

Chapter 5 Basin Plan Environmental Outcomes Monitoring for Fish (2014/15 – 2019/20): Lachlan Water Resource Planning Area



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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 Lachlan Water Resource Planning Area (WRPA) shown in [Figure 5.1](#).

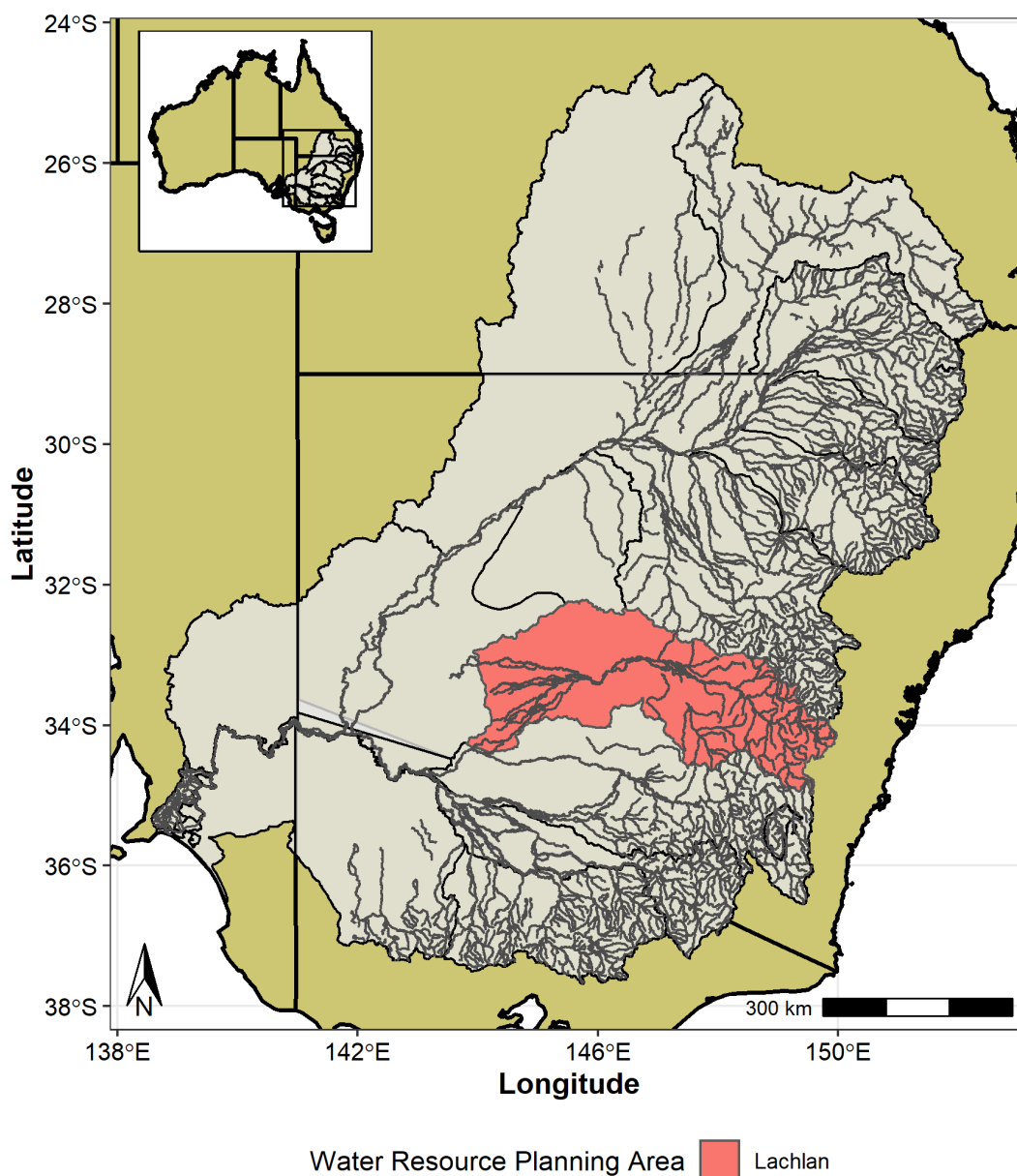


Figure 5.1: Murray-Darling Basin with the key region of this report highlighted. Inset map shows the whole of Australia with a box around the MDB.

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 Lachlan 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 Lachlan 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 Lachlan WRPA and greater MDB (excluding the Lachlan 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* are reported. The report includes threatened species that were recorded by the BPEOM-F program in the Lachlan 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 5.1). 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 5.1: 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	15 (0)
2015/2016	20 (5)
2016/2017	24 (2)
2017/2018	23 (11)
2018/2019	25 (11)
2019/2020	30 (5)

The sites sampled during the reporting period are shown in Figure 5.2. A breakdown of sites sampled each sampling season is shown in the Appendix (Figure 5.36).

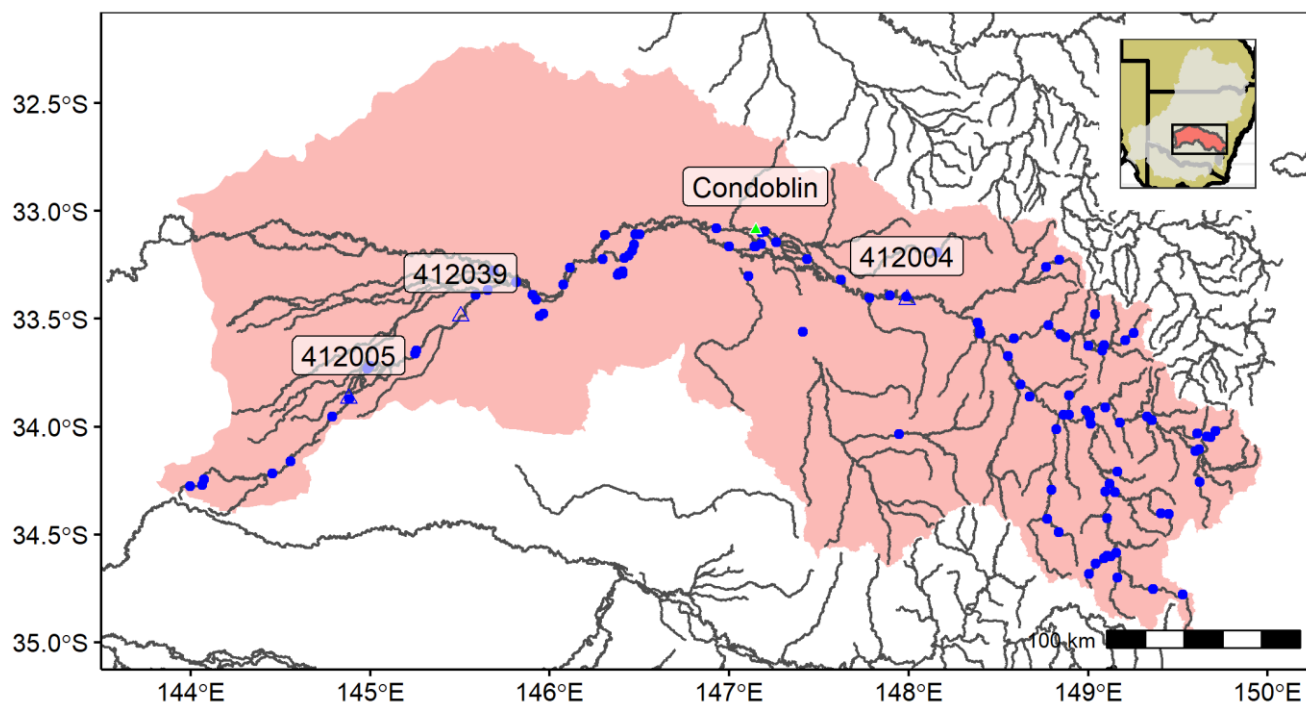


Figure 5.2: Sites (dots) sampled during the BPEOM-F program. Triangles show key flow gauges along with their gauge ID number. Dry sites are not shown.

Each sampling method has a different effectiveness at sampling each species. [Table 5.2](#) shows the total amount of each species caught by each method.

Table 5.2: 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	5	119	0
Golden perch	0	114	0
Freshwater catfish	0	2	0
Bony herring	30	1,858	1
Australian smelt	11	963	0
Common carp	468	2,477	618

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 5.3](#) shows the number of biological measurements taken each year for the six species.

Table 5.3: 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	4	26	1	147	19	153
2015/2016	25	10	0	137	55	323
2016/2017	17	21	0	335	162	837
2017/2018	9	9	0	460	45	146
2018/2019	15	24	1	162	32	302
2019/2020	54	24	0	7	26	243

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 Lachlan WRPA (Figure 5.3).

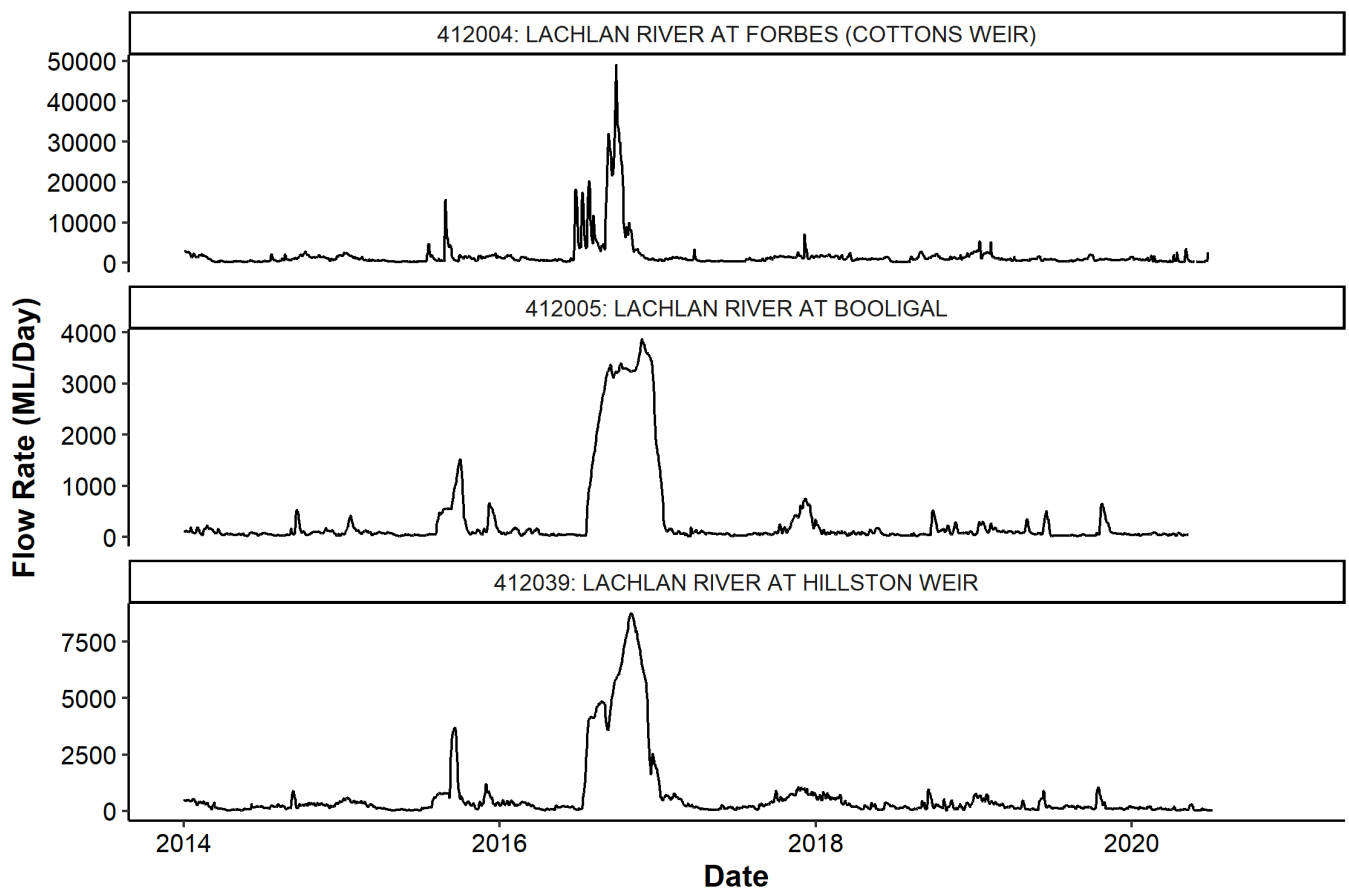


Figure 5.3: Flow data from various gauges in the Lachlan WRPA over the reporting period. Gauge locations can be seen on Figure 5.2. Note the differing scales on the y-axis.

Water temperature data, where available, are also shown in [Figure 5.4](#).

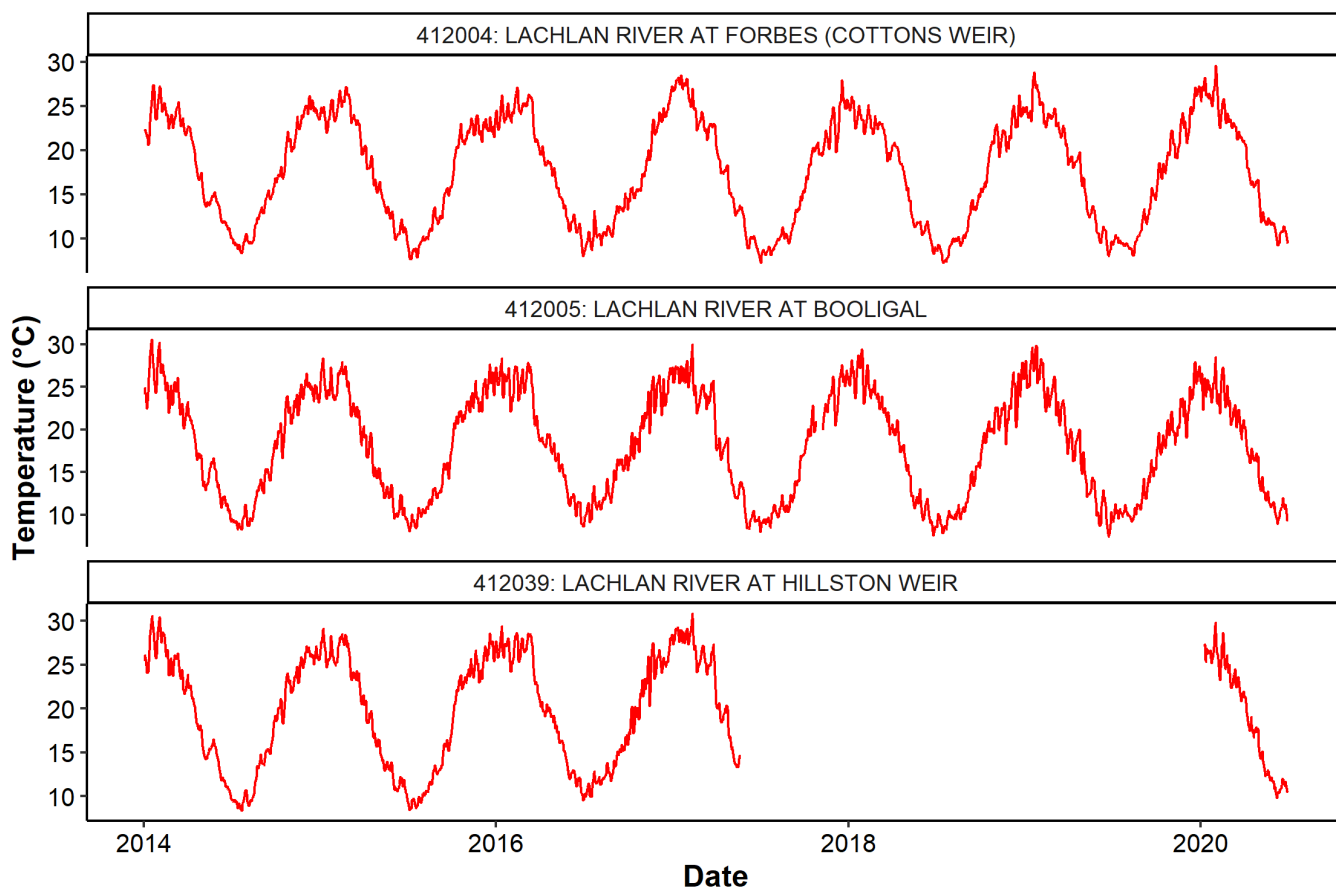


Figure 5.4: Water temperature data from various gauges in the Lachlan WRPA over the reporting period. Gauge locations can be seen on [Figure 5.2](#). Note the differing scales on the y-axis.

Species Diversity

A total of 19 fish species were observed across the Lachlan WRPAs including six alien species. [Figure 5.5](#) shows the number of native and alien species found at each site. The full list of species caught and observed is in [Table 5.7](#).

