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## Original Research Article

## Insights on fostering the emergence of robust conservation actions from Zimbabwe's CAMPFIRE program

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## ABSTRACT

One strategy to address threats to biodiversity in the face of ongoing budget constraints is to create an enabling environment that facilitates individuals, communities and other groups to self-organise to achieve conservation outcomes. Emergence (new activities and initiatives), and robustness (durability of these activities and initiatives over time), two related concepts from the common pool resources literature, provide guidance on how to support and enable such self-organised action for conservation. To date emergence has received little attention in the literature. Our exploratory synthesis of the conditions for emergence from the literature highlighted four themes: for conservation to emerge, actors need to 1) recognise the need for change, 2) expect positive outcomes, 3) be able to experiment to achieve collective learning, and 4) have legitimate local scale governance authority. Insights from the literature on emergence and robustness suggest that an appropriate balance should be maintained between external guidance of conservation and

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enabling local actors to find solutions appropriate to their contexts. We illustrate the conditions for emergence, and its interaction with robustness, through discussing the Communal Areas Management Programme for Indigenous Resources (CAMPFIRE) in Zimbabwe and reflect on efforts at strengthening local autonomy and management around the world. We suggest that the delicate balance between external guidance of actions, and supporting local actors to develop their own solutions, should be managed adaptively over time to support the emergence of robust conservation actions.

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## 1. Introduction

Conservation aims to protect biodiversity to ensure persistence through time. However, conservation actions (e.g. protected areas, community-based management) commonly do not reach their desired goals, as they fail to be implemented, are managed inappropriately, or are reversed as the social and political context changes (Salafsky et al., 2002; Mascia et al., 2014). At the same time, threats facing biodiversity, such as habitat loss, unsustainable levels of hunting, and the spread of invasive species continue to escalate, and available budgets and political will to mitigate against these threats are under renewed pressure (Craigie et al., 2010; Rands et al., 2010; Waldron et al., 2013). Thus, a deeper understanding of the drivers of successful implementation of conservation actions and their persistence through time is required. We argue that emergence and robustness, two related concepts from the Common Pool Resources (CPR) literature, can provide insight and guidance into achieving longer lasting conservation outcomes by harnessing and supporting the potential of self-organised action.

The CPR literature describes conditions that lead to long-term sustainable management of natural resources. Particularly relevant for conservation is the focus on self-organisation of resource governance by communities. The development or creation of new rules (also referred to as institutions or institutional arrangements) for sustainable resource management is described as 'emergence' in the CPR literature (Lubell et al., 2002; McCay, 2002). Within a conservation context, these rules are often thought of as conservation actions (e.g. derived from new policies, local initiatives) that can deliver conservation benefits. Robustness refers to the ability of these actions, and the supporting rules and institutions of management, to persist over time in the face of internal and external pressure (Ostrom, 2005; Cox et al., 2010). The principles for robustness have achieved prominence in the literature (including a Nobel Prize in Economics for Elinor Ostrom, who developed these "design principles"), and have been applied to a number of natural resource settings (e.g. Ostrom, 1990; Ostrom, 2009; Cox et al., 2010). However, the conditions for emergence, and how they relate to principles of robustness, have received little attention to date. While several conditions have been identified that enable the emergence of new rules among groups of stakeholders for collective action towards more sustainable management of common pool resources, and by extension the conservation of biodiversity (e.g. Ostrom, 1990; McCay, 2002; Heikkilä and Gerlak, 2005), they have not yet been synthesised. We aim to address this gap in this perspective article. First, we present an exploratory synthesis of the conditions that underpin emergence according to the CPR literature and focus on the Communal Areas Management Programme for Indigenous Resources (CAMPFIRE) in Zimbabwe as a case study to illustrate the conditions. Second, we discuss how the conditions for emergence interact with the principles of robustness and discuss these interactions in the CAMPFIRE program. Third, we reflect on the implication for contemporary conservation initiatives through incorporating insights from efforts at strengthening local scale resource governance around the world.

