Variation in movement and habitat use in sub-adult fishes within an estuarine seascape

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Introduction

Red drum (*Sciaenops ocellatus*) and southern flounder (*Paralichthys lethostigma*) are estuarine-dependent fishes found in subtropical waters of the Gulf of Mexico and the southeastern United States. Together red drum and southern flounder are among the most sought after species in near-shore Texas waters and support an economically important recreational fishery valued at over $1 billion dollars. While the importance of three dimensional estuarine habitats to juvenile settlement is well recognized, patterns of habitat use, movement, and connectivity of juveniles and sub-adults across estuarine seascapes are poorly understood. Because regional success of adult populations are dependent on local production, an improved understanding of the suite of habitats required to reach maturation is critical to effectively identify essential fish habitat (EFH) and evaluate the potential impacts of environmental change (i.e. habitat loss).

Objectives

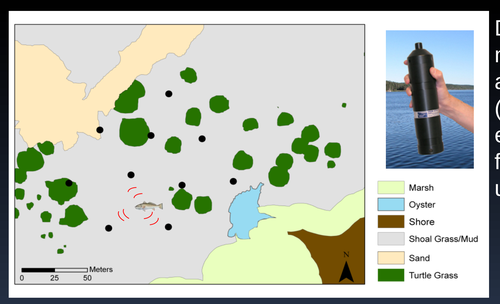
1) Examine habitat use and movement patterns at the habitat scale (m) for sub-adult red drum (age-1 and -2) and southern flounder (age-1)

2) Compare and contrast habitat use and connectivity at the bay scale (km) for sub-adult red drum and southern flounder

Methods

Map of Christmas Bay and adjacent bays in Galveston Bay, TX.

An array of 23 receivers deployed throughout Christmas Bay to study bay-scale habitat use.



Detailed habitat map of study site and receiver array (10 receivers) to examine patterns fine-scale habitat use.

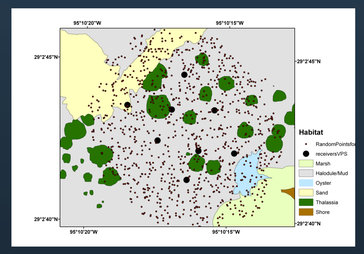
Vemco VR2W Positioning System (VPS) uses differences in time of arrival of detections (at 3 or more receivers) to triangulate fish positions (resolution~ 1-3 m) within the system array.

Age-1 (n = 8) and age-2 (n = 6) red drum and age-1 (n = 8) southern flounder were externally fitted with Vemco V9-1H acoustic transmitters (69kHz, nominal delay = 120 s) and released on the south shoreline of Christmas Bay in January 2012.

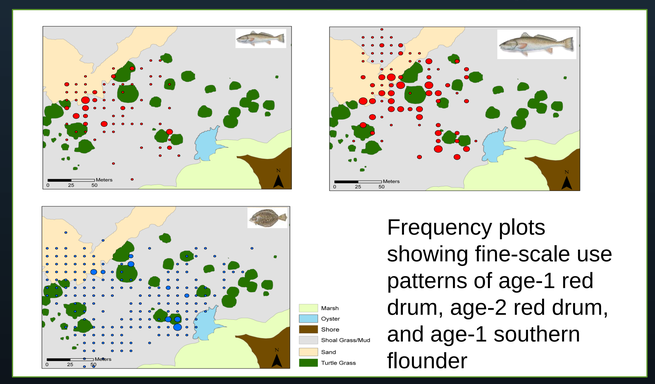
Fine-scale habitat use

Is habitat use random?

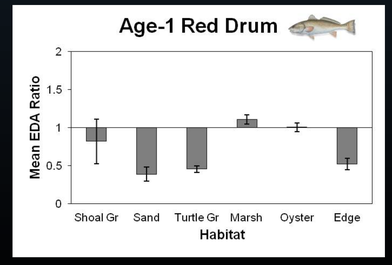
Euclidean Distance-Based Analysis (EDA)

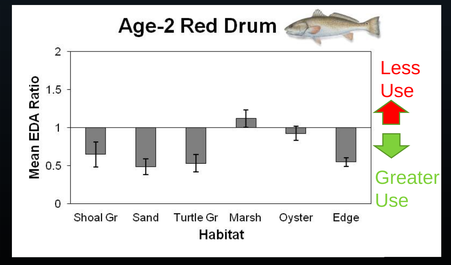


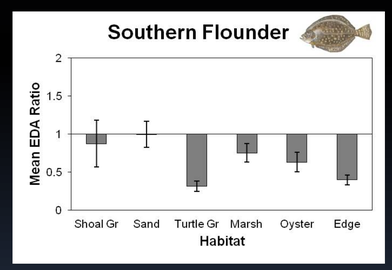
$$\text{EDA Ratio} = \frac{\text{Mean distance from fish locations to a habitat type}}{\text{Mean distance from random points to a habitat type}}$$



Frequency plots showing fine-scale use patterns of age-1 red drum, age-2 red drum, and age-1 southern flounder

