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Article

Commons and Bio-Cultural Learning: An Environmental Humanities View on Evolution, Materiality and Society

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ABSTRACT
This article aims to critically contribute to contemporary commons scholarship, using the lenses of the environmental humanities. Linking existing literature on collective action to a vast amount of literature from both the social sciences and the natural sciences could contribute to a new epistemological framework to understand anthropogenic processes of collective action. Both recent biological evolution theories and ontologically oriented philosophical perspectives have insisted on the endemic collaborative nature of coexistence processes as the embodiment of a larger ecological, material, and cultural whole. Looking at these processes through the lenses of coexistence could potentially reshape commons scholarship, overcoming what I define as the "long shadow of Hardinism," while simultaneously further stimulating dialogue, and hopefully consilience, between the social and natural sciences.
Keywords: commons; collective action; ecology, coexistence; matter.

RESUMEN
Este artículo pretende hacer una contribución crítica a los estudios contemporáneos sobre los bienes comunes utilizando la lente de las humanidades ambientales. La vinculación de la bibliografía existente sobre la acción colectiva con una gran cantidad de literatura de las ciencias sociales y naturales podría contribuir a un nuevo marco epistemológico para entender los procesos antropogénicos de la acción colectiva. Tanto las recientes teorías de la evolución biológica como las perspectivas ontológicas filosóficas han insistido en el carácter endémico de colaboración de los procesos de coexistencia como encarnación de un todo ecológico, material y cultural más amplio. Si se observan estos procesos a través de la lente de la coexistencia, se podría remodelar el estudio de los *commons*, superando lo que definimos como la "larga sombra del hardinismo", al tiempo que se estimula el diálogo, y posiblemente la consiliencia, entre las ciencias sociales y las naturales.
Palabras clave: bienes comunes; acción colectiva; ecología; convivencia; materia.

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1. Introduction

Since Elinor Ostrom's book Governing the Commons in 1990, research on collective action has multiplied, creating a consolidated community of scholars belonging to different disciplinary fields – from economics to political science, from anthropology to history, etc. Yet, while multidisciplinary approaches to the commons continue to grow, some underlying constraints remain. In this sense, one could argue that commons scholarship has been limited to a one-dimensional angle, especially concerning the nature of human cooperation and its relation to ecological systems. The main reason can be ascribed to what I have defined as the long shadow of Hardin's tragedy of the commons, a socio-biological argument on the inherently selfish nature of human beings.

This tension has produced a paradox for researchers approaching commons scholarship – namely, a manifest need to be inherently self-apologetic about the practice of collective action. The issue does not lie in the undeniable idea that different contextual factors can influence the behaviour of individuals in cooperative approaches but in a prejudicial ethos that considers human nature as inherently individualistic and self-centred. The same Elinor Ostrom, while challenging rationalist assumptions denying the possibility for human groups to pursue common welfare, described collective action as the result of "the combinations of situational variables that are most likely to affect individuals' choices of strategies" – individual choice still being a basic assumption of the argument (1990 p. 38). In other words, collective action for Ostrom is mainly understood as a relation of forced interdependence, as in several contexts, cooperation strategies allow more productivity and personal returns. The implications of this statement are remarkable, as they almost explicitly place human selfishness as the precondition of human sociability – the long shadow of Hardinism still looming in the background. Such a perspective contrasts with Ostrom's theory of common-pool resources, denying the presence of *any* underlying factor influencing human behaviour, thus understanding collective action as the result of contextual factors varying according to "the physical world, the rules in use, and the attributes of the individuals involved in a specific setting" (1990 p. 47).

