

Review

Mountain Graticules: Bridging Latitude, Longitude, Altitude, and Historicity to Biocultural Heritage

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Abstract: The interdependence of biological and cultural diversity is exemplified by the new conservation paradigm of biocultural heritage. We seek to clarify obsolescent notions of nature, whereby cultural construction and identity markers of mountain communities need to reflect localized, situated, and nuanced understanding about mountainscapes as they are developed, maintained, managed, and contested in spatiality and historicity. Using the nexus of socioecological theory, we question whether a convergent approach could bridge montological knowledge systems of either different equatorial and temperate latitudes, western and eastern longitudes, hills and snow-capped mountain altitudes, or hegemonic and indigenous historicity. Using extensive literature research, intensive reflection, field observation, and critical discourse analysis, we grapple with the Nagoya Protocol of the Convention of Biological Diversity (COP 10, 2010) to elucidate the benefit sharing and linkages of biocultural diversity in tropical and temperate mountain frameworks. The result is a trend of consilience for effective conservation of mountain socioecological systems that reaffirms the transdisciplinary transgression of local knowledge and scientific input to implement the effective strategy of biocultural heritage conservation after the UN Decade of Biological Diversity. By emphasizing regeneration of derelict mountain landscapes, invigorated by empowered local communities, promoted by the Aspen Declaration, the UN Decade of Ecological Restoration, and the UN International Year of Mountain Sustainable Development, montological work on sustainable, regenerative development for 2030 can be expected.



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1. Introduction

With the increasing trend of geospatial techniques for geographic research, the use of multidimensional datasets has become important indicator of scale and significance of analyses. We grapple with multidimensional space and time with the objective of finding a generalizable trend to do comparative montology work. The use of mountains as elements of comparative research allows us to use longitude (X) and latitude (Y) to define a graticule, which is changing not only through space, but also through time. Changes in space are related to the spatialities of mountain systems, mainly verticality (V) and altitude (Z). Changes in time are related to man-agement of the mountainscape due to historicity (T). Finding the right graticule in these four dimensions (4D) for biocultural heritage conservation becomes problematic in the generalization of montological theory [1,2], prompting convergence of disciplines of nature and culture linked as a hybrid socioecological system.

Heritage has also been problematized for the recalcitrant effect of quantifiable property value and incommensurable cultural traits. This gives credence to the tendency to commoditize nature with utilitarian goals, without regards to cultural and spiritual values driving the decision-making for heritagescape designation and management. A clear

example is found in the Nagoya Protocol's concept for the benefit sharing of genetic resources from natural areas that have deep cultural roots but no measurable economic output for indigenous people and local communities (IPLCs). A succinct glossary of terms of geoheritage is provided in Table 1.

Table 1. Glossary of terms used in the article with an emphasis on geoheritage, biocultural diversity, and montology. Note the addition of novel lexicon using the suffix *scape* instead of the prefix *eco* to denote current decolonial scholarship.

Term	Definition	Source
Agriscape	Holistic sphere of crop producing cycles of cultivation and rituals.	Haller & Branca 2020 [3]
Biocultural diversity	The many species of plants and animals that have been either created or domesticated and cohabiting the place of residence.	Eriksson 2018 [4] Rotherham 2015 [5]
Biocultural heritage	The collective of cherished memories of place, landscape and ecosystem that continue traditional lifestyles and ancient wisdom.	Ferrara et al. 2022 [6]
Consilience	The process tending to the unity of science, the ultimate wholistic approach of convergent knowledge.	Wilson 2008 [7]
Decolonial scholarship	Eliminates elitist and hegemonic legacies of colonial powers in favor of a pragmatic, inclusive, equitable and true integration of indigenous and traditional knowledge with the scientific corpus of Western science.	Pettenati 2022 [8] Longo 2022 [9]
Earth ethics	The interrelations, interactions and implications of people sharing the habitat with their habits towards the wellbeing of the coinhabitants.	Sarmiento & Hitchner. 2017 [10]
Ecological legacy	Process of familiarization and domestication that is passed from antiquity to modern communities	Ferrara et al. 2022 [6]
Farmscape transformation	Deep change in the condition of agricultural production towards other uses, with not only land-use change, but profound change in the lifescape and livelihood of the elements of the farm with the nearby forests.	Sarmiento et al. 2018 [11]
Fusion landscape	The summative characteristics of physical and cultural amalgamation toward an undistinguishable nature-culture linkage.	Sarmiento & Viteri 2015 [12]
Heritagization	Process of cultural and ecological appropriation of ancient identity markers and memory holders as tangible and intangible goods that form the essence of place	Pipan & Topole 2022 [13]
Heritagescape	The holistic sphere of interacting elements of tradition, ritual, mystic and cultural manifestations shared in a territory with deep intergenerational respect	Burlingame 2022 [14]
Historicity	The political ecology of the passing of time that marks significant steps taken to the present state of affairs.	Johnson & Davidson-Hunt 2011 [15]
Langscape	The holistic sphere of the interacting elements of language and linguistics of a mega diversity spoken and written forms of communication.	Sarmiento 2022 [16]
Manufactured landscape	The current landscape configuration resulting from the integration of natural and cultural processes in the creation of a significant place	Sarmiento 2020 [1]
Memoriescape	The holistic sphere of vivid experiences and cherished feelings associated with the development of the self as reflected by ancestors and knowledge keepers.	Polynczuk-Alenius 2022 [17]

Table 1. *Cont.*

Term	Definition	Source
Montology	Transdisciplinary and convergent mountain science, with transgressions of scientific disciplines and humanities and arts.	Sarmiento 2022 [16]
Mountainscape	The holistic sphere of multidimensional factors interacting to provide a novel epistemology of mountain systems.	Sarmiento 2022 [16]
Noetics	Part of the metaphysics that deals with the explanatory power of the unity of knowledge.	Prober et al. 2019 [18]
Socioecological system	Ecological properties triggered by social and cultural factors that render complex adaptations ds	Sarmiento 2020 [1]
Soundscape	The holistic sphere of sounds, noise, music, and other types of vibrations of the auditive wave.	Pinho & Maharaj 2022 [19]
Spatiality	Processes modifying the spatial dimension towards the creation of place.	Sarmiento & Frolich 2020 [20]
Territoriality	Tendency of biophilic organisms to defend the place for reproductive success. In heritage studies sometimes territory is defined as the rigid fabric of the community.	Sarmiento 2020 [1]
Transdisciplinary	Integrative approach to use the scalar of disciplines to obtain the cross-cutting of themes and convergence of methodologies by western science and indigenous ecological knowledge.	Sarmiento & Frolich 2020 [20]
Transgressivity	Propensity of breaking boundaries of disciplines otherwise locked in their own silos. Transgression is the first condition of transdisciplinarity	Sarmiento 2022 [16]
Zomia	Mythical place in the mountains of South East Asia, where indigenous communities live in a paradisiacal anarchy due to isolation and marginality,	Scott 2009 [21]

Biodiversity conservation based on the dominant western scientific paradigm of the “pristine” or “wild” fauna, flora, and gea [18] is the dominant model. Ever since the era of discovery, early naturalists and explorers started the narrative of bucolic nature identified in biblical accounts and philosophical hegemonic treaties of French, British, German, and Spaniard thinkers of the 1700s [22,23]. Geomorphological mapping is an important way to develop preservation strategies [24]. However, with the advocacy of counter-mapping and indigenous revival, the decolonial scholarship is bringing novel dimensions in the study of mountain biocultural heritage of IPLCs, in line with the requested recognition of this important stakeholder in mountainscape conservation by the Aspen Declaration of 2022 to “ensure mountain women and Indigenous peoples’ access to resources, including land, social protection and capacity building, to enable their economic autonomy and decision making” coordinated by the Mountain Partnership at FAO.