CAMPFIRE is an appropriate case study due to its focus on strengthening ownership, control, and decision-making power of rural communities and the establishment of supporting institutions (Martin, 1986; Child 1996a, 1996b). In addition, since 2000, a political and economic crisis (Balint and Mashinya, 2006, 2008; Child and Barnes, 2010; Gandiwa et al., 2014), including a controversial land reform program, has plagued Zimbabwe, which enables an exploratory assessment of how these external pressures impacted the robustness of CAMPFIRE.

## 2. Methodology

Through a series of workshops and discussions among the authors during which we drew on our knowledge of the CPR literature (e.g. Ostrom, 1990, 2005, 2010a, b; McCay, 2002; Heikkilä and Gerlak, 2005), augmented by non-systematic searches of Google Scholar and the Web of Science database we searched through the articles that had cited the emergence references listed in Table 1 to determine whether the conditions for emergence had been updated, adapted or evaluated. In addition we asked two common property researchers (Michael Cox (e.g. Cox et al., 2010) and Michael Schoon (e.g. Schoon and Cox, 2018)) to review the conditions we identified and point us to additional literature we may have overlooked.

To evaluate the presence or absence of the conditions for emergence and robustness in CAMPFIRE for this exploratory synthesis we combined searching through the peer-reviewed articles that had cited the initial peer-reviewed papers on CAMPFIRE (Child, 1993; Metcalfe, 1994; Child, 1995, Madzudzu, 1995; Child, 1996a, b) for relevant papers together with the authors knowledge of research outputs from CAMPFIRE.

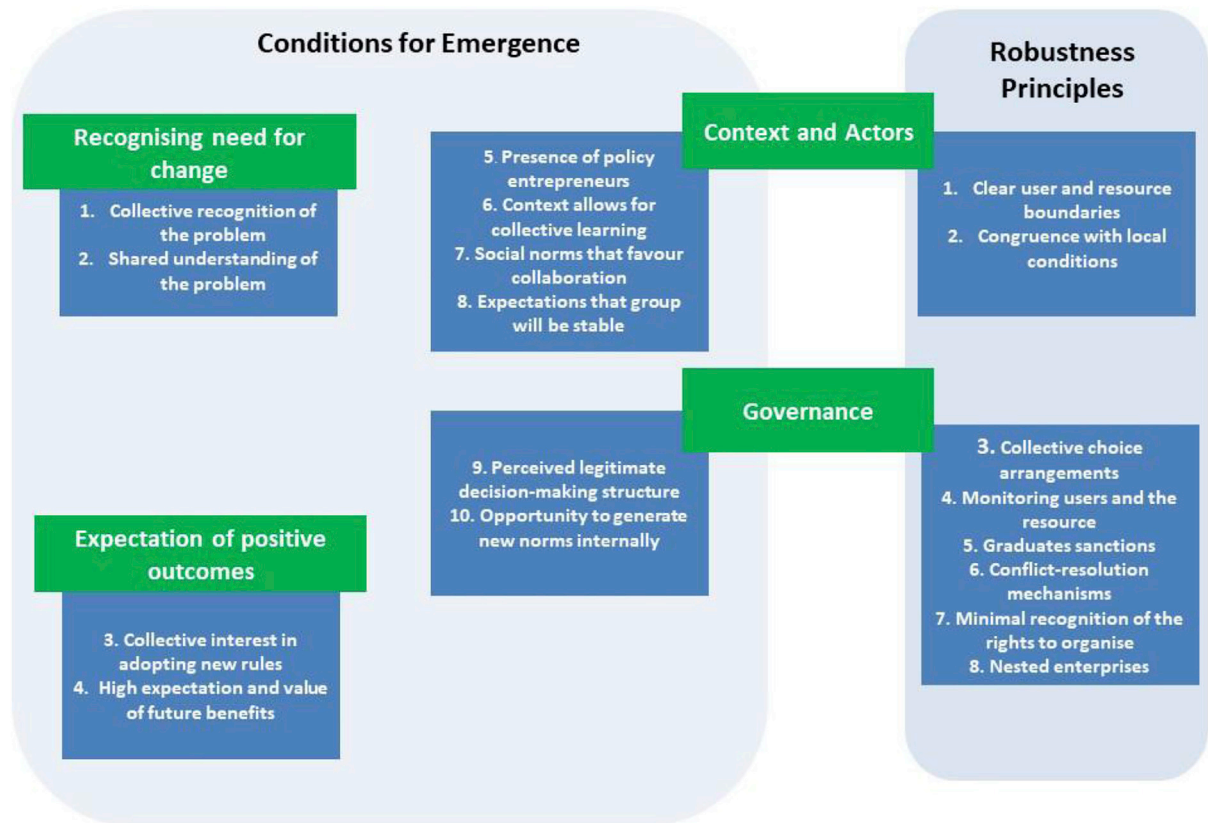
**Table 1**  
Conditions for emergence.

