

## Chapter 4 Basin Plan Environmental Outcomes Monitoring for Fish (2014/15 – 2019/20): Intersecting Streams Water Resource Planning Area



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## Citation Details

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Cover image credit: NSW DPI FER Staff; Fish images credit: Gunther Schmida

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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 Intersecting Streams Water Resource Planning Area (WRPA) shown in [Figure 4.1](#).

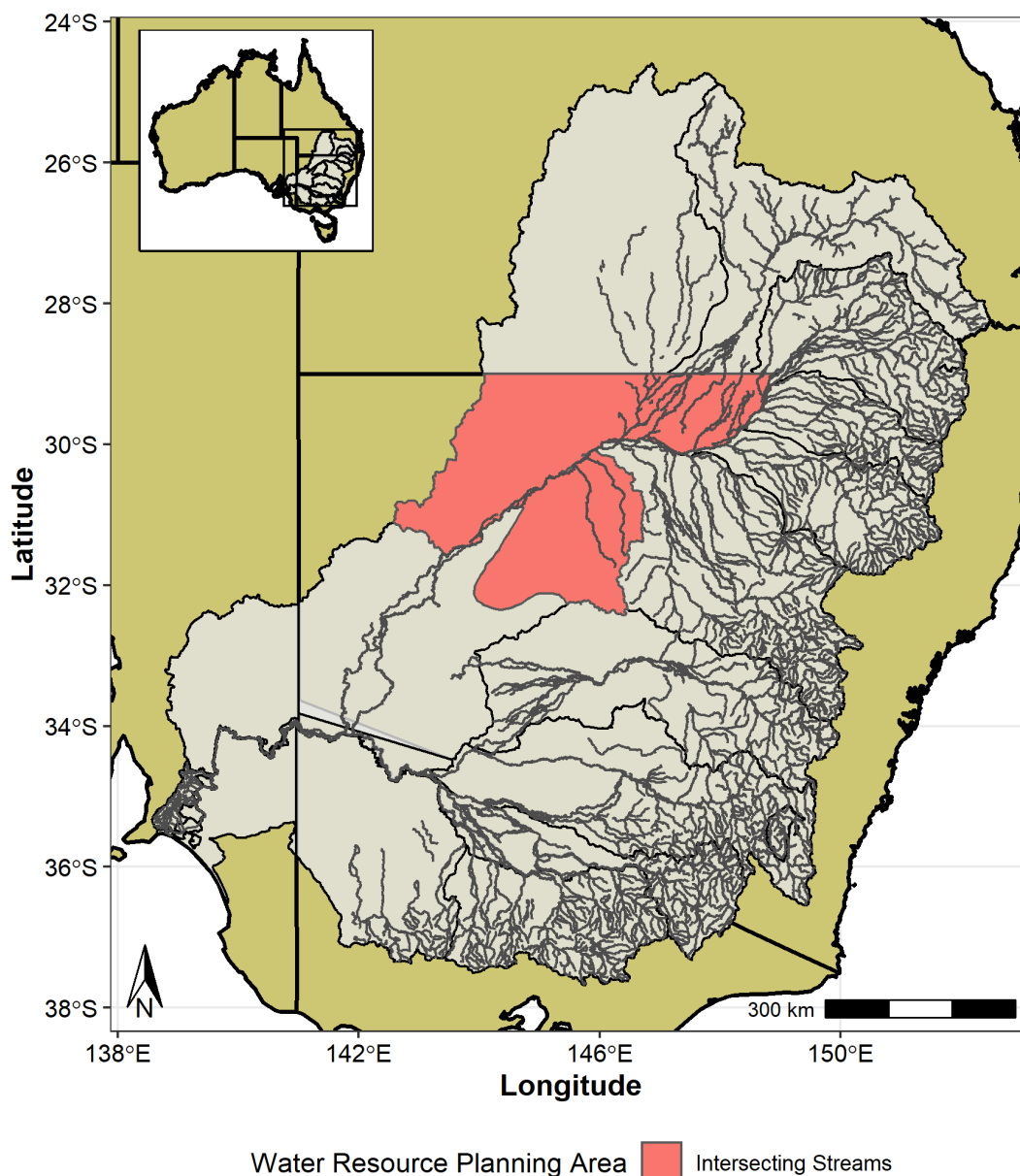


Figure 4.1: Murray-Darling Basin with the key region of this report highlighted. Inset map shows the whole of Australia with a box around the MDB.

## 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 Intersecting Streams WSPA. 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 WSPA 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 Namoi WSPA 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 Intersecting Streams WSPA and greater MDB (excluding the Intersecting Streams WSPA).

*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 Intersecting Streams WSPA 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 4.1). 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.

It should be noted that relatively little sampling was conducted in the Intersecting Streams WRPA each year so the results should be viewed with caution.

Table 4.1: 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	5 (0)
2015/2016	4 (9)
2016/2017	7 (6)
2017/2018	7 (27)
2018/2019	3 (21)
2019/2020	4 (4)

The sites sampled during the reporting period are shown in Figure 4.2. A breakdown of sites sampled each sampling season is shown in the Appendix (Figure 4.23).

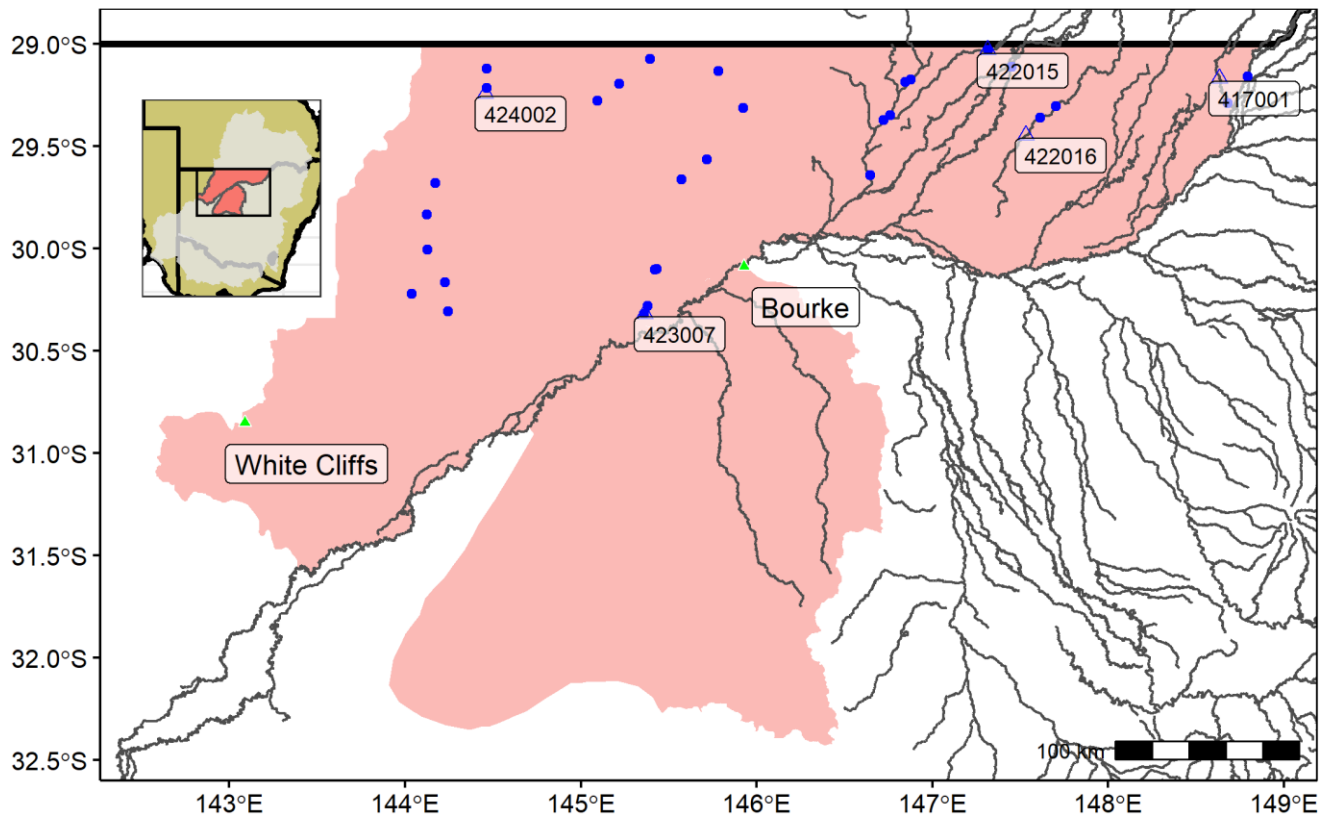


Figure 4.2: Sites (dots) sampled during the BPEOM-F program. Triangles show key flow gauges along with their gauge ID number. Dry sites are not shown.

Each sampling method has a different effectiveness at sampling each species. [Table 4.2](#) shows the total amount of each species caught by each method.

Table 4.2: Number of each key species caught by each 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	0	0	0
Golden perch	18	64	4
Freshwater catfish	0	0	0
Bony herring	6	2,199	2
Australian smelt	0	2	0
Common carp	15	95	14

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

Table 4.3: 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	0	13	0	194	0	32
2015/2016	0	13	0	72	0	11
2016/2017	0	26	0	269	2	47
2017/2018	0	22	0	100	0	25
2018/2019	0	0	0	1	0	0
2019/2020	0	12	0	4	0	9

## 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>



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## 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 Intersecting Streams WRPA (Figure 4.3).

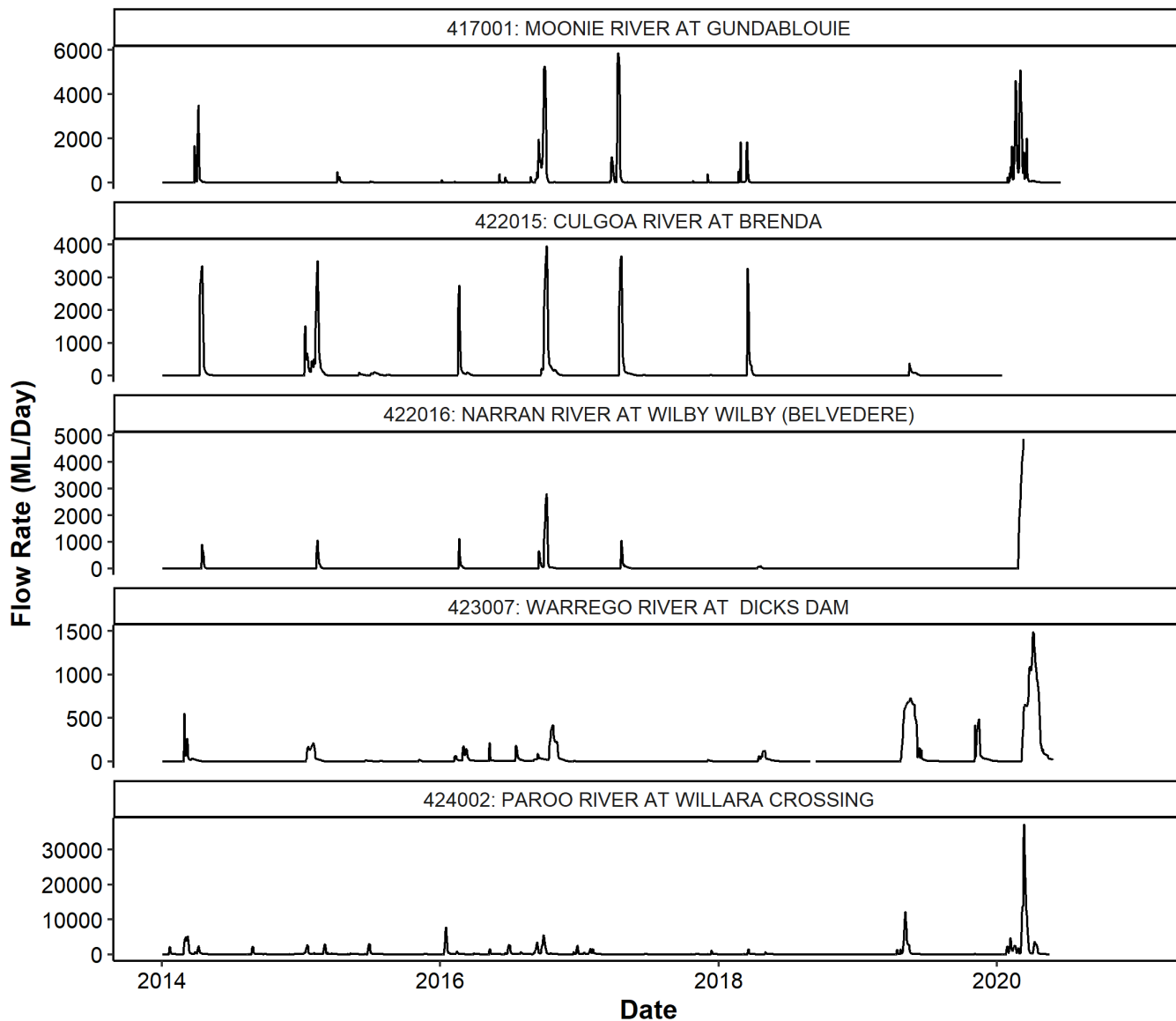


Figure 4.3: Flow data from various gauges in the Intersecting Streams WRPA over the reporting period. Gauge locations can be seen on Figure 4.2. Note the differing scales on the y-axis.

