Fishers’ perceptions on the Chilean coastal TURF system after two decades: problems, benefits, and emerging needs

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ABSTRACT.—Territorial use rights in fisheries (TURFs) are becoming a widely promoted tool to enhance the sustainability of small-scale fisheries. In 1991, Chile established a national coastal TURF policy that gave legal authority to assign exclusive access rights to artisanal fisher organizations. In 2014, there were several hundred TURFs decreed to fisher organizations in different biophysical and socioeconomic settings. To date, research assessing TURF implementation has generally been based on a few case studies and have had mixed results. Here, we present results from a survey of 535 fishers from 55 different artisanal fisher organizations. The survey consisted of three open-ended questions that explore users’ perceptions of the main problems, benefits, and improvements concerning assigned TURFs. We also sampled 55 presidents of artisanal fisher organizations to explore how they perceived the accomplishments of TURFs. Main key problems, as perceived by fishers, include increased costs associated with surveillance and poaching, and the variability and sometimes lack of financial returns. Despite strong price drops in exported species, TURFs have provided incentives for innovation and stewardship, and fishers are generally unwilling to relinquish them. In fact, fishers define TURF benefits in multiple dimensions, which include conservation/ecological and territorial empowerment. Fisher presidents stress that although expectations of economic benefits have not been fully realized, territorial empowerment is a critical benefit. Through the analysis of fishers’ perceptions on solutions to TURFs’ problems, we highlight the development of stocking activities, combining TURFs with marine reserves, food traceability, and what we call BIO+ seafood—products that have associated biodiversity benefits.

Territorial use rights in fisheries (TURFs) are being widely promoted as a co-management tool that has the potential to enhance the sustainability of small-scale fisheries (Castilla and Defeo 2001, Defeo and Castilla 2005, Gelcich et al. 2015, Defeo...
et al. 2016). TURFs are a spatial form of property rights in which individuals or a collective group of fishers are granted exclusive access to harvest resources within a geographically defined area (Christy 1982). Chile is at the forefront of establishing TURFs for small-scale fisheries management. In 1991, Chile established a national TURF policy for benthic resources, which gave legal authority to assign collective exclusive access rights to artisanal fisher organizations (Castilla 1994, Stotz 1997, González et al. 2006). By 2014, there were several hundred TURFs decreed to fisher organizations in different biophysical and socioeconomic settings.

The biological-fishery success of Chile’s TURF policy has been demonstrated through scientific papers and government stock monitoring efforts that have shown a significant increase in abundance and individual size of key targeted resources within TURFs in comparison with open-access sites (Castilla and Fernández 1998, Castilla et al. 1998, Navarrete et al. 2010, Defeo et al. 2016). These benefits depend, in part, on the life history characteristics of the target species (Aburto et al. 2014). In addition to increasing the abundance of some key target species, broader biodiversity benefits associated to the enforcement of TURFs have been documented for sub-tidal kelp forest ecosystems, though it is uncertain if this pattern holds for other ecosystems (Gelcich et al. 2008, 2012).

Despite the relative biological successes of TURFs, key questions remain about the socioeconomic impacts on the resource users. It is often perceived that the implementation of TURFs has been a positive change agent, in which fishing communities have commonly self-organized and created social capital via partnership with the government, universities, and the private sector (Schumann 2007, Marín et al. 2012). For example, as TURF members spend more time involved in management, they have clear shifts toward pro-environment perceptions (Schumann 2007, Gelcich et al. 2009). It is also clear, however, that the TURF policy shifts the responsibilities and costs associated with surveillance for preventing poaching to the fishers themselves, and these costs have increased substantially (Gelcich et al. 2009). Additionally, illegal fishing (González et al. 2006, Bandin and Quiñones 2014) has increased conflict in many areas and eroded trust (Gelcich et al. 2006). Experimental games assessing TURF fishers’ cooperation have shown how some fishers have embraced cooperation and association members have internalized pro-social norms, while other fishers and associations show low levels of cooperation and management and high levels of freeriding (Gelcich et al. 2013).

