Influence of Salinity and Freshwater Inflow on the Recruitment of Commensal Decapod Crustaceans to Oyster Reefs in Estero Bay, Florida

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Introduction

Fig. 1. Estero Bay estuary

The dominant decapods found commensally on oyster reefs in Estero Bay, Florida are the flatback mud crab *Eurypanopeus depressus*, green porcelain crab *Petrolisthes armatus* and Harris mud crab *Rhithropanopeus harrisii*. To examine the effects of salinity on the distribution and abundance of larvae, juveniles and adults of these species, two sampling approaches were employed: (1) Plankton tows were made monthly at 16 locations throughout the bay (including the mouths of the bay's five tidal tributaries) to examine spatial and seasonal patterns of larvae, and (2) lift nets were deployed monthly on oyster reefs located near the mouths of the bay's five tidal tributaries to examine spatial and seasonal patterns of juveniles and adults. These tributaries each experience different levels of freshwater inflow.

Estero Bay, in Southwest Florida (Fig. 1), is a shallow, microtidal estuary with an average depth < 2 m. The bay receives relatively little freshwater inflow from its tidal tributaries–Hendry, Mullock and Spring Creeks and the Estero and Imperial Rivers–though salinities can be reduced locally during the wet season. Flow regimes of these tributaries have been altered to drain the landscape during the wet season by increasing flows into the bay and to retain water during the dry season by restricting flow using water control structures).

Methods

Fig. 2. Data collection

(1) Larvae: Monthly plankton tows were made at 16 sites on an incoming tide from Mar 2005–Feb 2006. Salinity, temperature and dissolved oxygen was recorded at the surface, bottom and 0.5-m intervals between (Fig. 2). Organism abundance and water-quality contours were created using Surfer 8. (2) Juveniles and Adults: Lift nets (0.5 m^2) were deployed monthly on intertidal oyster reefs located near the mouths of the bay's five tributaries. Salinity, temperature and dissolved oxygen was recorded for each month and station. Provisional flow data were collected by the U.S. Geological Survey and were provided by the South Florida Water Management District.

Results

Spatial and Seasonal Patterns (Larvae): Abundance of *E. depressus*, a euryhaline species, was greatest in May and was depressed with the onset of seasonal rains in June (Fig. 3). This species was well distributed throughout the bay during subsequent months. Highest abundances occurred in the open waters of the bay, decreasing slightly near tributaries and tidal passes (Figs. 10, 13).

Abundance of *P. armatus*, a marine stenohaline species, was also greatest in May and was depressed with the onset of the rainy season (Fig. 4). Two lesser peaks in abundance occurred in July and September. This species was distributed throughout the bay with highest abundances near the passes to the Gulf of Mexico and the open waters of the bay and with lower abundances recorded near the mouths of the tributaries (Figs. 11, 14).

Highest abundance of *R. harrisii*, known to inhabit lower salinity waters, occurred in August well after the onset of seasonal rains and decreased in October with the beginning of the dry season (Fig. 5). Larvae were predominantly found in association with tidal tributaries and were less abundant in the open waters of the bay (Figs. 16, 18).

Abstract

Variability in recruitment of organisms to oyster reefs is dependent, in part, on larval supply. Distribution and abundance of larvae of three dominant decapods found on oyster reefs in Estero Bay, Florida – *Petrolisthes armatus*, *Eurypanopeus depressus* and *Rhithropanopeus harrisii* – were quantified using monthly plankton tows. Larval densities of the marine stenohaline *P. armatus* were greater in bay waters and near passes; the euryhaline *E. depressus* occurred abundantly throughout the bay and near tidal tributaries; and *R. harrisii*, which favors reduced salinities, were most abundant near tidal tributaries with high freshwater inflow. Densities of *P. armatus* and *E. depressus* peaked at the end of the dry season (May) and were depressed with the onset of seasonal rains (June). Larvae of *R. harrisii* were in short supply during dry months but abundant during the wet season. Weighted salinity of capture was higher for *P. armatus* (30.7) and *E. depressus* (30.1) than for *R. harrisii* (9.2), and larval density was positively correlated with salinity for *P. armatus* and *E. depressus* and negatively correlated for *R. harrisii*. The distribution of juveniles and adults, collected using lift nets from oyster reefs at the mouths of tidal tributaries, largely reflected larval supply: *P. armatus* was absent from reefs experiencing low salinities; *R. harrisii* was found only in association with reefs experiencing low salinities; and *E. depressus* was found on all reefs. These results suggest the importance of considering the effects of salinity on larval supply of commensal organisms when planning and executing oyster-reef restoration projects.

