

**A CONCEPTUAL MODEL FOR ANOSTRACAN
BIOGEOGRAPHY**

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**A DISSERTATION FOR THE DEGREE OF DOCTOR OF PHILOSOPHY
OF THE UNIVERSITY OF NEW ENGLAND**

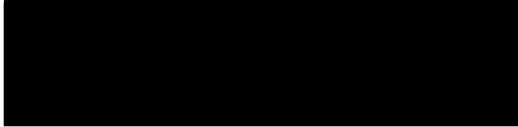
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Candidate's Certification

I certify that the substance of this dissertation has not already been submitted for any degree and is not currently being submitted for any other degree or qualification.

I certify that any help received in preparing this dissertation and all sources used have been acknowledged in this dissertation.

D. Christopher Rogers



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“Our purpose here . . . is not to (judge) the Crustacea but to be entertained by them; and if that has been realized, who could ask anything more – even of a scientist, or a crustacean?” — Waldo Schmitt, 1931

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Dedication

To the One who gave us anostracans.

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“After all, the most beautiful and most friendly looking animal of all is a swimming anostracan.” – Jens Hoeg, in an email, 2009

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ABSTRACT

The Anostraca are found globally in seasonally astatic basins, temporary pools and/or saline inland aquatic habitats. The primary question posed in this thesis is: why do anostracan taxa occur in some locations and not others? Of the more than 350 described species, greater than one third of anostracans are known to occur in only one location. Anostracan zoogeography research over large spatial scales has focused on climate and water quality data as the primary drivers of spatial distribution. Climate is difficult to quantify and water chemistry in astatic aquatic habitats is highly variable. Anostraca seem to defy any simple explanation of their zoogeography at any scale. In this thesis, the ideas that anostracan biogeography can be explained in terms of island biogeography and the Monopolisation Hypothesis are explored. Results from a series of research studies, undertaken in this thesis, directed to increasing our understanding of anostracan zoogeography highlight the following. First, local adaptation of a broadly distributed anostracan species to temperature across a geographical range, demonstrated that local adaptation to local conditions may drive clinal variation and population isolation. Next, anostracan dispersal pathways were found to affect hatching fractions and amplify priority effects of habitat monopolisation. Furthermore, anostracan speciation must occur allopatrically, either anagenically or cladogenically, because of the nature of the mixing and temporally staggered egg bank. Anostracan bioregions for North America and Australia are quantitatively described in this thesis and defined using Jaccard's Coefficient of Community Similarity, and qualitatively defined using climate data. Fager's Index of Recurring Species Groups is used to quantify species assemblages with the average Fager's Index for a bioregion. The percentage of co-occurring taxa decreases with the length of colonisation time for a given region, suggesting

1 that the Monopolization Hypothesis of De Meester et al. (2002) may function at larger landscape
2 scales. A general relationship between anostracan diversity, endemism, precipitation and
3 precipitation reliability is shown. A statistically significant relationship between specific
4 geochemical components, salinity and dominant salt cations parameters and the distributions of
5 all 63 US species and species assemblages was demonstrated. Distinct geochemical ranges for
6 different species were shown to impose a strong filter on egg banks as well as active stages.
7 Large dichotomies between geochemical tolerance values within each of three species across
8 more than one bioregion demonstrated the presence of cryptic species. Finally a conceptual
9 framework of anostracan biogeographical patterns is presented, demonstrating that anostracan
10 biogeography is structured along the fundamental biogeographic processes of immigration,
11 evolution and extinction. This conceptual framework suggests that patterns of anostracan
12 endemism, distribution and disjunction should be examined through the lens of island
13 biogeography theory. A catalogue of the Anostraca of the world is provided in an appendix to
14 this thesis.
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