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Measuring Social Interactions between Some Captive Animals Using Social Network Analysis in Duhok Zoo

Nizar Jalal Hussein[1]*; Basim. S. A. Al Sulivany[2,3]

[1]*Environmental Sciences Department, College of Sciences, University of Zakho, Kurdistan Region – Iraq.*
[2]*Department of Biology, College of Science, University of Zakho, Zakho, 42002, Iraq.*
[3]*Anesthesia Department, College of Health Sciences, Cihan University-Duhok, 42000, Iraq.*

*Corresponding Author e-mail: nizar.hussein@uoz.edu.krd

Keywords

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Abstract

The present study was designed to measure social connection in three captive animals in Duhok zoo, including the American white pelican, wild dogs, and red deer, using Social Network Analysis (SNA). The present study was carried out at Duhok Zoo. The study was undertaken from October to December 2021. Three species of captive animals were used for this study, which were: the American white pelican, wild dogs, and red deer. Their numbers were 5, 7, and 6, respectively. Data were collected from the studied animals using direct observations of social interactions. According to the results found with the three species studied, all individuals have social interactions with each other. From the present study, according to the results found, it can be concluded that the social bonding was acceptable to some degree as strong relations were found between some individuals of all the three species studied. However, some individuals were not socially connected at all.

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INTRODUCTION

The advancement of scientific methods for evaluating animal welfare (Hill & Broom, 2009) has enhanced our ability to identify violations and promote positive well-being in captive settings. Contemporary evidence-driven management strategies (Melfi, 2009; Mura et al., 2025), combined with assessments that consider emotional states and individual experiences (Whitham & Wielebnowski, 2013), provide zoos with the tools to create environments that better reflect natural biological conditions. The significance of social dynamics and relationship patterns cannot be overstated, as these factors directly influence the physical health, psychological well-being, and overall success of individual animals (Price & Stoinski, 2007; Silk et al., 2009).Social network analysis (SNA) is a toolbox that is commonly used for biologists to investigate the consequences and causes of ecological and social interactions that are complex in animal populations (Farine and Whitehead, 2015). SNA is a key technique in social sciences in which it was invented in the 1930s to study the link between social processes and local patterns of human relations, for instance the effect of social groups on the probability on the obesity (Wasserman and Faust, 1994; Christakis and Fowler, 2007). The term network can mean interactions between animals that integrate to form dynamics of the community. Social structure was defined by Hinde (1976) in terms of the quality, patterning and nature of the interactions among its members. For instance, animals may have non-agnostic,

aggressive, genetic, dominant, and cooperative and many other relationship types that form the true social networks or system (Barrat et al., 2004). This can be called the real network. The most common networks are that when biologists create are analytical representations of a combined set or subset of actions of the real relationships. This can be called the observed network (Farine and Whitehead, 2015). SNA provides a deeper basis of the assessment of social relationships between animals (Krause et al., 2007; Sueur et al., 2011). It produces a diagram that represents a group of animals (Croft et al., 2008; Makagon et al., 2012).

SNA allows identifying the following points: 1) animals that are central to the specific group cohesion; 2) animal special relationships with each other and whether this relationship is strong or not; 3) identifies which animals link particular subgroups together and 4) the significance of any particular demographic the association patterns and the structure of group (Krause et al., 2009). In the social network, nodes show the individuals within the social studied group, whereas edges (also called ties, connections, or links) show the interactions, linkages, and associations between them. The thickness of edges represents the strength of their relationships (Croft et al., 2008). The diagrams of SNA provide an entire picture of the social connections of individuals (Rose and Croft, 2015). These networks allow scientists to analyze different levels of social bonding among animals (Borgatti, 2006; Krause et al., 2007, 2009; Croft et al., 2008, 2011; Borgatti et al., 2013).

