RELATIONSHIP BETWEEN BEHAVIORS AND GROUP SIZES OF COMMON BOTTLENOSE DOLPHINS (*TURSIOPS TRUNCATUS*) IN THE GALVESTON SHIP CHANNEL, TEXAS

An Undergraduate Research Scholars Thesis

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TABLE OF CONTENTS

Page

ABSTRACT

Relationship Between Behaviors and Group Sizes Common Bottlenose Dolphins (*Tursiops truncatus*) in the Galveston Ship Channel, Texas. (May 2013)

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Galveston Bay is an inlet from the Gulf of Mexico that connects to the Galveston Ship Channel where common bottlenose dolphins (*Tursiops truncatus*) are regularly observed. These dolphins live in fission-fusion societies where group structure changes frequently and individuals associate in different ways. Group size may facilitate foraging efficiency or reduce predation risk and therefore may be influenced by behavioral states. For this study, we examined bottlenose dolphin group sizes and behaviors in the Galveston Ship Channel and surrounding coastal waters. Group size and predominant group behavior were recorded during each survey. Data were collected from boat- and land-based platforms from September through December 2012. Vessel-based research was conducted for 9 days and shore-based research was conducted for 41 days. Previous studies in this area found socializing dolphins to have the highest mean group size. This study's results were similar to the previous study. We also found that foraging was the most frequently recorded behavior. Resting dolphins were observed in groups on average of two to three individuals and were not often observed, which may be influenced by high vessel traffic within the area.

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CHAPTER I

INTRODUCTION

Common bottlenose dolphins (*Tursiops truncatus*) live in fluid societies where individuals change groups frequently (Bräger et al., 1994). Based on Aureli et al. (2008), a fission-fusion society refers to the "extent of variation in spatial cohesion and individual membership in a group over time." Therefore, groups vary by specific individuals within the groups, which make the group sizes larger or smaller depending on if the dolphins are fusing together or separating into smaller groups. Fission-fusion societies have been well documented in populations of bottlenose dolphins off Scotland (Eisfield and Robinson, 2004), Australia (Connor, 2007), Ireland (Foley et al., 2010), and New Zealand (Lusseau et al., 2003), and in other delphinid species such as dusky dolphins (*Lagenorhynchus obscurus*) (Pearson, 2009) and northern bottlenose whales (*Hyperoodon ampullatus*) (Gowans et al., 2001). Different group sizes may reduce predation risks, and provide benefits relative to feeding and reproduction (Foley at al., 2010; Bräger et al., 1994). At times, group formation may be based on the dolphins' behaviors (Smolker et al., 1992). Dolphins may divide into separate groups to forage to increase the amount of food each individual receives. Baird and Dill (1996) found the optimal group size for foraging North Pacific killer whales (*Orcinus orca*) to be three individuals. This group size allows for the maximum energy intake for each individual, but still allows cooperative foraging benefits (Baird and Dill, 1996). However, some species, such as spinner dolphins (*Stenella longirostris*) off Hawaii, form larger groups to feed and then break into smaller sub-groups when resting in bays (Norris and Dohl, 1980).

In this study, objectives included: determining if there was a relationship between behaviors and group sizes of the bottlenose dolphins in the Galveston Ship Channel and surrounding waters, and if there may be an optimal group size for each of the behaviors based on the mean group size found. Based on previous studies conducted in the same area, we expected to observe larger group sizes when dolphins engaged in socializing rather than other behaviors (Bräger et al., 1994). Foraging groups are expected to be seen most frequently but may not have the highest mean group size. However, the group sizes may be larger in those groups foraging if they are foraging behind a shrimp trawler. Due to high vessel traffic and confined areas, resting is not likely to be observed or will only be in small groups.

CHAPTER II

METHODOLOGY

Study area

The study area included the Galveston Ship Channel and surrounding waters between Pelican Island and Galveston, Texas (Figure 1). Land-based observations were conducted at the small boat basin of the Texas A&M University at Galveston Campus (Figure 1). The viewable area was approximately 500 m across from the study site and 900 m wide. Boat-based surveys were conducted throughout the entire channel and surrounding coastal waters (Figure 1). The area traversed in focal follows was approximately 7-8 km.

Field methodology

Data collection occurred from September through December 2012. Land-based data were collected during a one hour period each day from Monday to Thursday. Two observers rotated time slots to collect data three times per day; sunrise (0800-1030), mid-day (1200-1500), and sunset (1600-1800). Data collection occurred at set times and were modified mid-way through the study to adjust for daylight savings time.

