Department of Primary Industries
Department of Regional NSW

Chapter 3 Basin Plan Environmental Outcomes Monitoring for Fish (2014/15 – 2019/20): Gwydir Water Resource Planning Area

Citation Details

Please cite the overall report when referring to this chapter:

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Cover image credit: Gavin Butler (NSW DPI); Fish images credit: Gunther Schmida

Acknowledgements

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Introduction

This report spans the first series of the Basin Plan Environmental Outcome Monitoring – Fish (BPEOM-F) program, starting in 2014/15 as a pilot and running annually until 2019/2020. This report focusses on the Gwydir Water Resource Planning Area (WRPA) shown in Figure 3.1.

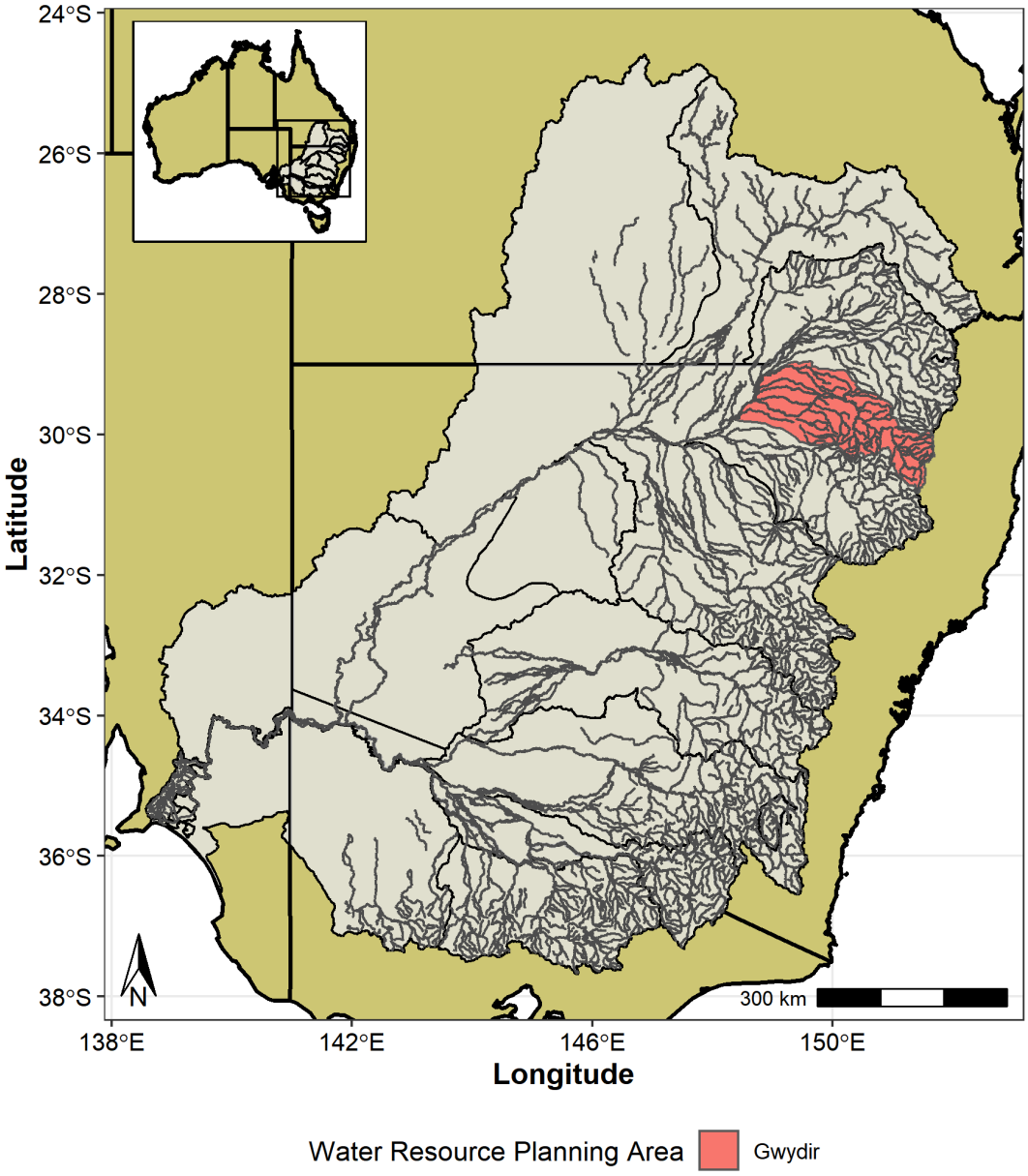

Figure 3.1: Murray-Darling Basin with the key region of this report highlighted. Inset map shows the whole of Australia with a box around the MDB.

What This Report Includes

This report starts with an overview of the BPEOM-F program 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 WRPA. Separate plots for native and alien species show the total number of unique species observed at each site.

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

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

Population structure information includes length frequency plots of observed 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 (a unit-less measure representing the number of fish in an area) information is presented based on 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 analysis uses Bayesian generalised additive mixed models to generate time series of relative abundance for each WRPA since the early 1990s. In this report we present the modelled time series of relative abundance showing the predicted number of fish observed per 90 second shot of electrofishing. The abundance trend for the Gwydir WRPA is contrasted with the overall NSW MDB dataset. It should be noted that these are modelled estimates of relative abundance, not absolute abundance as absolute abundance estimates require calibration surveys.

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. Healthier fish tend to have increased fecundity and reproductive success. 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 WRPA and greater MDB (excluding the Gwydir WRPA).

Distribution maps are provided for each species to show the observed distribution of each species from the BPEOM-F program (other sampling programs not reported in this report). 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* and populations are reported. The report includes threatened species populations that were recorded by the BPEOM-F program in the Gwydir WRPA during the study 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 were used during the BPEOM-F program: boat electrofishing, backpack electrofishing and bait traps. This report mainly includes the electrofishing data with the bait traps informing the distribution of small bodied threatened species. The electrofishing was conducted using the standard methodology implemented in the Sustainable Rivers Audit (SRA). This usually includes 12 shots of 90 seconds “power on” during each sampling event. Sites included in this round of the BPEOM-F program were chosen using a stratified random approach.

Various amounts of sampling effort (number of sites) were conducted for each year of the reporting period (Table 3.1). 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 the 10 unbaited bait traps that are set in areas of the sampling reach that are not electrofished. Most sampling occurred between the months of September and May.

Table 3.1 Sampling effort (Number of sites sampled) each sampling season. The number of sites which were planned to be sampled but were dry are shown in brackets and excluded from the sampled count.

Sampling Season	Number of Sites Sampled (Dry Sites)
2014/2015	14 (NA)
2015/2016	20 (10)
2016/2017	20 (5)
2017/2018	26 (14)
2018/2019	31 (4)
2019/2020	41 (20)

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 3.35).

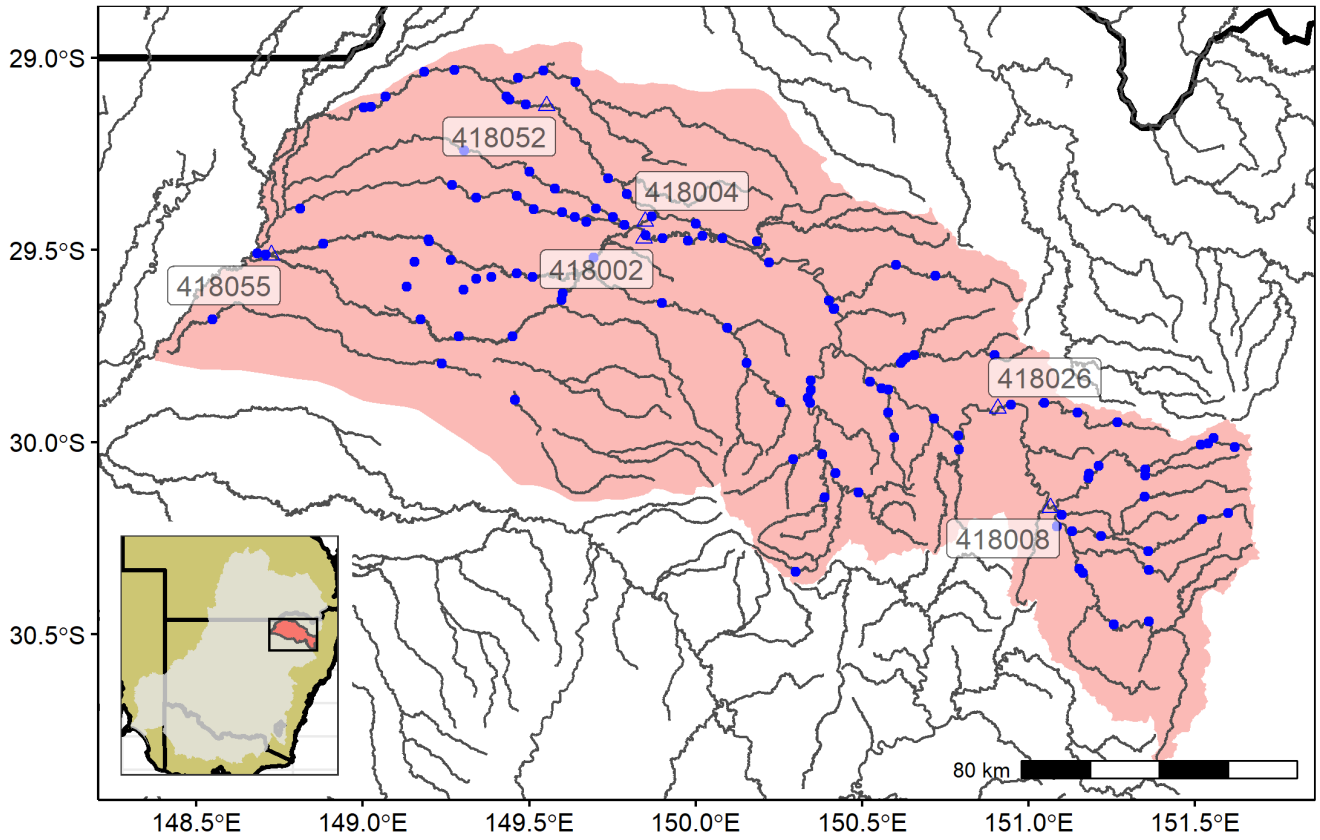

Figure 3.2: Sites (dots) sampled during the BPEOM-F program. Triangles show key flow gauges along with their gauge ID number. Dry sites are not shown.

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

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

Common name	Backpack Electrofishing	Boat Electrofishing	Bait Trap
Murray cod	39	297	0
Golden perch	17	78	0
Freshwater catfish	117	89	11
Bony herring	276	1461	14
Australian smelt	100	227	0
Common carp	1462	1155	131

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 species.

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

	Murray cod	Golden perch	Freshwater catfish	Bony herring	Australian smelt	Common carp
2014/2015	46	17	5	70	28	84
2015/2016	31	22	53	261	7	225
2016/2017	87	23	34	474	75	394
2017/2018	46	10	10	373	37	143
2018/2019	73	13	22	164	20	286
2019/2020	61	13	93	143	184	853

Reference:

Crook D. A., Schilling H. T., Gilligan D. M., Asmus M., Boys C. A., Butler G. L., Cameron L. M., Hohnberg D., Michie L. E., Miles N. G., Rayner T. S., Robinson W. A., Rourke M. L., Stocks J. R., Thiem J. D., Townsend A., van der Meulen D. E., Wooden I., Cheshire K. J. M. (2023) Multi-decadal trends in large-bodied fish populations in the New South Wales Murray–Darling Basin, Australia. *Marine and Freshwater Research* https://doi.org/10.1071/MF23046

Climate Overview

The following is a summary of the climatic conditions during the BPEOM-F program 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. As an example, 2014 states it was the warmest year on record, meaning 2014 was the warmest year on record up to and including 2014 but not the 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.

Flow Data

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

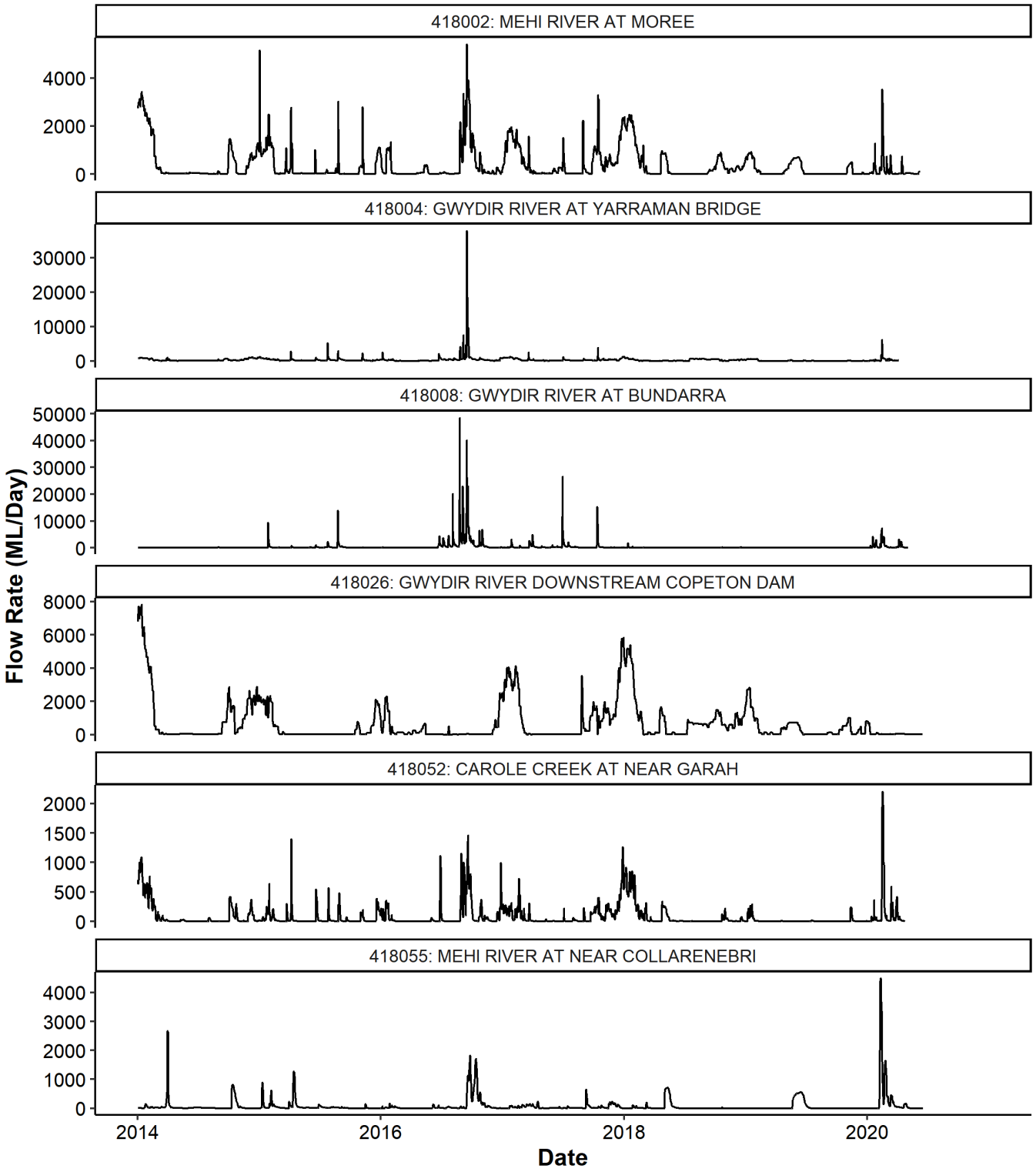

Figure 3.3: Flow data from various gauges in the Gwydir WRPA over the reporting period. Gauge locations can be seen on Figure 3.2. Note the differing scales on the y-axis.

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

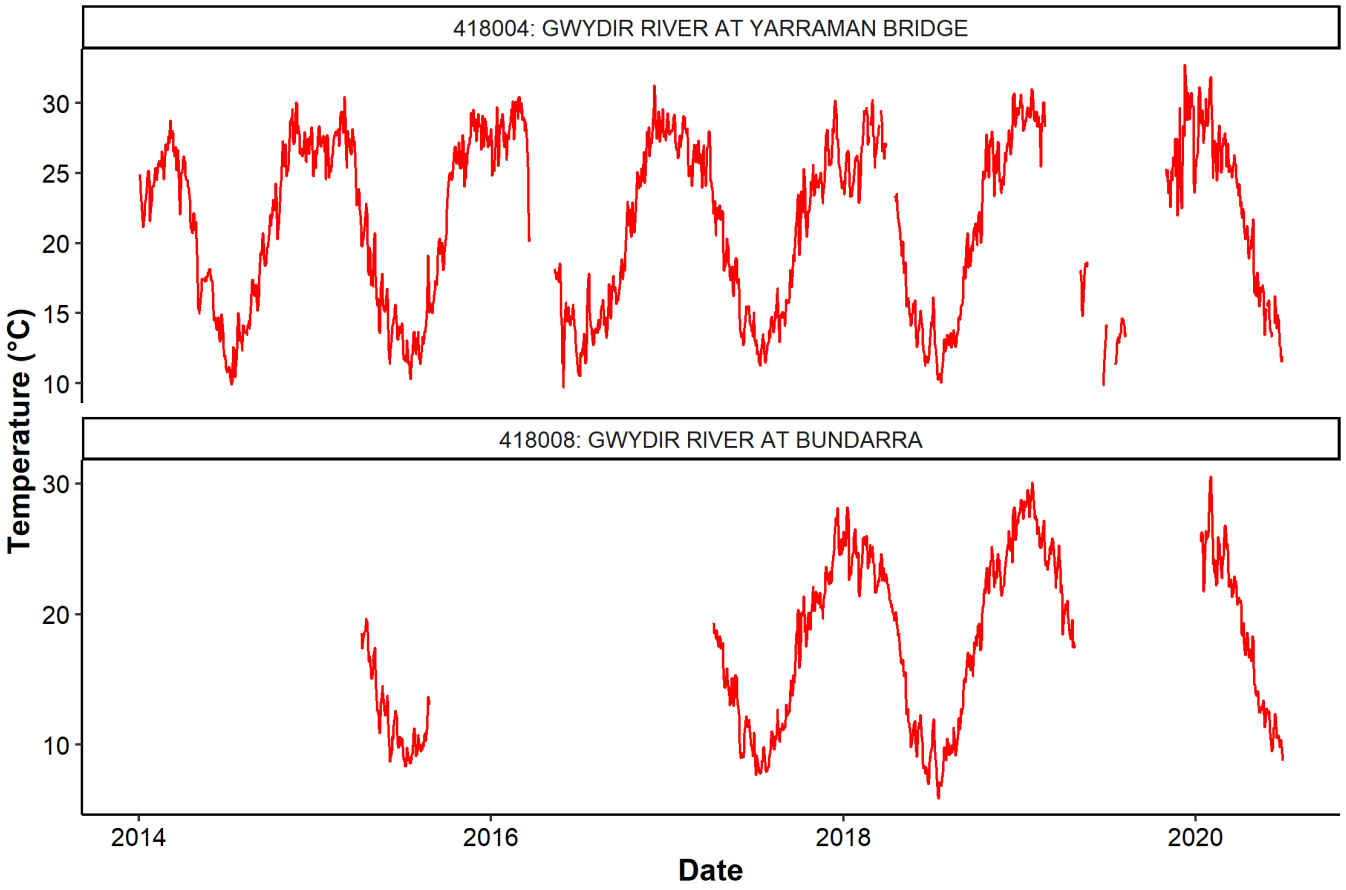

Figure 3.4: Water temperature data from various gauges in the Gwydir WRPA over the reporting period. Gauge locations can be seen on Figure 3.2. Note the differing scales on the y-axis.

