Received: 30 May 2020 | Revised: 29 August 2020 | Accepted: 21 September 2020

DOI: 10.1111/csp2.301

CONTRIBUTED PAPER

Conservation Science and Practice
A journal of the Society for Conservation Biology
Open Access

WILEY

Using Theory of Change to improve post-2020 conservation: A proposed framework and recommendations for use

Wayne Stanley Rice[1,2] | **Merle R. Sowman**[1] | **Maarten Bavinck**[2,3]

[1]Department of Environmental and Geographical Sciences, Cape Town, University of Cape Town, South Africa

[2]Amsterdam Institute for Social Science Research, University of Amsterdam, Amsterdam, The Netherlands

[3]Norwegian College of Fisheries, UiT Arctic University of Norway, Tromsø, Norway

Correspondence
Wayne Stanley Rice, Department of Environmental and Geographical Sciences, University of Cape Town, Private Bag X3, Rondebosch, 7701 Cape Town, South Africa.
Email: mr.waynerice@gmail.com

Funding information
Community Conservation Research Network; National Research Foundation, South Africa; Universiteit van Amsterdam; University of Cape Town; South African National Research Foundation

Abstract

Contemporary conservation must address social well-being while still protecting biodiversity. Accordingly, the objective of the Convention on Biological Diversity's recent Zero Draft Post-2020 Global Biodiversity Framework is to sustainably meet the needs of people while reducing biodiversity loss. However, frequent "failures" in achieving this social-ecological balance necessitates more holistic, systematic, and adaptive post-2020 conservation interventions. The Theory of Change (ToC) approach provides a useful and flexible tool to support this endeavor. However, debate persists over its usefulness, and "best" manner of use. This paper explores the elements of, and proposes a framework for developing robust conservation ToC pathways. The framework emphasizes the importance of producing a shared vision of desired results and actions, and associated causal assumptions, among actors. Furthermore, evaluation is considered key to informing required ongoing adaptation to better achieve desired results. The paper also critically explores the challenges associated with ToC, and makes recommendations for its improved use in post-2020 conservation. In particular, we aim to inform the implementation and mainstreaming of the Post-2020 Global Biodiversity Framework, especially at a national- and local-level. The framework and discussion should be relevant to a broad range of conservation actors at various scales that must address linked social and ecological objectives.

KEYWORDS

conservation management, governance, policy implementation, post-2020 framework, Theory of Change

1 | INTRODUCTION

Conservation is an "action-dependent" process aiming to positively influence biodiversity (Pressey et al., 2017). However, despite concerted action, global biodiversity loss increases (Jones, Klein, et al., 2018; Jones, Venter, et al., 2018). Conservation interventions are frequently inhibited by contextually inappropriate approaches and governance arrangements, often less suited to complex systems (Armitage, Mbatha, Muhl, Rice, & Sowman, 2020; Game, Meijaard, Sheil, & McDonald-Madden, 2014). More specifically, conservation priority-setting and area-based strategies promote quantity over quality, and are often ineffectively managed (Bhola

et al., 2020; Geldmann et al., 2018; Pressey et al., 2017; Sacre et al., 2020). Furthermore, the social impacts of conservation, such as the displacement of local communities, their exclusion from decision-making, and the inequitable distribution of conservation costs and benefits, require increased recognition, monitoring, and reconciliation (Armitage et al., 2020; Kaplan-Hallam & Bennett, 2018).

As Game et al. (2014, p. 271) suggest, "Conservation is not rocket science; it is far more complex." Contemporary conservation complexity stems from the need to address social well-being while still protecting biodiversity (Armitage et al., 2020; Sarkki & Acosta García, 2019). Therefore, scholars and practitioners are increasingly realizing the necessity for more "community-centered" conservation approaches to achieve this social and ecological balance (e.g., Redford, Hulvey, Williamson, & Schwartz, 2018; Armitage et al., 2020). This is specifically captured in the Convention on Biological Diversity's (CBD) recent *Zero Draft Post-2020 Global Biodiversity Framework* (hereafter post-2020 GBF), which recognizes the need for urgent global, regional and national action to reduce biodiversity loss *and* sustainably meet the needs of people (CBD (Convention of Biological Diversity), 2020a, p. 6).

Therefore, post-2020 conservation interventions require more holistic, community-centered, context-specific, and adaptive approaches and arrangements in their planning, implementation and evaluation if they are to facilitate essential social and institutional change (e.g., Armitage et al., 2020; CBD, 2020a; Game et al., 2014). This is the explicit purpose of the Theory of Change (ToC) approach, which promotes understanding of *how* and *why* an intervention works, and the processes that bring about "positive" change (Mayne, 2015; Weiss, 1997). Not surprisingly, ToC, in its various guises, has been shown useful by various conservation scholars and practitioners within diverse contexts (Biggs et al., 2017; Romero & Putz, 2018; Balfour, Barichievy, Gordon, & Brett, 2019; see also Table S1). Furthermore, the post-2020 GBF itself specifically employs a ToC approach to "plan, implement, and evaluate the impacts of the actions taken" (CBD, 2020a, p. 1).

However, while the use of ToC is common in international development (e.g., Douthwaite, Ahmad, & Shah, 2020; Valters, 2015; van Es, Guijt, & Vogel, 2015), its use in conservation interventions is still not widespread. Furthermore, some have specifically noted that "well-informed" conservation ToC pathways "remain uncommon" (Romero & Putz, 2018, p. 547). This is perhaps since as Weiss (1997, p. 524) states, the approach's "very ambitiousness seems to tempt the gods." Consequently, much debate persists over ToC's usefulness and the "best" manner of use (Davies, 2018; Mayne & Johnson, 2015; Prinsen & Nijhof, 2015), which is especially true for conservation interventions. Notwithstanding these debates, well-informed, robust conservation ToC pathways offer potential for improved understanding of *how* to design, implement, evaluate, adapt, and manage post-2020 conservation interventions.

This paper seeks to highlight ToC as a flexible and useful approach to incorporate diverse perspectives, and promote greater cooperation and learning among diverse conservation actors seeking to achieve socioecological outcomes. In doing so, ToC can promote greater understanding necessary for improved conservation policy and practice (Game et al., 2014; Game, Schwartz, & Knight, 2015; Sutherland et al., 2020). Accordingly, we provide a brief discussion and propose a framework on *how* to develop robust conservation ToC pathways for positive ecological and social outcomes. The framework is adaptable and should be relevant to a broad range of conservation actors associated with varying scales of conservation, inclusive of policymakers, donors, practitioners, and scholars, especially those operating at national- and local-levels. Finally, we discuss key challenges experienced, and make recommendations to improve the use of ToC, and thereby inform progress in post-2020 conservation. This is specifically to assist the implementation and mainstreaming of the post-2020 GBF.

2 | TOC AS A TOOL FOR IMPROVED POST-2020 CONSERVATION

2.1 | What is ToC?

Providing a common definition of, and methodology for applying ToC is challenging as it can simultaneously be considered a *way of thinking*, a *process* and/or a *product* (Davies, 2018; Mayne & Johnson, 2015). Nevertheless, ToC essentially involves logically "mapping" what needs to happen in a pathway for a sequence of actions, and assumptions made, to achieve an intervention's desired result (Mayne, 2015). Furthermore, ToC can used to account for both how change is *expected* to happen (i.e., planning and implementation of an intervention) and how change *has* happened (i.e., evaluation and adaptation of an intervention) (Douthwaite et al., 2020; Mayne, 2015, 2017a). In doing so, ToC can inform the actions required to bring about change by considering multiple levels of change and learning from the intervention as it evolves. Not surprisingly, ToC has increasingly, though not widely, been applied and shown useful in various conservation contexts. We refer throughout to three useful and diverse examples of ToC use in conservation, which are introduced in Box 1.

BOX 1 Three examples of Theory of Change use in conservation

Example 1 Increasing sustained timber yields in Indonesian natural forest management

Romero and Putz (2018) develop a country-specific ToC to improve the evaluation of sustained timber yields of natural forest management in Indonesia. This ToC expands on the ToC developed by the *Forest Stewardship Council's Indonesian Stewardship Standard* (FSCISS). The authors identify shortcomings in indicators and several "unsatisfied and unsatisfiable assumptions" in the FSCISS certification process (Romero & Putz, 2018, p. 547). Furthermore, they note how national governmental harvest regulations do not "allow full timber recovery," and require changes in national policy (Romero & Putz, 2018, p. 547).

Example 2 Decreasing illegal wildlife trade

Biggs et al. (2017) develop a ToC to guide actions of policy makers, practitioners, and donors tasked with decreasing illegal wildlife trade. The authors focus on identifying enabling community-level actions such as strengthening disincentives and increasing incentives to decrease illegal behavior, decreasing the community-level costs of wildlife, and supporting non-wildlife-based livelihoods (Biggs et al., 2017, p. 8). Furthermore, they emphasize the importance of strengthening enabling conditions (cf. Ostrom, 1990), increasing capacity, and promoting dialogue among diverse-associated stakeholders.

Example 3 RARE's Pride campaigns for behavior change in Corazon Bay no-take fishing area

RARE is a nonprofit organization which through its *Pride campaigns* seeks to inform and motivate local campaign managers and their communities to address conservation threats (RARE, n.d.). They provide a step-by-step guide to developing a ToC for local conservation interventions that emphasizes public participation to reduce "threatening" conservation behaviors (RARE, n.d.). RARE (n.d.) makes use of the Corazon Bay marine protected area in the Coral Triangle to showcase its approach to ToC development.

