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Site fidelity of bottlenose dolphins (*Tursiops truncatus*) in a highly-industrialized estuary

Kristi Fazioli¹, Vanessa Mintzer^{2,3}, George Guillen¹



¹ Environmental Institute of Houston, University of Houston
fazioli@uhcl.edu; guillen@uhcl.edu
² The Galveston Bay Foundation
³ School of Natural Resources and Environment, University of Florida
vmintzer@galvbay.org

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INTRODUCTION

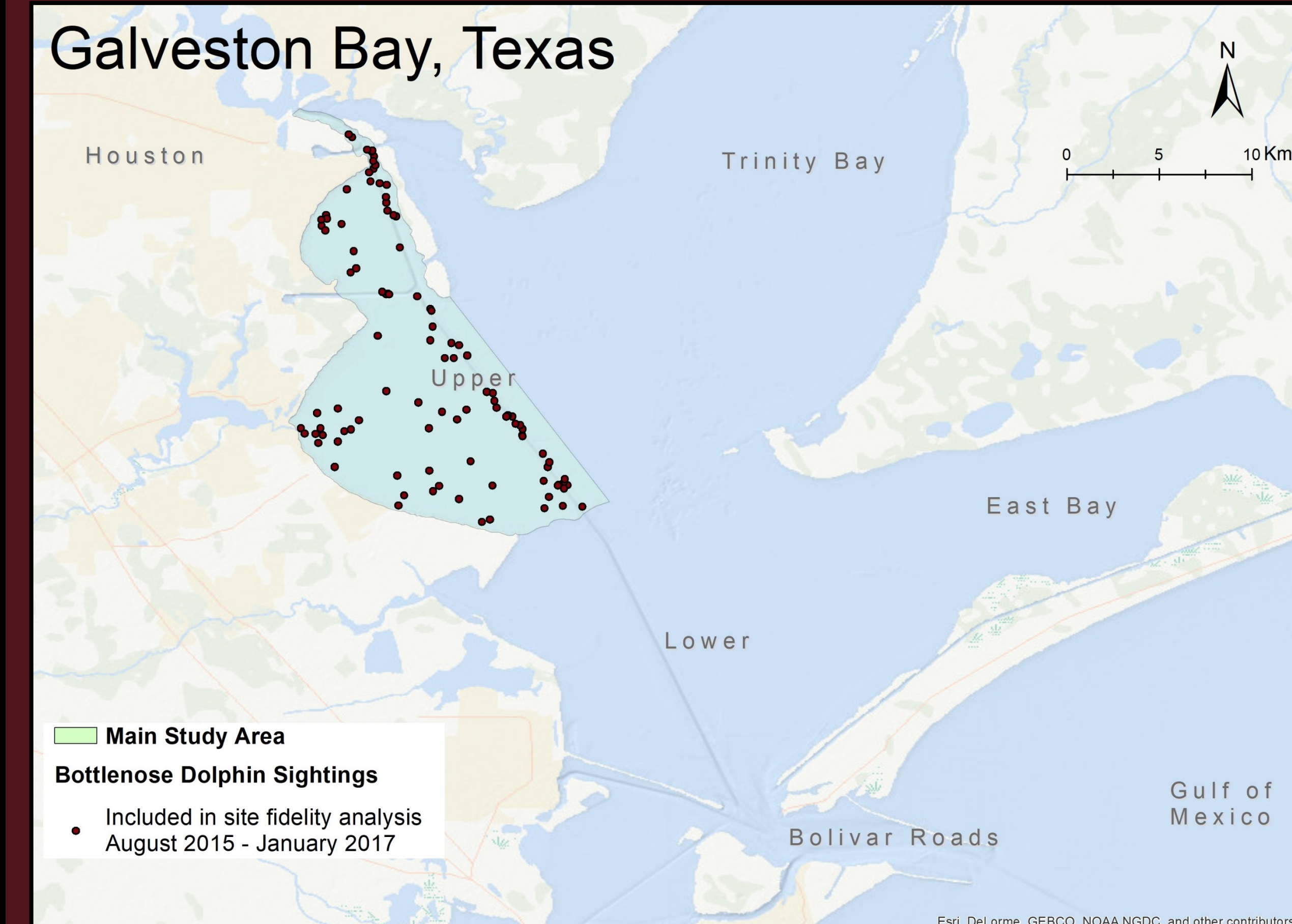
From the 1980's to early 2000's, studies of bottlenose dolphins in Galveston Bay (GB) found:

