The ebb and flow of adaptive co-management: A longitudinal evaluation of a conservation conflict

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ABSTRACT

Adaptive co-management (ACM) is an emerging approach to the governance of social-ecological systems, but there are few long-term assessments of its efficacy. This is especially true in conservation conflicts, where ACM can mitigate disputes between polarised stakeholders. We evaluated ACM that emerged in 2005 to address conflict between seal conservation and fisheries interests in the Moray Firth, Scotland. We interviewed 20 stakeholders in 2015, repeating a survey carried out in 2011 which applied an indicator framework to measure outcomes and pre-conditions for ACM to continue. In 2015, all but one of the 12 outcome indicators were positive, the exception being the conservation status of salmon. However, pre-conditions for ACM's continuation had weakened, with declines between 2005, 2011 and 2015. These were most marked for three indicators: leaders prepared to champion the process, presence of a bridging organisation or individual, and participation of all impacted stakeholders. The results show that ACM in this conservation conflict is dynamic. Perceived declines in salmon abundance and increases in seal numbers have renewed tensions amongst stakeholders, triggering a 'revival' phase of ACM initiated by fishery interests. Our study provides empirical evidence of ACM's fluid nature, and how resource crises can reignite ACM. We suggest that participatory evaluation is a potentially important early-warning mechanism that can identify remedial action and galvanise stakeholders to respond to the re-emergence of conflict.

1. Introduction

Globally, friction between stakeholders involved in wildlife management is escalating (Redpath et al., 2013). There is growing recognition that such conflict is driven by conservation interests wishing to protect wildlife species that impact the livelihoods of others (Young et al., 2010; Redpath et al., 2015). A typical example is the predation of livestock by protected predators, and retaliatory killing by the affected stakeholders (Butler, 2000; Butler et al., 2014). Resolution of such 'conservation conflicts' that reduces negative impacts on species and people requires stakeholders' polarised values and goals to be addressed via equitable participation, collaborative decision-making and appropriate government policy (Treves et al., 2009; Butler et al., 2015; Young et al., 2012; Bellanger et al., 2020).

Adaptive co-management (ACM) has been proposed as a governance approach that can mitigate conservation conflict (Butler, 2011; Butler et al., 2015) because it combines the iterative learning, knowledge generation and problem-solving of adaptive management with the stakeholder power-sharing of co-management (Olsson et al., 2004a; Plummer, 2009; Plummer et al., 2012). ACM typically emerges to maintain the resilience of social-ecological systems (e.g. Olsson et al., 2004a) but can also be intentionally introduced to transform them (e.g. Butler et al., 2016). Variables that initially catalyse the ACM process are referred to as pre-conditions, antecedents or inputs (Plummer, 2009). The outcomes or experiences of successful ACM should also create pre-conditions that facilitate ACM to continue (Plummer et al., 2012).

The efficacy of ACM in resolving conservation conflict, however, has been little explored (Butler et al., 2015). There are two reasons for this. First, longitudinal case evaluation is necessary to assess progress towards intended outcomes, and to determine whether the outcomes have

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created pre-conditions for the collaborative process to continue (Plummer et al., 2012, 2017), but ongoing monitoring and evaluation is rarely embedded within conflict resolution efforts (Young et al., 2016; Butler et al., 2019). Second, the context-specificity of ACM arrangements makes evaluation of the processes, outcomes and pre-conditions difficult, and suitable indicator frameworks remain under-developed (Plummer and Armitage, 2007; Fabricius and Currie, 2015; Plummer et al., 2017).

In response to this gap, Butler et al. (2015) presented the first generic indicator framework to evaluate ACM when applied to conservation conflict, together with a participatory method for its longitudinal implementation. The framework was constructed to evaluate the efficacy of the Moray Firth Seal Management Plan (MFSMP) in Scotland, which was initiated in 2005 to collaboratively address competing interests in salmon fisheries and seal conservation (Butler et al., 2008, 2011; Table 1). An initial evaluation was conducted in 2011 to assess progress since 2005. This analysis showed that the MFSMP had evolved through four phases, from Phase 1 where a crisis in 2002 catalysed stakeholder collaboration, to Phase 4, 'stakeholder apathy', where by 2011 many parties had disengaged from the process (Butler et al., 2015). The results of the participatory process formed a learning feedback loop into the MFSMP, highlighting actions that were necessary to maintain ACM, including revitalised government support.

In this study, Butler et al.'s (2015) indicator framework was applied to extend the evaluation of the MFSMP's progress from 2005 and 2011 to 2015. This creates a unique 11-year dataset that demonstrates how the characteristics of ACM ebb and flow in response to changes in the drivers of conservation conflict. The results also illustrate the potential value of longitudinal monitoring, which can create a learning feedback loop necessary for effective ACM. In the context of conservation conflict, this may form an early-warning system which can pre-empt the escalation of conflict, and prioritise appropriate policy responses.