Species Diversity

A total of 19 fish species were observed across the Gwydir WRPA including five alien species. Figure 3.5 shows the number of native and alien species found at each site. The full list of species caught and observed is in Table 3.7.

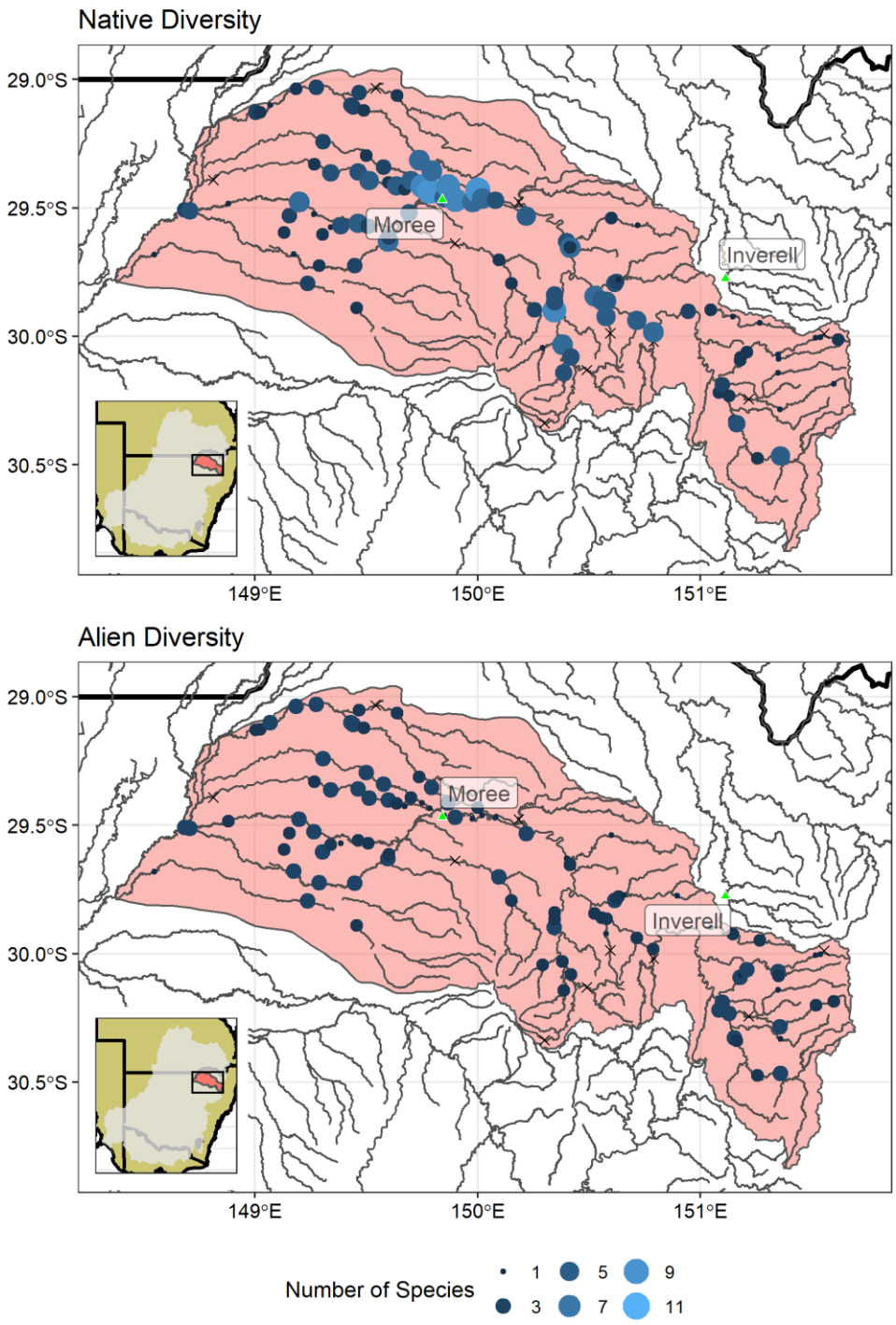

Figure 3.5: Diversity across all sampling sites. Bubble size represents the number of unique species observed at each site across all sampling methods and events. X represents a site that had water and was sampled, but no fish species were caught at all. Dry sites are excluded.

Summary Statement:

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

Murray cod

Population Structure

Figure 3.6 shows the observed length frequency plot for Murray cod across each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 1 to 14, and 3% to 29% of measured fish within a season.

Overall, during the BPEOM-F program, across all the MDB water resource planning areas, the percentage YOY for Murray cod was 13% (465 out of 3,543).

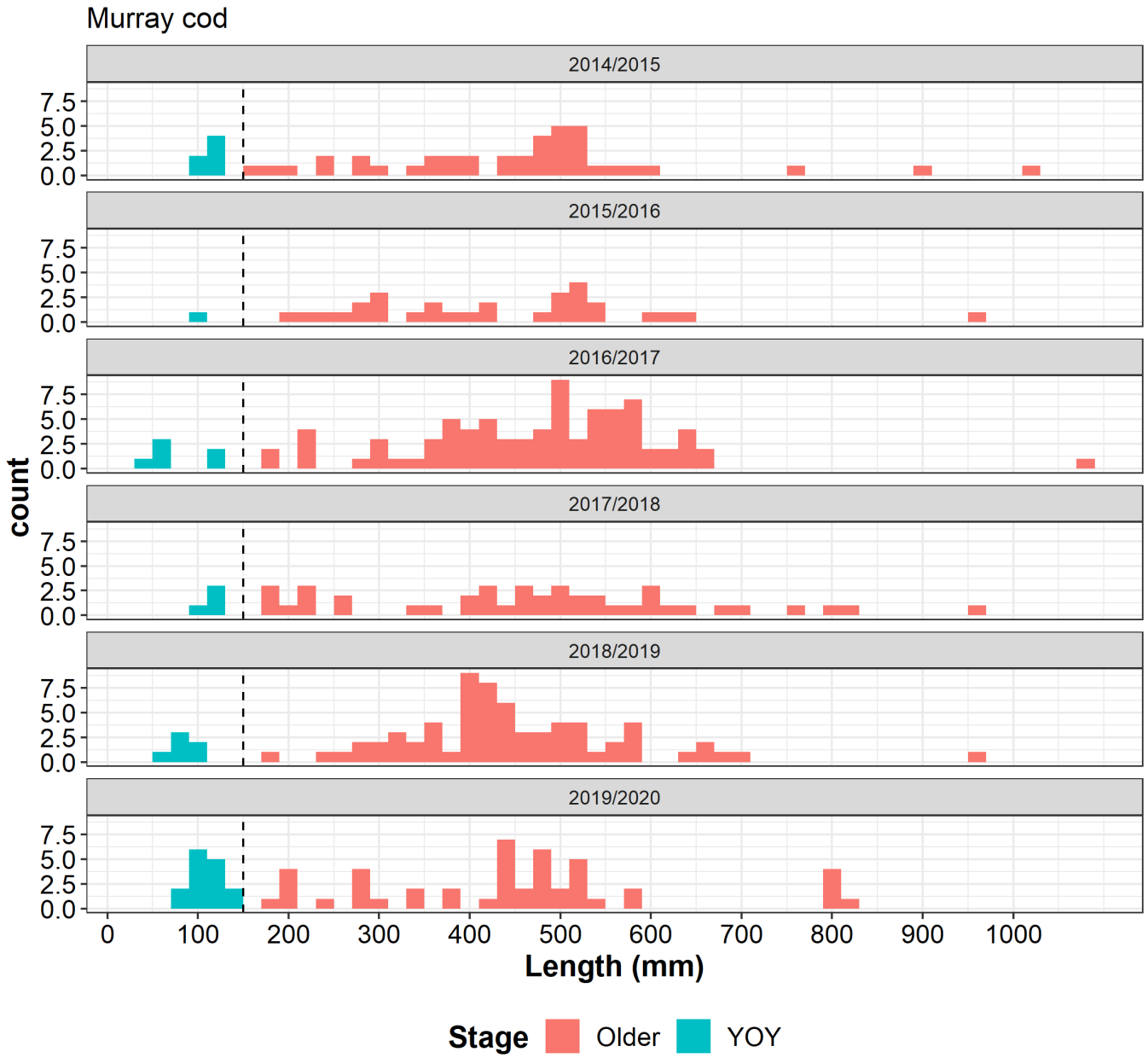

Figure 3.6: Length frequency plots for Murray cod by sampling season. YOY represents Young of the Year fish.

Summary Statement:

Regular recruitment but variable numbers of YOY, with a good range of size classes.

Stocking

A total of 212,298 Murray cod were stocked into the waterways of the Gwydir WRPA during the reporting period. Of these fish, 196,600 (92.6%) were stocked into impoundments while 15,698 (7.4%) were stocked into rivers or creeks. Table 3.4 shows the detailed breakdown of stocking by season, location and life stage while Figure 3.7 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

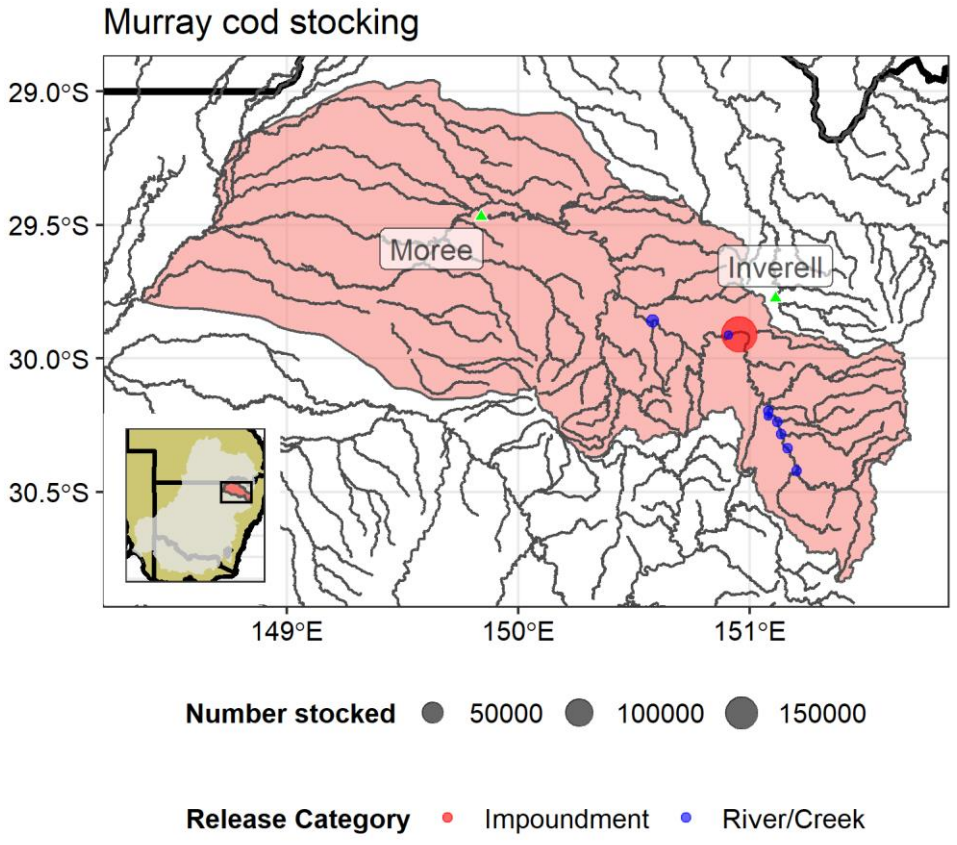

Figure 3.7: Locations of Murray cod stocking. Colours show whether a site was a river/creek site or an impoundment while the size of the point reflects the total number of fish stocked over the reporting period.

Temporal Trends in Abundance

We have modelled the relative abundance of Murray cod since 1994 based on all suitable boat electrofishing data. The left-hand panel of Figure 3.8 shows the abundance trend for the Gwydir WRPA and the right-hand panel shows the overall trend across the NSW MDB.

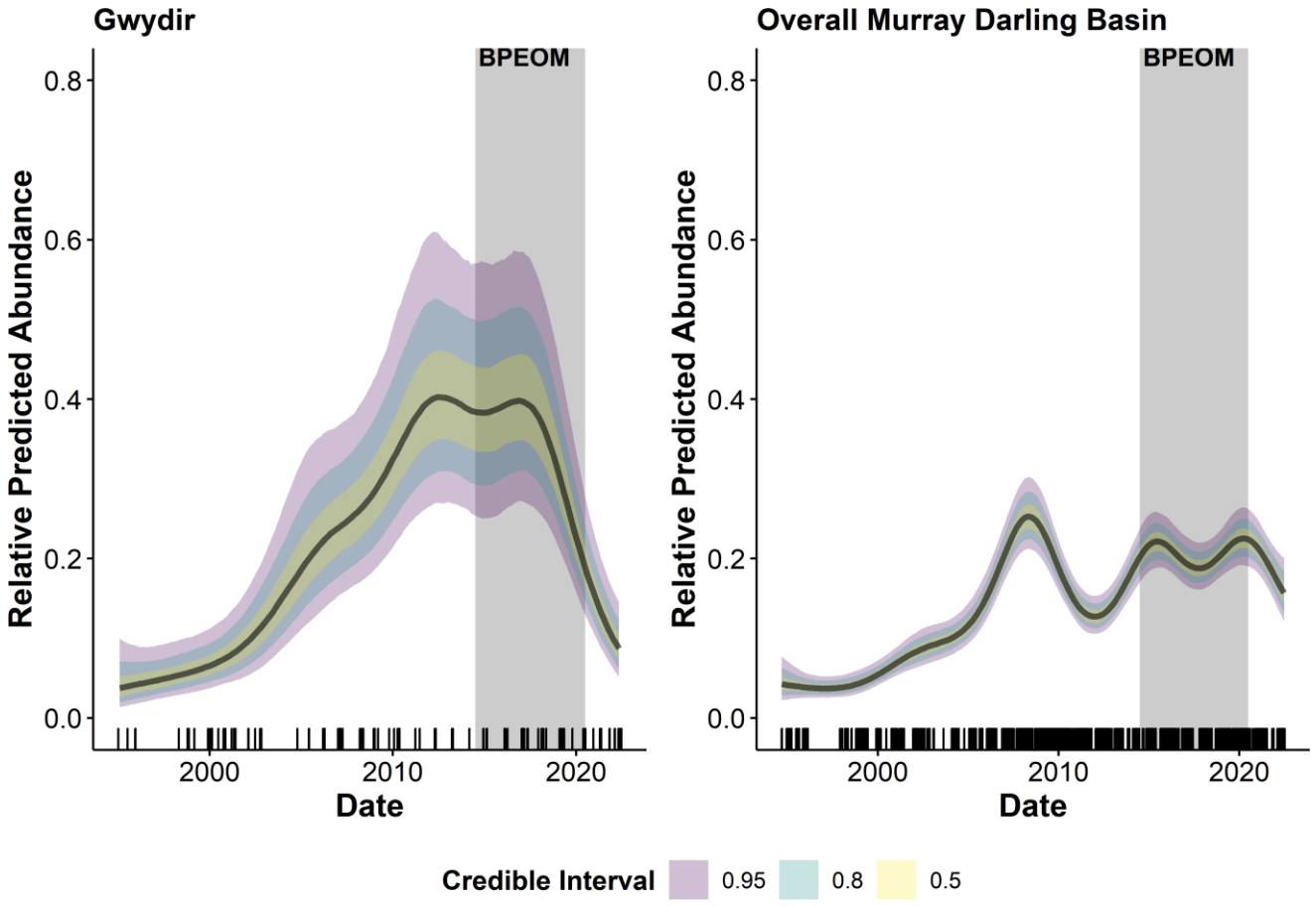

Figure 3.8: Relative abundance of Murray cod in both the Gwydir WRPA and the overall NSW MDB. These are model estimates based upon all boat electrofishing data within the NSW DPI Freshwater ecosystem database and are the output of Bayesian generalised additive mixed models. The grey shaded region represents the period during which the BPEOM-F program was run. The black lines on the x-axis represent data coverage while the colours on the figure show various levels of confidence. Note when overlapping, the colours look slightly different due to the transparency and the y-axes vary between chapters of this report.

Summary Statement:

An overall increase in abundance since the 1990s followed by a recent decline (although biomass appears to be stable based on other monitoring). Relative abundance currently lower than overall abundance across the NSW MDB but was higher during the BPEOM-F program.

Health

The prevalence of any health issues ranged from 2% of sampled fish in 2016/2017 to 16% of sampled fish in 2015/2016 (Figure 3.9). The most common health issue for Murray cod in the Gwydir WRPA was Lerneae, which was observed in a total of 17 fish corresponding to 5% of all Murray cod measured.

Across the other NSW MDB WRPAs, 18% of Murray cod (622 out of 3,506 Murray cod) showed a health condition (excludes the Gwydir WRPA).

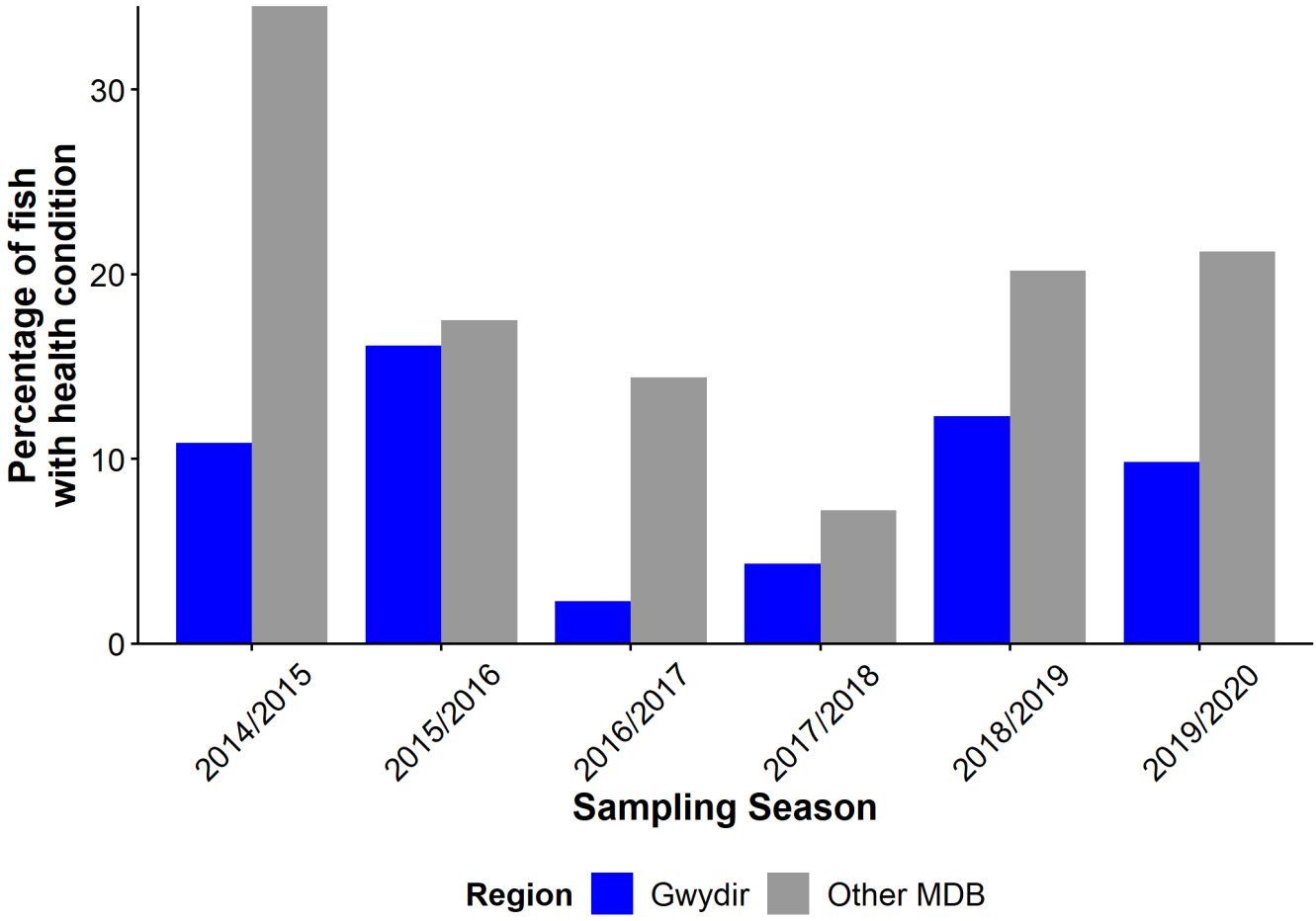

Figure 3.9: Timeseries showing the prevalence of health conditions in Murray cod. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPAs.

