Chapter 10 Basin Plan Environmental Outcomes Monitoring for Fish (2014/15 – 2019/20): New South Wales Lower Darling Water Resource Planning Area

Citation Details

Please cite the overall report when referring to this chapter:

Schilling, H., Crook, D. 2023. Basin Plan Environmental Outcomes Monitoring for Fish (2014/15 – 2019/20): Water Resource Planning Area Reports. NSW Department of Primary Industries. Fisheries NSW, Port Stephens Fisheries Institute. 517pp. (PUB23/369)

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Acknowledgement

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. The report focusses on the New South Wales Lower Darling Water Resource Planning Area (WRPA) shown in Figure 10.1.
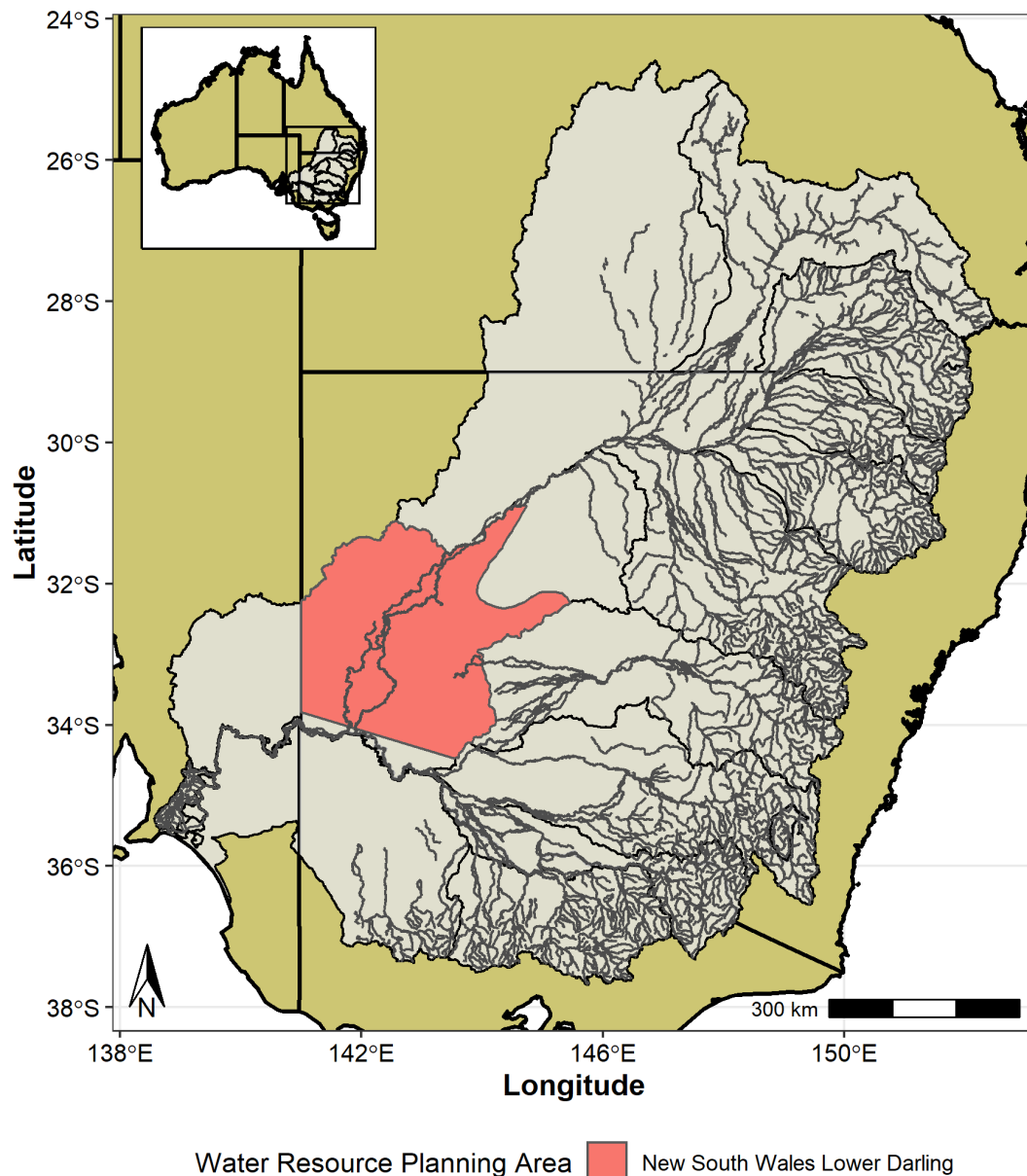

Figure 10.1: Murray-Darling Basin with the key region of this report highlighted. Inset map shows the whole of Australia with a box around the MDB.

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 New South Wales Lower Darling 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 New South Wales Lower Darling 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 New South Wales Lower Darling WRPA and greater MDB (excluding the New South Wales Lower Darling 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 New South Wales Lower Darling 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 10.1). 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 10.1: 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	2 (2)
2015/2016	5 (5)
2016/2017	13 (3)
2017/2018	8 (10)
2018/2019	9 (8)
2019/2020	3 (1)

The sites sampled during the reporting period are shown in Figure 10.2. A breakdown of sites sampled each sampling season is shown in the Appendix (Figure 10.28).
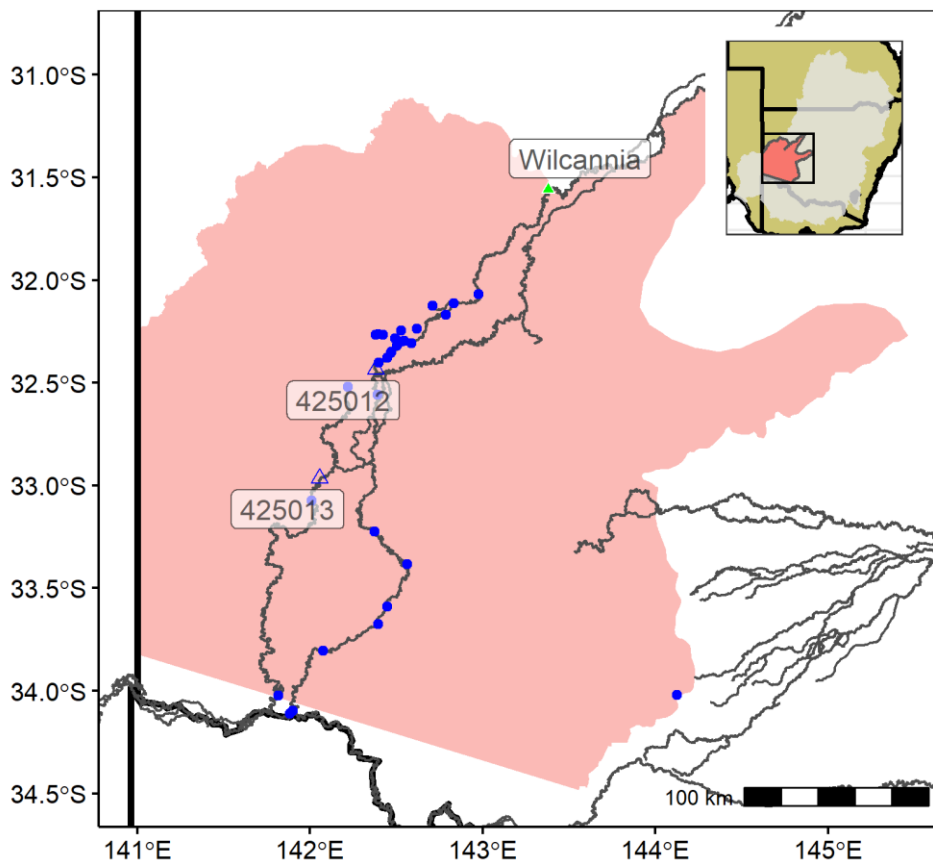
Figure 10.2: Sites (dots) sampled during the BPEOM-F program. Blue triangles show key flow gauges along with their gauge ID number. Dry sites are not shown. Green triangles show key cities.

Each sampling method has a different effectiveness at sampling each species. Table 10.2 shows the total amount of each species caught by each method.

Table 10.2: 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	Boat Electrofishing	Backpack Electrofishing	Bait Trap
Murray cod	90	0	0
Golden perch	166	0	3
Freshwater catfish	0	0	0
Bony herring	3,554	4	0
Australian smelt	120	0	0
Common carp	873	84	72

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 10.3 shows the number of fish biological measurements taken each year for the six species.

Table 10.3: Number of biological measurements taken for the key species each sampling season.

	Murray cod	Golden perch	Bony herring	Australian smelt	Common carp
2014/2015	12	4	104	0	21
2015/2016	12	14	153	8	60
2016/2017	5	42	524	50	320
2017/2018	9	25	400	6	148
2018/2019	50	74	305	56	264
2019/2020	0	12	47	0	60

It is important to note that there are large differences in sampling effort between sampling years, for example, the apparent drop in measurements taken in 2019/20 is reflective of only 3 sampling events in this sampling season (See Table 10.1 for sampling effort).

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. To interpret, 2014 states it was the warmest year on record, meaning 2014 was the warmest year on record up to and including 2014 but not 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 New South Wales Lower Darling WRPA (Figure 10.3).
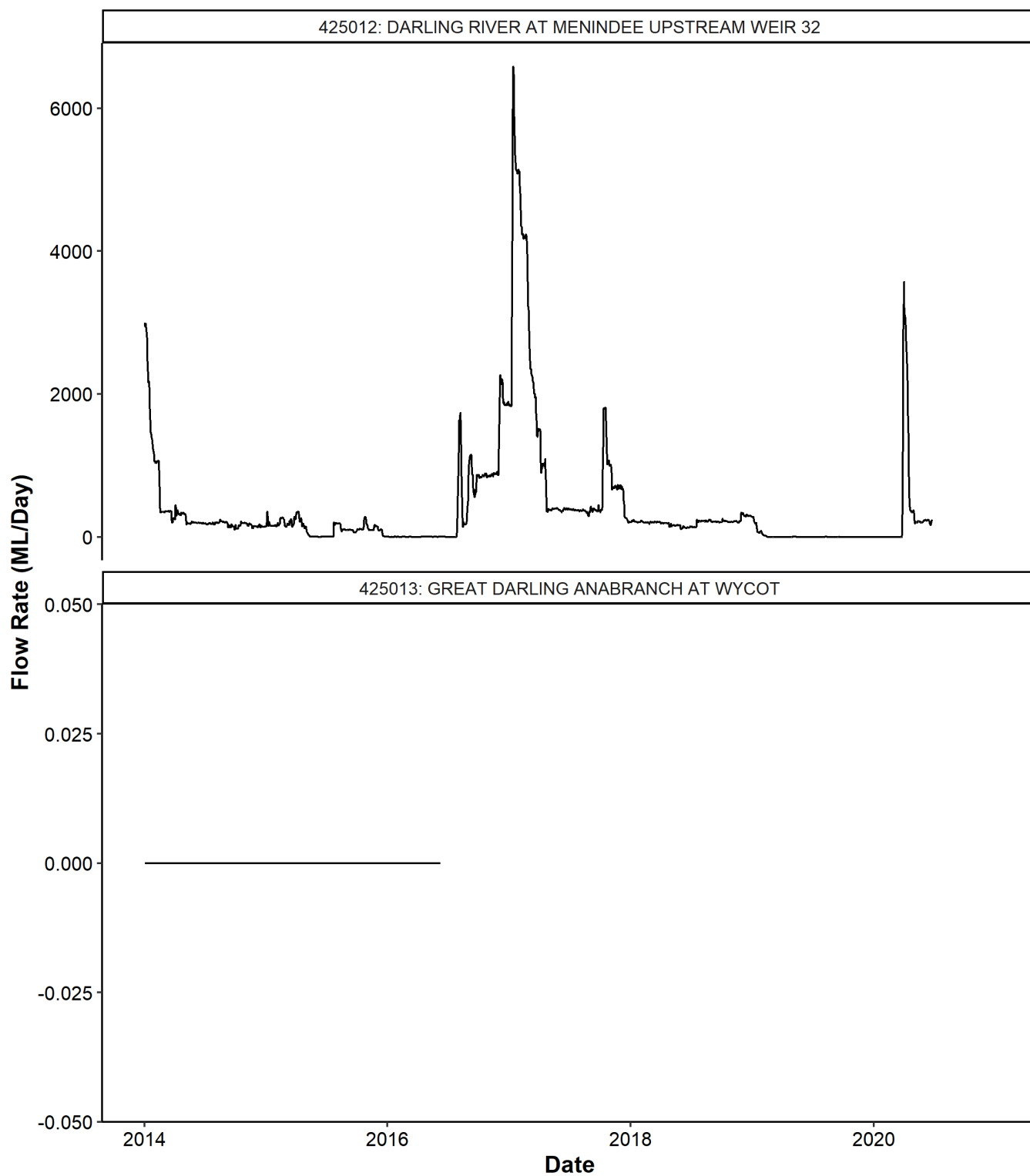

Figure 10.3: Flow data from various gauges in the New South Wales Lower Darling WRPA over the reporting period. Gauge locations can be seen on Figure 10.2. Note the differing scales on the y-axis. Note the anabranch data shows no flow before the period of no data.

