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The Eurotetic Approach in Ecocriticism

El enfoque erotético en ecocrítica

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Abstract

This article proposes an erotetic approach to define the ecocritical research program, analyzing the interrelationship between the conceptual frameworks of ecology and literary critical theory. A common structure based on problem agendas is suggested, enriching both scientific practice and teaching. The main objective is to demonstrate how the formulation of questions significantly contributes to the creation of open problem agendas that guide research, fostering the development of new hypotheses and promoting interdisciplinarity in research programs facing ecological challenges. The methodology includes a review of the theoretical structure of ecocriticism and how problem agendas provide methodological flexibility, allowing for the reformulation of questions as new data, technologies, and approaches emerge. The results highlight the importance of questioning in environmental sciences to redefine new research agendas, integrating conceptual frameworks not unified by a central theory. Ecocriticism is framed as a research program structured erotetically, much like ecology. The conclusions emphasize the interdependence between questions, problem agendas, and critical reflection on the scientific method, underscoring the creativity and utility of questioning and abductive hypotheses for a more suitable scientific practice, aligned with the urgency of the ecological crisis.

Keywords

Erotetic Organization, Problems Agenda, Ecocriticism, Interdisciplinarity, Ecological Crisis.

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Resumen

Este artículo propone un enfoque erotético para definir el programa de investigación ecocrítico, analizando la interrelación entre los marcos conceptuales de la ecología y la teoría crítica literaria. Se sugiere una estructura común basada en agendas de problemas que enriquecen, tanto la práctica científica como la enseñanza. El objetivo principal es mostrar cómo la formulación de preguntas contribuye de manera significativa a la creación de agendas de problemas abiertos que guían la investigación, fomentando el desarrollo de nuevas hipótesis y promoviendo la interdisciplinariedad en los programas de investigación ante los desafíos ecológicos. La metodología incluye una revisión de la estructura teórica de la ecocrítica y de cómo las agendas de problemas aportan flexibilidad metodológica, permitiendo reformular preguntas a medida que surgen nuevos datos, tecnologías y enfoques. Los resultados destacan la importancia de los cuestionamientos en las ciencias ambientales para redefinir nuevas agendas de investigación, integrando marcos conceptuales no unificados por una teoría central. La ecocrítica se configura como un programa de investigación estructurado de manera erotética, al igual que la ecología. Las conclusiones subrayan la interdependencia entre preguntas, agendas de problemas y la reflexión crítica sobre el método científico, enfatizando en la creatividad y utilidad de los cuestionamientos e hipótesis retroductivas, para una práctica científica más adecuada y ajustada a la urgencia de la crisis ecológica.

Palabras clave

Organización erotética, agenda de problemas, ecocrítica, interdisciplinariedad, crisis ecológica.

Introduction

In a world marked by ecological devastation, it is essential to reconsider the issues and questions that guide our educational and research practices. Ecocriticism is a science that investigates the relationship between literature and the environment, however, it lacks a defined theoretical structure and a consensus scientific status. We propose to define ecocriticism as a research program structured erotetically, i.e., organized around a set of ecoevolutionary and sociocultural problems served by various conceptual frameworks. This erotetic approach, based on the conceptual structure of modern ecology, focuses on the formulation of questions and the elaboration of lists of problems, fundamental tools to improve the structure and utility of this discipline in constant dialog with research programs such as standard evolutionary theory or developmental biology (Kleiner, 1970, pp. 162-163; Love, 2014). By linking the agendas of ecological and environmental problems with different conceptual frameworks, we can foster a more dynamic scientific practice adapted to current needs. As Berkes (2004) says "the failure of exclusionary conservation approaches, which often ignored livelihoods and local knowledge, led to the emergence of 'participation' and 'community' as central concepts in conservation projects" (p. 621). This highlights the importance of involving local communities in the design of action, education and research agen-

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das, adapting these initiatives to the specific contexts and needs of each environment, which favors a more inclusive and effective science.

The main objective is to demonstrate how question agendas guide research in ecology and ecocriticism, facilitating the development of new hypotheses and promoting transdisciplinarity. As Julie T. Klein (2019) points out, "transdisciplinary and transnational rethinking of borders is broadening the scope of both interdisciplinarity and literary theory" (p. 1). The same author, elsewhere, points out that this level of integration in "transdisciplinary" education and research is associated with an integrative reorganization. In schools, it is reflected in models such as "curriculum integration", where disciplinary boundaries are blurred and connections amplified, compared to a kaleidoscope, where varied images produce a new design complexity (Klein, 1990, p. 13). Thus, integration becomes the central objective of education, not only as a tool, but as a principle that guides its practice. Similarly, in university research and programs, transdisciplinary approaches connect with integrative frameworks that transcend disciplinary boundaries, encompassing fields such as systems science, political science, feminism, cultural criticism, ecology, and sustainability. Here it is argued that ecocriticism should be organized as an erotetic research program, based on agendas of open questions that guide research, promote interdisciplinarity and allow to address more effectively complex ecological and socio-environmental problems.

The agendas also integrate marginal concepts that are often left out of traditional scientific approaches (Funtowicz and Ravetz, 1993). Erotetic structuring in research programs stimulates multidisciplinary collaboration to solve problems not addressed in standard models. It also highlights the teaching of question-asking and the development of local agendas to socialize environmental concerns (Holling, 2001, p. 392). This integration of transdisciplinary thinking offers more effective tools for tackling complex challenges in fields such as ecology, where the boundaries between the natural and the social become increasingly blurred.

The accelerated and irremediable damage facing the planet's biomes challenges the ability of our scientific and educational structures to adapt and respond effectively. Literary criticism does not have definite theoretical structure. Ecocriticism is understood as an interdisciplinary approach to a field populated with cultural and environmental phenomena urged in the literature. However, this approach has a double risk. On the one hand, lacking a recognizable scientific structure, it may lose contact with better structured research programs in natural sciences such as ecology, evolution or bioclimatology. On the other hand, when formulated with a literary

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and sociological foundation, ecocriticism could lose its interdisciplinary focus and develop as a subprogram of critical theory, of the theory of literature or of another theory on the basis of any environmentalism.

In both cases, ecocriticism could lose its theoretical potential and decay into intellectualized or stylistic descriptions of ideological discourses. This is a dilemma. Without the scientific structure offered by a research program, ecocritical theory would be at the mercy of some arbitrariness. Whereas, with a scientific structure tailored to the exact sciences research programs, ecocriticism would be doomed to remain outside the boundaries of scientific demarcation. It is necessary to adopt an intermediate position, by virtue of which ecocriticism consolidates its theoretical structure and at the same time, making use of it, can interact on an equal basis with any other science emphasizing its own progressive character.

