ETHNOBIOLOGY AND CONSERVATION

RESEARCH ARTICLE

Ethnobiology and Conservation, 12:02 (07 March 2023)
doi:10.15451/ec2023-03-12.02-1-15
ISSN 2238-4782 ethnobioconservation.com

Applying the World-System theory in the conservation sciences to understand COVID-19 pandemic as a socio-environmental synergy

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ABSTRACT

The pandemic of COVID-19 caused a global epidemiological, economic and social crisis. In the conservation sciences, several studies have focused efforts on understanding the effects of declining human activities on biodiversity, understanding the pandemic as an anthropogenic "pause"of global scale. But the impact of the pandemic was not the same for everyone. Different impacts are consequences of political and ethical questions about who and what can pause or be paused, according to what authority and under what conditions. Therefore, the historical asymmetrical relations of power in the World System are crucial to understanding environmental impacts and thinking about solutions in the post-pandemic world. This article discusses why historical local-global inequalities should be an indispensable reference variable for examining the different experiences caused by the pandemic in biodiversity, aiming at advancing the discussion about the society-nature relationship that the pandemic has spurred. To do so, we use the World-System Theory, initially proposed by Wallerstein, whose analytical categories allow us to situate nature conservation within broader economic, historical, and contemporary contexts. We argue for the understanding of biodiversity conservation in the context of the historical-sociological and global-local relations of the World-System. Finally, we discuss that the COVID-19 pandemic should be understood as an emergent phenomenon of the society-nature dynamic of the world-system.

Keywords: Biodiversity conservation; Anthropause; World-System; Ecological crises; Social inequality; Interdisciplinary.

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SIGNIFICANCE STATEMENT

The strong interaction between social and natural processes exacerbated by the COVID-19 pandemic is a good reason to invite Conservation Biology to rethink the way it approaches socio-environmental problems. This paper incorporates world-systems theory (WST) into an analysis of impact of pandemic in biodiversity conservation. We argue that WST, besides providing bases for understanding the economic, and social relations that shape the modes of appropriation and expropriation of nature, brings important insights as an epistemological framework for understanding social-ecological systems. Likewise, we emphasize the need for a historical-sociological perspective in conservation sciences, and the development of an interdisciplinary scientific perspective, aiming to attack the bases of production and reproduction of inequalities that compromise the success of the objectives of biodiversity conservation and human well-being. World System Theory may be a new source of approaches for many conservation scientists.

INTRODUCTION

The spread of COVID-19, an acute respiratory infection caused by SARS-CoV-2 coronavirus, has caused a worldwide epidemiological, economic and social crisis to a degree that has not been seen since the 1918 influenza outbreak (Chakraborty and Maity 2020). The COVID-19 pandemic also brought science to the center of the public space. Scientific interest in COVID-19 increased after a "Public Health Emergency of International Concern" was declared by the World Health Organization (WHO) (Fraser et al. 2021). We observed that the academic community in most disciplines had quickly reacted to this sudden challenge (Beldarraín 2020; Kalmus 2021).

In conservation sciences, several research studies have focused on understanding the effects of human activities on biodiversity (Bates et al. 2021). Some expected, at least at the beginning of the pandemic, that the reduction of industrial activities and human mobility – also called "Anthropause" (Rutz et al. 2020) – would be a "giant global environmental experiment with potentially far-reaching consequences"(Davenport 2020). Researchers also have pointed out that the "dramatic changes in lifestyles and social systems during the pandemic led to an unprecedented change in the dynamics of human-nature interactions worldwide", which could be used in favour of conservation (Soga et al. 2021). But initial research points to several direct and indirect pathways that link changes in human presence and activity both to positive and negative outcomes for wildlife, ecosystems, and conservation (Bates et al. 2021; Smith et al., 2021), with more negative than positive effects (Gibbons et al. 2021). So here we ask, is the Anthropause really a global phenomenon? To what extent can we say that there have been dramatic changes in lifestyles and social systems? What are these changes? Has the pandemic impacted everyone in the same way? What are the differences and how do they relate to the impact on biodiversity? Such questions aimed at emphasizing an inadvertent element in the most widely publicized research on the relations between the pandemic and conservation: the global inequality of the pandemic's impact and the complex and synergistic relationship of political and social issues to biodiversity conservation, which needs to be analyzed from an interdisciplinary perspective.

The need for inter- or transdisciplinary research in conservation science is a long debate that has been growing and gaining ground in recent years (Perssons et al. 2018). The COVID-19 pandemic, in turn, strongly highlighted the importance of these approaches (Bontempi et al. 2020; El-Hani and Machado 2020; Mallee 2020), mainly because conservation science is an inherently transdisciplinary object, raising numerous questions about causes and consequences that involve perspectives from a wide range of social and natural sciences, surrounding the society-nature relationship. As Hornborg (2021) has pointed out, "It is as impossible to contain within academic as within national borders" to understand the pandemic of COVID-19. But, on the other hand, it encounters methodological and epistemological challenges. Although the contribution of social science is increasingly strong in conservation science, the role of social theory is not yet fully accepted, recognized or explored (Bennett et al. 2017; Bennett and Roth 2019; Massarella et al. 2021). However, there is no doubt that the diversity of social theory can contribute to understanding society-nature relations (Martin et al. 2016) through critical approaches, epistemic, empirical, and analytical insights fully embedded in a reality that is at once local, national, regional, and global.

In order to contribute to the ongoing debates, this article discusses why historical local-global inequality should be an indispensable reference variable for examining the different experiences caused by the pandemic in biodiversity, with the aim of advancing the discussion about the society-nature relationship that the pandemic has spurred. To do so, we use World-System Theory initially proposed by Wallerstein (1976), whose analytical categories allow us to situate nature conservation within broader economic, historical, and contemporary contexts. We assume that it is necessary to recognize the role of so-

cial structures and inequalities as variables that explain the processes we observe in nature. To achieve this goal, in the next section we elaborate some essential points of the theoretical approach that guides the argument, the world-system theory (WST). We then examine its usefulness for understanding the broader relationship between society and nature as a long-term socio-historical process and argue for understanding biodiversity conservation in the context of the historical-sociological and global-local relations of the World-System. We argue that WST besides providing bases for understanding the economic, and social relations that shape the modes of appropriation and expropriation of nature, brings important insights as an epistemological framework for understanding social-ecological systems. Finally, we discuss that the COVID-19 pandemic should be understood as an emergent phenomenon of the society-nature dynamic of the world-system. Although research in WST is broad, it is still underexplored in conservation science. This paper therefore brings an original contribution to the ongoing debates for the integration of social theory into conservation science, which we hope will inspire new directions in research.

THE WORLD-SYSTEM THEORY (WST)

World-System theory is a macrosociological perspective that seeks to explain the dynamics of the "capitalist world economy" as a "total social system"(Martínez-Vela 2001). The theory was developed by Immanuel Wallerstein, who in 1976 published "The Modern World System I: Capitalist Agriculture and the Origins of the European World-Economy in the XVI Century". Since then, world system research has inspired several research programs, constituting itself as an interdisciplinary theory and one of the main perspectives of International Political Economy.

