POWER SUPPLY

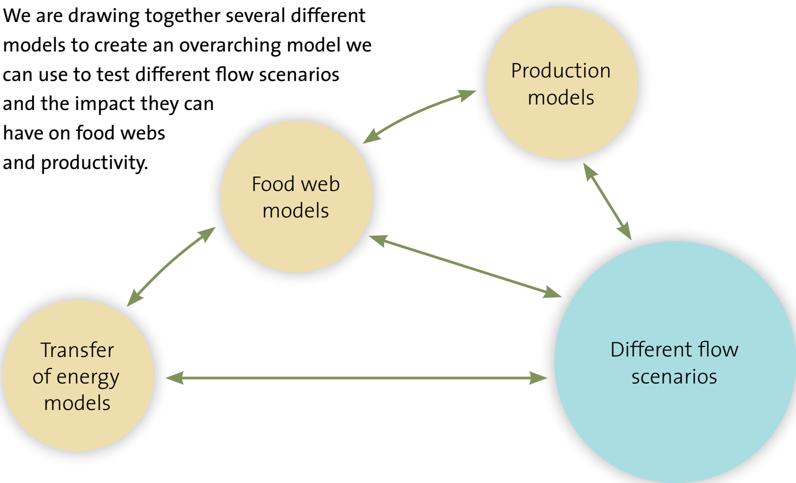
NICK BOND AND **REBECCA LESTER** ASK HOW MUCH ENERGY DOES A FISH POPULATION NEED?

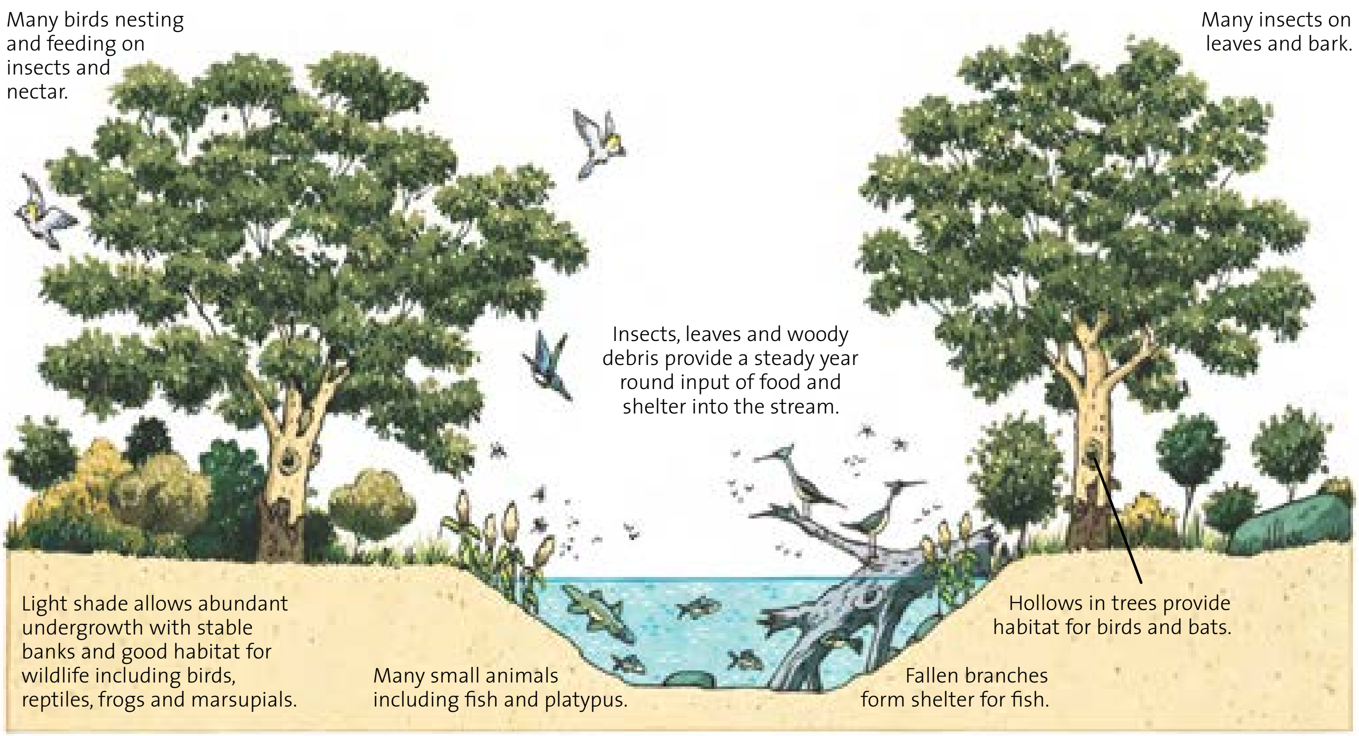
We often think about increasing the abundance of native fish and birds by promoting additional opportunities for breeding and recruitment. Another important question to ask, however, is whether there is sufficient food (or space or other resources) available to support larger populations? This carrying capacity—literally the capacity to 'carry' more individuals in a population, can be an important factor regulating animal abundances.

