CHAPTER
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Ecological Corridors as Management Tools

https://doi.org/10.56238/alookdevelopv1-075

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ABSTRACT
Full Protection Areas are central components of Brazil's nature conservation policy. These areas are responsible for protecting large fragments of natural ecosystems, as well as indigenous Lands. However, it is legitimate to ask whether the preservation of these fragments by itself ensures the long-term conservation of biodiversity. After all, the fragmentation of ecosystems, and the consequent fragmentation of natural populations, can lead to an increase in the rates of species extinction. It is postulated that the conservation of natural communities depends on the protection of the remaining native ecosystems, and on the expansion of connection between these fragments, reducing isolation and enhancing a greater gene flow of wild populations. This new approach takes the scale of the landscape into account, requiring the participation of society in the processes of conservation and sustainable use of biodiversity, which leads to the notion of Ecological Corridors or Biodiversity Corridors. The implementation of these Corridors was adopted to find biodiversity conservation strategies that include human dimensions, make the corridors a tool for territorial ordering with the goals of 1) strengthening protected areas, 2) conserving the set of remaining ecosystems and 3) increasing the permeability of the landscape to the flow of species. Along with that, only the development and consolidation of sustainable human activities in the Corridors can confirm such an approach. The various objectives of the Ecological Corridor Conservation Strategy are addressed in this paper.

Keywords: Ecological corridors, Biodiversity, Nature conservation.

1 INTRODUCTION

The concept of Ecological Corridor was used to define initiatives that aim to increase the flow of wild species between fragments of natural ecosystems, with a view to the conservation of their populations. It includes strategies and actions that vary in scale of planning and implementation, according to the species considered and their areas of life.

An initial characterization of this concept refers to vegetation corridors. With local coverage, they provide the physical connection between fragments, from the restoration of areas located between them. Its relevance for the conservation of species has been demonstrated by several works (NOSS, 1987; Damschen et al. 2006; CARLOS, 2006; MOSQUE, 2009; RODRIGUES, MOREIRA, FREIRE 2020). They can still represent an environmental management instrument when protected areas are restored, such as Permanent Preservation Areas (PPAs) or Legal Reserves (RLs).

However, the implementation of vegetation corridors has a limited role. They are important for the conservation of certain species, in the short term and specific locations. However, the concept of "new ecosystems", recently formulated, leads to consider the hypothesis that restored areas present permanent traces of their anthropic origin and may or may not be sustainable over time (EVERS et al. 2018). Also, for the conservation of ecological and evolutionary processes that ensure the maintenance of biological diversity in the long term, strategies to ensure the flow of wild species among the remnants of ecosystems need to act on various spatiotemporal scales, as pointed out by NOSS, already in 1991.

From another perspective, considering the Ecological Corridors as cutouts of territorial management is a policy that is being implemented in several parts of the world, such as the Netherlands and Australia (MELLO, 2013). It consists of developing and applying conservation strategies at multiple scales to reconcile the conservation of ecosystems and species with environmental sustainability and its socioeconomic dimensions.

This paper discusses the difficulties in the conservation of biodiversity from the implementation of policies limited to the protection of large fragments of natural ecosystems and analyzes the potential of the implementation of Ecological Corridors as tools for the conservation and sustainable use of biodiversity.

2 FRAGMENTATION AND CONSERVATION OF BIODIVERSITY

The effects of habitat fragmentation on the conservation of wild species have been studied for years. Least since Preston (1962) demonstrated the existence of a relationship between the extent of habitats and the number of species. Subsequently, with the publication of the Theory of the Biogeography of Islands (McARTHUR & WILSON, 1967) many works were carried out to discuss the relationship between the extinction of species and fragmentation, considering the fragments of ecosystems as similar to islands.

Part of these studies addressed the definition of the best design for the establishment of protected areas. Some authors claimed that it was better to conserve continuous areas compared to separate areas with the equal extension because the former would have the capacity to maintain a greater number of species (THERBORG, 1974; WILSON & WILLIS, 1975; DIAMOND & MAY, 1976). This statement is based on the existence of a direct relationship between the size of the islands and the richness of species, so that the decrease in the area implies the reduction of the number of species, according to the theory of Insular Equilibrium of the Theory of the Biogeography of Islands (McARTHUR & WILSON, 1967).