Condition	References
THEME A: Recognising the need for change	
1 Collective recognition of the problem: The collective recognition of a serious problem by a critical mass of actors is important for widespread adoption.	McCay (2002); Heikkila and Gerlak (2005)
2 Shared understanding of the problem: A shared view on the cause and effect of the recognised problem is needed for the recognition that an action is worthwhile.	McCay (2002); Heikkila and Gerlak (2005)
THEME B: Expectations of positive outcomes	
3 Collective interest in adopting new rules: A shared understanding of the perceived collective benefit of adopting rules or the collective cost of not adopting the rules. This includes the transaction costs of developing, negotiating, monitoring, and enforcing the action.	Heckathorn and Maser (1987); Ostrom (1990); Taylor and Singleton (1993); Lubell (2002); Heikkila and Gerlak (2005); Basurto and Ostrom (2009).
4 High expectation and value of future benefits: Changing one's day to day action to engage in a conservation action is more likely when the continuation of activities from the area (e.g. farming or fishing) is highly valued. A recognition of the detrimental personal impact of a past behaviour on the future of that activity can serve as an impetus to behavioral change.	Ostrom (1990); Schneider et al., (2003)
Theme C: Context that facilitates experimentation and collective learning among actors	
5 Presence of policy entrepreneurs: Someone who will champion the rule and advocate for its adoption will speed the rate of adoption by others.	Ostrom (1990)
6 Context allows for collective learning: Ability to share experiences and ideas among members of the group, as well as other groups will allow information from those who adopt the conservation action to pass to others in the population.	McCay (2002); Schneider et al., (2003)
7 Social norms that favour collaboration: Reciprocity, trust and cooperation should be valued by the actors in the system. There should be an alignment of core values and beliefs sufficient to want to work towards a solution.	Ostrom (1990); Ostrom (1998); Sabatier and Jenkins-Smith (1993); Heikkila and Gerlak (2005); Ostrom (2005)
8 Expectations that the group will be relatively stable: The group appropriating and benefiting from the new actions and rules will be stable.	Ostrom (1990); Lubell (2002); Heikkila and Gerlak (2005)
Theme D: Legitimate local scale governance	
9 Perceived legitimate decision-making structure: Decision making structures that provide stakeholders with an opportunity to present their own interests and are perceived to deliver a fair outcome are required.	Ostrom (1990); Schneider et al., (2003)
10 Opportunity to generate new norms internally: The opportunity is provided for norms to be internally generated rather than externally imposed facilitates the spread of norms which suit the majority of the population.	Ostrom (2005)

### 3. Conditions for emergence

We identified ten conditions for emergence that can be divided into four themes (Table 1; Fig. 1).