This article argues that the current proliferation of non-anthropocentric methodological approaches in the hard sciences and the humanities can help enlarge the commons' current conceptual and phenomenological scope, delineating research grounds informed by different philosophical and biological perspectives. Indeed, a study of the commons challenging the idea of human nature as inherently individualistic should not be limited to a one-dimensional analysis of individual choices as the precondition for cooperation. Conversely, it should consider exogenous ecological (f)actors as underlying assumptions of collective choices among human societies. While the influence of anthropocentrism in the study of ecological commons has already been discussed by environmental philosophy and psychology, most commons scholarship still lacks a comprehensive approach (Kortenkamp, Moore 2001 p. 261-272). Therefore, this text will not analyse the commons as the product of human epistemology but will look at patterns of collective action among human groups as part of a dynamic ecological mesh of interrelated entities influencing human practices. In looking for alternative theoretical perspectives informing the universe of the commons, I propose an interpretation of the commons as a bridge concept between nature and culture, participating in a conversation initiated by several humanistic disciplines, such as post-humanism, the sociology of science, object-oriented ontology, ecocriticism, and anthropology.[1] Although different in methodology and scope, these critical perspectives can be potentially incorporated by the emerging interdisciplinary field known as the environmental humanities.

[1] For post-humanism see Haraway 1992; Bennet 2010; Braidotti 2013. For the sociology of science see Latour 1993 and 2005. About object-oriented ontology see Harman 2018; Morton 2010, 2018 and 2019. For ecocriticism see Iovino, Oppermann 2014; about anthropology see Descola 2013, Kohn 2013.

2. Socio-Biological Premises and the Tragedy of the Commons

In her lifelong research on collective action, Elinor Ostrom considered contextual factors the thermometer of cooperative situations or individualistic choices. Her fascinating interdisciplinary approach, capable of successfully intermingling economic notions of game theory with behavioural psychology and even ethnographic observation, allowed her to construct a convincing argument favouring cooperative choices as a solution embedded in human groups. As she declared in *Governing the Commons*, a study delineating a methodological framework for studying common-pool resources in different institutional contexts, "the power of a theory is exactly proportional to the diversity of situations it can explain" (1990 p. 24).

Today, commons scholarship is steadily progressing along the path paved by Ostrom's research in both academic and policy-making contexts, creating a vast literary corpus that demonstrates the success of cooperative choices among different human groups in several historical contexts and geographical scales (Wall 2017; Laborda-Pemán, De Moor 2016; De Moor 2017). However, its main theoretical premises constitute a contested ground of confrontation: collective action is still considered a dilemma in constant negotiation with the innate human drive toward selfishness (Saijo, Feng, Kobayashi 2017 p. 597-620). Detractors of collective action constantly recur to Garret Hardin's famous concept of "tragedy of the commons" – a pessimistic argument demonstrating the restraints to cooperative behaviour among human groups aiming at maximising their utilities as a result of the "remorseless working of things" (Hardin 1968 p. 1244).

While Hardin's pessimistic argument diminishes against the valuable amount of evidence favouring collective action conjured up by researchers over the last decades, commons scholarship still relies on this ethos as one of its main *raison d'être*. Why should a consolidated discipline need to refute a substantially inconsistent argument to legitimise itself? The reason lies beyond self-referential narcissism or a perverse need to dominate its weaker opponent. The truth is that the theoretical assumptions of commons scholarship continue occupying a niche position in both academic and social discourse, at least compared to the hyper-rational pessimism characterising Hardin's individualistic paradigm. Rather than for eminently theoretical merits, the success of this simplistic argument lies in its capacity to bridge – or at least smooth – the gap between nature and culture. Although Hardin's argument is mainly based on deduction rather than scientific empiricism, it successfully drifts through a terrain of alleged heuristic empiricism supported by mathematical and biological assumptions. Adopting a psychological argument, Hardin described human consciousness as unnatural and pathological, thus justifying an innate drive towards competition in a "dog eat dog" biological world (Hardin 1968 p. 1246-1247). Humankind is therefore physiologically oriented toward maximising personal profit, and consequently, social arrangements at the core of commons economies are an infringement of personal liberties. In Hardin's words, "every new enclosure of the commons involves the infringement of somebody's liberty" (1968 p. 1248).

In this sense, Hardin's argument is inherently *modern*, as it manages to add a weak yet convincing scientific premise to an essentially sociological hypothesis, creating an irrefutable argument relying on allegedly solid scientific ground. As observed by sociobiologist Edward O. Wilson, the advantage of modern science over other investigative approaches equally based on human discernment, such as philosophy and religion, lies in the mythopoeic drive of "scientific materialism" – the idea of science as the most effective problem-solving activity operating through flawless tools and techniques (2001 p. 192-200). In other words, Hardin's tragedy of the commons provided scientific support to a consolidated popular idea regarding human beings as a highly competitive and inherently selfish species. Despite its disputability, the long shadow of Hardinism still provides an argument for individualism widely accepted by both scholars and policymakers.

