VEFMAP Stage 7 - Fish

Population Modelling

Forecasting responses of priority fish species and their interactions to environmental water in Victorian rivers.

Aims

To forecast fish population responses to environmental flows.

The specific aims are to:

- Develop population models for Murray Cod, River Blackfish and Murray-Darling Rainbowfish. These models will be used to predict fish responses to environmental flows, while accounting for all other flows within each system and factors (called 'modifiers") such as stocking, habitat quality and angling.

- Validate population model predictions. Model validation will identify when and where population models are reliable, including in unmonitored systems and into the future.

- Examine interactions between target species and other groups of fish and vegetation to determine whether species' interactions mask or offset the expected benefits of environmental flows.

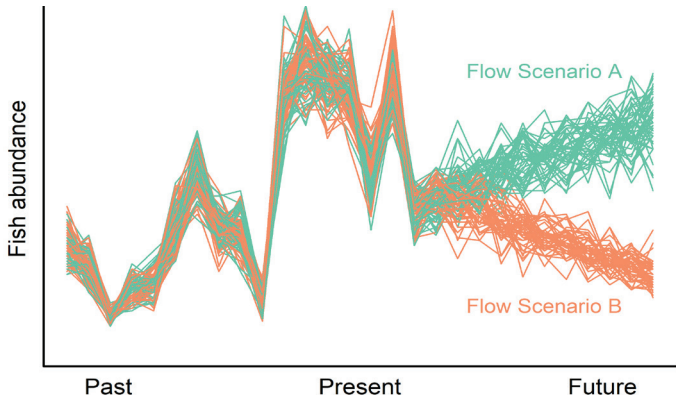

Figure 1: A conceptual presentation of how different flow scenarios can be compared with a population model. Population models are a valuable planning tool, including for management of water. They can be used to forecast ecological outcomes under different scenarios; for example the abundance of fish populations under two different flow scenarios. These models take into account uncertainties in past and future conditions, as well as a variety of other factors.

Victorian Environmental Flows Monitoring and Assessment Program

Fish population modelling

Background

Predicting species' responses to environmental water can inform decisions around when, where, and how to use limited water resources. Population models use information on reproduction and survival of species to predict how populations will change through time. They can be used to predict population responses to environmental water while accounting for the interacting effects of many modifiers (e.g., stocking, habitat quality, other flows). Population models focus on ecological processes rather than location-specific data sets, and so can be transferred among locations. They are a valuable planning tool because they are particularly effective in taking into account future uncertainties.

Interactions with other species are an important, yet under-studied modifier of population dynamics. The presence of exotic Common Carp, for example can negatively impact many native fish species. In some situations, flow management targeting native species can inadvertently benefit Common Carp which is undesirable. Species' interactions also provide opportunities for complementary outcomes, such as management interventions targeting aquatic macrophytes that provide habitat or food resources for native fish. Understanding how species' interactions (positive and negative) alter responses to environmental flows is critical to the efficient use of water.

While commonly used, models are rarely tested or 'validated'. Given their frequent use to predict what might happen in the future or in unmonitored locations, it is crucial that model validation addresses three key questions. First, does the model make sense based on what we already know (a "reality check")? Second, does the model reliably predict future outcomes? Third, does the model work in new locations?

Research questions

1. Do population model predictions demonstrate benefits of environmental flows for priority species and waterways?
2. Are population models reliable in monitored and previously unmonitored locations?
3. Do interactions with other fish species affect population dynamics to the extent that population models become unreliable?
4. Do we have the knowledge and data to identify interactions between fish and instream or riparian vegetation?

Approach The project has three stages:

Stage 1

- Update the existing population model for Murray Cod, incorporating recent research.
- Develop new population models for River Blackfish and Murray-Darling Rainbowfish.
- Examine likely outcomes from environmental flows in several Victorian rivers. The rivers and environmental flows scenarios will be selected in conjunction with waterway managers from the Goulburn Broken, North Central, and Glenelg Hopkins CMAs. Models will be applicable to other rivers where these three species occur.

Stage 2

- Assess the population models for reliability.
- Consider performance against existing data ("hindcasting"), new data ("forecasting"), and in previously unmonitored rivers ("transferability").
- Synthesise information on where and when population models are reliable, which is relevant to their use in all Victorian rivers.

Stage 3

- Examine the interactions between the three target species and other groups of fish and vegetation.
- Develop new population models that account for potentially unexpected outcomes (e.g., native species responding negatively to environmental flows in rivers with Common Carp).
- Use these updated models to assess the environmental flows scenarios developed in Stage 1 (see above).

Timeline January 2022 to June 2024

Outputs

- **Validated population models** for Murray Cod, River Blackfish, and Murray-Darling Rainbowfish.
- **Annual reports** including forecasts of the responses to environmental flows scenarios of Murray Cod, River Blackfish, and Murray-Darling Rainbowfish in target rivers. Forecasts for Murray Cod will be included in all annual reports, while the remaining two species will be included in 2023 and 2024.
- **Final reports** including information on when and where population models are reliable, and assessments of the relative influence of flows and species interactions on populations of native fish.

Outcomes

- Assessment of the outcomes of environmental flows targeting native fish species.
- Specific advice to inform seasonal and annual watering decisions.
- Quantification of the reliability of population models, including in previously unmonitored rivers.
- Identification of critical ecological processes that modify fish responses to environmental flows.

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