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EDITED BY

Marco Malavasi,
Czech University of Life Sciences Prague,
Czechia

REVIEWED BY

María Eugenia Morales Puentes,
Universidad Pedagógica y Tecnológica de
Colombia, Colombia
Anne Beaulieu,
University of Groningen,
Netherlands

*CORRESPONDENCE

Camilo Castillo-Estupiñan*
✉ camilo.castilloe@liu.se

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Topological encounters in biodiversity conservation: Making and contesting maps in the Colombian high Andean páramos

Camilo Castillo-Estupiñan*

Department of Thematic Studies, Linköping University, Linköping, Sweden

Páramos are one of the flagship ecosystems in the Northern Andes; the provision of water for millions of people in this region depends on these unique high mountains located at above 3,500 m of altitude. Besides, they are also the refuge of a rich biodiversity that is unique in the world, the conservation of which has become important in recent years. Human communities, such as campesino communities, have also inhabited some páramos. For example, in the Sumapaz region of central Colombia, campesino communities sought refuge in the páramos during the 20th century due to political violence. Since 2010, the Colombian government, following previous legislation and court sentences, has declared páramos “strategic ecosystems,” making their conservation a vital part of the environmental policy in the country. This was advanced through mapmaking as the tool to define clear-cut limits for human use, prohibiting mining, agriculture, and livestock in spaces demarcated as páramos. However, this made the conservation of the policy incompatible with the presence of campesinos living in páramos. Since then, their conservation in the Sumapaz region has been a contentious matter about what kind of páramos and biodiversity should be allowed and enacted in Colombia. As part of a two-year multi-sited ethnography with geographers and campesino communities in Sumapaz páramo, I developed a topological approach to study mapmaking practices in the context of biodiversity conservation. I argue that this can be a way to understand the diverse relations between humans and nature as partial space configurations that shape conservation practice and its forms of politics. With this social sciences contribution, I extend the mapmaking discussions in conservation that seek to open taken-for-granted notions of space that limit conservation possibilities for socioenvironmental change.

KEYWORDS

map-making, conservation, topology, ontology, space – society, páramo

Introduction

The proposal of a “new Global Biodiversity Framework for Managing Nature”¹ by The United Nations Convention on Biological Diversity (CBD), which among other goals, seeks to conserve 30% of the land and sea before 2030, is one of the most ambitious conservation challenges currently. Since then, scientific contributions have emerged to inform conservation practice toward this goal. Among them, mapmaking has been essential to providing estimates of the minimum areas to conserve, the priorities for conservation, the areas of global conservation importance, and more (Rinnan et al., 2020; Jung et al., 2021; Allan et al., 2022). These targets and the forms of space afforded by mapmaking in conservation practice require reconfiguring the spaces and geographies of any area designated as suitable for conservation. However, the specific forms of spatiality implicit in these proposals to put conservation into practice are often overlooked in conservation discussions (Malavasi, 2020).

It is not a coincidence that mapmaking has also occupied a prominent place as the privileged practice to spatialize the conservation of páramos in Colombia. New forms of spatiality facilitated by maps are in the making to create areas for conservation. However, what if we momentarily suspend and open the received assumptions of space that come with traditional mapmaking practices in conservation? This requires scrutiny of how space is produced in mapmaking to envision new possibilities for a reconfiguration of mapmaking, as other scholars in human geography and science and technology studies (STS) have previously suggested (Thrift, 1996; Turnbull, 2000; Hinchliffe, 2007; Wood et al., 2010; Malavasi, 2020). This study draws on that scholarship to consider to what extent the practice of biodiversity conservation can be benefited from a *spatially attuned* sensitivity using topological thinking as a heuristic tool to navigate across multiple spatial formations and the opportunity they can provide for an “otherwise opening” of biodiversity conservation mapmaking (Povinelli, 2011; Liboiron, 2021).

In this study, the empirical ethnographic material from the author’s experiences with geographers working with geographic information systems (GIS) and campesino communities in Sumapaz, Colombia, when their practices were engaged with the production of space, was analyzed. In the following sections, first, multi-sited ethnography as the method that made it possible to research the topologies of biodiversity conservation in the case of Sumapaz páramo in Colombia is presented. Second, the topological approach to understanding the multiple configurations of space in conservation is introduced and elaborated. In the same section, the analysis of the trajectory of the topology that configured páramos as objects of environmental and conservation management is presented. Then, the counter-mapping process of

the páramos is taken as the opportunity to highlight how campesino communities’ practices involve a completely different topology of space. Finally, in the third section, it is discussed how the topological approach developed in the study can help us understand space as an ontological multiple, which can help make mapmaking a more situated and potent practice beyond its traditional topology to open different possibilities of action for biodiversity conservation.

Methods

Since the conservation of páramos in Colombia involves multiple places and actors, there is no single place where páramos emerge as objects for conservation. This suggests that, to study the forms of space underlying the conservation of páramos, it is necessary to understand how their spatiality emerges in the practices and relationships of different actors. In this sense, this study was methodologically developed through a multi-sited ethnographic approach to construct an argument defined by following actors, tracing associations, and establishing connections across sites (Marcus, 1995). These actors were fundamentally geographers involved in the mapmaking of páramos and campesino communities living in Sumapaz páramo. I learned from their practices about how multiple spaces are involved in conserving páramos, which allowed me to situate the conditions and associations between these places. Most importantly, this methodological approach also contributed to conceptually calibrating the way multiple places were at play in the conservation of páramos.

During my two years of fieldwork, I had the opportunity to live in the páramo and become part of the daily life of campesino communities in Sumapaz. I participated in many activities such as cultivating plants, taking care of animals, milking cows, making cheese, harvesting food, and other activities related to campesinos’ lives in páramos. I also joined meetings where campesinos discussed matters of interest for their communities, where páramos conservation was a topic on more than one occasion. I also learned about the cartographic practices of the geographers involved in the mapmaking project to demarcate the limits of páramos in Colombia. During my experiences with them, I studied how they produced the maps of páramos and the páramos conservation legislation in Colombia. These experiences offered the empirical material to study the conservation of páramos as a matter concretely shaped by the practices of people and their interaction with technologies, legislation, and systems of classification, more than human beings, satellite images, and others.

The empirical material was collected in three notebooks containing the notes taken during conversations, meetings, and ethnographic interviews as part of my participation in the practices of geographers and campesinos. Then, they were chronologically transcribed as entries in more than 200 pages of fieldwork journals narrating those experiences and their potential

1 <https://www.un.org/sustainabledevelopment/blog/2021/07/a-new-global-framework-for-managing-nature-through-2030-1st-detailed-draft-agreement-debuts/>

analytical value. I organized a photographic album with approximately 500 photos of my journey in the páramo. Some of them were selected to organize the argument and narrative of the current study. Both the visual and textual materials complemented each other, so the photos included in the study should be taken as a fundamental part of the argument and not merely as secondary resources in the text. In this way, this study engaged with ethnographic methods as a process of opening insights to seek forms of noticing the spatial practices that were present in my data but not self-evident at first, as has been argued in current discussions about ethnography in the social sciences (Ballestero and Winthereik, 2021).