Despite the effort that has been devoted to the generation and implementation of the policy, research thus far assessing the TURF implementation process in Chile has generally been based on a few case studies that suggest mixed results (Gelcich et al. 2009, 2010, Aburto et al. 2013). Here, we attempt to provide broad insights beyond specific case studies. We do this by reviewing the number of TURFs currently in operation in Chile and those that have been allowed to lapse. Additionally, we present the results of a geographically extensive effort to understand small-scale fishers’ perceptions on TURFs problems and benefits after 20 yrs of implementation. Specifically, we surveyed 535 fishers and 55 fishing association presidents. We asked the following research questions: (1) “What is the operational status of TURFs in Chile?”; (2) “What do fishers themselves perceive to be the costs, benefits, and improvements for managing a TURF?”; and (3) “How do the presidents of organizations responsible for implementing TURFs perceive both the objectives and
accomplishments of their respective TURFs?" We use these survey data to provide insights on how to improve governance of TURFs for marine resources in Chile and around the world.

**Methods**

**Research Setting**

Chile is among the top 10 countries in terms of overall fishery landings (FAO 2010). In the last 5 yrs, the total aggregated industrial and artisanal wild species landings have ranged between 2.3 and 3.8 million tons yr\(^{-1}\) (SERNAPESCA 2014). Approximately 40%–50% of marine landings are based on artisanal fisheries operating in coastal zones. In Chile, to be classified as an artisanal fisher, vessels must not exceed 18 m in length and have a maximum of up to 50 gross register tons (Fisheries and Aquaculture Law No 18 892; Castilla 2010). Within coastal zones, the artisanal fleet supplies a significant fraction of high-valued finfishes, small-pelagic fishes, benthic invertebrates, and algal resources. For instance, between 2005 and 2012, approximately 90,000 registered artisanal fishers (i.e., fin-fishers, divers, gleaners) extracted an average of 1.14 million t yr\(^{-1}\) of high value finfishes and small-pelagic species, worth around US$2465 per t; in the same period, they extracted on average about 245,000 t yr\(^{-1}\) of benthic invertebrates, worth approximately US$340 million yr\(^{-1}\), and about 373,000 t yr\(^{-1}\) of algae worth US$250 million yr\(^{-1}\) (SERNAPESCA 2014). The present legal framework (Fisheries and Aquaculture Law No 18.892) that regulates fisheries in Chile outlines a number of management policies, including marine zoning, regulation of fleet mobility, the allocation of TURFs, and the establishment of management plans for open access areas (Castilla 2010, Gelcich 2014).

The Chilean TURF policy is referred to as the Management and Exploitation Area for Benthic Resource policy and focuses on the management of invertebrates and algae (Castilla 1994, 2010). The Undersecretary of Fisheries assigns exclusive access diving rights to small-scale fisher organizations (Castilla et al. 1998, Gelcich et al. 2010). The rationale for establishing these user rights is based on common-property and co-management theories, which establish that securing access and sharing control over resources can create incentives for sustainable institutional arrangements among fishers, who will then manage and fish collectively and sustainably (Ostrom and Schlager 1996). In addition, it should contribute to more effective enforcement by increasing their likelihood of compliance (Jentoft et al. 1998). To be granted a TURF, fisher organizations must actively engage in developing official management plans, often with assistance from environmental consultants. TURF members are also responsible for surveillance and enforcement of antipoaching measures (Castilla and Gelcich 2008). The first pilot comanaged TURF was informally established in 1989 (Castilla et al. 1998); while official granting of TURFs and associated co-management schemes started to be implemented in 1997 (Stotz 1997, González et al. 2006). Currently in Chile there are approximately 800 legally decreed TURFs (SUBPESCA 2015). Fisher associations in Chile can apply for up to three TURFs. Although there are mixed results with regard to the TURFs’ performance, they account for >1100 km\(^2\) of the nearshore seascape, with an average size of approximately 100 ha (Gelcich et al. 2010).
The overexploitation of the carnivorous muricid gastropod *Concholepas concholepas* (Bruguière, 1792) (known locally as loco) in the late 1980s, associated with the opening of international markets in the early 1970s, was the main driver to implement the TURF regime in Chile (Castilla 1994, Castilla et al. 1998). Loco is the posterchild species for TURF development in Chile, and is part of most TURF management plans. Although loco is managed locally and exclusively through the TURF co-management regime, it has been sold mainly in Asian markets. Thus, the price of loco is coupled to supply, market price fluctuation, and competition with other products, such as abalone (see Chávez et al. 2010, Castilla et al. in press). There is a growing recognition of the different factors affecting those couplings, which could influence TURFs performance and fishers’ perceptions (Castilla et al. in press).

