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Mark J. Butler IV

Old Dominion University, mbutler@odu.edu

William F. Herrnkind

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Are Artificial "Witham" Surface Collectors Adequate Indicators of Caribbean Spiny Lobster, *Panulirus argus*, Recruitment?

MARK J. BUTLER IV¹ and WILLIAM F. HERRNKIND²

¹*Department of Biological Science
Old Dominion University
Norfolk, VA 23529-0266 USA*

²*Department of Biological Sciences
Florida State University
Tallahassee, FL 32306 USA*

ABSTRACT

Understanding the local dynamics of Caribbean spiny lobster (*Panulirus argus*) postlarval influx, settlement, and recruitment may be essential for the responsible management of this important and heavily exploited resource. Most lobster recruitment research programs in the Caribbean employ derivations of the "Witham"-type surface collector to monitor postlarval (puerulus) lobster influx. However, the relevance of data obtained from surface collectors with respect to the estimation of actual puerulus influx, settlement, or recruitment to subsequent benthic juvenile stages remains untested. We investigated that relevance on regional (*i.e.*, tens of kilometers) and local (*i.e.*, tens of meters) scales by examining the quantitative relationships between the following:

- surface collector catch of pueruli
- planktonic density of pueruli
- benthic settlement of pueruli
- recruitment to the postlarval juvenile stage

Our study was conducted at one site in the middle Florida Keys in July 1988 and at the same site in June, July, and August 1989; three additional sites were incorporated into the study in June, July, and August 1989. A "site" in this study is defined as a region encompassing a single transport path (determined from surface water flow studies) used by pueruli to enter the inshore nursery, beginning approximately 0.5 km offshore of an inter-island channel leading into the Florida Bay nursery and ending approximately 7 km into the bay. At each site, we measured puerulus abundance on six surface collectors deployed approximately 0.5 km offshore of the inter-island channel and on five surface collectors deployed at each of three localities situated approximately 1.5, 3.5, and 7 km into Florida Bay. Pueruli were counted and removed from collectors daily for seven days, beginning two days prior to new moon. To estimate planktonic densities of pueruli at each site, four plankton net (1 m diameter; 750 μ m mesh) samples were taken within the inter-island channel nightly for seven nights during new moon flood tides when pueruli were entering the bay. Benthic settlement of pueruli was estimated at each locality within a site using benthic arrays of mesh bags (2 cm mesh) filled with natural settlement substrate (red algae, *Laurencia* spp.). Twenty five of these benthic collectors were deployed 2 m apart in a 5 x 5 array at each of the three localities. Postlarval juvenile lobster (15 - 35 mm carapace length) abundance was also estimated by making two

independent 30-minute diver surveys at each locality. To examine general relationships among the various factors measured, we computed Pearson product-moment correlations (r) among the various factors and tested the significance of these correlations with t -tests; experimentwise error rates were used and individual p -values were adjusted to 0.01. Using best-fit multiple regression techniques, we also evaluated several possible models constructed to predict settlement and recruitment to the postlarval juvenile stage given offshore surface collector catch, puerulus density in the plankton, bayside surface collector catch, and distance from inter-island channels.

Results from these experiments indicate that the abundance of pueruli on ocean side surface collectors (*i.e.*, those intercepting pueruli before they enter shallow nursery grounds) is correlated ($r = 0.81$; marginally significant at $p = 0.02$) with settlement at a site (*i.e.*, with abundances on benthic collectors at three localities per site combined). The correlation between planktonic puerulus density (plankton net data) and oceanside surface collector catch was positive and reasonably high, but not significant ($r = 0.61$; $p = 0.08$). There was no significant correlation between catch by surface collectors deployed at particular localities and settlement at those localities ($r = 0.14$; $p > 0.05$), and there was also no relationship between postlarval settlement at a locality and recruitment to the postlarval juvenile stage ($r = 0.26$; $p > 0.05$). Best-fit multiple regression models explained at best 20% of the observed variation in puerulus settlement or juvenile recruitment at a locality, and thus were unreliable for predicting local settlement or recruitment.

These results imply that "Witham"-type surface collectors deployed on the ocean-side of nursery areas provide a reasonably good relative measure of the number of pueruli entering the area and may thus serve as a useful technique for making general comparisons of puerulus abundance among regions. However, surface collectors deployed within nursery areas cannot be used as indicators of puerulus abundance or settlement, and care must be taken to situate surface collectors at appropriate locations (*i.e.*, offshore of nursery areas at locations where they can encounter incoming pueruli). Within the nursery, surface collector catch is a poor indicator of local puerulus settlement or of recruitment to the postlarval juvenile stage, which may depend more on the availability of settlement and postsettlement habitats, on predator abundance, and on the local transiency of these factors.