Studies into the social behavior of mammals living in groups demonstrate the importance of social bonds and the advantages of structured relationships to the welfare of single animals and a group of animals (Boccia et al., 1997; Krause et al., 2007; Silk, 2007a, b; Silk et al., 2009, 2010a, b). Social relationships that are stable could improve the state of health, reproductive success, longevity, and welfare state (Krause and Ruxton, 2002; Silk, 2007a, b). For zoo animals, these data can determine how welfare is positive and can be maintained for a long period for all captive animals. Thus, animal populations' social structure has consequences at not only the individual but also population levels. Comprehending these effects has the possibility for improving the captive animals' management through assisting recognize areas of management that animals attempt at choosing their social environment. For instance, by informing the design of the enclosure, the proximity between animals, as a result, is not forced (Swedell, 2002; Croft et al., 2004; Wittemyer et al., 2005; Wakefield, 2008, 2013; Wittig et al., 2008; Lehmann and Boesch, 2009; Wiszniewski et al., 2009, 2010; Bercovitch and Berry, 2012; Archie et al., 2014). Therefore, zoos can achieve their goals of conserving animals by understanding the limitation of animal behavior and their interactions. Hence, it is important that social grouping must be placed at the top of their agenda. This will ensure that breeding potential is met for all captive animals. The abovementioned points show the importance of social networking inside zoos for animals. However, no study has been undertaken to measure social interactions for any animal inside the Duhok zoo.

Therefore, the present study was designed to measure social connection in three captive animals in Duhok zoo, including the American white pelican (Pelecanus erythrorhynchos), wild dogs (Lycaon pictus) and red deer (Cervus elaphus) using SNA.

MATERIALS AND METHODS

Study site and subjects:

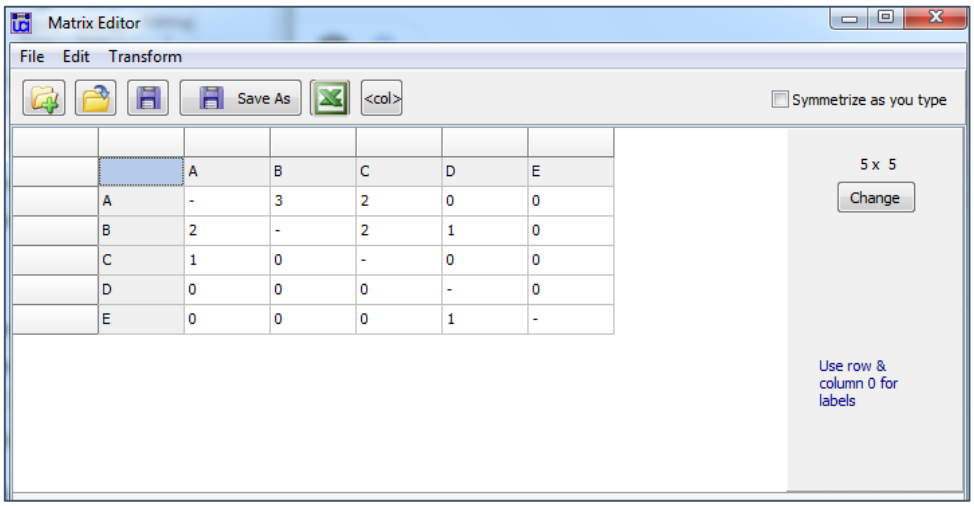
The present study was carried out at Duhok Zoo, which is located at Duhok governorate in Kurdistan Regional Government of north Iraq. The study was undertaken from October to December 2021. Three species of captive animals were used for this study which were: the American white pelican, wild dogs and red deer. Their numbers were 5, 7 and 6 respectively.

Ethical Statement

All the procedures of the present study were non-invasive and thus, animals were not caught or stressed. Therefore, the procedure was ethically approved by the Animal Ethics committee of the Faculty of Sciences of the University of Zakho with the code: AEC – 021.

