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Toothfish crises, actor diversity and the emergence of compliance mechanisms in the Southern Ocean

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ABSTRACT

Illegal, unregulated and unreported (IUU) fishing is a challenging form of non-compliance in many marine ecosystems. IUU fishing has attracted substantial political attention in the Southern Ocean, where a series of crises created windows of opportunity for change. A crises-response framework was used for examining these dynamics between 1995 and 2009. Crises were defined in relation to their perceived threat, decision time and surprise. Published material was combined with the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLRs) expert interviews, to evaluate changing perceptions of IUU fishing and corresponding actions. A first crisis led to an increased use of informal shortcuts and a concentration of power. A second crisis created windows of opportunities for policy entrepreneurs and stimulated policy innovation. A third crisis led to the implementation of existing contingency plans. These responses were consistent with predictions from the crisis-response framework used. The series of crises threatened the credibility of CCAMLR and changed the incentives for engaging in coalitions, which led to the development of both management and enforcement approaches to compliance. State and non-state actors became increasingly involved in developing these diverse compliance mechanisms, thereby actively contributing to the adaptive capacity of CCAMLR. Synergies between fisheries industry, environmental conservation, and state sovereignty interests were effectively utilized. Individual actors, organizations and countries providing leadership had strong incentives for doing so. Trust and reputation was important for the compliance mechanisms leading to a substantial reduction of IUU fishing.

1. Introduction

The accelerating scale and complexity of human activities are outpacing the development of institutions to regulate these activities (Berkes et al., 2006; Walker et al., 2009). Limited capacity to adapt to new challenges and inadequate mechanisms for compliance can play central parts in determining the effectiveness of international institutions (Breitmeier et al., 2006). Two classes of compliance mechanisms are often described: management and enforcement approaches. Management approaches include informal sanctioning mechanisms, sharing of information, technical assistance, capacity building and systems of review. Enforcement approaches focus on monitoring, formal sanctioning mechanism and rewards, thereby influencing the costs of non-compliance (Breitmeier et al., 2006; Mitchell, 2003). Compliance mechanisms in international governance have to address two levels of actors: states party to the governance body and the industries of these states (Young, 1979). Non-compliance can be either voluntary (cheating, or non-compliance due to a lack of legitimacy of rules), or involuntary (due to ambiguity of rules or a lack of capacity to ensure compliance) (Breitmeier et al., 2006). The type of non-compliance will determine the effectiveness of different compliance mechanisms and the relative importance of management and enforcement approaches respectively (Breitmeier et al., 2006).

Investments in compliance mechanisms will depend on their potential benefits in relation to their costs and the perceived social cost of non-compliance (Underdal, 1998; Young, 1979). Perceived benefits and costs can change over time. Crises can influence the incentives of actors to invest in compliance mechanisms and can create windows of opportunities for change (Kingdon, 1984; Mitchell, 2003; Young, 1982). Crises can be perceived or real and actors involved in governance can take an active part in communicating and contextualizing crisis and crisis-like situations. Non-state actors are increasingly taking part in international environmental governance (Biermann and Pattberg, 2008), but

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their role is poorly understood (Biermann, 2007). This increased diversity of actors can influence the adaptive capacity of social-ecological systems to respond to crises (Biermann, 2007; Folke et al., 2005; Underdal, 2010), and the capacity to maintain and strengthen resilience in the face of change (Dietz et al., 2003; Folke et al., 2010; Janssen et al., 2007).

Illegal, unregulated and unreported (IUU) fishing have emerged as a challenging form of non-compliance in many regional seas (Gallic and Cox, 2006; Pauly et al., 2002; Sumaila et al., 2006). Global IUU catches have been estimated to range between 11 and 26 million tonnes annually, with a total catch value of between US$ 10 and 23.5 billion dollars. The majority of catches are taken in developing nations with weak governance (Agnew et al., 2009). IUU fishing for Patagonian *Dissostichus eleginoides* and Antarctic *D. mawsoni* toothfish in the Southern Ocean constituted <0.2% (by weight and value) of these global estimates (Agnew et al., 2009), but has caused substantial concern and action in the regional management organization. The Convention for the Conservation of Antarctic Marine Living Resources (CAMLR Convention) came into force 1982 as part of the Antarctic Treaty System (ATS), with an aim to manage natural resources (excluding mammals) in the Southern Ocean (Molenaar, 2001). A Commission (CCAMLR) serves as the decision making body and has an independent secretariat responsible for, e.g., collecting and disseminating information on non-compliance. The Standing Committee on Implementation and Compliance (SCIC) review compliance related information provided by the secretariat and states and provide recommendations to the Commission on revision of existing Conservation Measures (CMs) or drafting of new CMs (see www.ccamlr.org). A Scientific Committee (SC) provides scientific advice with a strong emphasis on the precautionary approach (Constable et al., 2000). SC takes the levels of IUU fishing in to account when providing recommendations for quotas: a higher level of IUU fishing is translated into lower quotas for licensed fishing companies. Patagonian and Antarctic toothfish are in part managed by the Commission, but a number of states also exercise jurisdiction over their sovereign Sub-Antarctic islands (Fig. 1) and adjacent fishing grounds within the CAMLR area (Miller et al., 2010). CCAMLR has thus not the exclusive competence for all areas within the Convention area and several of the most productive fishing grounds fall within national jurisdiction. Flag states hold the primary responsibility for compliance (FAO, 2001) and if flag states are member of the Commission (Contracting Parties, CPs) and their vessels are fishing in contravention to existing CMs, that vessel is fishing illegally. Any vessel fishing in contravention to rules in national jurisdictions around Sub-Antarctic Islands are also fishing illegally. Vessels flagged to Non-Contracting Party states (NCP) fishing in the high seas (areas beyond national jurisdiction, but managed by CCAMLR) are engaged in unregulated fishing, which is not technically illegal.