2. Methods

2.1. Study area

The Moray Firth is a 5230 km^2 coastal embayment in north-east Scotland. Historically, the 18 major rivers that flow into the Moray Firth generated an annual run of up to 270,000 adult Atlantic salmon (*Salmo salar*), which in turn supported coastal netting stations and in-river rod fisheries. The Moray Firth is also an important habitat for marine mammals such as harbour seals (*Phoca vitulina*), grey seals (*Halichoerus grypus*) and bottlenose dolphins (*Tursiops truncatus*) which support a growing wildlife tourism industry. There is a long history of conflict between salmon fisheries and seal interests in Scotland. It has been legal for fisheries to counter seal predation on salmon by shooting seals outside closed seasons which covered pupping periods (Butler

Table 1

Butler et al.'s (2015) indicator framework for evaluating ACM applied to conservation conflict, divided between a) outcome indicators and b) pre-condition indicators for ACM to continue, and propositions given to interviewees. The three outcome and six pre-condition indicators that were added to the initial 2011 evaluation by Butler et al. (2015) are shown in italics.

a) Outcome indicators		
	Indicator	Proposition
1	New institutional arrangements	Changes have been made to organisations, rules or usual practices regarding seal and salmon management
2	New institutions codified in law	New institutions triggered by seal and salmon stakeholders have been established in law
3	Questioning of routines, values and governance	Stakeholders have reconsidered the underlying causes of the seal and salmon conflict, its complexity, and the way it is currently being thought about and managed
4	Legitimisation of policies and actions	Government and other policies and actions relating to the seal and salmon conflict are regarded as more legitimate by stakeholders
5	Agreed upon sanctions	Agreed sanctions have been established to address infringements of rules by stakeholders
6	*Outcome acceptable to all parties*	*Outcomes of the Moray Firth Seal Management Plan are acceptable to all relevant parties*
7	*No party asserting its interests to the detriment of others*	*No party in the seal and salmon conflict is asserting its own interests to the detriment of others*
8	Creative ideas for problem-solving	Creative and innovative ideas have been developed to solve the seal and salmon conflict
9	Engagement and learning across scales	Stakeholders from different scales and levels (e.g. national government and local communities) involved in the seal and salmon conflict have become more engaged and are exchanging information and learning from one another
10	Changes in perceptions and actions	Stakeholders in the seal and salmon conflict have changed their perceptions of the problem, and these are reflected in changes in their actions
11	Resource management plan	Resource management plans or agreements have been produced to address the conflict between seal and salmon stakeholders
12	*Acceptable conservation status of all contested species*	*Acceptable conservation status of salmon (12I) and seal species (12II) has been achieved*

b) Pre-condition indicators		
	Indicator	Proposition
1	Adaptable portfolio of management resources	Stakeholders in the seal and salmon conflict have access to an adaptable portfolio of management measures to address the conflict
2	Commitment to support a long-term institution-building process	Stakeholders in the seal and salmon conflict are strongly committed to the process of establishing new management structures, rules and approaches to resolve the conflict
3	Provision of training and capacity building	Stakeholders in the seal and salmon conflict from all levels have opportunities for training, learning and skills-building
4	Leaders prepared to champion the process	Leaders have emerged amongst the stakeholders in the seal and salmon conflict and are prepared to champion the process
5	Stakeholders drawing on and sharing diverse knowledge	Stakeholders in the seal and salmon conflict are willing to exchange information and accept their different kinds of knowledge
6	National and regional policy environment supportive of collaborative management	Government policies at the national and regional level are enabling collaborative management amongst the stakeholders in the seal and salmon conflict
7	*Formal and regular evaluation of outcomes and pre-conditions as a stakeholder learning process*	*Formal and regular evaluations of outcomes and conditions take place as part of continual stakeholder learning process in the seal and salmon conflict*
8	*Quality of information and resources*	*There is a high quality of information and resources available to stakeholders in the seal and salmon conflict*
9	*Transparency of stakeholders' goals and values*	*The goals and values of each stakeholder party in the seal and salmon conflict is transparent*
10	*Trust amongst stakeholders*	*There is a high level of trust amongst stakeholder parties in the seal and salmon conflict*
11	*Presence of a bridging organisation or individual*	*There is a presence of a bridging organisation or individual between different stakeholder parties in the seal and salmon conflict*
12	*Participation of all impacted stakeholders*	*There is participation of all affected stakeholders in the resolution of the seal and salmon conflict*

et al., 2015).