Data collection:

Data were collected from the studied animals using direct observations of social interactions. Sheets were previously prepared for animals according to their numbers and were named with English letters as actor and receiver animals as shown in Figure (1). Animals were observed for one hour every time. Then all collected data were projected to a new Microsoft excel datasheet. The weather was sunny each time of data collection.



	A	B	C	D	E
A	-	3	2	0	0
B	2	-	2	1	0
C	1	0	-	0	0
D	0	0	0	-	0
E	0	0	0	1	-

Fig. 1. *Shows the interactions between individuals. The letters represent animals. Actors are on the left and receivers are on the top.*

Data analysis:

All data were then projected to UCINET 6 (Version 6.689) software program (Havard: MA: Analytic Technologies) to be prepared for later analysis and then were saved as (.##h) files. Thereafter, the files were opened in NetDraw (version 2.168) software program (borgatts@bc.edu) to draw SNAs. The SNAs were checked by increasing the size of nodes and changing their shapes to different shapes. In addition, widths of edges which represent the interaction between individuals were added with arrow heads showing the directions of individuals.

RESULTS AND DISCUSSION

The SNAs for wild dogs, the American white pelicans and red deer are shown in figures 2, 3 and 4 respectively.

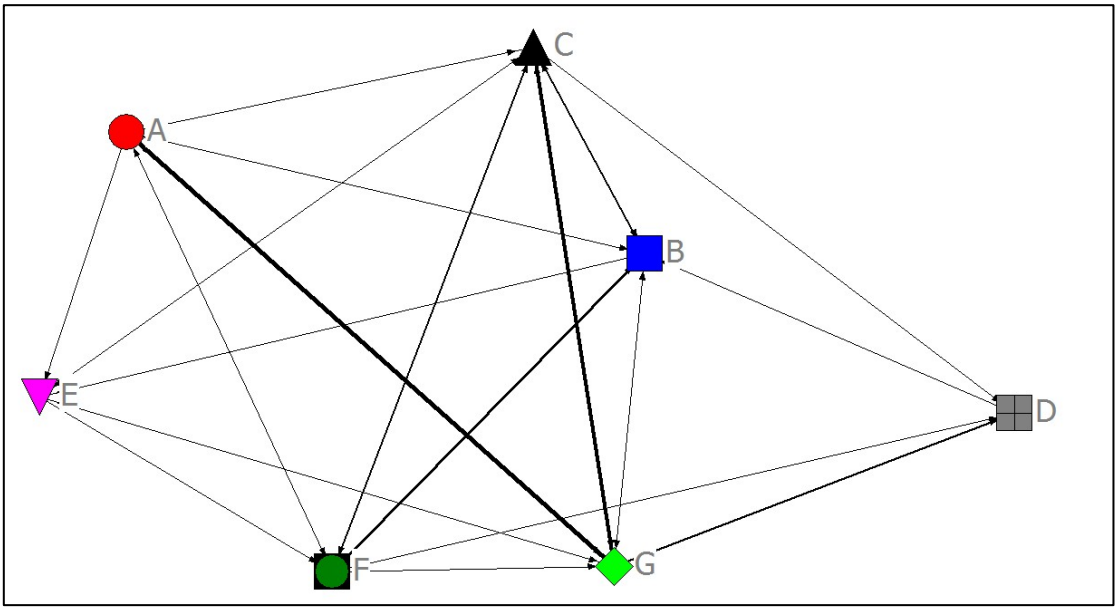


Fig. 2. *The social bonding among wild dog individuals*

According to the results found with the wild dogs, all individuals have social interactions with each other. The individual (G) has the strongest bonding with individuals (A) and (C). Individual (D) has no interactions with individuals (A) and (E). this bonding is not just behavioral but physiological. Research on numerous social mammals, from primates to wolves, have shown that affiliative touch can activate the release of endorphins, leading to reduce the stress and promoting a sense of well-being within the group.

