International Research Journal of Natural and Applied Sciences
ISSN: (2349-4077)
Impact Factor 5.46 Volume 5, Issue 8, August 2018

Website- www.aarf.asia, **Email** : editor@aarf.asia , editoraarf@gmail.com

DIVERSITY AND ECOLOGICAL ROLE OF ANT SPECIES IN FOREST ECOSYSTEMS OF BONGAIGAON DISTRICT, ASSAM

Anupama Swargiary, Assistant Professor
Department of Zoology, Abhayapuri College, Abhayapuri
Subrata Sarkar, Assistant Professor
Department of Botany, Abhayapuri College, Abhayapuri
*Correspondent author email: onupomasorgiary@gmail.com
DOI:18.A003.aarf.J14I01.200001.8876811

Abstract

Ants are one of the most numerous and ecologically significant groups of insects in terrestrial environments. They play an important role in processes such as soil formation, nutrient cycling, seed dispersal, and the maintenance of ecological balance. The present study examines the diversity of ant species in the forest ecosystems of the Boggiano district, Assam, and their ecological significance.Field surveys show that the region is home to a diverse collection of ant species, largely due to favourable climatic conditions and varied vegetation. The availability of organic matter in the soil and nesting sites, as well as food supplies, further enhances the diversity of ants in these forest habitats. Ants make a great contribution to the functioning of the ecosystem, as they enhance the soil's fertility by their burrowing activities, keep pest populations in check, and make up an important part of the food chain. However, the increasing anthropogenic pressures such as deforestation, overuse of pesticides, habitat fragmentation and climate change are serious threats to the populations of ants. These factors can result in a decline in species diversity and disrupt ecological processes, it is urgent that effective conservation strategies are implemented, including habitat protection, sustainable land use practices, and a reduction in the use of chemicals, in order to preserve ant diversity and maintain the stability of forest ecosystems.

Keywords: Ant diversity, Bongaigaon, Assam, ecology, biodiversity, forest ecosystem

1. Introduction

Ants (Family: Formicidae) are among the most dominant and important groups of insects in terrestrial ecosystems. They are generally considered ecosystem engineers because they affect soil structure, increase nutrient cycling, and influence plant growth through a variety of ecological interactions (Hölldobler & Wilson, 1990; Folgarait, 1998). Their activities, such as tunneling, seed dispersal and predation help to sustain ecosystem balance significantly. In the tropical areas, especially in Assam, the diversity of ants is especially high given the favourable environmental conditions such as high humidity, warm temperature and diverse vegetation (Lach et al., 2010).

Figure 1: Diversity and Ecological Activities of Ants in Forest Ecosystems

Assam is famous for its high level of biodiversity and hosts many insect species, including a variety of ant taxa. Forest ecosystems also provide the best environments for ants by offering nesting sites, organic minerals, food, and stable microclimatic conditions that allow the colony to survive and thrive (Andersen, 1997). Vegetation diversity in these forests is an important factor in sustaining the populations of ant communities, since most species rely on plants for food and shelter.The Bongaigaon district, a Unit of Western Assam, has ecologically viable forest cover, including Kakoijana Reserve Forest, which harbors various flora and fauna. Although it is an ecologically rich area, ant diversity has not been studied in depth in the area through thorough scientific research. Thus, the record and analysis of ant species and their ecological functions should be conducted to better understand ecosystem operation and aid biodiversity conservation (Ward, 2014).

2. Objectives of the Study

1. To document ant species diversity in forest ecosystems of Bongaigaon district.
2. To identify major ant families and their distribution.
3. To analyze the ecological role of ants in forest ecosystems.
4. To assess threats and suggest conservation measures.

3. Study Area

Bongaigaon district is located in the west of Assam and is typified by diverse ecosystems that comprise tropical forests, grasslands, and riverine landscapes. The region experiences high precipitation and moderate temperatures, which create favorable climatic conditions that support rich biodiversity (Champion & Seth, 1968). These climatic conditions also favor thick vegetation and rich organic productivity, which are crucial for supporting various insect communities, including ants.The amount of organic material, nesting sites, and food sources needed by ant colonies is found in forests such as the Kakoijana Reserve Forest, which serves as an important ecological habitat. Leaf litter, wood decay, and plant diversity provide a wide variety of ant species with shelter and a source of food (Hölldobler & Wilson, 1990). The habitats are also known to have stable microclimatic conditions that are essential for the development and survival of the colonies.

