

Analysing the epistemic consensus of fisheries co-management systems as a formula for democratic innovation and open government

Javier Seijo Villamizar^{a,*}, Antonio García-Allut^b

^a University of Santiago de Compostela (USC), Department of Political Science and Sociology, EqualSeaLab (CRETUS - USC), Spain

^b University of A Coruña, Faculty of Humanities and Sociology, Spain

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ABSTRACT

This research conducts a bibliometric analysis of the term “co-management” in scientific studies published between 1969 and 2021, indexed in the Scopus database. It identifies epistemic consensus, encompassing highly cited works, communities of practice (countries, researchers, and institutions), and theoretical foundations (exemplary narratives and the top ten narratives that explicitly reference the term at the title semantic level). The mixed-methods approach employed a semi systematic algorithm and analyzed 1078 references, demonstrating a significant connection between co-management and its institutionalization in the governance of common goods. The findings highlight its expansion to nearly 100 countries, high interdisciplinarity, epistemological advancements in fisheries co-management cases, and the role of Marine Policy journal as the leading platform for disseminating studies with explicit titles on co-management. Normative attributes (learning processes), epistemic frameworks (interconnected thematic lines), and key authors are analysed, positioning co-management as an interdisciplinary tool for cultural adaptation, collaborative decision-making, open government, co-governance and democratic governance and innovation. As an example of an ideal type among other cases, the term’s development is illustrated through the institutionalized co-management system implemented by the fishing community of Lira, ‘Os Miñarzos,’ in Galicia (NW Spain). Ultimately, this work offers an interpretative model for public decision-makers, researchers, stakeholders, disseminators. Its approach provides a path for the informed analysis of research topics, the systematisation of key information with which to improve decision-making processes and the dissemination of the current state of scientific knowledge.

1. Introduction

Co-management or comanagement (hereafter used interchangeably) constitutes and is viewed worldwide as a tool for the administration and management of fishery resources. The concept emerged and developed in a global community of practice [1–3] and has been defined as a proactive term regarding citizen participation and civic culture [4,5]. Traditionally, the literature associates co-management with the attributes related to interactions and decision-making, participation, networks and adaptive management [6]. These characteristics indicate that the term defines the actors in a socioeconomic context as facilitators—authorities, public servants, interested parties, scientists, academics, users—in the construction of a framework of meaning of public decisions, from the bottom up and based on social, political-administrative and socioeconomic processes [7–9]. Specifically, in the generation of shared decision-making, resilience and

sustainability across forests, fisheries, irrigation systems, pastures, and water resources [10]. All these natural resources are commonly the vehicular objects in the development of co-management and on which a contemporary public agenda has to consolidate good governance and management of the natural environment through adaptive governance models [11] and collaborative governance [12–14].

In the field of definition, the substantive characteristics attributed to co-management, among others, are linked to seven dimensions of good governance—shared power, institutional creation, trust generation, continuous process, social learning, problem-solving, and good or democratic governance [15]. Which insert the idea of civic empowerment in collective action [16–18] and the improvement of the practice of norms into the uses or institutional norms in the communities that manage common goods [19,20]. In this sense, Berkes [21,22] and Armitage et al. [23,24] argue that these dimensions constitute a dynamic institutionalization process based on co-responsibility and trust

* Correspondence to: University of Santiago de Compostela, CRETUS (USC), Spain.

E-mail address: seijo.javier@gmail.com (J.S. Villamizar).

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between actors in the public and private arenas [25]. This instrument with a focus on improving agreements and decisions aims to break down conflicting and/or ideological silos. To guide natural and human resources towards the reduction of uncertainty and vulnerability through collective learning that improves their resilience [26]. Table 1, in this sense, shows exemplary narratives that bring co-management closer to normative ideals for a situation of open government and co-governance.

Co-management, on the other hand, has the civic virtue of providing well-founded meanings to the demands that originate from collective intelligence [38,39]. From this perspective, co-management is presented as a management tool, participatory process, and means of learning for self-organization and the participation of the social majority and inclusive deliberation [40]. In fact, co-management was theorized in 2007 with the express idea of its contribution to collaboration, learning and multilevel governance [21]. Co-management is characterized by entailing a long journey, not only from its antecedents but also through examples of its communities of practice [30] and dialogic communities of learning [41]. This social and institutional practice is associated with the improvement of the governance and management of natural resources [42,43] through the use of traditional or ecological knowledge [44].

The most widespread cases, viewed as demonstrative of a non hegemonic form of government, are referenced to small-scale artisanal fishing [45,46]. However, the use of its philosophy leads to co-management being implemented with protection and management figures such as marine reserves or marine protected areas and in the community management of common goods, the generation of shared learning processes in Indigenous peoples and local communities, among other areas, such as health, technological innovation, and social sciences [6,47,48].

Recently, Gascó-Hermández [49] and Nicandro [50] have associated, using the international alliance for an open government, opportunities for co-government or co-governance with the use and development of good governance tools. From this perspective, co-management is considered both the engine and a valid means for ensuring participation, generating collaboration and ensuring the co-production of innovation policies and services across practice, theory and politics [51,52]. Table 2 illustrates this way of thinking proposed by Armitage et al. [35] and Kar [46]:

Co-management, on the other hand, as a tool available to the government and the public administration, facilitates the enhancement of the international SDGs (Sustainable Development Goals) promoted by the United Nations. In particular, goal 16, of the SDGs, make explicit the basic guidelines of an open government as follows: "Promote peaceful and inclusive societies for sustainable development, facilitate access to justice for all and build effective and inclusive institutional levels that are accountable" [53]. Furthermore, co-management is a tool that can potentially impact directly and indirectly on the facilitation of other SDGs. This vision is explained, for example, in the relationship of co-management with contributions in terms of social, economic, and environmental sustainability [36,37]. Also, among other development goals, the recovery of underwater life - SDG 14 [29]-, poverty reduction - SDG 1 - if environmental and economic sustainability is improved - SDG 2 [31,35]-. Its implementation generates partnerships to achieve common goals - SDG 17 [27]-. It allows for the dissemination of traditional and local knowledge and learning - SDG 4 [34]-.

Co-management, via the democratization paradigm in public

management, is related to a new logic of work and performance of public service and political-administrative management: the government's openness to participation with society and stakeholders in any issue and/or political-administrative process. Therefore, co-management is the expression of an open government and a renewal of the proposals for innovative democratic [54] and integrative governance [55,56] in three dimensions: transparency, participation and accountability [57]¹.

In the scientific paradigms, the idea of co-management and open government is linked to the diversity of scientific disciplines. These have the mission of achieving the democratization of the function of administration and management in the production of knowledge and its scope to transmute action into citizen science [58–61]. The interdisciplinarity and plurality of the themes on the term imply that there is a wide range of connections that show that the co-management tool transcends humanistic science and mixed methods in its operationalization. Its heuristic generates the integration of a constructivist, participatory-transformative episteme together with an abductive construction that emanates from social reality [62,63]. The main goal of this study is to systematise the epistemic consensus and the key attributes of co-management based on the Scopus case between from 1960 up to 2021.

2. Methodology

The methodology used here follows the main literature review proposals made by O'Brien et al. [64], Rousseau et al. [65], utilizing the bibliometric program VOSviewer version 1.6.13 [66], and the Atlas Ti program version 9.0. This form of inquiry has also been used recently to show epistemic consensus in other areas for other terms, such as transparency [67], networksociety [68], gender violence, and gender inequality [69], in express titles that give visibility to an emerging research gap, whether sustained and/or disused in the main literature.

