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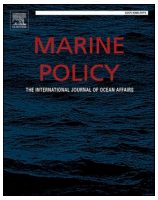

Facing the blue Anthropocene in Patagonia by empowering indigenous peoples' action networks

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ABSTRACT

Chilean Patagonia is a globally significant ecosystem for biodiversity, and simultaneously a global center for the aquaculture industry. Environmental crises have accelerated over the last decades with the installation of salmon farms, increasing impacts on indigenous livelihoods and the habitats of marine species. Indigenous Marine Areas (IMA) have confronted the effects of the blue Anthropocene in Chilean Patagonia, causing diverse indigenous communities to evolve mechanisms to enhance ocean health and sustainability. Based on an analysis of the main socio-spatial trends of IMA in Patagonia and their action networks in the Los Lagos Region, this study demonstrates the importance of a multiple agent network to mobilize the implementation of IMA. The study shows how indigenous people face the challenges of the UN Ocean Decade, enhancing the sustainability pathways of blue Patagonia.

1. Introduction

Chilean blue Patagonia is globally a significant ecosystem for marine life. It is internationally important for biodiversity conservation, while at the same time becoming a world-leading center for the aquaculture industry (Castilla et al., 2021).

Several environmental pressures impact Chilean blue Patagonia -extractive marine industries, urban pollution, maritime transport, climate change and marine resource overexploitation (Marquet et al., 2021). Environmental crises have increased over the last twenty years, from the Infectious Salmon Anemia viruses (ISA) to Harmful Algal Blooms (HAB) (Armijo et al., 2020), affecting both indigenous and local livelihoods and the habitats of marine species (Anbleyth-Evans et al. 2020). Salmon farming is the main source of pollution of Patagonian marine ecosystems (Quiñones et al., 2019). Large portions of their contaminated sediments cover the seabed, affecting shellfish banks and habitats. Salmon feed and waste residues provide high concentrations of nutrients and organic matter (nitrogen and phosphorus) which are not be dispersed or recycled through the environment, generating eutrophication and anoxic zones (Bouwman et al., 2013). All these environmental pressures have triggered the emergence of social conflicts, creating questions about justice in the governance of the remediation responses (Bustos-Gallardo et al., 2021).

Chilean Patagonia is thus an example of the blue Anthropocene, where a vast and biodiverse marine space is subject to multiple overlapping pressures based on social inequality and injustice, accumulating negative impacts on the socioecological systems and livelihoods (Anbleyth-Evans, 2018). Several contextual conditions are driving the patterns of change, providing challenges for a sustainable blue governance for the next decade in the Chilean blue Patagonia (Burch et al., 2019).

Responding to these sustainability challenges, the indigenous people have been applying Indigenous Marine Areas (IMA or *Espacios Costeros Marinos para Pueblos Originarios-ECMPOs* in Spanish). IMA are marine protected areas, established by decrees, that safeguard customary uses of indigenous and local peoples (Araos et al., 2020). Originally conceived to recognize fisheries rights in small areas, today many of them are oriented to marine conservation and sustainable inclusive development, protecting large marine areas (Araos et al., 2021). These IMA action networks have been leading collective action by mobilizing political and

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economic resources, connecting governance levels and actors and establishing intercultural alliances. A bottom-up social movement has confronted the centralized and hierarchical marine governance model to conserve biocultural diversity (Anbleyth-Evans et al., 2022), putting indigenous peoples at the frontline of blue Patagonia protection.

Based on anthropological research developed over the last three years, this article presents the latest IMA implementation trends across Patagonia. Using a network approach, we identify the main actors that have been mobilizing collective action in the Los Lagos Region in the northern area of Patagonia.

The study presents a literature review of the role of action networks in governing the blue Anthropocene. Then it reviews the major IMA trends in Chilean Patagonia, focusing on their institutional and political background, their spatial trends and contribution to marine conservation.

The methodological section explains the social network analysis dimensions considered in the study. The results section presents the action networks that support IMA implementation, their key measures and territorial dimensions. Finally, the discussion and conclusion summarize the main findings, discussing the role of indigenous communities and other central actors in IMA governance and their contribution to achieve UN Ocean Decade challenges.

2. Governing the blue Anthropocene through action networks

Public concern about the social effects and environmental impacts of the blue economy is growing globally (Cisneros-Montemayor et al., 2021; Bennett et al., 2021; Gerhardinger et al., 2021). These authors show the social sectors which are excluded from the benefits of the economic growth and the environmental externalities produced by the novel blue industries in the context of climate change, including coastal desalination plants and offshore wind farms.

Conceptualized originally by the Small Island Developing States of the United Nations (UN), a blue economy intends to be economically viable and environmentally sustainable, promoting culturally appropriate strategies and focused on social equity and well-being (Cisneros-Montemayor et al., 2021). The blue economy refers to both traditional sectors such as industrial fishing, transportation, infrastructure and energy production, as well as emerging industries such as biotechnology, underwater mining and carbon capture. The blue economy also advocates the expansion of protected areas and the proliferation of socioeconomic development tools (Pauli, 2017; Smith-Godfrey, 2016).

Despite the growing global support for blue economy as the new frontier for the ocean sustainability, in the context of the blue Anthropocene, which was defined by Anbleyth-Evans (2018) as the fetishization of economic growth without limits in the sea, the blue economy narrative is re-interpreted as a negative driver for the future of the ocean. The blue Anthropocene introduces the uncertainties and challenges produced by global environmental change, particularly the social injustices and vulnerabilities enhanced by climate change and the reduction in the capacity of local groups to sustains their livelihoods and to heal the damaged zones where they live (Tsing et al., 2017). This capacity takes the form of micro-political exercises of protection and safeguard of the marine environment, including its ecosystem services and its contribution to human wellbeing (Araos et al., 2019). To face the blue Anthropocene, several coastal communities, fishers, indigenous people, and local organizations, both locally and globally, have fostered action networks to recover control of marine commons and to sustain the regeneration of life in the oceans (De Castro et al., 2015; Aswani et al., 2018; Ban and Frid, 2018; Von der Porten et al., 2019).