- A. *Recognising the need for change* (conditions 1–2): This entails the need for a shared understanding of a problem and agreement among actors that action to address it is worthwhile (McCay, 2002; Heikkila and Gerlak, 2005).
- B. *Expectation of positive outcome* (conditions 3–4): This includes a collective interest in adopting new rules, based on high perceived benefits relative to cost and the likely collective cost of not adopting the rules (Ostrom, 1990; Heckathorn and Maser, 1987; Lubell, 2002; Heikkila and Gerlak, 2005; Schneider et al., 2003).
- C. *A context that facilitates experimentation and collective learning among actors* (conditions 5–8): The presence of policy entrepreneurs, individuals who take advantage of opportunities to influence outcomes (Kingdon, 2011), that can champion new rules and advocate for their adoption as well as a context that allows groups to communicate and share experiences (i.e. understand benefits of the new actions or rules based on experiences elsewhere) is required. In addition, social norms that favour collaboration, such as reciprocity, trust, and an expectation that the group benefiting from the adoption of new actions and rules will be relatively stable, are necessary.
- D. *An opportunity for legitimate local scale governance* (conditions 9–10): Actors should feel that their interests are represented and that the decision-making structure is legitimate (Schneider et al., 2003). Moreover, there should be an opportunity for norms to be generated internally, rather than externally imposed, because externally imposed sanctioning and enforcement seems to crowd out the development of cooperative behaviour (Ostrom, 2005; Bowles, 2016)



**Fig. 1.** How the conditions and robustness relate. The numbers refer to the conditions for emergence in Table 1 and S1 and the principles for robustness in Table 2 and S2.

## 4. Emergence in CAMPFIRE

### 4.1. Theme A: Recognising the need for change

From the late 1970s, a collective realisation began to materialize that Zimbabwe faced the dual challenge of rural poverty in communal areas and increasing pressure on wildlife and their habitats (Condition 1; Child, 1996a; Child, 1996b). A shared recognition of the problem emerged among conservationists, social scientists, social workers, economists, and politicians that the allocation of rights over wildlife to rural communities presented an opportunity to tackle both challenges (condition 2, Table S1; Child, 1996a; Child, 1996b).

### 4.2. Theme B: Expectation of positive outcomes

As a result of the shared recognition of the problem, and the need for change there was a collective interest in adopting new policies to improve the livelihoods of rural communities and conserve wildlife, with an expectation that the benefits of action would exceed costs (conditions 3 & 4, Table S1; Martin, 1986; Murphree, 1991; Metcalfe, 1994). Therefore in CAMPFIRE, rural communities occupying land under communal tenure obtained the authority to use wildlife commercially and have control over how to spend that income (Child, 1996a; Frost and Bond, 2008).

### 4.3. Theme C: A context that facilitates experimentation and collective learning among actors

The development of CAMPFIRE was further supported and enabled by the presence of policy entrepreneurs which engaged NGOs, representatives of government departments and community groups (Condition 5, Table S1) (Child, 1996a,b). Furthermore, the CAMPFIRE Association enabled collective learning and developed guidelines and processes for contracts with rural district councils and allowed for discussion of lessons learnt in Association meetings (condition 6, Table S1) (Child, 1996a). Social norms that favour collaboration were partially present as national government and rural district councils were reluctant to decentralise power to community level, and wanted to maintain control, particularly over revenue (condition 7,

Table S1) (Child 1996a, 1996b). Furthermore, although villages and wards were clearly defined, and the benefits associated to CAMPFIRE were restricted to these defined communities, and therefore there was an expectation that groups would remain relatively stable, there was a challenge of in-migration to communities that received income from successful CAMPFIRE projects (condition 8, Table S1) (Child, 1996a; Dzingirai, 2003).

#### 4.4. Theme D: Opportunity for legitimate local scale governance

CAMPFIRE was based on strong principles of community participation and equitable benefit sharing (conditions 9 & 10, Table S1), and the devolution of wildlife management and benefits to the smallest feasible scale (Child, 1996a). However, CAMPFIRE has been criticised for communities not being sufficiently independent of government, due to the reluctance by national and local governments to decentralise power to community level (Mutandwa and Gadzirayi, 2007). For example, the Zimbabwean national treasury tried to maintain control over all the income flowing to CAMPFIRE communities, undermining effective collaboration while CAMPFIRE was developing (Child, 1996b). As a result the weakened ability of groups in CAMPFIRE to represent their own interests and the opportunity to generate new norms internally negatively affected the perceived legitimacy of the decision-making structure (Condition 9 & 10). In addition, areas such as the Nkayi and Lupane districts were characterised by historic conflicts and violence which undermined the legitimacy of local scale governance (Alexander and McGregor, 2000).