Results

Opening the topologies of biodiversity conservation in the Colombian páramos

Topological thinking was used as a strategy to analytically approach the configurations and reconfigurations of space in biodiversity conservation. In this study, I considered the example of previous scholarship in the social sciences that has used topology to study culture, race, and science and technology (Law, 1999; Lury et al., 2012; M'charek et al., 2014). In this way, studying space through topological thinking serves the purpose of diversifying our understanding of it. Rather than being fixated on a singular notion of space, topology invites us to think about the logic of space underlying conservation practice to transcend any landscape of fixed distances and proximities (Allen, 2016). Following Lorimer (2015), topology can help us to understand conservation beyond the Cartesian cartography of the topographic map, so finding a way out of the “territorial trap” of conservation, in which “*nations, nature reserves, and other politicalized units become the bounded containers for Nature*,” is necessary (Lorimer, 2015, p. 164).

The encounters between STS and geography provide an entry point to explore this possibility. Proposals such as “hybrid geographies,” inspired by actor-network theory and other STS contributions, elaborate a topological spatial imagination. They emphasize the simultaneity of multiple and partial space–time configurations of social life generated by the rhythms and movements of heterogeneous associations between actors of different kinds (Thrift, 1996; Whatmore, 1999, 2002). Páramos conservation in Colombia allowed the exploration of a more open and generous notion of space in conservation. Such an opening can be elaborated following contributions in the social sciences that understand space as a production, be it social or natural (Lefebvre, 1991; Hinchliffe, 2007). This suggests that space is not taken as a given but as an ongoing production of interrelations and as the sphere of possibility for the existence of multiplicity (Massey, 2005). This line of thought can be encapsulated in the idea that spaces are dynamic and performative, not merely the background where the action takes place (Thrift, 1996). From

there, a spatially grounded approach to conservation practice will be explored in this study to unravel the forms of space involved in mapmaking.

In the case of maps, authors like Turnbull (2000) have studied how mapmaking, science, and the state were integrated in France and England during the 17th century. In those days, the problem of bureaucratic regulation and taxation for these states became a problem that needed to be solved through cartography. This assemblage of geographical knowledge produced what Turnbull calls the “knowledge space,” where maps became a tricky and fascinating object: they account for spatial relations, but what counts as such is provided by the very map in the first place. For this reason, there is a co-production circle of representations that is hard to break. According to Turnbull, this is because we are also part of that “knowledge space,” where maps are taken as mirrors and metaphors of external objective space. Understanding mapmaking and space beyond the recent knowledge assemblage of western thought and science is of paramount importance for this strand of scholarship.

This stance toward maps echoes other critical approaches to mapmaking as a historical and social practice. For example, in Scott's study (Scott, 1998), the cadastral map crystallizes the necessity of the state for specific forms of centralized control. Throughout this, the state not only secures the possibility to impose that logic of control but also that of intervening in the reality it pretends to observe. According to Scott, a cadastral map for taxation of individual landowners would imply a change of land tenure regimes. These consequences transformed space into a territory legible for easier state management. In a similar fashion, but more interested in a “textual” analysis of maps, Harley (1989) challenges the myth of mapmaking as the outgoing process of producing more precise representations of reality. Following his argument, when we take maps as “texts,” it would be possible to understand how they mesh in power relations and what their active role is in embodying specific forms of power and authority. In a similar vein, but with some fundamental differences, Wood (1993; and Wood et al., 2010) proposes a semiotic study of maps as systems of signs.

According to Wood, maps are not only used to promote power through the alignment of political goals but are also created for specific social situations. This suggests that we cannot simply view maps as objective “representations of the earth's surface” but must consider the social context in which they are created. According to Wood, this is just a projection of how cartography would like maps to be understood. Instead, he argues that maps should be understood as systems of signs that state propositions to affirm or deny the existence of something somewhere, expressed through signs such as the “postings” in the plane of the map. In short, for Wood, maps are “systems of ontological claims” (Wood et al., 2010, p. 86).

There is reason to suppose that mapmaking for biodiversity conservation is no exception to these critical remarks. The work of Peluso (1995), which takes the case of forest mapping in Indonesia, analyzes how maps of forests, whether for protection

or production, are drawings of a strategic space intended to increase state control over areas of social unrest and valuable resources. The interest of her account of forest mapping is that “counter-maps,” i.e., in opposition to the official ones, are increasingly being used by local communities to legitimize their land claims and negotiate with the state. A similar possibility is suggested by Orlove (1991) who follows through with maps the conflict between peasant communities and the Peruvian state regarding the creation of an ecological reserve close to Lake Titicaca. He shows that mapmaking also configures the stakes around conserving valuable ecosystems and serves as a vehicle for different parties to frame their actions and narratives.

These approaches help to open an analytical space for mapmaking study beyond representationalism, or the idea that maps deal exclusively with the problem of “representing the earth’s surface.” As the recent scholarship on nature mapping suggests, the interrogation of mapmakers’ choices is crucial to understanding the transformative notions of nature that maps articulate (Brosnan and Akerman, 2021). As Nekola (2021) analyzes the case of the United States in the late 19th century, mapmakers experimented with new forms of using field data to study patterns and conditions to map forests as systems and not simply as objects. This would also be important in informing how forests should be conserved. According to the author, a consequence was that this helped liberate environmental studies and the practice of using maps from objectifying “what cannot responsibly be objectified” (Nekola, 2021, p. 290). However, despite the remarks on critical geography and other related fields, Malavasi (2020) pointed out that maps are still taken as “mirrors of nature” in biodiversity mapping discussions. Following him, the problem of ignoring the forms of power that mapmaking conveys hinders the possibility of finding alternative spatial strategies to make conservation practices effective in mitigating biodiversity loss.

One strategy explored in this study is analyzing mapmaking in situations where other space topologies suspend our certainties about maps. In this way, my approach to expanding “space” in mapmaking is also inspired by other contributions in the social sciences that take seriously the potential of modes of living that can be beyond the limits of mapmaking spatiality. In this study, this work shares concerns with Povinelli’s (2017) project of developing an anthropology of the otherwise. In this project, forms of life that are at odds with dominant modes of being become indicators of a possible world beyond the sanctioned form of existence. To situate this proposal in the case of biodiversity conservation mapmaking and open up its privileged forms of spatiality, the study takes inspiration from Liboiron’s (2021) studies on pollution. It follows their suggestion to take land or, in my case, space as fundamentally relational and specific to those situated relations.

For this reason, the place of maps and their spatial effects in conservation should be interrogated, not discarded. The aspiration of this should be a reconfiguration of the use of maps in conservation beyond their traditional usage as “mirrors of

nature.” The case of páramos conservation in Colombia that I analyze in the following pages provides the opportunity to explore this possibility.