2.2 | A framework for robust conservation ToC pathways

Given the diverse ToC terms in use (see Funnell & Rogers, 2011), we first define the key "change elements" described below. We refer to *intervention* as the implementation of a specific set of actions to positively influence a desired result. While conservation interventions vary greatly in context, purpose, scale, and management approaches and governance arrangements, we use intervention as an "umbrella" term to describe any conservation initiative designed and implemented by a variety of actors (i.e., ranging from government and non-governmental organizations to local communities), to enhance positive social and ecological outcomes. Furthermore, an *action* can be an activity, event, a policy or strategy, and/or even the formation of an organization associated with the intervention (Mayne, 2017a). Moreover, an intervention's *desired result* encompasses intermediary *desired outputs* and *outcomes*, which in turn influence the final *desired impact* (i.e., the final desired change) (Mayne, 2015).

Based on broadly accepted theoretical ideas underpinning ToC (e.g., Mayne, 2017a; Valters, 2015; van Es et al., 2015; Vogel, 2012a; Vogel, 2012b), literature specifically applying ToC to conservation contexts (e.g., Biggs et al., 2017; Romero & Putz, 2018; Balfour et al., 2019; see also Table S1), as well as our experiences in the field, we propose that the development of robust, well-informed conservation ToC pathways comprises six core steps: (a) identify the intervention's main beneficiaries; (b) jointly identify and articulate the intervention's desired results; (c) define and analyze the contextual factors, conditions or events that may positively or negatively affect the intervention's desired results; (d) formulate actions, and identify and articulate the associated assumptions that underpin these actions, to achieve the intervention's desired results; (e) implement and evaluate actions to identify persistent and newly emerging issues; and (f) in so doing constantly adapt the intervention to better achieve the intervention's desired results (Figure 1a). Based on these six steps, we propose a framework for the development and application of conservation ToC pathways (Figure 1b). The subsequent discussion briefly explains these six steps as they relate to the framework, and provides conservation-relevant examples of the various change elements. Table 1 summarizes the findings related to the key change elements that emerge from the three conservation interventions from Box 1, and to which we refer throughout.

The first step is identifying the intervention's beneficiaries, that is, all actors who may be affected by or have an interest in the interventions objectives, which in contemporary conservation will notably include local

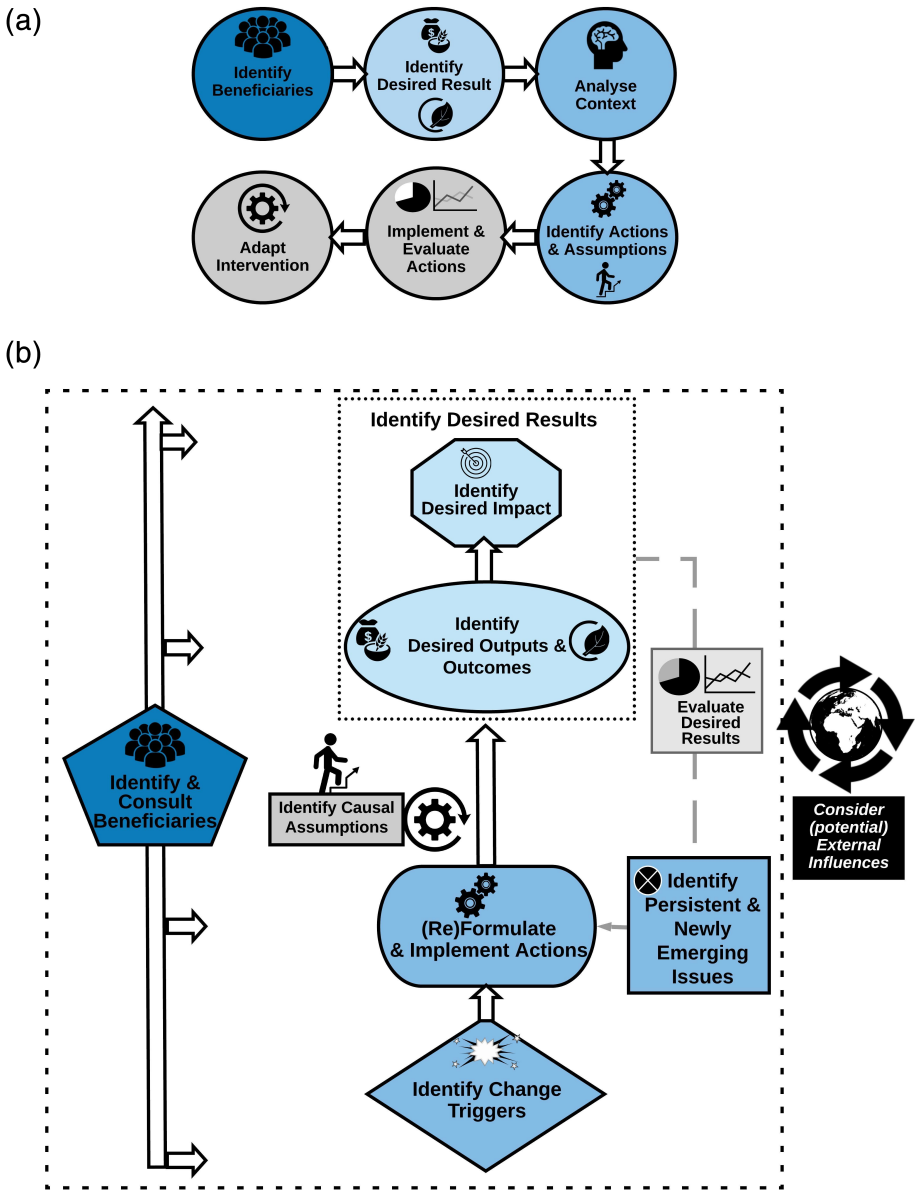

FIGURE 1 Developing robust conservation Theory of Change (ToC) pathways: (a) six core steps that frame a conservation intervention's ToC development; and (b) a framework for a conservation intervention's ToC development. Note that the framework emphasizes that an intervention's beneficiaries should be consulted throughout the ToC process. Evaluation of the desired results will identify persistent and newly arising issues that will systematically feedback into the process and lead to adaptation of an intervention through the reformulation and implementation of actions. The ToC process should also consider the effect of any potential external influences

resource users, as well as their partners (Table 1). This step is crucial to all subsequent steps, which all require high levels of active participation by, and collaboration among actors to develop a more robust ToC pathway (Figure 1b). Accordingly, the post-2020 GBF strives to "galvanize urgent and transformative action" by all stakeholders (CBD, 2020a, p. 6), and specifically calls for "The participation of indigenous peoples and local communities and a recognition of their rights in the implementation of the framework" (CBD, 2020a, p. 10).

The second step requires identifying and articulating the intervention's desired result, which should be clear, logical, based upon the context and past experiences, and ultimately be both achievable with the planned actions, and measurable through evaluation (Mayne, 2017a). Commonly conservation desired results include desired changes in attitudes and behavior of conservation actors toward natural resource use and management (Cinner, 2018; Bennett et al., 2019; Table 1).

Step (c) considers the intervention's context to propose and implement appropriate *actions* to achieve the identified desired results. This requires exploring the origins, causes and consequences of change triggers, that is, ecological and social factors, conditions and/or events that can stimulate initiation, and subsequently maintenance of an intervention (Bie, Addison, & Cook, 2018; Seixas & Davy, 2008). This can include both initial contextual issues and trigger events. Initial contextual issues refer to any ecological or socioeconomic, cultural and political factors, conditions, and/or events requiring change through the design and implementation of actions. Common conservation examples include

TABLE 1 A summary of key 'change elements' that emerged from the three conservation interventions making use of Theory of Change introduced in Box 1.

Example (reference)	Main beneficiaries	Desired result(s)	Change triggers	Actions	Causal assumptions	Persistent and newly emerging issues
Example 1: Evaluation of Forest Stewardship Council Certification in Indonesia (Romero & Putz, 2018)	• Natural forest management enterprises	• Sustained timber yield • Increased postlogging timber recovery rates	• Diminishing timber yields • Lack of markets • National policy approved increased harvesting intensity • Decline in certified natural forest management enterprises	• Train workers in reduced-impact logging techniques to avoid unnecessary damage • Increase understanding of the motivational context for worker performance for enabling environment for sustained timber yield decisions • Make decisions based on reliable harvesting data	• Workers will employ reduced-impact logging techniques • Presence of reliable harvesting data • Resources are available to adopt management practices • Presence of timber regulatory frameworks • Natural forest management enterprises will respect timber regulations and monitor annual tree growth	• Lack of political will and adequate policy • Concerns about worker and subcontractor training and supervision • Monitoring challenges • Lack of realized market benefits • Declining profits from subsequent harvests which produce small fraction of initial harvest • High opportunity costs of forest retention
Example 2: A community-based response to illegal wildlife trade (Biggs et al., 2017)	• Local communities living with wildlife	• Decreased illegal wildlife trade	• Escalating poaching and illegal wildlife trade • High cost of living with wildlife for local community	• Strengthen disincentives for illegal behavior • Increase incentives for wildlife stewardship • Decrease costs of living with wildlife • Support livelihoods that are not related to wildlife	• Community rangers use equipment and training to combat illegal wildlife trade and do not use them to poach themselves or for other purposes • Benefit sharing within communities is sufficiently equitable, and capture of benefits by elites does not undermine success. • Compensation does not lead to perverse behavior (e.g., damage from wildlife is not actively	• Local elite capture • Government resistance to decentralization of authority and community or individual ownership of wildlife • Government corruption leading to lack of trust in law enforcement authorities • Threats to community game guards enforcing laws • Risk of in-migration when benefits are perceived

