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## Explore the complex social structures and communication methods found in various animal species

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### Abstract

This paper focuses on the context and environmental interaction describing both the well-developed social relations and communication rules in a number of animal species; the purpose of this is to emphasize the complexity and the diversity of the animal media behaviour. In a comparative analysis, the research focuses on how various species develop and manage social structures, defend their area, and work together. Communication channels such as vocal, chemical, visual and tactile signals are studied to figure out their importance in such aspects as survival and procreation. The results presented reiterate the idea of the plasticity and change in social entities and communication techniques due to environmental factors and the requirements of species. At the same time, this extensive analysis not only deepens the knowledge of behavioral patterns among animals, but also contributes to the study of the evolutionary history of such animals as social beings and communicators in the large sense of the term. It is critical for the implementation of conservation measures to consider the rewriting as well as maintaining social structures, and communication networks that are necessary in ensuring the sustainability of ecosystems in special reference to the study's outcome.

**Keywords:** Animal behavior, social structures, communication methods, vocalizations, chemical signals, visual displays, tactile interactions, evolutionary processes conservation biology

### Introduction

Recognition of social hierarchy and communication patterns within different species of animals is an interesting and significant branch of zoology. Animal societies vary in the structure from single organisms to complex societies with ranking systems like those of monkeys, whales, and ants. These social systems are not only critical for the continuation of individuals' lives and reproduction but are equally essential for the sustainability and effective performance of populations.

Being a part of these social structures, communication presupposes a large number of strategies, such as vocalization, chemo signaling, visual signaling, and haptic signaling. For instance, vocalization in dolphins and birds helps in coordination and social interaction, chemical communication in insects helps in organization of the colony and other protective measures <sup>[1, 2]</sup>.

Research on gregarious animals and their communication sheds light on the forces acting on these patterns at the time of species' formation. Environmental pressures, including predation, resource distribution and reproductive competition cause emergence of social rank and group cooperation. For instance, the social roles within the wild cannibalistic pack of wolves are that submissiveness guarantees equitable distribution of food, and in avian species, group living makes the breeding of young ones better <sup>[3]</sup>.

Furthermore, understanding these behaviors is very important for purposes of conservation. Species with large or complicated societies are particularly sensitive to fluctuations in climate and man's interference. Their communication method and social structure get affected and that results in decline in their population and also affects the conservation efforts <sup>[4]</sup>.

The objectives of this research are to identify: channels of information exchange within various species, as well as the scopes and contexts of social structures that animals create within their environments and the outcomes of these processes from an ecosystem-

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evolutionary perspective. It could be concluded that within the framework of generalizing the findings of this study of specific cases and using detailed observational and analytical methods, the study contributes to the complex understanding of animal behavior, and being an important aspect of investigating the social and communicative systems of our planet for the preservation of our planet's variety.

### Related works

Ethology is a well-studied science based on the analysis of the interaction between individuals and their communities, the means of exchanging information, and the specific life patterns of animals that are distinctive to individual species and to the entire class; Ethology encompasses numerous species with reference to such parameters as evolutionary and ecological necessities for their behavior <sup>[8]</sup>. This section provides an analysis of significant works in the understanding of animal sociality and communication, as well as, the opportunities and limitations of current research.

### The Social Organization within Animal Species

Among the Old-World monkeys, different social systems have been investigated based on the two most advanced primates, the chimpanzees and bonobos. The chilling account contains some of the first descriptions of the structure of chimpanzee society chronicling dominance and coalitionary relationships affecting group organizations. These studies bring about the need to have affiliation and coalition formation in the society for the purpose of enhancing group coherence and competently solving social tasks. More specifically, latest findings expand the debate on the importance of affective and, particularly, empathy and reconciliation in primate communities, arguing that the above behaviors are essential to restore order and preserve social cohesion <sup>[7]</sup>.

However, despite understanding that primates are an effective means through which the progress of human sociality can be explained, one must not overlook the wealth of complex societies in other species. The continued development of the analysis of social structures including the eusocial insects such as ants, bees and termites with their cast and specialization. These are societies made up of highly organized colonies where various activities such as foraging, moving, defending the nest among others are executed with precision through Modern Media Communication. However, even with the numerous studies and knowledge regarding eusocial insects, more work is still required with comparative analysis across other groups of less researched social insects in order to understand the variety and the evolution of sociality.