Wallerstein's central aim was to analyze social change in its totality. This claim implied defining a social system that overcame the dichotomy between internal and external factors in explaining its dynamics (Arenti and Filomeno 2007). For him, it was necessary a systemic analysis in which the elements are in interdependence. Wallerstein thus defines social systems as complex historical systems that represent an integrated network of cultural, economic, social and political processes which, on the one hand, have their own dynamics and capacity for differentiation, but, on the other hand, are linked by global processes and structures (Wallerstein 2005; Cobério 2008). Thus, the modern World-System configures a space-time whole, whose epistemological characteristics are Globality, Historicity, Totalism, and Interdisciplinarity, which need to be perceived together, in their mutual interactions and multiple lines of causality (Wallerstein 2011; Mariutti 2004). WST also defines a World-Economy structured by historical relations of dependency and socioeconomic inequality, where the "development"of some invariably means the "underdevelopment"of others (Trazel 2020). This separation reflects the North-South socioeconomic and political division itself, where the North, with a quarter of the world's population, controls four-fifths of the world's income (Therien 2010). WST theorists consider it necessary to understand that these relations are phenomena emerging from the historical evolution of capitalism based on the international division of labor (Taylor 2009), where each region is specialized in some types of industries, processes, or services according to the interests of the major economic forces (Pochmann 2000). Therefore, they explain that the success of developed countries today is a product of the unequal systematic exchange of raw materials, products, and labor with developing countries (Wallerstein 2001). This dynamic of exploitation is discussed using three key concepts - the core, the semi-periphery, and the periphery -, where the core is basically the developed and rich countries, while the periphery is the poor countries.

An important difference with other perspectives that seek to understand the same object (such as Dependency Theory or Unequal and Combined Exchanges Theory) is that the disparity between North and South is explained in historical terms, related to persistent colonial relations, so that the territories of the global South tend to be impoverished even today (Litonjua, 2012), i.e., the exploitation of the periphery began at the time of colonization and still exists in terms of trade between central and peripheral countries that constantly favor the center. Therefore, it is inescapable to analyze the power conflicts and historical problems rooted in global political and economic structures (Birn, 2020). Therefore, WST explains structural inequality from a broader historical and spatial framework that links the local to the global given the economic and political relations established by power relations. Thus, the study of local-global relations is an indispensable step to understand the functioning of any system.

At this point, one last important issue to be highlighted here from WST is Wallerstein's (1979) critique of approaches that use the national state (or the national economy) as the central unit of analysis. From WST international trade should not be seen as a flow between autonomous national economies, which sovereignly decide to trade more or less with other national economies, but rather as a world trade organized according to the dynamics of the world division of labor, based on the interests of an economic elite, which,

as a unifying force, brings together regions with differentiated politics and culture (Arenti and Filomeno 2007). The analysis must therefore encompass the multiscalar relations between international organizations, business corporations, states, regional governments, and global and local non-governmental organizations, all shaping the world system. Therefore, the appropriate unit of analysis for understanding the transformations of the contemporary modern world is the world-system itself.

Since the first publication, Wallerstein and several other researchers have sustained the World-System research, giving movement to the theory and refining the conceptual constructions. It was Wallerstein who even recognized that theories must be short-lived, yielding to new conceptions as social reality changes and the models no longer fit (Straussfogel 1997). In this sense, WST research program has increasingly focused attention on the discussion around the ecological dimension of the World-System, given the growing global concern and awareness of the finite nature of natural resources and the increasing perception of biodiversity losses (Ciccantell 2021). The ecological dimension has thus become an object of study in several research programs in the social sciences and humanities, resulting in a variety of different perspectives that attempt to explain historical world relations including society-economy-nature relations. Among the formed strands some have been gaining importance, such as Ecological Unequal Exchange theory (Jorgenson 2006), World Ecology (Moore 2015) and Global Commodity Chains (Ciccantell 2021). While they all have differences in methodological and even epistemological approaches, a central similarity is that society-nature relations are seen as conditioning the expansionary dynamics of the world-system and the competitive relations between major states, with ecological devastation seen as an outcome of world-system dynamics, through the process of capital accumulation (Ciccantell 2021). Although all these approaches have gained traction and are widely discussed within respective research programs, little has been discussed since or within the conservation sciences, even though great convergences surely exist.

THE RELATIONSHIP BETWEEN SOCIETY AND NATURE FROM WST, LESSONS TO CONSERVATION SCIENCES

The understanding of nature as a "system"formed by interacting parts, where the whole is more than the sum of the parts, is the main paradigm of the natural sciences. WST's proposal involves the same understanding of system, which defines world-systems, comprising the core, the semi-periphery and the periphery, as multiscalar and hierarchical structures that exhibit emergent properties (Hornborg 2020). In fact, Wallerstein was inspired by complex systems theory, specifically the work of the physicist-chemist Ilya Prigogine (Dias and Tostes 2021). Thus, in this convergent view, one field studies how human societies are globally interconnected in a changing "world system"of trade, politics, and information flows (Abel 2007), while the other field studies the processes and dynamics of how natural systems function affect all their constituent parts. These two global systems are in turn linked to each other. Every natural system is partly a territory demarcated by political and cultural boundaries. Natural systems are thus directly or indirectly governed, managed, and used by institutions, organizations, corporations, companies, communities, and individuals. This means that the relationship each society establishes with nature, through aspects such as governance, territorial management, environmental policies, industrial and agricultural profile, and degree of economic globalization, shape natural systems, while being shaped by this latter at different scales (Azevedo et al. 2020; Liu 2021). We emphasize that this definition is similar to that of social-ecological (SE) systems, defined by the integration between natural and human systems at different hierarchical scales in complex and dynamic ways that result in emergent properties (Castillo et al. 2020). Indeed, understanding the interaction between social factors and processes with components, structures, and functions of natural systems is at the core of both SE and WST approaches that include the ecological dimension. Yet, here we seek to integrate these approaches within a broader whole, which includes both the study of socioeconomic and cultural conditions, as well as historical dependency and power relations, to understand SE systems and the units of study of conservation science, as part of the world-system.

Based on the basic epistemological categories of WST, here we propose to understand conservation systems as complex historical systems that represent integrated networks of natural and social processes, within the world-system unit, defined by the Globality of their interactions and by the Totality of their structure since they are systems that have their own characteristics at the local scale, but are united by processes on a global scale; by the Historicity of the processes that configure its structure; and, by the Interdisciplinarity that is required for understanding such systems and approaches. In Figure 1 we represent the proposed structure. In the following sections we will briefly treat each of the mentioned characteristics.

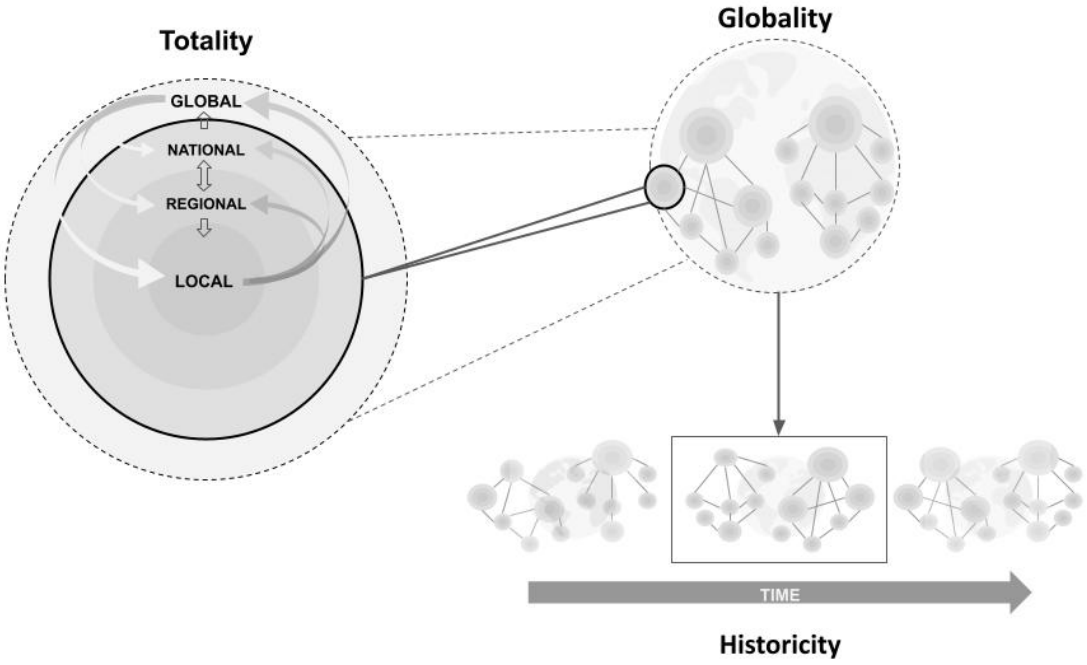

Figura 1. Representation of the theoretical framework of World-System Theory (WST). Three analytical categories and the relationship between them are represented in the figure: Totality, Globality and Historicity. Totality represents the unity of the system, globality the interactions between the subunits on a specific time scale, and, historicity represents the dynamics and trajectory of the relationships. For each moment in history a new totality can be defined, characterized by local-global relations among the subunits, which in turn are linked to previous conditions.