This study aims to disentangle and visualize how part of the world bibliographic literature, with greater dissemination and agreement, achieves a sustained consensus on the topic of fishery co-management and how this consensus is distributed among different world epistemic communities (Fig. 1). The search strategy is generated in three stages. The first step consists of deciding on a search algorithm in Scopus, which aims to determine a sample that combines the visualization of the term and production; thus, we turn to peer-reviewed publications. This is expressed in the analysis of the Table 3 to refer to the associated world production in a bibliometric database. Specifically, Table 3 shows two paths of methodological strategy. The macro approach - a systematic algorithm - a way of systematising an ordered database by linking all documents across all semantic levels - title, abstract and keywords. The micro approach - a semi-systematic algorithm - which associates the document database with one of three semantic levels (Table 4): first level, title (visualisation); second level, abstract (argumentative); and third level, keywords (topic correlation).

The second stage consists of the design and organization of the information. Using the Scopus database, the studies are chosen through the development of a systematization procedure and after debugging the bibliometric variables, and a total sample of 1078 documents and 10 top ten documents that are displayed in their titles is considered both the subject and the most cited literature, from which bibliometric indicators are obtained and compiled in contingency tables [70].

In a third stage, a sample of the documents in Scopus. This criterion

¹ Only 42 percent of the citizens of OECD countries trust their national government, although in some countries, the distrust is greater. The effect of this loss of confidence is the lack of effectiveness of the administration, [...] less compliance with regulations and the tax system; the difficulty of achieving social and political consensus; the reluctance to accept policies that require sacrifice; and the demobilization of citizen commitment to open and inclusive processes ([57], p. 21).

Table 1

The seven dimensions of co-management as a tool for democratic governance and open government.

Dimensions of co-management	Shared power	Institutional creation	Trust generation	Continuous process	Social learning	Trouble shooting	Good governance or democratic governance
Exemplary Case Narratives	Carlsson & Berkes, [27], Jentoft, [28]	Armitage et al. [29], Jentoft et al. [30]	Olsson et al. [31]	Pomeroy & Berkes [32]	Armitage et al. [33], Berkes [34]	Berkes [25], Armitage et al. [35]	Huitema et al. [36], Olsson et al. [37]

Source: Own elaboration

Table 2

Ideal types of co-management systems according to decision-making capacity and delegation of power.

Delegation of power	Decision-making capacity	
	Weak	Strong
Weak	Instructive management	Advisory co-management
Strong	Consultative co-management	Corporative co-management Informative co-management

Source: Own elaboration, based on Armitage et al. [35] and Kar [46]

to two levels. The macro level - all search fields: title, abstract, keywords - and a micro level - selection one of a single semantic search field: title, abstract, keywords. In addition, Table 4 illustrates the connections with Table 2 by indicating the main semantic level that produces and associates the study sample with a search algorithm. This result appears when asking the Scopus database about the level of semantic relevance and/or type of algorithm (systematic or semi-systematic). With this strategy, the references studied are based on the micro level - semi-systematic algorithm - and the sample associated with the titles of the documents is explored, for which a micro analysis is carried out with a semantic relevance: visualisation.²

Fig. 1 implements the methodological strategy through an interpre-

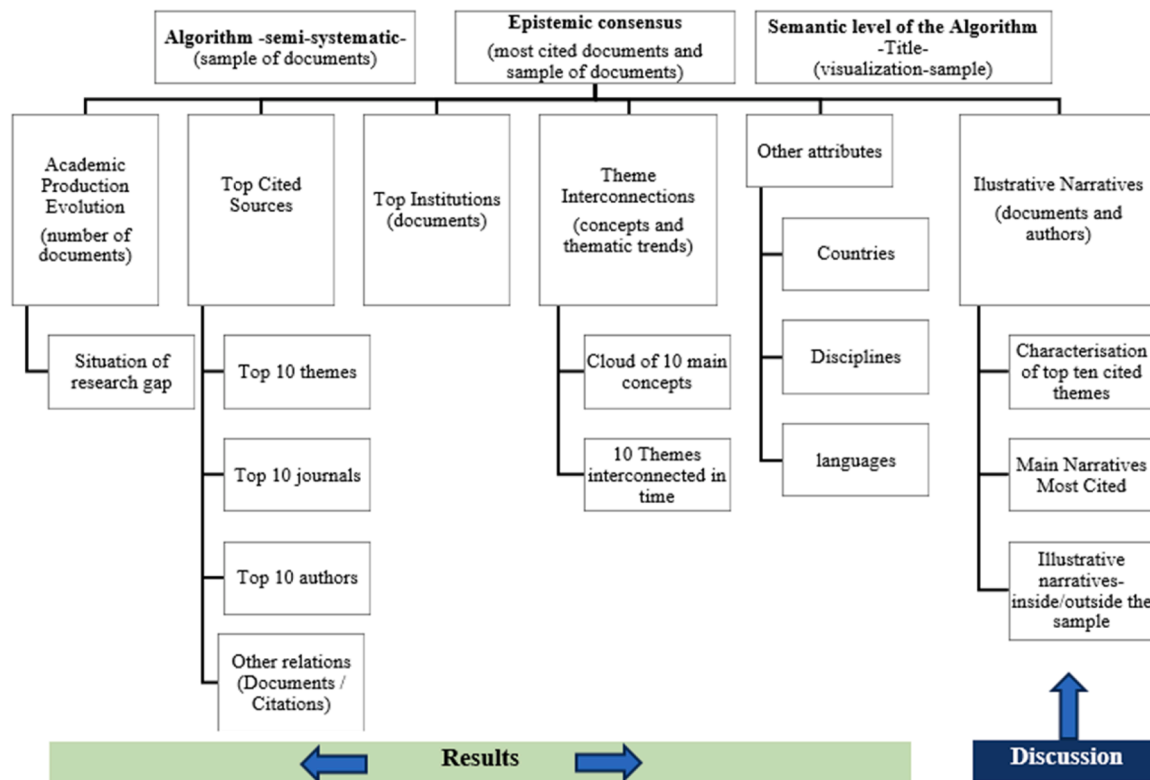


Fig. 1. Interpretative model of epistemic consensus according to research objective³¹

informs how the greatest epistemic consensus has evolved worldwide and how the visualization of this topic is referenced in the main scientific journals with recognized citation criteria (namely Scopus and SJR [71]). The database also identified the most cited authors by country and to know the evolution of bibliometric variables, for example, countries with more tradition in dissemination, the more productive scientific journals with greater citations, the institutions with a high impact on scientific dissemination, and the most cited documents, among others. The analysis is also accompanied by a visualization and frequency mapping of the concepts most associated with the sample of titles (N = 1708).

The Table 4 shows the epistemic consensus search strategy according

tative analytical model. This model connects variables such as categories, their relationships to cases, the most-cited works and exemplary developments both within and beyond the primary sample (Tables 3 and 4). Additionally, it facilitates a structured comparison with the main objective by enabling a dialogue between results and their discussion, supported by evidence. Its purpose is to investigate whether a significant and demonstrable qualitative relationship exists between co-

² The idea of title analysis has been explored in several proposals [96–98], as well as other levels of epistemic consensus at the macro level with a systematic algorithm [95,99].

Table 3
Search strategies by type of algorithm³.

