

Review

# Scientific Landscape Related to Mapuche Indigenous Peoples and Wallmapu Territory

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**Abstract:** Recent international recognition of indigenous peoples, their rights and contributions to solving current challenges has directed academic attention to the way research is conducted in relation to them, what topics are studied, by whom, and using which methodologies. The Mapuche are the most numerous indigenous peoples in South America and have ancestrally inhabited a territory denominated Wallmapu. This study undertook a comprehensive revision and meta-analysis of the scientific literature related to the Mapuche and Wallmapu. Through quantification and visualization of the scientific landscape, the goal was to enhance the understanding of the themes and patterns that have guided research in this field of study. We found 1611 documents in Web of Science and SciELO collections published between 1975 and 2020. Using CiteSpace software, we analyzed the main conceptual hotspots, identified central authors and pivotal works, among other aspects of the scientific knowledge domain. The main research themes found revolve around political and historical aspects of the relationship between Mapuche and the State; ethnobotanical research including plant properties and cultural knowledge transmission; and the indisputable connection between indigenous resistance and environmental depredation. We argue that valuing cultural diversity paves the road for reclaiming indigenous knowledge as a contribution to our understanding of the world.

**Keywords:** indigenous knowledge; Latin America; Chile; Argentina; mapping knowledge domain; bibliometric; indigenous movements; environmental defense

## 1. Introduction

Knowledge refers to our awareness and understanding of reality, and is acquired through experience or education [1]. Culture determines what is important in terms of perceiving, understanding, valuing and describing reality, as well as the methods that are valid for doing so [2]. Modern science deems knowledge legitimate when it rests on two foundations: first, it is acquired through purely logical thinking; and second, it is obtained from empirical observation [3]. There is a tendency to hold only Western ideas about reality as valid because they are based on these two fundamental aspects. Thus, other forms of knowledge have been excluded as legitimate ways of understanding and giving meaning to reality and our relation as humans to the rest of the world [4].

In this context, knowledge held by indigenous peoples has been seen through the binary lens of civilized-barbaric. This approach communicates a sense of superiority and yearning to bring progress to indigenous livelihoods in terms of intellectual, social and economic development. The discourse on development emanates from a specific dominant Western perspective that homogenizes other worlds' perspectives. This homogenization occurs through the consolidation of a particular form of knowledge (scientific), a system of power which regulates and implements such knowledge and particular forms of subjectivity which are considered as valid [5,6]. Advancing beyond this lens requires explicit recognition of the legitimacy of multiple forms of knowledge and knowledge acquisition [7,8]. This is a paramount condition in the search for encounter and dialogue of different knowledge systems. A necessary starting point is the acknowledgement of historical imposed hierarchies and moving past them, towards epistemological pluralism.

The global recognition (and lack thereof) of indigenous peoples can be traced back to the era of colonialism. The binary lens of civilization vs. wilderness that drove explorations was supported by scientific disciplines such as geography and anthropology. Early travel chronicles served to install a depiction of indigenous peoples as savages [9], which allowed to legitimize violence against them and their territories. Colonialism marked the trajectory of both social and ecological systems and structured societies where tenure of lands and resources is strongly unequal, concentrated in a few hands and characterized by the dispossession of ancestral indigenous territories [10]. Much harm continues to be done today to indigenous peoples and territories in the name of "development"—a concept which has served to impose a Eurocentric view on "less developed" regions [6]. The most emblematic example of this are the UN Sustainable Development Goals (SDGs) which have promoted a seemingly well-intended path for the global community. Although generally uncontested, some views of the SDG's point to their bias towards market-based solutions [11] and, furthermore, indicate that they could serve as a smokescreen for further environmental destruction [12].

Scientific disciplines in the XXI century have much to learn from indigenous peoples, and this is increasingly recognized by academic institutions [13]. One definition of indigenous knowledge refers to ecological knowledge held by place-based indigenous peoples, accumulated intergenerationally within their specific cultural context and belief system, and often complemented by contemporary observations on local-to-regional scales [14]. Recuperating indigenous knowledge can help assert agency and expertise from communities, and thus, provide important alternative representations of indigenous peoples to prevailing narratives that depict them with negative stereotypes [15]. This of course means to revisit the knowledge paradigm in place in Western societies, which, since conquest, has made indigenous peoples and their knowledge invisible [16]. It also means to incorporate explicit openness to "epistemologies from the [global] South" [17], and to question academic production in the form of "North about South."

Epistemologies of the South is a theoretical framework proposed as an avenue for acknowledging the multiple ways of understanding and making meaning of our world. The recognition of epistemological "pluriversity" [7] is a favorable starting point to dive into scientific landscapes related to indigenous peoples. Contemporary understanding about knowledge held by indigenous peoples requires an epistemological re-orientation [8]. These systems of knowledge have been historically plundered from indigenous peoples through colonialism. The permeation of colonialism into academic institutions, research topics and methodologies has been called "epistemological extractivism" [18]. Therefore, the acceptance of plural epistemologies that are historically situated is also part of the liberation process of the underlying colonialism [19]. Furthermore, there is a profound need for diverse epistemologies to coexist in what has been called a "knowledge ecology" [20]. This coexistence could allow the reconfiguration of human's colonial relation, not only with indigenous peoples, but also with nature herself [21–23].

There are in fact, other paths beyond the hegemonic conception of development. One significant contribution comes from diverse indigenous peoples from the Andean-Amazonic region: the "Buen Vivir" paradigm has emerged as a combination of traditional world vision and as a political response

to the social-ecological crisis resulting from capitalism [24,25]. Through concepts such as *sumak kawsay* (Quechua), *suma qamaña* (Aymara), *küme mongen* (Mapuche), *utz k'aslemal* (Maya) and *ñande reko* (Guaraní), among many others, indigenous peoples of Latin America refer to their own conceptions of wellbeing or “living well” [26].

Collaboration between scientists and indigenous knowledge-holders is a trend that is consistent with recent international recognition of their rights: ILO 169 Convention, 1989 and UN Declaration on the Rights of Indigenous Peoples, 2007 [27,28]. The most recent cornerstone recognition of indigenous peoples of the world came from the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. This institution emitted an urgent report on the state of global biodiversity [29] and informs policy-makers of the unequivocal importance of indigenous peoples to biodiversity conservation [30]. These reports indicate that at least a quarter of the global land area is traditionally owned, managed, used or occupied by indigenous peoples, including 35% of formally protected areas and another 35% of all remaining land, with very low human intervention. Although 72% of indicators showed increasing pressure on these lands, Nature deterioration is occurring less dramatically than in other lands. It is affirmed that regional and global scenarios currently do not consider, but would benefit from, explicit consideration of indigenous people’s knowledge and desired future development pathways.

Globalization has been a double-edge sword for indigenous communities. On one hand, making visible their potential contributions and highlighting their uniqueness; while on the other hand, pressuring to homologize and often profiting from folklorization of their customs and traditions [4,18]. Nonetheless, there has been an emergence of social movements around the world toward recognition of indigenous cultures, ways of living and systems of knowledge [19,31,32]. Proof of this in Latin America is the rapid increase and activation of Mapuche intellectuals who contribute from authentic perspectives to the debate and struggle for self-determination in their territories [33–37].

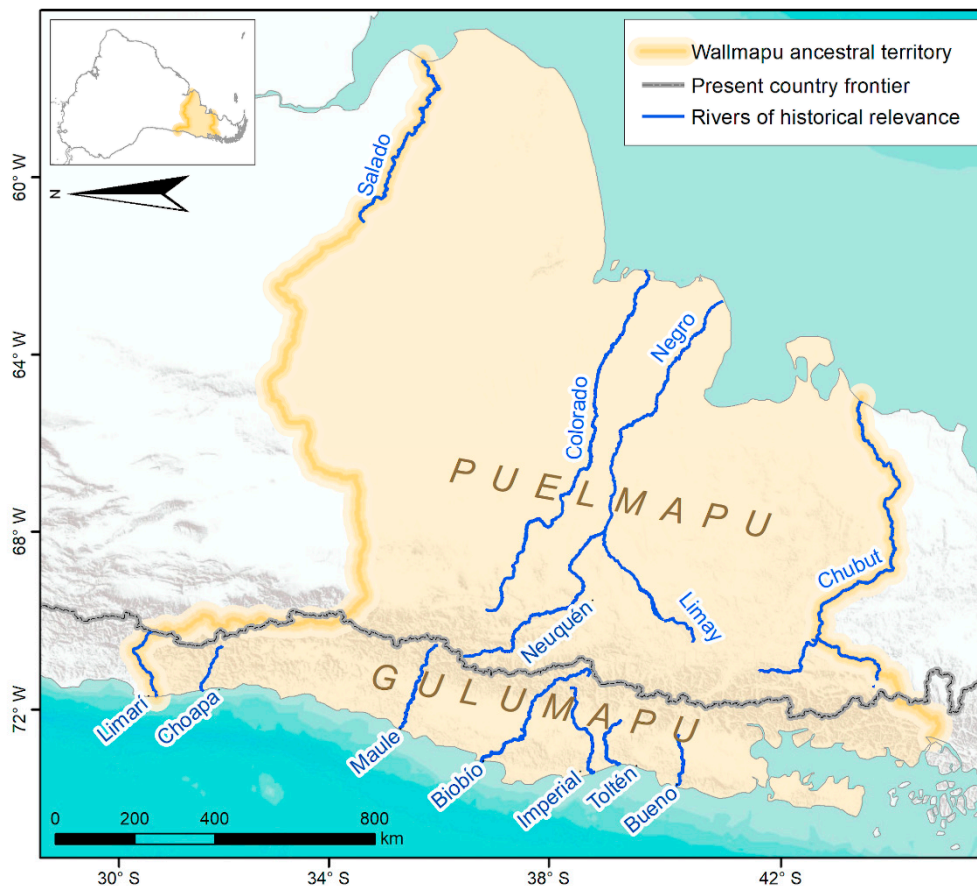
Mapuche peoples are diverse and historically inhabit lands across southern-most South America, which today is part of Chile and Argentina. Their ancestral territory, denominated *Wallmapu* [38], is broadly composed of *Gulumapu*, the land of the west of the Andes and *Puelmapu*, the land of the east. However, there are other territorial definitions as well, and multiple Mapuche identities which have co-evolved and adapted to the territory that they inhabit. To mention a few, people living in the Andes, specifically the upper Biobío River, identify as *Pewenche*, those living along the Pacific Coast as *Lafkenche*; in the southern limit of their territory live the *Williche* and those living east of the Andes identify as *Puelche*.

