Spatial and temporal variability in recruitment of decapod megalopae in the Duplin River, Georgia

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ABSTRACT

Callinectes sapidus **(blue crab) populations have declined in Georgia's coastal waters over the last decade. Commercial landings in 2002 were only 22% of those in 1995. Recruitment studies of this valuable species in Georgia's Duplin River estuary (a large tidal slough adjacent to Sapelo Island) have been conducted at only one site (Marsh Landing Dock) and showed poor settlement. The dock fouling community may have interfered with settlement cues and/or high water velocities may have made settlement difficult. Our study provides a more complete account of spatial and temporal variability of decapod recruitment in the Duplin estuary. We deployed cylindrical 'hogs hair' furnace filter samplers at two depths in 12 locations from the mouth to the headwaters of the Duplin. Samplers were retrieved every 24 hours over a six day period in August 2003. Organisms were removed, preserved, identified to the lowest possible taxon and counted. We found that although *C. sapidus* megalopae recruited to Marsh Landing Dock samplers, larvae were collected in greater numbers up river. Along with *C. sapidus*, *Uca* spp. and *Panopeus herbstii* were the most abundant megalopae collected. *C. sapidus, P. herbstii,* and *Uca* spp. settlement increased during southwestern wind events providing onshore flow into the estuary. *C. sapidus* settlement at up river sites increased during these events. On subsequent days, a greater number of *C. sapidus* juvenile crabs were collected up river. *C. sapidus* and *P. herbstii* settled preferentially on bottom samplers throughout the river. Water salinity and temperature were not correlated with settlement patterns.**

INTRODUCTION

The average annual harvest of blue crabs in Georgia from 1956-2002 was 8.54 million pounds. The 2003 forecast was for only 1.51 million pounds and in May 2003, a fishery resource disaster was declared by the National Marine Fisheries Service. Suggested causes for the declines of harvestable adults are continued drought conditions and the increased occurrence of the dinoflagellate *Hematodinium*, a blood parasite. Very little attention has been given to larval recruitment, an obviously important factor in determining the subsequent adult population. Wrona et al.(1995) recorded poor *Callinectes sapidus* settlement (60 megalopae) during successive fall and spring recruitment periods. Their study was limited to one location, near the mouth of the Duplin River (Marsh Landing), and provided little data about recruitment throughout the estuarine system. High tidal velocities in that location (Ragotzkie and Bryson, 1955) may physically limit settlement. Additionally, environmental cues may be insufficient to induce blue crab settlement there. Our study was unique in the use of open water (non-dock) sites in this area to monitor decapod crab larval recruitment, thus eliminating any confounding factors produced by standing structures and established fouling communities.

Our study was specifically designed to:

- **Determine spatial and temporal variability of recruitment in the Duplin River**
- **Reassess recruitment at Marsh Landing compared to other sites**
- **Determine important environmental influences on settlement patterns**

MATERIALS AND METHODS

Fig. 1: Sampler locations

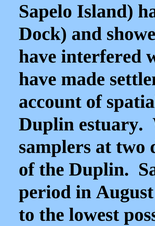
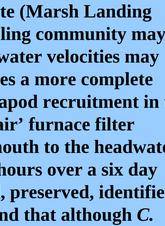


Fig. 2: Sampler design



Our study took place in the Duplin River (Fig. 1), a 12.5 km tidal slough, bordering the western side of Sapelo Island, GA. Passive settlement collectors ('hogshair' filter material attached to cylindrical PVC pipe, Fig. 2) were deployed at two depths in 12 locations from the mouth to the headwaters of the Duplin. Top samplers were designed to float freely just below the water surface. Bottom samplers were designed to remain 1 m from the sediment surface. Sites were chosen to represent a range of hydrodynamic conditions and for comparison to previous studies. Samplers were retrieved every 24 hours over a six day period (August 17-22, 2003). Organisms were removed, preserved, identified to species and counted.

RESULTS AND DISCUSSION

We collected a total of 1727 megalopae over all sites and depths during the six day period of this study. Megalopae of seven crab species were collected. *Uca* spp. were numerically dominant. Other species collected were *C. sapidus*, *Panopeus herbstii*, *Eurypanopeus depressus*, *Neopanope sayi* and *Ocypode quadrata*. We also found zoea of the invasive porcelain crab, *Petrolisthes armatus*, but no megalopae. *C. sapidus* recruitment was spatially variable (Fig. 3) and accounted for almost 16% (270) of the total number of megalopae collected. This represents a 4.5-fold increase in the number of blue crab larvae collected during seven months of sampling by Wrona et al. (1995). In our study, Marsh Landing collectors had fewer blue crab megalopae (15.6% of *C. sapidus*) than open water samplers, except for those at the uppermost reaches of the Duplin. These results suggest caution should be used in estimating blue crab recruitment levels based on a single sample location and supports the use of open water deployment of samplers.

