



Sex-Specific Differences in Movement and Residency of Leopard Sharks (*Triakis semifasciata*) in a California Estuary

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Introduction

Many shark species are seasonally abundant in estuaries, utilizing the habitat for reproduction and as nurseries. Habitats in estuaries are susceptible to alteration from anthropogenic and environmental effects such as global climate change, agricultural runoff, and dredging activities. These changes may have different impacts on groups within a population because sex-specific segregations are common for many shark species including Leopard Sharks (*Triakis semifasciata*). Sexual segregation and nursery habitats of Leopard Sharks have been previously documented in Elkhorn Slough, however there is a gap in knowledge of sex-specific differences in habitat use. Through this study, we will determine how movement and residence time of Leopard Sharks in Elkhorn Slough differs by sex.

Methods

- Leopard Sharks were caught using tended gillnets (Figure 1)
- Sharks were implanted with coded acoustic tags (male n=9; female n=8) and external dart tags
- Acoustic tags transmitted every 120 s (V-9P, V-13P) or 155 s (V-13P) on average
- Movements were recorded from March to September 2013 using acoustic receivers (n=9)
- Residency in study area was assessed by individual shark and compared by sex
- Acoustic receivers were grouped by area to analyze movement patterns (Figure 2)
- Proportion of detections for individual sharks were calculated by area and cluster analyses performed



Figure 1. Leopard Shark at tagging station after being caught in tended gillnet. Sharks were implanted with acoustic tags, given an external dart tag for identification, and released. Photo credit Anne Tagini.

Results

- Leopard Sharks had a mean residency of 0.68 ± 0.02 (Figure 3)
- Residency of sharks was not significant by sex (ANOVA, 0.158, $p > 0.05$) or individual shark (ANOVA, 0.936, $p > 0.05$)
- Bray Curtis similarity is statistically significant at 87% similarity, revealing four groups and three individuals (Figure 4)
- Shark detections in Fork region had the greatest contribution towards similarity for all defined groups (Figure 5)
- Leopard Shark detections in the Upper region contributed less than 4% in all groups

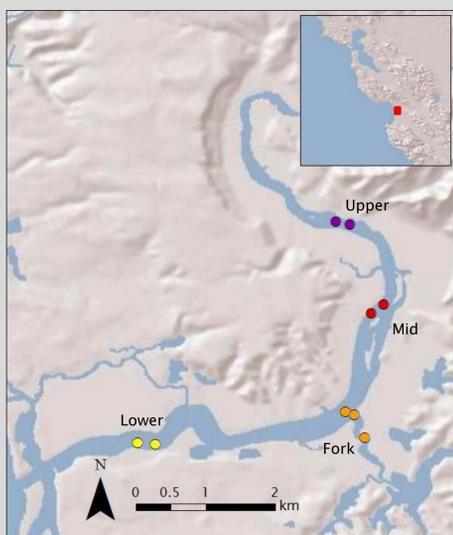


Figure 2. Map of Elkhorn Slough with acoustic receiver locations. Receivers were placed into four groups by geographic location: Lower, Fork, Mid, and Upper.

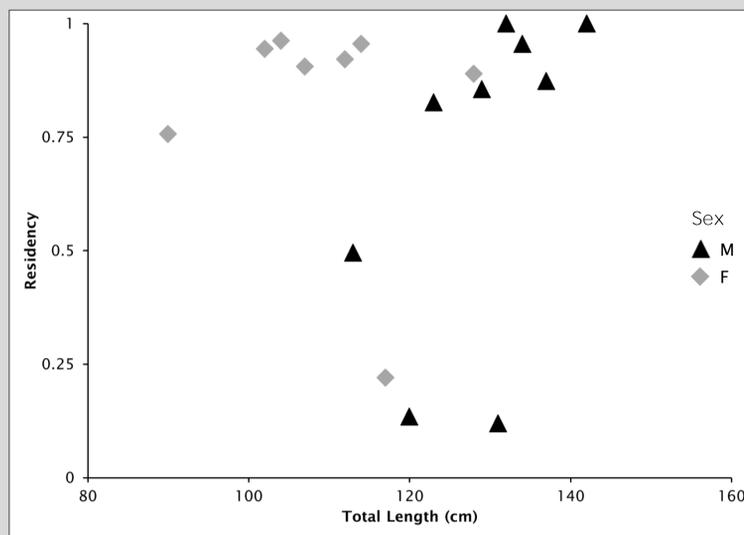


Figure 3. Residency of Leopard Sharks in Elkhorn Slough by size from March 14 to September 30, 2013. Female sharks are represented by grey diamonds, and male sharks by black triangles.