The emergence of páramos through mapmaking

Days in the high mountains of Sumapaz are rather foggy across the year. There are, of course, a few exceptions, like the sunny morning when I was with Fernand, a campesino living in a Finca² in Sumapaz as a tenant. On that day, we started early in the morning by milking the cows and having a hot breakfast. Afterward, we would hike to the highest point of the Finca. Nearly at the top, he stopped and pointed with a stick toward a pasture without hiding his scorn, and he said: “See that? Apparently, this is the páramo. “Honestly, it does not have any justification for me.” Fernand was skeptical because, according to the map we were using, a fraction of the Finca overlapped with the páramo demarcation of the map. For him, that was enough concern because of any possible restriction brought by the overlap between his Finca and the páramo, but the disconcerting issue for Fernand was that the place did not look like a páramo at all. However, how did we reach this situation? Why did maps become central to deciding where páramos are located? If we reverse Fernand’s logic, what kinds of places count as páramos in conservation?

In 2002, the United Nations General Assembly declared 11 December as International Mountain Day. As part of the commemoration, different campaigns are launched each year to raise awareness for mountains, forge alliances worldwide, and promote the importance of thriving life on earth. For the Colombian Ministry of Environment, that day is the perfect opportunity to show the world the richness of Colombia’s mountains and the country’s strategic location. “Colombia is a country of mountains; we have 50% of páramos in the world (...),” the ministry said on International Mountain Day 2021. Páramos should be somewhere in Colombia, but it is such a big place, so where to start? One option is to follow the practices of scientists, but for them, it is not surprising to recognize the polysemic character of páramos (Cortés-Duque and Sarmiento, 2013). Essentially, different disciplinary boundaries and their practices have finished their work to some degree, contributing to a diverse notion of páramos in terms of climate, plant distribution, geologic aspects, and more (Hofstede et al., 2003).

It is not surprising that, among the many different definitions of páramos, the spatiality of these places often remains implicit, with the focus being on their location within a specific set of coordinates if we attempt to make them explicit. The problem with this is that we lose the possibility to think of páramos and conservation beyond traditionally privileged spatial formations. To take an alternative direction, I explored the topological

² Finca is the dwelling where campesino families live.

arrangements that made possible the spatial formation of páramos through mapmaking practices. I analyzed three elements that converged to make the “páramo” the spatial unit to be demarcated in the current conservation plans: first, the biogeographical classification systems, second, the spatial assumptions behind the distribution potential model, and third, the cartographic practices involved in mapmaking.

What counts as páramo in the recent history of its conservation is the result of a classification system developed during the 1990s to determine the biogeographical units of Colombia. In a influential proposal, [Hernández Camacho et al. \(1992\)](#) classified nine biogeographical provinces that contained 99 districts according to landscape criteria, vegetation, climatic conditions, and biotic components. Despite the authors of the proposal explicitly recognizing the exploratory and partial character of the classification, the system started to be taken at face value in environmental policy. It advanced the notion that each unit should be assigned hierarchically with biogeographical criteria to make those units comparable. For example, in this classification, one of the provinces was called “North Andean Biogeographical Province,” and five of its 45 districts corresponded to paramo districts.

A central task of the classification was not to provide a precise or clear-cut division of each unit but to facilitate the characterization of the country’s biological diversity and address its conservation and management. The classification scales would also serve the purpose of assigning responsibilities to different authorities with jurisdiction in any given unit. Therefore, Thomas van der Hammen, a Dutch ecologist famous for his longstanding trajectory researching Colombian high mountains, decided to adapt that classification system for páramos. In a national report on biodiversity in Colombia published in 1998, he presented a proposal for classifying páramos according to three hierarchical units: *sectors, districts, and complexes* ([van der Hammen, 1998](#)). According to his classification, there were four sectors containing 12 districts in Colombia, which contained 26 complexes. These hierarchies were primarily based on differences in species distribution and genera, as well as the geographic separation of each area in the case of *sectors*. For *districts*, the main difference was the presence of endemic species. Finally, the *complexes* were the most detailed and basic unit of the biogeographic classification. They were also central because what would count as páramo for the upcoming mapmaking was precisely the so-called *complex* unit.

Nevertheless, these classification systems need to be understood within the configuration of the páramo as an object for conservation. The páramo as a spatial unit is the outcome of the performative work that brings it into being through scientific practices and objects like the classification system. This will be crucial because, as I will now explain, mapmaking does not operate over pre-given objects. As mapmaking analyst Dennis Wood proposes, these objects—in the case of mountains and rivers in the USA—are not constituents of parts of the world but “proposals we have advanced for talking and thinking about it”

([Wood et al., 2010](#), p. 45). In the same way, the páramo as the unit to be mapped cannot be understood without the elements and practices involved in mapmaking. It is the topological arrangement that produced a form of space where páramos as *complexes* can be mapped.

If mapmaking does not operate over pre-given objects, if these objects must be configured, the same needs to be done with space to secure the continuity of those objects ([Law, 1999](#)). In this regard, the mapmaking of páramos has been central to ensuring a spatial arrangement of páramos as singular and discrete entities scattered over the Colombian mountains. Drawing on the classification system proposed by van der Hammen and described above, the Colombian Humboldt Institute produced the first atlas of páramos in the country in 2007 ([Morales-Rivas et al., 2007](#)). No other mapmaking process had ever been attempted to produce maps of *all the páramos* in the country ([Ungar, 2021](#)). According to it, there were 34 *páramos complexes* in Colombia. As we will see, the word “complex” would be slightly collapsed into the word “páramo.” The novelty brought by the atlas was his role in making the “páramo complex” the unit for the mapmaking of páramos to arrange its spatiality as a differentiated entity. The atlas was divided into sections dedicated to each “páramo complex.” Those sections offered general aspects of their location, ecological, cultural, and management and conservation actions. However, most importantly for the current analysis, each chapter included a map. In the case of the *complex of Sumapaz páramo*, it was one of the four complexes inside the “Cundinamarca District,” which in turn was part of the “East Mountain Range Sector” ([Morales-Rivas et al., 2007](#), pp. 96–99).

When the atlas was made at the end of the 2000s, there were also new environmental movements that focused on protecting páramos. One of the most important movements began in Bucaramanga, a city in northeastern Colombia with a population of more than one million people ([Parra-Romero and Gitahy, 2017](#)). Simultaneously, many multinational mining companies were demanding clearer rules for obtaining mining titles in areas close to páramos. These companies wanted the demarcation of a páramo to set clear coordinates and boundaries so that they could be certain of their titles and rights to search for gold, coal, and other minerals in the high mountains and use them. Such demarcation would be useful for the companies to avoid overlaps with protected areas in their mining titles ([Parra Romero, 2023](#)). As a result, the demarcation of páramos became a point of interest for both mining companies and environmental movements, even though they may have differing views on the size of the páramos.