Totality

Thinking about totality implies understanding current systems, in relation to the actors and processes that manifest themselves at local, regional, national, and global scales. The totality of the system is the unity that gives sense to the parts. This "whole"is greater than the mere sum of the parts, yet belongs to a specific moment in history, since it will later become part of a new totality, the effective spatio-temporal totality is the World-System.

Thinking in totality is what gives meaning to the synergy that exists between political and social issues and the conservation of biodiversity. The synergy exists only because they are part of a totality. From this perspective, we can contextualize specific systems according to how they are inserted in the World-System, i.e., according to particular historical movements linked to broader processes, which in their totality characterize the system.

Historicity: the trajectory and historical-social context

For Wallerstein (1998), if a world-system really exists, i.e., an effective spatio-temporal totality, only its history, and not only the history of its parts, can explain the successive conformations of the system as well as its contemporary structure. This idea is not far from the logic behind the importance of evolution for biology, through which we seek to understand the history of life on our planet as a key process in the study of changes over time, from an integrated viewpoint. As Dobzhansky stated in 1973, "Nothing in Biology makes sense except in the light of evolution", the historicity proposed in WST has the same relevance. For the conservation sciences, historicity is also a key element since every system is the result of a long historical process in which social and ecological components interact (Moore 2010). Understanding historicity means understanding systems in their social-historical context, i.e., observing local particularities and situating them in appropriate space and time in relation to global history.

For example, researchers found in a protected area in Brazil that negative socioeconomic outcomes were associated with nature degradation due to failures in the creation and implementation of protected areas that led people living within the Park to a situation of dependence on external financial support and natural resources (Specht et al. 2019). On the other

side of the globe, in Bangladesh, researchers found that comparatively poorer households were significantly more likely to be involved in deforestation (Ullah et al. 2022). These papers, in addition to demonstrating the complex interplay of socioeconomic factors that influence the process of deforestation that occurs within protected areas, demonstrate the need of looking at these conflicts as part of a common whole. That is, these populations living in protected areas have particular characteristics related to culture, local, regional, and national history, but also, although they are spatially distant, they have common features, such as the fact that they live in "protected areas"which are national territories defined and managed based on an international entity, the IUCN (International Union for Conservation of Nature), with also has its own history. On the other hand, both populations have a common history associated with colonization, modernization, and globalization in the world-system, which shape their socio-economic characteristics. These common characteristics are important to understand the origin of the existing problems and also the possible solutions. After all, environmental problems are fundamentally based on how human society is organized (Brulle and Pellow 2006). Developing meaningful measures to mitigate ecological degradation, such as conservation or habitat restoration must begin by developing a theoretical perspective on the social processes by which these problems originate (Brulle and Pellow 2006; Carrillo and Pellow 2021).

Globality: the local-global relationship

As defined by the WST, no system is isolated in the world-system, every local is influenced by global multi-scalar relations, associated with historical processes that define the hierarchy of relations between and within units. Thus, every system is always influenced by internal and external forces in its different dimensions. The local position in the global system is what defines the local-global dimension and explains the degree of economic and political dependence, and thus inequality. In practice, this means that conservation units are immersed in political and economic relations from local to global, which are themselves historical relations. Just as Wallerstein rejected the idea of reducing explanations to nation-states, and showed the interdependence between them, it is necessary within the conservation sciences to reject the view of systems as isolated, whether they are protected areas or any other conservation unit. It is necessary to understand them as subsystems of a common unit that is the World-System.

Understanding this local-global relationship allows us to examine biodiversity loss as a local-global systemic phenomenon. One example of this, is the globalization of agricultural production, where international trade chains accelerate habitat degradation in places far from the site of consumption (Friis et al. 2015). It is widely studied that the large spatial footprint of export-oriented agriculture is responsible for large environmental costs, including local negative effects such as soil degradation, regional impacts due to excessive freshwater use or nutrient and pesticide runoff, and global concerns such as carbon emissions and biodiversity loss due to land conversion for agriculture (Levers and Müller 2019). Lenzen et al. (2012), for example, showed that a significant number of species are threatened because of international trade along complex routes where consumers in developed countries (which we prefer to refer as North-Global here) cause threats to species through their demand for commodities that are produced in South-Global countries (such as coffee, tea, sugar, textiles, fish, and other manufactured goods).

The work on telecoupling by Liu et al. (2001; 2013; 2021) also provides important examples of the same relationship through quantitative analysis (Liu et al. 2021). They show how the current consumer market creates a demand for agricultural products that is not satisfied by domestic markets, so that commodities are produced elsewhere, causing negative effects on biodiversity in places far from the consumption center. If natural resources are unevenly distributed, it is certainly the case of the environmental effects that the use of such resources entails. This is called the "global distribution of environmental degradation"by Hornborg and Crumley (2016) and means that improvements in one part of the world system are always offset by deterioration in other parts of the world system. Therefore, for WST, discussing conflicts within a given country confuses or even leads to the invisibilization of the original causes. Inequalities are no longer a local and contemporary problem, but a structural, historical, and global problem.

COVID-19 PANDEMICS AS AN EMERGENT PHENOMENON OF WS

As we become accustomed to thinking of our world as a single, coherent globe, we more easily recognize that changes in the world-system and changes in the Earth-system can be recursively connected. The COVID-19 pandemic is the most recent example of this relationship. It is an example of a phenomenon that requires, for its understanding, examining the links between human and natural systems in a global way, but whose impacts are unevenly distributed between and within nations. However, as we pointed out at the beginning, based on a preliminary analysis of early articles published in the field of conservation

science, the various dimensions of the social impact of the pandemic that interact with environmental issues have been little considered within the field, particularly aspects such as the political, economic, and social inequalities that shape the local-global reality.

In order to fill this gap, we conducted a search of research articles and discussions published in the Web of Science database, focusing on articles in the field of social science and conservation that discussed aspects related to the COVID-19 pandemic. We evaluated the results of several primary studies from July 2020 to March 2021. We searched for the topics TS=("covid19"OR "covid-19"OR "coronavirus"OR "sars-cov-2") AND (TS= governance OR "social inequality"OR "food insecurity"OR "globalization"OR indigenous land OR "protected areas"OR poaching OR pollution). We filtered the results by research area for Biodiversity Conservation or Sociology or Political Science or Economics or Geography. In order to get more complete results and reduce language bias, we searched all sub-collections, including Scielo which has a large collection of articles in Portuguese and Spanish. From the list of articles which we were able to obtain, we selected articles that explicitly addressed the effects of the pandemic on social and economic or environmental aspects, with a focus on conservation. We excluded experimental articles or articles with methodological proposals. Finally, we conducted a critical analysis of the selected articles, using the WST as a framework, situating the different results found in the context of local-global and historical-social relations. We present below our analysis organized according to the presented analytical categories of the WST to define the pandemic as an emerging phenomenon of the modern World System.