2. Theoretical Background

Decolonial scholarship calls for revisiting nature conservation for the sake of nature itself in Mountain Protected Areas (MtPAs), with the inclusion of considerations of the social creation of nature and the revival of indigeneity with their rights for environmental justice. In IPLCs hitherto, hegemonic impositions have been posited as best management practices (BMPs) including racialized considerations, violence and intimidation, for implementing colonial “fortress” conservation, favoring the “fundamental balance” of nature without human interference [18]. Yet, this loaded equilibrium framework abandoned the cryptic evidence of ancient indigenous management practices that allowed for current “realized harmonic” mountainscapes. Biocultural heritage is a new conceptual framework that highlights the ancient interaction between humans and their environment, thus creating a linkage between nature and culture that is often broken by technology and politics.

Heritage itself is directly linked to memory; either place, landscape, or ecosystem memories and their implications [25].

Biocultural diversity is the result of the interface of nature (biodiversity) with culture (ethnodiversity), obtained by the hybridity of actions of humans on the environment that leads to the creation of domesticated landscapes, often “manufactured” by the ingenuity of ancestral wisdom [4]. The indigenous revival process of the last decades called for the imperative of transdisciplinary approaches. These approaches include basic geographic tenets such as *Tobler’s law* (“everything is related to everything else, but near things are more related than distant things”), *Sauer’s commandment* of Geography (“know thy word”), and Edelson’s *three (i)s* of Geoliteracy (“interaction, interconnections, implications”). We will use mountains and MtPAs to demonstrate that the physical graticule changes for location, the social graticule changes for customary practice, and the spiritual graticule changes for religious affiliations, depending on how far apart they are, how they are known, and how they are implicated and committed in the imaginaries of mountain geographies.

With the inclusion of critical biogeography inputs, some physical conventions (Figure 1a) are being questioned so as to change our current understanding of mountains and MtPAs [26]. For instance, if the elevation above-sea-level is discontinued due to its contested fixed level or tide-dependent averages and the differential ocean salinity and temperature, other mountains can be identified as the highest in the world; for instance, *Chimborazo* in Ecuador would be the tallest if we measure the geometrical radius of the planet; *Sierra Nevada de Santa Marta* in Colombia with measured distance from seashore; *Denali* in the USA with projection of the prominence; *Kilimanjaro* in Tanzania with the ratio of horizontal/vertical isolation, and other possible conventions (Figure 1b). Mountains, hence, are categorized by agreed-upon physical parameters that should be applied anywhere in the world, making the physical graticule applicable anywhere.

Historicity of National Parks and Heritage Management

With the establishment of the National Parks in the late 1800s, the exaggeration to fit the “wilderness” concept into keeping untouched nature, as if existing without human influence, was notorious; however, starting with the first MtPA declared protected in *Bogd Khan Uul National Park*, Mongolia (1783), the human imprint was clearly evident in the ruins of *Manzushir Monastery*, *Buddha Park*, and *Zaisan Memorial* [27]. Nevertheless, a century later, when the push to establish *Yellowstone National Park* in the United States of America (1872), the priority changed to have all cultural evidence removed, in cases violently extirpating local populations, so that the conservation planners could verify the “wilderness” ideal in the Rocky Mountains of Wyoming. Native Americans that had shaped this mountainscape since ancestral times were evicted, and their domestic animals and plants later were taken as natural elements of an intact ecosystem [28]. The national identity was thus created with the imagery of “old faithful,” the geyser routinely erupting; it was taken as the flagship for the conservation of the mega-volcano underneath, and the flora and fauna of this MtPA, imposing the nationalistic idea of heritage as a “national monument” by completely erasing any evidence of prior human occupation as heritagescapes [29].

Similar hegemonic views were imposed onto more MtPAs such as *Royal National Park* in Australia (1879), highlighting the mountainous topography and the beautiful beaches of the area [30], but ignoring the previous millennial occupation of aboriginals, or as in *Banff National Park*, Canada (1885), without regard to the First Nations and their territorial claims to most of the so-called wilderness [9]. An interesting counterpoint is found when we include *Tongariro National Park* in New Zealand (1887), whereby the local *Maori* group *Ngāti Tuwharetoa* gifted their territory to secure protection of their cultural identity with sacred sites and cultural legacies, which prompted UNESCO designation as a mixed (natural and cultural) world heritage site [31]. Another contribution to fuse culture with nature was offered by the establishment of *Setonaiki National Park* in Japan (1934) with its iconic *Itsukushima tori* in the bay. Examples of preservation attempts were initiated in Chile’s *Vicente Pérez Rosales National Park* (1926), Ecuador’s *Galápagos National Park* (1959),

and Austria's *Hohe Tauern* National Park (1981) mistakenly considering them as wild places with nature pristine, dismissing the evidence of cultural landscapes of indigenous *Mapuche* people in Patagonia, of pirates, prisoners, and settlers in the archipelago, or of indigenous groups of South Tyrol, respectively.

