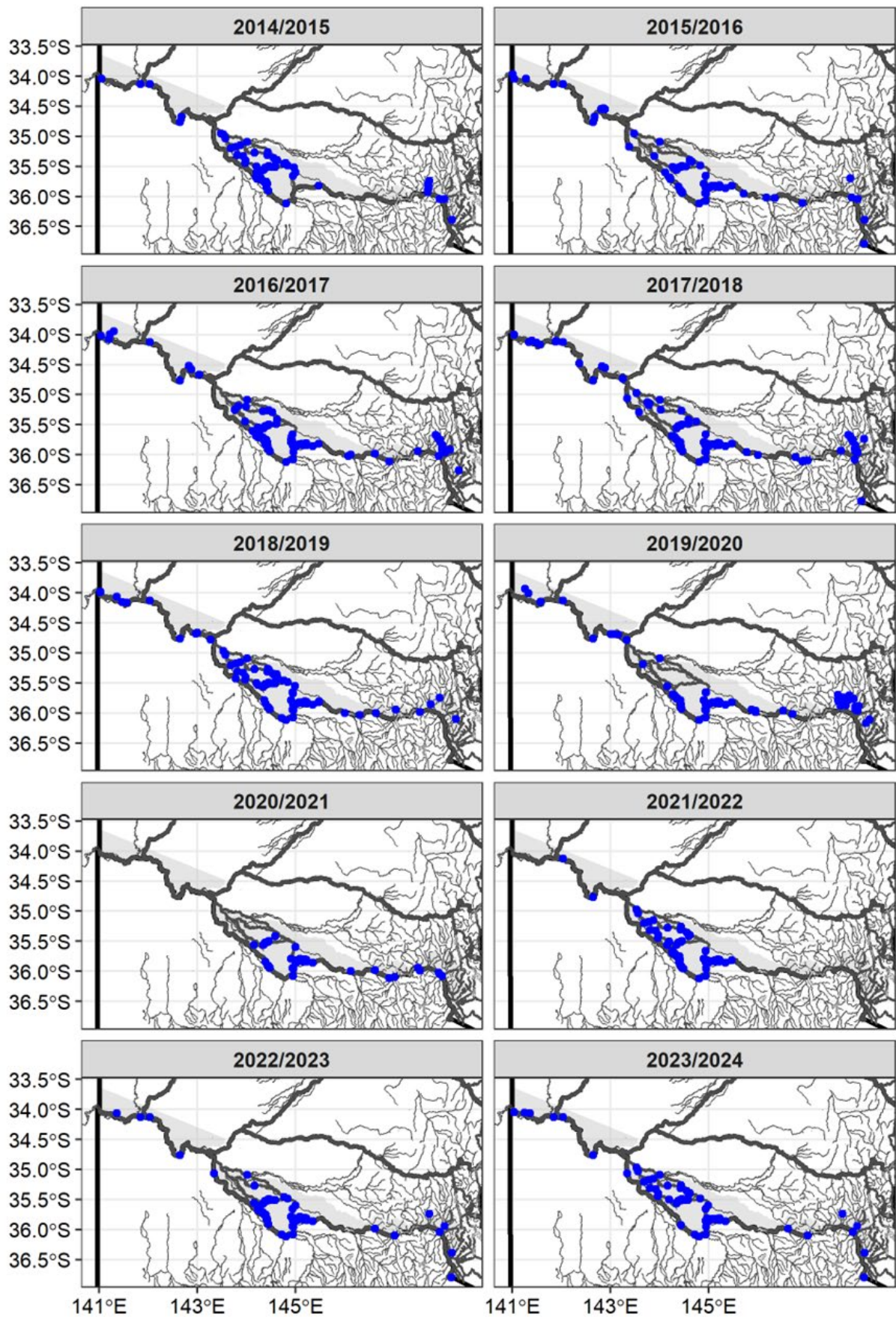


Figure 11.35: Sites sampled and included in this report by sampling season in the NSW Murray WRP. Dry sites are not shown.