Hardin's success lies in its intimate relation with the origin of liberal thought, supported by political and social theorists, whose eminently philosophical arguments also intermingled with proto-biological theories.

Perhaps the most meaningful example is constituted by Thomas Malthus' celebrated essay *On the Principle of Population*, a text written as the enclosure movement gained momentum in Great Britain, causing the almost complete disappearance of common lands in favour of private property – what Karl Polanyi (2001) would define as the *great transformation*. Far from venturing into eminently biologist arguments, the essay advocated liberalism by investigating the relationship between economics and population and the mutual constraints that economy and demography exercise on each other. While declaring that a proportional expansion in food production should accompany demographic growth, Malthus advocated ecological determinism. The forces of nature constituted the ultimate monitoring system for human action, providing checks and balances aimed at refraining expanding human populations (2016 p. 40-42). While the alleged relation between per capita economic growth and population increase was widely proven wrong by history, it became a great excuse to advocate individualism over collective action (Sowell 1962 p. 272). Thus, private property and the dissolution of every political apparatus of social support were necessary measures to incentivise self-reliance and physiological mechanisms to keep populations in check. Malthus considered a liberal system based on private property as the natural state of human beings, whose inherent drive toward expansion would ultimately bring chaos to a society based on collective property (Malthus 2016 p. 53-58). Adopting a successful proto-biological metaphor, Malthus defined human beings as "compound beings" whose rationality is continuously impaired by basic physiological needs, just like the physical body controls the mind (Malthus 2016 p. 65 and 73). In this light, Malthus saw the end of the centuries-old common land regime as a natural process, despite the economic data in his possession proved more efficient in guaranteeing daily subsistence *vis-à-vis* private property (Malthus 2016 p. 88-89).

Thomas Malthus' extremely liberal socio-economic perspective influenced subsequent political thinkers, particularly the so-called utilitarians, such as Jeremy Bentham and John Stuart Mill. While utilitarian thinkers' abstract-deductive approach clashed with Malthus' empiricism, his position on demography and population growth control found fertile ground (Sowell 1962 p. 270). The utilitarians' position on population checks was even more stringent, advocating birth control through the use of contraceptives, a perspective that Malthus firmly opposed with religious repugnance (Sowell 1962 p. 268-270). On the other hand, not all utilitarians equally endorsed Malthus's ecological determinism. For example, John Stuart Mill considered social relief systems as a legitimate measure to support poorer social layers (Quinn 2008). Mill's position on birth control and social relief echoed his ideals of individual freedom of action as an unalienable right of human beings, whose liberty could only be restrained if it threatened other citizens' freedom (2014 p. 46-48). However, while Mill's liberal thought displayed both political and social commitment, defending fundamental rights such as freedom of action within social acceptability and gender equality, his emphasis on individual action betrayed an underlying pessimism on human nature. In his renowned essay *On Liberty*, he defined the human mind as one-sided and advocated individual liberty as "uncontrolled freedom of action," completely disengaged from any social and political contracts, except those involving monetary relations (2014 p. 33 and 82). In other words, Mill considered every form of social contract that implied collective action as a dangerous infringement of personal freedom, which state authorities needed to guarantee (Mill 2014 p. 83).

Perhaps more importantly, Malthus' ecological determinism also influenced a whole generation of evolutionary scientists. The same Charles Darwin, in his natural selection theory, explicitly drew from Malthus' concept of "survival pressures" as a natural force exercised upon every sentient being part of the ecological food chain (Vorzimmer 1969 p. 527; von Sydow 2012 p. 175-176). In this light, ecological evolution could be explained as the result of individual ecological pressures, an indissoluble aspect of organic life, complemented by the individualistic tendency to overbreed as the ultimate form of self-assertion (Vorzimmer 1969 p. 539).

Malthusian pessimism also influenced the subsequent generation of Neo-Darwinist scholars, playing a central role in outlining the socio-political premises of social Darwinism and the scientific ethos of evolutionary biology based on Darwin's theory of natural selection (von Sydow 2012 p. 20).