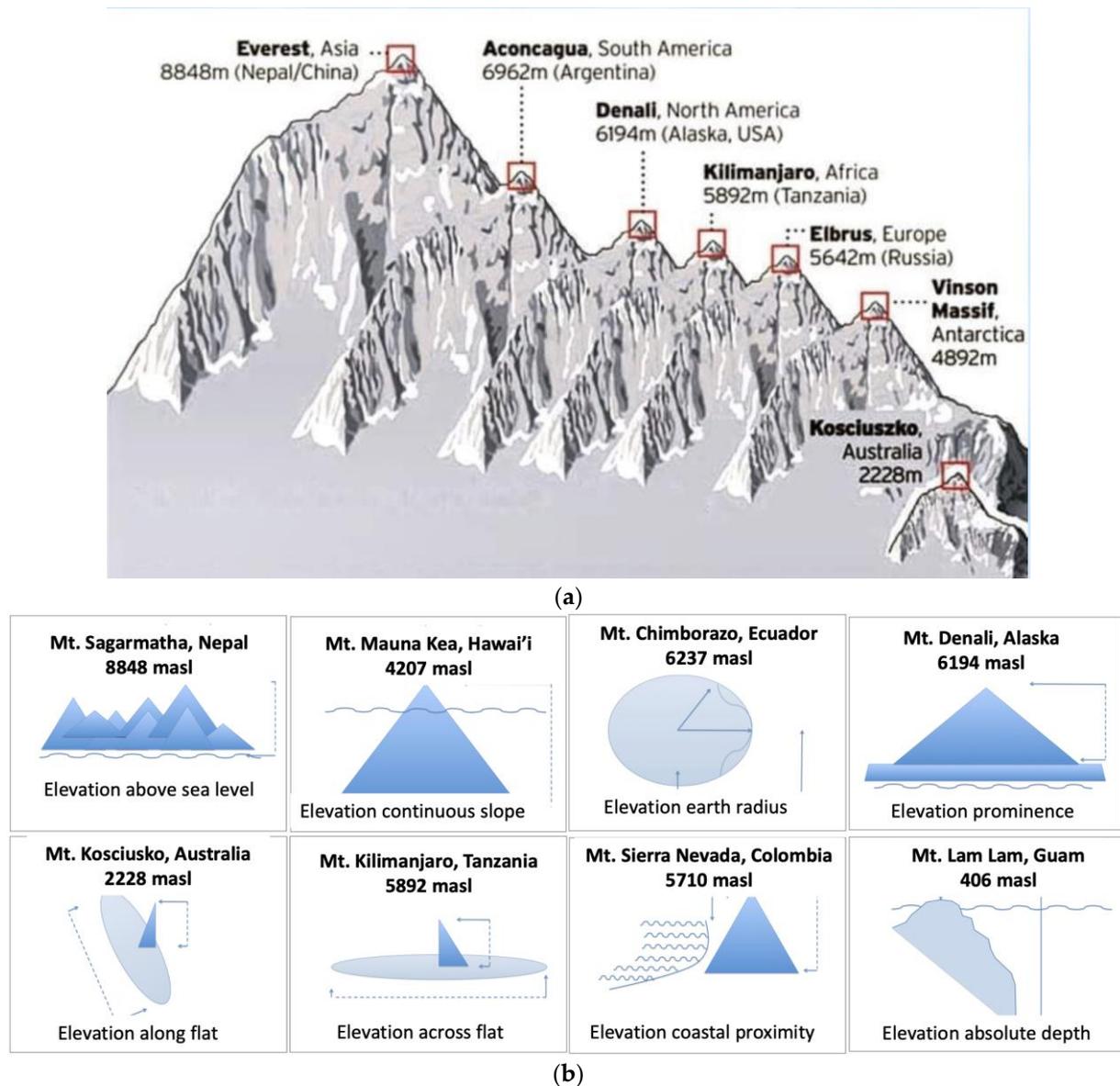


Figure 1. (a) Conventional representation of the tallest mountains of the seven continents. Source: Alan Ingram, https://www.caingram.info/Seven_summits.htm (accessed on 23 November 2022). (b) Different conventions apply to define what is considered as the tallest mountain on Earth. Source: Modified and adapted from [11].

After the initial declaration of those MtPAs, international efforts and foreign aid were secured to have each country develop its own national system of protected areas, which included the six categories of conservation that IUCN has established to cover the spectrum of nature-culture hybridity [32].

The pervasive trend in the binary of nature and culture, of separating the terminus from each end (Figure 2), persisted in the minds of young park ranges and conservation practitioners that tended to identify Categories V and VI as “cultural landscapes” leaving Categories I to IV as “natural areas” particularly strong in MtPAs. Current thinking has allowed to consider even the most archetypically pristine natural places, such as

the Galápagos Islands, the Andean páramos, the Amazonian tropical rainforests, or the Serengeti plains, as manufactured landscapes showing the ecological legacy of ancient traditions in heritagescapes [33–36].

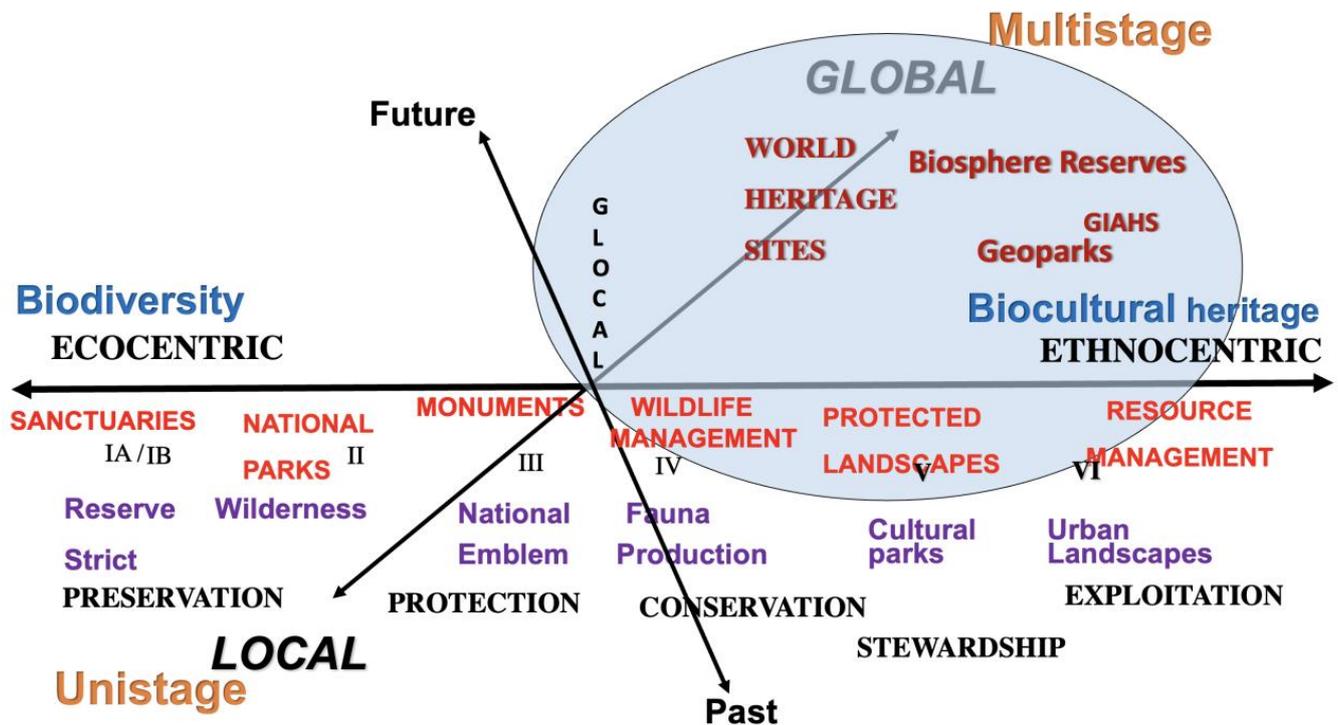


Figure 2. Representation of the spectrum of management possibilities, from preservation to exploitation, according to the six IUCN Categories for nature conservation, influenced by spatiality of the “glocal stage imperative” and the historicity of individual small reserves to big national parks and to larger international designations, such as World Heritage Site, Biosphere Reserve, Global Geopark, or Globally Important Agricultural Heritage Systems (GIAHS), highlighting the philosophical position to favor either nature (eco-centric) or culture (ethnocentric). Source: Elaboration F. Sarmiento.