Type of epistemic consensus	Macro vision Systematic algorithm	Micro Vision Semi-systematic algorithm
Total number of documents and search algorithms (sample)	3801 (TITLE-ABS-KEY ("comanagement") OR TITLE-ABS-KEY ("co-management")) AND PUBYEAR < 2022	1077 (TITLE ("comanagement") OR TITLE ("co-management")) AND PUBYEAR < 2022
		2979 (ABS ("comanagement") OR ABS ("co-management")) AND PUBYEAR < 2022
		1796 (KEY ("comanagement") OR KEY ("co-management")) AND PUBYEAR < 2022

^a The macro and micro levels allow us to identify, for the exemplary study base, Scopus, two types of algorithms. This allows us to generate a sample of documents or what the literature in bibliometric review points out as critical cases. González-Laxe et al. [95] defines this methodological approach: ‘To position the social imaginary according to the concept of “epistemic consensus”, it is understood that the total number of documents and the degree of epistemic consensus is reflected by the highest number of citations’, [95], p.3). In relation to their proposal, we extend the interpretative model of epistemic consensus with the variables in Figure 1. Source: Own elaboration from Scopus (04/01/2022)

Table 4
Methodological strategy for document sampling according to semantic level of the search algorithm.

Descriptors	Macro vision Systematic algorithm	Micro Vision Semi-systematic algorithm		
	Title, abstract, and/or keyword	Title	Abstract	Keyword
Semantic relevance of the topic				
Argumentative	✓		✓	
Visualization	✓	✓		
Correlation	✓			✓
N° documents	3801	1078	2979	1796

Source: Own elaboration from Scopus.

management systems and the arguments presented in the documents for establishing categories (e.g. grounded pathways or exemplary narratives) aimed at advancing or strengthening open government, governance, and democratic innovation.

Thus, the results and discussion are structured into five key elements. First, the bibliometric attributes (Tables 5 to 7), which classify journals, institutions, main papers, authors, and prominent topics according to

Table 5
Top ten scientific journals publishing about co-management.

Position	Sources	Total documents	SJR 2020	H index 2022	Country
1st	Marine Policy	79	1,36	95	United Kingdom
2nd	Ecology and Society	40	1,53	141	Canada
3rd	Ocean And Coastal Management	29	0,92	84	United Kingdom
4th	Society and Natural Resources	22	0,82	87	United Kingdom
5th	Journal Of Environmental Management	20	1,44	179	United States
6th	Sustainability	12	0,61	85	Switzerland
7th	Ecological Economics	11	1,92	202	Netherlands
8th	Environmental Management	11	0,89	118	United States
9th	Human Organization	11	0,31	53	United States
10th	Coastal Management	10	0,55	49	United Kingdom

Source: Own elaboration from Scopus

³ This approach consists of categorising social reality by means of a qualitative language that guides quantification or social categorisation [100].

Table 6
Top Ten institutions with high impact on the scientific dissemination of titles with visualization in fisheries co-management.

Position	Institution	N° documents	Country
1st	Brock University	24	Canada
2nd	University of Manitoba	22	Canada
3rd	Stockholm Resilience Center	21	Sweden
4th	Stockholms universitet	19	Sweden
5th	WorldFish	14	20 countries in Asia, Africa and the Pacific
5th	The University of Queensland	14	Australia
6th	James Cook University	13	Australia
7th	The University of British Columbia	12	Canada
8th	State University of Campinas	12	Brazil
9th	Pontifical Catholic University of Chile	12	Chile
10th	ARC Center of Excellence for Coral Reef Studies	12	Australia

Source: Own elaboration from Scopus

citations and/or number of papers. Second, Fig. 2 shows the temporal evolution of research output and status. Third, relationships between the number of authors (1 or 2) and citations (100 citations) are analysed, as well as the 100 most cited papers (Table 8). Fourth, the most frequent concepts are identified (Fig. 2). Fifth, the results are subjected to a reflective and analytical discussion following the interpretative model (Fig. 1). A connection of co-management to ideal types is proposed (Table 9). The establishment of qualitative categories on the degree of epistemic consensus and epistemic proposals of illustrative narratives (ten most cited documents, Table 7, and other exemplary narratives) and interpretations from the three main authors of the study sample (largest number of documents). Complementing the analysis is an internal discussion of the most frequent concepts (top ten) that guide the entire epistemic consensus from the entire study sample (Fig. 3), and which ten themes, among authors, generate a solid interconnection, as a network and evolution over time (Fig. 4).

3. Results

The documents with express titles that include the term co-management are located in 99 countries, and they are related to a total of 160 institutions involved in the visualization and dissemination of co-management. The first reference in Scopus that deals with co-management was developed in 1969, with the article ‘Participation, management and representation of nursing personnel and their professional delegates in the organization of health care’ [72]. In the field of natural resources, according to Berkes [21], there are known references to the term that begin in 1890 with the management of the cod fishery in

Table 7
Top ten documents and authors with titles in co-management until 2021.

Ranking	Author	Title	Journal	Epistemic consensus Citations
1st	Berkes [34]	Evolution of co-management: Role of knowledge generation, bridging organizations and social learning	Journal of Environmental Management	1409
2nd	Olsson et al. [37]	Adaptive comanagement for building resilience in social-ecological systems	Environmental Management	1187
3rd	Armitage et al. [35]	Adaptive co-management for social-ecological complexity	Frontiers in Ecology and the Environment	864
4th	Carlsson and Berkes [27]	Co-management: Concepts and methodological implications	Journal of Environmental Management	731
5th	Armitage et al. [33]	Adaptive co-management and the paradox of learning	Global Environmental Change	663
6th	Huiteima, et al. [36]	Adaptive water governance: Assessing the institutional prescriptions of adaptive (co-) management from a governance perspective and defining a research agenda	Ecology and Society	527
7th	Olsson et al. [31]	Social-ecological transformation for ecosystem management: The development of adaptive co-management of a wetland landscape in southern Sweden	Ecology and Society	502
8th	Armitage et al. [29]	Co-management and the co-production of knowledge: Learning to adapt in Canada's Arctic	Global Environmental Change	470
9th	Jentoft [28]	Fisheries co-management. Delegating government responsibility to fishermen's organizations	Marine Policy	403
10th	Pomeroy and Berkes [32]	Two to tango: The role of government in fishery co-management	Marine Policy	399

Own elaboration from Scopus

the Loffoten Islands (Norway), the agreements of Japanese fisheries in feudal Japan (1901), the communal management in Himalayan communities (1920), the West Bengal agreement for co-management in joint forest administration (1972), the salmon agreement between tribes and fishermen via the Boldt Decision (1970, United States), the agreement of 1975 in northern Quebec's "James Bay", and The New Zealand Conservation Law of 1987 for joint conservation with the Maori community [73], the implementation of sustainability programs from 2003 to 2005, and the 2005 Ecuador Initiative under the United Nations Development

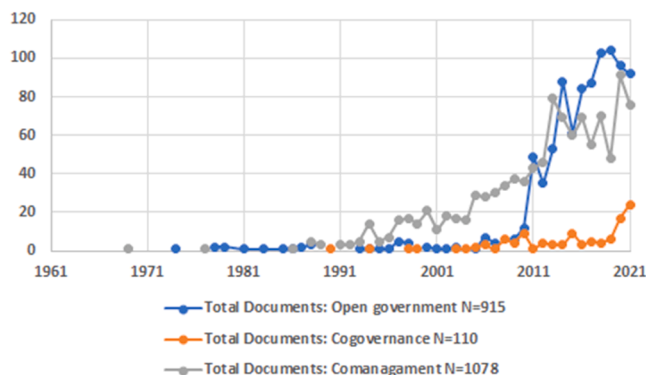


Fig. 2. Evolution of the annual production (number of scientific papers) in co-management, co-governance and open government in the visualization of informative titles. Own elaboration from Scopus.

Table 8
Other epistemic consensus according to papers with co-managed titles -N = 100 most cited articles and N = 1078 articles with 100 citations.