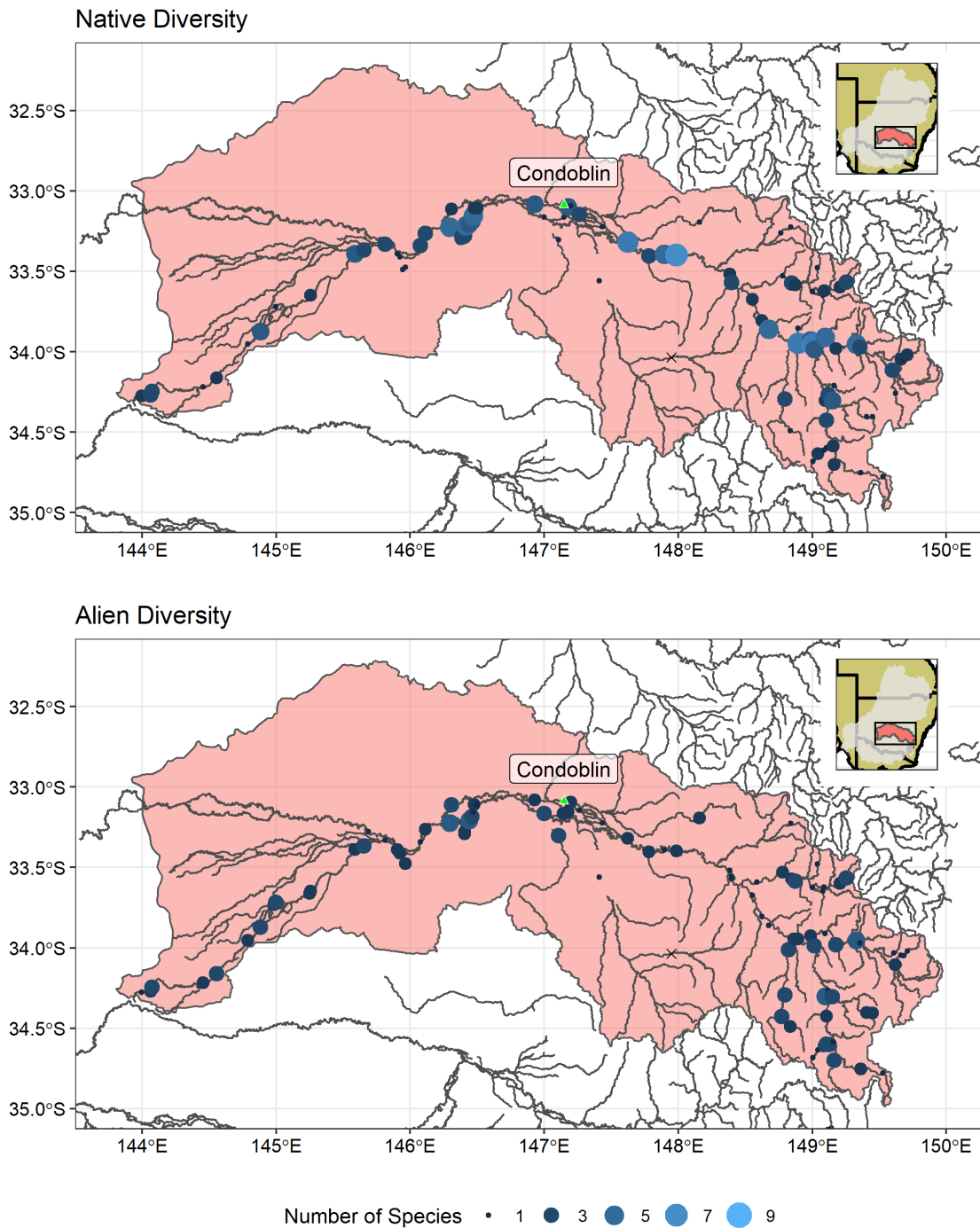


Figure 5.5: Diversity across all sampling sites. Bubble size represents the number of unique species observed at each site across all sampling methods and events. X represents a site that had water and was sampled, but no fish species were caught at all. Dry sites are excluded.

Summary Statement:

Native diversity was generally consistent across the Lachlan WRPAs region with the upland areas having slightly lower diversity. The alien diversity was generally consistent across the region.

Murray cod



Population Structure

Figure 5.6 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 one to six, and 0% to 25% 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% (491 out of 3,726).

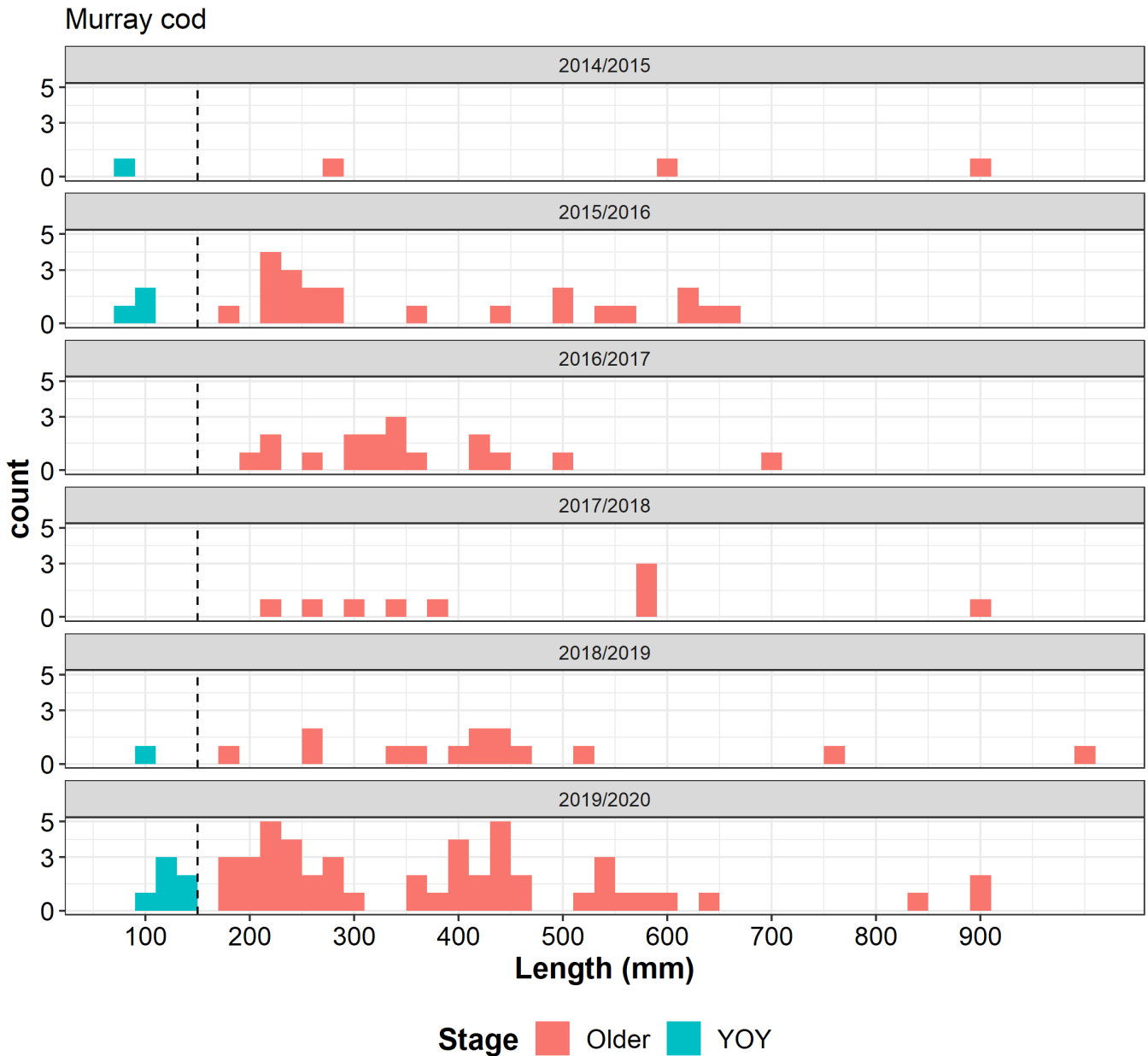


Figure 5.6: Length frequency plots for Murray cod by sampling season. YOY represents Young of the Year fish.

Summary Statement:

Sporadic recruitment with variable numbers of YOY among years. A range of size classes. There appears to have been recruitment failure in 2016/17 and 2017/18.

Stocking

A total of 334,806 Murray cod were stocked into the waterways of the Lachlan WRPA during the reporting period. Of these fish, 270,273 (81%) were stocked into impoundments while 64,533 (19%) were stocked into rivers or creeks. [Table 5.4](#) shows the detailed breakdown of stocking by season, location and life stage while [Figure 5.7](#) shows the locations of stocking.

Table 5.4: 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	43,085
2014/2015	River/Creek	Fry	2,171
2015/2016	Impoundment	Fry	125,000
2015/2016	River/Creek	Fry	9,090
2016/2017	Impoundment	Fry	10,000
2016/2017	River/Creek	Fingerling	13,772
2017/2018	Impoundment	Fry	27,000
2017/2018	River/Creek	Fry	6,000
2018/2019	Impoundment	Fry	33,500
2018/2019	River/Creek	Fry	13,500
2019/2020	Impoundment	Fry	31,688
2019/2020	River/Creek	Fry	20,000

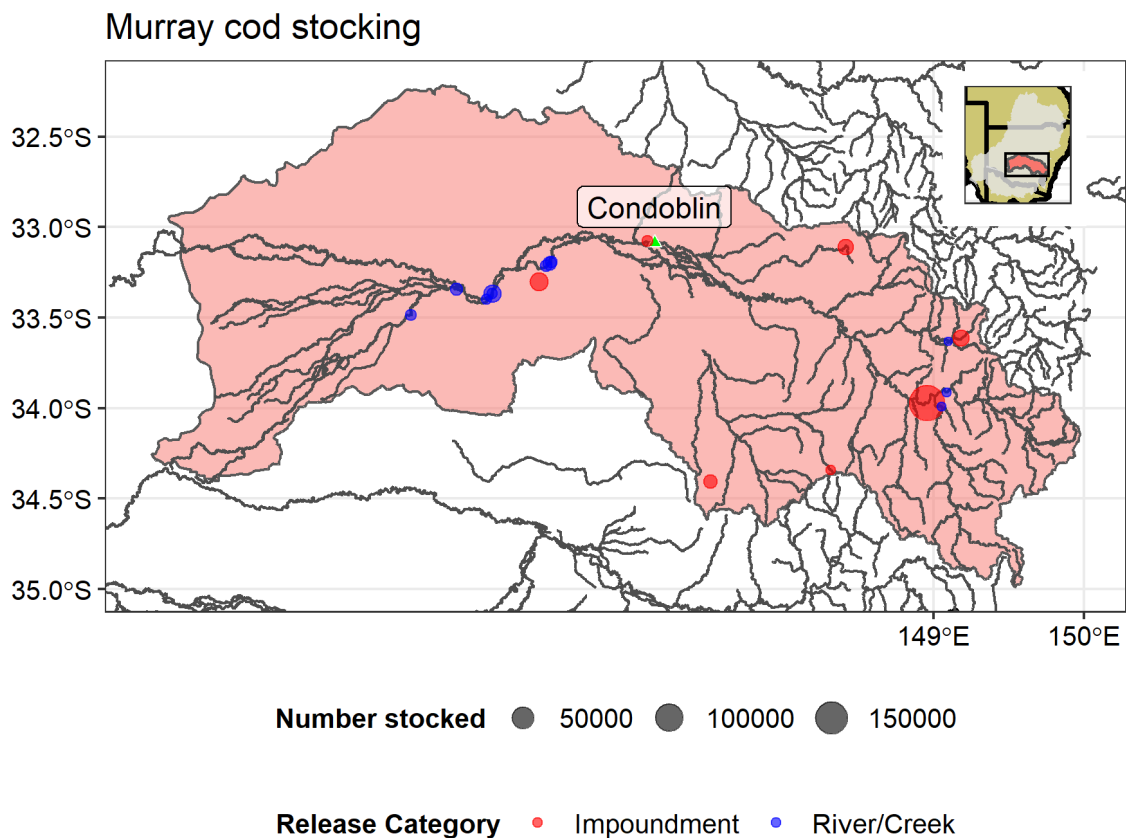


Figure 5.7: Locations of Murray cod stocking. Colours show whether a site was a river/creek site or an impoundment while the size of the point reflects the total number of fish stocked over the reporting period.

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 5.8](#) shows the abundance trend for the Lachlan WRPA and the right-hand panel shows the overall trend across the NSW MDB.

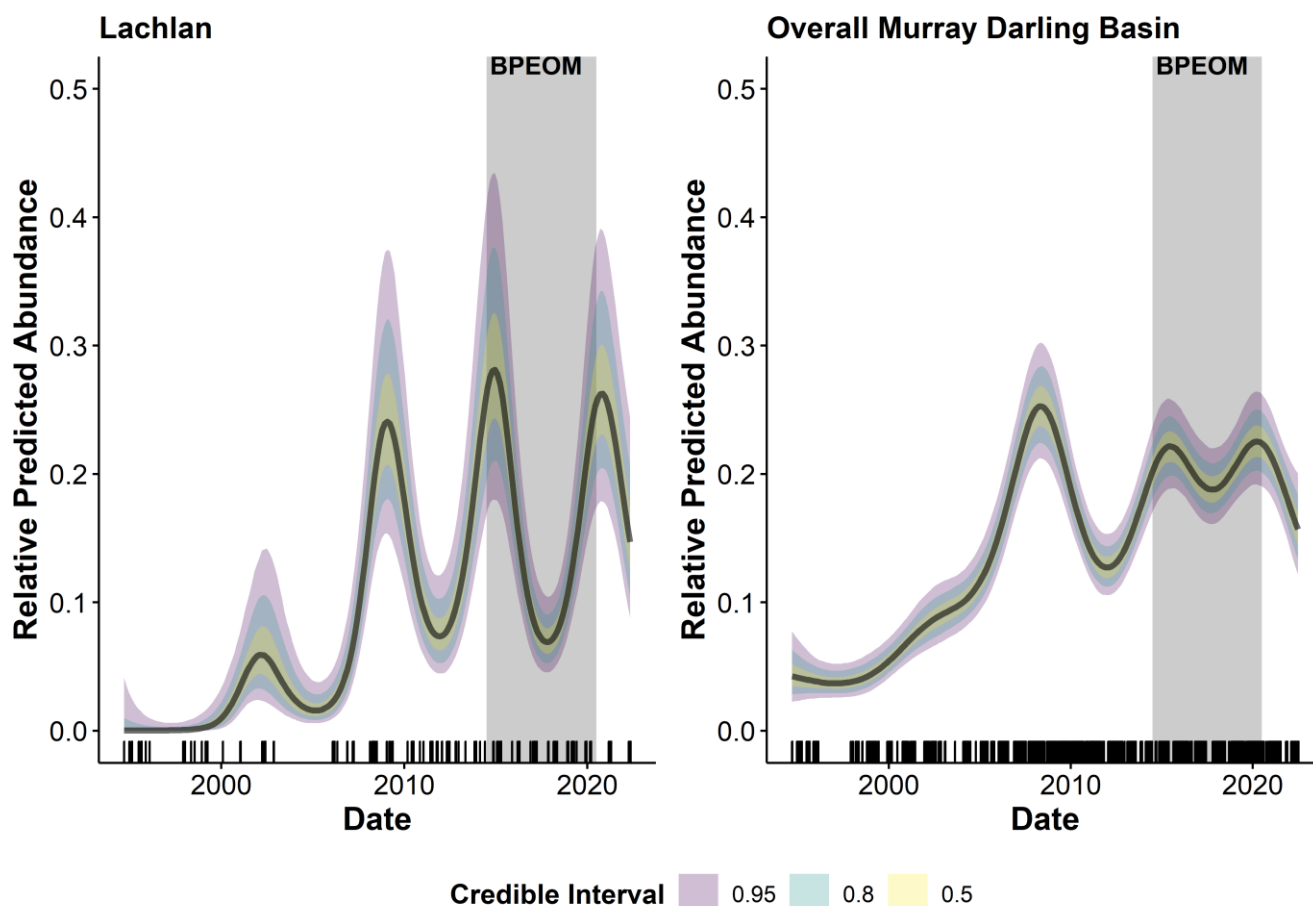


Figure 5.8: Relative abundance of Murray cod in both the Lachlan WRPA and the overall NSW MDB. These are model estimates based upon all boat electrofishing data within the NSW DPI Freshwater ecosystem database and are the output of Bayesian generalised additive mixed models. The grey shaded region represents 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:

Large fluctuations in abundance since the 1990s, but an overall increase since the 1990s. Current relative abundance approximately equal to overall abundance across the NSW MDB.

Health

The prevalence of any health issues ranged from 0% of sampled fish in 2017/2018 to 35% of sampled fish in 2016/2017 (Figure 5.9). The most common health issue for Murray cod in the Lachlan WRPA was *Lernaeae*, which was observed in a total of 25 fish, corresponding to 20% of all Murray cod measured.

Across the other NSW MDB WRPA, 16% of Murray cod (614 out of 3,726 Murray cod) showed a health condition (excludes the Lachlan WRPA).

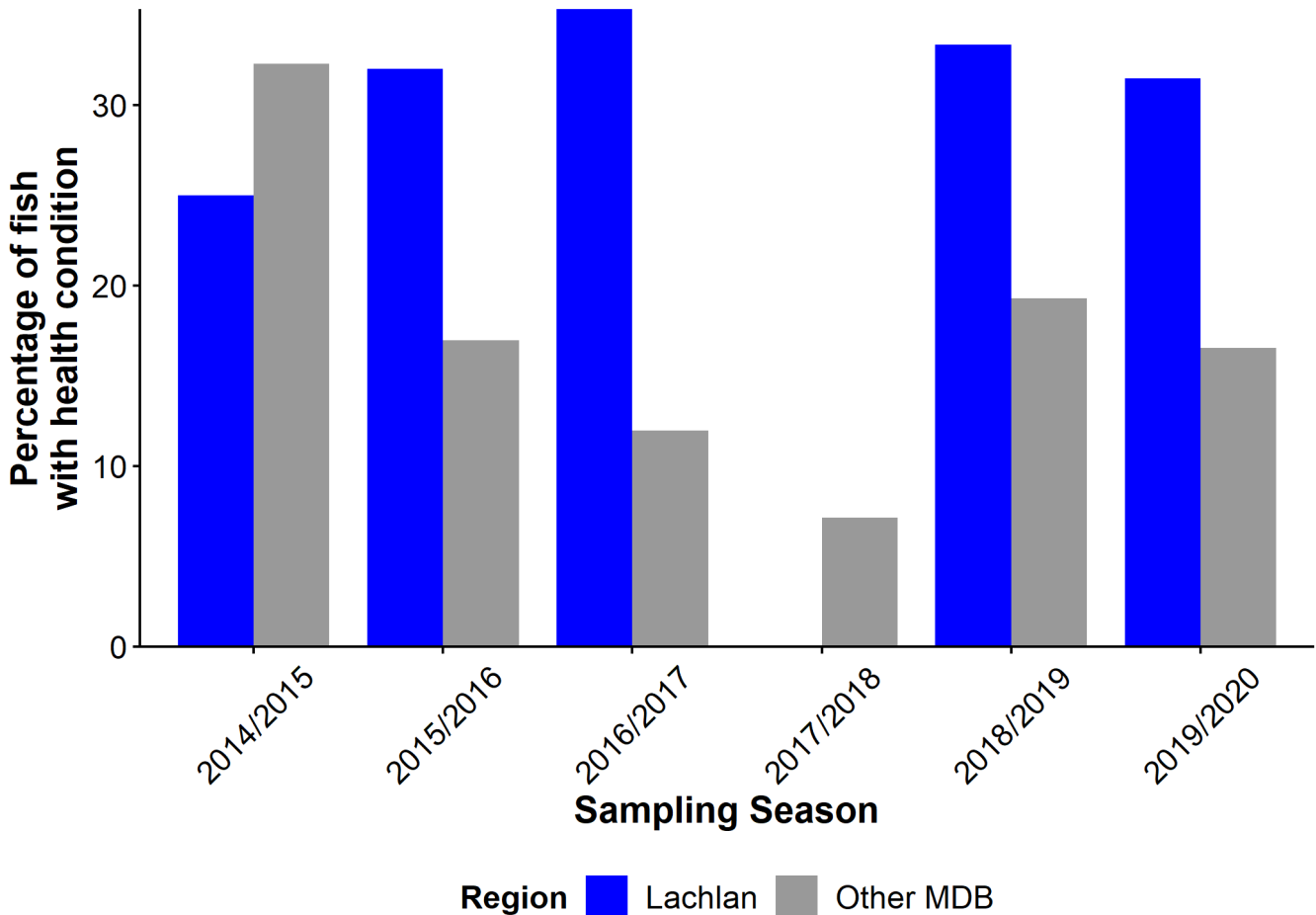


Figure 5.9: Timeseries showing the prevalence of health conditions in Murray cod. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPAs.