Water temperature data, where available, are also shown in Figure 10.4.
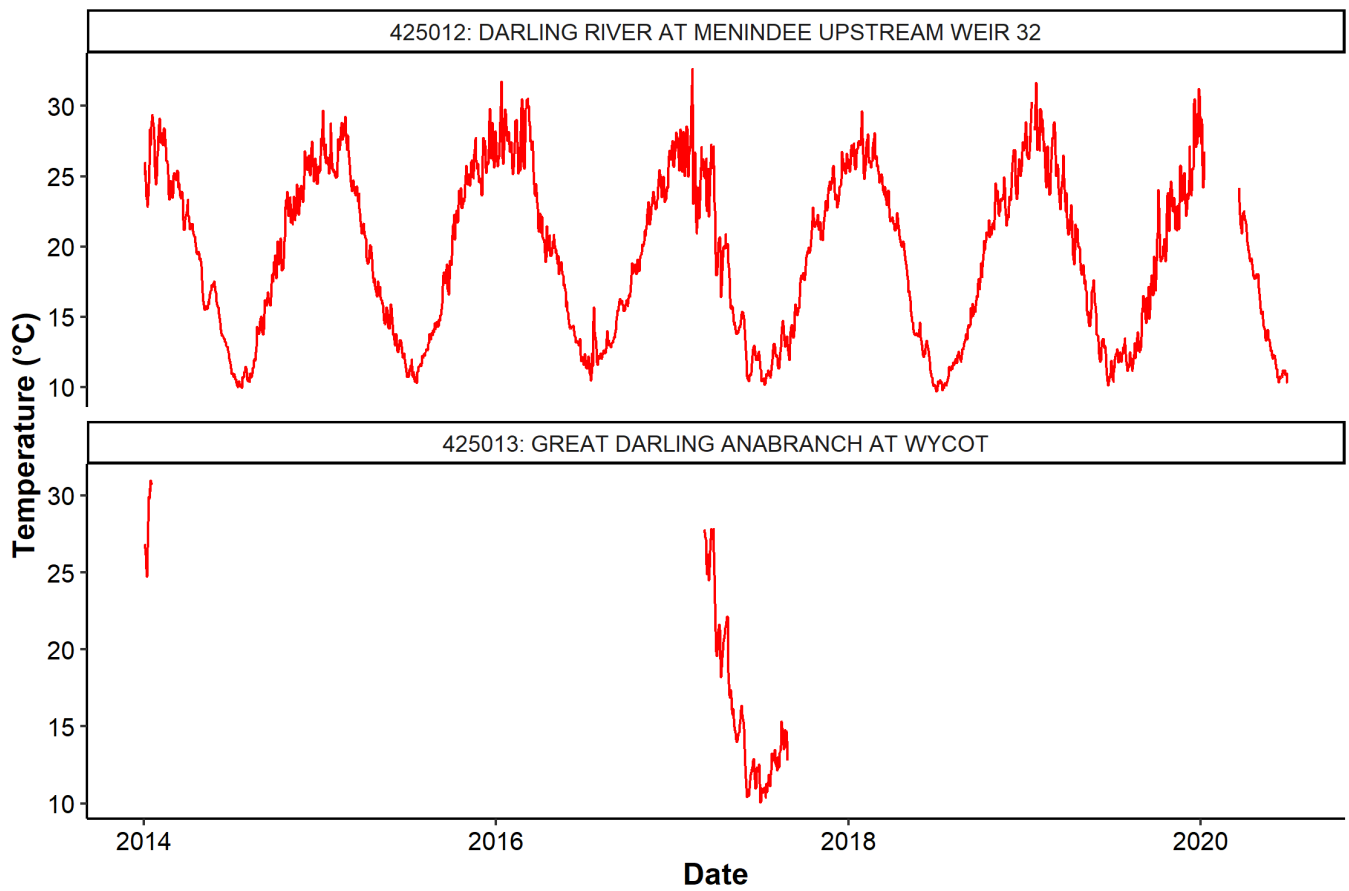

Figure 10.4: Water temperature data from various gauges in the New South Wales Lower Darling WRPA over the reporting period. Gauge locations can be seen on Figure 10.2. Note the differing scales on the y-axis.

Species Diversity

A total of 12 fish species were observed across the New South Wales Lower Darling WRPA including three alien species. Figure 10.5 shows the number of native and alien species found at each site. The full list of species caught and observed is in Table 10.5.
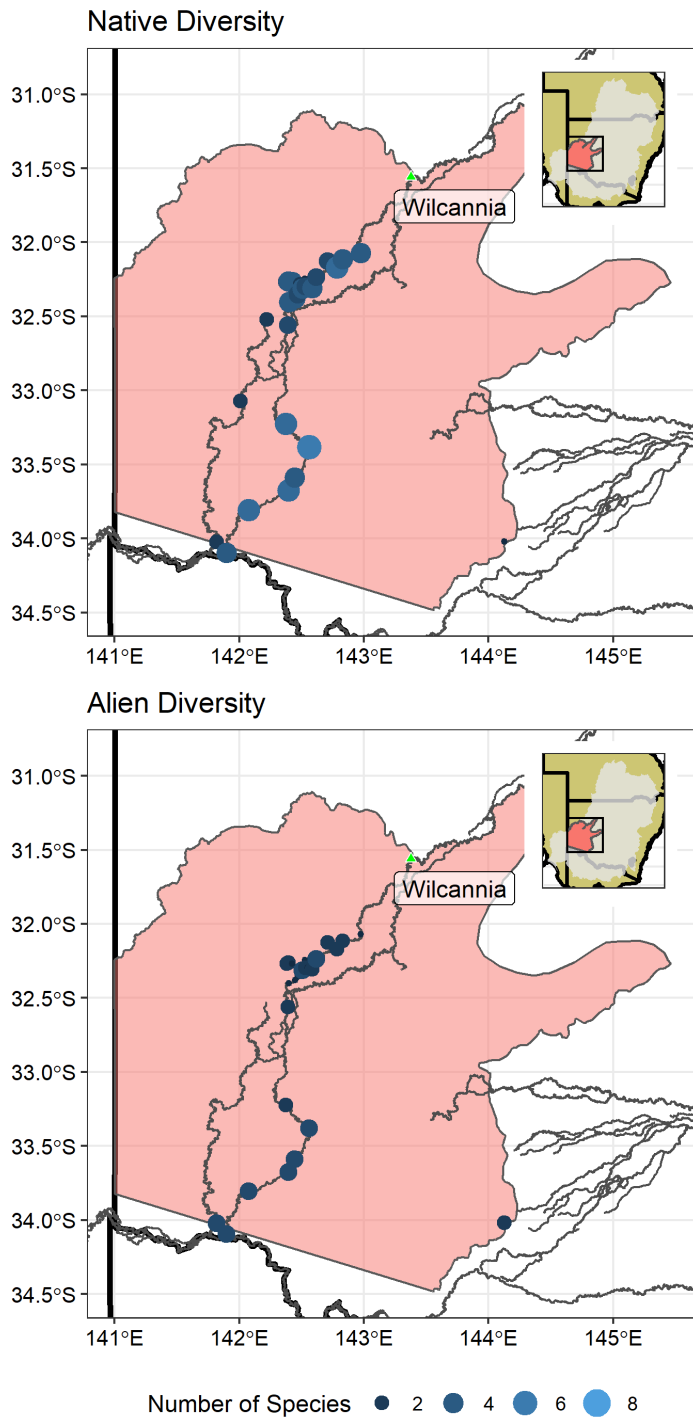

Figure 10.5: Diversity across all sampling sites. Bubble size represents the number of unique species observed at each site across all sampling methods and events. Dry sites are excluded. Green triangles show major towns.

Summary Statement:

Native and alien diversity was generally consistent and relatively low across the New South Wales Lower Darling WRPA.

Murray cod

Population Structure

<u>Figure 10.6</u> shows the observed length frequency plot for Murray cod for each of the sampling seasons. The observed numbers of Young of the Year (YOY) ranged from 0 to 19, 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 Murray cod was 13% (481 out of 3,762).
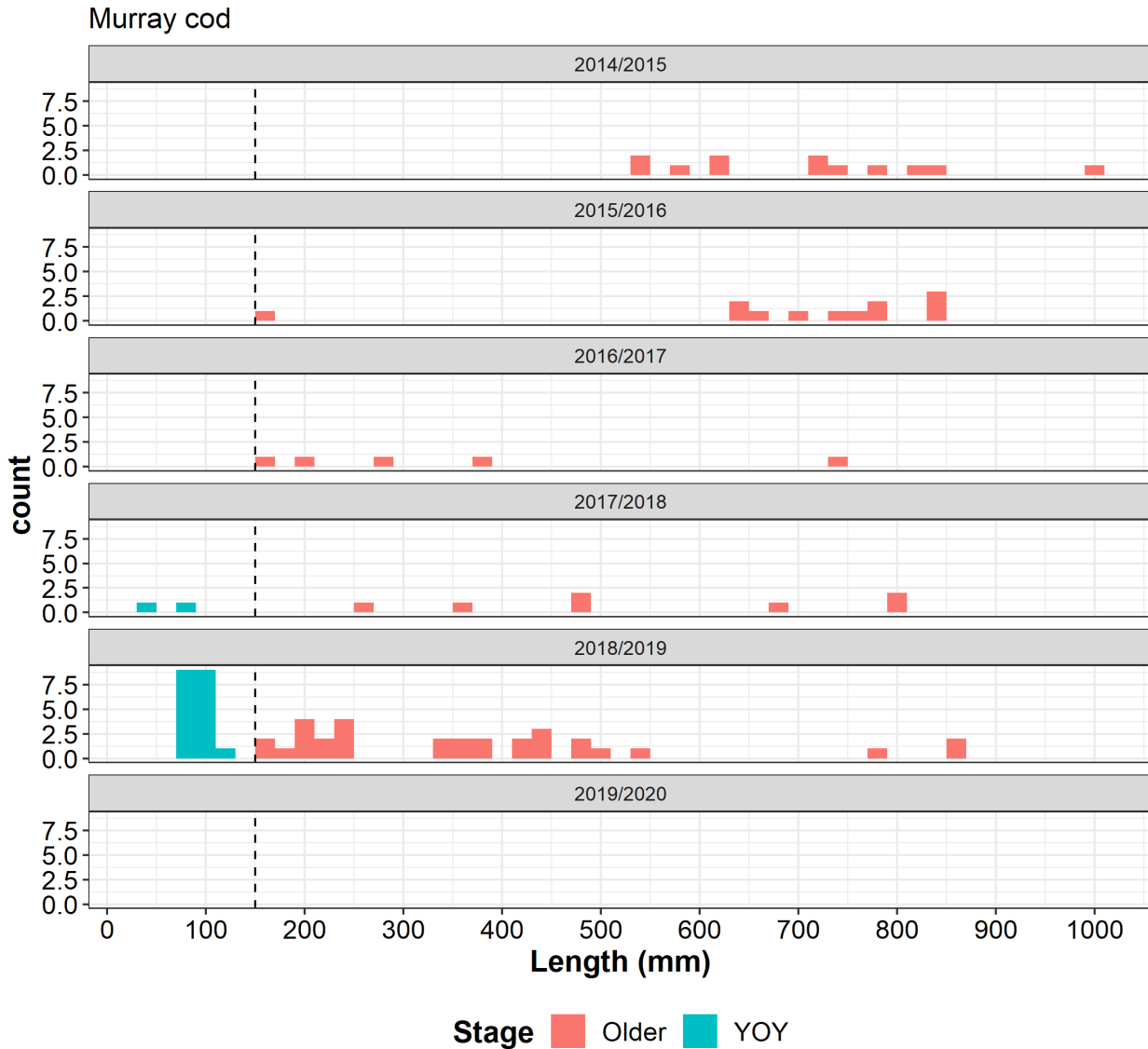

Figure 10.6: Length frequency plots for Murray cod by sampling season. YOY = Young of the Year fish. Note no Murray cod were observed as part of BPEOM-F in 2019/20 hence no data are shown here but there was also only 3 sites sampled in that sampling season. Other programs did observe Murray cod in this area in 2019/2020 (See Table 8).

Summary Statement:

No recruitment detected and low numbers of Murray cod suggesting limited recruitment over successive years from 2014 to 2017, before some recruitment detected in 2017/18 and 2018/19. BPEOM-F detected no Murray cod in 2019/20 although sampling was limited to 3 sites and other programs did detect Murray cod (<u>Table 10.8</u>).

Stocking

Zero Murray cod were stocked into the waterways of the New South Wales Lower Darling WRPA during 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 10.7 shows the abundance trend for the New South Wales Lower Darling WRPA and the right-hand panel shows the overall trend across the NSW MDB.
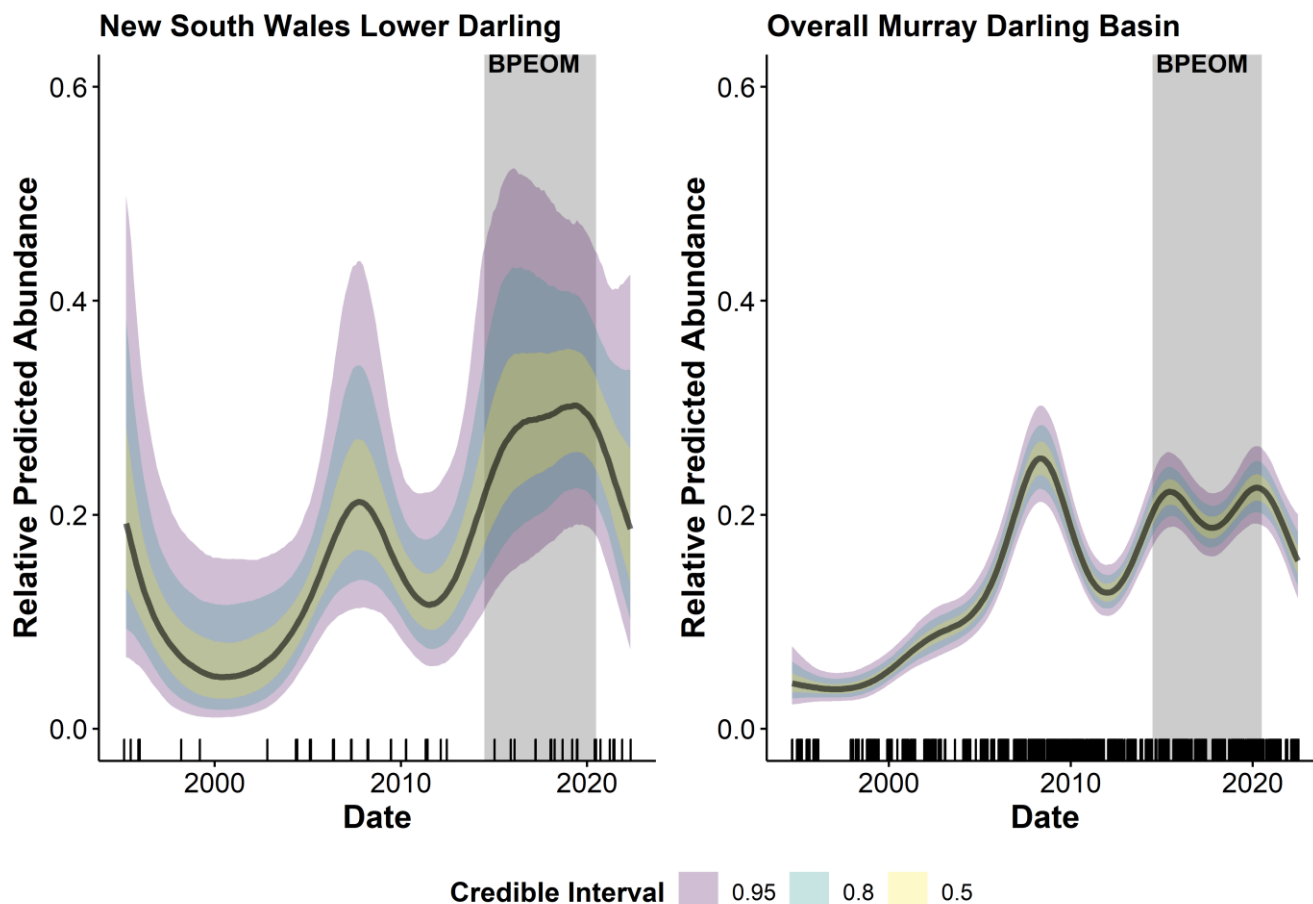

Figure 10.7: Relative abundance of Murray cod in both the New South Wales Lower Darling WRPA and the overall NSW MDB. These are model estimates based upon all boat electrofishing data within the NSW DPI Freshwater ecosystem database and the output of Bayesian generalised additive mixed models. The grey 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:

A slight increasing trend in abundance although the trend is uncertain. In the most recent years, relative abundance is similar to the overall abundance across the NSW MDB.