Within Chile, certain areas of inshore coastline are officially designated as caletas (Spanish for “coves”; see Castilla et al. 1998). These are strips of land above the high tide mark that provide certain rights to users, such as the access to the sea, boat landings, natural resource landings, and permission to construct certain buildings (Gelcich et al. 2009). Presently, there are around 90,000 artisanal fishers registered in Chile who operate from rural or urban caletas.

**Number and State of TURFs in Chile**

The number of decreed TURFs that are in full-operation, abandoned, or never used has not been officially assessed in Chile. Here, for the first time, we review the historic database for TURFs in Chile from 1997 to 2013 to determine the state of each TURF according to the following definitions: (1) in operation, defined as when TURFs have approved management plans with the Undersecretary of Fisheries within the past 4 yrs; (2) abandoned, when TURFs do not have an approved management plan sent to the Undersecretary of Fisheries for >4 yrs; (3) non-assigned TURF, when a decree establishing a TURF was granted, but no fisher association has complied with necessary initial baseline studies for it to be assigned to the association. The number of non-assigned TURFs could decrease as areas are put in operation by new fisher associations.

**Fisher and Fisher President Perceptions**

*Site Selection.*—Chile is divided into 15 administrative regions, and we surveyed the 10 regions where TURFs are more common; we did not survey the fjord ecoregion. Within these 10 regions, we randomly selected 55 different caletas from regional lists provided by local national fisheries service officials, selection was stratified by region. Sampling spanned approximately 3000 km of coast line, from Caleta Pisagua in the north (19°35’40.25˝S, 70°12’44.80˝W) to Caleta Quellon in southern Chiloé (43°8´13.41˝S, 73°39´50.21˝W).

*Sampling.*—We surveyed 535 individual fishers. We randomly selected fishers from the 55 different caletas in Chile. A sample of 10 fishers (not members of the directorate) was targeted per association. For 51 associations, the number of 10 fishers was achieved. In three associations, only seven fishers were surveyed; and in one association, only four fishers were surveyed. The proportion of overall fishers surveyed at each caleta ranged from 4% to 83%. Sampling took place during 2014, and a group of four surveyors conducted all the surveys in a face-to-face manner. An average response rate of 80% was achieved. Considering a total of around 32,000 artisanal fishers who form associations with functioning TURFs, our sample has a confidence...
interval of 2 at a 95% confidence level. In addition to sampling individual fishers, presidents of the 55 fisher associations were sampled in a face-to-face manner, with a different questionnaire (100% response rate).

Surveys.—To survey fishers (which includes divers, fin-fishers, gleaners, or any mix among these livelihoods), we developed a questionnaire that included multiple choice questions, Likert scale responses, and free elicitations of word associations. In this paper, we report only on the free elicitation questions aimed at exploring the main problems and benefits of having a TURF. These questions were done toward the beginning of the survey to allow respondents to define relevant problems, benefits, and solutions in their own terms, and as they came to mind (i.e., immediacy and availability) with no ranking required. We chose this method to minimize framing effects by enabling personal, spontaneous, and relatively unfiltered responses, thus offering insight into how fishers frame TURF issues in their own terms (this method has been used previously in some large scale studies, see Lorenzoni et al. 2006, Gelcich et al. 2014). Specifically, we asked fishers: (1) “What comes to your mind when you think of the main benefits of having a TURF?”; (2) “What comes to your mind when you think of the main problems of having a TURF?”; and (3) “What comes to your mind when you have to think of how to improve your TURF?”