The difficulty of effectively enforcing the remote Exclusive Economic Zones (EEZs) and high seas in the Southern Ocean (Fig. 1), combined with precautionary quota reductions for licensed fisheries as a consequence of IUU fishing, provides an example of a common pool resource dilemma (difficulty of exclusion and subtractability: (Ostrom et al., 1999). Toothfish is a long-lived, late maturing, white-fleshed bottom dwelling predatory fish (Agnew, 2000). It is also a valuable and truly global commodity (Lack and Sant, 2001; NET, 2004). Few regional organizations have been as successful as CCAMLR in reducing IUU fishing. This relative success, and long (>15 years) history of IUU fishing in the region provides an argument for a case study of past events leading to a reduction of IUU fishing. CCAMLR records are also transparent and easily available, which facilitates an in depth analysis. In contrast to many regions suffering from IUU fishing and weak governance, several CCAMLR countries score high on existing governance indexes

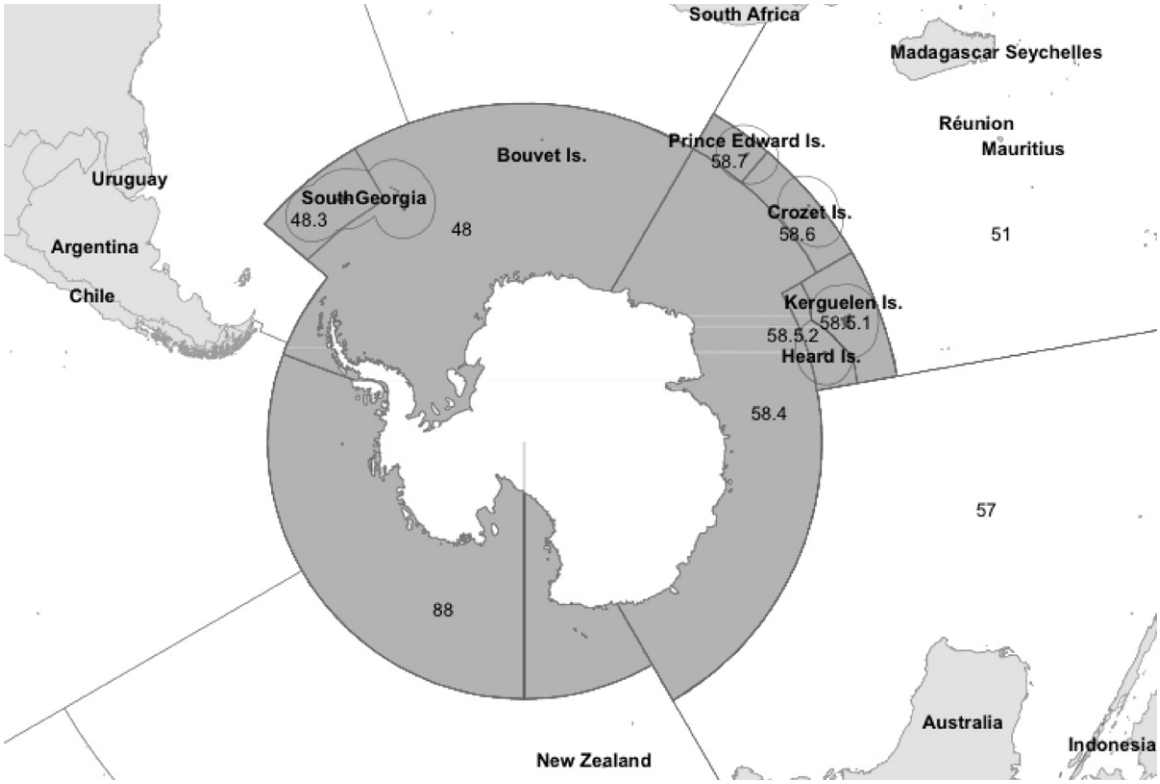

Fig. 1. The Southern Ocean, including the CCAMLR area (grey), and Sub-Antarctic Islands within the CCAMLR area. Circles around islands represents a UK exclusive fishing zone around South Georgia and South Shetland Islands (South Georgia), and EEZs around South African (Prince Edward Is), French (Crozet Is and Kerguelen Is) and Australian (Heard Is) territories. No EEZ has been declared around the Norwegian Bouvet Island. Data from *Sea Around Us* project www.seaaroundus.org. FAO areas and countries mentioned in the text are displayed. Argentina does not recognize UK claims around South Georgia. None of the other Sub-Antarctic Islands or adjacent zones are disputed.

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Table 1
Agencies, companies and organizations interviewed (number of interviews >1 in parenthesis). AAD (Australian Antarctic Division), AFMA (Australian Fisheries Management Authority), ASOC (Antarctic Southern Ocean Coalition), CapFish (Capricorn Fisheries Monitoring), CCAMLR (Commission for the Conservation of Antarctic Marine Living Resources) secretariat, COLTO (Coalition of Legal Toothfish Operators), DG MARE (Directorate-General for Maritime Affairs and Fisheries of the European Commission), FAO (Food and Agriculture Organization of the United Nations), FDA (Food and Drug Administration), IMCS (International Monitoring, Control, and Surveillance Network for Fisheries-related Activities), MARM (Ministerio de Medio Ambiente y Medio Rural y Marino), MCM (Marine and Coastal Management), NOAA (National Oceanic and Atmospheric Administration), OAM (Osprey Asset Limited), TAAF (Terres Australes & Antarctiques Françaises), TCT (Tasmanian Conservation Trust), TRAFFIC (Trade Records Analysis of Flora and Fauna in Commerce), UTAS (University of Tasmania), WWF (World Wide Fund for Nature). All interviewed industry organizations are members of COLTO.

	State actor	Industry	NGO	Other
International	CCAMLR (3) DG Mare FAO	(COLTO)	Greenpeace TRAFFIC	IMCS
Australia	Parliament AAD (3) AFMA (2)	Austral Fisheries (2)	TCT WWF (2)	OAM UTAS (3)
France	TAAF	Sapmer (2)		
New Zealand	Ministry of Fisheries	Sanford Ltd.	EcoWatch	
Norway	Ministry of Fisheries		Friends of the Earth	
South Africa	MCM		ASOC	CapFish
Spain	MARM			
USA	NOAA (4) FDA			Journalist

(Kaufmann et al., 2009). This institutional capacity could thus provide insights into strategies for achieving compliance for other multi-scale and complex human activities.

We used a crisis-response framework developed by (Hermann, 1969), see also (Underdal, 2010), as a structure for examining our case study (see below). We investigated the extent to which actions taken by state and non-state actors to address three pulses of IUU fishing (Österblom et al., 2010; SC-CCAMLR, 2008), corresponded to this framework. We suggest that the three pulses have created crises-like situations that influenced the development of compliance mechanisms, and evaluate the nature and effects of these mechanisms. By reviewing 15 years of these dynamics in the Southern Ocean, we suggest that:

(1) Three pulses of IUU fishing have created international crisis-like situations.
(2) These crises-like situations have created windows of opportunity for the emergence of compliance mechanisms.
(3) Actor diversity had a strong influence on the capacity to address emerging crises.