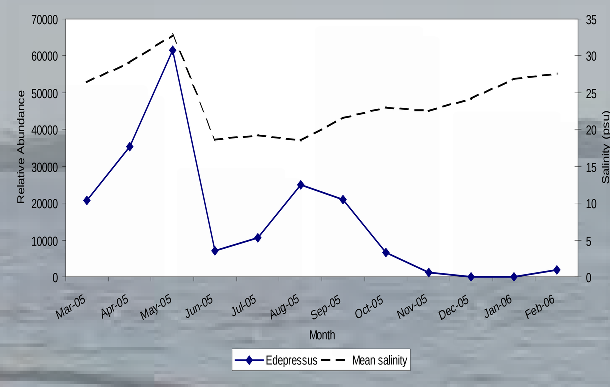

Fig. 3. Seasonal variation in salinity and density of *E. depressus* larvae.

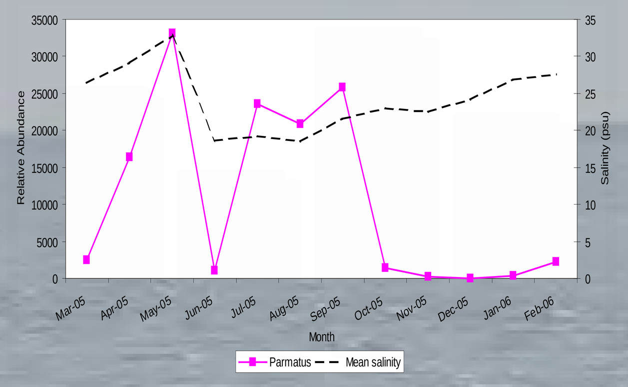

Fig. 4. Seasonal variation in salinity and density of *P.armatus* larvae.

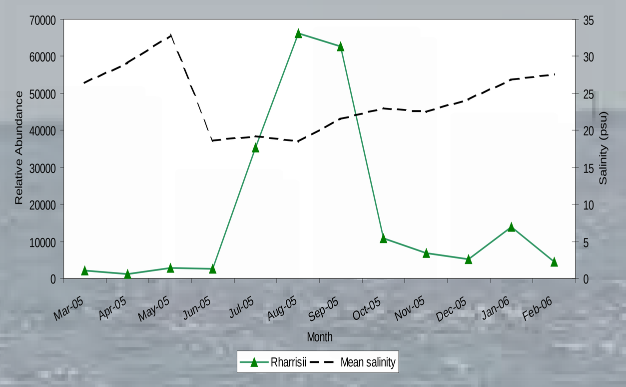

Fig. 5. Seasonal variation in salinity and density of *R.harrisii* larvae.

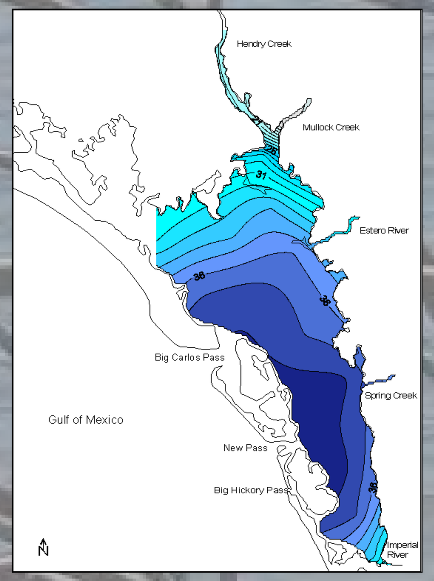

Fig. 9. Distribution of salinity (psu), May 2005.