Boat-based data were collected from a 6.6 m flat bottom bateau with a 90HP motor, on weather-possible Fridays from 0800-1030. Two to four observers were used to find dolphin groups. One observer collected group size and predominant behavior data. During the boat surveys, data were collected by traveling from the Texas A&M University at Galveston Campus boat basin east to the Galveston Ship Channel and parts of Galveston Bay. Behavioral information was collected

upon the sighting of a dolphin group. The group was approached from either the side or the back. Approaching groups head-on was avoided.

Land- and boat-based data collection included the number of individuals present in each group and predominant behaviors. A group was defined as any number of individuals in association, normally within 10 m of each other (Smolker et al., 1992) and having similar behavioral states for at least part of the survey (e.g., Mann, 1999). Behaviors were based on four different categories; traveling, resting, socializing, and foraging (Table 1) (Gero et al., 2005[1]; Smolker et al., 1992). Predominant behaviors were recorded based on the overall group behavior (>50% of individuals) (Mann 1999).

Table 1: Ethogram of common bottlenose dolphin behaviors (Pearson, 2009).

Behavior	Description
Resting	Individuals swimming together slowly with slow surfacing, typically in one general direction at approximately <3 knots
Traveling	Individuals swimming together at moderate to fast pace in one general direction at approximately ≥3 knots
Socializing	Group performing noisy acrobatic displays, or two or more individuals showing sexual behavior (chasing, rubbing, belly-to-belly swimming)
Foraging	Searching for/ingesting prey (indicated by long, deep dives followed by loud forceful exhalations) – may include coordinate rapid busts of swimming, and noiseless headfirst re-entry leaps

[1] © Canadian Science Publishing

Figure 1: Study area for land- and boat-based observations.

Statistical analysis

The mean group size, standard deviation and standard error were calculated for each behavior. The percentages of behaviors recorded were calculated by dividing the number of groups engaged in a behavior by the total number of groups observed. Mean group sizes, percentage of behaviors observed, and boxplots were performed using IBM® SPSS® Statistics for Windows

Version 21.0[2]. A one-way ANOVA test determined if the data were statistically significant and the Shapiro-Wilk tested for normally distributed data. The one-way ANOVA and Shapiro-Wilk test were conducted using R statistical software version 2.14.1.

[2]IBM® SPSS® Statistics 21.0, New Orchard Road Armonk New York 10504, 2013.

CHAPTER III

RESULTS

Boat-based data were collected on 9 days (16 hours) and land-based data were collected on 41days (102 hours). 32 hours of land-based data collection was during sunrise, 35 hours at mid-day, and 35 hours at sunset. Two-hundred and three groups of common bottlenose dolphins were recorded. The behavior most frequently observed was foraging (66.5%) (Figure 2). The maximum group size of foraging dolphins was 30 individuals; however, the mean group size was much smaller at 3.76 (± 3.399) individuals. Socializing groups comprised 17% of the survey (Figure 2) and the mean group size was 5.34 (± 2.828) individuals, with a maximum of 12 individuals (Table 2). Resting groups were observed 5.4% of the time (Figure 2) and had a mean group size of 2.91 (± 2.508) individuals (Table 2). Resting dolphins included only one or two individuals, and the largest group size was eight individuals. Traveling groups consisted of 11% of the sampling (Figure 1). Traveling groups ranged in size from 1-30 individuals, and accounted for one of the highest group sizes observed, but had a mean group size of 4 (± 5.984) (Table 2). All behaviors were most often observed during the sunrise block, except for traveling which was most often observed at sunset (Figure 3). Resting groups were never observed during mid-day (Figure 3).

Table 2: Sampling for behaviors and mean group sizes of bottlenose dolphins in the Galveston Ship Channel.

Descriptive Statistics

Behavior	n (sample size)	Minimum group size	Maximum group size	Mean group size	Std. Deviation
Traveling	22	1	30	4.00	5.984
Socializing	35	1	12	5.34	2.828
Foraging	135	1	30	3.76	3.399
Resting	11	1	8	2.91	2.508