Particularly relevant to this research is the example of sociobiology, an attempt to bridge the gap between science and the humanities initiated by Edward O. Wilson. Sociobiology promoted the idea of humans as a 'eusocial' species. Eusociality is a characteristic shared among nineteen animal species that base their survival on an organised social system whose resilience rests on the social skills and various types of relations among members, including cooperation and competition (2014 p. 19-22). The acknowledgement of human duplicity, oscillating between cooperative and individualistic behaviours, promoted a complex vision of humankind nowadays, almost unanimously endorsed by evolutionary biology (Wilson 2014 p. 27). On the one hand, some of the implications of sociobiology made a strong argument favouring cooperation as a crucial driving force for human evolution: multilevel natural selection based on group-to-group competition probably ended up favouring cooperative human groups than selfish ones (Wilson 2014 p. 28-29). However, on the other hand, eusociality also endorsed the idea of biological evolution as a process based on kinship evolution, or inclusive fitness. According to this school of thought, evolution is the result of individual choices made by group members in their interactions, passing down genes to the next generation through a cost-benefit relation between group members (Hamilton 1964 p. 1–16, and 17-52). Genetic evolution is, therefore, the result of individual interaction rather than complex genetic exchange (Wilson 2014 p. 69).

Sociobiology promoted a universal vision of humankind as an inherently competitive species, animated by a "selfish gene," a term popularised by Richard Dawkins to express the individualist nature of physiological survival and evolutionary mechanisms (Dawkins 1978). Similarly, the human brain constituted a functioning device facilitating the assembling of *human* genes for evolution. In this light, human evolution emerged as a genetically determined process in which cultural learning and behavioural changes had limited possibilities of interference (Wilson 2001 p. 2 and 41). In a paradoxical turn of events, the deconstructive analysis of sociobiology created a flawed pseudo-scientific narrative of human societies based on approximate assumptions rather than scientifically consolidated evidence – sociobiology without biology. It is rather evident that Hardin's neo-Malthusian argument found great support in sociobiology.

These assumptions are not wrong per se: certainly, human beings are the result of hundreds of thousands of years of evolutionary processes that have allowed an ape species to occupy a unique position on the ecological food chain. However, as recently demonstrated by new findings in evolutionary biology, human evolution cannot be explained through direct interaction with kinship groups but by complex evolutionary processes influenced by a comprehensive set of possible ecological (f)actors that affect gene mutation. In this light, the proliferation of different patterns of social behaviour among human societies can be better understood as the result of variations in the genomic ensembles that affect behaviour (Wilson 2014 p. 200-201). The same Wilson would come to dismantle these long-standing assumptions, collaborating on an empirical study proving the limitations of kin selection by demonstrating the "complex dynamical phenomena such as multiple and mixed equilibria, limit cycles, and chaotic attractors, ruling out the possibility of general maximands" (Allen, Nowak, Wilson 2013 p. 20138). In other words, according to this study, human evolution cannot be explained as the result of individual choices but as the ultimate consequence of natural selection by social interaction – that is, the "inherited propensities to communicate, recognise, evaluate, bond, cooperate, compete and from all these the deep warm pleasure of belonging to your own social group" (Wilson 2014 p. 75).

Yet, despite the advancement of these disciplines, the dilemma of human actions as the result of cultural or genetic determination continues to spark controversies and debates. Redeemed sociobiologists like Wilson

have learned to look at human biological constraints with a grain of salt and describe cooperative and individualistic tendencies as the result of an open struggle, in which generosity and social intelligence have to constantly confront a dysfunctional genetic patrimony resulting from thousands of years of hunter-gathering lifestyle (Wilson 2014 p. 176-179; Winterhalder 2001 p. 12-38). At the same time, individualistic paradigms based on Neo-Malthusian philosophical and evolutionary assumptions continue to inform every sphere of human knowledge and social organisation, proposing a reified image of human freedom that can hardly accommodate the complexities of a multifaceted ecological system as our biosphere (Burchett 2014 p. 119-137). A very telling example is constituted by how the dramatic increase of human involvement in the biosphere's life cycles has led scholars to coin the term 'Anthropocene', indeed a powerful socio-biological concept, but also the reflection of what Richard Dawkins would define as the human selfish gene's capacity to create extended phenotypes (1982).

