Florida International University
Department of Biological Sciences
Dissertation Proposal

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Forces driving habitat use patterns: Investigation of leadership in the bottlenose dolphin (*Tursiops truncatus*)

INTRODUCTION

For many social species, a small number of individuals may initiate and guide movement during group travel (e.g., Macdonald 1996, Holekamp et al. 2000 and Peterson et al. 2002). As a result, habitat use patterns can be under considerable influence from a fraction of the group members present (Garber 2000). Understanding the importance of those that guide movement can provide valuable insight into the costs and benefits of group formation (Boinski and Garber 2000).

While leadership in group travel decision making has been investigated in many species, this topic has not been explored in cetaceans. The bottlenose dolphin (*Tursiops truncatus*) provides opportunity for such research because their near shore distribution allows easy accessibility. In addition, the fission/fusion nature of their grouping allows comparison of different factors associated with leadership.

Previous studies on *Tursiops* sp. have investigated boundaries and ranges of travel for individuals (Mate et al. 1995 and Wells et al. 1999), communities (Gubbins 2002, Owen et al. 2002 and Urian 2002) and populations (Gubbins et al. 2003). However, understanding the relevance of areas within those boundaries and the reasons behind patterns of use are still lacking. The study of leadership as a force guiding movement for individual dolphins will offer insight into such questions.

Therefore, I propose to study leadership in the bottlenose dolphin as a way to learn more about why groups form in this species and the habitat use patterns that result.

Objectives

The goal of this project is to test the following hypotheses:

- Ha_1: Individual influence on group movement is non-random.
- Ha_2: Leadership is dictated by social (sex, relatedness and group composition) and physiological factors (reproductive state).
- Ha_3: Habitat use varies between leaders,
- Ha_4: Benefits and costs provided to followers differ between leaders
- Ha_5: Use of leader/follower tactics provides a mechanism towards achieving optimal habitat use and foraging

MATERIALS AND METHODS

Methods: Field

Data will be collected from a boat in the waters of the Lower Florida Keys (LFK) between Johnson Key in the northeast and Boca Grande in the southwest. The study area is divided into zones. Zones covered per day will be selected at random, with efforts to cover each equally by the end of the study. Once a group is located I will identify individuals and initiate a variant of focal animal sampling (Altmann 1974, Mann 1999). At each surfacing, the identity of the lead animal will be recorded. Positions of other group members will be recorded as front, middle or rear, dividing the group into two (just front and rear) or three sections according to group size. Identity of all individuals initiating successful direction changes will be recorded. Direction changes are indicated by change in the heading of an individual from that of the rest of the group.

As the follow progresses, the following data will be collected once every five minutes; location (using GPS readings), water depth (m), time of day, tidal state and predominant behavior state (following Shane's definitions for travel, feed and social, 1990). Photos of dorsal fins will be taken at the end of the follow for verification of group member identities (Würsig and Würsig 1977).

Biopsy collection will be separate from behavior or photo-identification surveys. Attempts will be made to sample all known leaders and >50% of followers. Dorsal fin photos will be made simultaneously with shots taken so that we can ensure the identity for each sample.

Methods: Analysis

Ha_1: Individual influence on group movement is non-random

Leadership will be defined in this study by 1) proportion of time in the front position, 2) the number of times noted as a leader over follows, and 3) through proportion of successful initiations of direction change. Leadership according to position will be measured through frequency of surfacings and through the bout length. I will use these indices of leadership to determine if some individuals lead more often then expected by random chance.

Ha_2: Leadership is dictated by social (sex, relatedness and group composition) and physiological factors (reproductive state)

Sex and Relatedness – To determine sex and relatedness, biopsies will be collected through darting (Krützen et al. 2002). All identified leaders and the majority (>50%) of the non-calf followers will be sampled. Gender information for each animal will be provided by NOAA Fisheries labs. Kinship will be determined using mtDNA haplotypes (maternal) and microsatellite genotypes (paternal).

Group Composition - Group composition will be monitored throughout follows, recording any changes in membership. Comparison of leaders between follows, and during follows will be made based on group composition. Specific attention will focus on what occurs when more than one known leader is present.

Reproductive State of Females - Reproductive state will be defined as either with or without calf. Because the LFK population is small, it is unlikely that large enough samples could be obtained over the course of this study to compare reproductive state according to age of calf.

Ha_3: Habitat use varies between leaders

Habitat Use Patterns - I will examine whether leaders differ in home ranges and habitat use patterns. Patterns investigated will include habitat use according to depth, bottom type (e.g., seagrass, sand bottom, hard bottom), relative openness of body of water (e.g., open basin, entrance or exit points to basins, channels) and tidal stages (flood verses ebb). Data will be collected every 5 min and analyzed using GIS spatial analysis, with comparisons both spatially and temporally.

Home Range Comparisons - Home range analysis will be conducted using initial sighting locations (collected with a GPS). Comparisons of the 95% (indicating breadth of home range) and 50% (indicating core use area) utilization distributions will be made between individuals.

Ha_4: Benefits and costs provided to followers differ between leaders

Comparison of Behavior Proportions– The proportion of each behavior state will be determined under each known leader for each follow. Averages will be compared between leaders. The effects of mixed leadership will also be examined. Additionally, it will be of interest to determine who leads to locations where probable feeding then occurs.

Comparison of Costs of Movement – I will test for differences in costs of movement among different leaders by comparing distances of movement over time, speeds and efficiency of paths. Distance will be calculated using coordinates obtained through GPS data collected every 5 min. Speeds will be calculated using distance information. Path efficiency will be determined by examining how direct of lines of travel are, and effort of travel (examining tidal current direction and speed of current).

Comparison of the Number of Followers – A final method examining influence of leadership will involve comparing the number of followers among leaders.

Ha_5: Use of leader/follower tactics may provide a mechanism towards optimal habitat use and foraging

Costs/Benefits vary between groups with different numbers of leaders – Costs and benefits will be measured as they were for Ha_4, and then compared between groups having different numbers of leaders. These measures will also be made comparing pre and post group fission/fusion.

SIGNIFICANCE

Bottlenose dolphins in Florida, while not endangered, are threatened from growing pressures of increased habitat encroachment and degradation. Preservation of this species will require specific knowledge about where and why movement occurs over habitats. The proposed study of leadership offers specific information about population level habitat use that can be used for this purpose, including 1) a greater understanding of forces driving habitat use patterns which will allow more certainty when answering management questions for this species 2) a measure of behavioral plasticity which will allow risk assessment for populations or communities of bottlenose dolphins if changes or perturbations in their environment were to occur and 3) a measure of variation in benefits to followers which will offer a more specific gauge of risk for individuals according to dependency on certain leaders.

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