

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

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<i>Citation Details</i>	67
<i>Acknowledgement</i>	67
<i>Introduction</i>	68
What This Report Includes	69
Sampling Methods	70
<i>Climate Overview</i>	73
<i>Flow Data</i>	75
<i>Species Diversity</i>	77
<i>Murray cod</i>	80
Population Structure	81
Temporal Trends in Abundance	84
Health	85
Distribution	86
<i>Golden perch</i>	88
Population Structure	89
Temporal Trends in Abundance	92
Health	93
Distribution	94
<i>Freshwater catfish</i>	96
Population Structure	97
Temporal Trends in Abundance	98
Health	99
Distribution	100
<i>Bony herring</i>	102
Population Structure	103
Temporal Trends in Abundance	104
Health	105
Distribution	106
<i>Australian smelt</i>	108
Population Structure	109
Temporal Trends in Abundance	110
Health	111
Distribution	112
<i>Common carp</i>	114
Population Structure	115
Temporal Trends in Abundance	116
Health	117
Distribution	118
<i>Threatened Species</i>	120
<i>Appendix</i>	125

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Introduction

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

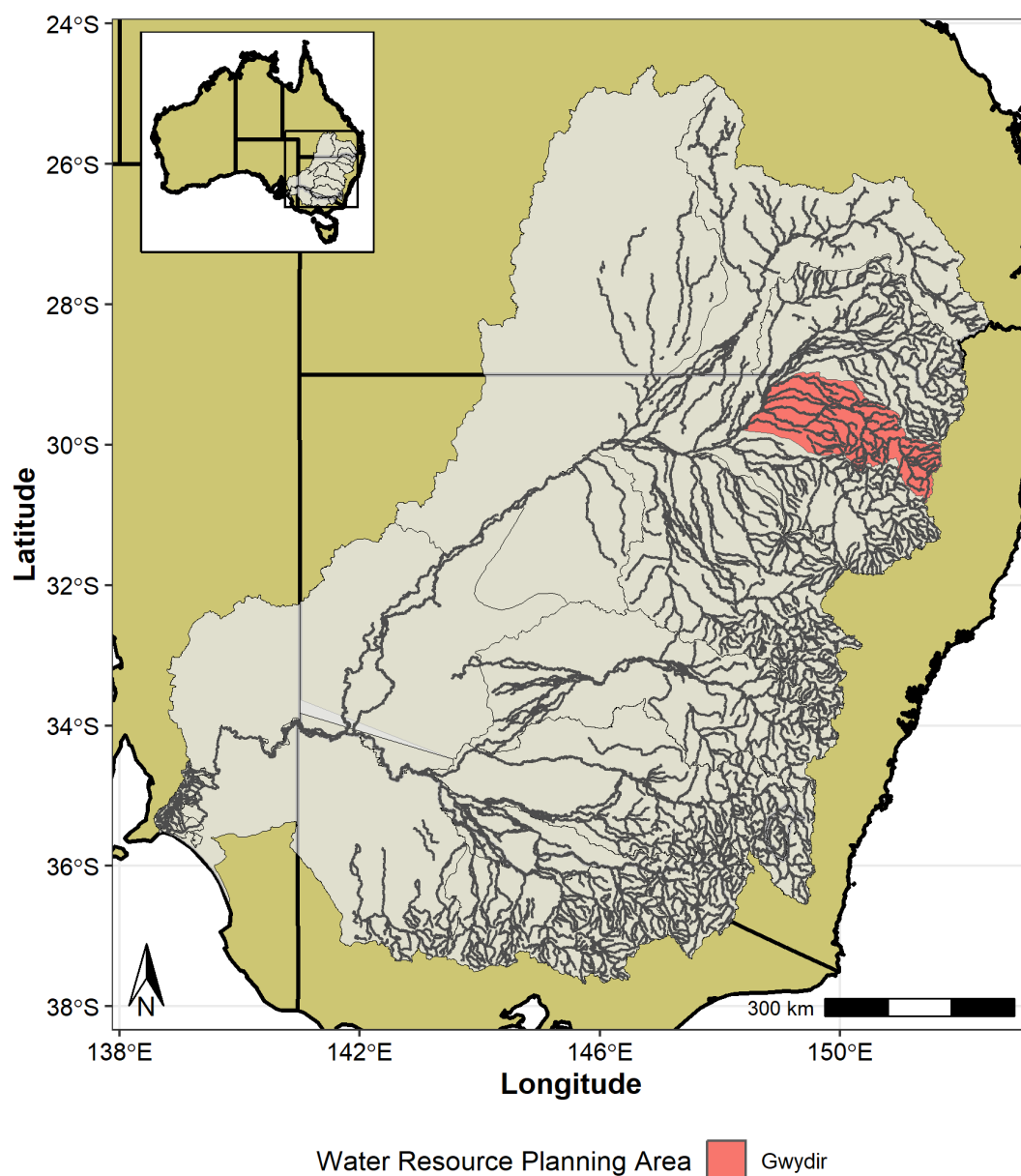


Figure 3.1: Murray-Darling Basin with the key region of this report highlighted. Inset map shows the whole of Australia with a box around the MDB.

What This Report Includes

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

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

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

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

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

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

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

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

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

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

Sampling Methods

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

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

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

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

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

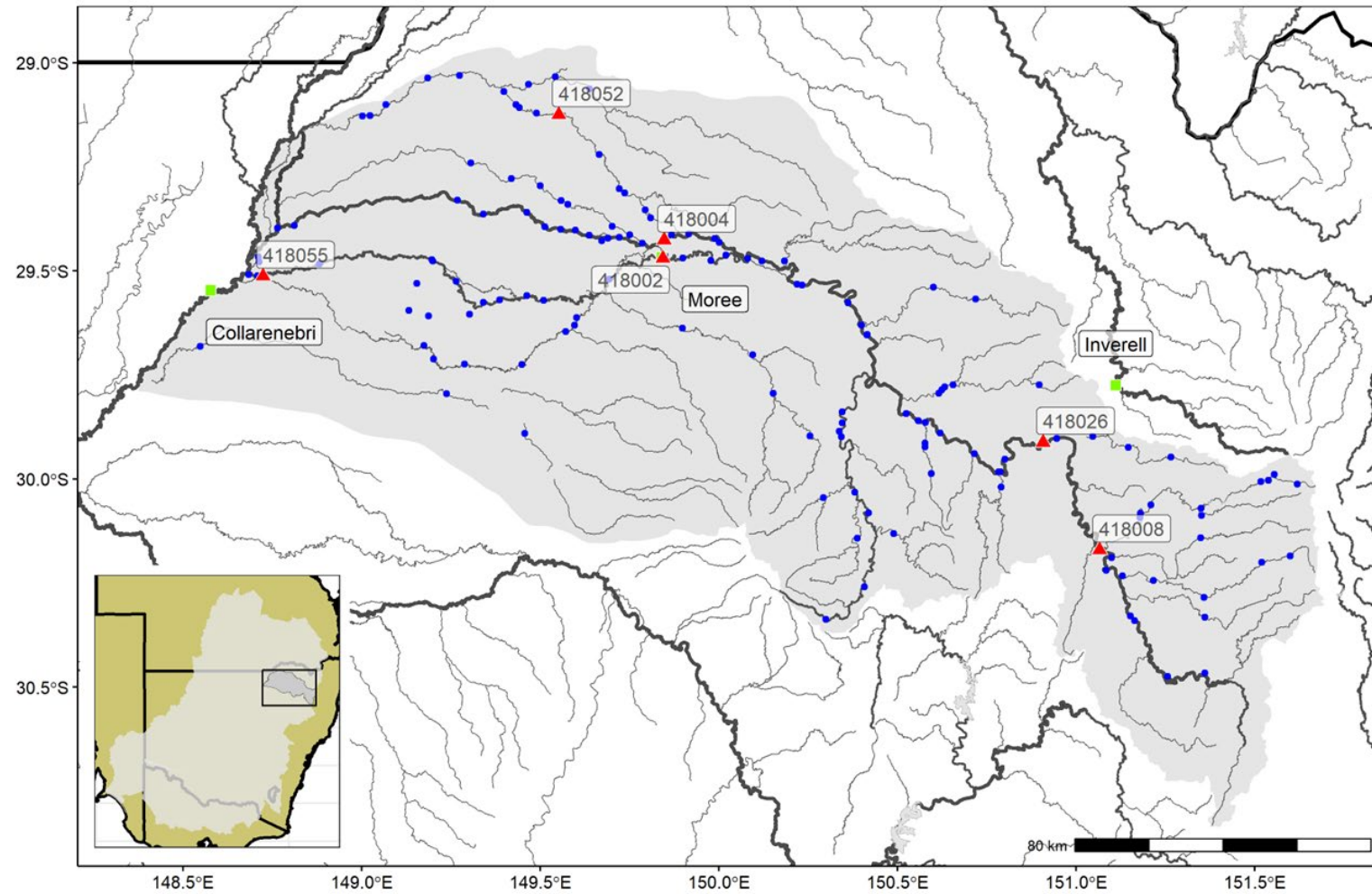


Figure 3.2: Sites (dots) sampled during the reporting period in the Gwydir WRPA. Triangles show key flow gauges along with their gauge ID number. Green squares show major towns.

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

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

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

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

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

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

Climate Overview

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

2014

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

2015

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

2016

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

2017

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

2018

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

2019

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

2020

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

2021

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

2022

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

2023

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

2024

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

Flow Data

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

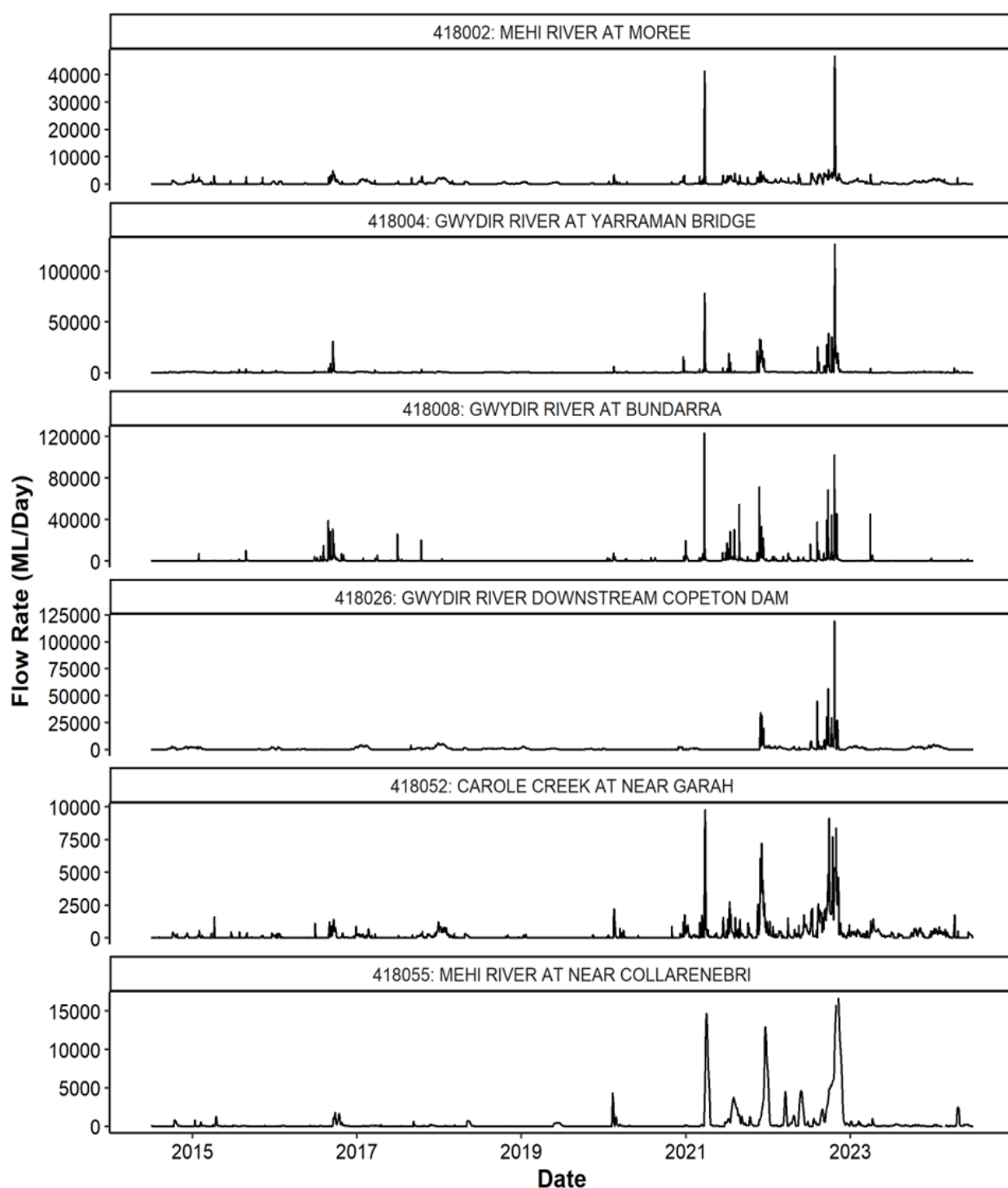


Figure 3.3: Flow data from various gauges in the Gwydir WRP over the reporting period. Gauge locations can be seen on Figure 3.2. Note the differing scales on the y-axis.

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

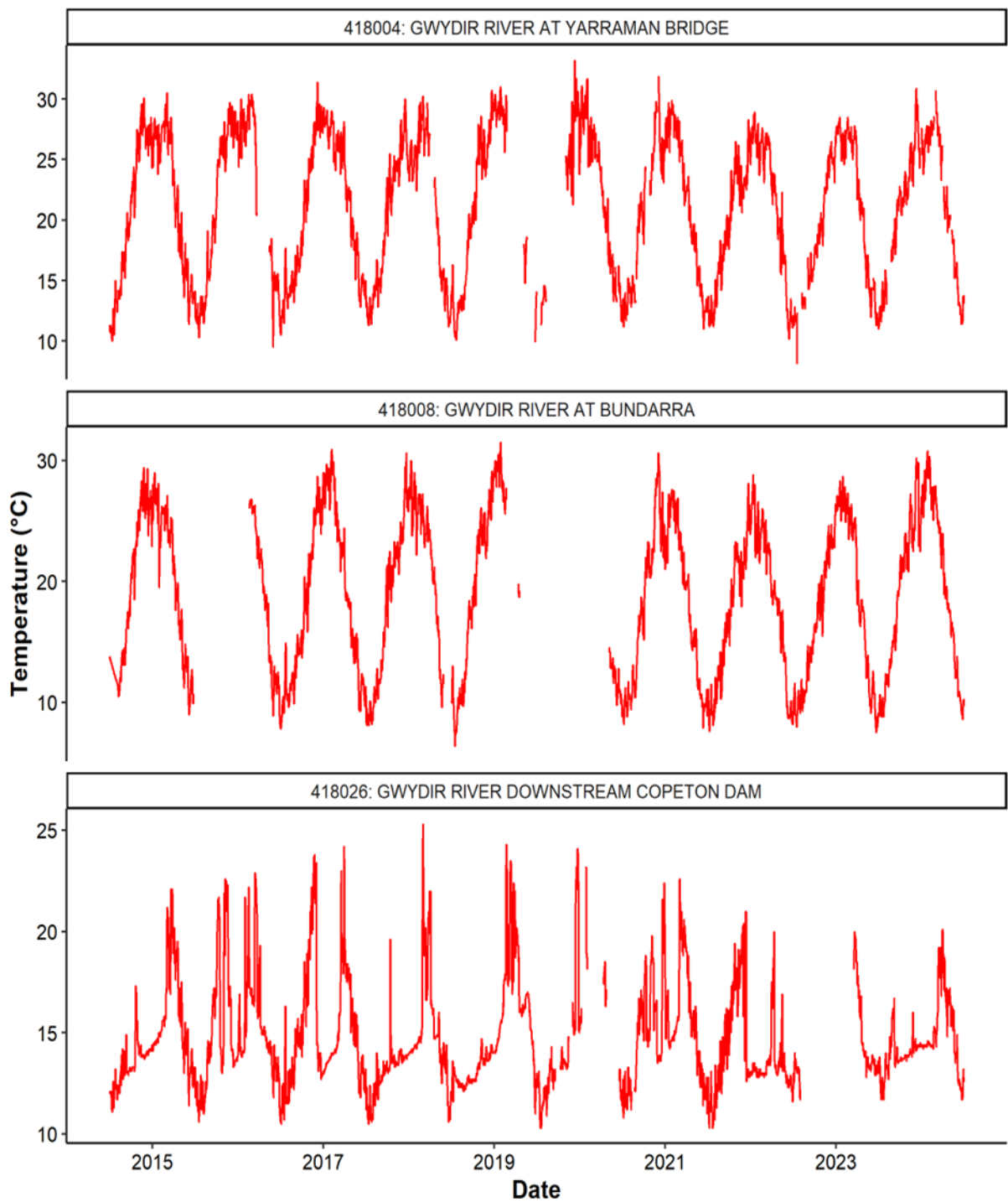


Figure 3.4: Water temperature data from various gauges in the Gwydir WRPA over the reporting period. Gauge locations can be seen on Figure 3.2. Note the differing scales on the y-axis.

