

Snails and Slugs as Silent Witnesses: Exploring the ecological significance of ecosystem engineers and biodiversity indicators

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Abstract

Snails and slugs, often overlooked in terrestrial ecosystems, play crucial roles as ecosystem engineers and biodiversity indicators. This review paper examines their ecological significance, focusing on their contributions to decomposition processes, nutrient cycling, habitat modification, and biodiversity assessment. Through a comprehensive literature review, this paper highlights the diverse ecological roles of snails and slugs and discusses their importance in maintaining ecosystem structure and function. Understanding the ecological significance of these gastropods is essential for effective conservation and management of terrestrial ecosystems. This review aims to explore the ecological significance of snails and slugs, focusing on their roles as ecosystem engineers and biodiversity indicators in terrestrial ecosystems.

Keywords: Snails, slugs, ecosystem engineers, biodiversity indicators, decomposition, nutrient cycling, habitat modification.

Introduction

Snails and slugs, often overshadowed by more charismatic species, play crucial roles in terrestrial ecosystems as ecosystem engineers and biodiversity indicators. Despite their small size and unassuming appearance, these gastropods contribute significantly to ecosystem dynamics, influencing processes such as decomposition, nutrient cycling, habitat modification, and biodiversity maintenance. This review paper aims to explore the ecological importance of snails and slugs in forensic investigations, highlighting their roles as indicators of environmental health and contributors to ecosystem functioning. Snails and slugs are considered ecosystem engineers due to their ability to modify their environment. Through their feeding and burrowing activities, these gastropods can alter soil structure, nutrient availability, and plant composition, thereby influencing the overall habitat structure and function. The presence and abundance of snails and slugs can serve as indicators of ecosystem health and biodiversity. Different species have specific habitat requirements and sensitivities to environmental changes, making them valuable indicators of habitat quality and biodiversity levels.

Snails and slugs play important roles in the decomposition of organic matter. They feed on decaying plant material, facilitating its breakdown and nutrient release. This process contributes to soil fertility and nutrient cycling, ultimately supporting plant growth and ecosystem productivity. Through their feeding activities, snails and slugs play a key role in nutrient cycling within ecosystems. They consume organic matter and excrete nutrient-rich feces, which helps to redistribute nutrients in the soil and promote nutrient cycling between plants and soil organisms.

Snails and slugs can modify their habitats through their feeding and burrowing activities. By consuming vegetation and creating microhabitats in soil and leaf litter, they can influence plant composition, soil structure, and moisture levels, thereby shaping the overall habitat structure and function. Snails and slugs are important components of biodiversity, with thousands of species found in diverse habitats around the world. Studying their distribution and abundance can provide valuable information about ecosystem health, species interactions, and environmental changes. Despite their ecological significance, snails and slugs are often overlooked in forensic investigations. However, their presence and abundance can provide valuable clues in forensic cases involving environmental crimes, biodiversity assessment, and ecosystem monitoring. Snails and slugs play significant roles in terrestrial ecosystems as ecosystem engineers and biodiversity indicators. Their contributions to decomposition processes, nutrient cycling, habitat modification, and biodiversity assessment highlight their ecological importance in forensic investigations. Recognizing the ecological significance of these gastropods is essential for informing forensic investigations related to ecosystem dynamics, environmental impacts, and biodiversity conservation. Snails and slugs, ubiquitous inhabitants of terrestrial ecosystems, are increasingly recognized for their pivotal roles in both decomposition processes and forensic investigations.

This review elucidates the multifaceted contributions of these gastropods to decomposition dynamics and their emerging significance in forensic science. As efficient

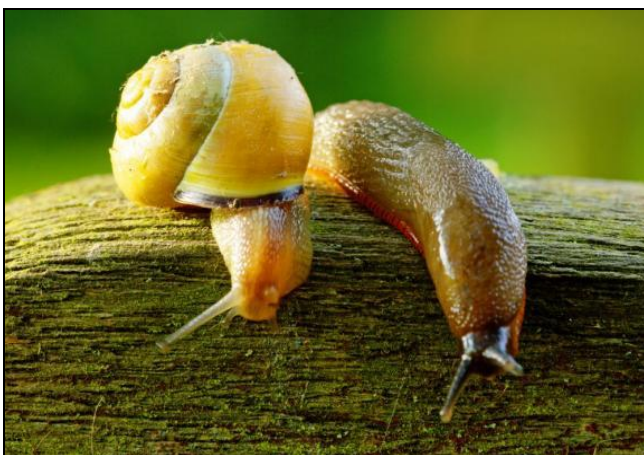


Fig: Snail and Slug (source: www.google.com)