How can the dominant narrative of human individualism cease to occupy such a prominent role in human epistemological practices? Such a question should particularly interest commons scholarship, as its future success lies precisely in solving this riddle. As shown in the following lines, recent findings in both evolutionary biology and the humanities provide a valuable alternative hermeneutics on the nature of humankind and its role in ecological systems. In so doing, they place human epistemology within a broader ontological context of non-anthropocentrism. Perhaps more importantly, they share the intent to reposition humans in the biosphere, exploring the relationship between social constructions and other ecological (f)actors. In this light, commons scholarship has the potential to re-contextualise anthropogenic processes of collective action, looking at cooperative interactions as part of a broader ecological mesh where different life forms meaningfully intermingle.

3. Ecological Complexity and the Art of Cooperation

If individualism has been at the core of both evolutionary theories and socio-economic paradigms, permeating multiple spheres of human understanding, how can this argument be reverted? A solution to the hegemonic influence of individualism is to analyse patterns of collective action as a unifying principle able to bridge the gap between nature and culture produced by the multiple nuances of scientific reductionism and philosophical essentialism that permeate human knowledge. Such a daring task implies repositioning human actors on the eco-biosphere both scientifically and philosophically, producing a more holistic approach to research addressing the meaningful interconnections between the natural and the social sciences. In other words, it implies unifying scientific and humanistic knowledge, a proposition that today is gaining momentum across both the social sciences and, albeit more reluctantly, the natural sciences.[2] Ultimately, as observed by Edward O. Wilson, "culture is created by the communal mind, and each mind in turn is product of the genetically structured human brain […] As part of gene-culture evolution, culture is reconstructed each generation collectively in the minds of individuals […] But the fundamental biasing influence of the epigenetic rules, being genetic and ineradicable, stays constant" (1998 p. 127-128).

In this context, multiple potential challenges for commons scholarship emerge. First, tackling the study of collective action from this more holistic perspective would allow this research field to gain further legitimacy within the academic world and fearlessly embrace interdisciplinarity without being dismissed as a marginal subject belonging to economics-related disciplines. Second, it would also allow the commons to face the long

[2] About the social sciences see Haraway 1991; Bennet 2010; Descola 2013; LeCain 2021 and 2015. For the natural sciences see Wilson 1998 and 2014; Caporael 2001 p. 607–28.

shadow of Hardinism with renovated vigour and conviction. Finally, it would connect commons scholarship with other non-anthropocentric critical paradigms, positioning the commons as a bridge concept at the crossroads between nature and culture. Naturally, accomplishing such an ambitious agenda requires looking at both science and the humanities to find valuable arguments supporting collective action as both a socio-cultural construction and a biological factor.

A first discipline that could meaningfully intersect with commons scholarship is the expanding field of evolutionary biology. Over the last decades, biologists have described evolution as a science investigating the meaningful connections between different life forms, attempting to overcome neo-Darwinian concepts such as cooperation, competition and selfishness (Harold 2001; Margulis, Sagan 2002 p. 44). From a purely semantic standpoint, the task mainly consists in creating a better understanding of biology by adopting more suitable terminologies such as metabolic nodes and ecological relations (Margulis, Sagan 2002 p. 16-17). While ambitious in its realisation, this agenda constitutes an unprecedented possibility for both scientists and social scientists to explore the evolutionary nature of ecological systems due to complex interactions. Remarkably, in its attempt to address complexity beyond scientific reductionism, evolutionary biology has unveiled the complex relational nature of ecological systems, allowing social scientists to adopt some leading concepts to describe the art of coexistence.