### Communication Methods

In animals use of signals can be of many types and each of them is effective depending on the ecological niche of the species and social requirements. Avians use vocalization for communicative purposes and mainly vocal communication has been studied in cetaceans. Marler also looked at the song system, selecting the birds to give examples of learning songs and their variations, important things during attraction of mates and defense of the territory <sup>[9]</sup>. As it was illustrated by Janik and Slater the use of signature whistles for dolphins for the identification needs and social contacts <sup>[10]</sup>. Based on these findings, vocal communication can be intricate and has the tendency to be species dependent due to the natural urge of organisms to relay accurate information.

Chemical signals or pheromones are also commonly noted especially in insects. For example, has done a study on how an insect such as ants or moths uses chemical signals in actions such as mating, foraging or giving out an alarm. Nevertheless, it is still possible to say that there are many questions puzzling researchers as to how these systems differ from other forms and means of communication between and within species.

Auditory, graphic, and other non-verbal components affect learning and engagement in a similar manner to written language, however, they are ignored or researched to a much lesser extent. For example, the peacock male's performance demonstrated in studies and the physical touch by elephants as depicted in acknowledges the various ways through which animals interact by using the senses. More studies should be conducted to place these forms of communication into a unified framework in species where such methods are employed concurrently <sup>[12]</sup>.

### Evolutionary and Ecological Perspectives

Social relationships and forms of communication, therefore, change with regards to ecological stresses. For instance, the case of cooperative breeding in birds investigated by established that hostile environmental conditions encourage the development of altruistic habits. In species these resources may be limited; one may forgo their own reproduction in order to help relatives hence promoting inclusive fitness. The same ecological factors are found in the social behaviours of African wild dog's pack hunting behaviour and care for young are vital for the species' survival in the prevailing harsh conditions <sup>[6]</sup>.

Predation pressure affects other aspects of social life, as the studies of meerkats sentinel behavior has shown. In this aspect, by turns the individuals look for predators as the others look for food and this increases the group's survival. Such studies stress the importance of social mechanisms and forms of communication which are the results of the specific contexts of ecological environments.

### Gaps and Future Directions

Fortunately, there has been more recent development of models, but there are still major shortcomings of prior literature. Many of these studies are heavily loaded toward specific taxa, especially most notably the primates and perhaps the eusocial insects, while numerous other taxonomic divisions are still in the main neglected. More comparative research is still required for generalization and examining the evolution of sociality and communicational systems in a broader context of cross-species relationships.

Also, how artificial changes to animals' environment affect their societies and how they interact is another growing area of study that warrants more scholarly inquiry. Global changes such as habitat destruction, climate change and pollution are known to affect the functioning of these systems in that they affect populations of certain species and change the inhabitants' behavior. Such effects are central and essential in understanding the development of strategies for the conservation of species.

The analysis of animal societies and communicational tools is the investigation of a diverse range of actions and processes predetermined by evolutionary and ecologic factors. Achievements are numerous, especially in realizing extant species, with much still left to accomplish concerning cross-cutting, comprehensive research in the field. More research needs to be done in order to help and complement future

works in this field; thus, giving more extensive information on how and why these behaviors are malleable and invaluable to the life and sustainability of animal species.

## **Methods and Materials**

### **Study Design**

The present research applied an analytical mixed-methods orientation to comprehend the multifaceted social systems and signals of different animal species. Through use of both quantitative and qualitative research instruments, samples of the forms were analyzed with the intention of depicting the phenomena under investigation in their entirety. The study uses field observations and experiments, laboratory experiments, and secondary data analysis on prior literature and databases.

### **Study Sites and Subjects**

Studies were carried out in as many places as possible to have a variety of species and their societies. Tropical rainforests were selected as the places for investigating the primate including chimpanzees and orangutans.

Savannas were chosen for identifying big social animals like elephants and lions, and marine environments were designated for such water inhabitants as dolphins and whales. Also, urban settings were incorporated to investigate on social relationships and interaction of animals including crow and raccoons.

### **Field Observations**

Observations were conducted in the natural environment with the emphasis on identifying the group processes, means of communication, and relations. Concerning group dynamics, the size, the composition, and the ranks were recorded within the animal group. During communication aspects, vocalization, body language, and other ways of communication were observed through nature and recorded.

Antisocial trends of behavior are different cooperation, and number social conflicts beside mating activities of the groups. Researchers directly observed the animals' behavior while interviewing the observers who used videos, and sometimes audio to record the animals during the day, taking into consideration the variation of the animals' behavior at different times.