However, Simberloff & Abele (1976a) showed that, depending on the colonization capacity of the species that form the species pool that can migrate to a given fragment, it is possible to construct a prediction based on this theory that indicates greater richness in two separate areas, when compared to one area continuum of similar size, and vice versa. Therefore, creating several small protected areas could be a strategy for the conservation of the species.

This discussion, which became known by the acronym SLOSS (single large or several small), continued with criticisms of the conception of Simberloff and Abele by Therborg (1977) and Diamond (1977). These authors state that small fragments do not guarantee the maintenance of species that require a certain area or minimum population for their long-term maintenance, nor the preservation of all trophic levels existing in larger fragments. In addition, they claim that the species existing in these fragments are subject to faster extinction processes.

Cole (1981), in response to Simberloff and Abele, states that only in conditions in which a system has few species or when biologically implausible assumptions are established, such as equal abilities for colonization between species, can larger fragments possess fewer species than two or more fragments whose sum of areas is similar. Later studies confirmed that larger fragments tend to have greater biological diversity than that observed in smaller fragments, as Turner (1996) showed for tropical forests. And the rate of extinction of wild populations tends to increase with the reduction of the size of the fragments (SOULÉ & SIMBERLOFF, 1986).

This does not mean that preserving the larger fragments guarantees the conservation of biological diversity. The difference in biodiversity between fragments of different sizes may be small or not occur for many groups of living beings and smaller fragments may have species that are not observed in larger fragments (SOULÉ & SIMBERLOFF, 1986; Turner, 1996).

Still, it is necessary to consider that significant differences can exist between biomes and even between different endemic nuclei in the same biome. It is enough to compare the ecosystems of the tropics to those of temperate regions or the distinct endemic nuclei of the Atlantic Forest. Therefore, a conservation strategy of the set of fragments, regardless of their sizes, can preserve biodiversity and its evolutionary mechanisms first on the scale of landscapes and, ultimately, in the whole biome.

2.1 CONSERVATION OF FRAGMENTED SYSTEMS FROM THE PERSPECTIVE OF POPULATION BIOLOGY

Conserving only the largest fragments does not guarantee the long-term conservation of diverse species, as they impose a limit on the size of their populations. Depending on the species and region, even the largest remnants of ecosystems can be limiting. This is particularly true for naturally small populations, such as large predators, in very fragmented biomes. Smaller populations tend to be more vulnerable to random demographic and environmental events (entries of competing species, mortality from pathogens, environmental changes) and to genetic problems derived from inbreeding (inbreeding), becoming more susceptible to local extinction (THERBORG, 1974; Shaffer, 1981;

SOULÉ, 1983; SOULÉ & SIMBERLOFF, 1986). The additional existence of small fragments may contribute to the viability of these populations.

The spatial distribution of several species in fragmented environments also indicates that the conservation of the set of fragments is essential. Populations of many species may be spatially structured in subpopulations heterogeneously distributed in the landscape as a function of the distribution of the remaining habitats, forming metapopulations (LEVINS, 1969a; Levins, 1970). The theory of metapopulations postulates, in these cases, an increase in genetic variability, since the smallest fragments can harbor wild populations with varying degrees of isolation about those inserted in the largest remnants.

The persistence of subpopulations can occur even if there is local extinction in a fragment, from the recolonization of this fragment by individuals coming from populations located in nearby fragments (rescue effect) (BROWN & KODRIC BROWN, 1977). Thus, in a landscape, the rate of local extinction of a given species tends to reduce with the increase in the number of fragments occupied by that species (HANSKI, 1982). Consequently, the conservation of the set of fragments reduces the probability of extinction of species and can ensure the viability of their populations in a landscape, even when transient extinctions occur in some remnants.

The subpopulations that inhabit certain fragments may have mortality rates higher than the birth rates (sink populations) but still be maintained in the long term from the entry of individuals who migrate from other fragments, where the subpopulations have higher birth rates high than mortality rates (source populations) (PULLIAM, 1988). This process avoids the excessive increase of the source populations, which would compromise the resources necessary to maintain them, in addition to ensuring the maintenance of the sink populations.