Health

The prevalence of any health issues ranged from 0% of sampled fish in 2015/2016 to 60% of sampled fish in 2016/2017 (Figure 10.8), noting no Murray cod were observed in 2019/2020. The most common health issue for Murray cod in the New South Wales Lower Darling WRPA was Lerneae, which was observed in a total of 12 fish, corresponding to 14% of all Murray cod measured.

Across the other NSW MDB WRPAs, 17% of Murray cod (635 out of 3,762 Murray cod) showed a health condition (excludes the New South Wales Lower Darling WRPA).
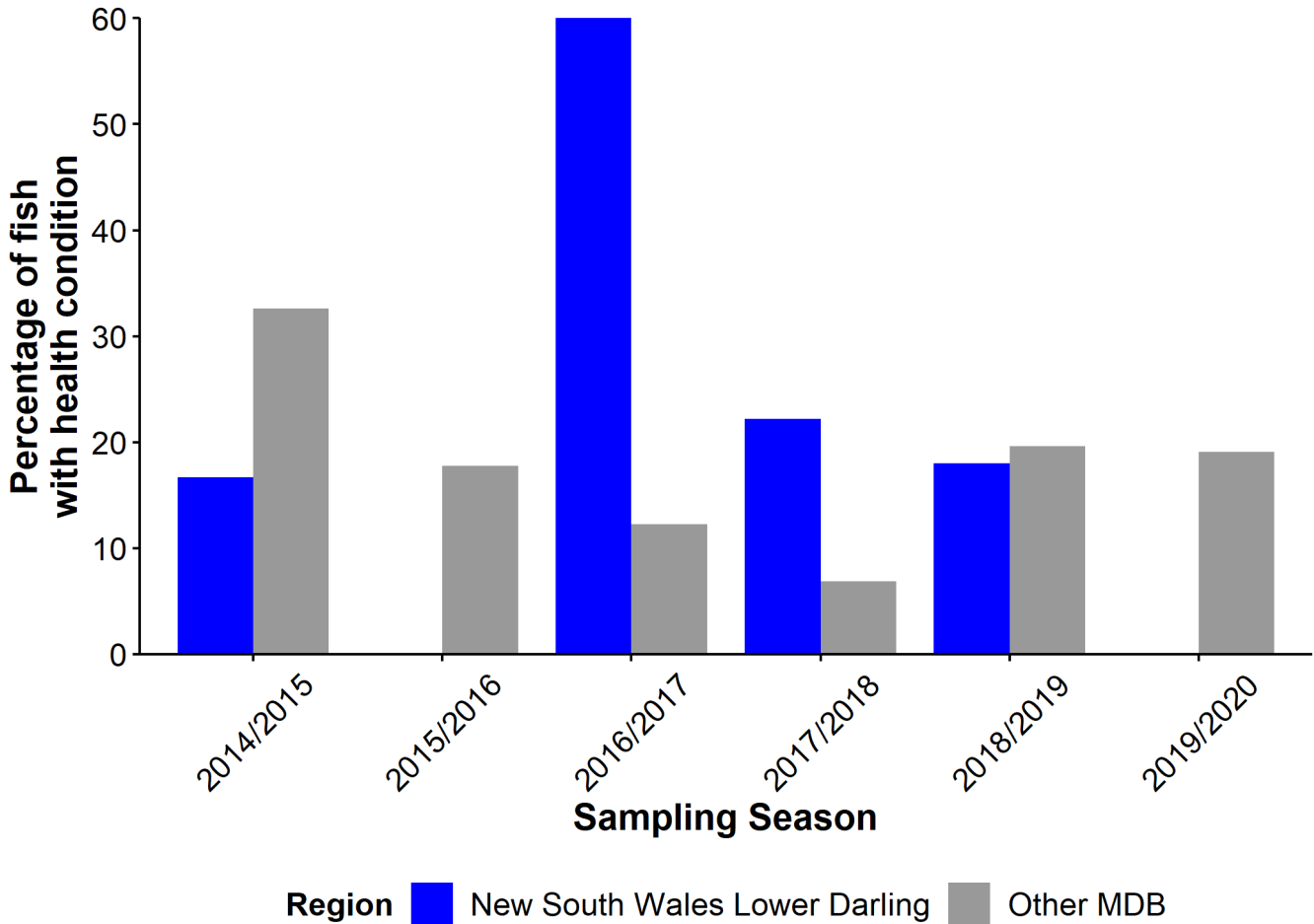

Figure 10.8: Timeseries showing the prevalence of health conditions in Murray cod. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPAs.

Summary Statement:

Presence of observable health conditions was variable across years but was similar to the overall NSW MDB.

Distribution

Murray cod were recorded at 9 out of 31 sites in the New South Wales Lower Darling WRPA. The maximum observed relative abundance at a site was 3 fish caught per 90 seconds of electrofishing. Figure 10.9 shows the distribution and relative abundance of Murray cod across the New South Wales Lower Darling WRPA.

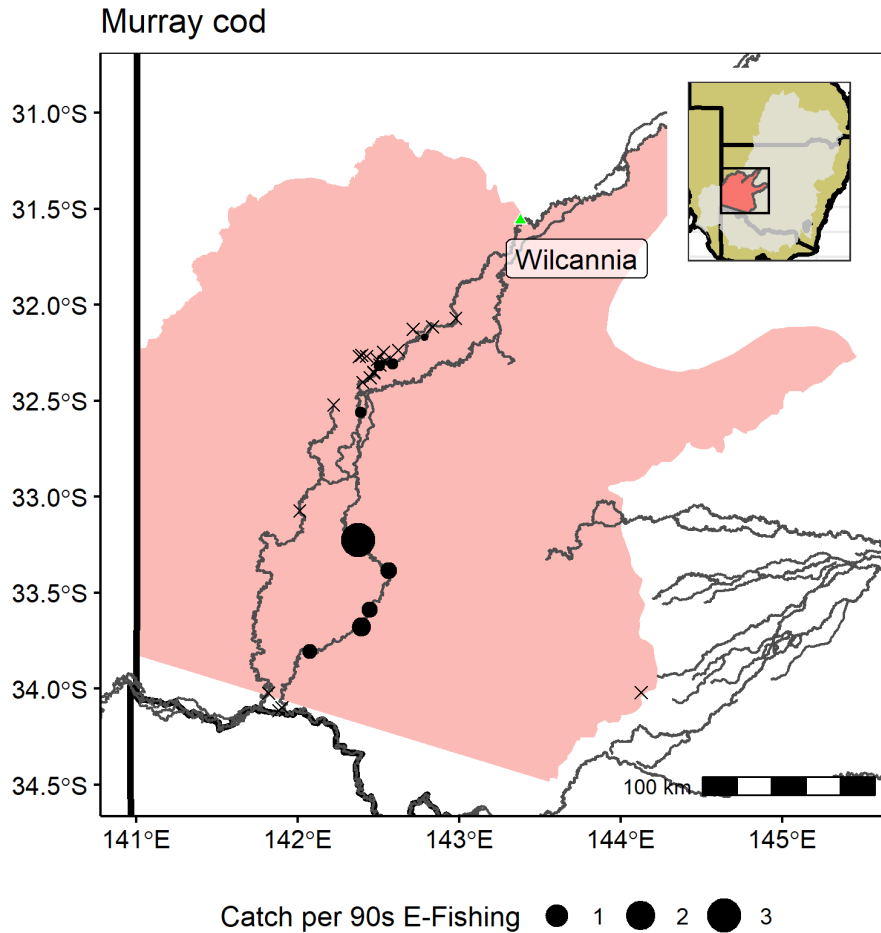Figure 10.9: Distribution of Murray cod. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green triangles show major towns.

Summary Statement:

Murray cod were recorded across NSW Lower Darling WRPA but were absent or less abundant in northern sites.

Golden perch

Population Structure

<u>Figure 10.10</u> 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 24, and 0% to 57% 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 11% (241 out of 2,130).
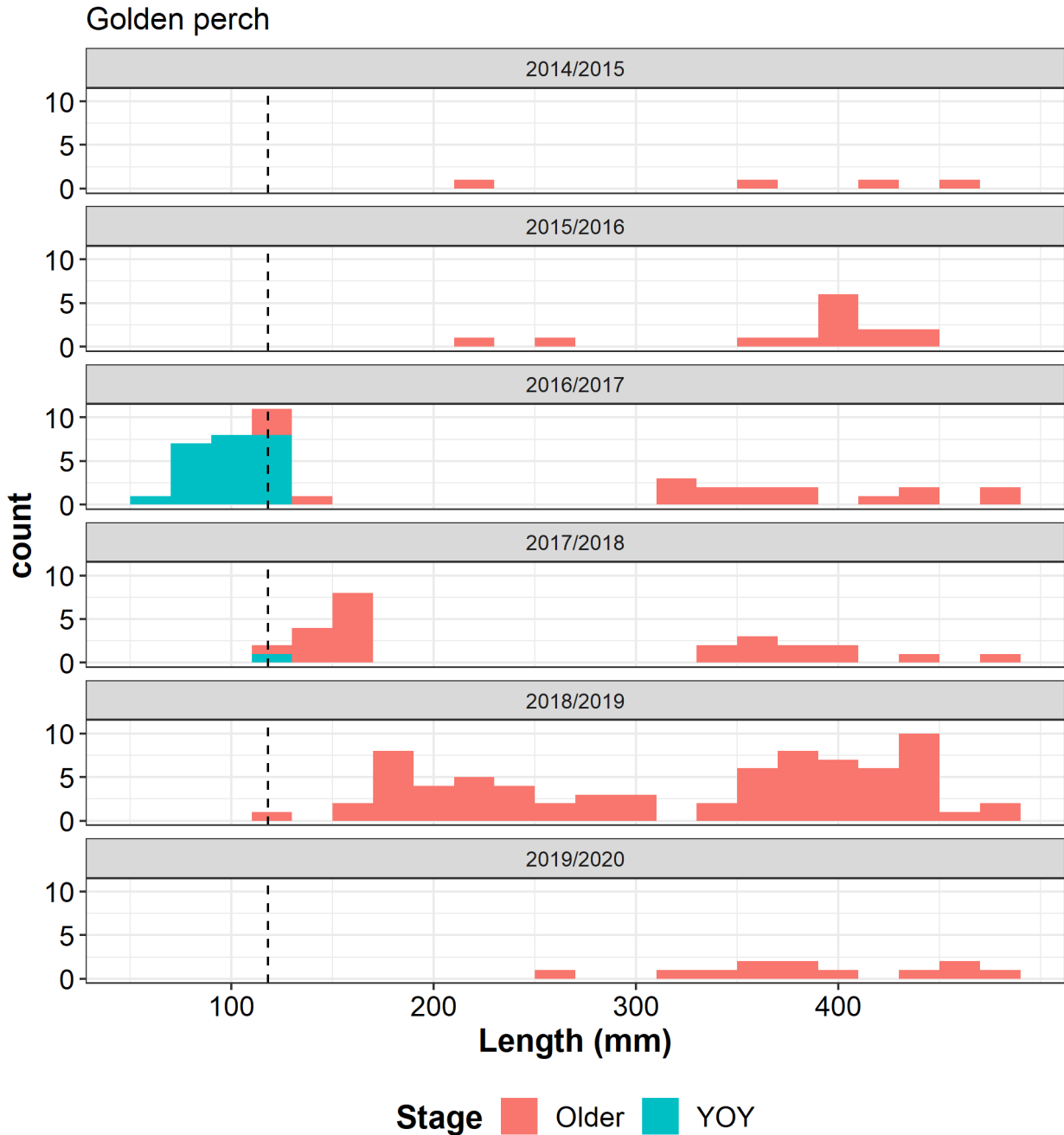

Figure 10.10: Length frequency plots for Golden perch by sampling season. YOY = Young of the Year fish.

Summary Statement:

Limited or no recruitment in most years except 2016/17. Larger size classes present most years.