Fig. 3: Spatial variability of crab larval recruitment

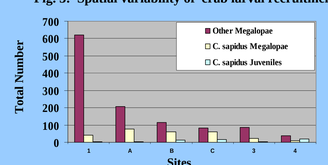


Fig. 4: Total number of *C. sapidus* megalopae at all sites.

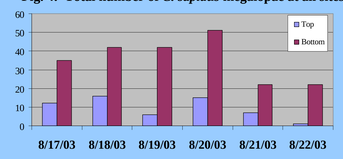


Fig. 5: Total number of *C. sapidus* juveniles at all sites.

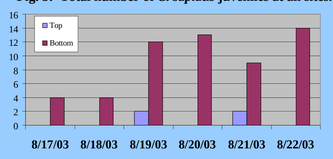
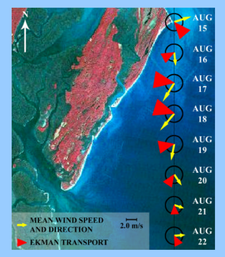


Fig. 6: Wind patterns and associated onshore transport during sampling.

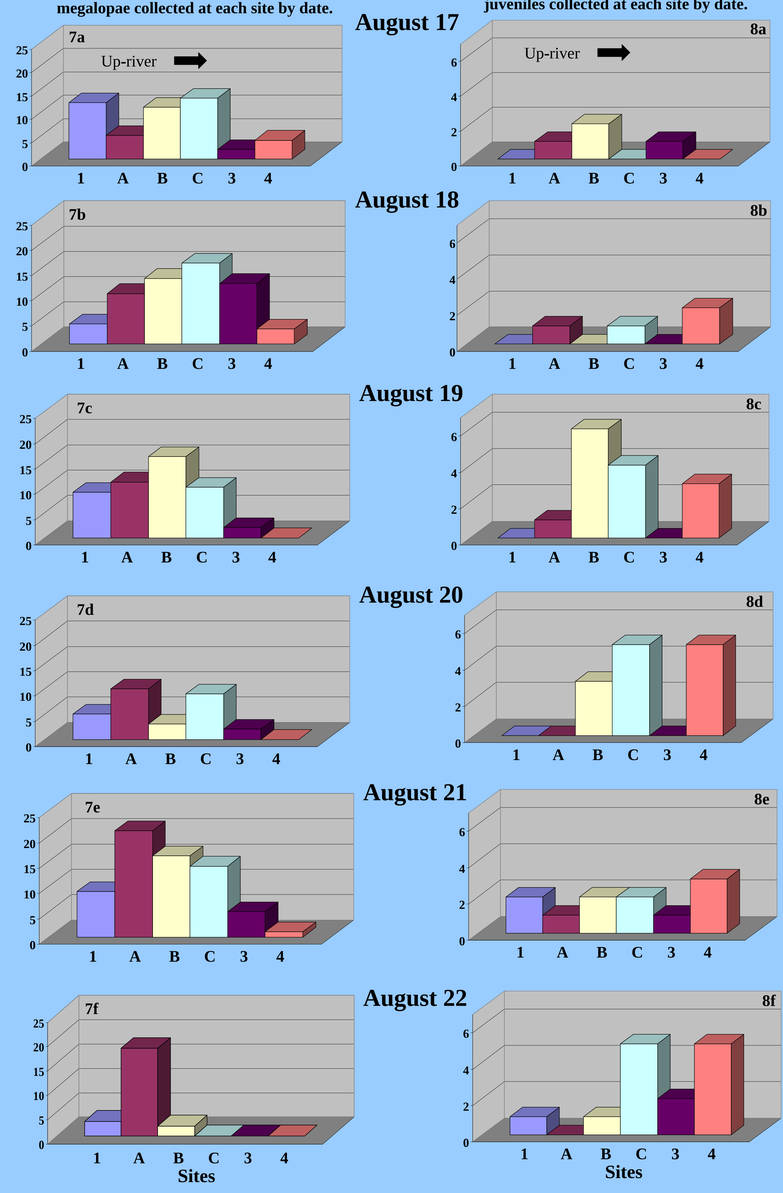
The broad ends of the red triangles represent the direction of onshore transport as a result of the wind conditions. Wind speed and direction are indicated by the length and direction of the arrows, respectively.



C. sapidus megalopae recruitment was temporally variable (Fig. 4) and was greater on days with southward winds. Onshore transport, as a result of the southward winds (Fig 6), may have aided the movement of the larvae into the usually ebb-dominated Duplin River. On days subsequent to increased megalopae transport, higher numbers of juveniles were collected (Fig. 5).

Fig. 7a-f : Total number of *C. sapidus* megalopae collected at each site by date.

