

Residency patterns and social structure of bottlenose dolphins (Tursiops truncatus) in Cedar Key, Florida Christina Ciarfella¹, Stefanie Gazda¹, Swami Iyer², Solange Brault¹ and Tim Killingback³

INTRODUCTION

Bottlenose dolphins are known to be highly social and mobile marine mammals, operating in a fission-fusion grouping pattern.¹ Individuals in a fission-fusion society associate in small groups that change in size and composition frequently, suggesting possible preferences in social relationships and/or geographic range. In this study, a network analysis approach was taken to investigate the association patterns of a population of bottlenose dolphins in Cedar Key, Florida. Photo-identification of individuals, activity and group membership data obtained from one field season (2008) in Cedar Key allowed for the breakdown of this social structure with respect to three activities: socializing, foraging, and traveling.



islands, numerous smaller islands, and wetland areas along Florida's northern Gulf coast.

FIELDWORK

Using transects, the distribution, group size, and behaviors of bottlenose dolphins in Cedar Key were documented from July through December 2008. Behaviors (activities) were classified via the following criteria:

- **Socialize** characterized by obvious body contact, rubbing and petting between individuals.
- **Forage** regular, consistent, and more or less exclusive search for prey items. Foraging techniques include peduncle diving and subsequent leaping into the air, fish-chasing, and bottom grubbing.
- **Travel** characterized by regular and consistent spatial progress with respect to the surface and shoreline features, i.e. directed swimming that is generally straight.

PHOTO-IDENTIFICATION

Using methods of photo-identification as described by Würsig and Jefferson (1990)², individuals were categorized by the unique markings (nicks, scars, scratches, and pigment spots) on the dorsal fin.



Photo © S. Gazda

140 120 · = 100 명 80 · 60 40 20 PARAME Nodes Edges Connected components Assortativity Average deg Average pat length Table 2: Network or Meas Node Edge Path Length Connected Component Degree Betweennes Eigenvector

Assortativity

NETWORK ANALYSIS

NetworkX² was used to quantify and graphically represent the social network of bottlenose dolphins in Cedar Key by activity type.

Disassortativ * In this case, ar

(1) Department of Biology, University of Massachusetts Boston, 100 Morrissey Blvd, Boston, MA, 02125, USA (2) Department of Computer Science, University of Massachusetts Boston, 100 Morrissey Blvd, Boston, MA, 02125, USA (3) Department of Mathematics, University of Massachusetts Boston, 100 Morrissey Blvd, Boston, MA, 02125, USA



, ,,				
DOLPHIN ACTIVITY			OTHER NETWORKS ⁴	
Socialize	Forage	Travel	Biology Co- authorships	Internet
107	141	56	1,520,251	10,697
698	569	179	11,803,064	31,992
2	11	10	-	-
0.31	0.49	0.70	0.127	-0.19
13.05	8.07	6.39	15.53	5.98
2.95	3.29	1.34	6.19	3.31
	DOLPH Socialize 107 698 2 0.31 13.05 2.95	DOLPHIN ACTIV Socialize Forage 107 141 698 569 2 11 0.31 0.49 13.05 8.07 2.95 3.29	Joll Joll DOLPHIN ACTIVITY Socialize Forage Travel 107 141 56 698 569 179 2 11 10 0.31 0.49 0.70 13.05 8.07 6.39 2.95 3.29 1.34	DOLPHIN ACTIVITY OTHER NET Socialize Forage Travel Biology Co- authorships 107 141 56 1,520,251 698 569 179 11,803,064 2 11 10 - 0.31 0.49 0.70 0.127 13.05 8.07 6.39 15.53 2.95 3.29 1.34 6.19

: Definitions of some common network terms ^{5,6}			
Term ure	What it Means		
	an individual in the network; represented as a circle in the network graph		
	social interaction or association between two nodes*; represented as a line in the network graph		
1	the distance between two nodes, measured in number of edges		
S	the number of islands in the network		
	the number of edges connected to the node in question		
6S	betweenness of an individual node <i>i</i> is the total number of shortest paths between pairs of nodes (other than the node <i>i</i>) that pass through <i>i</i> ; to have a value for betweenness an individual must be connected to at least two other individuals		
	an individual with high eigenvector centrality is considered "important" if connected to other "important" individuals; importance is evaluated as degree of connectedness within the network		
/	nodes with a high degree are connected to other high-degree nodes; typical in social networks; quantitatively represented as a value between 0 and 1		
vity	nodes with a high degree are connected to other low- degree nodes; typical in information, technological and biological networks; quantitatively represented as a value between 0 and -1		
n "association" is two individuals sighted together in the field.			





Photo © S. Gazda