



Examining the conditions that activate linking social capital to transition environmental governance: empirical insights from Chile's coast

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Abstract

As socio-ecological systems undergo regional environmental change, there is a need to create adaptive governance that can manage uncertainty through the coordination of actors. Social capital can help overcome some of these challenges to facilitate a transition to adaptive governance, but social capital has often been treated as a catch-all phrase without offering strong theoretical or empirical contributions to how social processes influence governance outcomes. This paper addresses this gap by offering empirical insights into the conditions that activate individuals' linking social capital to form new institutions to adapt to environmental change in two small-scale fishing communities in southern Chile. We used a mixed methods approach to examine the relationship between linking social capital and whether or not our individuals in our study adapted their diving practices or joined new organizations as a form of adaptation. We then use ethnography to illuminate the community-level factors and mechanisms that fostered the ability for individuals to use their linking social capital to transition governance and why a collaborative transition was successful in one community, but not the other. This paper suggests that leadership, shared visions, and a culture of cooperation underpin successful governance transitions, while intra-community conflict inhibits transitions even when linking social capital is present.

Keywords Adaptive governance · Adaptation · Social capital · Marine resources · Longitudinal · Environmental change

Introduction

It is evident that socio-ecological systems are undergoing environmental change with unpredictable consequences. Although environmental change occurs globally, the effects manifest differently across spatio-temporal scales. In many regions around the world, the effects of global environmental change will be shouldered at the local and regional scale.

Therefore, as futures of socio-ecological systems become more uncertain, there is a need to create adaptive governance that can manage uncertainty and conflicts through the coordination of actors (Berkas 2017; Dietz et al. 2003; Folke et al. 2005; Lebel et al. 2006; Lockwood et al. 2010; Olsson et al. 2006). The responsibility to meet these governance challenges falls on the shared, collective effort of stakeholders to make decisions, choose goals, and act to achieve those goals (Chaffin et al. 2014; Chaffin and Gunderson 2016; Jentoft and Chuenpagdee 2009) through the creation of a set of regulatory processes, mechanisms, and organizations (Lemos and Agrawal 2006). Yet, the formation of adaptive governance is complicated by the constantly evolving nature of socio-ecological systems, the ever-changing linkages between globalized and local economies, and the diverse stakeholders who often have various objectives, needs, and access to resources.

Studies have shown what conditions management institutions need to promote adaptive governance to socio-ecological change, such as the capacity to learn from unpredictable events (Armitage et al. 2009), the ability to accommodate

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stakeholder views and address various interactions between actors (Chaffin et al. 2014), and the capacity to link to other institutions at different scales (Armitage et al. 2009; Dietz et al. 2003; Olsson et al. 2004). To facilitate the development of these conditions, individuals and local-level formal institutions must draw upon social capital (Adger 2010; Bourdieu 1986). While social capital has been defined in various ways, such as obligations and expectations, information channels and social norms (Coleman 1988) or social networks and intimacy or frequency of human interactions (Burt 1997), we use the original theoretical conceptualization of social capital developed by Bourdieu and Richardson (1986) which suggests that social capital is the relations of trust, reciprocity and exchange, the evolution of common rules, and the role of social networks within a society. Specifically, Bourdieu (1986) discussed social capital as the capital that gives individuals or institutions power to enact social change or upward mobility through access to institutions and resources. This understanding of social capital has been suggested by scholars as one of the main determinants of adaptive governance (Adger 2003; Armitage 2005; Chai and Zeng 2018; Dressel et al. 2020; Tompkins and Adger 2004) as people who have social capital within their communities, between communities, and between multi-level formal institutions have an increased likelihood of working together towards a common objective (Adger 2010; Agnitsch et al. 2006; Cinner et al. 2018). In socio-ecological systems, societies that have experienced environmental change can often be restored to a more robust state by individuals who draw upon social capital to facilitate formal institutional change (Bourdieu 1986; Chai and Zeng 2018).

With scholarship's focus on social capital as a determinant of successful adaptive governance, studies of adaptive governance have often treated social capital as latent, something that could be drawn upon in the case of some external disturbance (Crona et al. 2017; Dressel et al. 2020). While social capital is treated as latent, it has also been treated as a catch-all phrase to include social processes and consequences without offering strong theoretical or empirical contributions to how social processes influence adaptive governance outcomes (Crona et al. 2017). Previously, theorizations of social capital have focused on what social capital is in adaptive governance, rather than what it does (Aldrich 2012; Bodin and Crona 2008; Marin et al. 2015). This is likely because research on social capital often does not measure the effect of social capital on outcome variables, such as the adoption of adaptive practices or changes in governance (Crona et al. 2017), nor is there an understanding of the factors that enable actors to draw upon their social capital to achieve adaptation. This research addresses those gaps by focusing on linking social capital—the relationships individuals and groups at one level have with formal institutions at other scales (Agnitsch et al. 2006; Woolcock 2001)—to ask:

What social and cultural mechanisms enable actors to draw upon linking social capital to form or join new institutions to transition to adaptive governance? By asking this question, we draw upon Bourdieu (1986) conceptualization of social capital, as one that gives individuals or institutions power to create change, to move away from the sole focus on social capital as a determinant of adaptive governance to instead identify the community-level factors and mechanisms that precipitate individuals' abilities to activate linking social capital to form or join new formal institutions. To do this, we first quantitatively examine the relationship between linking social capital with three outcome variables: adaptation plans to socio-ecological change, joining new institutions, and changes in individual behavior. Then, we use ethnographic data to explain why individuals were able or unable to enact their linking social capital to create a transition to adaptive governance.

This paper offers new insights into the factors that facilitate individuals' abilities to draw upon linking social capital to form new institutions to adapt to environmental change using a case study of two small-scale fishing communities in the Lakes Region of southern Chile: Ancud, on the island of Chiloé, and Carelmapu on the mainland. In 2016, the Lakes Region experienced a high magnitude harmful algal bloom (red tide) which disrupted the region's economy and left fishers without a source of income for 6 months (Ebel 2018). In some communities, the red tide was a driver of collective action to transition governance. In others, it served as a point of contention as actors disagreed on ways to move forward with adaptation. Using a mixed methods approach, this research first quantitatively examines the relationship between the prevalence of linking social capital among multi-level actors and outcomes in adaptation. Then, we draw upon ethnography to identify the community-level conditions that fostered the ability for individuals to use linking social capital to transition governance through the coordination of multi-level actors and why a collaborative transition was successful in one community, but not the other.