3. Methods and Conceptualization

Using extensive literature research, field observation, intensive reflection, and critical discourse analysis, we grapple with the Nagoya Protocol of the Convention of Biological Diversity (COP 10, 2010) and the extent of cultural factors in access and benefit sharing of mountain conservation in biocultural heritagescapes [37]. We reflected on several study cases, from different countries with distinct mountainous identities, to elucidate theoretical interlinkages of biological and cultural diversity in tropical and temperate mountain frameworks as they relate to critical biogeography and ethnoecological viewpoints [34,35]. An important source of inquiry was provided by the UNESCO Chair of Culture-Nature Linkages of the World Heritage Studies program and its Certificate Program on Nature Conservation in the Graduate School of Comprehensive Human Sciences at the University of Tsukuba. Materials and debate provided by faculty and students in the planning and executing of the yearly Capacity Building Workshop on Nature-Culture Linkages in Heritage Conservation in Asia and the Pacific (2016–19), particularly in Japan, were important resources. Other important sources were found at the library of the International Program of the Satoyama Initiative (IPSI) of the Institute of Advanced Studies of Sustainability (IAS) of the United Nations University (UNU) and the wealth of case studies from the *Satoyama Review* published by Springer.

In our efforts to include decolonial scholarship in the consideration of montological principles, such as transgression and transdisciplinarity, we kept an open view to decide topical comparisons and to select graticule settings of longitude, latitude and altitude. We emphasized the comparative analysis of mountain landscapes associated with sacred

or spiritual dimensions of conservation, those who show similar trends for gendered mountains, sentient features, or oneiric interpretation that help develop myths, legends, and oral histories from IPLCs [3,11]. In some intricate cases, we applied the inverse definition approach methodology (IDA) to clarify the many intersections of mountain geographies and the hybridity of nature-culture linkages for heritagized sites. We applied critical discourse analysis (CDA) to pin down the situational framework of the heritagized MtPAs that were considered as apt for comparative analysis of national parks and heritage sites.

To better grasp the entanglement of nature and culture, we use a multimethodological practice by which individual expertise has joined a collective reasoning of biocultural heritage and cultural landscape conservation in the Americas and elsewhere [3,10,15,38]. The cross-cutting of conservation priorities includes compartmentalizing the ideographic notions of cultural transmission in non-hegemonic settings, and revaluing IPLCs' perspectives associated with natural resource management in MtPAs [5,10,39,40]. We made an effort to integrate the fabric of mountain landscapes within their vernacular customs and traditions, particularly when linking religious and spiritual considerations for the heritagescape.

4. Results

4.1. Montology Palimpsest Framework

Biocultural diversity requires the mutual understanding of both tangible and intangible material heritage, gathered from transdisciplinary integration of mountainscape's knowledges and conservation practices of IPLCs that live in or around protected areas in mountainous terrain [12]. It requires also the innovation push of revisiting established tenets with new lenses of decolonial scholarship and providing a situated and localized problematization of nature-culture hybrids found in mountain ecoregions and their MtPAs [41].

Ideas that formed part of the initial corpus of the discipline (i.e., ecology, geography, conservation) with narrative of pragmatism and determinism have been debunked with the shift of priorities and new trope of romantic possibilism [42]. To grasp with the change following the Sauerian commandment, the difficult definition of each term is made obvious when defining its opposite. An example is given in Table 2 using the inverse definition approach (IDA). There is a plethora of terms identifying the graticules applicable to each situational and specific conditions of the socioecological landscape.

Table 2. Example of the inverse definition method when applied to otherwise very common terms of difficult construct and meaning, that becomes very clear when explained in its absence or opposite, contrary meaning. The IDA requires a series of examples or iterations to obtain the meaning of the factor in need of definition due to its reciprocal contradictory ideas.

Term	Construct	Inversed Definition	Source
<i>Sustainability</i>	Sustainable development	Easily explained when unsustainable practices affect the mountain socioecological system = damaged or unsustainable.	Hamilton & Hurni 2003 [43]
<i>Health</i>	Environmental health	Easily explained when sickness and disease is apparent in the mountain environment = unhealthy.	Dovjak & Kukec. 2019 [44]
<i>Kami</i>	Spiritual essence	Easily explained when no religious or spiritual reaction is observed in the presence of mountain features = unanimated, atheist.	Breen & Teeuwen 2001 [45]
<i>Harmony</i>	Natural harmony	Easily explained when disruption in the balance break the equilibrium in the mountain ecosystem = disequilibrium, chaos.	Botkin 1990 [46]
<i>Peace</i>	Pax Americana	Easily explained when violent acts and criminality pervade neighborhoods in the United States = revolts, insurgence and crime.	Kirkpatrick 2007 [47]
<i>Omotenashi</i>	Japanese hospitality	Easily explained by rude stares and lackadaisical bows to mountain tourists = non attentive.	Belal et al. 2013 [48]

Table 2. *Cont.*

Term	Construct	Inversed Definition	Source
<i>Happiness</i>	Satisfactory wellbeing	Easily explained when welfare malfunctions affect largely the emotions of mountain people = sadness, boredom.	Maddison et al. 2020 [49]
<i>Okuyama</i>	Deep mountain recess	Easily explained when climbing does not get to a resting state, bringing tiredness and boring distractions in the mountain slopes = unreachable paradise.	Iwatzuki 2008 [50]

4.2. *Montology through Main Players*

Development of the discipline of mountain geography experienced significant developments through the centuries ensuing its original setting of academic endeavors with Chinese, Arab, Hindu, Greek and Roman thinkers who posited mountain geographical thought as especially important. Then, with the age of discovery and exploration, a new trend started when the impressive richness of tropical biota was exhibited in European museums, prompting the longing for new realities of unclimbed mountains in faraway colonies [42].

A listing of scholars who worked in the construction of innovative ways to understand mountains as socioecological systems is listed in Table 3, with emphasis in their activity of recent decades, where the realization of transdisciplinarity became a guiding principle for mountain research [51]. We have chosen to divide the list with names from the Global North and the Global South countries, noting their country abbreviations, and different shade intensity to highlight engagement intensity shown through the decades.

Table 3. Decadal progression of montological thought as contributions from scholars from Global North and Global South converge in the development of montology; the list is taken as a sample of successes through teaching and research, reflected in publications on montology. Note the absence of indigenous scholars whose works have not been published in scientific outlets, but whose knowledge of mountains is remarkable. Additionally, note the very few women authors in the roster. Each author has a shade, with the stronger highlight during the decades of more significant efforts toward montology. Source: *J. Alpine Geography, Mountain Research and Development, J. Mountain Ecology, J. Mountain Science, Eco. Mont*, and recollection of Fausto Sarmiento and Andreas Haller.