In this context, philosophical reflection in environmental science should focus on concrete problems agreed from a common critical perspective, rather than addressing abstract questions derived from general theories or isolated frameworks of justification. Programs such as ecology or ecocriticism should not rely on centralized conceptual frameworks that do not always reflect the complexity of ecological problems. As Ostrom (2009) say "a common classification framework is necessary to facilitate multidisciplinary efforts towards a better understanding of complex ecological systems" (p. 420). This underscores the importance of developing more flexible and collaborative conceptual structures to address ecological challenges from a transdisciplinary perspective. Modern ecology has shown itself to be *quasi-independent* of the deep assumptions of evolutionary theory, coexisting without intention to disprove it. Similarly, ecocriticism can develop in a way that is not strictly dependent on literary theory, critical theory or ecological discourses, although collaborating and coexisting with them. This poses significant challenges: how to make science and teaching in fields such as ecology and ecocriticism more relevant and better adapted to their specific contexts? (Holling, 2001; Gotts, 2007) How to maintain the interdisciplinarity between ecology and ecocriticism without falling into superficial generalities? How can this theoretical field be structured so that ecocriticism functions as a research program in its own right?

We argue that problem agendas are essential to guide research and teaching in ecocriticism. By focusing on the formulation and adaptation of questions, we can improve the relevance and effectiveness of our scientific and educational practices (Nowotny *et al.*, 2001, p. 183). This erotetic approach facilitates the development of new hypotheses, promotes trans-

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disciplinarity and integrates marginal concepts (Pickett *et al.*, 2007, p. 11), in addition to using heuristic tools, such as representations and metaphors, that improve our understanding of reality at a decisive moment for the planet. By structuring an ecocritical research program erotetically, we can dispense with core theories and focus on organizing problems according to the contexts of discovery and participation, aligning them with environmental priorities.

The rationale for this study lies in the urgency of addressing ecological devastation effectively and adapted to local and current contexts. Erotetic logic can offer a useful tool to understand the structure and evolution of the sciences, clarifying which questions are valid under different paradigms and how they influence research (Kleiner, 1970, pp. 162-163). Question agendas can offer a flexible and dynamic framework needed to significantly improve understanding of socioecological dynamics (Folke *et al.*, 2005, p. 441), scientific practice in environmental sciences (Hourdequin, 2024), and ecocritical activity (Oppermann, 2006). The relevance of the erotetic approach (Werner, 2022) becomes evident when considering the need to integrate different disciplines and perspectives to address complex and specific problems (Rosenfield, 1992; Schrot *et al.*, 2020). In addition, the ability to adapt ecological and ecocritical research programs to new challenges and contexts is crucial in a changing world (Carpenter *et al.*, 2009). The suggested erotetic organization for ecology and ecocriticism allows focusing on the strategies of scientific discovery (Rivadulla, 2010), the practice and teaching of the sciences, maintaining an epistemic perspective attentive to the contexts that predispose to discovery (Reichenbach, 1938; Peirce, 1955) and also from a sociocultural perspective in local contexts that facilitate the expression of ecological concerns through the creative enunciation of emerging problems.

The methodology used in this article is a theoretical review of the conceptual frameworks and research programs that underpin ecological and ecocritical studies. This review examines how question agendas provide methodological flexibility and are adapted to various conceptual frameworks and research programs (Holland, 1995; Gotts, 2007). The inductive method is compared with deduction and abduction, emphasizing the relevance of the latter, together with "retroduction", in the formulation of questions and in the development of new hypotheses. In addition, it highlights its key role in the generation and sustaining of discovery contexts, which are fundamental to advance scientific knowledge (Rivadulla, 2010). Through a review of literary, cultural, environmental and ecologi-

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cal theories, we define the erotic structure of ecology and ecocriticism as research programs in constant dialog.

The article is structured in three parts. The first part explores the fundamental concepts, defines the organization of the sciences from an erotetic perspective and analyzes the importance of asking questions and how they contribute to the development of problem agendas. A connection is established between erotetic structuring and scientific research programs, highlighting the relationship between questions, problems, feedback and the context of discovery. In the second part, the erotetic approach is used to understand ecology and ecocriticism as theoretical structures, identifying common elements in their agendas. The importance of a current and specific scientific practice, which recognizes the dialectical way by which standard research programs become erotetic research programs, is underlined. It will address the idea that ecology and ecocriticism, lacking a central theory, integrate multiple conceptual frameworks and address a plurality of problematic aspects, which makes them a reference for ecosystem sciences, as well as for cultural and literary sciences. Finally, in the third part, the ecocritics as a research program is analyzed as a theoretical structure specifying the hard core, the protective area and the positive and negative heuristics, defining some conceptual frameworks and current problematic agendas in ecocritics.

Questions, problems and ecological agendas under construction

Questions, problems and problem agendas play a central role in the structure and evolution of scientific research. Philosophy of science suggests adopting an "erotetic organization" approach to emerging research programs, focusing on the formulation and resolution of interrelated questions, rather than focusing solely on the confirmation or refutation of theories (Kleiner, 1970; Brożek, 2015; Werner, 2022). The problematic agendas function at multiple levels in the hierarchy of objects of study, offering an organizational structure based on the nature of the problems and questions investigated, promoting methodological flexibility and transdisciplinarity.

Scientific questions seek knowledge about specific phenomena and can be empirical or theoretical (Love, 2014, p. 47). They are not isolated curiosities, but seek to deepen the understanding of complex natural or sociocultural systems. Formulating problem agendas around ecoevolutionary and sociocultural interactions is critical to developing strategies

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for ecosystem conservation and preservation. These agendas underpin the structure of the ecocritical research program, which provides hypotheses and guidelines for action on emerging issues. Questions about the phenology of a tree are not limited to its isolated flowering or fruiting, but relate this process to the phenology of the entire system, including the sociocultural subsystem.[1] Questions about the coexistence relationships in the biological community of the tree niche are explored, considering the organism as part of a community network. Some questions will concern symbiotic relationships, energy flows and biogeochemical cycles, or local aspects in a specific ecological and socio-environmental context. For example, what are the ecological actors involved in these phenological events? What is the relationship between the flowers and fruits of this tree and other organisms? How does deforestation and mining affect this biological community?

Some questions are resolved with basic or exploratory documentary research, while others address issues with no current resolution. Questions should avoid triviality and orbit around a coherent structure based on prior scientific knowledge. Problem agendas guide research within a specific field, helping to define priority topics and organize existing knowledge, facilitating the development of new theories and experiments. As Love (2014, p. 15) indicates, for the case of developmental biology as an erotetic research program, problem agendas act as units of scientific organization not as individual questions.

At the intersection of biological and political aspects, various ecoevolutionary and sociocultural issues for ecocriticism appear. An agenda issue may address the lack of knowledge about the symbiotic and ecoevolutionary relationships of a tree, or the need for governance and citizen participation to contain illegal exploitation of forest resources. The agenda will also reflect on the natural and anthropological history of the ecosystem and establish interdisciplinary contacts. In the face of the degradation of ecosystem processes, symbiotic and ecoevolutionary relationships will be addressed, extending the local agenda towards regional agendas.