Documents	N°. of documents per author	Total citations	Number of authors
N = 100 most cited*	1	18,143	341
N = 1.078**	1	100	173
N = 1.078**	2	100	92

Source: Own elaboration from Scopus* and VOSviewer**

Table 9
Public co-management as a framework for cultural and institutional integration in public performance.

Management culture	Institutional pluralism of the state	
	Weak	Strong
Weak	Individualistic governance Faulty co-management (centralized, hierarchical)	Hierarchical governance Implicit co-management (informality-legal systems)
Strong	Egalitarian governance Egalitarian co-management (equality before the law)	Participatory and community governance Institutionalized co-management (social justice, equity)

Source: Own elaboration from Seijo [79]

Program (UNDP).

Table 5 summarizes the epistemic consensus trends in the main scientific journals with the greatest impact. Of a total of 703 articles generated in journals, world production places 40.1 % in 282 documents across a total of 13 journals: 79 documents (11,2 %) are published by *Marine Policy*, 40 (5,7 %) by *Ecology and Society* and 29 (4,1 %) in *Ocean and Coastal Management*. Most of these journals are published in the United Kingdom, followed by the United States, Canada, Switzerland and the Netherlands.

The world classification, by country, shows that the topic fisheries co-management is led by the United States, with 340 documents (22,4 % of the total) in scientific production, followed by Canada, with 152 (10 %), the United Kingdom (81; 5,3 %), Australia (78; 5,1 %), Brazil (56; 3,7 %), Germany (42; 2,8 %), Spain (40; 2,6 %), Switzerland (40; 2,6 %), the Netherlands (35; 2,3 %), Norway (31; 2,0 %), Italy and Japan (27; 1,8 % respectively). Fisheries co-management systems have been recognized by the main literature across a total of 11 languages, in

authors.

The term fisheries co-management has emerged in different political systems and societies from 1890 to the present day and has spread to almost a total of 100 geographical points by 2021. The relevant disclosure format is diverse both in terms of the type of documents and the types thereof, as well as in the varied production of knowledge—in 11 languages and a total of 24 disciplines. Overall, the term co-management has followed an evolutionary practice, in motion, bringing it closer to becoming a tool for social and democratic innovation in the visualization literature.

The epistemic consensus format is also illustrated using the scientific journals with the highest citations and is represented with a number between 1 and 10 (Table 7). The most cited article obtains 1409 citations (20 % of the total) and is published in the *Journal of Environmental Management*. Of the nine most cited publications, three journals—*Environmental Management*, *Global Environmental Change and Ecology and Society*—reach a figure of over 1000 citations and account for 50 % of the top ten citations. The two remaining publications, *Frontiers in Ecology and the Environment* and *Marine Policy*, comprise a total of 802 citations, 20 % of the total citations on the most consensual documents. Likewise, the most cited scientific production is temporally located between 1997 and 2011, with a total of 7155 citations.

The 100 most cited articles generate an average number of authors per article of 3.41, and the total number of citations reached is 18,143, located in a range between 1409 for the first-ranked reference and 57 citations for the last. Regarding the total (N = 1078 references). The VOSviewer program calculates that once the publication of an influential document reaches 100 citations in other documents, the authors involved rises to 173; when an author publishes two documents, the number authors is reduced to a total of 92 (Table 8).

The word cloud, Fig. 3, shows a strong association between the term ‘co-management’ and key concepts such as ‘management’, ‘fishery’, ‘community’ and ‘governance’, which appear with greater prominence, indicating their central relevance in the literature analysed. Secondary terms such as ‘resource’, ‘conservation’, ‘policy’, and ‘participation’ reflect the practical, social and environmental dimensions linked to co-management. Similarly, domain-specific words such as ‘marine’, ‘forest’, ‘hospital’, and ‘health’ suggest their interdisciplinary application across sectors and geographical contexts.

In summary, this word cloud illustrates the centrality of co-management in natural and social resource management, highlighting its participatory, adaptive and interdisciplinary character, with a predominant focus on sustainability and collaborative governance across multiple practice areas.

4. Discussion of the epistemic consensus and evidence for democratic innovation⁴

The term that we have found is primarily referred to as co-management [24] is fishery governance; while over its development and practice, it has come to be called adaptive co-management [35,37]. Between 2005 and 2010, the term is connected with a holistic model of management and governance, such as adaptive governance [74]. However, the term is currently linked to co-governance, public innovation and open government. The expression of epistemic consensus among epistemic communities is exemplified by the most cited documents and other exemplary narratives from their learning processes (Fig. 1). In this arrangement, the characteristics by the community of practice of co-management are exemplified as follows:

- *Co-management as a backbone of bridging organizations*: the generation of bridging knowledge between civic organizations—bridging organizations—and the generation of social learning [34]. Co-management is defined as a management tool that involves the sharing of power and the transfer of responsibility across the government, stakeholders and users of local resources. Hence, it considers this an advantageous governance tool for the structuring of shared intelligence across society in public affairs,
- *Co-management and institutional resilience*: Olsson et al. [37] associate the meaning of co-management with institutional and organizational resilience to address the complexity of socioecological systems. They argue that co-management is an adaptive and feedback governance model based on social networks, institutions, scales and levels that generates better information and continuous learning that reduces uncertainty and allows self-organization, facilitated by the rules and incentives that protect public power.
- *Co-management as a model of collaboration*: Armitage et al. [35] argue that co-management is a collaborative method for generating integrated agreements with the following main characteristics: participation between actors—public and private—who propose and negotiate arrangements or norms in the use of an institutional type and innovative arrangements—products of mutual interaction and as a result of social learning, and the monitoring and evaluation of a political-administrative process linking science with politics.
- *Co-management to solve contextual problems*: Carlsson and Berkes [27] consider co-management a process for solving contextual problems and involves the shared power of a community of users. Their proposal concludes that co-management entails a virtuous circle of social learning based on six steps during its development: (a) definition of the complex socioecological system; (b) mapping of management, tasks and problems; (c) definition of the participants and conflict resolution mechanisms; (d) generation of an iterative network across levels, organizations and natural and/or organizational space; (e) evaluation of training needs; and (f) binding consultations for the formulation of public policies.
- *Co-management as a means of improving environmental management*: Armitage et al. [33] propose that improvement in environmental management occurs through adaptive co-management and collaboration and social learning with the purpose of review and self-evaluation via constant feedback, based on a continuous review of the objectives, goals, expectations, participants, risks, results, monitoring and evaluation in a management process.
- *Co-management associated with adaptive management*: Huitema, et al. [36] associate the semantic content of co-management with the idea of adaptive co-management and, from a governance perspective, which allows increasing the global research agenda. Olsson et al. [31] identify the wetlands of southern Sweden as a success case for ecosystem management based on adaptive co-management.
- *Co-management and the co-production of knowledge*: Armitage et al. [21] associate co-management with a framework of knowledge co-production that allows improving institutional performance and adapting knowledge from a natural environment. Jentoft [28] initiates the debate on co-management in fishermen’s organizations and establishes it as a working method of sharing power among the government, administrations and fishermen’s organizations.
- *Gradients of co-management*: Pomeroy and Berkes [32] provide a classification of a gradation of co-management, suggesting a gradual ordering from a more hierarchical to more participatory form of participation and decision-making with the aim of facilitating collaborative self-organization between the state, socioeconomic sectors and public administrations.

⁴ This discussion considers top ten examples from the literature referenced in the sample and, from an illustrative point of view, examples that show normative and prescriptive elements related to the analyzed tool: co-management.

proposed in Table 9, based on the proposal of Jentoft et al. et al. [76] and Hood [77]. An example which has served to disseminate a pioneering case study in Europe was facilitated among an organization of producers (cofradía de Lira, NW of Spain, Galicia) and a Non-Governmental Organization (Lonxanet Foundation for Sustainable Fishing⁵) [78,79].