Species Diversity

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

Summary Statement:

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

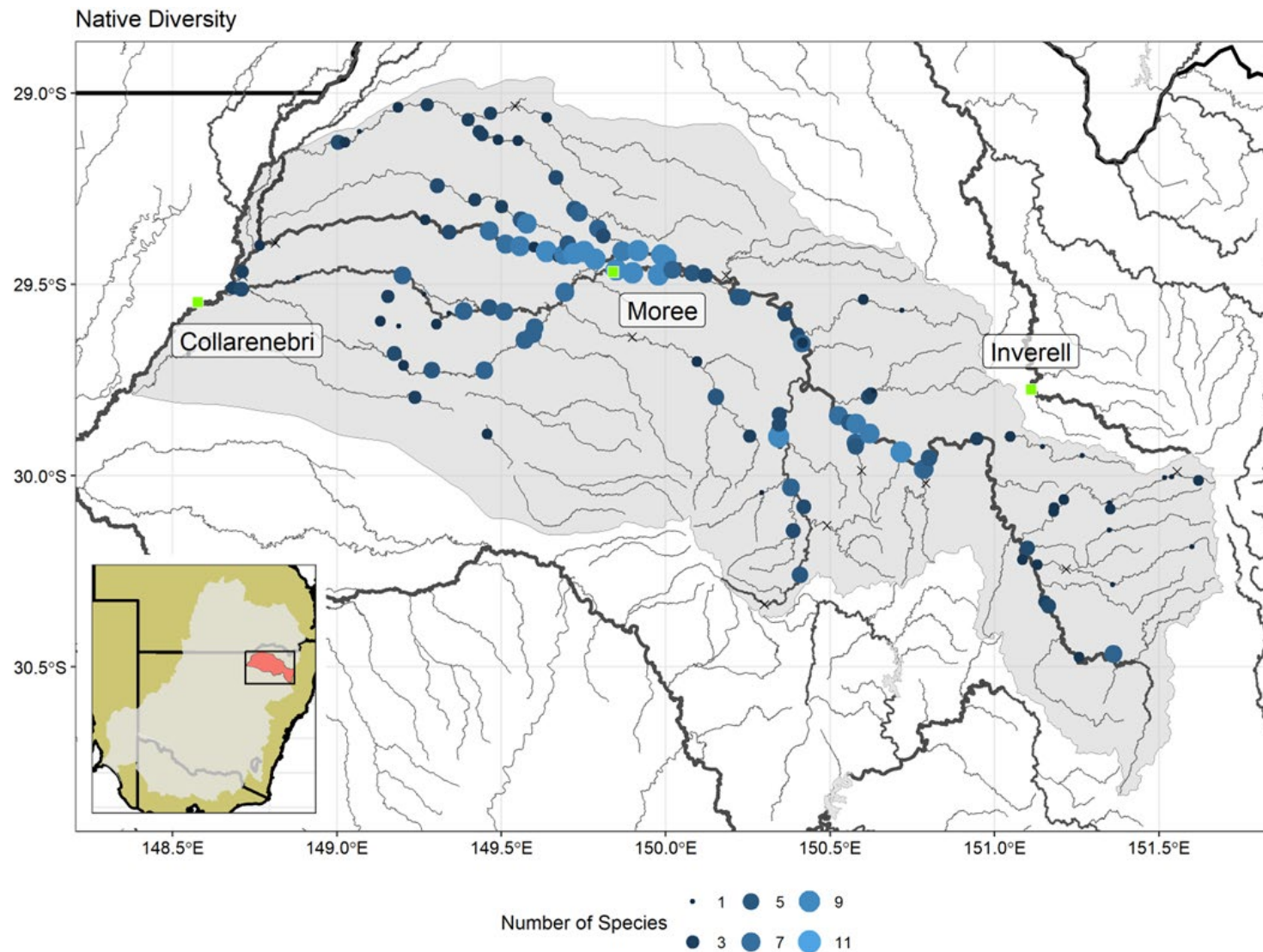


Figure 3.5: Native diversity across all sampling sites in the Gwydir WRP. Bubble size represents the number of unique species observed at each site across all sampling methods and events. X represents a site that had water and was sampled, but no fish species were caught at all. Dry sites are excluded.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

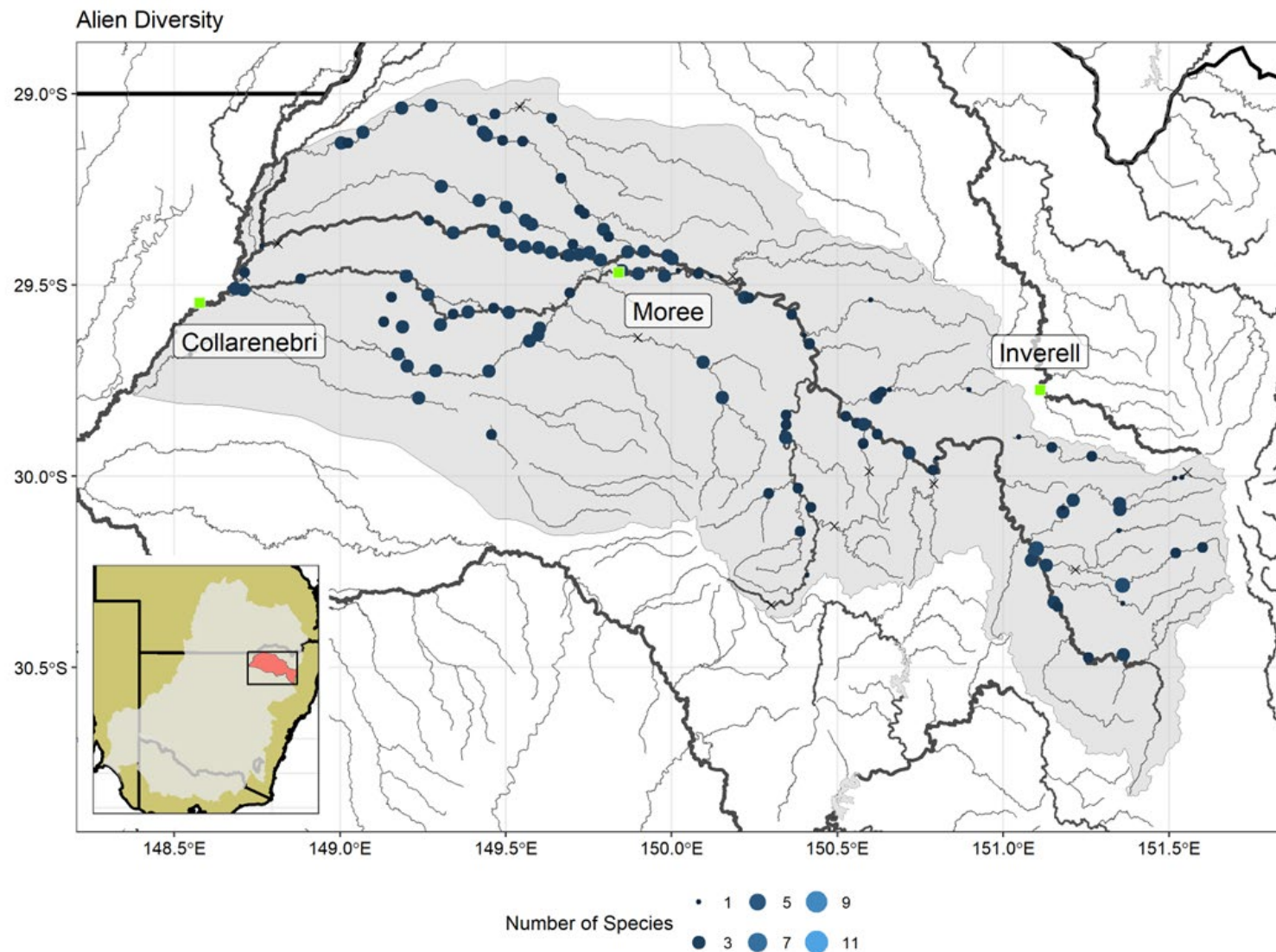


Figure 3.6: Alien diversity across all sampling sites in the Gwydir WRPA. Bubble size represents the number of unique species observed at each site across all sampling methods and events. X represents a site that had water and was sampled, but no fish species were caught at all. Dry sites are excluded.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

Murray cod



Population Structure

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

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

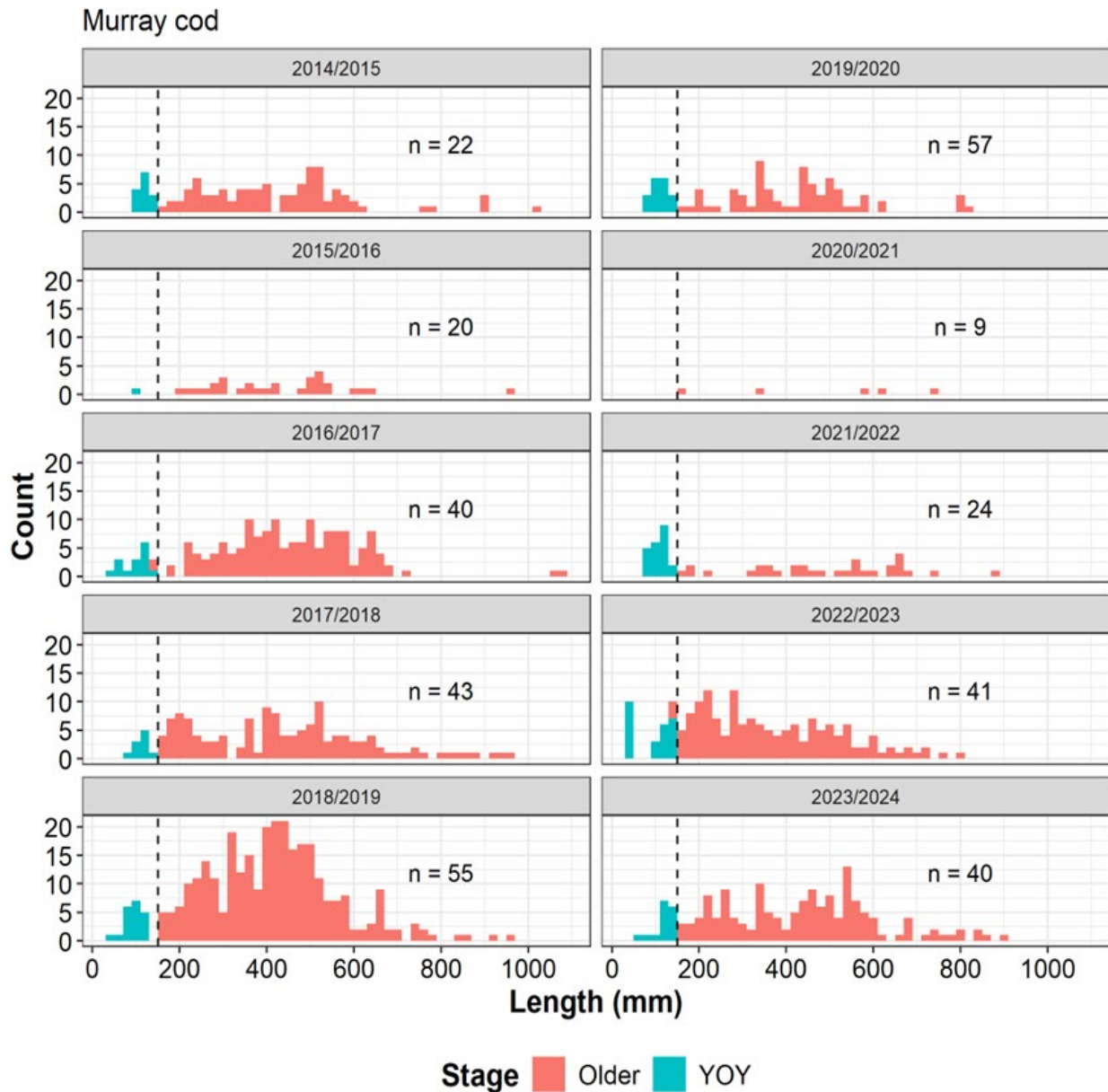


Figure 3.7: Length frequency plots for Murray cod by sampling season in the Gwydir WRPA. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRPA in a sampling season.

Summary Statement:

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

Stocking

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

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

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

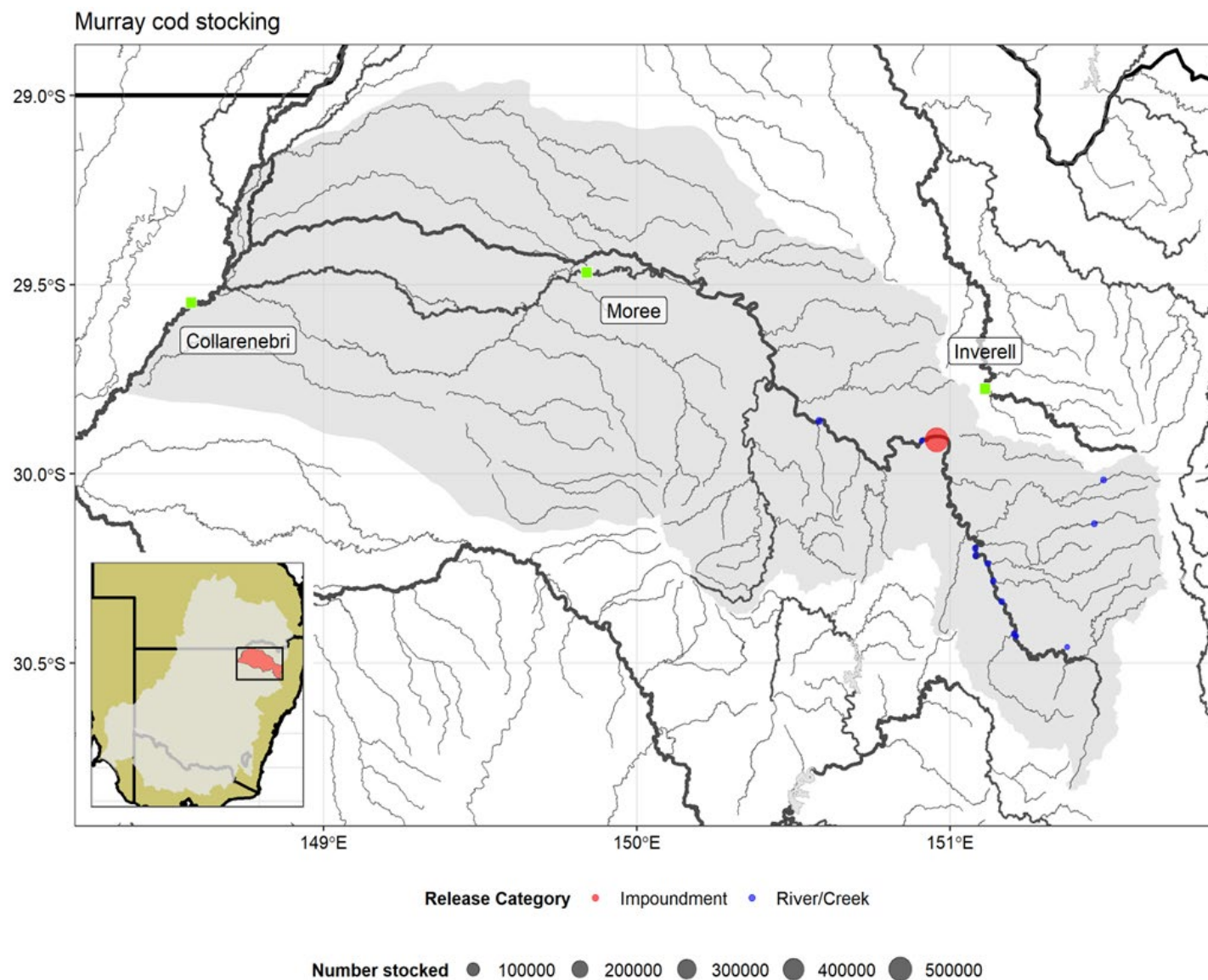


Figure 3.8: Locations of Murray cod stocking in the Gwydir WRPA. Colours show whether a site was a river/creek site or an impoundment, while the size of the point reflects the total number of fish stocked over the reporting period. The vast majority of stocking in the Gwydir WRPA was at Copeton Dam (large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

Temporal Trends in Abundance

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

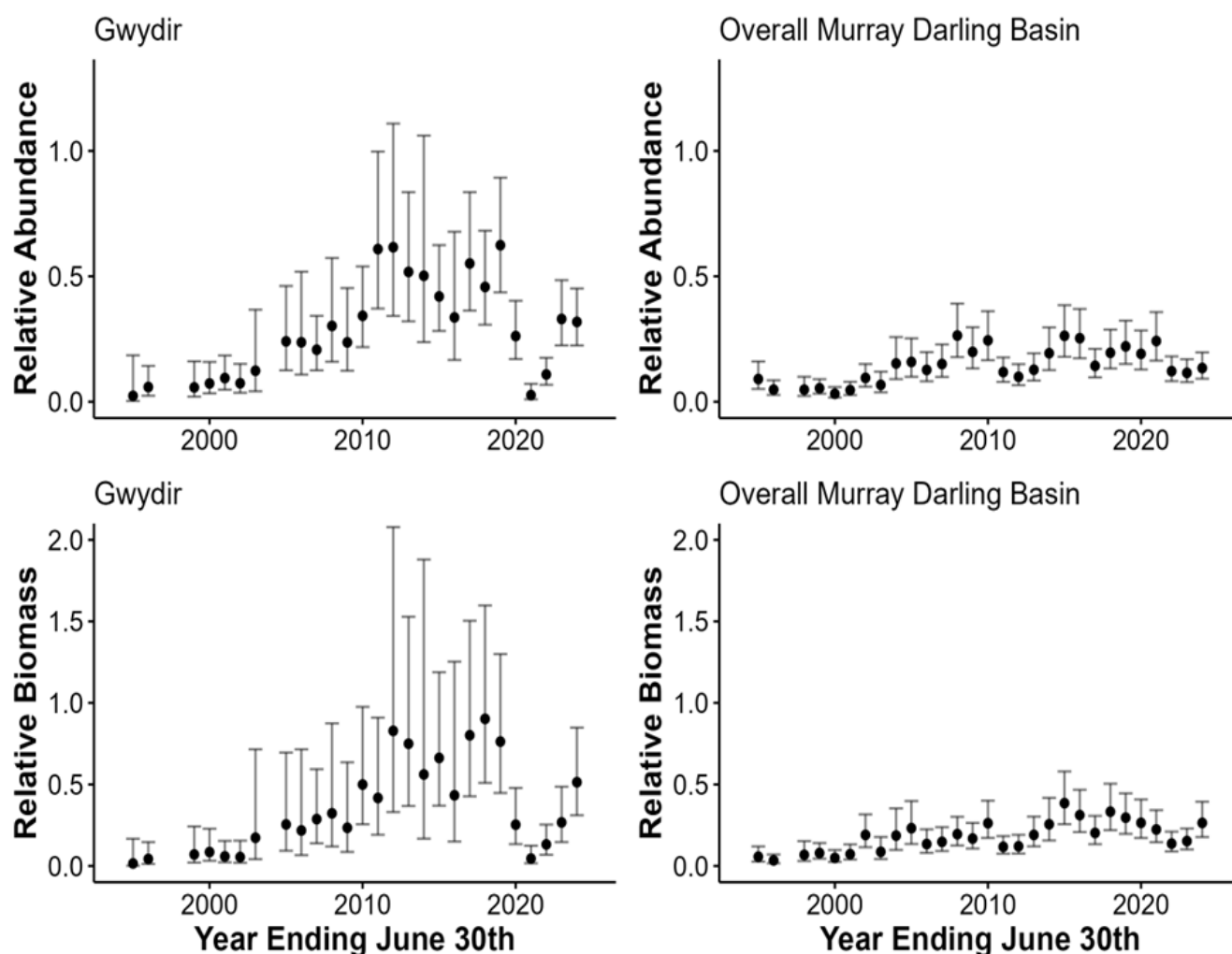


Figure 3.9: Relative abundance and biomass of Murray cod in both the Gwydir WRPA and the overall NSW MDB. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence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