## 5. Emergence, robustness & CAMPFIRE

### 5.1. Emergence and robustness

The principles for robustness have been studied extensively in the common pool resources research, primarily focussed on small communities, and small group settings (Ostrom 1990, 2005; McCay, 2002) (See Table 2). Common characteristics of these institutions (referred to as the design principles) have been developed and evaluated in a number of community-based natural resource management and conservation settings (Ostrom 1990, 2009; Cox et al., 2010; Mills et al., 2013).

Conservation actions that emerge must also be sustained through time. Therefore, understanding the similarities and differences among the conditions for emergence and principles for robustness is critical. The conditions for emergence in theme C (a context that facilitates experimentation and learning among actors) and theme D (opportunity for legitimate local scale governance) (Table 1) are closely related to key principles for robustness (Fig. 1). For example, the opportunity for norms to be generated internally rather than externally imposed (emergence condition 10) is related to the existence of minimal recognition of rights to organise (robustness principle 7). Similarly, the expectations that a group will be stable (emergence condition 8) is congruent with having clear use and resource boundaries (robustness principle 1); knowing who is within the group that benefits from the conservation action is thus important in determining its emergence and robustness.

**Table 2**

Principles of robustness. Source (Ostrom, 2005, 2009; Cox et al., 2010):

Principle	Description
1A	<b>Clear user boundaries:</b> Boundaries between legitimate users and nonusers must be clearly defined. De facto and de jure boundaries are clearly defined. Some Parks are protected on paper ( <i>de facto</i> ) but this designation is not recognised by local people.
1B	<b>Clear resource boundaries:</b> Clear boundaries are present that define a resource system and separate it from the larger biophysical environment.
2A	<b>Congruence with local conditions:</b> Appropriation and provision rules are congruent with local social and environmental conditions.
2B	<b>Access, use, and harvest are proportional and appropriate with local conditions:</b> The benefits obtained by users from a common-pool resource (CPR), as determined by access, use, and harvest rules, are proportional to the amount of inputs required in the form of labor, material, or money, as determined by provision rules.
3	<b>Collective-choice arrangements:</b> Most individuals affected by the operational rules can participate in modifying the operational rules.
4A	<b>Monitoring users:</b> Monitors who are accountable to the users monitor the appropriation and provision levels of the users.
4B	Monitors and enforcers are present and they are accountable to the community groups and individuals that they are monitoring
4B	<b>Monitoring the resource:</b> Monitors who are accountable to the users monitor the condition of the resource.
5	<b>Graduated sanctions:</b> Appropriators who violate operational rules are likely to be assessed graduated sanctions (depending on the seriousness and the context of the offense) by other appropriators, by officials accountable to the appropriators, or by both.
6	<b>Conflict-resolution mechanisms:</b> Appropriators and their officials have rapid access to low-cost local arenas to resolve conflicts among appropriators or between appropriators and officials.
	Systems with low cost conflict resolution mechanisms are more likely to survive.
7	<b>Minimal recognition of rights to organise:</b> The rights of appropriators to devise their own institutions are not challenged by external governmental authorities.
	Resource users have the rights to adapt harvesting and conservation rules themselves over time.
8	<b>Nested enterprises:</b> Appropriation, provision, monitoring, enforcement, conflict resolution, and governance activities are organized in multiple layers of nested enterprises.
	Smaller scale institutions for design and implementation of rules and enforcement are nested within larger organisations and institutions and that there are relationships between these scales

