

Species Interdependence and Biodiversity

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Abstract

For the survival of every species, a reliance on compatible counterparts is essential. This compatibility can be examined through various aspects, with food and shelter emerging as the most common yet crucial factors. In the realm of plants, sustenance plays a pivotal role in ensuring survival. Whether it be a tree, shrub, ground cover, creeper, climber, or any other category, the availability of sufficient food is paramount. The prospects of survival are significantly diminished if any part of the plant kingdom lacks ample nutrients. Unlike animals, plants lack internal causes of death or disease, with external forces being the primary contributors to their health deterioration. Maintaining their health is heavily dependent on adequate nourishment, while other factors can be more adaptable. Conversely, in the animal kingdom, both food and shelter are integral to species' survival. Animals require a habitat for various activities such as resting, hiding, reproducing, and even dying. While food serves as a major source for a healthy life, shelter becomes a crucial dependency. Unlike plants, animals cannot produce their food, earning them the title of consumers. They rely on consuming producers, ensuring the survival of their respective species. The Earth hosts an incredible diversity of billions and trillions of plants, animals, microorganisms, and single-cell entities, each differing in shape, size, and color. Across the globe, these organisms choose their habitats based on individual requirements for survival, encompassing needs like food, shelter, climate, temperature, topography, hydrology, geological aspects, and more. Various species exhibit diverse preferences for hosts; some choose a wide array, while others depend on a select few. For instance, small birds like munia select thin grass blades to construct their nests. The foundational plants for these nests may exhibit a bushy structure be it sturdy or not. The insects and seeds preferred by these birds are contingent on their host plants, which serve as both shelter and a food source for insects, as well as producers of seeds.

Keywords: Symbiotic interactions, intricately linked, genetic diversity, interconnectedness, ecological relationships.

INTRODUCTION

Interdependence among different species is a fundamental aspect of the natural world, with various organisms relying on each other for resources, such as food, shelter, and reproduction. Predator-prey relationships and symbiotic interactions contribute to balance and harmony within ecosystems. Biodiversity, encompassing a wide array of life forms, provides essential ecosystem services including pollination, water purification, and soil fertility [1, 2].

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Genetic diversity is pivotal for species' adaptation to environmental changes, disease resistance, and overall resilience. The interbreeding of genetically diverse individuals supports healthy populations and adapts to evolving conditions, thereby ensuring the long-term survival of species.

Human well-being is intricately linked to these ecosystem services as they directly or indirectly support agriculture, clean water availability, and

other critical functions. The delicate web of interdependency among organisms, regardless of their size or perceived significance, underscores the importance of maintaining biodiversity [3].

Species interdependence is unmistakably manifested in intricately balanced relationships between predators and prey, herbivores, and plants, and the multifaceted interactions observed in symbiotic partnerships. These interconnections extend beyond mere survival and play a pivotal role in maintaining equilibrium and regulating populations. This delicate balance is essential for preventing the unbridled expansion of specific species, which might otherwise jeopardize the stability of an entire ecosystem. Figure 1 illustrates the intricate and beautiful relationships among plants, small insects, birds, and animals.

Let us consider the case of *Butea monosperma*, commonly known as *Dhak*. This slow-growing deciduous tree holds significant importance as it serves various purposes, such as timber production, resin extraction, buffalo fodder, medicinal applications, and dye production. Particularly valued for crafting *hawan*-spoons and ladles, its wood is also an excellent source of charcoal.

