Department of Planning and Environment

dpie.nsw.gov.au

NSW GOVERNMENT

Turtles and flows

Water requirements of the Bell's turtle (*Myuchelys bellii*)

Sep 2023

Acknowledgement of Country

The Department of Planning and Environment acknowledges that it stands on Aboriginal land. We acknowledge the Traditional Custodians of the land and we show our respect for Elders past, present and emerging through thoughtful and collaborative approaches to our work, seeking to demonstrate our ongoing commitment to providing places in which Aboriginal people are included socially, culturally and economically.

Published by NSW Department of Planning and Environment

dpie.nsw.gov.au

Turtles and flows

First published: September 2023
ISBN/ISSN: 978-1-76058-753-6

Department reference number: PUB23/1086

More information

This research update is part of our Environmental Outcomes Monitoring and Research Program please visit our website for more information.

Citation: Coleman, D., Wood, R. and Streeting, L. (2023) Turtles and flows. Water requirements of the Bell's Turtle (*Myuchelys bellii*). NSW Department of Planning and Environment

Acknowledgements

Title page photo credit: A hatchling Bell's turtle being released into the wild. David Waugh.

Many thanks to Louise Streeting, Martin Dillon and Deborah Bower for their research efforts and assistance with this publication.

Contents

An adult Bell's turtle (*Myuchelys bellii*) on the bank of an unregulated stream

Image credit: Louise Streeting – University of New England

The Bell's turtle

The Bell's turtle (*Myuchelys bellii*) is an endangered freshwater species that occurs in the upper reaches of the Border Rivers, Gwydir and Namoi catchments. They prefer deep pools with shallow flowing sections between them. The species has received substantial recovery funding from the NSW Government[1] which has resulted in:

- wide-spread monitoring
- nest protection
- captive breeding and release of hatchlings
- targeted research by the University of New England
- 26 agreements with private landholders
- the rescue of 43 turtles from a waterhole drained by stock and domestic water use

However, to date there has been no targeted flow management to protect the water requirements of this species even though flow alteration is listed as a threat to the species' survival.

Core habitat for the Bell's turtle in the upper Border Rivers catchment

Image credit: Tim Haeusler - Department of Planning and Environment

1. Saving our species project report for the Bell's turtle: ISBN 978-1-922715-91-3; EES 2021/0489; October 2021

Distribution of the Bell's turtle

The Bell's turtle occurs within the upper catchments of the Namoi, Gwydir and Border Rivers in the northern Murray-Darling Basin (Figure 1). The 3 discrete NSW populations are spread across 13 unregulated water sources within the:

- Water Sharing Plan for the Gwydir Unregulated River Water Sources 2012
- Water Sharing Plan for the Namoi and Peel Unregulated Rivers Water Sources 2012
- Water Sharing Plan for the NSW Border Rivers Unregulated River Water Sources 2012