Water temperature data, where available, are also shown in [Figure 4.4](#).

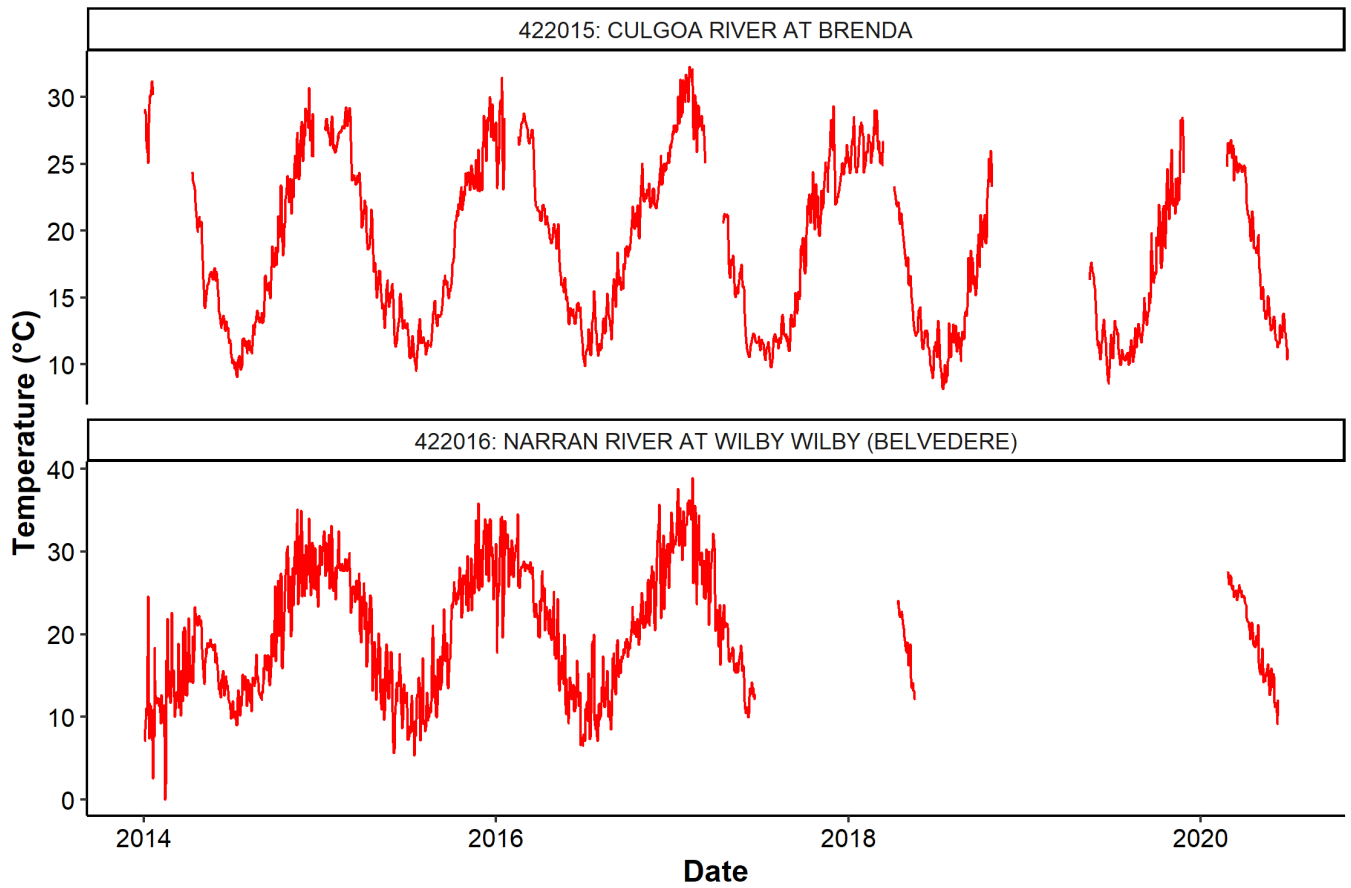


Figure 4.4: Water temperature data from various gauges in the Intersecting Streams WRPA over the reporting period. Gauge locations can be seen on [Figure 4.2](#). Note the differing scales on the y-axis.

## Species Diversity

A total of 11 species (including fish and invertebrates) were observed across the Intersecting Streams WRPAs including three alien species. [Figure 4.5](#) shows the number of native and alien species found at each site. The full list of species caught and observed is in [Table 4.5](#).

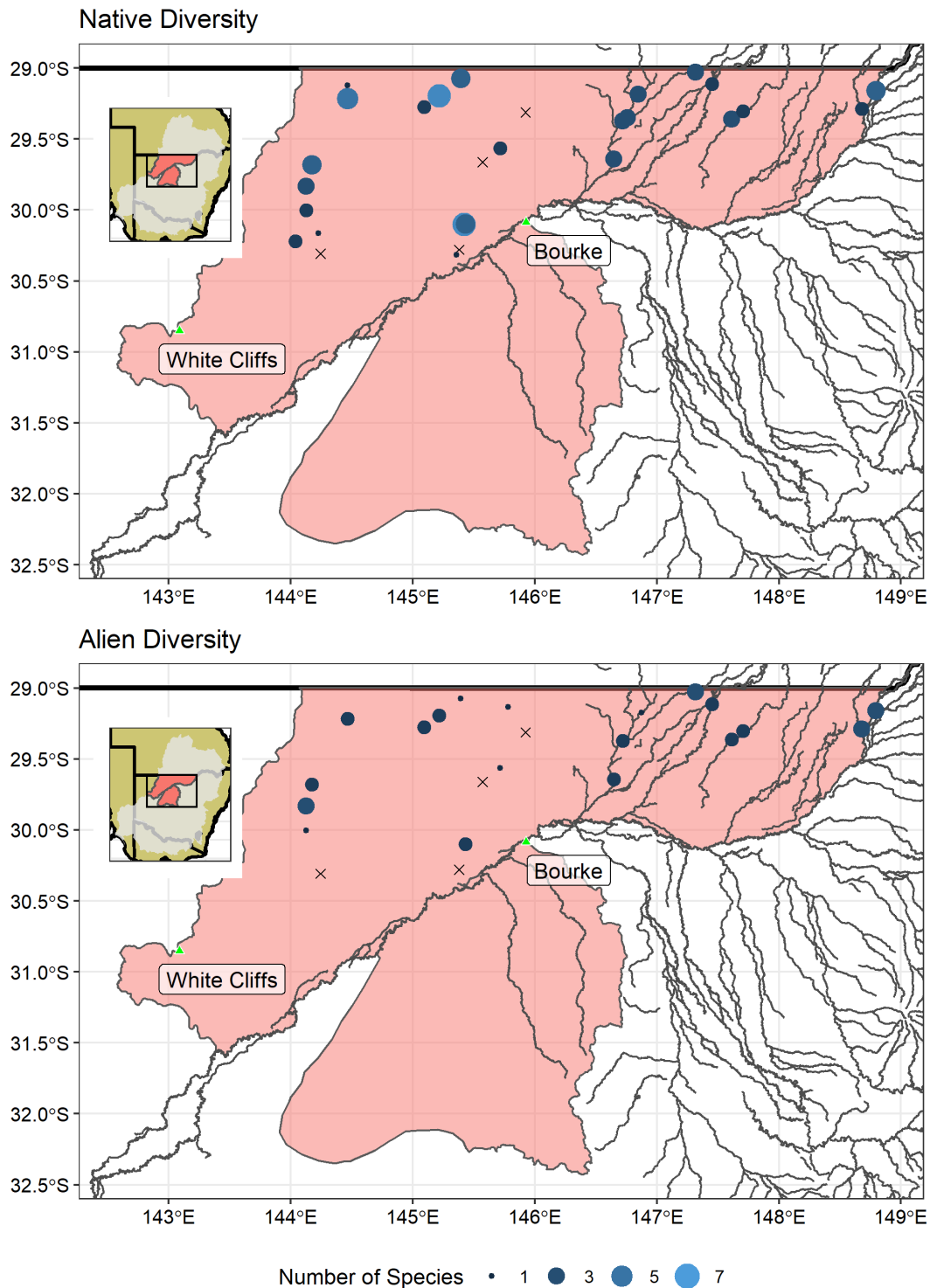


Figure 4.5: Diversity across all sampling sites. Bubble size represents the number of unique species observed at each site across all sampling methods and events. X represents a site that had water and was sampled, but no fish species were caught at all. Dry sites are excluded.

### Summary Statement:

Native and alien diversity was generally consistent across the region.

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## Murray cod



### **Summary Statement:**

No Murray cod were recorded across the Intersecting Streams WRPA as part of BPEOM-F (or any other sampling program) suggesting they are absent or in very low abundances.

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Golden perch



## Population Structure

Figure 4.6 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 1 to 14, and 8% to 100% 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 10% (222 out of 2,215).

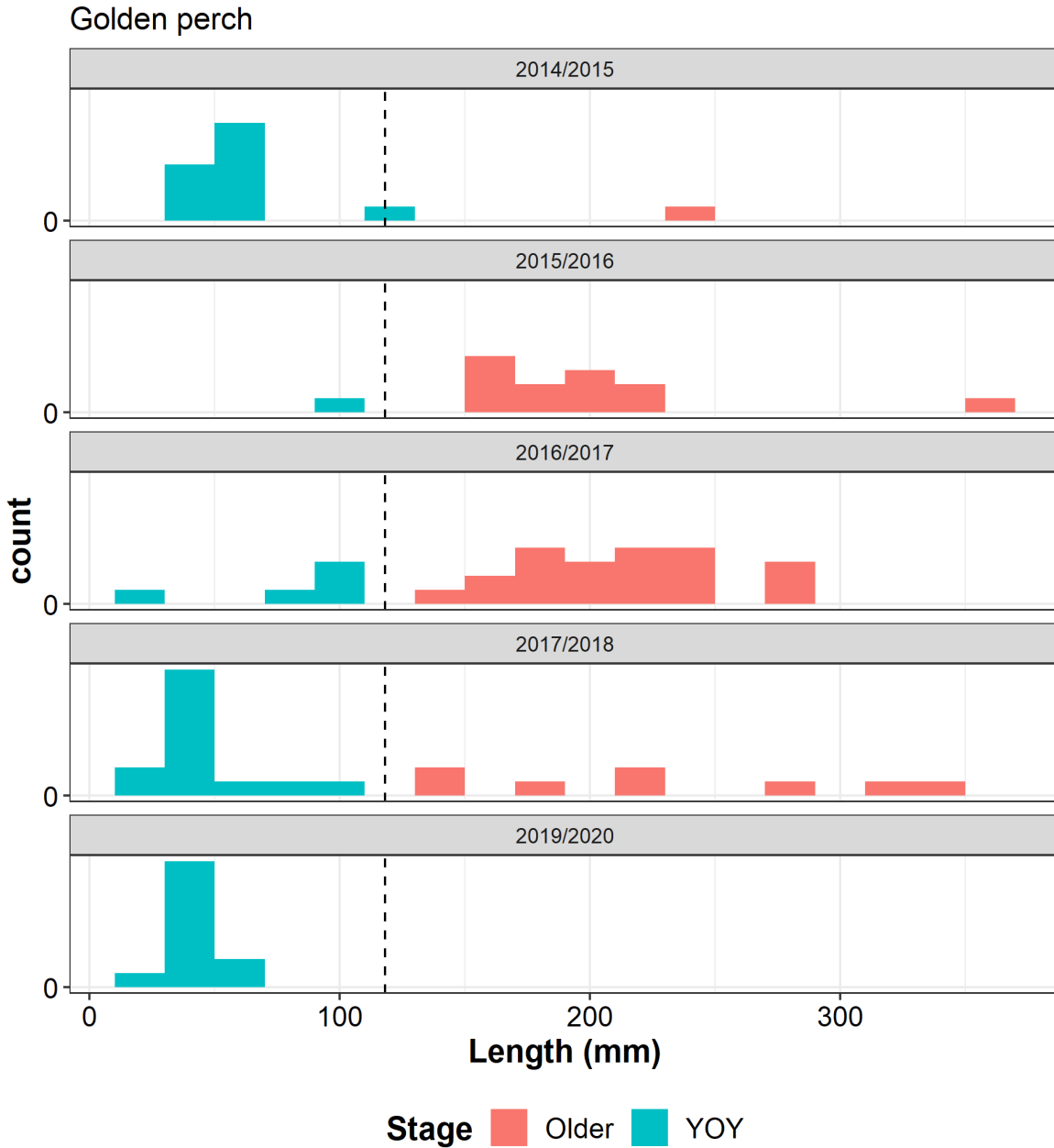


Figure 4.6: Length frequency plots for Golden perch by sampling season. YOY represents Young of the Year fish.