In addition, the problem agenda will recognize the intrinsic value of flowering and fruiting processes as eco-evolutionary, ethical and aesthetic processes that enrich the ecosystem and promote the eco-physiological health of humans, animals and ecosystems. These cases are part of various conceptual frameworks, requiring a coherent research structure. Eco-evolutionary and eco-critical agendas are central, and other areas of study will share problems and work interconnected. Evolutionary biology will establish adaptive principles, bioclimatology will assess the

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impact of threatened species, while jurists, engineers and environmental educators will develop strategies that will cohere the community and demand political, economic and judicial measures. Artists and literati will also highlight the ethical and aesthetic value of the eco-evolutionary process in literature, art and tradition. Ecocriticism will warn of the danger of the disappearance of a plant, which drags processes and values destabilizing the socio-cultural structure of the ecosystem.

The fundamental characteristics of the erotetic organization are: heterogeneity, historical stability, connectivity, hierarchy and epistemological accessibility (Love, 2012, 2014; Nickles, 1981, p. 15; Bromberger, 1992, p. 20). Questions on a problem agenda include empirical, theoretical, and speculative questions that fluctuate between different levels of organization (heterogeneity). For example, what are the historical and socioeconomic factors that define the distribution and interaction between niches in an ecosystem?, and how do these factors affect different levels of the ecosystem such as biomes, communities, or populations?

The questions are interconnected in the agenda, structuring long discussions (historical stability) and connected transversely between different types of phenomena, producing a network of interrelated problems (connectivity). For example, what is the relationship between the loss of Andean glaciers and fluctuations in river flows?, and how do variations affect socioeconomic and cultural relationships in the context of popular celebrations?

Questions are organized with a dynamic subordination (hierarchy), allowing problems to be addressed at different levels of abstraction and temporality, providing a clear organizational framework for research and education (epistemological accessibility). For example, in a debate about environmental policies in the face of problems such as institutional corruption, questions about seed pollinators and dispersers are subordinated to conservation strategies and anti-corruption policies. In a context of institutional transparency with optimal governance and environmental protection, the phenological problem can be addressed from its aesthetic consequences in poetry and art.

Contexts of discovery and formulation of abductive hypotheses in the Anthropocene

Questions lie at the base of our knowledge, all discovery and utterance occur in response to some kind of question (Collingwood, 1940, p. 23). This erotetic priority, although manifest in scientific logic, does not play a

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fundamental role in standard research programs, where experimental corroboration or refutation is paramount. However, in emerging contexts, research programs must address eco-evolutionary and socio-cultural issues in a flexible manner, using multiple conceptual resources to clearly identify problems and establish urgent hypotheses.

In this sense, emotions play a crucial role in both research and educational processes. Desire and enthusiasm, key components of educational emotional architecture, are essential not only to initiate, but also to keep these processes active and effective (Pérez, 2024, p. 55). Enthusiasm not only protects the emotional health of researchers and teachers, but also stimulates discovery and promotes the creation of new questions, essential elements to face complex problems such as the climate crisis and ecological devastation. In this way, the emotional dimension not only complements scientific logic, but strengthens research in areas where creativity and question generation are as important as experimental validation.

The experimentation and formulation of alternative hypotheses consolidate the scientific structure, although with some delay and commitment to keep the theoretical core intact in the face of emerging problems. The devastation of ecosystems not only changes planetary climate physiology, but also impoverishes the environment biologically and aesthetically. This global change can be approached scientifically from local and immediate perspectives, without conflicting with traditional scientific structure. Problem agendas must assume the centrality of new programs with erotetic structure and pluralistic research approach to avoid a split between mature scientific theory and the necessary pragmatic flexibility.

The process of scientific inference offers logical methods of knowledge: deduction, induction, and abduction. These processes do not operate in isolation, and various models of interaction exist (Hanson, 1958). The hypothetical-deductive model describes the scientific method as a cyclic and recursive induction-deduction process, where hypotheses are formulated to be confirmed or refuted by experimentation (Popper, 1959; Hempel, 1965). This cycle of scientific knowledge is developed in three contexts: discovery, justification and experimentation (Reichenbach, 1938; Schickore & Steinle, 2006). The context of discovery, associated with inductive logic, focuses on the generation of new hypotheses and theories. Here, abductive reasoning is crucial, allowing the formation of explanatory hypotheses from surprising facts (Peirce, 1955; Rivadulla, 2010, p. 120). The erotetic structure facilitates the incorporation of facts that trigger abduction, driving the creation of hypothe-

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ses. The justification context evaluates these hypotheses by logical and empirical methods, using deduction to derive logical consequences and induction to experimentally test a theory (Rivadulla, 2010, p. 120). The context of experimentation applies scientific theories and laws to understand coherently observed phenomena (Franklin, 1986; Radder, 2003).

In research programs, abduction is critical. According to Peirce (1955, CP, 5.145), it is the only logical operation that introduces a new idea, differing from induction, which validates theories from experience (*cf*. Rivadulla, 2010, p. 121). Abduction is essential in the creative process of science, generating new hypotheses, while induction validates these hypotheses by collecting and analyzing empirical data. Abduction and induction are complementary in scientific advancement (Hanson, 1958). For example, in the face of an observable environmental fact, such as variations in the flowering of a plant and the absence of certain birds that eat its fruits, the hypothesis of the relationship between these phenomena could be offered. Regional observers could link this phenological abnormality to deforestation or watershed contamination, establishing an abductive hypothesis about the correlation between these events and the disappearance of bird or insect species. Literatures, sociologists, ethnobotanists and artists could establish abductive hypotheses correlating the phenological event with losses in oral tradition, changes in uses and customs, or social and demographic phenomena.

Adopting an erotetic perspective in environmental sciences allows strengthening research programs, addressing emerging, surprising or problematic aspects without modifying the core of legacy programs. Among the surprising aspects can be cited the observation of new modes of organism-environment coevolution in an ecological context sensitive to anthropogenic bioclimatic modification. Among the problematic aspects are the ecological concerns that arise from the interaction between human technique and natural habitats. Observers will provide comprehensive and detailed information on the natural event, as well as the selection of the best available inferences. Then, specialists will design methodologies, choose inductive methods and develop alternative hypotheses, on the significant contribution of multiple actors who formulate novel questions and hypotheses. The ecologist will establish controlled experiments and use systematic and statistical data to analyze factors related to the phenology of the plant. The ecocritic will assess the impact of the ecological phenomenon on biodiversity and its ethical and aesthetic consequences, using symbols and metaphors to express themes of loss, climate change and human responsibility. It will also develop surveys to

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assess the impact on the food chain and trophic niches, collecting literature and structuring narrative and poetic works on this interdependence and the fragility of ecosystems.