Summary Statement:

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

Health

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

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

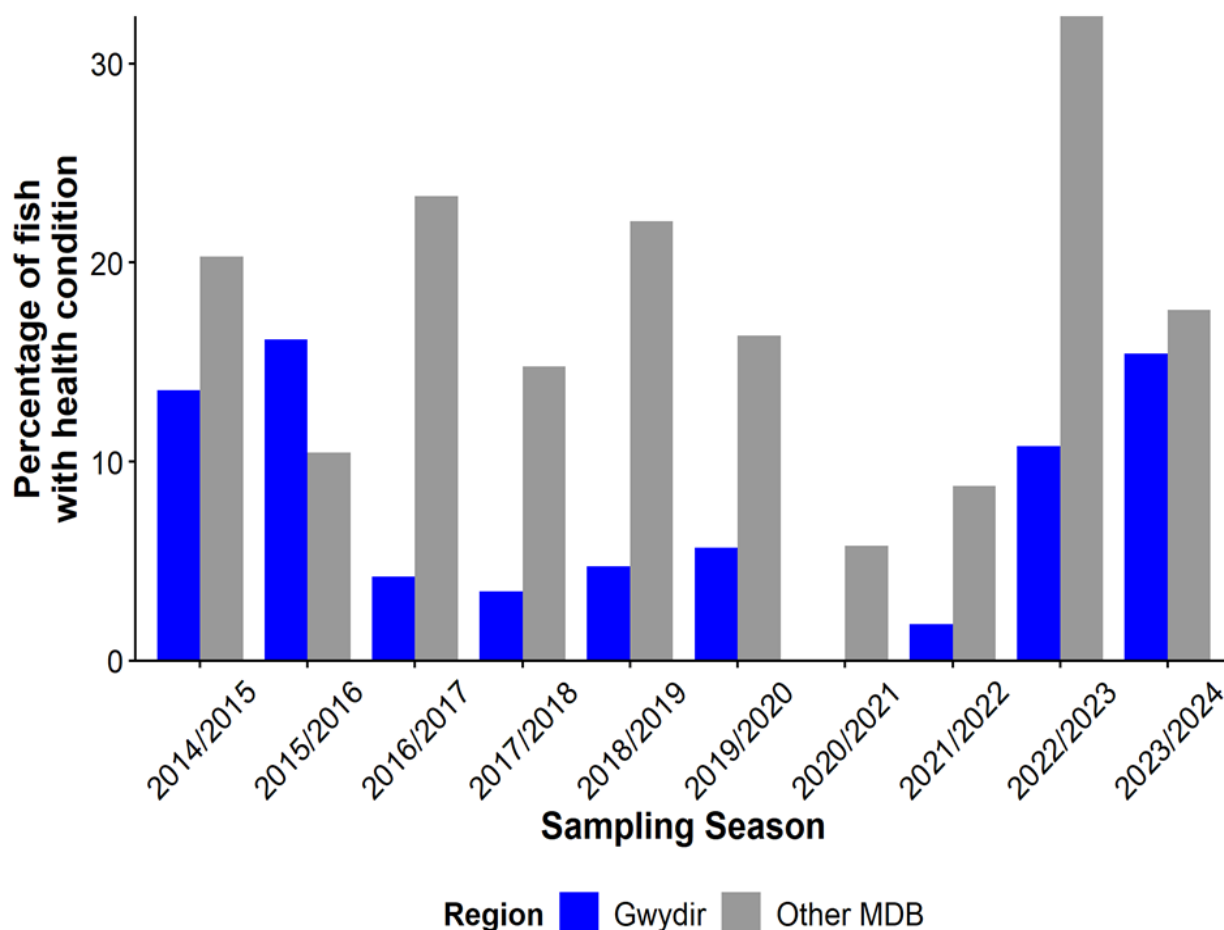


Figure 3.10: Timeseries showing the prevalence of health conditions in Murray cod. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA.

Summary Statement:

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

Distribution

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

Summary Statement:

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

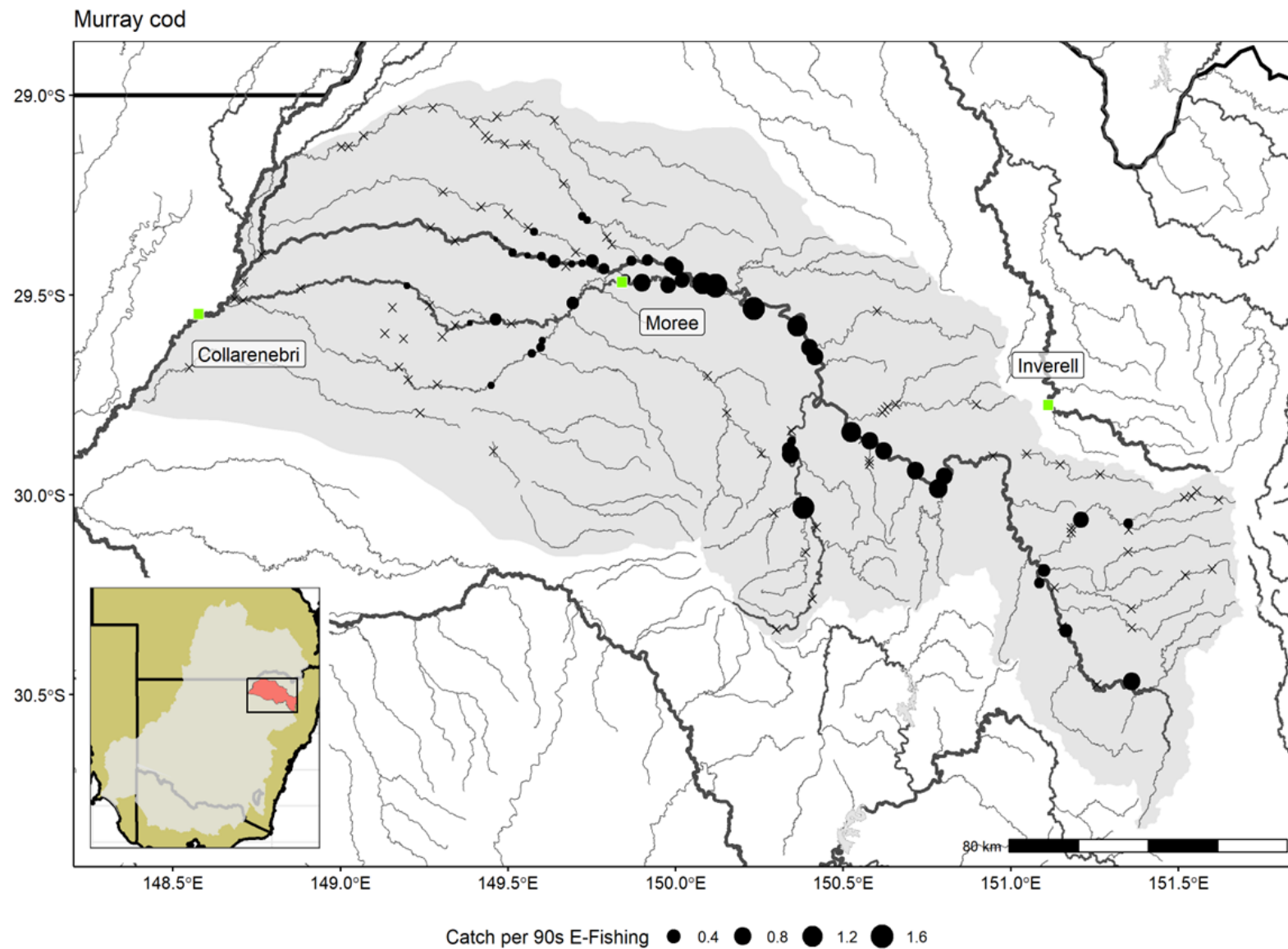


Figure 3.11: Distribution of Murray cod sampled from 2013/14 to 2023/24 in the Gwydir WRPA. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an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

Golden perch



Population Structure

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

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

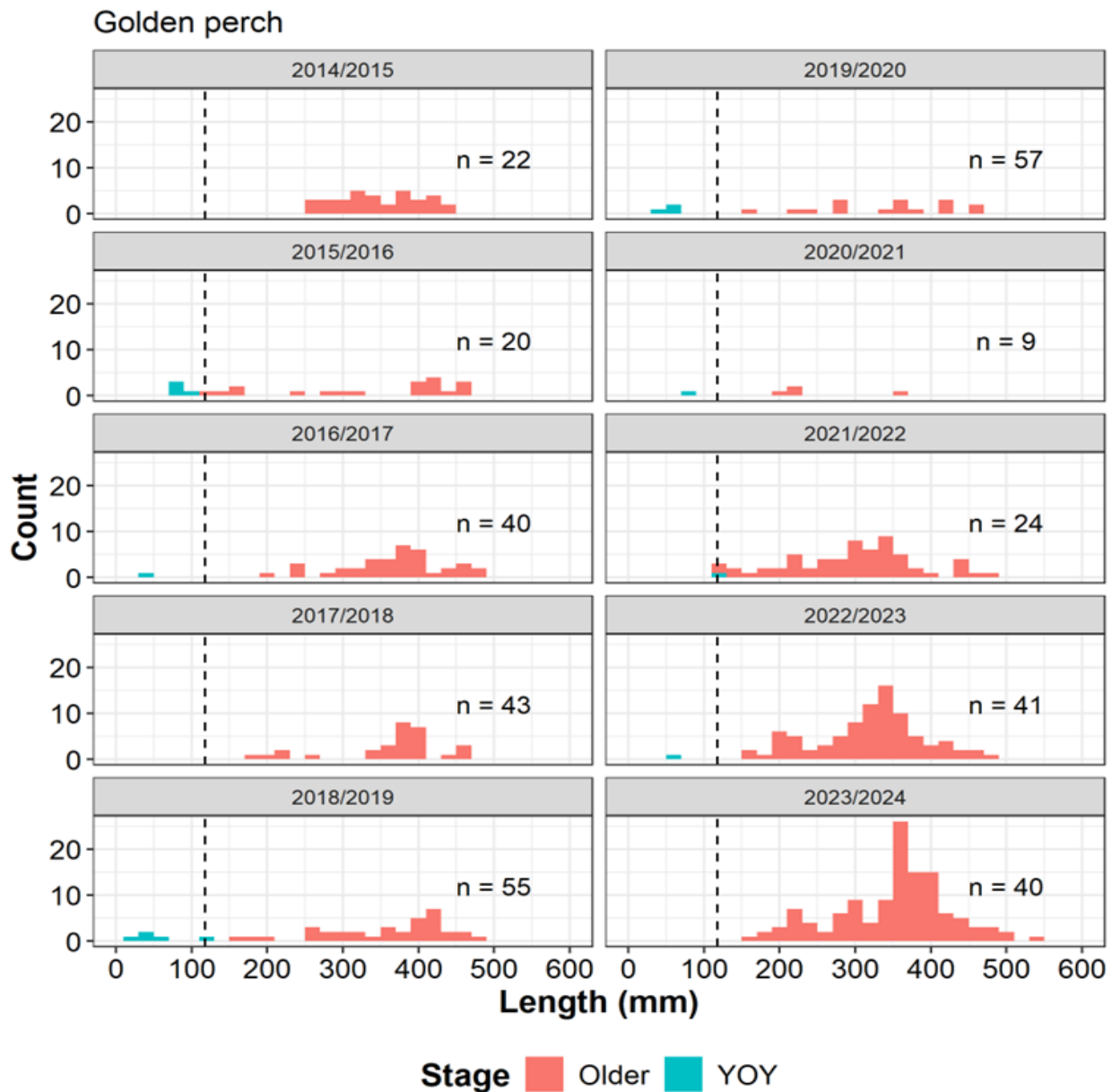


Figure 3.12: Length frequency plots for Golden perch by sampling season in the Gwydir WRPA. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRPA in a sampling season.

Summary Statement:

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

Stocking

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

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

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

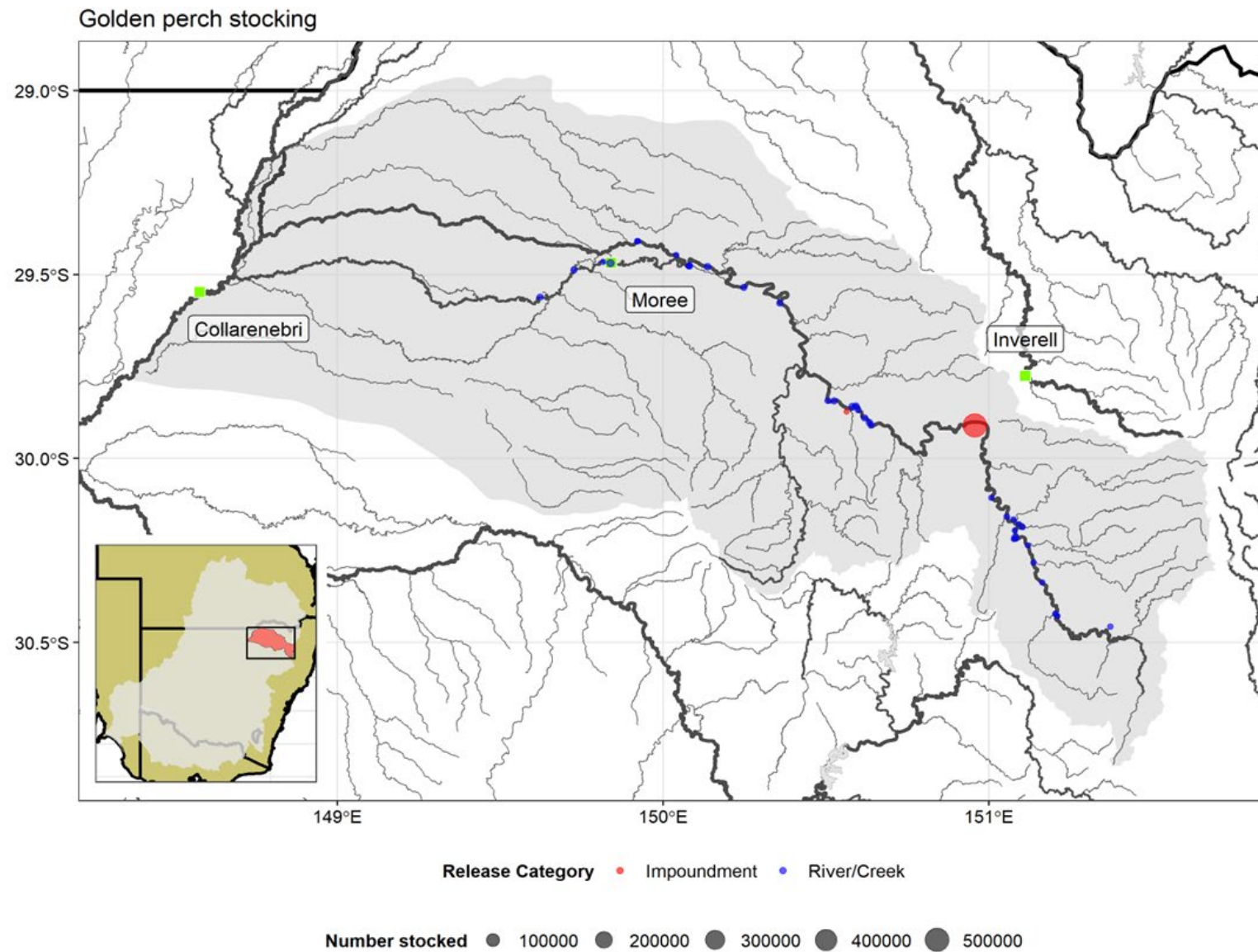


Figure 3.13: Locations of Golden perch stocking in the Gwydir WRPA. Colours show whether a site was a river/creek site or an impoundment, while the size of the point reflects the total number of fish stocked over the reporting period. The vast majority of stocking in the Gwydir WRPA was at Copeton Dam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