In 1992, the UK government adopted the European Union Habitats Directive, which aimed to secure the favourable conservation status of listed species through the designation of Special Areas of Conservation (SACs). Within the Moray Firth, the Dornoch Firth and six rivers were designated as SACs for their harbour seal and Atlantic salmon populations, respectively (Butler et al., 2008). The designations posed an unprecedented challenge for seal and salmon conservation, because they imposed new statutory responsibilities on the government and fishery managers to ensure the favourable condition of the seal and salmon SACs, yet the protection of one species could potentially impinge upon the status of the other. The tension escalated in 2002 when an outbreak of phocine distemper virus (PDV) in Europe prompted the Scottish Government to introduce a permanent national close season ('Conservation Order') to prevent any seal shooting. In the Moray Firth, no licences were granted to fishery managers to shoot seals due to concern about declining harbour seal numbers, which threatened the status of the Dornoch Firth SAC (Thompson et al., 2007).

The designation of seal and salmon SACs and the PDV outbreak, together with declines in harbour seal and salmon abundance, a growing wildlife tourism industry and opposition to seal shooting were the triggers for Phase 1 of ACM in the Moray Firth (Butler et al., 2015), defined by Olsson et al. (2004b) as 'preparing the system for change'. In Phase 1, triggered by a resource crisis, a leader emerges from local resource stewards to create stakeholder networks and integrate their knowledge in order to generate innovative solutions (Olsson et al., 2004b; Butler et al., 2015). In this case, a fishery executive convened meetings amongst fishery stakeholders, who agreed to collectively negotiate with the government to develop an alternative management approach for seals and salmon. They also engaged the wildlife tourism industry and other local stakeholders through the Moray Firth Partnership, an integrated coastal zone management group. National-level endorsement was secured by engaging with the Seals Working Group, a multi-stakeholder consultative forum established by the government in 2002.

Following three years of negotiation amongst stakeholders, the MFSMP was launched in 2005. It aims to restore the favourable conservation status of harbour seal and salmon SACs by reducing the impacts of shooting on seal populations and seal predation on salmon, monitoring seal and salmon numbers, and developing non-lethal methods of managing seal predation. Fishery managers coordinate a single annual licence application to shoot a specific number of seals in stakeholder-endorsed management areas (Butler et al., 2006; Graham et al., 2011). The government applies the Potential Biological Removal (PBR) method (Wade, 1998) to estimate the number of seals that can be removed without causing a population decline. In 2011, the MFSMP model was scaled-out nationally under the Marine (Scotland) Act (2010).

In 2004 and 2005 the Moray Firth case had evolved through Phase 2 and Phase 3 of ACM, defined by Olsson et al. (2004b) as the 'window of opportunity' and 'building resilience of the desired state', respectively. With the expiry of the Conservation Order in 2004, it became possible for the government to introduce a Moray Firth-specific order to legalise the MFSMP. The networks, alliances and knowledge created between stakeholders built adaptive capacity and resilience (Butler et al., 2015). The resulting governance framework in the Moray Firth is adaptive: annual licence applications are assessed based on the PBR method, augmented by learning through monitoring of seal and salmon populations, and research findings about seal-salmon interactions and innovative non-lethal tools to mitigate salmon predation. Co-management is also evident in the sharing of responsibilities and cross-scale networks between stakeholders including fishery, tourism, government and research agencies, and the national multi-stakeholder Seals Working Group (Butler et al., 2015).

2.2. Study design

Twenty semi-structured interviews were conducted with key MFSMP stakeholders in June and July 2015, including local fisheries (n = 13), regional scientific advisors (n = 2) and Scottish Government agencies for conservation and marine affairs (n = 5). This sample was initially delimited by those stakeholders that were interviewed in 2011 by Butler et al. (2015), who we sought to re-interview to maintain long-term consistency in the evaluation. These are referred to as 'repeat interviewees' (n = 6). If the 2011 individuals were no longer involved in the MFSMP, their successor was interviewed instead. Such chain referral sampling is appropriate for accessing members of small policy networks (Lewis-Beck et al., 2004). Those participants who had not been previously interviewed are termed 'new interviewees' (n = 14). The wildlife tourism representative interviewed in 2011 had moved to a new role. Their successor was approached but owing to their very limited knowledge of the MFSMP, this interviewee's responses were excluded.

2.3. Data collection

Interviews were conducted face-to-face (n = 18), or by telephone where this was not possible (n = 2). Only face-to-face interviews were audio recorded, subject to participant agreement. Interviewees were pre-informed that the objective of the study was to evaluate progress against the MFSMP's objectives, and to encourage learning and reflection amongst stakeholders.