This frees researchers and educators in environmental sciences from the perception of epistemic subordination by not being at the center of great unifying theories. Instead, it is proposed to co-exist alternative research programs that interpret biological and cultural cases outside the standard program. This preference for keeping the core intact and orienting observations towards peripheral aspects allows for coexistence and dialog between different conceptual frameworks without renouncing their fundamental assumptions. In addition, it opens the possibility that conceptual frameworks that orbit each other are understood as effective theoretical structures. It is suggested that the implementation of this erotetic perspective in ecology and ecocriticism fosters a dynamic vision that does not conflict with the strengthening of progressive research programs. Without ignoring the relevance of the contexts of justification and experimentation, it focuses, interacting with them, on the formulation of questions and current problems, approaching them with creativity and adaptability by formulating hypotheses in a context of discovery. This proposal redefines research in ecological and ecocritical sciences, promoting an inclusive and flexible approach that recognizes the importance of progressive change of agendas, the coexistence of multiple conceptual frameworks and methodological pluralism (Moss & Haertel, 2016; Webber, 2020). By implementing these strategies, a more comprehensive understanding of eco-evolutionary and eco-social systems is promoted, while "erotetic enthusiasm" is promoted, enriching the emotional and intellectual dimension in the structure of research and educational dynamics in environmental sciences.

Erotetic structure of research programs

Research programs are scientific approaches that include coherent theories and methodologies to explain observable phenomena and predict new outcomes. These programs are structured around a "hard core" of fundamental assumptions that are not questioned by researchers within the program. Around this core, there are "protective belts" of auxiliary hypotheses that can be modified or replaced in response to new evidence without endangering the central core (Lakatos, 1978). According to Lakatos, research programs are distinguished by two types of heuristics: negative heuristics, which forbids scientists from questioning the hard

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core of the program, protecting it from being directly refuted, and positive heuristics, which guides researchers in essential directions to extend and develop the theory, guiding the modification of auxiliary hypotheses and the generation of new predictions.

From the erotetic perspective, research programs can be understood as agendas of problematic issues that contain a set of questions. These agendas presuppose theories and models distributed around some fundamental assumptions and a set of conceptual frameworks that develop and expand them. By collecting problematic issues and enunciating themselves in the form of open questions, the agendas do not operate within the research program under the logic of empirical refutation, but rather they complementary direct their attention to conceptual frameworks that can provide their models and metaphors to address emerging challenges.

The organization of interrelated questions offers advantages that extend, adapt and improve the structure of research programs (Love, 2014, p. 20). It allows the incorporation of new questions and problems in the protective belts, ensuring the stability and continuity of the hard core, while integrating new knowledge and conceptual frameworks (integration of questions). Research programs can address problems at different levels of abstraction and temporality, providing a necessary structure to evolve and adapt to new scientific contexts (organizational structure). The interdependence between questions, problems, agendas and erotetic organization is fundamental for the development of sciences as research programs that dialog with different conceptual frameworks and transdisciplinary approaches, such as ecoevolutionary and ecocritical research programs.

Ecology as a science without central theory

The erotetic approach allows ecology to be configured as an "eco-evolutionary research program", also known as "extended synthesis in evolution" (Pigliucci, 2009), "eco-evo-devo" (Gilbert *et al*., 2015) or "synecological representation of evolutionary theory" (Toro Rivadeneira, 2021). Although historically linked to the theory of adaptive evolution, ecology benefits from new theoretical frameworks that expand its explanatory and erotetic capabilities, allowing it to address urgent environmental problems without limiting itself to an exclusively adaptive view. Despite having a solid scientific structure, it cannot be equated to research programs with a central theory of high predictability, such as relativity or plate tectonics. Ernst Haeckel (1866) named ecology shortly after the publication

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of *The Origin of Species* (Darwin, 1859). In its early days, ecology was not subordinate to evolutionary theory, but over time it was absorbed by the principles of Darwinian evolutionism and its modern formulation (Darwin, 1859; Wright, 1931; Mayr, 1942; Dobzhansky, 1970).

The modern synthesis of evolution, formalized in terms of genes and populations, encompasses ecological, embryological and ethological phenomena (Mayr, 1982). However, this framework excludes principles that do not align with the adaptive assumptions of population genetics. Fields such as population dynamics, ecological succession and island biogeography present robust principles, but omit surprising or anomalous facts to maintain the predictive ability of the standard model of biological evolution (Hempel & Oppenheim, 1948, p. 138). However, ecological phenomena are not limited to those explained by adaptive evolution in the strict sense. The theory of adaptive evolution is not enough to explain "anomalous" ecoevolutionary processes, such as the ecoevolution of biological communities and their bioconstructed environments, the evolutiveness of biological processes, the design of biological cycles and the inheritance of biosemantic contents (Toro Rivadeneira, 2021). These problems require a complementary view of standard evolutionary theory, recognizing new conceptual frameworks and problem agendas. The new perspective does not reject the standard representation of evolution, but recognizes that its ontological and epistemological assumptions do not encompass the full complexity of many observed ecological phenomena.

The theory of niche construction, for example, expands the evolutionary view by considering factors beyond genetics, proposing that communities of organisms modify their niches, affecting their own evolution and that of other species, and allowing the ecological and constructive to be as relevant as the genetic and adaptive (Odling-Smee *et al.*, 2003). These modifications include the transmission of non-genetic inheritances, such as material and cultural inheritances, and symbiotic or holobiont genetic inheritance, where multiple species co-evolve (Gilbert *et al.*, 2012; Jablonka & Lamb, 2005).

Although frameworks such as niche construction, phenology or bioclimatology address important issues, their scientific status seems subordinate to the central theory of evolution by not being formalized in their terms, remaining as accessory or superfluous hypotheses. There are two ways to broaden the perspective: a supplementary vision and a complementary one. The first seeks a new extended synthesis integrating evolution, developmental biology, and community ecology. The second does not pursue a large central theory for evolution and ecology, but va-

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lues scientific knowledge from its pragmatic concretion, recognizing the importance of scientific questions, problems and values in research and teaching (Müller & Pigliucci, 2010).

The eco-evolutionary research program will orient its agenda towards the flowering or fruiting process including the perspective of conceptual frameworks such as:

- The ecology of communities (synecology).
- The theory of building niches.
- The holobiont and symbiogenetic theories.
- Phenology and bioclimatology.
- Philosophy of evolution and ecology (Odling-Smee *et al*., 2003; Wilson & Holldobler, 2005; Margulis & Fester, 1991; Kylafis & Loreau, 2008).

