Unveiling the evolution of ecological crisis concepts: from origins to current perspectives

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Abstract. The concept of ecological crises has evolved significantly over time, reflecting changing interactions between society and nature. Historically, various stages of environmental impact have shaped our understanding of ecological crises, from early human activities to modern industrialization. This study aims to analyze the theoretical sources related to the emergence and development of ecological crisis concepts. It explores the periodicity of significant stages in the interaction between human societies and natural ecosystems and examines the reasons behind these crises. The research involved a comprehensive review of theoretical literature and historical records on ecological crises. The analysis focused on identifying key stages in the evolution of ecological crisis concepts and their implications for both natural ecosystems and human societies. The study reveals a pattern of increasing disruption in ecosystems due to human economic activities and resource exploitation. It highlights how past crises differ from contemporary ones in scope and impact, with modern crises being characterized by more profound global environmental degradation. The findings underscore the need for a complete assessment of ecological crisis reasons to better understand their origins and impacts.

1 Introduction

The evolution of ecological crisis concepts reflects the intricate interplay between literature, society, and nature across different historical periods. These concepts have been shaped by diverse approaches that highlight the mutual influences between societal development and biosphere dynamics. Understanding the ecological crisis involves recognizing the distinct mechanisms of societal and biospheric evolution and how they interact.

Historically, the evolution of ecological concepts has emphasized the need to address both societal and environmental issues in tandem. This approach underscores the importance of analyzing socio-economic formations in relation to natural processes and limitations. Such analysis helps to uncover the stages of ecological crises and offers insights into potential solutions.

The evolution of these concepts can be viewed through several distinct stages:

a) Pre-Industrial Culture Stage This period includes early human activities such as hunting, gathering, and agrarian economies, where environmental impacts were relatively localized and less severe.

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b) Industrial Culture Period. The onset of industrialization marked a significant shift, with increased environmental degradation due to industrial activities, urbanization, and resource exploitation.

c) Post-Industrial Culture Era. In this era, there is a growing recognition of ecological crises and a push towards sustainability and environmental stewardship. Current perspectives focus on addressing the legacy of industrial impacts and developing strategies for ecological balance and resilience.

These stages illustrate the evolution of our understanding of ecological crises and underscore the importance of integrating environmental considerations into socio-economic development strategies.

2 Materials and methods

The relationship between organisms and their environment has been recognized since ancient times. The classical philosophers Aristotle (384-322 BC) and Theophrastus (371-287 BC) provided the first information on the relationship between animals, plants and their habitats. Aristotle studied the behavior of about 500 species of animals, while Theophrastus studied the growth of plants in relation to climate and soil conditions.

The term "ecology" itself was not used much later. Instead, early thinkers focused on concepts related to the interaction between organisms and their environment. The foundations of ecological thinking can be found in ancient Greek and Indian texts such as the Avesta and the Indian epics the Ramayana and the Mahabharata, which discuss the relationship between animals, plants and their environment.

In the Middle Ages, Central Asian scientists, including Al-Farghani (9th century), Beruni (973-1048), Ibn Sina (980-1037), made a great contribution to the understanding of nature and its laws. They studied the environment, focusing on the interrelationships between environmental factors.

The development of ecological science in the present period was determined by the activities of European naturalists and scientists. Individuals such as Francis Bacon (1561-1626), Carl Linnaeus (1707-1778), and Jean Baptiste Lamarck (1744-1829) promoted the study of natural systems and their components. In the 19th and early 20th centuries, significant changes occurred in the work of scientists such as Alexander von Humboldt (1769-1859) and Ernst Haeckel (1834-1919), who contributed to the formalization of ecology as a separate scientific discipline [1-12].

In the 20th century, scientists such as Charles Elton (1927) and D.N. Kashkarov made major contributions to ecology and continued to study ecosystems and their dynamics. The Kashkarov-Karovin school in Uzbekistan, headed by D.N. Kashkarov and his colleagues, played a decisive role in promoting ecological research in Central Asia. This school remains influential in the field of ecology.

Ecology has developed as a multidisciplinary field that integrates knowledge from various disciplines, including biology, geography, and environmental science. Contemporary ecological studies emphasize the interconnectedness of organisms and their environments, focusing on issues such as climate change, biodiversity loss, and ecological sustainability.

The evolution of ecological concepts highlights the growing recognition of the need for integrated approaches to understanding and solving environmental crises. Historical perspectives combined with contemporary scientific research provide valuable insights into ongoing challenges and potential solutions to environmental sustainability.

3 Results

The development of ecological science can be divided into distinct periods, each characterized by different approaches to studying the environment and its complexities. These periods reflect the evolving understanding of ecological concepts and the relationships between organisms and their environments. The classification of these periods provides insights into how ecological science has progressed over time. The main periods can be summarized as follows (table 1):

Table 1. The main periods

Period	Description
1. Observation and Description	The initial era focused on the observation and description of nature, including the relationships between living organisms and their environments. This period was characterized by the early documentation of natural phenomena and the basics of ecological interactions.
2. Ecosystem Study	This era marked a shift towards studying living organisms within their environments, focusing on entire functional systems or ecosystems. Researchers began to examine the interactions between different species and their roles within ecosystems.
3. Mutual Relationships	The focus expanded to include the study of mutual relationships among ecosystems. This period emphasized understanding how various ecosystems interact and influence one another.
4. Biosphere Study	The concept of the biosphere emerged, which includes all living organisms and their environments on Earth. This era involved studying the biosphere as a whole system and understanding the global scale of ecological interactions.
5. Noosphere Era	The latest period introduced the concept of the noosphere, which emphasizes human influence and cognitive processes in the biosphere. This era reflects on how human activities impact the biosphere and the need for sustainable management.