- High concentrations of dolphins near the entrance to GB
- A decrease in abundance moving north into the Bay and little or no activity in upper GB^{1,2,3}

Observational surveys conducted between August 2013 and January 2017 resulted in the identification of 586 individual dolphins, suggesting a recent increase in dolphin activity in upper GB.

Objective: to explore the site fidelity of bottlenose dolphins to upper GB and identify groups within the population, if any, with varying affinity to upper GB.

Galveston Bay (GB) is a 1600km² anthropogenically altered shallow bay system. Growth and industrialization from the 1950's – 70's contributed to massive fish kills, a 95% decline in submerged aquatic vegetation and an EPA listing on the 10 most polluted waterways. Management activities have improved water quality and health; however, concerns over pathogenic bacteria and chlorinated organic compounds persist.⁴



METHODS

- Monthly boat-based photo-identification surveys were conducted between August 2015 and January 2017 → 238hrs and 3441km of total survey effort
- Individual dolphins were identified using the natural marks on their dorsal fins, following photo-analysis 'best practices'^{5,6}. Fins with low distinctiveness or poor photo quality were excluded, as were all calves.
- Site fidelity → the "tendency of individuals to remain, or return to, and reuse the study area"⁷
- Calculated three site fidelity parameters⁷:
 - 1) monthly sighting rate
 - 2) seasonal sighting rate → seasons: late warm (Aug-Oct), early cold (Nov-Jan), late cold (Feb-Apr), early warm (May-Jul)
 - 3) site fidelity index: ratio of the number of recaptures of an individual and the number of total surveys from the individual's first capture to its last
- Incorporated the three parameters into an agglomerative hierarchical cluster (AHC) analysis to identify groups of individuals with similar degrees of site fidelity

RESULTS AND CONCLUSIONS

- Dolphins utilize upper GB (Fig. 1,2), a region previously thought to have little or no dolphin activity. This could be an indication of water quality improvements.
- The cluster analysis identified at least three distinct groups of dolphins showing varying degrees of site fidelity (Fig. 2, 3, 4). While the number of year-round residents appears to be small (<5%), the number of seasonal (warm) residents make up at least a quarter of the marked population included in this analysis.
- The influx of dolphins during the warm months is supported by several trends: transient dolphins were primarily recorded during summer months, the greatest period of discovery is the summer (Fig. 1), and dolphin densities are higher in the warm months.
- Based on observations outside the study area but within GB, we expect that many transients of our study area spend most of their time in other areas within the Bay system (i.e., high level of site fidelity to GB as a whole, seasonal movement and individual regional preferences within).

Site Fidelity

- 53%** Group 1 - apparent one-time visitors to the study area (i.e., transients; n=124)
- 14%** Group 2 - individuals that were only seen during one set of consecutive months or seasons (i.e., temporary residents; n=32)
- 33%** Group 3 - individuals observed year-round or in multiple non-consecutive months or seasons (i.e. year-around residents and seasonal residents; n=76)