2. Materials and methods

Open-ended expert (identified using snow-ball sampling techniques) interviews were conducted in order to collect information on how three pulses of IUU fishing between 1995 and 2009 influenced perceptions of the problem with non-compliance and the corresponding investments in compliance mechanisms. Care was taken to involve experts from a wide range of countries identified as playing a lead role in reducing IUU fishing in the region, drawing on the expertise from civil servants, academia, environmental Non-Governmental Organizations (NGOs), the fishing industry and other private enterprises. These experts had substantial experience with IUU fishing in the CCAMLR area covering both state and non-state organizations, Table 1. Informed consent was obtained from all subjects and University of British Columbia Behavioral Research Ethics Board (H09-03483) reviewed the study. Interviews were complemented by a review of (public record) CCAMLR documents, which contain, e.g., scientific recommendations for quotas, information on non-compliance and annual meeting records from the Commission, which were analyzed in relation to the sense of urgency expressed by the Commission and the type of response taken. These documents also contain information on meeting participants, which was used to calculate trends over time. Information from the scientific literature, records from national and international court cases, national audits, NGO reports and websites complemented the information generated by CCAMLR experts and documents. Information on IUU catches and licensed catches was reported using data from a CCAMLR document (SC-CCAMLR, 2008) and database (CCAMLR, 2009b), with information by CCAMLR fishing seasons. Reported IUU fishing for the fishing season 1996/97 were reported in CCAMLR meeting documents 1997.

3. Theory

A crisis situation is defined as causing an abrupt or sudden change to an existing system. Hermann (1969) defines crises in relation to their relative score for three traits: Threat (Stakes), Decision Time (Urgency) and Awareness (Surprise). A "Crisis Situation" has high threat, short decision time and contains a high degree of surprise (see also Underdal, 2010). The predicted response is an increased use of informal shortcuts, a centralization of leadership and contraction of power (Hermann, 1969; Underdal, 2010). Many situations of environmental governance have longer decision times (are less urgent), but can score high on threat and surprise (Underdal, 2010). Hermann refers to such situations as an "Innovative Situation". Here, actors have longer time to consider different solutions. Ideas for which it has previously been difficult to gain support, can gain momentum (Hermann, 1969). The role of policy entrepreneurs may be particularly important under such conditions, as they can play a critical role in linking their agenda to developing and surprising events (Kingdon, 1984). A third category of a crisis-like situation is a "Reflexive Situation". Hermann (1969) define those as scoring high on threat and time, but low on surprise (i.e., a crisis-like situations that is important, urgent, but anticipated). Here, actors will have had sufficient time to consider the possibility of the crisis to occur and are ready to implement existing contingency plans.

The framework used here has been developed for international conflict between states where decision time can be a matter of days. For the purpose of our analysis, we use the time scale of years to define urgency and are primarily concerned with the difference in response to three pulses of IUU fishing in relation to their relative measure of stake, urgency and surprise.

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4. Results

4.1. A crisis situation

In 1995 and 1996, CCAMLR members were expressing a growing concern over IUU fishing in the convention area (CCAMLR, 1995, 1996). IUU fishing had been concentrated in FAO area 48.3, primarily in the UK exclusive fishing zone (Fig. 1), with high catch rates and proximity to ports. Increased UK enforcement and discovery of new stocks triggered an eastward expansion (Agnew, 2000), where catches were high and detection likelihood low (Sumaila et al., 2006). In 1997, vessels were observed and apprehended in the EEZs around South African (58.7: Prince Edward Island), French (58.6: Crozet and 58.5.1: Kerguelen) and Australian (58.5.2: Heard and McDonald) Sub-Antarctic Islands within the Convention Area (CCAMLR, 1997; SC-CCAMLR, 2008), Fig. 1. IUU fishing for Patagonian toothfish increased dramatically (Fig. 2a) and was explicitly stated to represent a crisis, which threatened the reputation and credibility of CCAMLR (CCAMLR, 1997). Several countries were simultaneously in the process of developing their licensed fishing operations for Patagonian toothfish (Table 2, Fig. 2b), illustrating the existence of high stakes. The scientific estimates of IUU catches communicated a strong sense of urgency, suggesting threats of a drastic decline of Patagonian toothfish stock and collapsing seabird populations as a result of by-catch in IUU fishing (CCAMLR, 1997). Prior to the 1997 meeting, a Norwegian NGO (Friends of the Earth) produced a report that identified the involvement of CCAMLR CP nationals in IUU fishing, using CP flagged vessels (Album, 1997). The report presented information that was new to many governments and environmental NGOs, but not to the fishing industry (Album, 1997). The involvement of CP nationals and the magnitude of IUU fishing (compare Fig. 2a with b) was a surprise to the Commission, illustrating that this first pulse of IUU fishing represents a Crisis Situation. The expected response includes an increased use of informal shortcuts, a contraction of power and centralization of leadership.