(Continues)

TABLE 1 (Continued)

Example (reference)	Main beneficiaries	Desired result(s)	Change triggers	Actions	Causal assumptions	Persistent and newly emerging issues
					induced to receive payments). • The value of wildlife products poached or traded in illegal markets is not so high that all other forms of income cannot come close to competing	• If illegal wildlife trade decreases and wildlife populations increase, this may lead to increased human–wildlife conflict
Example 3: RARE's pride conservation campaign. Case study: Corazon Bay no-take fishing area (RARE, n.d.)	• Local fishers and community members	• Increase white-spotted grouper population size • Reduce number of white-spotted grouper taken in no-take area	• Declining fish populations • Limited local income opportunities leading to overfishing, reef gleaning, and dynamite fishing in the no-take fishing area and surrounds • Fish is important source of protein to local community	• Build a local management committee • Train local enforcement teams to increase regular enforcement • Increase awareness of the effects of negative fishing behavior • Increase interpersonal communication among community members • Allocate exclusive community fishing rights outside no-take area	• Community will engage with the campaign • Fishers will respect local leaders and comply with no-take fishing regulations • Decreased fishing activity will increase white-spotted grouper population size • Provision of exclusive fishing rights will persuade fishers to fish outside the no-take area	• Family tradition of fishing in area • Local community do not see benefit of protecting no-take area to improve fishing • Enforcement teams are not respected and hesitant to arrest/prosecute fellow community members • If some fishers (notably outsiders) fish in the no-take area, others feel they should be able to too

ecological degradation, high levels of poverty and a lack of alternative nonextractive livelihoods, and low institutional capacity (e.g., Biggs et al., 2017; Sanders, Miller, Bhagwat, van der Grient, & Rogers, 2019). Trigger events include social—as described above—and ecological events (e.g., a decrease in species abundance) able to motivate and trigger management decisions and actions (Bie et al., 2018; Seixas & Davy, 2008). Consequently, initial contextual issues and triggers events can overlap, and we use the term change trigger to incorporate both concepts. See Table 1 for examples of change triggers.

Once a desired result has been articulated, and the intervention's context has been considered, this information informs formulation of socially and ecologically appropriate actions, that is, Step (d). Actions need to be broadly acceptable, doable, measurable, and sustainable to bring about the desired result (Mayne, 2017a, 2020). The post-2020 GBF views broadly acceptable actions as those considering the beneficiaries needs, interests, capacity, behavior, and visions for the conservation intervention, a process which will (or should) have begun in Step (a) (Table 1).

Formulating actions ultimately involves identifying underlying causal assumptions, that is, the events, factors or conditions considered likely to support a proposed action (Mayne, 2017a). Causal assumptions should be informed by the intervention's context. Furthermore, "enabling actions" can positively influence the presence of causal assumptions, for example, actions disincentivizing certain behaviors while incentivizing others (Biggs et al., 2017, p. 8; Table 1). Therefore, actions implemented, and the presence of casual assumptions affects each other and the ability to produce the intervention's desired result (Figure 1b).

Causal assumptions, in accordance with commons theory, specifically include consideration of enabling factors and conditions (i.e., "enablers") (Agrawal, 2001; Ostrom, 1990). As Berkes (2007, p. 151888) states, "Biodiversity conservation can be treated as a commons problem, specifically as a multilevel commons problem." In particular, commons theory informs how to enable collaborative governance arrangements, such as those characterizing contemporary conservation interventions (Herzog & Ingold, 2019). Therefore, while "enablers" will be highly context-specific, numerous scholars and practitioners, including the post-2020 GBF, have highlighted several conservation "enablers" (see Table S2). These conservation "enablers" include, among others, the presence of collective recognition of a conservation problem, such as a degraded natural resource; political will and enabling legislation recognizing local and indigenous community institutions; promoting gender equality and empowerment, empowerment of actors to make, enforce and change rules (or at the least participate in these processes); equitable benefit-sharing; high levels of alignment of the intervention with local context and priorities; and legitimately perceived "nested" institutional partnerships providing financial and technical support (Biggs et al., 2019; Sanders et al., 2019; CBD, 2020a; see Table S2 further). Finally, the presence of willing and motivated actors is a key enabler and overarching causal assumption. Table 1 depicts the key *causal assumptions* identified for each of the interventions within Box 1.

Notwithstanding the potentially enabling "environment" produced by the presence of causal assumptions, "counter pressures" may result in "at-risk" *assumptions* and their continued absence (Mayne, 2017a, p. 157). For example, high levels of poverty, elite-capture of benefits, and a lack of political will commonly affect the *causal assumptions* made, and may even derail a conservation ToC pathway (Biggs et al., 2017; Sanders et al., 2019). Therefore, continuous evaluation of causal assumptions is required to reformulate actions, that is, Step (e) (Béné, Riba, & Wilson, 2020; Romero & Putz, 2018).

Step (e) is the continuous monitoring and evaluation of the extent to which actions achieve the desired results (Béné et al., 2020; Gurney et al., 2019). Effective conservation monitoring requires long-term investments, comprehensive social and ecological indicators, and improved data collection, analysis and learning (Gurney et al., 2019). Furthermore, the availability of baseline and subsequent intermediary data, and an accurate means for comparison is key to evaluation (Béné et al., 2020). Moreover, the participation of local actors can improve the design and implementation of conservation monitoring (Biggs et al., 2017; Gurney et al., 2019).

A key ToC "evaluative" concept is systematic feedback, which is when, "results from some action travel through the system and eventually return in some form to the original action, potentially influencing future actions" (Larrosa, Carrasco, & Milner-Gulland, 2016, p. 318; Figure 1b). This "evaluative feedback" identifies persistent and newly emerging issues, which provide important practical guidelines for effectively adapting ToC pathways. For example, conservation actions such as potential conflicts between community game guards, employed to counter illegal wildlife trade, and local poachers can cause a "breakdown in social cohesion" within a community (Biggs et al., 2017, p. 10). Additional emerging issues include the cost and accuracy of monitoring and evaluation, a lack of realized benefits, and increasing in-migration of resource users to sensitive ecological areas as a result of an intervention's "success" (Table 1). The topic of evaluation is discussed in greater detail later in the paper.

Therefore, Step (e) informs the continuous adaptation of the ToC pathway to increase the chances of achieving the desired result, that is, Step (f) (Figure 1b). Adaptive conservation management is well-established

(Salafsky, Margoluis, & Redford, 2008), and considered crucial to both ecological (Nickols et al., 2019), and social aspects of conservation management (Kaplan-Hallam & Bennett, 2018). Graham et al. (2010) refer to the reformulation of actions based upon the identified emerging issues as "passive adaptation," but emphasize that conservation requires not only passive but "active adaptation," the latter stressing the need for active experimentation of different conservation actions. Nevertheless, adaption strategies need to avoid scale mismatches (Gurney et al., 2016; Wilson et al., 2016).

According to Mayne (2013), ToC pathways are merely "a model of the *contribution to* and not the cause per se of the intended result" (p. 128—*emphasis* in original). Therefore, while an intervention's actions influence the likely realization of a desired result, *external influences* can either enable or constrain this result. Common constraining external influences include a lack of scientific legitimacy toward the chosen conservation approach, a lack of political will or supporting policy, and a weak and/or corrupt government (Larrosa et al., 2016; Sanders et al., 2019). In contrast, commitments to international agreements such as the post-2020 GBF may legitimize and stimulate national and local action. Finally, conservation ToCs are also influenced by other sectors, and may even be improved by "co-producing" ToCs with other sectors (Reed, Barlow, Carmenta, van Vianen, & Sunderland, 2020). Consequently, the framework presented in Figure 1b provides a template for the design and application of conservation ToC pathways. However, many challenges exist in this endeavor.

2.3 | Challenges to developing robust conservation ToC pathways: Lessons from cross-sector ToC use

ToC use in conservation lags significantly behind many other sectors. In particular, the health, education and agriculture sectors possess rich empirical work evaluating the design and application of ToC, which offers several lessons for developing robust conservation ToC pathways (e.g., Armitage et al., 2019; Maini, Mounier-Jack, & Borghi, 2018; Mayne & Johnson, 2015; Valters, 2015; van Es et al., 2015). We now discuss common challenges emerging from multisector ToC literature within the conservation context.

2.3.1 | ToC terminology and representation

An overarching challenge to ToC use is a longstanding confusion over terminology, not only for what constitutes a ToC pathway, but also its components (Prinsen & Nijhof, 2015; Vogel, 2012a). Furthermore, diverse representations of ToCs have resulted in debate over their "best" manner of use (Davies, 2018; Prinsen & Nijhof, 2015). Whilst more nuanced and comprehensive ToCs are required to capture greater complexity within contemporary interventions (discussed below), the resultant elaborate and complicated diagrammatic representations may often prove counterproductive to broad multiactor engagement (discussed below), and the end-goal of influencing desired change (Davies, 2018; Valters, 2015). Therefore, designing a ToC requires a "balancing-act" of remaining *simple*, *readable*, and *useable*, for the purposes of communication and consensus, whilst still providing *sufficient* detail to reliably account for an intervention's *real-world context* (Davies, 2018; Koleros, Mulkerne, Oldenbeuving, & Stein, 2020; Mayne, 2015). Therefore, a ToC should rather strive to, "represent the intervention in a practical and evaluable way" (Koleros & Mayne, 2019, p. 293).