The questionnaire designed for presidents focused on assessing the degree to which they perceive certain objectives and accomplishments of TURFs, which have been mentioned in the literature, had been fulfilled. Questions were phrased as “To what extent have the following objectives been achieved thanks to your TURF.” Objectives were explained by interviewers and included economic (i.e., revenue from TURF resources), tourism (i.e., revenue from TURF related tourism activities), ecological (i.e., restoration of economic species and biodiversity), behavioral (i.e., cooperation and conflict reduction), and territorial (i.e., territorial negotiation, empowerment) objectives. These questions were assessed on a 1–5 Likert scale with anchor points “totally achieved” and “not achieved at all.” We used a Kruskal-Wallis and posteriori Dunns test to examine whether there were significant differences in achievement scores for the different types of objectives. In addition, we also asked fisher association presidents to grade on a 1–7 scale (such as the one used in the Chilean educational system) the support they would provide to different TURF improvement initiatives (full list of improvements can be found in results). Fisher presidents also responded about characteristics of their association and TURF, namely the number of fishers who participate in the association, the year they obtained their first TURF, the size of the TURF, the distance to the closest TURF, and the percentage of income that the TURF represents, on average for fishers on a yearly basis.

Results

Number and state of TURFs in Chile

The number of TURFs granted in Chile increased the greatest during the first 10 yrs of the policy. During the first 4 yrs of implementation, many of the TURFs were assigned but lacked initial baseline studies, as it takes 1–2 yrs before TURFs can be considered in full operation. The first TURFs abandoned were in 2003. Currently, there are around 450 TURFs in full operation (Fig. 1). In addition, there are about 100 TURFs that are decreed but have never been active, and about 200 that have been in
operation, but are currently abandoned (i.e., have no official monitoring or allowable catch approved by the Undersecretary of Fisheries in the last 4 yrs). This pattern has been relatively stable over the past 6 years (Fig. 1).

**Fishers’ Perceptions: Problems and Benefits of TURFs**

Table 1 shows the general characteristics of the 55 sampled associations and TURFs. The sample included TURFs which had been created from 1997 to some created in 2010, with 75% of the TURFs in the sample being allocated before 2005. The sizes of the TURFs that fishers participated in varied from 6 to 986 ha, with a median size of 98 ha (Table 1). The mean distance from the port/landing site to the closest TURF was of 5.3 (SE 1.13) km, with 75% of the sample being under 5 km. The percentage of income that the TURF generates on average for fishers ranged greatly from 1% to 90%. The average value was of 29% and median value of 20%. It is important to highlight that for the first quartile, income from TURFs represent <7%, and for 75% of the associations, it represented <50% of their income (Table 1).

The free elicitation questions were aimed to explore the main problems and benefits of having TURFs. Fishers consistently stated that theft/poaching (robos in Spanish) from their areas and the difficulty of enforcement was the main current problem of having a TURF. This pattern was consistent in all regions. Considering overall responses, around 70% of fishers stated that theft of resources was a main problem (Fig. 2A). Other important problems, such as conflict with other organizations (8%) and the difficulties for enforcing the areas (8%), relate to theft in some way.

When fishers were asked to freely state the main benefits of having a TURF, conservation of resource stocks provided by TURFs was recognized by 30% of fishers,

![Figure 1. Number of TURFs that have been decreed between 1998 and 2013 in Chile. The figure highlights active TURFs, abandoned TURFs, and non-assigned TURFs (those that have no baseline study of the area).](image)