Social capital and adaptive capacity in socio-ecological systems

In studies that examine the intersection of social capital and adaptation in socio-ecological systems, scholarship's main focus has been on the prevalence of social capital, broadly defined, as a determinant of adaptive capacity of both socio-ecological systems and individuals (Adger 2010; Donoghue and Sturtevant 2007; Dressel et al. 2020; Harrison et al. 2016; Whitney et al. 2017). Adaptive capacity, defined as the latent ability of a system or individual to respond proactively and positively to stressors or opportunities (Whitney et al. 2017), allows for individuals and institutions to respond to environmental change and adapt livelihoods and governance.

Social capital has been found to underpin successes in individual and institutional adaptive capacity (Crona et al. 2017; Chai and Zeng 2018; Harrison et al. 2016), specifically in the context of individual and community responses to natural disasters and regional climate change impacts (Marin et al. 2015; Marín 2019; Monteil et al. 2020; Pelling and High 2005). As a latent resource, social capital can be activated by individuals, often leaders, who are able to draw upon social capital to facilitate certain governance outcomes (Crona et al. 2017; Krishna 2002).

Three forms of social capital are discussed in relation to human's adaptive capacity in socio-ecological systems, including (1) bonding, the social relationships between individuals in the same group; (2) bridging, the social relationships between different groups; and (3) linking, the relationships individuals and groups at one level have with institutions at other scales (Agnitsch et al. 2006; Cinner et al. 2018; Pelling and High 2005). For individuals or institutions to have a high adaptive capacity, all forms must be present (Agnitsch et al. 2006; Pelling and High 2005; Whitney et al. 2017). All forms have been found in a diversity of natural resource settings, ranging from empirical-based studies of community-based management (Armitage 2005; Islam et al. 2011; Katz 2000) to recovery in post-disaster scenarios (Marín 2019; Marin et al. 2015; Monteil et al. 2020) and climate change adaptation (Pelling and High 2005; Wolf et al. 2010; Saptutyningsih et al. 2020).

In post-disaster scenarios, social capital has been shown to contribute to individual and community-level recovery (Marín 2019; Monteil et al. 2020). For example, Monteil et al. (2020) found that after a volcanic eruption on the Caribbean island of Montserrat, recovery of the island's communities was improved by the social cohesion created by social capital held between individuals and between multi-level institutions. Within the context of climate change and socioeconomic change, social capital has been demonstrated to be an integral contributing factor to social adaptation across diverse socio-ecological systems, from agricultural systems in Ghana (Abdul-Razak and Kruse 2017) to tropical coastal communities dependent upon marine resources (Cinner et al. 2018).

Not all forms of social capital are equal in their contribution to adaptive capacity. Studies of post-disaster recovery, adaptive capacity to climate change, and socioeconomic shifts illustrate that certain forms of social capital contribute to recovery and adaptation over others (Harrison et al. 2016; Marin et al. 2015; Monteil et al. 2020). Harrison et al. (2016) found that bonding social capital often prevented individuals from cultivating bridging and linking social capital within some forest communities in the United States' Pacific Northwest because internal conflict occurred among community members, preventing the formation of horizontal linkages needed for effective community networks. Communities

that had stronger bridging and linking social capital in the forms of vertical linkages between communities and external decision-makers were found to be more adaptive to economic and demographic changes (Harrison et al., 2016). However, in the absence of linking social capital, bridging social capital was not enough to ensure desired outcomes (Harrison et al. 2016). This is similar to Marin et al.'s (2015) study of a post-disaster scenario in Chile where, after an earthquake and tsunami in 2010, linking social capital was the key social capital that determined community recovery successes. Despite linking social capital's contribution to adaptation and post-disaster recovery in several recent studies (Harrison et al. 2016; Marin et al. 2015; Whitney et al. 2017), it has been called a "forgotten" component of social capital (Nunez 2016) and has historically been overlooked in its significance to the successful transition to adaptive governance (Chai and Zeng 2018; Dressel et al. 2020).

Linking social capital as a key to transitions to adaptive governance

It is well known that social capital can shape institutional forms and outcomes in the governance of natural resources (Adger 2010; Crona et al. 2017). More recently, a focus has turned to linking social capital which has been demonstrated to underpin transitions in governance and the emergence of adaptive formal institutions (Chai and Zeng, 2018; Dressel et al., 2020). Linking social capital between individuals and communities can mobilize individuals to act collectively in the face of environmental change and can generate the connections needed between institutions at multiple levels to facilitate a flexible and dynamic response (Adger 2003; Bodin and Crona 2009; Chai and Zeng 2018; Marin et al. 2012; 2015). Thus, a theoretical and empirical focus on linking social capital can elicit an understanding of how individuals' social relations relate to outcomes in environmental governance (Chai and Zeng 2018).

By examining the change of informal and formal irrigation system's water distribution rules over 50 years in Guandong, China, Chai and Zeng (2018) show that when a long-term self-governing system is affected by an external perturbation, it can be transitioned to a robust state through drawing upon linking social capital between the community and higher level institutions to create new institutional measures. Similarly, Dressel et al. (2020) illustrates that the multi-level governance structure of Sweden's moose management system is adaptive because of the linkages between individuals and external formal governing bodies. As in Chai and Zeng's (2018) and Dressel et al.'s (2020) studies, linking social capital is used in this study to understand outcomes in adaptation and governance transitions. However, we provide a comparative study between two communities that both quantitatively measure the prevalence of linking social

capital between multi-level actors as well as qualitatively explores the factors that activate linking social capital to transition to adaptive governance. In particular, this paper examines how certain conditions precipitated linking social capital and contributed to a governance transition in one community but not the other.

The impacts of regional environmental change and a shift to adaptive governance in the Lakes Region of southern Chile

In 2016, the Lakes Region of southern Chile experienced a large-scale red tide caused by increasing sea surface temperatures, high chlorophyll levels, and poor practices in large-scale finfish aquaculture (Buschmann et al. 2016; Daughters 2018). The red tide devastated the region's economy, causing the widespread death of marine species, closing wild fisheries to harvesting, and prohibiting the export of aquaculture products. As red tides are predicted to occur more frequently due to the impacts of regional environmental change and the environmental degradation from expansion of the aquaculture industry (Buschmann et al. 2016), individuals and institutions are faced with new challenges that demand transitions in marine resource governance.

