Factors influencing fish assemblages of Intermittently Closed and Open Lakes and Lagoons (ICOLLs) of the Central and Near-South Coasts of New South Wales, Australia

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Submitted in fulfilment of the requirements for the degree of Doctor of Philosophy at The University of Newcastle, Australia

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Statement of Originality

The thesis contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. I give consent to the final version of my thesis being made available worldwide when deposited in the University’s Digital Repository, subject to the provisions of the Copyright Act 1968.

Signed: .................................................................

(Leslie Milton Edwards)
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Abstract

Intermittently Closed and Open Lakes and Lagoons (ICOLLs) are coastal waterbodies that have intermittent connection to the ocean due to the formation of a barrier across the entrance. Catchment development is a major cause of pollution and also a justification for artificial barrier openings, which can have an adverse effect on the flora and fauna of ICOLLs. In most cases barrier openings may not have a direct effect on the biota of ICOLLs, but they can affect the factors which may influence invertebrate faunal and fish assemblages. The overall aim of this study was to determine what factors may influence fish assemblages of Central Coast ICOLLs. In order to understand these factors the research looked at the general ecology of Central Coast ICOLLs, including their invertebrate faunal assemblages and environmental parameters that may influence them (Chapter 3). Vegetated habitats within Central Coast ICOLLs include Ruppia sp. and the algae Chara sp. and Enteromorpha intestinalis that support an invertebrate fauna dominated by polychaetes, crustaceans and molluscs. No single environmental variable had a major influence in structuring the invertebrate faunal assemblages at all four Central Coast ICOLLs. However, salinity was a major influencing factor at Cockrone, Avoca and Terrigal Lagoons, with percentage sediment composition a major factor at Wamberal Lagoon.

Recruitment processes of larval and juvenile fishes are also presumably influenced by the status of the barrier. Larval and juvenile fishes occurring in Central Coast ICOLLs and their adjacent surf zones were identified to determine if movement of various species occurs once the barrier has been opened (Chapter 4). In this study, larval and juvenile fishes were more abundant in Central Coast ICOLLs but had lower species richness compared to their adjacent surf zones. The dominant larval and juvenile fish species found in ICOLLs included Ambassis jacksoniensis (Terrigal Lagoon), Philypnodon grandiceps (Avoca and Wamberal Lagoons) Atherinosoma microstoma (Wamberal Lagoon) and Acanthopagrus australis (Cockrone Lagoon). Hyperlophus vittatus was the dominant species collected from the adjacent surf zones. In this study there were no significant changes in larval and juvenile fish assemblages in either habitat from before to after barrier openings. Although some marine spawning species such as A. australis were present it could not be determined if these species were recruited from adjacent surf zones or from within these ICOLLs themselves. In most cases, Central Coast ICOLLs are considered to be generally self-recruiting environments, not for all species, but for many of their resident species of fish.

Chapter Five determined the effects environmental parameters have on influencing fish assemblages. Fish assemblages of Central Coast ICOLLs showed low species richness, but high abundances of particular species when sampled using seine nets and multi-panel gillnets.
Acanthopagrus australis (Cockrone Lagoon), Atherinosoma microstoma (Avoca and Wamberal Lagoons) and Ambassis jacksoniensis (Terrigal Lagoon) were the numerically dominant fish species collected using seine nets. Mugil cephalus was the species which was overall most frequently collected by gill netting. Fish assemblages were shown to be significantly different between Central Coast ICOLLs, and in this case were not directly influenced by barrier openings except at Wamberal Lagoon. However, Terrigal Lagoon, which had more barrier openings over the study period, compared to the other three ICOLLs, did have a higher diversity of fishes, which indicates that frequent barrier openings can influence fish assemblages. The major environmental influence on fish assemblages collected by seine nets at Cockrone and Wamberal Lagoons was salinity, and water temperature at Avoca and Terrigal Lagoons. The major environmental influence on fish assemblages collected by multi-panel gill nets at Cockrone and Avoca Lagoons was salinity, and water temperature at Terrigal Lagoon and >212 µm percentage sediment grain size at Wamberal Lagoon. Also, stochastic factors in the times and durations of barrier openings may play a large part in determining the fish assemblages that may be present at any one time in individual ICOLLs.

High abundances of fish and their isolation from the ocean for long periods can result in competition for limited food resources, along with the effects that barrier openings may have on these resources not being fully understood (Chapter 6). Gut contents for each dominant species examined were similar; however each fish species had a dietary preference for a particular taxonomic group. Amphipods were the main dietary component of Acanthopagrus australis and Atherinosoma microstoma, with zooplankton being the main dietary component of Ambassis jacksoniensis. Barrier openings had a significant effect on the diets of A. australis (in Cockrone Lagoon) and A. microstoma (in Wamberal Lagoon), but not for species examined from Avoca and Terrigal Lagoons.

Trace metal concentrations in sediments of Central Coast and Near-South Coast ICOLLs and gonad and liver tissues of Mugil cephalus were determined (Chapter 7). In the six ICOLLs studied, trace metal concentrations in both sediments and fish tissues were found to be relatively low and below guideline levels. Concentration levels did not differ significantly when compared between near-pristine (Termeil and Meroo Lakes), modified (Avoca and Terrigal Lagoons) and extensively-modified (Cockrone and Wamberal Lagoons) ICOLLs. Trace metal concentrations in sediments were not influenced by barrier openings.

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