From a microbiological perspective, evolutionary processes mainly function as complex mechanisms of metabolic interactions between the molecules that compose the basic infrastructure of life – e.g. proteins, enzymes, acids, etc. These processes happen daily in every living organism and result from self-organisational mechanisms that regulate phenotypic variations (Wagner 2014 p. 57). Self-organisation is regulated by a sensitive governance system, able to determine and monitor complex interrelations in which the main features of evolutionary biology appear: predation, adjustment and coexistence (Wagner 2014 p. 148). Certainly, due to their biological plasticity, bacteria constitute the most eloquent example of ecological complexity. Microbial species arguably form the fertile ecological meadow that allowed the tree of life to thrive by optimising aerobic and photosynthetic metabolisms. So far, about eighty per cent of life on earth has been bacterial. Not coincidentally, the evolutionary history of bacterial species reflects the features mentioned above. Evolutionary biologist Lynn Margulis has addressed the interconnected nature of bacterial evolution, adopting the term *restrained predation*. This concept explains evolutionary mutations resulting from a failed predatory relation that turns into fruitful coexistence, determining game-changing evolutionary patterns (1986 p. 130). Perhaps the most successful example of restrained predation is the evolutionary process that has led to the creation of prokaryotic cells – the union between two aerobic ancestral bacteria, as demonstrated by the autonomous genetic inheritance of mitochondria (Margulis, Sagan 1986 p. 130-131). In this light, the idea of evolutionary processes as a result of long-term symbiotic interactions between different microbial actors in specific environmental conditions becomes a valid hypothesis to justify evolutionary change (Margulis, Sagan 2002 p. 12-13).

Such a powerful image contains all the main characteristics of biological evolution. Moreover, it helps clarify a key concept in understanding the ecological nature of coexistence: predatory impulses to satisfy basic metabolic needs are counterbalanced by the natural robustness of life, generating a fruitful coexistence that is, in turn, responsible for the creation of positive evolutionary feedback loops (Margulis, Sagan 2002; Wagner 2014 p. 170). Ecological systems are, therefore, the result of discordant harmonies between different organic entities, whose interaction patterns generate mutual adjustment processes that, in turn, trigger evolution (Botkin 2012 p. 204; Wilson 2014). The implications of this statement are powerful: coexistence, rather than individual striving, stands as the milestone of biological evolution.

What is the role of humankind in this process? Are human beings, in their inherent complexity, so detached from these ecological laws? While one should neither praise the exclusive autonomy of human intellect nor advocate its subordination to broader ecological laws, the mysterious parable of human evolution seems to resonate with these evolutionary patterns. As part and parcel of ecological systems, human beings can do little but participate in the mysteries of natural evolution. This does not mean that humankind should not continue to strive to understand ecological processes, but that ultimately every anthropogenic step will permanently be inscribed in a broader context subjected to specific evolutionary laws. In this light, processes such as restrained predation and symbiosis can easily be applied to humankind, confirming predatory tendencies and the capacity for resilience and ecological adaptation. Naturally, as a latecomer on the biological stage, humankind has led a somewhat parasitic existence, benefitting from life cycles generated by other entities over long trial and error processes. As observed by Margulis and Sagan, "human beings are not particularly special, apart, or alone […] It might be a blow to our collective ego, but we are not masters of life perched on the final rung of an evolutionary ladder. Ours is a permutation of the wisdom of the biosphere […] We did not invent genetic engineering, we insinuated ourselves into the life cycles of bacteria, which have been directly trading and copying genes on their own for some time now. We did not 'invent' agriculture or locomotion on horseback, we became involved in the life cycles of plants and animals, whose numbers increased in tandem with ours" (1986 p. 195). Therefore, human evolution emerges from the capacity to treasure evolutionary processes accomplished by other species, thus profiting from the organic fabric of life. Evolutionary psychology has confirmed this tendency through the concept of *prepared learning* – the human likelihood to inherit one or a few alternative behaviours out of many possibilities (Wilson 2014 p. 139; Carey 2003 p. 257-272). Humankind can register and inherit behavioural patterns and impart them to future generations, thus facilitating their ecological adaptation. The intimate nature of human cooperation starts as a genetic process, and its final aim is to pass down essential qualities for survival and coexistence.