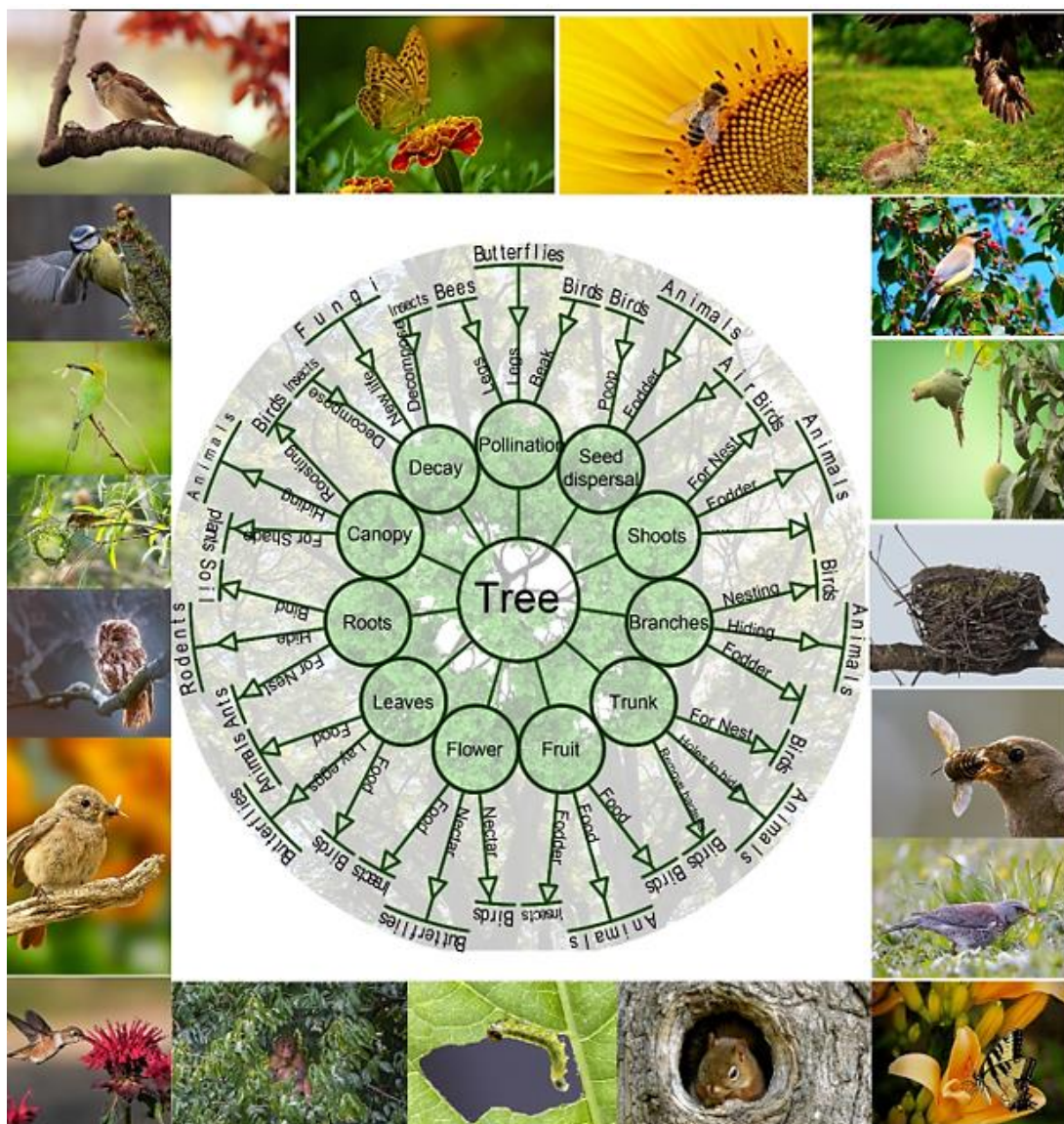


Figure 1. Illustrates the intricate and beautiful relationships between plants, small insects, birds, and animals.

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In addition to its economic use, *Butea monosperma* plays a crucial role in environmental conservation. Trees are instrumental in reducing soil erosion. Furthermore, it serves as a vital host for lac bugs (lac is famous for bangle production mainly in Rajasthan) and provides Butea gum from its bark (gum is used for making *laddoos* in winter in North India), which is widely used in leather tanning. Additionally, its extracts are used for dyeing silk and cotton [4, 5].