| Table 1. Basic characteristics of the associations and TURFs (reported by the presidents of fisher associations) sampled in the present study. |
|-----------------------------------------------|-------|-------|-----------------|--------|--------|--------|
| Number of association members                | Min   | Max   | Mean (SE)       | Median | 25%    | 75%    |
| First TURF (year)                            | 1997  | 2010  | 2002 (0.4)      | 2002   | 2000   | 2005   |
| TURF size (ha)                               | 6     | 986   | 146 (24)        | 98     | 48     | 155    |
| Distance to closest TURF (km)                | 0.2   | 45    | 5.34 (1.13)     | 2.5    | 0.95   | 5      |
| Income from TURF (% total)                   | <1%   | 90%   | 28% (4%)        | 20%    | 7%     | 50%    |
around 20% established the consolidation of caletas as important, and 15% referenced economic benefits; the remaining 35% was related to other aspects (Fig. 2B). Regarding the conservation of resource stocks, fishers’ main reply was “se conserva el recurso,” which translates to the resource is conserved. Interestingly, 3% of fishers who stated resource stock conservation added that this was important to have shellfish for local consumption and local sale. Beyond the conservation of resource stocks, 5% of fishers indicated the conservation of the environment or the conservation of many species as a critical benefit (“se mantiene la ecología y el medio ambiente” or “se conservan muchas especies”); this referring mainly to increased abundance of benthic resources, shellfish, algae, and also reef fish. The recognition of resource conservation/ecological benefits from TURFs was acknowledged at a greater extent in Central-North region of Chile (Fig. 2B). The consolidation of fisher associations and caletas due to the TURFs was another aspect acknowledged by fishers as being an important benefit (Fig. 2B). Economic benefits emerged as a response for 13% of sampled fishers, interestingly about half of these (7% of total sample) explicitly suggested TURFs were the equivalent of a saving account. Five percent of interviewed fishers expressed that there was no benefit of having a TURF, simply replying nada (“nothing” in Spanish).
FISHER PRESIDENTS’ PERCEPTIONS: ACHIEVEMENT OF TURF OBJECTIVES

Fisher association presidents were asked to categorize the level at which different TURF objectives have been achieved. The responses with the highest variability were those related to the achievement of economic objectives from managing a TURF. Around 22% of presidents scored this objective as being achieved (score 4 or 5), while 41% scored the objective with a 3 (neither achieved nor not achieved) and 37% scored it as not achieved. The average score for the economic objective was 2.8. Ecological (i.e., restoration of economic species and biodiversity conservation) and behavioral objectives (increased cooperation) scores were significantly higher than the score for economic objectives ($H = 64.218; P < 0.001$; Fig. 3). Territoriality objectives had the highest scores, reaching average values of nearly 4.5 and where no president scored a value under 3. This objective refers to the extent to which TURFs facilitate territorial empowerment and increased negotiation with other stakeholders.

PERCEPTIONS ON TURF IMPROVEMENTS

When fishers were asked about how to improve the TURF system in Chile, 63% of the unprompted responses mentioned the need for support of restocking activities or enforcement within TURFs. Aquaculture and support for commercialization, including seafood labeling, were considered important by 16% and 12% of respondents, respectively (Table 2).

Fisher association presidents showed high support for all TURF improvement alternatives. The need to develop restocking, support for commercialization, and the potential compensation for offsetting environmental impacts from other private sector actors (e.g., biodiversity offsets) scored on average above 6.0 (out of 7.0; Table 2). The use of artificial reefs to increase available space for TURF species and recruitment had a significantly lower support with a score of 5.1 ($H = 30.86, df = 4; P < 0.01$).

DISCUSSION

As academics, managers, conservation practitioners, and philanthropic organizations consider the implementation of TURFs as a way to address sustainability, it is increasingly important to understand fishers’ perceptions about key problems and benefits to tailor TURFs to local needs. Our study provides a broad view on how...
artisanal fishers, who have engaged with TURFs for years, perceive the problems and benefits of TURFs, going beyond the analysis of specific case studies. An underlying aspect to consider when analyzing these perceptions in Chile relates to the fact that from 2003 onwards, due to the huge development of abalone aquaculture, the price of the key TURF managed species (the loco) that is exported from Chile to the Asian luxury seafood markets was negatively affected (Chávez et al. 2010, Castilla et al. in press). In essence, it appears that the international export price of loco is determined by the interaction among supply and demand of abalone. The 40-fold increase of aquaculture abalone harvest, during 2002–2013, has strongly influenced the price of loco. In addition, Peruvian loco began to be exported in 1997. Indeed, these factors are considered as main determinants for a continuous decrease of Chilean loco exports, from 2400 t in 1993 to 522 t in 2012 (Castilla et al. in press). This strong link between the loco fishery, global trade, and distant consumers, which resulted in strong price drops, are decoupled from direct local management practices, but can strongly influence the performance and fishers’ perceptions of the TURF regime.