### Summary Statement:

Generally consistent recruitment, very few fish >30 cm were recorded. No Golden perch were caught in 2018/2019 and only young of the year fish were collected in 2019/20 (noting that sampling effort was low).

### Stocking

No Golden perch were stocked into the Intersecting Streams WRPA during this 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 4.7](#) shows the abundance trend for the Intersecting Streams WRPA and the right-hand panel shows the overall trend across the NSW MDB.

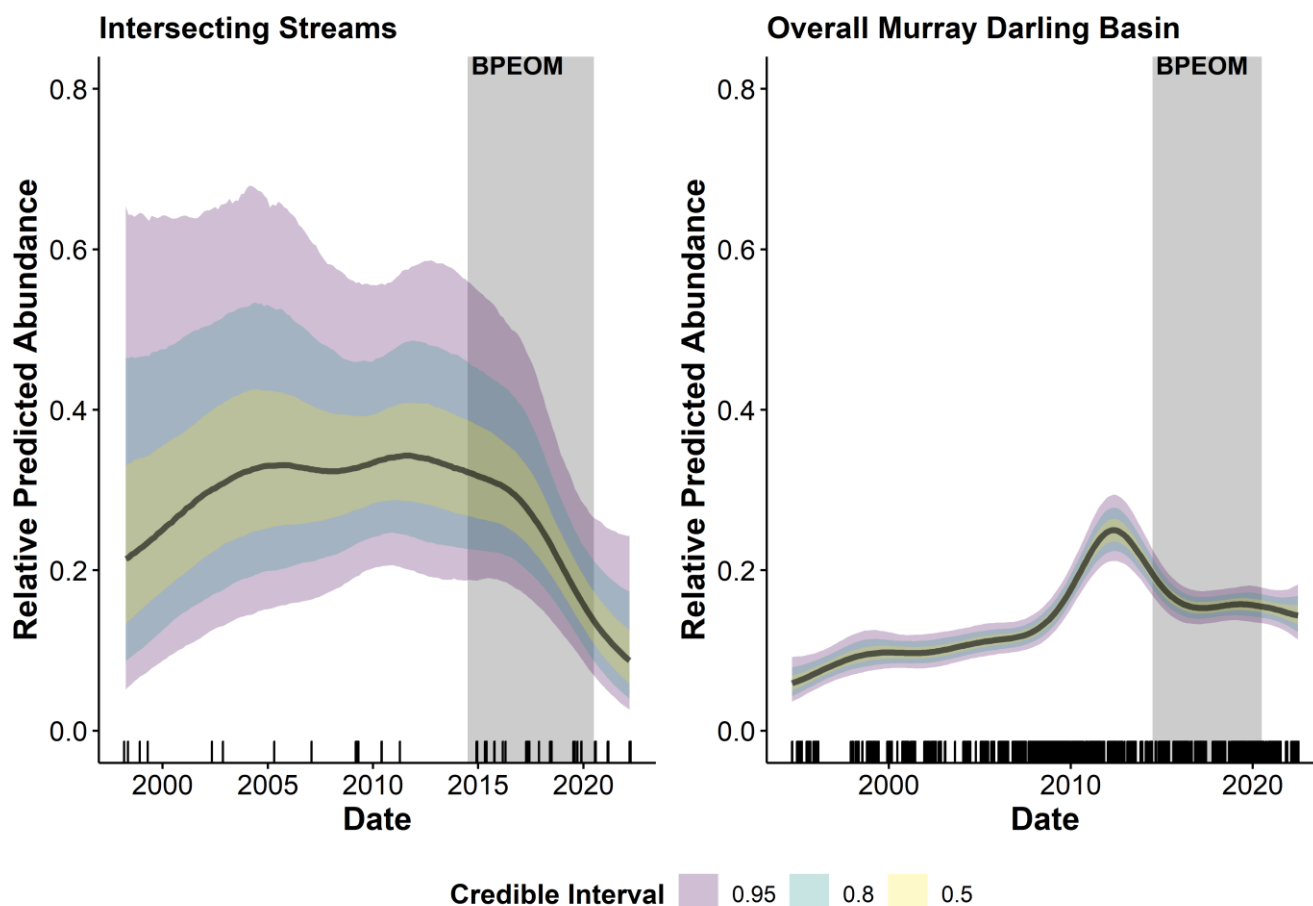


Figure 4.7: Relative abundance of Golden perch in both this valley and the overall Murray-Darling Basin. These are model estimates based upon all boat electrofishing data within the NSW DPI Freshwater ecosystem database and the output of Bayesian generalised additive mixed models. The grey shaded region 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:

A likely decrease in abundance since the late 1990s. Large uncertainty early in the time series but stronger evidence of a decline since 2015. Current relative abundance approximately equal (possibly lower) to the overall NSW MDB, which peaked in 2012.



## Health

The prevalence of any health issues ranged from 0% of sampled fish in 2014/2015 to 15% of sampled fish in 2016/2017 (Figure 4.8). The most common health issue for Golden perch in the Intersecting Streams water resource planning area was *Lernaeae*, which was observed in a total of 3 fish, corresponding to 3% of all Golden perch measured.

Across the other WRPA's, 34% of Golden perch (756 out of 2,215 Golden perch) showed a health condition (excludes Intersecting Streams).

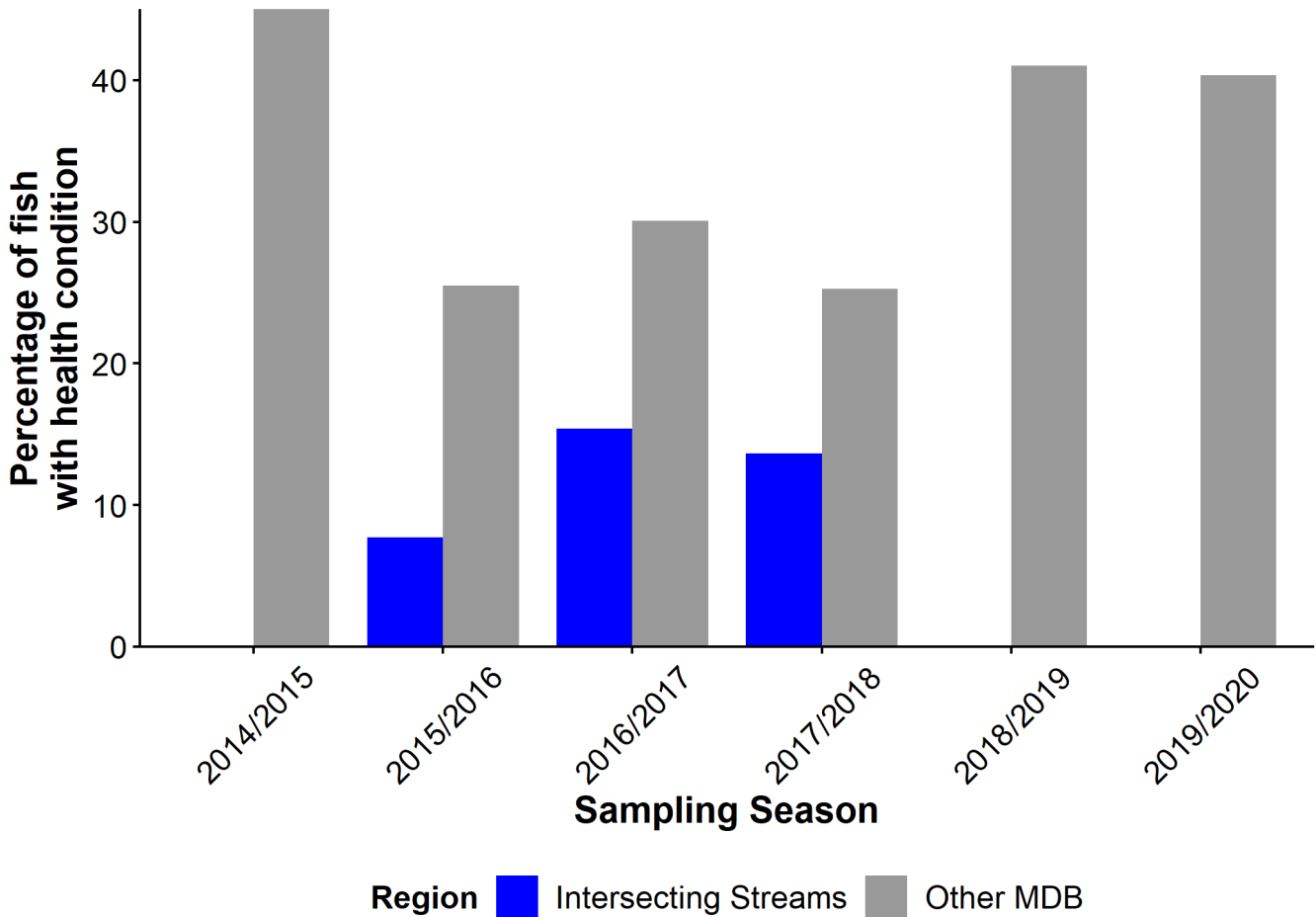


Figure 4.8: Timeseries showing the prevalence of health conditions in Golden perch. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA's.

### Summary Statement:

The presence of observable health conditions for Golden perch was low to moderate and consistently lower than the average across the rest of the NSW MDB.

## Distribution

Golden perch were recorded at 18 out of 26 sites in the Intersecting Streams WRPA. The maximum observed relative abundance at a site was 0.8 fish caught per 90 seconds of electrofishing. Figure 4.9 shows the distribution and relative abundance of Golden perch across the Intersecting Streams WRPA.

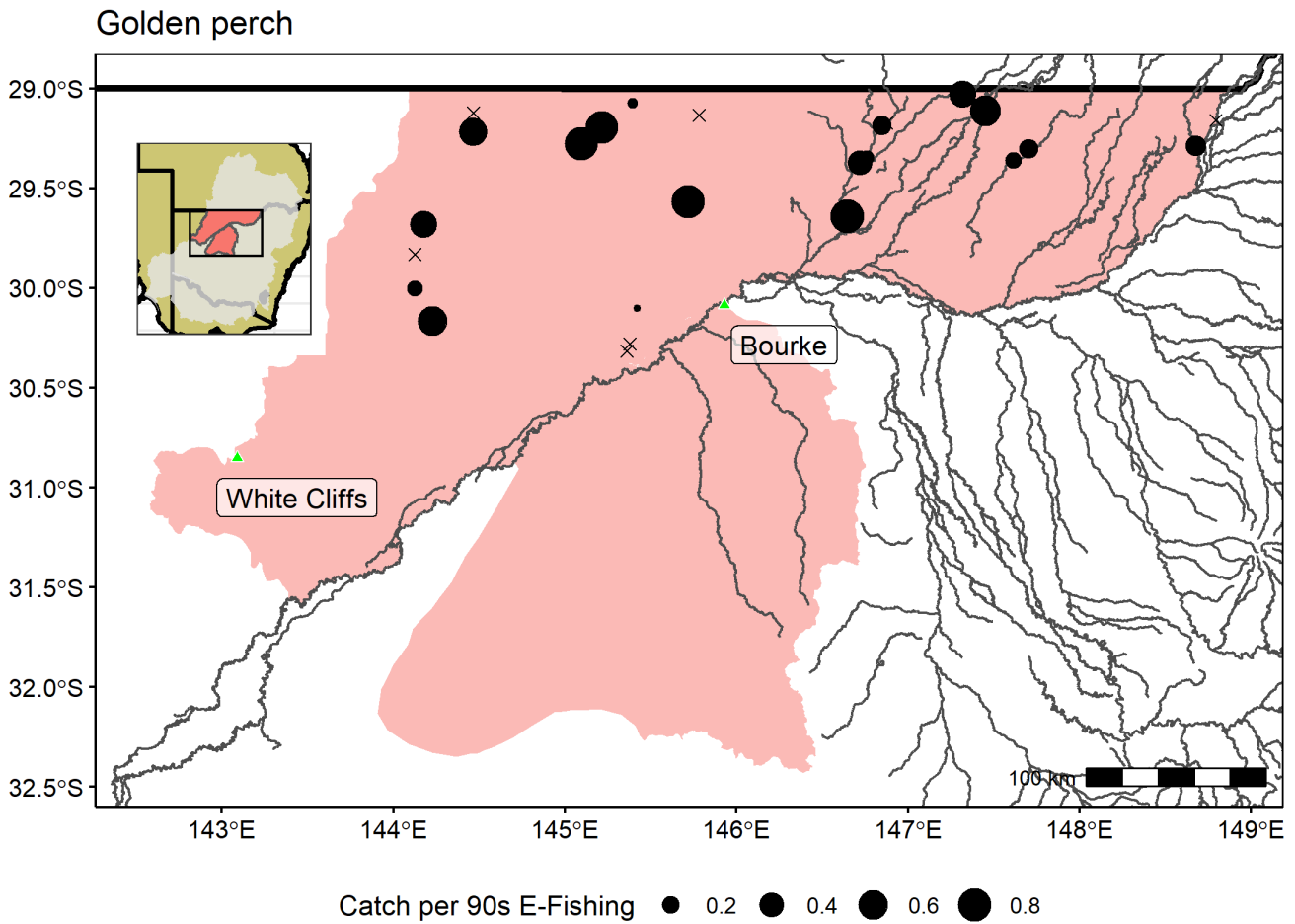


Figure 4.9: Distribution of Golden perch. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X.