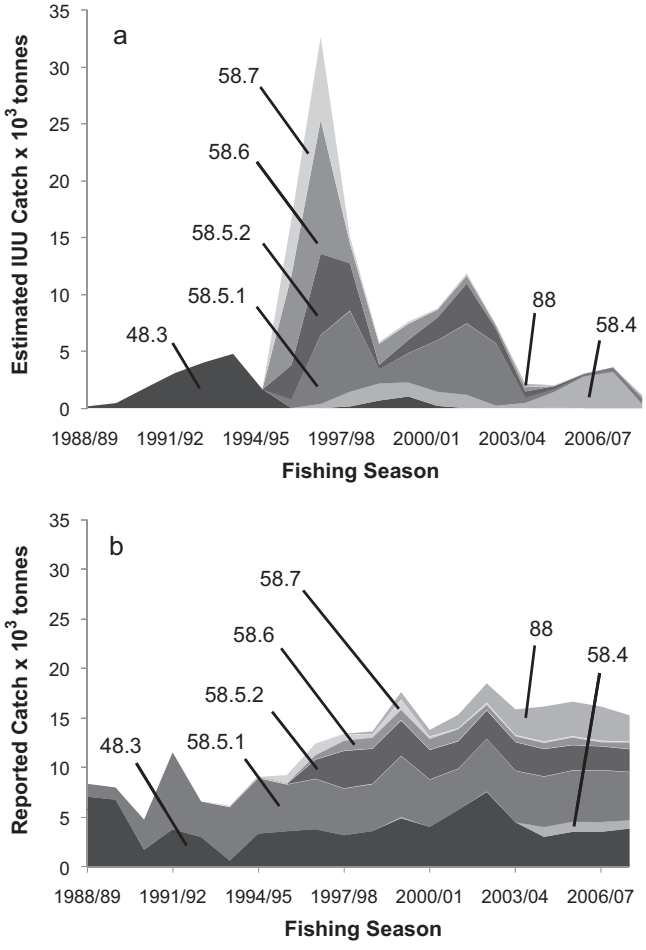

Fig. 2. Catches in the CCAMLR Area between 1989 and 2008, by FAO-area and CCAMLR fishing Season. Area 48.3: South Georgia – UK, 58.7: Prince Edward Islands – South Africa, 58.6: Crozet and 58.5.1: Kerguelen Islands – France, 58.5.2: Heard and McDonald Islands – Australia, 58.4 and 88 – high seas. (a) Estimated IUU catches, data from SC-CCAMLR (2008). (b) Reported legal catches, data from CCAMLR (2009b). Catches <250 tonnes from area 48, outside 48.3, but have been omitted for clarity and consistency with (a). For information on countries fishing, see Table 2.

4.1.1. Use of informal shortcuts

Representatives from NGOs and the fishing industry attended the 1997 meeting of CCAMLR as part of the Australian delegation (CCAMLR, 1997). Concerned with the capacity of governments to be able to react in time to conserve seabirds and toothfish stocks, these individuals established ISOFISH (International Southern Ocean Longline Fisheries Information Clearing House), a joint venture between Australian NGOs, Austral fisheries (the only Australian company licensed to fish for toothfish at the time) and additional partners (Fallon and Kriwoken, 2004). ISOFISH expanded on the work by the Norwegian NGO (ISOFISH, 1998a,b), with financial support from the Australian fishing industry and government (the Norwegian NGO was financially supported by the Norwegian government). The combined concerns about seabird mortality in longlines (as IUU operators did not use bycatch mitigation measures) and the reduction of future commercial potential due to IUU fishing, provided strong incentives for NGOs and industry to form this coalition. ISOFISH was supported by Antarctic Southern Ocean Coalition (ASOC), a respected and influential observer to CCAMLR and ATS, consisting of 250 conservation groups in more than 50 countries (Fallon and Kriwoken, 2004). ASOC could benefit from ISOFISH for information, and the industry could benefit from the capacity of NGOs to communicate information they provided. This created a win-win coalition leading to a number of compliance mechanisms with a strong focus on a management approach (Table 3).

ISOFISH used industry contacts to collect information on IUU operators in the docks and bars of Mauritius. They used polarized and strong language in their reports, referring to Mauritius as a "Pirate capital" (ISOFISH, 1998a) and to Scandinavians as "plundering Vikings" (ISOFISH, 1998b). As CPs were identified as flagging IUU vessels, the reports presented a substantial threat to their reputation. NGO efforts contributed to conceptualize the issue and increased the incentives of governments to address non-compliance in industries for which they were responsible. ASOC presented the ISOFISH reports at CCAMLR in 1998, where the language of the reports was criticized as unsuitable, but the information provided (details on vessel names, flag-, port states and ownerships) was generally perceived as a constructive contribution (CCAMLR, 1998), which illustrates the value of using informal shortcut. The factual background in the reports would likely never have been acceptable for a government report, but the legitimacy of the information was not officially questioned, in part due to the credibility of ASOC.

ISOFISH worked with media to publicize IUU fishing nationally, and to expose IUU operators in their home countries and hometowns (Fallon and Kriwoken, 2004). ISOFISH also formed partnerships with additional governments, industry and NGOs to improve information flow, resulting in the exposure of companies and nationals from additional CPs (ISOFISH, 1999). The uncommon

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Table 2
Commission members and their history of Patagonian and Antarctic toothfish catch. Year of first catch was defined as year when catches exceeded 10 tonnes. Main fishing areas only defined for countries catching >5% of catches. See Figs. 1 and 2 for catch areas and trends. Substantial catches (>15 000 tonnes in area 48, and >10 000 tonnes in area 58) were reported by the Soviet Union prior to the 1991/92 season. Data from CCAMLR (2009b).

Country	First catch (season)	Mean catch (tonnes)	Total catch (tonnes)	Percent (total)	Main fishing area
Argentina	1994/95	249	1740	0.9	
Australia	1996/97	2863	34 360	16.9	58
Belgium					
Brazil					
Chile	1991/92	1414	19 793	9.7	48
China					
European Community					
France	1980/81	5273	73 822	36.2	58
Germany					
India					
Italy					
Japan	1976/77	175	1573	0.8	
Korea	1993/94	496	6451	3.2	
Namibia	2006/07	164	328	0.2	
New Zealand	1997/98	1137	12 509	6.1	88
Norway	2003/04	188	942	0.5	
Poland	1979/80	0			
Russia	1991/92	446	4455	2.2	
South Africa	1995/96	821	10 681	5.2	48/58
Spain	1996/97	689	7582	3.7	
Sweden					
Ukraine	1991/92	703	5625	2.8	
United Kingdom	1996/97	1478	17 733	8.7	48
United States of America	1995/96	127	382	0.2	
Uruguay	1997/98	538	5914	2.9	

alliance between NGOs and industry was possible due to trust between key individuals and converging interests (Fallon and Kriwoken, 2004).

Work by ISOFISH and other non-state actors created public awareness, peer pressure within the fishing industry and political pressure that contributed to a substantial decrease in IUU fishing (Agnew, 2000; Baird, 2006; Fallon and Kriwoken, 2004). Greenpeace and licensed toothfish vessels also provided informal support to offshore patrols by reporting on vessel sightings (Fallon and Kriwoken, 2004). Diverse activities within the ASOC network appear to have been linked by ideas and goals, rather than organization, and benefited from the ability of ASOC to communicate with their observer status to CCAMLR. Investigations by non-state actors also led to the establishment of informal IUU vessel lists (Fallon and Kriwoken, 2004).