Temporal Trends in Abundance

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

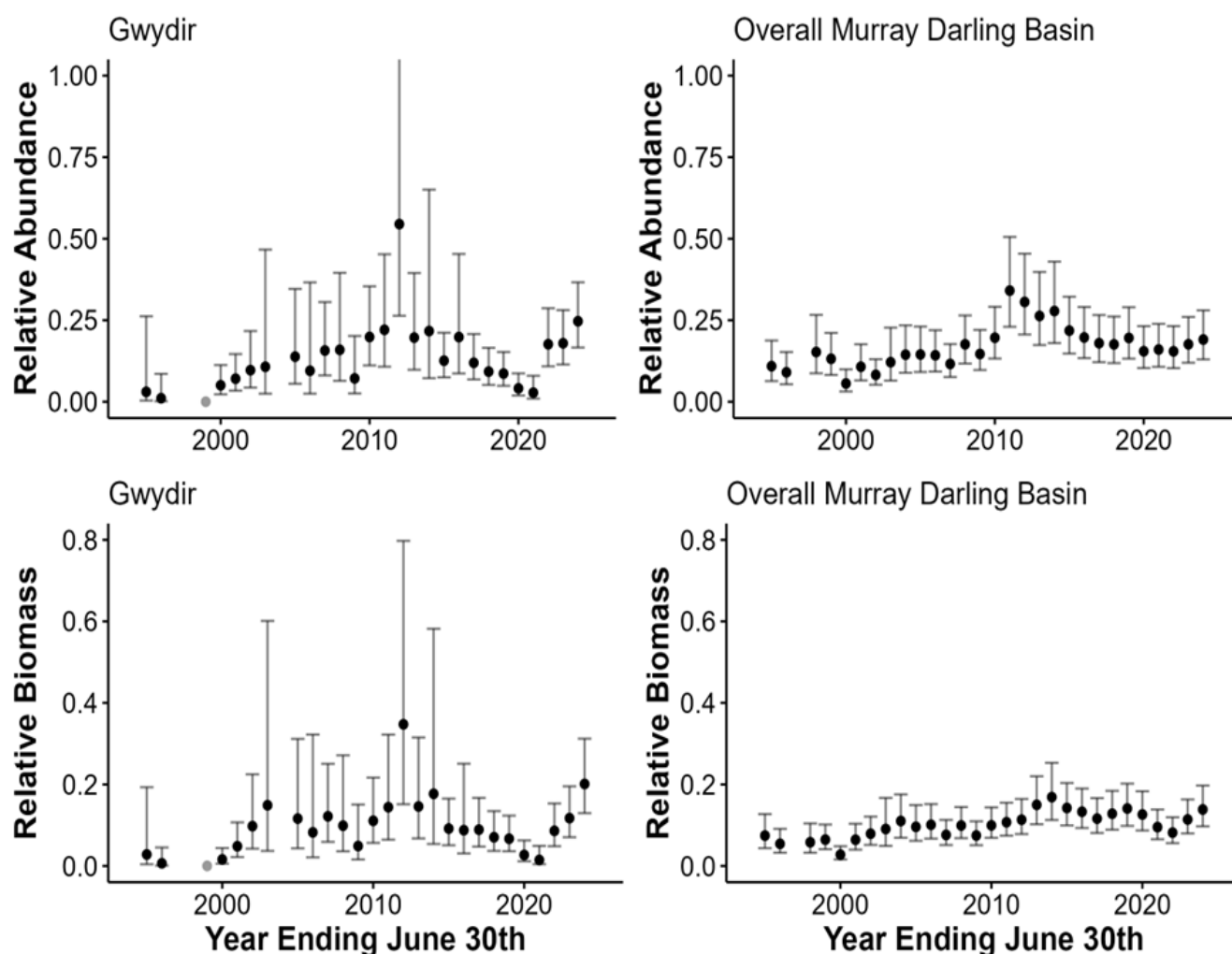


Figure 3.14: Relative abundance and biomass of Golden perch in both this valley and the overall Murray-Darling Basin. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show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

Summary Statement:

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

Health

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

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

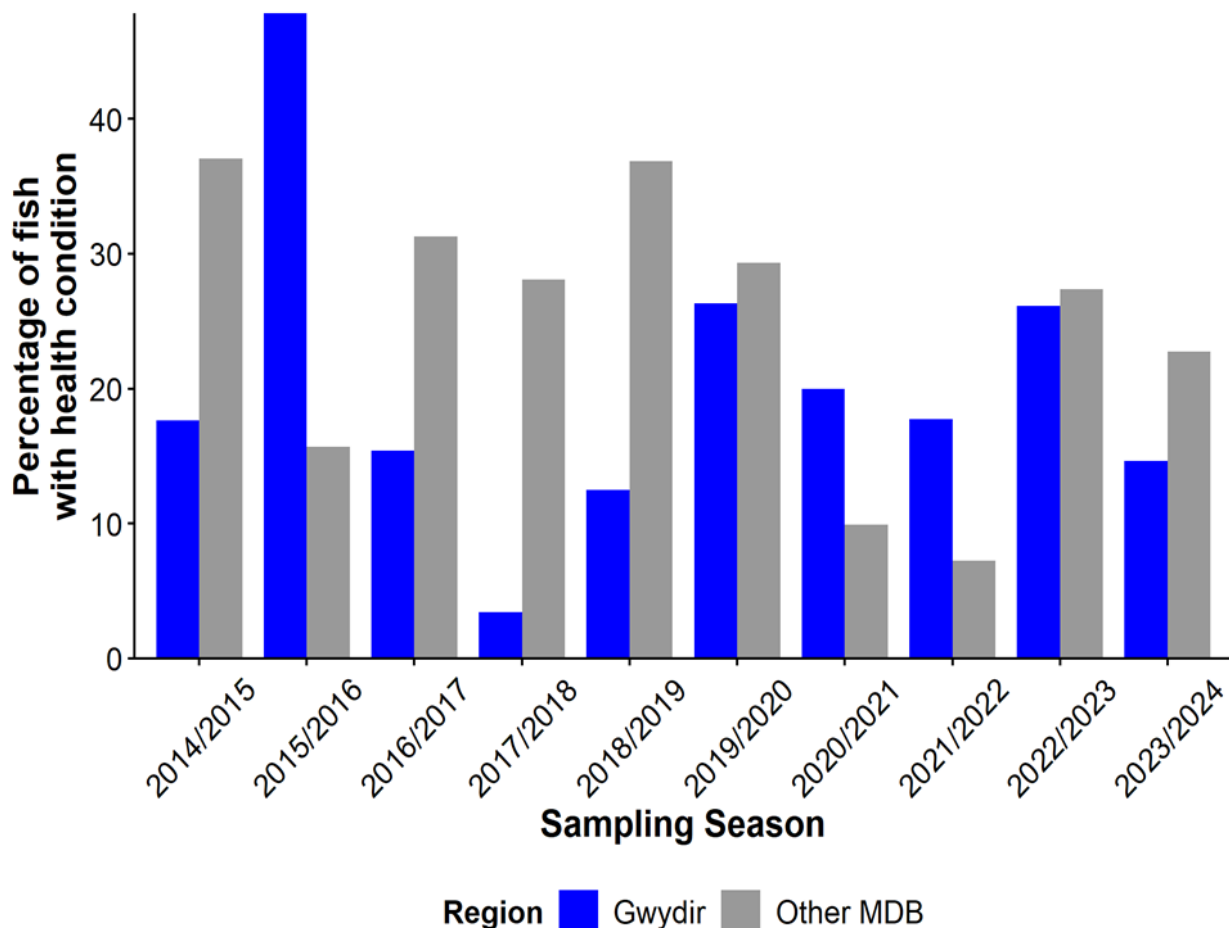


Figure 3.15: Timeseries showing the prevalence of health conditions in Golden perch. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA's.

Summary Statement:

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

Distribution

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

Summary Statement:

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

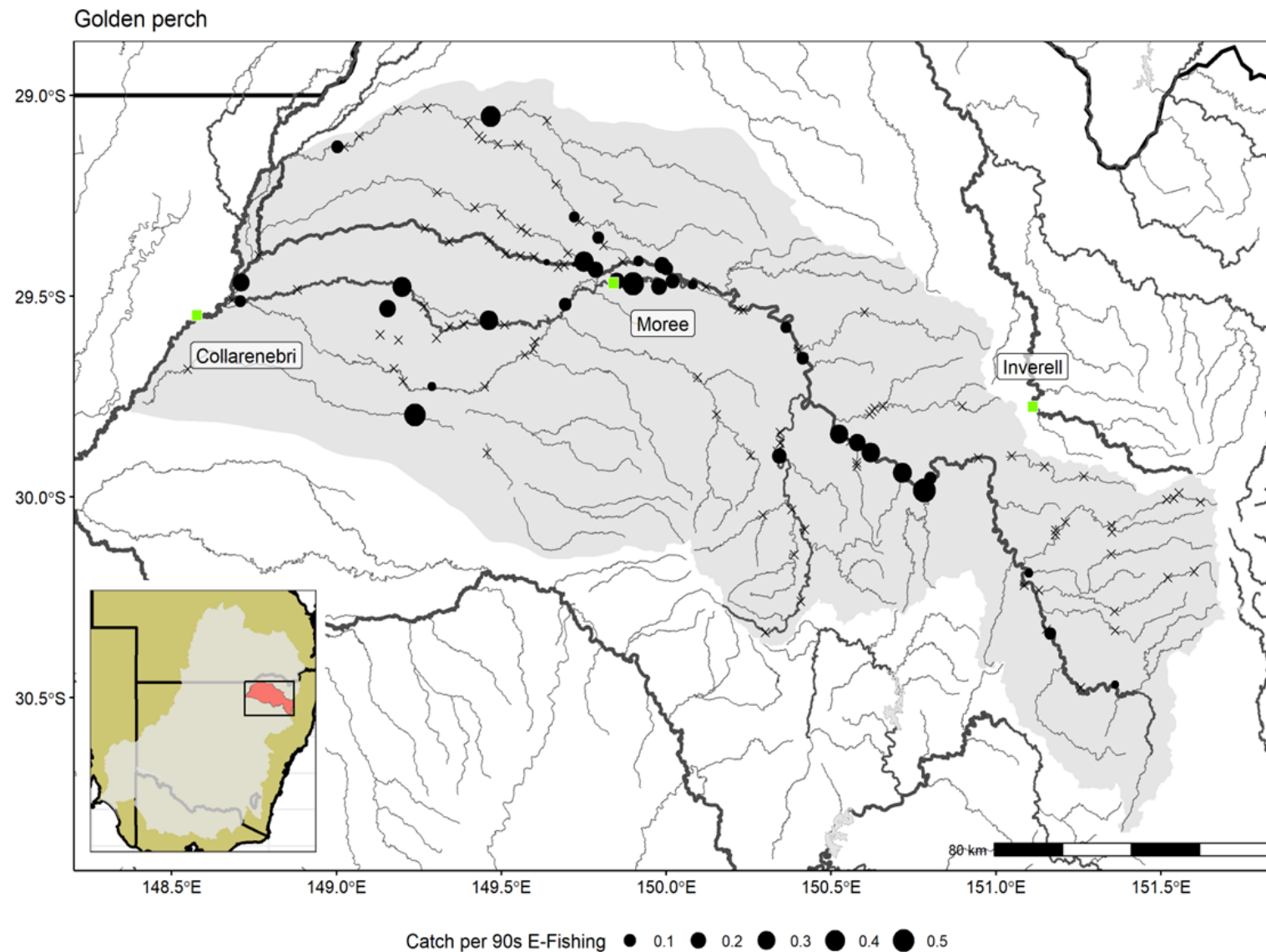


Figure 3.16: Distribution of Golden perch sampled from 2013/14 to 2023/24 in the Gwydir WRPA. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an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

Freshwater catfish



Population Structure

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

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

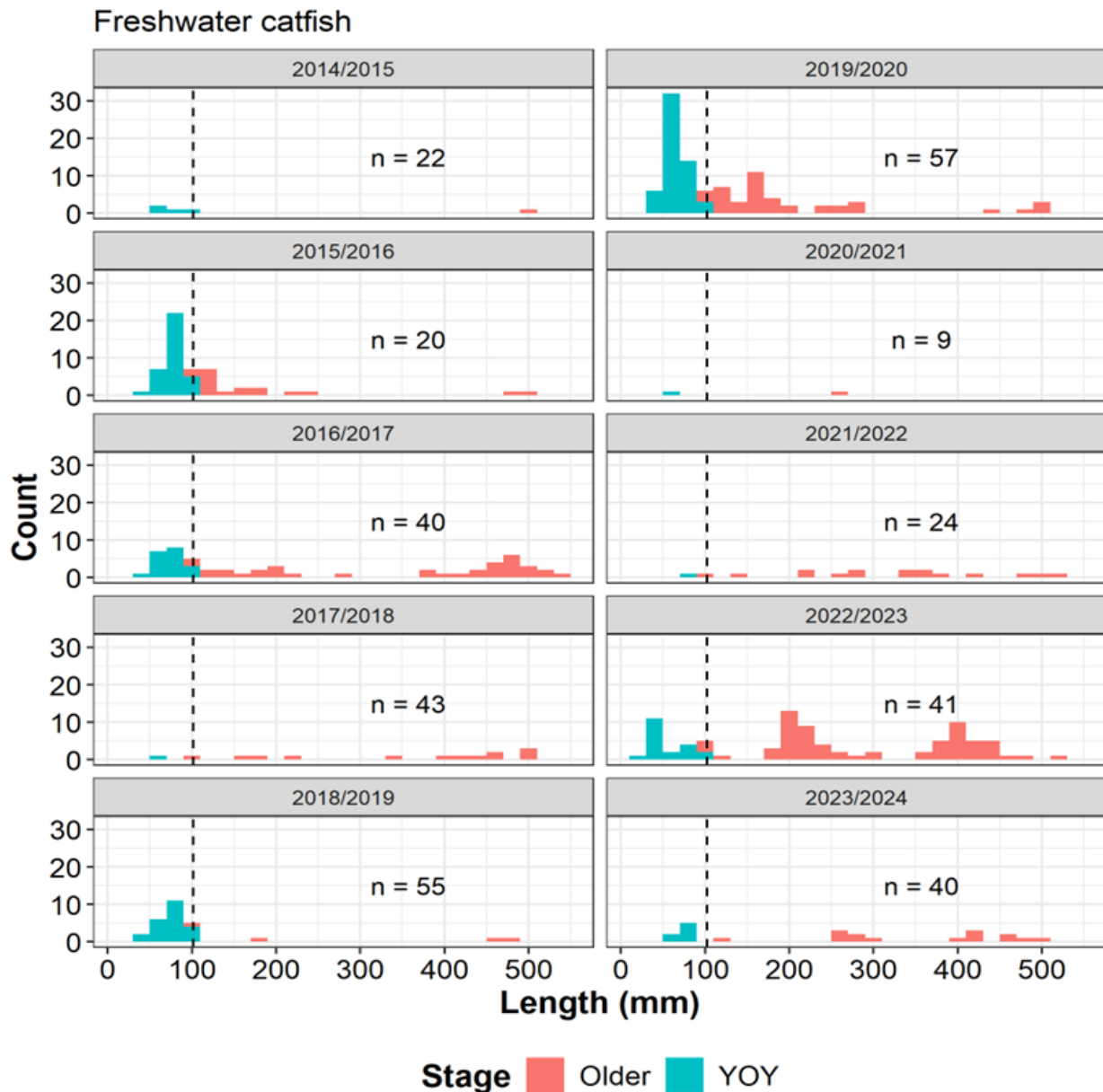


Figure 3.17: Length frequency plots for Freshwater catfish by sampling season in the Gwydir WRP. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRP in a sampling season.