Summary Statement:

Presence of observable health conditions was moderate to high across all years and generally higher than the rest of the Murray-Darling Basin, except for 2017/18 when no health conditions were observed in the Lachlan WRPA.

Distribution

Murray cod were recorded at 25 out of 104 sites in the Lachlan WRPA. The maximum observed relative abundance at a site was 1.5 fish caught per 90 seconds of electrofishing. [Figure 5.10](#) shows the distribution and relative abundance of Murray cod across the Lachlan WRPA.

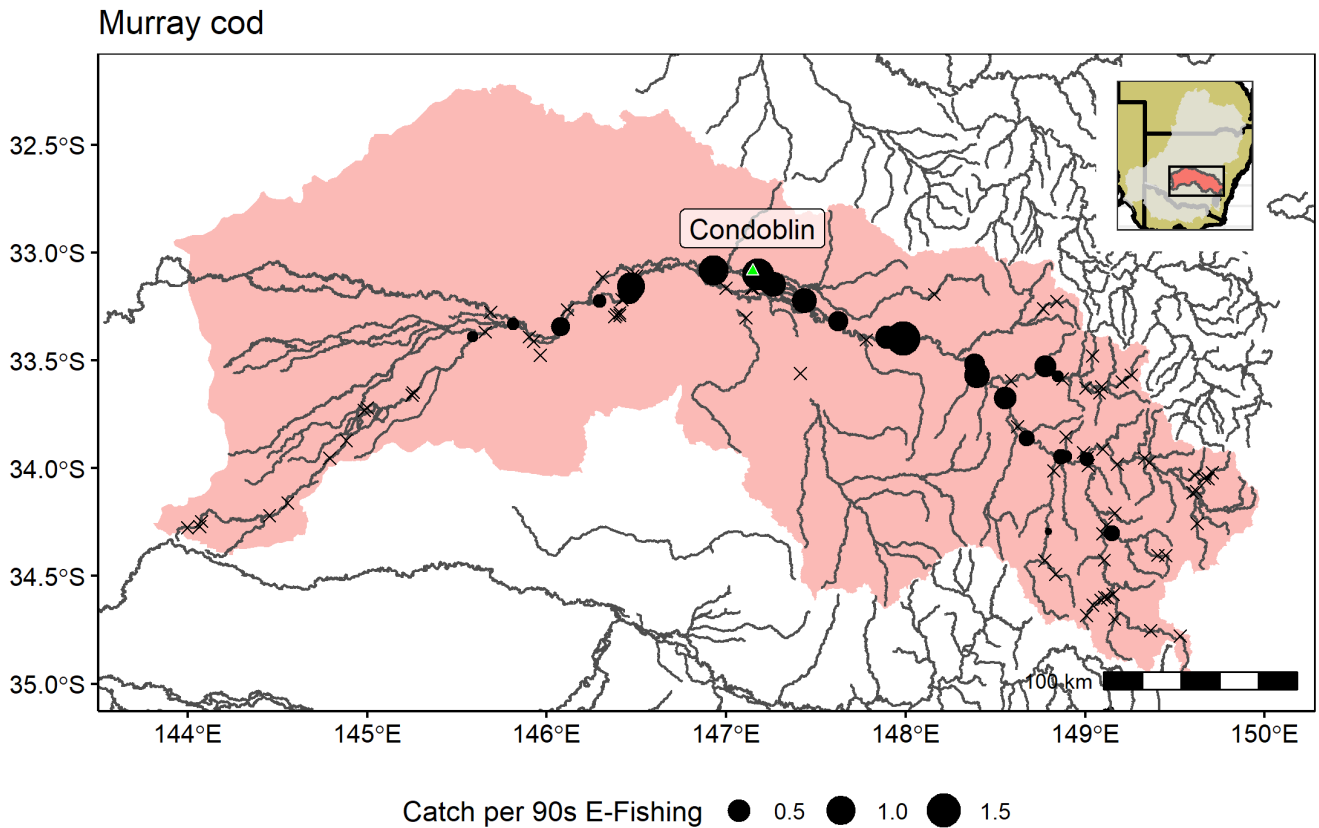


Figure 5.10: Distribution of Murray cod. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X.

Summary Statement:

Murray cod were recorded across the Central and eastern areas of the Lachlan WRPA but most abundant in the mid-reaches and absent in most upland areas.

Golden perch



Population Structure

Figure 5.11 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 zero to two, and 0% to 8% 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% (263 out of 2,187).

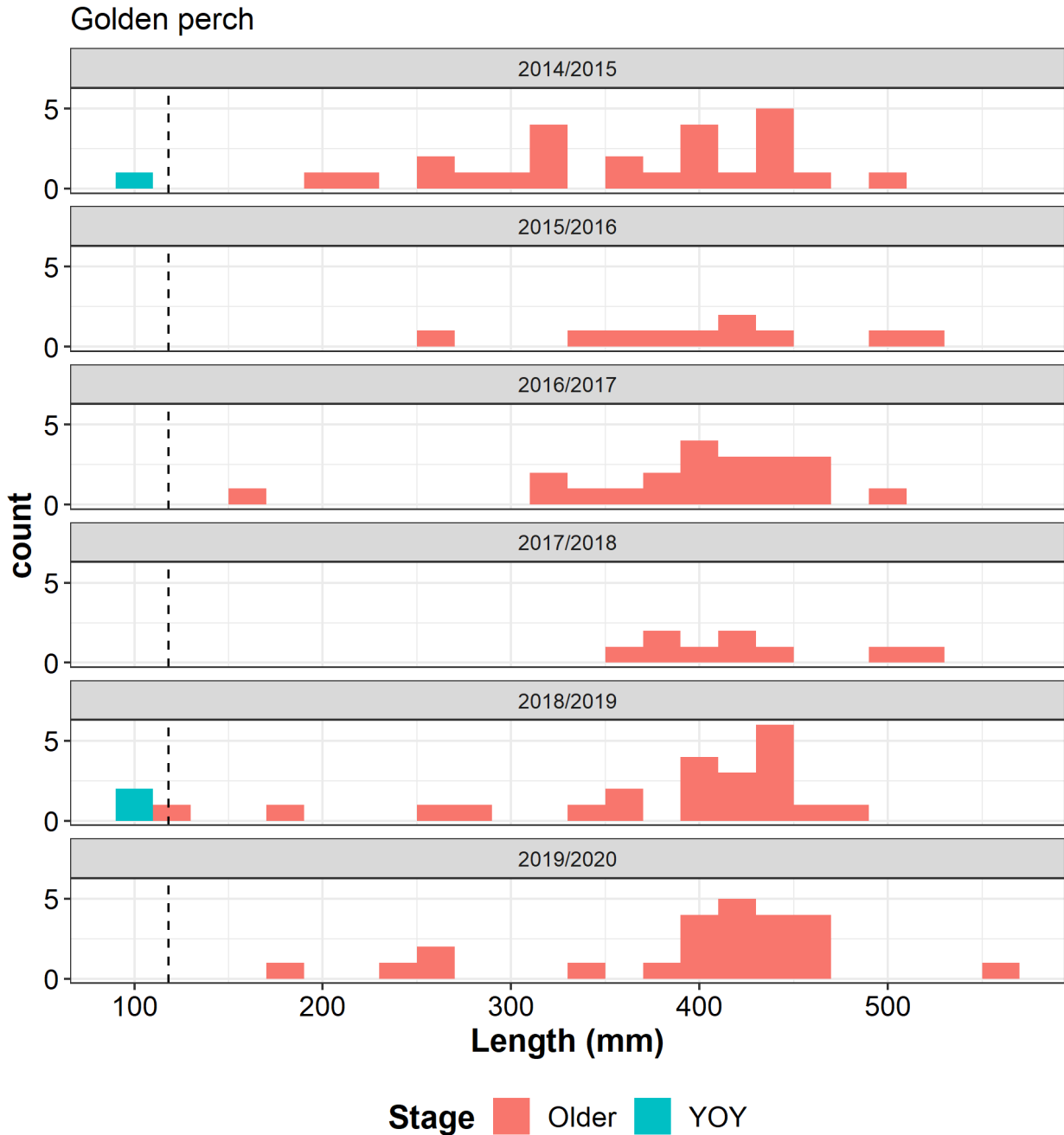


Figure 5.11: Length frequency plots for Golden perch by sampling season. YOY represents Young of the Year fish.

Summary Statement:

Limited or poor recruitment in most years with young of the year only observed in 2014/15 and 2018/19. Suggests recruitment limitation in most years. Population structure dominated by larger (older) fish.

Stocking

A total of 706,992 Golden perch were stocked into the waterways of the Lachlan WRPA during the reporting period. Of these fish, 540,374 (76.4%) were stocked into impoundments while 166,618 (23.6%) were stocked into rivers or creeks. [Table 5.5](#) shows the detailed breakdown of stocking by season, location and life stage while [Figure 5.12](#) shows the locations of stocking.

Table 5.5: 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	41,629
2014/2015	River/Creek	Fry	84,167
2015/2016	Impoundment	Fry	41,000
2016/2017	Impoundment	Fry	140,000
2016/2017	River/Creek	Fingerling	45,452
2017/2018	Impoundment	Fry	158,200
2017/2018	River/Creek	Fry	26,999
2018/2019	Impoundment	Fry	85,000
2019/2020	Impoundment	Fry	74,545
2019/2020	River/Creek	Fry	10,000

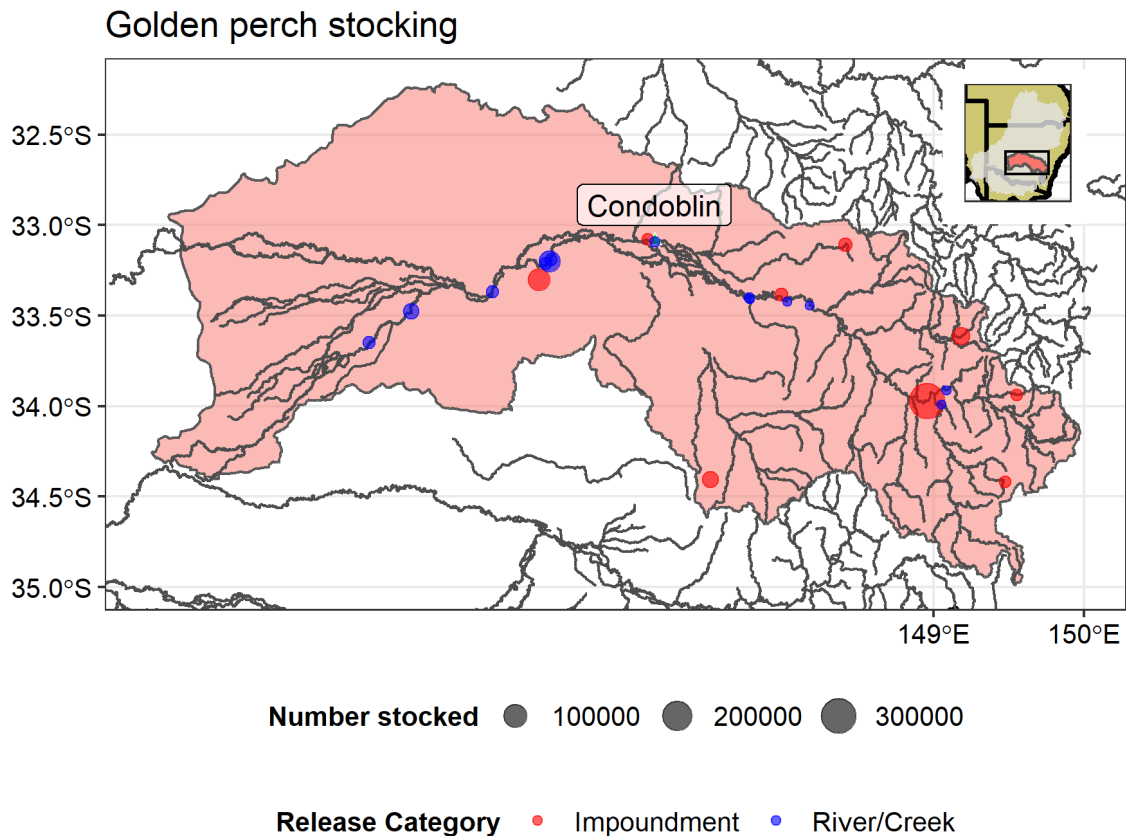


Figure 5.12: Locations of Golden perch stocking. Colours show whether a site was a river/creek site or an impoundment while the size of the point reflects the total number of fish stocked over the reporting period.

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 5.13](#) shows the abundance trend for the Lachlan WRPA and the right-hand panel shows the overall trend across the NSW MDB.

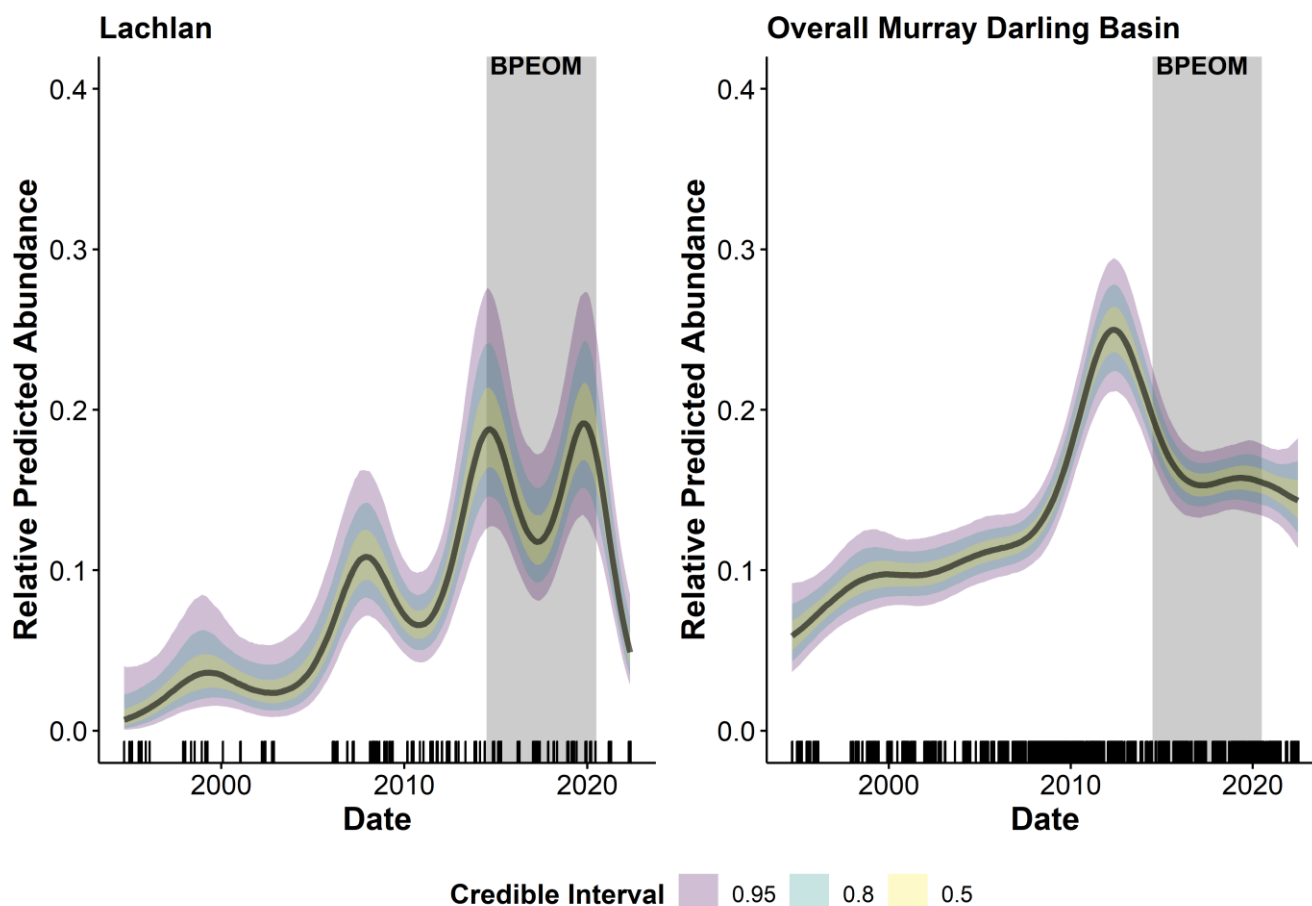


Figure 5.13: Relative abundance of Golden perch in both this valley and the overall Murray-Darling Basin. These are model estimates based upon all boat electrofishing data within the NSW DPI Freshwater ecosystem database and the output of Bayesian generalised additive mixed models. The grey shaded region 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:

Current abundance slightly higher than 1994 levels. Abundance previously peaked around 2015 and 2019 but has since declined. Relative abundance is lower than the overall abundance across the MDB, which peaked around 2012.

Health

The prevalence of any health issues ranged from 33% of sampled fish in 2017/2018 to 81% of sampled fish in 2014/2015 (Figure 5.14). The most common health issue for Golden perch in the Lachlan water resource planning area was *Lernaeae*, which was observed in a total of 51 fish, corresponding to 45% of all Golden perch measured.

Across the other WRPAs, 32% of Golden perch (703 out of 2,187 Golden perch) showed a health condition (excludes Lachlan).