4.1.2. Power and centralization of leadership

South Africa, France and Australia were developing national fisheries for toothfish around their sub-Antarctic islands during this crisis (CCAMLR, 2009b), as were the UK and New Zealand (Fig. 2b and Table 2). These countries were generally identified as countries leading efforts to reduce IUU fishing. The involvement of states (or their nationals) in IUU fishing has resulted in coordinated diplomatic pressure (where these countries has taken a leading role), forcing countries to take actions against their nationals or vessels in order to maintain credibility (Baird, 2006; Miller et al.,

Table 3
Coalitions involved in addressing IUU fishing in the Southern Ocean, the costs and benefits to actors of participating in the coalition and the effect of the coalition on non-compliance. Effects on IUU operators are described as an increase (+) or decrease (−) in Price: P, Cost of Fishing: CoF, Probability of Detection: PoD, Cost of Sanctioning: CoS, and Moral and Social Driver: MSD, see (Young, 1979; Sumaila et al., 2006).

	Type of coalition	Cost to participate in coalition	Net benefits for participants in coalition	Effect of coalition on non-compliance	
				On states	On IUU operators
ISOFISH	Non-state coalition (NGO and industry)	Reputation Lawsuit	Converging goals Information exchange Communication platform	Reputation	PoD, MSD (+)
ASOC	Non-state coalition (NGOs)	Transaction cost Lawsuit	Shared conservation goals Information exchange Communication platform	Reputation	PoD, MSD (+)
CCAMLR	Intergovernmental Commission	Political (reputation) Financial	Protect state interest/reputation Protect global heritage	Reputation Financial (no quota)	P (−) CoF, PoD, CoS, MSD (+)
COLTO	Non-state coalition (Industry)	Reputation Financial	Shared commercial goals Information exchange Communication platform	Reputation	P (−) PoD, MSD (+)
Government-industry	French public–private partnership	Financial	Improved MCS capacity (*Osiris*)		PoD, CoF (+)
France-Australia	Bilateral agreement	Requires continuous investment	Regional MCS synergies		PoD, CoF (+)
SADC	Multilateral agreement		Regional MCS synergies	Reputation	PoD (+)
IMCS	Multi-actor network		Global information sharing		PoD (+)

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2010). Australia was coordinating diplomatic initiatives (CCAMLR, 2000) towards NCP identified as having an interest in the fishing or trade of toothfish. Ports in Mauritius and Namibia were officially identified as involved in IUU fishing in 1997. Both countries attended CCAMLR as observers in 1998 (CCAMLR, 1997, 1998). CPs identified as involved in IUU fishing addressed non-compliance by changing national legislation, de-flagging vessels, closing ports, or prosecuting their nationals, with varying success.

Diplomatic pressure and CCAMLR CMs agreed on in 1997 and 1998, however, had limited capacity to effectively address this crisis (Agnew, 2000). The Norwegian government established a formal black list on vessels already in 1998 (Anonymous, 2010), but few other enforcement mechanisms were initially developed. A 1999 proposal (primarily developed by the US, Australia and the EU) aimed at tracing trade flows, became operational in 2000, in part due to pressure from NGOs (Agnew, 2000). This Catch Documentation Scheme (CDS) provided a mechanism for excluding IUU catches from the market, thereby reducing the price for IUU caught fish (Agnew, 2000; Miller et al., 2010). Several NCPs have been identified as important in the landing or trade of toothfish, and some have also become members of the CDS (Miller et al., 2010). The capacity and incentives for the full implementation of the CDS however, appear limited in some major ports (AAPA, 2010; CCAMLR, 2007, 2009a).

4.2. An innovative situation

IUU fishing was reduced following the Crisis Situation, but increased again and reached a new peak in 2002 (Fig. 2a), leading to a renewed sense of urgency within the Commission (CCAMLR, 2002). IUU fishing was referred to as a highly organized form of international crime (CCAMLR, 2002), following the Australian apprehension of Russian flagged vessels *Lena* and *Volga* in 2002. This arrest revealed how IUU operators reduced the probability of detection and sanctioning (Sumaila et al., 2006) through a number of measures, including using offshore fleet support (transshipment of fuel, bait, personnel, and receiving legal advice), coordination of fleet movements, faking distress signals and collection of intelligence on Australian fisheries control operations (Baird, 2006; ITLOS, 2002). Stakes remained high (Fig. 2b): future scenarios from SC indicated a need for dramatically, and long term, reduction of catches as a direct consequence of continued IUU fishing (SC-CCAMLR, 2002). Levels of IUU fishing was however not as dramatic as previously and the situation was not as urgent as in 1997. The highly sophisticated IUU fishing operations however, created a substantial surprise and this situation can be defined as an Innovative Situation. Programs and ideas that have been regarded as unfeasible can emerge as important innovations to problems identified under such conditions. Policy entrepreneurs can play a particularly important role.

4.2.1. Policy entrepreneurs

Fishing industry incentives to address IUU fishing are directly related to the estimated level of IUU fishing. Austral Fisheries, the major Australian quota holder for Patagonian toothfish, were facing a potential major loss of catch opportunities and gross revenues when SC presented their future catch scenarios in 2002 (SC-CCAMLR, 2002). The company was a key partner in the ISOFISH project and was investing substantially in lobbying the Australian government. According to a senior manager at Austral Fisheries:

> "Austral Fisheries were lobbying politicians including members of Parliament and senators, were participating in parliamentary briefings, doing lots of media work, and produced a short movie promo on illegal fishing designed to shock Parliamentarians into action. We also developed various schemes to eliminate illegal fishing from the Australian EEZ and surrounding waters, including offering free of charge a fishing vessel to use for government surveillance, and fully detailed planning of a system for aerial surveillance based at Kerguelen Island covering the entire Kerguelen Plateau region which includes both Kerguelen Island, as well as Heard and McDonald Islands. We provided considerable input to government agencies working on illegal fishing, and constantly provided new ideas to combat the problem in Australian waters. We also had COLTO (see below) informants providing details to international journalists who ran very controversial articles in both Spain and Uruguay."

The schemes designed by industry were not made operational, but contributed to increasing the political pressure on the Australian government. Austral Fisheries were also very active in obtaining information on IUU operators, e.g., by contracting consultants from OAM, a group of former agents from the Special Armed Services of Australia, specializing in covert investigations (www.oam-group.com). OAM obtained substantial information on an emerging IUU networks and their operations in Indonesia. This intelligence was presented in a nationally broadcasted TV show (Masters, 2002), which described the foreign threat of IUU fishing to Australian fish resources, jobs and environmental values. The show was aired soon after the Australian national elections in 2001, where border security and state sovereignty were the most prominent issues (in part as a response to the September 11 attacks in New York and increased attention to asylum seekers to Australia (Hugo, 2002). The threat of IUU fishing was also widely communicated as a result of a sequence of high profile hot pursuits of vessels fishing in the Australian EEZ of Heard and MacDonald islands (ANAO, 2008; Baird, 2006). The spectacular pursuit of the Uruguayan flagged *Viarsa I* (2003) was maintained for 21 days and 3 900 nautical miles, before her apprehension near South Africa (Knecht, 2006; Molenaar, 2004). The chase was reported on a daily basis in national media and contributed substantially to making IUU fishing a national priority.