### Summary Statement:

Golden perch were found across the Intersecting Streams WRPA.

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## Freshwater catfish



### **Summary Statement:**

No Freshwater catfish were recorded across the Intersecting Streams WRPA as part of BPEOM-F (or any other sampling program) suggesting they are absent or in very low abundances.

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Bony herring



## Population Structure

Figure 4.10 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 1 to 155, and 25% to 100% 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% (4,679 out of 15,758). Bony herring are not a stocked species.

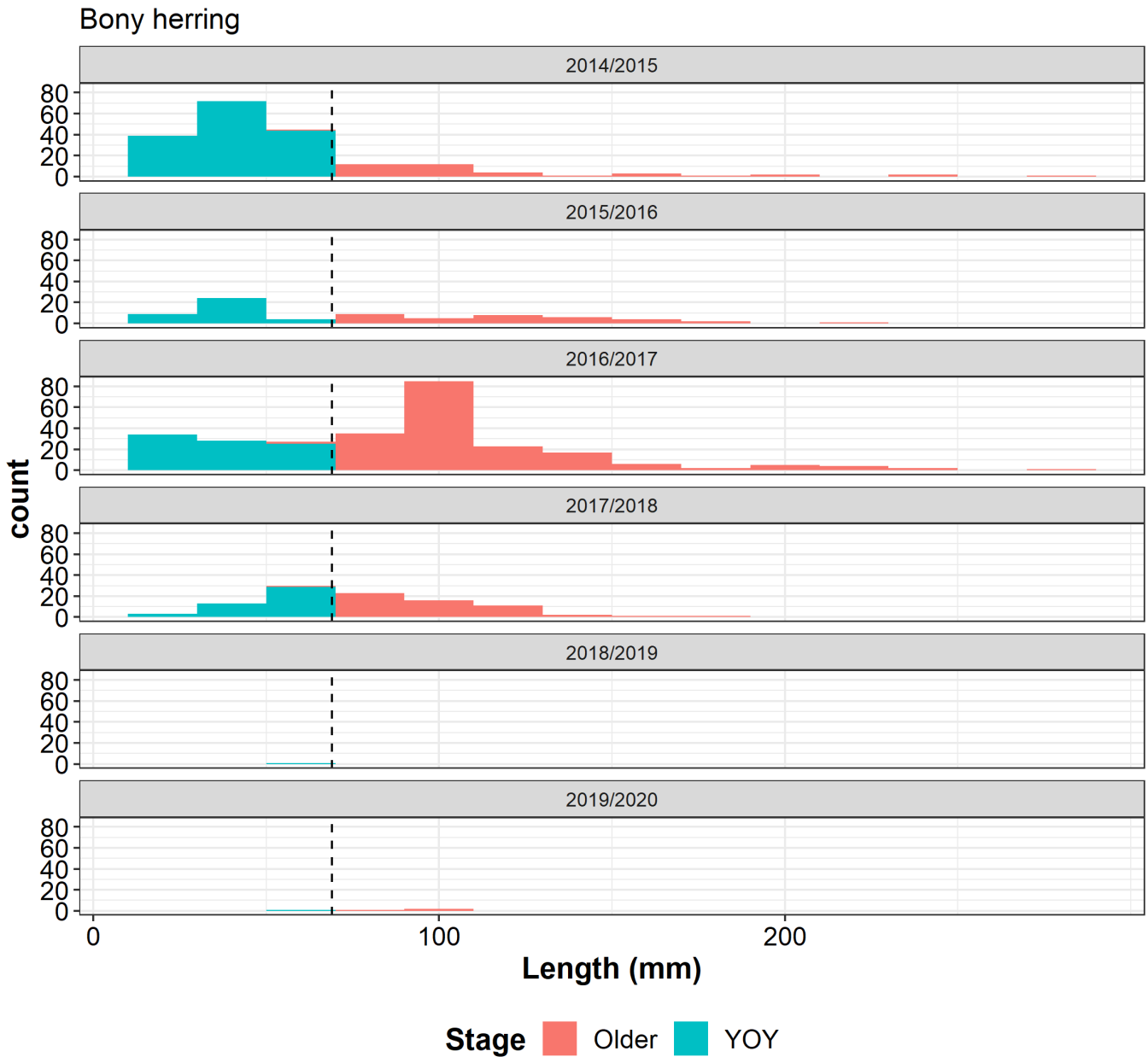


Figure 4.10: Length frequency plots for Bony herring by sampling season. YOY represents Young of the Year fish.

### Summary Statement:

Evidence of variable recruitment with very few YOY and adults observed in 2018/19 and 2019/20. It should be noted that sampling effort was particularly low in these years (Table 4.1).

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

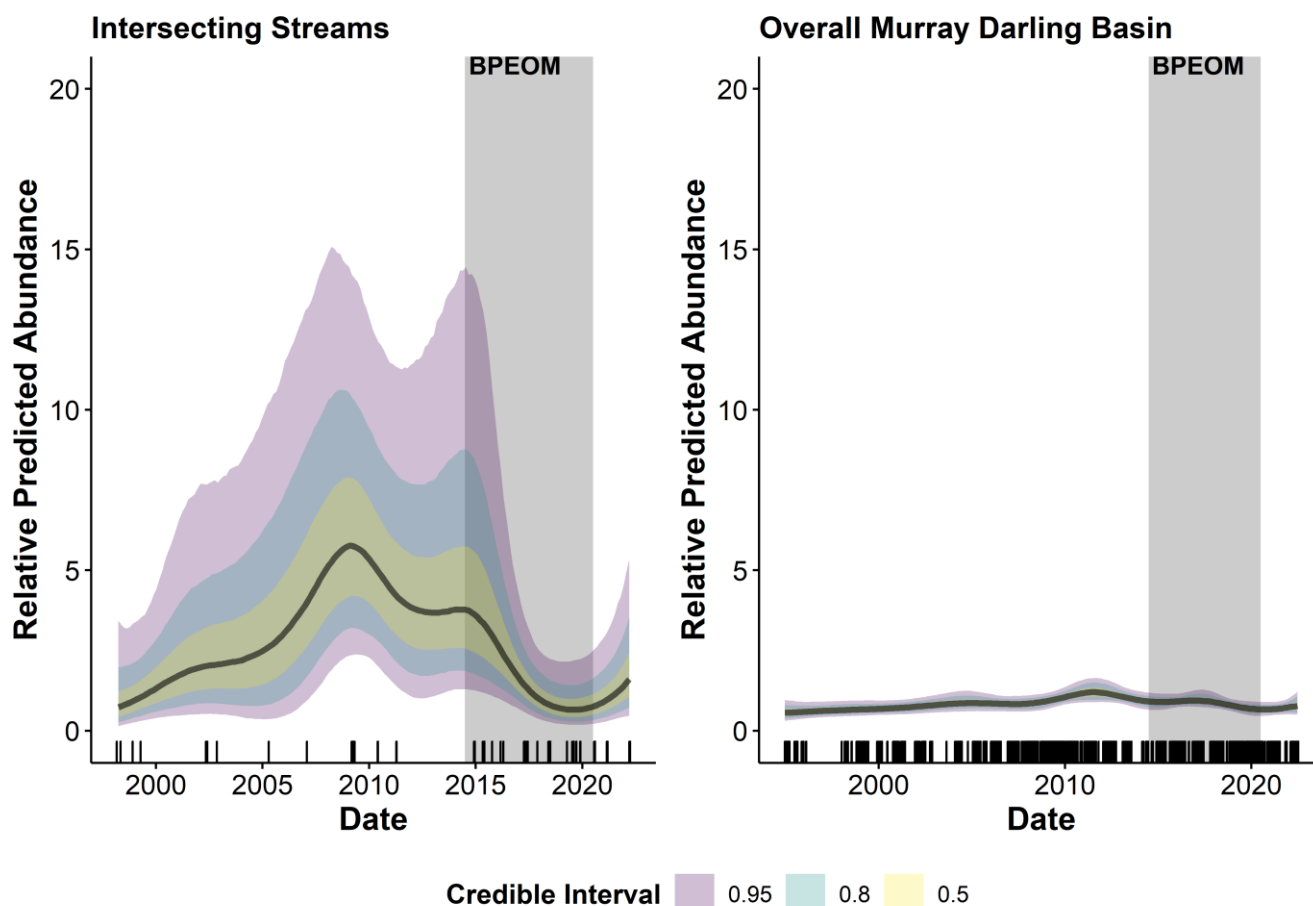


Figure 4.11: Relative abundance of Bony herring in both the Intersecting Streams WRPA and the overall NSW MDB. These are model estimates based upon all boat electrofishing data within the NSW DPI Freshwater ecosystem database and the output of Bayesian generalised additive mixed models. The grey shaded 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 increased to approximately 2010 but has since declined back to late 1990s levels. Current relative abundance likely to be slightly higher than the overall abundance across the NSW MDB.

## Health

The prevalence of any health issues ranged from 0% of sampled fish in 2015/2016 to 5% of sampled fish in 2016/2017 (Figure 4.12). The most common health issue for Bony herring in the Intersecting Streams WRPAs was Fungus, which was observed in a total of 13 fish, corresponding to 2% of all Bony herring measured.

Across the other NSW MDB WRPA, 1% of Bony herring (175 out of 15,758 Bony herring) showed a health condition (excludes the Intersecting Streams WRPAs).

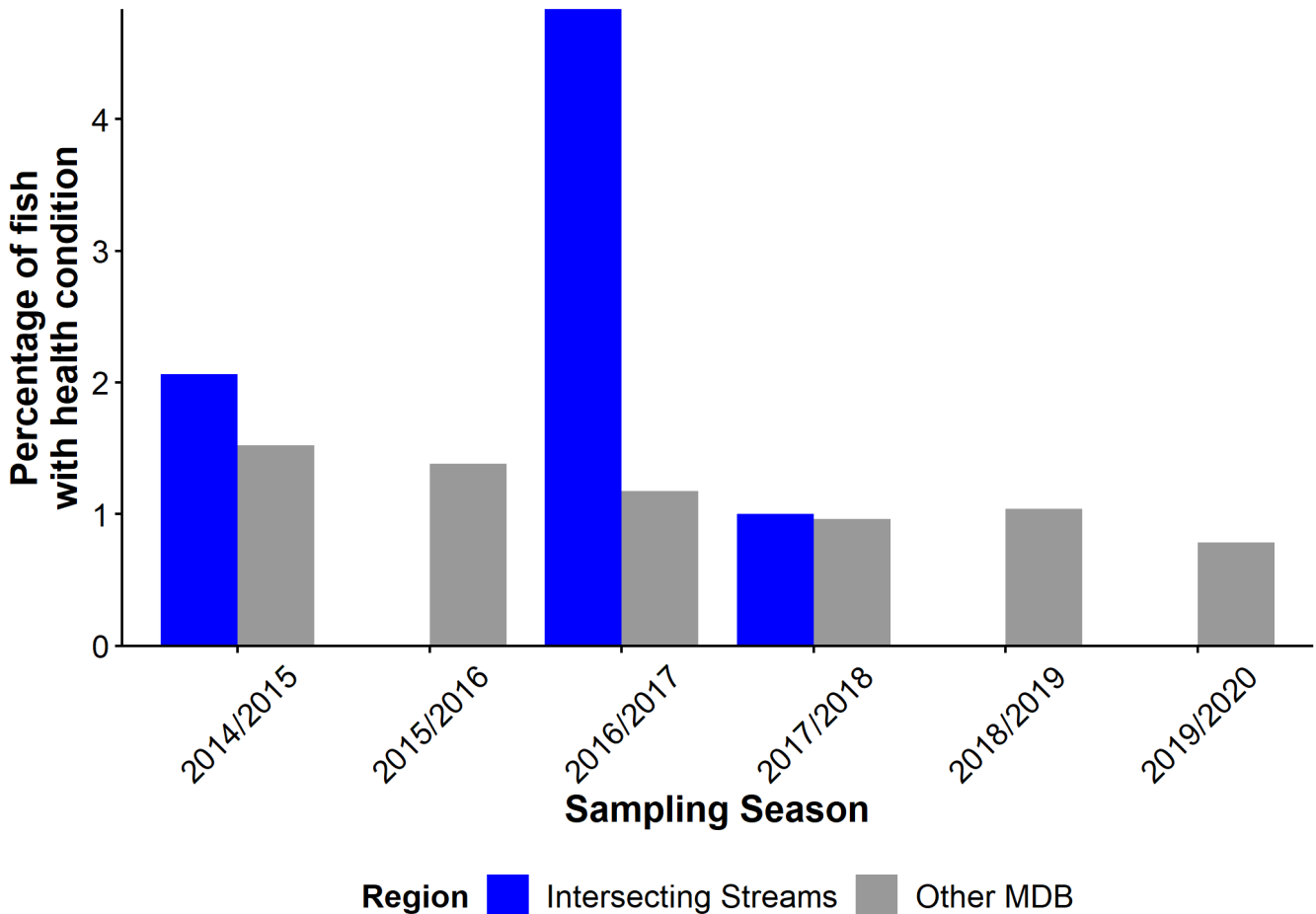


Figure 4.12: Timeseries showing the prevalence of health conditions in Bony herring. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA.

