Title [4723]: *A rapid approach to evaluate putative nursery sites for penaeid prawns*

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Definitions:

- 'penaeid' means any prawn of the family Penaeidae, many of which have economic importance.
- 'isotope' are variants of a particular chemical element which differ in the number of neutrons within the atom. Isotopes of an element, for example, Carbon, all share the same chemical properties.

Summary

Approximately 90% of prawns emigrating out of the Hunter River estuary could be assigned to a nursery site based on the isotope data.

What prompted the research

For aquatic organisms, a juvenile nursery habitat is characterised as one that supports growth and survival, and thus contributes a disproportionately higher number of individuals to an adult population relative to other habitats. An abundance of a particular species in a habitat is not sufficient in itself to imply nursery function. For an area to be considered a 'nursery', individuals have to migrate out of juvenile habitats and successfully recruit to the exploited or adult populations. Thus, identifying nursery habitats requires tracing older individuals back through time and space to the post-settlement habitat in which they developed as juveniles. Eastern King Prawn (EKP) and School Prawn (SP) are two commercially exploited temperate penaeid species endemic to the east coast of Australia. Adults of both species spawn in oceanic waters and postlarvae later recruit back into estuarine habitats for the duration of their juvenile phase. There is no doubt that estuaries function as important nurseries for these two penaeids, however it is unclear whether certain habitats within estuaries contribute more to the exploited adult population than others and are therefore of greater nursery value. Knowing these habitats will assist in valuing their economic contribution to exploited fisheries and in doing so help prioritise their protection and rehabilitation.

What we did

We evaluated the suitability of using stable isotopes to trace emigrating prawns to the nursery sites they used as juveniles. We looked at both EKP and SP. We collected juvenile SP and EKP directly from eight habitat sites in the Hunter River at a distance of between 8 and 20 km from the estuary mouth. We analysed the isotope composition of the prawn muscle tissue, which then provided a 'stable isotope signature' for each site. In addition, prawns of both species were collected as they emigrated from the estuary to sea. By analysing the muscle tissue of these prawns we were able to identify the areas from which these emigrating prawns originated. This enabled us to assess the relative contribution of each estuarine nursery habitat to adult stocks.

What we found

Although we sampled a relatively small subset of potential nursery habitat, around 90% of emigrating prawns collected could be assigned to these areas using the isotopic data. Important nursery sites identified for EKP largely included shallow sedimentary habitats in areas of low current flow in the lower estuary. In contrast, important nursery sites for SP extended much further along the estuary, which was expected based on prior knowledge of SP in the Hunter River and their broader salinity tolerance.

The isotopic signature of estuarine water varies with the salinity gradient due to the fluctuating influence of freshwater, and the associated differences in dissolved inorganic carbon and nitrogen inputs. The mixing of freshwater and seawater along the length of the estuary creates an isotope imprint that is recorded in producers at the bottom of the food chain, such as phytoplankton and benthic microalgae, and this signature is in turn transferred to consumers, such as prawns, via trophic linkages. Consequently, the isotopic composition of prawns captured in different potential nursery sites reflects this mixing, and provides a good reflection of location along the estuary, but spatially adjacent nursery sites were not well differentiated.

Implications

This study was done to evaluate the feasibility of applying stable isotopes as a tool to assign mobile animals to habitat, and compare analytical approaches to the problem. Either of the assignment approaches was feasible, and shows promise as a tool to generate a broad understanding of the relative importance of potential estuarine nursery habitats with a relatively rapid and straightforward sampling design. We wish to point out, however, that the patterns in stable isotope composition are potentially estuary- and seasonally-specific, influenced by catchment use, water chemistry, nutrient sources and dominant primary producers. This tool will be most powerful when sampling is also aimed at understanding nursery function by simultaneous monitoring of abundance, growth and survival within nursery habitats. We make several recommendations for applying a mixing model approach to habitat assignment.