# Contribution of Mangrove Nursery Habitats To Replenishment of Adult Reef Fish Populations in Southern Florida

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## Background

Connectivity between mangrove forests and coral reefs, mediated by ontogenetic migrations of reef fishes that use mangroves for juvenile nursery habitat, may be crucial for the replenishment of adult populations on the reef. However, direct evidence of this kind of linkage and an understanding of the influence variability of juveniles within mangrove nurseries has on the dynamics of nearby adult reef fish populations is lacking for many species.

Our goal is to establish the nature and extent of the linkage between mangrove and reef habitats by synthesizing two long-term monitoring efforts of populations of fishes from: 1) the inshore mangrove nursery habitats in Biscayne Bay (J. Serafy, Univ. of Miami/NOAA Fisheries) and 2) the adjacent Florida Keys reef tract (J. Bohnsack, NOAA Fisheries). This involves construction of predictive models of recruitment dynamics that incorporate ontogenetic habitat shifts (i.e., mangrove to reef), account for environmental variation, and allow estimation of adult reef fish stock size. Development of an annual, abundance-based index of recruitment, based on the juvenile survey data, will ultimately allow identification of essential fish habitat and provide information necessary for adequate stock assessment.

## Methods

Length and abundance data for fishes collected during 981 mangrove survey transects conducted over nearly a decade (1999–2007) form the basis of the present work (**Figure 1**). Based on their presence and abundance in both the mangrove and reef surveys, 10 target species from seven families were identified as having potential to exhibit ontogenetic shifts between the two habitats. Their relative abundance in the mangroves is shown in **Figure 4**.

Large-scale spatial and temporal trends in utilization of mangrove nursery sites within Biscayne Bay for each of the target species are shown in **Figures 2** and **3**.

Data were partitioned according to spatial (lat/long, habitat) and temporal (year, season) treatments and redundancy analysis (RDA) was used to establish the influence of these along with several other environmental predictors (temperature, dissolved oxygen, salinity, depth, freshwater discharge) on the distribution and abundance of the community of juvenile mangrove fishes (**Figure 5**).

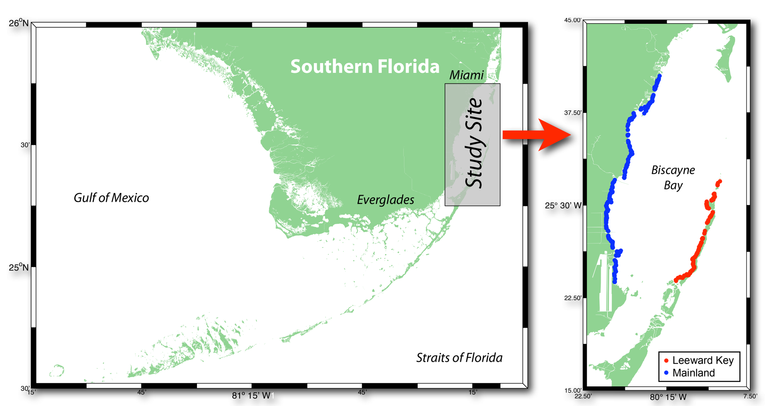


**Figure 1.** Map of the study site depicting location of 981 visual survey transects conducted along mangrove shorelines of Biscayne Bay (1999–2007).