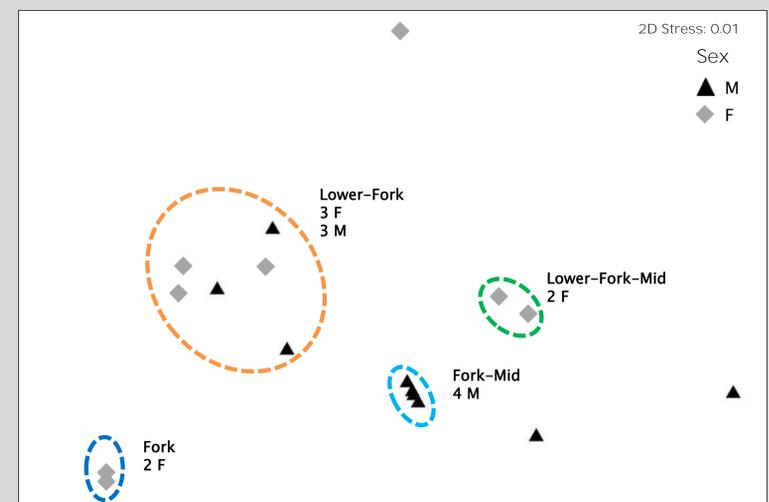


Figure 4. MDS plot of proportion of detections per area for individual sharks. Placement of symbols are the result of similarity in detection patterns (similarity greater than 87% is statistically significant denoted by dotted lines). Grouping reveals three outliers, three tightly plotted groups, and a more loosely aggregated group. Groups named for areas of importance and summarized by sex.

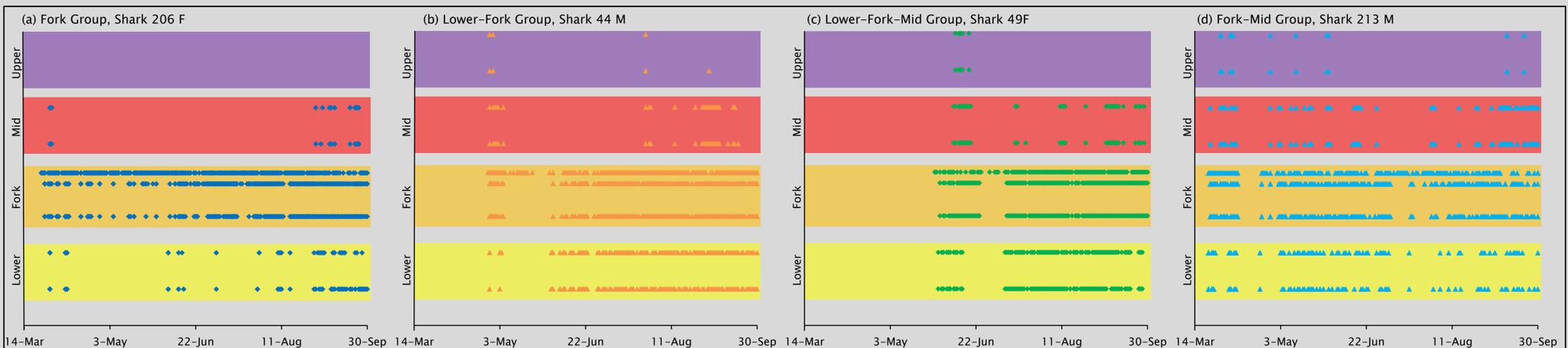


Figure 5. Detections plotted by receiver for individual representative sharks from each of the significant groupings based on the MDS plot. (a) Fork Group sharks are characterized by detections in the Fork region contributing 95% of similarity among individuals. (b) Lower-Fork Group sharks are characterized by detections from Fork and Lower regions contributing to similarity. (c) Lower-Fork-Mid Group sharks are characterized by similarity of detections in the Lower, Fork, and Mid regions. (d) Fork-Mid Group sharks are characterized by high proportion of detections in Fork region and some detections in the Mid region. The Upper region of Elkhorn Slough was not significantly used by any group.

Conclusions

- No patterns of sexual segregation were apparent though there may be some distinct patterns of movement by sex
- Groupings may be indicative of breeding vs. non-breeding individuals
- Sexual segregation may exist for shorter time periods or on a smaller spatial scale than regions defined by receiver groupings
- Fork region was an area of importance to all individual sharks

Future

- Analyze data for the entire season through March 2014
- Determine if temporal differences exist in movement patterns
- Utilize data for environmental factors to define possible causes for differences in distribution and movement
- Incorporate time into analyses to explore temporal use patterns

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