The data collection process applied Butler et al.'s (2015) indicator framework, which had added three outcome and six pre-condition indicators to the initial 2011 evaluation. Twelve outcome parameters (i.e. measures of progress) and 12 pre-condition indicators (i.e. conditions created by outcomes that facilitate the continuation of the collaborative process) were presented sequentially as propositions to the interviewee (Table 1). For each outcome indicator the interviewee provided a score based on the following Likert scale: strongly disagree (-2), disagree (-1), neutral (0), agree (1) and strongly agree (2). For each pre-condition indicator interviewees provided a score from weak (1) to very strong (5). Interviewees could give scores to one decimal point. If an interviewee could not score a proposition this was recorded as 'don't know'. The interviewee was then asked to provide explanatory comments for each score. To counter 'memory distortion' (Wiek et al., 2014), the repeat interviewees were reminded of their previous outcome and pre-condition scores and comments.

For outcome and pre-condition indicators, all interviewees were asked to give a score for 2015. Separate scores were given for outcome indicator 12I for salmon and 12II for seals (Table 1a). To assess longitudinal change in pre-condition indicators, new interviewees were asked to retrospectively provide a score and explanatory comments for 2005 and 2011, and these were combined with the scores given by the repeat interviewees for 2005 and 2011 recorded by Butler et al. (2015). For the additional six pre-condition indicators, both repeat and new interviewees were asked to provide retrospective scores for 2005 and 2011.

2.4. Data analysis

All audio recorded face-to-face interviews were transcribed verbatim. These transcripts, and notes from telephone interviews that were not audio recorded, were analysed by content analysis (Newing et al., 2010). The mean for each indicator was calculated to reduce response style bias (de Vaus, 2002; van Vaerenbergh and Thomas, 2013), excluding the 'don't know' responses.

Indicator score data had to be screened for two reasons. First, the scores for outcome indicators were based on the cumulative period of 2005−2015. To maintain consistency, scores given only for 2015 by three new interviewees were excluded. Second, for pre-condition indicator scores in 2005, 2011 and 2015, four new interviewees could only

provide scores for 2015, and these were also excluded from the analysis. A summary of resulting indicator score sample sizes and the stakeholder types concerned are shown in Table 2. For both the outcomes and pre-condition samples the majority of interviewees were fishery stakeholders (11 of 17 and 9 of 16, respectively).

Due to the small sample sizes, a Wilcoxon Matched Pairs Signed Rank Test was used to compare changes in mean pre-condition indicator scores between 2005 and 2011, and 2011 and 2015. For this test, only paired samples could be used whereby an interviewee had provided a score for the same pre-condition indicator in 2005 and 2011, or 2011 and 2015. The test could only be carried out if a change had occurred between years, and if there were at least six pairs of data.

3. Results

3.1. Outcome indicators

The mean scores for all but one indicator were positive, demonstrating that the perception was that these outcomes had been achieved by 2015 (Fig. 1). The exception was 'acceptable conservation status of Atlantic salmon', whose mean score was 'disagree'. Fishery stakeholders' perceptions were driven by unprecedented reductions in catches from 2013−2015. One remarked "*over the last couple of years the salmon numbers have certainly been returning at much lower levels*", and another stated "*this year they've been catastrophic*". From the perspective of stock status, a government respondent observed: "*salmon are declining quite badly. The Moriston SAC* [one of the salmon SACs]*, the salmon are now in unfavourable condition*", and "*the sustainability of some of our stocks is very questionable*".

The weakest positive outcome was 'engagement and learning across scales' (Fig. 1). The majority of interviewees made reference to the current low level of cross-scale engagement due to the completion of a research program in 2010, and that "*there has been no dissemination of information downwards*" and "*no regular meetings*". A common reflection was the lack of a review process for the plan. A fisheries respondent stated: "*what I would like to see is an annual review meeting involving participants and the government bodies and researchers as well*", because "*there's no evidence from the practitioners' point of view that changes in seal numbers, seal feeding habits and angler perceptions has been considered by the* licencing *process*".

The second weakest positive outcome was 'acceptable outcomes to all relevant parties'. A number of reasons were given. The most frequent was dissatisfaction amongst fishery interests, one of whom stated "*they* [fishers] *believe they have a significant problem with seals and their ability to deal with that is very limited by the nature of the licence*". This contrasted with government interviewees, who perceived that "*we've managed to successfully reduce the number of seals being shot whilst still allowing people to manage seal issues effectively*". This discrepancy was illustrated by the wide range of interviewee scores (Fig. 1).

'New institutional arrangements' and 'new institutions codified in law' were the strongest outcomes. For 15 of 17 interviewees this related to the ongoing licencing procedures and stakeholder-agreed designation of management areas, and the Scotland-wide implementation of the system under the Marine (Scotland) Act. Three interviewees disagreed

about 'new institutional arrangements' because the fundamental mechanisms of the MFSMP had not been reviewed since its implementation in 2005.