People who self-identify as indigenous compose 12.4% of Chile’s population and in 2.4% of Argentina. From Chile’s total indigenous population, 83.8% identify as Mapuche [39]; in the case of Argentina 18.9% identify as Mapuche [40]. They are the most numerous indigenous group in both countries and one of the most numerous and diverse in Latin America. Their identity was recognized very early by European colonizers as they were the only indigenous peoples who were not defeated by the Spanish invasion [41]. Their legacy and living culture is evidenced through the abundant toponyms present throughout Wallmapu, as well as through the diverse linguistic vitality throughout the territory [42–45].

According to Ñanculef Huaiquino [34], *Mapun kimiün* (knowledge of the Mapuche) is essentially pragmatic. “We don’t learn ‘how to do things’, we simply learn ‘to do things’”. This learning by doing, based on observation as a conscious process, doesn’t condition ways of thinking, feeling and acting of the educated; instead the individual learns and recreates knowledge from reality itself.

Decolonizing approaches have pushed for the depiction of cartography in a sense that is representative of the Mapuche world vision (Figure 1). First, placing the cardinal orientation to the east, which is where the sun rises and serves as orientation for the Mapuche world in general [46], and moreover, incorporating the concept of *xawümen* to indicate the delimitation of places (*xawüin* means gathering). In contrast with the concept of frontier, which deals with the separation and division of land, *xawümen* is associated with meeting, encounter and union of parts [47]. There is a

consciousness that any delimitation, whether precise or referential, is more a transition between lands and peoples rather than a strict division.



**Figure 1.** Wallmapu Ancestral Territory. The boundary of Wallmapu ancestral territory is depicted as a blurred line to represent the Mapuche concept *xawümen* (place of encounter), which is distinct from frontier (place of separation). The rivers displayed were historically places of encounter with other indigenous peoples or constituted frontiers in treaties with the colonizers. Source: own elaboration with cartographic reference of Wallmapu *xawümen* from Simón Crisóstomo Loncopán.

Before the independence of Chile and Argentina as independent republics, the Mapuche constituted a society without state, and governed themselves according to tradition or customary law, *Az Mapu* [33]. Despite current widespread negative stereotypes of Mapuche [48], there is ample evidence that in pre-colonial times they were a rich society and sustained historical commercial and diplomatic relations with other indigenous peoples, and later, with the Spanish colonizers [49]. In fact, they developed a series of treaties to establish and respect territorial autonomy. Once Chile and Argentina became independent republics, their respective governments pushed for territorial sovereignty, disregarded previous treaties and led violent campaigns to occupy Mapuche territories and exterminate their people [50].

Even though both Chile and Argentina adhere to the UN Declaration on the Rights of Indigenous Peoples and the ILO 169 Convention (since 2009 and 2000 respectively), there is evidence of the poor performance of the states to comply with what is compromised by international law [51–53]. This gap between what is written and what occurs in reality is not specific to Chile or Argentina, and happens also in other Latin American countries that have committed to safeguarding indigenous peoples' rights.

The aim of this study was conducting a literature review and a bibliometric analysis to elucidate the focus of academic endeavors and improve understanding on the way that scientific research has

been conducted. The main research question was: What are the characteristics of the scientific literature in the field of research related to Mapuche peoples and Wallmapu?

A broader goal was to serve as a stepping stone on the road towards knowledge dialogue between scientific disciplines and knowledge held by Mapuche. This work intends to be a contribution from the scientific tributary of knowledge, and is not necessarily extensive or inclusive of everything that has been published (beyond the scientific realm of literature) from and about Mapuche and their territory.

Still, we believe this analysis of the scientific literature to be a valuable input for future research in this field, because a review has not been carried out before, and because the application of the bibliometric tool chosen opens the debate for epistemological considerations resulting from this type of analysis.

## 2. Materials and Methods

The general procedure (Figure 2) started with data collection through scientific literature search, review and selection. Two sets of data were created: one containing all records from Web of Science (*WoS*) and *SciELO*, indexing in a database which was thoroughly debugged to eliminate duplicate items and ensure homogeneity; the second set was downloaded in plain text format for processing with CiteSpace software, and included only *WoS* items.

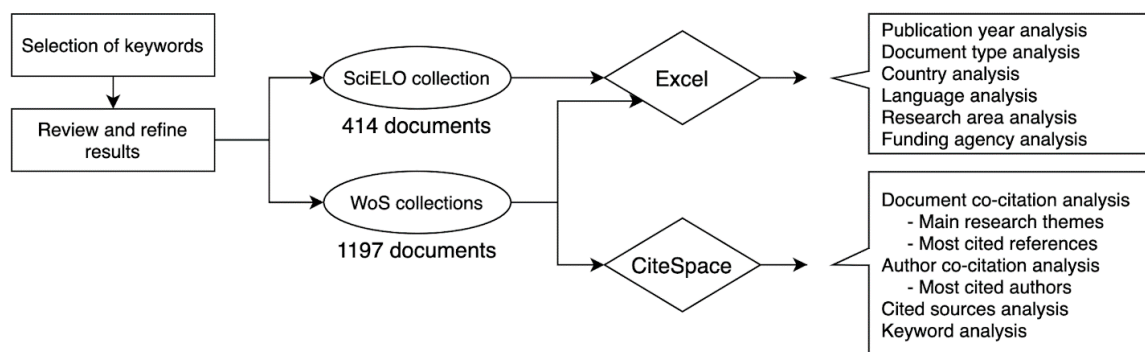


Figure 2. Flowchart of Bibliometric Procedure.

### 2.1. Data Collection

The data collection considered all documents found on the ISI Web of Science portal from 1975 to 2020. This search engine includes the following collections and citation indexes:

- Science Citation Index Expanded (1975–present)
- Social Sciences Citation Index (1975–present)
- Arts and Humanities Citation Index (1975–present)
- Book Citation Index—Science (2005–present)
- Book Citation Index—Social Sciences and Humanities (2005–present)
- Emerging Sources Citation Index (2015–present)

The search formula employed includes multiple identity denominations in order to capture the diversity of experiences in different geographical areas within Wallmapu (Figure 1). Using the same formula, the *SciELO* Indexed Collection was also consulted, which holds records from 2002 until 6 present.

The formula used contained the following terms and Boolean operators: “Mapuche” OR “Wallmapu” OR “Gulupmapu” OR “Puelmapu” OR “Lafkenche” OR “Lafquenche” OR “Williche” OR “Huilliche” OR “Pewenche” OR “Pehuenche” OR “Puelche” OR “Nagche” OR “Wenteche” OR “Huenteche” OR “Pikumche” OR “Pikunche.”

The results from each search were downloaded (data retrieval time: 11:15, 14 May 2020) and a joint database was built to process all the results in Microsoft Excel. We reviewed the joint database to



classify documents as belonging to *WoS* or *SciELO* or both. Documents present in both databases were analyzed together with *WoS* results, as these can be processed with CiteSpace software. References from *SciELO* were only processed in the first step of analysis, because CiteSpace does not support this collection download format.

Additional information was obtained from *WoS* portal, for example, the main research discipline and country of publication. Each document may be listed under more than one research discipline; for this analysis, we considered the first research discipline as representative of the document's content. With regard to the countries associated to a publication, the *WoS* portal indicates the countries of the institutions that the authors are affiliated to. Therefore, each document may have organizations from more than one country affiliated. Moreover, the country of the institution does not necessarily equal the country or nationality of the authors. Still, this is a representative enough depiction of the geographical distribution of authors.

## 2.2. Bibliometric Analysis

A scientometric analysis was conducted using CiteSpace version 5.6.R5. Bibliometrics is a branch of statistical applications concerned with the analysis of information contained in published literature. More specifically, scientometrics is concerned with the quantitative features of a scientific research field. Mapping or visualizing the scientific landscape is a way to identify main themes, pivotal publications or authors, and to understand the relationship between them [54,55]. CiteSpace creates visualizations of these networks and, through an interactive interphase, researchers can build and analyze the landscape of the knowledge domain in that field of research.

Co-citation means that two documents are cited together in a publication, which indicates the degree of association between the cited documents [56]. The more co-citations that a set of documents receive, the more likely that they are semantically related. Two main techniques were applied to the data collected. First, document co-citation analysis (DCA) allows one to identify documents that have been recognized by peers through citation. Each document constitutes a node and the links represent co-citation relationships. Second is the author co-citation analysis (ACA), where nodes represent authors connected through co-citation links.