The versatility of *Butea monosperma* extends to agroforestry practices, where it is used for seedling cultivation. Green branches of trees are strategically spread in rice fields to act as salt-filter agents and green manure. Another notable property of *Butea monosperma* is its ability to produce slime, which aids in aggregating clay particles. Farmers leverage this characteristic to effectively stabilize field soils. Moreover, tree seeds yield oil with hepatoprotective properties, making it beneficial for addressing liver disorders.

The intricate dance of pollination and reproduction in forests shows remarkable partnerships. Bees, butterflies, and birds seeking nectar inadvertently transfer pollen between flowers, thereby influencing the reproduction of various plant species. This mutualistic relationship exemplifies the interwoven destiny of plants and pollinators, where the success of one directly influences the prosperity of the other.

Seed dispersal mechanisms showcase the cooperative dynamics inherent in forest ecosystems. Various animals, ranging from birds to mammals, play a crucial role by ingesting fruits and subsequently distributing seeds across terrain. This dispersal process not only contributes to the proliferation of plant populations but also safeguards the genetic diversity and adaptability of these species. For instance, certain plants can aggregate clay particles, which is valuable for treating liver disorders. As an illustrative example, bees visit flowers for nectar and inadvertently transfer pollen between them, thereby facilitating the reproduction of numerous plant species. Simultaneously, bees rely heavily on nectar as an energy source, creating a mutually beneficial relationship [6].

The interdependence of organisms within biodiversity resembles an intricate and fragile web, in which every species, regardless of its size or apparent significance, plays a crucial role. In ecosystems, the existence and prosperity of each organism are intricately tied to the presence and actions of others. This interconnection manifests itself in numerous ways, underscoring the significance of preserving a diverse array of life forms.

How Does the Forest Become Home to Interdependency?

The forest becomes home to interdependency through the intricate ecological relationships among its inhabitants. Diverse predators and prey coexist, establishing a delicate balance in the population dynamics. Predators, in particular, play a vital role in controlling herbivore populations and preventing overgrazing, which could have detrimental effects on plant species [7].

In Figure 2, species interdependence is evident in finely tuned relationships within the forest ecosystem. These relationships involve not only predators and prey but also herbivores and plants, as well as various symbiotic partnerships. Beyond mere survival, these interactions contribute significantly to the balance and regulation of populations, preventing the uncontrolled growth of certain species that could disrupt the equilibrium of the entire ecosystem.

An exemplary species within this ecosystem is *Cascabela thevetia*, which has both ecological and medicinal benefits. This evergreen species, with a waxy coat to reduce water loss, is a food source for various creatures such as Sunbirds, Koels, Red-whiskered Bulbuls, Brahminy kites, Common Mynas, Bulbuls, and Common grey hornbills [8].

In Figure 2, the Asian Koel (*Eudynamis scolopaceus*) sustains itself by feeding on the seeds of *Cascabela thevetia*, Figure trees, along with insects, caterpillars, eggs, lizards, and small vertebrates. Koel lays its eggs in crow nests as well as in the nests of other bird species.