## 5.2. CAMPFIRE under pressure: impacts on emergence and robustness

From 2000 onwards, the political and economic crisis in Zimbabwe, including a controversial land reform program, severely tested CAMPFIRE and counter-acted the favourable conditions for its successful emergence (Balint and Mashinya, 2006, 2008; Child and Barnes, 2010; Nyamwanza, 2014). Following the onset of the land reform, an increasing number of CAMPFIRE communities became subject to the resettlement of new people within their communities that laid claim to the resources and benefits, and donors withdrew support (Mutandwa and Gadzirayi, 2007; Gandiwa et al., 2014). Thus, user boundaries became less clear and human wildlife conflict increased (Le Bel et al., 2011). As a result both the existence of conditions for emergence and the presence of the robustness principles were weakened. In particular conditions for emergence 7 (social norms that favour collaboration) and 8 (expectations that the group will be stable) and robustness principles 1 (clearly defined user and resource boundaries) were weakened (Tables S1 and S2).

Additionally, the rights of groups to organise and decide how to harvest and manage their resources (robustness principle 7, Table S2) and the collective choice arrangements where individuals affected by rules should be able to participate in their modification (robustness principles 3 and 7) were undermined both internally and externally. Within Zimbabwe, national government and rural district councils wanted to maintain control, particularly over revenue, and therefore resisted decentralising power to communities (Child, 1996b; Balint and Mashinya, 2006; Muboko and Murindagomo, 2014). For example, by 2001, over 40% of revenue from CAMPFIRE was retained by some government district offices compared to the guidelines of 15% (Balint and Mashinya, 2006), changing the relative benefits of engaging in the program. Externally, the ban on the import of elephant hunting trophies into the USA (US Fish and Wildlife Service 2015), a key source of income to CAMPFIRE communities, has reduced benefit flows to communities. These developments, weakened the perceived legitimacy of the decision-making structures (emergence condition 9) and the opportunity to generate new norms internally (emergence condition 10) (Tables S1 and S2).

Furthermore, the CAMPFIRE Association and NGOs supporting CAMPFIRE became weaker as a result of Zimbabwe's political crisis, impairing the existence of a nested structure of organisation and multi-level governance (robustness principle 8, Table S2) (Balint and Mashinya, 2006). This hindered the ability of participant communities to access external support or input if required (Balint and Mashinya, 2008).

## 5.3. Characteristics of robust CAMPFIRE communities

However, despite the challenges facing CAMPFIRE, the program remained robust in some communities. An analysis from south-east Zimbabwe around Gonarezou National Park showed that communities that have been more robust joined the CAMPFIRE program earlier and had more time to develop robust institutions and were characterised by higher levels of trust and cooperation (Ntuli and Muchapondwa, 2018). These communities were able to resist pressures sufficiently to maintain adequate levels of control over their defined boundaries (robustness principle 1, Table S2), and make collective choice arrangements (robustness principle 4, Table S2). Furthermore, adequate conflict resolution mechanisms were in place in these more robust communities (Principle 6), and they maintained the right and ability to organise themselves (robustness principle 7). Not unexpectedly, these communities characterised by the maintenance of the principles for robustness and higher levels of cooperation were also responsible for achieving better wildlife conservation outcomes (Ntuli and Muchapondwa, 2018).

## 6. Insights for addressing contemporary conservation challenges

### 6.1. Balancing decentralisation with the provision of external support through multi-level institutions

For new actions to develop and persist over time, local groups need to be afforded sufficient freedom to devise and adapt their own rules (Condition 10, Table 1). However, multiple levels of continued external support are important for the robustness of such new initiatives (Principle 8, Table 2). In the governance and CPR literature, multi-level institutions, also known as polycentric institutions (a governance system with multiple governing authorities at different scales, Biggs et al., 2012), have been shown to be effective at both enabling local autonomy, which allows for experimentation, whilst maintaining external support and guidance in response to crises and change (Anderies et al., 2007; Ostrom, 2010a). In a polycentric system, multiple organisations and governing bodies at a variety of scales (e.g. local to national and international) have different responsibilities and roles for governance and support (Ostrom, 2010a).

