Mesoscale Alongshore and Cross-shore Transport and Settlement of Invertebrate Larvae on the South East Coast of South Africa

Siphelele Buntu Dyantyi[1, 2*], Paula Pattrick[3], Christopher D. McQuaid[1], Francesca Porri[1, 2]

[1]*Coastal Research Group; Department of Zoology and Entomology, Rhodes University, P.O. Box 94, Grahamstown 6140, South Africa*

[2]*South African Institute for Aquatic Biodiversity, Private Bag 1015, 6140 Grahamstown, South Africa*

[3]*South African Environmental Observation Network, Elwandle Coastal Node, Ocean Sciences Campus, 4 Gomery Avenue, Summerstrand, Port Elizabeth, 6031, South Africa*

Emails in order of authors: bdyantyi92@gmail.com; paula@saeon.ac.za; C.McQuaid@ru.ac.za; f.porri@saiab.ac.za

Populations of most marine benthic species have pelagic larvae which is important in maintaining coastal populations. The populations of these species were previously interpreted as being demographically open. The scale of larval dispersal was explained by the physical mechanisms of the ocean and the duration of the larval phase. However, recently, with greater knowledge of the potential effects of larval behaviour on larval transport and dispersal, there has been a shift to understanding of these populations as being demographically more closed. The ocean is dynamic and offers several means of dispersal for larvae with limited swimming abilities. The mechanisms that influence larval transport and delivery to the adult benthic sites remain poorly understood. The aim of this study was to investigate the overall alongshore and cross-shore transport and temporal delivery of invertebrate larvae at four sites (Kenton on Sea, Cannon Rocks, Schoenmakerskop and Cape St Francis) along the south east coast of Eastern Cape, South Africa. February 2016 – May 2016 and October 2016 – February 2017 were the two sampling periods during which larval distribution of several taxa was determined by collecting water samples at nearshore line transects over three distances perpendicular to the shore and at three depths (surface, thermocline/middle and bottom). Several chemico-physical properties were measured in order to further explain larval distribution. The larvae were analysed as both total abundance and separately as the abundances of the following taxa: *Perna perna*, *Mytilus galloprovincialis*, oysters, early and late barnacle nauplii and cyprids. Larval settlement and recruitment on each shore were measured by monthly deployment and collection of artificial larval collectors for mussels and barnacles that were preserved in ethanol or frozen until processed. The abundances of larvae for each taxon were analysed separately using multiple Permutational Multivariate Analysis of Variance to test the effects of site, depth and distance. A distance based linear model was performed to analyse the relationships among total larval abundance and the chemico-physical variables. Multiple two-way analyses of variance were performed to test the effects of month and site on the settlement and recruitment of larvae to the shore.

The results revealed that the larvae of most taxa showed a significant site and depth interaction, the exception being 'early nauplii'. The larvae of nearly all taxa were found within the thermocline, with 'oyster' and 'cyprids' being located at the bottom or thermocline. Larval abundances were greatest at the offshore stations. Furthermore, larval abundances showed a significant effect of site, with highest larval numbers at Cannon Rocks and Kenton on Sea and lowest values at Schoenmakerskop and Cape St Francis. For the settlement and recruitment, most taxa showed a seasonal trend, with the highest abundance of

settlers and recruits appearing during the summer months. Additionally there was a site effect for most larvae (*P. perna*, *M. galloprovincialis*, other bivalves and juvenile barnacles), where settlers and recruits were mostly found at Cannon Rocks, indicating spatial and temporal variability along the targeted 180km stretch of coast.
Overall, taxon, time and ontogenetic stage of larvae were important in determining the distribution and abundance of larvae. Throughout the time frame of nearshore and intertidal sampling, Cannon Rocks was consistently a 'hot spot' for larval abundance, settlement and recruitment, while a broad west to east separation was also observed. These results indicate that, larval dispersal and recruitment in these benthic populations operates as a 'hybrid model' of open and closed systems, depending on time, taxon and ontogeny.

Keywords: Hybrid Model, Larval distribution, Settlement, Recruitment, Transport, Ontogeny, Taxon.

Presenting author: Siphelele Buntu Dyantyi

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