Similarly, modern anthropology seems to convene on the idea that food-sharing and its related socialisation practices, rather than warfare, constituted the basis of human societies as we experience them today (Jaeggi, Gurven 2013a p. 20131615; 2013b p. 186-195; 2015). This should not be interpreted simply as a cultural process based on risk maximisation through collective action but as an ultimate instance of prepared learning. While predatory impulses are essential to accomplish metabolic cycles – hunting in this case – survival cannot be guaranteed without coexistence. Consequently, human evolution cannot continue without cooperation. Therefore, collective action processes in human societies constitute the ultimate symbiotic instance of ecological adaptation. Like the complex web of microbial life, where different (f)actors such as acids, proteins and enzymes establish meaningful interactions to ensure ecological resiliency through mutually regulating systems, the survival of human societies relies on the capacity to coexist, negotiating complexity (Wagner 2014 p. 148).

These assumptions are as powerful as controversial. On the one hand, they deconstruct theories on human cooperation due to cultural progress and ideology. However, on the other hand, they conclusively debunk constraining socio-biological arguments on human selfishness, acknowledging ecological complexity and its organised multidimensional fabric as the hidden fabric of life (Wagner 2014 p. 194). Evolutionary arguments also help to better understand why the current degree of imbalance with other beings cannot last for long and is inherently against the evolutionary patterns described above. The art of coexistence is a mutual process and constitutes the ultimate precondition to evolution and life. Tools like prepared learning and scientific knowledge can be the torches to guide us in the mysterious meanders of evolution.

In this light, a second essential theoretical premise concerns the philosophical implications of the ecological complexities described above. While the attempt to overcome socio-biological metaphors such as cooperation and competition can be justified by the need to enhance scientific understanding, it poses further challenges to scholars attempting to bridge the gap between the hard sciences and the humanities. On the other hand, adopting new terminologies allows social scientists to bypass anthropocentric narratives without necessarily clashing against a consolidated ideological scaffolding. The social sciences are engaged in a similar operation, proposing a non-anthropocentric perspective that embraces ecological complexity to debunk hegemonic narratives of human epistemology as a determining ecological agent. In a sociological sense, we could compare the complex fabric of life that evolutionary biology is progressively unveiling with Bruno Latour's idea of collective society – "the association of humans and non-humans" (1993 p. 4). Society results from the intermingling of hybrid networks – namely, the proliferation of different beings (e.g. people, animals, but quasi-objects) that constitute a complex social assemblage (Latour 2005 p. 7). This perspective, known as the actor-network theory, includes a critique of modernity and its dialectics of purification, separating humans and society. According to Latour, the world's social fabric consists of different actors that are meaningfully entangled, creating hybrid networks where the borders of nature and culture are blurred, in contrast with the rigidity of modernist categories (1993 p. 51-55). Reality is a middle kingdom where different actors interact, establishing mutually dependent relations, and nature and culture are their satellites (Latour 1993 p. 79). Naturally, in such a reality, social strategies based on reciprocity constitute the most pervasive evolutionary strategy for both humans and non-humans (Latour 2005 p. 69).

In a similar tone, political philosopher Jane Bennet has insisted on the ontological vibrancy of materiality or, to borrow a term from Latour, "actant objects" (2010 p. 9). Drawing from Baruch Spinoza's notion of *associative* bodies – socially-oriented entities that continue to affect each other through mutual interaction – Bennet re-conceptualises reality as the result of the interaction between vital materials, humanity being just one remarkably heterogeneous assemblage (2010 p. 11-23). This materialist perspective entails dramatic political consequences. As John Dewey would maintain, humans need to develop ethically responsible policies that consider the confederacy of objects that compose the web of life (Dewey 1954 p. 36 and 101). If nature is an assemblage of affective bodies in close relation to each other, the art of coexistence constitutes the ontological basis for the future of human societies, which need to devise strategies of harmony with the cluster of bodies that compose the vital materiality of the world.

However, the philosophical perspective addressing the issue of coexistence in ecological systems most in-depth is the so-called Object-Oriented Ontology (OOO). Drawing from Heidegger's philosophical thought, OOO emphasises the ontological essence of things, looking at their phenomenology, qualities and modes of existence (Harman 2018 p. 255-260). In this sense, assessing the meaningful material relations and affections that underlie the universe of the commons means developing the capacity to look beyond the superficial cultural layer that engulfs and encompasses them. OOO defines this task as the difference between metaphors and signs, or the ability to move beyond the sensual relation of objects, learning how to recognise the genuine and unique characteristics of objects – also known as *ontography* (Harman 2018 p. 161). In a more environmentally-concerned fashion, Timothy Morton has defined this realisation as *ecological awareness* – the capacity to contextualise elements of reality, creating multiple possibilities of interconnection, a *symbiotic real* (2018 p. 91). The same Morton links this philosophical perspective with concepts such as coexistence and solidarity, understood as feelings that allow humans to perceive their degree of interconnectedness with a human-nonhuman symbiotic real, recreating a holistic perspective that agriculturalist visions of the world have contributed to forgetting (Morton 2019 p. 13-19). In this light, life resembles a pastiche, an *ecological mesh*