Different studies report communities that are actively managing their resources, as in the Locally Managed Marine Areas in the South Pacific (Govan et al., 2009). These areas recognize traditional management systems, and they are supported by governments and other agencies (Govan, 2009). The effectiveness of a locally managed marine area depends mainly on its organizational capacity, knowledge and economic resources (Rocliffe et al., 2014). This also must be complemented by the participation of diverse stakeholders in the planning of marine and coastal resource management (Newell et al., 2019). It is essential for this purpose to integrate the participation of stakeholders in governance networks. In the Solomon Islands, the actors recognize the value of the governance network in facilitating information flows between agencies and across governance scales and locations (Cohen et al., 2012). The most frequent challenges in resources management documented in the Western Indian Ocean include inadequate local management capacity, dependence on external support, overdependence on marine resources, poor governance, conflicting legislation and migrant fishing activities (Samoilys et al., 2017).

As we can see, interest in action networks is part of a broad relational change in environmental governance which has been growing over the last years, especially by the contribution of Social Network Analysis (Alexander and Armitage, 2015). Social Network Analysis is formally outlined by Carlsson and Sandström (2008) with the aim of dealing with the complexity of natural resource management. The authors focus on the multi-actor structures and relations, highlighting the heterogeneity and nuances of these multiple actors. For example, when speaking of the State, they don't speak of a single homogeneous and unidirectional entity, but of multiple organisms with different agencies and capacities to influence (Berkes, 2002), alongside different types of effects on local networks (Lansing, 1991).

A focus on action networks allows formalizing an empirical investigation of multi-stakeholder governance, especially in field contexts where governance is structured around the management and conservation of common-pool resources (Alexander and Armitage, 2015). This approach points out the strategic alliance of the actors, the organization of collective action through multi-agent networks, the cross-scale connections and the emergent institutional arrangements that formalize the action (Araos et al., 2020).

3. Indigenous marine areas in Patagonia: institutional and political background, spatial trends and contributions to marine conservation

The regime for the exploitation of marine resources has operated in Chile since the 1970 s, based on privatization through maritime concessions and quotas (Saavedra, 2013; Bustos-Gallardo and Irarrazaval, 2016; Tecklin, 2016; Anbleyth-Evans et al., 2020), which has sustained the growth of the aquaculture and fishery industry. The development of these sectors has also been promoted by a broad system of public incentives that have transformed the marine commons into commodities available for private exploitation. Ecosystem services are also currently privatized, allowing blue growth such as aquaculture in Chilean Patagonia, to the detriment of the well-being of the coastal communities (Cid and Araos, 2021).

This privatization has been confronted by coastal communities by the creation of common community properties. For instance, Chilean Territorial Use Rights for fisheries (TURFs) were the first institutional arrangement to manage local ecosystems and livelihoods (Gelcich et al., 2010), and was a relevant precedent for the IMA model by inspiring indigenous communities to apply their own TURFs (Araos et al. 2020). However, the expansion of the applications across the coastal zone of Chile demonstrates that IMA go beyond TURFs, integrating territorial claims of indigenous peoples over several ecosystems and habitats, many of them considered biodiversity hotspots in Patagonia (Araos et al. 2020; Tecklin et al., 2021).

Blue Patagonia is a complex and dynamic marine territory with multiple economic and political overlapping interests, including artisanal and industrial fishing, tourism, conservation zones, indigenous marine tenures, and is the center of the country's aquaculture industry. Fig. 1 illustrates this complexity and highlights the multiple lives (human and nonhuman) which are sustained by it.

Fig. 1. Illustration of the Chilean blue Patagonia. The illustration represents the socioecological complexity of the marine and coastal zone.
Source: LabC 2021.

Indigenous Marine Areas are the collective answer to the blue Anthropocene in Chilean Patagonia. Over the years it has been observed that IMA have increased in number and size, with applications led by associations of indigenous communities. At the beginning of the implementation of Law No. 20,249 (call Lafkenche law), the Mapuche Williche communities of the Los Lagos Region were the first to apply for IMA in Chilean Patagonia, while in recent years the Kawésqar and Yagán from Magallanes region communities have joined as applicants.

Based on the official information provided by the Undersecretary of Fisheries and Aquaculture (Subpesca in Spanish) in its web site, 101 IMA have been applied for nationwide, covering about 3700,000 ha from the enactment of the law in 2008 to September, 2021. Only 16 have been decreed, representing only 1.9% of the total area applied for. The administrative process of the approved IMA has taken 6 years on average; the fastest took 2 and a half years and the slowest 11 years. An undetermined number of applications have been declared inadmissible or are still waiting for their application to be formalized by Subpesca.

In Chilean Patagonia, 81 IMA have been applied for and 14 have been approved, all of which are in the Los Lagos Region. The approved IMA covered an area of 30,339 ha, representing only 0.96% of the almost 3150,000 ha applied for. As we present in Fig. 2, the application trend shows an incremental growth through the years, and a breakpoint in 2017 when applications almost doubled, going from 26 to 46, especially in the Los Lagos Region. This increment may be explained by the red tide crisis of 2016 in Chiloé Island and the social movements that emerged from it (Araos et al. 2020).

Fig. 3 shows the regional distribution of IMA applied for and granted: 75 in the Los Lagos Region, which extends from the San Juan de la Costa commune in the north to the Quellón and Chaitén communes in the south; three in the Aysén Region, in the communes of Guaitecas, Cisnes and Aysén; and two in the Magallanes Region, both in the commune of Natales.