Austral Fisheries spent more than US$ 2 million dollars during two years (2002–2003) on lobbying, surveillance, private investigators and consultants. The dramatic effect of IUU fishing in South African EEZs (CCAMLR, 2002), with estimated losses in excess of US$ 150 million dollars, illustrated the threat also to Australian fishing opportunities, thus motivating these expenses. In their lobbying campaign, Austral Fisheries benefited from a national reputation as a responsible company. ISOFISH had developed and maintained the international networks, but after it was disbanded (Fallon and Kriwoken, 2004), a new mechanism was needed to maintain international political momentum.

The industry coalition COLTO, launched in May 2003, aimed to reduce IUU fishing by working with CCAMLR. COLTO was formed with Austral Fisheries and ISOFISH contacts. The licensed toothfish industry involves a small number of relatively large fishing companies. These are bound together by product trade and marketing, which has facilitated the development of a 'social contract' for compliance, creating informal peer pressure. When COLTO started up, they produced "Wanted" posters in 18 languages, offering up to US$ 100 000 in reward for information leading to the conviction of illegal fisheries (OECD, 2005). Information about the reward scheme could be obtained through a multi-lingual call center. In 2003, COLTO consisted of 29 companies in 10 CCAMLR countries, and became observers to CCAMLR (CCAMLR, 2003). The document presented at the CCAMLR meeting (COLTO, 2003) provoked a strong reaction from a number of delegations and was subsequently withdrawn (CCAMLR, 2003).

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The participation of COLTO within CCAMLR, and their approach to addressing IUU fishing was a new experience to national delegations. Before, industry had only been present as members of national delegations, but was increasingly gaining legitimacy within CCAMLR. COLTO has been important for creating political pressure and developing management measures to address non-compliance (Table 3).

4.2.2. Policy innovations

States particularly affected by IUU fishing in their national territories in 2002 and 2003 had strong incentives to effectively take action. France was already investing substantial resources to maintain an armed enforcement capacity around Crozet and Kerguelen Islands, based at Reunion (Fig. 1). However, the continued reappearance of IUU fishing vessels and the increase in activities in 2002 and 2003 stimulated the development of innovative solutions. According to a senior manager at TAAF:

> "Between 1994 and 2004, we were at sea 250 days/year at Kerguelen and Crozet with two navy frigates (*Nivôse* and *Floreal*) and the patrol vessel *Albatros* (arresting and confiscating 23 IUU vessels), but IUU operators kept on coming back. In 2004, we installed a radar satellite system for surveillance, capable of monitoring all vessels around Kerguelen and separating IUU vessels from licensed vessels carrying VMS (Vessel Monitoring System). The same year, a former IUU vessel (the *Lince*, renamed *Osiris*) was confiscated and converted to a patrol vessel, and the industry is sharing the cost for its missions. Since 2004, IUU vessels have stopped their activities inside the French EEZs of Crozet and Kerguelen."

Australia was experiencing a similar need to address persistent and increasingly well-organized IUU fishing. Events unfolding during 2002 and 2003 stimulated national policies and an increase in enforcement capacity. Prior to this period, Australia only had an unarmed fisheries patrol vessel deployed around Heard and McDonald Islands (1997–2003), which proved to be an insufficient deterrent. Apprehension of suspected IUU vessels in the Australian zone required cooperation between armed forces from Australia, France, the UK and South Africa, which contributed to forming strong informal relationships (Baird, 2006).

Costly joint international operations, and ad-hoc deployment (Molenaar, 2004) of the Australian navy (trained and equipped for tropical and subtropical operations) underlined the importance of a new approach (ANAO, 2008; Baird, 2006). There was an initial political reluctance to commit the substantial resources required for effective enforcement of the Southern Ocean. However, mounting national political pressure, potentially in part stimulated by national policy entrepreneurs, and the perception of IUU fishing as a form of organized crime (Österblom et al., 2011) contributed to the Australian government allocating AUD $ 89.2 million for a two-year program in 2004. In 2005–2006, another AUD $ 181.3 million was committed for the period 2006–2010. An armed customs enforcement vessel (*Oceanic Viking*) was deployed and a new Australian fisheries patrol unit created (ANAO, 2008).

France and Australia signed a formal agreement on Southern Ocean surveillance and research in 2004 (ANAO, 2008). This unique bilateral treaty led to an exchange of human and technical capacity and sharing of information on IUU vessel activities. IUU fishing decreased dramatically also around Heard and McDonald Islands (ANAO, 2008; CCAMLR, 2006) and Australia has commenced formalizing cooperation also with South Africa (ANAO, 2008). According to a senior manager at AFMA:

> "We now have an efficient strike capacity from anywhere and at any time – and the illegal operators know it. We operate freely across our respective zones and we can share the cost, which would have been enormous for one country alone."

Individual states with a high degree of autonomy have thus developed compliance mechanisms independent from CCAMLR, with a strong focus on enforcement (see also, e.g., CCAMLR, 2002; Miller et al., 2010) for a description of unilateral actions taken by the US to ban suspected IUU products). CCAMLR was also able to innovate during this period. The CDS became effective as initial loopholes were addressed (CCAMLR, 2001; Miller et al., 2010). The CCAMLR IUU vessel list, established in 2003, was closely coupled to the CDS and CCAMLR VMS and constituted another important enforcement mechanism (Miller et al., 2010). Information flow between organizations is facilitated by the secretariat, which has been important in improving the effectiveness of the CDS scheme. According to a senior official in the CCAMLR secretariat:

> "The CDS changed the composition of CCAMLR delegations and brought more compliance-related personnel (lawyers, compliance officers, trade statisticians, customs officials) to CCAMLR meetings. The informal network of new people created linkages that contributed substantially to enforcement action, e.g., the arrest of the *Viarsa I*, seizures of catches and prosecutions relating to laundering catches within the CDS."