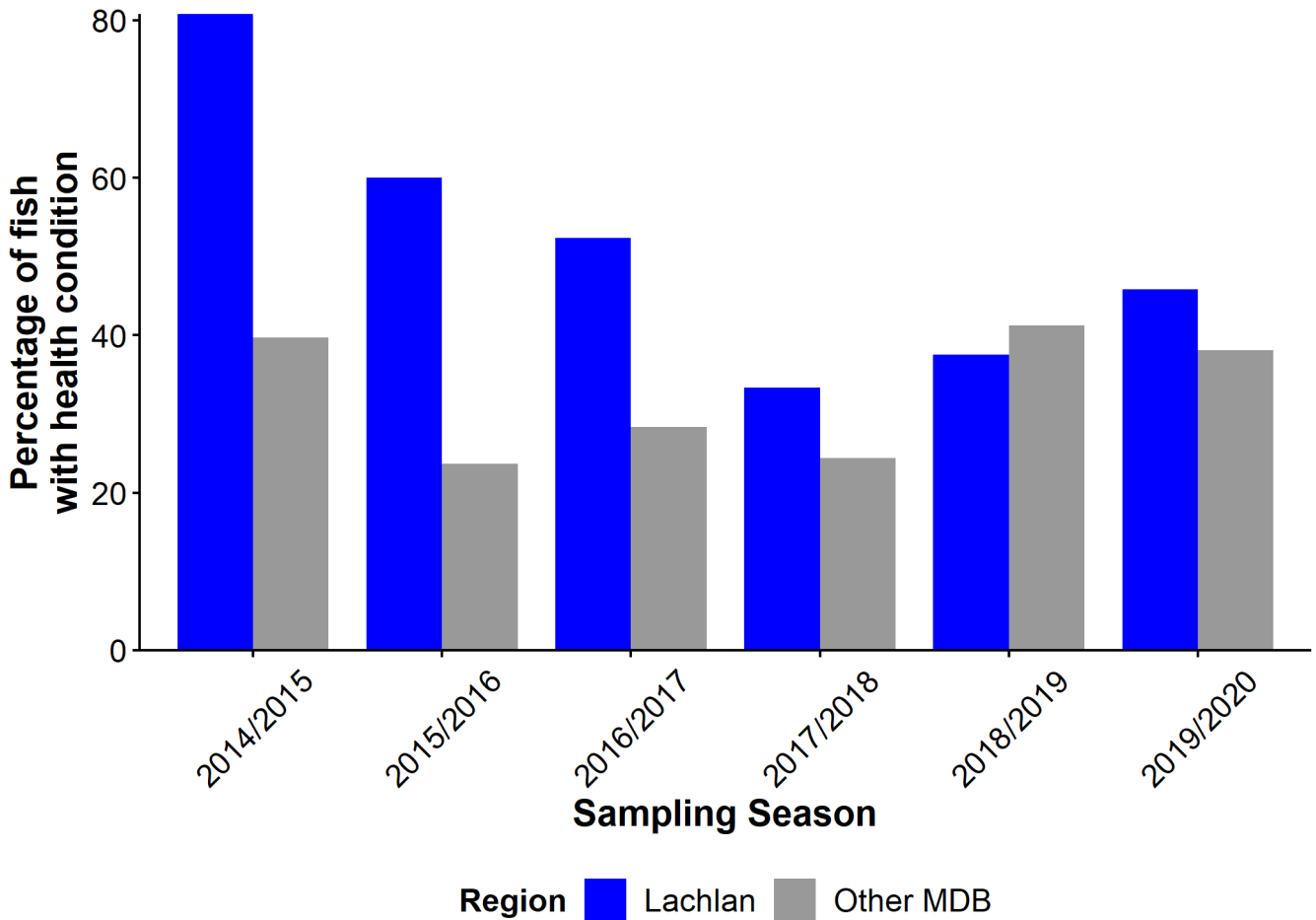


Figure 5.14: Timeseries showing the prevalence of health conditions in Golden perch. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA.

Summary Statement:

The presence of observable health conditions for Golden perch in the Lachlan WRPA was moderate to very high, and generally higher than the overall NSW MDB. 2014/15 and 2015/16 had a substantially higher prevalence of health issues compared to the wider NSW MDB.

Distribution

Golden perch were recorded at 34 out of 104 sites in the Lachlan WRPA. The maximum observed relative abundance at a site was 1.3 fish caught per 90 seconds of electrofishing. [Figure 5.15](#) shows the distribution and relative abundance of Golden perch across the Lachlan WRPA.

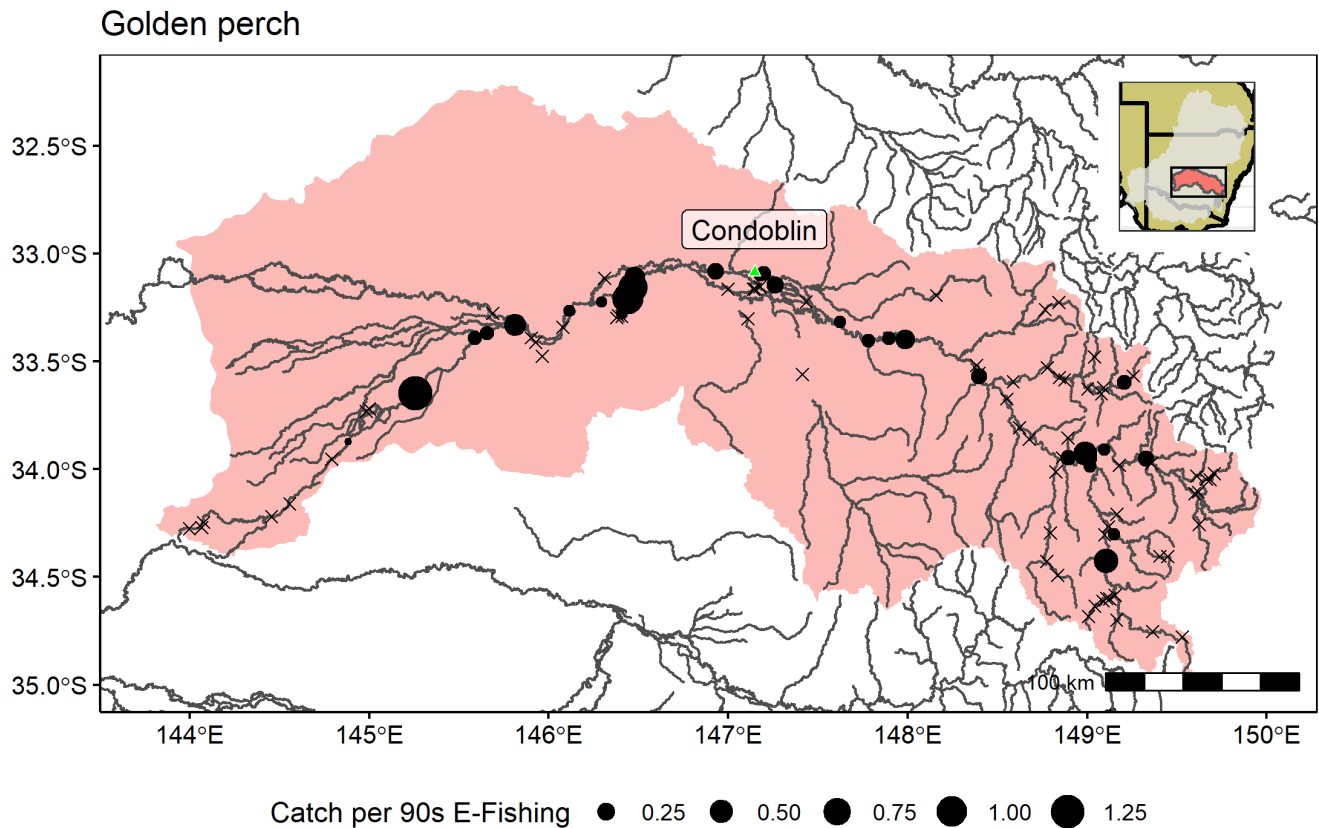


Figure 5.15: Distribution of Golden perch. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X.

Summary Statement:

Golden perch were distributed across the Lachlan WRPA excluding the western and eastern extremes and upland reaches.

Freshwater catfish



Population Structure

Figure 5.16 shows the observed length frequency plot for Freshwater catfish for each of the sampling seasons. Only two adult Freshwater Catfish were caught. Zero Young of the Year (YOY) were observed.

Overall, during the BPEOM-F program, across all the MDB water resource planning areas, the percentage YOY for Freshwater catfish was 44% (285 out of 644).

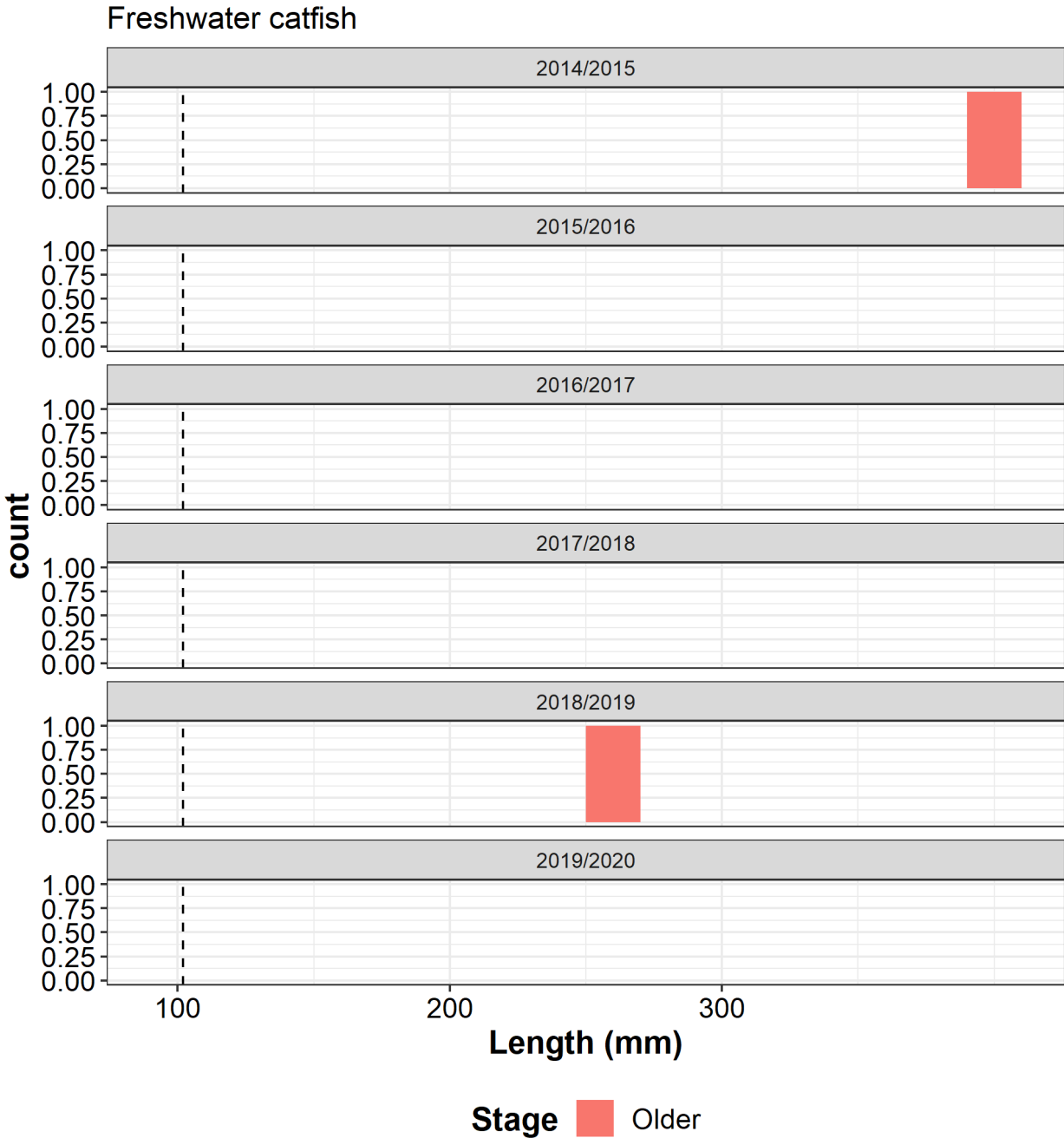


Figure 5.16: Length frequency plots for Freshwater catfish by sampling season. YOY represents Young of the Year fish.

Summary Statement:

Only two adult Freshwater catfish were caught, suggesting very low abundance and limited recruitment.

Temporal Trends in Abundance

We have modelled the relative abundance of Freshwater catfish since 1994 based on all suitable boat and backpack electrofishing data. There was insufficient data to model any abundance trends in the Lachlan for Freshwater catfish (Figure 5.17).

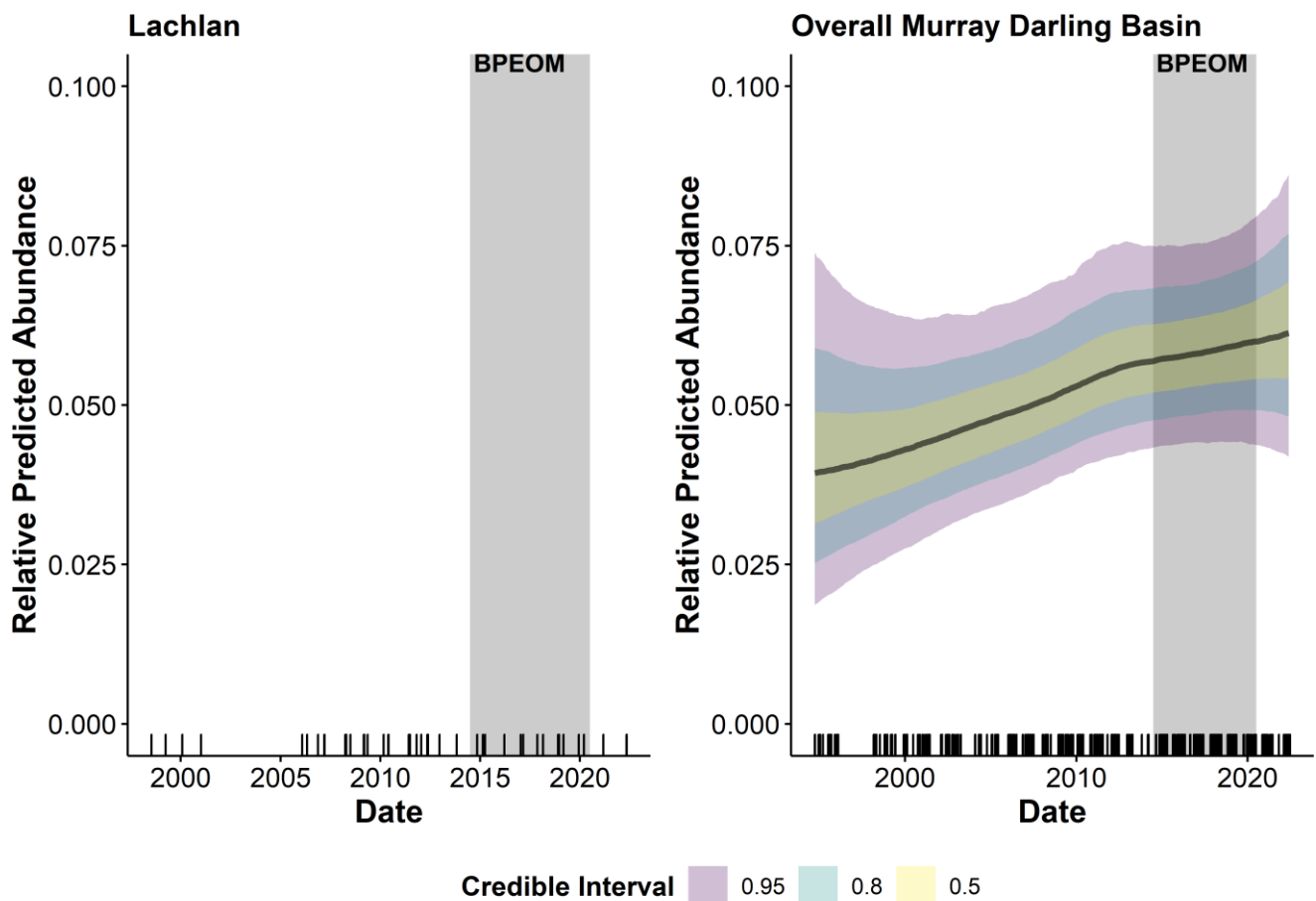


Figure 5.17: Relative abundance of Freshwater catfish in both this valley and the overall Murray-Darling Basin. Note there was insufficient data to model the abundance of Freshwater catfish, hence the empty plot. These are model estimates based upon all electrofishing data within the NSW DPI Freshwater 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:

There is insufficient data to draw any conclusions abundance trends of Freshwater catfish in the Lachlan WRPA but abundance is likely to be very low.

Health

The two Freshwater catfish sampled in the Lachlan WRPA did not show any health conditions (Figure 5.18).

Across the other WRPAs, 1.2 % of Freshwater catfish (8 out of 644 Freshwater catfish) showed a health condition (excludes Lachlan).

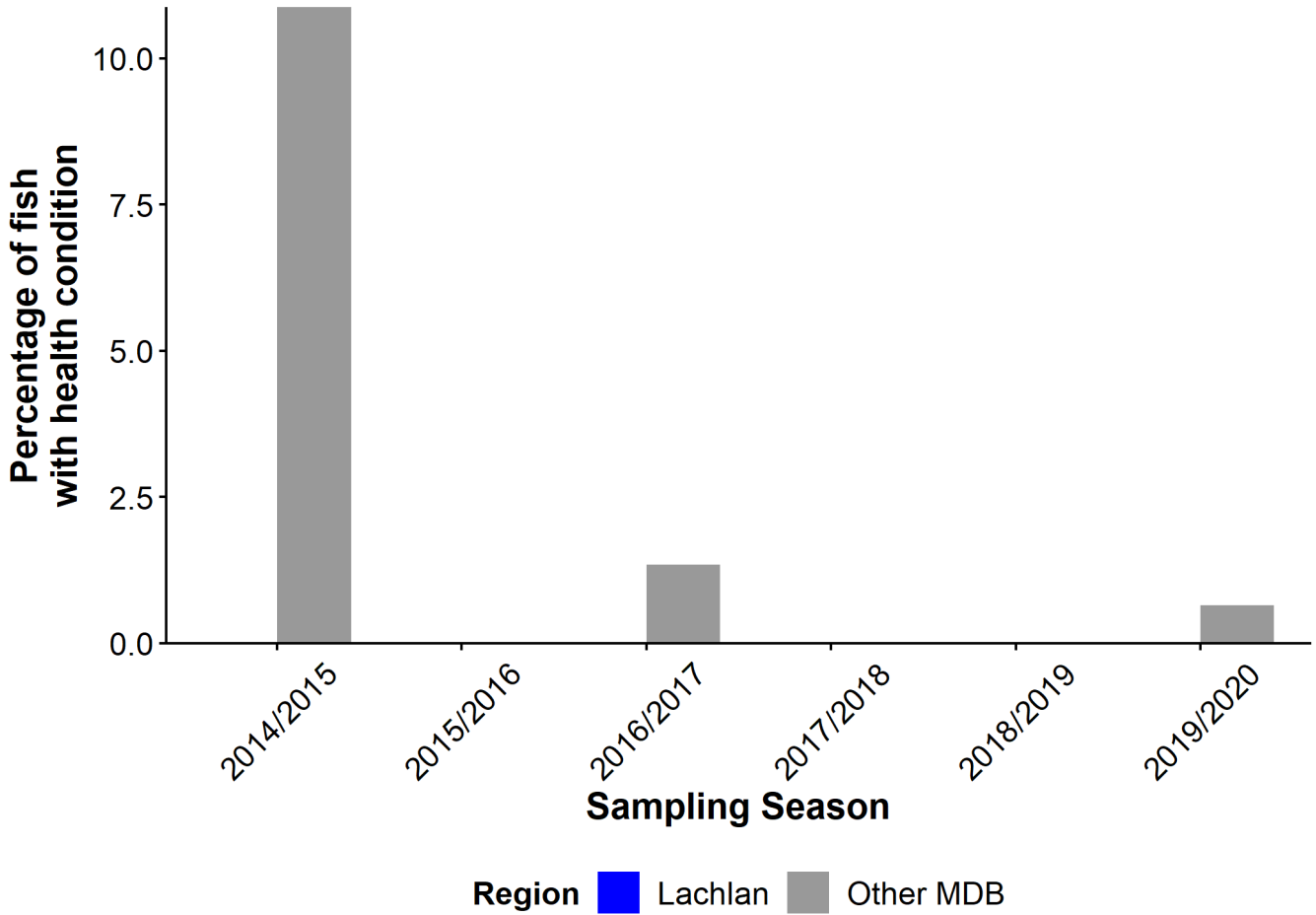


Figure 5.18: Timeseries showing the prevalence of health conditions in Freshwater catfish. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPAs.