Seven interviewees mentioned that fishery stakeholders had revitalised engagement amongst themselves in the past 18 months in response to the lack of progress: "*we've started to have review meetings amongst the practitioners, amongst the nominated marksmen, to share information, learn from others' experiences and generate better communications*". Also, the government had allowed fishery managers to transfer their licensed quotas between management areas, providing greater flexibility.

3.2. Pre-condition indicators

The means for 11 of the 12 pre-condition scores declined from 2005 to 2011, and nine declined further from 2011 to 2015 (Fig. 2). The strongest indicator for 2005, 'leaders prepared to champion the process', fell significantly ($p < 0.05$, n = 11 pairs) in 2011 and remained similarly weak in 2015 (NS). One fisheries respondent explained: "*I'm afraid the plan seemed to have been written, and then everybody agreed the plan and over the years it's just sort of fallen by the wayside*". A government respondent stated: "*for it to work, you need a champion within the fisheries to provide that leadership. That's not to say that people aren't committed, but it's like anything, you need someone to drive it and I think that has been a challenge*".

The second strongest indicator in 2005, 'presence of a bridging organisation or individual' followed a similar trend ($p < 0.05$, n = 7 pairs), and fell further from 2011–2015, but the difference was not significant. A government respondent commented: "*I think he* [the original coordinator] *set it up and then it was okay to run by itself almost, but if there were issues or problems, I'm not quite sure what would happen now*".

The third strongest indicator in 2005, 'participation of all impacted stakeholders' also fell from 2005 to 2011 (NS), and from 2011–2015, but not significantly. A government agency respondent stated: "*I think there are people who are interested in seals from a tourism or conservation point of view who don't really have a say in the seal plan*". 'Commitment to a long-term institution-building process' also declined from 2005 to 2011 (NS) but remained similar from 2011 to 2015. One fishery stakeholder commented: "*I would say that the approach has brought a huge opportunity for some real discussion solving these sorts of conflicts, but it hasn't been grasped by the other side*".

'Trust amongst stakeholders' also declined from 2005 to 2011, and 2011–2015, but not significantly. Two related explanations were given by fisheries respondents. First, an animal welfare group began campaigning against salmon netsmen shooting seals in 2013−2014. This resulted in netsmen becoming unwilling to report their information to the government under the agreed terms of the MFSMP because it would be possible for activists to source these data through the Freedom of Information Act (2009). Second, fuelled by this information, social media was thought to be used to expose and vilify netsmen, opening them to on-line and direct action. One fisheries respondent stated: "*the trust thing now has changed. We don't know if we can trust because if private and confidential information becomes public and it's in the wrong hands then you are physically at risk…*". Another commented: "*…it's people on their Facebook page writing in saying these fishermen should be shot…, which is public*" More broadly, declining trust was explained by a fisheries stakeholder as follows: "*there's a difference between government aspirations and the reality on the ground, the gulf is so vast now it's almost comical*".

'Supportive policy environment' also declined from 2005 to 2011 and 2011–2015, but not significantly. Only 'transparency of stakeholders' goals and values' remained consistently strong between 2005, 2011 and 2015. 'Adaptable portfolio of management measures', which was moderately weak in 2005, remained so in 2011 and 2015.

Table 2
Summary of sample sizes for interviewee indicator scores and stakeholder types (G government, S scientific advisors, F salmon fishery) relating to Figs. 1 and 2 in Results.

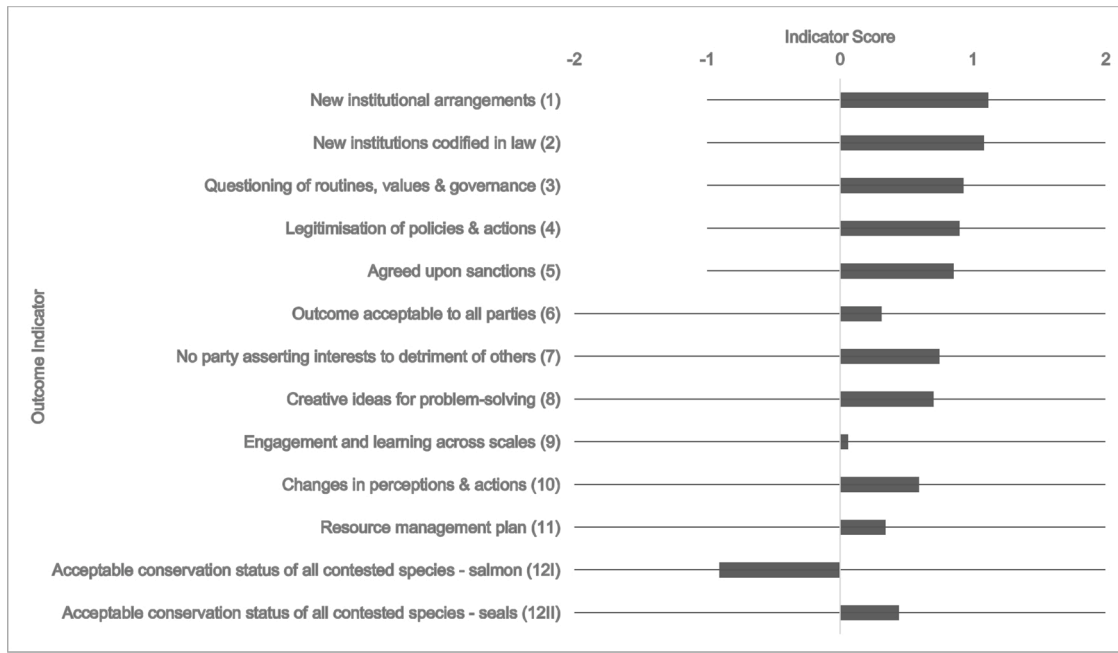| Results	Sample size	Repeat interviewees			New interviewees		
		G	S	F	G	S	F
Fig. 1. Outcome indicators (2015)	17	4	1	1	1	0	10
Fig. 2. Pre-condition indicators (2005, 2011 and 2015)	16	4	1	1	1	1	8