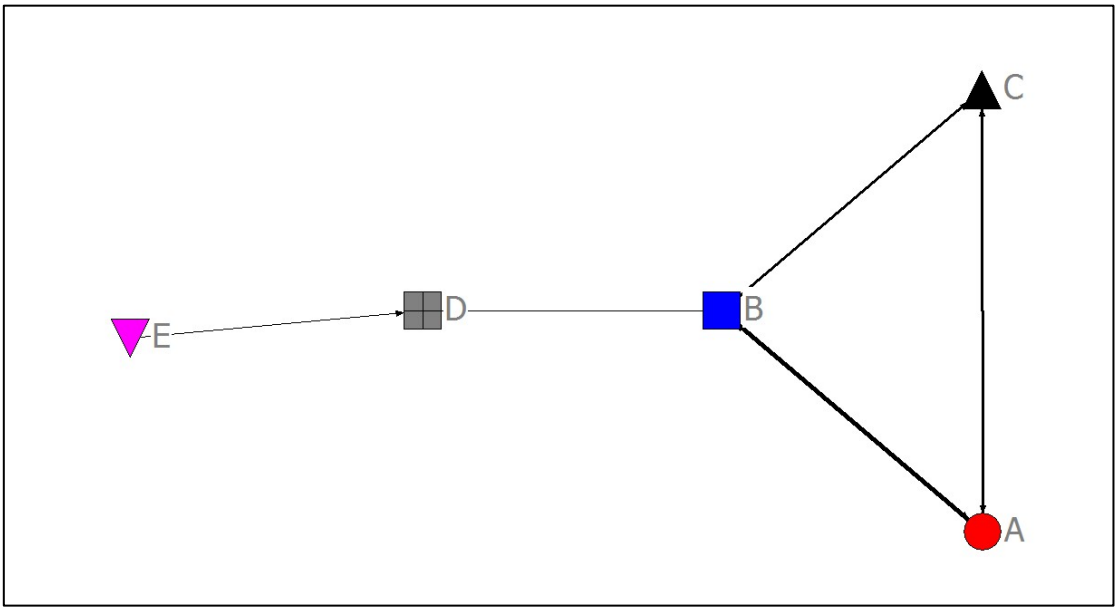


Fig. 3. *The social bonding among white American pelican individuals*

According to the results found with the American pelican, all individuals have social interactions with each other. The individual (A) has the strongest bonding with individuals (B) and (C). Individuals (A) and (C) has no interactions with individuals (D) and (E).