Summary Statement:

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

Temporal Trends in Abundance

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

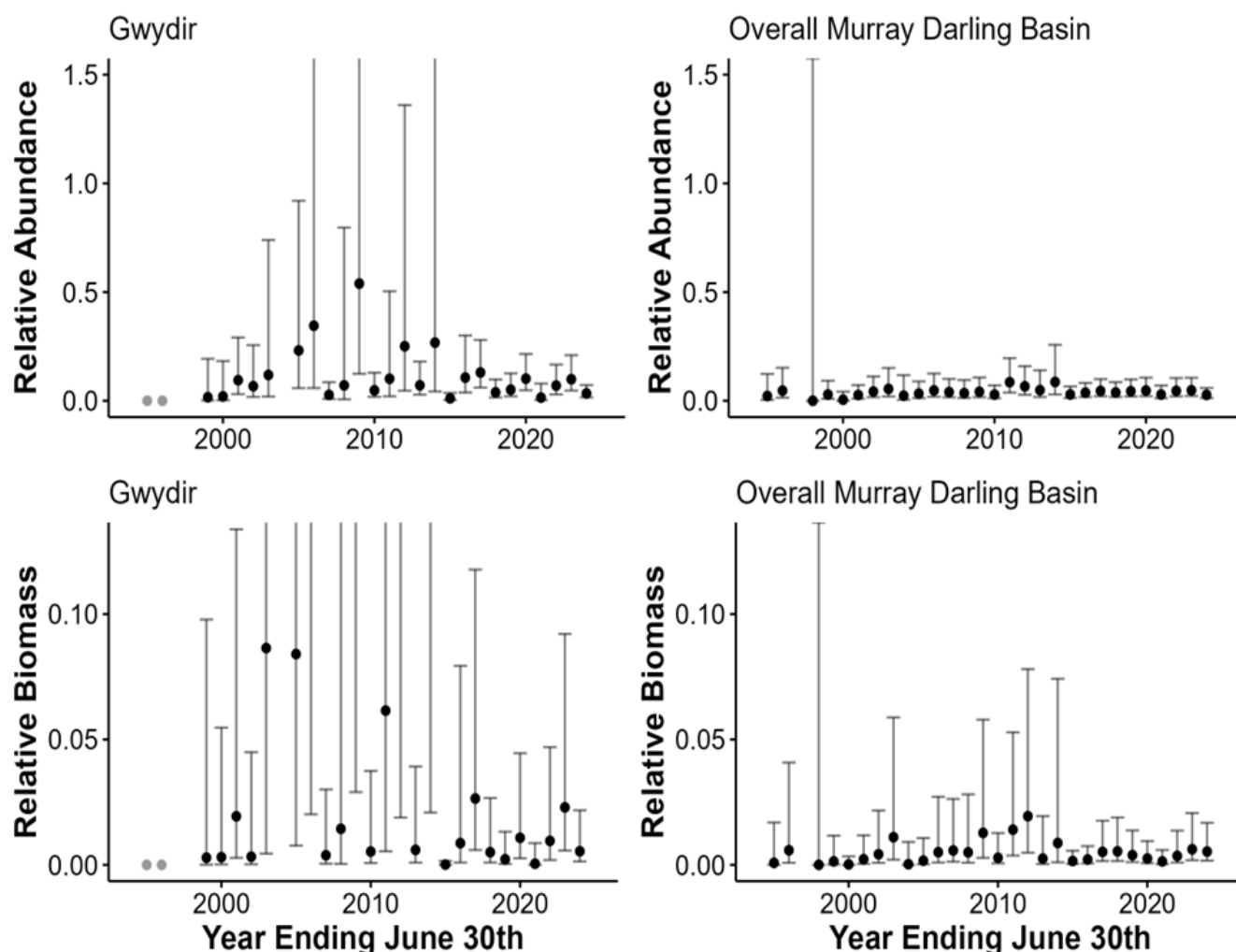


Figure 3.18: Relative abundance and biomass of Freshwater catfish in both this valley and the overall Murray-Darling Basin. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars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

Summary Statement:

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

Health

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

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

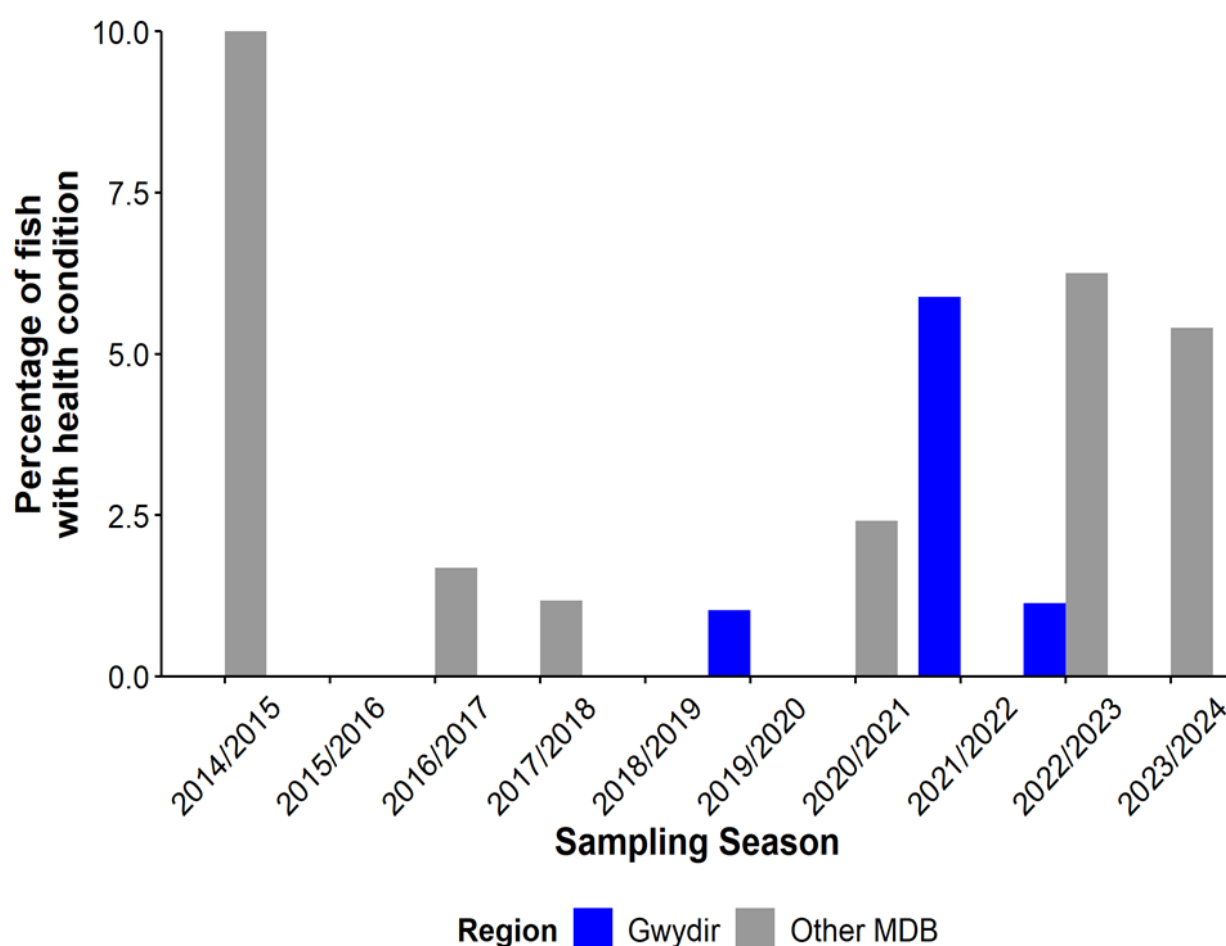


Figure 3.19: Timeseries showing the prevalence of health conditions in Freshwater catfish. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA's.

Summary Statement:

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

Distribution

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

Summary Statement:

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

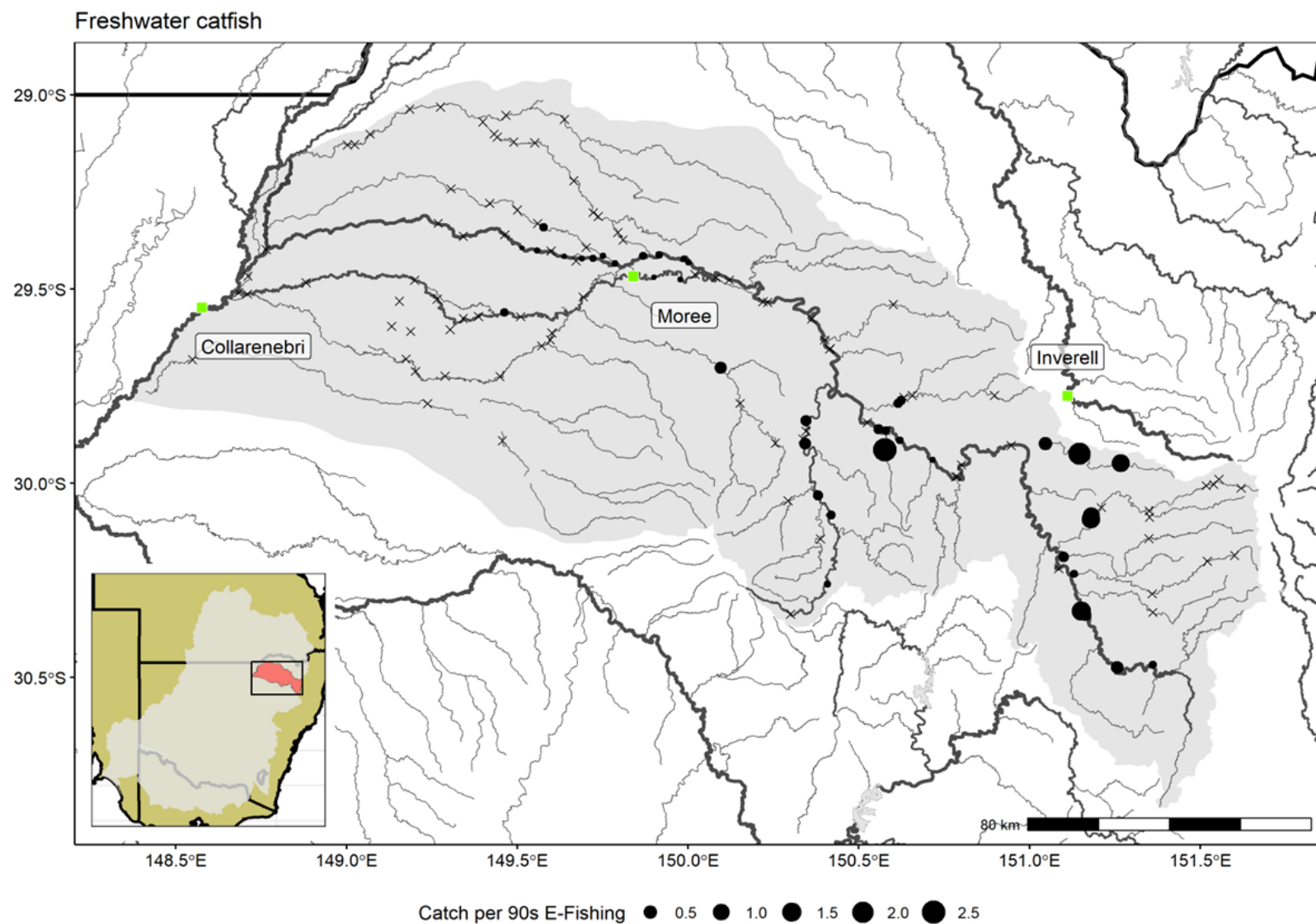


Figure 3.20: Distribution of Freshwater catfish sampled from 2013/14 to 2023/24 in the Gwydir WRPA. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown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

Bony herring



Population Structure

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

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

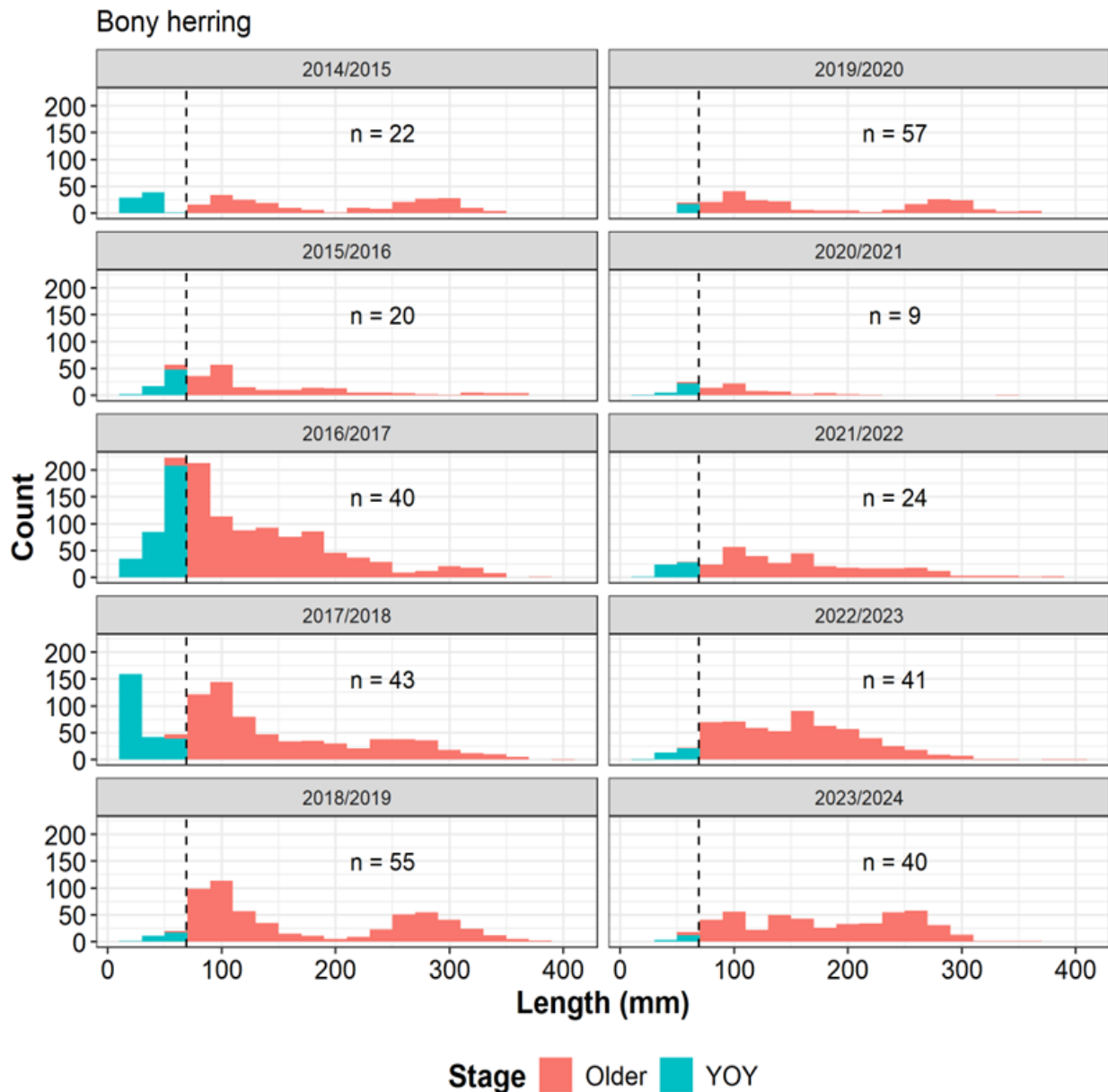


Figure 3.21: Length frequency plots for Bony herring by sampling season in the Gwydir WRP. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRP in a sampling season.

Summary Statement:

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

Temporal Trends in Abundance

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

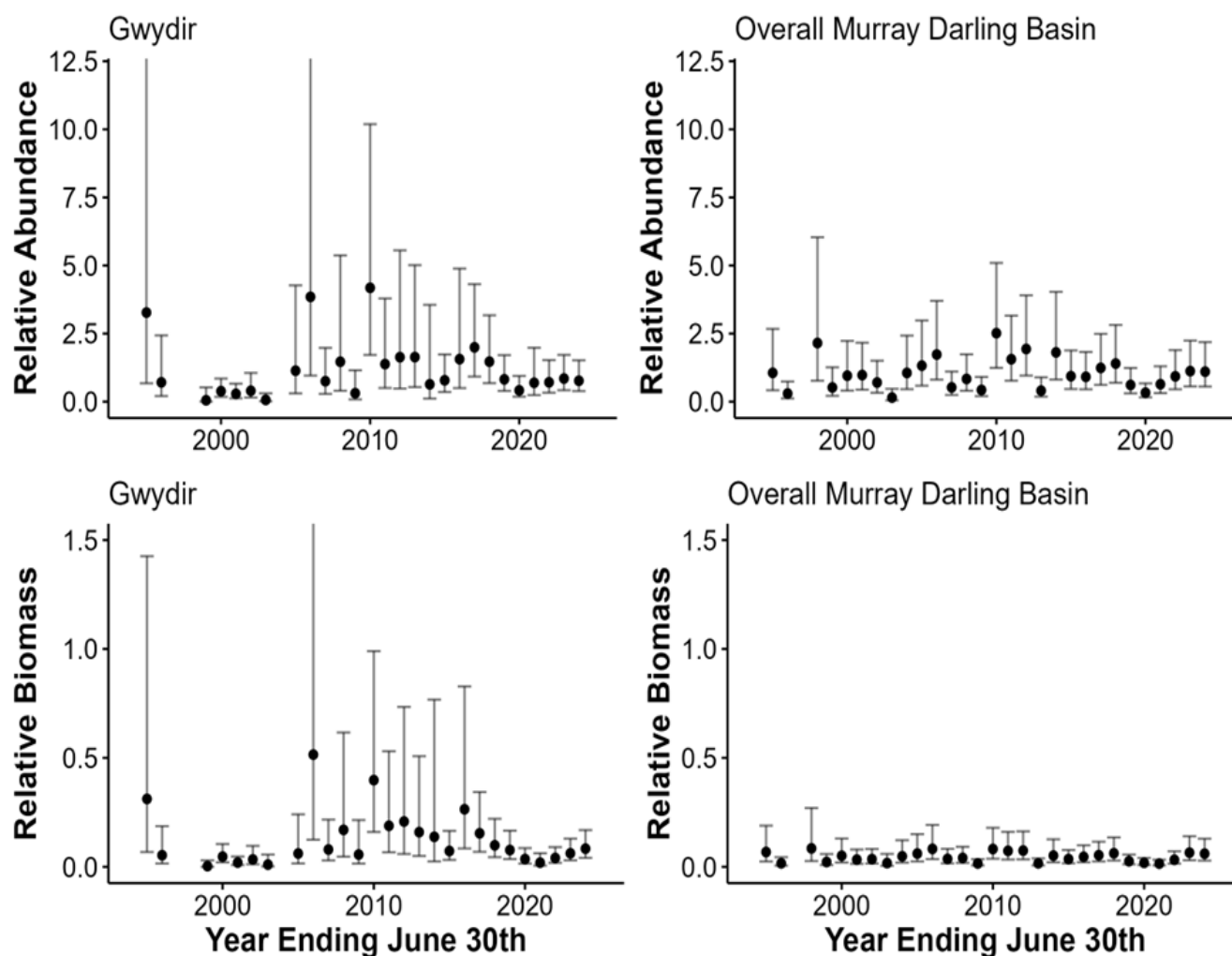


Figure 3.22: Relative abundance and biomass of Bony herring in both the Gwydir WRPA and the overall NSW MDB. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 %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

Summary Statement:

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

Health

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

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

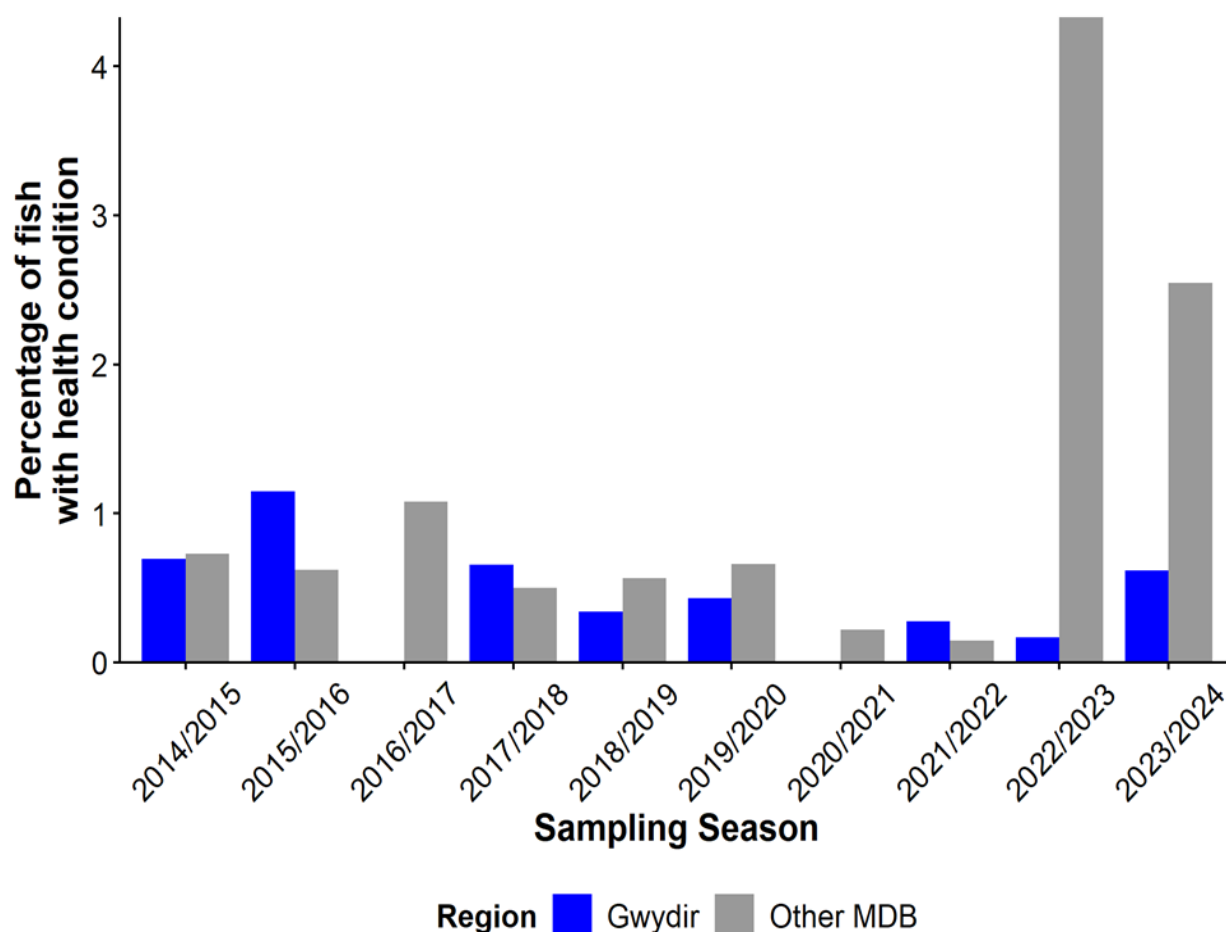


Figure 3.23: Timeseries showing the prevalence of health conditions in Bony herring. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA.

Summary Statement:

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

Distribution

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

Summary Statement:

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

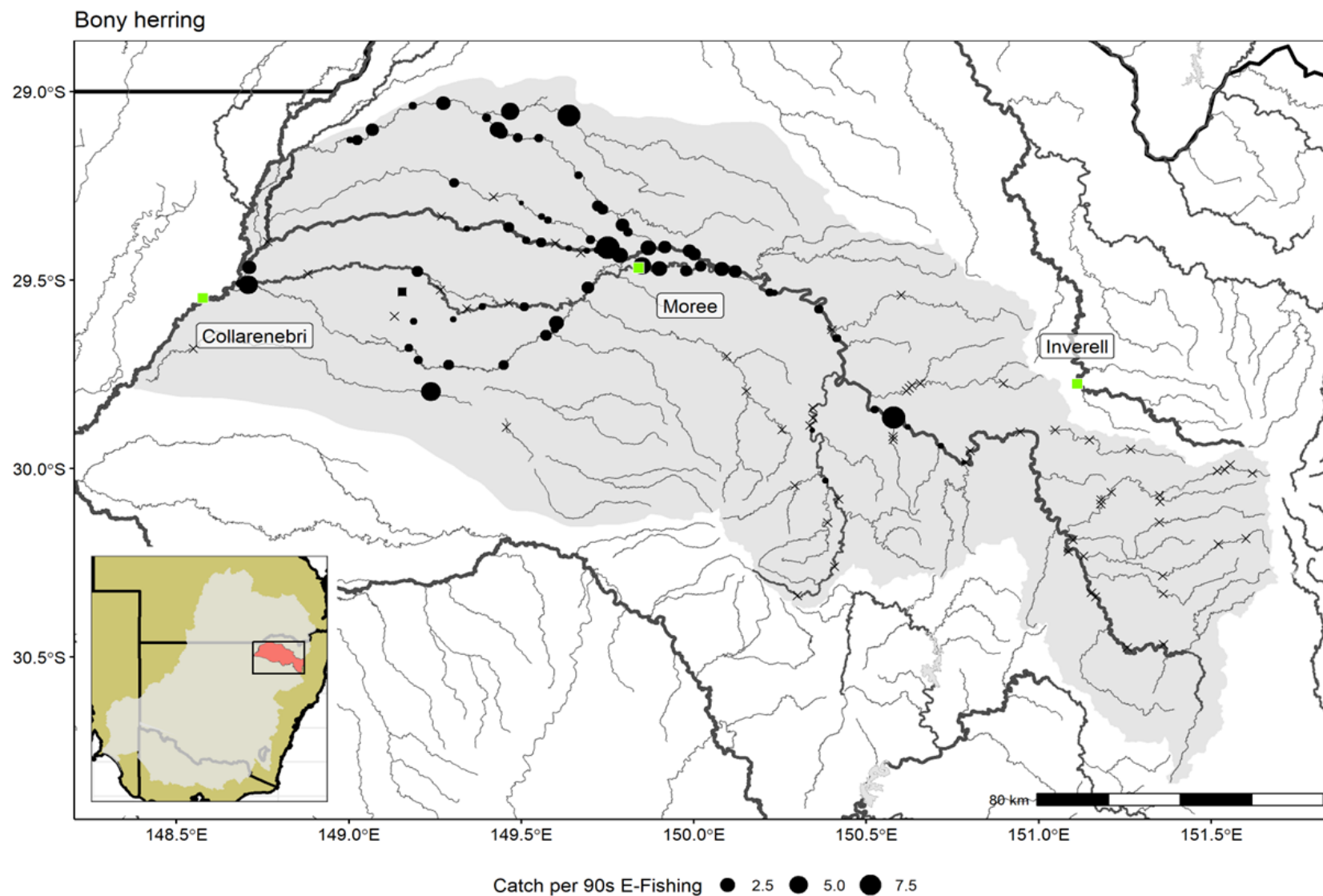


Figure 3.24: Distribution of Bony herring sampled from 2013/14 to 2023/24 in the Gwydir WRPA. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an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

Australian smelt



Population Structure

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

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

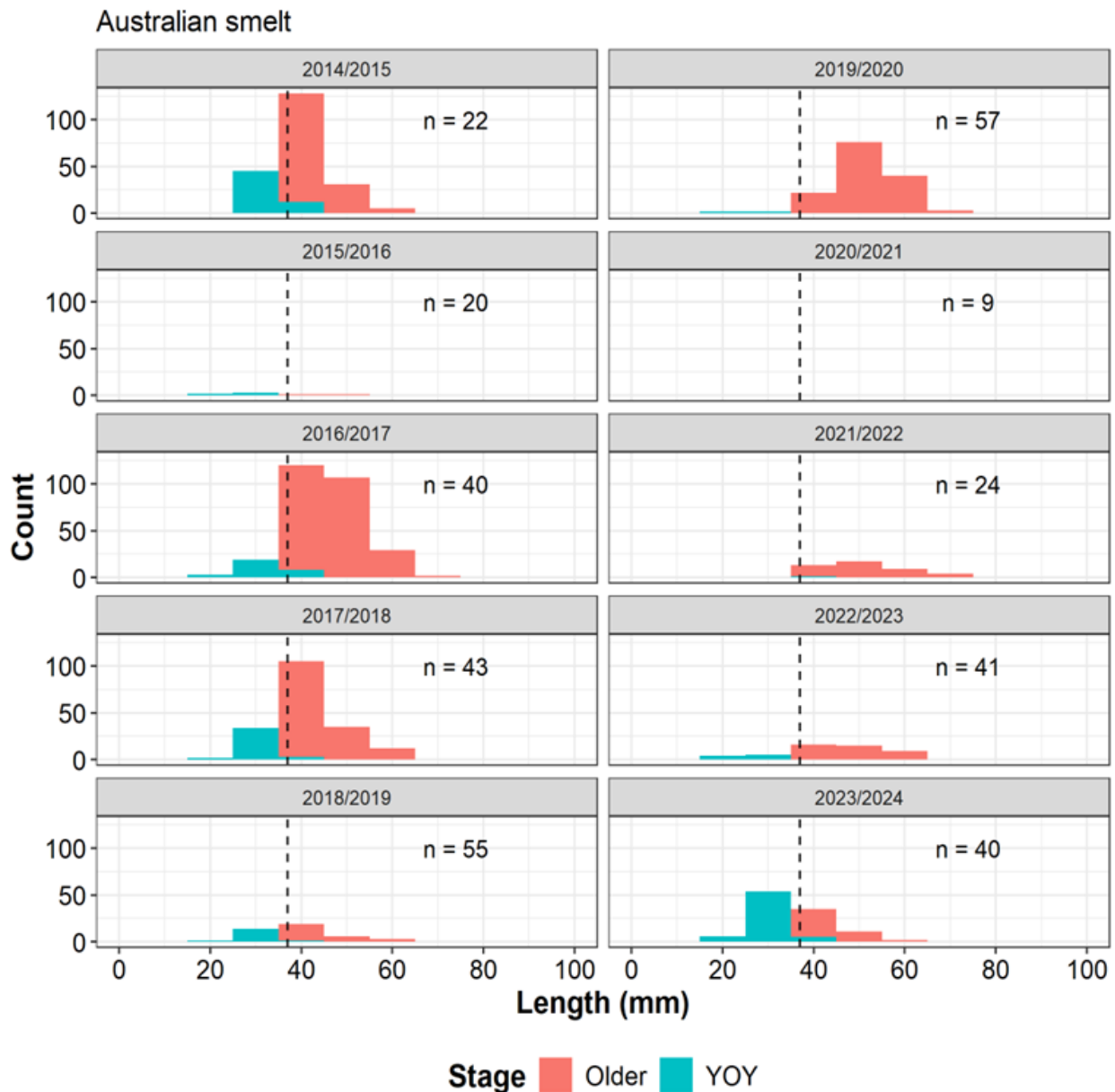


Figure 3.25: Length frequency plots for Australian smelt by sampling season in the Gwydir WRP. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRP in a sampling season.

Summary Statement:

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

Temporal Trends in Abundance

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

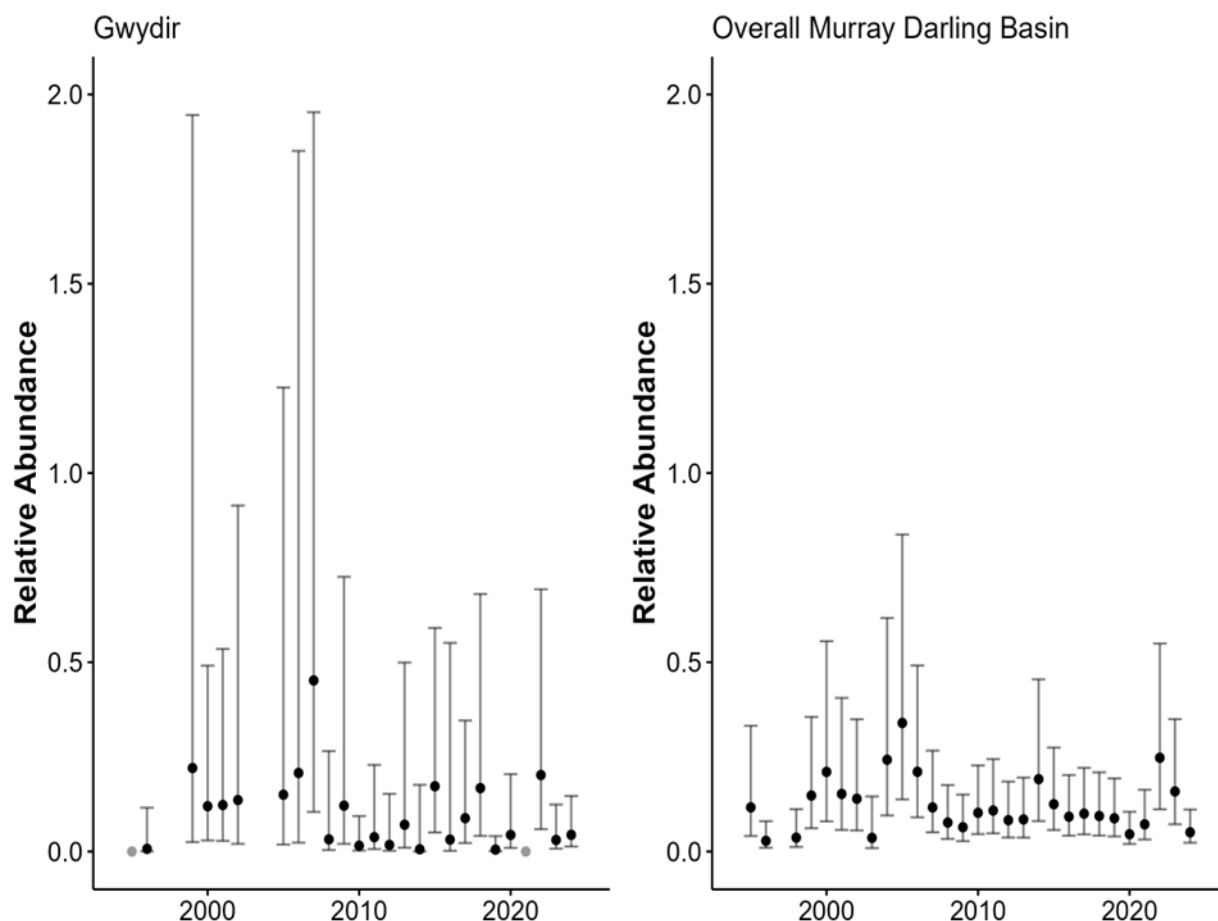


Figure 3.26: Relative abundance of Australian smelt in both the Gwydir WRPA and the overall NSW MDB. These are model estimates based upon all boat electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95 % confidence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

Summary Statement:

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

Health

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

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

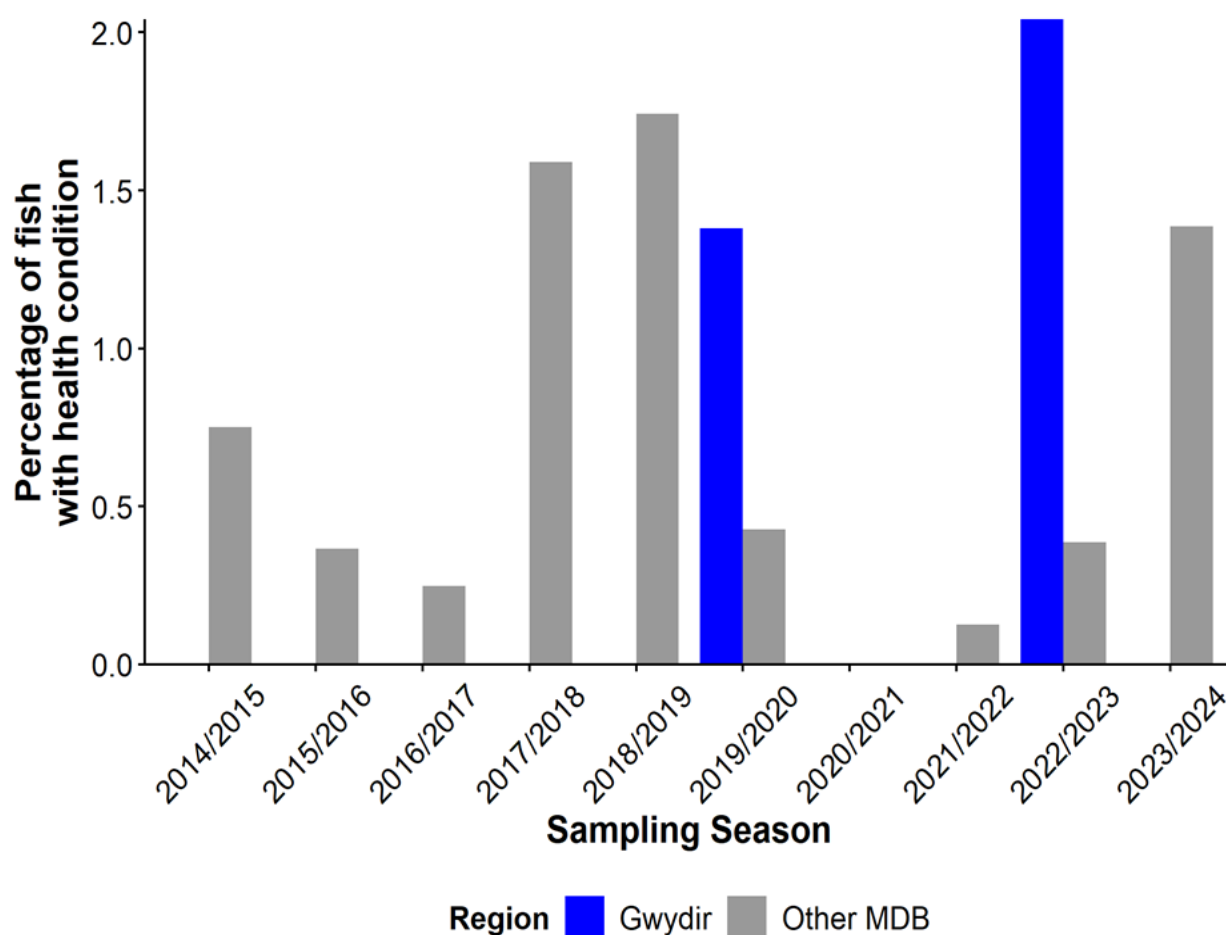


Figure 3.27: Timeseries showing the prevalence of health conditions in Australian smelt. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA.