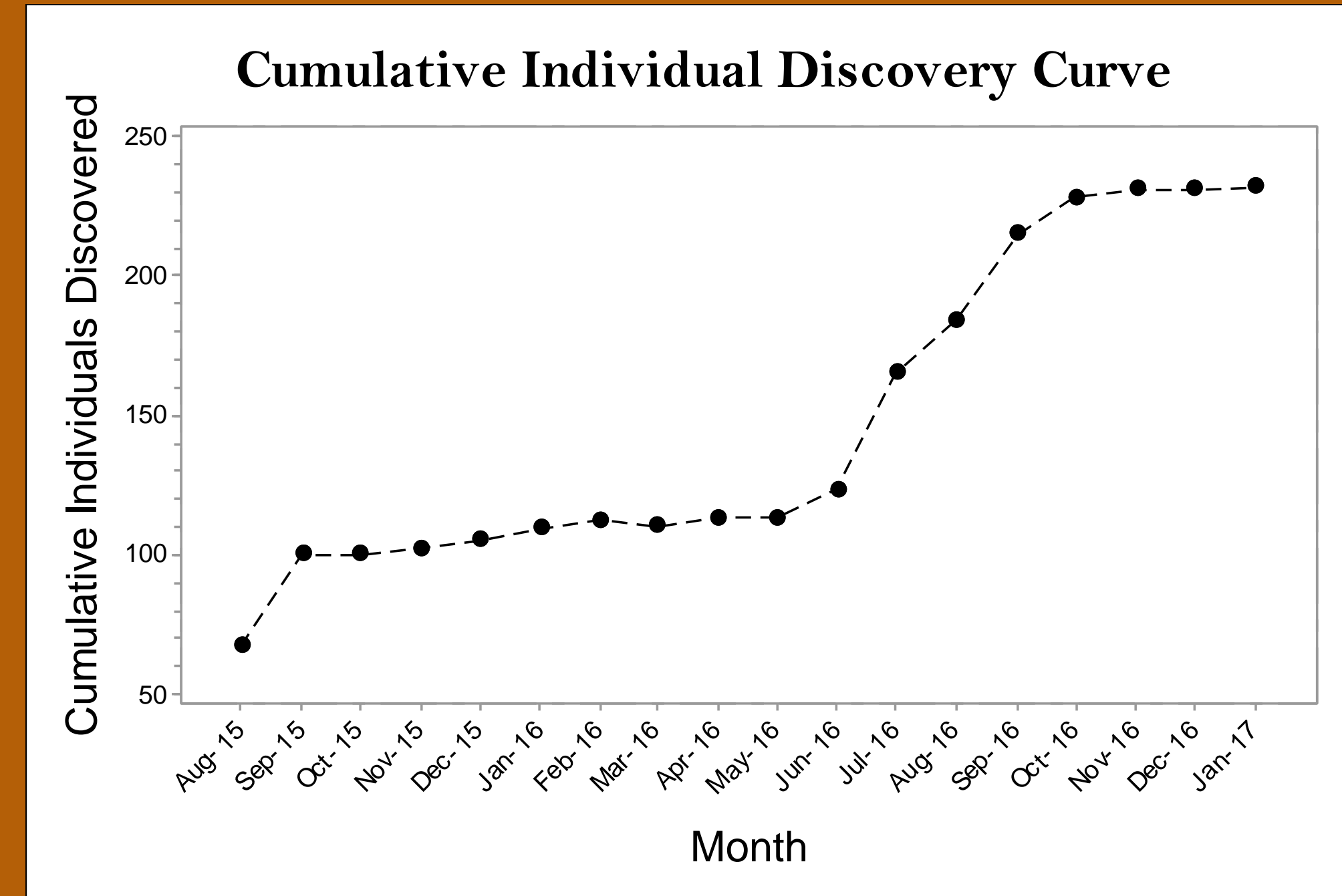


Figure 1. Discovery curve of the cumulative number of bottlenose dolphins identified in upper Galveston Bay, TX between August 2015 and January 2017.