Finding these limits by measuring them empirically can be extremely difficult. Instead, scientists often try to estimate them by modelling, using information about the ecosystem that can be more easily measured. Such approaches are commonly used in marine ecosystems and are currently being explored within the Murray–Darling Basin Environmental Water Knowledge and Research (MDB EWKR) Food Web Theme.

These coupled 'production/food web' models, incorporate estimates of rates of primary production by plants and algae, in the river and on the floodplain during floods, with representations of the food-web describing the transfer of energy between different food web 'compartments' (e.g. algae to zooplankton to fish), and the efficiency of those transfers from one compartment to the next. The outputs are approximations of the biomass of consumers (e.g. fish or water birds) that can be supported within an ecosystem. Comparing different scenarios can provide insights into the ways in which altered river flows and changes in food web structure might affect the size of populations that can be sustained.

We are drawing together several different models to create an overarching model we can use to test different flow scenarios and the impact they can have on food webs and productivity.





A healthy food chain has high carrying capacity. Illustration Paul Lennon

Reviewing and refining

Rather than starting from scratch, the MDB EWKR team are adopting an existing model developed from an earlier research project funded through the Australian Centre for Ecological Analysis and Synthesis (ACEAS) within the Terrestrial Ecological Research Network. A key first step is to publish the findings and modelling framework from that earlier project, so that its outputs and conclusions have been peer reviewed. Several members of the original team are currently working on behalf of the ACEAS team members to finalise a manuscript that will, in due course, provide confidence in the model validity and suitability for the current project.

Once completed, the model will provide a valuable tool helping the research team to understand the effects of carrying capacity on population dynamics, and to identify areas where energetic or food-web influences may limit the ability of populations to grow in response to increased breeding or recruitment opportunities. This will help scientists and managers identify situations where additional river flows or other complementary activities may be required to increase the capacity of the ecosystem to support larger population sizes of native fish. These background activities will be completed towards the end of 2017.

As well as applying the model to adult fish populations, the Food Web team will also be working with the MDB EWKR Fish Theme to explore similar questions regarding the role of flow in influencing food availability and larval fish survival. This work is being done at finer spatial and temporal scales and will continue into 2018. Updates will be shared through the MDB EWKR Story Space website as work progresses.

The MDB EWKR project is funded by the Australian Government's Commonwealth Environmental Water Office.