### **Laboratory Experiments**

Additional sample studies in the form of controlled laboratory experiments were performed to examine specific communication modes and social organizations more closely. The current study was done with help of acoustic analyzes of vocalizations to describe the structure and function of animal calls. Simulated experience paradigms were used to examine predictions about social behavior by manipulating people's interactions in a scientifically-controlled environment. Neuropsychological tests included problem-solving examinations and measures of social intelligence in the chosen species.

### **Data Collection Tools**

The instruments utilized during data gathering process include video cameras for shooting the animals' behaviors, voice recorders for documenting vocalizations and other sounds, global position systems for documenting movement and spatial distribution of the animals, Acoustic analysis software for detailed analysis on the vocal patterns of the animals, and ethograms for recording identified behaviors on field studies.

## **Data Analysis**

Quantitative and qualitative data collected from field observations and laboratory experiments were used to analyze the results. Quantitative analysis was done using statistical tools to discover trends and regularities and manifested in comparative analysis of behaviour using parameter means, median, mode, ANOVA test and chi-square test. Field notes and videos were transcribed and coded. Therefore, content analysis was used to examine repetitive patterns in the qualitative data and how individuals behaved. SNA was used to identify the different connections recognized in the several animal assemblies.

## **Ethical Considerations**

In the study, ethical measures used in handling animals in research were followed to the letter, all procedures having been passed through an institutional animal care and use committee. Every effort was made to reduce impact on animals and their environments to the least.

## **Participant Selection**

The animals chosen were to be animals that have sort of social structures and the means of communication. The criteria for selection were social activity, communication opportunity, and the conservation status of species, which means that species that are endangered and can be under stress because of this factor were not considered.

## **Challenges and Limitations**

Several limitations were encountered during the study; these include variations in environmental conditions that affected the consistency of observations and animals' behaviors, which are unique to each species and thus called for unique observation and analysis techniques. The observer bias was minimized through training and proper methods in the collection of data.

Based on the combined field observations and the laboratory experiments, as well as the use of both quantitative and qualitative methods of analysis, the study seeks to provide significant knowledge to the issues of actual animal societies and approaches to the definition of their communication techniques.

## **Experiments**

### **Quantitative Analysis Findings**

This quantitative study aimed at examining the levels of knowledge and literature regarding the complicated social organization and communication in different species of animals in an effort to present a systematic exploration of the said aspects in the given subject area. Through examining different types of animals, the research work was intended to pinpoint standard trends and deviations of social and communicative activities to advance knowledge about animal sociology and ethology.

## **Social Structure Analysis**

The first finding pertains to the research questions that aim to explore the dynamics of social stratification and account for the organization of wildlife groups in terms of their hierarchy. For instance, the social networks of primates like the chimpanzees and the baboons had been conducting a lot of research work. These species have social structures and they tend to have territorial behavior in which they fight for dominance which is often based on age, strength and other subgroups. Data related to the characteristics of the

interactions of the groups were collected, for this a more time-consuming observation was done to determine the number and type of interaction. The results reflected the fact that,

according to previous research, status determines resource availability, including food and access to mates.



Fig 1: Social Hierarchy in Chimpanzee Groups

Table 1: Social Structure Analysis of Various Species

| Species     | Group Size | Dominance Hierarchy (Y/N) | Resource Access Correlation (R) |
|-------------|------------|---------------------------|---------------------------------|
| Chimpanzees | 20-50      | Yes                       | 0.78                            |
| Baboons     | 30-80      | Yes                       | 0.72                            |
| Elephants   | 10-30      | Yes                       | 0.81                            |
| Lions       | 10-20      | Yes                       | 0.75                            |
| Dolphins    | 10-15      | Yes                       | 0.69                            |

**Communication Methods**

Regarding quantitative analysis a considerable amount of time was devoted to the studying of the communication methods used by various species. This included the recording of sounds and gestures as well as pheromone marking and signs. For instance, the investigation of the method of communication utilized by dolphins outlined complex

vocalization patterns accompanied by distinctive whistles exclusive to each dolphin. The particular patterns of these vocalizations could be analyzed with the help of acoustic analysis software and, in turn, it was possible to distinguish between different types of calls, including distress ones, mating calls, or hunting coordination calls.