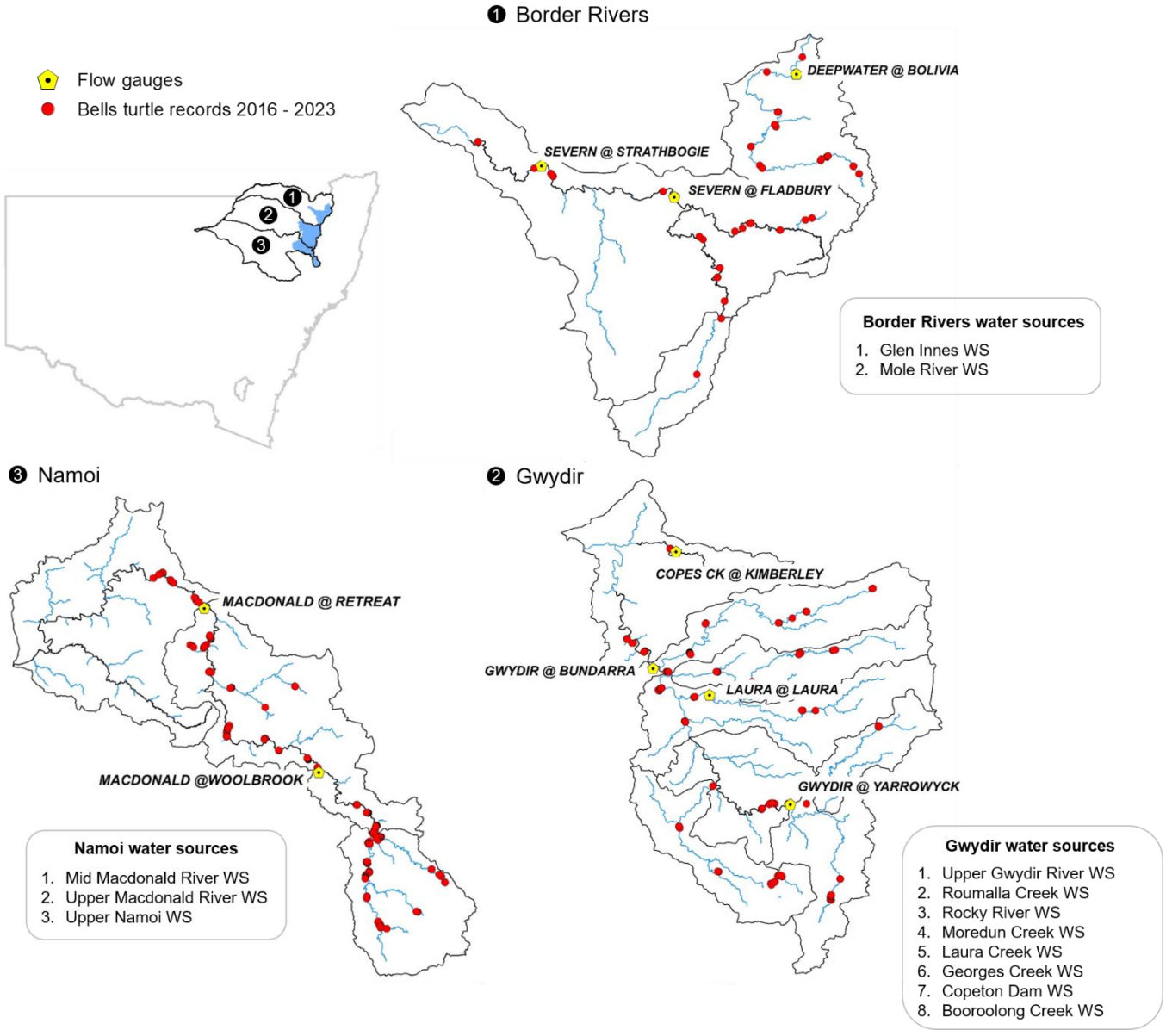

Figure 1. Map of recorded Bell's turtle captures between the 1 July 2016 and 30 June 2022. The figure also shows the active flow gauges and relevant water sources with Bell's turtle records for the Border Rivers, Namoi and Peel, and Gwydir unregulated water sharing plans.

The importance of flow

All components of the flow regime are likely to have some importance to the Bell's turtle (Figure 2). However, cease to flows, low flows and very low flows are the most critical components from an ecological and water management perspective.

Cease-to-flow periods

Cease-to-flow periods are periods of minimal to no flows when the river dries up into a series of disconnected pools. Flowing habitats are the first to be impacted, such as riffles, which are shallow sections of water flowing over cobbles and pebbles within the river channel. Adult Bell's turtles inhabit deep pools and forage in shallows and riffles at night[2], and adults can survive within deep pools through long cease-to-flow periods. However, hatchling Bell's turtles are dependent on the shallow vegetated pool edges[3].

Cease to flows, and pool drawdown can reduce the amount of habitat available to hatchlings, forcing them into deeper water without the vegetative cover necessary to protect them from predation. This means that reducing the length of cease-to-flow events, and ensuring full pool capacity (i.e. 100% at the start of a cease-to-flow period) with a natural rate of pool drawdown is critical for protecting the aquatic refuge habitats for the Bell's turtle, particularly in their early life stages.

Bell's turtle (*Myuchelys bellii*) hatchlings in shallow fringing aquatic vegetation

Image credit David Waugh

2. Fielder *et al.* (2015). *Myuchelys bellii* (gray 1844) – Western saw- shelled turtle, Bell's turtle

3. Streeting *et al.* (In prep). Movement, survival and habitat use of hatchlings of the western saw-shelled turtle (*Myuchelys bellii*) during their first two weeks in the wild.

Low and very low flows

Low and very low flows provide connectivity between pools and help to maintain refuge pools which are important habitats for this species, particularly hatchlings. Bell's turtle hatchlings leave the nest and enter the water between late January and late March to start searching for food and suitable habitat before winter.

