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Perspectives

Designing virtuous socio-ecological cycles for biodiversity conservation

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ABSTRACT

Increasing the pace and scale of biodiversity conservation in a human-dominated world requires conservationists to effect systemic change in complex and dynamic socio-ecological systems. Recently, Morrison (2015) introduced a conceptual framework to help conservation planners design a theory of change, i.e., a hypothesis of how their intervention will lead to a desired future condition. Here, I elaborate on that heuristic, and provide guidance for developing its core components. The framework focuses attention on identifying the conditions needed to support biodiversity, and on establishing virtuous socio-ecological cycles between people and their environment that will generate those conditions. Planning a virtuous cycle requires specifying the people whose interaction with nature is needed to change, and what relevance the proposed conservation would have to them. The conservation intervention will largely focus on mobilizing those people to institutionalize policies or practices that mainstream, through self-reinforcing positive feedbacks, the delivery of that conservation outcome. The framework complements existing conservation planning tools and methods – such as biodiversity mapping, situation analysis – by providing context and focus for their application. The clarity of objective versus strategy, of ends versus means, provided by this framework can increase the effectiveness of conservationists, who routinely must estimate and compare the conservation return on investment of different potential interventions and negotiate tradeoffs between biodiversity protection and other societal values.

1. Introduction

Conservationists must dramatically increase their effectiveness to stem the tide of extinction on Earth (Urban, 2015). Doing so, however, in our increasingly complex, crowded, and resource constrained world is challenging, in part because biodiversity conservation is a societal value not always shared by others. Advocates for biodiversity must compete with those working to advance other agendas, some of which may be compatible with conservation, others not. Thus, a key strategy in many conservation efforts is to demonstrate how conservation can be aligned with other societal goals, so as to broaden the constituency for conservation, reduce tradeoffs, and create "win–wins" for people and nature (Chan et al., 2007). Some argue further that the protection of ecosystem services should actually be the primary objective of conservation, in contrast to protection of biodiversity per se (e.g., Kareiva et al., 2012). Unfortunately, however, protection of many ecosystem services can be accomplished without benefitting native species (Bullock et al., 2011). Given that people and nature are inextricably linked in socio-ecological systems, how should conservationists consider the relationship between social and ecological objectives when planning their work?

Morrison (2015) presented a heuristic framework for characterizing a socio-ecological system that conservation planners can use to develop strategies for conservation in a human-dominated world (Fig. 1). The framework represents key components of a conservation 'theory of change', i.e., an articulation of how an intervention is expected via causal relationships to lead to a desired future condition (Weiss, 1995). The framework also helps reconcile tensions between proponents of intrinsic versus utilitarian values of nature (see Hunter et al., 2014, and Section 2), because the components of the theory of change are the same regardless of what values motivate the conservation. The framework depicts biodiversity conservation as the ultimate objective, but does not require users to differentiate why; the rationale may be because of its intrinsic, instrumental, or precautionary, option value. Instead, the framework focuses users on exploring why conservation might be relevant to people who need to be mobilized to act in a way that supports nature, because, ultimately, conservation depends on social, economic, political, and cultural systems to sustain it. Here, I expand on the initial framework and provide guidance for designing its central feature, a virtuous socio-ecological cycle that produces benefits for biodiversity.

2. Assertions

Five assertions concerning the focus and role of conservationists underpin the framework. The first is that biodiversity has value and biodiversity conservation is an important societal value. Accordingly, the framework sets protection of biodiversity as the ultimate objective. The value may be based on known or potential ecosystem services that

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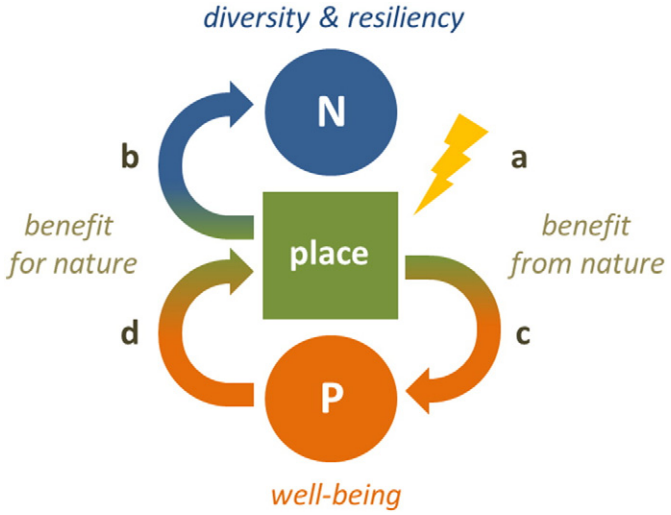