Fig. 4 shows the thematic consensus of co-management and how it is linked to an interconnected network with several significant nodes, based on the co-occurrence of the main words used by the authors. Specifically, the co-occurrences among the authors are obtained from a total of 2203 concepts and with a threshold of 10 relationships 10 concurrent concepts between documents-, amounting to a total of 34 topics.

The bibliometric network shows seven thematic clusters related to co-management. The clusters in this network cover key approaches related to governance, sustainability and natural resource management. The main cluster ('Co-management') highlights co-management as an essential approach to democratic governance and active participation in common resources. Other clusters, such as 'Fisheries management' and 'Fisheries co-management', emphasise the sustainable management of fisheries and protected areas. The 'Adaptive management' cluster addresses dynamic strategies based on adaptive learning, while 'Community-based management' underlines the importance of social capital and local management. Finally, the 'Resilience and evaluation' cluster explores the relationship between governance, resilience and policy evaluation.

The time gradient (2010–2016) indicates the evolution of the themes in the network. The clusters reflect diverse approaches, such as environmental governance, participation in protected areas, resilience, and social learning. The interconnected nodes underline the interdependence between key terms, highlighting the importance of interdisciplinary collaborations and conceptual evolution in co-management.

The most cited documents with a visualization of the term in their proposals written by the main authors comprise three key characteristics⁶:

- (1) *Co-management via the strengthening of social capital*: There are proposals that show that co-management, as an instrument for the consolidation of a public policy, supports the management of natural resources with a view to strengthening social capital [80], i.e., to share the public and private management of a natural asset through an exemplary social process and continuous intersectoral learning [47]. This implies not only the sustainability of the uses of resources and their social-ecological resilience but also the commitment to ethics, as argued via the case of Cambodia, and the evolutionary connectivity of the term toward adaptive co-management [81] and the basis of interdisciplinary collaborative management [33]. Co-management and its "adaptive" version imply that this management strategy and approach leads to "Building trust through collaboration, institutional development, and [that] social learning enhances efforts to foster ecosystem management and resolve multiscale society-environment dilemmas" [35]. This vision is also interconnected with the relationship to

sustainable development through the management of protected areas and the improvement of governance [82].

- (2) *Economic, environmental and cultural co-management and development*: Berkes et al., between 1991 and 2015, linked the term to participation, cooperative management and economic, environmental and cultural development [38]. In addition, Pomeroy and Berkes [32] have pointed out the virtue of fishery co-management is how it contributes to the transition from a hierarchical vision to a participatory vision and community self-organization. Olsson et al. [37], for their part, conceive co-management it as a method of governance that contributes to the connectivity of local groups for self-organization, leads to greater deliberation, negotiation, collective learning, and conceptualization—as an evolutionary process—and to continuous adaptation leading to the resolution and management of problems collectively, with the participation of users across power and public management [27]. The Chilean co-management system for seafood is associated with the strength of this government regime due to its commitment to generating inclusive training among users to increase their power of negotiation and arbitration across multiple sectors [83,84]. Additionally, participatory governance and adaptive co-management have been implemented in Piriápolis (Uruguay) and Paraty (Brazil) in small-scale fisheries [15, 85].
- (3) *Co-management and cultural change*: Pomeroy [86,87], between 1995 and 2012, has argued in his top ten most-cited references that co-management promotes attributes and cases that mark an identity for cultural change in centralized management. Thus, for example, it refers to the distribution of power in management through equitable access to rights and fairer distribution in the political, social, economic and cultural structures in the sustainable management of fisheries in Southeast Asia [86], or the case of San Miguel Bay (Philippines), which it demonstrates that sharing power across levels, government and local community is the centre of joint management [87].

5. Conclusions

This study identifies fishing co-management as a polysemic term, interconnected with multiple disciplines and demonstrative examples of organizational change. The flexibility of this organizational management model is prolonged in terms of academic visualization. Co-management, when viewed in this sample of documents, provides its own typology, becoming another vehicle and mechanism for paradigm change in the public management of marine resources, exemplified by the idea of co-governance, co-production and open government. This research provides seven key findings.

First, the co-management term has emerged in different political systems and societies since 1890 until the present and has spread to nearly 100 geographical points by 2021. The versatility of the concept and its practice for improving decision-making and reinforcing a decentralised paradigm, places it with a connection to emerging research gaps such as social innovation, democratic innovation, public innovation, collective intelligence and planetary justice. Second, the origin of the term and its theoretical-practical systematization encompass seven main attributes that have been sustained in the rest of the scientific literature: shared power, institutional creation, trust, continuous process, social learning, problem and/or conflict resolution, good governance and democratic governance. Third, the dissemination format is diverse both in terms of the types of documents and publications as well as the varied productions of knowledge in 11 languages and a total of 24 disciplines. Fourth, the three main authors generate an interconnection that places the term with attributes - social capital, cultural change, community development and cases - of deepening the democratisation of organisational structures. Fifth, the association, for all documents, is presented with a total of 99 concepts represented in the

⁵ The community of Lira develops for the first time a co-management system linked to a new type of democratic innovation, "peer co-management", following the Prestige disaster. Co-management would imply equal participation in decision-making between the public and private sector, stakeholders, NGOs [79].

⁶ The characteristics of the three main authors—R. Plummer (23 documents, 3058 citations), F. Berkes (16 documents, 5608 citations), and R.S. Pomeroy (12 documents, 1145 citations)—are presented as exemplary, illustrating the epistemic debate and the formation of epistemic consensus within this community of practice. These authors account for the highest number of citations and publications per author in the sample (N = 1708).

word cloud, and 3744 phrases. This classification places the term in relation to fisheries co-management, shows a link to marine areas and an application in the field of health. Sixth, Fishery co-management represents a valid and democratic response for attacking perverse problems [88,89] through agreed upon solutions among their communities and the local context of the public problem. The reason for this is mainly the existence of a high and conflicting, at times, economic, ecological and social complexity of biological systems [90]. For this purpose, co-management is invoked as the ideal participation ladder [91], the generation of models and strategies of public innovation [92] or the generation of typologies of social and democratic innovation [93,94]. Seventh, the main themes are linked through cross-cutting themes such as governance, participation, adaptive management and resilience, which consolidate ‘co-management’ as an effective tool to facilitate a co-governance and open government approach. Its evolution over time suggests a greater focus on sustainability and innovation in the participatory processes developed by the community of practice. An innovative example is illustrated by the ideal type referenced, “peer co-management” in the Marine Protected Area ‘Os Miñarzos’, Lira (A Coruña, NW Spain).

CRedit authorship contribution statement

Seijo Villamizar Javier: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **García-Allut Antonio:** Writing – review & editing, Visualization, Validation, Supervision, Investigation, Conceptualization.

Declaration of Competing Interest

The authors declare that there is no conflict of interest.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at [doi:10.1016/j.marpol.2025.106651](https://doi.org/10.1016/j.marpol.2025.106651).

Data availability

Data will be made available on request.