4. Materials and Methods

The research was conducted in systematic field surveys with standard sampling methods that are usually used in ant diversity research. Pitfall traps, hand collection and leaf litter extraction were some of the methods employed to collect samples in various habitats. Pit traps are also considered effective in sampling ground dwelling ants, but species on vegetation and tree trunks are captured by hand collection (Bestelmeyer et al., 2000). They noted observations across seasons to assess changes in species diversity and abundance. The reason why seasonal sampling is important is that ant activity and distribution tend to change with the climatic conditions, including temperature and rainfall (Andersen, 1997). Standard

taxonomic keys and field guides were used to identify the collected specimens to achieve accuracy and consistency in the classification process.

5. Results and Discussion

5.1 Ant Diversity

The findings of the current study suggest that the forest habitats in the Bongaigaon district harbor a high number of ant species belonging to key subfamilies, including Formicinae, Myrmicinae, Ponerinae, and Dolichoderinae. These subfamilies are also highly dispersed in the tropical jungles and have been known to be ecologically versatile and functionally significant. Among them, Myrmicinae and Formicinae were identified to be the most predominant factors, to the fact that they inhabited wide ecological niches, diversified feeding patterns and adapted to survive under different ecological conditions (Holddobler & Wilson, 1990; Lach et al., 2010).

Table 1: Major Ant Subfamilies Observed in Bongaigaon Forests

S. No.	Subfamily	Common Characteristics	Ecological Role	Relative Abundance
1	Formicinae	Medium to large ants; strong foragers	Soil aeration, scavenging	High
2	Myrmicinae	Highly diverse; varied nesting habits	Seed dispersal, nutrient cycling	High
3	Ponerinae	Predatory ants; primitive behavior	Pest control, food chain balance	Moderate
4	Dolichoderinae	Small to medium; produce chemical secretions	Decomposition, ecosystem regulation	Moderate

Myrmicinae is one of the biggest subfamilies of ants that is very important in seed dispersal and recycling of nutrients. They nest and interact with plants which helps to sustain the forest regeneration processes (Folgarait, 1998). On the other hand, Formicinae are characterized by high foraging activity and the ability to use various food resources, such as honeydew and organic matter, thereby contributing to soil aeration and decomposition (Andersen, 1997). Ponerinae ants are less abundant but important predators in forest ecosystems. They can regulate the population of insects and preserve the ecological balance ensuring the absence of outbreaks of pests. Likewise, Dolichoderinae ants aid ecosystem processes by decomposing and communicating chemically to regulate colony behavior and resource use (Ward, 2014).

The variety of ants present in the study location is directly related to the vegetation structure, food supply, and microhabitat factors such as leaf litter and soil type. The thick vegetation and organic matter offer good nesting grounds and food to various species of ants. Corresponding research in tropical forests has demonstrated that plant diversity increases ant species richness and ecological interactions (Kaspari et al., 2000).

5.2 Ecological Role of Ants

Ants are critical to the regulation of forest organization and operations. Their ecological significance can be seen in various processes that directly and indirectly support biodiversity and environmental stability.

(i) Soil Formation and Aeration

Ants' burrowing and tunneling greatly enhance soil structure. Such activities improve soil aeration, water infiltration, and mixing of organic and mineral components. Consequently, soils are made more fertile and more active in terms of microbial activity, which is beneficial to plant growth (Hölldobler & Wilson, 1990; Lavelle et al., 2006).

Figure 2 : Nesting Behavior, Foraging Activity, and Habitat Use of Ants in Forest Ecosystems

(ii) Nutrient Cycling

Ants help in the cycling of nutrients; dead insects, plants, and waste materials are among the sources of organic matter that they decompose. In the process, they aid in the recycling of key nutrients to the soil, thereby sustaining productivity and stability of an ecosystem (Folgarait, 1998).