Stocking

Zero Golden perch were stocked into the waterways of the New South Wales Lower Darling WRPA during 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 10.11 shows the abundance trend for the New South Wales Lower Darling WRPA and the right-hand panel shows the overall trend across the NSW MDB.
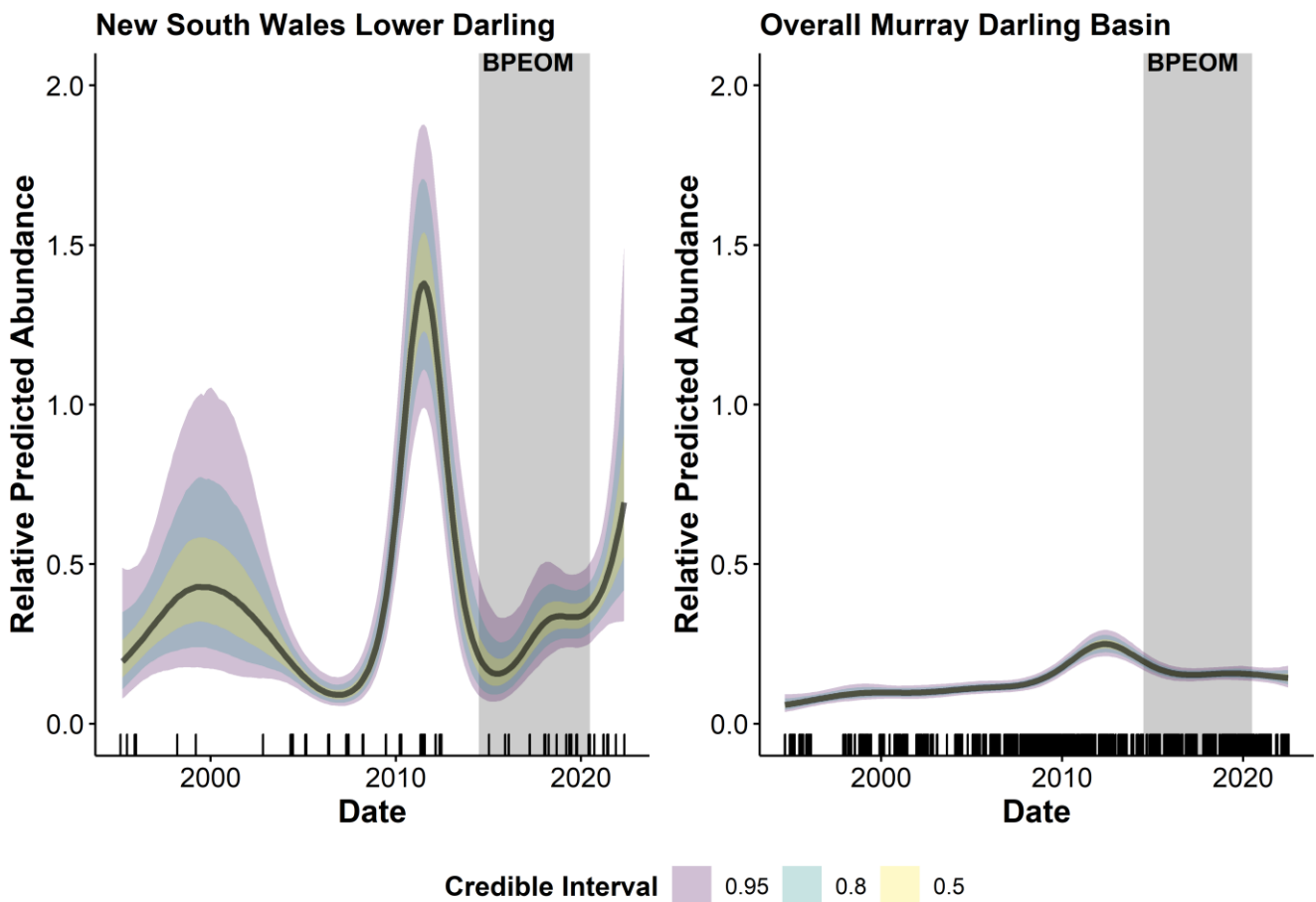

Figure 10.11: Relative abundance of Golden perch in both this valley and the overall Murray-Darling Basin. These are model estimates based upon all boat electrofishing data within the NSW DPI Freshwater ecosystem database and the output of Bayesian generalised additive mixed models. The grey shaded region 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:

Large fluctuations in abundance since the 1990s with a strong peak ~2010 – 2012 before a decline to 2014. Increase in abundance after major recruitment event in 2016/2017. Relative abundance of Golden perch is substantially higher than the overall abundance across the NSW MDB.

Health

The prevalence of any health issues ranged from 7% of sampled fish in 2015/2016 to 68% of sampled fish in 2018/2019 (Figure 10.12). The most common health issue for Golden perch in the New South Wales Lower Darling water resource planning area was Lerneae, which was observed in a total of 58 fish, corresponding to 34% of all Golden perch measured.

Across the other WRPAs, 32% of Golden perch (679 out of 2,130 Golden perch) showed a health condition (excludes New South Wales Lower Darling).
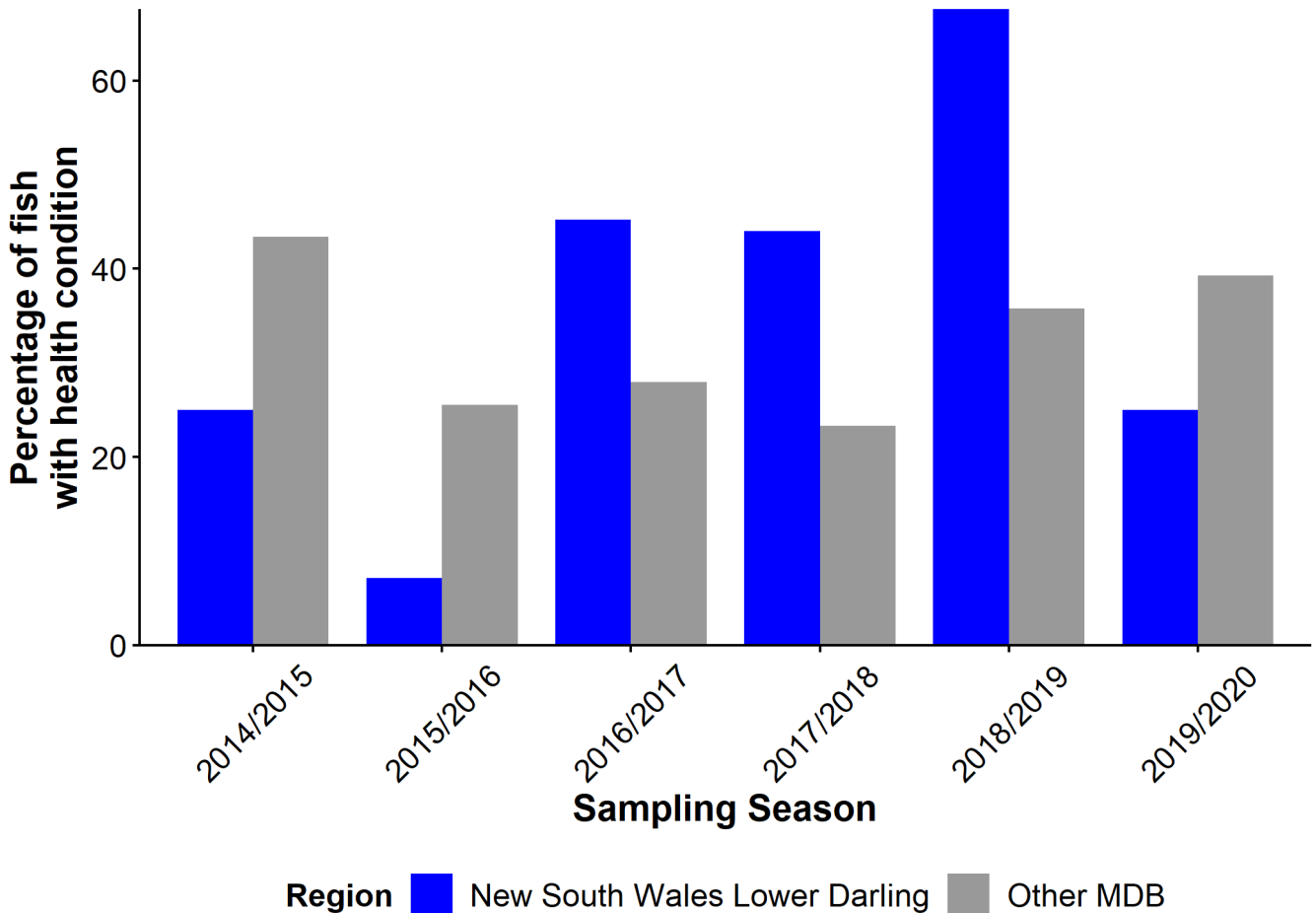

Figure 10.12: Timeseries showing the prevalence of health conditions in Golden perch. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPAs.

Summary Statement:

The presence of observable health conditions for Golden perch in NSW Lower Darling WRPA was variable ranging from 5 – 60% of fish in some seasons.

Distribution

Golden perch were recorded at 17 out of 31 sites in the New South Wales Lower Darling WRPA. The maximum observed relative abundance at a site was 1.5 fish caught per 90 seconds of electrofishing. Figure 10.13 shows the distribution and relative abundance of Golden perch across the New South Wales Lower Darling WRPA.
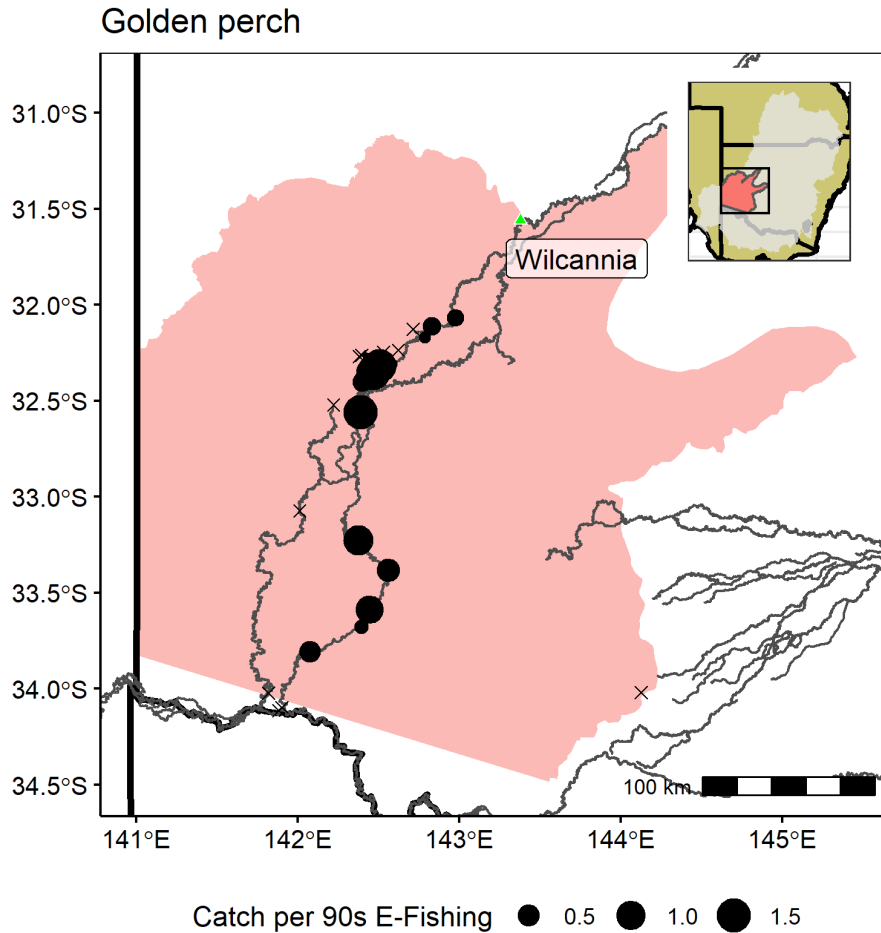

Figure 10.13: Distribution of Golden perch. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green triangles show major towns.

Summary Statement:

Golden perch were distributed across the NSW Lower Darling WRPA region.

Freshwater catfish

No Freshwater catfish were observed or collected in the New South Wales Lower Darling WRPA as part of the BPEOM-F sampling program or any other program during the reporting period.

Summary Statement:

Freshwater catfish were not recorded in surveys of the Lower Darling across the survey period. This suggests they are currently in very low abundance or absent from this region, even though the habitat is expected to be suitable.

Bony herring

Population Structure

Figure 10.14 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 382, and 0% to 73% 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 30% (4,457 out of 14,865). Bony herring are not a stocked species.

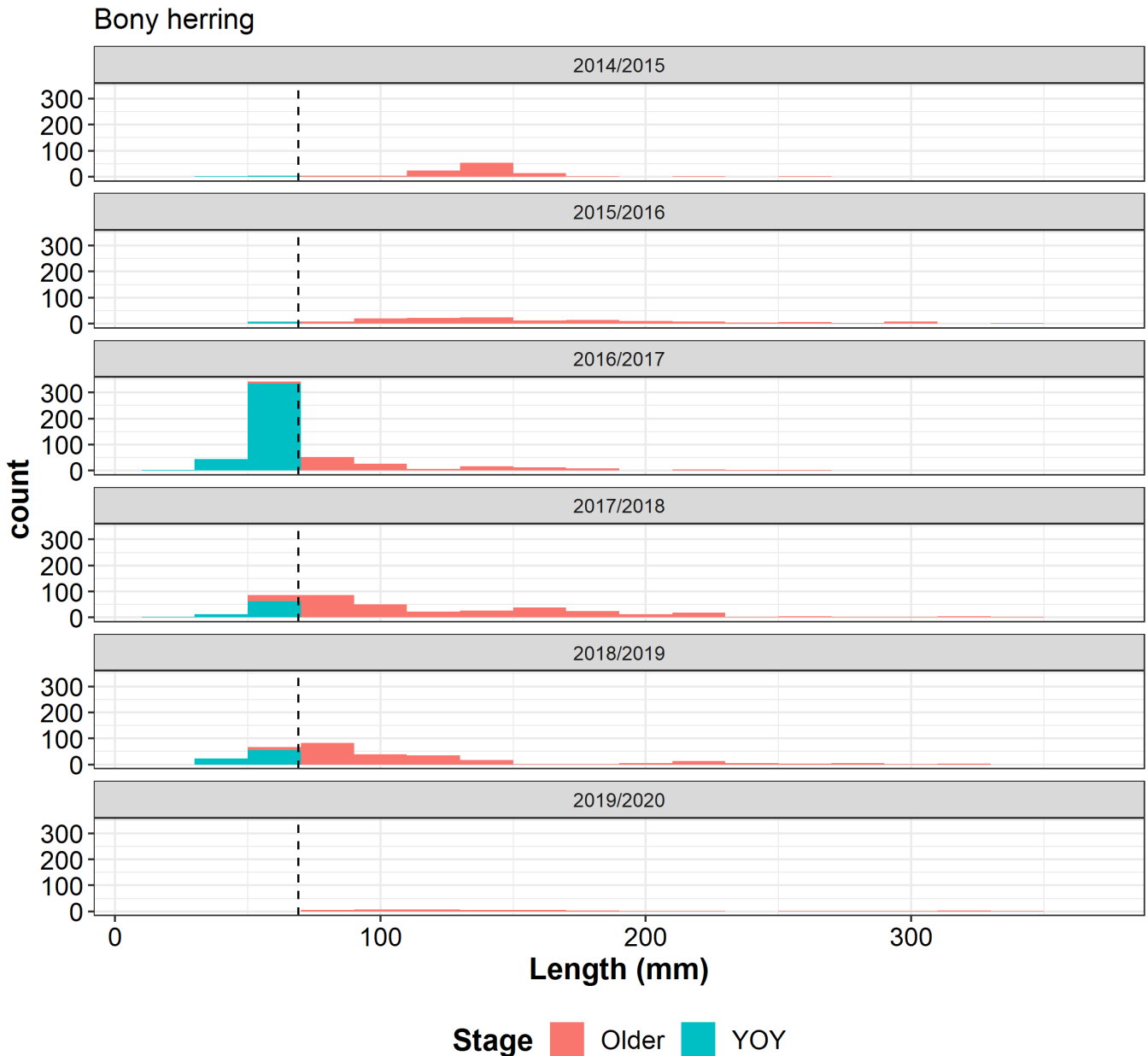Figure 10.14: Length frequency plots for Bony herring by sampling season. YOY represents Young of the Year fish. Note only 3 sites were sampled in 2019/2020 which may be the driver of the low numbers.