Fig. 1. Mean outcome indicator scores for 2015 (n = 17 interviewees). Bars show the range of scores given by interviewees for each indicator from strongly disagree (-2) to strongly agree (+2).
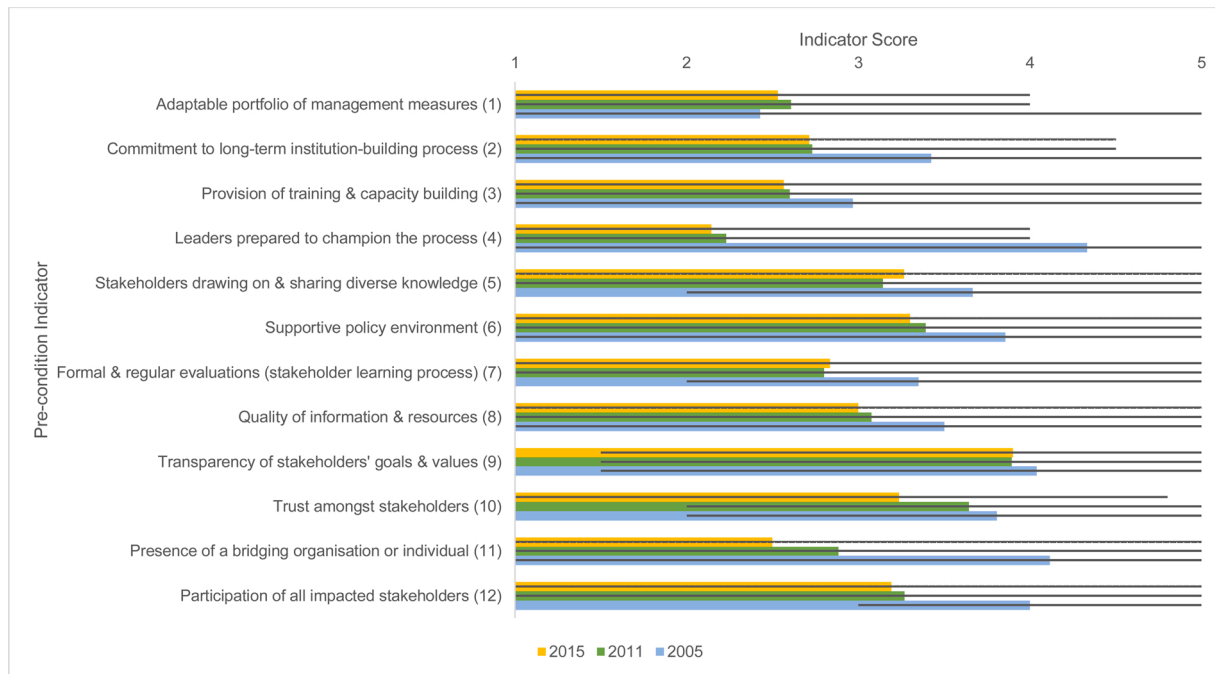

Fig. 2. Mean pre-condition indicator scores for 2005, 2011 and 2015 (n = 16 interviewees). Bars show the range of scores given by interviewees for each indicator from weak (1) to very strong (5).