Totality

The pandemic of COVID-19, is a process that can be interpreted as a "total"phenomenon that emerges and affects the entire environment, an evolving system formed by interdependent parts that synergistically interact. It manifests itself in a wide range of dimensions - ecological, economic, social, political, psychological - in highly complex imbrications that place at the center the relationship of humans with nature, economic activities, and globalization.

Historicity

The pandemic of COVID-19 is not just a health crisis with causes that are external to the social system (Cantu 2021), it is also a social and political crisis, which exacerbates social inequalities and reveals social structures, notably in terms of class, race and gender (Laurencin and McClinton 2020; Pleyers 2020). This statement is particularly true for the Global South (Pleyers 2020), because the pandemic, more than causing a new situation or a dramatic change, exposed and strengthened some historical features of world geopolitics, highlighting the profound crisis of being, knowledge and power of modernity/coloniality as a historical system, which at its center expresses a rupture in the relationship between nature and life (Bringel, 2020; Morin, 2020; Latour, 2020; Rios, 2020; Segato, 2020; Sousa Santos, 2020; Svampa, 2020).

For example, in Latin America, indigenous lands play an essential role on biodiversity conservation, by reducing the advance of deforestation and fire use in many fronts (Nepstad et al. 2006). This role, however, is performed under intense conflicts over land tenure and resource use. In Amazon, illegal miners, farmers, ranchers, loggers, squatters, and poachers represent a constant menace to the security of indigenous populations. Dozens of indigenous leaderships die annually by been outspoken in defense of their land and the environment, two thirds in Latin America (Global Witness 2020). During the COVID-19 crisis, such conflicts were exacerbated. Indigenous populations were trying to avoid infection by either moving to more pristine environments or closing access roads and obstructing the passage for non-indigenous. With reduction in governance, however, windows of opportunity are even more open to illegal activities, generating new conflicts and boosting those that already exist. Initially, more than 130 indigenous communities in Argentina, Paraguay, Colombia, Peru, Bolivia, Mexico, and Brazil were reached by COVID (Taylor, 2020). Indigenous associations demanded immediate government actions to prevent the introduction and spread of COVID-19 in their communities but, in most cases, the demands have been ignored, inefficient or are arriving too late. It is noteworthy that even some uncontacted tribes have been affected (Taylor 2020). As stated by the indigenous communities of Hidalgo in Mexico, "in this pandemic we are not at all in the same boat; some are on yachts, some on speedboats, some in life jackets, and some swimming with the remaining forces" (Szalkowicz 2020).

Biodiversity occupies a central place, serving both as a source of livelihood for small vulnerable populations (FAO and UNEP 2020) as well as a source of enrichment for large power groups (Buckley 2020). Just as for indigenous communities, in many other places during the pandemic protection policies and monitoring activities of existing protected areas have been suspended or relaxed worldwide (IUCN 2020), opening up opportunities for illegal activities such as poaching, logging, mining, and deforestation (Gardiner 2020). According to a WWF report (2020) this year was characterized by a wave of fires and fire alerts in

all continents. The climate change that causes higher temperatures and lower relative humidity would be closely associated with this phenomenon, but it is estimated that human activities are responsible for 75% of all forest fires. Although the causes vary from place to place, forest fires are mostly caused intentionally, to change land use or to "clean" and prepare new areas for cultivation and livestock (WWF 2020). At the same time, satellite data from 18 countries indicated that deforestation rose 150% in March 2020, in comparison to observed in the 2017-2019 period (Winter 2020). In Amazon, for instance, illegal poachers, miners, loggers, farmers, and land grabbers are pushing back the forest frontiers, leading to higher deforestation rates (Escobar 2020), although this is a product of the synergy between COVID and a more extensive and complex governance crisis. In Brazil, the government in office used COVID-19's "pandemic distractions"to relax and weaken environmental protection legislation across the territory. A study revealed 57 legislative acts aimed at weakening environmental protection, through the dismantling of the main government institutions responsible for environmental protection, and a 72% reduction in environmental fines during the pandemic, despite the increase in deforestation in the Amazon during the same period (Vale et al. 2021). The Wildlife Conservation Society has also reported increases in hunting of protected species since the beginning of the pandemic, especially in the areas most affected socioeconomically, related to the loss of rural livelihoods and reduced capacity to conduct patrols and field work in National Parks (WCS 2020). In addition, local economic support programs derived from the income generated by tourism have been temporarily cancelled, leading to an increase in poaching of endangered species by international criminal organizations (Buckley 2020).

Moreover, the pandemic has worsened the situation of general hunger in the Global South (Laborde et al. 2020), where the lack of income, food supply networks and social protection measures has produced a cascade of socio-environmental conflicts (O'Hara and Toussaint, 2020). With the COVID-19 crisis, food production and transport were disturbed, prices rose, and jobs were lost, putting many families in hunger. Not surprisingly such population turned to nature to insure their minimum daily intake. In rural India, freshwater fishing had a sudden increase in 2020 due to the synergy between unemployment, disruption on the food supply chain and improvement in river water quality caused by the pandemic (Pinder et al. 2020). In other countries such as Cambodia, Uganda, Brazil, China, and Botswana, very similar situations are being reported (Corlett 2020a). We see, therefore, that many populations of the Global-South have had to resort to illegal activities to survive, with consequences for the conservation of biodiversity, however, the cause of this is not necessary linked to the behavior pattern of these populations, but, in most cases, it is related to the lack of inspection and adequate measures in the protected areas, which includes the adoption of concrete social protection measures that guarantee the livelihood and autonomy of those historically neglected. Therefore, although there are ecological, political, and cultural differences between localities, there is a common historical picture of inequality and dependence, which has accompanied the historical development of capitalism, between the countries of the global North and South, which lead to the deterioration of social relations, the ecological crisis and the consequent loss of global biodiversity.

These aspects related to historical-social dimensions are analytically relevant for conservation science because, if considered, they can avoid biased analyses, as in the case of the "global"narrative surrounding Anthropause and the effects of the pandemic on biodiversity. Different impacts can be consequences of political and ethical questions about who and what can pause or be paused, according to what authority and under what conditions (Searle et al. 2021). Therefore, we argue that it is essential to consider the spatio-temporal dimension of "pausing,"because there are pre-existing historical and social conditions (i.e., contingencies) that can locally alter human impacts on biodiversity.

Globality

The environmental impact of the COVID-19 pandemic was felt at various spatial scales, from local biological communities to the biosphere, from local to global, but not always in the same way. Locally, the effect was shaped by local aspects such as the specific relationship that each human population has with nature, as well as aspects of governance, land management, environmental policies, access to health, housing and food, industrial and agricultural profile, and degree of economic globalization. In other words, the local impact of the pandemic was associated with synergistic effects between environmental and socioeconomic aspects, influenced by near and remote historical factors that shape the pandemic's trajectory.

On the other hand, the pandemic is a total phenomenon whose origin and dispersal are closely related to the global historical economic relations in the World-System. Globalization and the geography of economic relations are the main drivers of the spatial structuring and the speed of international dissemination of COVID-19 (Ludovic et al. 2020). It is noteworthy that current evidence indicate that the variables associated with globalization influenced the

intensity and spread of the COVID-19 pandemic (Cartenì et al. 2020). For instance, results from a research carried out in 100 countries showed that if countries with higher levels of socioeconomic globalization are more exposed to COVID-19, the degree of lethality (the number of deaths confirmed by the disease) is related to differences in health infrastructure and demographic structure (Farzanegan et al. 2020). Other research has shown that the degree of internationalization of countries (measured by the number of flights, number of passengers per flight) and the types of restrictions at international borders (Coelho et al. 2020; Ribeiro et al. 2020), the dynamics of mobility and the characteristics of the population, such as the Human Development Index (HDI) and the total size of the population (Sigler et al. 2020), are also variables that explain the different degrees of spread and lethality of the pandemic. Therefore, contrary to views that consider the disease as an external factor, arising from biological contingencies, we can understand the pandemic of COVID-19 as part of the expansion and intensification of economic, political and social relations. In this sense, we agree with Hornborg (2021), who emphasizes that it is counterproductive to argue that 'the pandemic is the result of humans penetrating a natural domain that should be left alone."This separation of nature and society reproduces recurring problems in conceptualizing the role of human economies in biodiversity (Hornborg 2021). We can thus say that the pandemic emerges as a phenomenon of society-nature relations of the world-system, constituting itself as a disturbing historical event, which highlights the contradictory and conflicting relations between human beings and nature, or more precisely between the hegemonic economic system and nature.

