Agent-based model of *Macrobrachium* sp. migration in the Daly River, Northern Territory, Australia

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Abstract: Increasing population and economic growth are driving demand for water from the Northern Territory's wild and pristine northern rivers. Meeting this demand while also providing adequate water for the environment is tricky, and often data are not available to make informed decisions on protecting individual species and other environmental assets. One way to investigate the uncertainty surrounding the impacts of water extraction on biota is through agent-based models (ABM).

The Daly River is the largest perennial river in the Northern Territory with significant environmental, economic and Indigenous cultural values, including a highly diverse aquatic fauna. One species, the giant river prawn (*Macrobrachium spinipes*), is of significant ecological, cultural and commercial value. It is especially susceptible to water extraction due to its complex lifecycle, which includes long migrations to the ocean as floating larvae, and an equally arduous and long (up to 400 km) journey back upstream as juveniles. Both migrations are cued by specific flow events or thresholds.

To investigate how water extraction and changes to flow regimes in the Daly River could impact on giant river prawns, we used an ABM presented in NetLogo, to simulate prawn movement in the river. The effects of reduction in flow on the likelihood of successful prawn migration, and the potential reduction in success rates under various extraction scenarios was predicted using spatial datasets of known hydrological and topographic constraints. Prawn movement was modelled across multiple discharge scenarios, representing years with both low and high Wet Season flows (when prawns drift downstream). Larval prawns must reach the estuary within 5–7 days or die. Modelling results suggest that migration success was highly flow dependent, with 100% of prawns successfully reaching the estuary in a high discharge year, while only 15% of prawns were predicted to successfully migrate in a very low flow year. This ABM provides a tool for scheduling of water extraction rates to maintain minimum instream flows necessary for successful migration, and can be applied to assess impacts on biota associated with applications for surface water wet season harvesting.

ABM are of value in predicting future conditions but are of far greater value in understanding the dynamics of the system in question, and the interactive effects of various elements. In this case, it provides a way to understand the interplay of prawn populations with various hydrological conditions and flow reduction scenarios, and how one must frame crucial questions in management decisions.

Keywords: *Macrobrachium, Daly River, agent-based model*