4. Discussion

Our longitudinal evaluation over 11 years provides novel empirical evidence of how ACM evolves in the context of a conservation conflict, and the factors that emerge to undermine conflict resolution. The key driver of escalating tension was the perceived decline in salmon stocks relative to perceived growing seal numbers. This was reflected in the only negative outcome indicator score, the 'acceptable conservation status of Atlantic salmon', which in turn was related to the weak score for the 'acceptability of MFSMP outcomes to all parties'. However, it

should be noted that the majority of interviewees (11 of 17) were fishery stakeholders, which may have accentuated this outcome result.

We suggest that as a consequence ACM is entering a fifth phase, 'revival', whereby increasing local stakeholder coordination and collaboration has been triggered by dissatisfaction with current processes and outcomes (Fig. 3). It is well-established that ACM can be catalysed by a crisis (Armitage et al., 2009; Plummer et al., 2012), but our longitudinal evaluation provides new evidence that periodic crises can also revive flagging ACM, generating a cyclical pattern of stakeholder relationships (Fig. 3). While some studies have described the
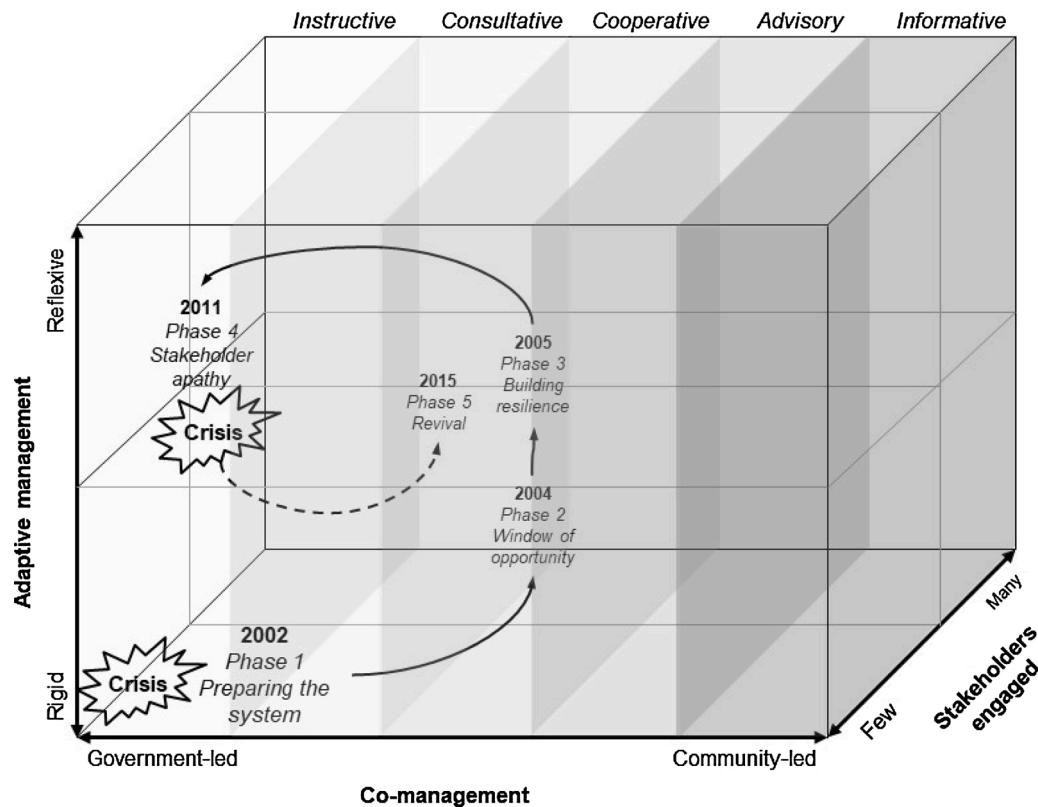
Fig. 3. Phases of the evolution of adaptive co-management in the Moray Firth from 2002 to 2015, updated from Butler et al. (2015). Since 2011 a second crisis has occurred which has triggered a revitalisation of adaptive co-management from Phase 4 'stakeholder apathy' into Phase 5 'revival'.

phases of ACM's establishment (e.g. Olsson et al., 2004b; Plummer, 2009), to our knowledge this is the first multi-year study that reveals ACM's evolution post-implementation.

Despite the deteriorating situation many pre-conditions for ACM remained in place, particularly participation of impacted stakeholders, trust amongst them and transparency of their goals and values. However, the levels of most pre-conditions had declined from 2005 to 2011 and changed little between 2011 and 2015. There was qualitative evidence of differences between stakeholder groups' views of the MFSMP, whereby national government were more positive about its outcomes and pre-conditions, while local stakeholders were sceptical and dissatisfied. This points to the reinstatement of cross-scale engagement as the priority remedial action, and the need to restore this facet while some trust and participation remains. It also underlines the necessity for a supportive government policy to facilitate local conflict management, particularly through resourcing (Young et al., 2012).