The ecoevolutionary perspective will resort to open problem agendas through different problematic approaches such as convergent evolution (McGhee, 2011), the ecological and embryological origin of evolutionary innovations (Love, 2003a), the genetic assimilation of cultural and ethological aspects (Badyaev, 2005; Staddon, 1981; Hunt & Gray, 2007), or the biosemantic approach (L'Hôte, 2010). These frameworks and approaches are quasi-independent of the standardized representation of evolutionary theory, which formalizes gene flow between populations by principles such as competitive exclusion from adaptive niches and allopatric speciation. The "legacy perspective" (Uller & Helanterä, 2019) restricts observation and hypothesis formulation according to the central assumptions and fundamental theories of evolutionary theory, while the new perspective shifts to novel conceptual frameworks and open question agendas.

Ecocritical theory as a research program without central theory

The ecocritical research program will approach these processes from the perspective of literary, cultural and environmental analysis, including conceptual frameworks such as: literary theory, linguistics, philosophy of language, philology or critical theory; as well as various theoretical approaches integrated with environmental perspectives and their ethical, aesthetic and political implications (Glotfelty & Fromm, 1996; Garrard, 2012; Heffes, 2022). The ecocritical perspective will turn to the agendas of open problems that are addressed from approaches such as post-colonialism (Vital & Erney, 2006; Huggan & Tiffin, 2007, 2015; Hartnett, 2021),

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ecofeminism (Gaard, 2010, 2017; Adams *et al*., 2010), postmodernism (Oppermann, 2006, 2012; Murphy, 1997), the studies of memory (Wardi, 201; Baker *et al*., 2023), deep ecology (Simonds, 2022), systems theories (Clarke, 2001), digital literature (Posthumus & Sinclair, 2014; Gould, 2017) and post-humanism (Oppermann, 2013; Feder, 2014; Iovino, 2016).

These frameworks and approaches contribute to partial theoretical-literary representations related to the complexity of aesthetic and ecological facts in the ecosystem within a general erotetic structure. By structuring ecocritics with an erotetic vision, the object of study is broadened and the understanding of the text and the literary phenomenon from an environmental and scientific perspective is enriched (Buell, 2005; Heise, 2008). This provides a multifaceted and comprehensive view of the literature, essential to addressing contemporary ecological challenges. Research programs in ecology and ecocriticism can act as central programs in the current ecological crisis, providing a multidisciplinary approach that coexists with other research programs. This coexistence allows interaction and adaptation to current challenges. Problem agenda structures scientific research, facilitating the evolution and adaptation of these programs. By integrating new questions and problems, it enables innovation while ensuring the stability and continuity of scientific knowledge, promoting relevant and applicable research into emerging problems, rather than focusing solely on the verification or refutation of the deeper assumptions of their theoretical foundations.

The absence of a unifying theory in ecocriticism and ecology could be seen as a sign of disciplinary immaturity. However, both disciplines have made significant progress in their respective fields. Ecocriticism has developed robust knowledge and methodologies to explore the interrelationships between literature, culture and the environment, while ecology has progressed in understanding essential ecological processes and created innovative theoretical and methodological frameworks. The idea that a mature discipline must be supported by a central theory is a philosophical prejudice deeply rooted in scientific tradition, but not necessarily applicable to all disciplines (Love, 2014). Both ecocriticism and ecology have been shown to be able to generate deep and applicable knowledge by investigating specific problems and particular contexts, without the need for a unifying central theory.

The lack of a central theory in disciplines such as ecology and ecocriticism must be accepted. These disciplines are organized around specific issues and emerging questions, allowing for greater adaptability and focus on specific issues. Even when applying theoretical knowledge

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from other disciplines, such as literary studies, philosophy, environmental sciences, chemistry, and physics, they do not organize research in the same way that a central theory would. Ecocriticism and ecology are disciplines informed by theories, but they are not directed by a single theory. This approach allows ecocritics and ecologists to be flexible and adaptive, responding to new data and emerging challenges. Flexibility and adaptability are some of the greatest strengths of ecocriticism and ecology. These disciplines stand out for their ability to adjust and respond to new data and challenges, allowing researchers to adapt their approaches and methodologies according to the needs of the problem in question. Rather than following a rigid core theory, both disciplines benefit from an approach that facilitates continuous exploration and discovery, adapting to changes in knowledge and technology.

Dialectics between eco-evo-critical research programs

Erotetic research programs have emerged in various disciplines of the natural, social and cognitive sciences. In historical biogeography (Craw & Weston, 1984), demoecology and historical ecology (Peters, 1988; Balée, 2006), as well as in the theory of non-equilibrium systems and dynamics (Zimmerer, 2000). In addition, highly specific research programs have been developed, such as nematology, parasitology, marine phytoplankton study and prion study (Schomaker & Been, 1998; Denegri, 2008; Nunes-Neto *et al*., 2009; Pidone, 2005).

In the cognitive sciences, erotetic research programs have also had a significant impact. Notable examples include the neuroconnectionist research program (Doerig *et al*., 2023) and the embodied cognition research program (Shapiro, 2007). Likewise, they have been implemented in studies on inter-organizational relations (Biermann, 2016), rural economy and land use (Lowe & Phillipson, 2006), and in approaches that integrate social policy with international political economy, providing a critical and holistic evaluation of contemporary social policies (Ferragina, 2024). They also address complex urban and planetary health issues (Black *et al*., 2018).

Erotetic research programs deserve recognition for their distinctive nature. Although they do not focus on core theories, they constitute theoretical fields composed of multiple peripheral conceptual frameworks, selecting the most favorable assumptions to address new problems. They are, therefore, useful to define their specificity against underestimated study objects and similar conceptual approaches applied in

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different disciplines (Nettle & Frankenhuis, 2020). Research programs are not restricted to a methodological monism or fundamental phenomena; instead, they include multiple methodologies and address emerging social phenomena in their specific contexts. This is not a history of isolated theories, but a history of research programs, i.e., of sets of related theories (Lakatos, 1978).

A theoretical possibility to understand erotetic research programs without falling into scientific relativism and retaining their explanatory value in scientific progress without resorting to the scientism of standardized perspectives is critical realism. Developed in the 1970s, critical realism is a philosophical perspective that focuses on a stratified, emergent, and transformational ontology (Bhaskar, 1978). According to this theory, reality is composed of different levels that interact with each other: the empirical domain (what can be observed and experienced), the current domain (the events and processes that occur regardless of whether they are observed), and the deep domain (the underlying structures and mechanisms that generate the observable events) (Fleetwood, 2014, p. 182). This approach allows for a comprehensive understanding of the social and natural phenomena, recognizing that our knowledge of the world is mediated by our social experiences and contexts, even though reality exists independently of our perception.

From the perspective of critical realism, scientific methodology involves protecting one or more "hard cores" of fundamental hypotheses while adjusting or making independent auxiliary hypotheses to confront falsifications and develop hypothetical formulations. This methodological strategy makes it possible to evaluate research programs not only for their ability to predict new phenomena and solve problems, but also for their ability to identify and structure new problems. In this way, the stratified and transformational ontology proposed by critical realism complements the methodological structure, allowing a dialectical relationship between progressive research programs and new erotetic research programs.