Over two decades prior to the 2016 red tide, national level marine governance in Chile began with the creation and implementation of Chile's small-scale fisheries policy, Management and Exploitation Areas for Benthic Resources, more widely known as Territorial User Rights in Fisheries (TURFs) policy. Chile's TURFs policy was implemented in 1991 under the Fisheries and Aquaculture Law (FAL) in response to the overexploitation of benthic resources. The policy incentivized cooperation at the local scale by allowing fishers to form local fishing unions to gain access rights to productive harvesting areas. The policy has had significant success since its implementation, improving inshore abundance and diversity of species, creating a diversity of marine ecosystem services, and empowering local communities to become stewards of the resources on which they depend (Gelcich et al. 2010, 2017, 2019; Moreno and Revenga 2014). Although the TURFs policy has facilitated fishers' acquisition of knowledge and the restoration of species abundance and biodiversity (Gelcich et al. 2010), the TURFs policy did not account for global change, particularly the more regional impacts of climate change and the proliferation of large-scale salmon aquaculture in the region. In 2013, the FAL was amended, implementing legislation that moved away from localized decision-making in TURFs to multi-stakeholder collaboration through the formation of management committees. In the Lakes Region, the amendment created an opportunity for fishers to form a management committee that can govern larger areas where they can diversify their livelihoods through fishing, tourism, and

small-scale shellfish aquaculture (Ebel 2020). In addition, they can create no-take protected areas and defend themselves from the infiltration and impacts of large-scale salmon aquaculture (Ebel 2020).

The formation of a management committee requires collaboration and communication across multiple levels of actors and institutions, including fishing unions, independent fishers, government officials, processors, Indigenous peoples, and other stakeholders (Ebel 2020; Gelcich 2014). Theoretically, it requires fishers to have linking social capital with higher level institutions to create a management committee. Below we examine the prevalence of linking social capital in two communities, where one community has created an established management committee and where one community has been unable to do so. We then explain the conditions and mechanisms that contributed to the existence and application of linking social capital.

Methods

This study used mixed methods to collect both quantitative and qualitative data. Qualitative, ethnographic data was gathered by the first author between 2016 and 2020. Quantitative data was gathered through a structured survey in 2018. Our mixed methods approach allows us to combine the strengths of qualitative and quantitative research approaches in a single case-study to answer the same research question and come to a more complete understanding of our research problem (Creswell and Garrett 2008). Further, by using a combination of explanatory and exploratory research designs, we are able to use our qualitative data to explain and extend our analysis of our quantitative survey results, thus highlighting not only the statistical relationship between linking capacity and adaptation outcomes, but also highlighting the broader social mechanisms that enable our participants to draw on that linking capacity to enable adaptation (Heigham and Croker 2009). The study sites and ethnographic and quantitative methods are described in detail below.

Study sites

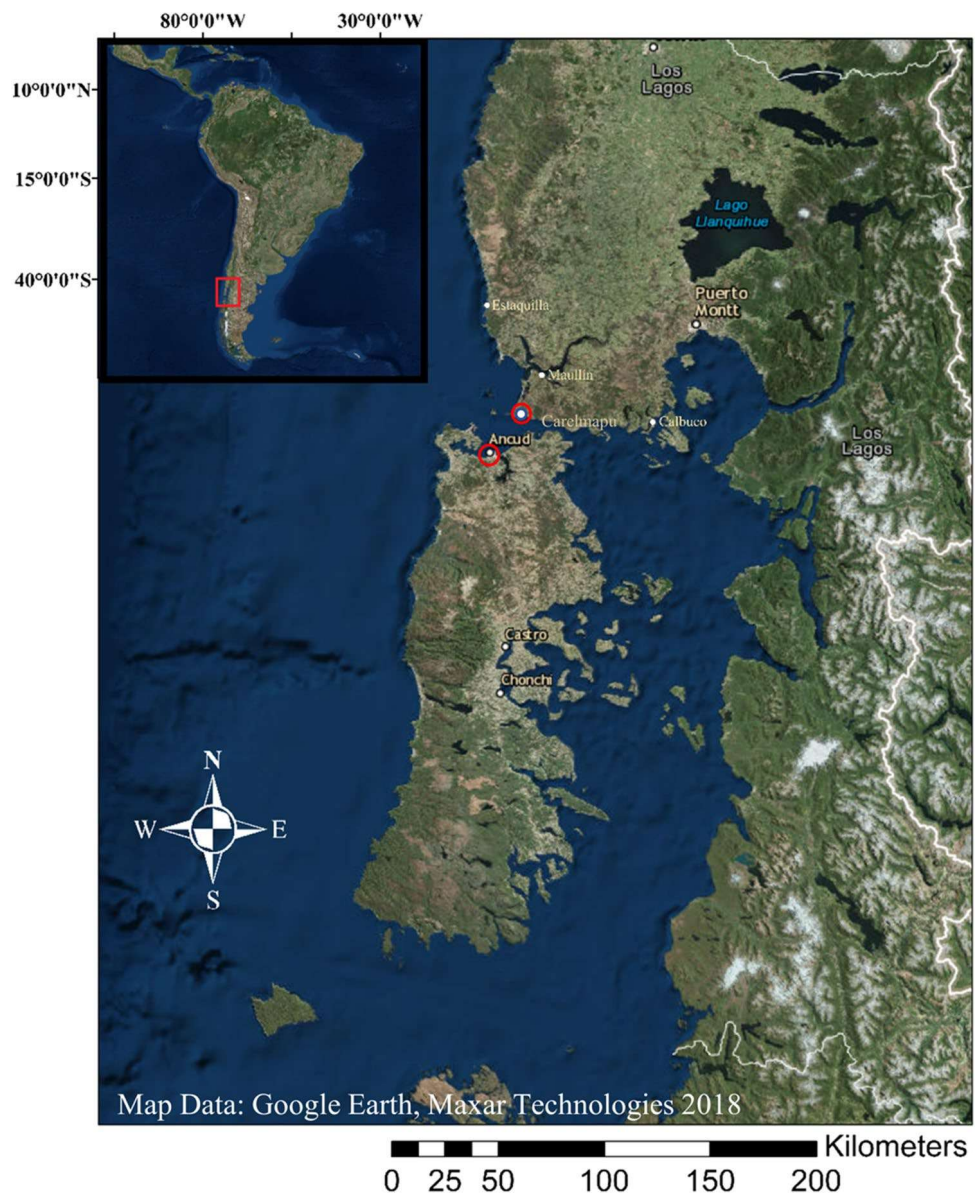
The Lakes Region is home to many rural communities whose livelihoods depend on the harvests of marine species, specifically the harvests of shellfish and seaweed (Ebel 2018). The Lakes Region is the most fisheries-dependent region in Chile (Moreno and Revenga 2014) as well as one of the most impoverished (Latta and Aguayo 2012; see OECD.stat 2021). Currently, around 24,000 individuals in the region are registered as benthic resource harvesters and participate in local fishing unions, called *sindicatos*. Around 28% of individuals in the Lakes Region identify as Original Peoples