Recent research from the University of New England tracked 39 Bell's turtle hatchlings and found that they occupied shallow vegetated margins of pools. They moved both upstream and downstream through shallow flowing riffles, rivulets and runs to disperse to new pool habitats[2]. The movement distance varied, but they moved up to 2 kilometres in just over two weeks, and tended to move further when water levels were elevated. This makes low and very low flows between February and April important as they provide the connectivity for young turtles to move between habitats after they hatch (Figure 2). Supporting the habitat and dispersal requirements of the hatchling stage will contribute to the Federal and Government's conservation aims for the species.

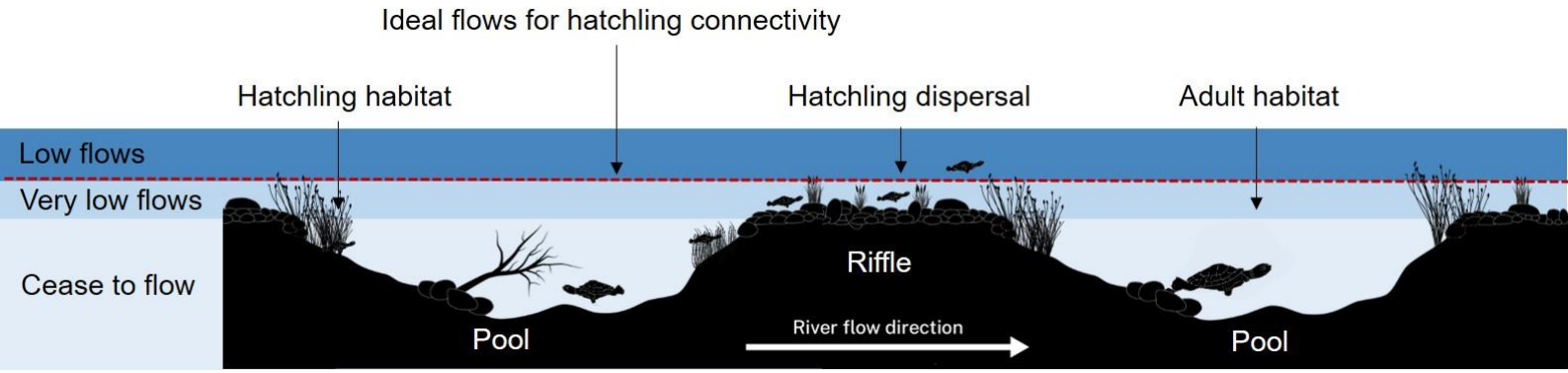

Figure 2. Conceptual diagram showing the core habitat of adult and hatchling Bell's turtle, as well as the required flows to protect connectivity for hatchling dispersal.

Radio tagged hatchling Bell's turtle (*Myuchelys bellii*) used to identify habitat and movement preferences by Louise Streeting from the University of New England.

Image credit: Louise Streeting – University of New England

3. Streeting *et al.* (In prep). Movement, survival and habitat use of hatchlings of the western saw-shelled turtle (*Myuchelys bellii*) during their first two weeks in the wild.

Water requirements for the Bell's turtle

Protecting very low and low flows in Bell's turtle habitats should manage connectivity and habitat requirements to support population viability into the future. The ideal, minimum and maximum requirements for hatchlings to move between pool habitats would be between the very low to low flows. These flow categories are defined within the NSW River Flow Objectives, which were endorsed by the NSW Government in 1999:

- Very low flows: flows below the level naturally exceeded on 95% of all days with flow.
- Low flows: flows below the level naturally exceeded on 80% of all days with flow.

This is particularly important during key recruitment periods; in this case, the first few months of a turtle's life. The focus on protecting flows between the 1 February and 15 April ensures hatchlings have the greatest chance of survival and dispersal before the colder winter months. The core water requirements of the Bell's turtle are identified in Table 1 for water sources with both active river flow gauges and Bell's turtle records between the 1 July 2012 and the 30 June 2022. These are intended to support water management decisions in the relevant water sharing plans. The methods used to calculate these water requirements are summarised in Appendix 1.

Table 1. Water requirements of adult and hatchling Bell's turtles for relevant flow gauges with Bell's turtle records (Figure 1). The thresholds are rounded to the nearest 0.5 ML/d for useability with the non-rounded values in Appendix 1.

