

Ecological Role of spiders in Terrestrial Ecosystem and Their Conservation Priorities.

Abstract

Spiders are members of the phylum Arthropoda, the largest phylum of animal group in the world under the class Arachnida. Spiders are ubiquitous in distribution and invade almost every type of habitat, and are the most abundant invertebrate predators in terrestrial ecosystems. Nearly 47,617 species of spiders under 4,092 genera in 114 families were recorded in the world. Spiders are a key component of terrestrial ecosystems, occupying a unique position in food webs. As predators, they are important in the regulation of invertebrate populations, which include pest species, and as prey they provide food for other invertebrates and birds. They are the important components of food chain. This is notwithstanding the contribution they make to ecosystems in their own right. Spider silk has unique properties that have potential applications in medicine and technology. Many species of spiders have been used as medicines. As bee populations plummet, spiders might be the next solution to the pollination process. Spiders are among the most fascinating creatures on earth, and their importance in scientific research cannot be overstated. Spiders play a critical role in maintaining ecological balance, and studying their behavior and biology can greatly advance our understanding of the natural world. The witnessing role of spiders in terrestrial ecosystem has made them ecologically important. From past few years the spiders are facing number of threats which have affected their populations and diversity. Prior conservation programmes are required to protect this species from being more vulnerable and endangered.

Keywords: Spiders, terrestrial ecosystem, ecosystem services, conservation. Int

roduction

Spiders are members of the order Arachnida, class Arachnida, and subclass Araneae. The biggest order of arachnids, spiders are ranked seventh among all other groupings of organisms in terms of overall species diversity (Cardoso, et al., 2004). Spiders are amazing

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Include more specific findings or conclusions.

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animals; the fossil record shows that they first appeared as living things 380 million years ago, during the Devonian period (Garrison, et.al., 2016). Their body is mainly divided in two segments ~~Their two main body segments are the~~ cephalothorax and abdomen; the former has four pairs of segmented appendages, is wingless, and lacks chewing mouthparts. Spiders were recognized by their distinctive ability to produce silk thread. Although many spiders are incapable of spinning webs, all spiders are capable of producing silk thread, which they employ to form sacs to hold eggs, build nests, and, most often, wrap prey. They make up a substantial percentage of the terrestrial arthropod diversity. Spider diversity can be beneficial for biological control since different species have different hunting tactics, preferred habitats, and activity cycles (Cotes, et.al., 2018). In reaction to concentrations of prey, spiders show both functional and numerical responses. Spiders are ubiquitous in distribution and invade almost every type of habitat, and are the most abundant invertebrate predators in terrestrial ecosystems. Nearly 47,617 species of spiders under 4,092 genera in 114 families were recorded in the world (Mohan, 2019). There are 1520 known species of spiders in India, categorized into 377 genera and 60 families (Dharmaraj, et.al., 2017). One of the most diverse and widespread orders of arthropods in the world is the spider. Among the Arthropoda, arachnids are a significant yet understudied category. Spiders are found as predators in nearly every type of terrestrial ecosystem, with the exception of Antarctica, such as caverns, tundra, high elevations, and intertidal zones (Platnick, 2020). The range of their abundance per square meter is 0.64 to 842 (Turnbul, 1973). They occupy a vast range of niches and, thanks to their amazing diversity of predation techniques, they also serve as important predators that control the majority of the insect population. These characteristics give them a perfect model for community assessments as extraterrestrial predators. With respect to this ecosystem functioning of the spiders, they also have the ability to provide various other protective, regulative and cultural ecosystem services. It is essential that these ecosystem services provided by the spiders should be properly documented. The previous studies have focused on the predator functioning of the spiders, which have been documented for different ecosystems (Michalko, et.al., 2019). But it is essential to report the other ecosystem functions of the spiders. Keeping in view the above discussion in the present study we have provided a brief description about the role of spiders in the terrestrial ecosystem. From past few years spiders have witnessed the drastic climatic changes and other natural climates, which have threatened the spider diversity. Thus in this context, the

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conservation of the spiders is necessary. In the present study we have highlighted the prior conservation strategies for the spiders.

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Research methodology

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Kindly provide scientific context and citation which can strengthen the methodology

The present study is a descriptive study, which uses secondary data to frame out the basic ecosystem services provided by the spiders. The secondary data were collected from different published research papers, review papers, short communications, reports, published PhD thesis, news papers, journals, magazines, blogs, websites, different publishers like Springer, Elsevier, etc. The data was collected and the literature related to the present study was screened and the results were formulated.

Results & discussion

Spiders are obligate predators, meaning they must obtain the energy needed to sustain life by eating other animals (Coppari, et al., 2024). Spiders can prey on a variety of organisms, including other spiders, vertebrates (rarely), and their most common prey type, insects. It is estimated that one spider can eat as many as 2000 insects in one year (Walker 2010). As generalist consumers, many spiders play an important role in each of the communities they are found in by regulating the density of organisms across multiple trophic levels (herbivores and predators). When you combine their variety of food types and their sheer abundance, spiders are one of the most important invertebrate predators in many ecosystems.