1,291 dolphins sighted in 162 groups during the study period
232 individuals included in the site fidelity analysis

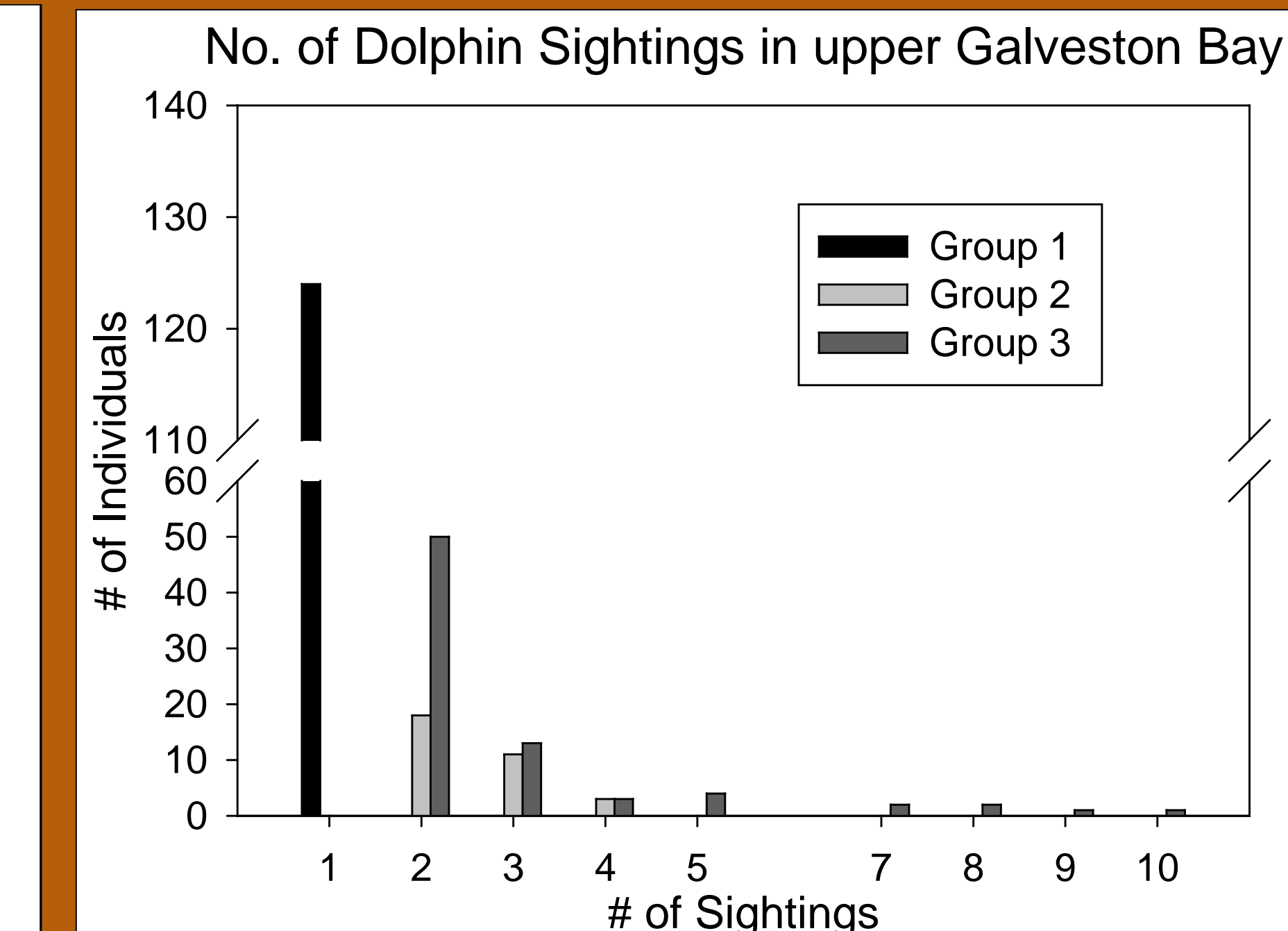


Figure 2. Number of sightings for individual bottlenose dolphins in upper GB from Aug 2015 to Jan 2017. Three groups are displayed based on the results of the AHC analysis using site fidelity metrics.