### Summary Statement:

Presence of observable health conditions was low overall and generally similar to the rest of the NSW MDB for all but one season when it was higher (2016/17).

## Distribution

Bony herring were recorded at 18 out of 26 sites in the Intersecting Streams WRPA. The maximum observed relative abundance at a site was 46 fish caught per 90 seconds of electrofishing. [Figure 4.13](#) shows the distribution and relative abundance of Bony herring across the Intersecting Streams WRPA.

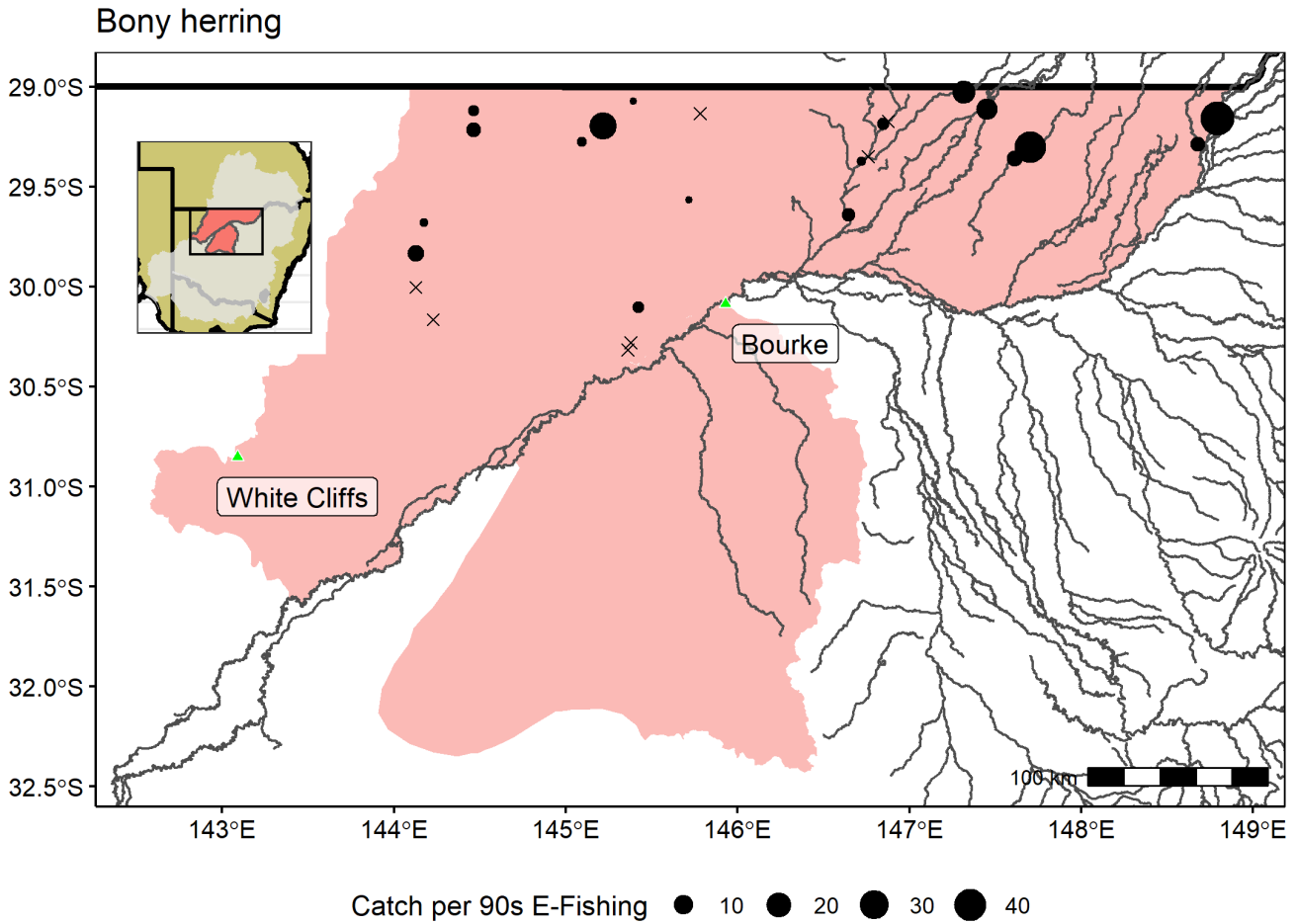


Figure 4.13: Distribution of Bony herring. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X.

### Summary Statement:

Bony herring were recorded across the northern areas of the Intersecting Streams WRPA.



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Australian smelt



## Population Structure

Figure 4.14 shows the observed length frequency plot for Australian smelt for each of the sampling seasons. Only 2 Australian smelt were observed during the BPEOM-F program, both were Young of the Year (YOY), and both were caught in 2016/17.

Overall, during the BPEOM-F program, across all the MDB water resource planning areas, the percentage YOY for Australian smelt was 42% (3,545 out of 8,405). Australian smelt are not a stocked species.

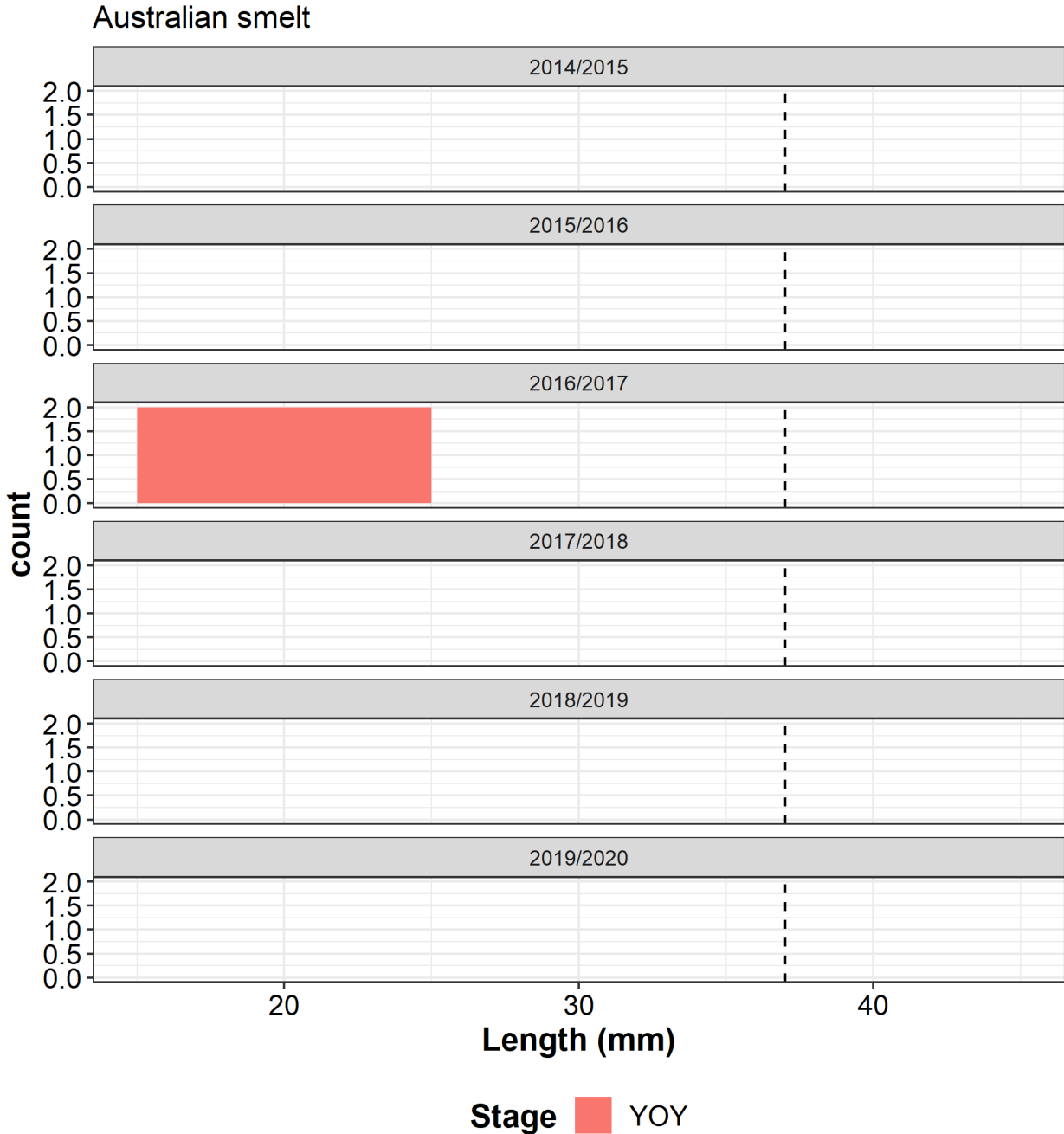


Figure 4.14: Length frequency plots for Australian smelt by sampling season. YOY represents Young of the Year fish.

### Summary Statement:

Only two individuals (Young of the Year) were observed suggesting very low abundances and possibly recruitment issues.

## Temporal Trends in Abundance

We have modelled the relative abundance of Australian smelt since 1994 based on all suitable boat electrofishing data. There was insufficient data to model the abundance through time for the Intersecting streams WRPA (left panel below). The right-hand panel of [Figure 4.15](#) shows the abundance trend for the overall NSW MDB.