(INE 2018) and, in many communities, Original Peoples are active in marine resource management decisions. In the two communities discussed in this paper, 29% of the population in Ancud on Chiloé Island identify as Original Peoples (Indigenous) while 22% of Carelmapu's population identifies as Indigenous (INE 2018). As salmon aquaculture has rapidly grown in the coastal zone since the early 2000s, more individuals have become reliant on the jobs provided by this global industry, including many children of benthic resource harvesters as the aquaculture farms provide increased wages and more reliable work hours (Daughters 2019; Pitchon 2015). However, the global economy of salmon aquaculture has created a tension in the Lakes Region, specifically on the island of Chiloé, where the global economy has changed family structure and mobility and promoted territorial

abandonment, diminishing aspects of traditional ways of life (Barton et al. 2013; Lazo and Cavajal 2018).

To examine the role of linking social capital in transitioning to adaptive governance, both ethnographic and quantitative research were conducted in two communities over 3 years (Fig. 1). Carelmapu is a rural community of 2800 people at the end of a peninsula on the mainland. The Lafkenche Indigenous Community in Carelmapu has recently proposed an Indigenous marine protected area, called a Marine Coastal Spaces for the Original Peoples (ECMPO), as a response to the red tide and the threat of offshore salmon aquaculture development. In Carelmapu's port, there are five active fishing unions, totaling 125–200 fishing union members. Ancud is an urban center on the northern end of Chiloé with a population of around 40,000 people. In the main port, called *El Muelle del Ancud*, there

Fig. 1 Map of the Lakes Region, Chile. Ancud and Carelmapu are circled in red



are seven active fishing unions, totaling between 175 and 250 fishing union members.

Ethnographic methods and analysis

Between July–September 2016 and January–June 2018, the first author conducted semi-structured interviews with 45 individuals ($n=45$), of which over 38 h are recorded and transcribed. The interview guide questioned individuals about the following themes: (1) demographics, (2) social learning and adaptation, (3) social capital and collective action, and (4) flexibility of institutions and livelihoods—mainly how individuals and institutions responded to environmental and policy change, with a focus on whether or not they formed or joined a new formal institution, changed their individual behavior, or had a plan to adapt. Participants were recruited through snowball sampling where the first author built off of her pre-existing relationships with fishers from research in 2010 and 2016. Research participants included fishing union members, independent fishers, and members of the Lafkenche Indigenous Community. These groups are not mutually exclusive, and some fishing union members and independent fishers also belong to the Indigenous Community.

The first author also conducted over 9 months of participant observation where she spent time with fishers in their homes, on fishing docks, and in meetings with fishing unions and the Indigenous Community. In addition, between 2018 and 2020, the first author had monthly virtual informal discussions with research participants. In total, she logged over 800 h of informal conversations with fishers, Indigenous peoples, and their families where she took extensive field notes, documenting individuals' perceptions of socioeconomic change and marine resource governance, their connections within and outside their communities, and their visions for the future of their communities. In addition, between February and May 2018, the first author attended five fishing union meetings and three Indigenous Community meetings which allowed her to understand the ethnographic context of local level institutions and vertical and cross-scale linkages between fishers, Indigenous peoples, government officials, and universities.

Semi-structured interviews and field notes were transcribed and manually coded for themes by the first author using inductive coding and then translated by the first author. Themes were determined salient if they arose three or more times in an interview and they were considered to represent a pattern across groups if they arose across ten or more interviews. Coding of the raw ethnographic data illustrated that the communities of Ancud on Chiloé and Carelmapu were responding differently to the red tide and that there was conflict between groups within the community of Carelmapu whereas individuals in Ancud were able to collaborate

across institutions to form a management committee. To better understand the underlying conditions that fostered collaboration in one community but not the other, the first author administered a structured survey to gather data on the factors that contributed to governance transitions. As detailed below, we wanted to measure the prevalence of linking social capital between local institutions, such as fishing unions and the Indigenous Communities, and government agencies and universities.

Structured survey

Between April and May of 2018, the first author administered 68 structured surveys to fishers in Carelmapu and Ancud on Chiloé. These surveys were administered in-person and orally, with the first author reading the survey to each participant to account for literacy issues. Each survey took around 30 min to complete. The structured survey measured individuals' levels of agreement with statements associated with (1) linking social capital, measured as individuals' connections to government officials and universities, and (2) individual adaptation outcomes, specifically whether or not an individual joined a new organization, had a plan to adapt, or changed their behavior after the red tide. The survey also included questions related to individual and institutional flexibility, values, collective action, and social learning, which are not treated in this paper. Participants were recruited on fishing docks and at fishing union and Indigenous Community meetings. The first author approached each individual to ask their willingness to take a survey. Sixty-eight out of seventy individuals asked agreed to take the survey (97%).

Quantitative data analysis and variable measurement

Outcome variables

Below, we present the results from three logistic regression models to assess how linking capacity influences whether or not survey respondents: (1) joined a new organization to adapt to the 2016 red tide; (2) self-reported that their organization had a plan to adapt to the 2016 red tide; and (3) adapted their fishing practices to adapt to the 2016 red tide. To measure if respondents had joined a new association after the 2016 red tide, we asked “did you join a new association after the red tide in 2016?” We gave the outcome variable in model 1 a value of 1 if the respondent had joined a new organization and a value of 0 if they had not. To measure if their association had a plan to adapt to red tide in the future, we asked respondents how much they agreed with the following statement “my association has a plan to adapt in the event of another red tide in the future,” with the

response options measured on a five point Likert scale ranging from 1 = “I strongly disagree” to 5 = “I strongly agree,” with 3 = “I don’t know.” We gave the outcome variable in model 2 a value of 1 if the respondent somewhat or fully agreed and a value of 0 if they somewhat or did not agree or if they did not know. To measure if respondents had adapted their diving practices after the red tide, we asked if they had “adapted my diving or harvesting practices after the red tide.” We gave the outcome variable in model 3 a value 1 if respondents indicated they had adapted and a value of 0 if they indicated they had not.

