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Ambient Underwater Sound:

Measuring the importance of spatial variability and its effect on late-stage larval crabs

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A thesis submitted in fulfilment of the requirements for the degree of Doctor of Philosophy in Marine Sciences

The University of Auckland, 2011
“The sea, once it casts its spell, holds one in its net of wonder forever”

Jacques-Yves Cousteau
Unidentified tropical megalopa
Abstract

Recent studies have shown that underwater sound emanating from coastal reefs may be used for guiding the movements of a wide range of reef organisms to suitable settlement habitats. However, it is not known whether this underwater sound is also capable of mediating the settlement and metamorphosis processes in these organisms. The present study used laboratory- and field-based methods to determine whether ambient underwater sound is used as a settlement and metamorphosis cue in 10 species of larval crabs.

The settlement stage larvae of five common crab species showed marked changes in swimming behaviour consistent with settlement and showed a significant decrease in time to metamorphosis (TTM) when exposed to replayed ambient reef sound compared with a silent control.

Ambient underwater sound has the potential to convey valuable information about the type and suitability of the habitat at its source to settlement stage pelagic larvae provided different habitats produce distinctive underwater sound. Analyses of recordings from several different habitat types along the coast of north-eastern New Zealand showed that the sound emanating from different habitat types had marked differences in terms of gross character, i.e., spectral composition and sound level. When habitat specific sounds were used in laboratory- and field-based experiments a significant decrease in TTM was observed for settlement stage crab larvae exposed to favourable settlement habitat sound when compared to unfavourable habitats.

Behavioural thresholds for habitat sound were determined experimentally by exposing settlement stage larvae to a range of sound levels from both favourable and unfavourable habitat types for settlement. Larvae did not respond to sound from unfavourable habitat types. However, for sound from favourable habitat types for settlement most crab species showed increasing reductions in TTM as sound levels were increased, suggesting that proximity to the sound source or settlement habitat is important in inducing faster settlement.

The results presented in this thesis demonstrate that ambient underwater sound originating from coastal habitats mediates the settlement processes of the megalopae of many
common coastal crab species in both temperate and tropical waters. It provides evidence that differences in the spatial and biological characteristics of underwater sound play a significant role in this process. Overall, the results of this research greatly extend our knowledge of the importance of underwater sound to recruitment processes of coastal larvae.
This thesis would have not been possible without the help and support of numerous people. Firstly, I would like to thank my supervisors Associate Professor Andrew Jeffs and Dr Craig Radford; this thesis would not be what it is without these two people and their patience. Andrew, this has been an amazing experience for me and I want to sincerely thank-you for all the hard work, support, encouragement, constructive criticism, and the occasional whip cracking you have put in over the last three years, the amount you have taught me is beyond description. You are a great inspiration. Craig, you have been brilliant in helping me with all the logistical nightmares that is Matlab, SASS and general experimentation. You have been a remarkable supervisor and a really great friend. I am very fortunate to have someone with such great qualities in both the serious and social side of my life; this experience would not have been the same without you!

A big thank-you to all the general and teaching staff at The Leigh Marine Laboratory. Arthur Cozens, you are a god send, thank-you so much for all your help in numerous areas over the past three years. Murray Burch, for the many contraptions you have made with me over the years, some of which haven’t been used, sorry about that. Brady Doak, for the great diving adventures we have had on the Hawere. Peter Browne, for the constant use of me as his scape goat for numerous breakages in the workshop. John Atkins, thank-you for your engineering genius. Viv and Alan Stamp, for making the lab really feel like a second family.

Thank-you to the Lizard Island staff, you run a well oiled machine. Thank-you for introducing me to the glamour that is tropical marine research. To the groups I met in 08 and 09 (most of which were the same), you guys are awesome, it was an er............experience.

I would also like to thank the acoustic group, it is great to see our numbers growing steadily. Fellow PhD student Shah, to get stuck next to me in not one but two offices has really proven your strength of character and internal band-pass filter; you are a patient and tolerant man.

During my time up in Leigh there have been several cohorts of student been and gone. Firstly, I would like to thank the original Cohort of 08’ whom are memorable to say the least. Thank-you for the introduction to Leigh and Thursday nights at the Mill. It was very hard to see you guys moving on without me, however, it is great to see you all now making your mark on the world with your valuable skills, thanks for an amazing year. I cannot forget the small middle Cohort of 09’ and the mid winter roast dinner nights; I really never thought I could eat than much! Cohort 10’, most of our time together was spent in the field measuring pippis and cockles, good times. Finally, Cohort 11, thank-you for making me feel over the hill!
I would also like to thank a swagger of colourful people that I managed to flat with over the years. Suz, Sera, Candice, Kathy, Luke and Leo and Natalie. The terrible two, Kate and Pippa; who although were not technically my flatmates, they still count. Thank-you for making my last year as enjoyable as my first. Javed, you are great guy with a superb future ahead of you. Bhakti, my very own kiwi Indian, thank-you for teaching me the art of Indian cuisine, I just can’t get enough of it. Thank-you for sharing numerous times with me where we were laughing so hard we would be doubled over in agony, ha ha, still funny. Paul, thank-you for the adventures, proof reading some of my thesis (blame him), needed affection during the hard times, and helping me stay sane during the last leg of my journey here.

Finally, I would like to thank my family. Dayna, you always manage to make me feel great about what I am doing in life, mainly because I think you are a little disappointed you didn’t do it, you are a great big sister. Denise and Roly, without you two I would never be where I am today. I cannot express how much I appreciate your support and love over the years. Dad, your never ending enthusiasm regarding my work kept me going when mine was waning. Mum, thank-you for all your help with the menagerie I left behind.

I dedicate this thesis to Alice (Yue Gui) who’s time was tragically cut short. We will all miss you greatly.
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