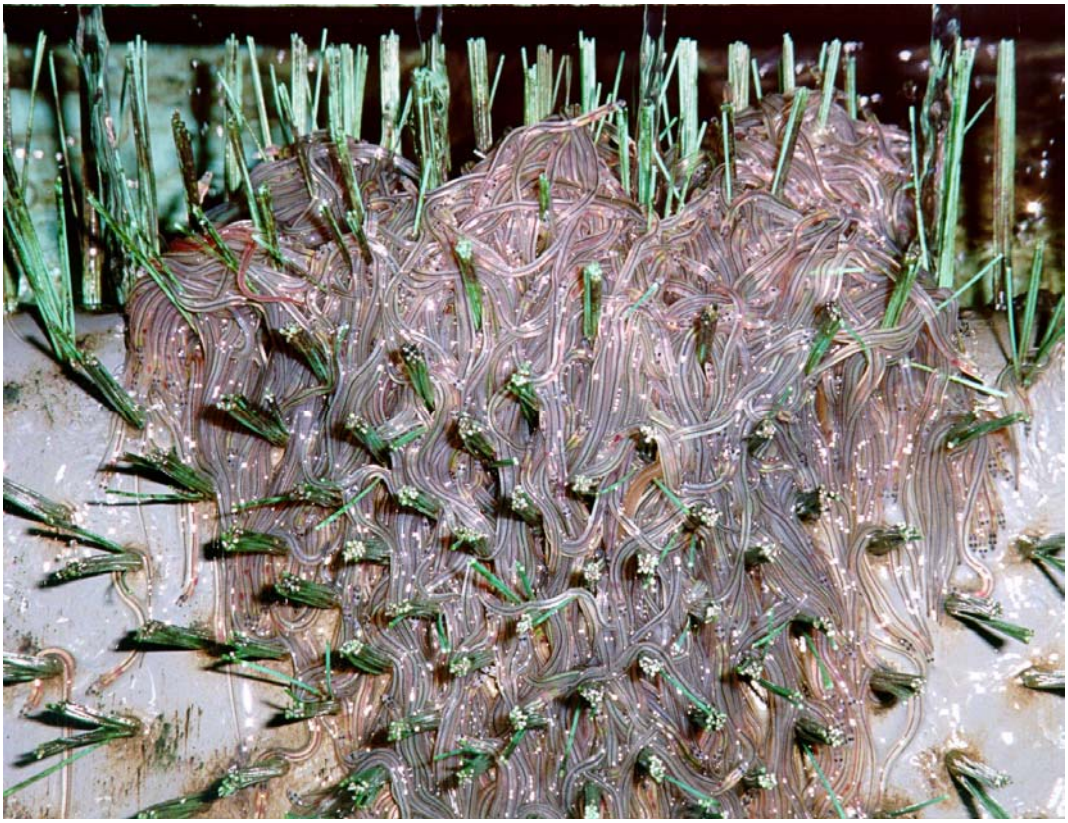
Recruitment and age dynamics of *Anguilla australis* and *A. reinhardtii* glass eels in the estuaries of New South Wales



Picture by C. Briand

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Certificate of Authorship

I certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree except as fully acknowledged within the text.

I also certify that this thesis has been written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

Signature of candidate

Acknowledgements

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Abstract

Shortfin eels (*Anguilla australis*) and longfin eels (*A. reinhardtii*) are true freshwater eels of the genus *Anguilla*. There are many mysteries still unsolved for the freshwater eel lifecycle, such as location of the spawning grounds, conditions that promote metamorphosis from the leptocephalid to glass eel phase, and the mechanisms that affect glass eel recruitment. In Australia, little is also known about the estuarine habitats of glass eels as they migrate towards freshwater, and the age at which these eels enter estuaries. Both species are of commercial importance in the estuary fishery where they are caught in eel traps for export. There is also a small, but potentially lucrative, aquaculture industry for ongrowing glass eels to market demand size. This thesis investigates the spatial and temporal recruitment of both species of glass eels to estuaries within NSW, the habitats that may be of importance to them as they continue their upstream migration, and the age at which these eels entered the estuaries.

Firstly, a new sampling device needed to be developed since conventional methods to catch glass eels often required constant observation of gear, multiple operators, specific physical site characteristics, and/or were expensive. The artificial habitat collectors that were developed were then used to sample six estuaries in NSW monthly within one week of the new moon. Shortfins showed a more consistent and defined recruitment across all sites than longfins, where the peak shortfin recruitment season was from April – August. Longfins recruited primarily from January – May but often recruited outside of this period. Five year collections at one of these sites provided important recruitment information. It appeared that longfins failed to recruit to this site during 2000/01, which could affect commercial catches of this species when they enter the fishery. The East Australian Current (EAC) probably transports glass eels from spawning sites in the Coral Sea southward to the east coast of Australia but there was no predicted lag time in the recruitment of eels from northern to southern estuaries. Therefore, it was not possible to predict the timing of recruitment of glass eels in one estuary based on the timing of recruitment in another more northern estuary.

When glass eels enter estuaries their upstream migration is assisted by the night flood tide. During the ebb tide, glass eels burrow into the substrate and resurface at the next night flood tide. The eels do not select particular habitats at this time, rather, their location is dictated by the tide. However, once glass eels reach the estuarine/freshwater interface, they may prefer more complex habitats such as seagrass/macrophytes or rocks/cobbles in which to hide during the day. At this interface, glass eels undergo a physiological change to adapt to a freshwater existence and this change may take up to a few weeks. During this time, glass eels commonly enter the water column during the night flood tide and may be able to locate more suitable habitats in which to hide during the day.

The ages of shortfin and longfin glass eels caught in estuaries were examined both spatially and temporally. As the EAC travels north to south, glass eels recruiting to the southern sites were expected to be older. However, shortfins that recruited to the northern-most site in this thesis were older than at all other sites while there was no difference in the ages of longfins. Also, when the ages of longfins that recruited during the main recruitment period were compared to the ages of longfins that recruited outside of this period, there was no difference in ages. Therefore, the hypothesis that these later recruiting eels may have been caught in an eddy prior to their estuarine arrival has been disproved. The ages of shortfins that recruited in two separate years were significantly different from each other and may be due to shortfins' ability to detrain more easily from the weaker currents that exist at these recruitment periods. Conversely, there was no difference in the ages of longfins that recruited in the same month during three separate years. The estimated hatch dates for shortfins was estimated at October to January, while for longfins, estimated hatch time was July to September for eels that recruited during the peak recruitment period. For longfins that recruited outside of the main recruitment period, estimated hatch times were from December to February. It is unknown, however, whether longfins have an extended spawning period, or whether silver eels arrived at the spawning grounds later and thus produced later arriving longfins. Continuous monitoring of glass eel recruitment to estuaries is necessary to determine whether there are long term declines in the recruitment of Australian eels similar to the declines recently observed for eels in Europe and Asia.