Recent studies highlight the contribution of IMA to the marine conservation of Chilean Patagonia (Tecklin et al., 2021; Araos et al., 2021). They recognize the contributions of applied for and decreed IMA, mainly by considering Article 10 of the Lafkenche law, which provides protection over the surface cover by the IMA during the administrative declaration process, contrasting it with other official marine protected

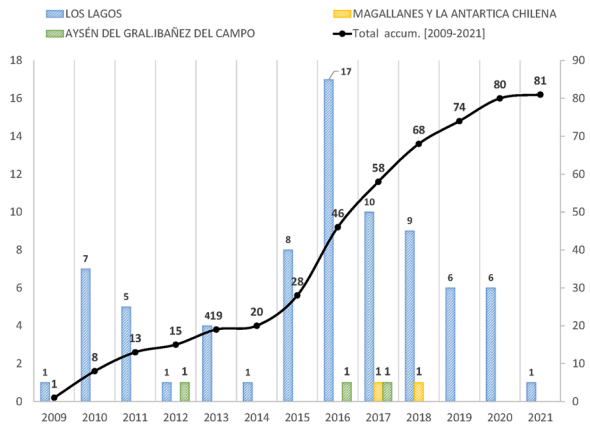

Fig. 2. Historical evolution of IMA applications in Chilean Patagonia. The graph shows the distribution of IMA by region and per year, and the total cumulative applications from 2009 to 2021.
Source: Elaborated by the authors based on data from SUBPESCA in September, 2021.

areas established in the territorial sea: Marine Parks, Marine Reserves, Multiple Uses Marine and Coastal Protected Areas, Nature Sanctuaries, Ramsar Sites, Terrestrial National Parks and Reserves established across islands and archipelagos with marine and coastal areas and Management and Exploitation Areas for Benthic Resources. Considering this information, based on data from Subpesca, in Fig. 4 we present the percentages of the different types of marine protected areas implemented in Chilean Patagonia. We found that 66% of the territorial sea does not have any protection category. Decreed and applied for IMA protect 11%, an area that would practically quadruple the contribution of the other Marine Protected Areas identified above which represent 3%, only less than the surface contained in the National System of Protected Areas (SNASPE, including National Parks and Reserves with marine and coastal portion) that protects 20%.

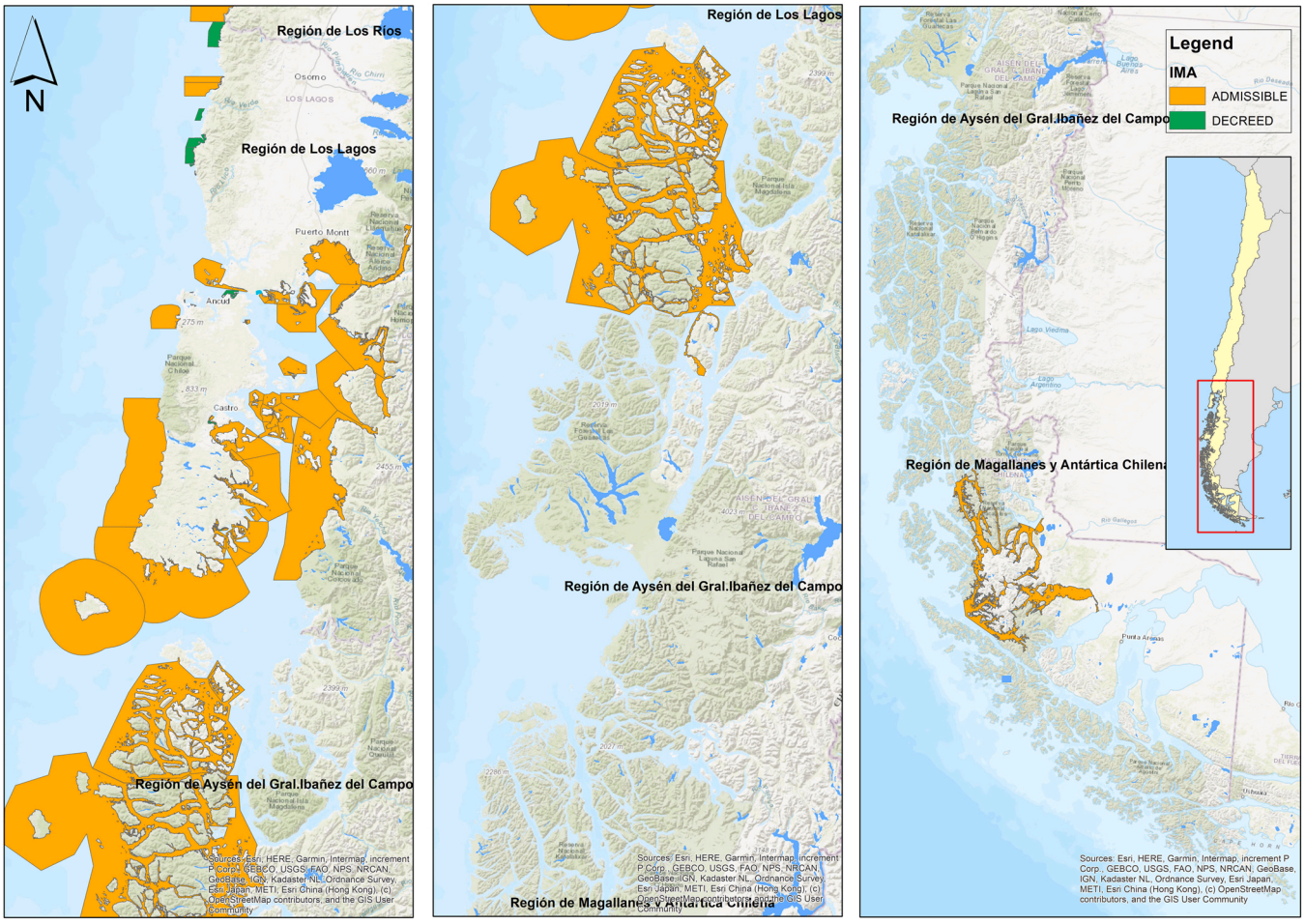

Fig. 3. MAP of the total IMA in Chilean Patagonia, including the Los Lagos, Aysén and Magallanes Region. In orange the IMA applied for and in green the IMA decreed.
Source: Elaborated by the authors based on data from SUBPESCA in September, 2021.

