

ARI Aquatic Quarterly Update – Influence

AUTUMN 2026



Golden Perch

This update provides four examples of projects that support waterway management.

They provide an overview of:

- an extensive study (integrating otolith and genomic data) providing the strongest evidence to date on the long-term fate of stocked Golden Perch in a large, connected freshwater system.
- how reinstating very low-flow regimes (allowing riverbed exposure for at least two weeks in late summer or autumn) can effectively stimulate recruitment of flood-tolerant and certain aquatic plants.
- a novel study showing that environmental flows can enhance fishway functionality, delivering greater ecological benefit than fishways alone.
- a nursery experiment showing that riparian plants are more resilient to seasonal inundation than terrestrial plants, particularly during spring and under short summer flooding.



About us

The Applied Aquatic Ecology section generates and shares knowledge, through world-class, applied, ecological research. This research supports and guides sustainable ecosystem policy and management to ensure healthy, resilient ecosystems. We work collaboratively with national, state and local agencies, research institutes, universities, interest groups and the community.

Our focus:

- To undertake high quality, relevant ecological research.
- To interpret research outcomes and communicate these effectively to key stakeholders.
- To guide and support sustainable ecosystem policy and management.

Stocking strategies to protect genetic diversity and enhance recovery outcomes for Golden Perch

ISSUE

Golden Perch (*Macquaria ambigua*), a species of immense cultural and recreational value, is a mobile, long-lived freshwater fish in Australia's Murray–Darling Basin (MDB). In some areas it is heavily reliant on hatchery stocking to support species' persistence and/or recreational fisheries (Figure 1). Managers currently lack evidence on how stocked fish disperse, survive and mix with wild populations over decades. This gap limits the ability to refine stocking strategies and assess genetic risks of stocking (e.g. reduced diversity or unintended mixing of distinct lineages) which may undermine long-term population resilience.

ACTION

The potential genetic effects of stocking on the natural populations of Golden Perch in the MDB was explored using a combination of:

- otolith (earbone) chemistry and otolith age data to identify stocked individuals according to their natal origin.
- genomic data to assess genetic structure, diversity among stocked and wild fish and the prevalence of close kin across the basin and over time.

This dual approach determined:

- whether fish were wild born or hatchery stocked
- where they recruited, and
- temporal patterns in dispersal and genetic structure.

Sampling was conducted across all major river basins to gain insights into how stocking influences populations over multiple decades. This large dataset brought together samples from many large Commonwealth and State fish monitoring projects including Flow-MER, The Living Murray and the former VEFMAP (Victorian Environmental Flows Monitoring and Assessment Program).

RESULTS

The analyses revealed that:

- stocked fish persisted in the system for many years and contributed to both local and distant populations, indicating substantial movement across the basin.
- in some areas, stocked individuals made up a notable proportion of sampled fish, while in others, wild recruitment dominated. Areas where stocked fish dominated tended to be relatively isolated due to the presence of artificial barriers to movement.
- otolith analyses confirmed recruitment locations, while genomic data detected subtle but important changes in genetic structure linked to stocking history.
- the species' high mobility facilitated widespread mixing, meaning stocking influences were detectable far from original release points.
- importantly, genetically distinct lineages were not homogenised, suggesting that previous stockings had not yet eroded key population structure. It was however apparent that active management of stocking is needed to mitigate this risk.



Managing low flows in rivers to enhance recruitment of instream plants

ISSUE

Many environmental flow planning frameworks include key objectives for riparian and instream vegetation. Most vegetation needs are met by elevated flows from environmental flows or natural flows, but some aspects of recruitment require low flows. Regulated lowland rivers now often lack natural warm-season low flows, resulting in persistent riverbed inundation. This constant inundation of the riverbed suppresses the recruitment of riparian and some instream vegetation, particularly flood-tolerant and aquatic species. This means that objectives might not be met in some waterways. In the regulated Campaspe River downstream of Lake Eppalock, post-regulation flows rarely drop below 50 ML/day, which is unlike the pre-regulation period when flows sometimes fell below 10 ML/day in late summer and autumn. This permanence may inhibit germination and establishment of riverbed vegetation that relies on sediment exposure.