Scientific progress requires a critique that goes beyond superficial empirical observations, exploring and transforming the underlying structures that inform observable phenomena (p. 184). In this sense, the evaluation of research programs is based on their ability to generate new predictions and solve anomalies, as well as on their ability to structure organized agendas of emerging problems. This fosters a theoretical coexistence that allows the adjustment and refinement of scientific theories through the acceptance of new perspectives that arise in the face of emerging problems.

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Critical realism provides a comprehensive approach that recognizes the complexity and depth of reality, complementing and enriching the methodology of research programs. Both approaches emphasize the importance of underlying structures and ongoing criticism, providing a sound theoretical framework for scientific research and the formulation of new hypotheses in the face of emerging problems. The characteristic nature of the questions that make up an agenda of problematic issues in ecology and ecocriticism constitutes the basis for their development as research programs and ensures their erotetic structures. There is a dialectical relationship between standard research programs and erotetically organized research programs.

The main distinction between a standard research program (A) and an erotetically structured one (B) lies in the fact that the limits of the former design the ontological and epistemological assumptions of the latter. Consider, for example, the standard evolutionary program. It has been said that a fundamental ontological and epistemological assumption in program (A) is that genes are the only units of inheritance subjected to adaptive natural selection. Its negative heuristics, i.e., the limits it imposes on the scientific community, forbids the development of hypotheses that question this assumption. If over time questions arise that cannot be resolved empirically within this framework, a complementary research program structured in an erotetic way, called the Eco-Evolutionary Research Program (B), could be established. This erotetic program would start from the restriction of the standard program and propose that, although genes are units in adaptive natural selection, they are not the only units of inheritance, as they interact with other physicochemical, ecological and cultural channels. The realistic vision coexists here with the constructivist vision because the research programs respond to different facets of reality according to certain purposes and under certain conditions.

The dialectic between (A) and (B) allows for their coexistence. (B) cannot empirically refute (A), nor (A) can underestimate the theoretical and pragmatic relevance of (B). Both programs are useful: (B) offers novel hypotheses and traverses unexplored paths to describe and explain unresolved phenomena, while (A) continues to accumulate robust evidence to explain more phenomena with fewer auxiliary hypotheses. This situation operates in our current science in an immense plurality of research programs around interdisciplinary question agendas. The agendas point to the relationship between pre-existing conceptual frameworks that attend from the periphery of a program (A) to the aspects of a stratified, emergent, and transformational ontology.

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In the realm of literary science, critical theory and environmentalism can be considered sociocultural research programs type (A), while ecocriticism would be an erotetic program type (B). The limits of each type of program (A) generate problematic issues that shape the minimum assumptions necessary for the new erotetic research program. It is suggested that ecocritical theory, like ecoevolutionary theory, has been constituted by a synthesis of problematic agendas collected from traditional research programs, the limits of which become the foundations of a new erotetic program.

Advantages of the erotetic approach in ecology and ecocritics

Environmental sciences face complex challenges stemming from the Anthropocene, such as social inequality, governance, cultural change and ecological phenomena (Steffen *et al*., 2007). These problems require methodological plurality, flexible conceptual frameworks, and heuristic tools to address them. Hence, new approaches to scientific research have emerged, responding to the growing complexity and urgency of global problems. "Post-normal science" focuses on situations where facts are uncertain and decisions are urgent, promoting the participation of a wide range of actors beyond traditional experts (Funtowicz & Ravetz, 1993; Ravetz, 1999). "Mode 2 research" emphasizes transdisciplinary collaboration and the integration of non-academic knowledge to address specific and complex problems more effectively (Gibbons *et al*., 1994). "Iterative problem-driven adaptation" (IPDA) advocates an iterative process of adaptation and continuous learning to address complex challenges in a flexible and responsible manner (Andrews *et al*., 2013). "Transdisciplinary research" (TDR.) also promotes collaboration between disciplines and social actors, seeking to "co-create" relevant and applicable knowledge (Klein, 2006; Walter et *al., 2007; Carew & Wickson, 2010; Jahn et al*., 2012; Lang *et al*., 2012; Wolf *et al*., 2013). "Sustainability science" seeks to understand and manage the interaction between human and natural systems to promote long-term sustainable development (Kates *et al*., 2001; Clark & Dickson, 2003; Komiyama & Takeuchi, 2006; Brandt *et al., 2013; Kauffman & Arico, 2014; Heinrichs et al*., 2016; Roux *et al*., 2017).

On the other hand, the concept "panarchy" describes the interaction of social and ecological systems through hierarchies and adaptive cycles (Gunderson & Holling 2002; Allen *et al*., 2014). Panarchy allows

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healthy systems to experiment and innovate while protecting themselves from instabilities by communicating between stable levels and more dynamic levels. This concept facilitates the understanding of sustainability as the ability to create, test and maintain adaptability and opportunities (Holling, 2001). Current approaches to science find a marked correspondence with the very constitution of nature, which is organized into complex units of interaction, from microorganisms to the biosphere. This organization reflects a dynamic hierarchy, where levels of restructuring are not discrete but interconnected. Epistemic categories are relative, just as scientific categories are not guaranteed by a natural taxonomy.

The erotetic structure, based on investigative questions, is suitable for ecocriticism. This structure allows methodological flexibility, interdisciplinarity and innovation to respond to new environmental challenges. To face complex challenges such as climate change, it is necessary to adopt an "ecology of knowledge" that integrates different forms of knowledge and disciplines, allowing a transdisciplinary approach that encompasses all human dimensions (Collado Ruano, 2017, p. 76). This critical approach contrasts with hegemonic science, which has been functional to power structures and which, according to Arce Rojas (2020), continues to impose an "epistemic colonialism", ignoring marginalized voices and alternative forms of knowledge (p. 82). It is remarkable the importance of considering the unknown in the planning of environmental problems, fostering the diversity of models and building resilience to face future significant environmental impacts (Carpenter *et al*., 2009).

In ecology and ecocriticism, the context of discovery rather than justification suggests asking dialectical questions and responding with retrospective hypotheses. This distinction is crucial for ecocriticism, which depends on creativity in formulating initial hypotheses rather than empirical justification. These hypotheses catalyze future empirical and theoretical research in rigorous justification contexts, allowing new ideas and interdisciplinary approaches to be explored.

Heterogeneity, historical stability, connectivity, dynamic hierarchy (panarchy), and epistemological accessibility ensure that ecocriticism can address a wide range of problems, maintaining internal coherence and a clear focus. This structure allows ecocriticism not only to analyze existing literature, but also to influence literary and scientific production, as well as environmental policies, promoting greater awareness and ecological action.