Summary Statement:

Variable recruitment with good numbers of young-of-year 2016/17 – 2018/19 and poor recruitment in other years. A range of size classes in most years except 2019/20 when only 3 sites were sampled.

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 10.15 shows the abundance trend for the New South Wales Lower Darling WRPA and the right-hand panel shows the overall trend across the NSW MDB.
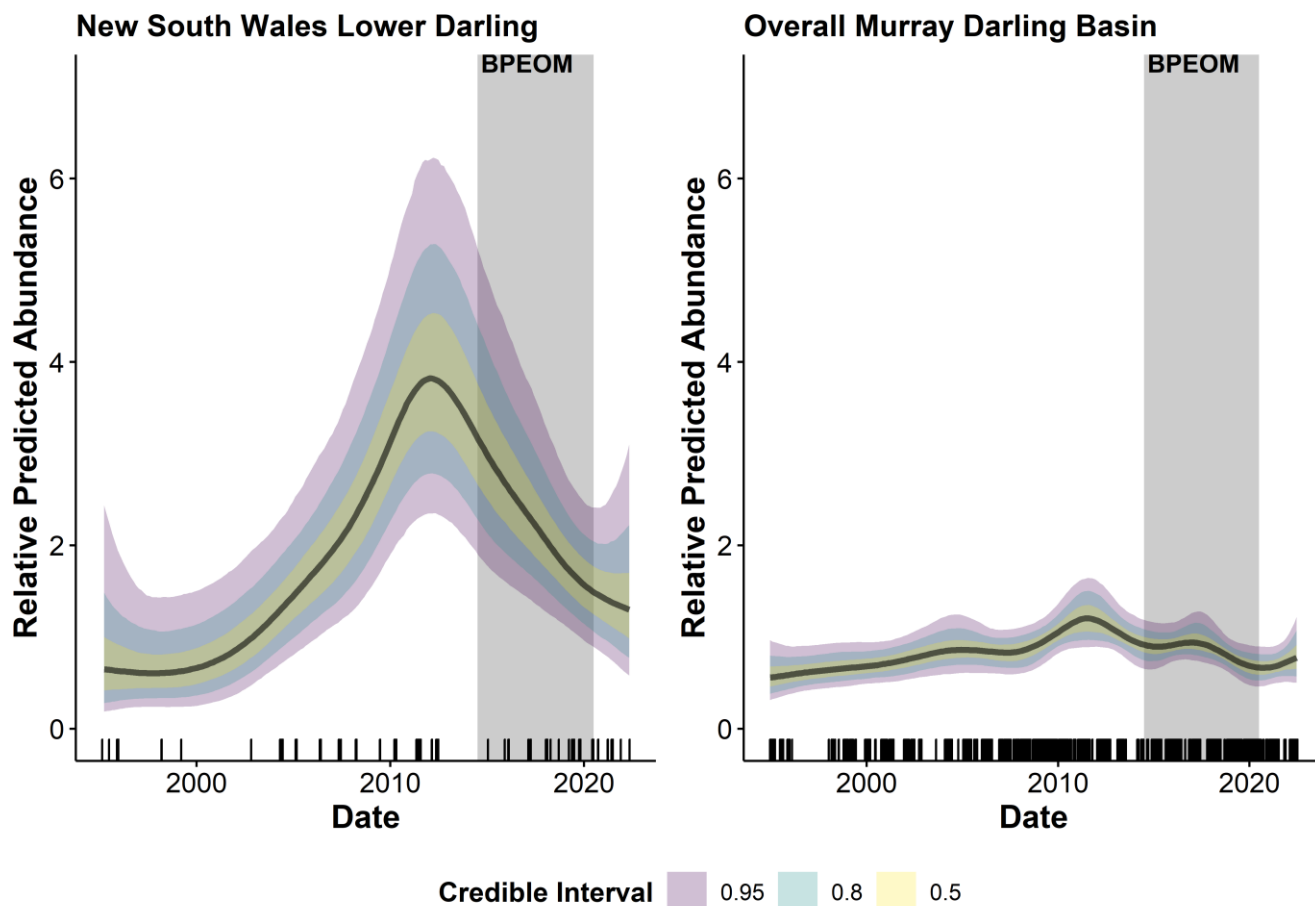
Figure 10.15: Relative abundance of Bony herring in both the New South Wales Lower Darling WRPA and the overall NSW MDB. These are model estimates based upon all boat electrofishing data within the NSW DPI Freshwater ecosystem database and the output of Bayesian generalised additive mixed models. The 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:

Overall abundance increased since the 1990s but has declined since 2012. Relative abundance was generally higher than the overall abundance across the NSW MDB over the study period.

Health

The prevalence of any health issues ranged from 0% of sampled fish in 2014/2015 to 4% of sampled fish in 2019/2020 (Figure 10.16). The most common health issue for Bony herring in the New South Wales Lower Darling WRPA was Wounds, which was observed in a total of 3 fish, corresponding to <1% of all Bony herring measured.

Across the other NSW MDB WRPAs, 1% of Bony herring (185 out of 14,865 Bony herring) showed a health condition (excludes the New South Wales Lower Darling WRPA).
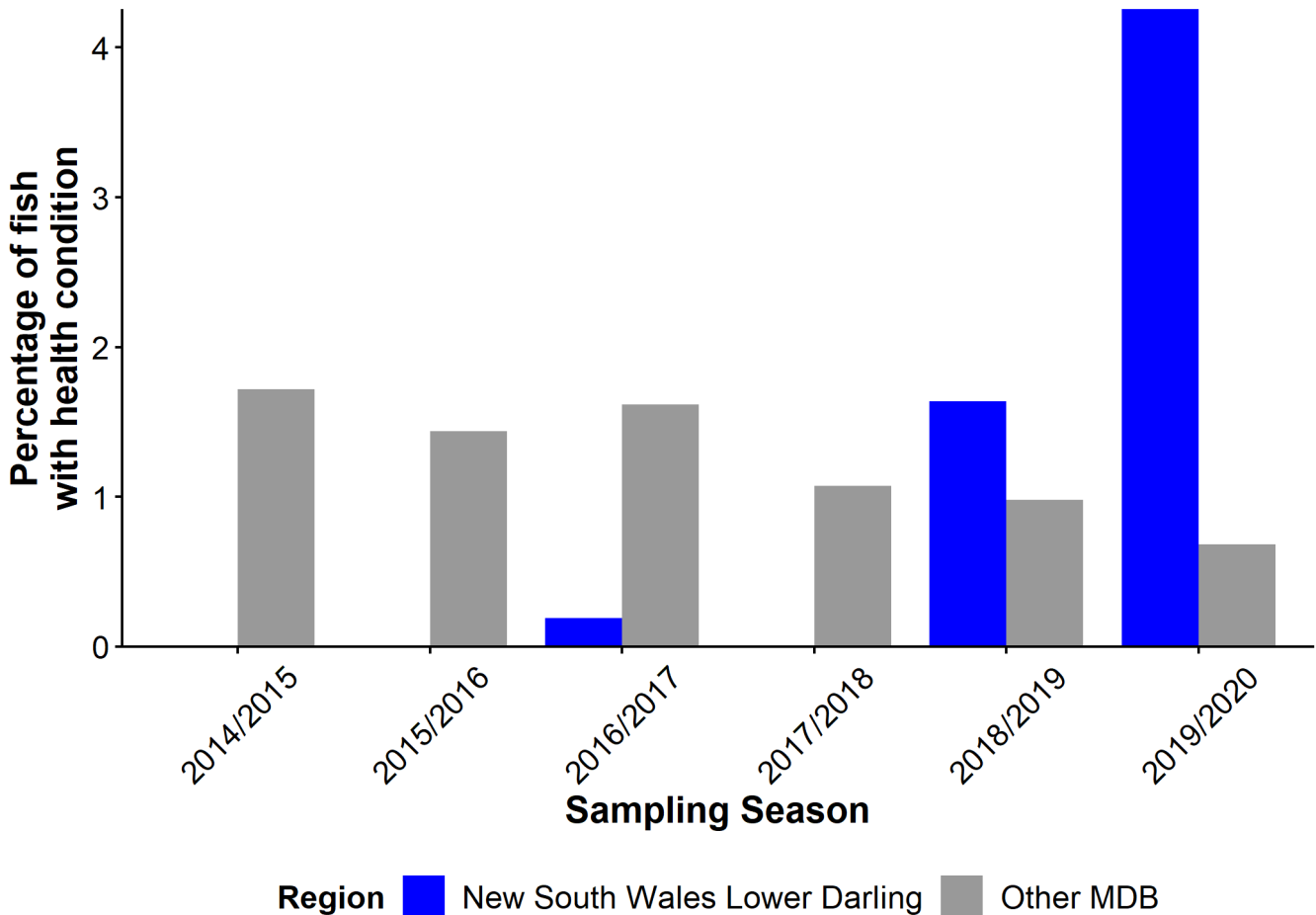

Figure 10.16: Timeseries showing the prevalence of health conditions in Bony herring. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPAs.

Summary Statement:

Presence of observable health conditions was overall low and generally similar to the rest of the NSW MDB. There was an increase in health conditions in the most recent years.

Distribution

Bony herring were recorded at 29 out of 31 sites in the New South Wales Lower Darling WRPA. The maximum observed relative abundance at a site was 64.5 fish caught per 90 seconds of electrofishing. Figure 10.17 shows the distribution and relative abundance of Bony herring across the New South Wales Lower Darling WRPA.

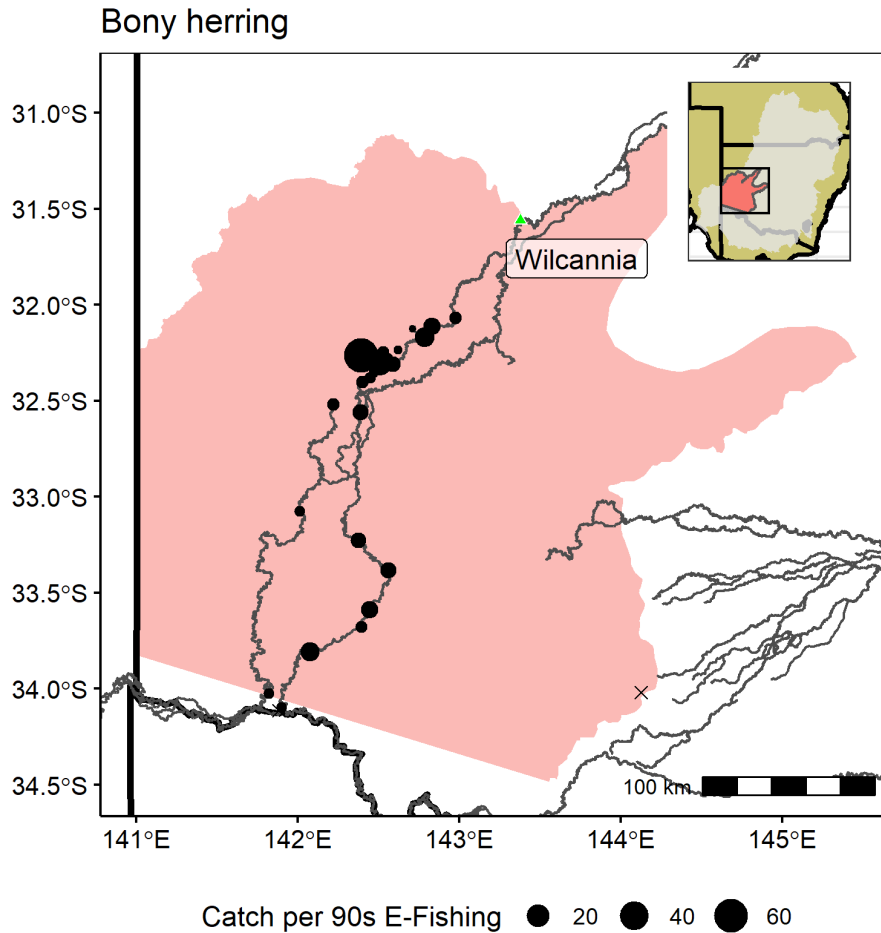Figure 10.17: Distribution of Bony herring. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green triangles show major towns.

Summary Statement:

Bony herring were present in relatively high abundance across the NSW Lower Darling WRPA.

Australian smelt

Population Structure

Figure 10.18 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 4 to 19, and 16% to 88% 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 42% (3,509 out of 8,287). Australian smelt are not a stocked species.
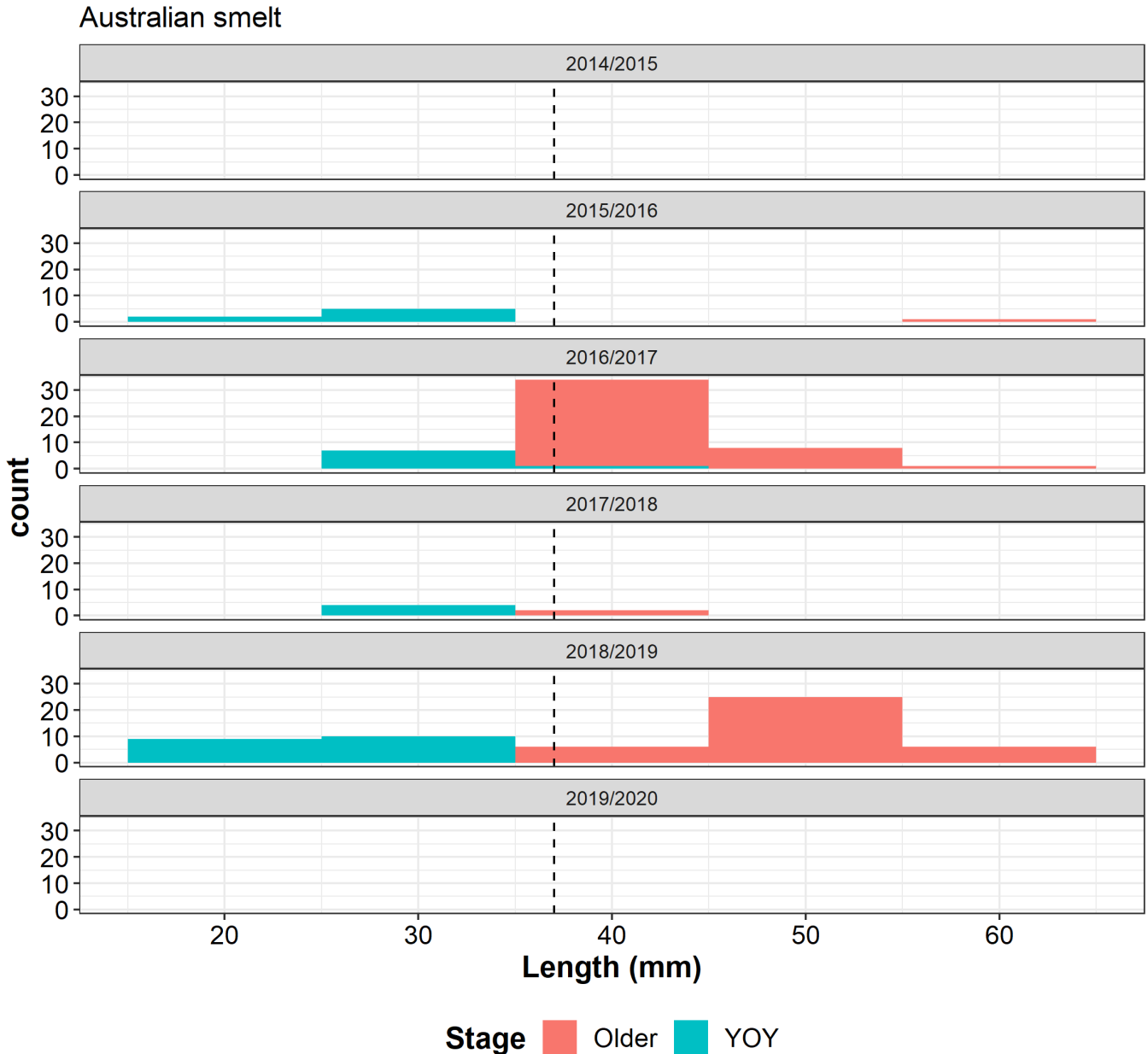
Figure 10.18: Length frequency plots for Australian smelt by sampling season. YOY represents Young of the Year fish. Note only 3 sites were sampled in 2019/20 and the no detections/measurements in this season are not representative.