It is worth mentioning that fragmentation does not generate the same consequences for all wild populations. Depending on the mobility of the species and the characteristics of the remnants' surroundings, processes that represent significant habitat fragmentation for a given species may be of little relevance to another. Thus, some species are distributed in the set of fragments existing in a landscape but do not form subpopulations. For these species, the fragmentation of remaining ecosystems does not represent a relevant fragmentation of habitats. There is a gene flow among the individuals who inhabit the set of fragments, either by the physical locomotion of animals or due to processes of pollination of plants. Thus, the set of individuals of a given species forms only one population. In this case, the existence of the smaller fragments is also relevant, as well as the conservation of the landscape characteristics that guarantee the flow of these living beings between fragments: the spatial distribution of these populations includes the set of fragments and the areas between fragments and not only the largest remnants.

In summary, the survival of many wild populations and the maintenance of the evolutionary processes that act on them requires that species have a flow of individuals between fragments. Such flow depends on the degree of isolation of the fragments, determined by the immigration rate of each population (WIENS et al., 1993).

Since this rate is related, among other factors, to the nature of the matrix between the fragments and the risk of mortality of dispersers, we can deduce that the level of connectivity between the fragments of ecosystems is relevant for the persistence of wild species in fragmented environments. The degree or level of connectivity represents the extent to which the landscape matrix facilitates or hinders the movement of wild species between fragments (FORMAN & GORDON, 1986). The issues raised above show that, in the long term, the conservation of biodiversity requires the maintenance of the ecological characteristics of the largest and best-preserved remnants of ecosystems, the conservation of the other fragments and the existence of favorable conditions for the flow of living beings between them.

This requires a nature conservation policy that not only considers the multiple scales that encompass the set of fragments of the same ecosystem present in vast areas, but capable of ensuring connectivity between them, reconciling the various human activities and environmental sustainability.

3 THE CONSERVATION OF THE REMNANTS: LIMITATIONS OF THE POLICY OF CONSERVATION UNITS OF INTEGRAL PROTECTION

In Brazil, the principles and practices related to conservation and environmental management were, as a rule, established and implemented in a way divorced from scientific knowledge, so that the system of protected areas established in the country was not based on or adapted to the problem synthesized above. With the creation and implementation of Integral Protection Conservation Units, the Brazilian nature conservation policy is focused, above all, on the protection of the largest remaining fragments of native vegetation (MEDEIROS, GARAY 2006). At the same time, the myth of an untouched nature in which human presence is excluded persists (DIEGUES, 1995).

Thus conceived, the role of this category of the protected area is difficult to be fulfilled, because the management of these Conservation Units (CUs) is often problematic, because it faces several conflicts, either with populations that live in the surroundings or within the units themselves, or with owners who own land in their interior (BRASIL, 2002; AYRES et al., 2005; FREITAS et al., 2016, NINIS et al, 2021).

Part of these problems results from specific characteristics of the Integral Protection PAs, where the direct use of natural resources is not allowed. In many cases, this characteristic increases the vulnerability of populations already historically fragile, such as indigenous, quilombolas, riverside dwellers, and caiçaras. The implementation of this group of units resulted in a hegemonic vision contrary to the PAs in the inhabitants of the surrounding populations, as pointed out by the Ministry of the Environment (MMA), the managing body of most of the units (BRASIL, 2002).

In addition to the social impact of this conservation policy on the most vulnerable communities, it has proven inadequate from a conservation point of view:

> Considering biodiversity solely on the taxonomic aspect leads in practice to dissociating the populations of these species from the numerous interactions that enable their adaptive strategies and the consequent survival. In past times, this approach has enabled the historical legacy of exotic plants in various places of the biosphere, even in the face of the possibility of using native species. Just the example of the presence of jackfruit trees in Rio de Janeiro and ironwood in the streets of India or Australian Queensland. (Garay, 2018 p . 126) .

3.1 NEED FOR TRANSDISCIPLINARY APPROACHES TO LANDSCAPE SCALE BIODIVERSITY MANAGEMENT

From this discussion emerges the perception that the fragmentation of ecosystems is one of the main problems to be faced to conserve biodiversity and that this confrontation requires a discussion that goes beyond the limits of natural sciences and traditional conservation systems. It is necessary that the contribution of social science disciplines, such as economics and management-related sciences, be included in conservation models (POSSINGHAM et al., 2001, apud BARBAULT, 2006).

BARBAULT (2006) states that the emergence, in the 1980s, of science focused on nature conservation - Conservation Biology (SOULÉ & ORIANS 2001) resulted in the identification of four complementary needs.