Valley	Flow gauge	Life-stage	Timing	Min low flow requirement Very low flows (95th %tile)	Ideal low flow requirement (87.5 %tile)	Max low flow requirement Low flows (80th %tile)
Border Rivers	416039 - Severn @ Strathbogie	Hatchling	1 Feb to 15 Apr	3.5 ML/d	7.5 ML/d	13.0 ML/d
	416022 - Severn @ Fladbury	Hatchling	1 Feb to 15 Apr	3.0 ML/d	6.0 ML/d	9.5 ML/d
	416023 - Deepwater @ Bolivia	Hatchling	1 Feb to 15 Apr	2.5 ML/d	5.5 ML/d	9.0 ML/d
Gwydir	418014 - Gwydir @ Yarrowyck	Hatchling	1 Feb to 15 Apr	1.5 ML/d	3.0 ML/d	5.0 ML/d
	418008 - Gwydir @ Bundarra	Hatchling	1 Feb to 15 Apr	1.5 ML/d	2.5 ML/d	4.0 ML/d
	418021 - Laura @ Laura	Hatchling	1 Feb to 15 Apr	1.5 ML/d	2.5 ML/d	3.5 ML/d
	418005 - Copes Ck @ Kimberley	Hatchling	1 Feb to 15 Apr	1.5 ML/d	2.0 ML/d	3.0 ML/d
Namoi	419010 - Macdonald @ Woolbrook	Hatchling	1 Feb to 15 Apr	6.5 ML/d	13.5 ML/d	21.0 ML/d
	419028 - Macdonald @ Retreat	Hatchling	1 Feb to 15 Apr	5.0 ML/d	13.0 ML/d	24.0 ML/d
All 3 valleys	All flow gauges	Adult	All year	100% pool capacity at the start of a cease to flow period followed by natural rates of pool drawdown		

References

Chessman, B.C., 2015. Distribution, abundance and population structure of the threatened western saw-shelled turtle, *Myuchelys bellii*, in New South Wales, Australia. Aust. J. Zool. 63, 245. https://doi.org/10.1071/ZO15034

DCCEEW, 2023. Conservation Advice for *Myuchelys belli* (western saw-shelled turtle). Department of Climate Change, Energy, the Environment and Water, Canberra ACT 2601.

Deeth, C., Coleman, D., 2022. Review of freshwater turtle ecology and flow. NSW Department of Planning and Environment, Sydney NSW, Australia.

DPIPWE (2016). Eco-hydrological assessment of the Boobyalla and Tomahawk rivers. Water Assessment Aquatic Ecology Report Series, Report No. WMA 16/03. Water and Marine Resources Division. Department of Primary, Industries, Parks, Water and Environment, Hobart, Tasmania.

DPE, 2022. NSW Border Rivers Long Term Water Plan Parts A and B. State of NSW and Department of Planning and Environment.

Fielder, D.P., Chesssman, B., Georges, A., 2015. *Myuchelys bellii* (Gray 1844) – Western Saw-shelled Turtle, Bell's Turtle, in: Conservation Biology of Freshwater Turtles and Tortoises, Chelonian Research Monographs. Chelonian Research Foundation. https://doi.org/10.3854/crm.5

Lerat J., Egan C., Kim S., Gooda M., Loy A., Shao Q., and Petheram C. (2013) Calibration of river models for the Flinders and Gilbert catchments. A technical report to the Australian Government from the CSIRO Flinders and Gilbert Agricultural Resource Assessment. CSIRO Water for a Healthy Country and Sustainable Agriculture flagships, Australia.

NSW Threatened Species Scientific Committee, 2019. Western sawshelled turtle (*Myuchelys bellii*) - endangered species listing [WWW Document]. NSW Environment, Energy and Science. URL http://www.environment.nsw.gov.au/topics/animals-and-plants/threatened-species/nsw-threatened-species-scientific-committee/determinations/final-determinations/2017-2018/western-sawshelled-turtle-myuchelys-bellii-endangered-species-listing (accessed 8.6.20).

Streeting L. M., Dillon M. L., McKnight D., McDonald P. G., Watson S., Soderquist T, and Bower D, S. (In prep). Movement, survival and habitat use of hatchlings of the western saw-shelled turtle (*Myuchelys bellii*) during their first two weeks in the wild.