References

- [1] S. Vázquez Bronfman, Communities of practice, *Educar* 47 (2011) 51, <https://doi.org/10.5565/rev/educar.71>.
- [2] J. Dewey, Democracy and educational administration, *Sch. Soc.* 45 (1937) 457–467.
- [3] E. Wenger, *Communities of Practice: Learning, Meaning, and Identity*, Cambridge University Press, 1999.
- [4] G.A. Almond, S. Verba, *The Civic Culture*, Princeton University Press, 2003, <https://doi.org/10.30570/2078-5089-2010-5859-3-207-221>.
- [5] F. Berkes, Toward a New Social Contract: Community-based Resource Management and Small-scale Fisheries, 2021. (<http://toobigtoignore.net/toward-a-new-social-contract-by-fikret-berkes/>).
- [6] M.P. L. D'Armengol, I. Castillo, E. Ruiz-Mallén, Corbera, A systematic review of co-managed small-scale fisheries: social diversity and adaptive management improve outcomes, *Glob. Environ. Chang.* 52 (2018) 212–225.
- [7] J. Brix, Exploring knowledge creation processes as a source of organizational learning: a longitudinal case study of a public innovation project, *Scand. J. Manag.* 33 (2017) 113–127, <https://doi.org/10.1016/j.scaman.2017.05.001>.
- [8] L. Bherer, C.W. Lee, Consultants: the emerging participation industry, in: S. Elstub, O. Escobar (Eds.), *Handb. Democr. Innov. Gov.*, Edward Elgar Publishing, Cheltenham, UK, 2019, pp. 196–208, <https://doi.org/https://doi.org/10.4337/9781786433862>.
- [9] M. Saari, E. Lehtonen, M. Toivonen, Making bottom-up and top-down processes meet in public innovation, *Serv. Ind. J.* 35 (2015) 325–344, <https://doi.org/10.1080/02642069.2015.1003369>.
- [10] F. Van Laerhoven, M. Schoon, S. Villamayor-Tomas, Celebrating the 30th anniversary of Ostrom's governing the commons: traditions and trends in the study of the commons, revisited, *Int. J. Commons* 14 (2020) 208–224, <https://doi.org/10.5334/ijc.1030>.
- [11] C. Ansell, J. Torfing, *Handbook on Theories of Governance*, Edward Elgar Publishing, Cheltenham, 2016 <https://doi.org/DOI:10.4337/9781800371972>.
- [12] C. Ansell, A. Gash, Collaborative governance in theory and practice, *J. Public Adm. Res.* 18 (2008) 543–571.
- [13] C. Ansell, J. Torfing, *Public Innovation through Collaboration and Design*, Routledge, 2014, <https://doi.org/10.4324/9780203795958>.
- [14] C. Ansell, Community embeddedness and collaborative governance in the San Francisco Bay area, in: M. Diani (Ed.), *Soc. Movements Networks Relational Approaches to Collect, Action*, Doug McAdam, New York, 2003, pp. 123–144.
- [15] M. Trimble, F. Berkes, Towards adaptive co-management of small-scale fisheries in Uruguay and Brazil: lessons from using Ostrom's design principles, *Marit. Stud.* 14 (2015), <https://doi.org/10.1186/s40152-015-0032-v>.
- [16] C. Tilly, J. Wood, *Los Movimientos sociales 1768-2008. Desde sus orígenes a Facebook, Crítica*, Barcelona, 2014.
- [17] M. Olson, *The Logic of Collective Action: Public Goods and the Theory of Groups*, Harvard University Press, Cambridge, 1965.
- [18] R. Zibechi, Movimientos en las instituciones: entre la transformación y la domesticación, in: N. Bergantiños, P. Ibarra (Eds.), *Respuestas y Propuestas Regen. Frente a La Cris.*, La Democr. Tecnos, Madrid, 2018, pp. 103–116.
- [19] E. Ostrom, *Governing the Commons: The Evolution of Institutions for Collective Action*, Cambridge University Press, Cambridge, 1990.
- [20] F. Berkes, Community-based conservation in a globalized world, *Proc. Natl. Acad. Sci.* 104 (2007), <https://doi.org/10.1073/pnas.0702098104>.
- [21] F. Berkes, Adaptive co-management and complexity: exploring the many faces of co-management, in: D. Armitage, F. Berkes, N. Doubleday (Eds.), *Collab. Learn. Multi-Level Governance. Adapt. Co-Management*, UBC Press, Canada, 2007, pp. 19–37.
- [22] F. Berkes, Rethinking community-based conservation, *Conserv. Biol.* 18 (2004) 621–630, <https://doi.org/10.1111/j.1523-1739.2004.00077.x>.
- [23] D. Armitage, F. Berkes, N. Doubleday, *Collaboration, learning, and multi-level governance. Adaptive Co-Management*, UBC Press, Canada, 2007.
- [24] D. Armitage, F. Berkes, N. Doubleday, Introduction: moving beyond co-management, in: D. Armitage, F. Berkes, N. Doubleday (Eds.), *Collab. Learn. Multi-Level Governance. Adapt. Co-Management*, UBC Press, Canada, 2017, pp. 1–19.
- [25] F. Berkes, *Coasts for People. Interdisciplinary Approaches to Coastal and Marine Resource Management*, Routledge, UK, 2015.
- [26] N.J. Bennett, R. Roth, S.C. Klain, K. Chan, P. Christie, D.A. Clark, G. Cullman, D. Curran, T.J. Durbin, G. Epstein, A. Greenberg, M. Nelson, J. Sandlos, R. Stedman, T. Teel, R. Thoms, D. Veríssimo, C. Wyborn, Conservation social science: understanding and integrating human dimensions to improve conservation, *Biol. Conserv.* 205 (2017) 93–108, <https://doi.org/10.1016/j.biocon.2016.10.006>.
- [27] L. Carlsson, F. Berkes, Co-management: concepts and methodological implications, *J. Environ. Manag.* 75 (2005) 65–76, <https://doi.org/10.1016/j.jenvman.2004.11.008>.
- [28] S. Jentoft, Fisheries co-management delegating government responsibility to fishermen's organizations, *Mar. Policy* 13 (1989) 137–154, [https://doi.org/10.1016/0308-597X\(89\)90004-3](https://doi.org/10.1016/0308-597X(89)90004-3).
- [29] D. Armitage, F. Berkes, A. Dale, E. Kocho-Schellenberg, E. Patton, Co-management and the co-production of knowledge: learning to adapt in Canada's Arctic, *Glob. Environ. Chang.* 21 (2011) 995–1004, <https://doi.org/10.1016/j.gloenvcha.2011.04.006>.
- [30] S. Jentoft, B.J. McCay, D.C. Wilson, Social theory and fisheries co-management, *Mar. Policy* 22 (1998) 423–436, [https://doi.org/10.1016/S0308-597X\(97\)00040-7](https://doi.org/10.1016/S0308-597X(97)00040-7).
- [31] P. Olsson, C. Folke, T. Hahn, Social-ecological transformation for ecosystem management: the development of adaptive co-management of a wetland landscape in Southern Sweden, *Ecol. Soc.* 9 (2004) art2, <https://doi.org/10.5751/ES-00683-090402>.
- [32] R.S. Pomeroy, F. Berkes, Two to tango: the role of government in fisheries co-management, *Mar. Policy* 21 (1997) 465–480, [https://doi.org/10.1016/S0308-597X\(97\)00017-1](https://doi.org/10.1016/S0308-597X(97)00017-1).
- [33] D. Armitage, M. Marschke, R. Plummer, Adaptive co-management and the paradox of learning, *Glob. Environ. Chang.* 18 (2008) 86–98, <https://doi.org/10.1016/j.gloenvcha.2007.07.002>.
- [34] F. Berkes, Evolution of co-management: role of knowledge generation, bridging organizations and social learning, *J. Environ. Manag.* 90 (2009) 1692–1702, <https://doi.org/10.1016/j.jenvman.2008.12.001>.
- [35] D.R. Armitage, R. Plummer, F. Berkes, R.I. Arthur, A.T. Charles, I.J. Davidson-Hunt, A.P. Diduck, N.C. Doubleday, D.S. Johnson, M. Marschke, P. McConney, E. W. Pinkerton, E.K. Wollenberg, Adaptive co-management for social-ecological complexity, *Front. Ecol. Environ.* 7 (2009) 95–102, <https://doi.org/10.1890/070089>.