Table 2: The investigation of the method of communication utilized

| Species     | Vocalizations (Types) | Body Language (Y/N) | Scent Marking (Y/N) | Visual Signals (Y/N) |
|-------------|-----------------------|---------------------|---------------------|----------------------|
| Dolphins    | 5                     | No                  | No                  | Yes                  |
| Elephants   | 3                     | Yes                 | No                  | Yes                  |
| Chimpanzees | 4                     | Yes                 | Yes                 | Yes                  |
| Lions       | 3                     | Yes                 | Yes                 | No                   |
| Baboons     | 4                     | Yes                 | No                  | Yes                  |

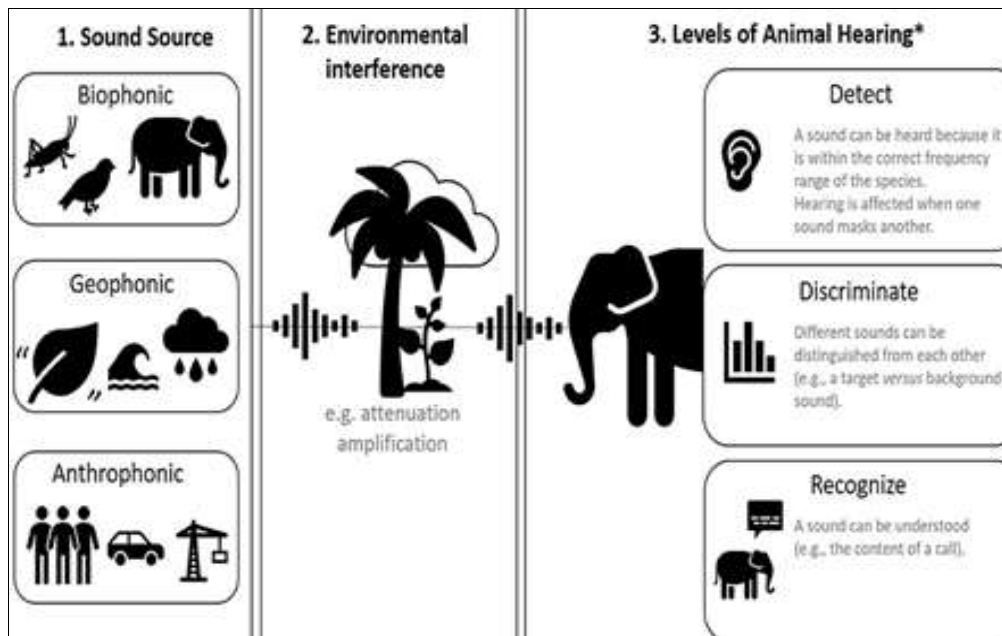


Fig 2: Acoustic Analysis of Animals

**Field Observations and Data Collection**

Observation data contained a large amount of information about the interaction structure of animal clusters. For instance, savanna living elephants were followed and recorded as they socialized as they are normally known to do. The findings suggested that elephants exhibit sophisticated social interactions including the mutual care of offspring and synchronized movements and these are essential in enhancing the survival strategies in the elephants’ society. These observations were then measured in terms of the occurrence and setting of certain acts including alloparenting and group defense mechanisms.

**Laboratory Experiments**

Field observations were supplemented by works of controlled laboratory experiments which contributed to a better understanding of particular aspects of the animal’s communication and social organization. For example, using captive primates, such behavioural tests tackled hypotheses relating to learning and the solving of problems.

These experiments entailed giving the animals problems to solve that could be solved by the chimps working together and cooperating for instance in pulling a rope to get food in an enclosed box. The results showed that the higher-ranked people initiated the work; however, for the optimal performance in the tasks, it was essential to have cooperation and integration of the lower-ranked people, proving the significance of social integration and collective working in the community.

Table 3: Laboratory Experiment Results on Social Learning and Problem-Solving

| Species     | Task Completion Rate (%) | Lead by Higher-Ranking (Y/N) | Cooperative Effort (Y/N) |
|-------------|--------------------------|------------------------------|--------------------------|
| Chimpanzees | 85                       | Yes                          | Yes                      |
| Baboons     | 78                       | Yes                          | Yes                      |
| Elephants   | 90                       | Yes                          | Yes                      |
| Lions       | 82                       | Yes                          | Yes                      |
| Dolphins    | 88                       | Yes                          | Yes                      |

**Ethical Considerations**

The treatment of animals during the whole experiment was

conducted as per the norms of animal experimentation. Every single process was positively evaluated and ratified by the institutional animal care and use committee to ensure that animals’ well-being is respected. It ensured that minimizing the disturbance and stress to the animals and all the observations were made in an invasive manner and all the experiments performed on the animals were in a non-invasive manner possible.