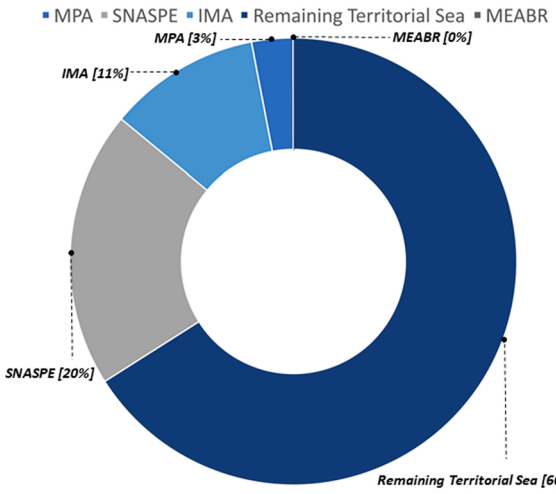

Fig. 4. Percentages of different types of protection figures in the territorial sea of Chilean Patagonia, including Marine Protected Area (MPA), The National System of Protected Areas (SNASPE), Indigenous Marine Areas (IMA), Management and Exploitation Areas for Benthic Resources (MEABR), and the remaining territorial sea without protection.
Source: Elaborated by the authors based on data from SUBPESCA in September, 2021.

4. Material and methods

The study was carried out using mixed methods, with a focus on the IMA implementation process in northern Patagonia. Document analysis was conducted by an exhaustive review of public information sources of spatial infrastructure from Geospatial Infrastructure Data Service (SDI, IDE in Spanish), Undersecretary of Fisheries (SUBPESCA), National Indigenous Development Corporation (CONADI), and Municipalities, supporting the characterization of the IMA with demographic and spatial data, including Los Lagos, Aysén and Magallanes regions. This information was presented in Section 3.

Social Network Analysis was focused on the IMA applied for in the Los Lagos Region, the area with the most and largest applications in Patagonia. A total of 43 questionnaires were conducted to collect information, mainly with indigenous organizations applying for IMA, plus other relevant actors who were identified after the first round of interviews with leaders of applied organizations. The interviews consider associative information of each organization in its application process for each IMA. We attempted to identify organizations or persons that collaborated in any part of the application process. This showed the resulting network is made up of two types of actors: organizations/institutions (indigenous, NGOs, municipalities, State agencies, other organizations) and local activists. Therefore we constructed a network composed of different types of agents involved in the submission of IMA in the Los Lagos Region; the relational data needed to construct the network was obtained through these questionnaires applied to indigenous organizations and other relevant agents, who were asked about the

agents that collaborated in the process of applying for their IMA. To construct it, we considered that there is a link between nodes *i* and *j* if node *i* declared that *j* collaborated with the application of agent *i*'s IMA. This allowed us to construct a bipartite matrix built upon agents' *i* data, where *i* were basically the indigenous organizations that applied for IMA. The resulting network has relational data of collaboration between different sets of agents involved in this application process. The information collected in the field was systematized and processed using the Gephi software (Bastian et al., 2009), through which the network diagram and their quantitative measurements were generated.

The Social Network analysis presented in the results is made up of the social network diagrams and a series of quantitative measures that account for the structural characteristics of the network and the role of the actors that compose it. In this study we focus on measures presented in Table 1.

We use the modularity measure to organize the subgroups or subcommunities within a social network. This result is represented spatially in the territory of the Los Lagos Region, identifying the number of relationships between the subgroups analyzed.

5. Results

The results of the Social Network Analysis yielded a network composed of 108 nodes and 126 relationships between these nodes. The actors were identified in seven categories; indigenous organizations; local agents (natural persons); NGOs; State agencies; the salmon industry and other organizations. The disaggregated result of this classification for the IMA network is presented below (Table 2).

In the next figures we present the diagrams of the application network in the Los Lagos Region adjusted by the measures indicated above. Fig. 5 represents the actors and their networks spatially, as well as other characteristics. The different modules are grouped spatially and differentiated by color. The size of each node is adjusted by its centrality of intermediation, that is, the capacity to act as a bridge between different sets of network actors. Thus the larger the node, the greater its intermediation capacity.

Fig. 6 presents the same IMA application network with the size of the nodes adjusted for their centrality of intermediation (as in the previous case, the larger the node, the greater the centrality of intermediation). In this sociogram, however, the different colors no longer represent the different modules of the network, but the types of actors already identified. This diagram was generated to visualize the composition of different types of actors in each module.

The complete network shows a decentralized structure in both diagrams, which are almost completely connected except for two isolated and small modules (of two and three actors).

Despite this general decentralization there are fairly central figures, such as the role of LA and Costa Humboldt NGO. Decentralization is explained by the existence of nine modules or subgroups. As can be seen disaggregated for each module, each of these shows heterogeneity of types of actors, which accounts for the diverse articulation that makes up each of these network aggregates behind each IMA application. The types of actors of the central or dominant nodes of each module are another indicator of the diversity of the network. These actors correspond to different types of groups, which shows that there is no single type of actor around which each module is grouped. Finally, a relevant element is the differences between modules; as we have seen, there are differences in the composition of types of actors by module, some with a high number of NGOs and others without NGOs but with greater ties to functional social organizations such as fisheries unions.

Table 3 presents the ten actors with the highest in-degree and out-degree centrality. This result of degree centrality confirms what has already been observed in the diagrams; there is a distribution by type of actor in both degree centralities, not being concentrated in a single type of actor. This result is visualized in the actors with the most in-degrees as established in Table 2, in which the types of actors with greatest preponderance in the network (indigenous organizations, local activists and NGOs) are divided into the ten actors with higher in-degrees. An equally relevant result is the role of CONADI, one of the State agencies with participation in the IMA application process. This is relevant because in this network it is a State agency that is viewed as a supporting actor for the indigenous organizations. Equally important is the role played by local activists (persons) who, in their role as technical or political support in the procedures, constitute central roles in different modules and incorporate the role of people and not just organizations within the network.