The first is the need to scale up ecological research. It is important to move from strictly population approaches to ecosystemic and macroecological approaches, typical of landscape ecology. The notion of landscape should be the smallest conceptual and methodological unit, to incorporate the spatial dimension and the socio-economic and cultural aspects. The second is the researcher's need to position his research in the context of a world entirely influenced by man, which requires the use of concepts and tools from the social sciences. The author also states that it is fundamental to reflect and act from a perspective of sustainable development since conservation is only effective when it considers in its policies the interests of individuals and governments. The fourth need, which is a consequence of the other three, is the development of partnerships between researchers, managers responsible for biodiversity conservation, and the people who use the spaces where the priority ecosystems for conservation are.

This same perspective is pointed out by other authors, who argue that biodiversity management needs to incorporate different scientific disciplines, but also the managers and users of biological diversity (GARAY, DIAS, 2001; GARAY, 2006). It is not enough to structure and implement conservation policies and actions that supposedly guarantee the full protection of the tropical forest, excluding the direct relationship with people. This is currently a questioned premise, considering that the presence of man in ecosystems leads to different human-nature interactions and the formation of mosaics of ecosystems whose functioning is sustainable (GARAY, 2018). In addition, recent studies have shown that in

In territories managed by ancestral populations, the conservation of biodiversity can be favored. Ninis et al. (2021) clearly express this issue when discussing results obtained by Hill et al. (2019):

> In 2019, an article published in the journal Nature, based on research conducted in 60 countries, showed that the practices of traditional communities are fundamental to the management of pollinators, the preservation of the environment, and the well-being of man throughout the planet. The research concluded that customary ownership of traditional land strengthens biodiversity conservation by promoting diverse agricultural systems within a food sovereignty approach that provides mutual benefits for pollinators and humans. (Ninis et al., 2021 , p 190).

The need for transdisciplinarity in biodiversity management is highlighted, which should cover the technical-scientific knowledge of the natural sciences, but also requires knowledge concerning social disciplines and territorial and environmental management and knowledge of local populations (BURSZTYN & SAYAGO, 2006).

Managers and social agents, usually absent from the elaboration and implementation of conservation strategies, begin to integrate their knowledge and interests in a symmetrical process of partnership and consensus building. It is a procedure of construction of new knowledge from the dialogue between scientific and popular knowledge, in what was defined by Santos (2007) as the Ecology of Knowledge.

In practice, the conceptual framework and institutional structure related to the management of protected areas in Brazil do not allow a transdisciplinary dynamic of this nature. Traditional management tools restrict actions to the limits of the UC and, sometimes, to areas immediately in the surroundings, so that, in general, they do not provide conservation strategies at the landscape scale. In addition, the legal attributions of the managers of the PAs, often associated with a strict view of conservation, lead to prioritizing tasks of nature preservation and control of threats to some emblematic species. However, crucial issues related to its surroundings, such as environmental sustainability or socio-cultural diversity, become secondary.

The formulation of policies that guarantee concrete measures of conservation and sustainable development requires another approach that encompasses not only the different spatial scales but also the different social agents involved and their knowledge. Ecological Corridors, also called Biodiversity Corridors, can and should be built on this basis.

4 ECOLOGICAL CORRIDORS

The term Ecological Corridor encompasses a variety of notions that concern different spatial and conceptual scales. The first meaning simply refers to the physical connection between fragments of remaining ecosystems carried out through the restoration, usually forest, of areas situated between these fragments.

The interest in this type of proposal was made explicit by Wilson & Willis (1975), who analyzed the importance of the physical connectivity built by a corridor, according to the theory of Insular Equilibrium of the Theory of Biogeography of Islands. Recall that this theory states that the number of species in an island area depends on the dynamic balance between the local extinction of species and the entry of individuals by migration. Thus, the restoration of areas of connection between fragments of ecosystems, by facilitating the migration of individuals between fragments, tends to increase the richness of species and reduce the probability of extinction of the same in a given fragment.

This definition of Ecological Corridor was adopted by the International Union for the Conservation of Nature in 1980 when this institution published its Strategy for World Conservation. This model of Ecological Corridors became part of public policies for nature conservation in several countries of the world, especially in Europe and North America (SIMBERLOFF et al. 1992).