Therefore, one of the biggest challenges for páramos conservation during those years was to limit the expansion of mining in páramos areas ([Cortés-Duque and Sarmiento, 2013](#)). For the Colombian Ministry of Environment, this required a new mapmaking of páramos. The atlas would not be enough to satisfy the requirements of mining companies’ though, since their activities usually occur within very detailed demarcations. The Colombian Humboldt Institute was again in charge of this process. First, by updating the existing atlas of páramos to a scale of

1:100,000 and, second, by producing a demarcation of páramos at a scale of 1:25,000. Jules, a geographer who has been researching the elusiveness of paramo in maps since 2006, was involved in both projects. As he described the situation to me, this new mapmaking of páramos articulated new material arrangements that changed the composition of páramos as objects for conservation.

It introduced the use of potential distribution models for the mapmaking of páramos. Based on two variables, topography and weather, they operated on two fundamental assumptions underlying the topological arrangement of paramos spatiality. First, whatever is to be mapped, in this case, the páramo, is composed of variables that define the probability of its occurrence. As Jules described the process in relation to the weather variable:

“The weather map shows you the temperature variable in what we call the raster format, which is pixel by pixel. It is a map consisting of small squares, just as a photography (...) So you say, for this particular pixel the average temperature is 5°C, and the neighbour pixel is 4°C, the next one 7°C and so on in such a way that inside the map, you can say I need, I mean if I understand from what I know from the ground that páramos occur where the average temperature is 9°C, then I can have that map to ask “hey tell me where are the areas with 9°C temperature average” and the computer will draw for you an area so you can say: this is something that approximates more to a páramo than that that can give you the expert in páramos.”

This indicates that it is perhaps futile to ask for the “páramo itself,” against which the map can be traced. As the first assumption, the páramo, in the case of the potential distribution model, is an emergent outcome of the composition of the variables that can express the probability of locating the páramo in the plane of a map. However, each one of those variables is also the result of other practices. For example, as a variable, the weather depends on other practices and assumptions to measure it, model it, calculate its annual average, and map it. My point is not to dismiss the use of potential distribution models in páramos mapmaking. Similar to the case of páramos, maps in conservation are part of a generative and performative process where the objects to be mapped are the result of the mapmaking choices and not the other way around.

This brings us to the second assumption, which conceives the spatiality of such a probability as expressed through pixel colors in the GIS grid of the mapmaker. Like any other tool involved in mapmaking, this one has a fundamental role in producing maps. I learned this from Arturo, a former mapmaker hired by the Humboldt Institute during the páramos demarcation. In a conversation where we were watching his laptop screen with the GIS software running, he explained a critical feature when working with GIS grids:

“At 1:25,000 scale the level of detail that I can have and represent is of 6 ha. But if you take a satellite image at 1:25,000 scale you can zoom in to patches of 1 ha, yes you can have it and see a house roof you can see it, very tiny just there. But cartographically you cannot do it because you will have a very thick world for the map. When you talk about scale you are also talking about generalizations, so each scale has a generalization level. It gives you some scientific standards that visually I can see and take data to cartographically represent elements of 6 ha when working at 1:25,000 scale (...) It operates within international cartographic standards, so we all understand, for example at scale 1:25,000, you will find elements bigger than 6 ha. Everything smaller is generalized in a patch, there can be fincas, fires, and so on but since that is very small then all is generalized as pastures.”

Every small cell of the grid for the case of the páramos demarcation operated under the standards of the 1:25,000 scale, as explained by Arturo (Figure 1). At the national level, these standards dictate the level of cartographic detail that can be presented on the map and processed through the grid (Instituto Geográfico Agustín Codazzi, 2014). As other authors have pointed out, grids are usually invisible, but they can help to understand the sociotechnical decisions that regulate the experience and politics of space (Rankin, 2016). In this case, the type of paramo that could exist through the map resulted from how the standards and grid intervention were part of the topology shaping a form of space through cartographic practice. It is not only the páramo that gets spatialized but also the standards of cartographic practice and its politics. However, all of this disappears if we take the maps as given because their spatiality as objects that can be distinguished by their relative position remains uninterrogated.

One issue with this is that we can miss not only the interests and power relations involved in the production of maps, as critical cartography has pointed out (Harley, 1989, 1990; Wood et al., 2010). We also missed the process by which conservation mapmaking produces its objects, as well as the actions and interventions associated with a particular form of making space. In other words, we missed conservation objects' configuration and dynamism. For example, since the first classification system of páramos to the inception of the first atlas in 2007, its update in 2011, and the demarcation project, both the quantity and area of páramos in Colombia have increased: from 26 páramos of the first classification system to 36 in the atlas of 2011 and from 1,980,454 ha of páramo in the first atlas to 2,906,137 ha in its update in 2011 (Morales-Rivas et al., 2007; Sarmiento et al., 2013).

These increases were not simply because we gained more precise knowledge of páramos. It was because more elements contributed to reconfiguring them as an object for conservation. One illustrative example of this was during the latest reconfiguration of the páramos through their demarcation when the Humboldt Institute proposed to include a “forest-páramo transition zone” in their area (Sarmiento and León Moya, 2015). According to the institute, it was necessary to secure the

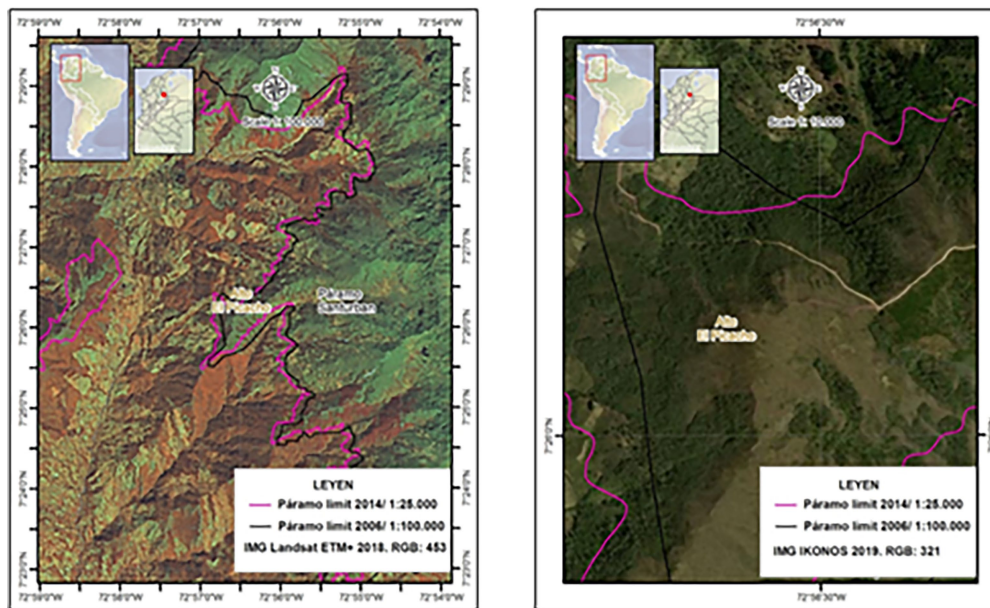


FIGURE 1

A comparison of two maps at different scales with the páramo limits, to the left side at 1:100,000 and the right side at 1:10,000. The purple line indicates the limit according to the demarcation (2014), and the black line according to the first atlas (2006). The more detailed scale makes it possible to include more elements, although those limits do not seem to delimit two differentiated areas when zooming in. Cartography courtesy of Alexi Cusva.