In this context of epistemological evolution (Belcher & Hughes, 2021) the erotetic approach of the ecocritical research program synthesizes current positions in favor of flexible scientific structures, while atten-

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ding to the urgency of addressing environmental concerns from literary expression and socio-ecoevolutionary research. Erotetic logic is used to clarify which issues are valid under different paradigms and how they influence research. Question agendas provide a flexible and dynamic framework needed to significantly improve understanding of socio-ecological dynamics, scientific practice in environmental sciences, and eco-critical activity, integrating different disciplines and perspectives to address complex and specific problems. The ability to adapt research programs to new challenges and contexts is crucial in a changing world.

The erotetic organization suggests strategies of scientific discovery, practice and teaching of the ecosocial sciences, maintaining an epistemic and sociocultural perspective attentive to local contexts that facilitate the expression of ecological concerns through the creative enunciation of emerging problems. Understanding, practicing and teaching ecology and ecocriticism as erotetic structures will allow researchers and educators to adapt to new contexts and challenges, facilitating methodological flexibility, interdisciplinarity, adaptability and innovation.

Erotetic perspective is necessary because neither ecology possesses a central theory, nor ecocriticism can be considered a theory in the strict sense of scientific logic. If assuming the relevance of thinking ecocritically about the ecology and the symmetric consequence of this approach (thinking ecologically about ecocriticism), then there are three possible paths:

- Give up a scientific structure for these disciplines.
- Subsume them in the hypothesis belts ancillary to other research programs.
- Structure them erotetically so that they can be constituted as research programs in their own right.

We assume the third way, in both sciences the erotetic perspective is extremely useful, avoiding that the complex and multidimensional ecological issues are reduced to specific instances of a genetic dynamic between populations (way 2) or that the ecocriticism is interpreted from a positivist perspective as a loose collection of literary or poetic speculations without basis in reality or problem-solving capacity (way 1). From this suggested perspective, ecology and ecocriticism can be experienced as eco-evolutionary and socio-cultural research programs that interact and enrich each other without losing their identity. The intersections between the two fields allow for a more comprehensive and multifaceted understanding of environmental problems.

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We do not accept this quality of the ecocritical research program by renouncing any other theoretical qualification. In the same way that ecology and developmental biology are progressive sciences that accumulate observations and experimental evidence, ecocriticism advances by constructing conceptualization and dialog with scientific evidence. For example, ecocriticism, by incorporating evolutionary theory, can debunk the distortions of social Darwinism (Love, 2003b) and, by adopting the perspective of niche building and synecology, can draw attention to ecological ideologizations, demagogy, greenwashing, or pseudoecological literature. On the other hand, from a phenological and bioclimatic perspective, it can inspire essayists, literati, and artists to objectify their aesthetic experiences through narratives and poetics that find their historical foundation in cultural references.

Biologically informed ecological criticism is crucial to address contemporary ecological issues, as understanding the materiality of the natural world and its relationship to human cultures can challenge anthropocentric representations and promote a more integrated view of nature and culture (Feder, 2014, p. 78). For ecocritics to be a progressive research program, it must strengthen its interdisciplinarity with knowledge of the natural sciences (Buell, 2005; Heise, 2008), particularly of evolutionary biology and community ecology in order to understand with physiological rigor the relationship between human beings and nature. This vision is relevant not only to improve the conceptual spectrum of both areas of environmental thinking, but to continually review their assumptions, concerns and representations. For ecology to be a progressive research agenda, it must also draw on knowledge of the social sciences and humanities. Particularly literature and environmental ethics. This approach offers an expanded view of how organisms and their environments coevolve through complex and coordinated processes, eliminating the anthropocentric perspective and expressing in their problematic agendas a critical "ecoevocentric"[2] perspective of global processes.

Erotetic organization of the ecocritical research program

Ecocriticism, as an emerging field of study examining the relationship between literature and the environment, can be effectively conceptualized as a research program in the strict sense, following Imre Lakatos' methodology. Lakatos, in his works *Proofs and Refutations* (1976) and *The Methodology of Scientific Research Programs* (1978), proposes a structure for research programs that is divided into hard core, protective belt, po-

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sitive and negative heuristics. This structure provides an organized and coherent way to address ecocriticism, ensuring its sustained development and its ability to generate new knowledge.

The hard core of a research program, according to Lakatos (1978, p. 4), is the series of fundamental hypotheses that cannot be abandoned without discarding the entire program. In the context of ecocriticism, this hard core is composed of fundamental epistemological and ontological assumptions. These include the interconnection between culture, literature and the environment, the importance of literary representations, the interdisciplinary approach, ecological ethics and climate change. These premises form the unshakable foundation on which the entire ecocritical program is built. For example, the interconnection between literature and the environment is crucial because it allows to analyze how literary texts reflect and shape cultural perceptions of the natural environment (Glotfelty & Fromm, 1996, p. XVIII). Ecological ethics drives the study of how literature can foster an ecological awareness and a responsibility towards environmental conservation (Buell, 2005, p. 2). Interdisciplinarity with the human sciences and ecology extends the scope of ecocritical analysis, allowing an enriching dialog between disciplines that have traditionally been seen as separate. It is notable that due to its erotetic constitution, the hard core of the ecocritical program does not have theories but rules of the game that consist in maintaining the problematic issues of multiple agendas by structuring the program from an interdisciplinary perspective.

The protective belt, according to Lakatos, consists of a set of auxiliary hypotheses that protect the hard core by absorbing anomalies and allowing adjustments without compromising fundamental premises (Lakatos, 1978, p. 48). In ecocriticism, these auxiliary hypotheses include literary genres such as scientific fiction, nature poetry, travel narrative, children's literature, and magical realism. These genres offer different perspectives and approaches to explore the relationship between literature and the environment. Furthermore, historical and cultural contexts, such as the Industrial Revolution, colonialism and postcolonialism, modernity and postmodernity, indigenous cultures and social movements, enrich ecocriticism by providing specific historical and social frameworks for analysis (Heise, 2008, p. 5). Artistic interactions, such as film adaptations, visual arts, theater and performance, music, and art installations, further expand the scope of ecocritical analysis. Ecological movements, such as environmentalism, deep environmentalism, climate justice, sustainability and community resilience, and digital technologies and media, such as social networks, blogs, websites, digital literature projects, video games,

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and virtual and augmented reality, provide new tools and approaches for eco-critical study (Garrard, 2012). These elements allow a continuous adaptation of the program as new developments and challenges arise in the environmental field.

Positive and negative heuristics are methodological strategies that guide the development and protection of the research program. Positive heuristics in ecocriticism include strategies that foster new interpretations, questions, interdisciplinary advances, sustainability and awareness, and methodological innovation (Lakatos, 1978, p. 50). These strategies allow the ecocritical program to evolve and adapt, continuously generating new hypotheses and theories that enrich the field. For example, methodological innovation may include the use of new digital technologies to analyze literary texts or the incorporation of climate justice perspectives into literary analysis (Haraway, 2016, p. 31). Sustainability and awareness promote the idea that literature not only reflects but can also influence environmental action and social change (Buell, 2005, p. 7).