Fig. 1. A virtuous cycle framework for durable biodiversity conservation (*adapted from* Morrison, 2015). Key components of the heuristic include an intervention (a) aimed to improve the ability of a place (center box) to support biodiversity (N), represented by the link (b) between place and N. Improved conditions in place are also valued by specific people (P), represented by the link (c) from places to P. Those people are then mobilized to change policy or practices so as to improve places – represented by the link (d) between P and place – to create a virtuous cycle that sustains benefits to P and N through time.

biodiversity provides, or its inherent existence value based on moral or spiritual grounds (see Vucetich et al., 2015). To some, intrinsic values of nature are considered a human value and so a cultural service for the people who value it in that way (see Reyers et al., 2012). The framework does not require resolution of such debate. For those who do not consider biodiversity to have intrinsic value, the argument for nevertheless protecting the full suite of biodiversity is that it is unclear how one would determine which subset of diversity should *not* be protected, given that our understanding of the relationship of biodiversity to ecosystem services is often poorly understood (Díaz et al., 2006). Protecting only the species that happen to be currently valued by the public risks basing conservation decisions on ignorance or arrogance, and foreclosing opportunities for future generations to value nature differently. In other words, it is prudent to protect what has or someday may have value to humans.

The second assertion is that conservation cannot be contingent upon the general public valuing biodiversity, per se. Society has many competing priorities and even when there are relationships between those other priorities and biodiversity, they often are not generally appreciated (Novacek, 2008). Hopefully over time support for biodiversity conservation will increase, and conservationists should be striving to expand that constituency of support. In the meantime, it is today's conservationist who carries the mantle of valuing diversity, and being resourceful and creative in making sure its needs are accommodated. Fortunately, conservation often can advance by aligning with and leveraging the interests of others. Fishers, for example, do not need to care about the full diversity of marine life in order to support marine reserves; their interests may be more narrowly focused on whether those reserves improve their catch. Conservation depends on sufficient constituencies of people valuing enough of the elements of biodiversity and acting to protect them, and those protections aggregating to encompass the species that represent the full suite of biodiversity.

Third, conservation is a negotiated outcome, because it will preclude uses of resources other people may desire. Species have specific needs that must be accommodated if conservation is to succeed, and in most cases, that accommodation requires concessions from people. The negotiation to meet those needs, however, is not always adversarial. Conservation at times may be a consensus decision between parties — a "win–win" scenario. Indeed, because cooperative solutions may produce better and more durable conservation outcomes, conservation negotiation might best be a good faith effort to establish trust, understand the interests of others, and seek mutually beneficial solutions (e.g., Gleason et al., 2013). Creative solutions may emerge by engaging stakeholders not only in problem solving but also in the identification of the problems themselves (Scarlett, 2013). However, clarity of objective is critical in achieving such integrative outcomes, and conceding too early in the negotiation process may reduce the exploration of options and the likelihood of arriving at a "win–win" (Trötschel et al., 2011). The framework herein (Fig. 1) can provide a helpful construct for conservationists engaging in such negotiation: the ultimate objective is maximizing biodiversity conservation; the effort to identify and establish virtuous cycles is the arena of principled negotiation where alignment and tradeoffs with other societal values are evaluated, compromises are made, and optimized solutions are developed.

Fourth, conservationists – and more specifically, conservation organizations – have a distinct and essential role in the socio-ecological system: to represent the needs of nonhuman species. Other actors in the system usually well represent their own. As they do, some may advocate for particular elements of biodiversity (e.g., fishers for desired fish species, water users for upstream forest protection); conservationists might seize upon those synergies as potential partnerships. The unique role of conservationists, however, is to keep watch on the needs of the full suite of biodiversity, and motivate a sufficient segment of society to help meet them. This is not to say that conservationists should not strive to improve human well-being, where possible; the more people that can benefit from biodiversity protection, the better. Rather, it is to recognize that conservation priorities and strategies, and so biodiversity outcomes, would be different if human well-being were the ultimate outcome, or if biodiversity and human well-being were considered co-equal (Chan et al., 2006). Under the framework discussed here, when conservationists ally with stakeholders representing other interests and work in partnership to advance 'co-equal goals', those allied interests would be accounted for in the virtuous cycle component of the framework (see Section 3), as a means to advance toward the broader, ultimate objective of biodiversity conservation.