Consistent with previous studies (Gelcich et al. 2009), fishers mentioned poaching (theft) from within their TURFs by outsiders as a key problem. Indeed, in a comparative study of 43 different co-management institutions across five countries, those with access restrictions tended to have the lowest levels of perceived compliance (Cinner et al. 2012, Cinner and Huchery 2014). Poaching implies increased costs associated with surveillance, loss of revenue from harvests, and reduced economic revenue (Davis et al. 2015). The importance and prevalence of poaching is suggestive of a needed policy change to increase logistical support to stop and prosecute poachers (Arias et al. 2016). This may be especially so since recent research suggests enforcement benefits exceed costs, and can result up to a 50% increase in fisher revenue when TURFs are enforced (Davis et al. 2015). Despite this cost-benefit situation, many fisher associations are stopping their enforcement as a first step towards TURF abandonment. Possible explanations for this are that fishers may be underestimating the benefits of enforcement or lack the capacity and external government support to enforce TURF areas. In our surveys, fishers consistently identified financial assistance as an important factor that would improve their organization’s capacity for surveillance. Although direct subsidies for fishing may encourage unsustainable extraction (Sumaila et al. 2010), subsidies for enforcement are considered by some to
be beneficial, and even necessary (Sumaila and Delagran 2010, Sumaila et al. 2010). Small-scale fisher organizations in Chile are generally not wealthy, and additional financial resources for enforcement would undoubtedly remove some constraint to their productive capacity (see Davis et al in press for a detailed analysis of TURF enforcement).

Results from our survey of presidents of fisher organizations show that when it comes to economic performance, TURFs are generally perceived as not fulfilling the objective. Ironically, despite the lack of financial returns, the decrease in the international price of loco, and all the perceived problems, TURF statistics show that fishers are generally still unwilling to relinquish them (Fig.1). This is probably related to the fact that a median fisher receives just 20% of their income from TURFs, and has managed to identify other benefits, such as conservation of stocks as a safety net (Gelcich et al. 2007), the consolidation of associations, territorial empowerment, and access to projects. This is not to say that direct economic benefits of TURFs are not an important incentive, but it suggests it is beginning to be viewed in context of other TURF benefits. This evidence leads us to conclude that in Chile, fishers predominantly approached TURF benefits in a multidimensional way, making connections between them and in relation to other matters of concern in their everyday lives (Basurto et al. 2013).

Fisher association presidents’ response to the prompted questions about the degree to which different objectives of TURFs have been fulfilled support the view of a multidimensional view of benefits associated to TURFs. In fact, territorial empowerment is the main objective fishers have considered achieved through TURFs. The reason for fishers acknowledging conservation and territorial empowerment as critical elements of TURF outcomes probably relates to the role TURFs are playing in leveling power relations between fishers and other productive sectors when defining spatial use of the coast. TURFs have also become a negotiating tool for fishers when faced with socio-environmental problems, such as the installation of outfall pipes, mining ports, cellulose installations, and thermoelectric plants (Gelcich et al. 2009). Importantly, the multidimensional nature of TURFs should be considered in assessments. In Chile, therefore, the Undersecretary of Fisheries should look beyond assessing TURFs in terms of just economic income and total allowable catch, and begin acknowledging territorial, conservation, and behavioral benefits associated with TURFs. In our view, it is this novel multifaceted understanding of TURF outcomes that can provide opportunities to innovate on future TURF development.