Appendix 1: Flow calculation methods

The very low flow and low flow metrics used in Table 1 were calculated using R Studio for the available flow record for each river flow gauge (Table 2). Flow data was sourced from the Department of Planning and Environment's Hydstra database. Very low flows and low flows were defined as the 95th and 80th percentile of flowing days respectively. This is in line with the NSW River Flow Objectives. The ideal water requirements is the half-way point between the very low and low flow thresholds (percentile 87.5), and considered sufficient for hatchling connectivity. However, the values presented in Table 1 reflect observed flow percentiles, not natural flow percentiles. Therefore, the observed flows are influenced by water extraction and may result in lower flow thresholds than would be expected under natural flow conditions. To account for this, flowing days were defined as flows greater than 0.99 ML/d. This also addresses issues with the measurement of flows below 1 ML/d at sand and gravel controlled gauging stations, which is often considered the cease-to-flow condition[3-5]. In addition, there is a high uncertainty for flows below 1 ML/d due to:

1. Small errors such as measurement uncertainty for very small height changes.
2. Wind moving water within pools, creating movement and subsequent detection of flows.
3. The ecological significance of any flow below 1 ML/d is negligible.
4. The influence of channel size, for example the Macdonald River.

Table 2. Period of record used to calculate flow metrics presented in Table 1 for flowing days between the 1 February and 15 April.

Valley	Flow gauge	Period of record used	Number of data points (i.e. days) available between 1 February and 15 April
Border Rivers	416039 - Severn @ Strathbogie	11/05/1974 – 24/07/2023	3,136
	416022 - Severn @ Fladbury	8/03/1978 – 24/07/2023	2,900
	416023 - Deepwater @ Bolivia	9/03/1978 – 25/07/2023	2,967
Gwydir	418014 - Gwydir @ Yarrowyck	3/05/1955 – 26/06/2023	2,745
	418008 - Gwydir @ Bundarra	29/05/1971 – 25/07/2023	2,743
	418021 - Laura @ Laura	5/06/1965 – 26/06/2023	1,882
	418005 - Copes Ck @ Kimberley	19/04/1929 – 26/06/2023	2,813
Namoi	419010 - Macdonald @ Woolbrook	20/05/1979 – 21/06/2023	3,033
	419028 - Macdonald @ Retreat	2/10/1982 – 21/06/2023	1,832

Table 3. Water requirements of adult and hatchling Bell's turtles for relevant flow gauges with Bell's turtle records. The thresholds are rounded to the nearest 0.1 ML/d.

Valley	Flow gauge	Life-stage	Timing	Min low flow requirement Very low flows (95th %tile)	Ideal low flow requirement (87.5 %tile)	Max low flow requirement Low flows (80th %tile)
Border Rivers	416039 - Severn @ Strathbogie	Hatchling	1 Feb to 15 Apr	3.5 ML/d	7.3 ML/d	12.9 ML/d
	416022 - Severn @ Fladbury	Hatchling	1 Feb to 15 Apr	2.8 ML/d	6.1 ML/d	9.5 ML/d
	416023 - Deepwater @ Bolivia	Hatchling	1 Feb to 15 Apr	2.5 ML/d	5.4 ML/d	8.8 ML/d
Gwydir	418014 - Gwydir @ Yarrowyck	Hatchling	1 Feb to 15 Apr	1.6 ML/d	3.1 ML/d	4.8 ML/d
	418008 - Gwydir @ Bundarra	Hatchling	1 Feb to 15 Apr	1.5 ML/d	2.6 ML/d	4.2 ML/d
	418021 - Laura @ Laura	Hatchling	1 Feb to 15 Apr	1.5 ML/d	2.5 ML/d	3.7 ML/d
	418005 - Copes Ck @ Kimberley	Hatchling	1 Feb to 15 Apr	1.4 ML/d	2.1 ML/d	3.1 ML/d
Namoi	419010 - Macdonald @ Woolbrook	Hatchling	1 Feb to 15 Apr	6.3 ML/d	13.3 ML/d	20.7 ML/d
	419028 - Macdonald @ Retreat	Hatchling	1 Feb to 15 Apr	4.9 ML/d	13.1 ML/d	23.7 ML/d
All 3 valleys	All flow gauges	Adult	All year	100% pool capacity at the start of a cease to flow period followed by natural rates of pool drawdown		