Summary Statement:

No health issues were observed in the two Freshwater catfish caught. Overall, in the NSW MDB Freshwater catfish have few observed health issues.

Distribution

Freshwater catfish were recorded at 2 out of 104 sites in the Lachlan WRPA (both sites were located in Lake Wyangala). The maximum observed relative abundance at a site was 0.16 fish caught per 90 seconds of electrofishing. [Figure 5.19](#) shows the distribution and relative abundance of Freshwater catfish across the Lachlan WRPA.

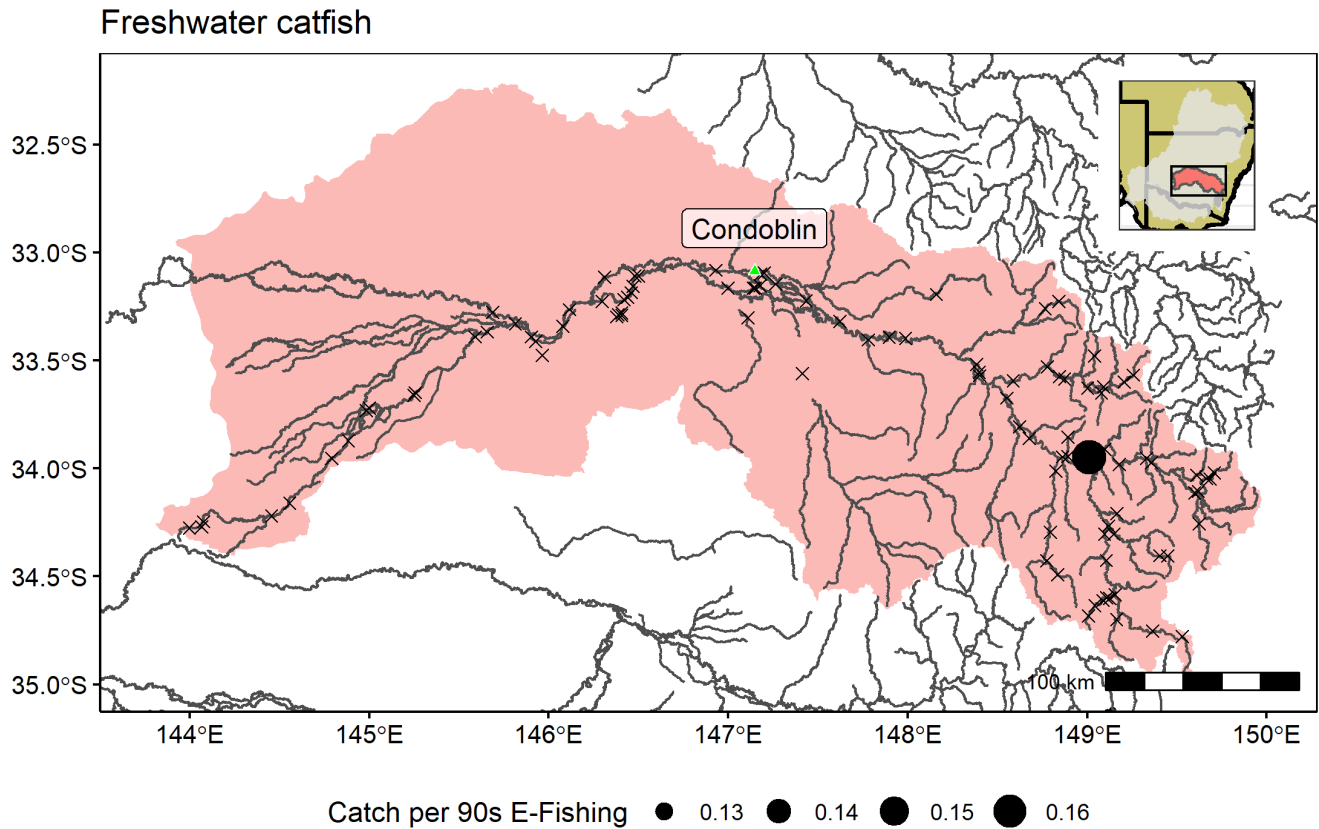


Figure 5.19: Distribution of Freshwater catfish. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X.

Summary Statement:

Freshwater catfish appear to be in very low abundance and possibly restricted to Lake Wyangala, being absent in most of the region.

Bony herring



Population Structure

Figure 5.20 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 zero to 125, and 0% to 42% 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% (4,717 out of 15,150). Bony herring are not a stocked species.

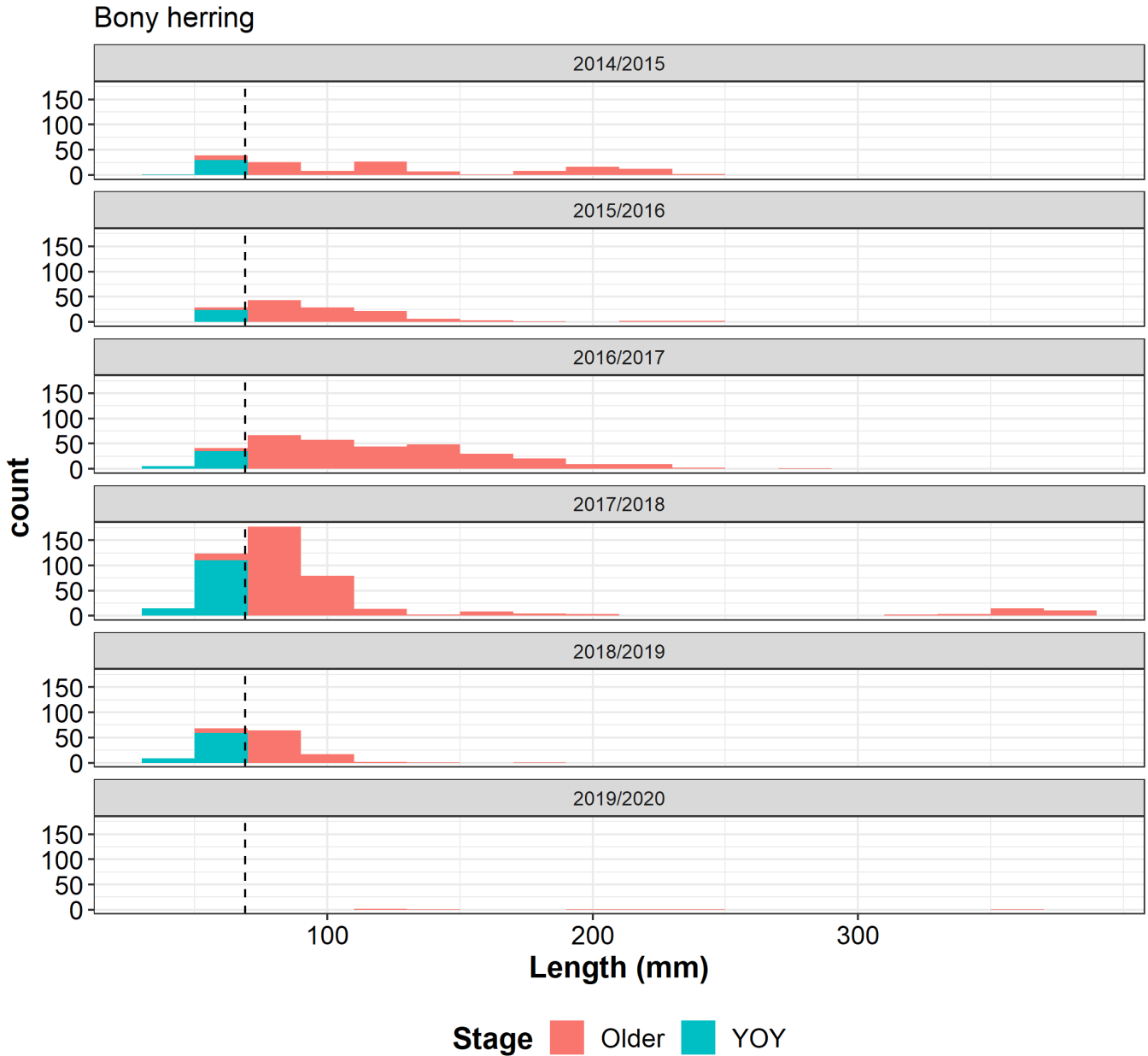


Figure 5.20: Length frequency plots for Bony herring by sampling season. YOY represents Young of the Year fish.

Summary Statement:

Variable recruitment with among years. Possible recruitment failure or mass mortality in 2019/20, with no young of year and very few adults recorded in this year. Large fish only observed in 2017/18.

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 5.21](#) shows the abundance trend for the Lachlan WRPA and the right-hand panel shows the overall trend across the NSW MDB.

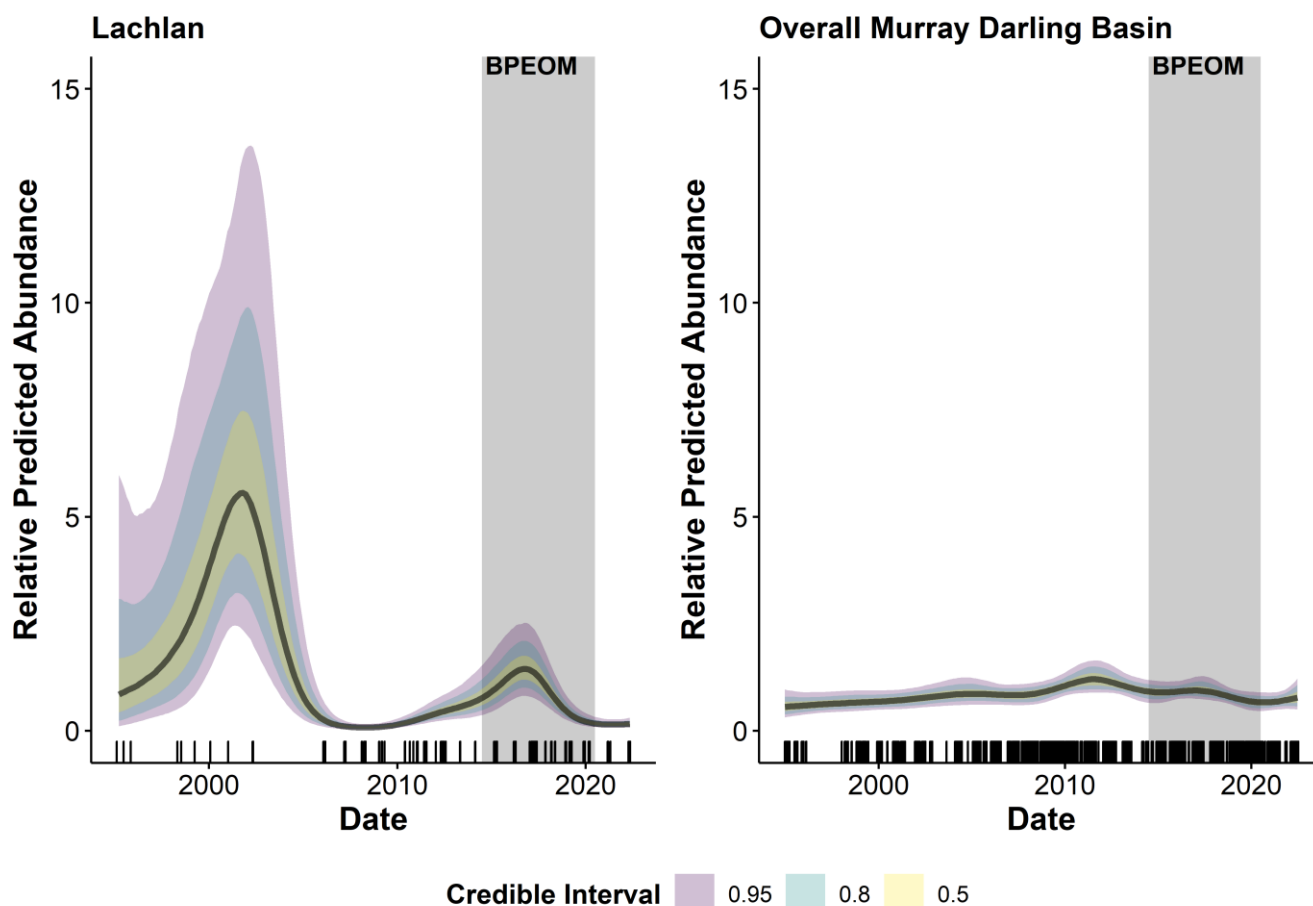


Figure 5.21: Relative abundance of Bony herring in both the Lachlan WRPA and the overall NSW MDB. These are model estimates based upon all boat electrofishing data within the NSW DPI Freshwater ecosystem database and the output of Bayesian generalised additive mixed models. The grey shaded region represents 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:

Abundance likely to be lower than 1994 levels and has declined since the BPEOM period. The early time series is highly uncertain. Abundance is currently lower than the overall NSW MDB.

Health

The prevalence of any health issues ranged from 0% of sampled fish in 2016/2017 to 1% of sampled fish in 2015/2016 (Figure 5.22). The most common health issue for Bony herring in the Lachlan WRPAs was Wounds, which was observed in a total of two fish, corresponding to 0% of all Bony herring measured.

Across the other NSW MDB WRPAs, 1.2 % of Bony herring (188 out of 15,150 Bony herring) showed a health condition (excludes the Lachlan WRPAs).

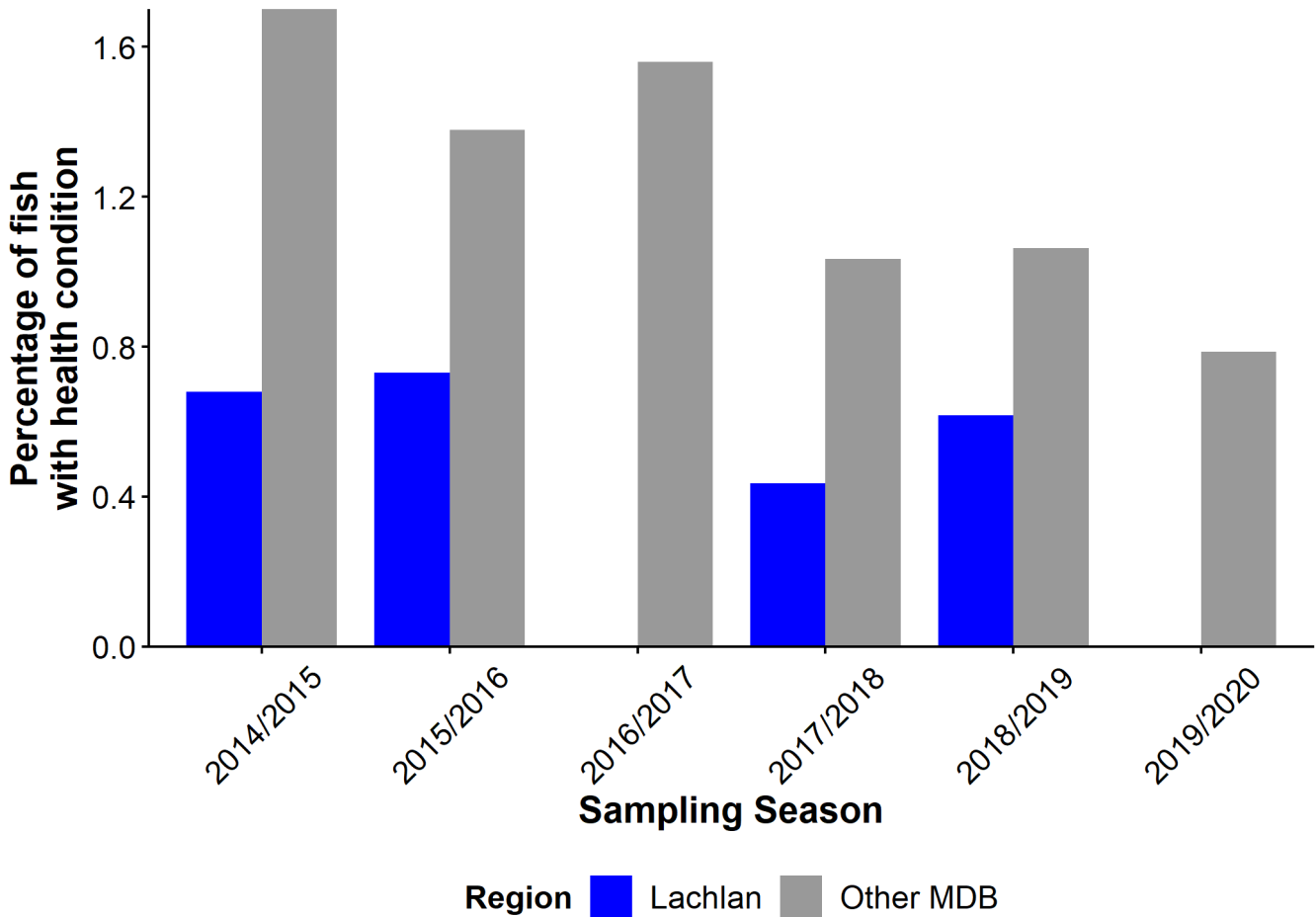


Figure 5.22: Timeseries showing the prevalence of health conditions in Bony herring. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPAs.

Summary Statement:

Presence of observable health conditions was low overall and lower than the rest of the NSW MDB in all years.

Distribution

Bony herring were recorded at 23 out of 104 sites in the Lachlan WRPA. The maximum observed relative abundance at a site was 25.7 fish caught per 90 seconds of electrofishing. [Figure 5.23](#) shows the distribution and relative abundance of Bony herring across the Lachlan WRPA.