composed of complex flows of entities – or strange strangers – that intermingle, creating adaptation through checks and balances that allow our essence to materialise (Morton 2010 p. 15). Therefore, the ultimate frontier of ecology is cooperation, translated into trans-species altruism: "community we inherit; we have to choose cooperation. The factory system enabled workers to choose to cooperate with each other by throwing them together, turning them into replaceable parts of replaceable machines. We inhabit a gigantic network of interlocking mechanical structures that become increasingly detailed and increasingly global" (Morton 2010 p. 101).

While all different in their radical messages, these theories share some basic assumptions. They look at life as an interactive set of agents, each one of them gifted with inherent characteristics that affect other actors in different ways while at the same time keeping each other in check through adaptation strategies, equally based on ontological characteristics and epistemological qualities. Collective action among human societies, in this sense, emerges as the result of processes of bio-cultural learning, where human epistemology meets the ontological fabric of life and, like any other agent, strives to understand the art of coexistence. This perspective contributes to understanding collective action as the result of complex evolutionary factors complemented by cultural paradigms. In philosophical terms, one could argue that human epistemology is part of a complex set of ecological relations. Adopting a similar discourse allows expanding Ostrom's behavioural paradigm to patterns of collective action resulting from contextual human choices. Consequently, cooperative choices should not only be solely considered a choice dictated by contextual circumstances but as a set of bio-cultural strategies aimed at finding a balance. In other words, we need an ontological approach to the commons as a key expression of the complex interactions that constitute the web of life. Such an accomplishment would allow reframing collective action as the result of both bio-evolutionary drives and cultural-contextual circumstances. Moreover, it would also enable politicising the commons beyond human epistemology.

Conclusion

This contribution has explored the potential role of evolutionary biology and the environmental humanities in studying collective action and overcoming the limits of commons scholarship set by the socio-biological arguments characterising Hardin's tragedy of the commons. While it is undeniable that the great narration of selfishness continues to dominate several spheres of academic and popular knowledge, these critical perspectives could potentially help humankind mitigate the effects of allegedly *natural* drives such as predation and individual kin selection. Such a process means rediscovering the centrality of coexistence in both individual evolution and complex ecological systems as essential preconditions for life. Such an effort would allow future scholars willing to explore the fascinating universe of the commons to place their research effort beyond human epistemology, creating ontologically meaningful narratives tackling the complexity of ecological systems through concepts such as multi-species alliance and symbiogenesis, co-evolution and coexistence. More specifically, this article has analysed the potential links between commons scholarship and the interdisciplinary approaches proposed by the environmental humanities. Addressing the role of collective action within ecological systems allows understanding the pivotal role of biological coexistence well beyond the human sphere. The potential of this critical perspective is striking: a similar approach could enable a different reckoning of the commons: not simple human-centred strategies of survival in different environmental conditions but bio-cultural learning processes emerging from the constant interrelation between nature and culture (LeCain 2017 p. 132). The history of collective action is undeniably riddled with contradictions and conflicting behaviours. However, the socio-biological trajectories of evolutionary history demonstrate that coexistence mechanisms emerge from unquantifiable types of interrelations between different actors. Although such a

perspective seems to imply a constant struggle for equilibrium, it also means establishing beneficial mutual systems of check and balance that can ignite evolutionary feedback loops (Russell 2011; LeCain 2017). Certainly, historical studies addressing the interrelation of collective action and the environmental humanities constitute one the most promising research fields if commons scholarship will embrace its mission to shed light on the long shadow of Hardinism and claim a central role on the academic stage as well as in policy-making processes.

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