Building and maintaining multi-level institutions and governance practices and achieving the balance between giving local groups sufficient freedom to develop their own solutions, whilst continuing to provide external support and guidance in conservation and resource management initiatives was one of the key challenges facing CAMPFIRE (Tables S1 and S2). Effective multi-level governance is a challenge beyond CAMPFIRE and Zimbabwe. For example, in the Gulf of California, community groups that successfully established locally crafted harvesting rules and marine reserves experienced rapid increases in marine resource abundance (Cudney-Bueno and Basurto, 2009). However, the increased resources attracted outside poachers, which the communities did not have the capacity to counter. Effective multiple governance, and assistance with the enforcement of local management and harvesting rights is recommended to strengthen these successful community groups (Cudney-Bueno and Basurto, 2009).

## 6.2. *The challenge of insufficient decentralisation and local autonomy*

The lack of willingness of both the national government in Zimbabwe as well as the rural district councils to devolve power and control, particularly over revenue, to local communities was one of CAMPFIRE's key challenges (; Child, 1996b; Mutandwa and Gadzirayi, 2007; Mapedza, 2009). A lack of willingness of governments to decentralise and devolve power has been demonstrated across the tropics in forestry management (e.g. Ribot et al., 2006) and in African fisheries (Bene et al. 2009). Furthermore, well-intentioned international environmental and conservation initiatives need to be carefully managed to ensure healthy, and well-functioning multi-level institutions and governance (Gruby and Basurto, 2013). For example, the Reductions of Carbon Emissions through Deforestation and Degradation program (REDD+) has been criticised for initiating a recentralisation of forest policy (Phelps et al., 2010). Consequently, local groups could lose effective ownership and rights over forests, and also lose the flexibility to manage their forest resources according to their own needs, reducing the environmental and social benefits of REDD+ (Chhatre and Agrawal, 2009).

## 6.3. *Examples of successful multi-level governance*

Examples of multi-level governance aimed at maintaining a balance between external guidance and support and local management do exist. For instance, the fisheries policy in Chile was recently revised in a way that strengthens the capacity of actors to develop locally agreed upon fisheries management plans (Gelcich, 2014). This new policy aims to maintain a healthier balance between the need for external support for enforcement and monitoring through national scale rules and institutions and allowing for local autonomy and adaptability (Ostrom, 2010b; Gelcich, 2014). This type of approach has potential to inform novel conservation strategies in which local communities control conservation areas, whilst national level institutions steer and support these processes (Gelcich et al. 2008, 2012). Indeed, multi-national organisations such as the European Union or international or national NGOs can be key to maintaining effective polycentric institutions by supporting the enactment of sub-national, national, or global conservation policies, while simultaneously supporting a greater devolution of rights to local groups. Support from these organisations could include technical advice, facilitation, subsidies or financial support especially at critical times, and assistance in communication and in applying political pressure where necessary. The continuation of such international support during Zimbabwe's political crisis and the pressures faced could have led to more CAMPFIRE communities remaining robust. Indeed, a long term commitment of support from external agencies can play a critical role in maintaining conservation outcomes, especially during times of internal strife (Struhsaker et al., 2005). Moreover, if this support is accompanied by a deep understanding and respect for local contexts, the support is likely to be more effective at delivering sustainable outcomes locally (Lancaster, 1999; Ika, 2012).

## 6.4. *Importance of ongoing communication and dialogue*

To build and maintain multi-level institutions, communication that enables social learning between stakeholders across multiple levels of governance is critical (Condition 6 and 7, Table 1 and Principle 8, Table 2) (Schusler et al., 2003; Blaikie, 2006; Cumming et al., 2006; Armitage, 2008; Gruby and Basurto, 2013). Structures and fora for communication between community groups, supporting NGOs, technical advisors, and government officials played an important role in the successful development and implementation of CAMPFIRE (Child, 1996a). Adequate structures for communication among resource users, researchers and the government were also essential in the development of new policy in Chile (Gelcich, 2014). Adequate communication, supported by local and international non-governmental organisations, was also critical for the adoption and spread of Locally Managed Marine Area Network in the Pacific (Mascia and Mills, 2018) and in small-scale community based initiatives fisheries in other countries in Latin America (Castilla et al., 1998; Defeo and Castilla, 2012).