Spiders can maintain a dynamic interaction of the ecological units in a micro level food web (Suzuki, et al., 2023). In integrated crop pest management it can serve as an essential element (Nyffeler and Benz, 1987). They are efficient natural controllers of many insect-mediated diseases like malaria, dengue etc (Kwenti, 2017). Spiders being ecologically important are economically beneficial also. In pharmaceutical industries spider silk and venom are now very important industrial inputs (Wong, et al., 2014). Spider silk being proteinaceous and antibacterial in nature with very high tensile strength is not only helpful in spinning web, wrapping the prey, egg sac covering, medium of transportation or movement from one place to another but also for making surgical threads, bullet proof jackets and threads of musical instruments, while its venom is useful as an antidote in many ailments (Umarani and Umamaheswari, 2013). Abundance as well as diversity of spiders is a good indicator of the health of a particular ecosystem (Prajapati et al., 2023).

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It is clear that spiders have important ecological roles in maintaining a healthy and stable community. Spiders also directly benefit humans by consuming prey items that are pests to humans and thus reducing their abundance. Many of the insects that spiders eat are directly affect humans, including mosquitoes, a pest that transmits deadly diseases like West Nile virus, malaria, dengue and yellow fever. While many spiders eat mosquitos that fly into their web, two species of jumping spiders, *Evarchaculicivora* and *Paracyrbawanlessi*, are known as “mosquito terminators.” Both of these species are specialist predators, each preferring to eat mosquitoes from different life stages (adult & nymph respectively; Jackson, et al., 2014). Regardless of how mosquitoes are consumed, spiders that have this pest as a part of their diet directly reduce numbers of these pests and have the potential to reduce the spread of disease.

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There is an ancient proverb: “The enemy of my enemy is my friend.” Agricultural pests directly reduce crop yields by feeding on the plants, robbing their fruit/seed output that we harvest

for food. Spiders indirectly benefit humans by eating of a variety of pests, including aphids, grasshoppers, leafhoppers, beetles, caterpillars (Maloney et al. 2003). Reductions in pest abundance have led to decreased crop damage (Reichert & Bishop, 1984), which could help increase yields. Sadly, farmers spend billions of dollars on non-natural pesticides designed to reduce weeds and insect pests that have been shown to reduce the abundance of spiders in fields, a natural and thus environmentally friendly form of pest control (Maloney et al. 2003, Haughton et al. 1999, Thomas & Jepson 1997), and could end up resulting in a pest resurgence (Tanaka et al. 2000).

Spiders are seen to be kind animals that bring wealth, happiness, and/or good fortune in many cultures around the world (Lake-Thom, 1997). Because they come from heaven above, Chinese people hold a great esteem for spiders and refer to them as “happiness spiders” or “good luck spiders.” It’s reported in India that at weddings, spiders are scattered like confetti! The spider was regarded by the Egyptian goddess Neith as the “spinner” and “weaver” of fate. Spiders are the subject of several mythology and folktales across the globe (Doniger, 2011). These are a few convictions:

- You will meet a friend that day if you step into a spider web.
- You will bring rain if you step on a spider.
- Even if a spider manages to get into your pocket, money will always be there.

- A bride will be happy if she discovers a spider on her wedding gown.
- Anticipate company if a spider weaves a web over your door.
- Sunny weather is on the way as spiders begin weaving their webs before midday.

In the view of scientists and researchers, spiders have already established themselves as model organisms for research and education because of their ability as bio-indicators, biological control agents, having high medicinal value, and architects (Gandy, 2022). In the current era we find that many researchers are involved to prove various biological theories. Thus from this perspective we can highlight that the spiders play a pivotal educational role.

The above discussion has cleared that how spiders play an important regulatory, protective, and cultural role in a terrestrial ecosystem. From past few years it has been reported that the spider population across the globe, is under threat (Samu, 2023). Many species of spiders are extinct, are facing vulnerability, and many species are endangered due to various factors. The major reasons of spider threats are given as under;

- Climate change
- Habitat destruction
- Use of pesticides in agricultural ecosystems
- Environmental pollution
- Introduction of invasive species
- Habitat shifts and ecotones
- Negative people perception
- Lack of people awareness
- Overgrazing and deforestation

Recent data raises the possibility that local and global spider populations are falling, endangering the viability of the ecological services that spiders offer. Since the Neotropics are home to some of the world's hotspots for spider diversity and endemism, losses in the species are especially concerning. One strategy to stop and lessen spider reductions is through conservation legislation, however they are typically skewed in favor of vertebrate species. Here, we address the possible benefits and drawbacks of many important policy tools for the protection of spider biodiversity. These include sectoral policies, biodiversity offsetting, market-based mechanisms, protected

areas and Indigenous and Community Conserved Areas (ICCAs), species-specific action programs, and the international policy instruments that support these initiatives. While these policies may indirectly increase the variety of spider species, there are ways to better address the unique requirements of spiders in policy to slow down the reductions. Assessing the possibility of extinction for additional spider species would enable policymakers to more effectively target at-risk species and protect their habitats through area-based actions. Different approaches to pest management and improved spider monitoring across several land-based production sectors. Incorporating into international agreements and conventions quantifiable and attainable goals for spider conservation. Lastly, the critical roles that increased public knowledge and community involvement had in accomplishing these advancements in spider conservation laws.

Conclusion

Spiders have been regarded as important species from an ecological point of view. It has been reported that spiders provide different ecological services to the terrestrial ecosystem. Some of these services include; act as obligate predators, occupy a specific position in trophic levels of the food web, have reported high medicinal values, bear a wide gene pool, seed dispersal, pollination, integrated pest management, educational value and cultural value. These ecological services have made this species an important one. The spiders are facing serious threats from different factors. This has resulted in the decrease in the spider population. Keeping in view the threats to the spider population, prior conservation programmes are required to save this precious species on the earth.

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