

## Preliminary report into the 2023 fish deaths in the Lower Darling-Baaka River: summary of available Fisheries data

### DPI Fisheries

July 2023





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## Background

In early 2023, mass fish deaths occurred in the Menindee Town Weir Pool of the Lower Darling-Baaka River (LDBR). NSW DPI Fisheries estimated tens of millions of Bony Herring, thousands of Golden Perch and (at least) dozens of Murray Cod and Silver Perch perished. Thousands of pest Carp also perished.

DPI Fisheries also received reports and attended fish death events in the LDBR river channel and in wetlands downstream of the Menindee Lakes as floodwaters receded. Noting that access was limited, DPI Fisheries still estimate that hundreds of thousands of Bony Herring, thousands of Golden Perch and hundreds of Murray Cod perished throughout this section of river. Threatened Silver Perch and pest Carp were also among the casualties.

These events were larger in scale than the drought related fish deaths recorded during 2018 – 2020.

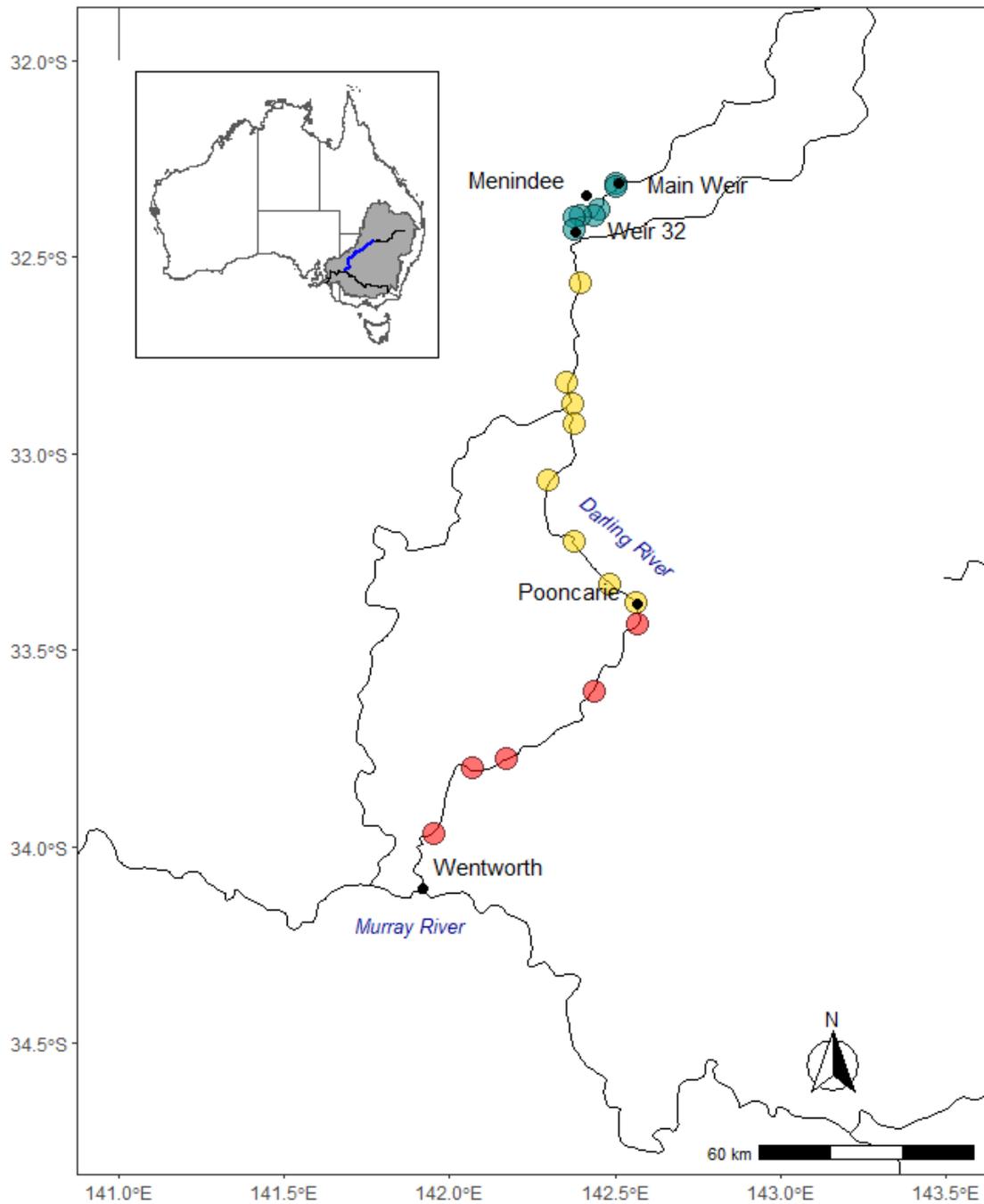
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## DPI Fisheries surveys, May 2023

DPI Fisheries has a range of fish research and monitoring surveys in the LDBR region. In 2022, these efforts were deferred due to poor access and the limited efficiency of electrofishing under high-flow/flood conditions. After the fish deaths in March 2023, surveys were again postponed to avoid additional stress on surviving fish in the system.