Criticisms of these corridors were formulated, such as the lack of empirical knowledge about the consequences of their implementation and the need to analyze this implementation on a case-by-case basis (SIMBERLOFF & COX, 1987; SIMBERLOFF et al., 1992). On the other hand, several studies, including in the Brazilian Atlantic Forest, indicate that this type of ecological corridor brings more benefits to the conservation of wild populations than damages (PARDINI et al. 2005; MOSQUE, 2009; RODRIGUES et al., 2020).

Faced with this controversy, it is worth mentioning the case of the Netherlands. The discussion of the validity of the implementation of these corridors was important in that country in the late 1990s and early 2000s when nature conservation policies were being defined. Two study groups, including researchers, managers, and representatives of civil society, were constituted to evaluate the validity of the implementation of these corridors. The conclusions of both groups showed that the implementation of corridors favors the conservation of biodiversity and that they should be

implemented without waiting for a consensus from the scientific community (VAN DER WINDT, 2008).

However, the implementation of vegetation corridors from the restoration of ecosystems has limited social and economic reach, generating difficulties in the realization on a large scale. The areas among the largest ecosystem fragments are for human use, where the restoration of natural ecosystems is largely dependent on the owners, residents, or users. In addition, the areas of the larger fragments themselves have human use, often practiced by traditional communities that already occupied the territory interacting with the fragments hundreds or even thousands of years ago. Connecting the largest remaining fragments from the restoration of the original vegetation alone tends to increase the vulnerability of these populations. From an economic point of view, the cost of ecosystem restoration is high, reducing the ability of governments and society to enforce this policy. In particular cases, the partnership with social agents and their local institutions enables a reduction in costs. On the other hand, the benefits resulting from restoration actions must be evident and significant for the local population (GARAY, 2006).

These limitations create a restriction on the scale of the scope of ecosystem restoration actions to connect fragments. Increasing the connection between sets of fragments of great relevance to conservation requires broader policy objectives, in which the implementation of vegetation corridors is only one of the tools to increase connectivity between ecosystem remnants.

It is worth mentioning here that forest restoration can represent an instrument of carbon sequestration, contribute to water control and siltation of streams and rivers, and reduce erosive processes on the slopes. In contrast, agroforestry, organic or agroecological production systems, for example, can contribute to the environmental sustainability of the landscape as a whole. In this context, the definition of the Ecological Corridor is inserted as a territorial cutout for the implementation of policies focused on environmental and social sustainability, as explained below.

4.1 BIODIVERSITY CORRIDORS - THE CONCEPTUAL BREAKTHROUGH

The first conceptions of the Ecological Corridor as a territorial management cutout had an aspect essentially focused on the preservation of nature. Proposals put forward by U.S. researchers in the mid-1980s to create a corridor to protect the Florida Panther (Felix concolor Coryi), for example, recommend closing highways and prohibiting people from accessing areas central to conservation, as well as restoring ecosystems (CRISTHOFFER & EISENBERG, 1985; NOSS, 1985; NOSS & HARRIS, 1986).

The definition of the Ecological Corridor as a territorial management framework, which has been discussed and implemented in different parts of the world since the 1990s, is more comprehensive: it includes social agents, considering their sociocultural diversity, and inserts conservation in the sphere of territorial planning (MELLO, 2013).

In Brazil, this definition of Ecological Corridor is generally called the Biodiversity Corridor, a term adopted by the MMA. Its implementation aims to consider biodiversity in its evolutionary context, from the conservation of fragments of natural ecosystems and the increase in the flow of individuals between the fragments. The scale of implementation is at least regional.

This strictly biological objective conditions three general environmental management objectives for the implementation of the Biodiversity Corridors, namely: 1) to strengthen protected areas; 2) promote the conservation of the lands and, above all, of the set of remnants of natural ecosystems; 3) create conditions of environmental sustainability in the landscape, from the conservation of socio-cultural diversity.

The notion of a biodiversity corridor assumes that large tracts of natural ecosystems are necessary for the long-term conservation of biodiversity and ecological and evolutionary processes. But, as a rule, the largest remaining fragments of ecosystems located in protected areas do not have a sufficient extension. Thus, policies aimed at nature conservation need to include the areas among these remnants subject to more intense human use. This enables a reduction in the pressure on the remnants of ecosystems and an expansion in the connectivity between them, from the stimulus to sustainable development based on strategies and actions that value social diversity (BRASIL, 2002; AYRES et al., 2005). It starts from the postulate that sustainable practices favor the conservation of natural remnants and the connectivity between them since there is an interaction between ecosystems and the environment at broader scales.