ACTION

A low-flow field experiment was carried out in early May 2022. Flows were gradually reduced from 50 ML/day to 15–20 ML/day over one week, maintained for two weeks, and then ramped back up over another two weeks, totaling a 36-day experiment. Paired plots at high-elevation (exposed) and low-elevation (inundated) positions were established across eight sites, and surveyed at three timepoints (at Week 0, Week 2 and Week 6) (Figure 2).

A concurrent *ex-situ* nursery experiment was also carried out. This experiment used sediment samples from the field site plots in three treatments: long exposure (exposed throughout the experiment), short exposure (two weeks) followed by inundation, and continuous inundation over 22 weeks.

RESULTS

The field experiment found that:

- a two-week exposure was sufficient to trigger germination of thousands of flood-tolerant riverine species, whereas aquatic plants responded minimally and terrestrial species were rare.
- seedlings that emerged tolerated early re-inundation, but prolonged submersion reduced survival for non-aquatic plants.

The nursery experiment mirrored these results:

- short and long exposure treatments led to higher seedling counts from aquatic and flood-tolerant groups, while continuous inundation resulted in few recruits.

OUTCOME

The study demonstrated that reinstating very low-flows in regulated flow regimes—allowing riverbed exposure for at least two weeks during late summer or autumn—can effectively stimulate the recruitment of flood-tolerant and certain aquatic plants species. However, survival post-germination depends on timely re-inundation. While these very low-flows pose potential risks to some aquatic fauna and water quality management, the benefits for reinstating natural biotic processes are potentially substantial. As such, environmental water planning where objectives include recruitment of instream vegetation should consider incorporating warm-season low-flow pulses.

Managing low flows in rivers to enhance recruitment of instream plants (cont')

NEXT STEP

Subsequent studies are underway to assess the effectiveness of instream revegetation where flow management cannot be used to facilitate natural recruitment, as well as studies to better understand recruitment processes for aquatic plants.

FUNDER

The former VEFMAP (Victorian Environmental Flows Monitoring and Assessment Program), DEECA Water and Catchments.

CONTACT

Dr Chris Jones, ARI

[Jones et al. \(2025\)](#) Managing river low flows to enhance instream vegetation recruitment. Environmental Management.