The DCA and ACA allow clustering the network into recurring themes or conceptual hotspots. The nature of a cluster depends on the documents composing it, the connectedness between them and with documents in other clusters. Clusters are labeled based on top key terms. CiteSpace determines a hierarchy of key terms through different algorithms. The optimal labeling algorithm is the LLR (log-likelihood ratio), because it captures the uniqueness of the cluster [57]. However, we also considered the LSI (latent semantic index) and MI (mutual information) algorithm, because they capture other frequent terms in the cluster.

The results from both DCA and ACA can be represented through two visualizations: the network layout and a timeline layout. The first shows the structure of the network, i.e., the distribution of nodes and where they are located with respect to one another. The timeline visualization distributes the nodes and co-citation links along a temporal axis. This allows one to understand the temporal extent and density of co-citation links in times. In the case of DCA, when the network has been clustered, the nodes are placed within each cluster, which allows one to observe the evolution of research themes in time.

To run the DCA and ACA, two important parameters were defined: the selection criteria for nodes and look back time. The selection criteria used was the *g*-index [58], which quantifies scientific productivity, and is defined such that most-cited articles stand out. The *g*-index was set at 30. Look back time was set to 8 years. This tells the software to examine the cited references of each document and consider references from up to 8 years ago. Both parameters were chosen after iterative runs to find the optimal combination of silhouette and modularity values. Silhouette and modularity are structural metrics that indicate the correct configuration of a network. The following structural and temporal metrics allow validation and reliable interpretation of the results from a bibliometric analysis:

### 2.3. Temporal and Structural Metrics

**Burstness:** The only temporal metric considered and signifies an increase in the citation count of a document in a short period of time, which indicates the sudden interest from the peer community [59]. The software reports the strength of the burst, the starting year and the duration. Similar to total citation count, this metric is susceptible to self-citation.

**Betweenness centrality [60,61]** is a structural metric of the extent to which a node is located in the path between two or more nodes. A node with high centrality connects two or more groups of nodes, indicating that it has a high impact in the field of research and is “potentially revolutionary” [57]. In contrast to citation count, centrality indicates the structural relevance of a node in the network as a whole.

**Frequency:** This hierarchy measure was employed specifically for keyword analysis [62] and journals with most publications, as in other similar studies [63–65]. Relevant keywords were extracted from titles, abstract and list of keywords. The analysis was conducted for three time periods (1975–1994; 1995–2009; 2010–2020), which were determined based on historical landmarks in Chile and Argentina, specifically the legal recognition of indigenous peoples and implementation of the ILO 169 Convention. The statistical relevance of these time periods was corroborated through the slope inflection, from total publications curve and the yearly publications curve [63].

**Average silhouette width (ASW, range = −1–1)** evaluates how homogeneous a cluster is based on the ration of within-cluster and between-cluster distance [66]. Values closer to 1 show high precision in clustering, a value close to 0 indicates that items may be shared by two clusters, negative values suggest inappropriate clustering. Reasonable values are above 0.7.

**Modularity (Q, range = 0–1)** measures how well a network can be broken down into discrete clusters or modules [67]. Values closer to 1 indicate a clear decomposition into unique clusters.

To ensure a good interpretation of results, a balance should be found between Q and ASW. A high ASW by itself is not necessarily good. For example, if a cluster is too small, it is possible that all documents are citing one single reference, which reduces its overall reliability [57].

## 3. Results

A total of 1611 documents were found, dating from 1975 to present (Table 1). From these, 414 were unique to the *SciELO* Collection, 894 were unique to the *WoS* Collections, and 303 were common to both bibliographic databases. Documents present in both collections were analyzed together with *WoS* results (total of 1197).

**Table 1.** Distribution of documents found.

Collection	Total Documents	Time Interval	Highest Citation Per Year	Average Citation Per Year
<i>SciELO</i>	414	2002–2020	5.5	0.4
Both collections	303	1975–2020	5.5	0.5
<i>WoS</i>	894	1975–2020	26.3	0.9
Total	1611			

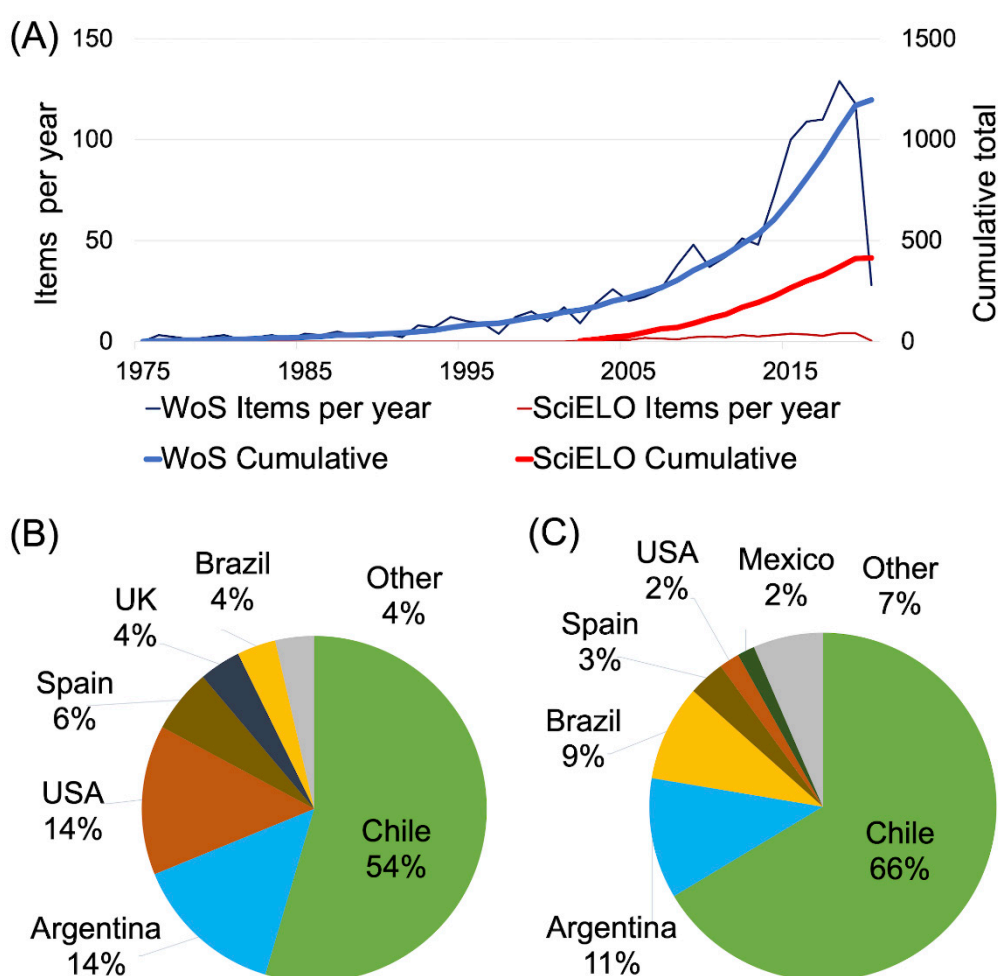
Most documents published were scientific articles: 81.5% in *WoS* Collections and 91.3% in *SciELO* (Table 2). The second most frequent type in *WoS* were book reviews (7.7%), and in *SciELO*, literature reviews (3.9%). *WoS* Collections included literature formats other than traditional scientific formats, such as book chapters (35 items) proceedings papers (21 items), letters (4 items) and even poetry (1 item).

**Table 2.** Types of documents found in each dataset.

Document Type	WoS	% from 1197	SciELO	% from 414
Article	976	81.5%	378	91.3%
Book Review	92	7.7%	4	1.0%
Review	21	1.8%	16	3.9%
Editorial Material	15	1.3%	6	1.4%
Other (*)	93	7.8%	10	2.4%

Note: \* Other types of documents include book chapters, book reviews, case study reports, commentaries, letters, poetry, proceedings papers and short communications.

The rate of accumulation was steady (Figure 3A), the yearly change was, on average, by a factor of 1.3. There was no particular year when the number of published documents increased drastically, rather it was a sustained exponential growth. More marked accumulation is seen since early 1990s.



**Figure 3.** (A) Temporal Distribution of Documents and Publishing Countries in (B) WoS and (C) SciELO.

The countries with most publications were Chile and Argentina, representing 68% of WoS (Figure 3B) and 77% of SciELO results (Figure 3C). Other countries with less participation were Brazil, Spain and USA. A similar pattern was seen through the languages of publications (Table 3), where most documents were published in Spanish, 50.0% of WoS results and 97.1% of documents in SciELO results.



**Table 3.** Language of Documents Published.

Language	WoS	% from 1197	SciELO	% from 414
English	598	50.0%	8	1.9%
Spanish	560	46.8%	402	97.1%
French	16	1.3%	0	
Portuguese	12	1.0%	4	1.0%
German	10	0.8%	0	

Table 4 shows the top 20 research disciplines most frequently listed in published documents in *WoS* and *SciELO*. The majority are social science disciplines, and very few (highlighted) are from the natural and physical sciences.