Summary Statement:

Evidence of regular recruitment with YOY and adult size ranges in most years. No Australian smelt were detected in 2014/15 and 2019/20 although only two and three sites were sampled respectively. Smelt were detected in other sampling programs in the 2019/20 season.

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 10.19 shows the abundance trend for the New South Wales Lower Darling WRPA and the right-hand panel shows the overall trend across the NSW MDB.
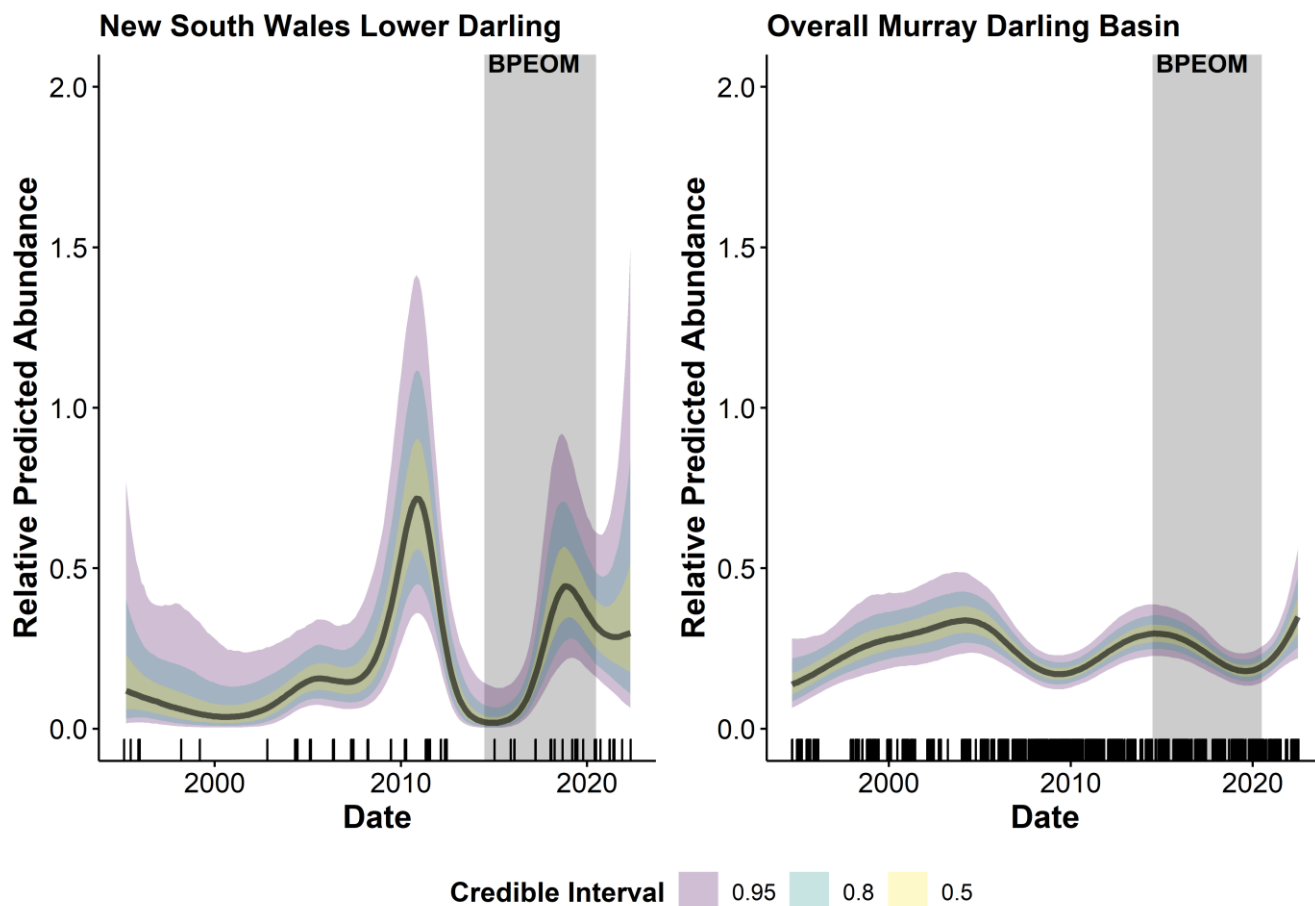
Figure 10.19: Relative abundance of Australian smelt in both the New South Wales Lower Darling WRPA and the overall NSW MDB. These are model estimates based upon all boat electrofishing data within the NSW DPI Freshwater ecosystem database and the output of Bayesian generalised additive mixed models. 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:

Relative abundance is similar to the overall abundance across the NSW MDB, although there is evidence of strong variation in abundance among years.

Health

No health issues were detected in Australian smelt in the New South Wales Lower Darling (Figure 10.20). Across the other NSW MDB WRPAs, <1 % of Australian smelt (53 out of 8,447 Australian smelt) showed a health condition (excludes the New South Wales Lower Darling WRPA).
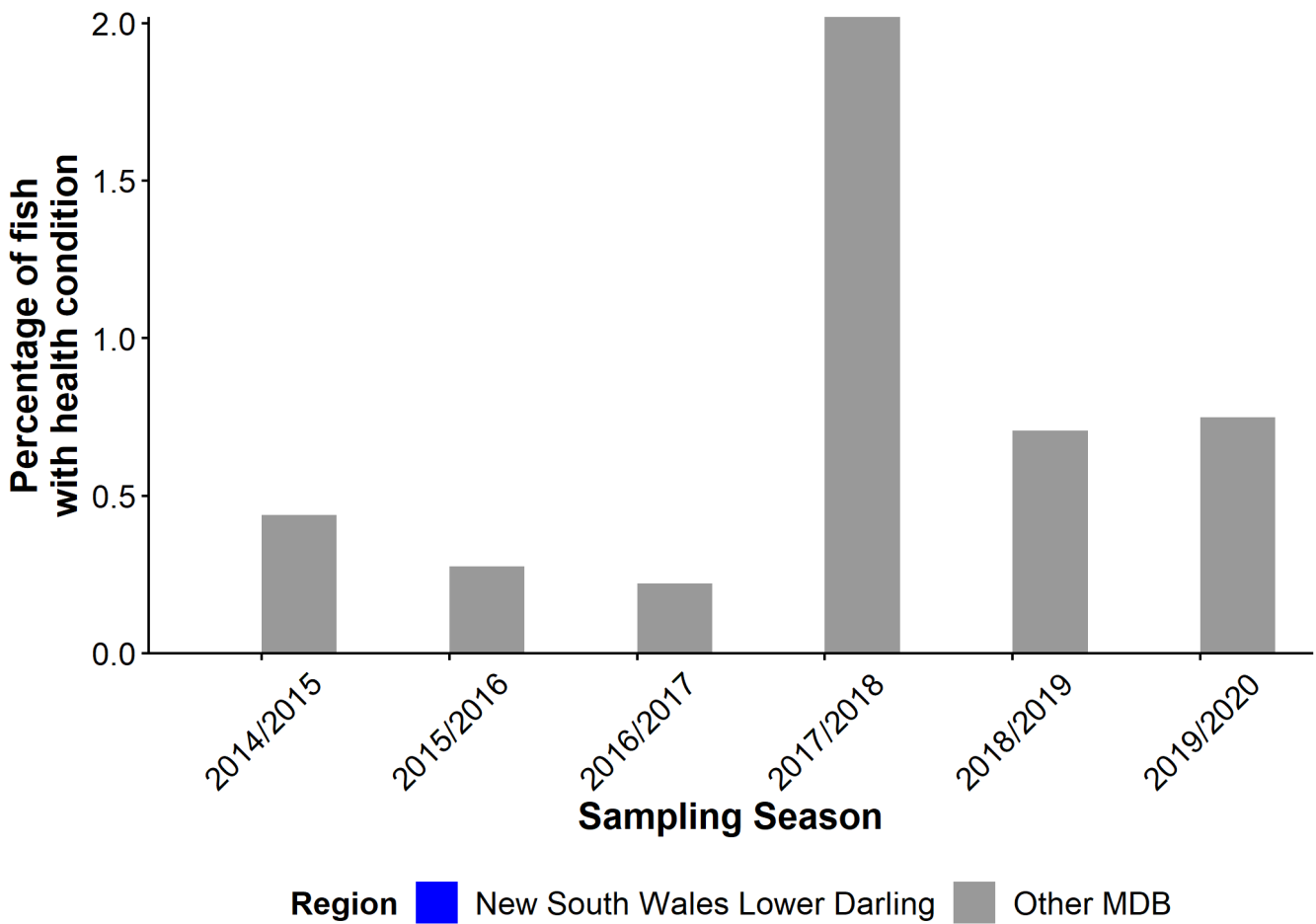

Figure 10.20: Timeseries showing the prevalence of health conditions in Australian smelt. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPAs.

Summary Statement:

No health issues were detected in Australian smelt in the NSW Lower Darling.

Distribution

Australian smelt were recorded at 14 out of 31 sites in the New South Wales Lower Darling WRPA. The maximum observed relative abundance at a site was 1.6 fish caught per 90 seconds of electrofishing. Figure 10.21 shows the distribution and relative abundance of Australian smelt across the New South Wales Lower Darling WRPA.

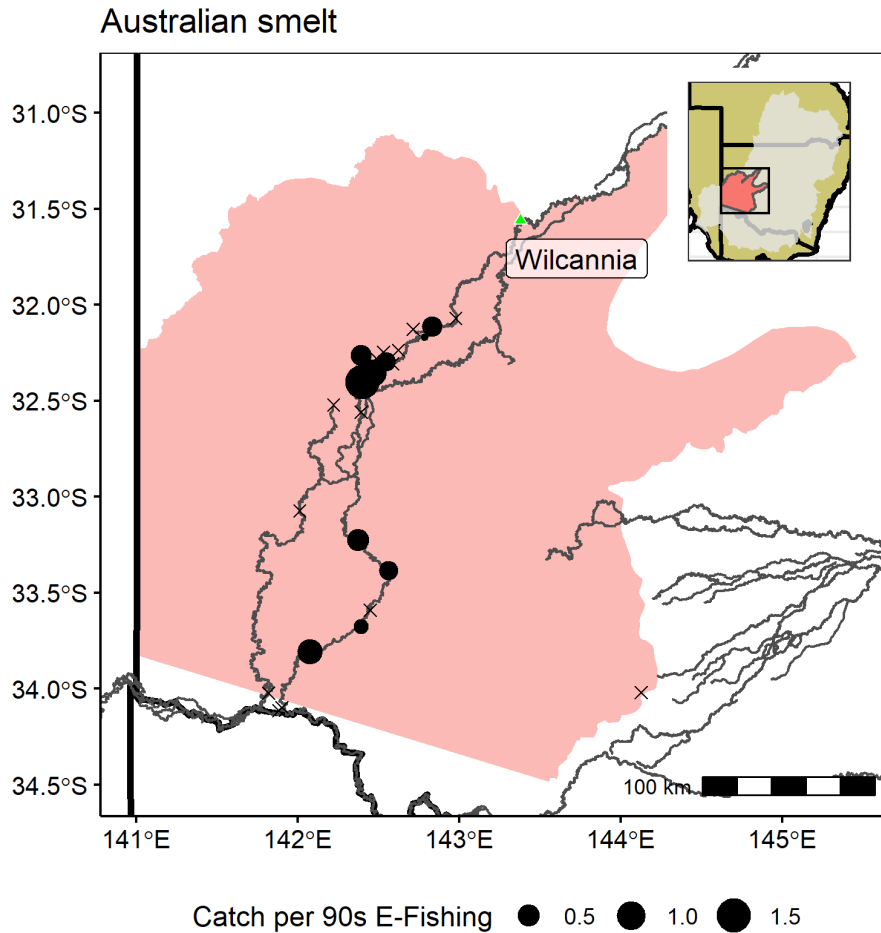Figure 10.21: Distribution of Australian smelt. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X. Green triangles show major towns.

Summary Statement:

Australian smelt were recorded across the NSW Lower Darling (except the Darling Anabranch).