Summary Statement:

Presence of observable health conditions was variable across years but lower than the rest of the Murray-Darling Basin.

Distribution

Murray cod were recorded at 36 out of 107 sites in the Gwydir WRPA. The maximum observed relative abundance at a site was 1.45 fish caught per 90 seconds of electrofishing. Figure 3.10 shows the distribution and relative abundance of Murray cod across the Gwydir WRPA.

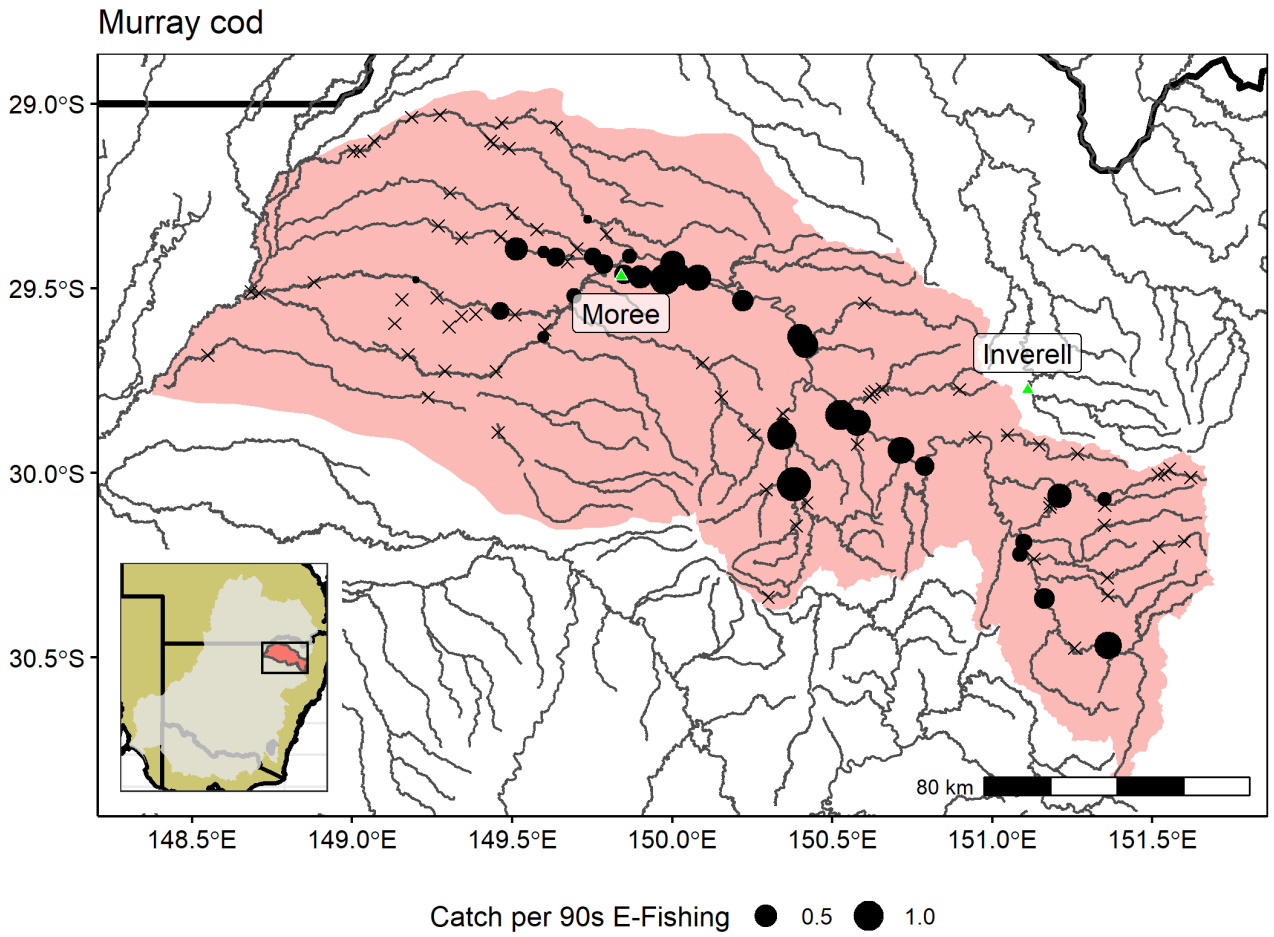

Figure 3.10: Distribution of Murray cod. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X.

Summary Statement:

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

Golden perch

Population Structure

Figure 3.11 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 38% of measured fish within a season.

Overall, during the BPEOM-F program, across all the MDB water resource planning areas, the percentage YOY for Golden perch was 12% (265 out of 2,222).

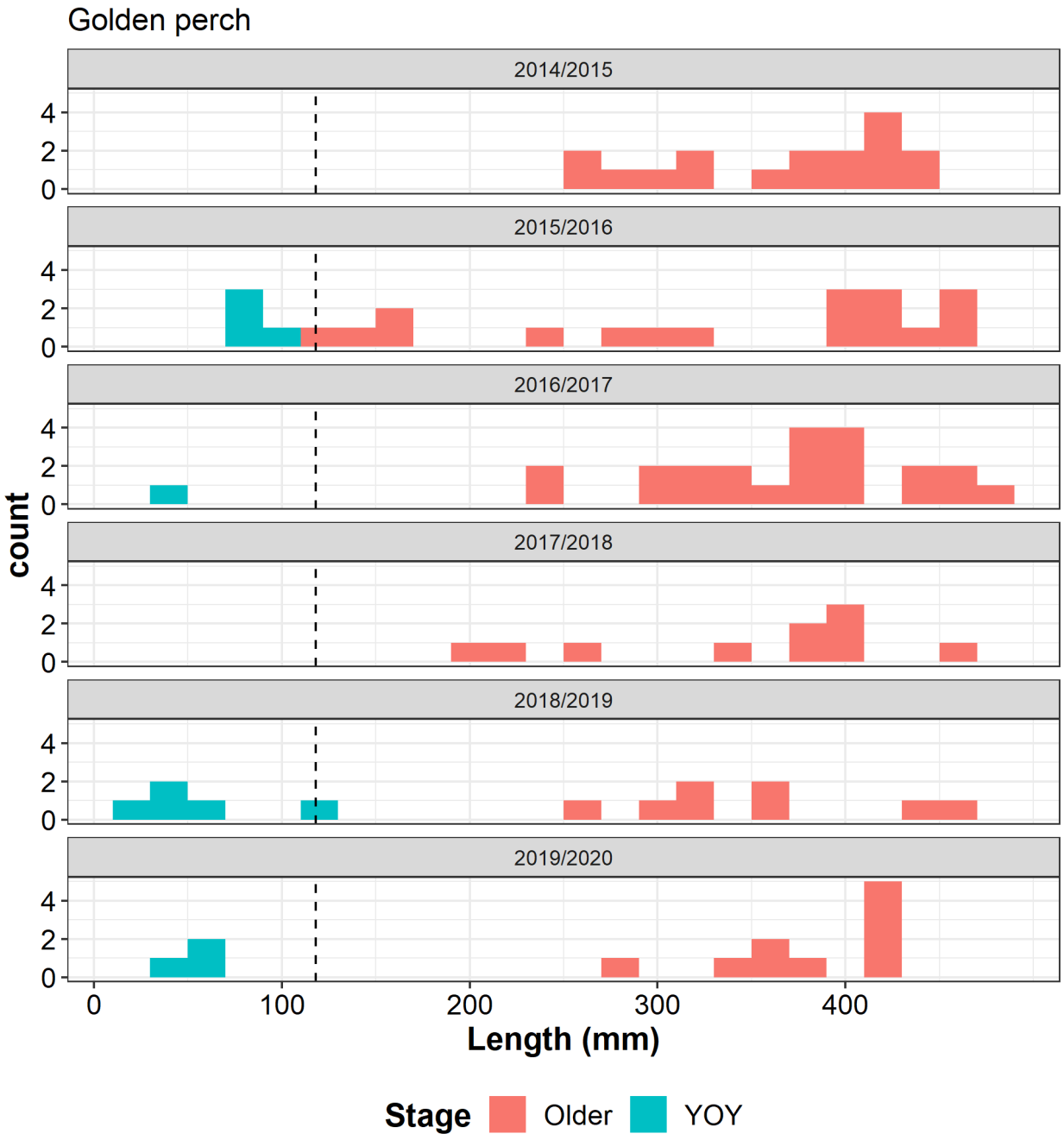

Figure 3.11: Length frequency plots for Golden perch by sampling season. YOY represents Young of the Year fish.

Summary Statement:

Recruitment in most years but variable numbers of recruits across years, with a good range of size classes. Possible recruitment failure in 2014/15 and 2017/18.

Stocking

A total of 318,831 Golden perch were stocked into the waterways of the Gwydir WRPA during the reporting period. Of these fish, 281,585 (88.3%) were stocked into impoundments while 37,246 (11.7%) were stocked into rivers or creeks. Table 3.5 shows the detailed breakdown of stocking by season, location and life stage while Figure 3.12 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

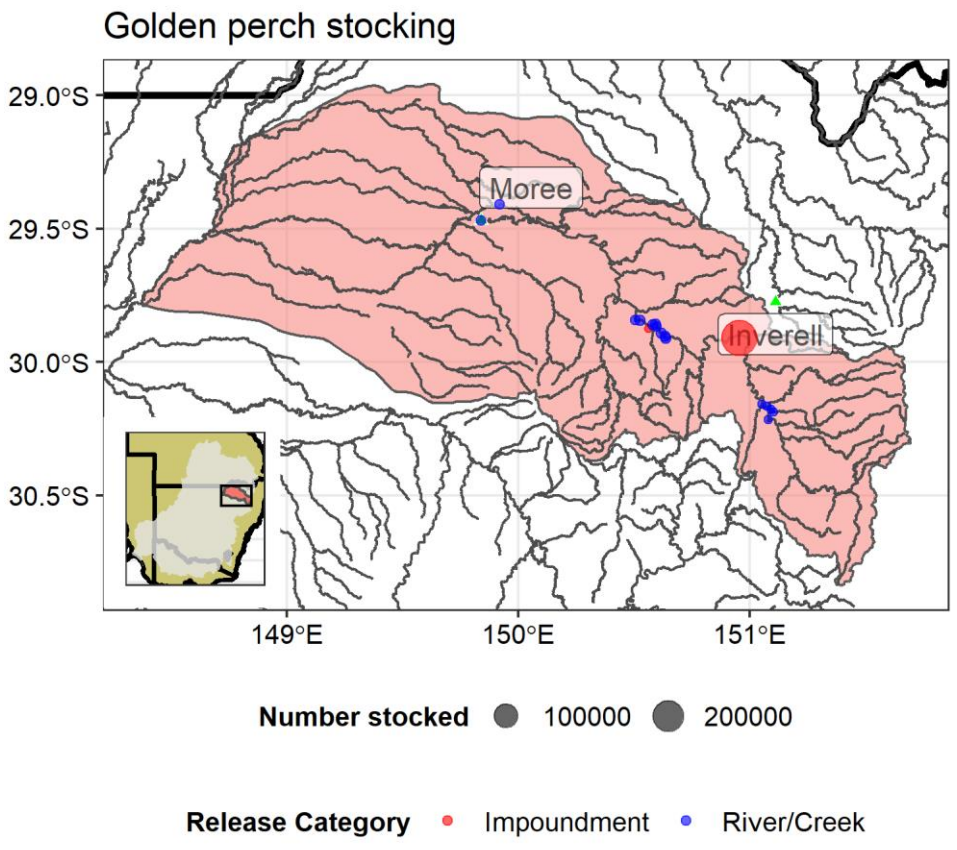

Figure 3.12: Locations of Golden perch stocking. Colours show whether a site was a river/creek site or an impoundment while the size of the point reflects the total number of fish stocked over the reporting period.

Temporal Trends in Abundance

We have modelled the relative abundance of Golden perch since 1994 based on all suitable boat electrofishing data. The left-hand panel of Figure 3.13 shows the abundance trend for the Gwydir WRPA and the right-hand panel shows the overall trend across the NSW MDB.

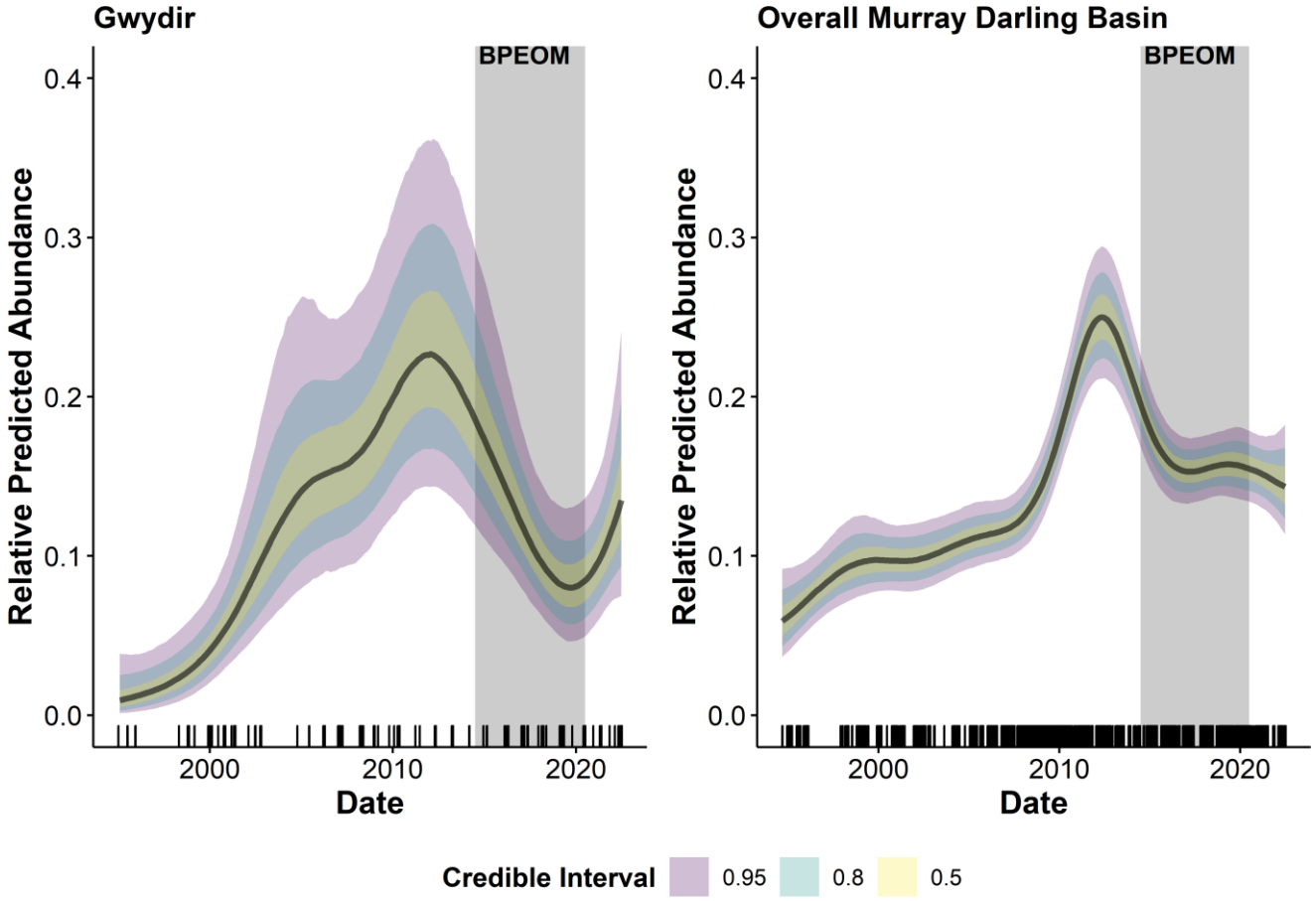

Figure 3.13: Relative abundance of Golden perch in both this valley and the overall Murray-Darling Basin. These are model estimates based upon all boat electrofishing data within the NSW DPI Freshwater ecosystem database and the output of Bayesian generalised additive mixed models. The grey shaded region represents the period during which the BPEOM-F program was run. The black lines on the x-axis represent data coverage while the colours on the figure show various levels of confidence. Note when overlapping, the colours look slightly different due to the transparency and the y-axes vary between chapters of this report.

Summary Statement:

Overall increase in abundance since 1994 but has declined since 2012 to almost 1994 levels with possible recent increase. Relative abundance slightly lower than the overall abundance across the MDB, which also peaked in 2012.

Health

The prevalence of any health issues ranged from 10% of sampled fish in 2017/2018 to 46% of sampled fish in 2014/2015 (Figure 3.14). The most common health issue for Golden perch in the Gwydir water resource planning area was Lerneae, which was observed in a total of 14 fish corresponding to 14% of all Golden perch measured.

Across the other WRPAs, 33% of Golden perch (739 out of 2,222 Golden perch) showed a health condition (excludes Gwydir).