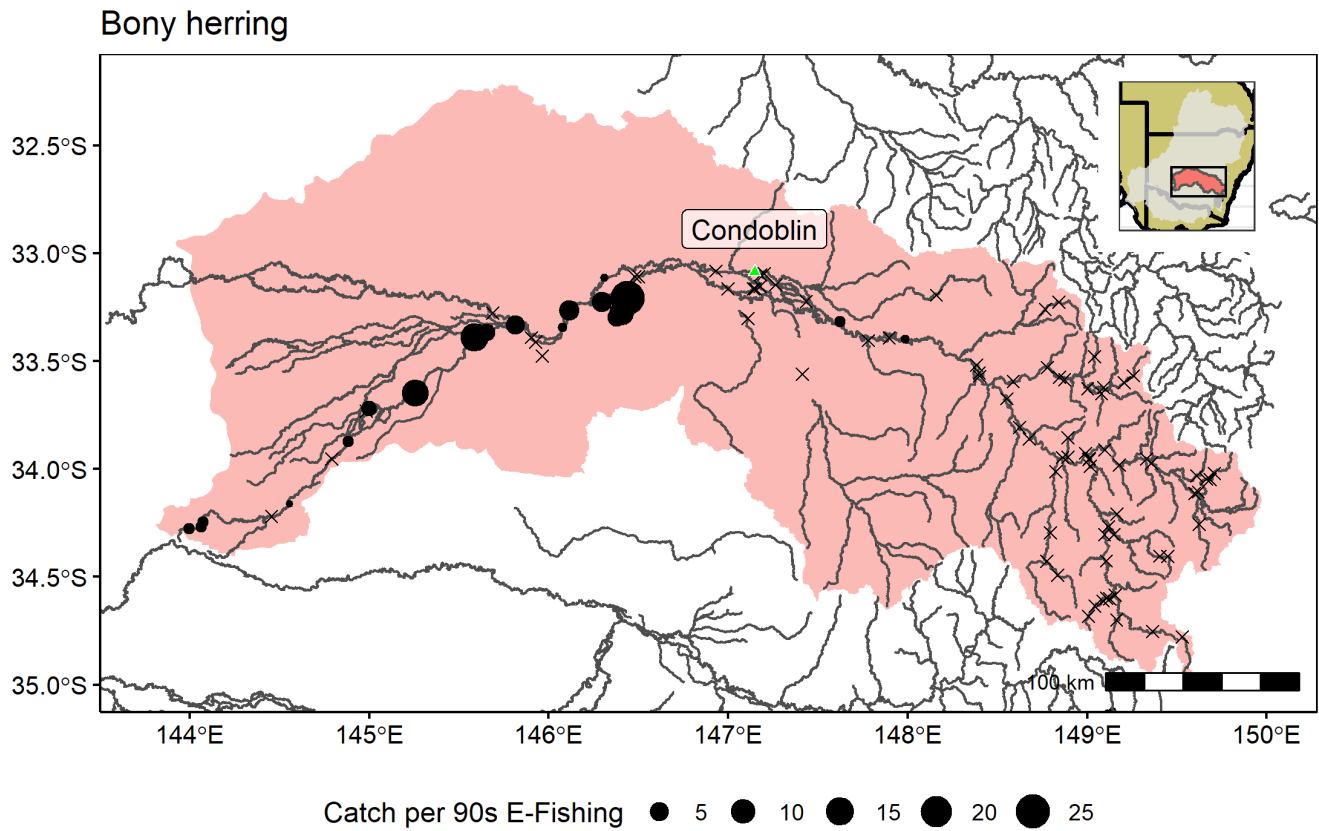


Figure 5.23: Distribution of Bony herring. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X.

Summary Statement:

Bony herring were recorded across the western half of the Lachlan WRPA but absent in eastern and upland sites. Abundance was highest in the downstream reaches.

Australian smelt



Population Structure

Figure 5.24 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 one to 34, and 4% to 67% 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 43% (3,542 out of 8,203). Australian smelt are not a stocked species.

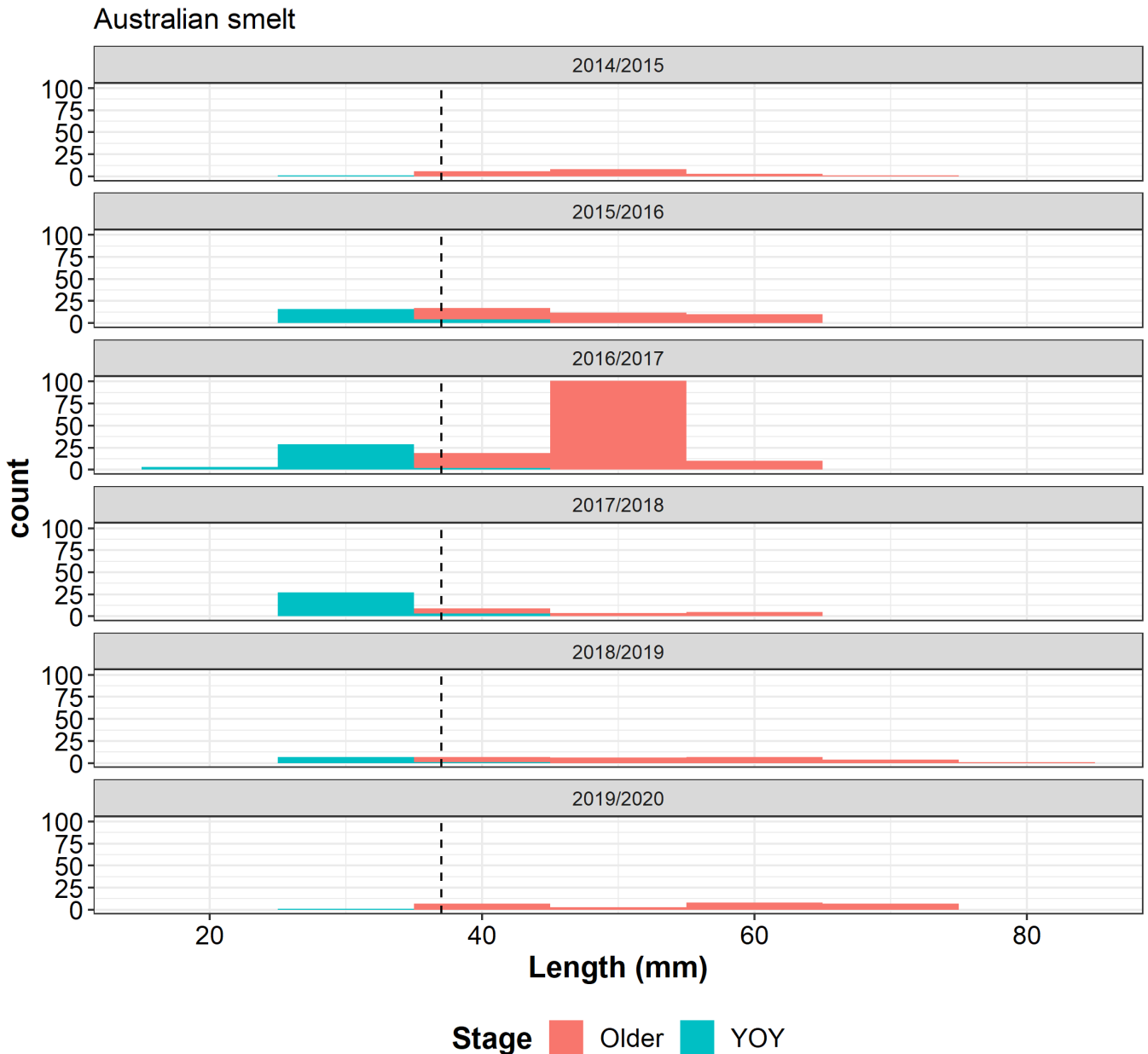


Figure 5.24: Length frequency plots for Australian smelt by sampling season. YOY represents Young of the Year fish.

Summary Statement:

Evidence of variable recruitment in all years with a peak in 2015/16 and possibly recruitment limitation in 2014/15 and 2019/20.

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 5.25](#) shows the abundance trend for the Lachlan WRPA and the right-hand panel shows the overall trend across the NSW MDB.

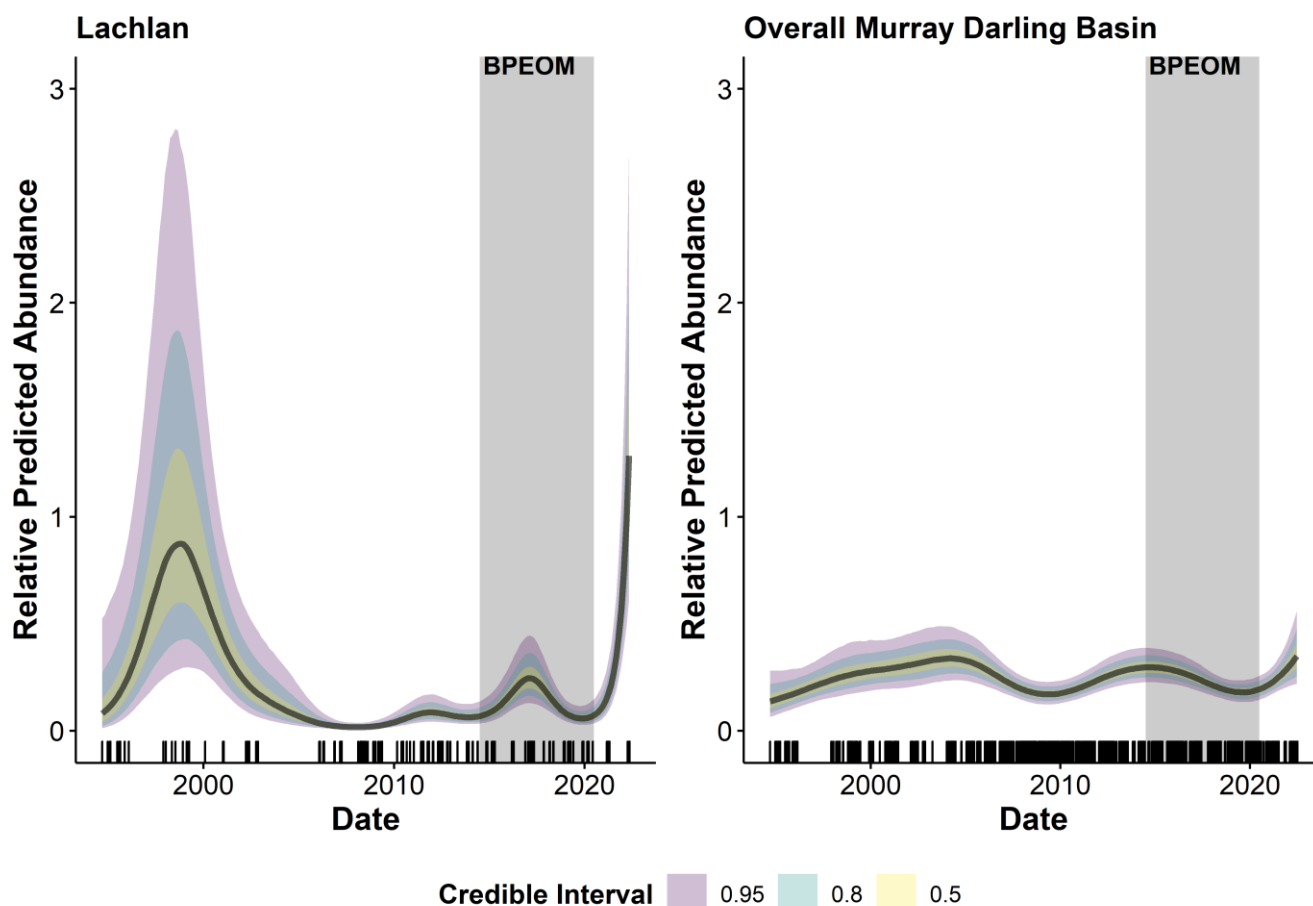


Figure 5.25: Relative abundance of Australian smelt in both the Lachlan WRPA and the overall NSW MDB. These are model estimates based upon all boat electrofishing data within the NSW DPI Freshwater ecosystem database and the output of Bayesian generalised additive mixed models. The grey shaded region 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:

Abundance has increased substantially since the 1990s (driven by an increase post-2020) and is currently higher than the overall NSW MDB. During the BPEOM-F period abundance was approximately equal to the overall NSW MDB.

Health

The prevalence of any health issues ranged from 0% of sampled fish in 2014/2015 to 8% of sampled fish to 2019/2020 (Figure 5.26). The most common health issue for Australian smelt in the Lachlan WRPA was *Lerneae*, which was observed in a total of four fish, corresponding to 1% of all Australian smelt measured.

Across the other NSW MDB WRPA, 1% of Australian smelt (49 out of 8,203 Australian smelt) showed a health condition (excludes the Lachlan WRPA).

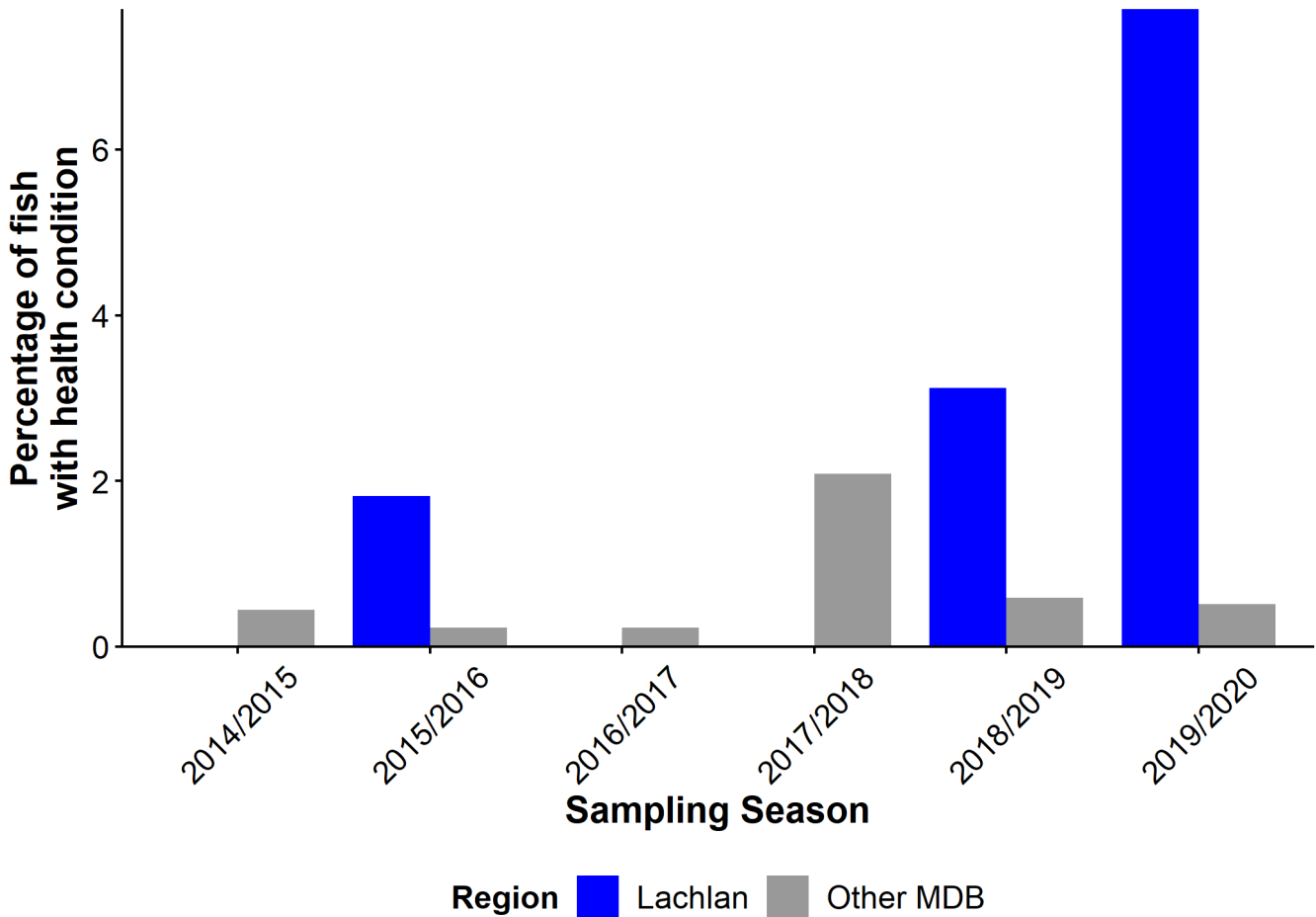


Figure 5.26: Timeseries showing the prevalence of health conditions in Australian smelt. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPAs.

Summary Statement:

Presence of observable health conditions was low but, when present, health issues were more common than the overall NSW MDB. Large increase in health issues in 2018/19 and 2019/20.

Distribution

Australian smelt were recorded at 31 out of 104 sites in the Lachlan WRPA. The maximum observed relative abundance at a site was 48 fish caught per 90 seconds of electrofishing. [Figure 5.27](#) shows the distribution and relative abundance of Australian smelt across the Lachlan WRPA.