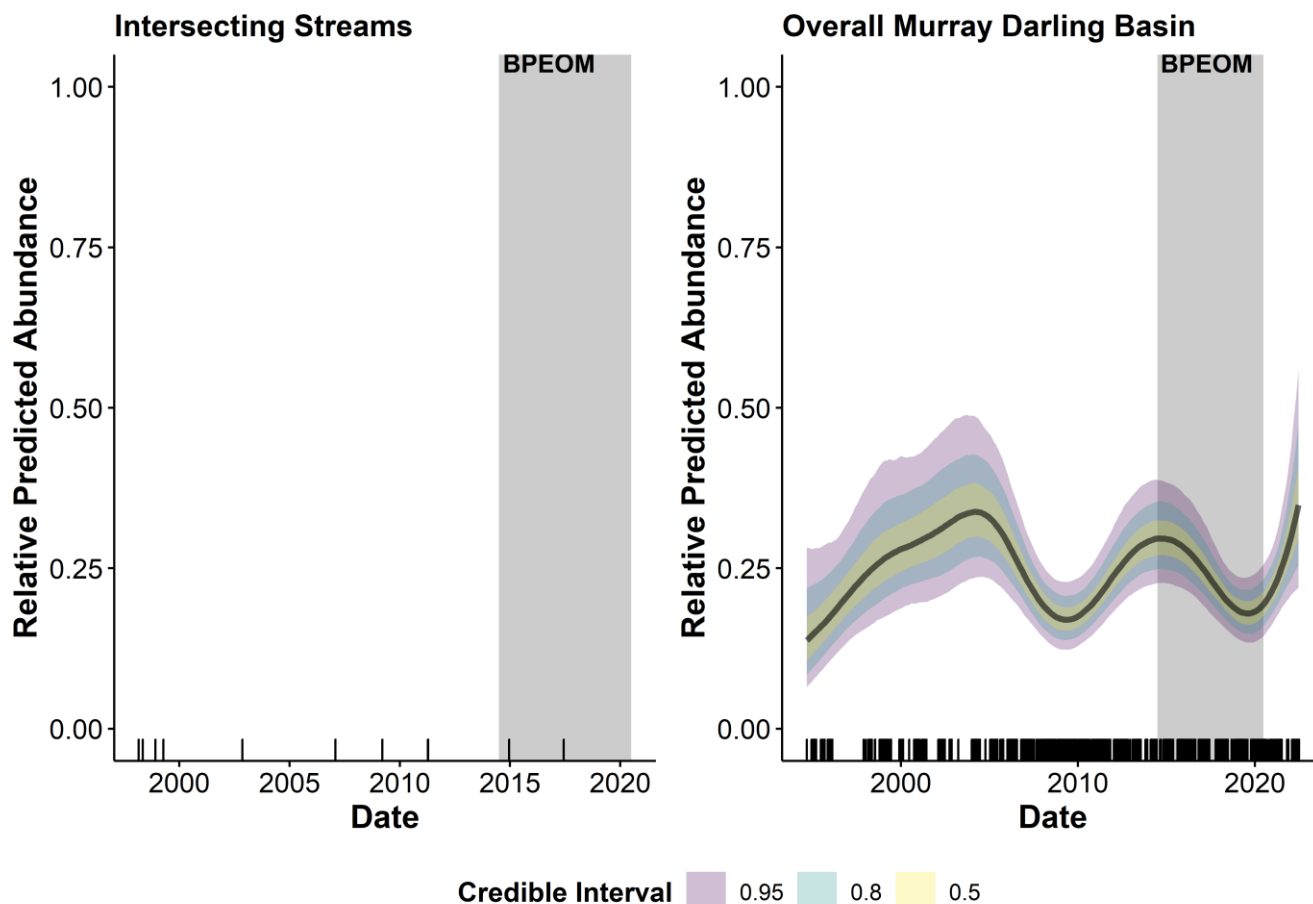


Figure 4.15: Relative abundance of Australian smelt in both the Intersecting Streams WRPA and the overall NSW MDB. These are model estimates based upon all boat electrofishing data within the NSW DPI Freshwater ecosystem database and the output of Bayesian generalised additive mixed models. The grey 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:

There is insufficient data to draw any conclusions about the trends in relative abundance for Australian smelt in the Intersecting Streams WRPA but the abundance is likely to be very low.

## Health

No health issues were observed in any Australian smelt within the Intersecting Streams WRPAs (Figure 4.16).

Across the other NSW MDB WRPA, 1% of Australian smelt (53 out of 8405 Australian smelt) showed a health condition (excludes the Intersecting Streams WRPAs).

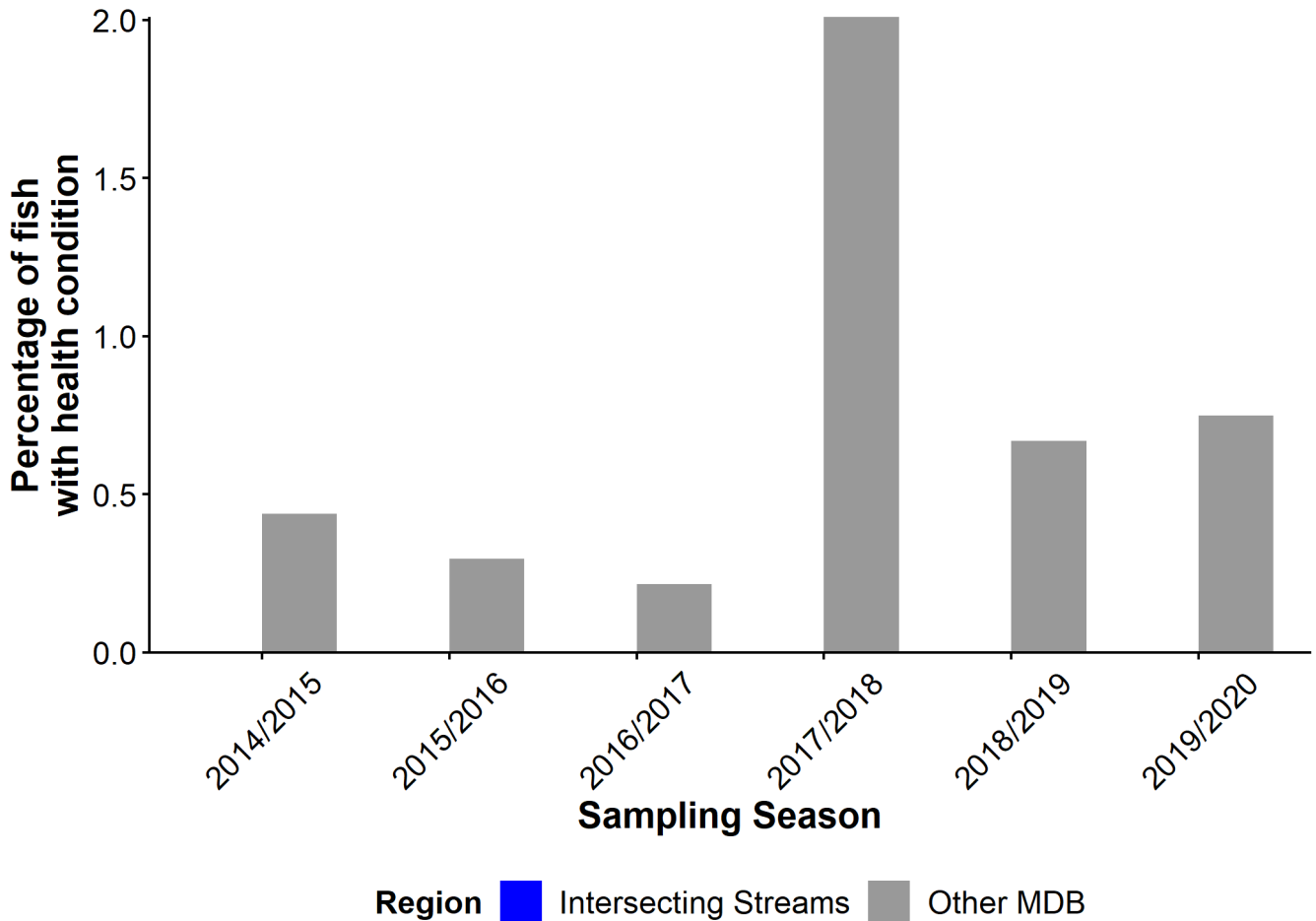


Figure 4.16: Timeseries showing the prevalence of health conditions in Australian smelt. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPA.

### Summary Statement:

No health conditions were observed for Australian smelt in the Intersecting Streams WRPAs noting only 2 individuals were captured.

## Distribution

Australian smelt were recorded at 1 out of 26 sites in the Intersecting Streams WRPA. The maximum observed relative abundance at a site was 0.17 fish caught per 90 seconds of electrofishing. [Figure 4.17](#) shows the distribution and relative abundance of Australian smelt across the Intersecting Streams WRPA.

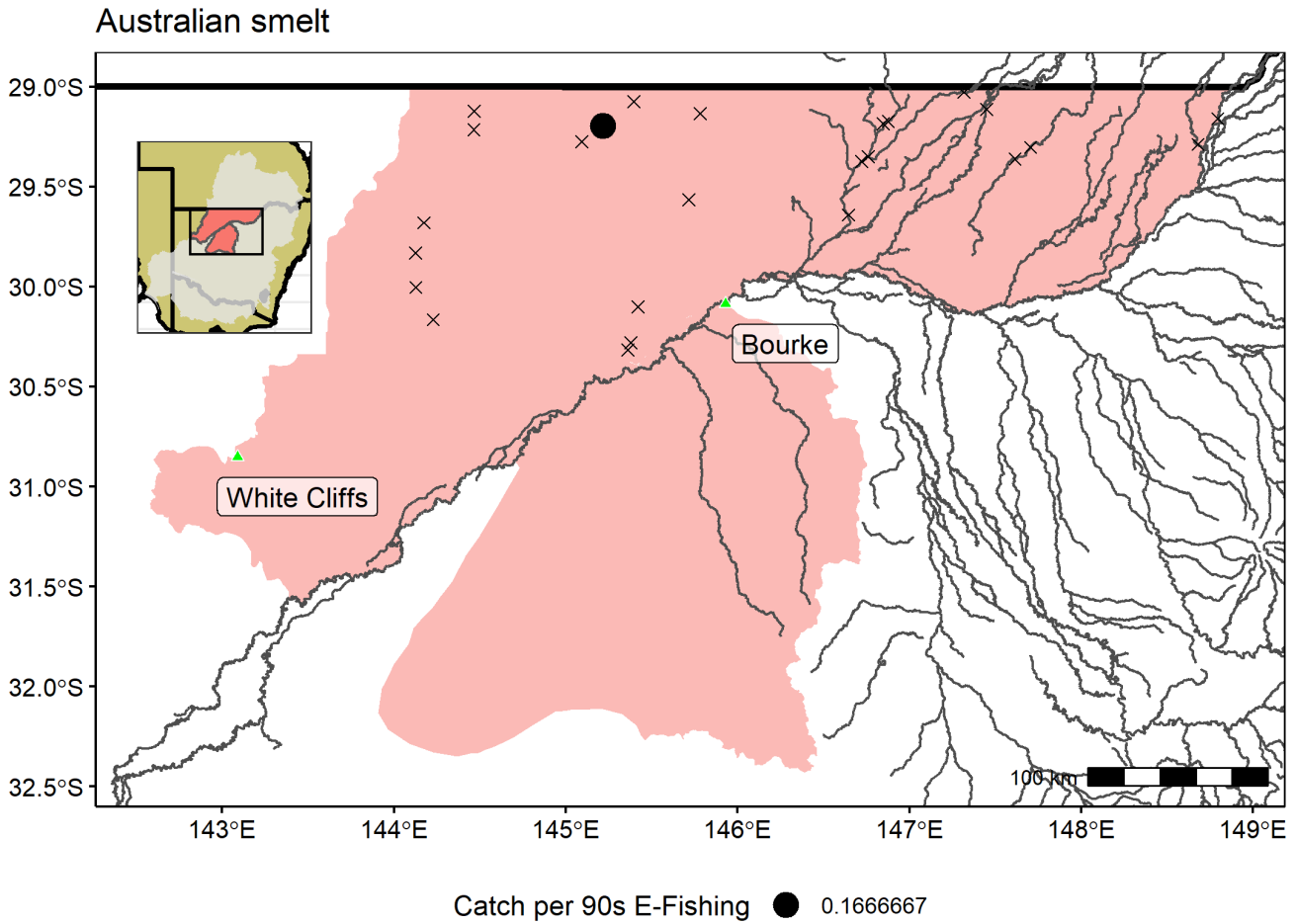


Figure 4.17: Distribution of Australian smelt. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X.

### Summary Statement:

Australian smelt were restricted to a single site suggesting they have a limited distribution in the Intersecting Streams WRPA.

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Common carp



## Population Structure

Figure 4.18 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 1 to 24, and 9% to 78% 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% (11,983 out of 21,019). Common carp are not a stocked species.