The IMA network is deployed across the coastal zone of the Los Lagos Region. As we noted in previous section on the multiple subgroups or modules of the network, they are organized in relation to the different territories where the IMA have been applied: Chiloé Island, Northern Patagonia and Osorno Province. Fig. 7 confirms this initial result and expands its observation, showing: i. High spatial decentralization of the network, without a unique central node or module that concentrates the relations; ii. The existence of cross-scale interaction that surpasses the local, regional or even national level; iii. Four of the nine modules identified in Fig. 5 (modules 1, 3, 5, 8) are spatially fixed to a specific territory, while five modules are positioned across multiple places and spatial levels. Modules 1 and 3 were recognized in the previous work cited above (Araos et al., 2020), and modules 5 and 8 are subgroups that complement the initial observations.

6. Discussion

The trend of IMA in Chilean Patagonia demonstrates the continuous growth of applications, mainly concentrated in Los Lagos Region, but with recent expansion across Aysén and Magallanes regions. These latest IMA cover a large area, including islands, channels and fjords, which sustain high marine biodiversity and fisheries resource species. The large IMA, such as Mañihueico-Huinay in Hualaihue, Wafo Wapi in Quellón and Cisnes in Aysén, also cover an important area of the municipal coastal zone containing other management and exploitation areas such as the MEARB of the artisanal fishers or aquaculture farms for industrial purposes which have been included or banned (e.g. when salmon farms are polluting the coastal zone) in the management plans, transforming IMA into an unexpected marine spatial planning tool.

In terms of an inclusive marine conservation perspective, IMA represent the most important institutional instrument to promote both biodiversity conservation and human well-being. The other marine conservation figures presented in blue Patagonia such as Marine Parks, Marine Reserves and Multiple Uses Marine Protected Areas have some instruments to include human well-being or social participation in governance (i.e. cultural conservation objectives or management councils); however these instances are reduced to specific experiences without scalable strategies. IMA is the only conservation category oriented to indigenous people and their maritime territories.

Northern Patagonia was the frontier for the expansion of the salmon industry, which moved gradually south, expanding into marine areas with better environmental quality after ISA virus crisis of 2008 and the red tide crisis of 2016 (Bustos-Gallardo and Irarrazaval, 2016; Castilla et al., 2021). IMA act as a legal instrument of spatial restriction to the expansion of the salmon industry across Patagonia, reducing its environmental impacts and redistributing power in the decision-making process. The indigenous communities and associations use IMA to confront salmon farmers and to recover damaged ecosystems. This has the potential to bring blue justice to Patagonia, where in the past all the legal and economic architecture was oriented toward private profit. IMA governance is based on the power and legitimacy of the indigenous communities, which begins at the application process with "the awareness of the indigenous communities of the potential threats for the future of the local territories and their customary practices" (Araos et al., 2020:301). From this point the action network begins to act, bringing resources to support the application and mobilizing the social and

Table 1
Social Network measures used in the study.

Social Network Measure	Description	Explanatory uses
Modularity	The procedure of detecting the existence of subgroups or sub-communities within a network. This is the sets of actors with a higher degree of interconnections among them (Blondel et al., 2008; Newman, 2006). In this way it is possible to identify the different subgroups (called modules) that make up the general or complete network.	According toBodin et al. (2006), high levels of modularity are an indicator of the development of different types of knowledge and actor diversity. This structural characteristic of the network is a key element for its resilience, due to the capacity of the network to communicate different types of knowledge and to face external pressures.
Degree centrality	The number of relationships that a node possesses. In general terms, this measure of centrality makes it possible to identify the actors that handle the largest number of relationships within a network, or at least within a network module.	According toZhang and Luo (2017), degree centrality is one of the measures that can be associated with the power and influence of the actors in the networks.
Intermediation	Also called betweenness centrality, this measure corresponds to the property of different actors to act as intermediaries (bridges or brokers) between another set of nodes in a network (Freeman, 1977).	As has been noted byBodin and Crona (2009), intermediation can be associated with the modularity of the entire network, insofar as, by definition, the nodes with the greatest centrality of intermediation will be the actors who act as bridges between two or more modules in the network. Bridge actors allow a more efficient or faster flow of information and connect different stakeholder groups mobilizing collective action.

political capital of some key nodes (LA1 or Costa Humboldt NGO) across the State agencies, private donors and other local actors (fishers' organizations and local activists).

As we can see in the network analysis, the IMA implementation process enjoys the presence of multiple agent action networks. This has been crucial to supporting the administrative tasks of the applications, expanding the connections of the indigenous communities with other actors (e.g. environmental and indigenous rights NGOs, donors, universities, indigenous and non-indigenous activists) across the region and beyond.

The action network of the IMA in Chilean Patagonia is composed of leaders of indigenous communities, local activists (in most cases indigenous and non-indigenous people with technical expertise), Non-Governmental Organizations (NGOs) and State institutions (Araos et al., 2020). This network gradually began to support the applications, participating in reports on customary uses, baseline studies of natural resources and biodiversity and in mapping the area, enhancing the role of indigenous communities as stewards of their territories by monitoring their social and environmental variables. In other words, we can see that the IMA process has been turned into a learning community, where the indigenous people take the central role.

Following Bodin & Cronás (2009) network approach, a positive value may be assigned to actors' brokers, who connect the different modules. Especially relevant in the IMA network is the broker role of the local indigenous and non-indigenous activists, the indigenous communities' leaders (not individualized in the network) and national and international NGOs, which interact across the network connecting modules and mobilizing resources. The presence of a second tier organization is also important for the brokerage in the network, Willi Lafken Weichan and Indentidad Territorial Lafkenche play this role and the political representation in governmental arenas as well. The presence of these multiple broker actors implies the existence of a diversity of knowledge (e.g. indigenous and scientific) and experiences between the different modules, which could flow through the network and thereby improve the performance of the governance process, reducing the vulnerability to possible external disturbances.