Key Concepts in Ecology:

autecology - derived from the Greek word "autos" meaning "self," autecology focuses on the study of individual species and their adaptation to specific environmental conditions. This branch examines how organisms interact with their immediate surroundings and how they adapt to environmental changes;

population ecology - the term "population" (from French "population") refers to the study of population structure and dynamics. Population ecology investigates how the number and biomass of organisms in a population change over time and the factors influencing these changes;

synecology - from the Greek word "syn," meaning "together," synecology studies the structure and properties of biocenoses (communities of organisms) and their interactions with their external environments. It focuses on the relationships among different species within a community and their collective impact on the environment;

ecosystem ecology - this area involves studying ecosystems, which are systems comprising living organisms and their interactions with the physical environment. Ecosystem ecology seeks to understand the functioning and development of ecosystems as a whole, including energy flow, nutrient cycling, and ecological processes.

The progression through these periods illustrates the growing complexity and depth of ecological science, from early observations to comprehensive studies of global ecological systems. Each period has contributed to our current understanding of ecological crises and the need for integrated approaches to environmental management and conservation.

4 Discussion

In ecological literature, the study of ecology has evolved from a purely biological perspective to incorporate a broader array of scientific disciplines. Historically, ecology was divided into four main branches:

global ecology - focuses on the ecosphere and biosphere, examining global environmental processes and their impacts;

synecology - investigates ecosystems and their interactions, including the study of ecosystems as a whole;

demoecology - concerned with population ecology, studying how populations of organisms interact with their environment;

autoecology - deals with the physiology, biology, and molecular aspects of individual organisms.

As modern science and technology have advanced, the concept of ecology has expanded beyond these traditional boundaries. This evolution has introduced new fields such as **Human Ecology**, which examines the relationship between humans and their environment. Human Ecology, a term first introduced by American scientists Borges and Park in 1921, initially focused on medical aspects but has since expanded to include social, technical, administrative, economic, and legal dimensions.

Social Ecology, a subset of Human Ecology, was further developed by Roderick McKenzie. He defined it as the study of the relationships between individuals and their environments, emphasizing the social aspects of these interactions. This interdisciplinary approach integrates various scientific, moral, aesthetic, political, and legal dimensions, reflecting the need for a holistic understanding of ecological issues.

Ecology today is not just a natural science but also encompasses elements from social sciences, including philosophy, economics, law, and sociology. This integrated approach seeks to address environmental challenges through a combination of natural and social scientific perspectives. The main objectives of contemporary ecology include:

- Understanding the laws of organization and function of life, including anthropogenic impacts on natural systems and the biosphere.
- Developing scientific principles for the rational use of natural resources and managing human activities to minimize negative impacts on nature.
- Regulating population numbers and managing agro-industrial chemical tools to optimize productivity.
- Determining ecological indices for landscape elements and assessing environmental contamination.
- Restoring degraded natural systems, such as recultivating abandoned fields, pastures, and water bodies to improve ecosystem productivity.
- Conserving reference areas of the biosphere and improving environmental quality through technical, legal, and organizational measures.
- Facilitating adaptation tools for industrialized and heavily populated regions to mitigate environmental changes.
- Preventing and reducing the impact of dangerous natural and man-made events on people and nature.

• Enhancing ecological awareness, culture, and education, and promoting public information on environmental issues.

The evolution of ecological concepts reflects a growing recognition of the complex interplay between natural and human systems. Today's ecology aims to provide comprehensive solutions to environmental challenges, integrating scientific knowledge with social considerations to foster a more sustainable and resilient relationship between humanity and the environment.

5 Conclusions

The ecological crisis represents a profound threat to both social stability and ecological balance. Despite various efforts, the state's responses have often fallen short, and environmental issues continue to escalate.

State Responses and Theoretical Perspectives:

State's Role and Efficacy: Critics argue that the state has not adequately addressed the ecological crisis, failing to create an environment of peace and stability for its citizens. The prevailing state models have struggled to meet the challenges posed by environmental degradation.

Ecoliberals, building on Lockean principles, highlight that unlimited growth, industrialization, and overconsumption are primary causes of environmental issues. They advocate for significant reductions in growth and consumption to mitigate the crisis. However, given the finite nature of Earth's resources, these measures alone may be insufficient to sustain long-term ecological balance.

In contrast, eco-authoritarians propose a Hobbesian approach, advocating for a strong, centralized government with limited democratic oversight to address environmental problems. This model, though stringent, fails to align with contemporary democratic values and may not effectively address ecological needs.

The green state perspective suggests that the state can transform to become more environmentally oriented through changes in its functions and priorities. However, the feasibility of such a transformation before reaching irreversible environmental damage remains uncertain.

Economic and Environmental Dynamics:

The capitalist mode of production often exacerbates environmental issues by extracting natural resources and converting them into waste, leading to irreversible damage. This system prioritizes growth and market value over ecological sustainability, separating natural assets from their ecological functions and contributing to increased inequality and environmental pressure.

The economic sphere increasingly influences the political sphere, often prioritizing market interests over environmental protection. This dynamic hinders genuine environmental efforts, as the free market is often protected at the expense of ecological considerations.

The state, despite its claims of neutrality, often aligns with the ruling class's economic interests rather than focusing on the public good. This bias undermines efforts to address environmental issues comprehensively.

The need for a green transformation that aligns with ecological principles is evident. This transformation should prioritize environmental needs over economic growth and consider non-economic aspects of development. Achieving such a transformation requires a combined effort in both environmental and class struggles, advocating for a system that genuinely integrates ecological sustainability with social equity.

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