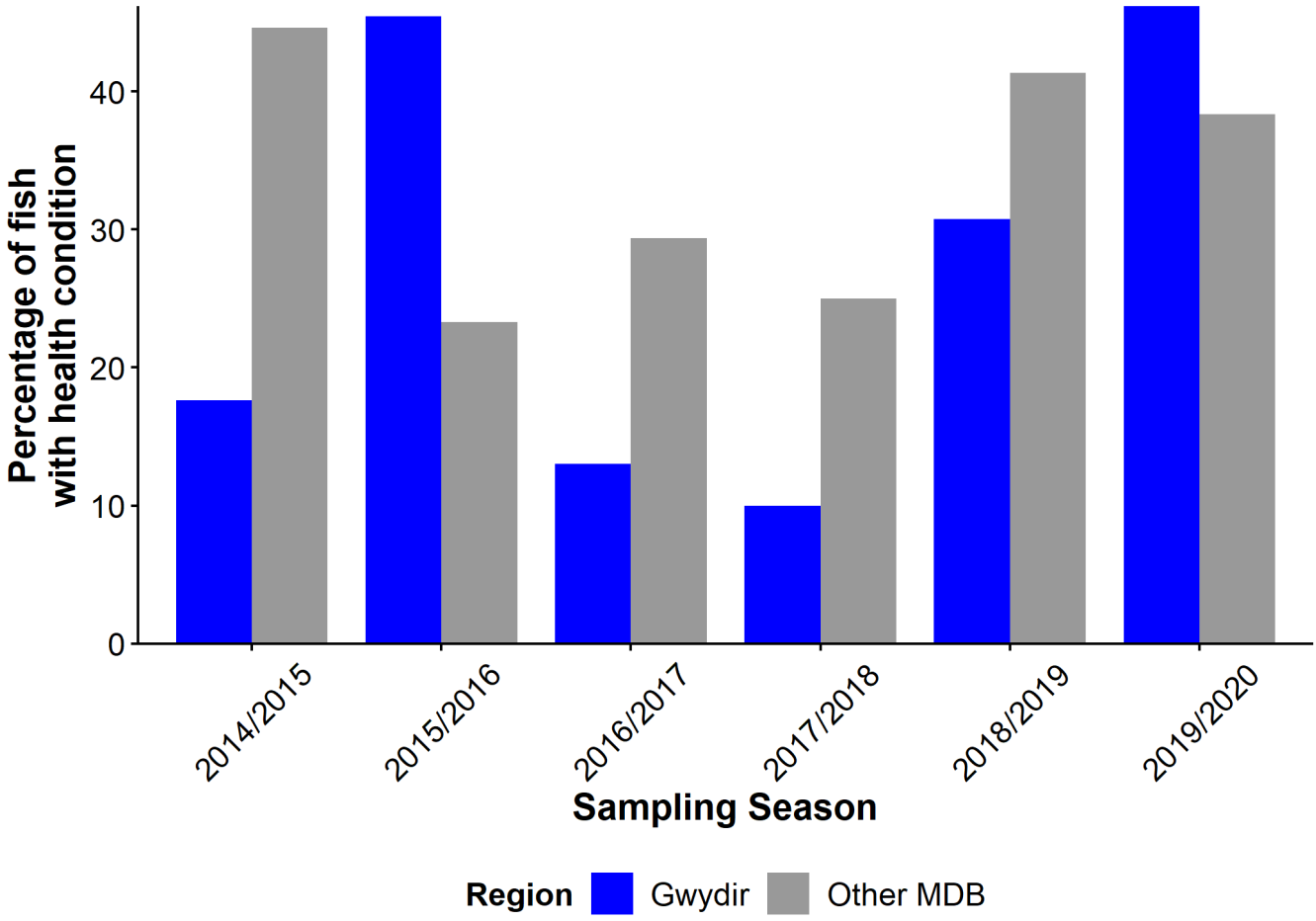

Figure 3.14: Timeseries showing the prevalence of health conditions in Golden perch. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPAs.

Summary Statement:

The presence of observable health conditions for Golden perch in the Gwydir was variable and similar to the average across the rest of the Murray-Darling Basin.

Distribution

Golden perch were recorded at 22 out of 107 sites in the Gwydir WRPA. The maximum observed relative abundance at a site was 0.5 fish caught per 90 seconds of electrofishing. Figure 3.15 shows the distribution and relative abundance of Golden perch across the Gwydir WRPA.

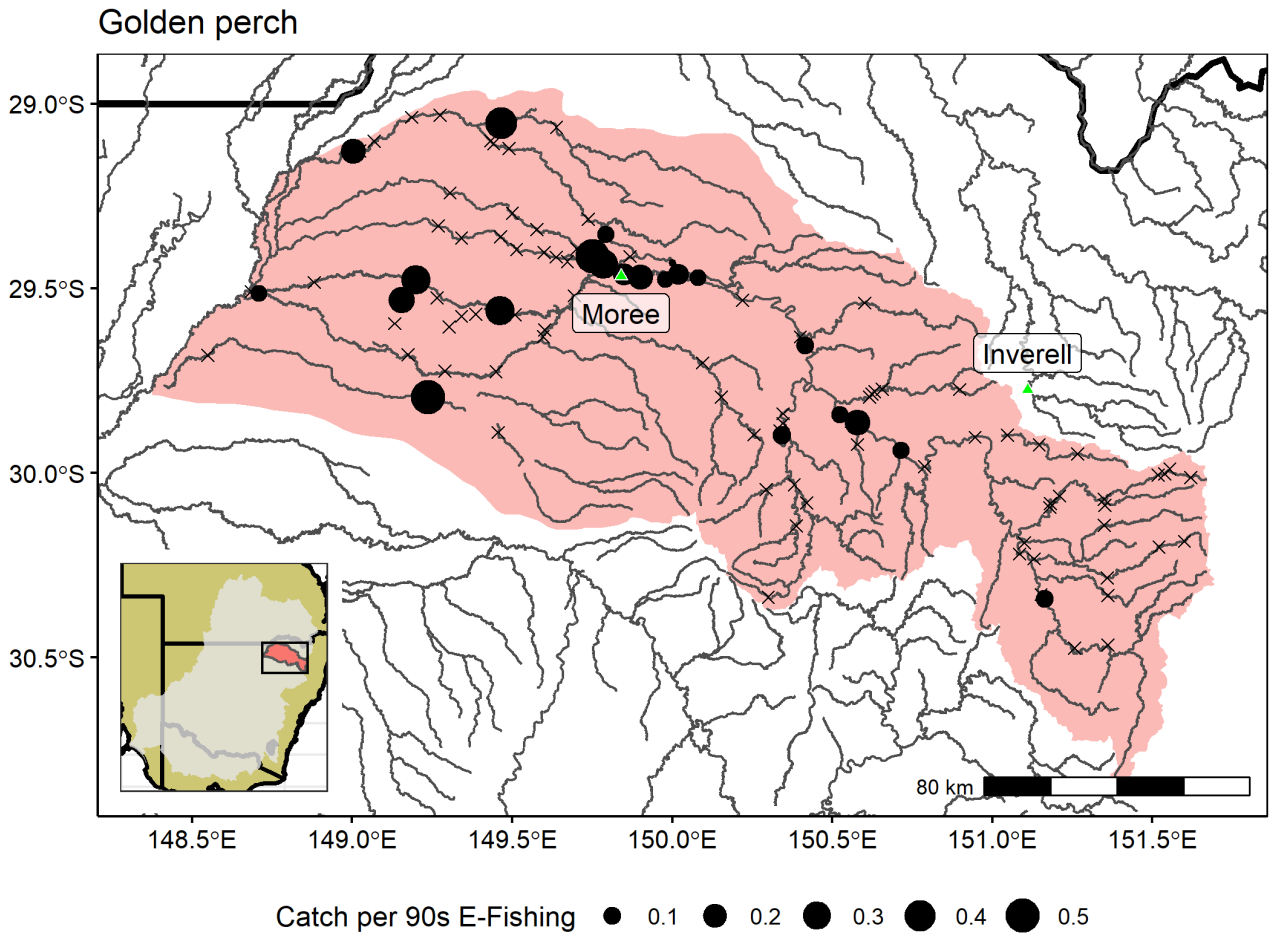

Figure 3.15: Distribution of Golden perch. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X.

Summary Statement:

Golden perch were more commonly found in the western area of the Gwydir region.

Freshwater catfish

Population Structure

Figure 3.16 shows the observed length frequency plot for Freshwater catfish for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 0 to 53, and 0% to 91% of measured fish within a season.

Overall, during the BPEOM-F program, across all the MDB water resource planning areas, the percentage YOY for Freshwater catfish was 39 % (166 out of 429).

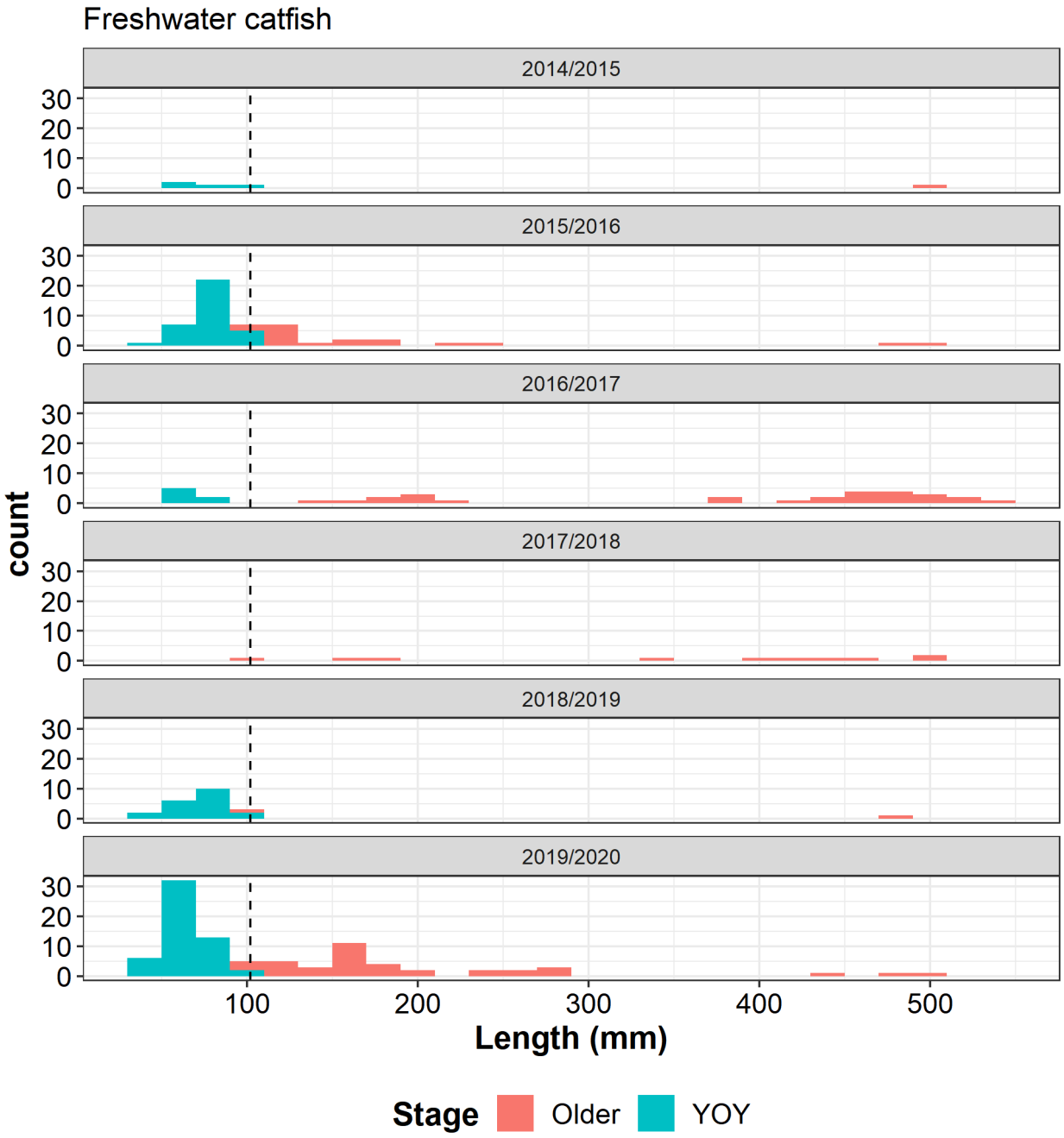

Figure 3.16: Length frequency plots for Freshwater catfish by sampling season. YOY represents Young of the Year fish.

Summary Statement:

Recruitment observed in most years but highly variable, population comprised mainly of small fish (less than 200mm) with large fish only present in small numbers in most years.

Temporal Trends in Abundance

We have modelled the relative abundance of Freshwater catfish since 1994 based on all suitable boat and backpack electrofishing data. The left-hand panel of Figure 3.17 shows the abundance trend for the Gwydir WRPA and the right-hand panel shows the overall trend across the NSW MDB.

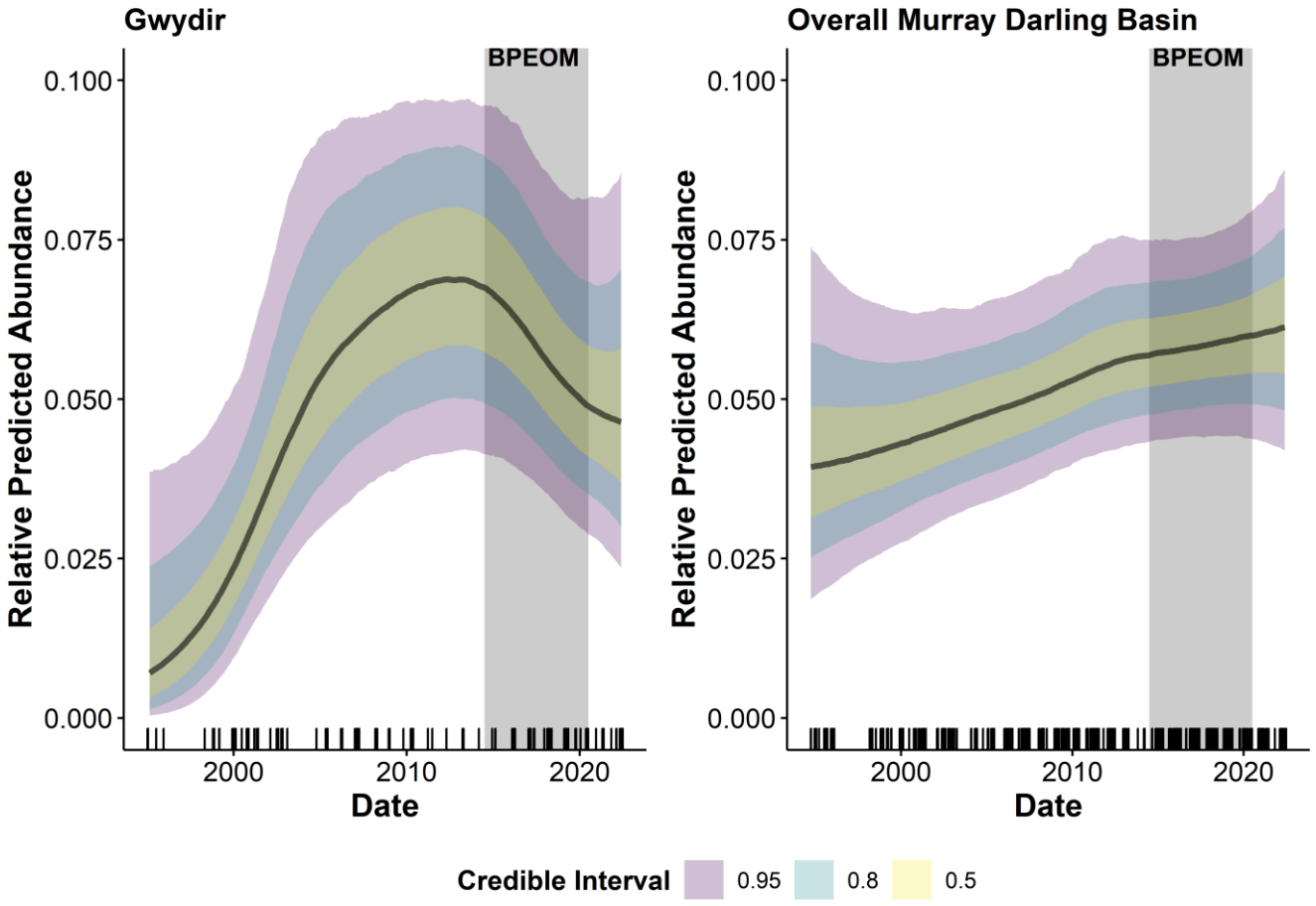

Figure 3.17: Relative abundance of Freshwater catfish in both this valley and the overall Murray-Darling Basin. These are model estimates based upon all electrofishing data within the NSW DPI Freshwater ecosystem database and the output of Bayesian generalised additive mixed models. The grey shaded region represents the period during which the BPEOM-F program was run. The black lines on the x-axis represent data coverage while the colours on the figure show various levels of confidence. Note when overlapping, the colours look slightly different due to the transparency and the y-axes vary between chapters of this report.

Summary Statement:

An overall increase in abundance since 1994, remaining stable since 2010. Relative abundance approximately equal to the overall abundance across the MDB, which has shown a minor increasing trend since the 1990s.

Health

The prevalence of any health issues ranged from 0% of sampled fish in 2014/2015 to 1% of sampled fish in 2019/2020 (Figure 3.18). The most common health issue for Freshwater catfish in the Gwydir water resource planning area was Fin condition which was observed in one fish, corresponding to <1% of all Freshwater catfish measured.

Across the other WRPAs, 2% of Freshwater catfish (7 out of 429 Freshwater catfish) showed a health condition (excludes Gwydir).

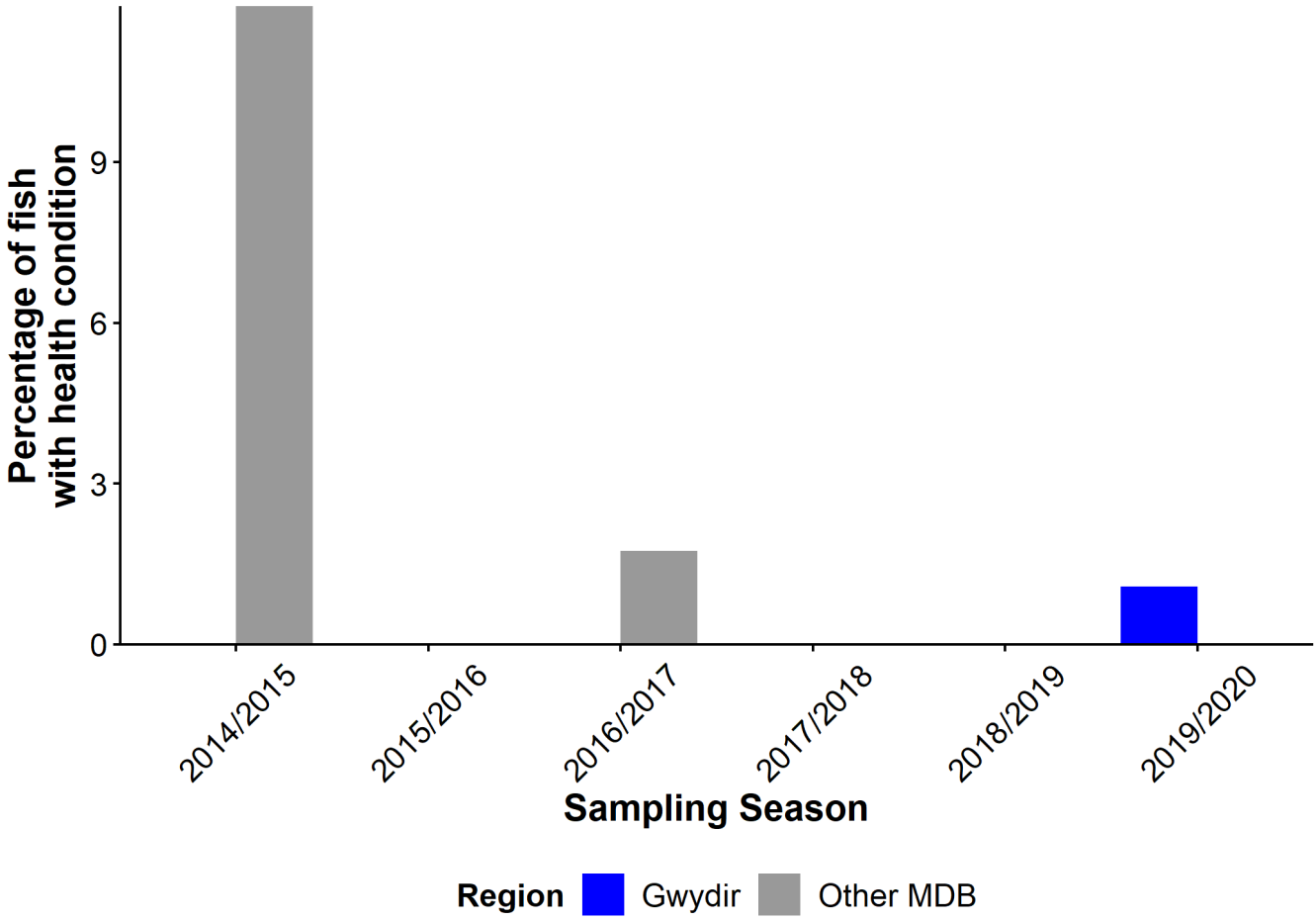

Figure 3.18: Timeseries showing the prevalence of health conditions in Freshwater catfish. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPAs.