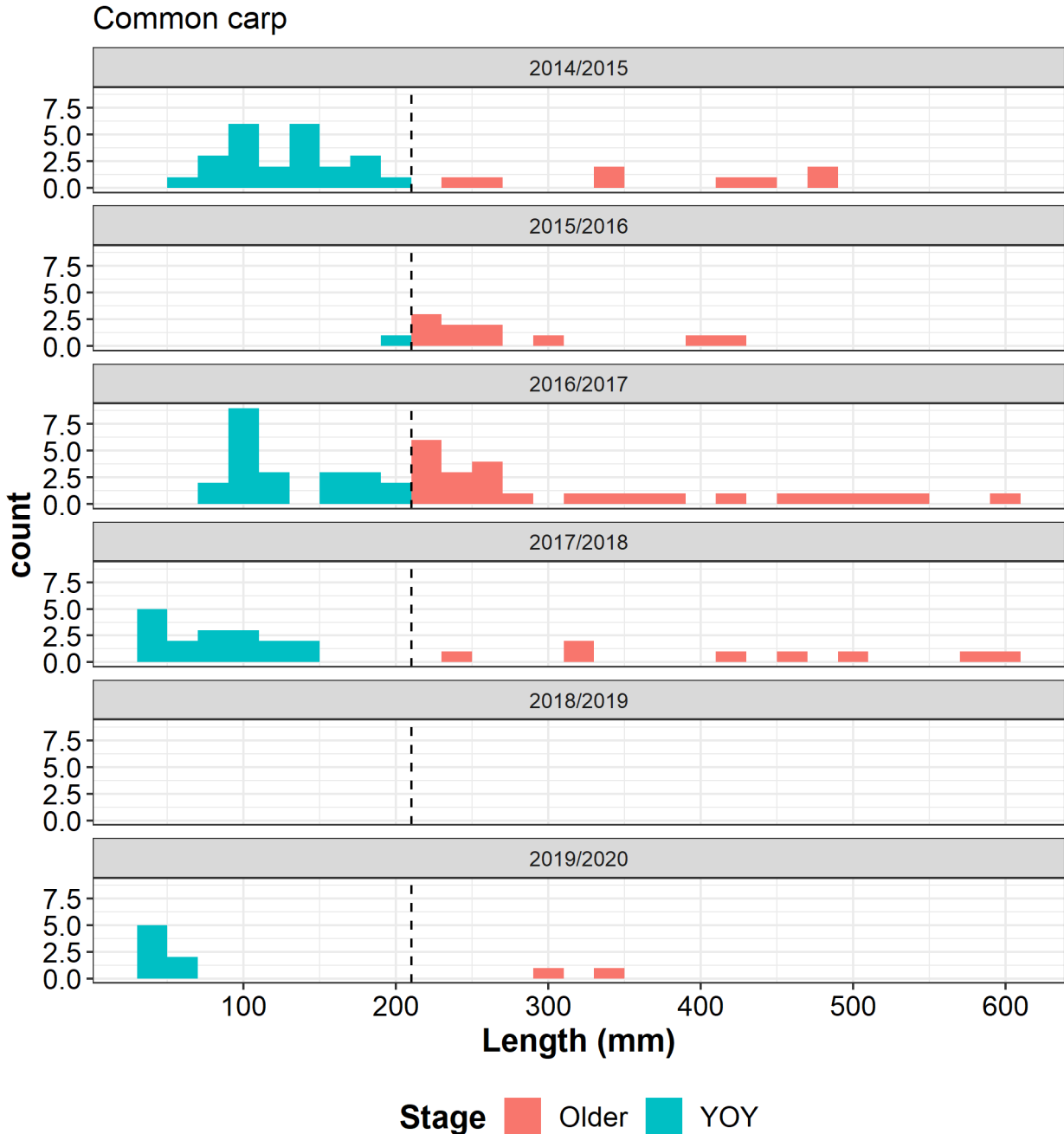


Figure 4.18: Length frequency plots for common carp by sampling season. YOY represents Young of the Year fish.

### Summary Statement:

Variable recruitment with a single YOY observed in 2015/16 and no carp observed in 2018/19. It should be noted sampling effort was generally low, particularly in later years.

## Temporal Trends in Abundance

We have modelled the relative abundance of Common carp since 1994 based on all suitable boat and backpack electrofishing data. The left-hand panel of [Figure 4.19](#) shows the abundance trend for the Intersecting Streams WSPA and the right-hand panel shows the overall trend across the NSW MDB.

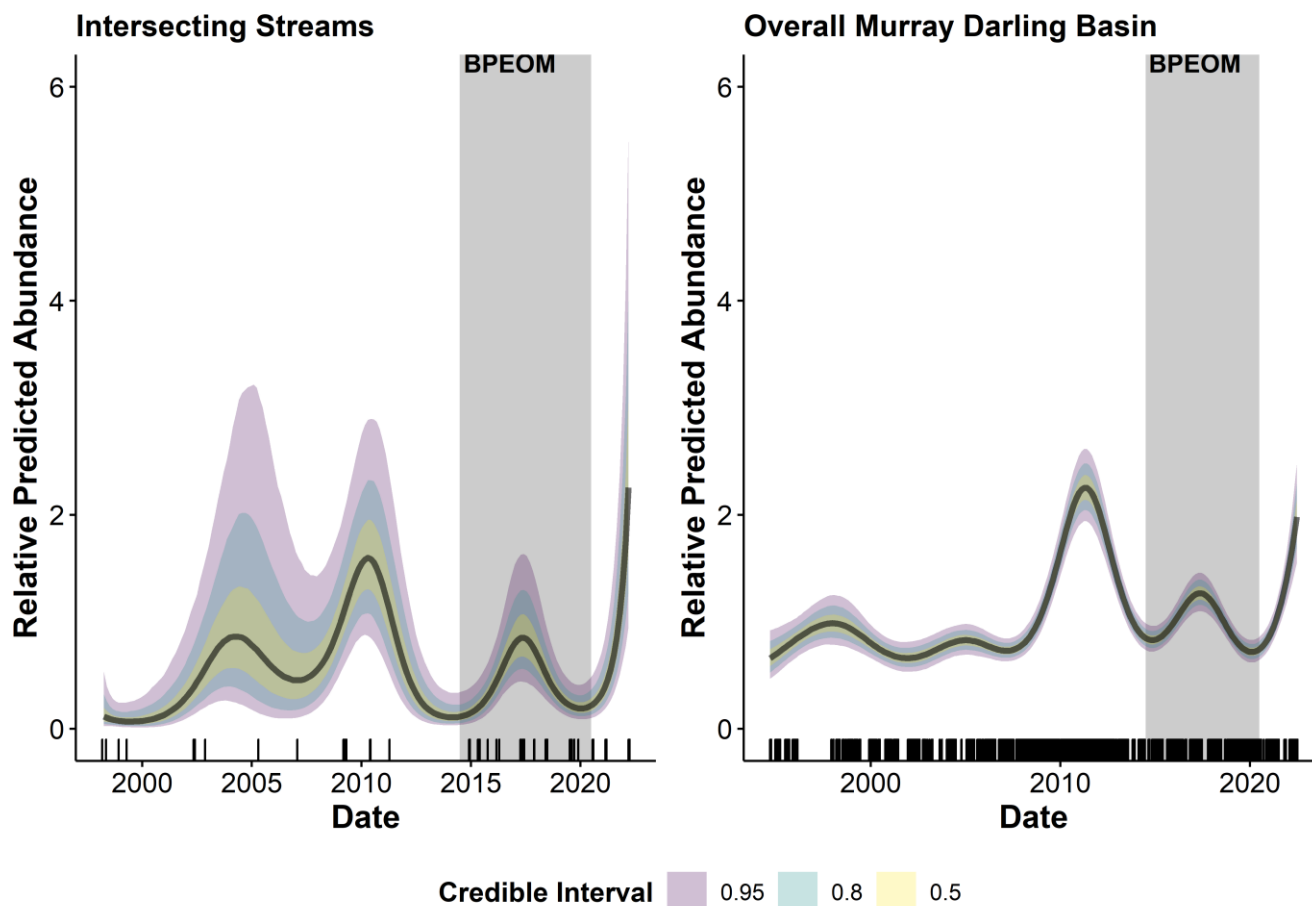


Figure 4.19: Relative abundance of Common carp in both this valley and the overall Murray-Darling Basin. These are model estimates based upon all electrofishing data within the NSW DPI Freshwater ecosystem database and the output of Bayesian generalised additive mixed models. The grey shaded region represents 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:

Overall increased relative abundance since the late 1990s driven by an increase in recent years. Large fluctuations in abundance are evident across the time series. Current relative abundance similar to the overall abundance across the NSW MDB, which peaked in approximately 2011.



## Health

The prevalence of any health issues ranged from 0% of sampled fish in 2015/2016 to 9% of sampled fish in 2014/2015 (Figure 4.20). The most common health issue for Common carp in the Intersecting Streams water resource planning area was *Lernaeae*, which was observed in a total of 3 fish, corresponding to 2% of all Common carp measured.

Across the other WRPAs, 6% of Common carp (1,160 out of 21,020 Common carp) showed a health condition (excludes Intersecting Streams).

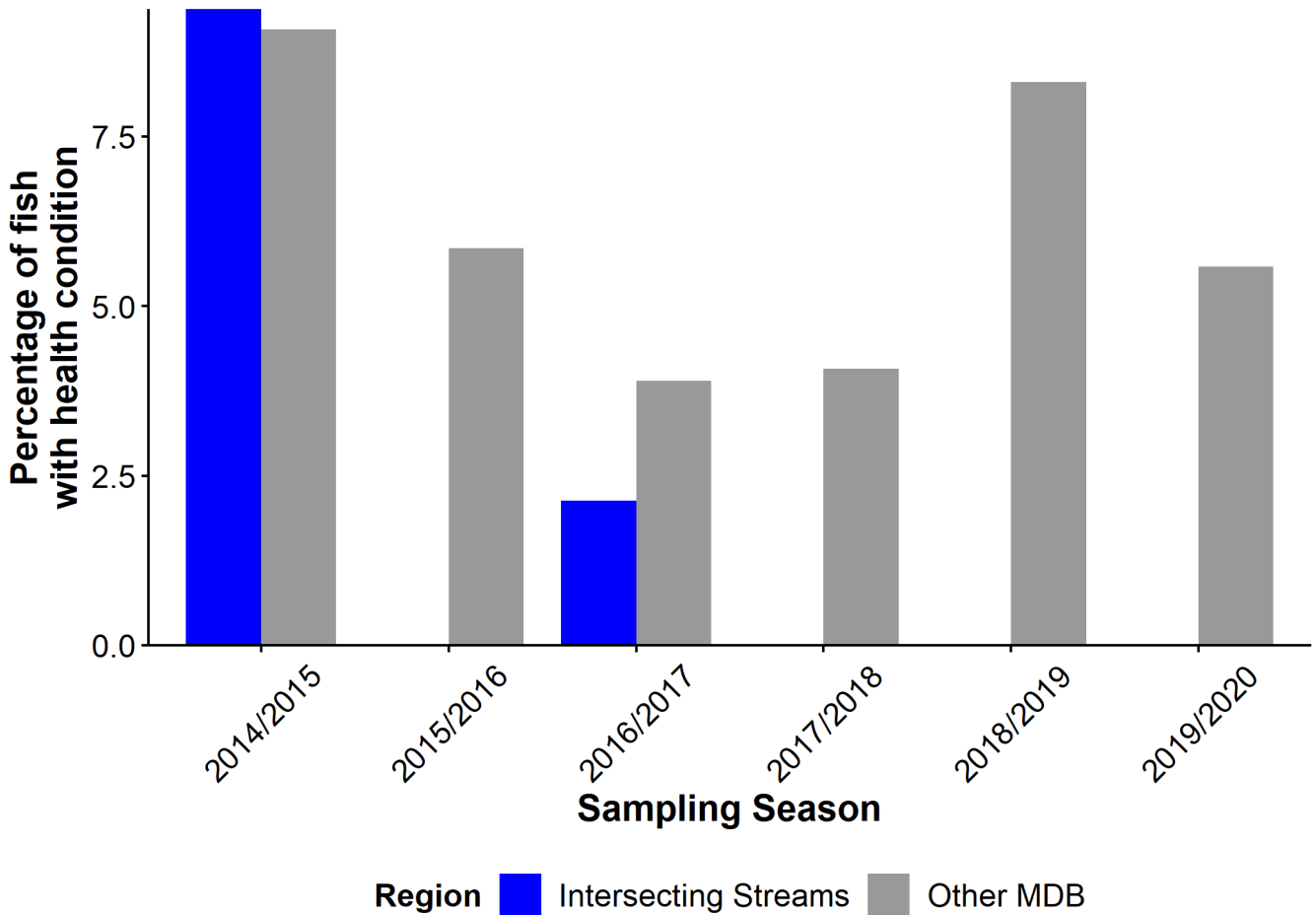


Figure 4.20: Timeseries showing the prevalence of health conditions in Common carp. Blue shows the region-specific data while the grey shows the average across the other NSW MDB WRPAs.

### Summary Statement:

Presence of observable health conditions in the Intersecting Streams WRPAs was low and generally lower than the overall NSW Murray-Darling Basin.

## Distribution

Common carp were recorded at 16 out of 26 sites in the Intersecting Streams WRPA. The maximum observed relative abundance at a site was 1.5 fish caught per 90 seconds of electrofishing. [Figure 4.21](#) shows the distribution and relative abundance of Common carp across the Intersecting Streams WRPA.