**Table 4.** Top 20 Research Disciplines of Documents Published in *WoS* and *SciELO*.

WoS				SciELO		
Rank	Research Discipline	Items	% from 1197	Research Discipline	Items	% from 414
1	Anthropology	180	15.0%	Anthropology	98	23.7%
2	Arts and Humanities	100	8.4%	Educational Research	56	13.5%
3	History	77	6.4%	Arts and Humanities	55	13.3%
4	Linguistics	65	5.4%	Sociology	32	7.7%
5	Literature	63	5.3%	Linguistics	28	6.8%
6	Social Sciences	54	4.5%	History	19	4.6%
7	General and Internal Medicine	46	3.8%	Psychology	13	3.1%
8	Area Studies	45	3.8%	Dentistry	12	2.9%
9	Psychology	36	3.0%	Nutrition and Dietetics	10	2.4%
10	<b>Plant Sciences</b>	30	2.5%	Nursing	7	1.7%
11	<b>Biodiversity and Conservation</b>	29	2.4%	Government and Law	6	1.4%
12	<b>Environmental Sciences and Ecology</b>	29	2.4%	Anatomy and Morphology	5	1.2%
13	Government and Law	25	2.1%	Philosophy	5	1.2%
14	Educational Research	24	2.0%	Business and Economics	5	1.2%
15	Geography	24	2.0%	Pediatrics	5	1.2%
16	Integrative and Complementary Medicine	21	1.8%	Zoology	4	1.0%
17	Zoology	21	1.8%	Geology	4	1.0%
18	Sociology	18	1.5%	Women's Studies	4	1.0%
19	Communication	17	1.4%	Literature	3	0.7%
20	Public, Environmental and Occupational Health	16	1.3%	Social Sciences	3	0.7%

Note: Disciplines in bold are in the area of the natural and environmental sciences.

Journals concentrating on most publications were mostly focused on social sciences, arts and humanities (Tables 5 and 6). A noteworthy exception is *Revista Médica de Chile*, which publishes works related to topics of medical interest. Furthermore, *Journal of Ethnobiology and Ethnomedicine* and *Journal of Ethnopharmacology* gather publications on plant sciences and biodiversity. Other important journals are *Chungará*, *Estudios Filológicos*, *Alpha* and *Polis*, all published by Chilean universities and covering topics related to education, linguistics, history and anthropology.

**Table 5.** Journals with more than 10 documents published (WoS collections).

Source Tile (City or Country)	Items	% From 1197
<i>Revista Médica de Chile</i> (Santiago, Chile)	41	3.4%
<i>Chungará</i> (Arica)	35	2.9%
<i>Estudios Filológicos</i> (Valdivia, Chile)	34	2.8%
<i>Alpha</i> (Osorno, Chile)	33	2.8%
<i>Atenea</i> (Concepción, Chile)	17	1.4%
<i>Boletín Latinoamericano y del Caribe de Plantas Medicinales y Aromáticas</i> (Santiago, Chile)	16	1.3%
<i>CUHSO</i> (Temuco, Chile) *	16	1.3%
<i>Historia</i> (Santiago, Chile)	14	1.2%
<i>Journal of Ethnobiology and Ethnomedicine</i> (London, UK)	14	1.2%
<i>Journal of Ethnopharmacology</i> (Clare, Ireland)	14	1.2%
<i>Revista Chilena de Literatura</i> (Santiago, Chile)	12	1.0%
<i>Anthropos</i> (Baden, Germany)	11	0.9%
<i>Izquierdas</i> (Valdivia, Chile)	11	0.9%
<i>Journal of Latin American Studies</i> (Cambridge, UK)	11	0.9%
<i>Zootaxa</i> (Auckland, New Zealand)	11	0.9%
<i>International Journal of Morphology</i> (Santiago, Chile)	10	0.8%
<i>Revista de Lingüística Teórica y Aplicada</i> (Concepción, Chile)	10	0.8%
<i>Revista Tefros</i> (Río Cuarto, Argentina)	10	0.8%

Note: Journals marked with (\*) indicates indexation in Emerging Sources Citation Index.

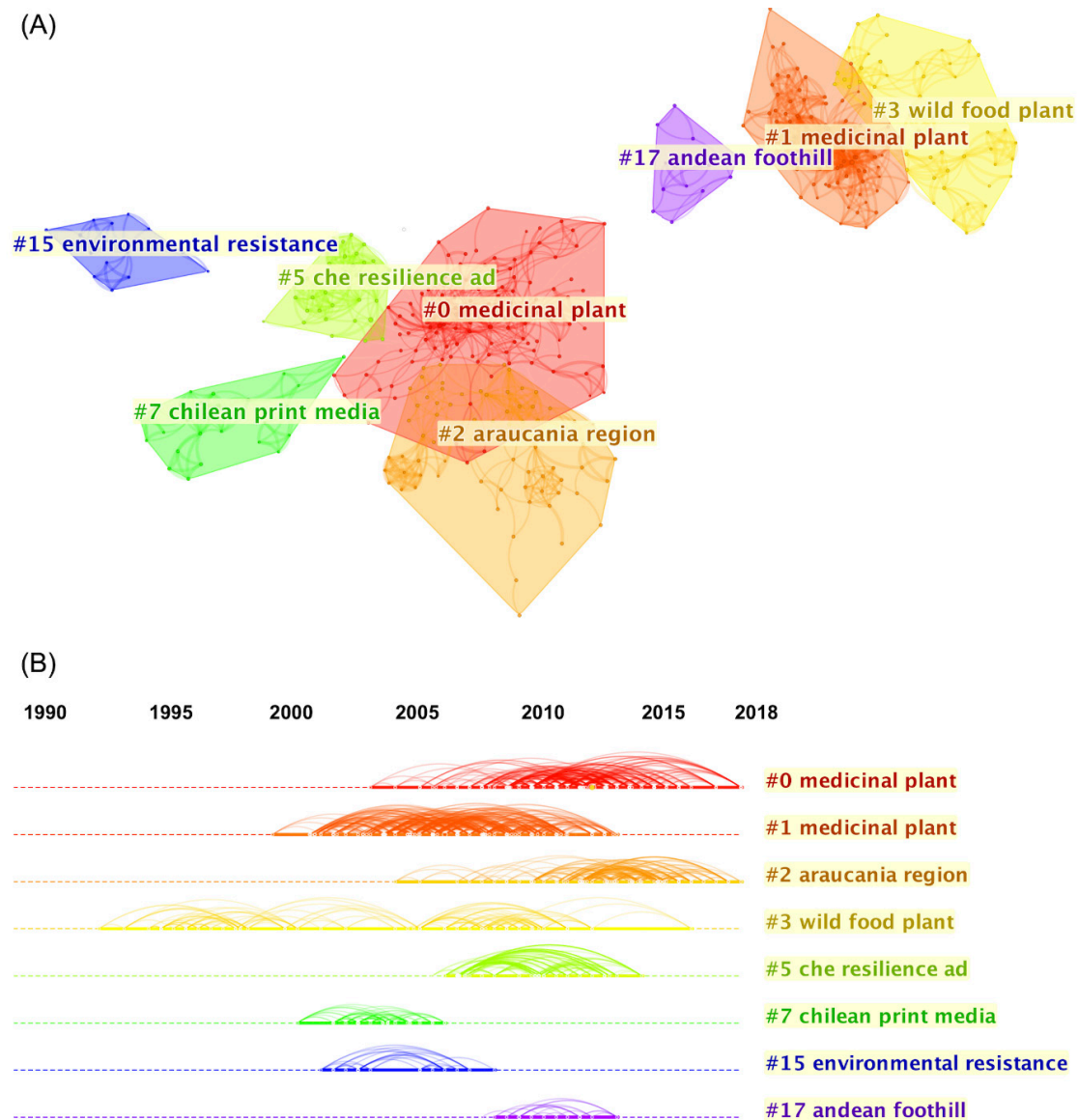
**Table 6.** Journals with more than 10 documents published (SciELO collection).

Source tile (City or Country)	Items	% From 414
<i>Polis</i> (Santiago, Chile)	25	6.0%
<i>Estudios Pedagógicos</i> (Valdivia, Chile)	17	4.1%
<i>Cuadernos de Antropología Social</i> (Buenos Aires, Argentina)	14	3.4%
<i>Papeles de Trabajo - Centro de Estudios Interdisciplinarios en Etnolingüística y Antropología Socio-Cultural</i> (Rosario, Argentina)	13	3.1%
<i>Literatura y Lingüística</i> (Santiago, Chile)	12	2.9%
<i>Universum</i> (Talca, Chile)	12	2.9%
<i>RUNA</i> (Buenos Aires, Argentina)	11	2.7%
<i>Memoria Americana</i> (Buenos Aires, Argentina)	10	2.4%

Qualified records for processing the DCA yielded a network with 1336 nodes (cited references) and 4129 links (co-citations). The modularity (Q) of the network was 0.91 and the average silhouette value was 0.52.

There were fourteen clusters identified in the network. For clarity, we focused on the top eight of them which contained the largest numbers of references and satisfactory silhouette values (>0.8). Figure 4A shows the landscape of the co-citation network with the top eight clusters highlighted through polygons to display overlapping and connectedness between them. The two main clusters (#0 and #1) presented the same log-likelihood ratio (LLR) top term: “medicinal plant,” however, the documents that composed them differed in overall geographical setting, average year and topics covered (Table 7).