2.3.2 | Incorporating sufficient complexity into ToCs

As Van Tulder and Keen (2018, p. 315) state, "Systems change requires complex interventions." However, incorporating sufficient complexity is a fundamental challenge to designing and evaluating ToC pathways (Douthwaite et al., 2020; Koleros et al., 2020).The complexity of conservation is exacerbated by multiple objectives, among multiple and diverse affected actors that interact within diverse socioinstitutional and ecological contexts, across a variety of scales (Armitage et al., 2020; Baird, Plummer, Schultz, Armitage, & Bodin, 2019; Cockburn et al., 2020). Therefore, ToC pathways are at risk of oversimplifying "real-world challenges," particularly in relation to "longer term effects and relationships" (Armitage et al., 2019). An intervention's complexity differs based upon uncertainty, external influences, and emergent properties (Douthwaite et al., 2020; Mayne, 2015; Walton, 2016). Furthermore, interventions exist within a multisector context, and therefore can be enabled or constrained by interventions from other sectors (Maini et al., 2018; Reed et al., 2020).

Therefore, ToC pathways should inform "complexity-aware" interventions that strive, "to harness the dynamics of complexity to catalyze system learning, innovation, and adaptive change" (Douthwaite & Hoffecker, 2017, p. 89). This requires the ability to unpack and better harness complexity (Douthwaite et al., 2020; Koleros & Mayne, 2019), to produce ToCs able to positively affect the desired change. Nevertheless, as alluded to above,

many caution against the use of excessive complexity in ToC to avoid confusion and disillusionment among the affected actors, and instead suggest ToCs should strive for *sufficient detail* of the intervention's context and scale (e.g., Davies, 2018; Koleros & Mayne, 2019; Mayne, 2017a).

2.3.3 | Designing scale-appropriate ToCs

ToC pathways must consider at what scale(s) the intervention is taking place. Designing *scale-appropriate* conservation ToCs requires accounting for ecological and socioinstitutional context (Baird et al., 2019; Gurney et al., 2016; Wilson et al., 2016). Achieving desired temporal (and spatial) ecological outcomes is particularly challenging as these are frequently only feasible in the long term (Wilson et al., 2016). Furthermore, short-term conservation project funding cycles have implications for conservation ToCs (Biggs et al., 2019; Sanders et al., 2019). Designing an appropriate temporal scale and addressing the contradictions between short-term and long-term goals is therefore of eminent importance.

Geographical scale is also relevant to the implementation and mainstreaming of the post-2020 GBF (CBD, 2020a). The post-2020 GBF, designed at a global level, is reliant upon interventions taking place at the national- and local-levels to influence global transformative action. Accordingly, parties to the post-2020 GBF will be required to design and implement national strategies to meet their obligations, which will in turn require local-level interventions. However, the interactions between diverse actors and institutions at various scales may either enable or constrain a nation's post-2020 GBF success. At a national-level, this principally requires *political will*, characterized by government support, and legitimacy through enabling legislation (CBD, 2020a; Sanders et al., 2019). Furthermore, at a local-level this requires willing local communities, and strong and supportive local leaders, to actively participate and collaborate with each other and the intervention's partners (Biggs et al., 2017; Crona, Gelcich, & Bodin, 2017). Moreover, government and/or nongovernmental partners require the financial and technical capacity to actively engage with each other and local actors, with nongovernmental partners often essential to as "bridging organizations" between local and government actors (Armitage et al., 2020; Sanders et al., 2019). In particular, actors need to recognize and reconcile the benefits of each other's knowledge and contributions, including the importance of local ecological knowledge (Armitage et al., 2020; CBD, 2020a; Tengö, Brondizio, Elmqvist, Malmer, & Spierenburg, 2014). Therefore, *improving multiactor engagement* is central to designing scale-appropriate conservation ToC pathways.

2.3.4 | Improving multiactor engagement in ToCs

The greater the complexity of the problem, the greater an intervention's need for multiactor engagement (Armitage et al., 2020; Van Tulder & Keen, 2018). Therefore, ToC use needs to engage and generate consensus among actors, both initially and moving forward with the intervention (Koleros & Mayne, 2019; Mayne, 2017a; Vogel, 2012a; Vogel, 2012b). This has also been emphasized within the conservation interventions from the case studies (Box 1).

Multiactor engagement can improve the effectiveness of deliberations required to inform shifts in knowledge, attitude, and skills that may enable the desired change (Vogel, 2012b). These deliberations will in turn be affected by the intervention's social, political and environmental context; the sequence of anticipated and/or required events leading to the desired change; and the identification and consideration of assumptions, related to contextual conditions, that may affect the intervention's actions, and therefore, its ability to influence the desired change (Vogel, 2012b, p. 2).

Strong partnerships between target beneficiaries and partners are key to more "complexity-sensitive ToCs," however, multiactor engagement will always be subjected to "collaborative complexities" (Van Tulder & Keen, 2018, p. 316). Therefore, a common threat is institutional power dynamics (e.g., Biggs et al., 2017). ToC development and implementation often remains a top-down process managed by a few, with the inputs of many excluded (Maini et al., 2018; Valters, 2015; Walton, 2016). This exclusion is commonly mirrored within conservation contexts (Armitage et al., 2020). Therefore, the perceived "sense-of-ownership" of a ToC, and its development process, has implications for how the ToC is received by actors and the intervention's success (Koleros & Mayne, 2019; Sullivan & Stewart, 2006; Van Tulder & Keen, 2018).

The post-2020 GBF itself emphasizes "the need for whole-of-society engagement to implement it" (CBD, 2020a, p. 11), and specifically stipulates the need for greater recognition and participation of women, youth, and local and indigenous peoples (CBD, 2020a, pp. 6-7). Doing so can promote shared understanding of ways to tackle an intervention's problems (Armitage et al., 2020; Biggs et al., 2019; CBD, 2020a). Therefore, the development of robust conservation ToCs should promote multiactor engagement by developing actor's

capabilities, and presenting *opportunities* and *motivating* actors to actively engage in the process (Cf. Michie et al., 2011).

2.3.5 | Enhancing enabling conditions for ToCs

Enabling conditions are an often overlooked, but key component of any response to reducing biodiversity loss (Rands et al., 2010). This requires consideration of multiple social and ecological enablers, introduced previously (see also Table S2). The post-2020 GBF specifically stipulates the enabling effect of: a shared understanding of and consensus on how to address a conservation problem; broader participation in decision-making and management activities; interventions characterized by a strong alignment with local socioeconomic and cultural priorities; and the presence of "nested" support (CBD (Convention of Biological Diversity), 2020a, pp. 10-11). Finally, ToC use can encourage "overly mechanistic" pathways when identifying and representing enabling conditions and desired results (Armitage et al., 2019). Therefore, the ability to enhance the presence of enabling conditions requires ToCs that incorporate sufficient *complexity*, promote *multiactor engagement*, and are *sustainable*, and *evaluable*. The last two aspects are discussed below.

2.3.6 | Improving the "sustainability" of ToCs

Sustainability of an intervention's components and its impacts, as well as its effects on future interventions, should be central to its design; however, this is rarely addressed in the ToC development process (Mayne, 2020; Sridharan & Nakaima, 2019). In particular, a ToC should produce sustainable desired outcomes in the form of both material benefits, as well as partnerships and/or capabilities for positive long-term effects (Hunter, 2006; Mayne, 2020; Sridharan & Nakaima, 2019).

Mayne (2020) suggests sustainable ToCs need to consider: *what actions and contexts are needed*, and *what intervention planning is required to enhance sustainable benefits*. A specific ToC sustainability consideration is the differing "needs, preferences, and values" of actors, and the ability, "to incorporate knowledge of such heterogeneities into their planning and implementation" (Sridharan & Nakaima, 2019, pp. 377-378). Furthermore, sustaining an intervention's components must consider the differing levels of support required over the intervention's lifespan (Mayne, 2020). Therefore, not only causal link assumptions, but also "sustainable assumptions" are required in the ToC design (Mayne, 2020). Accordingly, by identifying barriers, and by taking "supporting actions," the ability for an intervention to generate sustained benefits is improved (Mayne, 2020). Finally, sustained intervention "success" relies on evaluating its progress and adapting where necessary.

2.3.7 | Improving the "evaluability" of ToCs

Evaluation is a core component of robust ToCs. As Mayne (2017a, p. 170) states, "Theories of change are the basis for theory-based evaluation approaches... As such, the robustness of the ToC used matters." A past criticism of ToC is its perceived inability to respond to contextual changes highlighted by evaluation (Weiss, 1997). Accordingly, ToC components should be analyzed to identify "evaluation questions to be addressed; issues that need to be carefully watched or explored; issues, results, and/or assumptions that should be monitored; and/or identifying data that should be collected" (Mayne, 2017a, p. 164). In doing so, the ToC provides a solid foundation for both monitoring and evaluation, which is key to an intervention's impact (Brousselle & Buregeya, 2018; Funnell & Rogers, 2011; Mayne, 2017a; Rogers, 2014a, 2014b).

In accordance with discussions throughout, evaluation needs to account for complexity (Brousselle & Buregeya, 2018; Koleros & Mayne, 2019; Walton, 2016). A "complexity-informed evaluation" is affected by the organizational, political, and broader social science environment (Walton, 2016, p. 414). Mitigation of evaluative constraints relies on a strong "evidence-based ToC," which requires a strong "evaluative culture" (Mayne, 2017b). Furthermore, a strong "evaluative culture" is characterized by accountability, self-reflection, and evidence-based learning and experimentation (Koleros & Mayne, 2019; Maini et al., 2018; Mayne, 2017b). Furthermore, once again, active participation of a broader array of actors will strengthen evaluation (Maini et al., 2018; Walton, 2016). As introduced previously, this is of particular importance within conservation interventions (e.g., Béné et al., 2020; Biggs et al., 2017; Gurney et al., 2019). Consequently, evaluation is pivotal to understanding *whether*, *how* and *why* an intervention works, and therefore, developing robust, well-informed ToC pathways.