As water quality improved through April and May of 2023, fish surveys in the LDBR resumed. Twenty (20) sites were sampled using standardised boat electrofishing in May 2023, from immediately downstream of Lake Pamamaroo Outlet and Menindee Main Weir down to Wentworth (Figure 1). Sites were grouped into three (3) zones separated by large weirs (Pooncarie and Weir 32). Survey efforts were conducted under four (4) separate existing DPI Fisheries projects, with the data combined and rapidly assessed to contribute to addressing agency and community concerns regarding the immediate status of native fish in the Lower Darling-Baaka.

Additional detailed analysis will continue as part of project specific work and shared when possible.



**Figure 1. Map of sites sampled via standardised electrofishing methods in May 2023 in the LDBR. Sites are classed into three (3) zones; Upstream Weir 32 (7 sites), Between Weir 32 and Pooncarie Weir (8 sites) and Downstream Pooncarie Weir (5 sites).**

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## Results

The May 2023 surveys in the LDBR have documented some substantial changes in the fish population in comparison to similar surveys in 2019, 2020 and 2021. The five (5) most abundant species detected were (from most abundant to least abundant): Carp, Bony Herring, Goldfish, Golden Perch and Spangled Perch. Figure 2 shows the catch-per-site for species recorded in each zone of river during May 2023, noting the different scales between plots.

### Carp and Goldfish (introduced pests)

- Carp (and Goldfish) are generalist species that breed in shallow still or slow flowing habitats, particularly inundated floodplain during flooding. Populations typically increase in abundance following floodplain inundation.
- There was a substantial increase in Carp and Goldfish abundance in 2023, relative to surveys in 2019, 2020, and 2021. There are now more pest fish (especially Carp and Goldfish) than prior to the recent flood and fish deaths events.
- Carp abundance was highest between Pooncarie and Wentworth, decreasing between Pooncarie and Weir 32 and lowest between Weir 32 and Menindee Main Weir.
- The increased abundance of these pest species will cause ongoing problems for native fish, emphasizing the need for effective and integrated pest management strategies to mitigate their impact, enhance native fish recovery, and maintain the balance in the ecosystem.

### Bony Herring

- Bony Herring are often considered a “boom-bust” generalist species that can increase in abundance rapidly during wetter periods.
- The abundance of Bony Herring fluctuated across sampling periods, being lower in the most recent sampling (May 2023) than it was in 2021 (prior to major flooding) but noting that the May 2023 abundance in the Menindee Weir Pool was higher than in June 2019 (after the 2018/19 fish kills).
- Bony Herring abundance was highest in the reach between Menindee Main Weir and Weir 32, decreasing downstream to Wentworth.

### Golden Perch

- Golden Perch are a highly mobile and highly fecund (up to 500,000 eggs per female), with breeding and recruitment success generally related to periods of higher flows or floods.
- Golden Perch abundance in the Menindee Town Weir pool was higher in May 2023 than in preceding years (2020, 2021), despite the recent fish kills.
- Golden Perch abundance was substantially lower downstream of Weir 32 than the last sampling occasion in 2021.
- During the most recent sampling (May 2023), Golden Perch abundance was comparable between the zone upstream of Weir 32 and downstream of Pooncarie but was substantially lower in the zone between Weir 32 and Pooncarie.
- In May 2023, the Golden Perch population in the upstream zone (Menindee Town Weir pool above Weir 32) was dominated by adult fish >300 mm, whilst the two downstream zones were dominated by juvenile fish <300 mm.