FOR FURTHER INFORMATION

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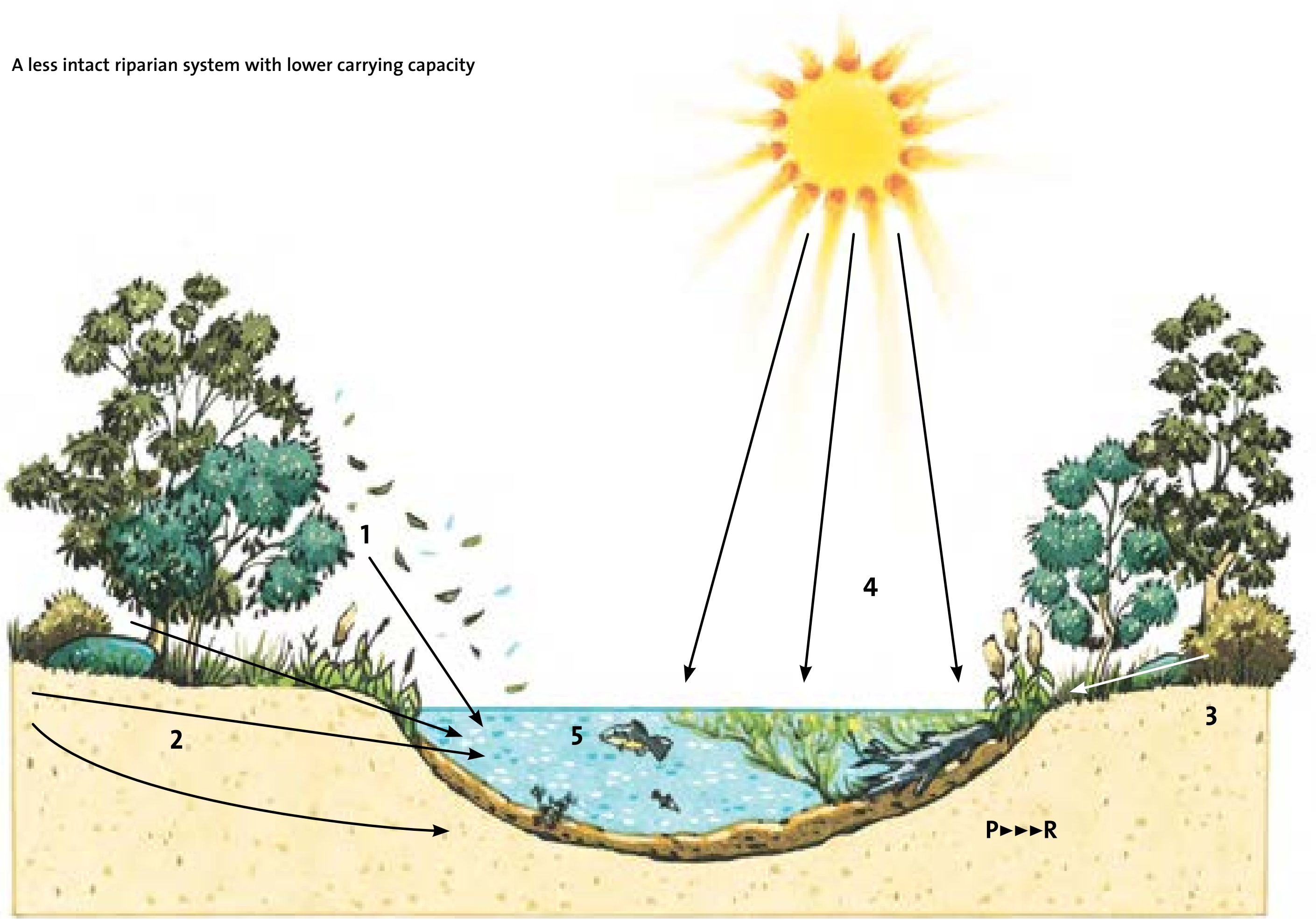
A less intact riparian system with lower carrying capacity



1. Reduced inputs of leaf litter and terrestrial invertebrates.
2. Changes in the quantity and quality of organic matter from surrounding catchment.
3. Reduced inputs of logs and branches.
4. Prolific growth of filamentous algae and aquatic macrophytes stimulated by high sunlight and nutrient run-off. These sources are not readily consumed by aquatic invertebrates and cause major changes in habitat.
5. High respiration from plant growth and decomposing organic matter leads to reduced oxygen and lowered water quality. This together with loss of habitat results in loss of biodiversity and major impacts to ecosystem function.

Source: S. Bunn (1998). Illustration Paul Lennon.