MAJOR PLAYERS	DECADAL ADVANCE OF MONTOLGY						
GLOBAL NORTH	60s	70s	80s	90s	00s	10s	20s
Carl Troll (DE)							
Jack D. Ives (CA)							
Eugene P. Odum							
Bruno Messerli (CH)							
Maurice Strong (UNEP)							
Carol Harden (US)							
Lawrence Hamilton (US)							
Axel Borsdorf (AT)							
Robert Rhoades (US)							
Bernard Debarbieux (FR)							
Teiji Watanabe (JP)							
Jörg Balsinger (CH)							
Zev Naveh (IL)							
Nigel Allan (US)							
Edwin Bernbaum (US)							
Hermann Kreuzmann (DE)							
Christoph Stadel (CA-AT)							

Table 3. Cont.

MAJOR PLAYERS	DECADAL ADVANCE OF MONTOLOGY						
GLOBAL NORTH	60s	70s	80s	90s	00s	10s	20s
Martin Price (UK)							
Monique Fort (FR)							
José María García Ruiz (ES)							
Alton Byers (US)							
Thomas Schaaf (DE)							
Hans Hurni (CH)							
Yuri Badenkov (RU)							
Donald Friend (US)							
Thomas Kohler (CH)							
Alexey Gunya (RU)							
GLOBAL SOUTH							
Gerardo Budowski (CR-VE)							
Misael Acosta-Solís (EC)							
Trilok Singh Papola (IN)							
Fausto Sarmiento (US-EC)							
Víctor Toledo (MX)							
Hugo Romero (CL)							
Mesfin Woldemariam (ET)							
Radu Rey (RO)							
J. Gabriel Campbell (NP)							
Guangyu Huang (CN)							
Irasema Alcántara-Ayala (MX)							
Esther Njiro (ZA)							
Constanza Ceruti (AR)							
Gustavo Martinelli (BR)							
Virginia Nazarea (PH)							
Elías Mujica (PE)							
Arturo Eichler (VE-DE)							
Eduardo Gudynas (UR)							
Ricardo Rozzi (CL-US)							

4.3. The Three “L”s of Critical Biogeography: Location, Locale, and Localities

Biocultural heritage conservation depends in the proverbial iteration of *location* as defining geography. This assertion relates to simplistic assumptions of spatial correlations and heterogeneity in nature, without considering the complex adaptive responses in the mountainscape to create, appropriate, and contest manifestations of culture. This is often problematic because space is treated as an apolitical entity, only determined by the coordinates of the graticule. “Location, location, location” has hitherto been iterated as the mantra for city planning and urbanized mountain areas. Nevertheless, the key agency of technical decisions made by administrators and legislators in the governance of mountains has been pointed out as the actual driver of impactful pulses and presses felt in the development of SEPLs [3,9,11].

To break the mold of location, we incorporate conditions of *locale*, whereby the notion of situational conditions of the locus imprint an individuality that makes generalizations difficult in heritage studies [40]. On the same vein, when looking at *localities* we are often favoring the traditional practice of registering elements visible and collected from the road traveled or the transect followed, and printed in gazetteers for biogeographers. The records listed in the catalogue can now be complemented by remote-sensing and geospatial analyses of MtPAs, creating digital elevation models (DEMs) that are easy to illustrate for modeling conservation of mountain biocultural heritage [5,18,24].

We are applying the Japanese pattern of space organization and spatial relations to look into nuances of location, locale and locality [10,16] that define place. Just like the UNESCO Biosphere Reserve Model, the application of Central-Place Theory (CPT) in Mt-

SEs is a good reference when considering the nucleus or core, the buffer or transition, and the periphery or margin. In Japan, *Okuyama* relates to the mature forest that is often found in mountaintops and sacred coves (cf., core), *Satoyama* relates to the cultivation created by the harmony of productive socioecological landscapes and seascapes (SEPLS), or farmscapes (cf., buffer), and *Hitozato* relates to the heavily modified village and agroindustrial cityscapes (cf., periphery). However, with their monoethnic customs, they also include the 4D approach by linking the space with historicity of ancient traditions and seasoned customary practices of land-use and nature worship [52], such as the esoteric *Shugendō* lifestyle of *Yamabushi* priests in Mt. *Ōmine-san* and other sacred mountains of the *Kii Peninsula*, a World Heritage Site [20,50,53,54].

Selecting a specific locus of ritualized veneration in a MtPA brings not only specificity but also scaling to create a pilgrimage locale of national significance, with important attributes to become a National Heritage under the cultural laws of the country and a World Heritage in the WHC listings, depending on the crucial elements of authenticity and universality, both contested ideas depending on the standpoint of the official position. In addition, the understanding of natural values (i.e., mountain fauna, planted trees, and coppiced forests) amidst ancestral cultural and religious practices dating back to the 6th and 7th centuries in *Yoshino-Kumano* National Park should amalgamate the linkages that bring the *Ōmine-san* mountainscape as a unit of both national identity and localized ritual significance (Figure 3a,b). The increasing number of conservation units designated as mixed heritage (both natural and cultural) makes the important contribution of extant functional linkages of the heritagescape, maintained by tradition and custom through cherished intergenerational equity. The older the practice, the more rooted heritage considerations for the incommensurable value of the hybrid area protected and conserved [53].



(a)

Figure 3. Cont.



(b)

Figure 3. (a) Professor Masahito Yoshida, UNESCO chair of Nature-Culture Linkages in Heritage Conservation at the University of Tsukuba, Japan, explaining the spatial and temporal linkages of the main heritage areas of the *Yoshino-Kumano* National Park integrated as World Cultural Heritage of the Sacred Sites and Pilgrimage Routes of the *Kii* mountain range. Photo: Fausto Sarmiento, 23 November 2022. (b) A panoramic view of *Dorogawa Onsen*, a secluded mountain hotspring town catering temples and pilgrimage routes for religious tourism as well as aesthetically healing culture and therapeutic landscape services for those pursuing both blessings from *Shugendo* priests', or *Yamabushi*, and invigorating meditation and inspiration with the "forest bathing" or *shinrin-yoku*, under an impressive canopy of cherry blossoms in Spring, or autumn foliage in the understory as well as in the deciduous canopy during windy Fall in the extensive monoculture plantations of *Chamaecyparis obtusa*, *Cryptomeria japonica*, and *Prunus serrulate*, as well as coppiced woodlands of *Quercus acuta*. Photo: Fausto Sarmiento. 24 November 2022.