Dendrogram of Dolphin Groups

Ward Linkage, Euclidean Distance

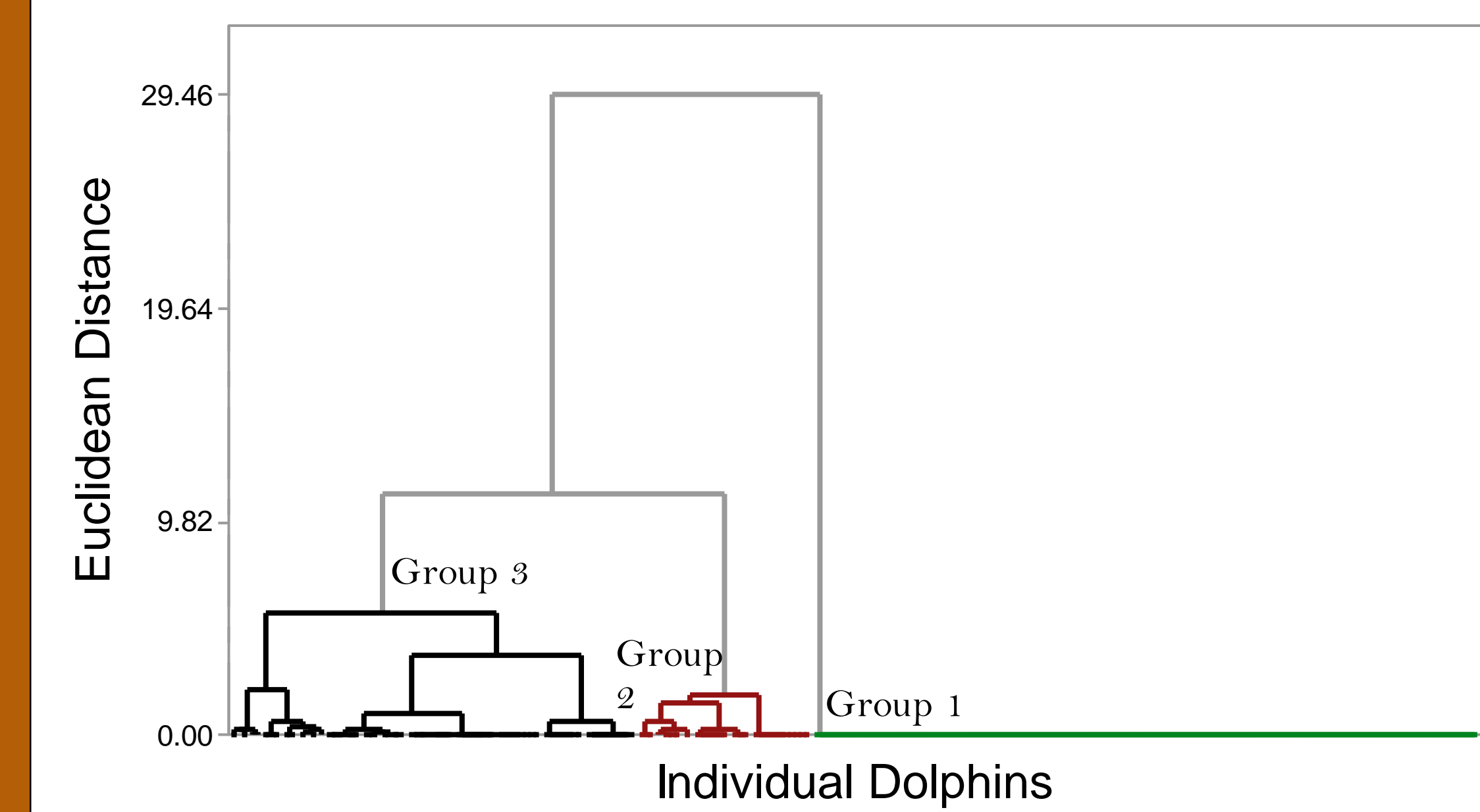
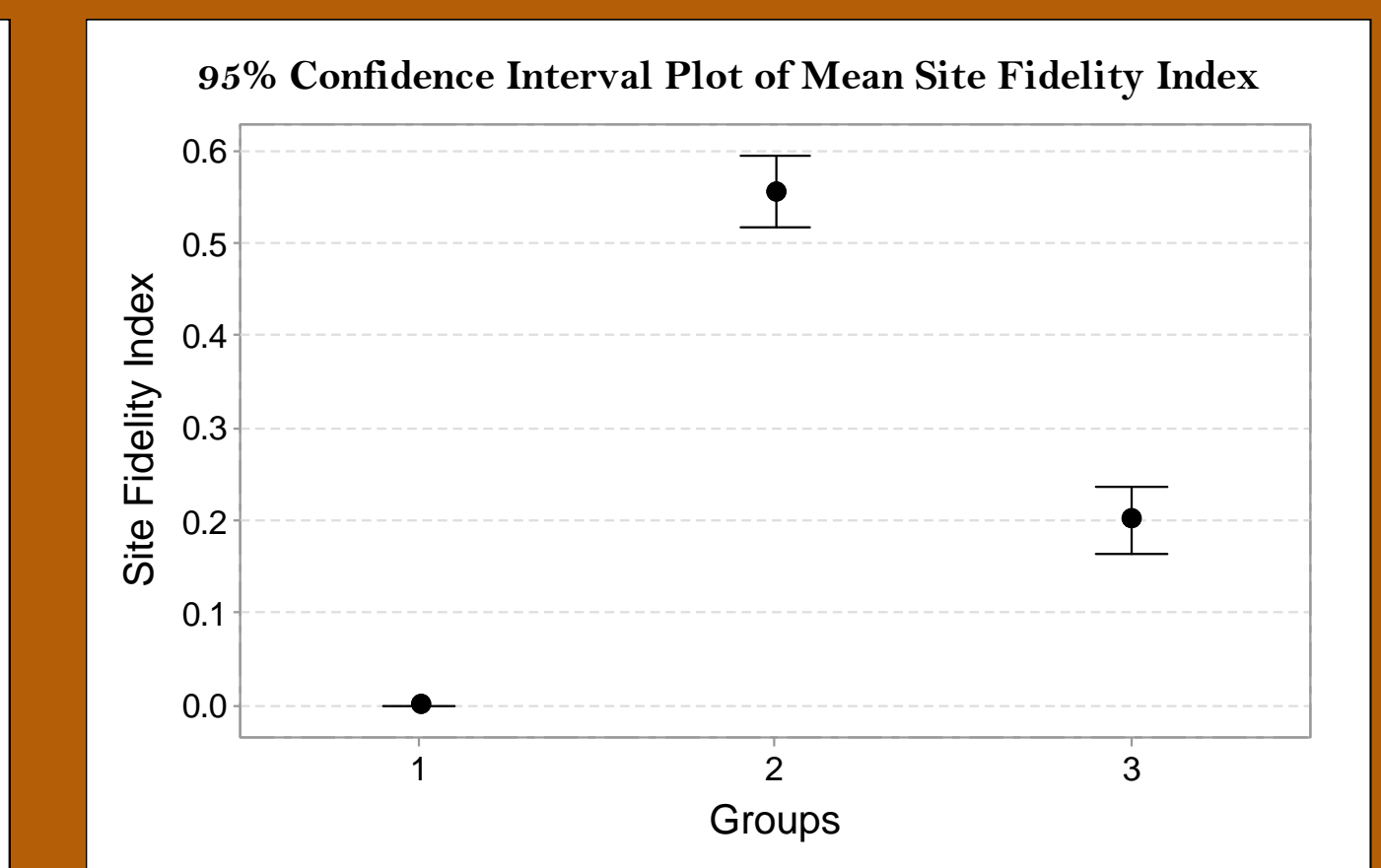