CONCLUDING REMARKS

Here, we incorporate world-systems perspectives into an analysis of impact of pandemic in biodiversity conservation. By placing the COVID-19 pandemic in a comprehensive historical and sociological perspective, the evidence moderates the perception of the pandemic's unusualness and shows us the synergy between political, economic, and social issues with biodiversity conservation. We argue here that the theoretical framework and analytical categories of WST - Totality, Historicity, and Globality - allow us to understand the COVID-19 pandemic not as a phenomenon exogenous to the world-system, but rather as an endogenous crisis, emerging from the complex relationship between society and nature, and preserving existing historical inequalities.

We conclude that although studying anthropause is interesting and in some cases revealing for the conservation of biodiversity, it is essential to consider the spatial and temporal scale of the phenomenon. On the one hand, because the research itself shows us that anthropause is a phenomenon relative to scale. And, on the other hand, because much of the research in the field of conservation science has extrapolated the phenomenon of anthropause without verification of the local and global reality. They started from place-specific perspectives to answer global and temporary questions, which need to be treated with more caution, given the existing local-global inequality. Actually, local-global inequality should be the starting point for research in conservation. The pandemic highlighted in this sense, the vulnerabilities inherent in the social and economic models on which many conservation efforts are based. Thus, while we agree with the pandemic's potential to provide a pivot point for societal transformation (Bates et al. 2021), we believe that the pandemic represents another opportunity to reconsider the status quo of conservation.

Undoubtedly, the ecological, social, and economic legacy of this event will persist. This article is an attempt to introduce the local-global and historical-sociological dimensions into the overall equation of analyses in the conservation sciences for our understanding of global change. We thus raise the final considerations that the WST provides a heuristic tool that could influence the research in the field: understanding protected areas as subsystems of the World-System; recognizing local-global inequalities as undisputable elements of analyses; and, recognizing that it is not humans per se that cause widespread environmental degradation, but rather the destructive patterns of global economic activities. Finally, the conservation biology should evolve from a biological perspective to a more interdisciplinary perspective, questioning the basis of production and the social inequalities that create the environmental problems and affect the practice and success of biodiversity conservation objectives.

ACKNOWLEDGMENT

This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nivel Superior – Brazil (CAPES) – Finance Code 001. MNCH received a PhD studentship from CAPES. CRF were supported by CNPq (PQ 306812/2017-7).

DATA AVAILABILITY

The data used to support the findings of this study are available from the corresponding author upon reasonable request.

CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

CONTRIBUTION STATEMENT

Conceived of the presented idea: MNCH, CRF Wrote the first draft of the manuscript: MNCH, LRRF, CRF
Review and final write of the manuscript: MNCH, LRRF, GSG, CRF
Supervision: MNCH

REFERENCES

Alaei K, Akgüngör S, Chao WF, Hasan S, Marshall A, Schultz E, Alaei A (2019) **Cross-country analysis of correlation between protection of women's economic and social rights, health improvement and sustainable development.** *BMJ Open 9*, e021350, doi: 10.1136/bmjopen-2017-021350.

Allen T, Murray KA, Zambrana-Torrelio C, Morse SS, Rondinini C, et al. (2017) **Global hotspots and correlates of emerging zoonotic diseases.** *Nat. Commun.*, 8:1124–1124. doi: 10.1038/s41467-017-00923-8.

Álvarez L and Coolsaet B (2020) **Decolonizing environmental justice studies: a Latin American perspective**. *Capitalism nature socialism*, 31:50-69. doi: 10.1080/10455752.2018.1558272.

Andersen KG, Rambaut A, Lipkin WI, Holmes EC and Garry RF (2020) **The proximal origin of SARS-CoV-2.** *Nat. Med.*: 26, 450–452.

Arenti WL and Filomeno FA (2007) **Economia política do moderno sistema mundial: as contribuições de Wallerstein, Braudel e Arrighi.** *Ensaios FEE*, 28(1).

Azevedo JC, Luque S, Dobbs C, et al. (2020) **The ethics of isolation, the spread of pandemics, and landscape ecology.** *Landsc. Ecol* 35:2133–2140. doi: 10.1007/s10980-020-01092-8.

Bambra C, Riordan R, Ford J and Matthews F (2020) **The COVID-19 pandemic and health inequalities.** *J Epidemiol Community Health*, 74(11):964-968. doi: 10.1136/jech-2020-214401.

Bao R, Zhang A (2020) **Does lockdown reduce air pollution? Evidence from 44 cities in northern China.** *Sci.Total Environ.* 731, 139052, doi: 10.1016/j.scitotenv.2020.139052.

Barichello R (2021) **Revisiting the effects of the COVID-19 pandemic on Canada's agricultural trade: The surprising case of an agricultural export boom.** *Canadian Journal of Agricultural Economics/Revue canadienne d'agroeconomie,* 69:251-260.

Bates AE, Primack RB, Duarte CM andand PAN-Environment Working Group (2021) **Global COVID-19 lockdown highlights humans as both threats and custodians of the environment.** *Biological Conservation*, 109175. doi: 10.1016/j.biocon.2021.109175.

Bates AE, Primack RB, Moraga P, and Duarte CM (2020) **COVID-19 pandemic and associated lockdown as a "Global Human Confinement Experiment" to investigate biodiversity conservation.** *Biological conservation*, 248, 108665. doi: 10.1016/j.biocon.2021.109175.

Bates AE, Mangubhai S, Milanés CB et al. (2021) **The COVID-19 pandemic as a pivot point for biological conservation.** *Nat Commun* 12:5176. doi: 10.1038/s41467-021-25399-5.

Beldarraín CER (2020) **La información científica confiable y la COVID-19.** *Revista Cubana de Información en Ciencias de la Salud*, 31:3.

Bennett NJ andand Roth R (2019) **Realizing the transformative potential of conservation through the social sciences, arts and humanities.** doi: 10.1016/j.biocon.2018.07.023.

Bennett NJ, Roth R, Klain SC, Chan K, Christie P, et al. (2017) **Conservation social science: Understanding and integrating human dimensions to improve conservation.** *Biol. Conserv.*, 205:93-108.

Berbes-Blázquez M, Gonzalez JA, Pascual U (2016) **Towards an ecosystem services approach that addresses social power relations.** *Current Opinion in Environmental Sustainability. Sustain. Sci.* 19:134–143.

Bertazzoni G, Ruggiero M and Bertazzoni B (2020) **Spatial inequalities of COVID-19 in Italy.** *J-READING-Journal of Research and Didactics in Geography,* 1. doi: 10.4458/3099.

Bezerra ACV, Silva CEMD, Soares FRG, Silva JAMD (2020) **Factors associated with people's behavior in social isolation during the COVID-19 pandemic.** *Ciência andand Saúde Coletiva* 25:2411–2421.

Birn AE (2020) **How to have narrative-flipping history in a pandemic: Views of/from Latin America.** *Centaurus*, 62:354-369.