Common carp

Population Structure

<u>Figure 10.22</u> 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 0 to 294, and 0% to 92% 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% (11,597 out of 20,330). Common carp are not a stocked species.
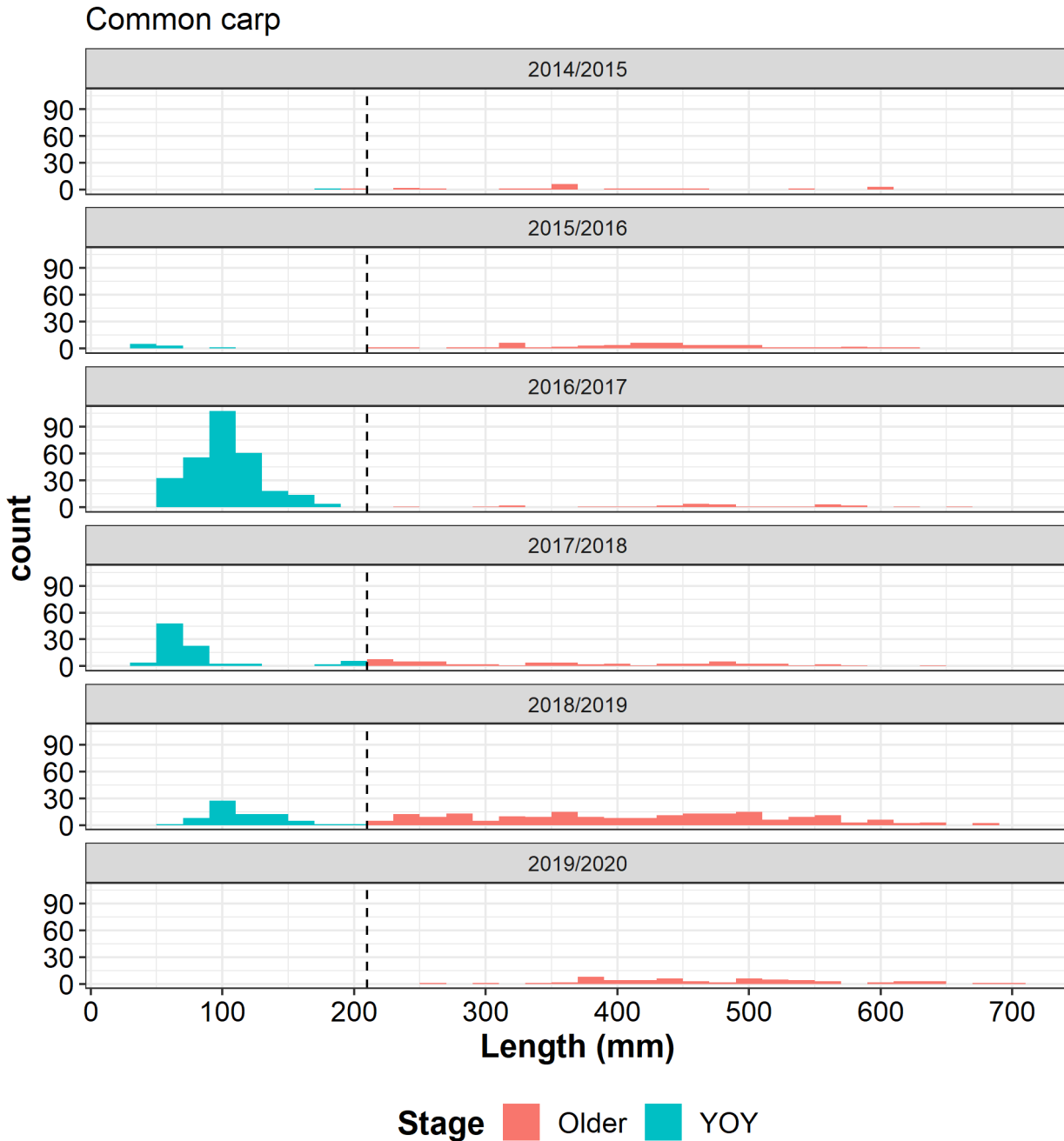

Figure 10.22: Length frequency plots for common carp by sampling season. YOY represents Young of the Year fish.

Summary Statement:

Variable recruitment with a strong peak in 2016/17, moderate recruitment in 2017/18 and 2018/19, and low recruitment in 2014/15, 2015/16 and 2019/20. Large fish present in all years but most abundant in 2018/19.

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 10.23 shows the abundance trend for the New South Wales Lower Darling WRPA and the right-hand panel shows the overall trend across the NSW MDB.
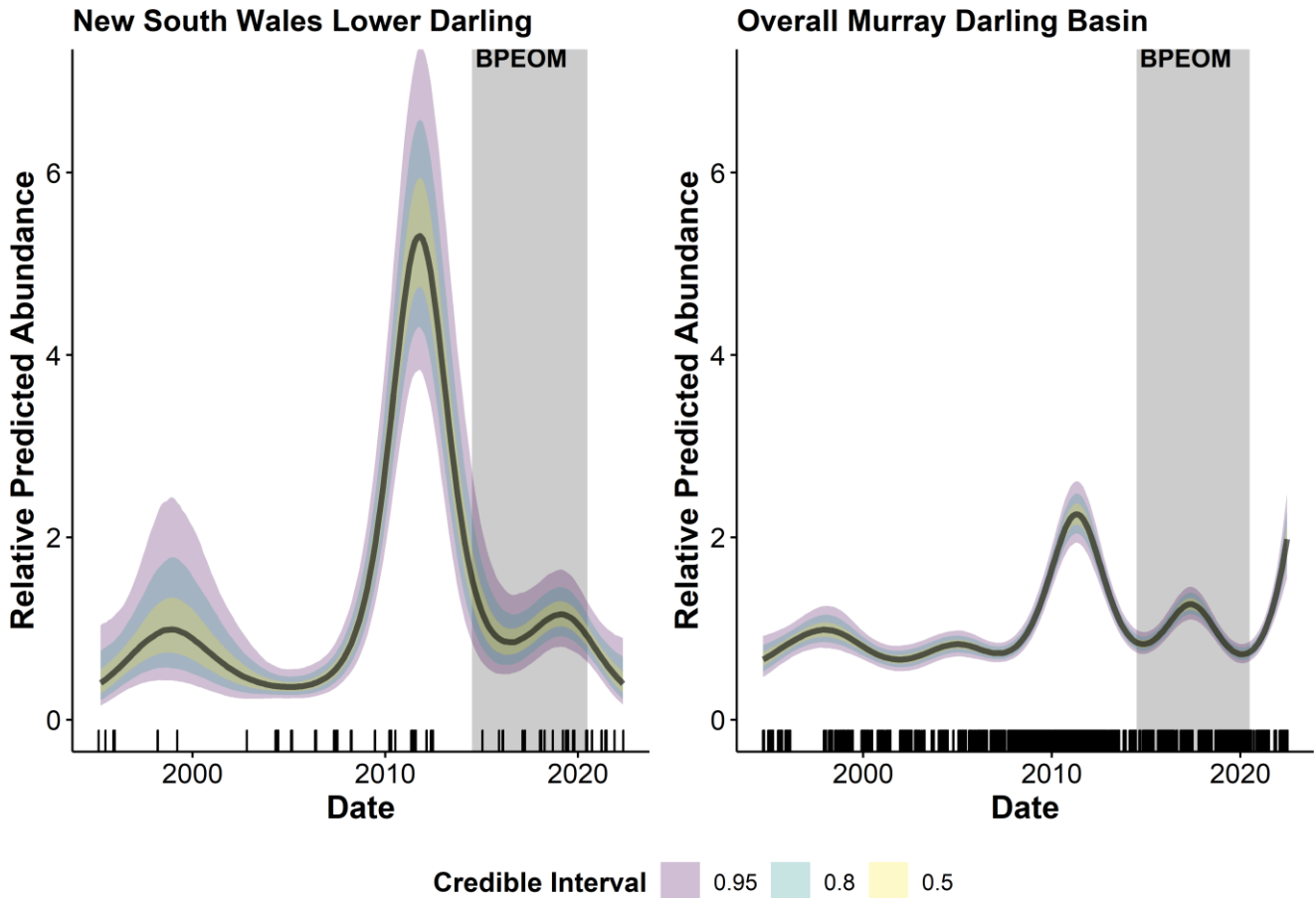
Figure 10.23: Relative abundance of Common carp in both this valley and the overall NSW MDB. These are model estimates based upon all electrofishing data within the NSW DPI Freshwater ecosystem database and the output of Bayesian generalised additive mixed models. The grey shaded region represents the 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:

A major increase in abundance around 2011/12 before return to approximate 1990s levels. Evidence of a decline in abundance in recent years. Relative abundance is was equal to the overall abundance across the NSW MDB during BPEOM-F but is currently lower than the overall NSW MDB.

Health

The prevalence of any health issues ranged from 0% of sampled fish in 2014/2015 to 7% of sampled fish in 2019/2020 (Figure 10.24). The most common health issue for Common carp in the New South Wales Lower Darling water resource planning area was Lerneae, which was observed in a total of 14 fish, corresponding to 2% of all Common carp measured.

Across the other WRPAs, 6% of Common carp (1,131 out of 20,331 Common carp) showed a health condition (excludes New South Wales Lower Darling).
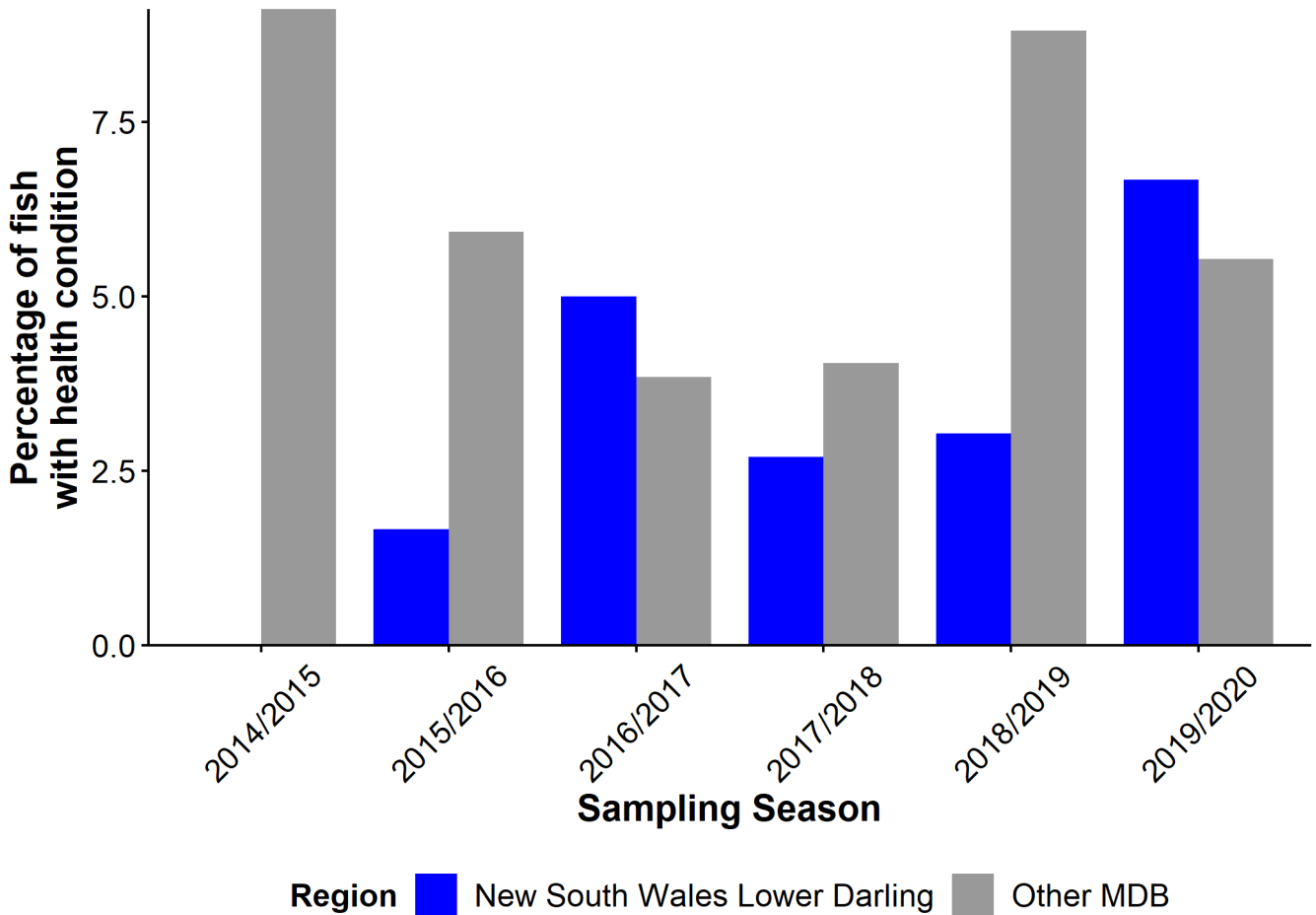
Figure 10.24: Timeseries showing the prevalence of health conditions in Common carp. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPAs.

Summary Statement:

The presence of observable health conditions for Common carp in the NSW Lower Darling was low to moderate and generally similar to the wider NSW MDB.

Distribution

Common carp were recorded at 26 out of 31 sites in the New South Wales Lower Darling WRPA. The maximum observed relative abundance at a site was 14.5 fish caught per 90 seconds of electrofishing. Figure 10.25 shows the distribution and relative abundance of Common carp across the New South Wales Lower Darling WRPA.

Figure 10.25: 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. Green triangles show major towns.

Summary Statement:

Common carp were found in relatively high abundance across the NSW Lower Darling region.