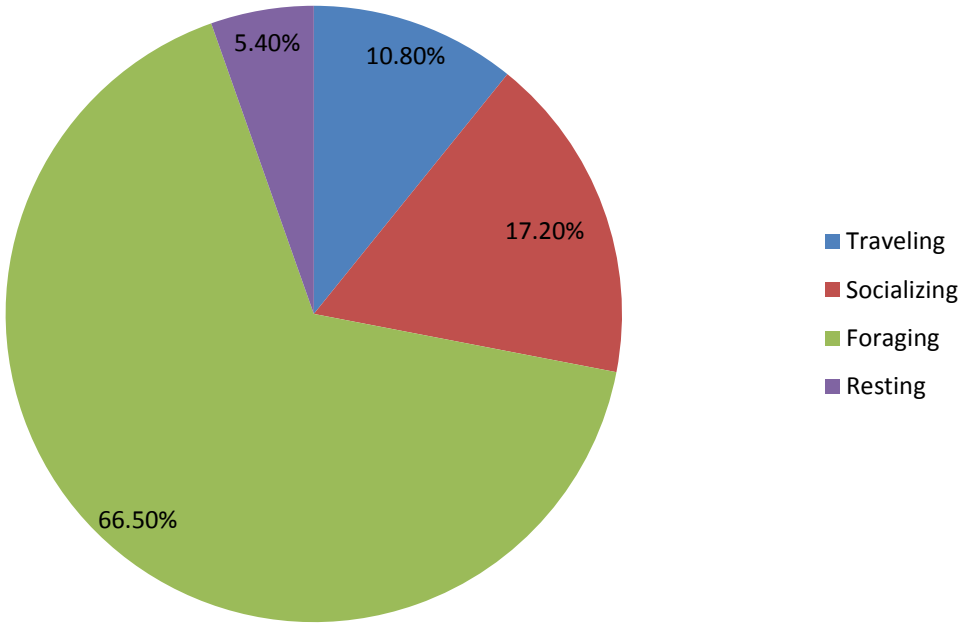

Figure 2: Percentage of behaviors observed by bottlenose dolphins throughout the Galveston Ship Channel.

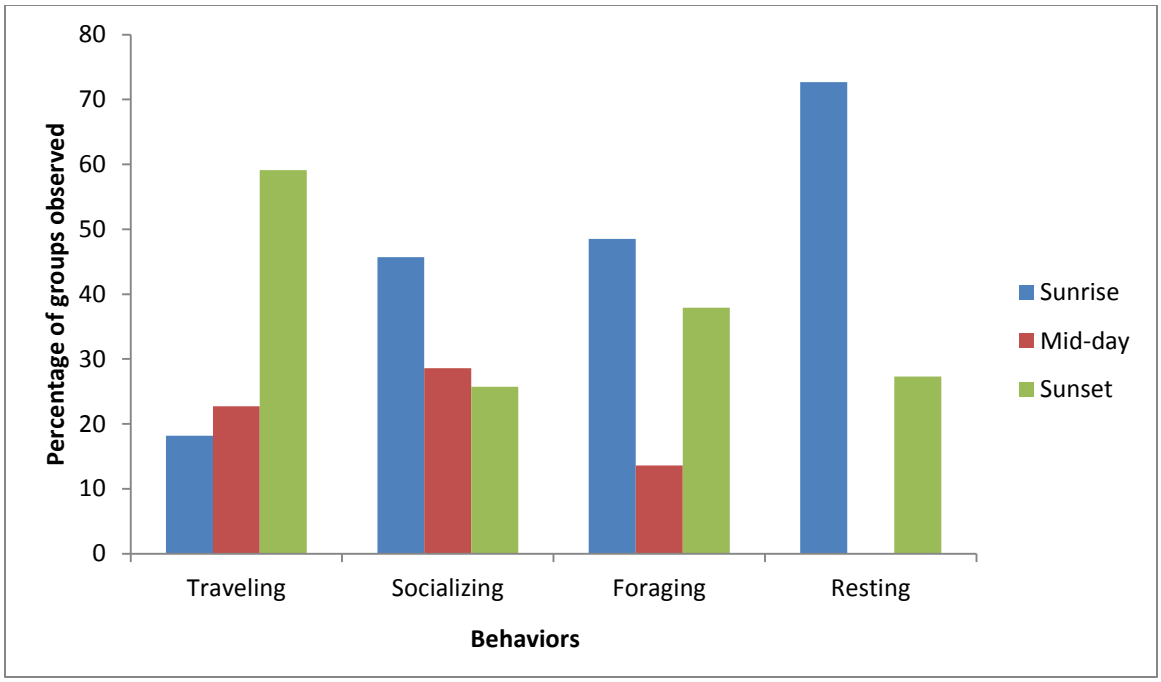

Figure 3: Percentage of behaviors of bottlenose dolphin groups observed during each time block.

The data collected were not normally distributed (Shapiro-Wilk p-value < 2.2e-16). Socializing dolphins had the highest mean group size; however, there were outliers in foraging and traveling groups that may have shifted the mean group sizes significantly. A one-way ANOVA test determined the data were not statistically significant (p-value = 0.1). The data were log transformed due to the extreme outliers. A one-way ANOVA test was then performed on the log transformed data (Figure 4), and the data were determined to be statistically significant (p-value = .001923).