Blum B, Neumärker B (2020) **Globalization, environmental damage and the Corona pandemic - lessons from the crisis for economic, environmental and social policy.** *Social Sciences andand Humanities Open*, doi: 10.2139/ssrn.3613719.

Bontempi E, Vergalli S, and Squazzoni F (2020) **Understanding COVID-19 diffusion requires an interdisciplinary, multi-dimensional approach.** *Environmental Research*, 188, 109814 doi: 10.1016/j.envres.2020.109814.

Braga F, Scarpa GM, Brando VE, Manfè G, Zaggia L (2020) **COVID-19 lockdown measures reveal human impact on water transparency in the Venice Lagoon.** *Science Total Environ.* 736, 139612, doi: 10.1016/j.scitotenv.2020.139612.

Bright C (1999) **Invasive species: pathogens of globalization.** *Foreign Policy*, 116:50-60.

Bringel B (2020) **Geopolítica de la pandemia, escalas de la crisis y escenarios en disputa.** *Geopolítica* (s), 11:173. doi: 10.5209/geop.69310.

Brook BW, Sodhi NS and Bradshaw CJ (2008) **Synergies among extinction drivers under global change.** *Trends Ecol. Evol.*, 23:453-460.

Brulle RJ and Pellow DN (2006) **Environmental justice: human health and environmental inequalities.** *Annu. Rev. Public Health*, 27:103-124.

Buckley R (2020) **Conservation implications of COVID19: Effects via tourism and extractive industries.** *Biol. Conserv* doi: 10.1016/j.biocon.2020.108640.

Cantu R (2021) **A crise da Covid-19 e o sistema mundo: perspectivas sobre epidemias na história e desigualdades globais.** *Simbiótica. Revista Eletrônica*, 8:81-102.

Carlitz RD and Makhura MN (2021) **Life under lockdown: Illustrating tradeoffs in South Africa's response to COVID-19.** *World development*, 137, 105168.

Carrillo I and Pellow D (2021) **Critical environmental justice and the nature of the firm.** *Agriculture and Human Values*, 38:815-826.

Cartenì A, Di Francesco L and Martino M (2020) **How mobility habits influenced the spread of the COVID-19 pandemic: Results from the Italian case study.** *Science of the Total Environment*, 741, 140489.

Castillo A, Bullen-Aguiar AA, Peña-Mondragón JL and Gutiérrez-Serrano N (2020) **The social component of social-ecological research: moving from the periphery to the center.** *Ecology and Society*, 25:1.

Chakraborty I and Maity P (2020) **COVID-19 outbreak: Migration, effects on society, global environment and prevention.** *Science Total Environ.* 138882. doi: 10.1016/j.scitotenv.2020.138882.

Chew SC (1997) **"For Nature: Deep Greening World-Systems Analysis for the 21st Century."** *Journal Q(World -Svstems Research*, 3:381-402.

Ciccantell PS (2021) **World-systems theory, nature, and resources.** In The Routledge Handbook of Critical Resource Geography (pp. 177-187). Abingdon, Routledge.

Cobério CGV (2008) **Os Sistemas-mundo e a Globalização.** *RACE-Revista de Administração, Contabilidade e Economia*, 7:53-70.

Coelho MTP, Rodrigues JFM, Medina AM, Scalco P, Terribile LC, Vilela B and Dobrovolski R (2020) **Global expansion of COVID-19 pandemic is driven by population size and airport connections.** *PeerJ,* 8, e9708.

Conticini E, Frediani B, Caro D (2020) **Can atmospheric pollution be considered a co-factor in extremely high level of SARS-CoV-2 lethality in Northern Italy?** *Environ. Pollut.*, 21, 114465, doi: 10.1016/j.envpol.2020.114465.

Cooke SJ, Twardek WM, Lynch AJ, Cowx IG, Olden JD, Funge-Smith S, ... and Britton JR (2021) **A global perspective on the influence of the COVID-19 pandemic on freshwater fish biodiversity.** *Biological Conservation*, 253, 108932.

Corbera E, Anguelovski I, Honey-Rosés J, Ruiz-Mallén I (2020) **Academia in the Time of COVID-19: towards an ethics of care.** *Plan Theory Pract.*, 21:191–199.

Corlett RT, Poonia A, Grelle CEV, Christianini A, Mujuni N (2020) **How is the COVID-19 pandemic impacting protected area management?** https://www.researchgate.net/post/How_is_the_COVID-19_pandemic_impacting_protected_area_management#view=5e974d62d8edad62df541921 Accessed 02.07.20.

Corlett RT, Primack RB, Devictor V, Maas B, Goswami VR, Bates AE, Cumming GS (2020) **Impacts of the coronavirus pandemic on biodiversity conservation.** *Biol Conserv.*, 246, 108571, doi: 10.1016/j.biocon.2020.108571.

Cumming GS (2016) **The relevance and resilience of protected areas in the Anthropocene.** *Anthropocene*, 13:46-56.

de León-Martínez LD, Palacios-Ramírez A, Rodriguez-Aguilar M and Flores-Ramírez R (2020) **Critical review of social, environmental and health risk factors in the Mexican indigenous population and their capacity to respond to the COVID-19.** *Science of The Total Environment*, 733, 139357 doi: 10.1016/j.scitotenv.2020.139357.

DGHIC (2021) **The Launch and Scale Speedometer is led by the Duke Global Health Innovation Center,** https://launchandscalefaster.org/COVID-19.

Dias GV and Tostes JGR (2021) **Um sistema complexo longe do equilíbrio: a complexidade nas críticas ao capitalismo de Wallerstein e Mészáros.** *Tramas y Redes*, 1:87-102.

Dorninger C et al. (2021) **Global patterns of ecologically unequal exchange: implications for sustainability in the 21st century.** *Ecol. Econom.*, 106824 doi: 10.1016/j.ecolecon.2020.106824.

Duhon J, Bragazzi N and Kong JD (2021) **The impact of non-pharmaceutical interventions, demographic, social, and climatic factors on the initial growth rate of COVID-19: A cross-country study.** *Science of The Total Environment*, 760, 144325. doi: 10.1016/j.scitotenv.2020.144325.

ECLAC - Economic Commission for Latin America and the Caribbean (2015) **Os povos indígenas na América Latina: avanços na última década e desafios pendentes para a garantia de seus direitos.** Santiago do Chile: Nações Unidas. https://www.cepal.org/pt-br/publicaciones/37773-os-povos-indigenas-america-latina-avancos-ultima-decada-desafios-pendentes.

Ehrenfeld D (2003) **Globalization: effects on biodiversity, environment and society.** *Conservation and Society*, 1:99-111.

El-Hani CN and Machado V (2020) **COVID-19: The need of an integrated and critical view.** *Ethnobiol. Conserv.* doi: 10.15451/ec2020-05-9.18-1-20.

Elliott RJ, Schumacher I and Withagen C (2020) **Suggestions for a Covid-19 post-pandemic research agenda in environmental economics.** *Environ. Resource Econom*, 76:1187-1213.

Escobar H (2020) **Deforestation in Brazil is still rising sharply.** *Scienc.* 369:613, doi: 10.1126/science.369.6504.613.

FAO and UNEP (2020) **The State of the World's Forests 2020. Forests, biodiversity and people.** *Rome.* doi: 10.4060/ca8642en.

Farzanegan MR, Feizi M and Gholipour HF (2020) **Globalization and outbreak of COVID-19: An empirical analysis.** *MAGKS Papers on Economics*, 202018.

Fernandes N (2020) **Economic Effects of Coronavirus Outbreak (COVID-19) on the World Economy.** https://ssrn.com/abstract=3557504 or doi: 10.2139/ssrn.3557504.

Fraser N, Brierley L, Dey G, Polka JK, Pálfy M, Nanni F and Coates JA (2021) **The evolving role of preprints in the dissemination of COVID-19 research and their impact on the science communication landscape.** *PLoS biology*, 19: e3000959. doi: 10.1371/journal.pbio.3000959.