In addition to the increased diversity in national delegations, there was also a significant increase in the proportion of NGO ($r = 0.79$, $n = 15$, $P < 0.001$) and industry ($r = 0.76$, $n = 15$, $P < 0.01$) representatives at annual CCAMLR meetings between 1995 and 2009. The combined participation of non-state actors (NGOs and fishing industry) increased from below 10% to above 20% during the period. There was also a significant increase in the number of invited countries between 1998 and 2009 ($r = 0.89$, $P < 0.001$, $n = 12$). From a total of 38 invited countries, 9 (24%) have participated, out of which 2 joined the Commission and 2 acceded to the Convention. These countries have officially been identified as associated with catch, landing or trade of IUU fish, or as flag states of IUU vessels. Diplomatic pressure directed towards some flag states also resulted in mandates to take actions towards their vessels (CCAMLR, 2007; Griggs and Lugten, 2007).

4.3. A reflexive situation

Estimated IUU catches decreased substantially in the following years. Despite overall low estimated levels in a historical context (Fig. 2a), the Commission noted with alarm that IUU catches in the high seas of the Convention Area substantially exceeded the corresponding legal catch in 2007 (CCAMLR, 2007). The high level of IUU fishing created a large threat to the existing licensed operations in the area, illustrating a high degree of threat. IUU fishing in the high seas (Fig. 2b, 58.4 and 88) is directed at Antarctic toothfish and is urgent to address as very little is known about its stock status. However, the emergence of IUU fishing in the high seas (close to the Antarctic continent) was not a surprise, as it had been predicted already in 2000 (Agnew, 2000). This situation, with a high threat, and an urgent, but anticipated situation, corresponds to a Reflexive Situation. The expected response is to use existing contingency plans.

Governments had had substantial time to develop a contingency plan prior to the increase of IUU fishing in areas 58.4 and 88. Australia was one of few countries with a capacity for high seas monitoring and enforcement and were well equipped to increase this effort in the high seas. In 2008, when New Zealand apprehended the *Paloma V* (CCAMLR, 2008), the country had been relatively unaffected by IUU fishing. The main interests of New

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Zealand fisheries for toothfish are in area 88, the Ross Sea (Fig. 2b, Table 2), where estimated IUU catches has consistently been low (Fig. 2a). New Zealand policy makers were well aware that increased surveillance in other areas could result in growing incentives for IUU operations to operate in the area. However, there is no close access to ports and the area is covered with ice for a large portion of the year. The presence of licensed vessels also increased the risk of detection. New Zealand monitoring efforts has previously focused on aerial patrols, but has (in 2010) also developed a capacity for high seas surveillance and enforcement, using new navy vessels (NZDF, 2010).

IUU fishing has been described as threatening the credibility of CCAMLR in all years (1995–2009), except 2005, 2008 and 2009. In 2009, IUU catches were no longer threatening toothfish stocks within national EEZs, but remained problematic in the high seas (CCAMLR, 2009a). The future developments of IUU fishing are unclear and it cannot be excluded that additional IUU fishing may emerge in the Convention area or beyond.

4.4. Collaboration beyond CCAMLR

As IUU fishing developed and was addressed in CCAMLR, the importance of this issue was becoming apparent also in other international forum (FAO, 2001; HSTF, 2003; UNGA, 1999). A formal global network (IMCS) between government agencies developed rapidly, from an original 6 countries in 2001, to almost 50 in 2009. The aim of the network was to share information and build capacity of relevance for addressing IUU fishing (HSTF, 2003), www.imcsnet.org. IMCS has substantially facilitating information flow between government agencies and have expanded to also include other actors, including NGOs. Trust is a key element for maintaining the functioning of the network. According to a senior manager in IMCS:

> "The same people were involved in compliance related issues in CCAMLR, ICCAT (International Commission for the Conservation of Atlantic Tunas), IOTC (Indian Ocean Tuna Commission) and all saw the need for an informal network for exchange of information. We needed to be able to contact each other directly and not thru the regular government channels, which would have been too cumbersome and too slow."

Few countries have successful prosecuted individuals involved in IUU fishing. International cooperation beyond CCAMLR, including the IMCS network has facilitated US prosecutions and convictions. Complex international seafood cases require the competence, mandate and cooperation of several countries and agencies (GAO, 2009). Patagonian toothfish (NOAA, 2004, 2006) and other seafood related cases (DOJ, 2009) have substantially strengthened the national and international networks for addressing IUU fishing (Hauck and Kroese, 2006; NOAA, 2004). According to Special Agents at NOAA:

> "The toothfish cases send a strong signal (to vessel owners, middlemen involved in the trade and buyers) that the US is committed to investigating and prosecuting those involved in the illegal toothfish trade. The possibilities for doing so have improved significantly through our global partnership with South Africa, New Zealand, Australia and our MCS partners. Collaboration with partners in the US has improved significantly after 9/11."

The success of CCAMLR to reduce IUU fishing within the convention area has had unintended side effects. It is not uncommon that non-compliance in one regions emerges as an externality of compliance mechanisms elsewhere (Young, 1979). IUU operators have adapted to actions by flag- and port states, and increased enforcement, through a number of different measures (CCAMLR, 2009a; Österblom et al., 2010), resulting in lower costs, lower risks and higher profits. There have been indications that vessels from the CCAMLR IUU list were targeting sharks around Southern Africa in recent years (MRAG and Capfish, 2008). Cooperation with, and capacity building in, African countries has been identified as critical for addressing IUU fishing (Agnew et al., 2009). In 2008, the Ministers of fisheries in Southern African Development Community (SADC) countries (Angola, Madagascar, Mauritius, Mozambique, Namibia, Seychelles, South Africa and Tanzania) signed a formal statement of commitment to cooperate when addressing IUU fishing (SADC, 2008). Many Southern African countries, with the exception of South Africa (Hauck and Kroese, 2006), lack most recent technology (high seas vessels, aircrafts, satellites, radar systems). Regional cooperation and collaboration with the MCS network have substantially increased regional capacity (Miller, 2010).

5. Discussion

5.1. Crises and compliance mechanisms

The observed response to the series of crisis-like situations was consistent with predictions from the framework used. These events unfolded in the context of a global fisheries crisis and increased attention to state sovereignty and border protection security, which created an opportunity for coupling problems with politics in emerging windows of opportunity (Kingdon, 1984). Alternative and/or complementary explanations for the emergence of these compliance mechanisms include, e.g., other political considerations between states not described here.