Summary Statement:

The presence of observable health conditions for Freshwater catfish in the Gwydir was very low, like the overall NSW MDB.

Distribution

Freshwater catfish were recorded at 25 out of 111 sites in the Gwydir WRPA. The maximum observed relative abundance at a site was 2.1 fish caught per 90 seconds of electrofishing. Figure 3.19 shows the distribution and relative abundance of Freshwater catfish across the Gwydir WRPA.

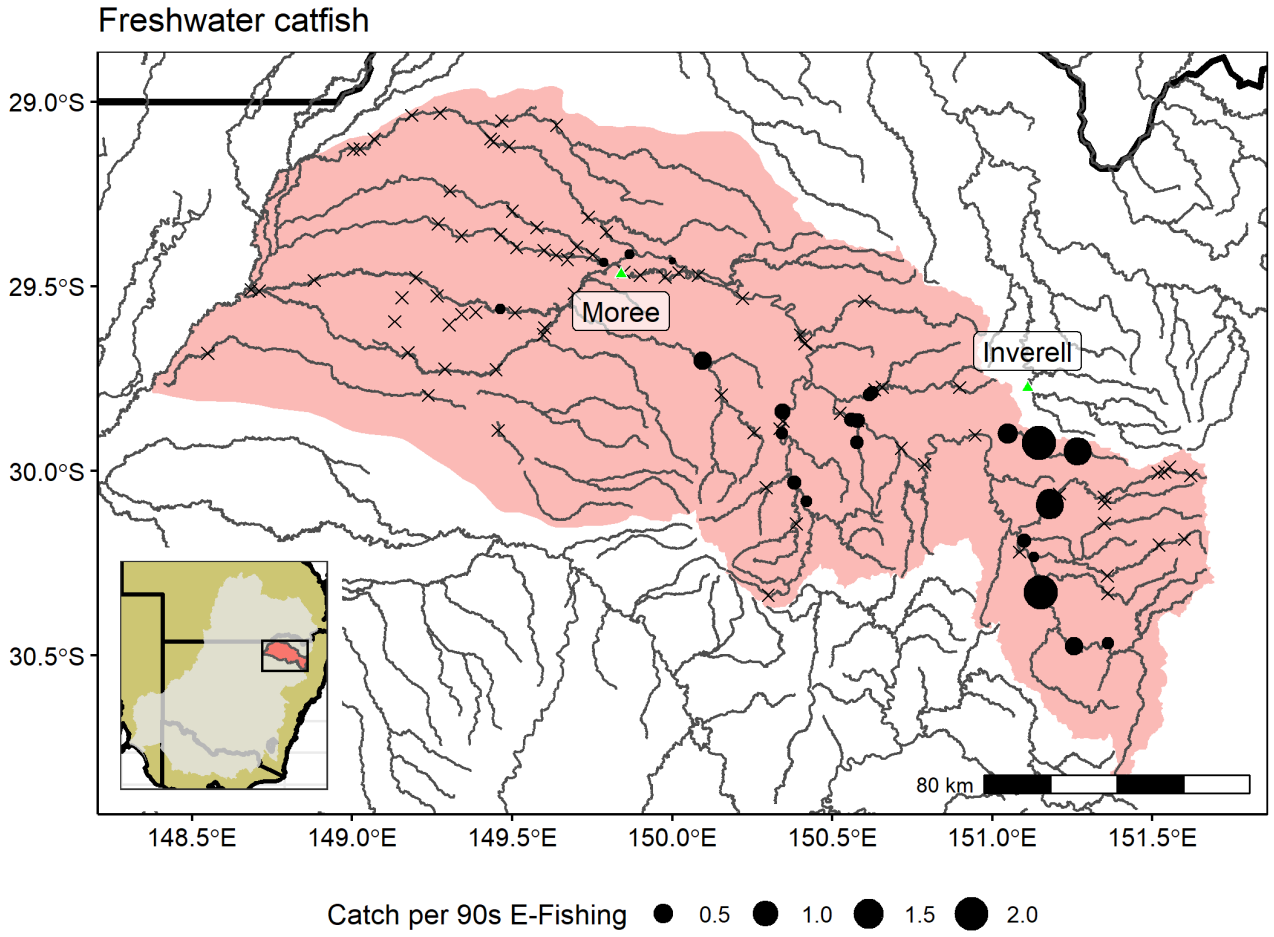

Figure 3.19: Distribution of Freshwater catfish. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X.

Summary Statement:

Freshwater catfish restricted to the eastern region of the Gwydir WRPA, and in unregulated systems, being rare or absent in the western reaches of the valley.

Bony herring

Population Structure

Figure 3.20 shows the observed length frequency plot for Bony herring for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 0 to 160, and 0% to 34% of measured fish within a season.

Overall, during the BPEOM-F program, across all the MDB water resource planning areas, the percentage YOY for Bony herring was 31% (4,697 out of 15,081). Bony herring are not a stocked species.

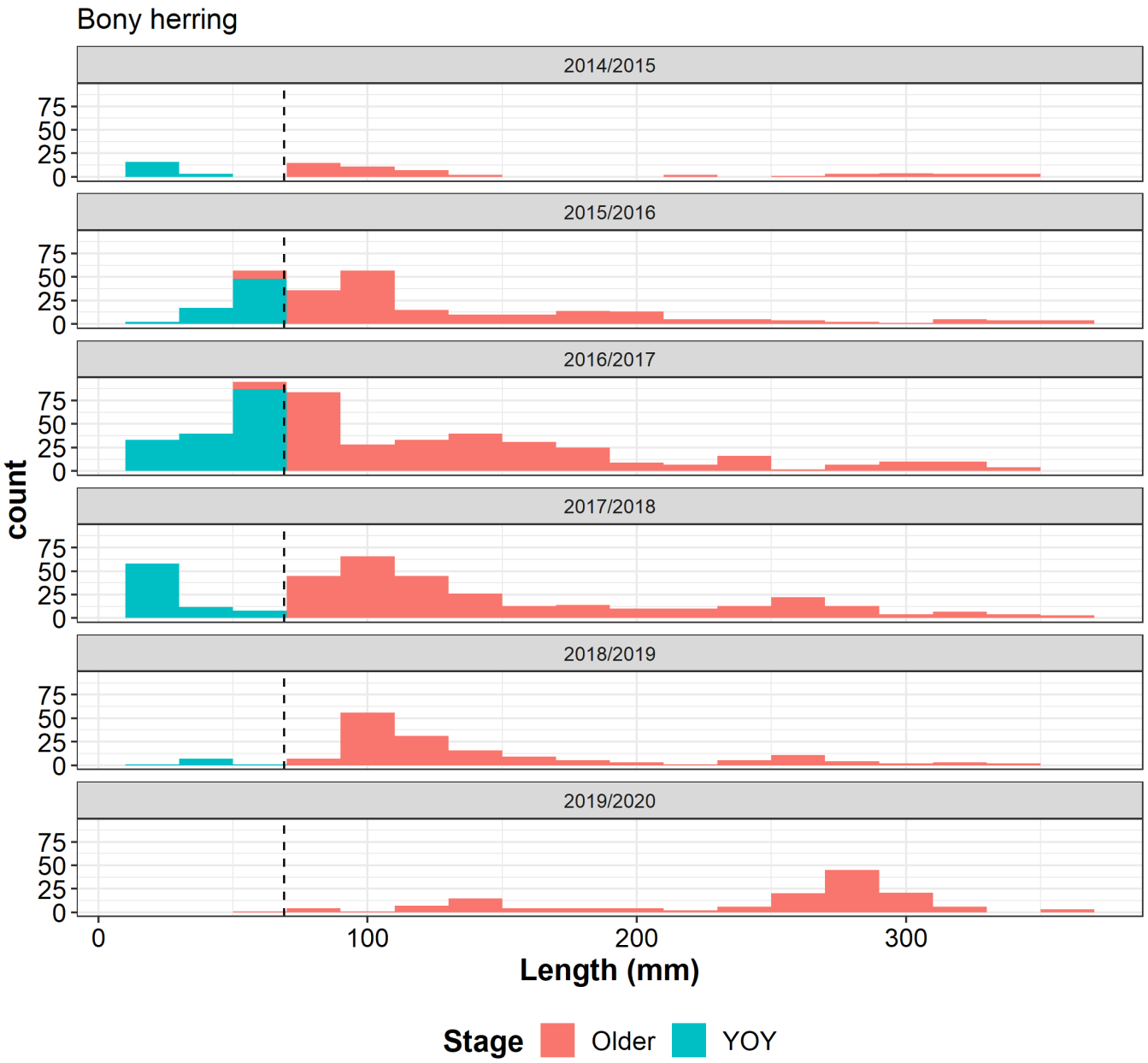

Figure 3.20: Length frequency plots for Bony herring by sampling season. YOY represents Young of the Year fish.

Summary Statement:

Evidence of recruitment most years although it is variable with few YOY (and young adults) observed in 2019/20 suggesting a possible recruitment failure.

Temporal Trends in Abundance

We have modelled the relative abundance of Bony herring since 1994 based on all suitable boat electrofishing data. The left-hand panel of Figure 3.21 shows the abundance trend for the Gwydir WRPA and the right-hand panel shows the overall trend across the NSW MDB.

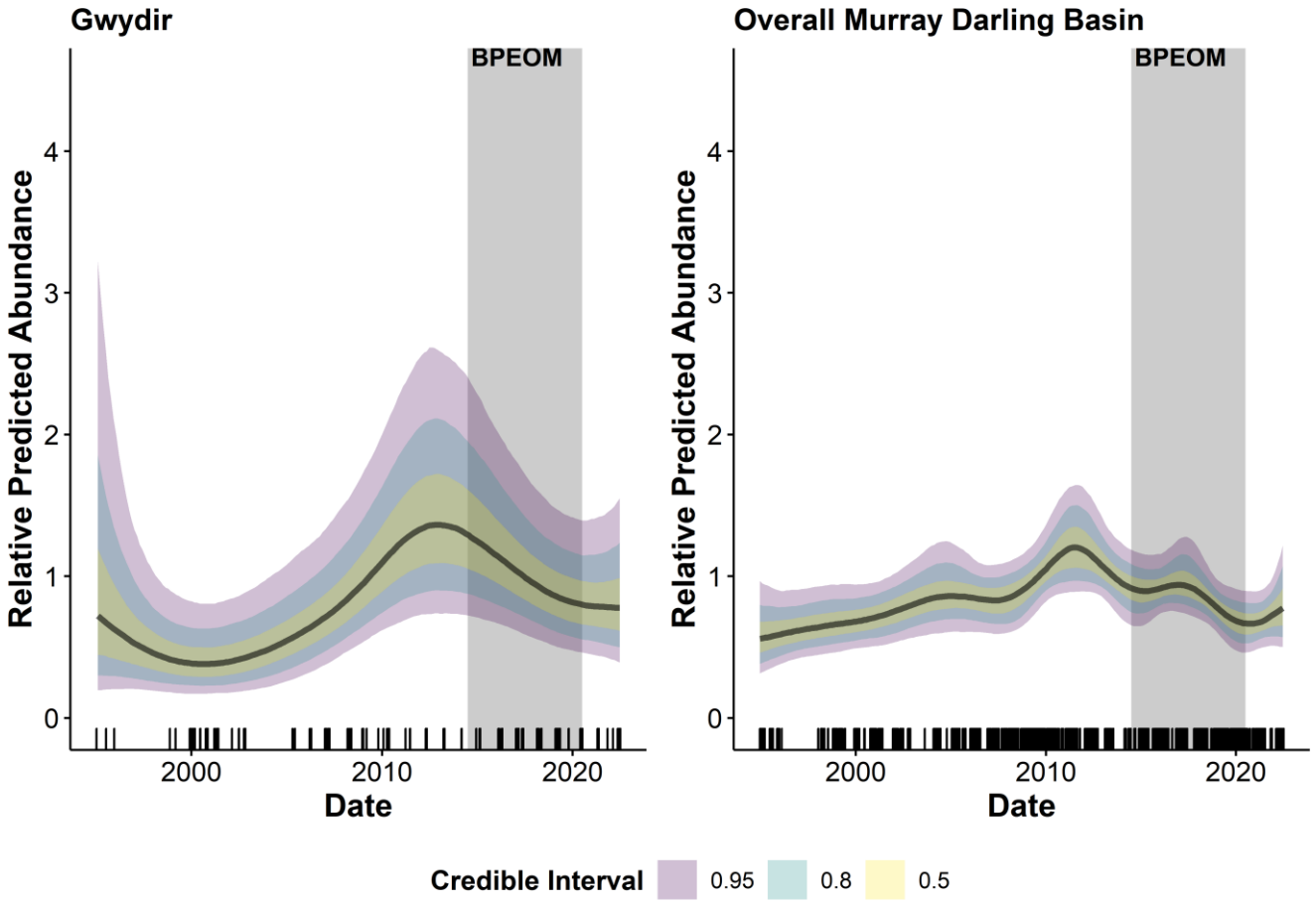

Figure 3.21: Relative abundance of Bony herring in both the Gwydir WRPA and the overall NSW MDB. These are model estimates based upon all boat electrofishing data within the NSW DPI Freshwater ecosystem database and the output of Bayesian generalised additive mixed models. The grey shaded region represents the period during which the BPEOM-F program was run. The black lines on the x-axis represent data coverage while the colours on the figure show various levels of confidence. Note when overlapping, the colours look slightly different due to the transparency and the y-axes vary between chapters of this report.

Summary Statement:

An overall increase in abundance since the 1990s followed by a recent decline. Relative abundance similar to overall abundance across the NSW MDB.

Health

The prevalence of any health issues ranged from 0 % of sampled fish in 2016/2017 to 2% of sampled fish in 2014/2015 (Figure 3.22). The most common health issue for Bony herring in the Gwydir WRPA was Other, which was observed in a total of five fish, corresponding to <1% of all Bony herring measured.

Across the other NSW MDB WRPAs, 1% of Bony herring (168 out of 13,886 Bony herring) showed a health condition (excludes the Gwydir WRPA).

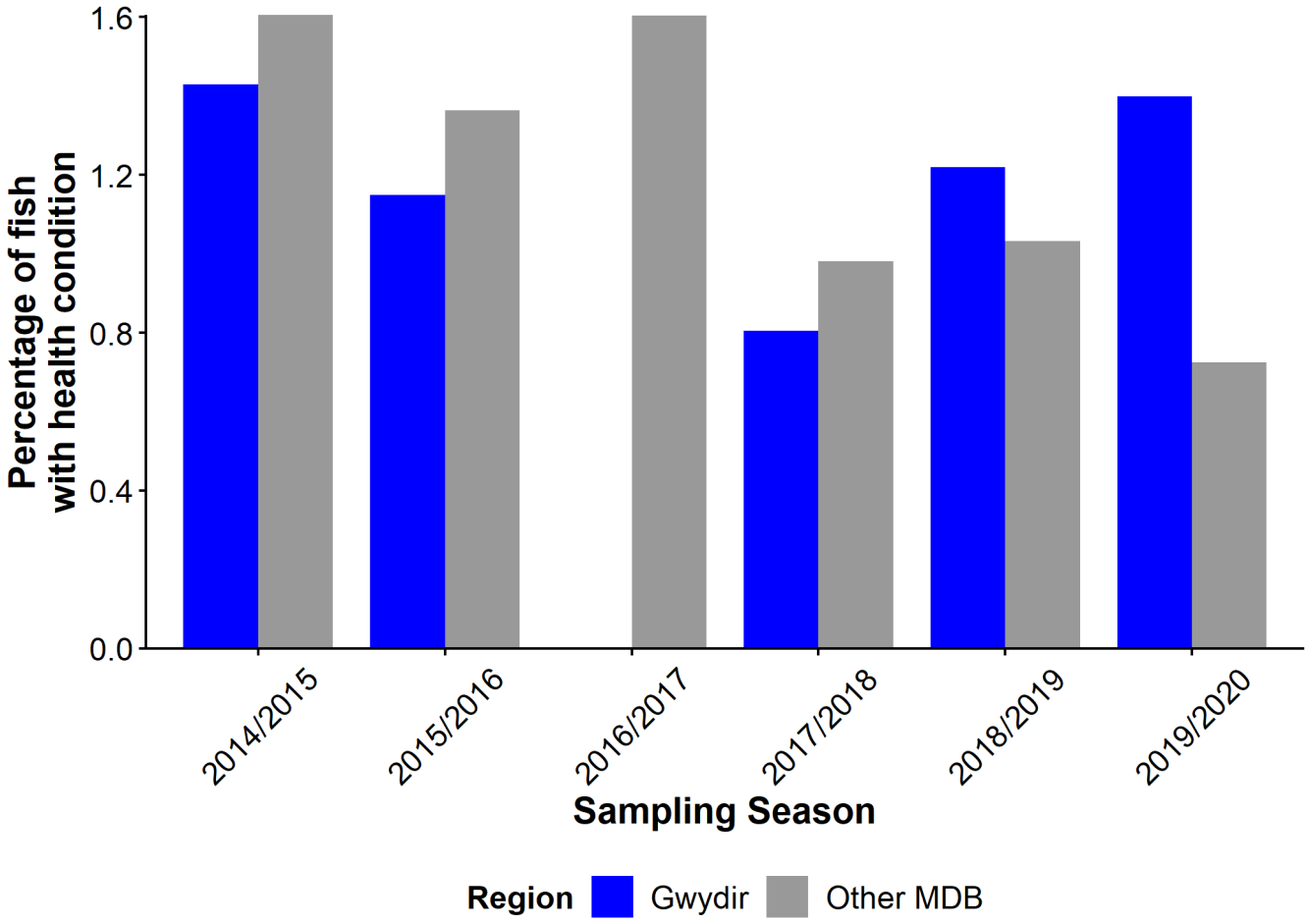

Figure 3.22: Timeseries showing the prevalence of health conditions in Bony herring. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPAs.

Summary Statement:

Presence of observable health conditions was low overall and lower than the rest of the NSW MDB for all but one season.

Distribution

Bony herring were recorded at 44 out of 107 sites in the Gwydir WRPA. The maximum observed relative abundance at a site was 9.9 fish caught per 90 seconds of electrofishing. Figure 3.23 shows the distribution and relative abundance of Bony herring across the Gwydir WRPA.