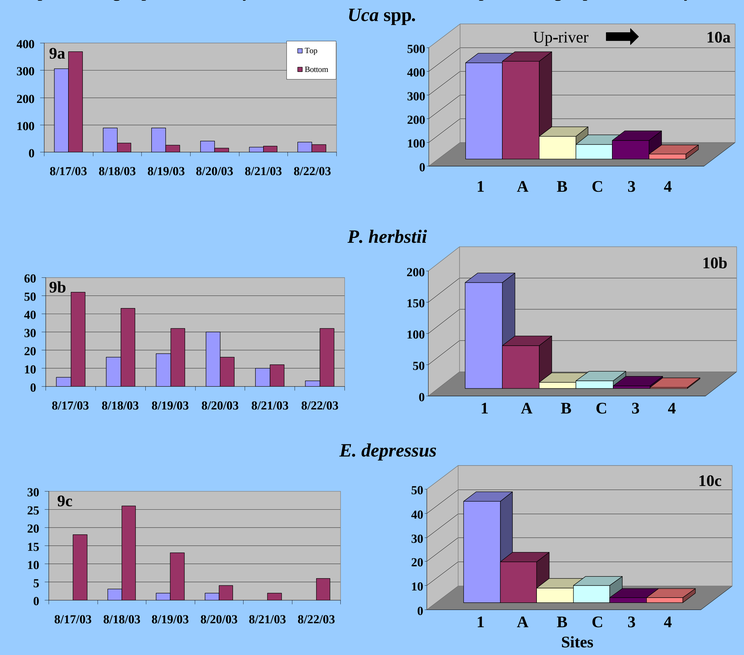
Fig. 8a-f : Total number of *C. sapidus* juveniles collected at each site by date.



Winds favorable for enhanced transport of larvae into the estuary not only increased the number of larvae within the Duplin, but also resulted in peak settlement of *C. sapidus* megalopae further up river on August 17-18 (Fig 7a-b). As wind direction changed and speed decreased during August 19-22 (Fig. 6), peak megalopae recruitment shifted down river (Fig 7c-f). The shift of recruitment may have been aided by heavy rainfall at low tide on the evening of August 18 (~ 18 mm). Similar rain events, which scour the exposed marsh surface and cause down river displacement of normally distinct and stable water masses (Ragotzkie and Bryson, 1955), have been documented by Chalmers et al. (1985). The net effect would have been to decrease recruitment on the upper river samplers although southward winds continued. Numbers of *C. sapidus* **juveniles** were higher at up river sites after the increased megalopae recruitment events and the rainfall (Fig 8c-f). Settlement cues may have been enhanced by the marsh runoff resulting from the rainfall.

Fig. 9a-c: Total number of *Uca* spp., *P. herbstii,* and *E. depressus* megalopae collected by date.

Fig. 10a-c: Total number of *Uca* spp., *P. herbstii,* and *E. depressus* megalopae collected by site.



Uca spp., *P. herbstii and E. depressus* also displayed increased recruitment during southward winds (Fig 9a-c). However, they did not show greatly increased recruitment at upper river sites (Fig 10a-c) as *C. sapidus* did. *Uca* spp., did not display a strong preference between top or bottom samplers (Fig 9a). *P. herbstii*, *E. depressus*, and *C. sapidus* settled preferentially on bottom samplers (Figs 9b,9c, and 4 respectively). No correlation was found between lunar cycle, water temperature, salinity or air temperature and settlement of megalopae.

CONCLUSIONS

- **Larvae of seven crab species were collected over a six day period in August 2003 from Marsh Landing Dock and open water collectors in the Duplin River, GA.**
- **Of 1727 megalopae collected, ~ 16% were *Callinectes sapidus*. *Uca* spp. were numerically dominant. *Panopeus herbstii* and *Eurypanopeus depressus* were also abundant.**
- **Crab larval recruitment was variable across spatial and temporal scales.**
- **The recruitment of *C. sapidus* to distant, up river sites was enhanced by southward winds providing enhanced transport into the Duplin River.**
- **Strong rainstorms at low tide in the upper Duplin, along with the usual ebb-dominated flow, may have shifted peak settlement to down river sites.**
- ***C. sapidus*, *P. herbstii* and *E. depressus* showed preference for bottom samplers. *Uca* spp. showed no preference.**
- **Our results caution against predicting blue crab recruitment levels based on a single location and supports the value of open water sampler deployment.**

Literature Cited

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Acknowledgements

This project received funding or logistical assistance from the Georgia Coastal Ecosystems Long Term Ecological Research project, the University of Georgia Marine Institute and the Sapelo Island National Estuarine Research Reserve. Taxonomic assistance was provided by David Knott of the Southeastern Regional Taxonomic Center. Graphic assistance was provided by Wayne Listing, Chris Lasher, Wade Sheldon and Sharon Barnhart. The field work would not have been possible without the help of Ken Helm.