Negative heuristics, on the other hand, are strategies that protect the hard core of the program, prohibiting changes that could compromise its stability and coherence. In ecocriticism, these include protecting the interconnection between literature and the environment, the importance of literary representations, maintaining the interdisciplinary approach, conserving ecological ethics, and maintaining the relevance of climate change as a central theme (Lakatos, 1978, p. 51). These strategies ensure that the program maintains its integrity and focus, avoiding deviations that could dilute its fundamental purpose. The erotetic structure, which organizes knowledge around investigative questions, is particularly suitable for ecocriticism. The integration of questions and the organizational structure based on inquiry allow the field to remain dynamic and relevant. Methodological flexibility, interdisciplinarity and adaptation and innovation ensure that the program can respond to new challenges and developments in the environmental field.

The erotetic structure of ecocritical research programs emphasizes the plurality and diversity of approaches within the field. Each discipline, from literature and philosophy to evolutionary biology and economics, provides specific conceptual frameworks and research questions that enrich ecocritical analysis. Fields of literature such as literary theory, linguistics, and philology explore how literary narratives influence public perception of climate change, the role of linguistic discourses in constructing environmental identity, and the evolution of descriptions of na-

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ture in literature (Johns-Putra, 2019; Fill, 2018; Stibbe, 2015; Glotfelty & Fromm, 1996; Buell, 2005; Heise, 2008).

Philosophical domains such as philosophy of language, environmental ethics and environmental aesthetics investigate how ecological concepts affect our philosophical constructions of language, ethical principles to guide environmental policies, and the influence of aesthetic perceptions of natural landscapes on conservation policies (Morton, 2007; Alaimo, 2010; Plumwood, 2002; Attfield, 2014; Gardiner, 2011; Jamieson, 2014; Brady, 2018; Berleant, 2012; Carlson, 2009).

Areas of philosophy of science, such as ontology, epistemology, sociology of science, and philosophy of technology address questions about the emerging new ontological realities of the ecological crisis, the construction of ecological knowledge in modern science, and the role of technology in climate change mitigation and adaptation (Bennett, 2010; Braidotti, 2013; Morton, 2016; Haraway, 2013; Latour, 1999; Harding, 1991; Yearley, 1996; Jasanoff, 2012; Wynne, 1996; Schneider 2014; Klein 2015; Lovins 2019).

Sociology and anthropology with their set of theories of culture examine how cultural theories can mobilize collective action against climate change and how critical theory can dismantle power structures that perpetuate environmental degradation (Norgaard, 2011; Manzo, 2010; Pellow, 2017; Pulido, 2018; Mohai *et al*., 2009). Political theory and economic theory address governance models to address global ecological challenges and how economic theories can incorporate sustainability principles to foster a green economy (Dryzek, 2013; Ostrom, 2010; Paavola, 2005; Jacobs, 2013; Pearce *et al*., 2019; Daly, 1996). Likewise, economics with its approach to urban planning theory examines urban approaches that can mitigate the impacts of climate change in cities, exploring how urban planning can be adapted to improve climate resilience (Bulkeley, 2013; Calthorpe, 2010).

Conclusions

An erotetic approach has been proposed to structure ecocriticism, focusing on the formulation of questions and the elaboration of problematic agendas. The main findings and results of the research can be summarized as follows:

Research shows that the interdependence between questions and problem agendas is crucial for the flexibility and methodological adap-

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tability of ecocriticism. This effectively addresses the complexity of contemporary ecological problems. The erotetic structure facilitates the continuous updating of hypotheses and problems, incorporating new data and technologies. This approach is essential to maintain the relevance of scientific and educational practices in an ever-changing environment. The integration of concepts and methodologies from different disciplines, such as biology, philosophy and literature, enriches the ecocritical analysis and allows to address ecological problems from an integral perspective. In addition, the use of retrospective questions and hypotheses promotes creativity in scientific practice, facilitating the generation of new ideas and conceptual frameworks that are vital for the evolution and adaptation of research programs.

Ecocriticism, lacking a unifying central theory, is organized around specific problems and emerging issues. This feature avoids rigidity and facilitates continuous exploration and discovery of new perspectives and solutions. It emphasizes the need to teach the formulation of questions and the development of problematic agendas in scientific and literary education. This prepares researchers to effectively address emerging ecological problems and improves the structure and usefulness of ecocriticism. The research highlights the deep relationship between the ecocritical program and the ecoevolutionary program, considering them research paradigms with an erotetic structure. This dialectical relationship facilitates the development of new hypotheses and the adaptation of conceptual frameworks to current needs, highlighting the importance of interdisciplinarity in scientific research.

The results suggest that the erotetic approach can be a powerful tool to improve flexibility, adaptability and interdisciplinarity in ecocritical and ecoevolutionary research. This has important implications for scientific and educational practice, as it allows for a better response to contemporary ecological challenges. However, a potential limitation of this study is that, although the usefulness of the erotetic approach has been demonstrated, its practical implementation may require a significant change in traditional research and teaching methodologies. In addition, more empirical research is needed to validate and refine this approach. Future research could explore the practical implementation of the erotetic approach in various educational and scientific contexts. In addition, comparative studies could be developed to evaluate the effectiveness of this approach in relation to other methodological models. In short, the erotetic approach proposed in this article provides a robust and flexible structure for ecocriticism, integrating various disciplines and promoting

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methodological innovation. This approach is crucial to effectively address the complexity of ecological and social problems in the context of the Anthropocene, facilitating a more dynamic scientific and educational practice adapted to current needs.

Notes

1 A current problem arising from anthropic ecosystem degradation is seasonal anomalous variations. This example will focus on the phenology of a plant species and its relationship to the ecosystem and sociocultural processes of the habitat. By developing questions about this case, it will be illustrated how a specific process with ecological, evolutionary, aesthetic and sociocultural implications generates a series of questions and problematic issues. These issues are included in two complementary research programs: the ecological and the ecocritical.

2 There is no shortage of terms coined to overcome anthropocentric perspectives. Examples include "biocentrism" (Naess, 1973), "ecocentrism" (Leopold, 1949; Callicott, 1989), and "evocentrism" (Sarrazin & Lecomte, 2016). Nevertheless, I consider it useful to bring a new perspective, if only to enrich this conceptual and semantic field. In it, the fundamental aspect of ecological and ecocritical studies is both the scientific understanding and the aesthetic satisfaction that emanates from the ecoevolutionary processes, which are defined throughout this article under the term "ecoevocentrism" (Pagano, 2013, p. 25).

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