### Silver Perch

- In May 2023, only two Silver Perch were recorded, both in the Menindee Town Weir Pool.
- Only 6 silver perch had been detected in earlier LDBR monitoring conducted for the Native Fish Recovery Strategy across 2019, 2020 and 2021 (4 individuals between Pooncarie and

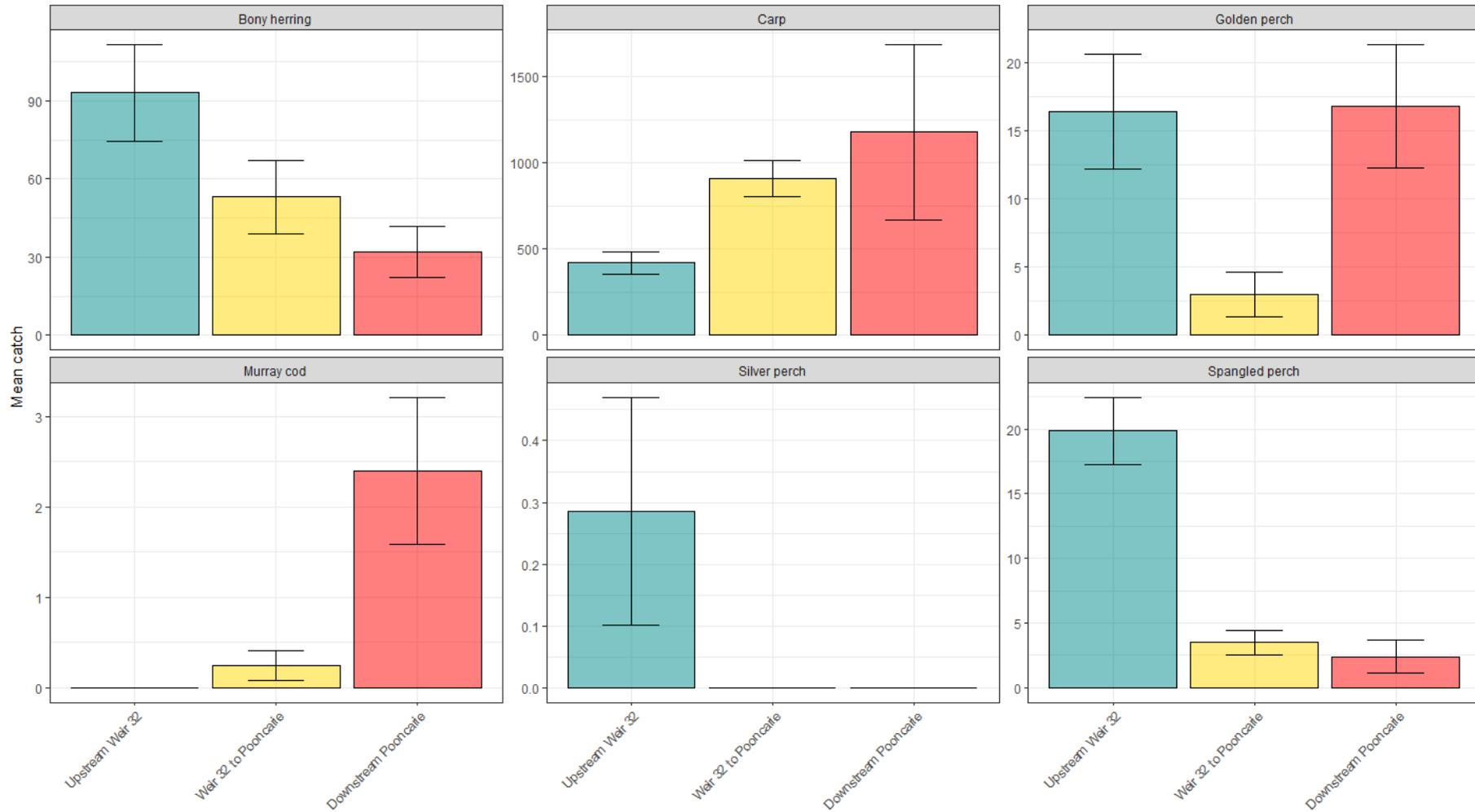
Weir 32 in June 2019 near a Fisheries Aerator, 1 downstream of Menindee Main Weir in June 2019 and 1 downstream of Menindee Main Weir in October 2019).

## Murray Cod

- Murray Cod are a large long-lived species that breed annually in 'nests' which are protected for several weeks by adult males. Higher flows and flooding generally contribute to breeding and recruitment success, although being large (therefore with high oxygen demand) and less mobile than species like Golden Perch, they can be more susceptible to local water quality issues such as hypoxia.
- Murray Cod abundance during the most recent sampling (May 2023) was substantially lower throughout the LDBR in comparison to preceding years (including post the 2018/19 fish kills).
- Murray Cod were not captured at sites upstream of Weir 32 (although we note anecdotal captures by anglers in this reach).
- Murray Cod were captured in low abundance between Weir 32 and Pooncarie, and at moderate abundance downstream from Pooncarie.
- All Murray Cod captured were  $\leq 500$  mm in length and typically sub-adult.
- Prior to 2018 the Lower Darling-Baaka Murray cod population was considered one of the most robust in the Murray Darling Basin.
- Being long-lived, recovery of the local population will take time and will depend on the provision of a flow regime spanning years (or decades) that considers perennial (year-around) base flows and annual spring rises to support breeding, recruitment (survival and growth of young fish), and opportunities for movement and access to key habitat features.