Predictor variables

To measure linking social capacity, we asked respondents how much they agreed with the following statements: (1) I speak with people at universities who study artisanal fisheries; (2) I regularly speak with leaders from national confederations; (3) sometimes I talk with state policymakers to communicate my organization’s needs; (4) I have connections to state government; and (5) I have the information I need to make informed decisions. Response options were measured as 5-point Likert scale, with values ranging from 1 = “I strongly disagree” to 5 = “I strongly agree,” with 3 = “I don’t know.” Because an “I don’t know” response does not represent a true middle point, all three values were re-coded as twos. High correlations between the individual items used to measure linking capacity suggested that the items are multi-dimensional and factor analysis could be used to reduce the number of items to a set of factors that measure the latent dimensions of linking capacity. To accomplish this, we conducted an exploratory factor analysis using the three survey items (Table 1). We present the results of the factor analysis here because the factor we generated is used as a predictor variable in the models presented below. To determine the number of factors to retain, we examined scree plots of the factors and those located above the sharp elbow were kept and those below it were removed (Costello and Osborne 2005). We calculated a Cronbach’s alpha score for each item strongly associated (> 0.5) with the factor to

measure its internal consistency. Generally, values of 0.70 or higher indicate sufficient scale reliability (Nunnally 1978). To compute factor scores that measure the location of each survey respondent on the factor, we used a regression scoring, which generates a factor score as the weighted sum of each item by assigning a scoring coefficient to each based on its factor loading and correlation with other items. This method provides a more reliable score than a summative or mean score because of the optimal weighting of each item (Acock 2013).

Control variables

We included several control variables to account for the influence of sociodemographic variables on the response variables. The included variables were whether or not respondents had a high school degree, monthly income, age, membership in an Indigenous community, had a bank account, whether or not they received a government subsidy for the red tide, being or feeling like a leader in their community, and union membership.

Finally, prior to running the models, we calculated pairwise correlations for all predictor variable models to check for multicollinearity. All pairwise correlations were below 0.6, leading us to retain all the predictor variables. Further, we calculated a variance inflation factor for all three models, all of which fell below 1.5, which is below the commonly used heuristic that suggests a score of 10 or higher indicates a potential problem with multicollinearity.

Results and discussion

This section reports on the results from both quantitative and qualitative analysis of linking social capital and associated themes to understand how local level actors draw upon their relationships with hierarchical institutions to transition to adaptive governance. First, we present the findings from the quantitative data. Then, we explain our findings through a close examination of the ethnographic data.

Table 1 Description of survey items measuring linking capacities. Item scale: 1 = strongly disagree, 2 = somewhat disagree, 3 = somewhat agree, 4 = strongly agree

Item description	Rotated factor loadings ^a Linking capacity
I speak with people at universities	0.73
I speak with leaders from national fishermen confederations	0.79
Sometimes, I talk to state policymakers	0.81
I have connections to state government officials	0.71
I have the information I need to make informed decisions	0.74
Cronbach’s alpha	.81
Eigenvalue	2.87

^aOblique promax rotation

Quantitative data

We summarize the result of our three logistic regression models in Table 1. In each of our models, linking social capacity had a positive, statistically significant relationship with the outcome variable at at least the 5% level. In model 1, higher scores on the linking social capital factor were positively associated with having joined an association after the 2016 red tide, and for each one unit increase in linking social capital, the odds of reporting having joined a new association were 7.54 times higher for respondents. In model 2, linking social capital was positively associated with respondents reporting they had a plan to adapt to red tides, and in model 3, those with higher linking social capital scores were more likely to report having taken an individual action to adapt to red tides. These results suggest that there is a clear statistical relationship between linking social capital and an individual's ability to form new institutions or change their own behavior to adapt to environmental change. In what follows, we use ethnographic data to explain how the contextualized conditions of each study community enables or delimits individuals' abilities to draw on linking

social capital to develop new formal institutions to adapt to regional change [Table 2].

Ethnographic data

Four salient themes emerged from semi-structured interviews and informal conversations with local level actors related to why one community was able to transition to collaborative, multi-level governance (Table 3). The themes include (1) linking social capital, described as any social connections local level actors had with hierarchical formal institutions; (2) conflict, which included any mention of conflict between local level actors or between actors across levels; (3) shared visions, when local level actors had a collective vision for the future of marine governance; and (4) plans to adapt, including how individuals said they were adapting to environmental change.

Through analysis of our qualitative data, we found that linking social capital between fishing unions and higher-level institutions were frequently mentioned in discussions related to adaptation plans in Ancud, primarily by leaders of fishing unions. In Ancud, fishers had drawn upon their connections

Table 2 Logistic estimates of the empirical models for estimating the relationship between linking social capital and adaptation outcomes

Variable	Model 1 (joined) ^b		Model 2 (plan) ^c		Model 3 (adapt) ^d	
	Odds ratio ^a	Standard error	Odds ratio ^a	Standard error	Odds ratio ^a	Standard error
Community						
Ancud	Baseline					
Caremapu (1 = yes)	0.61	0.53	0.50	0.39	1.21	1.30
Individual characteristics						
High school degree (1 = yes)	1.67	1.57	5.97	5.33	0.60	0.68
Monthly income 100–200	Baseline					
Monthly income 201–300	1.88	1.48	1.17	0.85	3.02	3.19
Monthly income 301–400	6.83	9.94	0.32	0.35	30.24*	63.04
Monthly income 401 +	1.74	2.92	0.06*	0.09	7.62	16.38
Age (young)	Baseline					
Age (middle)	4.24	4.49	2.28	2.18	1.82	3.65
Age (old)	9.75	16.73	1.83	2.49	9.84	1.97
Member of Indigenous community (1 = yes)	0.11*	0.14	0.29	0.33	1.64	3.30
Have a bank account	0.39	0.47	1.96	1.92	12.41	22.96
Bonus received	0.78	0.81	0.91	0.80	0.15	0.26
Community leader	0.04**	0.05	0.30	0.33	0.20	0.38
Feel like leader	2.32*	1.04	1.10	0.34	0.71	0.32
Fishing union member	4.94	5.67	1.69	1.61	1.04	1.46
Linking social capital						
Linking social capital factor	7.54***	6.43	2.62**	1.33	9.30**	9.13