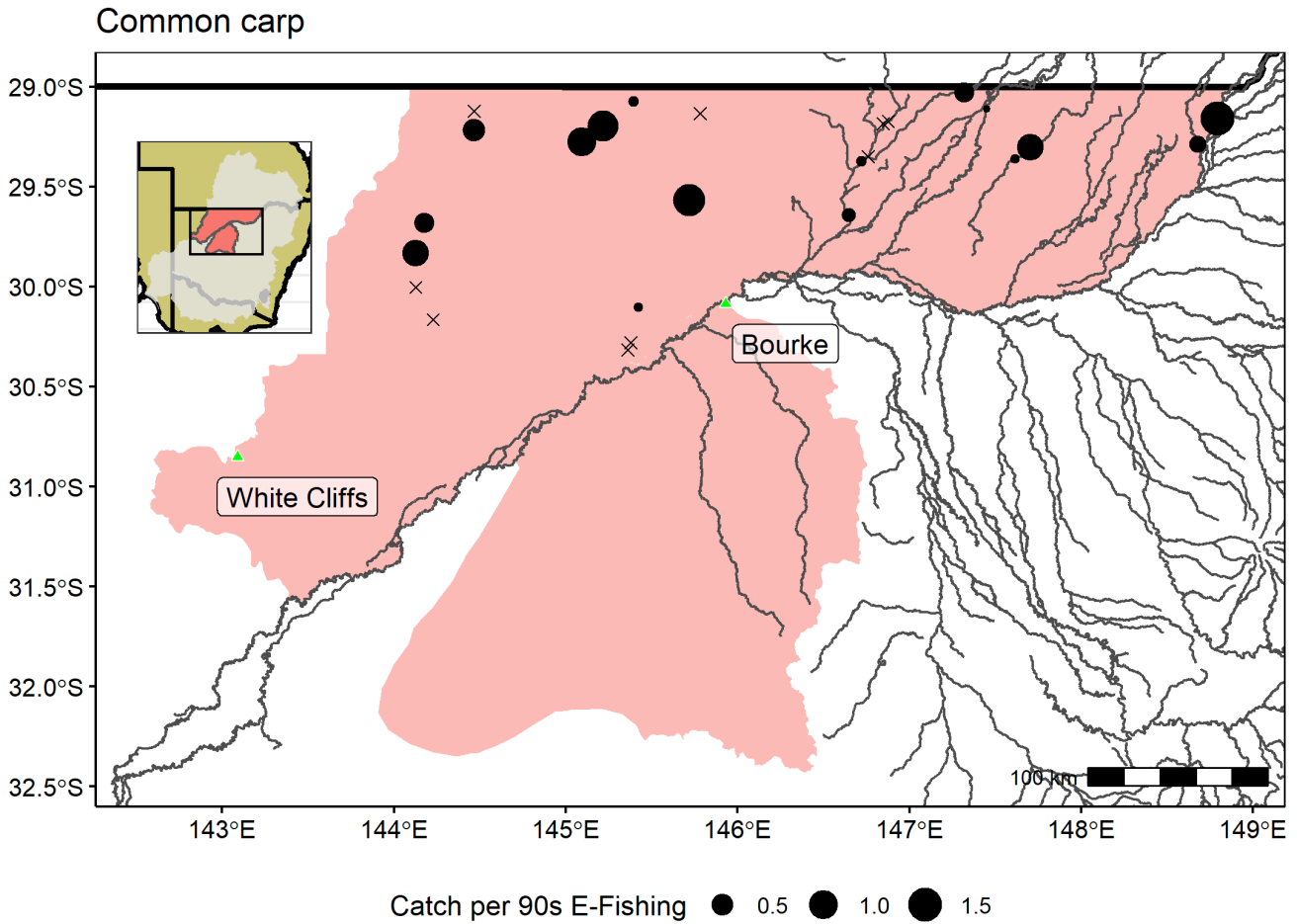


Figure 4.21: Distribution of Common carp. Filled circles show sites where the species was present, and the size of the circle represents relative abundance. Sites that were sampled with electrofishing but did not contain the species are shown with an X.

### Summary Statement:

Common carp were collected across the Intersecting Streams WRPA although only recorded in 60% of the sites.

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## Threatened Species

The following table ([Table 4.4](#)) 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 Intersecting Streams 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 4.7](#).

Table 4.4: Listed species which were observed in this region during the BPEOM-F program. (\* = FMA, # = EPBC)

Species	Common name	Total caught (observed)
<i>Ambassis agassizii</i>	Olive perchlet*	25 (1)

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

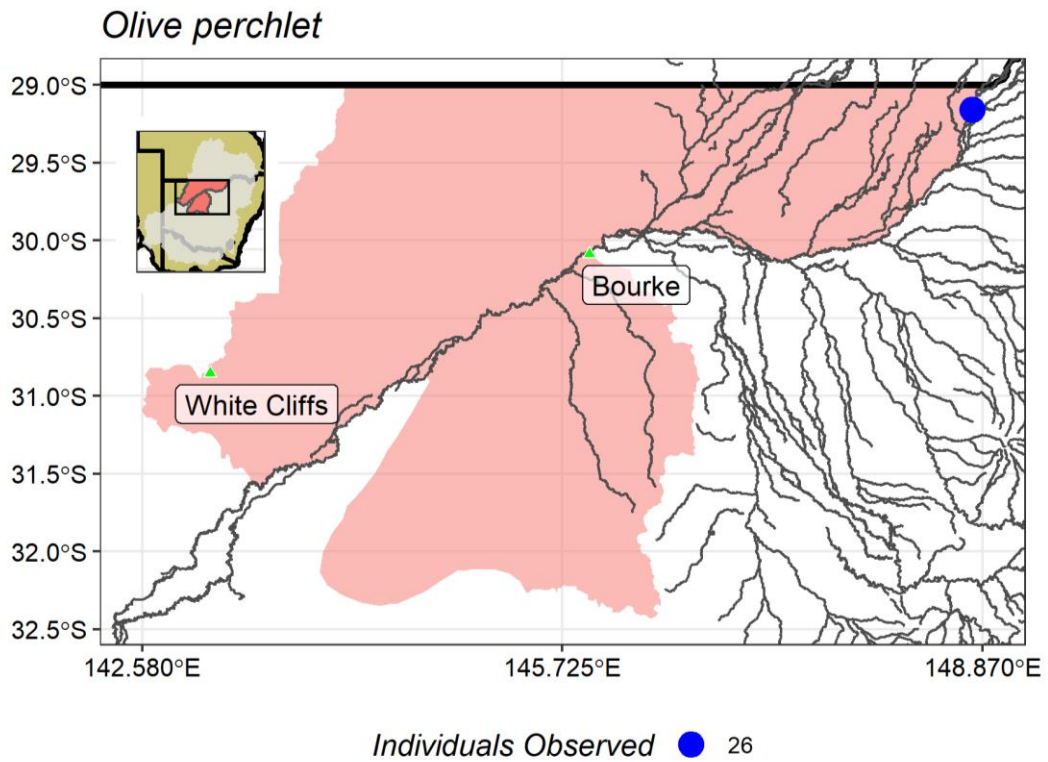


Figure 4.22: Distribution of Olive perchlet. Filled circles show sites where the species was present and the size of the circle represents number of observed individuals abundance.

**Summary Statement:**

A total of 25 Olive perchlet were caught with one additional individual observed at a single site located in an unnamed lagoon near the Barwon River.

## Appendix

Figure 4.23 shows the locations of sites sampled in each sampling season.

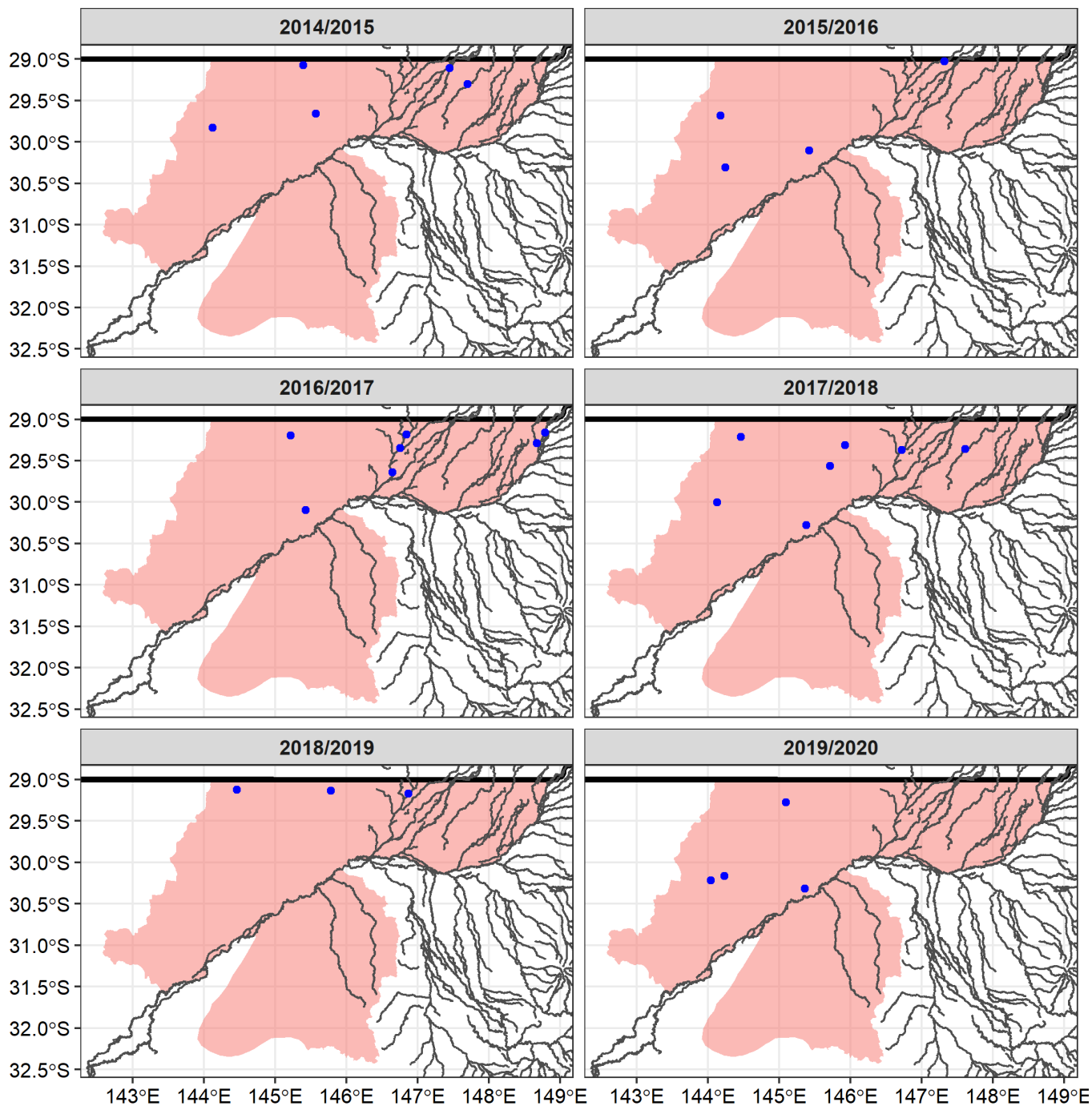


Figure 4.23: Sites sampled during the BPEOM-F program by Sampling Season. Dry sites are not shown.

Table 4.5 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 4.1. 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 Intersecting Streams WRPA were: Silver perch, Murray hardyhead, Unspecked hardyhead, Murray cod, Southern purple-spotted 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 4.8.

Table 4.5: 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	0	2	0	0	0
Bony herring	YES	676	211	1,215	100	1	4
Carp-gudgeon species complex	YES	9	3	1	0	0	0
Common carp	NA	32	11	47	25	0	9
Eastern gambusia	NA	2	8	107	10	1	0
Golden perch	YES	13	13	26	22	0	12
Goldfish	NA	2	1	70	4	1	0
Hyrtl's catfish	YES	1	1	4	2	0	0
Murray-Darling rainbowfish	YES	0	5	11	1	0	0
Olive perchlet	YES	0	0	25	0	0	0
Spangled perch	YES	8	5	32	19	0	1

The following table summaries the sampling methods by which each fish species was caught ([Table 4.6](#)).

Table 4.6: Total catch of each species by sampling method.

Common name	Backpack Electrofishing	Bait Trap	Boat Electrofishing
Australian smelt	0	0	2
Bony herring	6	2	2,199
Carp-gudgeon species complex	9	3	1
Common carp	15	14	95
Eastern gambusia	9	0	119
Golden perch	18	4	64
Goldfish	3	1	74
Hyrtl's catfish	2	1	5
Murray-Darling rainbowfish	0	0	17
Olive perchlet	0	2	23
Spangled perch	17	3	45

Table 4.7: 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 4.8 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 Intersecting Streams WRPA were: Silver perch, Murray hardyhead, Unspecked hardyhead, Murray cod, Southern purple-spotted 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 4.5.

Table 4.8. 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	2014/2015	2015/2016	2016/2017	2017/2018	2018/2019	2019/2020
Australian smelt	YES	0	0	16	0	0	29
Bony herring	YES	676	292	2,745	129	1	130
Carp-gudgeon species complex	YES	9	59	12	0	0	1,518
Common carp	NA	32	50	804	511	0	660
Eastern Gambusia	NA	2	12	457	136	1	13
Golden perch	YES	13	54	131	395	0	1,067
Goldfish	NA	2	4	423	9	1	13
Hyrtl's catfish	YES	1	171	892	5	0	4
Murray-Darling rainbowfish	YES	0	5	103	4	0	0
Olive perchlet	YES	0	0	25	0	0	0
Spangled perch	YES	26	262	857	68	0	22