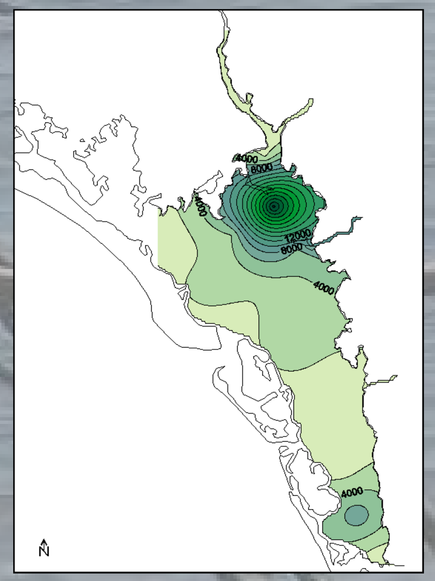

Fig. 10. Distribution and abundance (no. m^{-3}) of *E. depressus* larvae, May 2005.

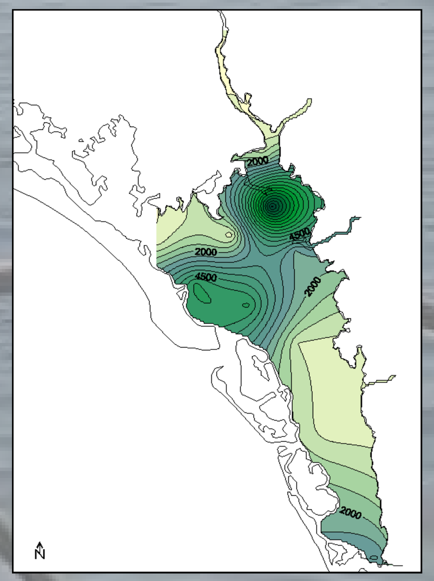

Fig. 11. Distribution and abundance (no. m^{-3}) of *P. armatus larvae*, May 2005.

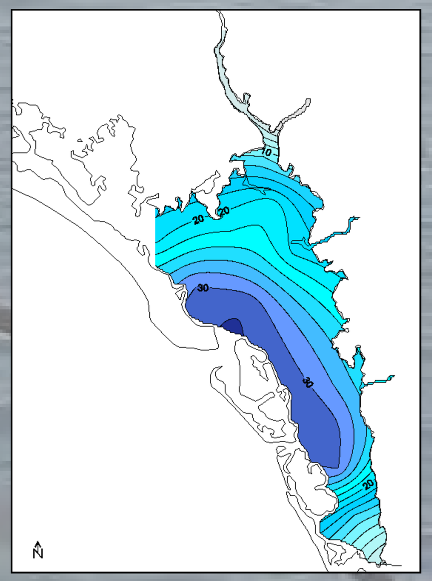

Fig. 15. Distribution of salinity (psu), Aug 2005.

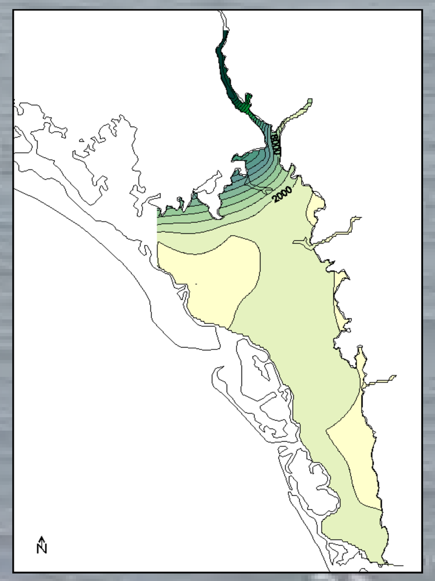

Fig. 16. Distribution and abundance (no. m^{-3}) *R. harrisii* larvae, Aug 2005.