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- Collaborating and networking with a range of organisations
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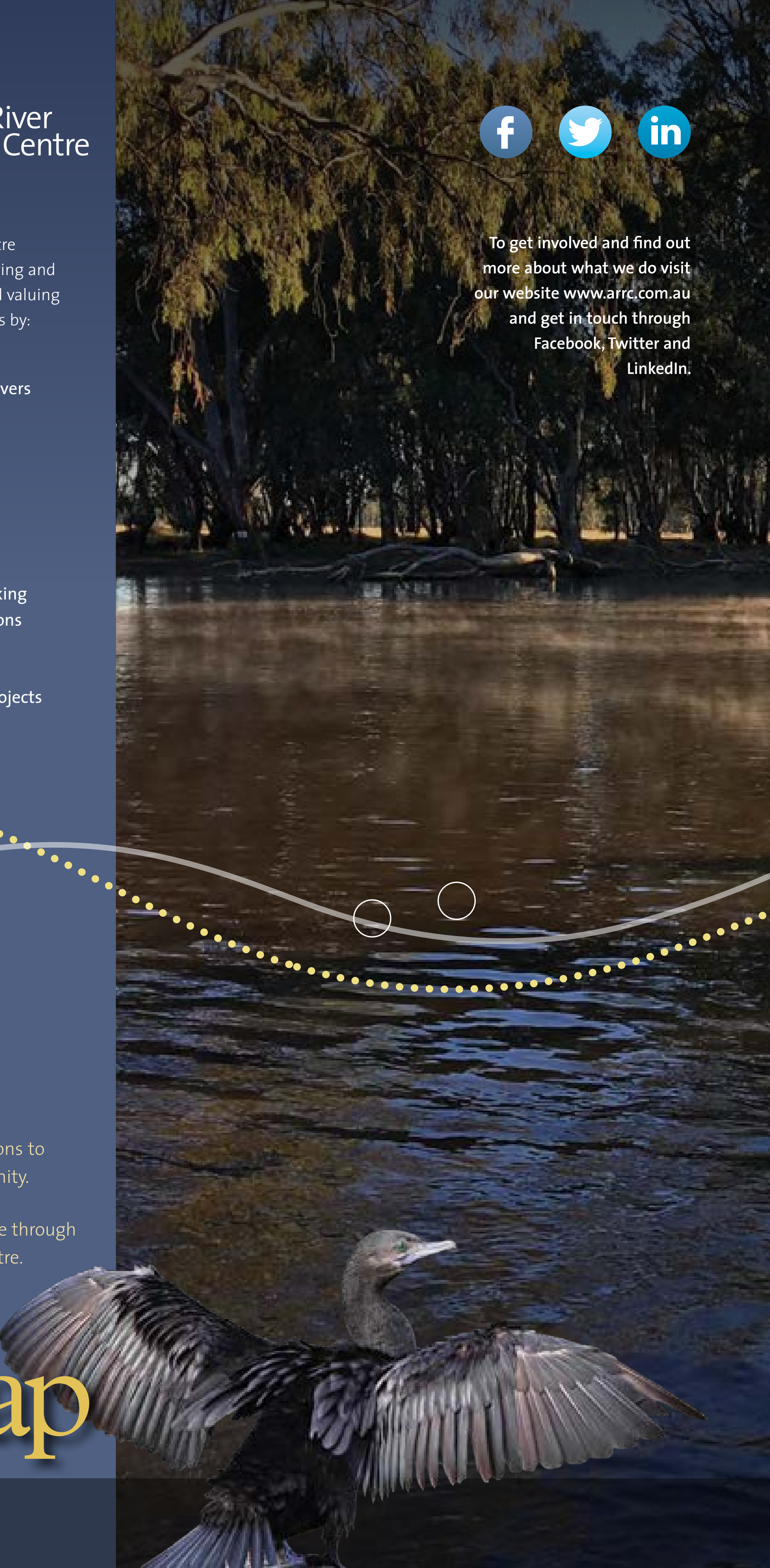

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