The heterogeneity of the IMA network, expressed by its internal diversity and decentralization, favors a learning process between actors. This allows information flow about the critical knots of the administrative procedures (e.g. formal certification of the customary uses by CONADI or the IMA approval meetings in the Regional Commission of Coastal Zone Use), access to financial or technical support (e.g. by contacting NGOs, donors and universities) and cultural revitalization through the practice of rituals or indigenous ceremonies (e.g. Mapuche lellipun, an indigenous prayer). This requires a context-specific approach for revitalizing bio-cultural diversity (Anbleyth-Evans et al., 2022).

The spatial representation of the Los Lagos IMA action network presented in Figure 8 demonstrated that the territorial and institutional growth of the IMA is supported by a large variety of actors located in different geographical and administrative levels. These cross-scale dynamics (Cash et al., 2006) are reflected by the links that cross the Los Lagos Region to diverse nodes situated in Valdivia, Temuco, Santiago and overseas, which are at the same time part of specific modules identified in Fig. 6(e.g. module 0 or green color) which have an important presence of national and international NGOs. The modules fixed to specific territories also have a highly local core network (e.g. module 1 or purple color) mainly composed of indigenous communities and local activists. Hence, the analysis shows that more than 10 years after the enactment of the law, the establishment of the IMA has been based on a bottom-up, decentralized action network. They are increasingly organizing in multi-agent networks which promote horizontal collective actions across the diverse territories.

The IMA implementation process shows the complexity of its action network and the multiple layers which must be articulated to sustain participatory governance across the territory. The IMA action network

Table 2
Actors that compose the IMA network of the Los Lagos Region, indicating their participation in the network.

Actor type	Number of observations	Percentage in the Network
Mapuche Williche organizations	49	45.4%
Local activists (LA)	31	28.7%
NGO	15	13.8%
Municipalities	7	6.4%
Agents of the State	3	2.7%
Other organizations	2	1.8%
Salmon industry	1	0.9%
TOTAL	**108**	**100%**

of the Los Lagos Region clarifies some paths needed to move towards the participation and inclusion of indigenous peoples in the coastal and marine zone decision-making arenas that define the future sustainable transformation of the Chilean blue Patagonia.

7. Conclusions

The Indigenous Marine Area policy was created to fill an institutional lacuna in the recognition of the rights of indigenous peoples over ecosystems and fishing resources. The IMA became more complex over time, acquiring new meanings and purposes as they spread throughout southern Chile.

IMA offer several social and environmental contributions to the marine governance of blue Patagonia in terms of spatial planning, environmental justice and inclusive conservation, positioned as a key