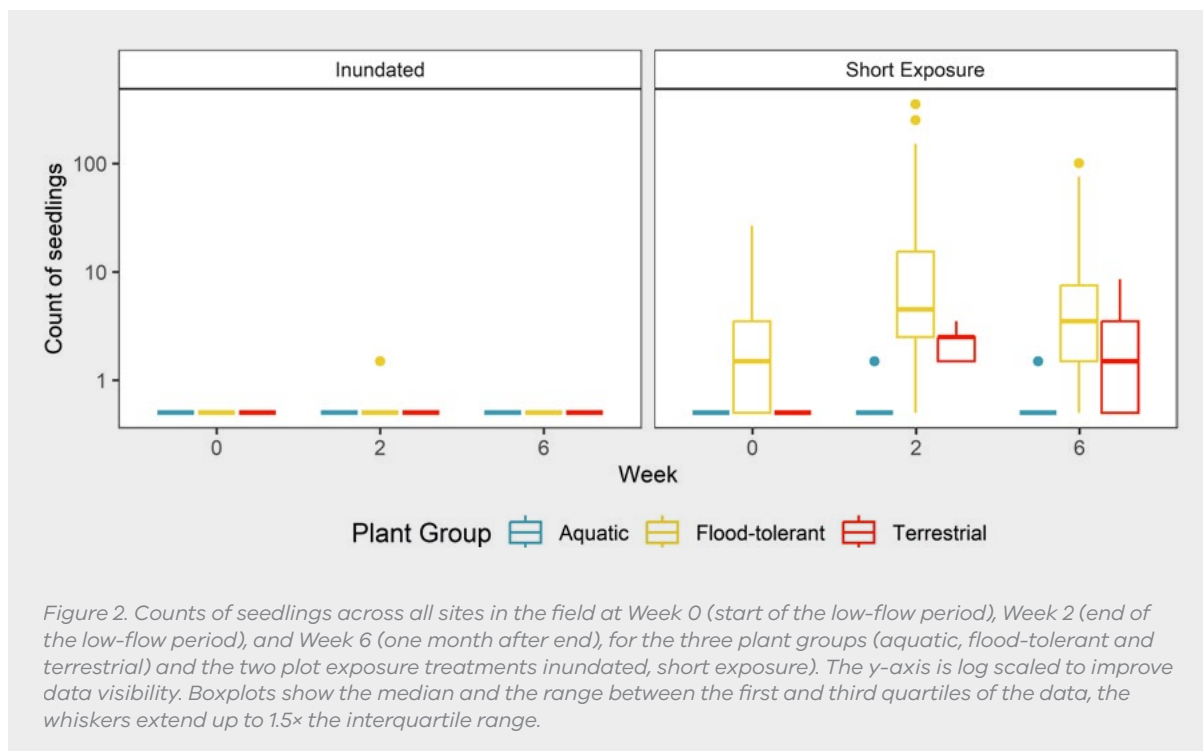


Figure 2. Counts of seedlings across all sites in the field at Week 0 (start of the low-flow period), Week 2 (end of the low-flow period) and Week 6 (one month after end), for the three plant groups (aquatic, flood-tolerant and terrestrial) and the two plot exposure treatments (inundated, short exposure). The y-axis is log scaled to improve data visibility. Boxplots show the median and the range between the first and third quartiles of the data, the whiskers extend up to 1.5x the interquartile range.



Carrying out vegetation surveys during low-flow periods

Environmental flows increase fish movement and improve fishway performance

ISSUE

Fishways and environmental flows both commonly aim to enhance instream connectivity and fish movement, however the combined benefits of these management interventions are rarely evaluated or reported on, despite the costs of implementing the flow and fishway interventions.

ACTION

Fish movement responses to environmental flows were examined across multiple fishways in two regulated lowland river systems (Broken Creek and the lower Loddon River). Fish movement was assessed using fishway trapping and PIT (Passive Integrated Transponder) tag detections. Fishway hydraulics (i.e. turbulence, water velocity and discharge) were modelled under low, medium and high discharge conditions. Environmental flows were delivered as seasonal “freshes” which aim to raise river levels, stimulate fish movement, and enhance river connectivity. This work assessed which fish species used fishways, how their movement changed with river discharge, and how flow driven changes in fishway hydraulics influenced fish movement, increased movement frequency and species diversity.

RESULTS

Increasing river discharge driven largely by environmental flows substantially increased fish movement across all fishways, particularly during spring when water temperatures were rising. Fish movement was greater during medium to large flow events.

- Large bodied native fish species (e.g. Murray Cod and Golden Perch) showed strong river discharge related increases in fishway use (up to 20 fold for Murray Cod in Broken Creek).
- Small bodied native fish species (e.g. Australian Smelt, Carp Gudgeon) responded even more dramatically, with movement increasing by 30 to 140 fold during high flow events.
- Higher flows raised tailwater levels and partially drowned out low level fishways, reducing turbulence and headloss (loss of hydraulic energy) by ~50%, creating more favourable hydraulic conditions for small fish.
- Alien species (e.g. Common Carp, Oriental Weatherloach and Goldfish) also moved more during high flows. This highlights the need to integrate pest management with river connectivity restoration.