## 6.5. *Constraints of donor cycles and political circumstances*

Many conservation actions are subject to the constraints applied by donors and aid agencies. The constraints on donors to continue to provide funding to projects in Zimbabwe after the onset of the political crisis from 2000 onwards weighed heavily on CAMPFIRE (Balint and Mashinya, 2006, 2008). Political crises and constraints aside, donor cycles typically run for three years, requiring reportable deliverables to be met within a specified timeframe (Sayer, 2004; Wells and McShane, 2004). In addition, centralised management structures are often preferred by donors because these structures allow donors to maintain greater control (Morss, 1984). Donors' desire to maintain control and the relatively short funding cycles can be incongruent with lengthy and unpredictable participatory processes that enable communities to develop their own rules (Atkinson et al., 2006). The longer-term benefits of taking a participatory approach aligned with the conditions for the emergence and principles of robustness of conservation actions may not be visible over the time-frames of donor reporting (Wells and McShane, 2004). Similarly, conservation actions that are led or implemented by governments can also be affected by shorter term political and election cycles (Stein, 2001).



## 6.6. Emergence, robustness and enhancing resilience

The conditions for emergence and principles of robustness overlap with the principles that have been identified on how to enhance the resilience of desired features of social-ecological systems (e.g. Anderies et al., 2007; Ostrom, 2009; Biggs et al., 2012). There is a strong degree of overlap with three principles for enhancing resilience, as summarised by Biggs et al. (2012). First, the principle of encouraging learning and experimentation overlaps with two conditions of emergence: a shared understanding of the problem (condition 2, Table 1) and a context that allows for collective learning (condition 5 Table 1). Second, the resilience principle of broadening participation coheres with three conditions for emergence: social norms that favour collaboration (condition 7, Table 1), perceived legitimate decision-making structure (condition 9, Table 1), and the opportunity to generate new norms internally (condition 10, Table 1). The resilience principle of broadening participation also concurs with two principles of robustness: collective choice arrangements (principle 3, Table 2), and minimal recognition of the rights to organise (principle 7, Table 2). Third, the resilience principle of promoting polycentric governance systems concurs closely with the robustness principle of nested enterprises (Ostrom, 2005; Cox et al., 2010) (principle 8, Table 2).

## 7. Limitations and future research directions

Our exploratory synthesis of the conditions for emergence aims to provide a basis for more in-depth, systematic, and rigorous literature reviews and empirical analyses of emergence. For example, the types of analyses that have been conducted testing the robustness principles in differing contexts would be useful to evaluate or modify the conditions for emergence synthesised here (Cox et al., 2010; Mills et al., 2013). Moreover, the conditions for emergence described here were established through studies that focussed primarily on small communities and groups (Ostrom 1990, 2005). However, the extent to which the conditions hold at larger scales, and which conditions may be more important than others in particular contexts, requires investigation.

Further research is needed on how the conditions for emergence and the principles of robustness of conservation actions relate to the findings from work on the emergence of governance (e.g. O' Mahony and Ferraro, 2007). The development of a shared conception of authority that is able to adapt and change over time is critical for a self-organised community to develop successfully and work together to achieve shared objectives (Brechin et al., 2002). The role of authority and control, and its establishment in a group, and how it changes and develops over time among groups working to achieve conservation outcomes will provide additional insights to fostering the emergence of conservation actions and maintaining their robustness.

Finally, understanding how conservation actions emerge and are robust over time: 1) extends and deepens our understanding of enabling conditions and durability of conservation actions, 2) allows the identification of conservation actions achieved through harnessing self-organised action and 3) provides guidance on how to maintain the appropriate balance between external support, and local autonomy. Therefore, we argue that conservation organisations should explicitly consider emergence and its interactions with robustness in their policy and practice and that research that informs the evolution and adaptation of the conditions for emergence presented here is urgently required.

## Article impact statement

Principles of emergence and robustness can guide how to enable self-organisation to drive locally-developed conservation outcomes.

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## Appendix A. Supplementary data

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