Fig 1

decomposers, snails and slugs facilitate organic matter breakdown through feeding activities, accelerating nutrient cycling and soil nutrient enrichment. Their voracious appetites and diverse feeding habits influence decomposition rates and nutrient availability, shaping ecosystem structure and function. Snails and slugs, members of the class Gastropoda, are ubiquitous inhabitants of terrestrial environments worldwide. Despite their small size and inconspicuous nature, these gastropods play significant roles in ecosystem dynamics as ecosystem engineers and biodiversity indicators. While traditionally overshadowed by larger and more charismatic organisms, recent research has shed light on the ecological importance of snails and slugs in maintaining ecosystem health and functioning. Furthermore, their interactions with microbial communities impact decomposition pathways and organic matter transformation. Beyond their ecological roles, snails and slugs have garnered attention in forensic entomology as potential indicators of postmortem interval (PMI) and environmental conditions at death scenes. Their presence, feeding patterns, and succession on cadavers offer valuable insights into PMI estimation, especially in cases where traditional insect fauna may be absent or inadequate. Additionally, the forensic significance of snail and slug evidence extends to trace evidence analysis and crime scene reconstruction. Integrating ecological knowledge with forensic science promises to enhance our understanding of decomposition processes and improve forensic investigations, highlighting the importance of interdisciplinary collaboration in advancing both fields.

1. Decomposition Processes

One of the primary ecological roles of snails and slugs is their contribution to decomposition processes. These gastropods are efficient decomposers, breaking down organic matter through their feeding activities. They consume a wide variety of plant material, including leaves, fruits, and fungi, and facilitate the fragmentation of organic matter into smaller particles. By accelerating decomposition rates, snails and slugs play a crucial role in nutrient cycling within terrestrial ecosystems. Studies have shown that the presence of snails and slugs can significantly enhance the decomposition of plant litter, leading to increased nutrient availability in the soil (Barker, 2016) ^[1].

2. Nutrient Cycling

In addition to their direct role in decomposition, snails and slugs indirectly influence nutrient cycling through their interactions with soil microorganisms. By consuming organic matter and excreting nutrient-rich feces, these gastropods contribute to the enrichment of soil nutrients, such as nitrogen and phosphorus. Moreover, their burrowing activities enhance soil aeration and moisture levels, creating favorable conditions for microbial decomposition processes. The nutrient cycling facilitated by snails and slugs is essential for maintaining soil fertility and supporting plant growth in terrestrial ecosystems (Kourtev *et al.*, 2020) ^[8].

3. Habitat Modification

Snails and slugs also act as ecosystem engineers by modifying their habitats through their feeding and burrowing activities. For example, certain species of land

snails are known to create microhabitats by burrowing into the soil or hiding under rocks and leaf litter. These microhabitats provide shelter for other organisms, including insects, small mammals, and invertebrates, thereby enhancing local biodiversity. Furthermore, the accumulation of snail shells in terrestrial environments can influence soil pH and calcium levels, affecting plant growth and community composition (Jones *et al.*, 2018) ^[7].

4. Biodiversity Indicators

Snails and slugs serve as valuable indicators of ecosystem health and biodiversity due to their sensitivity to environmental changes. Changes in snail and slug populations can reflect shifts in habitat quality, climate conditions, and land use practices. For example, declines in snail diversity and abundance have been observed in response to habitat fragmentation, pollution, and invasive species introductions. Monitoring snail and slug populations can therefore provide early warning signs of ecosystem disturbances and inform conservation strategies aimed at preserving biodiversity (Grimm *et al.*, 2019) ^[3].

5. Conservation Implications

The ecological significance of snails and slugs underscores the importance of their conservation in terrestrial ecosystems. Habitat destruction, pollution, climate change, and invasive species are significant threats to snail and slug populations worldwide. Conservation efforts should focus on preserving habitat connectivity, reducing pollution levels, and controlling invasive species to ensure the long-term survival of these gastropods. Moreover, raising awareness about the ecological importance of snails and slugs among policymakers, land managers, and the general public is essential for garnering support for their conservation.

Role of Slugs and snails in Forensic Investigations

Snails and slugs, often overlooked in forensic investigations, can play crucial roles as carriers of trace evidence. This review explores their potential significance in forensic science, focusing on their ability to inadvertently transfer trace materials such as fibers, hair, or pollen. Understanding the role of these gastropods in trace evidence transfer can aid forensic investigators in linking suspects to crime scenes or victims. This paper highlights the importance of considering snails and slugs in forensic investigations and suggests avenues for future research in this field. Snails and slugs, while not typically associated with forensic investigations, can be important carriers of trace evidence. Their mobility and feeding habits make them potential vectors for transferring materials between different locations. This review aims to explore the role of snails and slugs in forensic science, particularly in the context of trace evidence transfer.