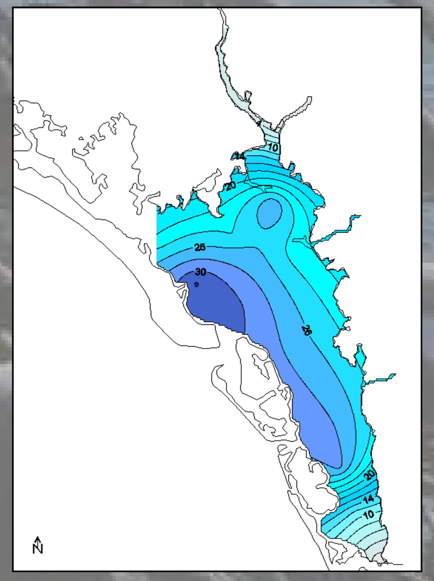

Fig. 12. Distribution of salinity (psu), Jun 2005.

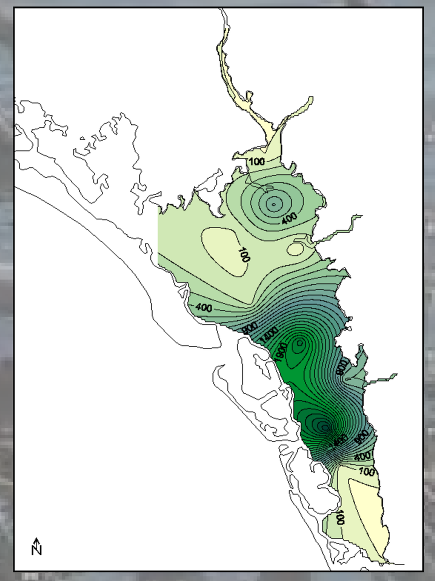

Fig. 13. Distribution and abundance (no. m^{-3}) of *E. depressus* larvae, Jun 2005.

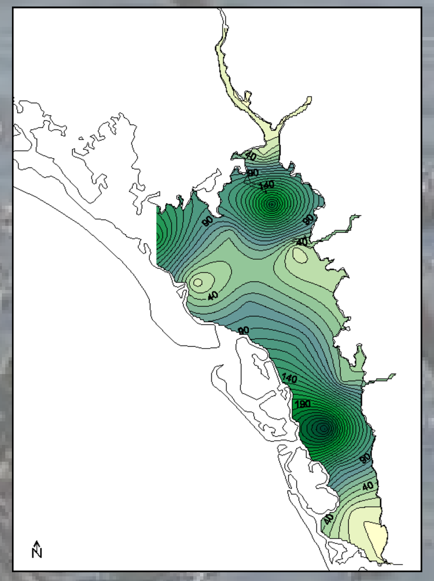

Fig. 14. Distribution and abundance (no. m^{-3}) of *P. armatus* larvae, Jun 2005.

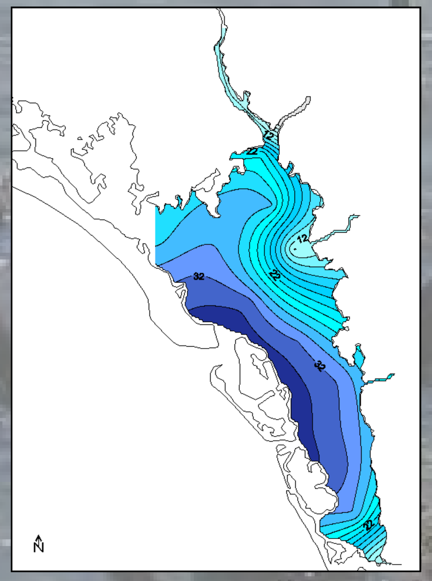

Fig. 17. Distribution of salinity (psu), Oct 2005.