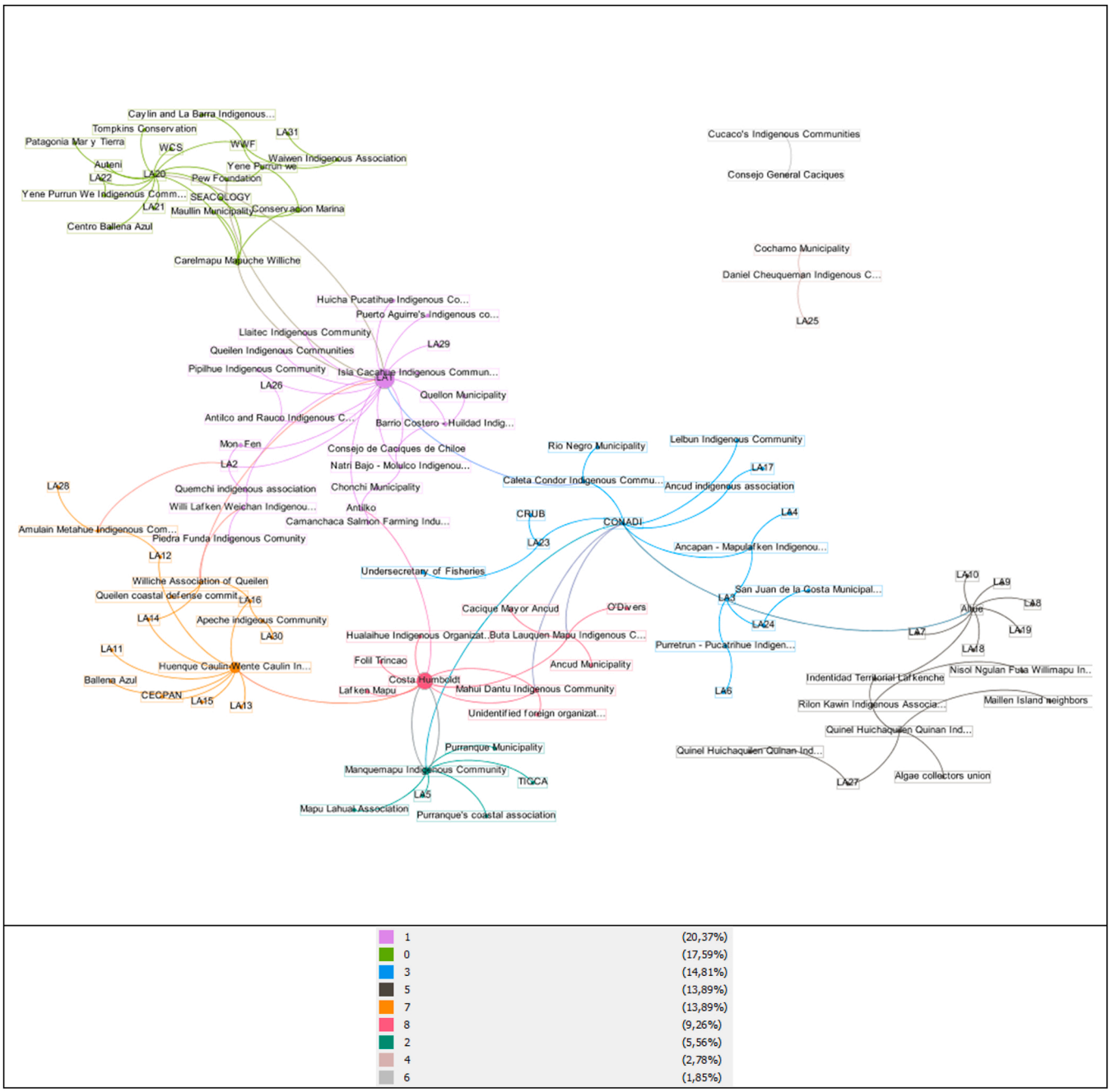

Fig. 5. IMA application network in the Los Lagos Region, modularity by colors and size of nodes by intermediation.

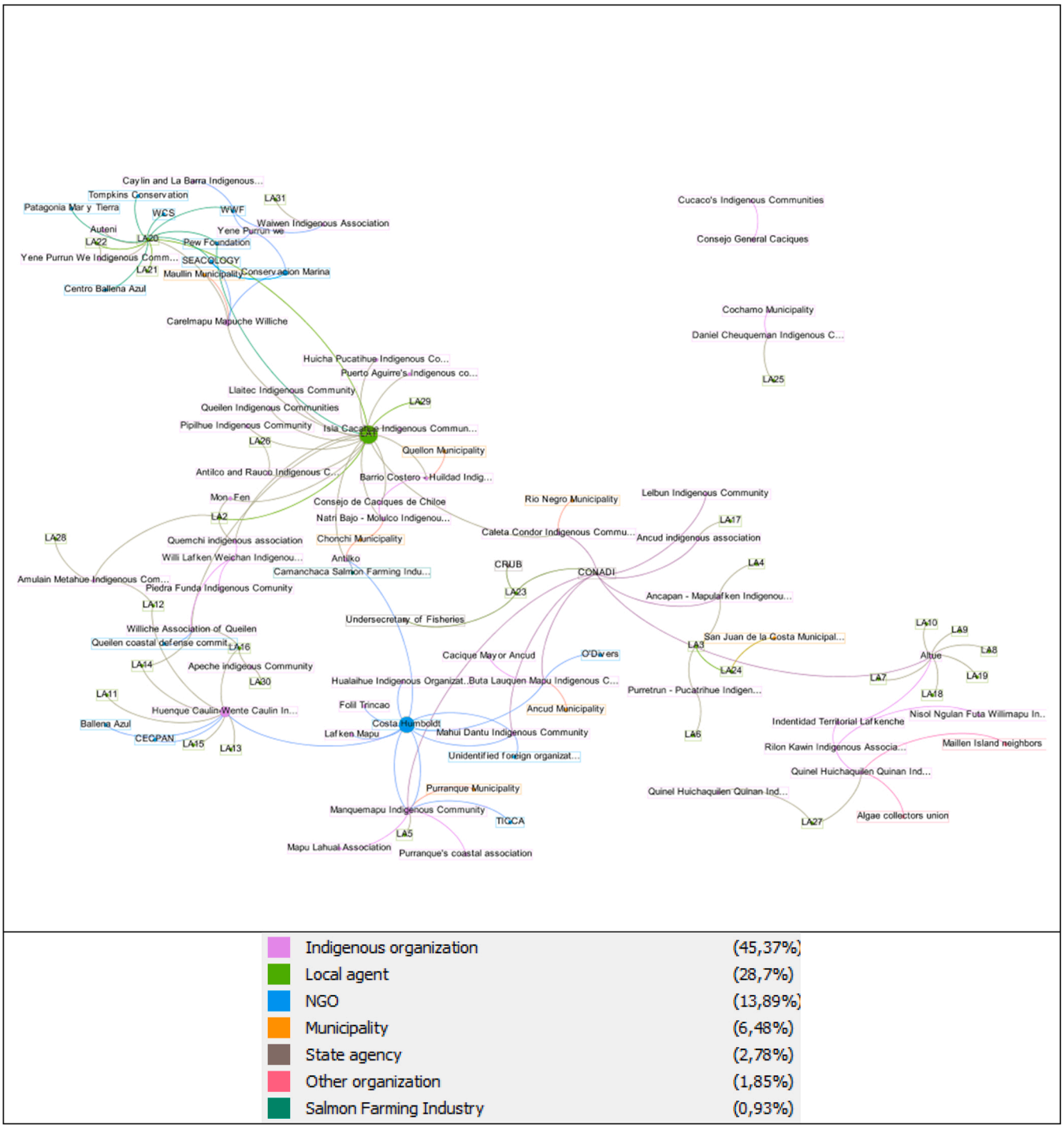

Fig. 6. IMA application network in the Los Lagos Region, actor types by color and size of nodes by intermediation. In this sociogram, the different colors represent the types of actors already identified.

instrument to face the blue Anthropocene.

In Chilean Patagonia, the IMA represent a key figure for promoting the sustainability of the marine-coastal zone by promoting processes to safeguard customary uses and the ecosystems that support them. Their contributions to marine conservation are undoubted; they refer to the possibility of establishing complementary conservation strategies oriented around local indigenous communities' rights that help already established projects and expand the models currently in use.

The blue Anthropocene represents the main challenge for IMA policy, considering the cumulative effects of diverse productive activities, conflicting interest, and the current and future impacts of climate change. IMA could operate as sheltered spaces in extensive multipurpose seascapes, as well as delimited areas that regulate practices and interests in specific areas of the sea, for example, in bays and fjords. These options are inseparable, so the spatial planning of the IMA must consider their connections both at the regional or intercommunal level as well as locally.