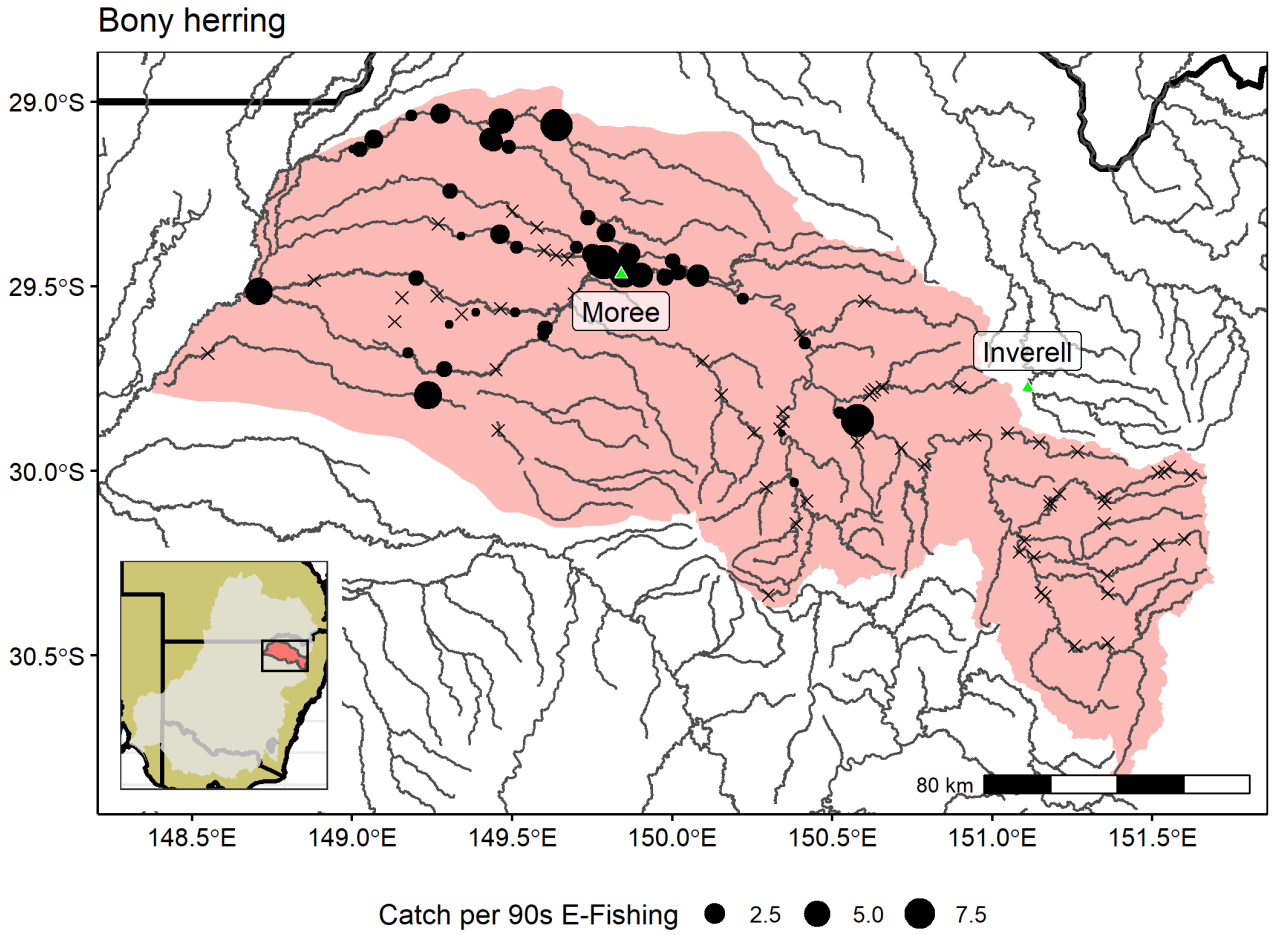

Figure 3.23: Distribution of Bony herring. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X.

Summary Statement:

Bony herring were recorded across the Gwydir WRPA but less abundant or absent in eastern and upland sites.

Australian smelt

Population Structure

Figure 3.24 shows the observed length frequency plot for Australian smelt for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 0 to 14, and 0% to 71% of measured fish within a season.

Overall, during the BPEOM-F program, across all the MDB water resource planning areas, the percentage YOY for Australian smelt was 44% (3,593 out of 8,196). Australian smelt are not a stocked species.

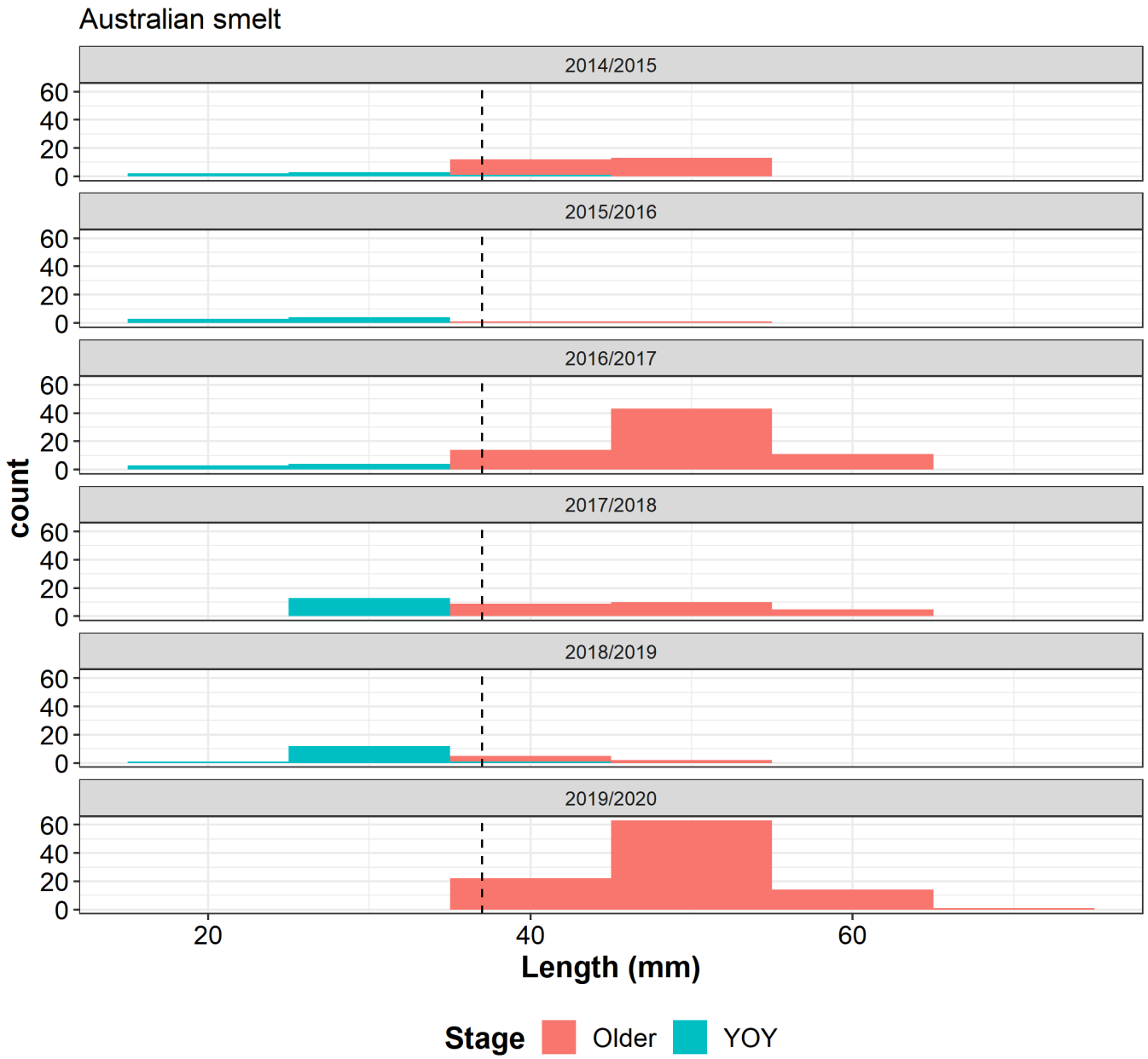

Figure 3.24: Length frequency plots for Australian smelt by sampling season. YOY represents Young of the Year fish.

Summary Statement:

Evidence of recruitment most years although no YOY observed in 2019/20 suggesting possible poor recruitment. Adults observed most years but very few observed in 2015/16.

Temporal Trends in Abundance

We have modelled the relative abundance of Australian smelt since 1994 based on all suitable boat electrofishing data. The left-hand panel of Figure 3.25 shows the abundance trend for the Gwydir WRPA and the right-hand panel shows the overall trend across the NSW MDB.

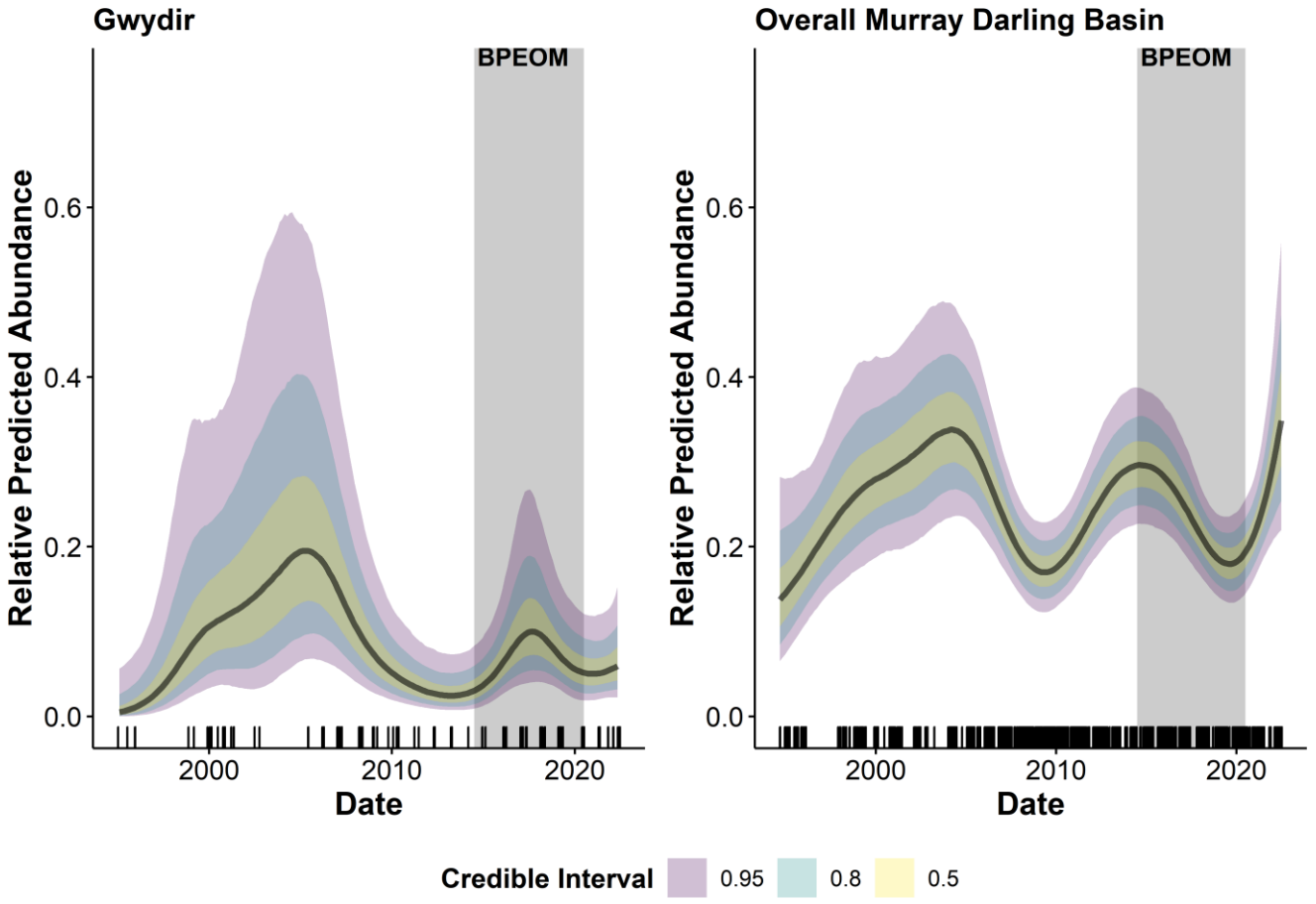

Figure 3.25: Relative abundance of Australian smelt in both the Gwydir WRPA and the overall NSW MDB. These are model estimates based upon all boat electrofishing data within the NSW DPI Freshwater ecosystem database and the output of Bayesian generalised additive mixed models. The grey shaded region represents the period during which the BPEOM-F program was run. The black lines on the x-axis represent data coverage while the colours on the figure show various levels of confidence. Note when overlapping, the colours look slightly different due to the transparency and the y-axes vary between chapters of this report.

Summary Statement:

No evidence of overall changes in abundance although abundance was high between 2000 and 2005, and showed a minor peak in 2018. Relative abundance in the Gwydir is lower than the overall NSW MDB.

Health

The prevalence of any health issues ranged from 0% of sampled fish in 2014/2015 to 1% of sampled fish in 2019/2020 (Figure 3.26). The most common health issue for Australian smelt in the Gwydir WRPA was Lerneae, which was observed in a total of two fish, corresponding to 1% of all Australian smelt measured.

Across the other NSW MDB WRPAs, 1% of Australian smelt (51 out of 8191 Australian smelt) showed a health condition (excludes the Gwydir WRPA).

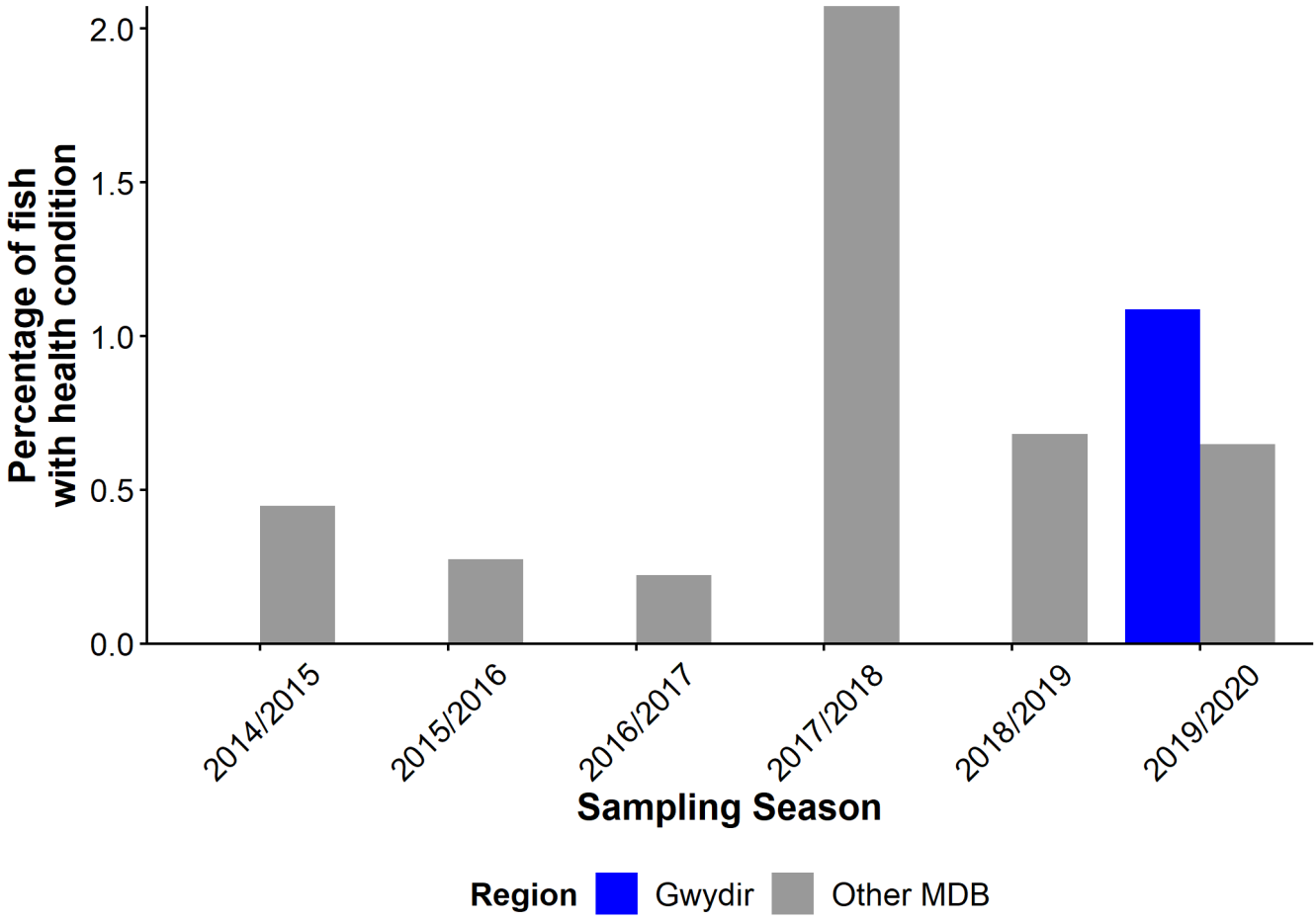

Figure 3.26: Timeseries showing the prevalence of health conditions in Australian smelt. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPAs.

Summary Statement:

Presence of observable health conditions was generally absent or low at levels similar to the rest of the NSW MDB.

Distribution

Australian smelt were recorded at 27 out of 107 sites in the Gwydir WRPA. The maximum observed relative abundance at a site was 14 fish caught per 90 seconds of electrofishing. Figure 3.27 shows the distribution and relative abundance of Australian smelt across the Gwydir WRPA.