3 | RECOMMENDATIONS FOR TOC USE IN POST-2020 CONSERVATION

ToC pathways are merely "a model of expectations" (Mayne, 2017a, p. 163), and "works in progress" (Davies, 2018, p. 16), and will never be perfect or complete

(Davies, 2018; Mayne, 2017a). That said, we now offer some practical recommendations to improve ToC use in post-2020 conservation interventions, and in particular to facilitate the implementation and mainstreaming of the post-2020 GBF, especially at national and local levels.

A conservation intervention will benefit from the design of multiple ToC pathways spanning its duration. Therefore, like others, we recommend developing both an initial *overarching* ToC, and subsequent more *detailed* ToCs (Koleros & Mayne, 2019; Mayne, 2017a). At its core, a ToC pathway requires a theory explaining how it should work, and how actions will lead to the desired change, which is the purpose of an initial ToC. Therefore, an initial overarching ToC pathway should be tested against the logic and assumptions proposed, and available evidence (Mayne, 2017a). This prior research should incorporate diverse sources of knowledge, including theoretical and practical knowledge emerging from both "scientific" research and local ecological knowledge.

Therefore, an initial overarching ToC pathway is useful to identify potential weaknesses in the intervention's design, particularly identifying initial contextual conditions that may enable or constrain the desired result. Furthermore, it can assist in identifying conflicts of interest, to better facilitate deliberations required to generate both greater awareness and consensus. The post-2020 GBF provides an example of an initial *overarching ToC pathway* to promote global transformational conservation action (i.e., top of Figure 2). The *Informal Advisory Group on Mainstreaming of Biodiversity* has since expanded this initial framework by incorporating additional strategies, targets, and indicators required to "integrate mainstreaming" into the post-2020 GBF (i.e., bottom of Figure 2; CBD, 2020b).

Notwithstanding the above post-2020 GBF progress, *scale-appropriate ToCs* will be required at national and local levels. For the purposes of the current discussion, we present a "generic" initial overarching ToC pathway

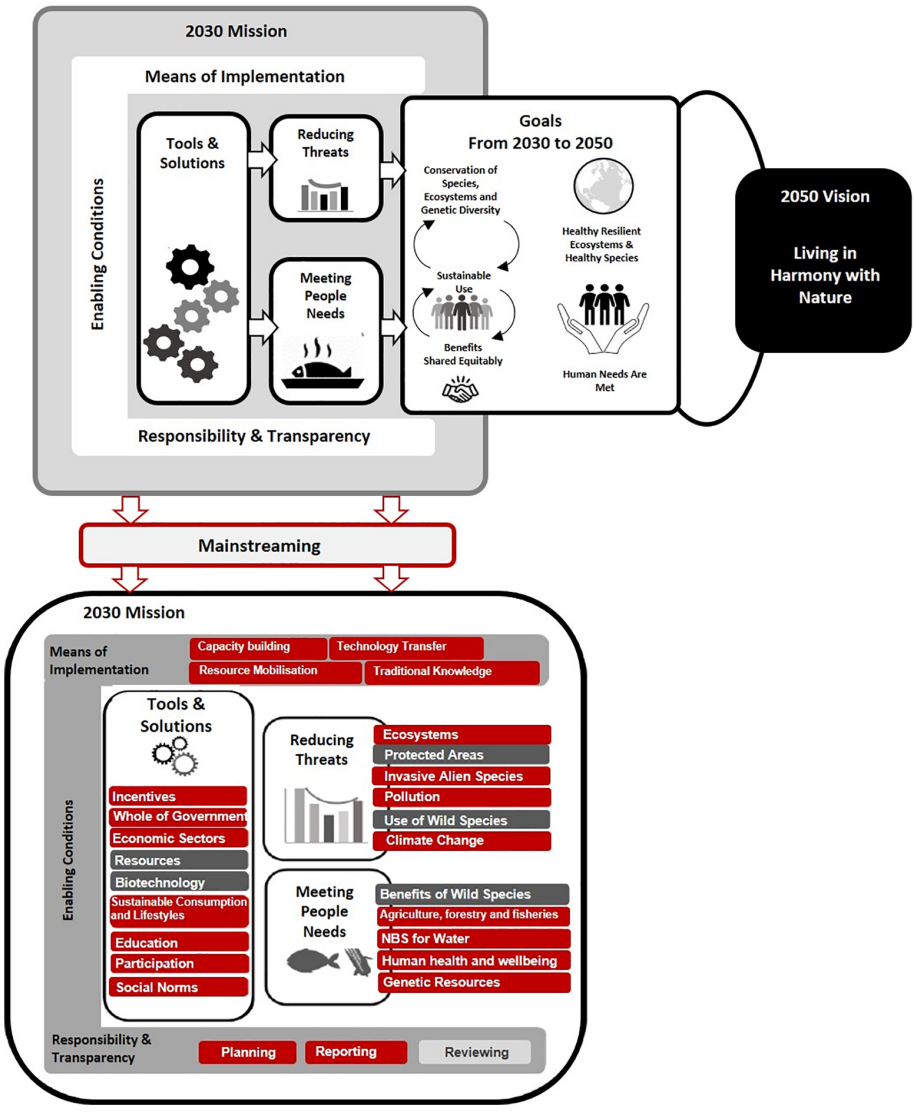

FIGURE 2 An adapted diagrammatic representation of the Post-2020 Global Biodiversity Framework (top), and the updated version including the integration of mainstreaming by the Informal Advisory Group on Mainstreaming of Biodiversity (bottom). Source: (CBD (Convention of Biological Diversity), 2020a, 2020b)

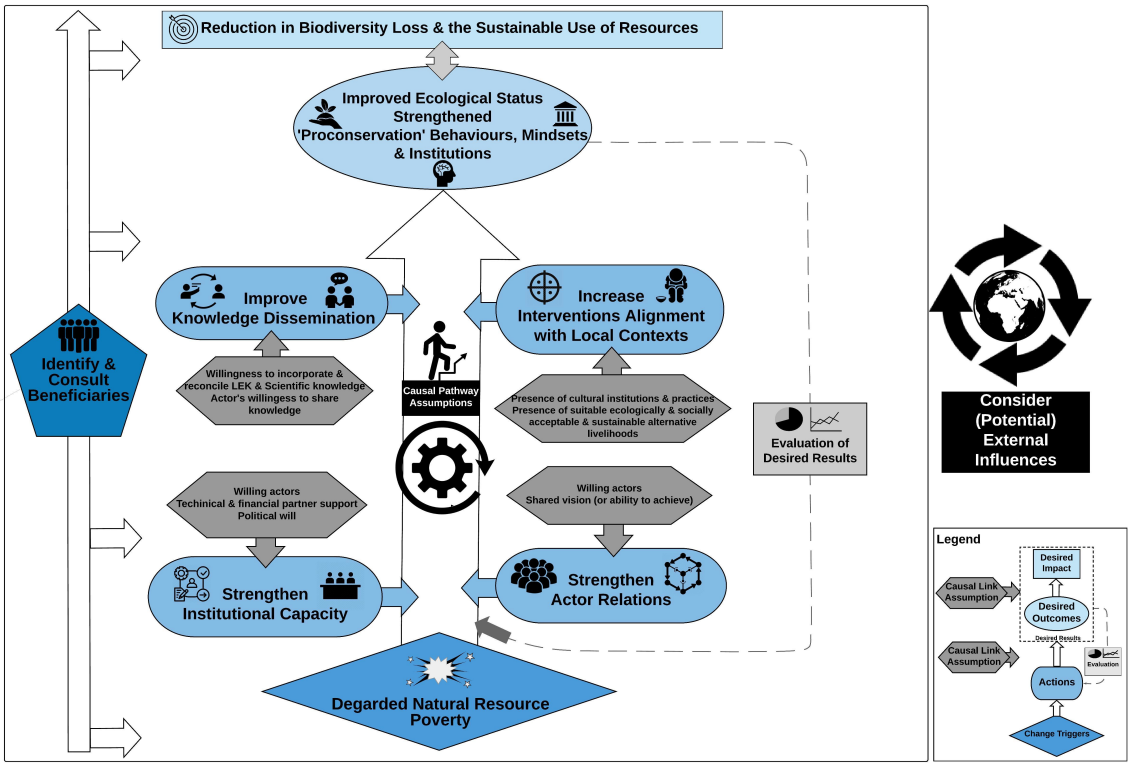

FIGURE 3 A generic overarching conservation Theory of Change (ToC) pathway. Note that like the framework presented in Figure 1b, this ToC pathway emphasizes that an intervention's beneficiaries should be consulted throughout the ToC process. Evaluation of the desired results will identify persistent and newly arising issues that will systematically feedback into the process and lead to adaptation of an intervention through the reformulation and implementation of actions. The ToC process should also consider the effect of any potential external influences

for post-2020 conservation (Figure 3). This ToC provides an adaptable "template" for different national-, and local-level post-2020 conservation intervention contexts. The stated desired impact of *reduction in biodiversity loss and the sustainable use of resources* comes directly from the post-2020 GBF.