“ecological integrity” of páramos. Their reliance on other ecosystems and ecological processes, particularly those in the high Andean Forest, is significant. For biologists and ecologists, the páramo had a transition zone rather than a hard limit. It is the meeting point of the páramo and the high Andean Forest.

For this reason, since the atlas was updated in 2011, the Humboldt Institute has recommended including the “lower limit of the transition zone” as part of the páramo. In a litigation process, the first páramo demarcation in Colombia was sued. The reasons were that the demarcation affected the participation rights of local communities. The Constitutional Court, the highest institution of constitutional control in the country, ordered a new demarcation, but interestingly, the court also decided the following:

“The Ministry of Environment must take into account as a priority the classification concept issued by the Humboldt Institute and its vision that the limits of the páramo must include the forest-páramo transition zone” (Corte Constitucional de Colombia, 2017)

By making the forest-to-páramo transition zone an official part of the páramo, the Constitutional Court also changed the way páramos are used as places to protect wildlife. Its decision gave legal weight to what now counts as “páramo” in discussions about the environment and in upcoming legal disputes. Nonetheless, this would not be possible without the mapmaking process that produced a legible version of páramo for the conservation policy

years ago. This process was not based on the way páramos are naturally arranged, as shown on the maps. Although the páramo was a changing and dynamic object, this was not a limit for mapmaking. According to Allen (2016), the process of mapmaking involves various changes. However, some relationships remain intact through this transformation. Topology can help us understand these continuous but transformed relationships, which allowed us to transition the páramo from a classification system to a map. However, this process is not dictated by an intrinsic spatiality of páramos reflected in maps, as it is the result of the diverse practices and elements involved in creating maps for conservation purposes. For the emergence of those maps, it was necessary to arrange topologically the space that allowed páramos to transit between biogeographical classifications, atlases, GIS grids, potential distribution models, maps, and constitutional court pronouncements. How these elements that were arranged in the context of conservation practice maintained páramos continuously despite constant transformation.

I guess that from up there, everything looks so strange

The ecological assumptions behind the “integrity of páramos” and its connectedness with other high mountain ecosystems can be a good reason to include the transition zone of páramos in the mapmaking process. However, as shown above, maps in conservation are not straightforward instantiations that spatialize

ecological concepts. The páramo is self-evident for the policy once it is on the map, and the sociotechnical conditions of its production are invisible, whereas a bigger páramo area on a map can be compatible with its “integrity” and connectedness with other nearby ecosystems; it also suggests an expansion of more restrictive regimes for people living in the Colombian high mountains. This was the case in the Sumapaz region, where at least 13,000 people live in the demarcated páramo and 25 municipalities have jurisdiction over the area (van der Hammen et al., 2015).

Due to the magnitude and scope of the páramos conservation, campesinos living in different parts of the Sumapaz region have been discussing páramo demarcation. Among many, demarcation is not that different from previous conservation plans designed without their participation. As other researchers showed, for campesinos, this kind of policy is not different from others that aim at grabbing their lands and restricting their livelihoods as much as possible based on agricultural activities (Paéz, 2019; Grajales Urrego, 2020). For this reason, since 2019, campesinos and allied organizations have organized meetings to find a way and reclaim a space in the páramos conservation. In 2021, one of those meetings was organized in the high mountain rural area of Cabrera, a municipality 150 km south of Bogotá. I was part of the “technical committee” of the Sumapaz Campesino Coordinator, a campesino organization that allowed me to do my research in Sumapaz. On the same day, the Secretary of Agriculture of Cabrera municipality, in collaboration with local campesino organizations, arranged a meeting with campesinos living in this area concerned with the demarcation.

“Here it is, my friends,” said Gregor, a campesino leader, in the cold classroom of the rural school where the meeting was held. With those words, he finished his presentation. He projected a map on the wall before an audience of campesinos taking notes and wearing their *ruanas*, a thick garment made of wool used by most high Andean campesinos to keep warm. In his presentation, he showed how the limits of the demarcated páramo overlapped with some fincas in the rural area of the municipality. Nevertheless, he was not using the official demarcation map. This was a different map, which can be seen in Figure 2, and it was produced with the help of a student doing his internship in Cabrera Municipality, as told to me by the Secretary of Agriculture present during the meeting.