^a $p < 0.1$; * $p < 0.05$; ** $p < 0.01$ ***

^b $R^2 = 0.28^{**}$

^c $R^2 = 0.20^{**}$

^d $R^2 = 0.55^{***}$

Table 3 Themes that arose from ethnographic data in Ancud and Carelmapu

Theme	Theme description	Ancud (n = 20)	Carelmapu (n = 25)
Linking social capital	Any social connections between local level actors, government officials and university scientists. Leaders of local institutions were found to have more vertical linkages than non-leaders	10	8
Conflict	Includes any mention of conflict between local level stakeholders or between different levels of stakeholders	4	23
Shared visions	When stakeholders at the local level shared a vision for the future of marine governance	20	10
Plans to adapt	Stakeholders discussed how they planned to adapt to environmental change	18	16

with state officials and universities to develop a Management Committee which brought together fishers, Indigenous peoples, seaweed harvesters, government officials, seafood processors, and university researchers. The Management Committee's objective was to transition governance from a focus on smaller areas (TURFs) to a larger, diversified use area. When asked what factors fishers felt helped them create this new institution and form a larger management area, fishers in 10 out of 20 interviews in Ancud said that they had connections with university researchers, government officials, and/or fisher confederation leaders that helped them facilitate this process. In addition, when fishers were asked about their visions for the future of marine governance, fishers in 20 out of 20 interviews had similar visions for the future of marine management and their communities, specifically that they wanted to have a larger management area to diversify their livelihoods and protect themselves from large-scale aquaculture.

In Carelmapu, fewer individuals mentioned having linking social capital with the exception of three Indigenous Community leaders and five fishing union leaders who had connections to state officials. Although both the Indigenous Community and fishing union leaders had linking social capital, only the members of the Indigenous Community were seeking to transition governance to form an ECMPO under the Lafkenche Law, a law implemented in 2009 that returned ancestral rights to the ocean back to the Original Peoples of Chile. Fishing union leaders wanted to maintain the status quo of management through TURFs, and only proposed having spearfishing for finfish as an adaptation option. Our ethnographic data illustrated that there was a conflict in Carelmapu between the Indigenous Community and the non-Indigenous fishers. Although these two groups are not mutually exclusive, the non-Indigenous fishers were unwilling to cooperate with the Indigenous Community to form a Management Committee that would govern the proposed ECMPO because the non-Indigenous fishers perceived that they were losing power in governance. In Ancud, the only conflict discussed was how the management committee was trying to defend their coastal management spaces from the development of large-scale aquaculture industries.

The quantitative relationship between linking social capital and outcomes in adaptation suggests that in both Ancud and Carelmapu, individuals who had connections to hierarchical institutions were more likely to have joined a new institution, had a plan to adapt, or changed their behavior after the red tide. In addition, whether or not an individual was a community leader was also correlated with the outcome variables: if an individual was a community leader, they were more likely to have had a positive adaptation outcome. Our qualitative data corroborates these quantitative relationships as we found that individuals who discussed their connections to government officials and universities also discussed their community's transition to more adaptive governance. Furthermore, we found that the individuals who had connections outside of their fishing unions were community leaders. Here, we use ethnographic data to better explain the relationship between linking social capital and adaptation outcomes and identify the community-level mechanisms that underpin or inhibit governance transitions to show how social processes influence governance transitions (Crona et al. 2017a). We propose that linking social capital is essential to the transition to adaptive governance in natural resource contexts, and that several community-level factors are necessary to facilitate individuals' abilities to draw on their linking social capital, including leadership, shared visions, and cooperation, as we illustrate in the case study of Ancud. Here, leadership means that leaders of institutions held the same visions as their constituents which facilitated the transition to adaptive governance. Lastly, we suggest that intra-community conflict can hinder collaborative governance transitions even when linking social capital is present, as shown in the case study of Carelmapu.

Activating linking social capital to transition governance in Ancud: a result of leadership, shared visions, and cooperation

While the existence of linking social capital and its relationship to adaptation outcomes was evident in Ancud on Chiloé through our quantitative analysis, we can better understand the mechanisms that activate linking social capital when we

analyze the social and cultural foundations that precipitated its creation and activation. In Ancud, fishers drew upon their linking social capital to collaborate between fishing unions and with independent fishers, seafood processors, seaweed harvesters, Indigenous Communities, universities, and the government to create a new institution, a Management Committee, under the 2013 FAL amendment. Below we describe how fishers activated their linking social capital by identifying several mechanisms that precipitated the formation of this new formal institution, including leadership, shared visions for governance, and a culture of cooperation. It is these community mechanisms that enable individuals to participate in, and influence, the transition to adaptive governance, as suggested by the foundational concept of social capital by Bourdieu (1986).

Leadership and shared visions as a prerequisite to activating linking social capital

After the red tide in 2016, fishers in Ancud began in earnest to transition governance from the TURFs policy to a Management Committee. Although fishers had begun this transition prior to the 2016 red tide to protect themselves from growing ocean industries, the severe impacts of the red tide pushed them to move more quickly on developing a larger management area to protect their marine resource access.

In Ancud, individuals' abilities to activate linking social capital to create a new formal institution was in part a result of leadership and shared visions for governance. This is corroborated by several studies that suggest that leadership must be present because social capital is not always enough to foster natural resource management, community sustainability, or governance transitions (Bodin 2017; Crona et al. 2017a, b; Dale and Newman 2010). While leadership is sometimes complicated because leaders sometimes place their own needs and objectives above the group's (Bodin 2017), we found that in Ancud, leaders reflected their members' visions for governance transitions, which fostered cooperation and collaboration across actors. This was evident in the meetings where these multiple stakeholder groups came together to discuss adaptation and the future of their community. In our qualitative interviews and during our participant observation at meetings, we found that fishers had similar visions for the future of marine management and their communities, saying that they wanted to diversify their livelihoods and make change through policy development that protected them from the growing aquaculture industry and impacts of regional environmental change. Their shared vision is encapsulated by one fisher's perspective when he said,

We need larger, more inclusive areas. We are contained to the management areas [TURFs] and there are others who cannot enter these areas because they are not

union members. We need to all be involved together in another area. We must try to do things together because there is no work anywhere else. We need to think of something else to take care of ourselves and the ecosystem.