The theoretical consideration of this generic initial ToC pathway's desired outcomes, actions and assumptions are informed by the above discussions and "well-established" conservation findings framed by institutional theory, behavior change theory, conservation psychology (Bennett et al., 2019; Cinner, 2018; Clement, Moore, Lockwood, & Mitchell, 2015). Therefore, we summarize the desired outcomes for the present purposes simply as *improved ecological status*, and *strengthened "pro-conservation" behaviors, mindsets and institutions* (Figure 3). Furthermore, the generic action categories presented depict some, though by no means all, common overarching contemporary strategies identified in the empirical conservation literature, namely: *increase institutional capacity and participation*; *strengthen actor relations*; *improve knowledge dissemination*; and *increase alignment with local contexts* (Figure 3). These actions also emerged from the three cases in Box 1, and directly align with the "Tools and solutions for implementation and mainstreaming" as specified in the post-2020 GBF (CBD (Convention of Biological Diversity), 2020a, pp. 9-10). Moreover, the generic *causal link assumptions* provided focus on the willingness and motivation of actors, partner support and the presence of sociocultural intuitions and practices upon which to build the intervention (Figure 3). Additionally, the *causal pathway assumptions* are broadly considered as common enabling conditions for conservation as discussed previously (see also Table S2). This pathway also considers the potentially enabling or constraining *external influences*, introduced previously. Finally, the pathway allows for the *evaluation* of the desired results, and the presence of causal assumptions, and the systematic feedback of identified persistent and emerging issues, to *adapt* the pathway through *reformulated actions* (Figure 3).

While an overarching ToCs is useful in framing the intervention, many scholars and practitioners of ToC suggest the explicit need for a more *detailed ToCs*, "nested" under the intervention's overarching ToC, to better represent an intervention's complexity, account for scale,

providing greater clarity on actor roles and interactions, and even showcase the multiple potential pathways to achieving the desired result (e.g., Douthwaite et al., 2020; Koleros & Mayne, 2019; Mayne, 2015, 2017a). Representation of these factors is key to robust conservation ToC able to improve complex multiactor and multiobjective interventions (Armitage et al., 2020; Baird et al., 2019; Cockburn et al., 2020). Therefore, like others, we recommend designing "nested" actor-based pathways, which are especially beneficial to evaluation (Koleros & Mayne, 2019). This allows for early detection of trajectories constraining the desired result, and provides crucial information for adapting the pathway where necessary (Koleros & Mayne, 2019; Mayne, 2015, 2017a). Therefore, for the purposes of discussion we build upon Figure 3 to present an example of a generic "nested" actor-based conservation ToC (Figure 4).

The ability to *increase institutional capacity and participation* will include actions such as capacity building workshops (Figure 4). Furthermore, increasing participation will require decision-making meetings to be open to all actors. Key actor-based considerations in this action category include strengthening inter-departmental collaboration among State actors, non-State partners acting as bridging organizations, a strengthening of local leadership to promote local community brokers able to facilitate collaboration between local resource users and partners, and the identification of "champions" to drive the intervention (Figure 4). *Strengthening actor relations* is key to improving collaboration. This notably includes the identification of "champions," non-State partners acting as bridging organizations, and the strengthening of local leadership (Figure 4). Furthermore, a key action required to strengthen actor relations is the building trust and accountability among actors, which will often require long-term multiactor engagement (Figure 4). *Increasing alignment with local contexts* requires identifying local socioeconomic and cultural priorities and reconciling these with the intervention's conservation objectives, which often includes identifying and building local capacity for alternative non-resource extractive livelihoods (Figure 4). Finally, *improving knowledge*

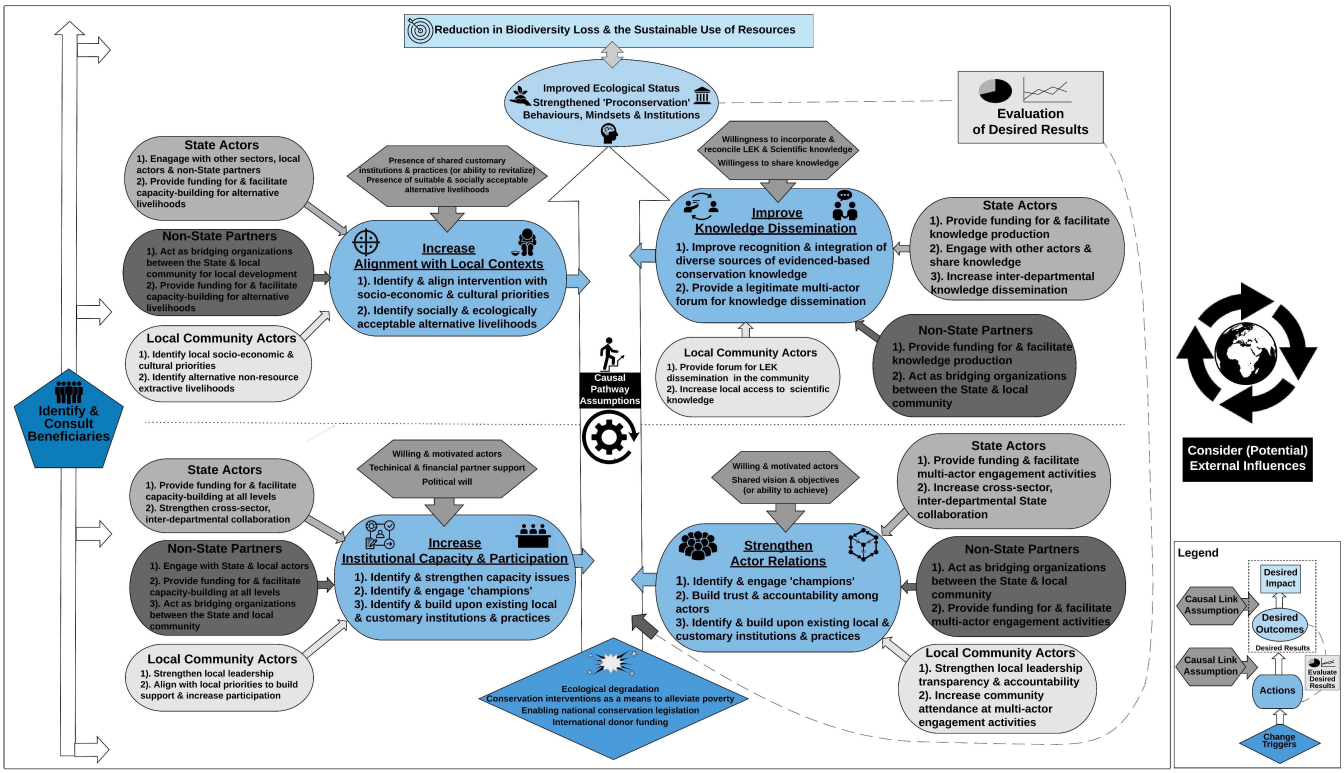

FIGURE 4 A generic nested actor-based conservation Theory of Change (ToC) pathway. Note this ToC pathway expands upon Figure 3 to provides specific actions within each action category, as well as actions linked to State, non-State partners, and local community actors. Like the framework presented in Figure 1b, and the generic overarching ToC pathway presented in Figure 3, this ToC pathway emphasizes that an intervention's beneficiaries should be consulted throughout the ToC process. Evaluation of the desired results will identify persistent and newly arising issues that will systematically feedback into the process and lead to adaptation of an intervention through the reformulation and implementation of actions. The ToC process should also consider the effect of any potential external influences

dissemination requires all actors to recognize and integrate diverse sources of evidence-based conservation knowledge, and recognize, accept and share this knowledge (Figure 4). The causal pathway and causal link assumptions are retained from Figure 3. Once again, neither Figure 3 nor Figure 4 represent perfect or complete ToC pathways, but highlight the potential products of developing robust, well-informed post-2020 conservation ToC pathways.

4 | CONCLUDING REMARKS

Persistent global biodiversity loss and ineffective conservation management require urgent social and institutional change. This requires tools that enable greater understanding of change processes, and promote more holistic and adaptable approaches. ToC offers a flexible, useful, transdisciplinary and systematic approach that is well suited to the task. However, improved post-2020 conservation interventions, able to produce more ecologically sustainable and socially supported outcomes, will require the design, implementation, and adaptation of robust, well-informed ToC pathways to overcome complex challenges. This paper first proposes a framework to develop robust pathways, which requires identifying and actively engaging beneficiaries, jointly identifying desired results, and careful consideration of various change elements. This most notably includes the importance of evaluation and constant adaptation of the ToC pathway to improve the chances of achieving a conservation intervention's desired result.

However, the design and implementation of robust and well-informed conservation ToC pathways is both "multitargeted" and "messy" (Mayne, 2015, p. 133). This is not a simple process and requires more effectively incorporating sufficient complexity, at appropriate scales, and encouraging improved levels of multiactor engagement. Furthermore, a robust conservation ToC needs to identify and enhance enabling conditions, and improve the sustainability and "evaluability" of their components and desired results, to better inform necessary adaptations to achieve desired social and ecological changes. Consequently, a robust, well-informed ToC pathway should query, "*what* it is about an intervention that works for *whom*, in *what* circumstances, in *what* respects, over *which* duration" (Pawson, 2013, p. 167—*emphasis* added). This is admittedly a "daunting" prospect, but by taking on lessons emerging from other sectors, greater success in the use of ToC in post-2020 conservation interventions is possible. In doing so, ToC can assist diverse conservation actors working towards achieving the post-2020 GBF's objective to sustainably meet the needs of people and reduce biodiversity loss.