4.3.1. Graticular Sacred Mountains?

Montology provides incentives to redefine the controversial yet customary use of spirituality by diverse religious sects, with churches of various denominations located around the world [38], which makes it hard to apply a spiritual graticule across the world's mountains. Whether in Islamic, Hebrew, or Christian cults, the Abrahamic tradition of written authority makes allegiance to theocratic dogma with exegesis. The hermeneutic effect determines each of those variations, including the Suni-Shia divide in Islam; the Haredi-Dati-Masorti divide in Judaism; and the Church of the East-Oriental Orthodoxy-Eastern Orthodoxy-Roman Catholicism-Protestantism-Restorationism divide in Christianity. The countries colonized by those respective imperial powers brought their own versions of these faiths, with battles and political upheavals while dividing [55].

Same processes occurred with the separation of Hinduism, Jainism, Buddhism, Sikhism in Southwest Asia and Taoism (or Daoism), Confucianism and Shintoism in the East, with the respective divisions therein, namely Vaishnavism-Shaivism-Shaktism-Smartism divide of Hinduism; Digambara-Svetambara sects of Jainism; Theravada or Hinayana-Mayahana-Vajrayana divide of Buddhism; Khālsā-Nāmdhari-Nirankāri sects of Sikhism; Shen Hsiao-T'ai-Cheng-i-Dong-Neidan-Xi divide of Taoism; Mencius-Xunzi-Dong Zhongshu-Song-Ming-Korean-Qing-Modern sects mostly related to dynastic China; and Jinja-Kyoha-Minzoku divide of Shintoism in medieval and modern Japan [56].

Each of these variations highlights the importance of mountains as center of spirituality and abode of the gods. Even the most imperceptible manifestation of the divine (or *Kami* in Japanese) can be found in the awe-inspiring elements of the functional mountain socioecological system [33,38,57,58], and the elements that could feel the spiritual energy or aparitions (*Yōkai*) emanating from the water (*Kappa*), the cave (*Rokurokubi*), the ground (*Oni*), the trees (*Kodama*), and other elements of the mountain ecosystem, where the sun goddess (*Amaterasu Ōmikami*) resides [50].

So much spirituality is afforded in the notion of *Kami*, that Shinto religion acknowledges the existence of plentiful gods, goddesses, semi-gods, demons, some demonic, some angelical, about eighty million deities, *Yaoyorozu no Kami*, which in Japan is considered infinity, as the countless opportunities to worship nature exist continuously for more than 1300 years [56]. The common assertion of IPLCs about other-than-human entities, spirits, or deities allow to expand the graticules through mountain beings of different continents, such as the *oni* in Japan, *tomte* in Swedden, *elf* in Austria, *gnome* in Germany, *dwarf* in Poland, *duende* in Spain, *nain* in France, *schtroumpfs* in Belgium, *sacharuna* in Ecuador, *laftrache* in Chile, *sombrerón* in Guatemala, *alux* in México, *aisha Kadisha* in Morocco, *leprechaun* in Ireland, *troll* in Norway, *asuang* in the Philippines, *guayota* in the Canary Islands, *domovói* in Russia, and *mogwai* in China [56,59–62] and many others. Even literary and cinematic bestsellers talk about the Tolkien's *hobbits*, Cameron's *avatars*, Puyo's *smurfs*, and Grimm brothers' *seven dwarfs*.

4.3.2. The Three “H”s of Biocultural Ethic: Habit, Habitat and Co-inHabitation

Another important unifying theme for the extensive spiritual graticule is the social construct of gendered mountains differentiated by the three “H”s of Habit, Habitat and co-inHabitation suggested recently by bioethicist Ricardo Rozzi for sentient landscapes, like rivers in the MtPAs [41], often highlighting the feminine in biocultural heritage. Observing sexual clues in the habitat physiography of the mountainscape, people assign either male or female identities to their mountains, which make the sentient landscape less pensive for infidels or surely discrete for believers. The majority of mountains, by habit of ancient observance, seems to be female, described in English with the noun “mountain” after her proper name, as in the Green Mountain (*Al Jabal Al Akhdar*) in Oman. Sometimes the genderized mountain takes directly from the grammatical gender of the word (e.g., *montaña* in Spanish, *gora* in Russian, *núi* in Vietnamese). Conversely, the majority of male mountains are described with the noun “mount” before his proper name, as in Mount *Tayta Chimborazo* in Ecuador or Mt. *Amavad* in Iran. Whatever category is given to isolated mountain

edifices, the neutral article is used, as in the case of the Korean lack of grammatical gender. Sometimes a neutral name is given to keep local memoryscape of the colonial registered landowner of a mountainous property (e.g., *Lo Barnechea*, in Santiago, Chile). In some cases, the poiesis of the place-name conferred masculinity is manifested with sounds, tremors, or eruptions of ‘angered’ or ‘vociferous’ mountains such as Mt. *Imbabura* in Ecuador or Mt. *Popocatepetl* in Mexico. However, most representative volcanoes of the Pacific Rim are female, as *Mauna Kea* in Hawai’i, *Fuji-san* in Japan, *Krakatau* and her daughter *Anak Krakatau* in Indonesia, *Pinatubo* in the Philippines, *Chaitén* in Chile, *Kutacahi* in Ecuador, or *Iztaccihuatl* in Mexico, symbolizing the maternal strength of character, the idea of fertility to grow crops, and the origin myths associated with these volcanic mountainscapes [8,17].

In some cases, multipeak mountains exhibit male and female apexes nearby in the jagged mountain edifice. This is the case of sacred Mt. *Tsukuba-san* in Ibaraki Prefecture, Japan, where the male summit (*Nantai-san*) and the female (*Nyotai-san*) will confer blessings of a long marriage and match-making bliss for those praying in the *Tsukubasan-jinja*, a Shinto shrine revering *Izanagi-no-mikoto* and *Insanami-no-mikoto*, the coupled creators of life and dead. If the mountains are separated by a valley or gap, one is considered male and the other is female (Figure 4), as the landscape memory of *Payachatas*, with the tumbs of mythical princess *Parinacota* and prince *Pomeraque*, in *Lauta National Park* in northern Chile. The same ontology is applied with Mt. *Cotopaxi* (male, nemesis of nearby Mt. *Chimborazo*) and *Tungurawa* (female) separated by the *Patate* valley in Ecuador, or the spectacular snowcapped twin volcanoes, *Iztaccihuatl* (sleeping lady) and *Popocatepetl* (smoking mountain), separated by the high saddle “Paso de Cortéz”, on the *Izta-Popo Zoquiapan National Park* in the eastern trans-volcanic belt of Mexico.



Figure 4. Panoramic view of Mt. *Tsukuba-san*, with harvested rice paddies in the foreground, urban settlement, citrus plantations and other fruits at the base, and forested slopes towards the two sacred summits. In the lower right slope is the *Tsukubasan-jinja* temple complex, and the higher white structure near the summit is the tourist facility and cable-car station. Photo: Fausto Sarmiento and Kenichi Ueno. 18 November 2022.