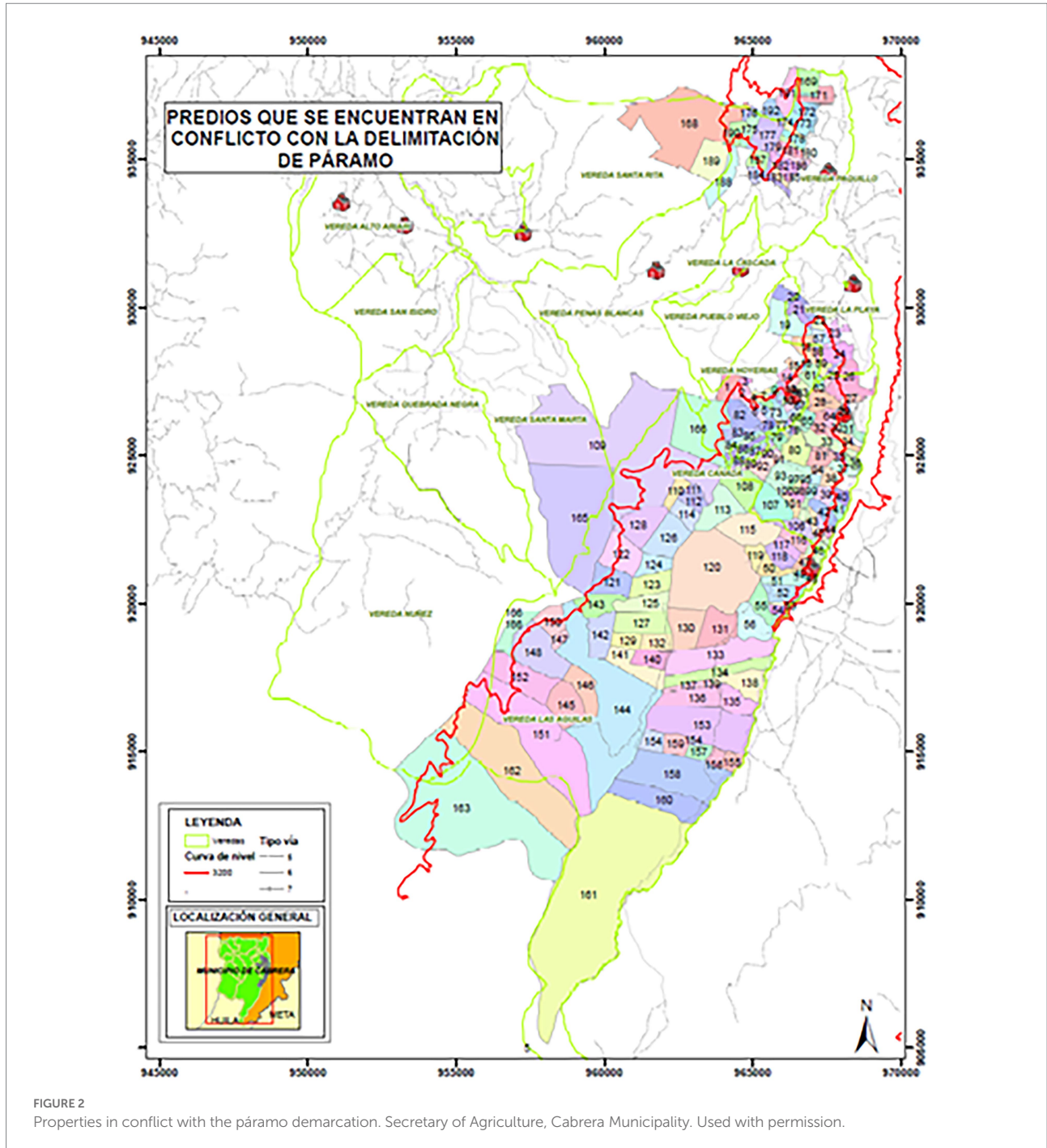
This was a very particular unofficial map that located the corresponding line of the demarcated páramo in the rural area of this municipality. However, in contrast with the official demarcation map, this one included the limits of the different fincas and properties registered in the municipality. In other words, the map was intended to identify the fincas completely or partially inside the demarcated area of the páramo. Each finca overlapping with the páramo line was identified with a number. This number could be compared with a list showing the owner’s name, the property’s name, the total area, and the area inside the páramo. There are three red lines from the top of the map in Figure 2. The first one contains a small area, which corresponds to the páramo. The second one, on the right side of the previous one, is barely visible, and it is located in the upper right corner of the map. Everything on the right side of it is also part of the páramo.

Finally, the third line, which is the longest one, sets a limit in which everything to the right counts as páramo. In the rest of the section, this counter-mapping process did not necessarily dispute the originally demarcated páramo. Instead, it aimed to alert campesinos about the possible negative consequences of a demarcation process in which they did not participate.

The map’s title, “*Properties in conflict with the páramo demarcation*,” invites a different use than the official one titled “*Cruz-Verde Sumapaz Páramo Demarcation at scale 1:25,000*,” whereas the latter was engaged in producing the páramo as a singular entity that covers a demarcated area as part of the topological arrangement analyzed in the previous section, the former takes the páramo not as a discrete object but just as a line in a map. This is the first reconfiguration of the demarcated páramo through a counter map, which raises the topic of demarcation as an issue to be addressed by campesinos. The main divergence of this counter-map is that there is no engagement or interest in producing definitive versions of the páramo. In other words, its main task is not to represent the páramo, not even the distribution of campesino fincas. Rather than that, this counter map serves as the entry point for campesinos to start the discussion of how to act in relation to the páramos demarcation and what that entails in terms of the required political organization for taking further actions.

This was evident in how the meeting was organized that day. The first point was a general introduction about how the demarcation of páramos attempted to limit the expansion of mining in the Colombian high Andean mountains and how this did not work quite well in páramos with campesino communities. According to the presenter, the main reason was that the same prohibitions to mining activities should not apply to campesino communities living in páramos for generations and engaged with other “human activities” different than mining. The second point was the presentation Gregor mentioned before, where he described the map and then read aloud the list of properties overlapping with the demarcation. Finally, the third point was a plenary discussion to brainstorm ideas for constructing an alternative proposal of transition toward forms of agriculture compatible with a páramo conservation where campesinos could continue living in their historic lands.

“*Properties in conflict with the páramo demarcation*” also had another use. There was one more proposal when we organized the meeting the days before: I would offer my help to visit some campesino families in their fincas, show them the map, locate their fincas within it, and hear from them about how their agriculture practices could transition toward less agrochemical dependent crops and to different forms of animal farming. These have been topics part of the agenda of campesino organizations all over the country in the last decades to demand support from the government both in financial and technical terms to improve the conditions of campesino livelihoods. The conservation of páramos then, once part of the discussions of campesino communities, was also a matter of agrarian politics regarding the possibilities to change their conditions of life. Conservation was not simply an independent matter separable from longstanding campesino struggles.



However, the campesinos' divergence with the conservation of páramos also had more subtle dimensions involving their own space topologies. I realized that, in the weeks following the meeting, I spent time with many campesino families visiting their fincas and talking about the páramos conservation with the previous map. On paper, the plan was straightforward. I would visit each day as many fincas as possible with another campesino that would volunteer to guide me and introduce me to each family. Soon, I would realize that the carefully arranged topology of the páramos produced in the counter-map was not enough to make sense of the campesino practices. Their own topological

arrangements of space make life possible in the high mountains beyond any map.

During my time with campesino communities, it was common for us to have difficulty locating the specific finca (farm) where we were sitting on the map within the first few minutes of being introduced to a new family. There was always hesitation once we had the map. Its orientation pointing toward the north was not helpful. On more than one occasion, the map was rotated in any imaginable direction by the campesinos. Sometimes, it was even easier to check the list with the owners' names and then look again at the map to locate the Finca. As

one campesino said while holding the map and talking about the direction of a river: “*This [the map] is rather odd. I guess that from up there [the view from satellites] everything looks so strange than from here on the ground.*” An elemental question such as “where are we” was difficult to answer with a map. What an irony for a usually unproblematic object to solve that kind of problem. It is fair to say that none of these maps (the demarcation map and “properties in conflict...”) were made to locate oneself in the land. However, the difficulties of campesinos with these maps were not simply because there was not a more precise map at hand or one designed for their needs. The issue was that the question of “where,” or in other words, the spatiality of campesinos practices, was not necessarily to be found in the topologies of space that come with maps.