The timeline visualization (Figure 4B) shows the emergence and duration of each cluster. The cluster with oldest average year (2002) was #3 “wild food plant,” although it also had the widest temporal spread, from early 1990s to present, showing continued scholarly interest. As seen in the network layout (Figure 5), this cluster was closely related to #1 “medicinal plants” (average year 2006). The most recent cluster was #2 “Araucanía region”, with an average year of 2012, which had some works overlapping with cluster #0 “medicinal plant” (average year 2011).



**Figure 4.** Distribution of cited references in the (A) network layout and (B) timeline visualization. Note: Each node represents a cited reference in the network and the links are co-citation relationships. (A) The top eight largest clusters are displayed through colored polygons and labels represent the top concept identified through the LLR (log-likelihood ratio) algorithm. (B) The timeline view allows to see the temporal distribution and density of co-citations within each cluster, as well as the evolution of research topics. The earliest co-citation links appear when scientific publications start accumulating in the early 1990s (see Figure 3A).

Table 7. Cluster metrics and core terms of the top eight clusters.

ID#	Size	Silhouette	Average Year	Common Terms
0	123	0.823	2011	<b>Medicinal plant</b> , Chile, settler colonial frontier, Mapuche poetry, individual prison cells, linguistic dynamic, oral memory, neoliberal multiculturalism, cultural hegemony, Pewenche knowledge, autonomy, ancestral land, ethnic self-recognition, historical background, Panguipulli forestry, urban Mapuche identity, Williche culture, Lafkenche communities, Lafkenmapu, dispute, dispossession
1	100	0.862	2006	<b>Medicinal plant</b> , Argentina, Patagonia, Bariloche, applied ethnobotany, northwestern Patagonia, use pattern, gathering practice, Patagonian berries, commercialization, Mapuche knowledge, chemosensory perception, cultural transmission, environmental availability, edible underground storage organ, Patagonian steppe, local market
2	73	0.949	2012	<b>Araucanía region</b> , Biobío region, intercultural productive activities, rural Mapuche entrepreneurship program, linguistic dynamic, proficiency levels, sociolinguistic diagnosis, rural school, urban development, Mapuche dispossession, educational knowledge, racial subordination, republican colonialism, cultural pride, traditional educator, disciplinary device, oral memory, taypi chixi, bilingual poetry
3	49	0.958	2002	<b>Wild food plant</b> , foraging strategies, biodiversity, native wild edible plant, seasonal dry forest, local market, conservation strategies, Patagonian berries, aboriginal communities, Brazil
5	38	0.931	2009	<b>The resilience ad</b> , ethnohistory, materiality introduction, Spain, America, Araucanian resilience, Mapuche autonomy, teleoscopic polity Andean patriarchy
7	27	0.98	2003	<b>Chilean print media</b> , political recognition, Mapuche women, neoliberal multiculturalism, Mapuche worker, Chilean state, Chilean elites, intergroup conflict, ethnical prejudice
15	15	0.987	2004	<b>Environmental resistance</b> , Mapudungun, political recognition Mapuche-Williche territory, comparing indigenous language revitalization, te reo Maori, Aotearoa New Zealand, swans
17	13	0.961	2010	<b>Andean foothill</b> , cultural vulnerability, indigenous Mapuche livelihood, Andean temperate ecosystem, Mapuche knowledge, generational change, climate change

Note: The cluster average year refers to the average year of cited references composing a particular cluster. In the column with common terms, the cluster label is shown in bold.

To better comprehend the nature of each cluster, the most frequent and representative terms from the latent semantic index (LSI) algorithm and the mutual information (MI) algorithm were summarized in Table 7. Furthermore, the documents composing each cluster were examined meticulously to find and discuss the uniqueness of the themes they covered.

From the co-citation network, a total of 28 references were detected with strong burstness, or a sudden increase in citation count, indicating interest from the peer community [59]. These top references with the strongest burst scores are shown in Table 8.

**Table 8.** Cited references with the strongest citation burst ranked by burst strength.

References	DOI	Year	Strength	Begin	End	1976–2020
Ladio AH, 2004, BIODIVERS CONSERV, V13, P1153	DOI	2004	11.559	2006	2012	
Estomba D, 2006, J ETHNOPHARMACOL, V103, P109	DOI	2006	11.1213	2008	2014	
Marimán J, 2012, AUTODETERMINACION ID		2012	10.3386	2015	2020	
Ladio A, 2007, J ARID ENVIRON, V69, P695	DOI	2007	8.6836	2009	2015	
Richards P, 2012, J LAT AM STUD, V42, P59	DOI	2010	6.9662	2012	2018	
Bacigalupo A, 2016, THUNDER SHAMAN MAKING		2016	6.8403	2017	2018	
Course M, 2011, INTERPRET CULT NEW		2011	6.365	2012	2018	
Di Giminianni P, 2012, TIERRAS ANCESTRALES		2012	6.2701	2015	2018	
Richards Patricia, 2013, RACE CHILEAN MIRACLE		2013	6.0767	2014	2020	
Zavala JM, 2008, MAPUCHES SIGLO 18 DI		2008	5.9958	2014	2015	
Boccarra G, 2007, VENCEDORES HIST PUEB		2007	5.7936	2013	2015	
Crow J, 2013, MAPUCHE MODERN CHILE		2013	5.3597	2015	2020	
Ladio AH, 2000, HUM ECOL	DOI	2000	5.335	2001	2008	
Bacigalupo AM, 2007, SHAMANS FOYE TREE		2007	4.9046	2008	2015	
Lozada M, 2006, ECON BOT, V60, P374	DOI	2006	4.6056	2009	2014	
Ladio AH, 2009, J ARID ENVIRON, V73, P222	DOI	2009	4.5427	2011	2016	
Ochoa JJ, 2010, B LATINOAM CARIBE PL, V9, P269		2010	4.3237	2012	2015	
Carruthers D, 2009, THIRD WORLD Q, V30, P743	DOI	2009	4.2988	2016	2017	
Bailliet G, 1994, AM J HUM GENET, V55, P27		1994	4.2375	1995	2000	
Molares S, 2009, J ETHNOPHARMACOL, V122, P251	DOI	2009	4.2282	2012	2017	
Molares S, 2008, BOL LATINOAM CARIBE, V7, P149		2008	4.1845	2009	2014	
Ginther C, 1993, EXS, V67, P211		1993	4.1239	1995	2001	
Klubock T, 2014, FRONTERA FORESTS ECO		2014	4.0364	2017	2020	
Dillehay T, 2007, MONUMENTS EMPIRES RE	DOI	2007	4.0237	2010	2013	
Ladio AH, 2011, BIOREMEDIATION		2011	3.9812	2013	2014	
Molares S, 2009, J ETHNOPHARMACOL, V123, P397	DOI	2009	3.9579	2011	2013	
Bacigalupo AM, 2001, VOZ KULTRUN MODERNID		2001	3.8944	2003	2004	
Ezcurra C, 2005, PLANTAS NAHUEL HUAPI		2005	3.8632	2009	2013	

Note: References are presented with the year of publication, as well as the years where the burst began and ended. In the case of research articles, a direct link to the DOI is given. The timeline column shows in dark blue the period since the document publication and in red the duration of the burst.

In the author co-citation analysis, the network was created with 1394 nodes (corresponding to cited authors) and 6605 links (Figure 5). The most frequently cited authors (Table 9) in the network were José Bengoa, Rolf Foerster, Ana Ladio and Guillaume Boccarra. Those with the highest burst strength were Diego Estomba, Ana Ladio, Pablo Marimán and Daniel Quilaqueo. Citation count and burst strength should be esteemed in complement with centrality, which is an indicator of structural relevance in the network. The authors with the highest centrality scores were José Bengoa, Félix de Augusta, Fikret Berkes, Luca Citarella and John Cooper.





**Figure 5.** Author co-citation network. Note: Authors with higher citation counts are shown with proportional circles and larger labels. Centrality is indicative of structural relevance in the network as a whole or within a particular theme or group of themes.

**Table 9.** Most relevant authors in the co-citation network, ranked by citation count.

Author	Citation Count	Centrality	Burst
Bengoa, José	293	0.18	-
Foerster, Rolf	149	0.06	4.15
Ladio, Ana	128	0.03	9.63
Boccara, Guillaume	109	0.05	4.3
Bacigalupo, Ana Mariella	92	0.02	6.76
Pinto, Jorge	91	0.02	7.1
Dillehay, Tom	83	0.02	6.34
Guevara, Tomas	78	0.04	-
<b>Marimán, Pablo</b>	73	0.01	8.64
Richards, Patricia	64	0.01	6.28
Faron, Louis	63	0.04	6.28
Villalobos, Sergio	61	0.02	-
Course, Magnus	54	0.02	-
Bello, Álvaro	53	0.01	5.8
Briones, Claudia	52	0.01	-
<b>Quilaqueo, Daniel</b>	45	0.02	8.28
Estomba, Diego	44	0.01	10.35
Foucault, Michel	44	0.01	-
Grebe, Maria Ester	44	0.04	-
Crow, Joanna	42	0.01	4.47
<b>Marimán, José</b>	39	0.01	7.82
Berkes, Fikret	37	0.1	4.85
Latcham, Ricardo	31	0.07	-
Citarella, Luca	29	0.1	4.6
<b>Coña, Pascual</b>	23	0.06	-
de Augusta, Felix	21	0.14	-
<b>Quintriqueo, Segundo</b>	12	0	4.99

Note: Burst strength shows sudden increase in citation count in a short period of time. Centrality is indicative of structural relevance in the network as a whole; higher centrality indicates a greater degree of connection between different nodes. The authors shown in bold are those who self-identify as Mapuche.