Table 11.8 shows all species detected during this survey period as part of standardised monitoring projects (see Table 11.7). Note there are variations in effort between sampling seasons so this information should be considered in conjunction with Table 11.1. The Expected from Modelling column identifies species which are possible to occur based upon MaxENT habitat modelling (likelihood threshold > 0.33; NA represents no modelling was undertaken). Species that were possible from the modelling but not observed during standardised sampling in the New South Wales Murray WRPAs were: Olive perchlet, Darling hardyhead, Murray hardyhead, Flat-headed galaxias, Southern purple-spotted gudgeon. It should be noted that the MaxENT modelling models habitat availability and is not always a reliable index of abundance, it merely indicates possible distribution based upon habitat. A full list of species observed during this period across the standardised monitoring protocols and sampling methods is presented in Table 11.11.

Table 11.8: Total number caught of each species by sampling season in the NSW Murray WRPAs.

Common name	Expected from modelling	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24
Australian smelt	YES	1,680	3,177	5,121	2,625	2,244	1,657	643	2,539	7,460	1,172
Bony herring	YES	486	592	946	1,222	1,166	670	395	1,553	538	492
Brook trout	NA	0	0	0	0	0	0	0	0	6	1
Brown trout	YES	4	0	1	44	2	9	0	0	9	11
Carp-gudgeon species complex	YES	7,471	4,038	3,279	3,321	3,501	3,054	1,299	2,680	377	614
Common carp	NA	974	1,044	8,381	2,445	1,563	391	1,256	8,777	14,348	1,743
Common carp - Goldfish hybrid	NA	1	0	0	0	0	0	0	0	3	1
Dwarf flathead gudgeon	YES	22	49	1	19	6	26	32	2	0	0
Eastern gambusia	NA	2,020	824	1,585	1,171	615	388	504	829	680	88
Flathead gudgeon	YES	38	364	62	55	89	188	250	36	44	23
Freshwater catfish	YES	1	2	0	1	0	0	0	0	0	1
Galaxias spp	NA	0	0	0	0	0	7	0	0	26	30
Golden perch	YES	189	224	95	127	108	45	117	66	119	171
Goldfish	NA	261	173	1,163	469	497	61	102	589	5,243	377
Macquarie perch	YES	0	0	9	3	0	0	0	0	0	0
Mountain galaxias	YES	2	246	47	10	73	160	0	0	0	0
Murray cod	YES	335	510	125	130	186	82	331	180	133	120
Murray-Darling rainbowfish	YES	521	673	776	763	777	93	963	309	153	47
River blackfish	NA	42	3	11	33	6	59	0	0	22	2

Common name	Expected from modelling	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24
Obscure galaxias	YES	0	0	0	0	1	0	0	0	0	0
Oriental weatherloach	NA	54	1	7	13	5	2	6	7	179	7
Rainbow trout	YES	0	0	3	7	5	21	0	0	2	5
Redfin	YES	0	33	39	157	72	59	0	64	114	18
Riffle galaxias	YES	0	0	0	0	0	0	0	0	22	0
Silver perch	YES	22	20	19	20	14	8	20	12	11	13
Southern pygmy perch	YES	3	0	0	0	0	595	0	0	4	0
Spangled perch	NO	0	0	0	0	0	0	0	0	1	0
Trout cod	YES	7	75	37	25	60	45	67	56	17	22
Two-spined blackfish	YES	15	15	3	1	0	0	0	0	6	11
Unspecked hardyhead	YES	130	1,146	625	1,131	397	214	240	190	133	0

The following table summarises the sampling methods for each species (Table 11.9).

Table 11.9: Total catch of each species by sampling method in the NSW Murray WRP.

Common name	Backpack Electrofishing	Bait Trap	Boat Electrofishing
Australian smelt	1,062	35	27,221
Bony herring	17	9	8,033
Brook trout	7	0	0
Brown trout	75	0	5
Carp-gudgeon species complex	10,163	12,884	6,587
Common carp	7,436	6,284	27,202
Common carp - Goldfish hybrid	0	0	5
Dwarf flathead gudgeon	126	5	26
Eastern gambusia	4,282	2,087	2,335
Flathead gudgeon	264	122	763
Freshwater catfish	0	0	5
Galaxias spp	28	1	34
Golden perch	1	1	1,259
Goldfish	2,515	31	6,389
Macquarie perch	11	1	0
Mountain galaxias	500	26	12
Murray cod	23	0	2,109
Murray-Darling rainbowfish	68	48	4,959
River blackfish	157	0	21
Obscure galaxias	0	0	1
Oriental weatherloach	245	4	32
Rainbow trout	43	0	0
Redfin	139	11	406
Riffle galaxias	22	0	0
Silver perch	2	0	157
Southern pygmy perch	588	14	0
Spangled perch	0	0	1
Trout cod	16	0	395
Two-spined blackfish	45	2	4
Unspecked hardyhead	11	37	4,158