Gardiner B (2020) **Why COVID-19 will end up harming the environment, National Geographic.** nationalgeographic.co.uk/environment-and-conservation/2020/06/why-covid-19-will-end-up-harming-the-environment.

Ghai DP and Schmeling D (1992) **Conservation, livelihood and democracy: social dynamics of environmental changes in Africa (Vol. 33).** Geneva, Switzerland: United Nations Research Institute for Social Development.

Gibbons DW, Sandbrook C, Sutherland WJ, Akter R, Bradbury R, Broad S, ... and Ockendon N (2021) **The relative importance of COVID-19 pandemic impacts on biodiversity conservation globally.** *Conservation Biology.* doi: 10.1111/cobi.13781.

Grove M, Ogden L, Pickett S, Boone C, Buckley G, Locke DH, Hall B (2018) **The legacy effect: understanding how segregation and environmental injustice unfold over time in Baltimore.** *Ann. Am. Assoc. Geog.*, 108:524–537, doi: 10.1080/24694452.2017.1365585.

Helm D (2020) **The environmental impacts of the coronavirus.** *Environ. Resour. Econom.*, 76:38. doi: 10.1007/s10640-020-00426-z.

Hobbs JE (2020) **Food supply chains during the COVID-19 pandemic.** *Canadian Journal of Agricultural Economics.* doi: 10.1111/cjag.12237.

Holland TG, Peterson GD, and Gonzalez A (2009) **A cross-national analysis of how economic inequality predicts biodiversity loss.** *Conservation biology*, 23:1304-1313.

Hooke RL, Martín-Duque JF (2012) **Land transformation by humans: A review.** *Geological Society of America.* 22:4–10, doi: 10.1130/GSAT151A.1.

Hornborg A (2020) **The World-System and the Earth System.** *Journal of World-Systems Research*, 26:184-202.

Hornborg A and Crumley CL (2016) **The World System and the Earth System: global socio-environmental change and sustainability since the Neolithic.** *Routledge.*

Hughes TP, Kerry JT, Baird AH, Connolly SR, Dietzel A et al. (2018) **Global warming transform coral reef assembrages.** *Nature.* 556:492–496. doi: 10.1038/s41586-018-0041-2.

IUCN (2020) **Conserving Nature in a time of crisis: Protected Areas and COVID-19.** https://www.iucn.org/news/world-commission-protected-areas/202005/conserving-nature-a-time-crisis-protected-areas-and-covid-19 Accessed 02.07.2020.

Kalmus V (2021) **"Jobs that Really Matter": Critical Reflections on Changes in Academic Life during/after the Covid-19 Pandemic.** *TripleC19* 1:255-261. doi: 10.31269/triplec.v19i1.1255.

Kaneda T and Greenbaum C (2020) **How Demographic Changes Make Us More Vulnerable to Pandemics Like the Coronavirus.** *PRB.* how-demographic-changes-make-us-more-vulnerable-to-pandemics-like-the-coronavirus Accessed 20.07.2020.

Kashwan, P (2016) **Power asymmetries and institutions: landscape conservation in central India.** *Regional Environmental Change*, 16(1), 97-109.

Klemeš JJ, Van Fan Y, Tan RR and Jiang P (2020) **Minimising the present and future plastic waste, energy and environmental footprints related to COVID-19.** *Renewable and Sustainable Energy Reviews*, 127, 109883, doi: 10.1016/j.rser.2020.109883.

Laborde D, Martin W and Vos R (2020) **Poverty and food insecurity could grow dramatically as COVID-19 spreads.** International Food Policy Research Institute (IFPRI): Washington, DC.

Latour B (2020) **No es el fin del mundo, es una advertencia.** Chicago Tribune. Available in: `https://www.chicagotribune.com/espanol/sns-es-no-es-fin-mundo-`.

Laurencin CT, McClinton A (2020) **The COVID-19 pandemic: a call to action to identify and address racial and ethnic disparities.** *Journal of racial and ethnic health disparities*, 43:1–5, doi: 10.1007/s40615-020-00756-0.

Lenzen M, Moran D, Kanemoto K, Foran B, Lobefaro L and Geschke A (2012) **International trade drives biodiversity threats in developing nations.** *Nature*, 486:109-112.

Levers C and Müller D (2019) **Mapping export-oriented crop production.** In Telecoupling (pp. 89-113). Palgrave Macmillan, Cham.

Lidskog R and Waterton C (2016) **Anthropocene–a cautious welcome from environmental sociology?.** *Environ, Sociol.*, 2-395-406. doi: 10.1080/23251042.2016.1210841.

Litonjua MD (2012) **Third world/global south: From modernization, to dependency/liberation, to post-development.** *J. Third World Stud.*, 29:25–56, doi: 10.2307/45194852.

Liu J, Dietz T, Carpenter SR, Alberti M, Folke C, Moran E, ... and Taylor WW (2007) **Complexity of coupled human and natural systems.** *Science*, 317:1513-1516. doi: 10.1126/science.1144004.

Ludovic J, Bourdin S, Nadou F and Noiret G (2020) **Economic globalization and the COVID-19 pandemic: global spread and inequalities.** *Bull. World Health Organ.* doi: 10.2471/BLT.20.261099.

Mallapaty S (2020) **How sewage could reveal true scale of coronavirus outbreak.** *Nature* 580:176–177 doi: 10.1038/d41586-020-00973-x.

Mallee H (2020) **A time for transdisciplinarity.** *Current Opinion in Environmental Sustainability* doi: 10.1016/j.cosust.2020.09.011.

Manenti R, Mori E, Di Canio V, Mercurio S, Picone et al. (2020) **The good, the bad and the ugly of COVID-19 lockdown effects on wildlife conservation: Insights from the first European locked down country.** *Biological conservation*, 249, 108728.

Mariutti EB (2004) **Considerações sobre a perspectiva do sistema-mundo.** Novos Estudos CEBRAP, 69:71-88.

Martin JL, Maris V, Simberloff DS (2016) **The need to respect nature and its limits challenges society and conservation science.** *Proceedings of the National Academy of Sciences* 113:6105–6112.

Martínez-Vela, C. A (2001) **World systems theory.** *Engineering system division*, 83:1-5.

Massarella K, Nygren A, Fletcher R, Büscher B, Kiwango WA, Komi S, ... and Percequillo A. R (2021) **Transformation beyond conservation: How critical social science can contribute to a radical new agenda in biodiversity conservation.** *Current Opinion in Environmental Sustainability*, 49, 79-87.

Moore, JW (2010) **The end of the road? Agricultural revolutions in the capitalist world-ecology, 1450–2010.** *Journal of agrarian change*, 10:389-413.

Morin E (2020) **"Lo que el coronavirus nos está diciendo".** *Servindi.*

Morrison J (2020) **Exposure and Inequalities: African Descendants During COVID-19** https://www.undp.org/latin-america/blog/exposure-and-inequalities-african-descendants-during-covid-19 Accessed 07.09.2020.

Nepstad D, Schwartzman S, Bamberger B, Santilli M, Ray D, et al. (2006) **Inhibition of Amazon deforestation and fire by parks and indigenous lands.** *Conservation Biology* 20:65–73. doi: 10.1111/j.1523-1739.2006.00351.x.

O'Hara S and Toussaint E C (2020) **Food access in crisis: Food security and COVID-19.** *Ecological Economics*, 180, 106859. doi: 10.1016/j.ecolecon.2020.106859.

Persson J, Hornborg A, Olsson L, and Thorén H. (2018) **Toward an alternative dialogue between the social and natural sciences.** *Ecology and Society*, 23:4.