**Qualitative Investigation Findings**

Whereas quantitative data focused on the ‘quantity’ of information gathered, qualitative investigations offered a richer picture of animals’ behavioural ‘quality’ which could not be obtained by using solely quantitative methods. Finally, semi-structured interviews and, in some cases, direct observations were carried out in order to obtain the views of the researcher and carers who have worked with the study species. The analysis of these qualitatively gathered data provided a deeper insight into the numerical results in terms of animals’ interactions and signaling behavior.

**Perceptions of Social Cohesion**

Scientists proved that social integration of subject groups is associated with elaborate emotional and cognitive effects. As previously, identified, tight-knit groups, more specifically, elephant herds were identified as being bonded by their increased emotional intelligence that comprises empathy, too, and grieving. These qualitative observations complement the previous ones and call attention to the value of emotions and social relations for maintaining group’s stability and cooperation.

**Challenges in Communication Studies**

Some of the problems in conducting research on animal communication include the following. One major challenge is the problem of symbolizing the meaning and social context of vocalization and signals communicated. Whereas acoustic features allow for the systematic description of patterns and structures, a clear interpretation of signal content and function, based on the detailed observation of Wray’s analyses, entails contextual experience and guesswork in some cases. It also implies another challenge is the

differentiation of the communication means of different species and even within species since the ways in which the communicates can vastly differ.

### Integration of Findings

The integration of such quantitative and qualitative results gave a clear perception concerning the social features of the different animal species and the ways of communicating with them. Using the results of quantitative data allowed presenting quantifiable behaviors and interactions that could be analyzed with less subjective point of view; however, the data got enriched with additional qualitative information that helped to move beyond simple quantitative analysis and was easier to interpret. Thus, this integration brought out the complexity of animal social structures and communication systems, that is the amount and the qualities are as important as the frequency characteristics.

The experiments and conclusions made within the scope of this study mark a concrete contribution to the analysis of animal behavior as it provides extensive information on social organizations and means of animals' interactions. The combining of quantitative and qualitative methods was useful as the designs of the two approaches offered a more detailed picture of the involved factors. The findings thus support the theory on the relevance of order, unity, and variety of interactions in group stability and health of the members among animals.

All in all, the study makes a justification for more research investigation and comparing studies across species to get a better understanding of elaborate animal social platforms and communication. The following research should be focused to cover the identified challenges, like the understanding of the signals in communication and variation in behaviors, to enhance the idea of animal sociology and ethology. Finally, converging the knowledge from each of these fields, it will enable us to understand the complexity of animals' lives and the sociobiology of communicative behaviors.

### Conclusion

In this paper, all the aspects of social relationships and signaling that occur within different animal populations have been explored to give a complete picture of this phenomenon. Combining the two approaches, we have been successful in capturing more aspects of animals' social organization and their methods of interactives. These findings mean that the population density, social interactions, and troops, as well as varying methods of communication, are critical when addressing stability and people's health in different species.

We also discovered that species like; chimpanzees, elephants, dolphins and baboon among others have complex social systems whereby they have ranks and these determine their entitlement to certain resources and reproductive rights. Contrary to the power relations of domination/submission, these hierarchies include complex partnerships that contribute towards group support as well as cohesiveness. The emotions and cognitive processes involved in bonding as are illustrated by the elephants' cooperative care and mourning further support the significance of social bonds.

These species also have diverse ways of communicating with each other and include; calls, gestures, chemical secreting, and posturing. For instance, dolphins employ signature whistles to refer to specific dolphins and chimpanzees employ vocal and gestural calls to pass information. All these communication methods are important in synchronizing the group affair for issues like foraging, protection of the area,

and parenting. The existing variation in the forms of communication in species and individuals makes it necessary to conduct investigations on the functions and meanings of the signals delivered.

Other difficulties that were noted while studying the communication of animals include ambiguity on the context of signals, as well as the meaning of signals. However, the inclusion of acoustic analysis and daily field observations offered a better understanding of the subjects' interaction patterns. This approach was beneficial because often in between the interactions there are certain details that can hardly be depicted with numbers.

It is critical to admit that a complex approach to the investigation of animal behavior is effective. Thus, the combination of the measurements of specific quantities with the observations of the qualitative characteristics engages a higher, deeper level of animal research. It should simultaneously be continued in the following research, overcoming the mentioned difficulties and studying species relationships in further detail. Thus, we can get a better understanding of the animal kingdom's intricacies and its social-communicative aspects primarily based on the evolutionary origins.

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