A Flood Tidal Transport for Pink Shrimp Larvae on the SW Florida Shelf

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Collaborators

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UM/ CIMAS-NOAA/ NMFS- USGS:
Thomas Jackson, Hernando Cardenas, Jeremy Hall, Destiny Hazra, Joe Contillo, Andre Daniels
- Connectivity among stages and habitats
- Recruitment variability
Offshore-onshore circulation

Subtidal currents (N-S)

SWF shelf

- Subtidal currents are weak and mainly alongshore

- Tidal currents are strong in the E-W component

Tidal Currents (E-W)
Influx of postlarvae into Florida Bay

- Two different influx patterns
- Highest concentrations at the NW border
- A feasible transport mechanism across the SWF shelf

Criales et al. (2006, FB)
Transport and behavior on the SWF Shelf

Dry Tortugas

Marquesas

Onshore

Depth (m)

July 2-3, 2004

July 3-4, 2004

July 4-5, 2004
Cross-shelf temperature and larval concentrations

Winds

- SE winds do not favor onshore Ekman transport
- Large scale offshore forces, intrusions of the Loop current or eddies
Currents at MQ Station

E-W current (cm*s⁻¹)

N-S current (cm*s⁻¹)

Depth (m)

July 3-4, 2004 (h)

-60
-40
-20
0
20
40
Temperature, salinity and density

Marquesas, July 3-4, 2004

Temperature

Salinity

Density

Density, shear and Richardson numbers

Density gradient (kg m\(^{-3}\))

Current shear (10\(^{-4}\) s\(^{-2}\))

Richardson numbers
Linear internal tides (LIT)
- A shallow thermocline with strong density gradients and high frequency motions of ~ 12 h
- Strong vertical shear, vertical turbulent mixing
- High concentration of larvae at the shallow thermocline

LIT don’t contribute to onshore transport but convergent current may concentrate larvae at the upper layer

Non-linear internal tides or bores on the SEF shelf: Leichter et al. (2003, 2005, 2006), Davis et al. (2008)
Vertical distribution and behavior

Ontogenetic vertical migrations

Protozoae

Myses

Postlarvae

July 3-4, 2004
Larval concentrations, fluxes and onshore transport

<table>
<thead>
<tr>
<th>Physical variables</th>
<th>Multiple Cumulative</th>
<th>R2</th>
<th>F</th>
<th>P</th>
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</thead>
<tbody>
<tr>
<td>Cross-shelf current (E-W)</td>
<td>0.80 0.64 0.64</td>
<td>17.68</td>
<td>0.001**</td>
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<tr>
<td>Water temperature</td>
<td>0.87 0.75 0.11</td>
<td>3.97</td>
<td>0.078</td>
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<tr>
<td>Water density</td>
<td>0.89 0.79 0.04</td>
<td>1.55</td>
<td>0.248</td>
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</tbody>
</table>

July 3-4, 2004 (h)

(+): onshore

(-): offshore
- Vertical migrations synchronized with the tides
- Larval peaks occurring at the upper layer with a semidiurnal periodicity
- Larval concentrations highly correlated with the E-W current
- Positive larval fluxes during flood tidal periods

**Evidence of a Flood Tidal Transport (FTT)**

a type of STST for myses and postlarvae at ~ 80 km from nursery grounds

Criales et al. (2007, MEPS)
FTT at the entrance to nursery grounds
FTT on the inner SWF shelf
Salinity and turbulence are the most likely environmental factors associated with the FTT behavior.

The inner SWF shelf dominated by tidal currents and affected by freshwater sources may behave as an estuary where larvae may easily recognize tides.

Salinity changes on the natural ecosystem may have negative effect on migration of larvae.

Johns et al. NOAA/AOLM
Modeling larval transport

- What are the main factors affecting recruitment success?
- What is transport like during the first days of development?
- Is FTT the dominant onshore transport?
- What is the origin of the anomalous water near MQ?
Conclusions and current research

- Pink shrimp larvae enter Florida Bay in much larger numbers through its NW border than through the FK channels.

- Uplifted cool waters detected near MQ may be associated with offshore oceanographic forces.

- Linear internal tides were observed at a shallow thermocline near MQ.

- Pink shrimp larvae were highly concentrated in the shallow thermocline at MQ; convergent currents associated with internal tides may contribute to it.
A FTT involving tidal currents and behavior was evident for pink shrimp late stages on the SWF shelf 80 km from nursery grounds constituting the first record of this behavior outside an estuary for decapod larvae.

This potential cross-shelf transport may be used by other estuarine organisms that migrate to Florida Bay using a tidal behavior.

A biophysical Lagrangian model including tides, freshwater discharges and larval behavior is being developed to provide policymakers more detailed information about interconnections between behavior, local, meso and large scale processes.
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Thanks !!!