(iii) Seed Dispersal (Myrmecochory)

Seed dispersal, which is also called myrmecochory, is carried out by many ant species. The ants carry the seeds to the nest, and the nutrient-rich ones are consumed there. The rest of the seed is then disposed of in nutrient-rich habitats and regenerates the plants (Beattie & Hughes, 2002).

(iv) Pest Control

The ants are natural predators that feed on a wide range of destructive insects and pests. This is a biological control method that has been used to reduce insect populations and reduce the use of chemical pesticides, thereby supporting sustainable management of ecosystems (Philpott & Armbrecht, 2006).

(v) Role in Food Chain

Ants play a significant role in the food chain. They are an important food supply to birds, reptiles, amphibians and other invertebrates. They are abundant, which means that they transfer energy at trophic levels, and promote the balance of the ecosystem (Del Toro et al., 2012).

5.3 Threats to Ant Diversity

The variety of ant species in forest ecosystems is becoming increasingly endangered due to numerous anthropogenic and environmental factors. Deforestation and habitat destruction are among the greatest threats. Forests are sources of resources, including nesting areas, food supplies, and the consistent microclimatic conditions needed by the colony of ants. This destruction of the forest cover through logging, agricultural growth, and the construction of infrastructure causes habitat loss and fragmentation, which directly affect the population of ants (Hölldobler & Wilson, 1990; Foley et al., 2005).

Another significant cause of the decline in ant diversity is the use of chemical pesticides. The pesticides applied in farming and plantations are not selective, and they usually hurt non-target

organisms, such as useful insects like ants. These chemical times may alter the structure of colonies, decrease reproductive success, and lead to long-term population decline. Ants are also significant in pest control, and thus their decline can adversely affect ecosystem functioning (Philpott et al., 2010).

Ant populations are also at severe risk from climate change. Temperature variations, changes in rainfall, and seasonal patterns might modify the distribution of species, nesting, and foraging. Ants are very sensitive to environmental conditions, and even small changes in climate can affect their survival and reproductive rates. Research has indicated that rising temperatures can displace ant populations and reduce species richness in tropical ecosystems (Dunn et al., 2009; Del Toro et al., 2012).

Change in land use and urbanization are also contributors to the decline in ant diversity. Due to urban growth, habitats are fragmented, and continuous forest habitats are divided into small, isolated patches. This restricts the migration of the ant species and genetic diversity, leading to increased susceptibility to environmental stress and extinction (McKinney, 2008). Moreover, urban habitats usually lack sufficient organic matter and plant cover to sustain the variety of ant species, and they are also notorious for altering ecosystem function, since ants are instrumental in soil formation, nutrient cycling, and biological control. A reduction in the number of ants can then cascade through the forest ecosystem. To address these threats in a sustainable manner and practice conservation, it is important to balance biodiversity and the ecosystem.

6. Conservation Strategies

To protect ant diversity in forest ecosystems, there is a need for a long-term, sustainable solution that will help curb both ecological and human-made threats to the ecosystem. The protection of forest habitats is one of the most significant strategies. Forests provide vital resources such as nesting areas, food supplies, and favorable microclimatic conditions that are essential for the survival of ant colonies. Deforestation can also significantly reduce the diversity of ants and disrupt the ecosystem's balance by degrading these habitats (Hölldobler & Wilson, 1990).

Table 2: Conservation Strategies

S. No.	Conservation Strategy	Description	Expected Outcome
1	Protection of Forest Habitats	Conservation of natural forests and prevention of deforestation	Preservation of nesting sites and biodiversity
2	Promotion of Organic Farming	Use of eco-friendly farming methods without harmful chemicals	Reduced toxicity and improved ant survival
3	Awareness Programs	Educating local communities about the ecological importance of ants	Increased public participation in conservation
4	Sustainable Forest Management	Controlled use of forest resources and prevention of habitat fragmentation	Maintenance of ecological balance
5	Reduction in Pesticide Use	Limiting chemical pesticide application and promoting alternatives	Protection of non-target species like ants