Connectivity, in this case, cannot be understood only as the physical connection between fragments. It should also be considered the characteristics

socio-economic and institutional that will influence people's relationship with the land and natural resources, including the main remnants of ecosystems, which may also constitute areas of use, notably of traditional extractive populations.

It is essential to strengthening the protected areas that are not UCs as a fundamental part of the Biodiversity Corridors, especially Indigenous Lands and Territories and Quilombo, in addition to the areas of use of other traditional peoples, such as caiçaras and ribeirinhos, as it expands the protection of the remnants and the connectivity of the landscape.

More than physical areas, the Biodiversity Corridors are, therefore, cuts of territorial planning where policies are established, in a coordinated way, that seek to create, implement, strengthen, expand, and increase the connectivity between protected areas and areas of human use, with a view to the conservation of biodiversity (BRASIL, 2002; RAMBALDI OLIVEIRA, 2003; SÃO PAULO, 2019).

The Biodiversity Corridors make it possible to include multiple conceptual scales in nature conservation. In the first term, it is about strengthening the different protected areas by stimulating their creation and effective implementation. In the case of Brazil, they correspond to the UCs of

Integral Protection, Sustainable Use, Indigenous Lands, Quilombo Territories, APPs, and Legal Reserves (MEDEIROS & GARAY, 2006). In addition, the objective is the integration of these protected areas in a broader conservation perspective, where they are the main nuclei for conservation. Secondly, the conservation of the remaining nuclei and the environmental recovery of degraded areas between fragments of ecosystems are added to these nuclei. Finally, the adoption of effective policies and actions that facilitate low-impact productive activities and value socio-cultural diversity as a fundamental element of biodiversity conservation should be encouraged. In a more general scope, it will be necessary to consider the multiple scales of conservation to develop policies and institutional tools for territorial planning, nature conservation, and the promotion of socio-environmental justice.

4.2 INTEGRATING THE HUMAN DIMENSION IN THE CONSTRUCTION OF CORRIDORS: FROM INSTITUTIONAL ASPECTS TO THE INCORPORATION OF LOCAL SOCIAL AGENTS

Considering local social agents and their activities as an integral part of the Biodiversity Corridor requires a transdisciplinary elaboration of the conservation model since the areas of human use represent important elements of this model. And it cannot be forgotten that even the main remnants can constitute areas of human use. Two major consequences emerge from this finding: one concerns the incorporation of the social sciences in the elaboration of the model and the evaluation of its implementation, given the need to understand the sociocultural and economic dimensions concerning conservation and environmental sustainability. Secondly, effective and proactive participation of the communities living in the areas included in the biodiversity corridors requires them to be partners in the conservation process, in all its stages. Enabling the inclusion of the demands of social agents and their leaders and integrating their perceptions and knowledge are sine qua nonconditions of the transdisciplinary approach. Only participatory and decentralized conservation management enables an effective implementation of Biodiversity Corridors:

> In this sense, it is essential to consider that the conservation of biodiversity is not only a scientific challenge of geobiophysical and economic dimensions. It must also encompass, and in a central way, the social dimension. Especially when we understand that the conservation of biodiversity is only possible when associated with the reduction of social inequalities. (Coutinho, Freitas , Lovejoy, 2021, p 74).

From an institutional and socio-political point of view, the goal of environmental justice and human well-being in the transdisciplinary approach requires considering a multi-jurisdictional and conceptually hierarchical dimension. Thus conceived, the conservation model at the scale of Biodiversity Corridors covers areas under the jurisdiction of different agents and the performance of different groups: municipal, state, federal, and, eventually, supranational governments, as well as institutions and representatives of civil society. To strengthen biodiversity conservation in this context, a key role of the Biodiversity Corridors is to include conservation policy in regional planning, incorporating it into all stages of planning in the public and private jurisdictional spheres (VAN DER WINDT, 2008; WHITTEN et al., 2011).

Therefore, for the effective implementation of Biodiversity Corridors, the involvement and cooperation of institutions and people who work in different sectors and who have multiple and diverse interests is fundamental, which necessarily requires an articulated vision on the part of the institutions that conduct this work, contemplating diverse actors at different scales of action (LINDENMAYER et al., 2008).