Shared visions for governance have been shown to facilitate collective action (Adger 2010; Rudd 2000) and similar preferences for adaptation (Ebel et al. 2020) and environmental governance transitions (Bodin and Prell 2011; Ebel 2020). Between 2015 through 2018, diverse groups of stakeholders held meetings to discuss the future of their *caleta* and learned that they shared visions for their future, as described in the quote above. The joining of individuals from multiple institutions in these meetings allowed multi-level actors to facilitate a governance transition, to create a new institution, the Management Committee, which could develop and declare a new management area that allowed for their desired community adaptation and sustainability. The new management area not only allowed fishers to continue to dive for benthic resources in TURFs, but also allowed for the creation of a no-take marine protected zone for marine research and areas for aquaculture concessions for small-scale shellfish aquaculture. In addition, it allowed for independent fishers who do not belong to unions to apply to the Management Committee to fish in open-access zones within the management area.

A culture of cooperation activates linking social capital to promote governance transitions

In addition to leadership and shared visions for governance, we suggest that a deeply embedded culture of cooperation and reciprocity on Chiloé Island, where Ancud is located, also activated local actors' linking social capital. Chilotes, including people from Ancud, have a culture of reciprocity dating back prior to Spanish colonization (Daughters 2019) and have an identity and way of life tied to both isolation and mobility (Baldacchino 2003; Lazo and Cavajal 2018). While Chilotes have been mobile and migratory since time immemorial due to their needs for work and resources (Lazo and Carvajal 2018), Chilotes have also maintained many of their traditions and cultural ways of life even after colonization and the founding of Chile. Prior to, and during, colonization, Chilotes had a reciprocal labor system where individuals exchanged work with neighbors and community members. Called *la minga*, this reciprocal labor consisted primarily of sowing and harvesting crops or moving houses for neighbors (Daughters 2019). Community members relied on *la minga*, as the work they did for their neighbors was reciprocated when they needed it. This system fostered strong social connections and a culture of cooperation (Daughters 2019). While *la minga* still exists today, the individuation of islanders through new capitalist mobility, including youth

emigrating to urban centers for work and modern conveniences and women entering the workforce, has weakened this traditional practice (Lazo and Carvajal 2018). However, many young Chilotes recognize that *la minga* and Chilotes' shared values of community and rural life are unique to their home and influence their interactions with neighbors and strangers alike (Daughters, 2019).

Remaining largely unchanged by outside influences until the 1960s and early 1970s, the overthrow of Chile's democracy by Pinochet's authoritarian regime (Daughters 2019), followed by the 1980s shift from subsistence to a global economy, specifically the aquaculture industry (Barton and Román Castillo 2016; Lazo and Cavajal 2018), thrust Chiloé into a wage labor economy (Barton and Román Castillo 2016; Daughters 2019; Lazo and Cavajal 2018). This shift has created a tension between traditional ways of life and modernity, what Lazo and Cavajal (2018) call a new "habitat" for Chiloé (152). Increasing opportunities for wage labor through work at aquaculture farms in some ways has disembedded individuals from their social ties, yet Chilotes say that they still maintain their culture of reciprocity as it is inextricably tied to their identity (Daughters 2019; Lazo and Cavajal 2018). We suggest that despite these transitions, a culture of reciprocity and the evolution of cooperation underpins individuals' collaboration in transitioning marine governance in the context of this paper. The evolution of cooperation has been shown to arise through centuries of resource dependence in hostile climates (Brooks et al. 2018; Safarzynska 2017) or defense against outsiders during times of colonization and neoliberal regimes (Boyd and Richerson 2002, 2009; Henrich 2004). In Chile, Chilotes are known for their significant capacity to adapt to both adverse natural and working conditions, underpinned by cooperative community work (Lazo and Cavajal 2018). In socio-ecological systems worldwide, this type of cooperation has resulted in the emergence of both formal and informal institutions for natural resource management (Waring et al. 2017). Thus, the evolution of cooperation in the context of Chiloé's hostile climate and their history of the push and pull between isolation and mobility (Lazo and Cavajal 2018) offers a potential explanation for the collaboration and institutional emergence that transitioned governance in Ancud on the island of Chiloé.

In Ancud, leadership, shared visions for governance, and a culture of cooperation and reciprocity laid the groundwork for individuals to activate their linking social capital to hold meetings with diverse stakeholder groups and transition governance in the face of environmental and socioeconomic change. Despite these successes in Ancud on Chiloé, across the channel in Carelmapu, individuals were unable to create the form of collaboration seen in Ancud as their discussions for transitioning governance were riddled with conflict and struggles for power.

Community-level conflict in Carelmapu inhibits collaborative transition

In Carelmapu, we found that individuals who had linking social capital also joined a new institution, had a plan to adapt, or changed their behavior after the red tide. Similar to Ancud, it was mostly leaders who had connections to hierarchical institutions, and it was these individuals who had perspectives on how to transition governance. However, dissimilar to Ancud, community members and leaders in Carelmapu did not have shared visions for governance in the aftermath of the red tide in 2016. While the Indigenous Community wanted to create an ECMPO and a new institution, non-Indigenous fishing union leaders instead wanted to maintain the TURF system and change legislation that would allow spearfishing for finfish to diversify their harvesting practices. The differences in how each group wanted to move forward with governance created a conflict in the community. We suggest that despite the linking social capital leaders had with multi-level institutions, a struggle for power and divergent conceptualizations of belonging hindered a collaborative transition.

A struggle for power in Carelmapu

In 2008, the state recognized Indigenous ancestral rights to the ocean through enacting the Lafkenche Law which gave Indigenous Communities the opportunity to create an ECMPO that could be used for subsistence and to maintain their cultural ways of life. In Carelmapu, the Indigenous Community started discussions about forming an ECMPO, called the "Borde Costero," prior the red tide in 2016. However, in interviews, Indigenous leaders said that they acted quickly after the red tide to submit their proposal. The ECMPO would give them jurisdiction over the coastal zone from the shore out to 12 km, allow them to reserve the rights to manage resource access and extraction, and give them the legal right to act on any industrial contamination that affects their waters.

In 2017, the Indigenous Community invited fishing union leaders to join them in creating a Management Committee to govern the ECMPO. Out of five fishing union leaders, only three attended the first meeting. After the first meeting, no fishing union leaders would cooperate with the Indigenous Community to form a Management Committee. One Indigenous Community leader said,

We must have a new vision of what is done on the coastline. We have raised some ideas and we are taking this action of requests towards the coastline and they [fishers] have not been able to understand that what we seek is to generate a protection of the coastline. They

look at it with distrust, thinking that they will not be able to work anymore. We have suggested that this is impossible since our own people are members of the unions, they also need the ability to work.