- [36] D. Huitema, E. Mostert, W. Egas, S. Moellenkamp, C. Pahl-Wostl, R. Yalcin, Adaptive water governance: assessing the institutional prescriptions of adaptive (co-)management from a governance perspective and defining a research agenda, *Ecol. Soc.* 14 (2009) art26, <https://doi.org/10.5751/ES-02827-140126>.
- [37] P. Olsson, C. Folke, F. Berkes, Adaptive comanagement for building resilience in social-ecological systems, *Environ. Manag.* 34 (2004), <https://doi.org/10.1007/s00267-003-0101-7>.
- [38] F. Berkes, P. George, R.J. Preston, Co-management: the evolution in theory and practice of the joint administration of living resources, *Alternatives* 18 (1991) 12–18.
- [39] A.W. Woolley, I. Aggarwal, T.W. Malone, Collective intelligence and group performance, *Curr. Dir. Psychol. Sci.* 24 (2015), <https://doi.org/10.1177/0963721415599543>.
- [40] H. Landemore, *Democratic Reason: Politics, Collective Intelligence, and the Rule of the Many*, Princeton University Press, 2012.
- [41] S. Sen, J. Raakjaer, Fisheries co-management: A comparative analysis, *Mar. Policy* 20 (1996) 405–418, [https://doi.org/10.1016/0308-597X\(96\)00028-0](https://doi.org/10.1016/0308-597X(96)00028-0).
- [42] R.S. Pomeroy, R. Rivera-Guieb, *Fishery Co-Management: A Practical Handbook*, Wallingfor, CABI Publishing, 2006.
- [43] R.S. Pomeroy, M.J. Williams, Fisheries co-management and Small-scale fisheries, A Policy Brief. (1994). (<https://digitalarchive.worldfishcenter.org/handle/20.500.12348/2857>).
- [44] N. Houde, The six faces of traditional ecological knowledge: challenges and opportunities for canadian co-management arrangements, *Ecol. Soc.* 12 (2007), <https://doi.org/10.5751/ES-02270-120234>.
- [45] L. Evans, N. Cherrett, D. Pems, Assessing the impact of fisheries co-management interventions in developing countries: a meta-analysis, *J. Environ. Manag.* 92 (2011) 1938–1949, <https://doi.org/10.1016/j.jenvman.2011.03.010>.
- [46] D. Kar. *Community-based Fisheries Management: A Global Perspective*, Academic Press, 2021.
- [47] R. Plummer, J. Fitzgibbon, Co-management of natural resources. A proposed framework, *Environ. Manag.* 33 (2004) 876–885, <https://doi.org/10.1007/s00267-003-3038-y>.
- [48] R. Plummer, B. Crona, D.R. Armitage, P. Olsson, M. Tengö, O. Yudina, Adaptive comanagement: a systematic review and analysis, *Ecol. Soc.* 17 (2012), <https://doi.org/10.5751/ES-04952-170311>.
- [49] M. Gascó-Hernández (Ed.), *Open Government*, Springer New York, New York, NY, 2014, <https://doi.org/10.1007/978-1-4614-9563-5>.
- [50] C. Nicandro Cruz-Rubio, *Clasificando Instrumentos de políticas públicas en gobierno abierto: Hacia una agenda de investigación*, 2014. (<https://www.openpovpartnership.org/stories/clasificando-instrumentos-de-politicas-publicas-en-gobierno-abierto-hacia-una-agenda-de-investigacion/>).
- [51] P. Pita, A. García-Allut, S. Villasante, The role of marine stakeholders in the co-production of scientific knowledge: lessons from Galicia (NW Spain), 2018.
- [52] N. Mahony, J. Newman, C. Barnett, *Rethinking the public: Innovations in research, theory and politics*, Bristol University Press, Policy Press, 2010. <https://doi.org/10.2307/j.ctt9gpph0>.
- [53] U. Nations, *Transforming our world: the 2030 Agenda for Sustainable Development*, 2015 (<https://undocs.org/en/A/RES/70/1>).
- [54] W. Bijllevan, M. van Hulst, F. Hendriks, Public servants in innovative democratic governance, in: S. Elstub, O. Escobar (Eds.), *Handb. Democr. Innov. Gov.*, Edward Elgar Publishing, Cheltenham, UK, 2019, pp. 209–224, <https://doi.org/10.4337/9781786433862>.
- [55] M. Bevir. *Democratic Governance*, Princeton University Press, Oxford, 2010.
- [56] M. Stout, J.M. Love, *Integrative Governance. Generating Sustainable Responses to Global Crise*, Routledge, New York, 2019.
- [57] OCDE, *Panorama de las Administraciones Públicas 2017*, Madrid, 2018.
- [58] J. Silvertown, A new dawn for citizen science, *Trends Ecol. Evol.* 24 (2009) 467–471, <https://doi.org/10.1016/j.tree.2009.03.017>.
- [59] R. Bonney, C.B. Cooper, J. Dickinson, S. Kelling, T. Phillips, K.V. Rosenberg, J. Shirk, Citizen science: a developing tool for expanding science knowledge and scientific literacy, *Bioscience* 59 (2009) 977–984, <https://doi.org/10.1525/bio.2009.59.11.9>.
- [60] R. Bonney, J.L. Shirk, T.B. Phillips, A. Wiggins, H.L. Ballard, J.K. Miller-Rushing, A.J. Parrish, Next steps for citizen science, *Science* (80-.) 343 (2014) 1436–1437, <https://doi.org/10.1126/science.1251554>.
- [61] C.C. Conrad, K.G. Hilchey, A review of citizen science and community-based environmental monitoring: issues and opportunities, *Environ. Monit. Assess.* 176 (2011) 273–291, <https://doi.org/10.1007/s10661-010-1582-5>.
- [62] J.W. Creswell, V.L. Plano Clark. *Designing and Conducting Mixed Methods Research*, Sage, Thousand O, 2011.
- [63] J.W. Creswell. *Research Design: Qualitative, Quantitative and Mixed Methods Approaches*, Sage, Thousand O, 2009.
- [64] N. O'Brien, J. Barboza-Palomino, M. Ventura-León, J.S. Caycho-Rodríguez, T. Sandoval-Díaz, W. López-López, G. Salas, Nuevo coronavirus (COVID-19). Un análisis bibliométrico, *Rev. Chil. Anest.* 49 (2020) 408–415, <https://doi.org/10.25237/revchilanestv49n03.020>.
- [65] R. Rousseau, L. Egghe, R. Guns, *Becoming Metric-Wise. A Bibliometric Guide for Researchers*, United Kingdom, 2018.
- [66] N.J. Van Ek, L. Waltman, *VOSviewer versión 1.6.13. Manual*, 2019. (<https://www.vosviewer.com/>).
- [67] J.Seijo Villamizar, Tendencia de la transparencia en los países miembros de la UE, ¿Evolución incremental o moda en la gestión cíclica?, in: Ponencia en VI Congreso Internacional de Transparencia, 27-29 de septiembre de 2021, Alicante, Alicante, 2021.
- [68] J.Seijo Villamizar, Una aproximación al consenso de las comunidades epistémicas globales en la tendencia temática: “network society”, *Estud. Comun. GICID, Fragua* (2021) <https://doi.org/978-84-18167-69>.
- [69] J. Seijo Villamizar, I. Mejía Mejía, Y. Taher Shawabkeh, Un análisis bibliométrico sobre la desigualdad de género en el marco de una gobernanza democrática: evidencias desde España, Jordania y México, in: Congreso: “Los caminos de América. AEA. Santiago de Compostela”, 14-16 junio 2021, Universidad de Santiago de Compostela, Santiago de Compostela, España, 2021: pp. 176–184.