OUTCOME

This study showed that increased stream discharge driven primarily by environmental flows enhanced fishway functionality, delivering greater ecological benefit than fishways alone. By improving hydraulic conditions and aligning flow timing with biological cues, managed flows enable a wider range of species and size classes to move through regulated rivers. These findings support coordinated investment in flows and fishway design/operation to maximise connectivity outcomes in highly regulated rivers.

A conceptual model was also developed which details the hydraulic interplay between environmental flow magnitude and river height, fishway performance, fish size class movement and the likely fish movement pathways to simplify and visualise these relationships (Figure 3). This model effectively demonstrates how the degree of connectedness within regulated waterways fluctuates for fishes, even after fishways have been constructed, and environmental flows delivered.

Environmental flows increase fish movement and improve fishway performance (cont')

FUNDER

The former VEFMAP (Victorian Environmental Flows Monitoring and Assessment Program), DEECA Water and Catchments, University of Melbourne, Goulburn-Broken Catchment Management Authority and the Murray-Darling Basin Authority.

CONTACT

Dr Matt Jones, ARI

[Jones et al. \(2025\)](#) More than the sum of their parts – Environmental flows increase fish movement and fishway functionality. Ecological Engineering.

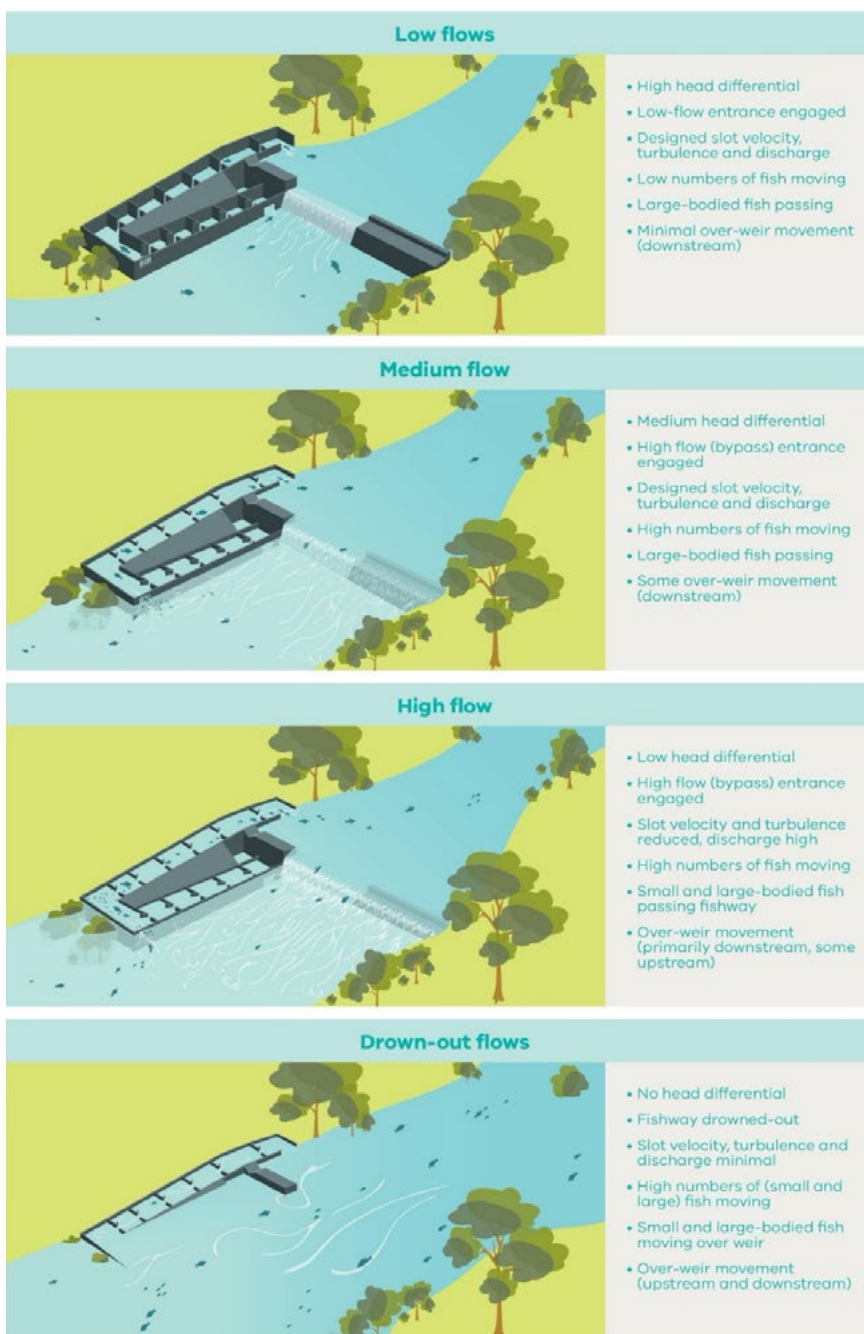


Figure 3. Conceptual model of a low-level (e.g., <3m high) fixed-crest weir and fishway and how fish passage is influenced by increasing river discharge. Note the flow induced changes could occur from natural flow events or environmental flows.



Spring inundation can mimic natural flows to benefit riparian plant growth

ISSUE