Table 11.10: Listed threatened species recorded in the Murray-Darling Basin (from the NSW DPIRD Fisheries Freshwater Ecosystem research database). Species are listed under either the NSW Fisheries Management Act 1994 (FMA) or the Commonwealth Environmental Protection and Biodiversity Conservation Act 1999 (EPBC).

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

Table 11.11 shows all species detected during this survey period across all programs and methods. Due to variations in project methods protocols, this data is presented only to give a complete list of species observed in the region. The Expected from Modelling column identifies species which are possible to occur based upon MaxENT habitat modelling (likelihood threshold > 0.33; NA represents no modelling was undertaken). Species that were possible from the modelling but not observed during standardised sampling in the New South Wales Murray WRPAs were: Olive perchlet, Darling hardyhead, Murray hardyhead, Flat-headed galaxias and Southern purple-spotted gudgeon. It should be noted that the MaxENT modelling actually models habitat availability and is not always a reliable index of abundance, it merely indicates possible distribution based upon habitat. A list of species caught as part of standardised monitoring during this period is in Table 11.8.

Table 11.11: Total catch of each species by all sampling programs and all methods in the NSW Murray WRPAs. Note these include projects with sampling not representative of the community and the data should be used with caution.

Common name	Expected from modelling	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24
Australian smelt	YES	1,682	3,178	5,131	2,629	2,270	1,702	644	2,540	7,553	1,175
Bony herring	YES	507	592	946	1,222	1,166	675	395	1,553	538	492
Brook trout	NA	0	0	0	0	0	0	0	0	6	1
Brown trout	YES	4	0	3	44	2	9	0	0	9	11
Carp gudgeon species complex	YES	11,773	6,405	10,093	11,125	5,897	7,927	4,594	10,468	556	3,637
Common carp	NA	1,002	1,044	8,421	2,447	1,564	391	1,257	8,782	14,431	1,745
Common carp - Goldfish hybrid	NA	1	0	0	0	0	0	0	0	3	1
Dwarf flathead gudgeon	YES	22	49	1	19	6	26	32	2	0	0
Eastern gambusia	NA	2,195	1,190	1,710	1,226	625	388	508	1,475	680	635
Flathead gudgeon	YES	38	367	62	55	89	188	255	43	44	23
Freshwater catfish	YES	1	2	0	1	0	0	0	0	0	1
Galaxia spp	NA	0	0	0	0	0	7	0	0	26	30
Golden perch	YES	267	224	95	127	108	45	117	66	119	171
Goldfish	NA	264	173	1,165	470	497	61	103	589	5,332	377
Macquarie perch	YES	0	0	33	28	0	2	0	0	0	0
Mountain galaxias	YES	2	246	49	10	73	160	0	0	0	0
Murray cod	YES	448	511	126	130	186	82	331	180	133	120

Common name	Expected from modelling	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24
Murray-Darling rainbowfish	YES	689	750	795	782	860	176	996	327	153	47
River blackfish	NA	42	3	60	37	6	59	0	0	22	2
Obscure galaxias	YES	0	0	0	0	1	0	0	0	0	0
Oriental weatherloach	NA	54	1	7	13	5	2	6	7	184	8
Rainbow trout	YES	0	0	3	7	5	21	0	0	2	5
Redfin	YES	0	33	48	285	72	62	0	64	114	18
Riffle galaxias	YES	0	0	0	0	0	0	0	0	22	0
Silver perch	YES	28	20	19	20	14	8	20	12	11	13
Southern pygmy perch	YES	3	0	0	0	0	595	0	0	4	0
Spangled perch	NO	0	0	0	0	0	0	0	0	1	0
Trout cod	YES	7	75	37	25	60	45	67	56	17	22
Two-spined blackfish	YES	15	15	3	1	0	0	0	0	6	11
Unspecked hardyhead	YES	194	1,181	697	1,138	406	239	245	198	133	0

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