Figure 6 shows a network layout of the sources that were most frequently cited. Cited sources included research articles, as well as books and non-indexed sources which were in the cited references list of the documents analyzed.



**Table 10.** Top 5% of most frequent keywords in each time period.

Keyword	1975–1994			1995–2009			2010–2020		
	Freq	Burst	Cent	Freq	Burst	Cent	Freq	Burst	Cent
Mapuche	2		0.01	41		0.39	213		0.26
Chile				29		0.34	127		0.28
Mapuche community				13	3.93	0.02	45	2.51	0.07
Knowledge				5		0	35		0.09
Medicinal plant	2		0.01	8		0.01	27		0.03
Mapuche people				3		0	26		0.05
Patagonia				15		0.03	25		0.04
Argentina				14		0.15	25	3.84	0.13
Ethnobotany				7		0	25	3.39	0.04
Indigenous people				2		0	25		0.14
Pattern				8	3.03	0.01	24		0.05
Diversity				7		0.14	21	2.83	0.06
Identity				2		0	19		0.05
Politics							19		0.04
Children	3		0.06	8		0.02	14		0.04
Environment	2						14	4.82	0.01
Territory							14	2.78	0.01
Conservation				6		0.06	12	2.6	0.02
Education							12	3.22	0.02
Aboriginal community				1		0	11	2.51	0.02
Memory							11	3.03	0.01
Population	2		0	6		0.06	10		0.03
Ethnic group	1			6		0.05	9		0.03
Amerindian	1		0	9		0.06	7		0.02
Epidemiology	2			7		0.04	4		0.01
Gender				5		0.01	4		0
Evolution				5		0.05	2		0
Indian	1		0	13		0.22			
Frequency				5		0.05			
Diagnosis	6		0.02	3		0			
Hypotensive effect	3		0.06						
Indians South American	3		0.01						

Note: Keywords are ranked by the frequency of the 2010–2020 period.

#### 4. Discussion

The goal of this work took into account the fact that it was not possible to cover everything that has been published from and about Mapuche peoples and Wallmapu. Nonetheless, a thorough revision and analysis of the published scientific research had not been conducted before on this field of research.

The principal conceptual hotspot elucidated was centered around historical and political aspects of the relationship between Mapuche and the state. A second hotspot was composed by ethnobotanical studies. Finally, a strong connection between Mapuche social movement and pressure on Earth's living systems there stood out. Other important inter-linked topics were efforts for linguistic revitalization; educational research and the role of oral memory; the impact of public policies that promote multi-culturalism; and the stigma constructed around Mapuche. With regards to the authors of published literature, a significant finding, although not surprising, was the low proportion of Mapuche and female researchers, with a few exceptions.

##### 4.1. Overview of Scientific Literature

The majority of documents found in both collections were research articles. Inevitably, non-scientific publications or non-indexed publications were left out. Previous authors researching local knowledge in a similar geographical area (i.e., Gulumapu) indicated the importance of non-indexed publications for building context-specific knowledge that is locally relevant, as well as for setting the basis for initiating knowledge co-production based on traditional and local knowledge [68].

Most importantly, this analysis left out the non-written body of knowledge, which is especially valuable, considering the central role of oral memory for Mapuche [69]. This form of knowledge has been vastly documented in the Mapuche world [33,70]. Historically, written forms of knowledge have been considered superior to oral memory [19]. If we aspire to establish a genuine and horizontal dialogue between knowledge systems, this needs to be considered. Non-written knowledge should be explicitly incorporated for co-constructing solutions to current challenges.

In terms of the temporal distribution of publications, a steady accumulation started markedly around the mid-90s. This could be due to research interests on the effects of the Chilean Indigenous Law N° 19.253 passed in 1993, as well as growing pressures from within the academic structure that demand more publishing. Yearly publications started to increase around 2005, going from 15 publications yearly on average to 50 publications yearly. Since 2015, yearly publications were, on average, 150.

The country associated to each document did not represent the country of origin of authors of publications, but rather the organizations they were affiliated to. Nonetheless, the percentages serve to give an idea of the overall geographical participation. It was expected that most documents were published by scholars in Chilean and Argentinian institutions, because it is these countries that today occupy Wallmapu, and where scholars with these research interests reside.

In relation to the language of publication, *SciELO* held a greater proportion of documents in Spanish in comparison with the *WoS* collections. The large number of documents in Spanish in both collections is extremely valuable. Spanish is most likely the first language of the audience that might find this literature useful. This is increasingly relevant in an era where decolonial perspectives demand critical approaches to conducting research and sharing results. Moreover, in the field of research related more broadly to indigenous peoples globally, increasing attention is being paid to who is doing research, whether they are or not indigenous researchers, what their motivations are [71] and how research is being conducted [72–74].

#### 4.2. Research Disciplines

The research disciplines identified with the strongest interest in this field of research were mostly from the social sciences. In both collections, the most important discipline was anthropology, which has a history of complex relations with colonialism. As the study of peoples and cultures, anthropology evolved as a fruit of encounters between Europeans and the native peoples of the lands where they arrived. Initial anthropological research focused on non-European others and established a lasting relationship between colonizer and colonized. Contemporary anthropology has evolved and made efforts to adapt its theories and methods [74] to avoid epistemological extractivism resulting from traditional anthropology [18]. One example in the literature analyzed incorporated the novel approach of anthropology by demand [70]. This research lens transforms traditional “objects of study” into relational “subjects” with whom researchers interacted, in part, directing research to the subjects’ specific needs and demands.

Another observation was that *WoS* database contained more documents from natural sciences. Greater interest on indigenous peoples has historically come from the social sciences. However, there is mounting evidence of the depth and value of knowledge held by indigenous peoples, concerning biological, astronomical, geophysical and environmental aspects of our world [75]. Research disciplines from the natural sciences are increasingly looking to collaborate with indigenous knowledge holders. This tendency has been powered by the coupling of environmental protection interests and social movements for reclaiming ancestral territories and achieving self-determination [4]. Research interest from these disciplines is likely to continue to increase, especially as world organizations and scientists have pointed to how much of Earth’s living systems are currently on lands that are owned, managed or occupied by indigenous people [29,30].

Beyond current existing disciplines, true knowledge dialogue in line with decolonial perspectives, will require openness to emerging research categories, which shall be own to indigenous epistemologies. These should consider unique “disciplines”, objects of knowledge [76], logics of knowledge



construction [77] and distinct learning and teaching methodologies [78]. Overcoming traditional categories from Western scientific thought and reclaiming new meanings should be part of the decolonial process.

#### 4.3. Main Publishing Journals

The top publishing journal identified in the WoS Collection was *Revista Médica de Chile*, published monthly since 1872 by the Sociedad Médica de Santiago. This journal had 41 items published related with Mapuche, which covered a wide array of topics of medical interest, such as anatomical research [79], genetic studies [80], intercultural health [81], reproductive characteristics [82] or the incidence of particular illnesses on Mapuche populations [83,84].

Following that were the journals *Chungará*, *Estudios Filológicos* and *Alpha*, with 35, 34 and 33 documents, respectively. *Chungará* is one of the earliest social science journals in Chile, founded in 1972, and focuses on anthropology and archeology, as well as associated social sciences. Today, it publishes two issues per volume annually by the Universidad de Tarapacá (Arica, Chile). The most cited works from this journal included research on the consolidation of the field of intercultural health [85], epistemological aspects of intercultural education [86], reproductive and pregnancy beliefs [87], and the configuration of identity in relation to water and other landscape features [88]. There are also contributions from the historic genetic perspective to inform readers on the ethnogenesis of indigenous peoples in Chile [89].

The journal *Estudios Filológicos* is published every semester by the Universidad Austral de Chile (Valdivia, Chile). It focuses on studies about language, linguistics and literature, especially about Spanish and Hispanic-American literature. 40% of the publications from this journal were by author Hugo Carrasco Muñoz. He has dedicated a great part of his research to features in Mapuche discourse related to indigenous identity and inter-culturality, for example, through university students' public discourse [90] or through the analysis of Mapuche poetry [91]. His work also examined the way that "intercultural" communication has been used as an instrument to improve insertion and acculturation of Mapuche into dominant Chilean society [92].

*Alpha* is a journal published bi-annually by the Universidad Los Lagos (Osorno, Chile) focused on arts and humanities. Some of the most cited works published in these journals were in the area of linguistics [93–95], intercultural communication [96] and intercultural education [97].

In the *SciELO* Collection, the journal with the most publications was *Polis*, with 25 items. *Polis* is an open access Latin American journal published every four months, and including articles of multiple social science topics. The most cited work from this journal, with a citation count of 24, six-fold more than the rest of documents, was one presenting the contribution of *kimches* (wise Mapuche elder) to educational knowledge [69]. Another highly cited work was that of Gabriel Pozo [98], which discussed the problem with the concept of "interculturality", its origin as a result of programs and policies promoted after the creation of the Chilean Indigenous Law, and how it has served as a way to cover up state intervention through entrepreneurship subsidies and so-called intercultural education in formal school settings.

#### 4.4. Conceptual Hotspots and Evolution of Research Themes

The development of the research themes identified responds, in part, to the historical trajectory of political events, legal turning points and keystone publications that have directed the course of research interest.

