Dispersal of Double-ended Pipefish (*Syngnathoides biaculeatus*): Measurement Using Otolith Microchemistry

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The double-ended pipefish (*Syngnathoides biaculeatus*) is in the diverse and intriguing family Syngnathidae, which also includes seahorses and seadragons. The species is used commercially in Australia and throughout east Asia in traditional Chinese medicine. As with all species in this family the male pipefish raises the eggs, which in this case are glued onto the underside of its tail, and releases juveniles directly. Since there is no pelagic larval stage, and the adults are very weak swimmers, pipefish are thought to have limited dispersal. Ultimate threats to conservation of this species are from overharvesting and degradation of the seagrass habitat with which they are associated. The most pressing need is to know about patterns of movement, especially with a view to estimating possible rates of recolonisation after local depletion. The aim of this project is to determine how far double-ended pipefish move from the time just after hatching to adulthood, with a spatial resolution of several kilometres.

Otoliths are calcium carbonate structures in the head of fish that grow in size as the fish grows. It is well known that growth rings in the otolith can be used to age fish, but the chemistry of the otolith is also thought to reflect that of the water in which the fish lives. New technology enabling precise measurement of a wide range of elements from minute amounts of material means that otoliths can be used to give an "elemental fingerprint" reflecting where a fish has lived. We are using Laser Ablation Inductively-Coupled Plasma Mass Spectroscopy (LA-ICPMS) which permits chemical analysis of different parts of even the tiny otoliths (about 0.5 mm in adults) of pipefish. Composition of otolith nuclei (that part formed when juvenile) in adult fish can be compared with composition of otoliths from juveniles of the same cohort collected earlier. As long as it is possible to discriminate amongst juveniles from different locations (i.e. chemical composition of otoliths differs amongst locations more than within), then it is possible to determine from where adult pipefish derived.

Initially we are collecting juvenile pipefish from five locations, each separated by approximately 15 km, stretching throughout Moreton Bay. The different locations have been chosen to maximise the chance that water chemistry will differ among them. The otoliths are mounted in resin and carefully ground to expose their midplane. Initial chemical analysis indicates that the elements Li, Na, Mg, Ca, Mn, Cu, Sr, Ba, Pb, and U are likely to be most useful in distinguishing locations from which fish came. Later we will return to collect adults from the same locations to test whether they are from the same cohort. The chemical composition of otolith nuclei from adults will be compared with that of otoliths from juvenile fish. Differences in chemistry between otoliths of juveniles and otolith nuclei of adults collected in the same location will imply some degree of dispersal. Furthermore, if the chemistry of otolith nuclei of adults matches the chemistry of otoliths of juveniles from other locations, that will be taken as a strong indication of movement between those locations from the juvenile to adult stage.

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For fish, such as the double-ended pipefish, that are too small or fragile to tag, otolith elemental fingerprinting seems to offer a chance to answer carefully framed questions about movement. Rather than measuring dispersal as genetic techniques do, as average rates of dispersal over long periods and many generations, otolith microchemistry can glean information about movement over the life of an individual. This project is funded by SeaWorld Research and Rescue Foundation.