ACKNOWLEDGMENTS

The authors gratefully acknowledge funding from the Community Conservation Research Network (CCRN), the South African National Research Foundation, the University of Cape Town, and the University of Amsterdam. This paper benefited from the useful insights of Derek Armitage, and three anonymous reviewers.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

Wayne Stanley Rice, **Merle R. Sowman**, and **Maarten Bavinck**: Conceptualized the idea. **Wayne Stanley Rice** led the drafting of the manuscript and designed the figures. All authors provided critical feedback, edited the manuscript, and approved of the final version.

DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

ETHICS STATEMENT

This manuscript is solely the work of the authors. No ethical approval was required for this research, as it did not involve any experiments on animal or human subjects.

ORCID

Wayne Stanley Rice https://orcid.org/0000-0003-4308-6011

REFERENCES

Agrawal, A. (2001). Common property institutions and sustainable governance of resources. *World Development*, *29*(10), 1649–1672. https://doi.org/10.1016/S0305-750X(01)00063-8

Armitage, D., Arends, J., Barlow, N. L., Closs, A., Cloutis, G. A., Cowley, M., ... Weins, C. (2019). Applying a "theory of change" process to facilitate transdisciplinary sustainability education. *Ecology and Society*, *24*(3), 20. https://doi.org/10.5751/ES-11121-240320

Armitage, D., Mbatha, P., Muhl, E. K., Rice, W. S., & Sowman, M. (2020). Governance principles for community-centered conservation in the post-2020 global biodiversity framework. *Conservation Science and Practice*, *2*(2), e160. https://doi.org/10.1111/csp2.160

Baird, J., Plummer, R., Schultz, L., Armitage, D., & Bodin, Ö. (2019). How does socio-institutional diversity affect collaborative governance of social–ecological systems in practice? *Environmental Management*, *63*(2), 200–214. https://doi.org/10.1007/s00267-018-1123-5

Balfour, D., Barichievy, C., Gordon, C., & Brett, R. (2019). A theory of change to grow numbers of African rhino at a conservation site. *Conservation Science and Practice*, *1*(6), e40. https://doi.org/10.1111/csp2.40

Béné, C., Riba, A., & Wilson, D. (2020). Impacts of resilience interventions—Evidence from a quasi-experimental assessment in Niger. *International Journal of Disaster Risk Reduction*, *43*, 101390. https://doi.org/10.1016/j.ijdrr.2019.101390

Bennett, N. J., di Franco, A., Calò, A., Nethery, E., Niccolini, F., Milazzo, M., & Guidetti, P. (2019). Local support for conservation is associated with perceptions of good governance, social impacts, and ecological effectiveness. *Conservation Letters*, *12*(4), e12640. https://doi.org/10.1111/conl.12640

Berkes, F. (2007). Community-based conservation in a globalized world. *Proceedings of the National Academy of Sciences of the United States of America*, *104*(39), 15188–15193. https://doi.org/10.1073/pnas.0702098104

Bhola, N., Klimmek, H., Kingston, N., Burgess, N. D., van Soesbergen, A., Corrigan, C., … Kok, M. T. J. (2020). Perspectives on area-based conservation and its meaning for future biodiversity policy. *Conservation Biology*. https://doi.org/10.1111/cobi.13509

Bie, K., Addison, P. F., & Cook, C. N. (2018). Integrating decision triggers into conservation management practice. *Journal of Applied Ecology*, *55*(2), 494–502. https://doi.org/10.1111/1365-2664.13042

Biggs, D., Ban, N. C., Castilla, J. C., Gelcich, S., Mills, M., Gandiwa, E., … Possingham, H. P. (2019). Insights on fostering the emergence of robust conservation actions from Zimbabwe's CAMPFIRE program. *Global Ecology and Conservation*, *17*, e00538. https://doi.org/10.1016/j.gecco.2019.e00538

Biggs, D., Cooney, R., Roe, D., Dublin, H. T., Allan, J. R., Challender, D. W., & Skinner, D. (2017). Developing a theory of change for a community-based response to illegal wildlife trade. *Conservation Biology*, *31*(1), 5–12. https://doi.org/10.1111/cobi.12796

Brousselle, A., & Buregeya, J. (2018). Theory-based evaluations: Framing the existence of the new theory in evaluation and the rise of the 5th generation. *Evaluation*, *24*(2), 153–168. https://doi.org/10.1177/1356389018765487

CBD (Convention of Biological Diversity). (2020a). Zero Draft of the Post-2020 Global Biodiversity Framework. Retrieved from https://www.cbd.int/doc/c/efb0/1f84/a892b98d2982a829962b6371/wg2020-02-03-en.pdf

CBD (Convention of Biological Diversity). (2020b). Informal Advisory Group on Mainstreaming Biodiversity: Progress Report and Elements for the Mainstreaming of Biodiversity in the Post-2020 Global Biodiversity Framework. Retrieved from https://www.cbd.int/doc/c/bb51/b5cd/7710cb4ac2d839522477404d/wg2020-02-mainstreaming-en.pdf

Cinner, J. E. (2018). How behavioral science can help conservation. *Science*, *362*(6417), 889–890. https://doi.org/10.1126/science.aau6028

Clement, S., Moore, S. A., Lockwood, M., & Mitchell, M. (2015). Using insights from pragmatism to develop reforms that strengthen institutional competence for conserving biodiversity. *Policy Sciences*, *48*(4), 463–489. https://doi.org/10.1007/s11077-015-9222-0

Cockburn, J., Schoon, M., Cundill, G., Robinson, C., Aburto, J. A., Alexander, S. M., & Thondhlana, G. (2020). Understanding the context of multifaceted collaborations for social-ecological sustainability: A methodology for cross-case analysis. *Ecology and Society*, *25*(3), 7. https://doi.org/10.5751/ES-11527-250307

Crona, B., Gelcich, S., & Bodin, Ö. (2017). The importance of interplay between leadership and social capital in shaping outcomes of rights-based fisheries governance. *World Development*, *91*, 70–83. https://doi.org/10.1016/j.worlddev.2016.10.006

Davies, R. (2018). Representing theories of change: Technical challenges with evaluation consequences. *Journal of Development Effectiveness*, *10*(4), 438–461. https://doi.org/10.1080/19439342.2018.1526202

Douthwaite, B., Ahmad, F., & Shah, G. H. (2020). Putting theory of change into use in complex settings. *Canadian Journal of Program Evaluation*, *35*(1), 35–52. https://doi.org/10.3138/cjpe.43168

Douthwaite, B., & Hoffecker, E. (2017). Towards a complexity-aware theory of change for participatory research programs working within agricultural innovation systems. *Agricultural Systems*, *155*, 88–102. https://doi.org/10.1016/j.agsy.2017.04.002

Funnell, S., & Rogers, P. (2011). *Purposeful program theory: Effective use of theories of change and logic models*. San Francisco, CA: Jossey-Bass.

Game, E. T., Meijaard, E., Sheil, D., & McDonald-Madden, E. (2014). Conservation in a wicked complex world; challenges and solutions. *Conservation Letters*, *7*(3), 271–277. https://doi.org/10.1111/conl.12050

Game, E. T., Schwartz, M. W., & Knight, A. T. (2015). Policy relevant conservation science. *Conservation Letters*, *8*(5), 309–311. https://doi.org/10.1111/conl.12207

Geldmann, J., Coad, L., Barnes, M. D., Craigie, I. D., Woodley, S., Balmford, A., … McRae, L. (2018). A global analysis of management capacity and ecological outcomes in terrestrial protected areas. *Conservation Letters*, *11*(3), e12434. https://doi.org/10.1111/conl.12434

Graham, H. S., Bode, M., McDonald-Madden, E., Game, E. T., Knight, A. T., & Possingham, H. P. (2010). Effective conservation planning requires learning and adaptation. *Frontiers in Ecology and the Environment*, *8*(8), 431–437. https://doi.org/10.1890/080151

Gurney, G. G., Cinner, J. E., Sartin, J., Pressey, R. L., Ban, N. C., Marshall, N. A., & Prabuning, D. (2016). Participation in devolved commons management: Multiscale socioeconomic factors related to individuals' participation in community-based management of marine protected areas in Indonesia. *Environmental Science & Policy*, *61*, 212–220. https://doi.org/10.1016/j.envsci.2016.04.015

Gurney, G. G., Darling, E. S., Jupiter, S. D., Mangubhai, S., McClanahan, T. R., Lestari, P., … Muthiga, N. A. (2019). Implementing a social-ecological systems framework for conservation monitoring: Lessons from a multi-country coral reef program. *Biological Conservation*, *240*, 1–9. https://doi.org/10.1016/j.biocon.2019.108298

Herzog, L. M., & Ingold, K. (2019). Threats to common-pool resources and the importance of forums: On the emergence of cooperation in CPR problem settings. *Policy Studies Journal*, *47*(1), 77–113. https://doi.org/10.1111/psj.12308

Hunter, D. E. K. (2006). Using a theory of change approach to build organizational strength, capacity and sustainability with not-for-profit organizations in the human services sector.