Another important measure is promoting organic farming. Pesticides used in traditional farming often harm non-target organisms, such as ants. Conservation awareness programs are crucial for

preserving soil biodiversity and thus conserving ant populations by educating local communities on the ecological value of ants (Philpott et al., 2010). Conservation awareness programs prove useful in preserving the soil biodiversity of the environment and, as such, in preserving the ant population by educating local communities on the ecological importance of ants (Philpott et al., 2010). People would want to embrace environmentally friendly practices when they realize how ants help form soil, cycle nutrients, and control pests (Folgarait, 1998). Conservation initiatives can only be successful with community participation. Sustainable forest management is an important factor in ensuring ecological balance. It entails the management of forest resources while ensuring that it does not negatively impact biodiversity. Other practices known to maintain stable ant communities include habitat protection by avoiding habitat fragmentation and conserving native vegetation (Andersen, 1997).

7. Conclusion

The forest ecosystem of Bongaigaon district has significant potential to sustain a wide variety of ant communities owing to favorable environmental factors such as an appropriate climate, abundant vegetation, and the presence of organic matter. Ants are very important in maintaining ecological balance by enhancing soil structure, nutrient cycling, and seed dispersal, and also as a natural pest controller. Their environmental roles help maintain the stability and productivity of forest ecosystems, but the growing anthropogenic stresses, such as deforestation, urbanization, pesticide use, and climate change, are threatening ant populations. These might cause habitat loss, a decrease in species richness, and ecosystem-disrupting processes, which is why effective conservation measures are necessary, including habitat protection, sustainable land use, and awareness programs. Long-term monitoring and species-level investigation should become priorities of future research to ensure that ant diversity and the sustainability of forest ecosystems are guaranteed.

References

Andersen, A.N. (1997). Functional groups of ants in relation to environmental stress and habitat. *Journal of Biogeography*, 24(4): 497–507.

Beattie, A.J., & Hughes, L. (2002). Ant-plant interactions and seed dispersal (myrmecochory). *Annual Review of Ecology and Systematics*, 33: 341–368.

Bestelmeyer, B.T., et al. (2000). Field techniques for the study of ground-dwelling ants. *Journal of Insect Conservation*, 4(1): 81–90.

Champion, H.G., & Seth, S.K. (1968). *A Revised Survey of Forest Types of India*. New Delhi: Government of India, pp. 1–404.

Del Toro, I., Ribbons, R.R., & Pelini, S.L. (2012). The ecological importance of ants in ecosystems. *BioScience*, 62(8): 725–735.

Dunn, R.R., et al. (2009). Climatic drivers of ant diversity and distribution. *Ecology Letters*, 12(3): 324–333.

Foley, J.A., et al. (2005). Global consequences of land use. *Science*, 309(5734): 570–574.

Folgarait, P.J. (1998). Ant biodiversity and its relationship to ecosystem functioning. *Biodiversity and Conservation*, 7(9): 1221–1244.

Hölldobler, B., & Wilson, E.O. (1990). *The Ants*. Cambridge: Harvard University Press, pp. 1–732.

Kaspari, M., et al. (2000). Ant diversity across environmental gradients. *Ecology*, 81(8): 2220–2234.

Lach, L., Parr, C.L., & Abbott, K.L. (2010). *Ant Ecology*. Oxford: Oxford University Press, pp. 1–402.

Lavelle, P., et al. (2006). Soil ecosystem services and biodiversity. *European Journal of Soil Biology*, 42: S3–S15.

McKinney, M.L. (2008). Effects of urbanization on species diversity. *Biological Conservation*, 141(10): 247–260.

Philpott, S.M., & Armbrecht, I. (2006). Biodiversity in agroecosystems and ant ecology. *Ecological Applications*, 16(5): 1817–1827.

Philpott, S.M., et al. (2010). Ant diversity and ecosystem services in agricultural landscapes. *Ecological Applications*, 20(1): 79–92.

Ward, P.S. (2014). The phylogeny and evolution of ants. *Annual Review of Ecology, Evolution, and Systematics*, 45: 23–43.