## Habitat

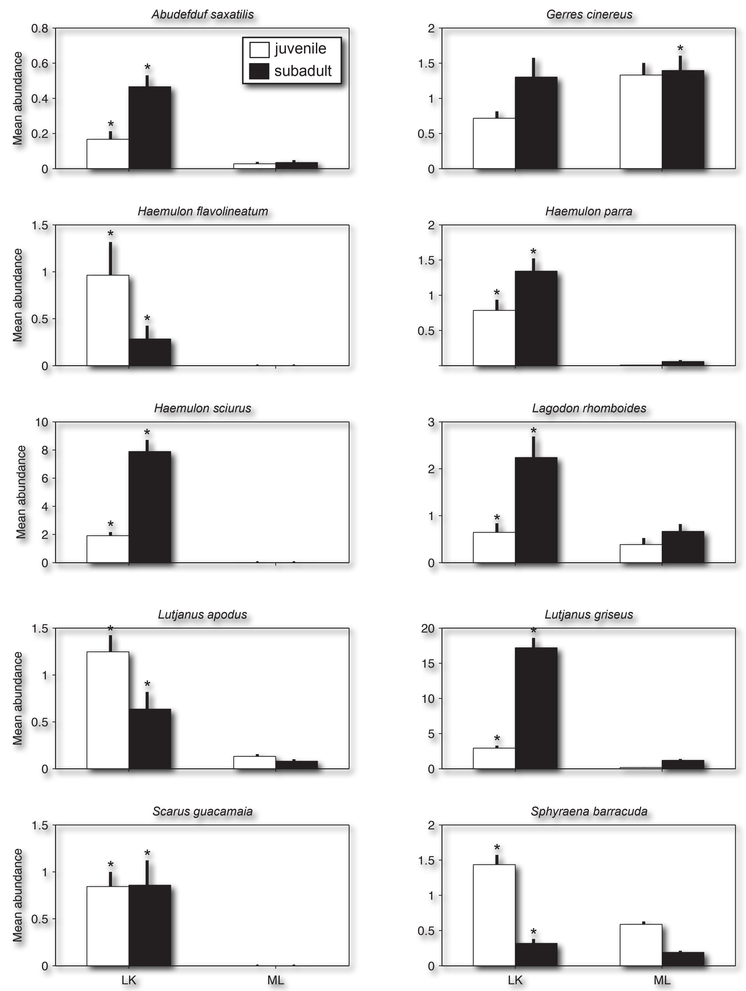


**Figure 2.** Mean abundance (+SE) by habitat for immature stages of 10 species of fishes from the mangrove visual surveys (n = 981 transects); habitats: LK = Leeward Key, ML = Mainland; * identifies the habitat in which the corresponding stage was significantly more abundant.

## Season

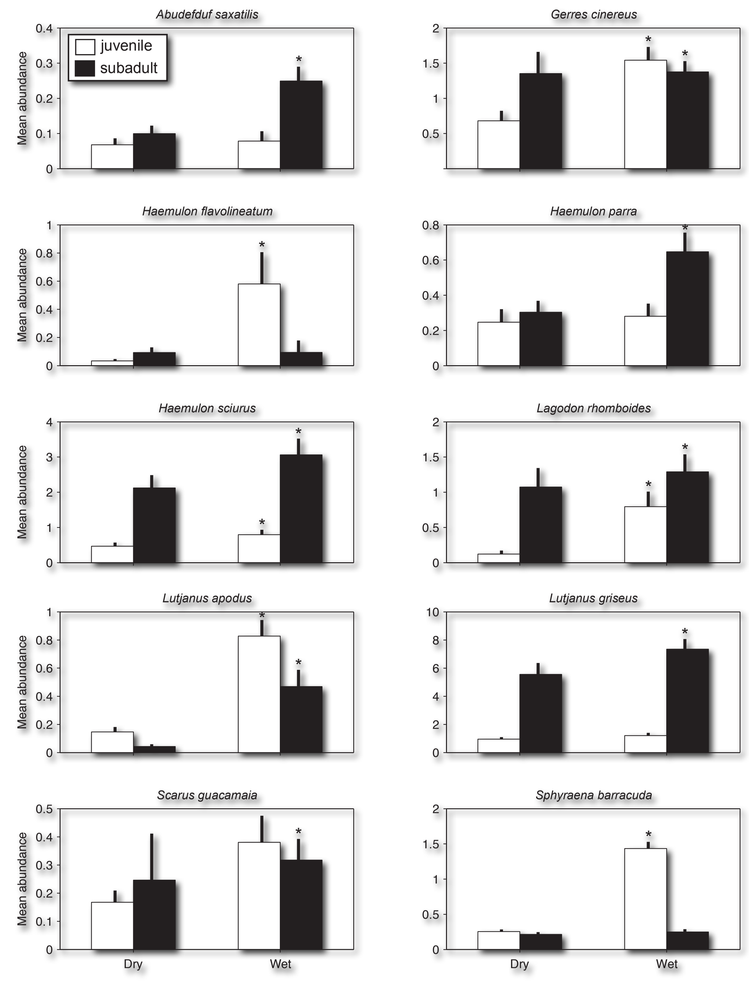


**Figure 3.** Mean abundance (+SE) by season for immature stages of 10 species of fishes from the mangrove visual surveys (n = 981 transects); seasons: Dry vs. Wet; * identifies the season in which the corresponding stage was significantly more abundant.