This study highlight the importance of management approaches to address non-compliance as an initial response to crises-like situations, as it may be difficult to arrive at consensus for international enforcement measures for politically sensitive issues. Non-state actors were instrumental in developing such mechanisms. Treaty dependent (i.e., resulting from CCAMLR) management approaches to non-compliance addressed involuntary non-compliance of states thru diplomatic pressure, capacity building and inclusiveness of NCPs. CCAMLR also developed a number of enforcement-type mechanisms changing the incentives of industries to engage in voluntary non-compliance, and has also actively reduced the ambiguity of rules. States with fishing interests and sovereign territories within the Convention area developed similar compliance mechanisms nationally, independent from CCAMLR. This illustrates the importance of policy diffusion (Underdal, 1998) and national flexibility to adapt to changing conditions. Regular meetings of the Commission, an independent secretariat and implementation review (SCIC), precise rules, increasing inclusiveness of states contributing to the problem and non-states actors, contributed to increasing compliance. These findings are consistent with theory (Underdal, 1998; Young, 1979) and empirical analysis from 23 environmental regimes (Breitmeier et al., 2006). Compliance in the CCAMLR area also benefitted substantially from novel technologies (Miller, 2010). Alternative and/or complementary explanations to changes in levels of IUU fishing may exist, but, e.g., an analysis of market value of IUU caught toothfish was beyond the scope of this study.

5.2. Are insights from CCAMLR relevant elsewhere?

Countries in CCAMLR share a commitment to protect Antarctica for the benefit of all mankind. A failure to do so would have global political consequences. The relatively limited impacts of human activities during recent decades also make the Southern Ocean

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different from many other marine ecosystems. The observed success to address IUU fishing was likely in part a result of the good reputation and high legitimacy of CCAMLR. The long history of involvement of officials in CCAMLR delegations (Andresen, 2002), substantial international cooperation around vessel detection and apprehension (Knecht, 2006; Molenaar, 2004), leadership and sustained collaboration between diverse actors (this study) has created important trust (Ostrom, 1998) and institutional memory (Breitmeier et al., 2006; Young, 1979). Long-term face-to-face interaction has been critical for successful outcomes.

CCAMLR has evolved over time and new actors have contributed to solving emerging issues. The success of CCAMLR clearly benefitted from this diversity (cf. Biermann and Pattberg, 2008; Hong and Page, 2004; Lemos and Agrawal, 2006). It is generally agreed that NGOs can complement the role of states by engaging in agenda setting, increasing transparency and compliance monitoring (Haas, 2004; Lemos and Agrawal, 2006; Mitchell, 2003). In CCAMLR, NGO concerns with drowning of charismatic seabirds benefitted from converging interests with the fishing industry and governments: actors had symmetrical or converging interests, with a low cost production function (Ostrom, 1998). This study also highlighted the importance of proactive collaboration with the licensed fishing industry. This suggests that an increased inclusiveness of actors can, if incentives are aligned, contribute to novel ways of addressing emerging issues.

In contrast to many fisheries management organizations, CCAMLR put a strong practical emphasis on the precautionary approach. There is thus a strong social-ecological feedback between IUU fishing-stock status-scientific advice and long-term economic outcomes for the licensed fishing industry, which could be of relevance also for other management systems. CCAMLR has emerged as a global leader in addressing IUU fishing and similar approaches to the CCAMLR CDS and IUU list are currently being developed elsewhere (Flothmann et al., 2010; Miller et al., 2010).

A more fundamental aspect of CCAMLR leading to the successful reduction of IUU fishing is the existence of this governance institution prior to the emergence of the first crisis. CCAMLR was the natural platform for addressing IUU fishing in the Southern Ocean. It has been suggested that there are substantial governance gaps for a number of complex, global governance challenges (Walker et al., 2009). For instance, polar resources in the Northern Hemisphere lack an analogous governance institution, although this region is facing a number of social, political and ecological governance challenges in the present and near future (http://www.arcticgovernance.org/).

5.3. Future challenges for CCAMLR

Large costs associated with effective control of remote areas initially exceeded the perceived benefits. The combined costs of non-compliance for a general public (seabirds concerns) and a concentrated industry, contributed to changing the social costs of non-compliance (Underdal, 1998; Young, 1979). This was particularly evident in Australia, where non-compliance had a strong link to state sovereignty and border protection.

Hot pursuits and multilateral coalitions, although expensive and pushing the edge of international law, tested the adaptive capacity of governments and built public and political support. Sustaining investments in compliance mechanisms is critical for sustainability (Underdal, 2010). The current absence of vessel sightings within EEZs and high profile hot pursuits reduce the incentives to invest in expensive compliance mechanisms and participate in routine monitoring missions. Incentives for industry are reduced when national EEZs or preferred landing ports are unaffected by IUU fishing. Unregulated fishing using NCP flagged vessels reduce the capacity of CPs to control their nationals if engaged in such non-compliance (Underdal, 1998). Flag states may have inadequate capacity or incentives to address compliance (Österblom et al., 2010; Underdal, 1998). Continued investment appears dependent on a maintained level of urgency, synergies between interests and leadership from dedicated key individuals, organizations and countries (Folke et al., 2005).

Most vessels on the CCAMLR IUU list in 2009 appeared to have shifted to gillnets which was increasing uncertainties in CCAMLR catch estimates (CCAMLR, 2009a). There is a continuous risk for new crises within or beyond CCAMLR (Flothmann et al., 2010; MRAG and Capfish, 2008). Recent European (EC, 2008) and global (FAO, 2009) legislation may (Flothmann et al., 2010) improve the prospects for addressing potentially emerging problems and complement the work carried out by CCAMLR. The adaptive capacity of IUU operators emphasizes the importance of continuous innovation when managing natural resources (Berkes et al., 2006; Dietz et al., 2003; Österblom et al., 2010; Walker et al., 2009).

6. Conclusions

Crisis-like situations resulting from IUU fishing in the Southern Ocean created windows of opportunity for change. These observations were consistent with analogous situations in international relations. A diversity of actors, operating at multiple geographical scales, contributed to an adaptive capacity. Management and enforcement approaches had synergistic effects on non-compliance, addressing voluntary non-compliance of actors and involuntary non-compliance of states. Non-state actors and policy entrepreneurs were important for increasing the social costs of compliance mechanisms, which became feasible in existing political contexts. Synergies from interests in environmental conservation and sustainable use contributed to creating incentives for developing mechanisms that improved compliance.

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