## Northern visitors

- Threatened **Olive Perchlet** were detected in the Lower Darling-Baaka in 2023 surveys, in addition to being detected in the Menindee Lakes in 2022 (NSW DPI Fisheries Data). Spreading into new habitats from remnant populations in the Northern Basin is important for the survival of this species.
- Often associated with wetland habitats, the presence of the Olive Perchlet in the LDBR highlights the significance of hydrological connectivity (both along rivers and laterally with floodplain habitats). It also highlights opportunities for conservation efforts and the need to monitor and protect endangered populations.
- **Spangled Perch** were also detected in the Menindee Lakes and Lower Darling-Baaka River. These fish likely dispersed from warmer regions in the Northern Basin with recent floodwaters



**Figure 2. Mean catch per site ( $\pm$  SE) of select medium/large bodied fish species captured in May 2023 electrofishing surveys conducted in the LDBR. Catch is pooled by sites within the three select zones outlined in Figure 1. Note y-axis scale differs between plots.**

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## Conclusion

The abundance of some native fish species in the Lower Darling-Baaka River has declined (in comparison to data collected since 2019) following the fish deaths events of early 2023. This is despite earlier demonstrated recovery of native fish from 2020-2022, driven by natural flows and deliveries of water for the environment to the LDBR.

Large-scale, extreme changes in flow conditions – from zero flow to major flooding in the space of four years – pose significant and ongoing risks and challenges to native fish. Such extreme changes represent a departure from the natural flow regime in the LDBR, which were typified by within-channel flow variability throughout the majority of years, punctuated by larger floods and occasional short cease-to-flow events (Mallen-Cooper and Zampatti 2020).

The risks to native fish that result from these broad changes in the LDBR flow regime include:

- Fewer within channel flow pulses – these events are important for river productivity, spawning by some species, supporting recruitment of young fish, and providing opportunities for movement, including downstream dispersal of young.
- Protracted periods during drought where the river contracts to a series of disconnected pools, prone to algal blooms and thermal stratification/de-stratification, which can result in mass fish deaths (as experienced during 2018 - 2020 at Menindee and along the LDBR).
- Long periods between flood events that flush floodplain carbon and nutrients into and along rivers. Regulation of our rivers has reduced flood frequency, so when major flooding does occur it mobilises unnaturally large volumes of carbon and other nutrients which contribute to poor water quality (e.g. hypoxic blackwater) and algal blooms.
- Ecosystem bottlenecks, where rapid increases in abundance of food and fish during floods (particularly pest species Carp) are followed by rapid reductions in habitat and resources, compounded by large aggregations of fish downstream of barriers to fish movement.
- Depletion of populations of key species throughout long stretches of the river system. Population recovery in these stretches can be compromised by existing barriers to movement from upstream and downstream waterways, as well as availability and access to preferred habitat.

It will be crucial to adaptively manage and conserve native fish and their habitats by using the best available knowledge. The long-term sustainability of native fish populations in the LDBR is dependent on a variable but perennial flow regime that supports the life history needs (spawning, breeding habitat, growth and dispersal) of different species. To achieve this, system-scale connectivity in water management and planning must be considered so that appropriate flows support the ecological, social, cultural and economic values of the LDBR.

The delivery of operational and environmental flows to the LDBR to support breeding, recruitment and dispersal of native fish will be a crucial part of future planning. It is noted that carefully planned and optimised delivery of environmental water in the LDBR in 2016/17, and again in 2020/21, contributed to positive outcomes relating to Murray Cod breeding and recruitment and dispersal of Golden Perch.

DPI Fisheries will continue to work with other Government agencies to ensure water is managed appropriately to contribute to native fish protection and recovery.

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## Acknowledgements:

We wish to acknowledge the agencies and individuals that contributed to the funding, planning and management of programs for which the data summarised here was collected. These include the Department of Planning and Environment - Environment and Heritage Group, the Commonwealth Environmental Water Office, Murray-Darling Basin Authority, Ivor Stuart from Charles Sturt University, Department of Planning and Environment – Water, and Water NSW. We are also grateful to LDBR Traditional Owners, Lower Darling and Anabranche landowners, and community members and for their support and contributions towards environmental recovery programs in the region.

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## References

Mallen-Cooper, M., and Zampatti, B. P. (2020). Restoring the ecological integrity of a dryland river: why low flows in the Barwon–Darling River must flow. *Ecological Management & Restoration* 21, 218–228. doi:10.1111/EMR.12428