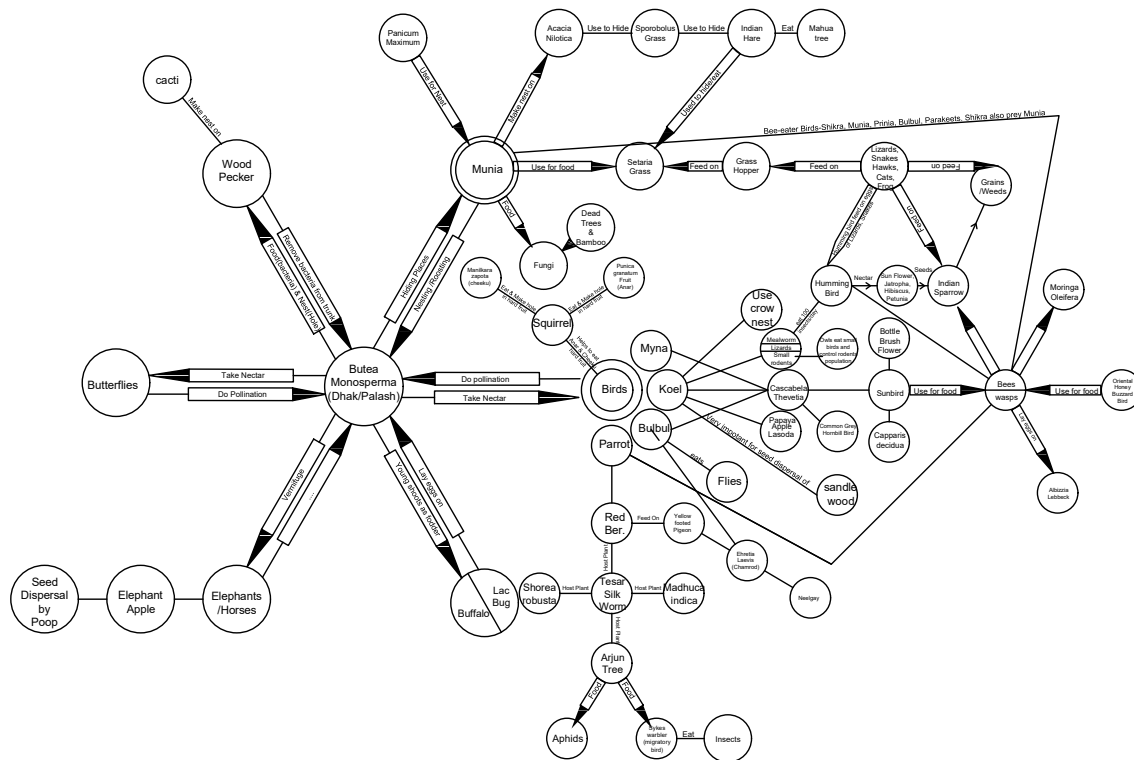


Figure 2. Interdependence of species.

In Figure 2, the Asian Koel plays a crucial role in the dispersal of sandalwood trees. It contributes to the growth of sandalwood trees as the large-seeded fruits quickly sprout near the parent tree. This intricate web of dependencies showcases the interconnectedness and reliance of various species within the forest ecosystem.

Brahminy Myna (*Sturnia pagodarum*), another species that relies on *Cascabela thevetia*, adds to the intricate web of dependencies within the forest ecosystem. Being an omnivorous bird, it consumes fruits and eggs while also residing in tree holes and seasonally feeding on grains. This exemplifies how life within an ecosystem is interlinked, thus forming the foundation of biodiversity.

In the intricate tapestry of biodiversity, certain species have special significance as keystone species within forest ecosystems. These species have a disproportionately large impact on their environment, relative to their abundance. The removal of keystone species can trigger cascading effects that influence an entire ecosystem. For instance, beavers, recognized as keystone species, engineer habitats by building dams, thereby shaping the water flow, and creating new niches for other species.

In forests, organisms often develop specific adaptations tailored to their niches. This specialization allows different species to coexist by minimizing direct competition for resources. For example, plants in the understory may evolve adaptations suited to low-light conditions, whereas those in the canopy employ strategies to capture sunlight efficiently. Birds and mammals contribute to the ecosystem by consuming fruits from trees and dispersing seeds in their feces. This process aids in the dispersal and germination of seeds in new locations, fostering a continuous life cycle within the forest. The intricate dependencies and roles of various species underscore the importance of preserving biodiversity for the overall health and resilience of the ecosystem [9].

In this illustration, the myriad benefits of trees extend far beyond their direct advantages for humans. The cultural significance of trees is deeply embedded in ancient texts, such as Matanga Purana, where their importance is equated with elements vital to life itself.

- 10 wells equal a step well.
- 10 steps will equal a tank.
- 10 tanks equal a son.
- 10 sons are equal to a tree.

According to these scriptures, trees are akin to noble beings, providing shade, sustenance, and shelter without discrimination.

Similarly, they emphasize the noble birth of trees, attributing them as the givers of life to all beings.

The five biggest favors bestowed by trees are fuel to families, shade and rest to travelers, nests to birds, and medicine from their team roots and bark. Now, it has become a never-ending chain and can be seen in forest life and even in anyone's private garden. In a potted plant, as well as in 100s of acres of land.