4.4. Genderized Mountains Lore

The genderized mountains are problematized by the changes from tradition to modernity in relation to banning women access to mountains, a practice held in many religious traditions in the middle ages, but now maintained in only two places in the world, both listed as World Heritage Sites: the monastic community of Mt. *Athos* in Greece, with Eastern Orthodox monks' ascetic lifestyle on the tabletop mountains of central Macedonia, and the hermit esoteric monks (*Yamabushi*) of the syncretic *Shugendō* tradition (mix Buddhist, Taoist, and Shintoist beliefs) in the *Kii Mountain Range* of the Nara Prefecture, who maintain prohibition to allow entrance of women to Mt. *Ōmine-san*, and its highest peak *Sanjōgatake*, with clear signs for *Nyonin Kekkai Mon* marking the boundary on the prohibition gate after the *Ohashi* bridge of Figure 5a [50,54].

In parallel consideration, there are mountains where men are banned from entry as the norm, such as in Mt. *Inamura* in the Kōchi Prefecture. The summit of *Inamura yama* is the place where the fertility goddess *Ame-no-Uzume* is revered with ritualized touching of the divine phallus made of Japanese cypress (*Chamaecyparis obtusa*). Another female-only practice is observed in some coastal villages (*satoumi*) with the *ama* free divers, harvesting pearls and seafood from the shallow bays, without scuba gear or air tanks. Their unique whistling when resurfacing after demanding dives are typical of the *ama* soundscape.



(a)

Figure 5. Cont.



(b)

Figure 5. (a) Signage for the *Ōmine-san* pilgrimage route at the *Ohashi* bridge, where a map and legends explain the main features of the site. Alongside, a new sign with the instructions for trekking and the warnings against women entering the path of the route, curiously provided a female cartoon in the foreground. In the background, the many markers of ascents to *Sanjōgatake*, and a small Shinto shrine in the background. Photo: Fausto Sarmiento. 23 November 2022. (b) View of the prohibition gate for women to enter *Ōmine-san*. Fausto Sarmiento reacts to the dilemma between modern feminist policies in the West and traditional and customary practices of many centuries in the East. The tall vertical stone border marker reads *Nyonin Kekkai Mon*, or women do not enter. The smaller markers and menhirs celebrate successful expeditions throughout the pilgrimage routes of the *Yoshino-Kumano* area and mountaineering ascents to *Sanjōgatake-san* and other peaks of the *Ōmine-san* mountain complex at the World Cultural Heritage Site of the Sacred Sites and Pilgrimage Routes of the *Kii* Mountain Range in Nara and Wakayama Prefectures. Photo: Masahito Yoshida. 23 November 2022.

In these times of radical feminist politics (i.e., me-too movement, equal pay, reproductive rights, etc.) it could be questionable for the modern countries of Europe and Japan that women were not allowed to enter; however, reading the declaration of the IPLCs of the *Yoshino-Kumano* area, the traditions of one thousand three hundred years old should be maintained with respect and veneration to the sacredness of Mt. *Ōmine-san* and its local tradition (Figure 5b) [50,54]. This oxymoric linkage between tradition and modernity is key for heritagescape management, particularly if they are sacred sites [16,41].

The female conception of IPLCs is not only reflected in the matriarchal structure of community decision-making, but also in the elite role of wise women considered the true nexus between this and otherworldly realities. Famed fortunetellers of Greek antiquity are exemplified by the *mantis*, who whether for magic or superstition, foretold the future as unlicensed female healers and prophets. The art of prophecy, or *theopropia*, is not

historical, but a vivid reality observed in many parts of the world, such as the *curanderas* of Ilumán, Ecuador, the *machis* of Wallmapu land in Chile and Argentina, the *ghigau* of the Cherokee in the United States, the *male* of the Maya in Guatemala, the *gul'i daj* of the Roma in Slovakia, and the *ogamiya* of Japanese folk culture, that serve as shamanic healer, or the *Arikura-no-baba* with divination powers. With ethnobotanical uses and a touch of hallucinogenic substance, they have the capacity to interpret the vision quest of IPLCs with thousands of devotee followers. In some countries, new laws allow for the practice of “traditional healing with alternative medicine”, preventing what was seen as witchcraft in past “zombie-laws” for which many wise medicine women were penalized with expulsion at the least, or death as malign sorceresses burned at the stake at the worst.

5. Discussion

5.1. Heritagezing Biocultural Mountains

Our analysis of the applicability of the graticule in montology helps to divide the concept in three main areas of concern: physical, cultural and spiritual graticules [20,51]. Whether in different longitudes or latitudes, the identification of physical landscape features is applicable throughout the site altitude. The four mountain provinces (i.e.: colline, montane, alpine, and nival) serve as a good framework of the mountain spatial distribution. Nevertheless, identified cultural landscape features allow to compare the graticules of distant mountain ecoregions sharing the cultural frame of the dominant society, namely western, eastern, or southern perspectives; the dependency of situational factors determine our understanding of the national, regional identities linked by language and economy. Moreover, the spiritual landscape features allow to individualize the graticule according to customary practice of IPLCs but sharing a worldwide appeal for a widespread observance of the sacred. Hence, the importance of critical perspectives on mountainscape heritage [8] to redefine biocultural diversity conservation (Figure 6).