In Gulumapu (today occupied by Chile), we highlight some key historical events and periods which marked the relationship between state and Mapuche. First a constitutional reform to the 1925 Constitution as part of the Agrarian Reform, enacted in 1967 through law N° 16.640. Then, the military dictatorship (1973–1990) aimed to eliminate indigenous peoples from the legal system. After the return to democracy in 1990, came the passing of the Indigenous Law N° 19.253 (1993), the implementation of the ILO 169 Convention in 2009 as part of the approval of numerous human rights treaties [99].



Another key historical consideration was the consolidation of the contemporary Mapuche movement between 1990 and 2002 [100,101].

In Puelmapu (today occupied by Argentina), there were similar historical events, earlier or later. A fundamental legal distinction is that Argentina, unlike Chile, has explicit recognition of indigenous peoples in the Constitution, which was reformed in 1994 [102]. As in Chile, a military dictatorship (1976–1980) had effects in the Mapuche world, and after the return to democracy, the State responded in 1985 to some of the demands for recognition of indigenous peoples with the Law 23 [52]. The enactment of ILO Convention N° 169 happened in 2000, through Law N° 24.071.

As is discussed below, these political and legal turning points in Wallmapu marked the trajectory of events to which contemporary scientific interest responds.

The scientific landscape represented through the network layout and the timeline view was grouped into clusters or groups of documents, which constituted conceptual hotspots or important themes in the field of research. The labels represented the most representative term of the cluster, although its uniqueness was better understood when exploring other frequent terms and the most important citing documents or cited references. The two largest clusters (#0 and #1) shared the label “medicinal plant,” however, they differed in geographical and thematical coverage. The second most frequent term in each one is “Chile” and “Argentina”, respectively.

Cluster #0 was the most central and largest cluster in the network, with 123 items. It covered a broad selection of topics which have been strongly researched in Chile, including language revitalization, rural and urban Mapuche identity, medical topics, Mapuche knowledge and intercultural education. Although ethnobotanical research was also covered, it was not the strongest theme in this cluster. Some of the documents in this cluster were shared with other clusters, especially #2 “Araucanía” and #5 “che resilience ad”. The strongest theme in cluster #0 was centered on the historical and political aspects of the Mapuche world. Frequent terms indicated the presence of ethnic identities, such as Pewenche, Lafkenche and Williche as well as the importance of Mapudungun language through education and Mapuche poetry.

Several terms in cluster #0 related to the development of the Mapuche movement and Mapuche’s claims for rights, self-determination, recuperation of ancestral territory and conflict with the State. In fact, the most central document in this cluster was Patricia Richards’ work [103], exploring ideas about race, ethnicity and nation. Richards showed how the concept of “multiculturalism” had been implemented in a top-down fashion by the Chilean State on Mapuche territory and communities, while simultaneously validating local elite’s construction of some Mapuche as terrorist. One of works that covered most references in the cluster [104] exposed the stark confrontation between State and Mapuche. The author analyzed the Chilean government’s controversial decision in 2010 to feed, intravenously and against their expressed will, thirty-two Mapuche men who were on hunger strike while imprisoned. This determination sparked debate on the consideration of human rights ethical treatment of inmates, being exposed as yet another form of domination of colonial over colonized [105]. The intervention was deemed as inhuman and transgressing international standards established through the World Medical Association Declaration of Malta on Hunger Strikers adopted first in 1991 [106].

Next in size (100 items) was cluster #1, also labeled “medicinal plant,” which revolved more specifically than cluster #0 around ethnobotanical research. This cluster has been especially pushed forward in Puelmapu (Argentina), as is shown by frequent terms referring to Patagonian steppe ecosystems. The literature contained in this cluster focused on properties and commercialization of local plants, fruits and fungi. The work with highest centrality gave insight about chemosensory perception, nutritional and medicinal value of plants used by a Mapuche community [107]. Research on medicinal plants was also closely linked to the cultural transmission and loss of knowledge about medicinal and edible plants [108–110], and the conservation of ecosystems where they are found [111]. This cluster was intimately linked with cluster #3 labeled “wild food plants.” Cluster #3 was distinct in that it considered more specifically foraging strategies and ecological variables of plant use, such

as plant diversity, search cost, handling time and nutritional content. The publication with highest centrality dealt with these aspects in a Mapuche-Pehuenche community of Neuquén, Argentina [112]. Cluster #3 had the earliest average year, indicating a group of female Argentinian scholars who established pioneer and steady research interest around medicinal plants, collection methods and cultural transmission of this knowledge. Notably, this cluster contains some documents referring to research in Brazil, where there has been strong research development in ethnobotany and indigenous knowledge on biodiversity.

The third largest (73 items) was cluster #2, labeled “Araucanía region,” which had the most recent average year, 2012. Recurring concepts were “multi-cultural” and “inter-cultural”, which have been strongly pushed forward in Chile since the 1993 Indigenous Law [113]. In the case of Mapuche, these concepts have been a diplomatic expression of state intervention in the indigenous world while not responding or resolving the breaching of their rights [98]. Questioning the concepts of multi- and inter-culturalism is necessary for overcoming the limitations imposed by them on social, legal and institutional arenas. These limitations have to do with the fact that they are descriptive terms that sometimes obscure the relational dimension and perpetuate social inequalities. The use of these terms creates a false illusion of cultural coexistence and validates processes in realms of human interaction such as education, communication and productive activities.

Intercultural education, for example, has been an expression of the State used as a disciplinary device from early childhood in indigenous contexts around the world, and the Mapuche communities are no exception [114]. Similarly, the promotion of intercultural productive activities have introduced business dynamics foreign to Mapuche world [115], both generating opportunities for fighting poverty, but also creating challenges related to the collision of cultural values and Mapuche identity recognition.

In the realm of communication, these terms have served in most regions and countries as an instrument to assimilate ethnic minorities to the dominant culture through systematic education, generally limited to the official language of the country [92]. The most central work in cluster #2 was Hector Nahuelpan’s article on the grey zones emerging from a history of colonial violence and conditions of social marginalization [116].

Following this was cluster #5 “che resilience ad,” centered around historical aspects of the relationship built between the Mapuche and colonizers from Europe and later with the Chilean State. Two of the most central and highly cited works visualized the conflicts, articulation and dynamism emerging from the interphase between Spaniards and Mapuche during the colonial time: the books “Mapuches del Siglo XVIII. Dinámica interétnica y estrategias de Resistencia” [117] and “Los vencedores: Historia del Pueblo Mapuche en la época colonial” [41]. The most cited work was the book “Shamans of the Foye Tree” [118], which conveyed the multiple aspects of the *machi* (shamans) and their paramount role in ritual, social and political contexts.

Cluster #7 “Chilean print media” revolves around the concept of multiculturalism and how the implementation in a neo-liberal context generated profound contradictions. Media has served to consolidate the elite’s point of view of Mapuche and perpetuate negative stereotypes, which largely determines the possibilities for recognition of their rights. Two of the most relevant works in the cluster were Patricia Richard’s work on the portrayal of Mapuche women [119] and Mapuche workers [120] in neo-liberal Chile.

Cluster #15 “environmental resistance” presented the inexorable link between Mapuche socio-cultural resistance and environmental depredation caused by the neoliberal economic model in Chile. This is eloquently presented in the article “Mapuche protest, environmental conflict and social movement linkage in Chile” [121]. The authors provide insight on the way that Mapuche leaders have cultivated links with organizations dedicated to environmental protection and human right activism, as well as with scholars and other indigenous groups. This finding was consistent with contemporary global attention on indigenous knowledge as a result of the connection identified between development and environmental conservation [4]. The work with both highest centrality and citation count in this

cluster was the book “Neoliberal Economics, Democratic Transition, and Mapuche Demands for Rights in Chile” [122].

One interesting aspect of cluster #15 was the appearance of terms related to Maori people: their push for rights recognition and language revitalization in New Zealand has served as inspiration for local Mapuche efforts [123]. Another group of terms pointed to the environmental disaster in the Carlos Anwandter Sanctuary, located in Mapuche-Williche territory, today Valdivia province, in Southern Chile [124]. This sanctuary is a wetland recognized internationally by the RAMSAR convention. It gained much attention after contamination from a pulp mill in the Cruces River, which sustains the wetland, generated massive death and the disappearance of emblematic black-necked swans [125].

Clusters #7 and #15 reflected research interest in response of the effects of the implementation of Indigenous Law in Chile. Some principal effects of this law in a neo-liberal context were the folklorization of multiculturalism and the demonstration of conspicuous inter-relation between indigenous movements and environmental protection. These clusters also showed the receptivity of particular scholars and of academic institutions to tackle and account for the concrete problems of Wallmapu.

Finally, cluster #17 linked documents belonging to clusters #0 and #1, both in the network layout and geographically speaking. The label refers to a particular ecosystem: the “Andean foothills”, indicative of how central these ecosystems are to Mapuche geography and communities’ livelihoods. This group of publications referred to climate change and impacts on ecosystems and how this leads to cultural vulnerability [126]. Together with climate change, another threat to Mapuche livelihoods are cultural and physical restrictions imposed on knowledge inter-generational transmission. For example, the article “How can we teach our children if we cannot access the forest? Generational change in Mapuche knowledge of wild edible plants in Andean temperate ecosystems of Chile” [127]. This work exposed how younger generations were not being able to acquire traditional knowledge due to lack of access to the forest and exposition to formal school regime. The two most frequently cited works were the books “Las razones del illkun/enojo. Memoria, despojo y criminalización en el territorio Mapuche de Malleco” [128] and “Sacred Ecology” [75].