Restocking, aquaculture, biodiversity compensation, traceability, and seafood certification were all mentioned by fishers to some extent as strategies to improve the TURFs system. However, successfully dealing with these innovations must necessarily include some form of coproduction of knowledge through manipulations or experimentation within fishers’ geographical user right boundaries (Castilla 1994, Castilla and Defeo 2001). In this sense, the development of these initiatives will not only depend on funding, but on the constraints of the present legal structure of the policy. In Chile, the management procedures within TURF policy currently implicitly establishes that the Undersecretary of Fisheries set and control management objectives (Gelcich et al. 2006). It also determines that research-based biological knowledge is the basic knowledge to include in the TURFs management plan process (Gelcich et al. 2006). Participatory research in support of adaptive management has become almost commonplace (Edwards-Jones 2001, Navarrete et al. 2010),
under the premise that the participation of resource users is important not only in the management of resources, but also in research oriented toward the generation of information and innovations that shape how resources are understood and exploited (Olsson and Folke 2001). Ideally, government should facilitate a shift toward an adaptive co-management approach (Folke et al. 2003). We specifically propose the need to include derogations in TURF policy for participatory research aimed at generating learning platforms, collaborative demonstration-scale experimental trials, where fishers, managers and scientists can co-construct the necessary knowledge (Navarrete et al. 2010), and from which successful adaptation of the TURF regime may evolve. Through learning platforms, fishers would be able to adapt policy to their own conditions through experimentation. Researchers (social and natural scientists) and managers would gain from fisher experimentation because they will observe the results of numerous experiments over a wide range of conditions among and within years, allowing them to generalize about outcomes of experiments, and to develop or amend theory accordingly (Defeo and Castilla 2005, Ostrom 2007, Cinner et al. 2013).

An interesting model that is currently under consideration and analysis that could address some alternatives to developing fisher-proposed solutions is based on developing a mixed TURF-Reserve system (Afflerbach et al. 2014) as a business model innovation to increase revenue in the Chilean TURF regime (Gelcich and Donlan 2015). The innovation specifically relates to the establishment of no-take zones within a portion of a TURF (Gelcich and Donlan 2015). The aimed outcome of generating no-take reserves within TURFs is a scalable program that can provide a supplementary revenue stream to fishers in exchange for management actions that produce enforced and verified biodiversity benefits, while also promoting sustainable fisheries (Gelcich and Donlan 2015). TURFs hold the potential to enable at least two business model innovations that could improve fishers’ livelihoods with biodiversity benefits. First, outcomes could be commoditized and sold as credits in offset type markets (Gelcich et al. 2015, Donlan 2015). Because there are ongoing marine and coastal impacts from the private and public sector throughout Chile, we anticipate opportunities for marine biodiversity offset programs. In fact, the Chilean government has recently modified important aspects of environmental impact assessment policy to allow offsetting. In addition, it is in the process of revising the offset framework within a new biodiversity and protected area policy, that for instance, has just approved a national energy roadmap in which all energy generation investments must operate under a no-net loss framework by 2035 (Ministerio de Energia 2015). Second, biodiversity benefits from TURFs could be integrated and add value to products within emerging sustainable seafood markets (e.g., traceable seafood products with biodiversity benefits). What could be called BIO+ seafood—products that have associated and verified biodiversity benefits created by the same community of fishers extracting the seafood.

New interdisciplinary approaches will be critical to solve the emerging research and governance frontiers associated with TURFs in a broader management context. Most importantly, developing these approaches into implementable policies and management protocols requires the development of new tools which can complement and enrich TURFs through the establishment of learning platforms. Identifying ways to improve TURFs, from the perspective of participating fishers, fills an important gap to design necessary refinements of these types of policies. Such refinements may
provide important insights into the emerging needs associated to nationwide rights-based management approaches. These insights can provide early warning signals for other countries considering similar policies and can be used to anticipate and ideally avoid critical bottlenecks (Gelcich et al. 2010). In essence, reinforcing ongoing collaborations between fisher organizations, scientists, managers, and government institutions to create social and market incentives for the TURF system to continually evolve and adapt to new social-ecological realities is key if TURFs are going to be successfully propagated into the 21st century.

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