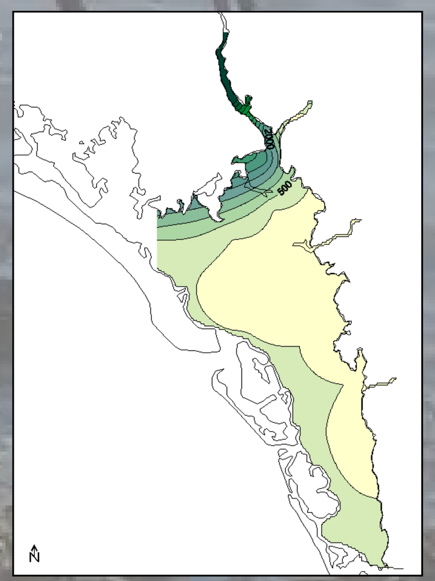

Fig. 18. Distribution and abundance (no. m^{-3}) of *R.. harrisii* larvae, Oct 2005.

Results Continued

Relationship with Salinity (Larvae): Salinities within the bay ranged from 0.2–38.5 with maximum mean values occurring in February and minimum values in August (see Figs. 9, 12, 15, 17). The start of the wet season in June brought 36.5 cm of rain and a substantial decrease in salinity. Weighted mean salinity of capture was higher for larval *P. armatus* (30.7) and *E. depressus* (30.1) than for *R. harrisii* (9.2). Natural log of larval density was positively correlated with salinity of capture for *P. armatus* ($r=0.48$, $p<0.01$, $n=190$) and *E. depressus* ($r=0.62$, $p<0.01$, $n=190$) and was negatively correlated for *R. harrisii* ($r = -0.57$, $p<0.01$, $n=190$).

Patterns for Juveniles & Adults: Although no seasonal differences were detected, decapod abundance did vary among stations. *E. depressus* was found in significantly greater numbers at the Estero and Spring stations (Fig. 19), two tributaries experiencing reduced freshwater inflow and higher relative salinities (Table 1). Abundance was lowest at Mullock (Fig. 19), which experiences the highest degree of inflow (Table 1).

Abundance of *R. harrisii* was significantly higher at Mullock and Hendry, with the highest abundance occurring in Mullock. Although Hendry does not receive much freshwater inflow from its own watershed (Table 1), salinities at this site were reduced due to the impact of the high level of freshwater inflow from the neighboring Mullock Creek. Though salinities at Imperial were also low, oyster-reef habitat is limited upstream due to watershed development, likely resulting in the low numbers of *R. harrisii* at this station. Abundance at the other stations (reduced inflow) was low and did not differ significantly (Fig. 19).

P. armatus was consistently found in significantly greater numbers at Estero and Spring (Fig. 19) sites, which experience little freshwater inflow and relatively high salinities.

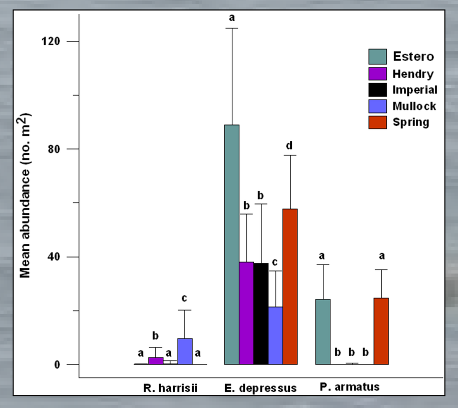

Fig 19. Juvenile and adult decapods collected Mar 2005-Feb 2006.

Table 1. Freshwater inflow (cu ft s^{-1}) for Estero Bay tributaries, April–September 2005.

Station	Inflow (cfs ± SD)	Max daily inflow (cfs)
Estero	64.94 ± 76.51	392.69
Hendry	7.2 ± 13.93	98.76
Imperial	223.97 ± 211.05	690.59
Mullock	416.31 ± 556.18	2698.35
Spring	15.83 ± 20.67	169.83

Conclusions

The effect of salinity on the spatial and temporal variability of larvae should be considered when examining recruitment dynamics of oyster-reef commensal organisms. Understanding the relationship between salinity (as affected by freshwater flow), larval dynamics and recruitment to oyster reefs by these species can be a valuable tool when managing coastal resources and mitigating for watershed alteration. These relationships should also be considered when planning and executing shellfish restoration activities.

Acknowledgements

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