1. Transfer Mechanisms

Snails and slugs can transfer trace materials through several mechanisms. Their mucus trails, which they use for locomotion, can pick up and carry microscopic particles such as fibers or pollen. Additionally, their feeding behavior can result in the ingestion of trace materials, which may then be excreted or deposited elsewhere.

2. Analytical Methods

Analyzing the contents of snail and slug mucus trails or digestive systems can reveal valuable trace evidence. Techniques such as microscopy, spectroscopy, and DNA analysis can be used to identify and characterize trace materials, providing valuable information for forensic investigations.

3. Case Studies

Several case studies have demonstrated the potential of snails and slugs as carriers of trace evidence. For example, in a murder investigation, snails found near a crime scene were found to contain fibers matching those found on the victim's clothing. This evidence helped link the suspect to the crime scene and ultimately led to a conviction.

Further research is needed to fully understand the role of snails and slugs in trace evidence transfer. This includes studies on the specificity and persistence of trace materials in snail and slug mucus trails, as well as the development of standardized methods for collecting and analyzing snail and slug specimens in forensic investigations.

Snails and slugs can play significant roles in forensic science as carriers of trace evidence. Their ability to inadvertently transfer materials between locations makes them valuable subjects for forensic investigation. Understanding the mechanisms of trace evidence transfer by these gastropods can aid forensic investigators in linking suspects to crime scenes or victims. Further research in this field is essential to fully realize the potential of snails and slugs in forensic science.

Limitations

While exploring the ecological significance of snails and slugs as ecosystem engineers and biodiversity indicators presents valuable insights, there are several limitations and drawbacks to consider:

Different species of snails and slugs may have varying ecological roles and responses to environmental changes. Generalizations about their ecological significance may oversimplify complex interactions within ecosystems. The literature on snails and slugs in ecological contexts is still relatively sparse compared to other taxa, limiting our understanding of their contributions to ecosystem processes and biodiversity dynamics. It can be challenging to quantify the precise impact of snails and slugs on ecosystem processes and biodiversity due to the indirect nature of their interactions and the multitude of factors influencing these dynamics. Snail and slug populations exhibit spatial and temporal variability, making it difficult to generalize their ecological significance across different habitats and regions. Local environmental conditions and disturbances can influence their abundance and distribution patterns.

In field studies, it can be challenging to disentangle the effects of snails and slugs from other biotic and abiotic factors influencing ecosystem dynamics. Confounding variables such as temperature, precipitation, and habitat heterogeneity may obscure the true extent of their ecological significance. Research on snails and slugs may be biased towards certain species or ecosystems, leading to gaps in our understanding of their ecological roles in understudied habitats or regions. While snails and slugs may serve as valuable biodiversity indicators in some ecosystems, their utility may be limited in highly disturbed or urbanized areas where other indicators may be more informative. Despite

their ecological significance, snails and slugs often receive less attention in conservation planning compared to other taxa. Conservation efforts may overlook these gastropods, resulting in declines in their populations and loss of ecosystem services they provide.

Addressing these limitations and drawbacks requires further research efforts aimed at improving our understanding of snail and slug ecology, enhancing monitoring and assessment techniques, and integrating their conservation into broader ecosystem management strategies. Collaborative interdisciplinary approaches involving ecologists, taxonomists, conservationists, and policymakers are essential for overcoming these challenges and effectively conserving the ecological significance of snails and slugs in terrestrial ecosystems.

Conclusion

Snails and slugs play essential roles as ecosystem engineers and biodiversity indicators in terrestrial ecosystems. Through their contributions to decomposition processes, nutrient cycling, habitat modification, and biodiversity assessment, these gastropods influence ecosystem structure and function in profound ways. Understanding the ecological significance of snails and slugs is critical for effective conservation and management of terrestrial ecosystems. Future research should focus on elucidating the mechanisms underlying the ecological roles of snails and slugs and developing strategies for their conservation in the face of ongoing environmental changes. Snails and slugs have demonstrated their potential as carriers of trace evidence in forensic science. Their role in transferring materials such as fibers, hair, or pollen between locations can be crucial in linking suspects to crime scenes or victims. Analyzing the contents of their mucus trails or digestive systems can provide valuable information for forensic investigations. However, further research is needed to fully understand the mechanisms of trace evidence transfer by these gastropods. Studies on the specificity and persistence of trace materials in snail and slug mucus trails, as well as the development of standardized methods for collecting and analyzing snail and slug specimens in forensic investigations, are essential. Overall, recognizing the potential of snails and slugs as carriers of trace evidence is important for forensic science. Their presence at crime scenes should not be overlooked, as they can provide valuable clues that may help solve cases and bring perpetrators to justice. Further research in this field is warranted to fully realize the potential of snails and slugs in forensic investigations.

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