A view from “*up there*” or above, following the campesino account in the previous paragraph, was exotic. As with other campesinos, their topologies to organize their space forms do not depend on the same spatiality produced by the cartographic practices analyzed in the previous section. It does not mean that they cannot engage with maps. Of course, they can, but they are not fundamental to locating themselves or organizing their spaces. The limit of the páramo traced in the map was illegible in the topologies of campesinos unless it was in relation to other places or entities fundamental in their practices: “*The line goes up to the school, and then towards Aurora’s,*” said a campesina after her husband gave up trying to make sense of the map. They were not interested in locating the páramo. According to the map, their concern was if they were inside it. Their engagement with the páramos conservation was not that enthusiastic, for it came as a vision from above that would dictate restrictions or evictions from their lands in the worst-case scenario.

The situation of a páramo in a map “*that crossed us,*” as said by one campesino, was suggestive of how the demarcation came to campesino communities in Sumapaz: as a map and a páramo that “*crossed*” their worlds as almost coming from nowhere or from “*up there.*” This friction between the space of the páramo in terms of its demarcation and the páramo as part of the campesino practices living there was permanent. The interesting is that, whether directly or indirectly, the campesinos were reconfiguring in front of me the páramo space that seemed perfectly settled on the map. This is not to say that the páramo on the map does not have any existence or is not useful at all. My point is to raise the issue of how the privileged status of maps in conservation can be problematic. This is especially pressing when we consider mapmaking spaces from the practices of campesinos and other communities that configure space differently. I learned this with Andrés, a young campesino³ living not so

far from the Sumapaz river. He taught me about the experimental possibilities of his and his father’s finca to make possible the growth of new crops in very unexpected seasons of the year. With the same tireless disposition that he devoted to his crops, he invited me to walk the finca and compare the map with what we could see there. After almost a quarter an hour of walking uphill, we reached the spot. He took the map with his left hand, pointed toward the area corresponding to his finca, and then pointed back again to the trees and vegetation that, according to the line of the map, were inside the páramo area:

“*That is not a páramo,*” were his words. He told me that páramos are places with smaller vegetation and pastures that are almost inexistent (Figure 3). In other words, if anything else could be a páramo, this place was not certainly one. However, Andrés’ account is not an isolated one. Many campesinos with whom I talked during the visits were emphatic in mentioning that locating the páramo on a map was not only strange but also quite inaccurate when walking the land and realizing that the páramo was somewhere else. This is only one side of the coin because, as mentioned before, the issue is not the lack of a more precise map. The tricky problem is trying to solve the question about the spatiality of páramos exclusively through maps and, on top of that, plan their conservation through a topology of space where entities are discrete and must occupy a specific place seen “*from above.*”

This was certainly not the first time campesinos from Sumapaz dealt with maps. In the 1960s, they participated in the process of agrarian reform through which the Colombian government formalized the ownership of lands to campesinos in Sumapaz (Daza Rincón, 2019, pp. 66–68). That is at least one precedent where campesinos engaged with maps. However, maps created in an agrarian reform served a completely different purpose because they secured land ownership to campesinos. In contrast with agrarian reform mapmaking, conservation was engaged with potential restrictions or prohibitions to campesinos. This was certainly new for them because that was the first attempt of a similar scale to map the páramo in Sumapaz and set whose and what practices were allowed there. One of the unintended effects of páramos mapmaking and its counter-mapping was that the páramo was increasingly being perceived as a limit or a line on a map. However, this line is a hybrid of cartography, ecology, environmentalism, and law that encapsulates the conservation concerns underlying the mapmaking process.

The friction with the páramo as it emerges from campesino practices does not have to do with the shortcomings of maps as representational devices but with their limitation to engage and be part of other topologies that configure space differently. The frustration of campesinos during my visit was not in relation to an incorrect map but to the implicit obligation to make their spaces legible through the map’s optics, and worse, significant decisions for their lives were made based on a map. I was finishing my visit on another rainy afternoon and having lunch with a campesino family. The husband, with whom we were drinking the night before, was supposed to guide me to the next finca, located far from there. The problem was that he was still a bit hangover, and

³ During my research, I had the chance to talk with campesinos from different generations, which suggest that there must be differences between them regarding how they engage with maps and technologies. However, these differences are less noticeable in the occasions I studied, where maps brought more confusion and disconcertment to them as it was in the case of páramos maps.



FIGURE 3
Looking for the páramo on the map. Author.

I could not reconcile myself with the idea of taking him out of home in the middle of a lousy and cold day outdoors:

“I can go to Gustavo’s by myself if you tell me how to get there” I suggested.

“Yes, thanks, it is really simple” he said relieved.

“Good, well, maybe you can show me the way through the window” I said after a sip of hot milk offered by his wife.

“Just cross that barb wire fence, then walk straight uphill until you see one cow, from there you’ll see a line of trees, walk next to them but don’t get inside the woods and at some point, cross the fence to the left, but be careful because it is an electrified fence. From there you’ll start to descend, and you’ll see a crop of fruits, that’s Gustavo’s crop, but that is not his finca yet. You must walk to the left but try not to get too much into the pastures or you’ll end up soaked in water. After walking a bit more you’ll see his house.”

Of course, the first house I saw and where I asked for Gustavo was the incorrect one. Eventually, I found out that the road was far from easy, not because of the conditions, which by the way were difficult due to the heavy rain and fog ascending from the pastures, and not even for lack of better directions. The main difficulty for me was that all the indications, such as the “fence,” “some point,” “the woods,” “the crop,” “from there,” and “the house,” were located in a space that I could not navigate with the maps or in an instinctive space transparent for my most basic orientation skills. The road was complicated because all the indications were part of

a topology configuring space differently than mapmaking. First, there was no view from above as a vantage point to organize how things were distributed in space to sustain a vision from nowhere (Haraway, 1988). Second, elements configuring this spatial formation were not fixed and would only emerge as part of the task involved, in this case going from one finca to another. Tomorrow the cow can be somewhere else, the fence will eventually be moved, and the crop can be harvested the weeks after. In other words, this experience with campesinos helped me to realize how space and the relations they enable are indexical. It is situated in practical accomplishments (Garfinkel, 1967; Liberman, 2013).

The form in which mapmaking facilitated an answer to the question of “where was” the páramo did not provide the elements that are elemental in practice for campesinos to engage with space (Figure 4). “Where is” a crop, “where is” a cow, “where is” a fence, “where is” a sheep, “where is or not” the páramo, or “where to go” after visiting a family is not possible,



FIGURE 4
A campesino road in the páramo. Author.

at least in a practical manner, to be solved by maps. This changes when one is engaged in practice with the topology of campesinos to organize, act, and intervene in their worlds. Seen from the practices of campesinos, spatiality is not a mental construct or a representation of a given landscape. In their practices, space emerges as performative, enabling certain possibilities for campesinos to configure their lives and sustain their worlds and relations.