Pinder AC, Raghavan R, Britton JR, Cooke S (2020) **COVID-19 and biodiversity: The paradox of cleaner rivers and elevated extinction risk to iconic fish species.** *Aquatic Conservation: Marine and Freshwater Ecosystems*, 30:1061–1062 doi: 10.1002/aqc.3416.

Pinho CES (2020) **Pandemia global, governo e desigualdade no Brasil: Um olhar das ciências sociais.** Instituto Humanitas Unisinos www.ihu.unisinos.br/78-noticias/597877-pandemia-global... Accessed 13.07.2020.

Pleyers G (2020) **A plea for global sociology in times of the coronavirus.** Report International Sociological Association https://www.isa-sociology.org/frontend/web/uploads/files/Global%20Sociology%20in%20Times%20of%20the%20Coronavirus.pdf Accessed 13.07.2020

Pochmann M (2000) **Economia global e a nova Divisão Internacional do Trabalho.** IE/Unicamp, Campinas. http://decon.edu.uy/network/panama/POCHMANN.pdf.

Prata JC, Silva AL, Walker TR, Duarte AC, Rocha-Santos T (2020) **COVID-19 pandemic repercussions on the use and management of plastics.** *Environ Sci Technol* 54:7760–7765.

Ribeiro SP, Dáttilo W, Barbosa DS, Coura-Vital W, Chagas IAD, Dias CP and Reis AB (2020) **Worldwide COVID-19 spreading explained: traveling numbers as a primary driver for the pandemic.** *Anais da Academia Brasileira de Ciências*, 92:4.

Rutz C, Loretto MC, Bates AE, Davidson SC, Duarte CM, Jetz W et al. (2020) **COVID-19 lockdown allows researchers to quantify the effects of human activity on wildlife.** *Nat Ecol Evol*, 4:1156-1159. doi: 10.1038/s41559-020-1237-z.

Saadat S, Rawtani D, Hussain CM (2020) **Environmental perspective of COVID-19.** *Science of The Total Environment*, 138870, doi: 10.1016/j.scitotenv.2020.138870.

Schell CJ, Dyson K, Fuentes TL, Des Roches S, Harris NC, Miller DS et al. (2020) **The ecological and evolutionary consequences of systemic racism in urban environments.** *Science*, 369:6510 doi: 10.1126/science.aay4497.

Searle A, Turnbull J and Lorimer J (2021) **After the anthropause: Lockdown lessons for more-than-human geographies.** *The Geographical Journal*, 187: 69-77.

Segato R (2020) **Todos somos mortales: del significante vacío a la naturaleza abierta de la historia. Lobo Suelto.** Available in: http://lobosuelto.com/todos-somos-mortales-segato.

Silva ALP, Prata JC, Walker TR, Duarte AC, Ouyang W, Barcelò D, Rocha-Santos T (2020) **Increased plastic pollution due to COVID-19 pandemic: challenges and recommendations.** *Chem Eng J*, 405, 126683. doi: 10.1016/j.cej.2020.126683.

Smith MKS, Smit IP, Swemmer LK, Mokhatla MM, Freitag S, Roux DJ and Dziba L (2021) **Sustainability of protected areas: Vulnerabilities and opportunities as revealed by COVID-19 in a national park management agency.** *Biological Conservation*, 255, 108985. doi: 10.1016/j.biocon.2021.108985.

Soga M, Evans MJ, Cox DT and Gaston KJ (2021) **Impacts of the COVID-19 pandemic on human–nature interactions: Pathways, evidence and implications.** *People and Nature*, 3:518-527.

Sousa Santos B (2020) **La cruel pedagogía del virus.** Ed. CLACSO, Buenos Aires.

Specht MJ, Santos BA, Marshall N, Melo FPL, Leal IR, Tabarelli M, and Baldauf C (2019) **Socioeconomic differences among resident, users and neighbour populations of a protected area in the Brazilian dry forest.** *Journal of environmental management*, 232:607-614.

Straussfogel, D. (1997) **World-systems theory: Toward a heuristic and pedagogic conceptual tool.** *Economic Geography*, 73:118-130.

Svampa M (2020) **Reflexiones para un mundo post-coronavirus. Revista Nueva Sociedad.**

https://www.nuso.org/articulo/reflexiones-para-un-mundo-post-coronavirus.

Szalkowicz G (2020) **Los pueblos originarios de América Latina en la era Covid-19.** Los-pueblos-originarios... Accessed 02.07.2020.

Taylor L (2020) **Coronavirus in the Amazon.** *New Scientist*, 245:10 doi: 10.1016/S0262-4079(20)31121-0.

Taylor M (2009) **Who works for globalisation? The challenges and possibilities for international labour studies.** *Third World Quarterly*, 30:435-452. doi: 10.1080/01436590902742230.

Teel TL, Anderson CB, Burgman MA, Cinner J, Clark D, Estévez RA and John FAS (2018) **Publishing social science research in Conservation Biology to move beyond biology.** *Conservation Biology*, 32:6-8 doi: 10.1111/cobi.13059.

Therien JP (1999) **Beyond the North-South divide: the two tales of world poverty.** *Third World Quarterly*, 20:723–742, doi: 10.1080/01436599913523.

Ullah SA, Tsuchiya J, Asahiro K and Tani M. (2022) **Exploring the socioeconomic drivers of deforestation in Bangladesh: The case of Teknaf Wildlife Sanctuary and its surrounding community.** *Trees, Forests and People*, 7, 100167.

United Nations (2020) https://sdgs.un.org/goals/goal2 Accessed 12.08.20.

Vale MM, Berenguer E, de Menezes MA, de Castro EBV, de Siqueira LP and Rita de Cássia QP (2021) **The COVID-19 pandemic as an opportunity to weaken environmental protection in Brazil.** *Biological conservation*, 255, 108994. doi: 10.1016/j.biocon.2021.108994.

Vallet A, Locatelli B, Barnaud C, Makowski D, Conde YQ, and Levrel H (2020) **Power asymmetries in social networks of ecosystem services governance.** *Environmental Science and Policy*, 114, 329-340.

Wallerstein, IM (1976) **A world-system perspective on the social sciences.** *The British Journal of Sociology*, 27:343-352.

Wallerstein IM (2011) **El debate en torno a la economía política del moderno Sistema-Mundial.** Mundo Siglo XXI, revista del CIECAS-IPN, 24, 5-12.

Wallerstein IM (2005) **Análisis de sistemas-mundo: una introducción.** ed. Siglo xxi, México.

WCS (2020) **Updates on COVID-19 Coronavirus. Wildlife Conservation Society** Accessed 05.08.2020.

Winter S (2020) **Mehr Wald geht durch Corona verloren.** World Wildlife Foundation. https://blog.wwf.de/wald-corona.

WWF (2020) **Fires, forests and the future: a crisis raging out of control?** https://wwf.panda.org/discover/our_focus/forests_practice/forest_publications_news_and_reports/fires_forests/.

WWF (2020) **WWF Launches 'Planet-Based Diets' - for Human Health and the Future of the Planet.** https://wwf.panda.org/wwf_news/press_releases/local_press_releases/?944291/WWF-Launches-Planet-Based-Dietsb.

Zambrano-Monserrate MA, Ruano MA, Sanchez-Alcalde L (2020) **Indirect effects of COVID-19 on the environment.** *Science Total Environ.* doi: 10.1016/j.scitotenv.2020.138813.

Zerefos CS, Solomos S, Kapsomenakis J et al (2021) **Lessons learned and questions raised during and post-COVID-19 anthropopause period in relation to the environment and climate.** *Environ Dev Sustain* 23:10623–10645 doi: 10.1007/s10668-020-01075-4.

Received: 23 June 2021
Accepted: 30 January 2023
Published: 06 March 2023

Editor: Thiago Gonçalves-Souza