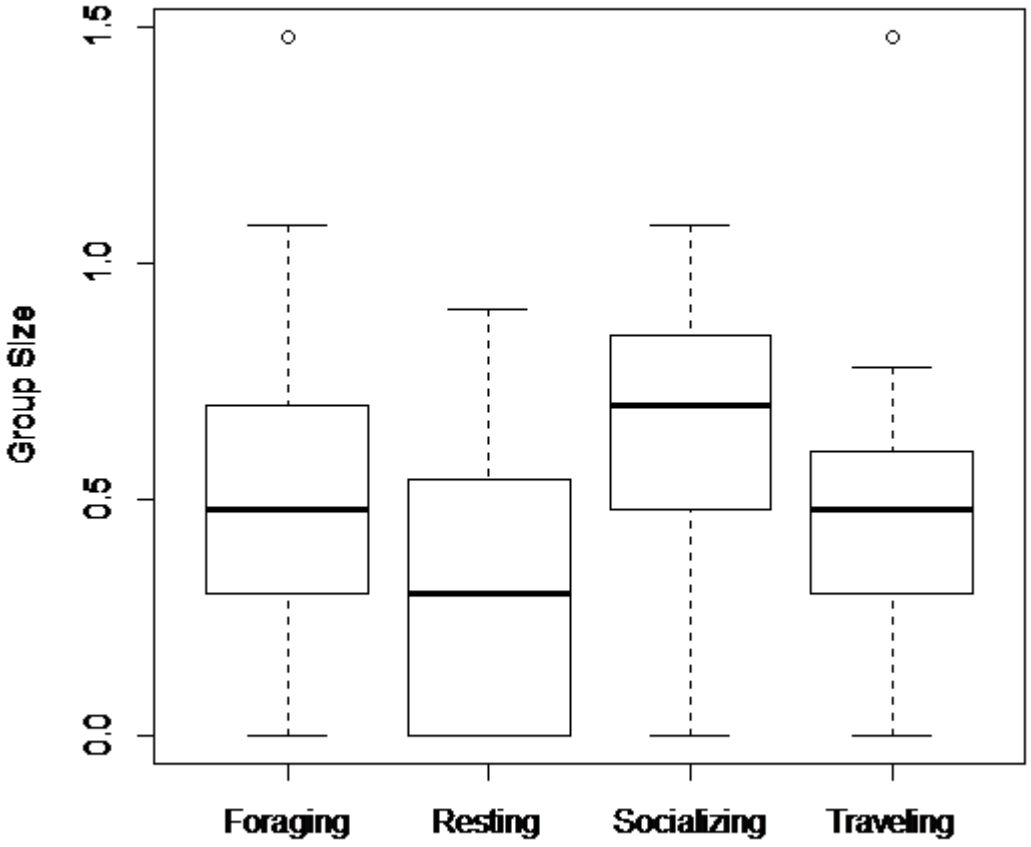

Figure 4: Log transformed boxplot of bottlenose dolphin mean group size based on behavioral states.

CHAPTER IV

CONCLUSION

In this study, socializing dolphin groups in the Galveston Ship Channel had the largest mean group size. The confinement within the Ship Channel may allow for these dolphins to be closer together and more interactive with one another. In a study conducted by Bräger et al. (1994) in the same area, socializing groups were observed with the largest mean group size.

Foraging groups were observed most frequently, but they had smaller group sizes. The Galveston Ship Channel provides an accessible food source where many dolphins can forage individually or in small groups. Many of the fish preyed upon are not schooling fish, and therefore coordinated prey herding is not necessary. On several surveys, dolphins were observed throwing flounder in the air. Flounder are benthic fish and have no need to school together. Smaller group sizes in foraging dolphins were observed, except when following behind a shrimp trawler. The trawlers drag nets close to the ocean bottom and chase fish upwards. This provides easy access to food sources for the dolphins.

Resting groups were observed less frequently than the other behaviors and had the smallest mean group size. Most of the resting groups consisted of one or two individuals. These small group sizes may indicate mother-calf pairs. However, group composition was not collected during this study. The Ship Channel also has a high level of vessel traffic. It is used for recreational purposes, such as sport fishing, kayaking, and jet skiing. It is also used for commercial purposes where there are several terminals along the banks for ferries, container ships, cruises, transportation of goods, and a sulfur plant. The channel is also used by the Coast Guard when

they are conducting routine drills. The dolphins may only rest at night when vessel traffic is lower and they do not have to keep moving to avoid vessel traffic.

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