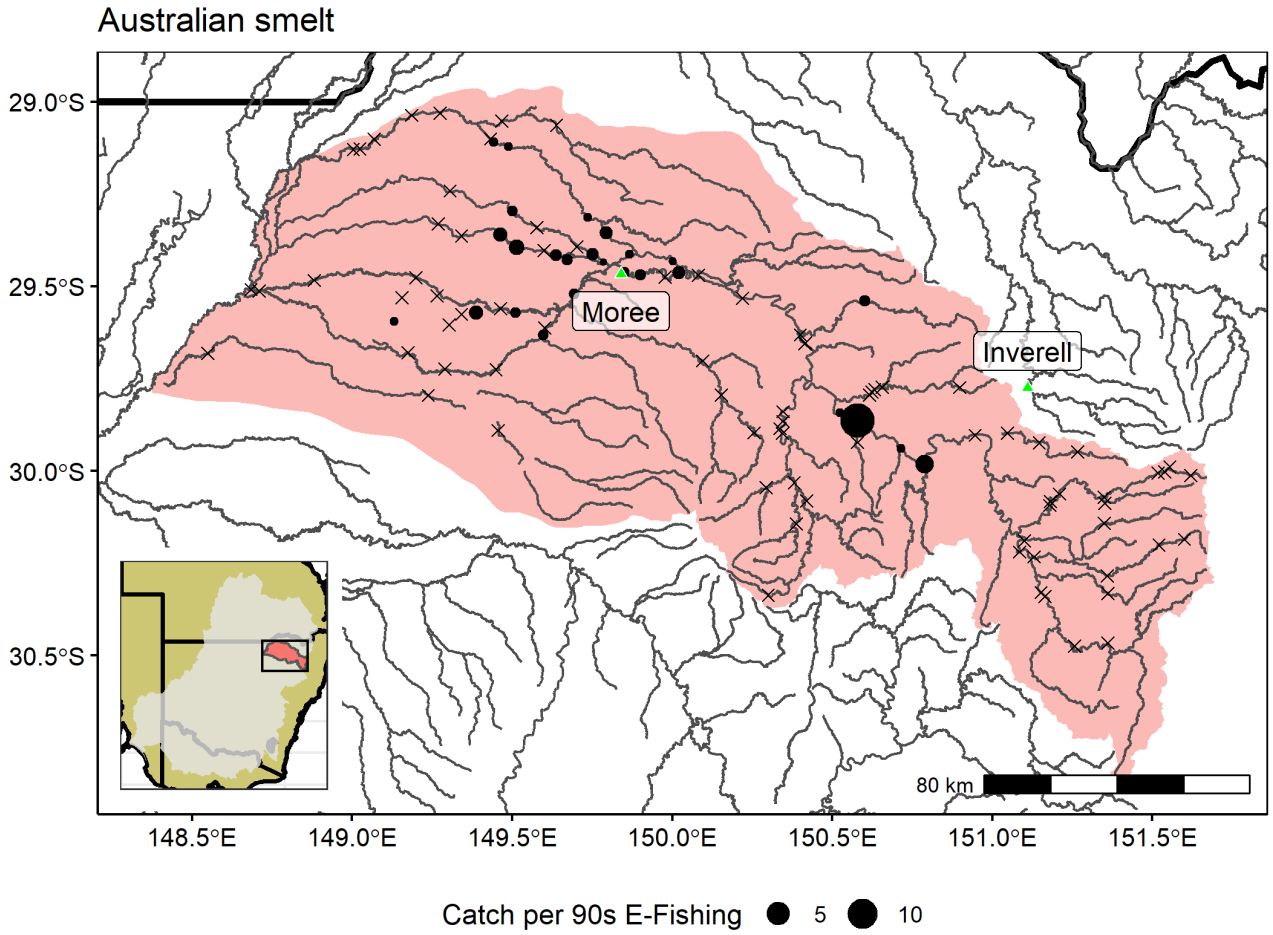

Figure 3.27: Distribution of Australian smelt. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X.

Summary Statement:

Australian smelt were recorded across the Gwydir WRPA but less abundant or absent in eastern upland sites.

Common carp

Population Structure

Figure 3.28 shows the observed length frequency plot for Common carp for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 27 to 771, and 25% to 90% of measured fish within a season.

Overall, during the BPEOM-F program, across all the MDB water resource planning areas, the percentage YOY for Common carp was 55 % (10,546 out of 19,227). Common carp are not a stocked species.

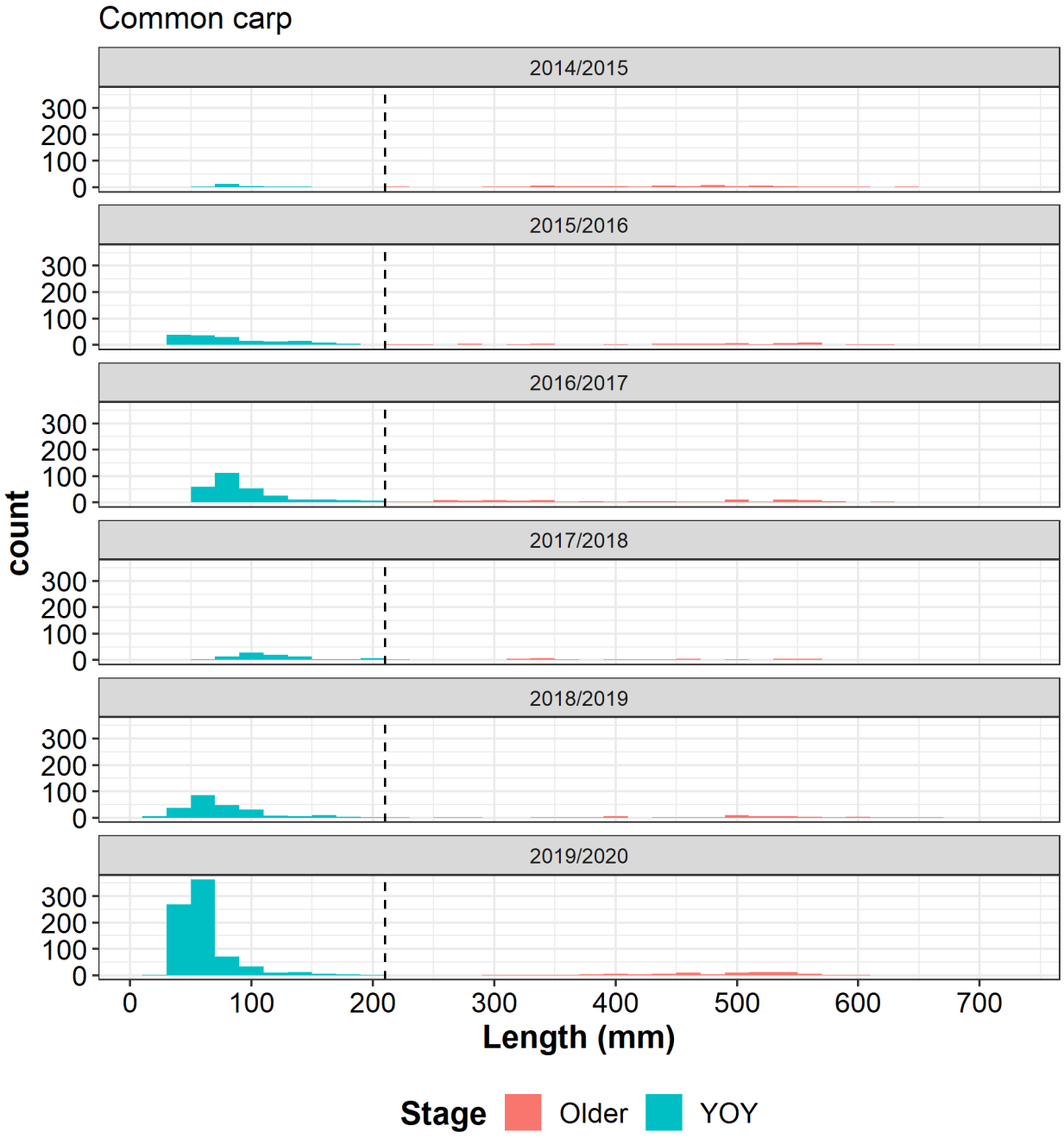

Figure 3.28: Length frequency plots for common carp by sampling season. YOY represents Young of the Year fish.

Summary Statement:

Regular recruitment with occasional years of extremely high recruitment, and a wide range of size classes but population dominated by small fish in most years.

Temporal Trends in Abundance

We have modelled the relative abundance of Common carp since 1994 based on all suitable boat and backpack electrofishing data. The left-hand panel of Figure 3.29 shows the abundance trend for the Gwydir WRPA and the right-hand panel shows the overall trend across the NSW MDB.

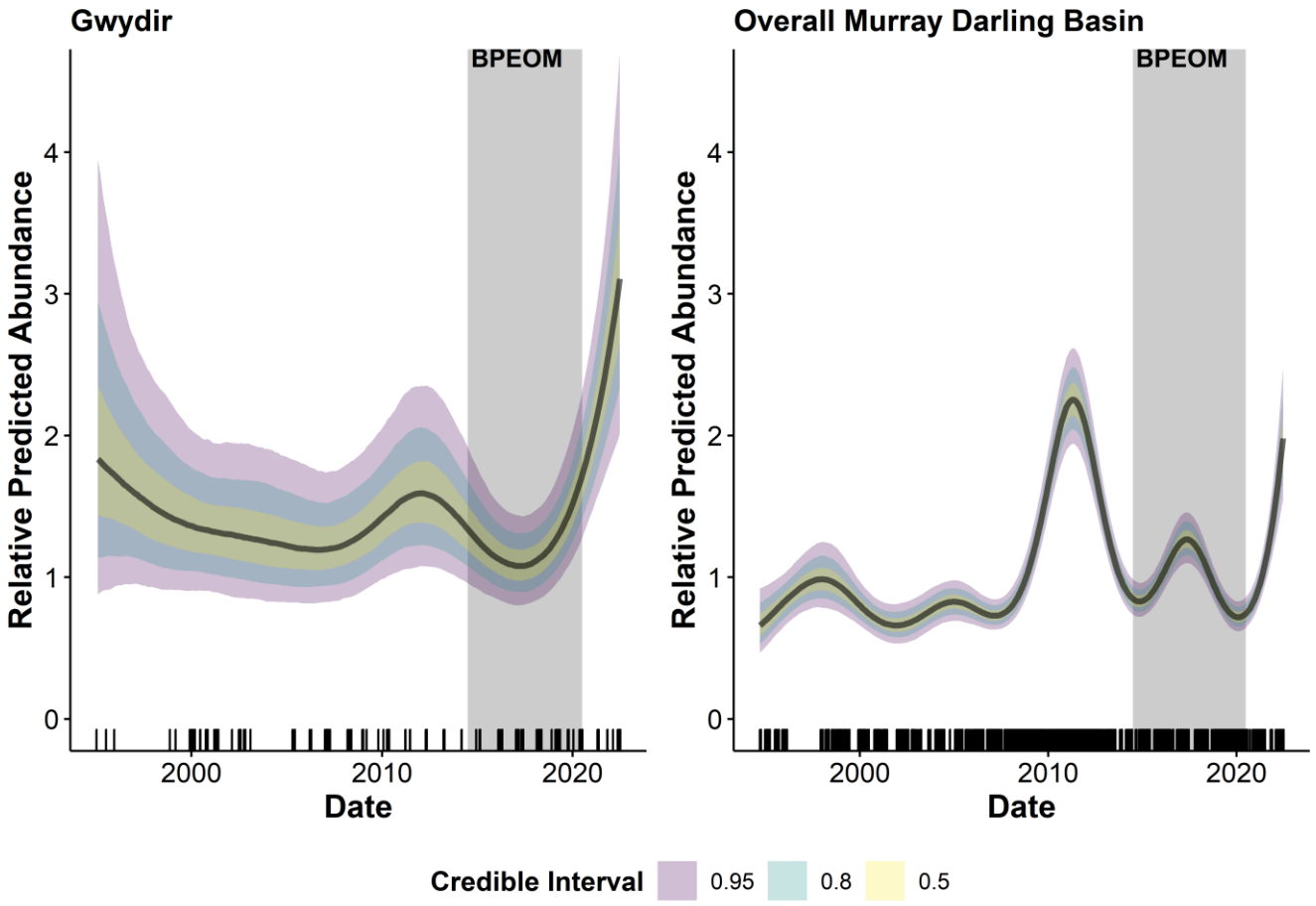

Figure 3.29: Relative abundance of Common carp in both this valley and the overall Murray-Darling Basin. These are model estimates based upon all electrofishing data within the NSW DPI Freshwater ecosystem database and the output of Bayesian generalised additive mixed models. The grey shaded region represents the period during which the BPEOM-F program was run. The black lines on the x-axis represent data coverage while the colours on the figure show various levels of confidence. Note when overlapping, the colours look slightly different due to the transparency and the y-axes vary between chapters of this report.

Summary Statement:

Moderate evidence of increased abundance since 1994 driven by an increase in recent years. Relative abundance slightly higher than the overall abundance across the NSW MDB, which peaked in approximately 2011.

Health

The prevalence of any health issues ranged from 0% of sampled fish in 2016/2017 to 4% of sampled fish in 2019/2020 (Figure 3.30). The most common health issue for Common carp in the Gwydir water resource planning area was Lerneae, which was observed in a total of 15 fish, corresponding to 1% of all Common carp measured.

Across the other WRPAs, 6% of Common carp (1,116 out of 19,278 Common carp) showed a health condition (excludes Gwydir).

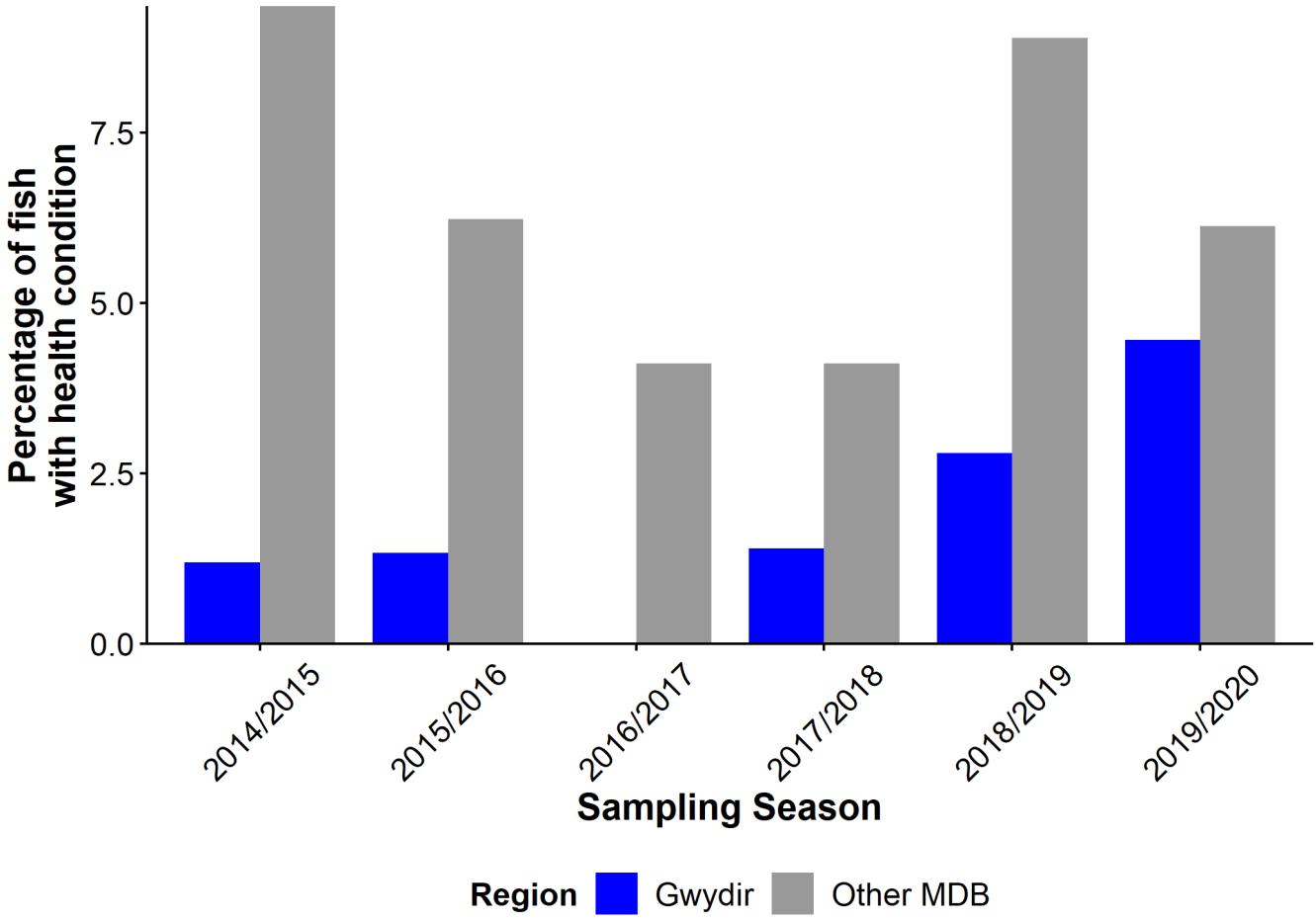

Figure 3.30: Timeseries showing the prevalence of health conditions in Common carp. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPAs.

Summary Statement:

Presence of observable health conditions in the Gwydir low with small increases over recent years. Lower rates of health conditions than the overall Murray-Darling Basin.

Distribution

Common carp were recorded at 72 out of 107 sites in the Gwydir WRPA. The maximum observed relative abundance at a site was 26 fish caught per 90 seconds of electrofishing. Figure 3.31 shows the distribution and relative abundance of Common carp across the Gwydir WRPA.

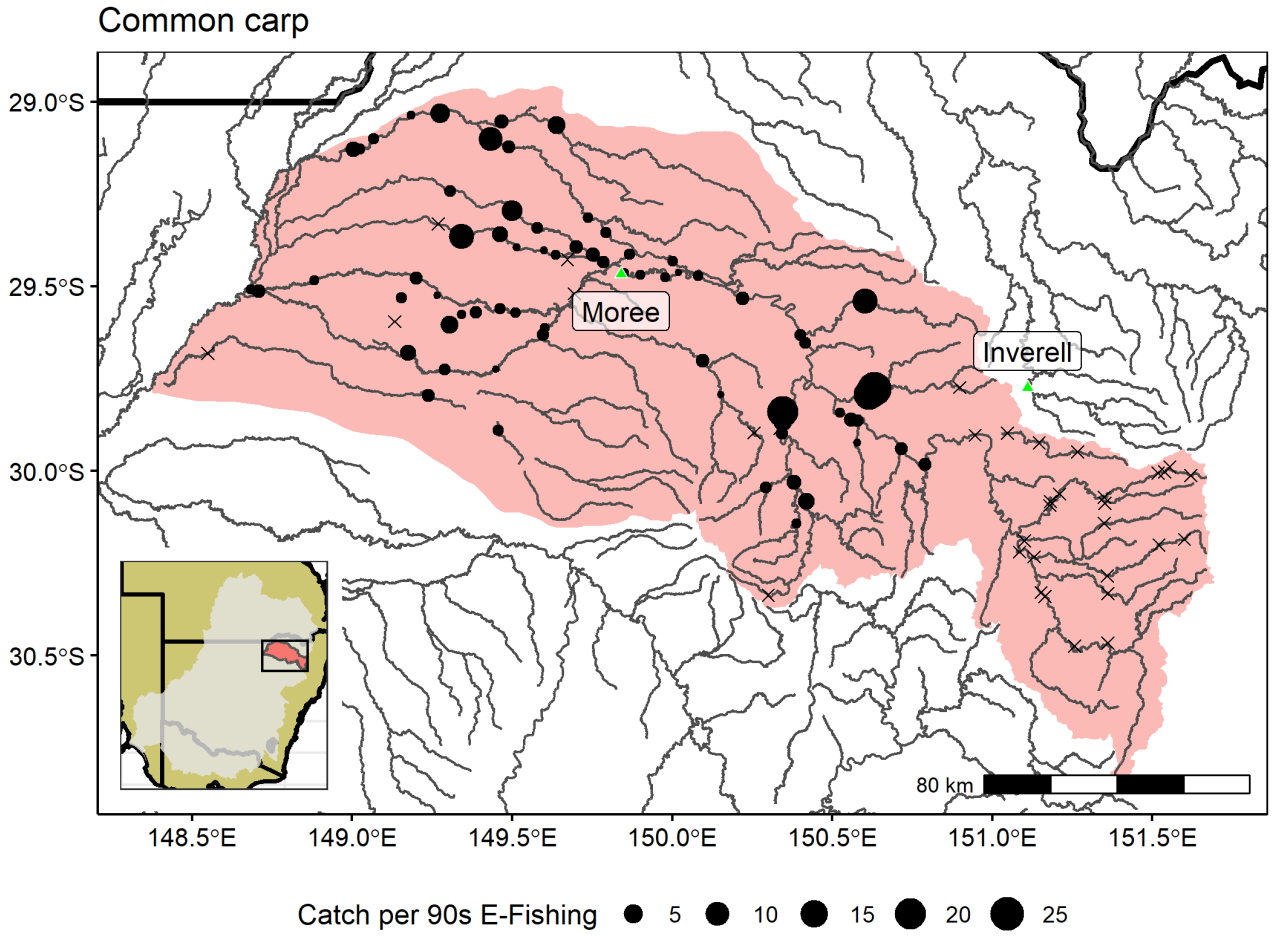

Figure 3.31: Distribution of Common carp. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X.