Summary Statement:

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

Distribution

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

Summary Statement:

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

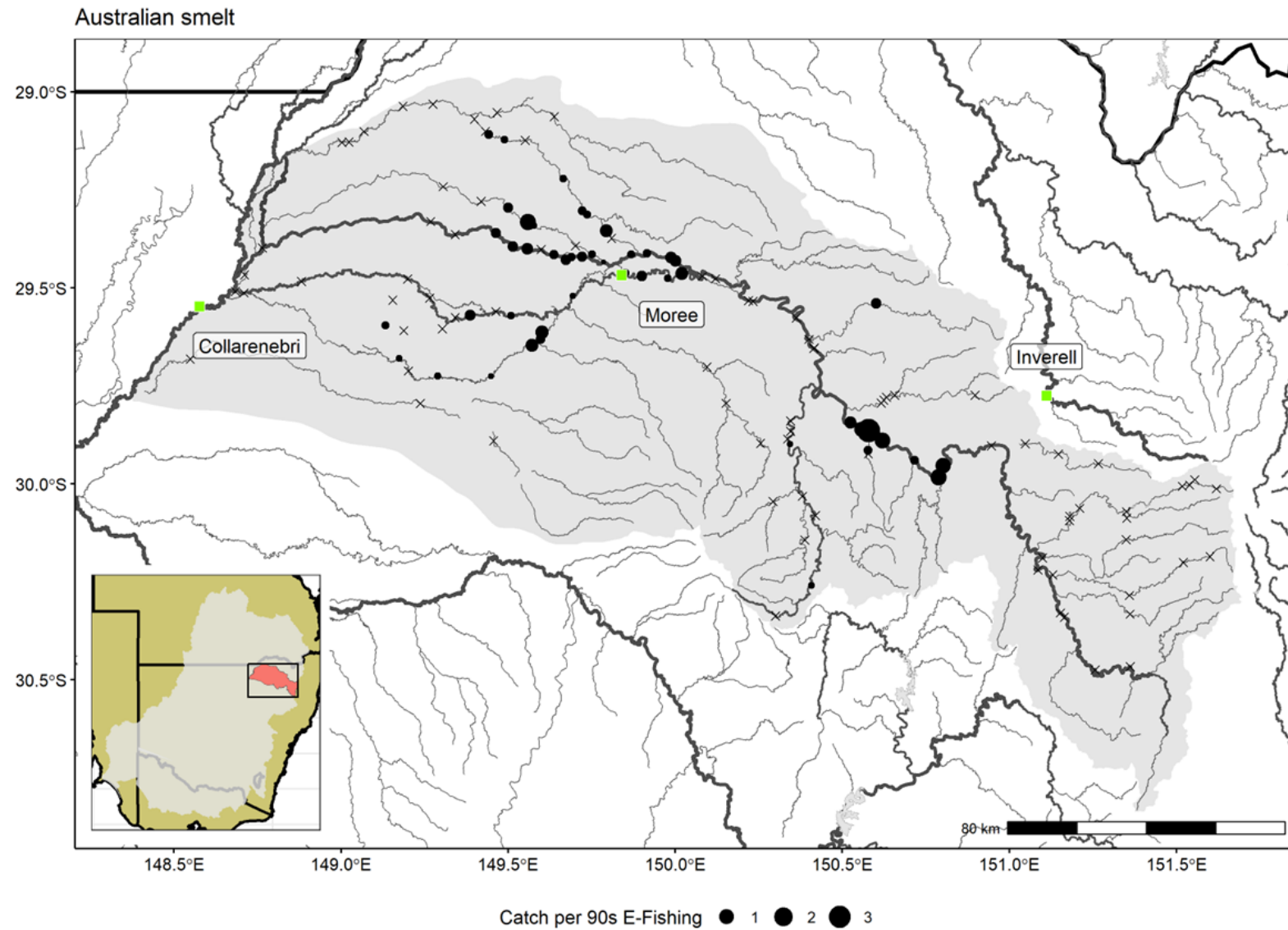


Figure 3.28: Distribution of Australian smelt sampled from 2013/14 to 2023/24 in the Gwydir WRPA. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with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

Common carp



Population Structure

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

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

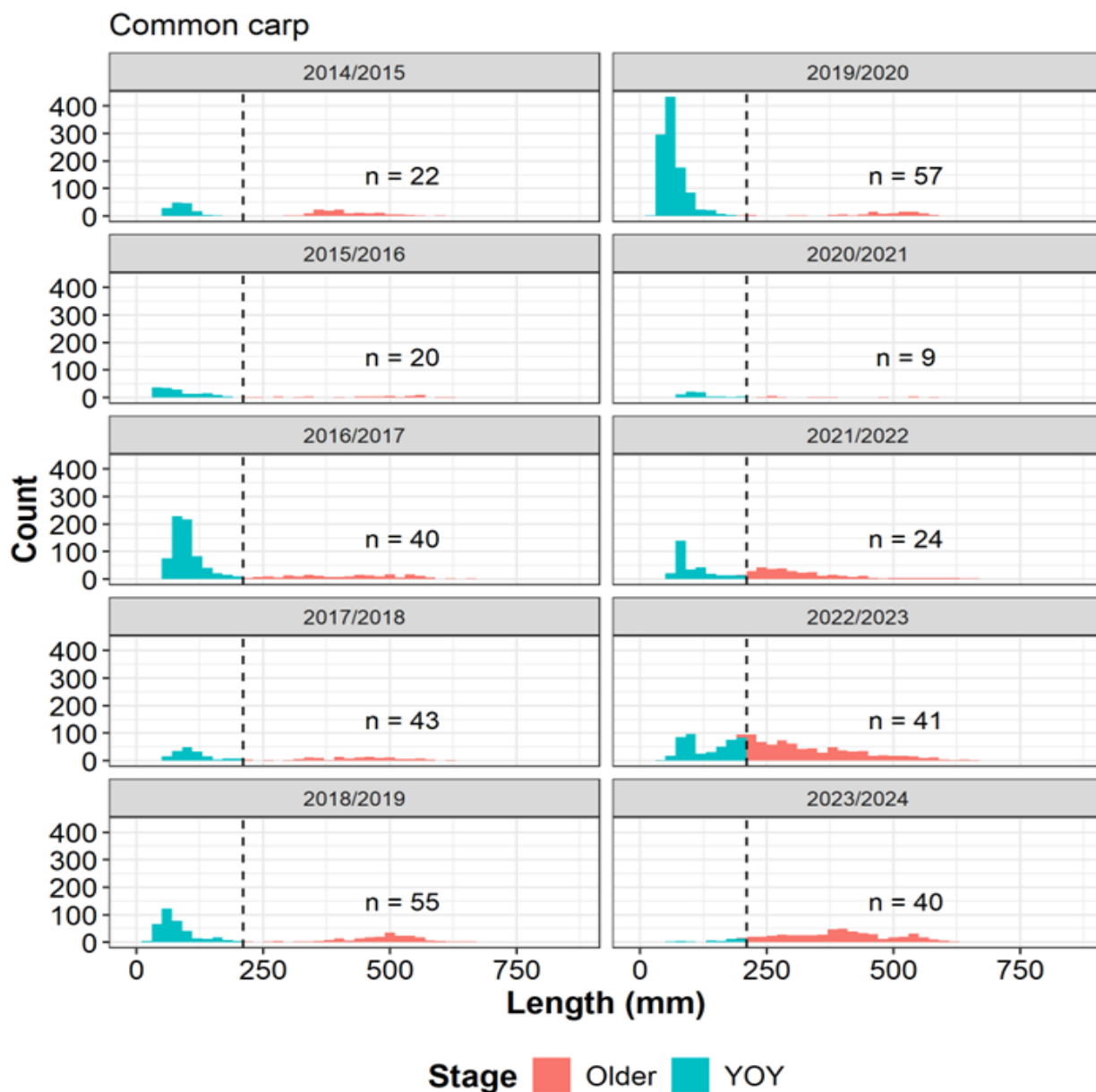


Figure 3.29: Length frequency plots for common carp by sampling season in the Gwydir WRPA. YOY represents Young of the Year fish. n shows the number of sites sampled in the WRPA in a sampling season.

Summary Statement:

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

Temporal Trends in Abundance

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

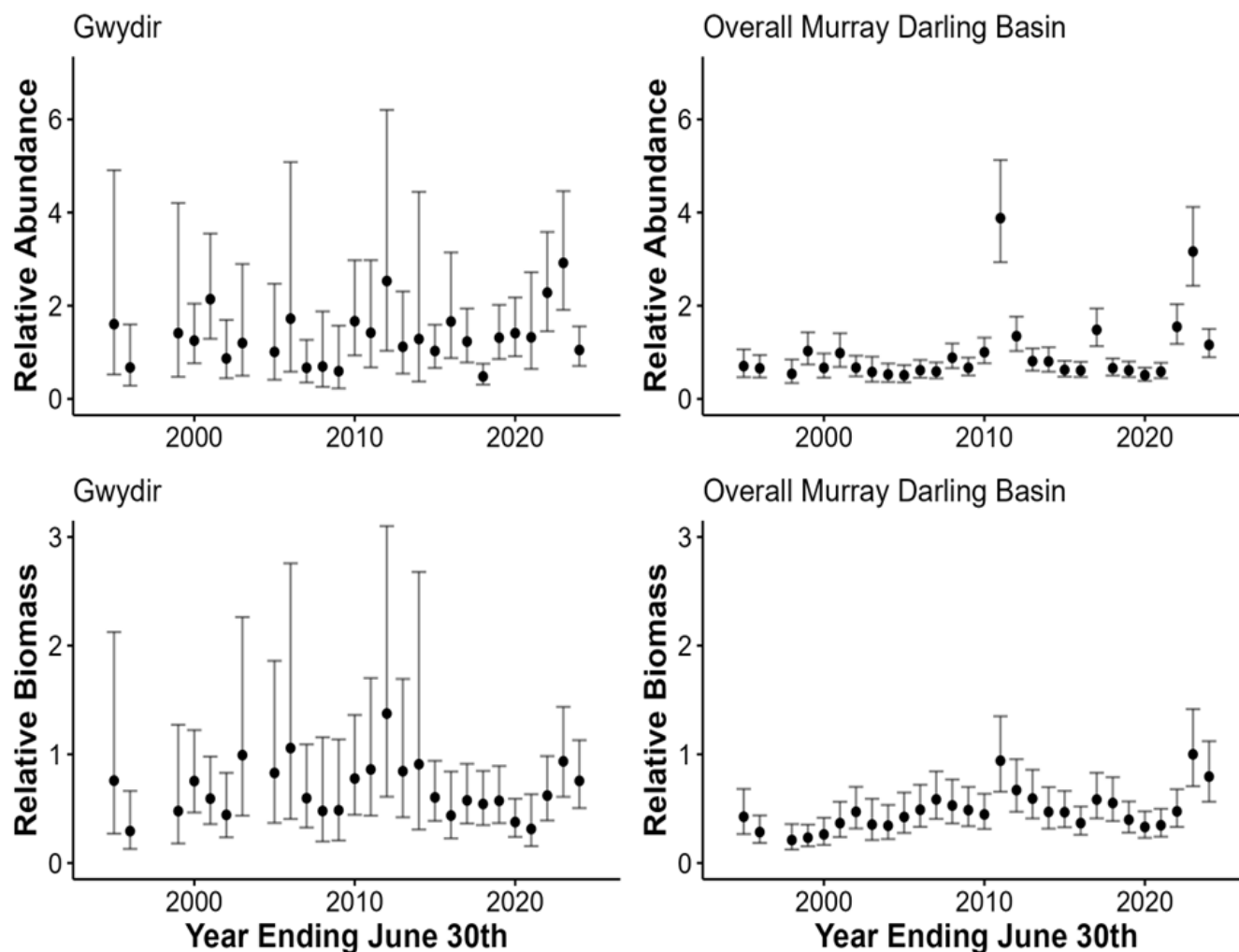


Figure 3.30: Relative abundance and biomass of Common carp in both this valley and the overall Murray-Darling Basin. These are model estimates based upon all electrofishing data within the NSW DPIRD Freshwater ecosystem database and the output of generalised linear mixed models. Error bars show the 95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

Summary Statement:

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

Health

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

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

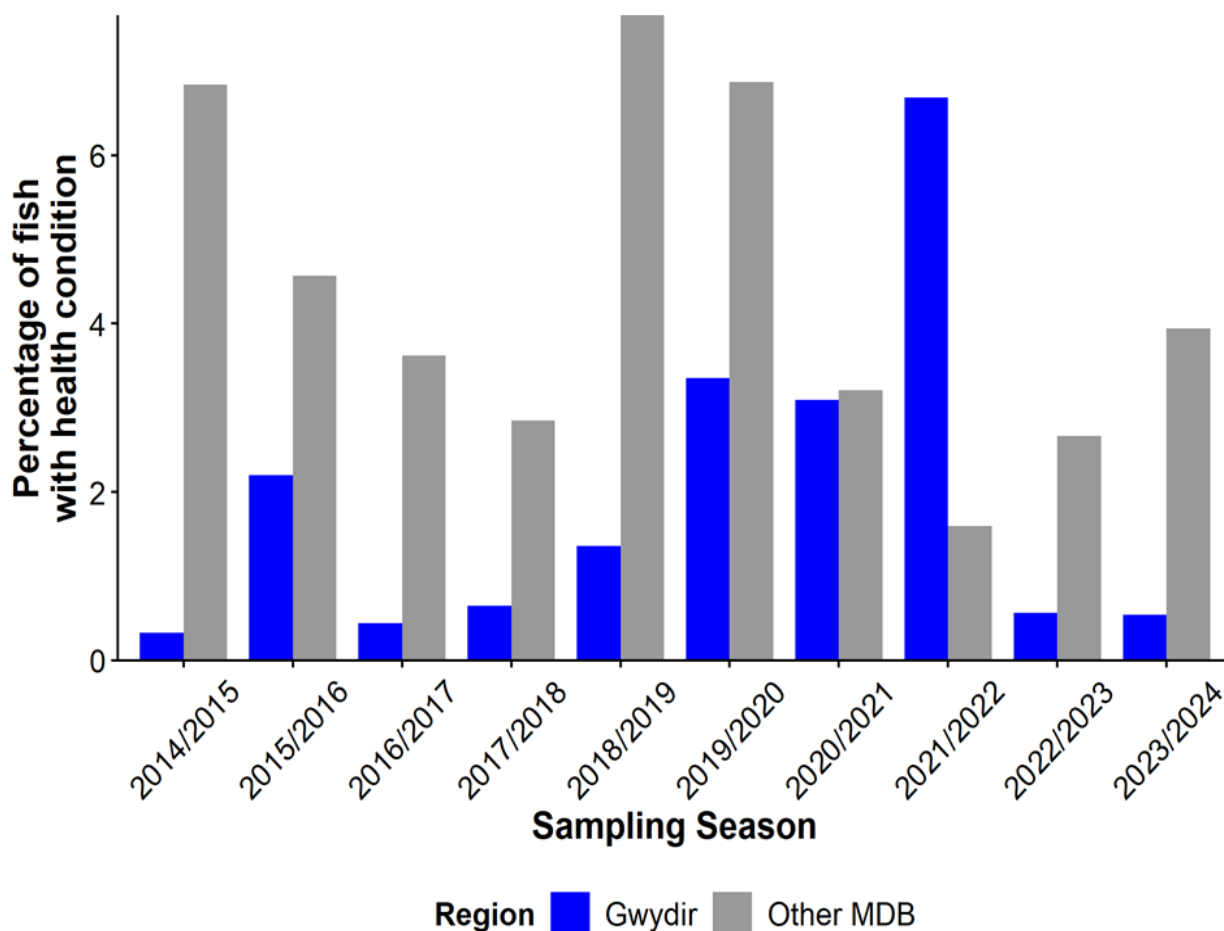


Figure 3.31: Timeseries showing the prevalence of health conditions in Common carp. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA's.