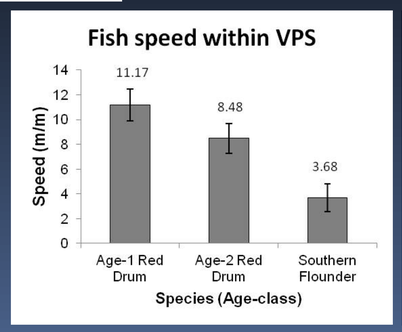




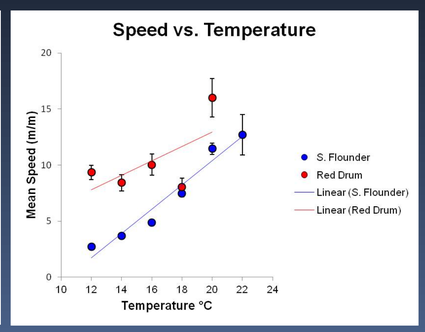


Mean EDA ratios for age-1 red drum (n = 8), age-2 red drum (n = 6), and age-1 southern flounder (n = 8). All species/age-classes were found in close association with turtle grass and edge habitats ($p<0.05$). Red drum were found more closely associated with sand habitats ($p< 0.05$) while southern flounder were more closely associated with marsh habitats ($p<0.05$).

Movement

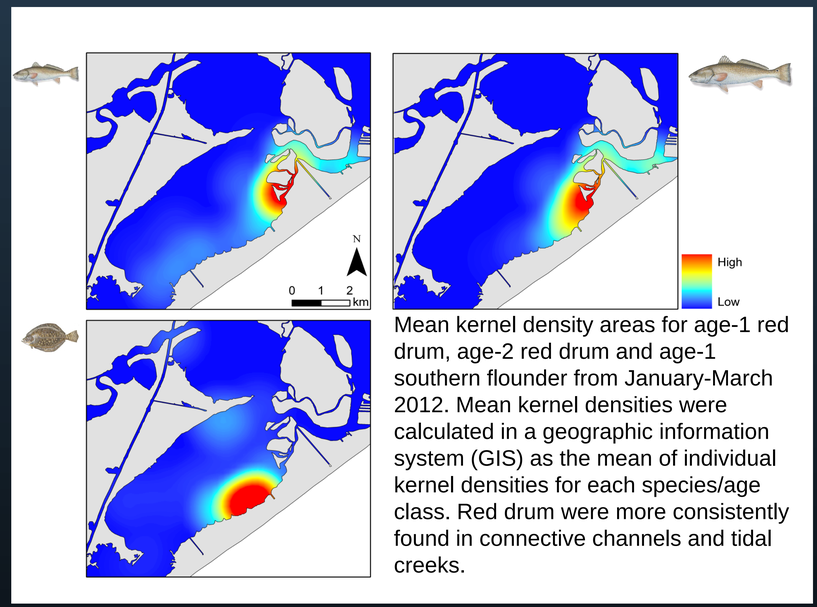


Red drum exhibited greater movement speeds than southern flounder ($p<0.05$).



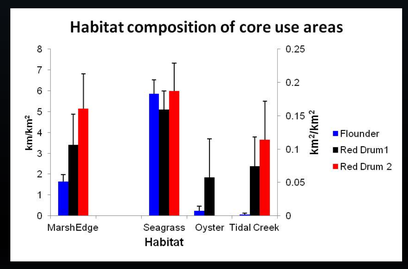
Both species' speed increased with temperature ($p < 0.05$); with a more dramatic increase for southern flounder.

Bay-scale habitat use

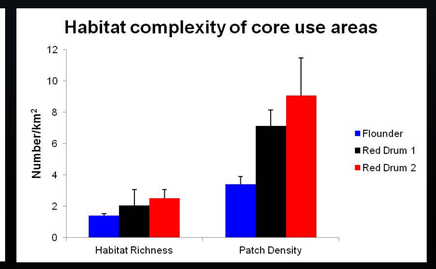


Mean kernel density areas for age-1 red drum, age-2 red drum and age-1 southern flounder from January-March 2012. Mean kernel densities were calculated in a geographic information system (GIS) as the mean of individual kernel densities for each species/age class. Red drum were more consistently found in connective channels and tidal creeks.

Habitat composition (e.g. aerial coverage of habitats) and complexity (e.g. number of habitat types, density of habitat patches) were calculated for the core use area (50% kernel density) of each fish. Means are displayed below.



Increased marsh edge and tidal creek habitat in red drum core use areas.



Red drum core use areas had greater patch density (patches/km^2) than southern flounder.

Conclusions

1) Habitat use varies between important fishery species within the same seascape
2) Habitat use differs ontogenetically
3) Degree of habitat connectivity is affected by environmental factors (i.e. temperature)
4) Habitat use patterns may vary at different spatial scales (e.g. for red drum marsh habitat was very important at the bay scale but used relatively little at finer scales)

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