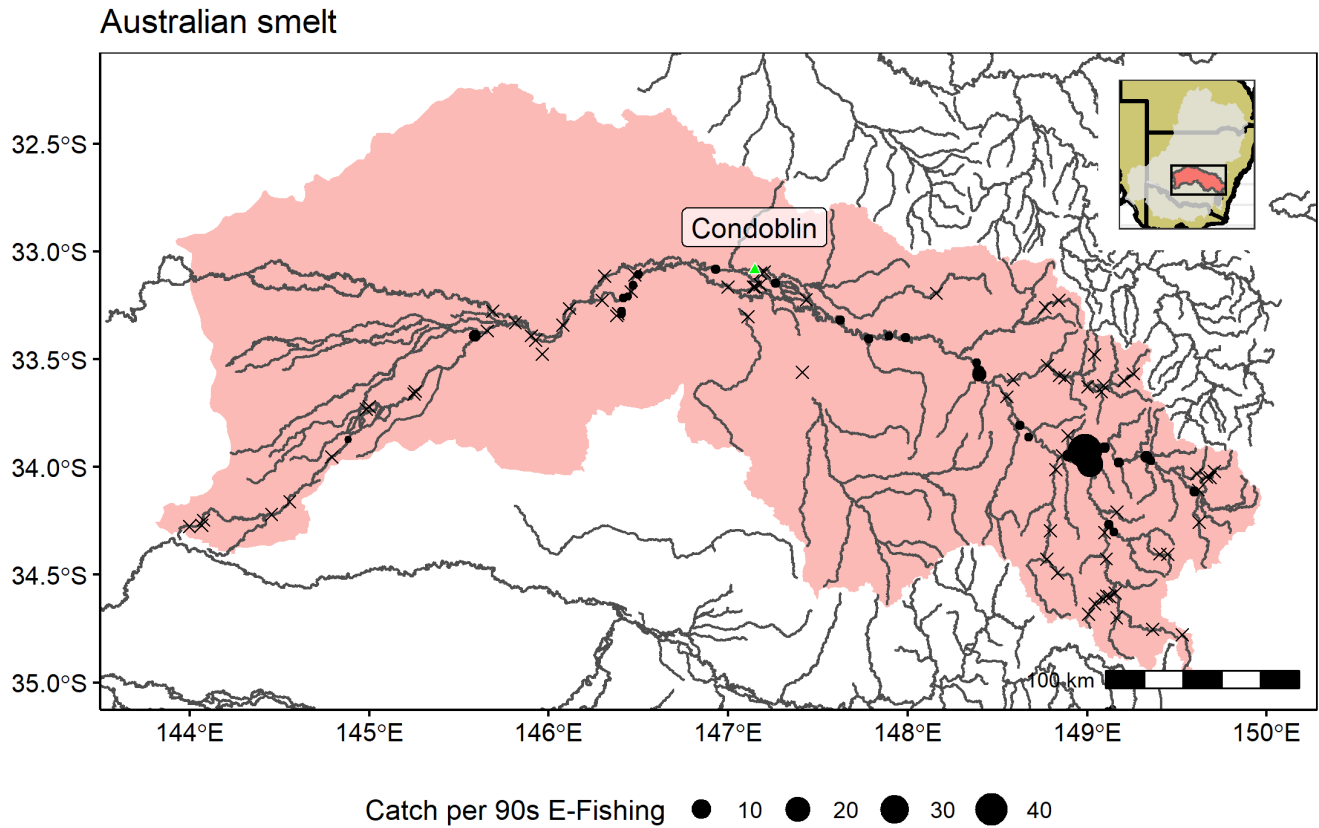


Figure 5.27: Distribution of Australian smelt. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X.

Summary Statement:

Australian smelt were recorded across the Lachlan WRPA but less abundant or absent in western reaches and some eastern upland areas.

Common carp



Population Structure

Figure 5.28 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 one to 672, and 1% to 80% 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 57% (10,974 out of 19,154). Common carp are not a stocked species.

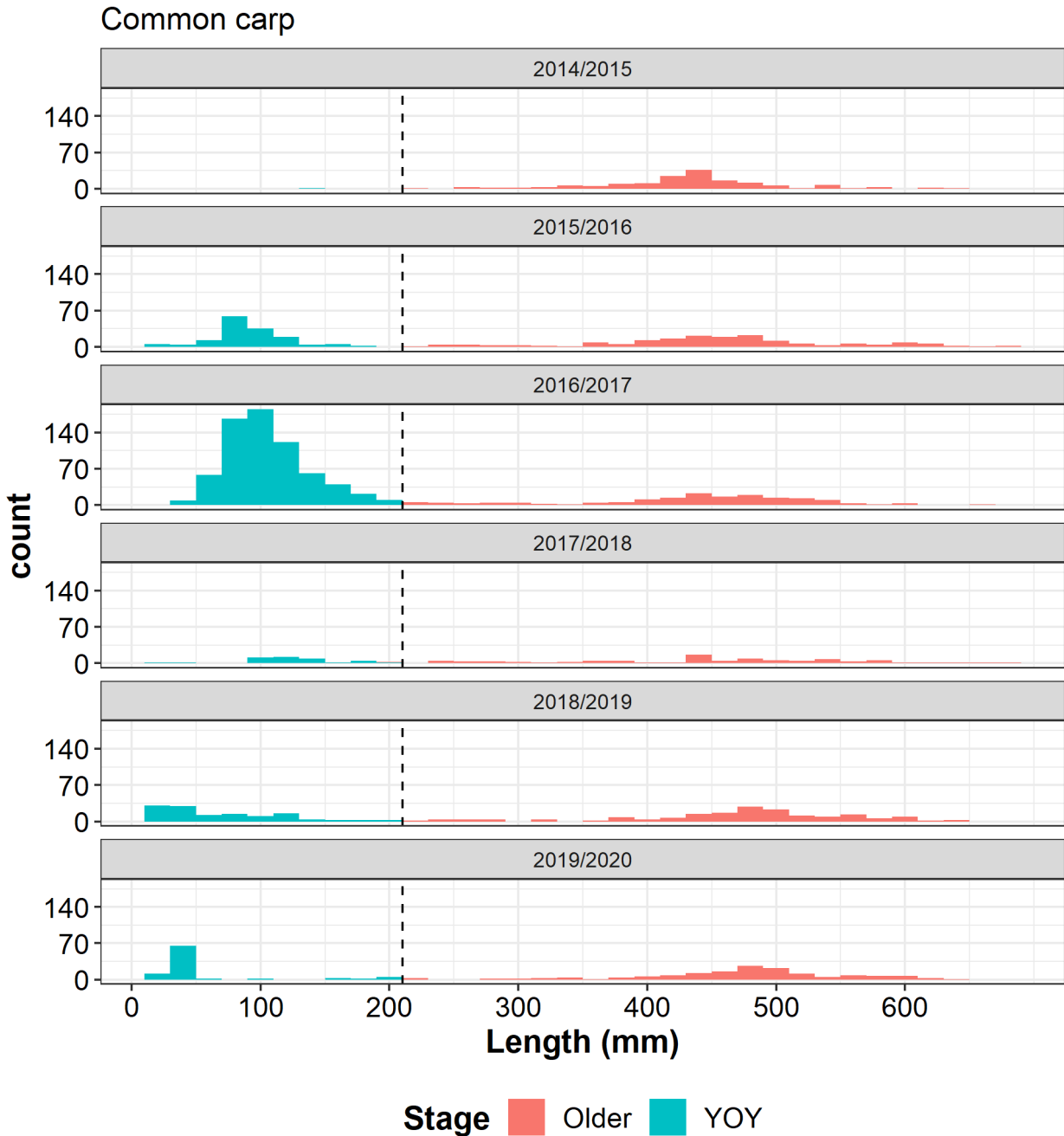


Figure 5.28: Length frequency plots for common carp by sampling season. YOY represents Young of the Year fish.

Summary Statement:

Variable recruitment among years with a very strong peak in 2016/17. Large fish present in all years but possible recruitment failure in 2014/15.

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 5.29](#) shows the abundance trend for the Lachlan WRPA and the right-hand panel shows the overall trend across the NSW MDB.

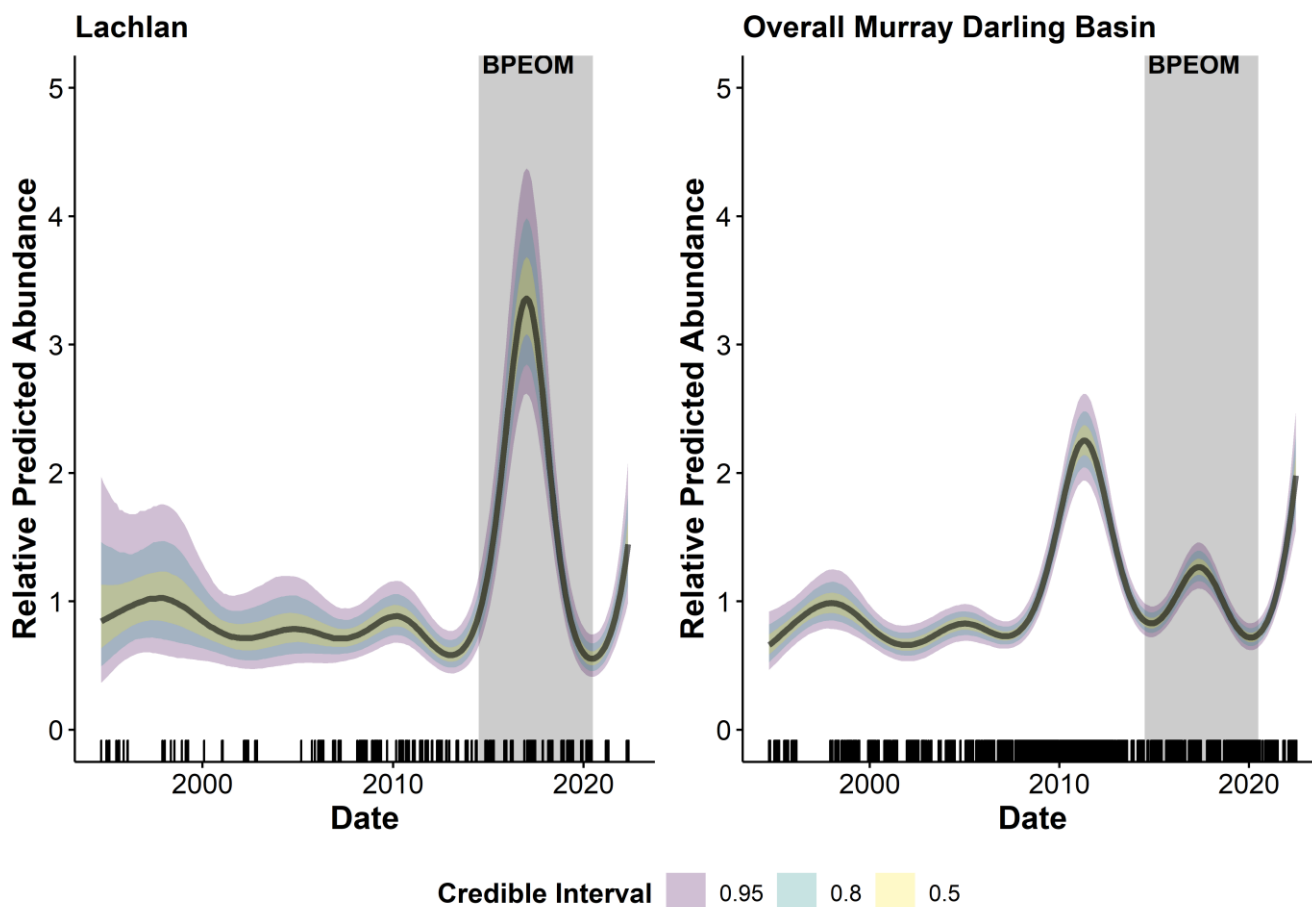


Figure 5.29: Relative abundance of Common carp in both this valley and the overall Murray-Darling Basin. These are model estimates based upon all electrofishing data within the NSW DPI Freshwater ecosystem database and the output of Bayesian generalised additive mixed models. The grey shaded region represents 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:

Current abundance slightly higher than 1994 levels. Abundance peaked in approximately 2017 but has since declined. Recent increase in abundance corresponds to a recent decline in relative biomass suggesting the increase in abundance is driven by a large proportion of juveniles (NSW DPI unpubl.). Current relative abundance slightly lower than the overall NSW MDB.

Health

The prevalence of any health issues ranged from 4% of sampled fish in 2016/2017 to 11% of sampled fish in 2018/2019 (Figure 5.30). The most common health issue for Common carp in the Lachlan water resource planning area was *Lernaeae*, which was observed in a total of 60 fish, corresponding to 3% of all Common carp measured.

Across the other WRPAs, 5% of Common carp (1,024 out of 19,154 Common carp) showed a health condition (excludes Lachlan).

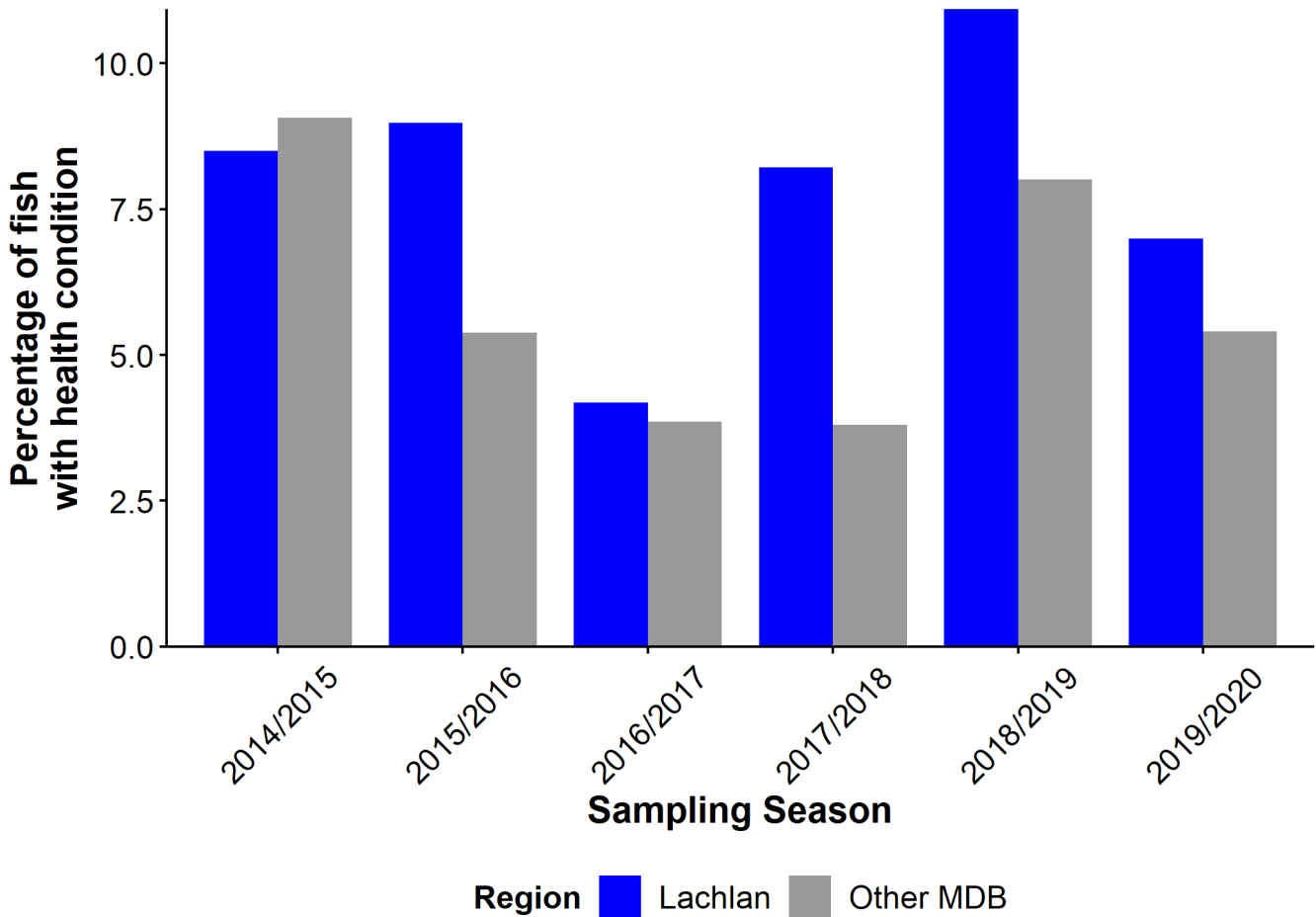


Figure 5.30: Timeseries showing the prevalence of health conditions in Common carp. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA.

Summary Statement:

Presence of observable health conditions in the Lachlan was low to moderate and generally slightly higher than the rest of the NSW MDB.

Distribution

Common carp were recorded at 78 out of 104 sites in the Lachlan WRPA. The maximum observed relative abundance at a site was 23 fish caught per 90 seconds of electrofishing. [Figure 5.31](#) shows the distribution and relative abundance of Common carp across the Lachlan WRPA.

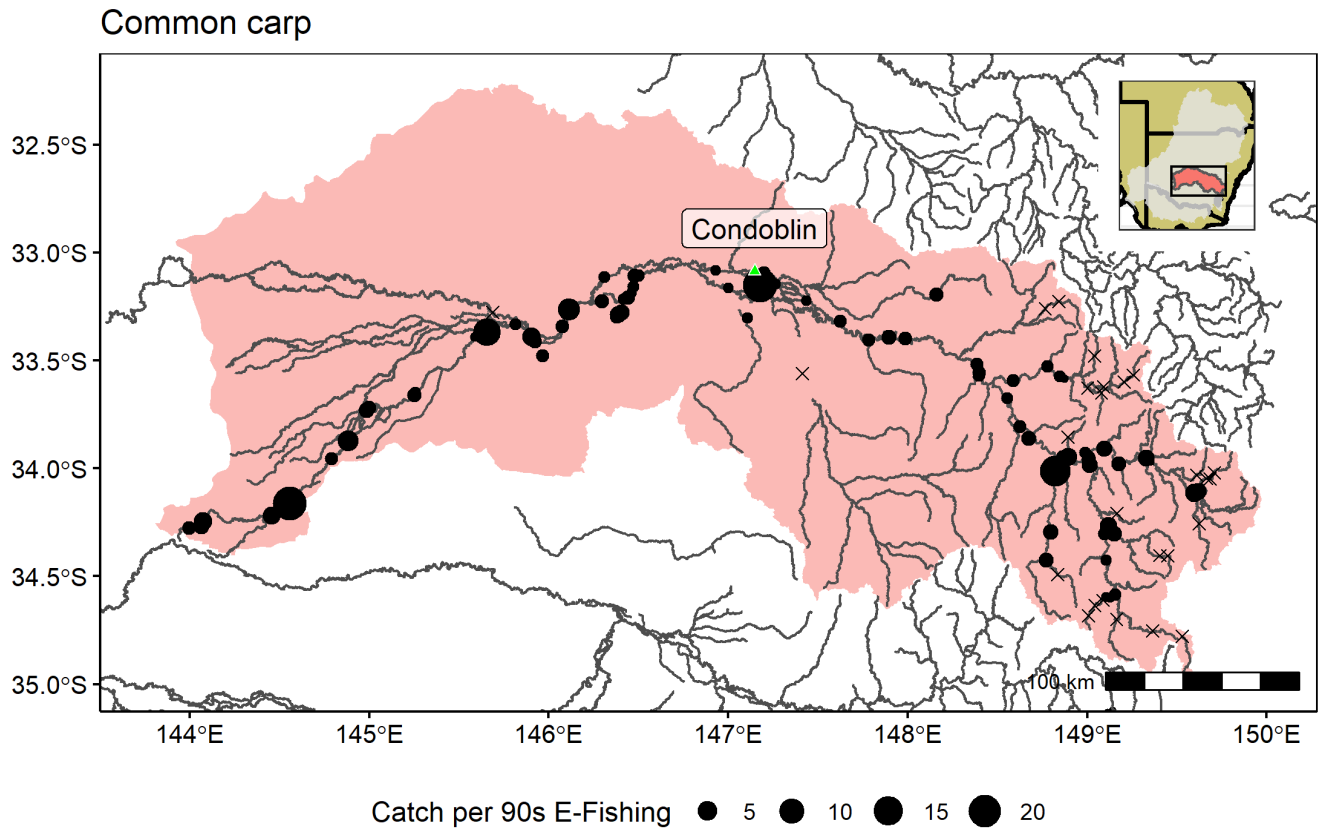


Figure 5.31: Distribution of Common carp. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X.