Threatened Species

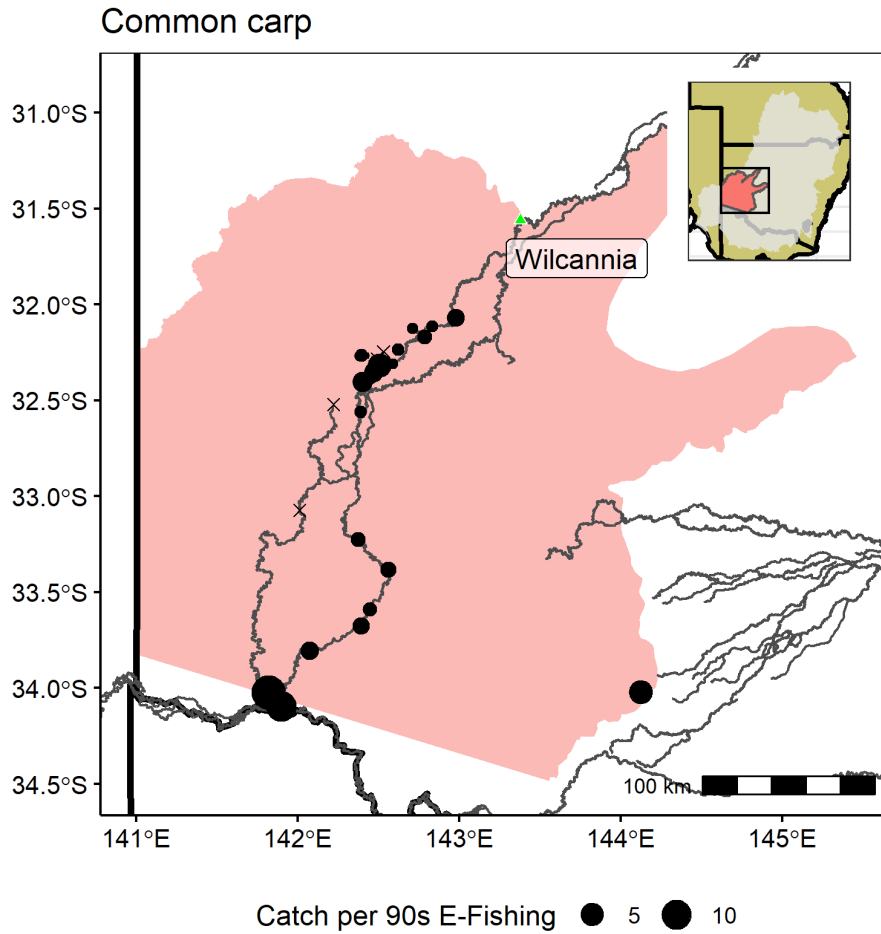The following table ([Table 10.4](#)) shows the fish species listed under either the *NSW Fisheries Management Act* 1994 (FMA) or the *Commonwealth Environmental Protection and Biodiversity Conservation Act* 1999 (EPBC) which were observed in the NSW Lower Darling Water Resource Planning Area during the BPEOM-F 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 10.8](#).

Table 10.4: Listed species which were observed in this region during the BPEOM-F program. (* = FMA, # = EPBC)

Species	Common name	Total caught (observed)
Bidyanus bidyanus	Silver perch[*#]	2 (0)
Maccullochella peelii	Murray cod[#]	90 (25)

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

Silver perch

Individuals Observed • 1 ● 4 ● 16
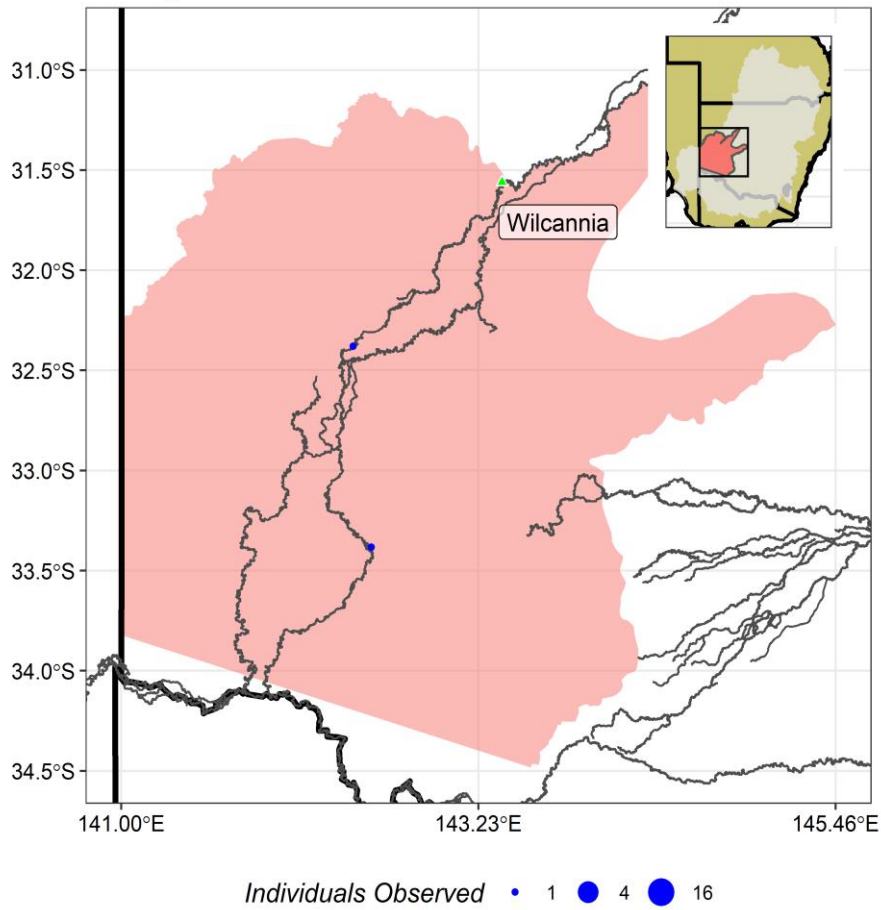
Figure 10.26: Distribution of the observed threated species. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance. Green triangles show major towns.

Summary Statement:

Two Silver perch of ≈300 mm fork length were recorded in the NSW Lower Darling near Pooncarie in March 2017 and Menindee in October 2019.
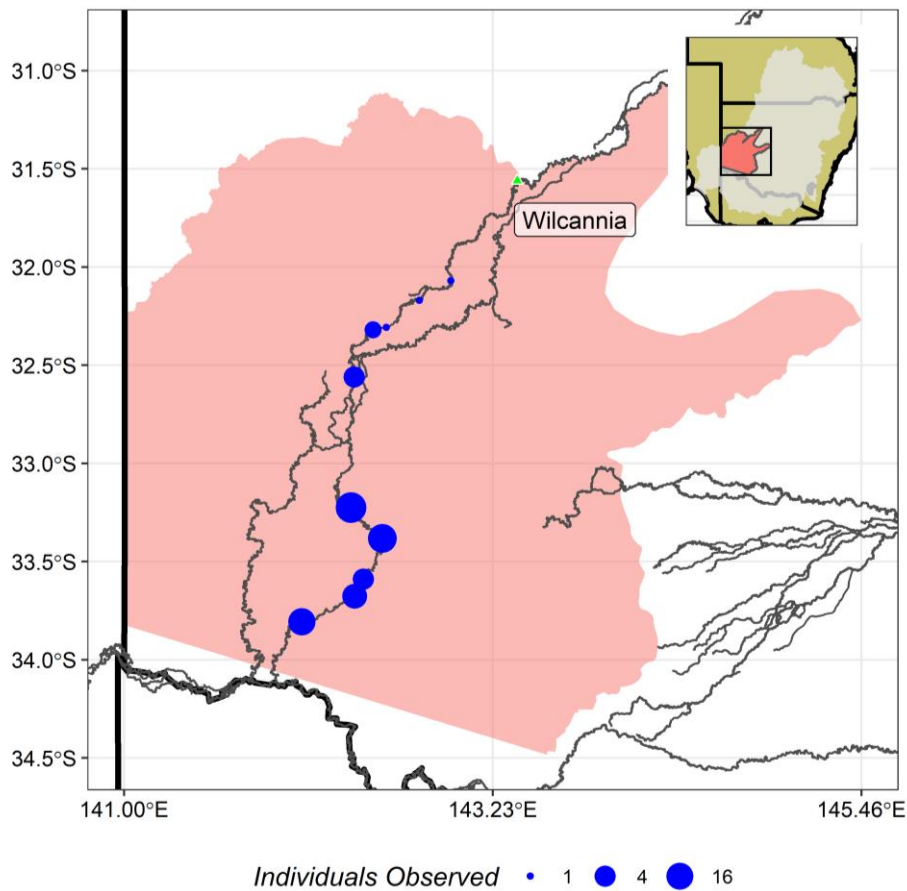
Figure 10.27: Distribution of the observed threated species. Filled circles show sites where the species was present, and the size of the circle represents number of observed individuals abundance. Green triangles show major towns.

Summary Statement:

A total of 115 Murray cod were caught or observed across 10 sites in the NSW Lower Darling region over the study period. The sites were distributed across the whole region except the anabranch. No Murray cod have been collected from NSW Lower Darling region since 2018/19.

Appendix

<u>Figure 10.28</u> shows the locations of sites sampled in each sampling season.
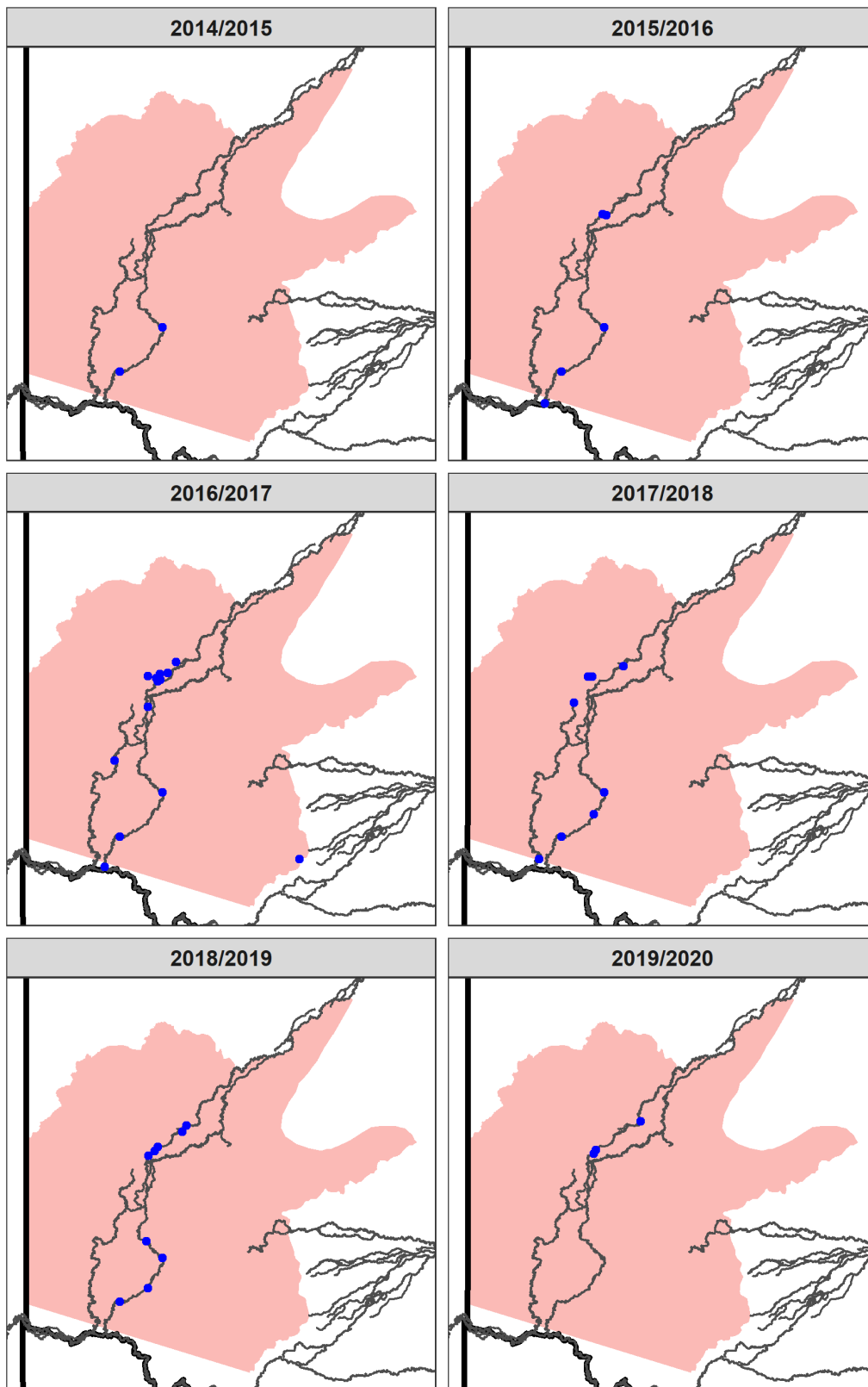
Figure 10.28: Sites sampled during the BPEOM-F program by Sampling Season. Dry sites are not shown.

Table 10.5 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 10.1. 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 New South Wales Lower Darling WRPA were: Olive perchlet, Murray hardyhead, Flat-headed galaxias, Macquarie perch, Trout cod, Southern purple-spotted gudgeon, Flathead gudgeon, Dwarf flathead gudgeon, Freshwater catfish, Redfin. 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 10.8.

Table 10.5: 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	0	8	50	6	56	0
Bony herring	YES	272	160	1,665	858	556	47
Carp-gudgeon species complex	YES	36	621	231	1,380	579	132
Common carp	NA	21	60	385	239	264	60
Eastern gambusia	NA	1	16	160	71	57	0
Golden perch	YES	4	14	42	23	74	12
Goldfish	NA	1	48	16	10	63	0
Murray-Darling rainbowfish	YES	0	0	6	0	0	0
Murray cod	YES	12	12	5	11	50	0
Silver perch	YES	0	0	1	0	0	1
Spangled perch	YES	0	0	2	0	0	0
Unspecked hardyhead	YES	0	1	4	0	0	0

The following table summaries the sampling methods by which each fish species was caught (<u>Table 10.6</u>).

Table 10.6: Summary of total catch of each species by sampling method.

Common name	Backpack Electrofishing	Bait Trap	Boat Electrofishing
Australian smelt	0	0	120
Bony herring	4	0	3,554
Carp-gudgeon species complex	13	2,692	274
Common carp	84	72	873
Eastern gambusia	3	8	294
Golden perch	0	3	166
Goldfish	1	1	136
Murray-Darling rainbowfish	0	0	6
Murray cod	0	0	90
Silver perch	0	0	2
Spangled perch	2	0	0
Unspecked hardyhead	0	0	5

Table 10.7: Listed threatened species recorded in the MDB (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 10.8 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 New South Wales Lower Darling WRPA were: Olive perchlet, Murray hardyhead, Flat-headed galaxias, Macquarie perch, Trout cod, Southern purple-spotted gudgeon, Flathead gudgeon, Dwarf flathead gudgeon, Freshwater catfish, Redfin. 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 10.5.

Table 10.8: 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	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20
Australian smelt	YES	0	8	50	6	172	58
Bony herring	YES	272	160	1,701	858	2,432	393
Carp-gudgeon species complex	YES	36	621	225	1,380	1,898	204
Common carp	NA	21	60	313	239	796	238
Eastern Gambusia	NA	1	16	159	71	88	4
Golden perch	YES	4	14	42	23	233	78
Goldfish	NA	1	48	17	10	137	5
Murray-Darling rainbowfish	YES	0	0	6	0	0	0
Murray cod	YES	12	12	5	11	97	20
Silver perch	YES	0	0	1	0	5	1
Spangled perch	YES	0	0	2	0	0	0
Unspecked hardyhead	YES	0	1	4	0	0	0
Australian smelt	YES	0	8	50	6	172	58
Bony herring	YES	272	160	1,701	858	2,432	393