Viewing this relationship in the reverse manner reveals a delicate balance between species. For instance, insects act as regulators and control the populations of plants and other organisms.

The munia population is managed by predators, such as snakes, birds, and cats, and these predators are regulated by their respective predators. The flow of interactions is reciprocal, creating a dynamic equilibrium in nature.

The Flow is Always Two Ways

In addition to living organisms, the intricate dance of ecosystems involves both biotic and abiotic factors. The soil, climate, and topography interact with plants and animals, shaping the unique characteristics of diverse forest ecosystems. These relationships extend beyond mere survival, as seen in the interconnected flowering and fruiting cycles of plants, influencing bird migration patterns.

Species interdependence manifests itself in various forms, including mutualistic relationships. For instance, mycorrhizal fungi form symbiotic connections with plants, aid nutrient absorption, and receive sugars in return. Ant-plant mutualism showcases how certain plants provide shelter and food to ants, which, in turn, defends plants against herbivores.

The forest ecosystem is characterized by diverse layers, including the canopy and understory, each harboring unique species adapted to their specific niches. In addition to supporting a rich diversity of life, forests also have a significant influence on the water cycle. Through transpiration and evaporation, trees absorb and release water into the atmosphere. This dynamic water exchange not only sustains the forest itself but also contributes to local and regional precipitation patterns.

How do species make it two ways? In ecosystems, the development of interdependencies among species is a dynamic and reciprocal process that involves coevolution and adaptation. The intricate web of relationships and dependencies between species is continually shaped by their ongoing evolutionary interplay. Recognition and communication between species further contribute to the complexity of these interdependent relationships. For example, certain plants release specific chemicals to attract predators that help control herbivore populations, thereby demonstrating a sophisticated form of mutual reliance.

Coevolution is a key driver of interdependence, particularly among closely interacting species. In such cases, species often influence each other's evolutionary trajectory. A classic example is the coevolution between plants and pollinators. Plants may develop specific shapes and colors to attract pollinators, while pollinators, in turn, evolve specialized traits for efficient nectar extraction. This reciprocal interaction results in the mutual shaping of characteristics, enhancing the compatibility and effectiveness of their interdependence [10].

Consider the case of *Euphorbia hirta*, commonly known as the asthma plant. Despite being perceived as a weed by humans, this resilient seasonal plant plays a crucial role in supporting local ecosystems. Numerous small insects and pollinators, including common ants, depend on *Euphorbia hirta* for flowering nectar. This dependence forms the basis of a complex food chain where ants become prey for jumping spiders, which are then consumed by larger spiders, such as wolf spiders, and other significant insects, such as wasps. The cycle extends further and involves lizards that attract birds of various sizes and dietary habits. The continuous cycle of survival and adaptation reflects the perpetual and dynamic nature of ecological relationships that sustain biodiversity.

CONCLUSION

In conclusion, interdependence among species in ecosystems unfolds as a dynamic and reciprocal process involving coevolution, adaptation, and mutual benefit. This intricate web of relationships is far from a one-sided affair; rather, it operates as a two-way street where species shape each other's evolutionary paths and behaviors. Over countless generations, species have forged interdependencies that amplify their efficiency, optimize resource utilization, and contribute significantly to the overall health and stability of ecosystems.

Recognizing the importance of interdependence is of paramount significance in conservation efforts and sustainable ecosystem management. Human activities that disrupt these delicate balances, such as habitat destruction and climate change, can set off cascading effects that impact the entire ecosystem. Therefore, nurturing an understanding and appreciation of the reciprocity inherent in interdependence is fundamental to preserving biodiversity and ensuring the resilience of our planet's ecosystems. As stewards of the Earth, it is our responsibility to safeguard and value the intricate relationships that weave the natural world into a thriving, interconnected, tapestry of life.

Dedication

I dedicate this paper to my children Parv and Parnika. Through this work, I hope to impart the understanding that no one can thrive in isolation; we need the support and companionship of others to succeed.

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