Summary Statement:

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

Distribution

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

Summary Statement:

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

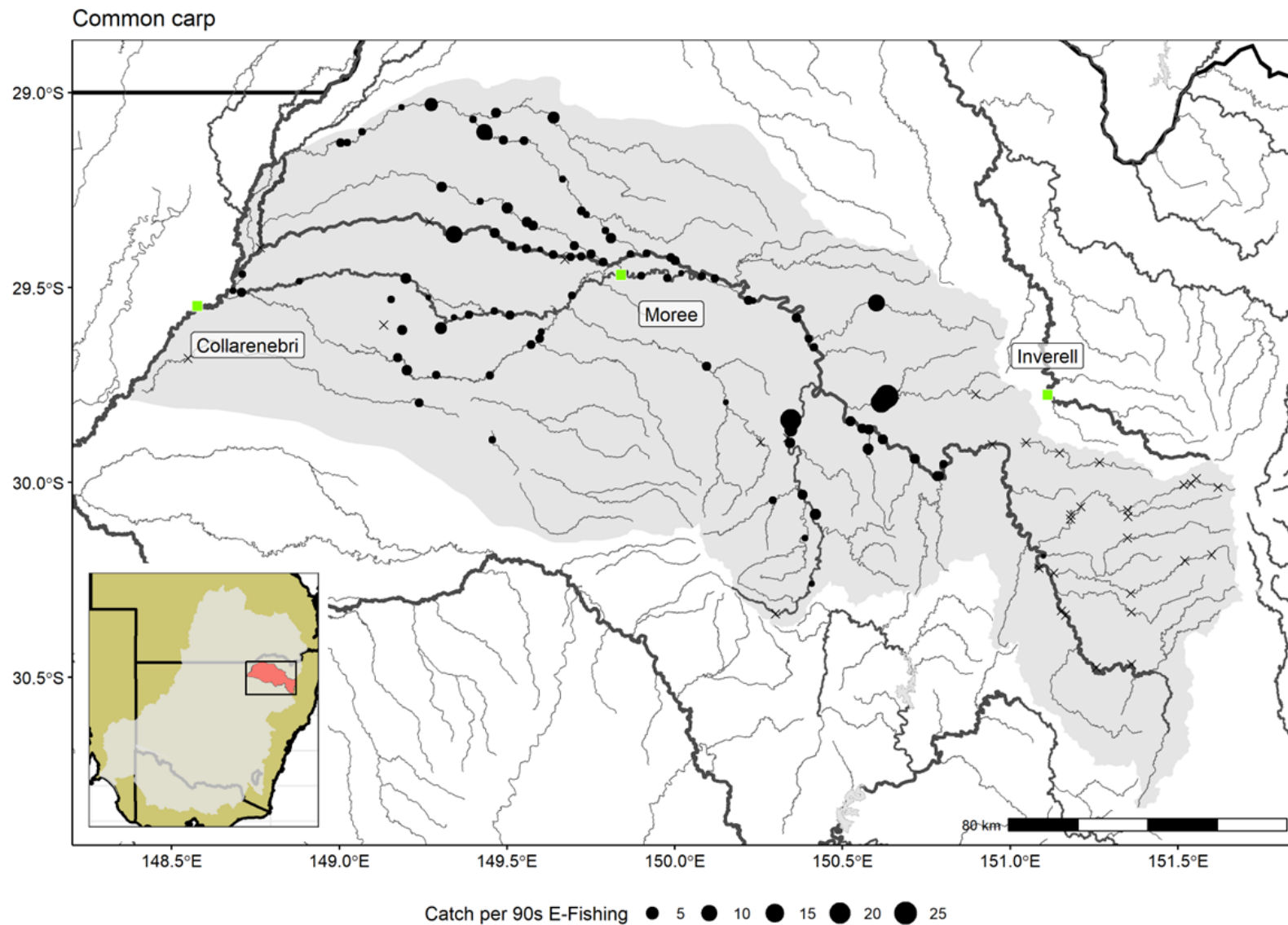


Figure 3.32: Distribution of Common carp sampled from 2013/14 to 2023/24 in the Gwydir WRPA. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an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

Threatened Species

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

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

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

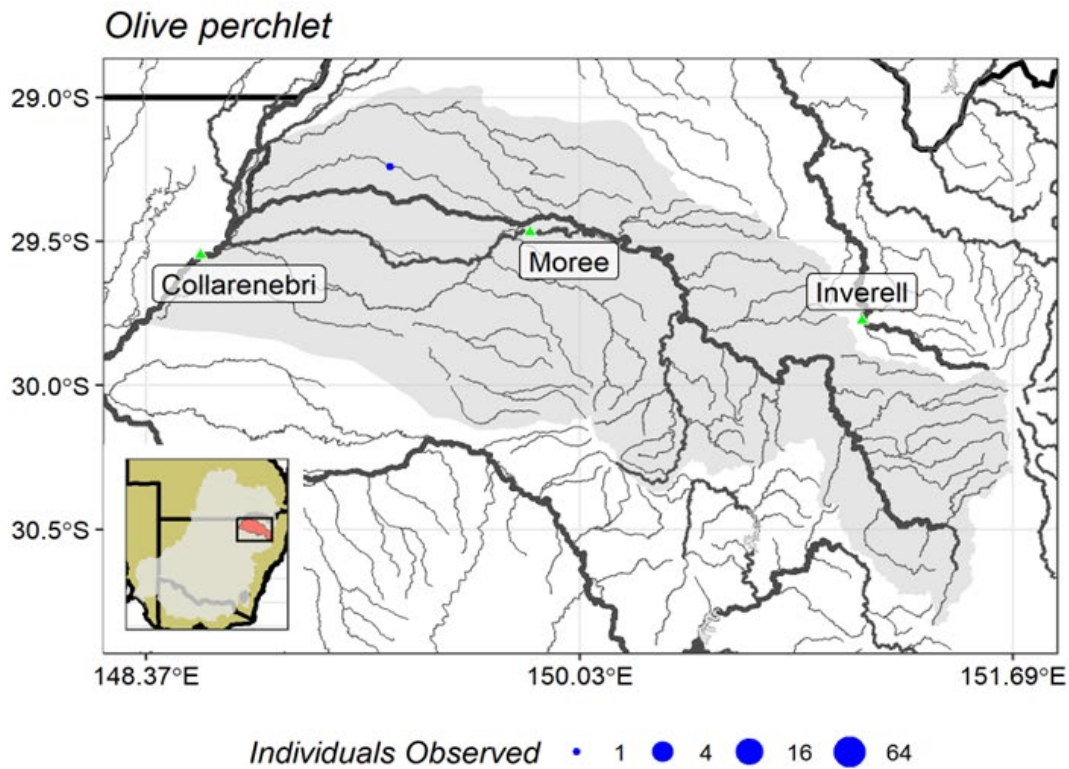


Figure 3.33: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the Gwydir WSPA. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance.

Summary Statement:

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

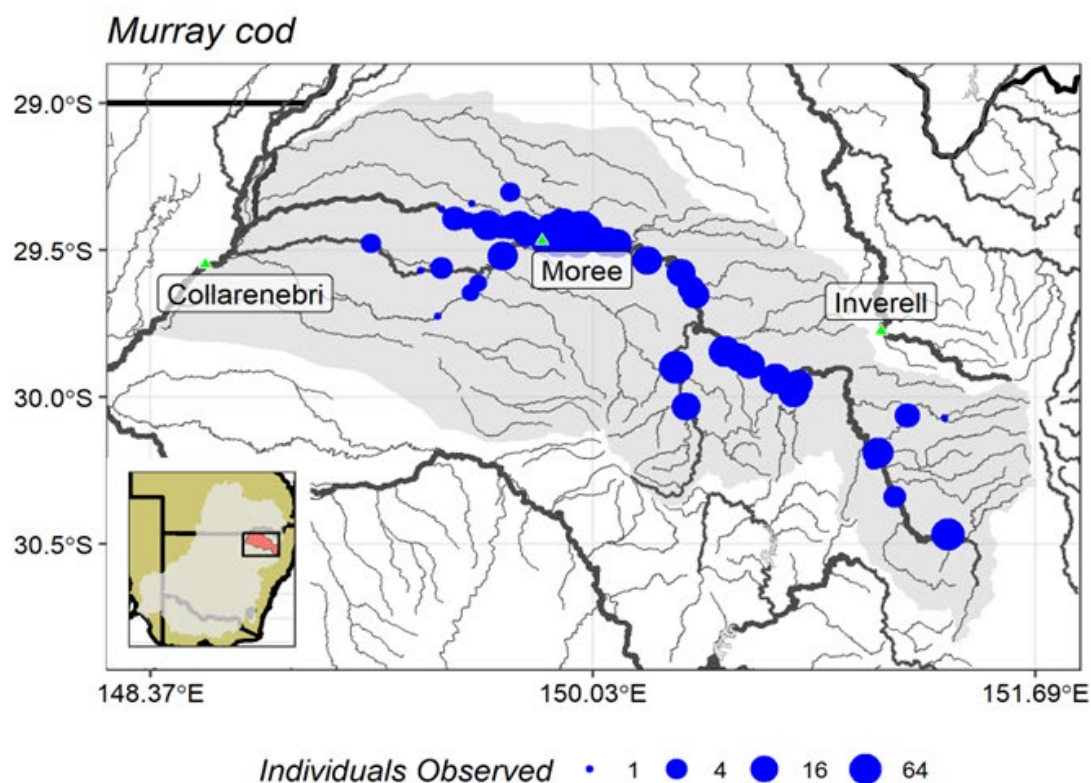


Figure 3.34: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the Gwydir WRP. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance. Note the lower image shows a juvenile Murray cod.

Summary Statement:

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

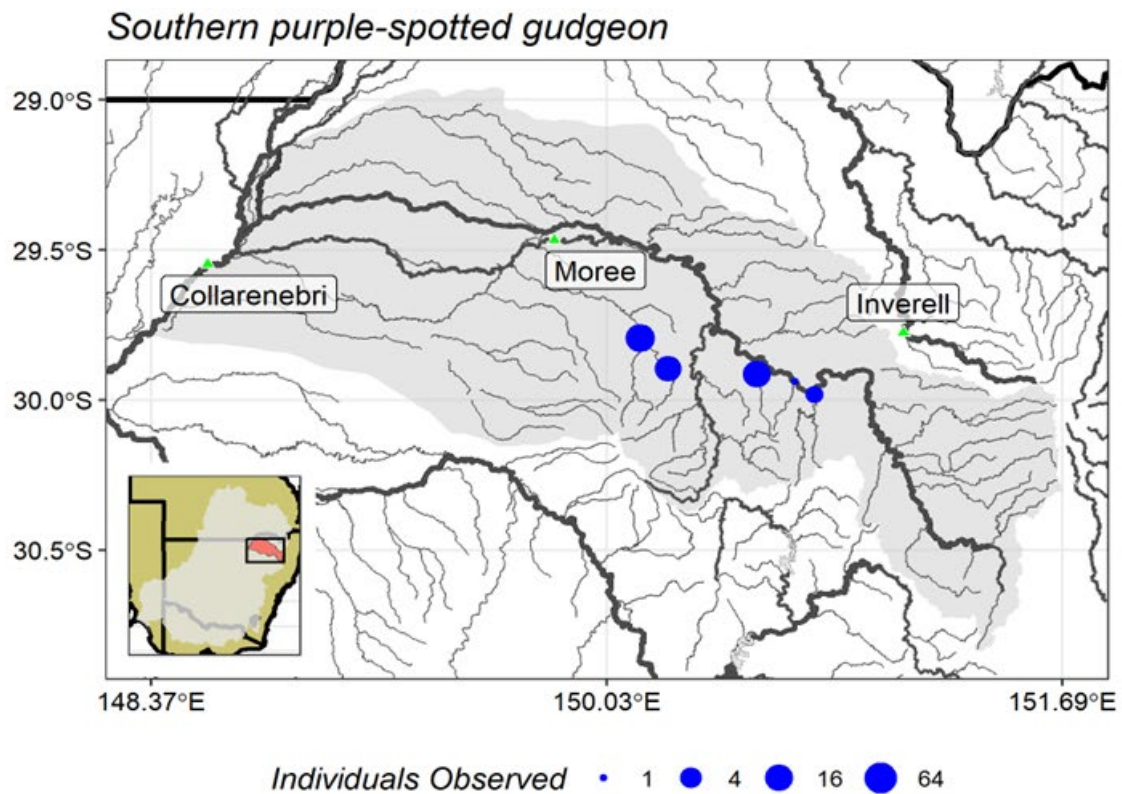


Figure 3.35: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the Gwydir WRPA. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance.

Summary Statement:

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

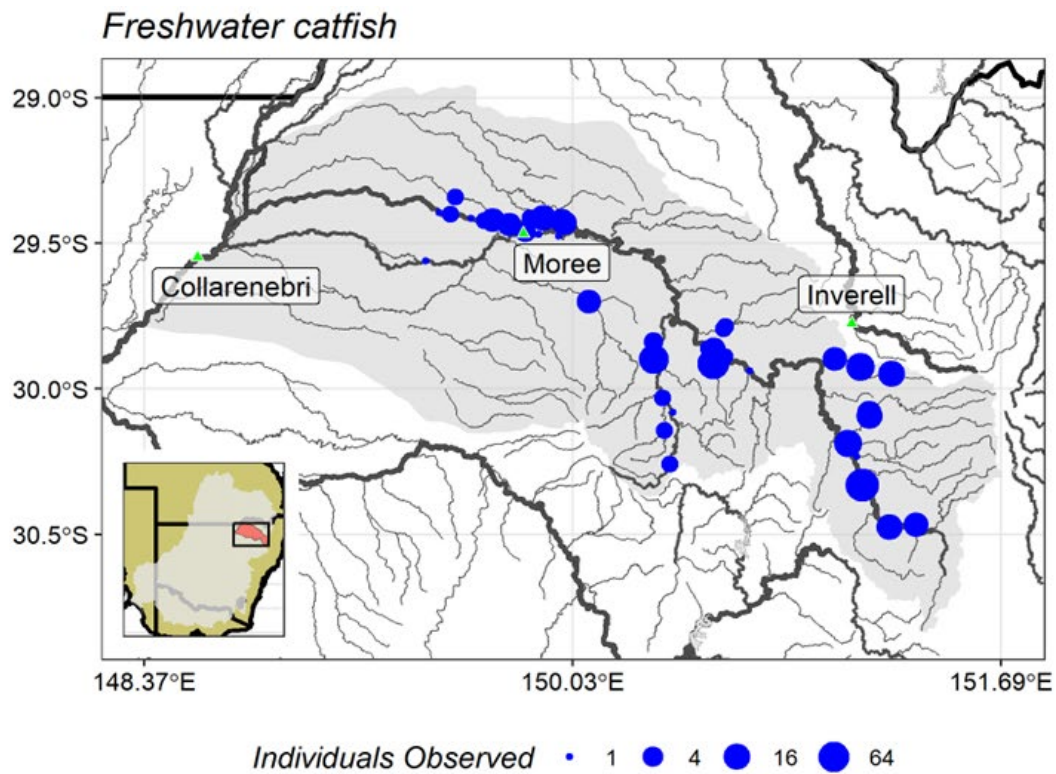


Figure 3.36: Distribution of the observed threatened species sampled from 2013/14 to 2023/24 in the Gwydir WRPA. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance.

Summary Statement:

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

Appendix

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

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

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

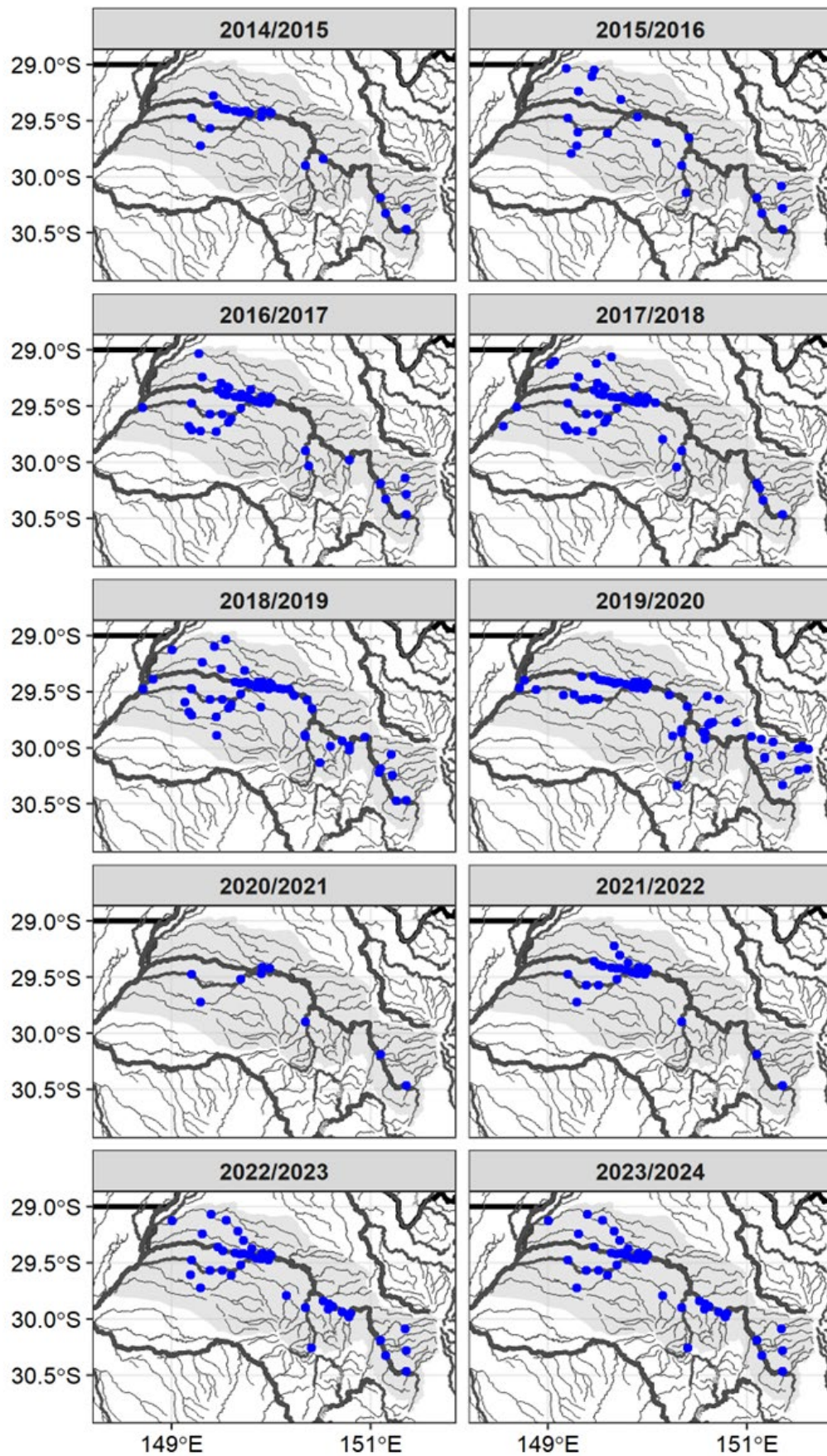


Figure 3.37: Sites sampled and included in this report by sampling season in the Gwydir WRPA. Dry sites are not shown.

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

Table 3.11.

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

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

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

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

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

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

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

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

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

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

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

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