Summary Statement:

Recorded across the western and central areas of the Gwydir WRPA, but rare or absent in the east, especially above Copeton Dam.

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 in the Gwydir Water Resource Planning Area during the BPEOM program. A list of all threatened fish species observed by NSW DPI Fisheries (as part of any sampling program in any area) is provided in Table 3.9.

Table 3.6: Listed species which were observed in this region during the BPEOM-F program. (* = FMA, # = EPBC)

Species	Common name	Total caught (observed)
Maccullochella peelii	Murray cod#	336 (104)
Mogurnda adspersa	Southern purple-spotted gudgeon*	18 (1)
Tandanus tandanus	Freshwater catfish*	217 (93)

The following pages provide more information on where each species was observed.

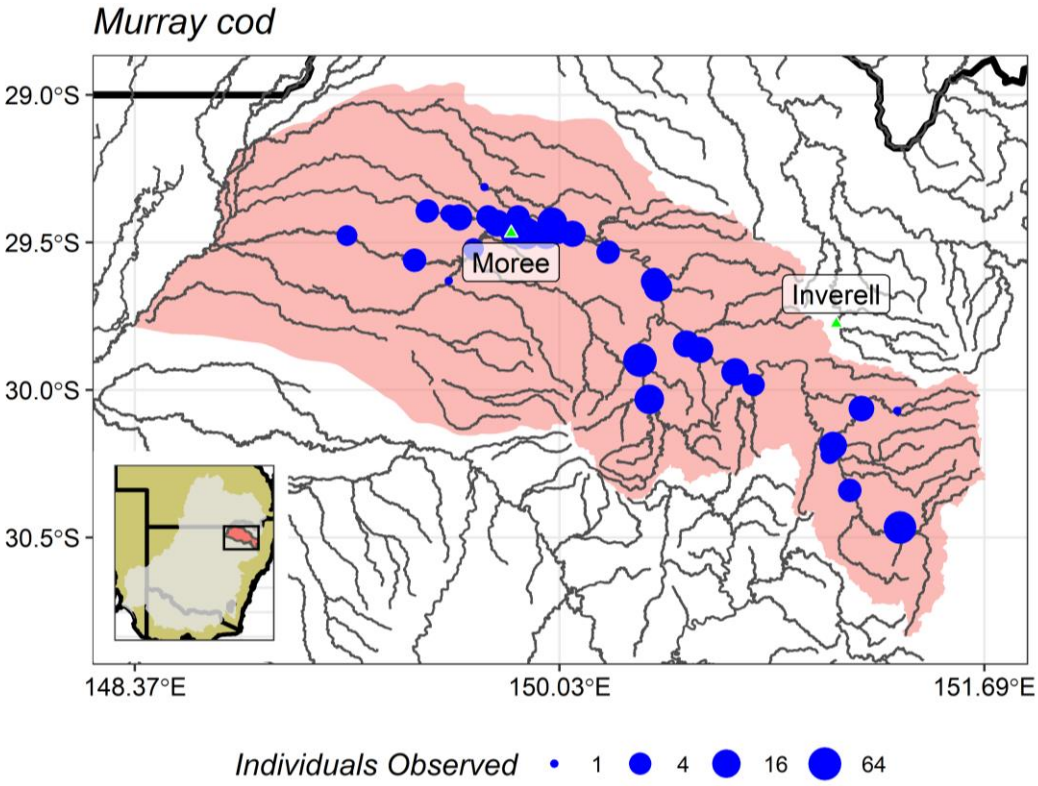

Figure 3.32: Distribution of Murray cod. Filled circles show sites where the species was present and the size of the circle represents number of observed individuals abundance. Note the bottom image shows a juvenile Murray cod.

Summary Statement:

A total of 339 Murray cod were caught across 36 sites across the Gwydir region.

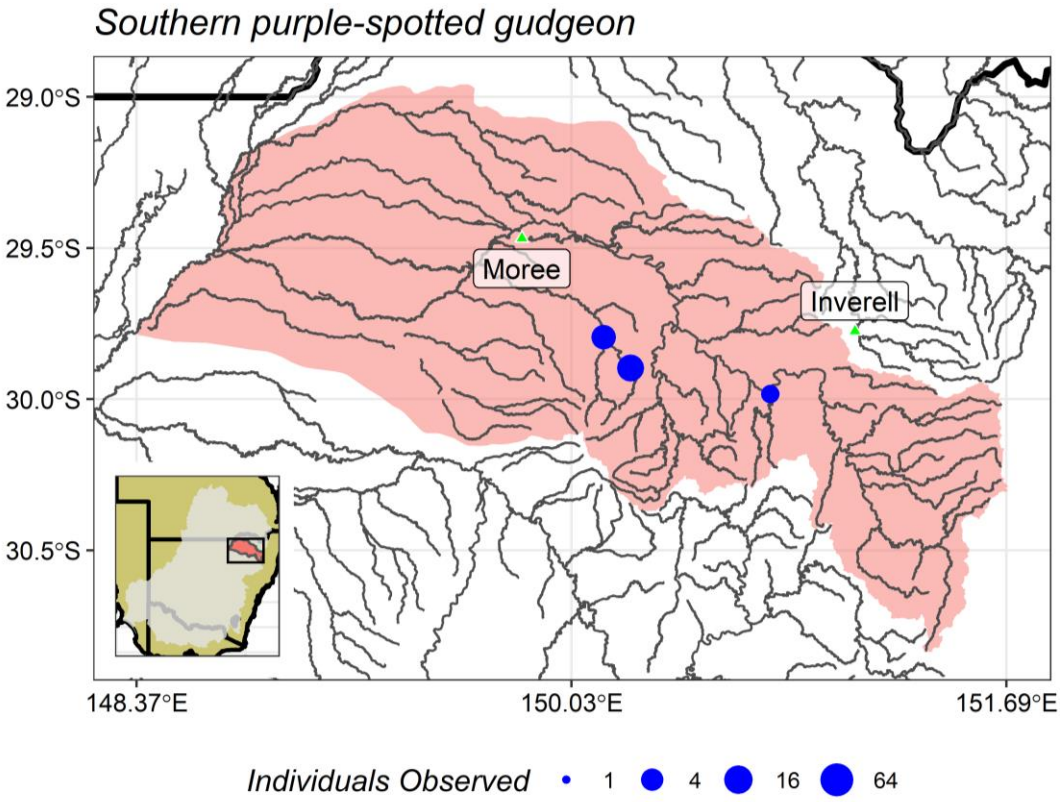

Figure 3.33: Distribution of Southern purple-spotted gudgeon. Filled circles show sites where the species was present and the size of the circle represents number of observed individuals abundance.

Summary Statement:

Nineteen Southern purple-spotted gudgeon were caught or observed at three sites (two sites on Tycannah Creek and the Keera site on the Gwydir River). There were no other records of this species.

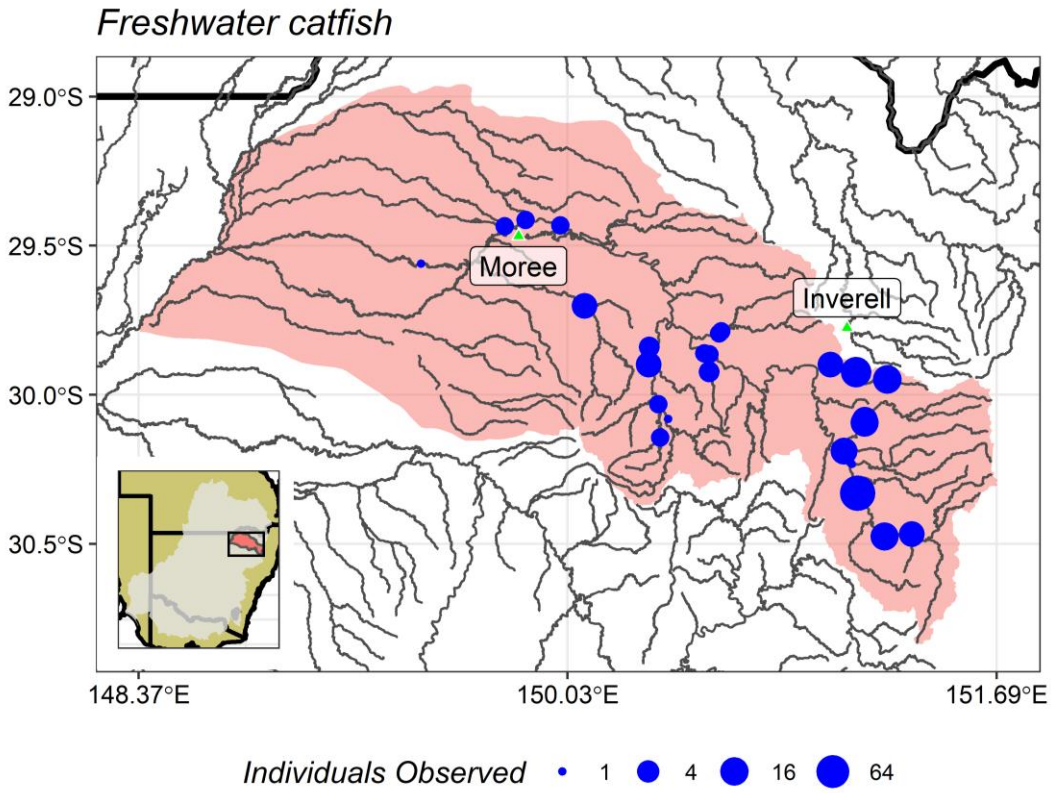

Figure 3.34: Distribution of Freshwater catfish. Filled circles show sites where the species was present and the size of the circle represents number of observed individuals abundance.

Summary Statement:

A total of 217 Freshwater catfish were caught across 25 sites in the Gwydir region, mostly in the central and eastern areas, and predominantly in unregulated systems.

Appendix

Figure 3.35 shows the locations of sites sampled in each sampling season.

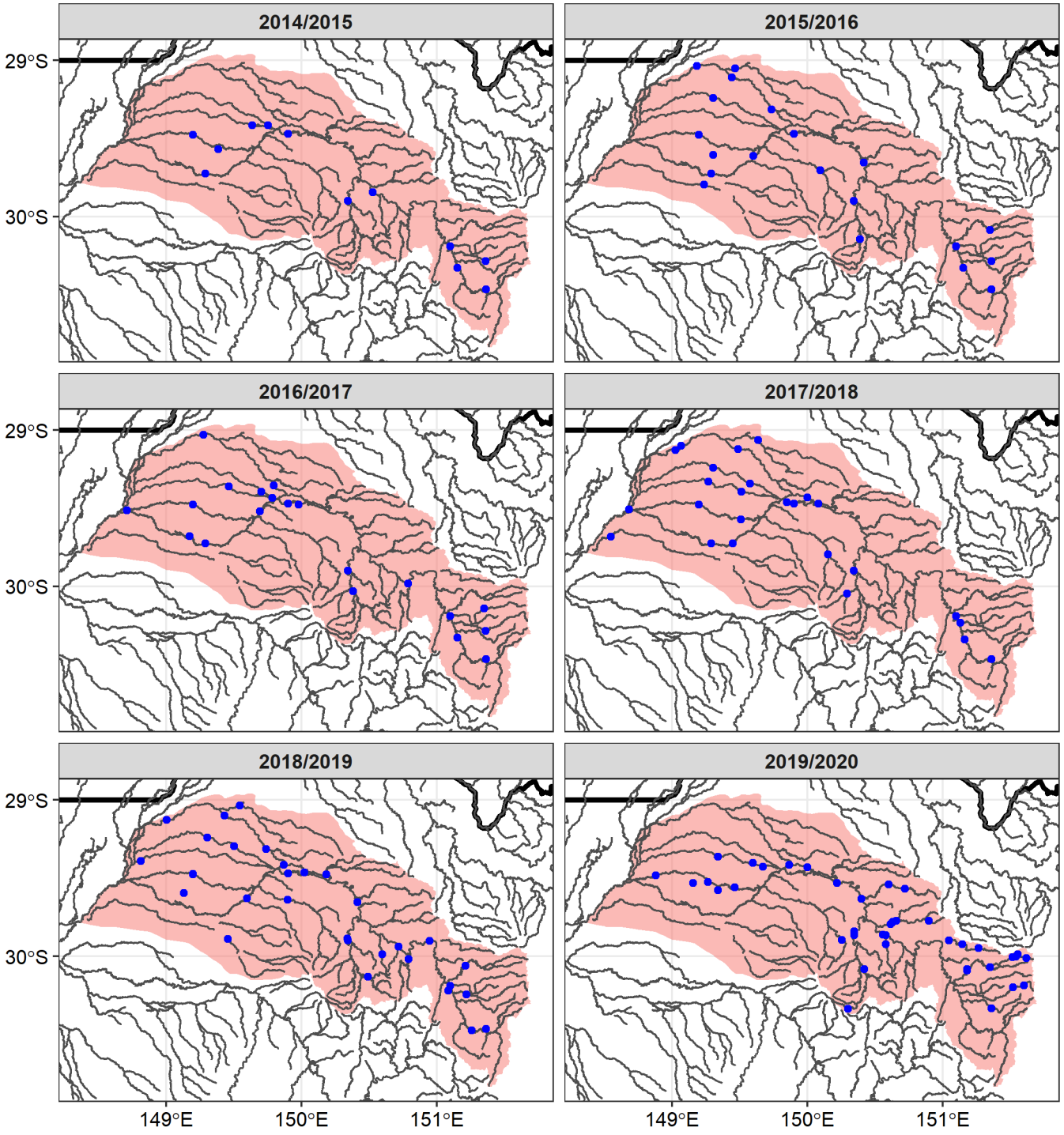

Figure 3.35: Sites sampled during the BPEOM-F program by Sampling Season. Dry sites are not shown.

Table 3.7 shows all fish species detected during this survey period as part of BPEOM-F. 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 BPEOM sampling in the Gwydir WRPA were: Olive perchlet, Silver perch, 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 full list of species observed during this period across all programs is in Table 3.10.

Table 3.7: Total number caught of each species by sampling season.

Common name	Expected from modelling	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20
Australian smelt	YES	28	7	75	37	20	160
Bony herring	YES	70	279	663	421	164	154
Carp-gudgeon species complex	YES	384	456	1,048	1,216	2,589	1,332
Common carp	NA	84	225	416	143	339	1,541
Darling hardyhead	YES	0	0	0	0	41	0
Eastern gambusia	NA	163	2,494	319	1,845	2,810	715
Freshwater catfish	YES	5	53	34	10	22	93
Galaxias spp	NA	0	0	0	0	0	0
Golden perch	YES	17	22	23	10	13	10
Goldfish	NA	80	29	147	107	156	153
Mountain galaxias	YES	33	64	21	0	0	11
Murray-Darling rainbowfish	YES	36	7	255	49	75	83
Murray cod	YES	46	31	87	46	73	53
Northern river blackfish	YES	0	3	1	0	0	0
Rainbow trout	YES	0	0	2	0	0	0
Redfin	YES	134	104	12	294	43	14
Southern purple-spotted gudgeon	YES	0	0	2	6	0	10
Spangled perch	YES	8	66	31	154	141	241
Unspecked hardyhead	YES	242	53	86	125	38	769

The following table summarises the sampling methods by which each species was caught (Table 3.8).

Table 3.8: Total catch of each species by sampling method.

Common name	Backpack Electrofishing	Bait Trap	Boat Electrofishing
Australian smelt	100	0	227
Bony herring	276	14	1,461
Carp-gudgeon species complex	1,343	3,862	1,820
Common carp	1,462	131	1,155
Darling hardyhead	0	0	41
Eastern gambusia	2,594	4,373	1,379
Freshwater catfish	117	11	89
Galaxias spp	0	0	0
Golden perch	17	0	78
Goldfish	444	5	223
Mountain galaxias	127	2	0
Murray-Darling rainbowfish	173	7	325
Murray cod	39	0	297
Northern river blackfish	3	0	1
Rainbow trout	2	0	0
Redfin	74	4	523
Southern purple-spotted gudgeon	14	2	2
Spangled perch	477	19	145
Unspecked hardyhead	313	506	494

Table 3.9: Listed threatened species recorded in the Murray-Darling Basin (from the NSW DPI 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
Ambassis agassizii	Agassiz's glassfish, olive perchlet, western New South Wales population	NA	Endangered Population
Bidyanus bidyanus	Silver Perch, Bidyan	Critically Endangered	Vulnerable
Craterocephalus fluviatilis	Murray Hardyhead	Endangered	Critically Endangered
Galaxias rostratus	Flathead Galaxias, Beaked Minnow, Flat-headed Galaxias, Flat-headed Jollytail, Flat-headed Minnow	Critically Endangered	Critically Endangered
Galaxias tantangara	Stocky Galaxias	NA	Critically Endangered
Maccullochella macquariensis	Trout Cod	Endangered	Endangered
Maccullochella peelii	Murray Cod	Vulnerable	NA
Macquaria australasica	Macquarie Perch	Endangered	Endangered
Mogurnda adspersa	Southern Purple Spotted Gudgeon	NA	Endangered
Nannoperca australis	Southern Pygmy Perch	Vulnerable	Endangered
Tandanus tandanus	Freshwater catfish, eel tailed catfish, Murray-Darling Basin population	NA	Endangered Population

Table 3.10 shows all fish species detected during this survey period across all programs and methods. Due to variations in project methods and 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 BPEOM sampling in the Gwydir WRPA were: Silver perch, 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 BPEOM-F during this period is in Table 3.7.

Table 3.10. Total catch of each species by all sampling programs and all methods in the region. Note these include projects with sampling not representative of the community and the data should not be interpreted.

Common name	Expected from modelling	2014/2015	2015/2016	2016/2017	2017/2018	2018/2019	2019/2020
Australian smelt	YES	294	7	282	193	45	229
Bony herring	YES	603	279	1,728	1,279	595	298
Carp-gudgeon species complex	YES	2,557	456	2,302	7,649	12,719	4,233
Common carp	NA	525	225	992	315	643	1867
Darling hardyhead	YES	0	0	0	0	41	0
Eastern Gambusia	NA	280	2,494	547	2,150	3,910	1,031
Freshwater catfish	YES	6	53	55	14	27	102
Golden perch	YES	48	22	39	29	39	19
Goldfish	NA	209	29	410	205	214	161
Mountain galaxias	YES	33	64	21	0	0	11
Murray-Darling rainbowfish	YES	499	7	2,902	477	503	224
Murray cod	YES	139	31	166	145	317	93
Northern River Blackfish	NA	0	3	1	0	0	0
Olive perchlet	YES	0	0	1	0	0	0
Rainbow trout	YES	0	0	2	0	0	0
Redfin	YES	134	104	12	294	43	14
Southern purple-spotted gudgeon	YES	0	0	2	6	0	10
Spangled perch	YES	140	66	168	226	205	276
Unspecked hardyhead	YES	452	53	254	227	145	812