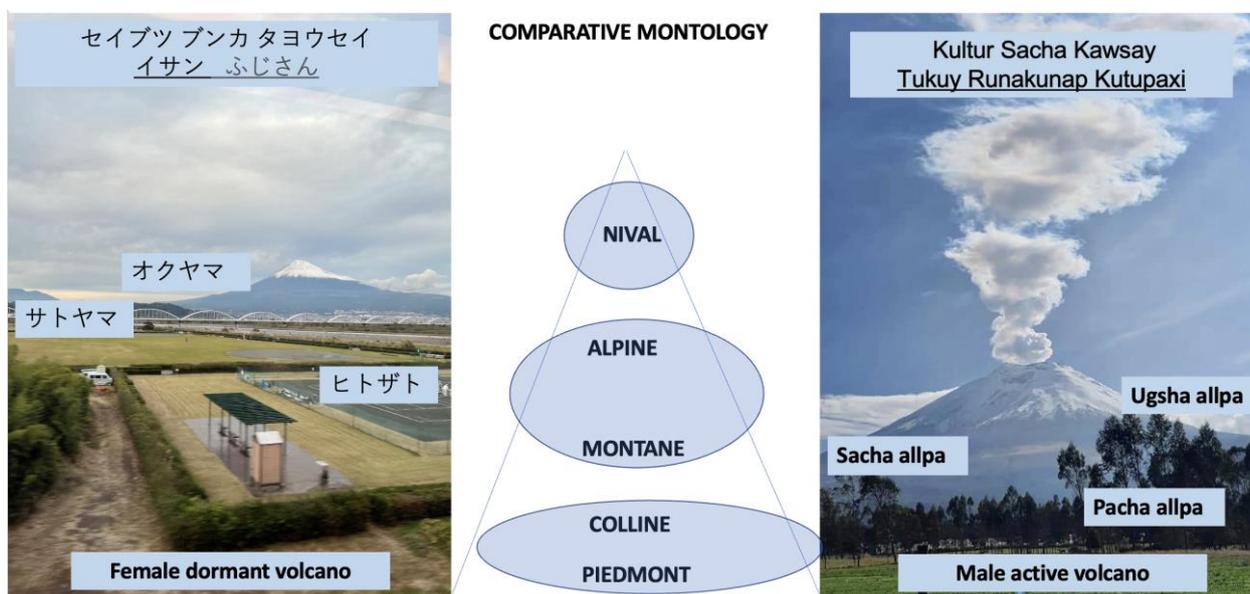


Figure 6. Exemplifying comparative montology of two similar stratovolcanoes (Mt. *Fuji-san* in Japan and Mt. *Cotopaxi* in Ecuador) located at different longitudes (Asia, South America), latitudes (temperate, tropical) and altitude (3776 masl, 5897 masl) with hints of physical, social, and spiritual considerations of the heritagescape. The heading on top of the photos indicates “Biocultural Diversity” and “heritage” (underlined); the inserts identify the three main zones of traditional space allocation, given in Japanese *Katakana* (left) and Ecuadorian *Kichwa* (right). In the center, the traditional segmentation of the mountain provinces is given in English. Photo: *Fuji-san*, Fausto Sarmiento 26 November 2022. Photo: *Cotopaxi*, Oswaldo Báez 15 December 2022.

The imperative of biocultural heritage conservation requires to define the graticule for analyzing and supporting sustainable mountain development scenarios with attention to traditional and customary cultural, economic, and religious practices of IPLCs [2,5], giving strong credence to the memoryscape cherished intergenerationally [17,63]. The unique characteristics afforded to a biocultural site will allow for both maintenance of identity values and regeneration of diminished ritualized practices of nature worship [61]. Assessment of landscape features that can be considered biocultural heritage must comply with some of the ten WHC required criteria for natural beauty, geology and geomorphology, ecosystem and biodiversity for MtPAs, and required masterpiece of human creativity, long established exchange of values of material culture, testimony of cultural tradition, exemplar monument or architectural design, traditional land-use practices and human interaction and associated ideas, beliefs, literary or artistic works of outstanding universal significance. To create the heritage site or a polyvalent heritage complex it is highly recommended that official commitment for the protection and management of the site, as well as the authenticity and the integrity of the material tangible and intangible goods, is secured for posterity [6,13].

5.2. Heritagization and Heritagized Communities

Several international expert meetings have been conducted with the notion of establishing priority areas to create heritage considerations and to socialize the benefits of biocultural heritage conservation. Unlike the initial trend of monopolizing western European cultural sites, with numerous designated catholic churches in Spain, Italy, France, Germany and Great Britain, the tendency now includes other types of cultural and religious affiliations from faraway cultures and even more distant ethnic groups. The decolonial turn and indigenous revival has taken central place in the deliberations of national committees and international agencies dealing with the listing of sites in the UNESCO structure and to maintain candidate sites for future consideration with respect to diversity and inclusion [64,65].

Currently, there are 1154 properties listed in the UNESCO WHC register, with the participation of 167 states parties of the 193 members of the General Assembly of the United Nations. The sites include 43 considered transboundary when two or more countries share the designated area (e.g., the *Qhapac Ñan* Andean Road System in Colombia, Ecuador, Peru, Bolivia and Chile). The majority of sites are for Cultural Heritage (897), but there are also for Natural Heritage (218) and for Mixed Heritage (39). From the conditions-on-the-ground and the interest of emending risky situations in some signatory countries of the Heritage Convention, 3 sites have been delisted to date and 52 sites remain considered as “in danger” of potential delisting [66–69].

In their quest for legitimacy as strong political forces, IPLCs are making strides for having their territories being heritagized to acknowledge their identity and to reaffirm their claims to water, food, housing, garb, and rituals of the original people or “*pueblos originarios*”, with decolonial epistemes of self-determination and value-added myths [13]. The critical construction of heritage discourse of IPLCs is now being incorporated in redesigned modern plans for ecotourism and ethnotourism of MtPAs [65,66] with landscape memory, including national and provincial heritage designated areas [6,12,17,40]. Furthermore, the process of heritagization continues strongly in the global South as countermapping of the process of the World Heritage program allows for inclusion of glocal concerns, including climate change and political invigoration [19,70–72], that will help to use this biocultural heritage strategy as an important instrument in the difficult attempt to attain sustainable, regenerative mountain communities in affective heritagescapes [14] of sentient mountainscapes [19,52,61,62].

6. Conclusions

We grappled with defining the multidimensional space and time of biocultural heritage mountainscapes to find a generalizable way to do comparative montology work. We concluded that the graticule of mountain sciences must be attuned with scientific con-

vention and alternative, traditional ecological knowledge of wisdom keepers and other non-western ontologies for understanding the mountains environment. The convergence of different disciplines in transdisciplinary montology will best afford a better grasp of the pressing issues of mountain communities facing sustainable and regenerative development; we considered the route plan to dynamize the graticule with nuanced, situated, localized characteristics, applying the four dimensions (4D) of montology.

Firstly, the trilemma of identity has shown that the physical factor (i.e., altitude) can be generalized for the majority of situations, except for those of inverse verticality in canyonland occupation and in marine mountains or islands. The geomorphological arrangement linked to elevation could be generalized at every meridian location with attention to temporal scales.

Secondly, the vast cultural conditions afforded by the social factors (i.e., latitude) have made obvious the colonialism and hegemony expressed between the Global North and the Global South. There are situations that make this categorization difficult, as the location of Australia in the down under South, yet it has always been associated with the Global North. By tackling concepts of decolonial scholarship, we identified cultural traits that can be generalized in the paralleled graticule of MtSEs with attention to spatio-temporal scales affected by historicity.

Thirdly, the unique dimension with many religious and mystic realities afforded by the spiritual factors (i.e., longitude) have made strides in heritagized territories and providing a more encompassing approach to management of conservation of nature and natural resources within tradition and myth. This helps to invigorate the “indigenous revival” trend of many native, aboriginal, first nations, and original people, a condition that is generalizable all over the world, in the purpose of establishing geoparks, biocultural MtPAs such as sacred sites in the heritagescape of the “fourth world” with attention to consilient and noetic scales affected by tradition and ritual.

We are uncertain of the level of integration that convergent sciences can reach in montological projects, as the limitation of funding and isolation of ivory towers can exert on transdisciplinary studies. We claim the need of accepting the montological approach to better know the MtSEs’ intricate realities, that will help define the appropriate stance in heritagized MtPAs. We plea for incorporating decolonial scholarship in the teaching of mountain geographies. Only then, a socially and environmentally just, inclusive, and diverse socioecological system will be nurtured for future sustainable, regenerative mountain heritagescapes.

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