Summary Statement:

Present across the Lachlan WRPA with the exception of some upland areas in the east.

Threatened Species

The following table (Table 5.6) 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 Lachlan 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 5.9.

Table 5.6: Listed species which were observed in this region during the BPEOM-F program. (* = FMA, # = EPBC)

Species	Common name	Total caught (observed)
<i>Bidyanus bidyanus</i>	Silver perch*#	15 (1)
<i>Maccullochella peelii</i>	Murray cod#	124 (29)
<i>Macquaria australasica</i>	Macquarie perch*#	13 (4)
<i>Tandanus tandanus</i>	Freshwater catfish*	2 (0)

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

Silver perch

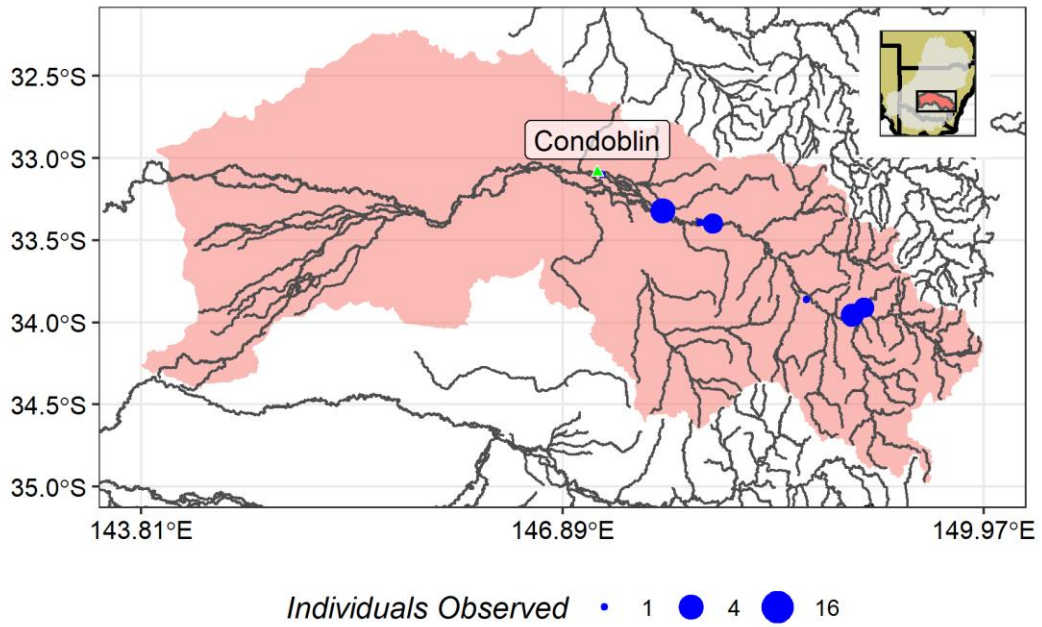


Figure 5.32: Distribution of Silver perch. Filled circles show sites where the species was present and the size of the circle represents number of observed individuals abundance.

Summary Statement:

A total of 16 Silver perch were caught or observed across eight sites in the eastern half of the Lachlan WRPA in both the Lachlan River and Lake Wyangala.

Murray cod

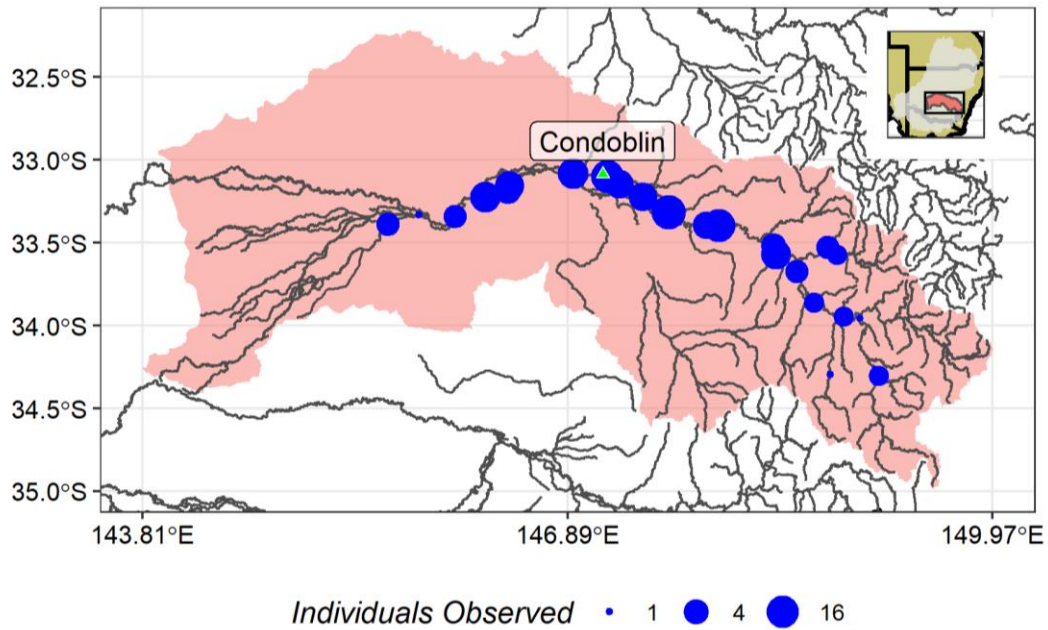


Figure 5.33: Distribution of Murray cod. Filled circles show sites where the species was present and the size of the circle represents number of observed individuals abundance. Note the bottom photo shows a juvenile Murray cod.

Summary Statement:

Murray cod were widely distributed and were 153 were caught or observed across Lachlan WRPA, mostly in the Lachlan River.

Macquarie perch

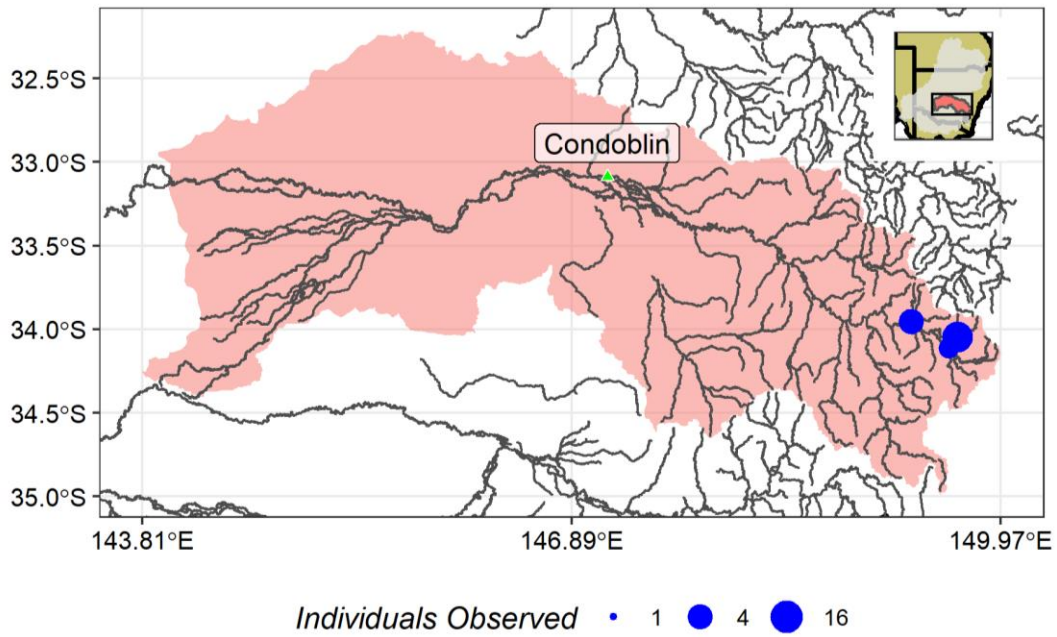


Figure 5.34: Distribution of Macquarie perch. Filled circles show sites where the species was present and the size of the circle represents number of observed individuals abundance.

Summary Statement:

A total of 17 Macquarie perch were caught or observed across four sites in the Abercrombie and Retreat Rivers.

Freshwater catfish

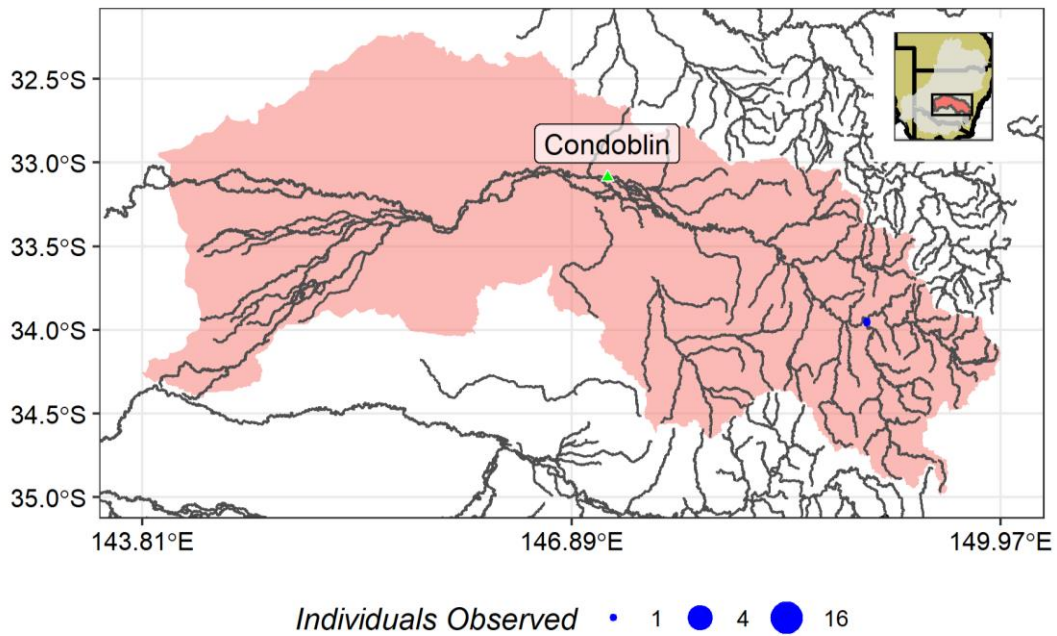


Figure 5.35: Distribution of Freshwater catfish. Filled circles show sites where the species was present and the size of the circle represents number of observed individuals abundance.

Summary Statement:

Two Freshwater catfish were caught in Lake Wyangala in 2014 and 2018.

Appendix

Figure 5.36 shows the locations of sites sampled in each sampling season.

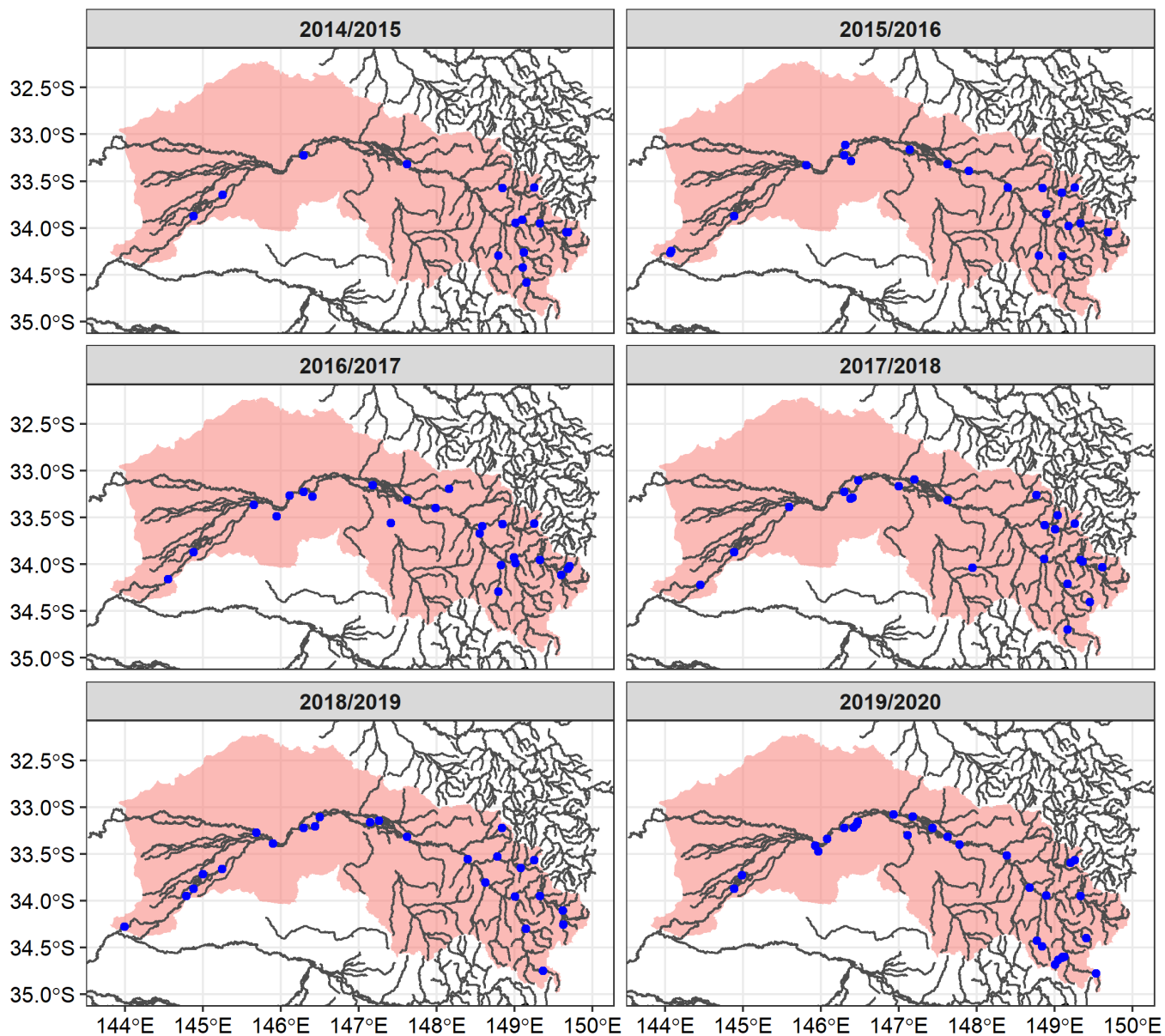


Figure 5.36: Sites sampled during the BPEOM-F program by Sampling Season. Dry sites are not shown.

Table 5.7 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 5.1. 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 Lachlan WRPA were: Olive perchlet, Darling hardyhead, Murray hardyhead, River Blackfish, Flat-headed galaxias, Spangled perch, Trout cod, Murray-Darling rainbowfish, Southern purple-spotted gudgeon, Southern pygmy 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 5.10.

Table 5.7: 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	19	55	797	45	32	26
Bony herring	YES	259	220	438	538	427	7
Brown trout	YES	0	0	1	25	0	30
Carp-gudgeon species complex	YES	786	696	234	208	252	258
Common carp	NA	153	341	2378	146	302	243
Common carp - Goldfish hybrid	NA	0	0	15	0	0	0
Eastern gambusia	NA	3	96	304	250	650	508
Flathead gudgeon	YES	57	19	93	2	10	69
Freshwater catfish	YES	1	0	0	0	1	0
Galaxias spp	NA	0	0	0	11	0	16
Golden perch	YES	26	10	21	9	24	24
Goldfish	NA	1	19	35	25	86	77
Macquarie perch	YES	7	2	3	1	0	0
Mountain galaxias	YES	276	155	229	281	655	8
Murray cod	YES	4	25	17	9	15	54
Rainbow trout	YES	2	1	0	0	2	0
Redfin	YES	2	1	32	14	90	9
Silver perch	YES	4	3	2	1	3	2
Unspecked hardyhead	YES	0	2	2	0	0	4

The following table summarises the sampling methods by which each fish species was caught (Table 5.8).

Table 5.8: Total catch of each species by sampling method.

Common name	Backpack Electrofishing	Bait Trap	Boat Electrofishing
Australian smelt	11	0	963
Bony herring	30	1	1,858
Brown trout	55	0	1
Carp-gudgeon species complex	92	2,159	183
Common carp	468	618	2,477
Common carp - Goldfish hybrid	0	0	15
Eastern gambusia	1,078	390	343
Flathead gudgeon	14	91	145
Freshwater catfish	0	0	2
Galaxias spp	11	0	16
Golden perch	0	0	114
Goldfish	77	0	166
Macquarie perch	10	0	3
Mountain galaxias	1,560	41	3
Murray cod	5	0	119
Rainbow trout	4	0	1
Redfin	12	2	134
Silver perch	0	0	15
Unspecked hardyhead	0	0	8

Table 5.9: 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
<i>Ambassis agassizii</i>	Agassiz's glassfish, olive perchlet, western New South Wales population	NA	Endangered Population
<i>Bidyanus bidyanus</i>	Silver Perch, Bidyan	Critically 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 5.10 shows all fish 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 BPEOM sampling in the Lachlan WRPA were: Darling hardyhead, Murray hardyhead, Flat-headed galaxias, Spangled perch, Trout cod, Murray-Darling rainbowfish, Southern purple-spotted gudgeon, Southern pygmy 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 5.7.

Table 5.10. 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	96	59	806	279	38	44
Bony herring	YES	1,855	237	2463	8,455	2,865	353
Brown trout	YES	9	0	19	38	0	30
Carp-gudgeon species complex	YES	957	6,191	596	4,482	627	3,116
Common carp	NA	416	516	8,156	802	508	479
Common carp - Goldfish hybrid	NA	0	0	15	0	0	0
Eastern Gambusia	NA	481	117	1,468	1,201	854	1,700
Flathead gudgeon	YES	57	21	95	9	15	84
Freshwater catfish	YES	2	0	0	0	1	0
Galaxia spp	NA	0	0	272	1221	78	16
Golden perch	YES	201	12	108	291	135	152
Goldfish	NA	13	65	92	56	103	119
Macquarie perch	YES	109	16	36	45	12	74
Mountain galaxias	YES	2,705	544	397	404	847	129
Murray cod	YES	198	30	36	41	55	149
Olive perchlet	YES	0	126	0	0	0	0
Rainbow trout	YES	3	1	1	4	2	0
Redfin	YES	2	2	33	142	135	19
River Blackfish	YES	0	0	0	0	42	0
Silver perch	YES	4	3	2	1	3	2
Unspecked hardyhead	YES	7	3	15	18	0	6