We suggest that regular evaluations should form a core part of the learning component of ACM. In terms of conflict management, Niemela et al. (2005) also propose that evaluation should not be the endpoint of projects, but instead form a feedback mechanism which can encourage deliberation amongst polarised stakeholders. If undertaken as a participatory exercise, evaluation can be a catalyst for stakeholder learning and action to remedy collectively identified problems and barriers (Butler et al., 2016; Trimble and Plummer, 2018). Their inclusion in the design of evaluation can also promote 'ownership' and commitment to problem-solving, especially in novel contexts such as re-wilding (Butler et al., 2019). The inclusion of a 'suggested adaptive action' section to the evaluation (after Fabricius and Currie, 2015) could also encourage participants' commitment to remedial actions.

Three issues should be considered in future evaluations of ACM and conservation conflict. First, the existing framework (Butler et al., 2015) seeks to evaluate the status of contested species through stakeholder opinion, and hence results may be skewed by any preponderance of interest groups surveyed. In the Moray Firth there have been significant differences between stakeholder's perceptions of seal impacts relative to available data (Butler et al., 2011), and hence objective scientific information may be useful to discuss with participants and counter any bias. Second, it is important to evaluate the influence of the provision of aggregated evaluation results (such as those presented here) on stakeholders and their subsequent actions. The learning feedback provided by evaluation is a key component of the ACM process (Plummer et al., 2017), but its influence and efficacy warrants further research.

Third, our method was hampered by the difficulty of maintaining repeat interviewees over a long timeframe, and thus consistent and comparable indicator data. The moving of original stakeholders to alternative professional roles, and their replacement by new actors is inevitable over time, but it results in small sample sizes of repeat interviewees. Also, interviewees were asked where possible to provide scores and comments retrospectively, but memory distortion could have impacted their scores. Given the time frames in question (i.e. up to 11 years) this is not surprising (Wells et al., 2006), especially for more abstract intangible indicators such as trust, leadership and transparency. In addition, interviewees may have subconsciously exaggerated affirmative scores due to 'acquiescent response styles' (Dolnicar and Grun, 2007), particularly if they supported the MFSMP.

To mitigate such distortion and bias, Wiek et al. (2014) suggest the use of documents and photographs to help stakeholders remember more specific details of past events and their effects. Also, our method attempted to mitigate these risks by combining and triangulating between semi-quantitative indictor scoring and qualitative explanations. In response to these challenges, Plummer et al. (2017) suggest that more objective evaluation methods should be developed but acknowledge that this could be at the expense of generating stakeholder learning through their participation. A fertile avenue for research, therefore, is how to combine participatory and objective evaluation methods.

Interviewees engaged in our 2015 survey were fisheries, government

(representing conservation and marine affairs) and scientific stakeholders. The wildlife tourism stakeholder involved in 2011 was absent, having moved to a new professional position, and their successor had had little experience of the MFSMP, resulting in an absence of representation for this stakeholder group in 2015. A further limitation was the chain referral sampling approach, which by its nature defined the stakeholders as those currently involved in the MFSMP, or those associated with them. The emerging 'revival' phase of ACM provides an opportunity to update and expand the stakeholder sectors engaged in the MFSMP and its revision, and should include wildlife tourism, and particularly the animal welfare groups who have had a growing and influential role in declining levels of trust.

In conclusion, our longitudinal evaluation builds understanding about the efficacy of ACM as an alternative approach to resolving conservation conflict and highlights the key drivers of renewed conflict. Our data reveal that ACM is dynamic, and ebbs and flows due to changes in the status of the resources in question, and the shifting social context. In this case the decline in salmon, leadership and stakeholder involvement has triggered a response by local stakeholders to revitalise the process. Despite its limitations and challenges, the participatory evaluation methodology illustrated here provides a useful early-warning tool that can highlight critical interventions necessary to revive ACM and conflict resolution. Of relevance to other similar initiatives is the importance of long-term government policy commitment that can maintain local stakeholder engagement and coordination, which in the Moray Firth has declined consistently since 2005. Without such resourcing, local ACM and community-based conflict resolution efforts are likely to wane, and local revival efforts may revert to stakeholder apathy.

CRediT authorship contribution statement

Thea R. Cox: Data curation, Formal analysis, Investigation, Methodology, Project administration, Writing - original draft, Writing - review & editing. **James R.A. Butler:** Conceptualization, Methodology, Supervision, Visualization, Writing - original draft, Writing - review & editing. **Amanda D. Webber:** Resources, Funding acquisition, Supervision, Project administration, Methodology, Writing - review & editing. **Juliette C. Young:** Conceptualization, Methodology, Resources, Project administration, Writing - original draft, Writing - review & editing.

Declaration of Competing Interest

None.

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.envsci.2020.09.017.

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