Evaluation and Program Planning, *29*(2), 193–200. https://doi.org/10.1016/j.evalprogplan.2005.10.003

Jones, K. R., Klein, C. J., Halpern, B. S., Venter, O., Grantham, H., Kuempel, C. D., ... Watson, J. E. M. (2018). The location and protection status of earth's diminishing marine wilderness. *Current Biology*, *28*(15), 2506–2512. https://doi.org/10.1016/j.cub.2018.06.010

Jones, K. R., Venter, O., Fuller, R. A., Allan, J. R., Maxwell, S. L., Negret, P. J., & Watson, J. E. M. (2018). One-third of global protected land is under intense human pressure. *Science*, *360* (6390), 788–791. https://doi.org/10.1126/science.aap9565

Kaplan-Hallam, M., & Bennett, N. J. (2018). Adaptive social impact management for conservation and environmental management. *Conservation Biology*, *32*(2), 304–314. https://doi.org/10.1111/cobi.12985

Koleros, A., & Mayne, J. (2019). Using actor-based theories of change to conduct robust contribution analysis in complex settings. *Canadian Journal of Program Evaluation*, *33*(3), 292–315. https://doi.org/10.3138/cjpe.52946

Koleros, A., Mulkerne, S., Oldenbeuving, M., & Stein, D. (2020). The actor-based change framework: A pragmatic approach to developing program theory for interventions in complex systems. *American Journal of Evaluation*, *41*(1), 34–53. https://doi.org/10.1177/1098214018786462

Larrosa, C., Carrasco, L. R., & Milner-Gulland, E. J. (2016). Unintended feedbacks: Challenges and opportunities for improving conservation effectiveness. *Conservation Letters*, *9*(5), 316–326. https://doi.org/10.1111/conl.12240

Maini, R., Mounier-Jack, S., & Borghi, J. (2018). How to and how not to develop a theory of change to evaluate a complex intervention: Reflections on an experience in the Democratic Republic of Congo. *British Medical Journal of Global Health*, *3*(1), e000617. https://doi.org/10.1136/bmjgh-2017-000617

Mayne, J. (2015). Useful theory of change models. *Canadian Journal of Program Evaluation*, *30*(2), 119–142. https://doi.org/10.3138/cjpe.230

Mayne, J. (2017a). Theory of change analysis: Building robust theories of change. *Canadian Journal of Program Evaluation*, *32*(2), 155–173. https://doi.org/10.3138/cjpe.31122

Mayne, J. (2017b). Building evaluative culture in community services: Caring for evidence. *Evaluation and Program Planning*, *80*, 101450. https://doi.org/10.1016/j.evalprogplan.2017.05.011

Mayne, J. (2020). Sustainability analysis of intervention benefits: A theory of change approach. *Canadian Journal of Program Evaluation*, e70004. https://doi.org/10.3138/cjpe.70004

Mayne, J., & Johnson, N. (2015). Using theories of change in the Agriculture for Nutrition and Health CGIAR research program. *Evaluation*, *21*(4), 407–428. https://doi.org/10.1177/1356389015605198

Michie, S., van Stralen, M. M., & West, R. (2011). The behaviour change wheel: A new method for characterising and designing behaviour change interventions. *Implementation Science*, *6*, 42. https://doi.org/10.1186/1748-5908-6-42

Nickols, K. J., White, J. W., Malone, D., Carr, M. H., Starr, R. M., Baskett, M. L., ... Botsford, L. W. (2019). Setting ecological expectations for adaptive management of marine protected areas. *Journal of Applied Ecology*, *56*(10), 2376–2385. https://doi.org/10.1111/1365-2664.13463

Ostrom, E. (1990). *Governing the commons: The evolution of institutions for collective action*. Cambridge, England: Cambridge University Press.

Pawson, R. (2013). *The science of evaluation: A realist manifesto*. Los Angeles, CA: Sage.

Pressey, R. L., Weeks, R., & Gurney, G. G. (2017). From displacement activities to evidence-informed decisions in conservation. *Biological Conservation*, *212*, 337–348. https://doi.org/10.1016/j.biocon.2017.06.009

Prinsen, G., & Nijhof, S. (2015). Between logframes and theory of change: Reviewing debates and a practical experience. *Development in Practice*, *25*(2), 234–246. https://doi.org/10.1080/09614524.2015.1003532

Rands, M. R., Adams, W. M., Bennun, L., Butchart, S. H., Clements, A., Coomes, D., ... Sutherland, W. J. (2010). Biodiversity conservation: Challenges beyond 2010. *Science*, *329*(5997), 1298–1303. https://doi.org/10.1126/science.1189138

RARE. (n.d.). Theory of Change for community-based conservation. Retrieved from https://www.europarc.org/wp-content/uploads/2015/05/2014-Theory-of-Change-Theory-of-Change.pdf

Redford, K. H., Hulvey, K. B., Williamson, M. A., & Schwartz, M. W. (2018). Assessment of the conservation measures partnership's effort to improve conservation outcomes through adaptive management. *Conservation Biology*, *32*, 926–937. https://doi.org/10.1111/cobi.13077

Reed, J., Barlow, J., Carmenta, R., van Vianen, J., & Sunderland, T. (2020). Engaging multiple stakeholders to reconcile climate, conservation and development objectives in tropical landscapes. *Biological Conservation*, *238*, 108229. https://doi.org/10.1016/j.biocon.2019.108229

Rogers, P. (2014a). *Theory of change, methodological briefs: Impact evaluation 2*. Florence, Italy: UNICEF Office of Research Retrieved from https://www.unicef-irc.org/publications/pdf/brief_2_theoryofchange_eng.pdf

Rogers, P. (2014b). *Overview of impact evaluation, methodological briefs: Impact evaluation 1*. Florence, Italy: UNICEF Office of Research Retrieved from https://www.unicef-irc.org/publications/pdf/brief_1_overview_eng.pdf.

Romero, C., & Putz, F. (2018). Theory-of-change development for the evaluation of forest stewardship council certification of sustained timber yields from natural forests in Indonesia. *Forests*, *9*(9), 547. https://doi.org/10.3390/f9090547

Sacre, E., Weeks, R., Bode, M., & Pressey, R. L. (2020). The relative conservation impact of strategies that prioritize biodiversity representation, threats, and protection costs. *Conservation Science and Practice*, *2*(8), e221. https://doi.org/10.1111/csp2.221

Salafsky, N., Margoluis, R., & Redford, K. H. (2008). Adaptive management: A tool for conservation practitioners. Retrieved from http://www.fosonline.org/resources/Publications/AdapManHTML/Adman_1.html

Sanders, M. J., Miller, L., Bhagwat, S. A., van der Grient, J. M. A., & Rogers, A. D. (2019). Practitioner insights as a means of setting a context for conservation. *Conservation Biology*, *34*(1), 113–124. https://doi.org/10.1111/cobi.13394

Sarkki, S., & Acosta García, N. (2019). Merging social equity and conservation goals in IPBES. *Conservation Biology*, *33*(5), 1214–1218. https://doi.org/10.1111/cobi.13297

Seixas, C. S., & Davy, B. (2008). Self-organization in integrated conservation and development initiatives. *International*

Journal of the Commons, *2*(1), 99–125. https://doi.org/10.18352/ijc.24

Sridharan, S., & Nakaima, A. (2019). Till time (and poor planning) do us part: Programs as dynamic systems—Incorporating planning of sustainability into theories of change. *Canadian Journal of Program Evaluation*, *33*(3). 375–394. https://doi.org/10.3138/cjpe.53055

Sullivan, H., & Stewart, M. (2006). Who owns the theory of change? *Evaluation*, *12*(0), 179–199. https://doi.org/10.1177/1356389006066971

Sutherland, W. J., Brotherton, P. N. M., Davies, Z. G., Ockendon, N., Pettorelli, N., & Vickery, J. A. (2020). *Conservation research, policy and practice*. Cambridge, England: Cambridge University Press. https://doi.org/10.1017/9781108638210

Tengö, M., Brondizio, E. S., Elmqvist, T., Malmer, P., & Spierenburg, M. (2014). Connecting diverse knowledge systems for enhanced ecosystem governance: The multiple evidence base approach. *Ambio*, *43*(5), 579–591. https://doi.org/10.1007/s13280-014-0501-3

Valters, C. (2015). *Theories of change: Time for a radical approach to learning in development*. London: Overseas Development Institute Retrieved from https://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/9835.pdf

van Es, M., Guijt, I., & Vogel, I. (2015). *Theory of change thinking in practice*. The Hague, The Netherlands: Hivos Retrieved from http://www.theoryofchange.nl/sites/default/files/resource/hivos_toc_guidelines_final_nov_2015.pdf

van Tulder, R., & Keen, N. (2018). Capturing collaborative challenges: Designing complexity-sensitive theories of change for cross-sector partnerships. *Journal of Business Ethics*, *150*(2), 315–332. https://doi.org/10.1007/s10551-018-3857-7

Vogel, I.. (2012a). Review of the use of "Theory of Change" in international development: Department for International Development (DFID). Retrieved from http://www.oxfamblogs.org/fp2p/wp-content/uploads/DFID-ToC-Review_VogelV4.pdf

Vogel, I.. (2012b). ESPA guide to working with Theory of Change for research projects. Retrieved from http://www.espa.ac.uk/files/espa/ESPA-Theory-of-Change-Manual-FINAL.pdf

Walton, M. (2016). Expert views on applying complexity theory in evaluation: Opportunities and barriers. *Evaluation*, *22*(4), 410–423. https://doi.org/10.1177/1356389016667890

Weiss, C. H. (1997). How can theory-based evaluation make greater headway? *Evaluation Review*, *21*(4), 501–524. https://doi.org/10.1177/0193841X9702100405

Wilson, R. S., Hardisty, D. J., Epanchin-Niell, R. S., Runge, M. C., Cottingham, K. L., Urban, D. L., ... Peters, D. P. C. (2016). A typology of time-scale mismatches and behavioral interventions to diagnose and solve conservation problems. *Conservation Biology*, *30*, 42–49. https://doi.org/10.1111/cobi.12632

SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

How to cite this article: Rice WS, Sowman MR, Bavinck M. Using Theory of Change to improve post-2020 conservation: A proposed framework and recommendations for use. *Conservation Science and Practice*. 2020;2:e301. https://doi.org/10.1111/csp2.301