IMA action networks are composed of multiple agents that represent diverse social groups and actors. These networks are anchored in specific local territories and socioecological scenarios through the IMA applications (by identifying the threats, interests, narratives, the administrative task and the protection polygon), but as we show here,

Table 3
Measures of in-degree and out-degree actors. In-degree refers to the number of relations that a node receives from the other actors and out-degree is the number of relations the node has.

IN-DEGREE			OUT-DEGREE		
Actor	Type of actor	Centrality In-degree	Actor	Type of actor	CentralityOut-degree
CONADI	State Agency	9	LA1	Local Activist	14
LA1	Local Activist	6	LA20	Local Activist	13
WWF	NGO	4	Huenque Caulin-Wente Caulin	Indigenous organization	8
Costa Humboldt	NGO	4	Altue	Indigenous organization	8
Carelmapu Williche	Indigenous organization	4	Manquemapu	Indigenous organization	7
Willi Lafken Weichan	Indigenous organization	3	Costa Humboldt	NGO	6
Pew Foundation	NGO	3	Williche Association of Queilen	Indigenous organization	5
LA16	Local Activist	3	Buta Lauquen Mapu	Indigenous organization	5
LA3	Local Activist	3	Quinel Huichaquilen Quinan	Indigenous organization	4
LA2	Local Activist	3	Antilko	Indigenous organization	4

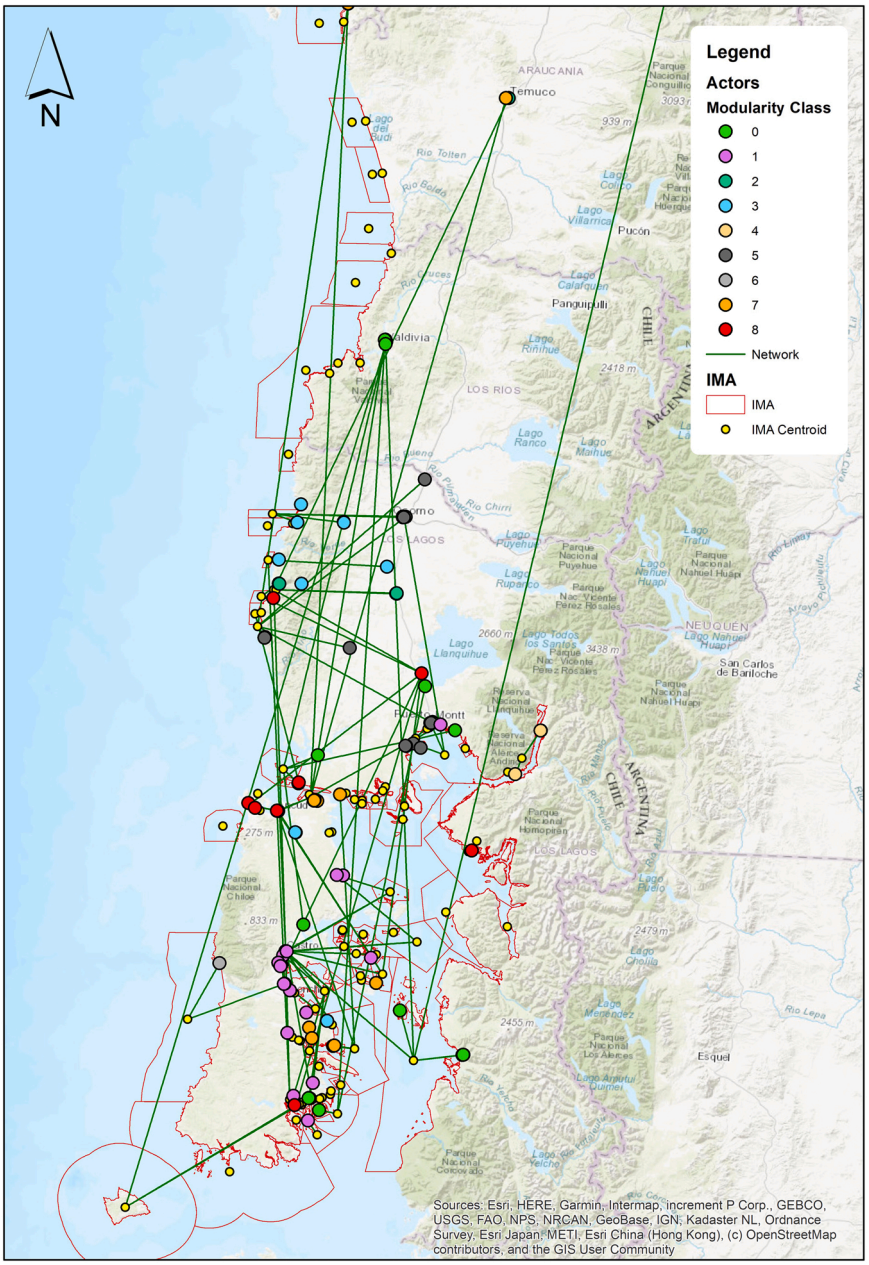

Fig. 7. Los Lagos Region IMA action network map. The map shows the localization of each actor (i.e. address) and its connections within the IMA network. The colors of each node are classified by its modularity measure.

they are modulated by the connections that expand their influence to other places and levels. There is a major potential contribution of IMA to the discussions of the UN Ocean Decade and challenges worldwide, as well as the possibility to incentivize local transformations of the current governance regime, introducing a novel interplay between agency and institutional architecture through action networks.

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CRediT authorship contribution statement

Conception and design of study: Francisco Araos. Acquisition of data: Francisco Araos, Francisco Brañas, Florencia Diestre. Analysis and/or interpretation of data: Francisco Araos, Carlos Hidalgo, Francisco Brañas, Jeremy Anbleyth-Evans, Allan Yu Iwama. Drafting the manuscript: Francisco Araos, Carlos Hidalgo, Jeremy Anbleyth-Evans, Allan Yu Iwama, Florencia Diestre. Revising the manuscript critically for important intellectual content: Francisco Araos.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data Availability

The data that has been used is confidential.

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