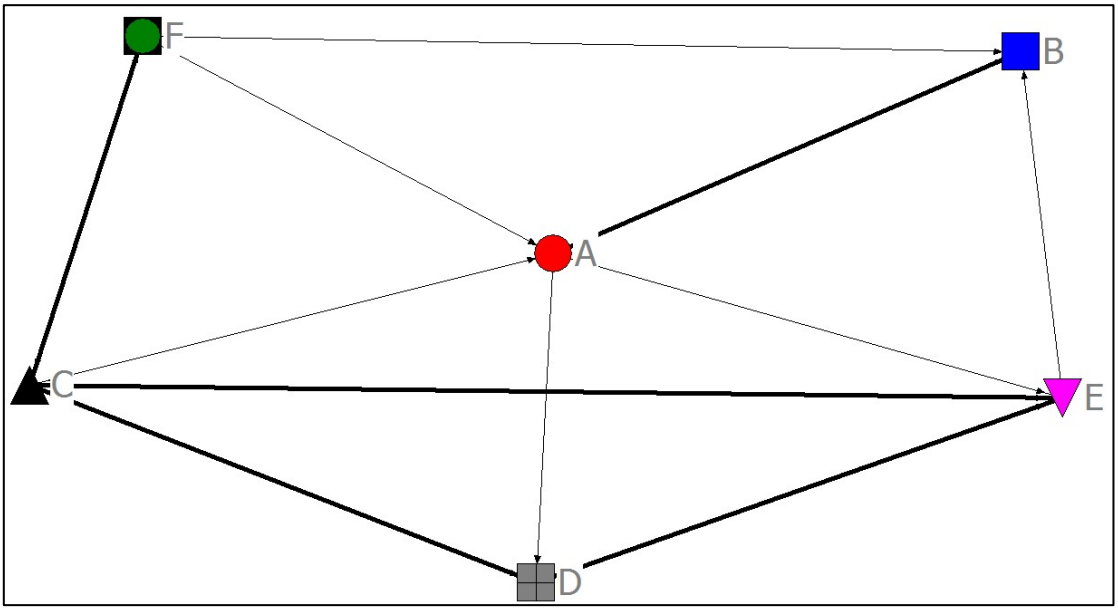


Fig. 4. *The social bonding among red deer individuals*

Regarding to the findings of the red deer, all individuals have social interactions with each other. Strong relations were found between most of them. The individual (D) has the strongest bonding with individuals (E) and (C), and individual (A) had a strong bond with individual (B). Similarly, individual (F) had a strong bond with individual (C) Individual (D) had no interactions with individuals (B) and (F).

Zoos must provide the animals requirements as they obtain in the wild. Good zoos undertook research on any problem that they consider will affect animal welfare or behavior. Measuring social bonding between animals is a good measure to indicate animal welfare in captivity. In the present study, strong relations were found between some individuals, however, there were no social interactions among some animals as shown in the findings (Figures 2, 3, and 4).

Research across multiple species has demonstrated that maintaining consistent social bonds with other group members contributes to extended longevity and decreased stress responses throughout various developmental periods (Archie et al., 2014; Fürtbauer et al., 2014). Understanding the motivations behind why certain individuals prefer spending time with particular conspecifics, or actively distance themselves from others, enables more informed decision-making regarding animal transfers between social groups. When animal welfare is evaluated through the lens of individual subjective experience and condition within captive settings (Bracke & Hopster, 2006; Clark, 2011), this scientifically grounded approach to managing group dynamics can lead to improved long-term outcomes, a pattern already observed in agricultural animal studies (Boe & Farevik, 2003). Scientific investigations examining the social dynamics of gregarious mammalian species have highlighted how meaningful social connections and well-organized relationship structures benefit both individual animals and entire populations (Boccia et al., 1997; Krause et al., 2007; Silk, 2007a,b; Silk et al., 2009, 2010a,b).

The presence of enduring social bonds has been linked to improved breeding outcomes, physical health, well-being, and lifespan (Krause & Ruxton, 2002; Silk, 2007a,b). Consequently, the detailed social organization within animal groups carries implications for both individual animals and the broader population. Recognizing these impacts offers opportunities to refine captive species management by pinpointing practices that may restrict an individual's capacity to select its preferred

social partners; this knowledge can inform habitat design, ensuring that animals are not compelled into unwanted proximity with one another. While research examining this aspect of 'social function' currently encompasses a limited range of species, evidence suggests that numerous common zoo inhabitants exhibit sophisticated social structures in their natural habitats (Swedell, 2002; Croft et al., 2004; Wittemyer et al., 2005; Wakefield, 2008, 2013; Wittig et al., 2008; Lehmann & Boesch, 2009; Wiszniewski et al., 2009, 2010; Bercovitch & Berry, 2012; Archie et al., 2014). When captive conditions restrict an individual's behavioral expression, this can compromise the achievement of conservation objectives, specifically the successful reproduction necessary for species preservation. Consequently, zoological institutions must prioritize the formation of suitable social configurations (Price & Stoinski, 2007) to maximize reproductive success for all captive individuals.

CONCLUSIONS

From the present study, according to the results found, it can be concluded that the social bonding was acceptable to some degree as strong relations were found between some individuals of all three species studied; although some individuals were not socially connected at all. Therefore, more research is required with longer duration and studying their feeding system and behavior in addition to social bonding.

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