River regulation has altered the timing, duration and frequency of inundation in many Australian rivers, fundamentally changing riparian vegetation dynamics. These changes often favour terrestrial plants over native riparian plants, reducing ecosystem function and management outcomes associated with environmental flows. While inundation is known to influence plant growth and reproduction, there is limited experimental evidence on how different seasons and flood durations affect riparian versus terrestrial plant groups (which are often the objective of delivered flows). This limits the ability of water managers to design environmental flows that most efficiently and effectively support targeted vegetation objectives.

ACTION

The study experimentally tested the effects of seasonal inundation on plant performance using four riparian species (a mix of sedges and rushes) and four terrestrial grass species common to regulated rivers in southern Australia. Plants were exposed to three inundation treatments (no inundation, short inundation of one week, and long inundation of four weeks) during spring and summer. Survival, growth, flowering, seed production and seed viability were measured to assess both health and reproductive responses. This controlled approach enabled direct comparison of plant group responses across seasons and inundation durations relevant to environmental flow delivery.

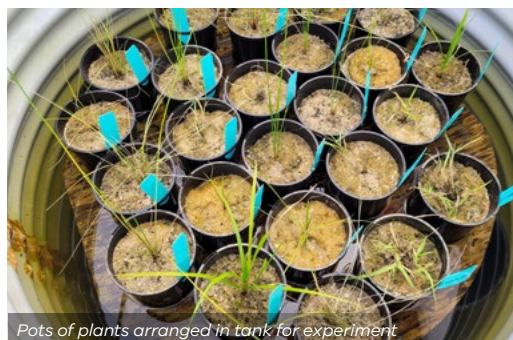
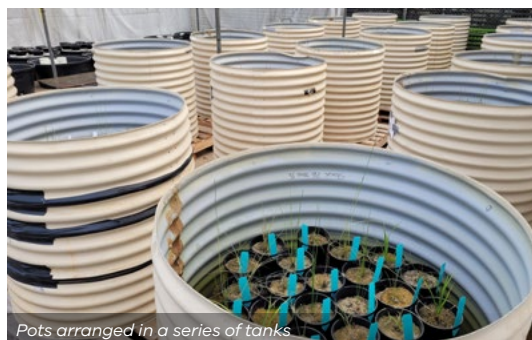
RESULTS

In spring, long inundation reduced survival and growth of terrestrial grasses, while riparian species showed consistently high survival and relatively stable growth across all treatments (Figure 4). Spring inundation often delayed or reduced flowering and seed production in both plant groups. During summer, terrestrial grasses again showed reduced survival and growth under inundation. In contrast, riparian species generally performed best under short summer inundation, with some evidence of enhanced reproduction. Notably, summer inundation promoted reproduction in *Juncus amabilis* (Hollow Rush) while seed viability showed few consistent treatment effects across species or seasons.