That is why the question of a páramo that comes from a map, with consequences that can abruptly affect campesino communities' subsistence, is an example where the question of nature brought by conservation does not suspend politics (Latour, 2004a; Hinchliffe, 2007). Instead, this has kept páramos conservation and its spatiality as a simplified problem of central control over a demarcated area, leaving its sociotechnical unfolding as a given (Ungar, 2021). A more accurate map of páramos will not possibly change the situation because, as one campesino said during the meeting in the rural school: "*we are the first generation that faces a páramo demarcation.*" Counter-maps of the páramo demarcation were a tool to engage campesinos in that struggle and keep open the nature politics that came with the conservation. It made visible the frictions of conservation spatiality and the opportunity for campesinos to expand the politics of conservation. In the terrain of agrarian politics, campesinos could make the páramos conservation a new scenario to struggle for their demands.

Discussion

As map-mapping scholars Wood et al. (2010) and Turnbull (2000) have argued before, maps are called for specific social situations and not for any intrinsic or transcended capacity of them to capture space. The aim of this study was not to repeat a traditional critique of maps to debunk them. What I tried to do was to use a topological sensitivity to analyze in practice how "*we have created a naturalized space amenable to be mapped*" (Turnbull, 2000, p. 97). Not interrogating this "naturalized space" only limits the possibilities of how we use maps in biodiversity conservation, either by taking them as *mirrors of nature* as it has been identified in ecology (Malavasi, 2020) or as *representations of power* as it happens in traditional social science (Harley, 1989). Neither of those poles sufficiently addresses what mapmaking does in the practice of biodiversity conservation. Topological thinking helped in that regard to consider space in its making and not reducing it to a container for action but as part of how the world is composed and reconfigured.

Map-making, as I analyzed in this study, arranges a particular topology of space where objects can remain stable for certain ends.

For example, the páramo, as an object for conservation, is taken as a discrete object, but this object does not remain stable by itself. It is through the topological arrangement organized by potential distribution models, standards of cartographic practice, biogeographical classification systems, and legislation that it is possible to produce both the space and the páramo amenable to be mapped and conserved. In other words, maps are performative in that they advance notions of objects that come into being as part of the world (Bay-Larsen et al., 2021). However, as I also suggested, this is far from easy. To sustain maps and the objects they bring, it is necessary to unfold and associate diverse practices, standards, technologies, legislation, and other elements that help enact a particular way to act and intervene in biodiversity conservation.

This topological approach makes salient the importance of spatial differences as the basis to make mapmaking attentive to the diversity of space topologies sustained by other conservation actors, such as the campesinos in the case of Sumapaz in Colombia. Map-making, then, is not less relational than, for example, campesino topologies of space. Both are relational because, for sustaining space, it is necessary to put together a variety of heterogeneous elements. The difference is that they are not relational in the same way because it is precisely how these elements are arranged what produces important differences and consequences. As analyzed in the paper, campesino practices configure space in a way that exceeds maps by activities as mundane as going from one place to another. The problem is that these differences are usually not addressed in mapmaking discussions or biodiversity conservation debates. Not recognizing the existence of those differences, and worse, imposing a particular topological arrangement, as a rule, to make others legible, oversees the indexicality of space as a practical accomplishment that makes possible diverse forms of action and intervention, including, of course, those of conservation.

Considering the multiplicity of space can open up mapmaking in conservation beyond their representational use that narrows the possibilities of what maps can do. Restricting maps and mapmaking only to their role of resembling ideas or objects (Lynch, 2014) misses their role as practices that, rather than passively describing the world, are making things come into being for further actions and reconfigurations in the context of biodiversity conservation. By recognizing this dimension of mapmaking as a situated practice, it would be possible to expand its topology of space and its possibilities of action for biodiversity conservation. For this task, we can take stock of previous proposals to democratize mapmaking and put it to the service of communities or the public in general. One example is the advent of "Participatory GIS" to make a more contextualized and reflexive use of these tools and shift the usual divisions between users and designers (Dunn, 2007). However, as Wood et al. (2010) suggested, this requires decoupling GIS

from the planning model that has dominated its development for decades. In their examples (Wood et al., 2010, pp. 156–188), GIS is shaped by concerns other than “knowing where things are.” In those cases, participatory GIS is not simply about its instrumentalization by other actors to vest their claims with authority. Instead, GIS and mapmaking, according to the cases surveyed by the authors, are modeled and shaped by the contexts of practice where their use is reconfigured. In that situation, the divisions of labor and assumptions behind GIS can be radically remade and the public can become a partner in the task of mapping the future.

This is a desirable direction for biodiversity conservation mapmaking, which can be potentialized by cultivating the otherwise and taking seriously alternative possibilities of existence and their topologies of space, like in the case of campesino and other ancestral communities all over the world. The studies on pollution in the social sciences are instructive in showing the importance and complexities of engaging in this kind of project. The work of Hoover (2017) is a good example that shows that community-based projects, mapmaking for my current argument, is not about integrating communities’ priorities with academic priorities but about engaging with “decolonizing methods” to make communities, researchers, and map-makers partners in defining and implementing participatory projects. That is a similar direction in pollution monitoring, where current research encourages the priorities of local communities in future programs of that kind. Simultaneously, there are proposals of methods for collaboratively remaking how knowledge about environmental health issues is made and how to redress the problem beyond the idiom of academic science (Wylie et al., 2017; Lusher et al., 2022). Undoubtedly, this line of thought can inspire future collaborative projects in the mapmaking of biodiversity conservation.

However, it is important to be mindful of Liboiron’s call regarding an “ethic of incommensurability” that recognizes the different obligations of communities to sustain different good relations than, for example, scientists, so some room is necessary for specificity (Liboiron, 2021). One example of this can be found in the work of Steinauer-Scudder (2018) and the film “counter-mapping” by Loften and Vaughan-Lee (2019). They took the case of Zuni Maps to show how they convey a particular way of being in space, telling details of the landscapes we live in that are not addressed by conventional maps. In the context of mapmaking and biodiversity conservation, we cannot risk conflating different obligations of communities and mapmakers as if they were the same. That is perhaps the challenge for new biodiversity conservation strategies because mapmaking participates in the making of the world and, more precisely, serves a fundamental role in what is possible to do in conservation practice. If one of the biggest conservation challenges is biodiversity loss, then its practice should certainly be attuned to the political concern of making up alternative worlds where multiple actors and geographies play a role toward the

goal of making a liveable world both for humans and more than humans. This ongoing composition of a common world, or cosmopolitics as it is known among social scientists (Latour, 2004b; Stengers, 2010; Papadopoulos, 2018; Martínez Medina, 2020), is where mapmaking in biodiversity conservation can contribute. It could make possible new forms of negotiating the making and remaking of the world, facilitating alliances with actors across different scales and places. This task certainly requires more collaboration between actors inside and outside academia because, as Dennis Wood said, more than a decade ago, “the power of the map is waiting to be unleashed” (Wood et al., 2010, p. 38).

Data availability statement

The datasets presented in this article are not readily available because there is an agreement with one of the local communities organizations that took part in the research that states that they will be the only ones with access to the dataset result of the research such as photos, notes, transcriptions and journals. Requests to access the datasets should be directed to camilo.castilloe@liu.se.

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