#### 4.5. Pivotal Works

Burstness indicates the sudden increase in citation count during a relatively short period of time [59]. In other words, it shows which references have captured significant interest from the peer community. Within the citing network, there were twenty-eight references with strong burstness.

Books in this list are all from foreign authors, with the exception of José Marimán [35]. This disparity in representation of Mapuche authors stands out. What structures behind scientific research have led to indigenous voices not being as visible? Why are the most cited authors who write about Mapuche and Wallmapu, not Mapuche themselves? Part of the answer could be the fact that knowledge transmission in the Mapuche world is mostly oral and horizontal. This horizontal logic doesn’t fit well with the hierarchal structure in academia. We contend that research frameworks that admit plural epistemologies [7,17,19] could allow the amplification of indigenous voices, in order to balance representation in the academic field.

Half of the research articles with high burst strength speak of the close connection between Mapuche and Nature. Such is the main message transmitted by Carruthers and Rodriguez [121], who propose that claims of injustice over ancestral land go hand in hand with demands for resource rights and autonomy. The research theme that captured most attention from environmental and natural sciences is ethnobotany. Most of the articles related to this have already been discussed as part of cluster #1.

Our curiosity is sparked around the question of why only plants have been the focus of ethnobiological research. Why not also animals, water bodies, star constellations or other elements of the natural world? This is not to say that there haven’t been authors that have opened the road on such topics. The following studies are part of the knowledge landscape that does not stand out as visibly.

Two early works that provide abundant ethnobiological knowledge are Pedro Armengol Valenzuela's etymological glossary of names of people, animals, plants, rivers and places that have become part of vernacular language in Chile [42] and the testimony of Pascual Coña on the customs and lives of Mapuche [129].

As for contemporary authors, Carolina Villagrán's work on ethnozoology [130] was pioneering in the study of Mapuche names of vertebrates and invertebrates. Lorenzo Aillapán and Ricardo Rozzi have advanced the field of ethno-ornithology [131,132], presenting implications for conservation and environmental philosophy that Mapuche narratives offer. The richness of Mapudungun language has inspired further research in ornithology [133,134], as well as entomology [135]. Some authors have contributed to the comprehension of values and symbolism from a Mapuche perspective that configure the relationship of humans with threatened mammals [136], or with fish and other living beings in continental waters [137].

Physical elements of the landscape which are seen as living beings from the Mapuche perspective have also been researched. For example, Debbie Guerra and Juan Carlos Skewes have studied Mapuche life around lakes [138,139], and the cultural meanings and practices in relation to trees and volcanos [140]. Rivers have also been studied as living beings with whom Mapuche communities construct inter-dependent relations [70]. Finally, there has also been research on Mapuche astronomy and cosmology [141] and traditional knowledge held by Mapuche-Pewenche regarding the connection between star and seasons during the year [142].

These works give insight to the depth and richness of biological and environmental knowledge held by the Mapuche. We suggest that researchers from the natural sciences should cultivate openness to learning from the Mapuche. Co-construction of new knowledge should be marked by efforts to do so in a horizontal fashion. Decolonial approaches and ethical considerations should be at the center of these academic endeavors.

#### 4.6. Most Cited Authors and Sources

The network of author co-citation displays a similar grouping pattern than the reference co-citation network. It is possible to differentiate two large groups: one contains most authors who have published through Chilean institutions, covering research themes in clusters #0, #1, #2, #5, #7 and #15; the second group of authors is composed of authors publishing mostly in Argentinian institutions and covering themes from clusters #1, #3 and #17.

The authors constituting the principal bridges (in terms of being co-cited) between the two groups were Fikret Berkes and Carolina Villagrán. Berkes is a Canadian ecologist who has contributed to the global scientific community by pushing research on the connection between humans and nature, specifically around the term of social-ecological systems [143] and the importance of local and indigenous knowledge for adaptative management [14]. His iconic book "Sacred Ecology" [75] explored knowledge held by indigenous and local communities as knowledge-practice-belief complex composed by resource management systems, social institutions, knowledge and particular worldview. Carolina Villagrán is a Chilean biologist known for her work on biogeography and the origin of Chilean flora. Some of her contributions that were most cited in this network were surrounding ethnobotany [144] and ethnozoology [130].

From the twenty-seven most relevant authors in the co-citation network, it is significant to note that only five of them self-identify as Mapuche, all of whom are men: Pascual Coña, José Marimán, Pablo Marimán, Daniel Quilaqueo and Segundo Quintriqueo. Pascual Coña was a *Lonko* (traditional lead authority) from the Budi lake area (Chile). In the 1920s, he shared his life and the customs of Mapuche peoples with capuchin friar Ernst Wilhelm von Mösbach. Mösbach transcribed the oral biography and knowledge into a unique work in Mapudungun and translated it into Spanish [129]. José Marimán is PhD in political science and has dedicated his research to Mapuche's demands for self-determination and the Chilean elite's reaction. He had a strong burst in citation related to his book "Autodeterminación: Ideas políticas Mapuche en el albor del siglo XXI" [35]. His brother, Pablo

Marimán, is a historian who has investigated the relationship between Mapuche and the Chilean State, the development of the Mapuche movement in the XX century and the formation of Mapuche intellectuals. Daniel Quilaqueo has a PhD in education, and his research focuses on sociology of intercultural societies, Mapuche knowledge and intercultural education. Segundo Quintriqueo also has a PhD in education; his research focuses on intercultural education and the articulation of Mapuche epistemologies into the school curriculum.

Most cited sources included not only research articles, but also books. In fact, some of the most cited sources that stood out were cornerstone books. For example, “La Emergencia Indígena en América Latina” [31], “Historia del Pueblo Mapuche. Siglos XIX y XX” [145] and “Escucha Winka: Cuatro ensayos de historia nacional Mapuche y un epílogo sobre el futuro” [46]. The latter opened a thematic line that translated into a series of emblematic works, including an improved edition of the book in 2019 [146]. This line of academic work gathered a group of intellectuals who identified the need to describe and register history from a Mapuche perspective [147,148]. Many of the intellectuals who have given continuity to this research theme were formed in the Center of Latin American Cultural Studies (CECLA) at Universidad de Chile.

As with the author co-citation network, the distribution of nodes in the cited sources network followed a similar pattern to the reference co-citation network. A group of sources, centered around the book “Historia del Pueblo Mapuche. Siglos XIX y XX”, represented publications associated with historical, social and political themes. There was a second group of sources, exclusively scientific publications, that dealt with ethnobotanical and biological conservation research. A third group of cited sources, although more disaggregated, represented citations of the publications related to medical and anatomical themes. The most important of these sources was *Revista Médica Chilena*.

Finally, the word cloud displays how scholars selected broader terms to categorize their research, such as “Mapuche”, “Chile”, “knowledge”, “ethnobotany”, “Mapuche community”, “indigenous people” and “Patagonia”. These broader terms contrast with algorithmically chosen terms, as those generated to label to network clusters. The latter tended to be more specific and limited to concepts and phrases actually used in the text [57].

The keyword analysis also provided insight into the transition of both academic interest as in similar studies [63,65], but also evidenced the change in academic language used to refer to Mapuche peoples. For example, the descriptive terms used in the first time period were “indian,” “amerindian” and “indians South America”, in contrast to more recent research referring to them as “indigenous peoples” or directly as “Mapuche” and “Mapuche community.” This semantic shift reflects the identity reconfiguration process linked to self-determination movement and the emergence of new voices [149,150]. A transition in topics of scholarly interest was also observed: in the first period, most keywords are related to medical topics (“diagnosis”, “hypotensive effect”, “epidemiology”), whereas in more recent periods, terms indicative of contemporary indigenous movements and self-determination claims (“identity”, “territory”, “memory” and “politics”) and environmentally related terms (“medicinal plant”, “ethnobotany”, “environment” and “conservation”) emerge.

## 5. Conclusions

The results from this bibliometric analysis give an account of the diversity that composes the scientific landscape related to Mapuche and Wallmapu. The method employed allows one to visualize a broad landscape of research themes and the most structurally important authors and works are discussed. Through a visualization and quantification of the current knowledge landscape, the results allow to visualize emerging lines of work, in relation to the self-determination processes that Mapuche live.

This study is relevant to understand what has been the interest of academic research related to Mapuche. The results speak also of what has been left out and shows the requirement to pose new questions: How many Mapuche academics are there out there? How many female voices? Who has been empowered by this academic work? Who is the audience of these publications? Is there a



language barrier, and in what direction(s)? How is this knowledge being transferred or shared with Mapuche communities who have participated in academic studies? In this sense, we believe that the socialization of information should be conducted in the most inclusive fashion possible.

An epistemological approach to the results is necessary: Who and from where are the people writing about these topics? Indigenous peoples of the world have historically been considered objects of study in academic settings. The recent international recognition of their fundamental rights has unchained a paradigm shift. Part of the developing affirmations is their right to refer to their own epistemologies. This poses the challenge for researchers to learn from the existing knowledge from the Mapuche perspective.

Moreover, in the legal realm, it would mean a change in the sources of law and acceptance that indigenous peoples have their own set of rules that need to be respected. Plural epistemologies should translate into legal pluralism and the acceptance of customary law to solve tensions between Western and indigenous lifestyles and worldviews.

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