- [70] J. Carrión Sánchez, *Análisis de tablas de contingencia*, CIS, Madrid, 1992.
- [71] SJR, *Country Rankings*, 2021. (<https://www.scimagojr.com/countryrank.php?category=3318>).
- [72] C. Wilde, Participation, comanagement and representation of nursing personnel and their professional delegates in the organization of health care [Participation, cogestion et représentation du personnel infirmier et de ses délégués professionnels dans l’organisatio, *Nursin* 41 (1969) 35–45.
- [73] E. Pinkerton. *Co-operative Management of Local Fisheries*, University of British Columbia Press, Vancouver, Canada, 1989.
- [74] C. Folke, T. Hahn, P. Olsson, J. Norberg, Adaptive governance of social-ecological system, *Annu. Rev. Environ. Resour.* 30 (2005) 441–473, <https://doi.org/10.1146/annurev.energy.30.050504.144511>.
- [75] G. Morgan, *Imágenes de la Organización, Ra-Ma*, Madrid, 1990.
- [76] S. Jentoft, M. Bavinck, D. Johnson, K. Thomson, Fisheries co-management and legal pluralism: how an analytical problem becomes an institutional one, *Hum. Organ.* 68 (2009) 27–38, <https://doi.org/10.17730/humo.68.1.h87q04245t63094r>.
- [77] C. Hood, *The Art of State*, Oxford University Press, Oxford, 1998.
- [78] A. García Allut, Bases para unha actividade pesqueira sustentable, in: X. Ferreiro, X. Duro (Eds.), *Ecol. Política. Olladas Desde Galicia, oben común*, Galicia, 2015, pp. 105–122.
- [79] J.Seijo Villamizar, La Gobernanza y la educación ambiental como instrumentos para el fortalecimiento de la pesca artesanal: el caso de la Fundación Lonxanet, in: Congr. Int. SIPS 2021. XXXIII Semin. Interuniv. Pedagog. Soc. Educ. Ambient. y Cult. La Sostenibilidad Construyendo La Transición Ecológica, 28-29 Oct. y 4-5 Noviembre 2021 /Lugo (Galicia, España), 2021.
- [80] R. Plummer, J. Fitzgibbon, People matter: the importance of social capital in the co-management of natural resources, *Nat. Resour. Forum* 30 (2006) 51–62, <https://doi.org/10.1111/j.1477-8947.2006.00157.x>.
- [81] D. Fennell, R. Plummer, M. Marschke, Is adaptive co-management ethical? *J. Environ. Manag.* 88 (2008) 62–75, <https://doi.org/10.1016/j.jenvman.2007.01.020>.
- [82] R. Plummer, J. Baird, D. Armitage, Ö. Bodin, L. Schultz, Diagnosing adaptive comanagement across multiple cases, *Ecol. Soc.* 22 (2017) art19, <https://doi.org/10.5751/ES-09436-220319>.
- [83] A. Marín, F. Berkes, Network approach for understanding small-scale fisheries governance: the case of the chilean coastal co-management system, *Mar. Policy* 34 (2010) 851–858, <https://doi.org/10.1016/j.marpol.2010.01.007>.
- [84] A. Marín, S. Geleich, J.C. Castilla, F. Berkes, Exploring social capital in chile’s coastal benthic comanagement system using a network approach 17 (2012), <https://doi.org/10.5751/ES-04562-170113>.
- [85] M. Trimble, F. Berkes, Participatory research towards co-management: lessons from artisanal fisheries in coastal uruguay, *J. Environ. Manag.* 128 (2013) 768–778, <https://doi.org/10.1016/j.jenvman.2013.06.032>.
- [86] R.S. Pomeroy, Community-based and co-management institutions for sustainable coastal fisheries management in southeast asia, *Ocean Coast. Manag.* 27 (1995) 143–162, [https://doi.org/10.1016/0964-5691\(95\)00042-9](https://doi.org/10.1016/0964-5691(95)00042-9).
- [87] R.S. Pomeroy, M.D. Pido, Initiatives towards fisheries co-management in the philippines: the case of san miguel bay, *Mar. Policy* 19 (1995) 213–226, [https://doi.org/10.1016/0308-597X\(94\)00008-G](https://doi.org/10.1016/0308-597X(94)00008-G).
- [88] C.W. Churchman, Guest editorial: wicked problems, *Manag. Sci.* 14 (1967) B141.
- [89] B.W. Head, H. Ross, J. Bellamy, Managing wicked natural resource problems: the collaborative challenge at regional scales in Australia, *Landsc. Urban Plan.* 154 (2016) 81–92, <https://doi.org/10.1016/j.landurbplan.2016.03.019>.
- [90] C.S. Holling, Understanding the complexity of economic, ecological, and social systems, *Ecosystems* 4 (2001) 390–405, <https://doi.org/10.1007/s10021-001-0101-5>.
- [91] S.R. Arnstein, A ladder of citizen participation, *J. Am. Inst. Plann.* 35 (1969) 216–224, <https://doi.org/10.1080/01944366908977225>.
- [92] FAO, *Estrategias innovadoras de gestión de riesgos en mercados financieros rurales y agropecuarios*, FAO, 2016. (<http://www.fao.org/3/a-i5503s.pdf>).
- [93] M. Parés, S. i Franzi, J. Ospina, *Subirats, Social Innovation and Democratic Leadership*, Edward Elgar Publishing, USA, 2017.
- [94] S. Elstub, O. Escobar, *Handbook of Democratic Innovation and Governance*, Edward Elgar Publishing, UK, 2019, <https://doi.org/10.4337/9781786433862>.
- [95] F. González-Laxe, J. Seijo-Villamizar, F. Martín-Bermúdez, Twenty years of sustainable development and port authorities: a critical review of the literature, *Mar. Policy* 172 (2025) 106491, <https://doi.org/10.1016/j.marpol.2024.106491>.
- [96] F. Bauerdorf, R. Kaczmarczyk, A. Zink, T. Florestan, T. Biedermann, Trends and perspectives for dermatological research in Europe: an abstract title analysis of ESDR and IID Congresses 2010–2019, *J. Invest. Dermatol.* 140 (2020) S197–S200, <https://doi.org/10.1016/j.jid.2020.04.022>.
- [97] S.S. Hossain, Y. Arafat, M.E. Hossain, Context-based news headlines analysis: a comparative study of machine learning and deep learning algorithms, *Vietnam J. Comput. Sci.* 08 (2021) 513–527, <https://doi.org/10.1142/S219688822500014>.

- [98] R. Kaczmarczyk, F. King, T. Biedermann, A. Zink, What's driving dermatology? Contribution title analysis of the largest German Dermatology Congress 2019, *Digit. Heal.* 7 (2021), <https://doi.org/10.1177/20552076211012138>.
- [99] S. Seijo, J. Villasante, Atributos de la economía digital: un análisis de su impacto y consenso epistémico en la era de la post verdad, in: *Manip. En Imágenes Vis. y Son. En Ficción y No Ficción*, Dykinson, 2023: pp. 594–620.
- [100] M. Bevir, R.A. Rhodes, *Routledge Handbook of Interpretative Political, Science*, Routledge, New York, 2016.