Despite the Indigenous Community's insistence that the groups would co-govern the area through the Management Committee, fishers refused to cooperate with the Indigenous Community. In interviews, fishers said that the Indigenous Community had ignored non-Indigenous historical fishing rights because the ECMPO would prohibit harvesting in former open-access areas and would require fishers to seek approval from the Indigenous Community to create a new harvesting area. Non-Indigenous fishers saw this as a threat to their livelihoods, and that the Indigenous Community was taking too much power in the control of marine resources. One fishing union leader said,

The Lafkenche Law would have been good if it said that the artisanal fishers from unions did not lose their rights to harvest. But the fact is, this law makes us lose our rights, there will be no more free entry. This is the main conflict we have with the Indigenous Community.

Non-Indigenous fishers' perceptions that the Indigenous Community was seizing power in marine governance caused a palpable tension within Carelmapu. This intra-community conflict inhibited leaders to collaboratively draw upon their linking social capital to form a new institution to transition to adaptive governance. Instead, when the fishing union leaders turned down the invitation to form a Management Committee, the Indigenous Community moved forward without them, submitting their proposal for the ECMPO. In 2020, a research participant told the first author that the fishing union leaders still refused to cooperate with the Indigenous Community, despite the potential new jurisdiction and new regulations that were pending to govern open-access areas. Intra-community conflict has been found in natural resource settings to prevent individuals from cultivating linking social capital (Harrison et al. 2016), but here we show that intra-community conflict can also inhibit actors' abilities to collaboratively adapt and form new institutions for governance transitions even when linking social capital already exists. While showing that intra-community conflict can impede adaptation even when linking social capital exists, it leaves us to question what conditions underpinned the conflict in Carelmapu.

Legitimizing belonging: divergent perceptions of historical connections to the sea

At the heart of the conflict in Carelmapu was a disagreement as to who belonged to the area and had rights to govern the sea, which was rooted in divergent perceptions of history and narratives of belonging. The non-Indigenous

fishers believed they had historical rights to the ocean and that their ties to the sea should be recognized in governance. These fishers had perceived themselves as stewards of the ocean since the early 1990s when they were given rights to develop management areas for harvesting (TURFs). As beneficiaries of the TURFs system, they saw their belonging as equal to or stronger than that of Indigenous peoples, despite the Indigenous peoples' centuries of marine harvesting in the region. Non-Indigenous fishers may have felt this way because Indigenous peoples were heavily persecuted prior to the mid 1990s and the fishing unions were granted resource access prior to state recognition of Original Peoples' ancestral rights to the sea. Non-Indigenous fishers' relationship with the state through the management of benthic resources fostered their narrative of belonging and, in their minds, legitimized their claims to marine resources. However, many of these non-Indigenous fishers settled in Carelmapu in the late 1980s and early 1990s when Chile transitioned to TURFs from a moratorium on benthic resource harvesting after the overexploitation during Pinochet's neoliberal dictatorship. Formerly nomadic fishers settled in the Lakes Region to organize themselves into fishing unions in order to have the opportunity to develop management areas under the original FAL, passed in 1991.

In contrast, the Indigenous Community had lived in the region since time immemorial (Daughters 2019; Holton 2004). Despite decades of persecution and oppression by colonizers and the state (Holton 2004), Indigenous peoples maintained a strong connection to the sea. After severe persecution in the 1970s and 1980s by Pinochet's dictatorship, during which their lands were taken by the state (Holton 2004), Indigenous peoples in Carelmapu began to organize themselves again in the mid 1990s. In 2009, a policy window opened where they could claim their ancestral rights to the sea through the Lafkenche Law, and they submitted the ECMPO proposal in 2018. Indigenous Community members said that the law finally recognized their reciprocal relationship with the sea that had existed for centuries, and that the law would allow them to continue and strengthen their rhythm of life and their cultural well-being.

The disagreement in who belonged and had rights to govern the ocean laid bare how environmental governance and adaptation to environmental change "should be understood in terms of struggles over power, knowledge, and the government" (Rademacher 2011: 26). In natural resource-dependent communities undergoing environmental change, actors frequently attempt to legitimize their belonging to a place through the creation of narratives that are rooted in their perceptions of belonging (Rademacher 2011). These ideologies of belonging arise from perceived histories, social relationships, and identity-based constructions of a landscape (Casagrande et al. 2007; Rademacher 2011) as actors try to assert their identities to ensure both ecological

and political stability. Thus, despite the fact that actors may have had linking social capital to hierarchical institutions, the community of Carelmapu was unable to collaboratively transition governance.

Conclusion

In the context of environmental crises, such as the red tide in Chile's Lakes Region in 2016, an individual or group's social capital can help communities overcome these environmental challenges (Bourdieu 1986; Crona et al. 2017a, b; Chai and Zeng 2018; Harrison et al. 2016; Marin et al. 2015; Marín 2019; Monteil et al. 2020; Pelling and High 2005). Yet, little is understood about the conditions that precipitate the ability, or inability, for individuals to activate their linking social capital to create or join new institutions and adapt to environmental change (Crona et al. 2017a, b). As we have shown in the case of Ancud on Chiloé, leadership, where leaders share visions with their constituents, and a culture of cooperation, fostered multi-level collaboration between actors and institutions to form a new institution and transition governance. However, in Carelmapu, although linking social capital existed between leaders and hierarchical institutions, intra-community conflict, underpinned by divergent ideologies of belonging, inhibited the creation of a new institution and prevented collaboration to facilitate a governance transition.

This paper highlights the need to examine the conditions that precipitate and foster individuals' abilities to draw on social capital to transition to adaptive governance. In doing so, the paper illuminates the cultural, social, and political factors that precipitated actors' abilities to create a new management institution to transition governance under environmental change. We suggest that it is not enough to just know that linking social capital exists. Instead, we must examine how environmental change creates new social problems where diverse actors' needs and objectives for adaptation and governance may be influenced by their socio-political and cultural histories. Not only are environmental crises and their resolutions affected by diverse cultural and social connections to the environment and other actors, but political transformations of the state, such as the Lafkenche Law in 2008 and the FAL amendment in 2013, can open policy windows and provide various opportunities for adaptation and governance transitions. As regions continue to experience the impacts of socio-ecological change, further research is needed to understand how communities and governments can foster just transformations in environmental governance that recognize diverse actors' objectives and needs, resolves conflict, and creates opportunities for multi-level collective action that shares power (Bennett et al. 2019).

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Declarations

Competing interests The authors declare no competing interests.

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