Among these actors, in most parts of the world, the owners and residents of rural areas generally deserve to be highlighted, since most of the areas included in biodiversity corridors in various parts of the world are private rural properties (NATURAL RESOURCE MANAGEMENT MINISTERIAL COUNCIL, 2010; WHITTEN et al., 2011). The establishment of partnerships with rural landowners becomes essential for the effective implementation of these corridors.

4.3 ECOLOGICAL CORRIDORS IN BRAZIL

This conception was adopted for the implementation of Ecological Corridors in Brazil, where the MMA, in 1997, started the Biodiversity Corridors project, in which it proposed the implementation of 8 corridors, 6 in the Amazon and 2 in the Atlantic Forest.

The Brazilian Biodiversity Corridors have relative normative importance because, in general, they do not focus on restricting access to or use of natural resources, being closer to a regional planning unit than to a form of territorial zoning (PRADO et al., 2003). The policies implemented within the scope of these Corridors are aimed at the construction of political-institutional tools that expand the mechanisms of nature conservation and initiatives that encourage owners to commit to conservation.

In the case of Brazil, it is also essential that the corridor policy focuses its priorities on traditional populations, since their territories, especially Indigenous Lands, play a fundamental role in the protection of native ecosystems, particularly in the Amazon (ISA, 2017).

Despite this important role in nature conservation, traditional communities, including indigenous, quilombolas, riverside dwellers, caiçaras, among others, have been the target of several attacks, mainly due to interests in their territories. Often, these interests are centered on the simple expropriation of the

land, breaking ancestral socio-spatial relationships that are decisive for the conservation of biodiversity in vast areas and, therefore, fundamental for the effective implementation of a policy of biodiversity corridors (NINIS et al., 2021). Even more seriously, these human-nature relations are the basis of the social reproduction of these peoples and an essential component of the maintenance of sociocultural diversity.

These processes of expropriation are based on the distance between humanity and nature, from which the destruction of socio-diversity and biodiversity is justified and is based on racism as a policy, as Krenak (2019) puts it:

> This package called humanity is being displaced, in an absolute way, from this organism that is the Earth, living in a civilizational abstraction that suppresses diversity, and denies the plurality of forms of life, existence, and habits.
> The only nuclei that still consider that they need to be clinging to this land are those that have been half-forgotten by the edges of the planet, on the banks of rivers, on the edges of the oceans, in Africa, Asia or Latin America. They are caiçaras, Indians, quilombolas, aborigines - the sub-humanity. (KRENAK , 2019, p. 12) .

Therefore, implementing Biodiversity Corridors in Brazil that strengthen the conservation of biodiversity and socio-diversity and promote environmental justice requires ensuring the permanence of these communities in their territories and their socio-spatial reproduction.

5 CONCLUSION

The conservation of biodiversity in a fragmented environment depends on preserving the set of ecosystems and ensuring the flow of wild species between the remaining fragments. However, the sustainability of the matrix in which the fragments are inserted ensures both the permeability between them and the environmental health of the interstitial areas, which is an essential assumption for human well-being.

The approach of conservation policies is necessarily multiscalar, encompassing the protection of ecosystems and the conservation of landscapes in an articulated way to ensure the conservation of biodiversity and socio-diversity.

To this end, the design of the Ecological Corridors has shown great promise. After all, spatially broader scales that incorporate spaces of more intense human use, with emphasis on the territories of traditional communities,

enable management of natural resources that favor the restoration of ecosystem services, the protection of ecosystems, and the conservation of the landscape associated with improving the quality of life of human populations.

The conservation of ecosystems from the Conservation Units is fundamental for the conservation of biological diversity. However, it is insufficient, because an effective action in the protection of the largest fragments can generate and/or amplify conflicts. This must be carried out in an integrated way with landscape management, with the implementation of other conservation mechanisms, especially those related to territorial planning, and actions effectively aimed at sustainable development. Ensuring the social and economic sustainability and cultural diversity of the communities that inhabit the surroundings and historically use the main fragments of ecosystems is, in this approach, an essential premise for the conservation of biodiversity at its biological scales: populations, communities and ecosystems.

A transdisciplinary approach is essential because from the integration of the scientific knowledge produced by the natural and social sciences and the knowledge of managers and communities, it is possible to develop actions that generate sustainable development, to ensure the conservation and sustainable use of biodiversity . In summary, the conservation of biodiversity is closely associated with the mitigation of climate change and human activities progressively focused on sustainable systems in a process of environmental transition.

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