## Developmental Stage

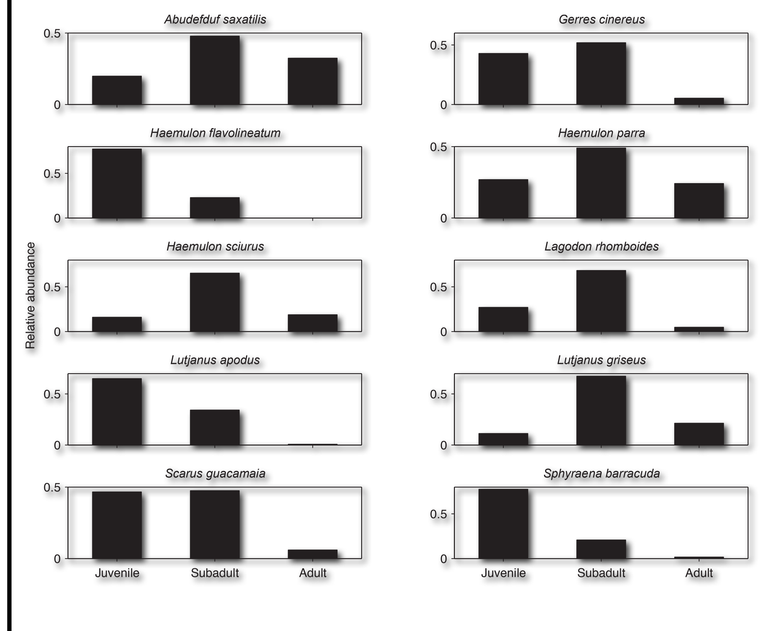


**Figure 4.** Relative abundance (by stage) for 10 species of fishes from the mangrove fish visual surveys (n = 981 transects).

## Multivariate Analysis

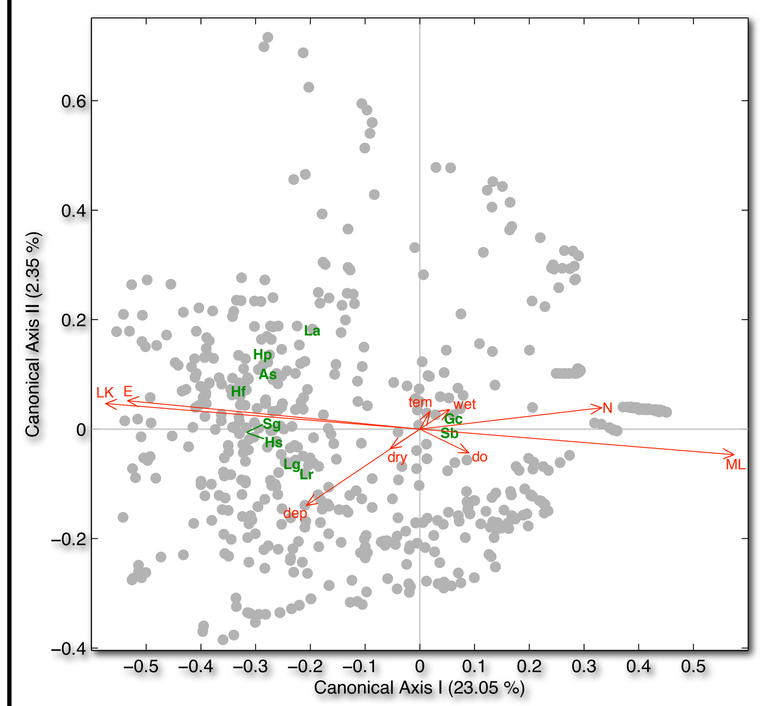


**Figure 5.** Bray-Curtis distance-based redundancy analysis; circles depict transect sites (n = 709); weighted averages species scores: *As* = *Abudefduf saxatilis*, *Gc* = *Gerres cinereus*, *Hf* = *Haemulon flavolineatum*, *Hp* = *H. parra*, *Hs* = *H. sciurus*, *La* = *Lutjanus apodus*, *Lg* = *L. griseus*, *Lr* = *Lagodon rhomboides*, *Sb* = *Sphyraena barracuda*, and *Sg* = *Scarus guacamaia;* arrows depict magnitude and direction of the environmental, temporal, and spatial gradients that substantially influenced species distribution and abundance: LK/ML = Leeward Key/Mainland habitat, E = UTM Easting, N = UTM Northing, dep = depth, do = dissolved oxygen, dry/wet = season, tem = water temperature.

## Conclusions

### Habitat
The importance of Leeward Key mangroves functioning as essential nursery habitat is highlighted by the fact that 90% of the target species immature stages were significantly more abundant in this portion of the Bay vs. the Mainland.

### Season
Juveniles and/or subadults of all species showed greatest abundances in the mangroves during the wet season, ostensibly coincident with seasonal peaks in reproduction and the subsequent timing of habitat shifts made by early juveniles that initially settled in seagrass beds.

### Developmental Stage
The life history stage data provide evidence suggesting habitat shifts from the mangroves occur between the juvenile and adult stages in 9 of the 10 species examined. Patterns of habitat utilization among closely related species indicate alternative life history strategies exist to minimize competition. For example, *H. flavolineatum* and *L. apodus* inhabit the mangroves at earlier stages and for shorter durations than their generic counterparts, *H. sciurus* and *L. griseus*.

### Multivariate Analysis
The community of juvenile mangrove fishes were influenced the greatest by habitat, with 80% of the target species showing an affinity for Leeward Key sites. These are farther from the influence of freshwater canal discharge than sites along the Mainland and closer to offshore waters where the adults reside and larval input originates.

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