OUTCOME

This work provided clear evidence that seasonal inundation delivered by environmental flows not only supports riparian plant growth compared to terrestrial species but also that spring and summer environmental flows benefit riparian plant reproduction relative to terrestrial species.

The results provide clear, experimentally based guidance for water managers to use in environmental flow design. This work supports the use of seasonally targeted flows to promote riparian vegetation outcomes in regulated rivers. Environmental flows in spring and short events in summer are likely to promote riparian vegetation in regulated rivers.



Spring inundation can mimic natural flows to benefit riparian plant growth (cont')

NEXT STEPS

Verifying these responses in controlled conditions is a very important step and can allow us to assess plant responses to a range of flow conditions in a single year. We now need to validate how these responses occur in field conditions of Victorian waterways to see how the natural setting may influence outcomes.

FUNDER

The former VEFMAP (Victorian Environmental Flows Monitoring and Assessment Program), DEECA Water and Catchments, with support from the University of Melbourne.

CONTACT

Dr Chris Jones, ARI

[Wijepala et al. \(2025\)](#) Effects of seasonal inundation on riparian plant growth and reproduction. River Research and Applications.

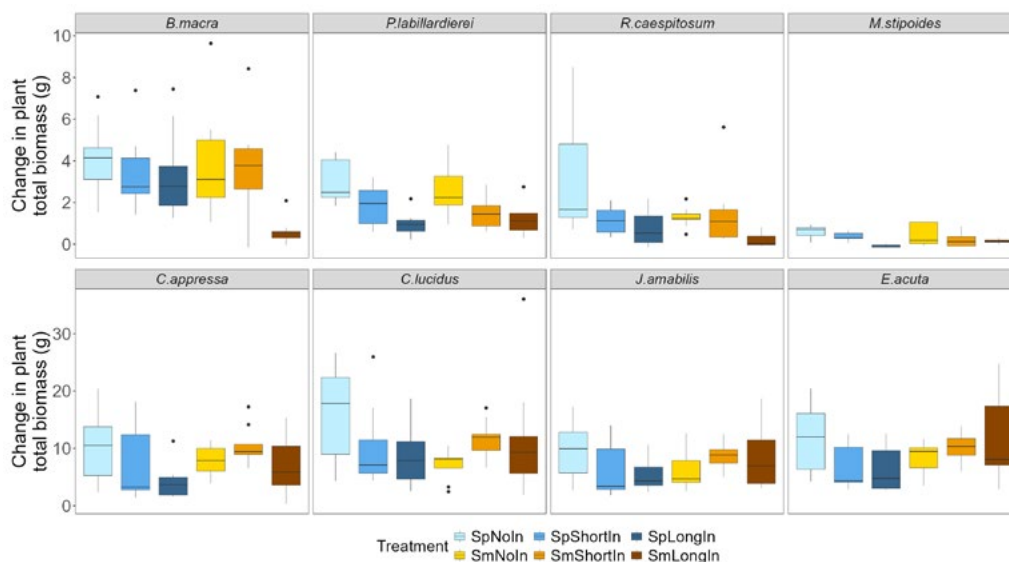
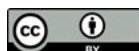


Figure 4. Change in plant biomass by species during the experiment for the different treatments (Noln = no inundation, ShortIn = short inundation, LongIn = long inundation) in spring (Sp) and summer (Sm). N.B. different y-axes

We acknowledge Victorian Traditional Owners and their Elders past and present as the original custodians of Victoria's land and waters and commit to genuinely partnering with them and Victoria's Aboriginal community to progress their aspirations.



Compiled by Pam Clunie
Further info: research.ari@deeca.vic.gov.au



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