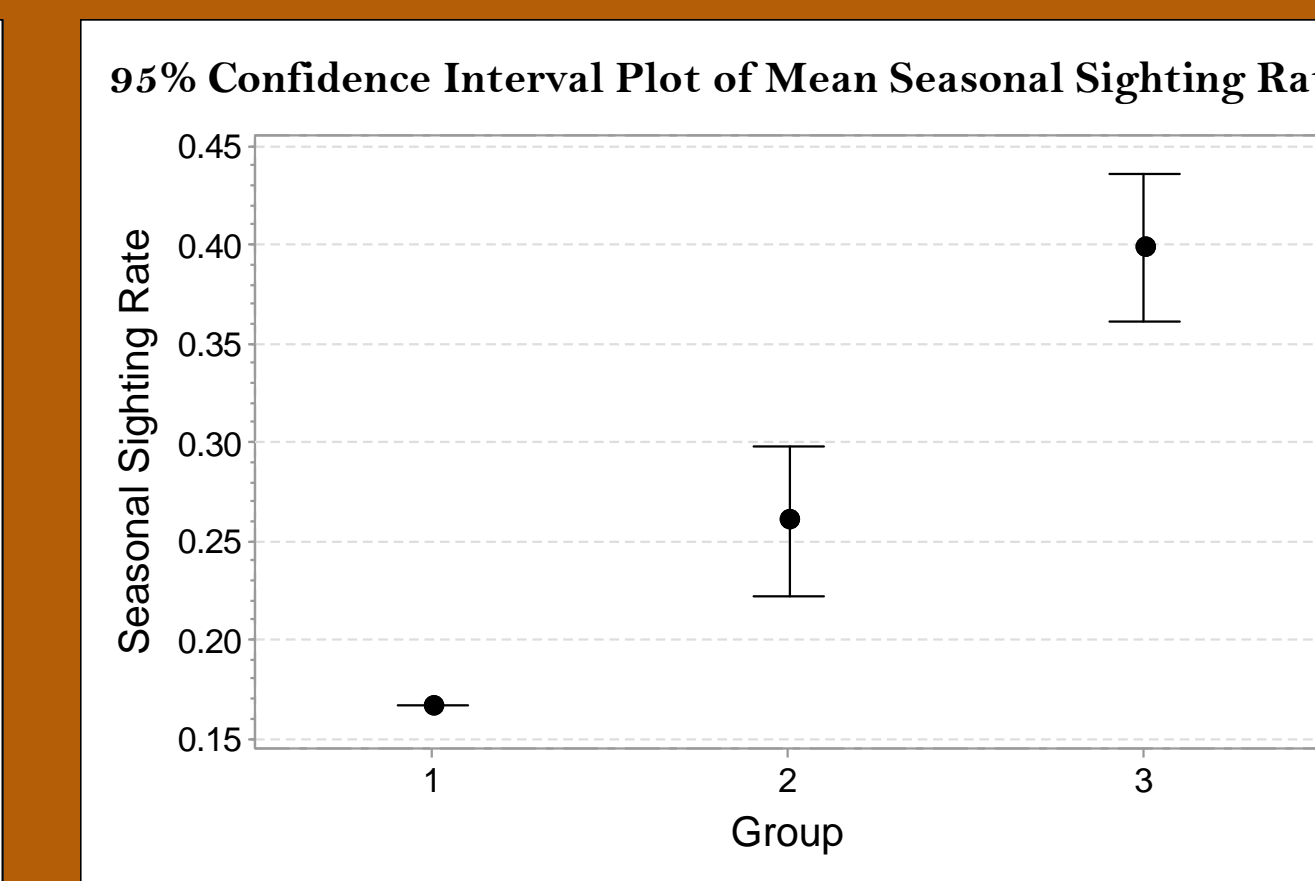
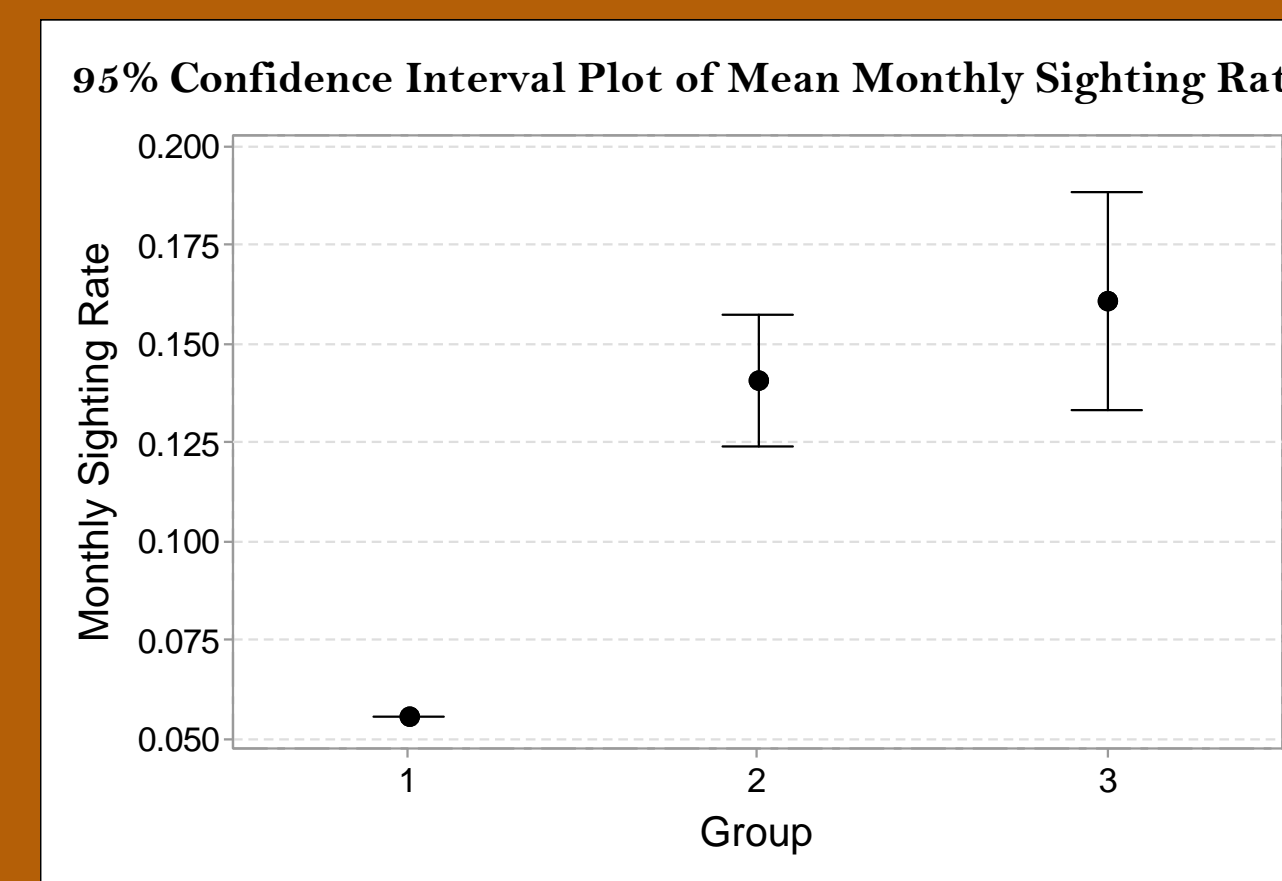


Figure 3. Dendrogram of the AHC analyses used to separate groups of bottlenose dolphins in upper Galveston Bay, TX based on three measures of site fidelity.



Figures 4a-c. Confidence interval plots of the means of the three measures incorporated in the site fidelity analysis. Three groups are displayed based on the results of the AHC analysis.

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