The fifth assertion is that given the interconnectedness of socio-ecological systems, conservationists must better account for the societal implications of conservation actions, especially as they affect disadvantaged populations. This is not to assert that conservationists should necessarily be responsible for mitigating all societal impacts of those actions; that would be a standard that few, if any, other advocates in the system are expected to meet. Rather, it is to acknowledge that understanding the linkages between people and their environment is critical for developing effective strategy. Conservation planners need to anticipate and address in their strategies how conservation can both positively and negatively affect people. Though the conservationist's role is to advocate for nature, accountability for understanding effects on humans is nonetheless paramount, whether based on ethical or wholly pragmatic grounds. Creating populations disenfranchised by conservation efforts can set back conservation over the long if not near term. In contrast, conservation that helps to solve problems for people can build much needed constituency and a more resilient socio-ecological system. Engaging stakeholders in conservation problem solving can help ensure that the myriad social dimensions of a conservation outcome are considered in the planning phase.

3. A virtuous cycle framework

The framework highlights relationships between people, places, and biodiversity that should be considered when planning a conservation intervention (Fig. 1).'Place' is central in the model because ultimately conservation actions must affect places to benefit biodiversity in situ. 'Place' may include not only wild areas but also very human-dominated habitats (e.g., urban areas, intensive agriculture) where conservationists might focus on enhancing their compatibility for priority species (Rosenzweig, 2003). Places provide (or, in the case of altered ecosystems,

could provide) habitat, or support (or could support) ecological processes that contribute to overall conservation goals; hence the link from place to biodiversity. Places also support processes or provide habitat for species that provide services or other benefits of interest to people; thus the linkage from place to people.

The framework depicts biodiversity conservation as the ultimate objective, and does not require diversity per se to feedback as a benefit for people (i.e., there is no link depicted from biodiversity to places or people in Fig. 1). As discussed earlier, this accommodates the interests of adherents of both intrinsic and instrumental values of nature, assuming precautionary principles apply (because even if some elements of biodiversity are not valued today they may be in the future). There are also practical reasons why this planning framework accounts for biodiversity as distinct from the values people derive from the biosphere. First is a recognition that meeting the needs of the full suite of biodiversity requires explicit focus in planning. Secondly, it removes the onus on conservationists to demonstrate the value of that full suite to people, which (for instrumental purpose) is often poorly understood (Díaz et al., 2006). Thirdly, and most importantly, the framework does not aim to account for general relationships in the socio-ecological system. Rather, it aims to identify *specific* elements of biodiversity (e.g., an ecosystem service) or the consequences of actions to conserve them (e.g., job creation, resolution of conflict) that are valued by the people who are integral to the theory of change (see Section 4). In the framework, those valued elements are accounted for as attributes of place. To illustrate, consider a region that supports a forest ecosystem. Although a variety of people interact with the forest biodiversity in myriad ways, involvement of a specific group of people – e.g., bushmeat hunters – may be needed to achieve a desired conservation outcome. In the framework, the value of bushmeat as a food or income source would be considered a flow from place to those people; actions of bushmeat hunters to help sustain the species they value would be accounted for in the link from people to place; and, the contribution of management of the bushmeat species to the conservation of the overall forest community would be accounted for in the link from place to 'nature'. The focus of the planning process is to identify the interests of specific people that can be leveraged to motivate action that will ensure that the place from which they derive value from conservation will continue to deliver that value.

The framework's foundational feature is a virtuous cycle between people and places. A self-reinforcing feedback is created when people act to affect places in a way that will secure the continued accrual of conservation-based benefits from place. The cycle is designed also to drive broader biodiversity outcomes, i.e., the link from place to 'nature'. Different aspects of conservation may be valued by different people; those distinct interests would be accounted for as separate links between place and those corresponding people. The more elements of the focal biodiversity that can be linked to specific people, the more can be incorporated directly into a virtuous cycle. And, in general, the more and the stronger the socio-ecological positive feedbacks, the reduced reliance of biodiversity on the continued direct input of resources by conservationists.

The conservation intervention usually aims to mobilize people to create the positive feedback from people to places. Mechanisms to secure that feedback include institutionalizing changes in policy or practices, such as by establishing conservation-compatible regulations, markets, or cultural norms. Incorporating protection of resources into economic sectors and development policies 'mainstreams' the conservation outcome (Cowling et al., 2008) and helps secures durable, systemic change. I illustrate with case studies (Figs. 3 and 4) that retrospectively apply the framework to theories of change in two quite different socio-ecological systems.

If individual virtuous cycles are insufficient to achieve the biodiversity conservation goals for a place, conservationists may need to establish multiple cycles that reinforce or complement one another, and that perhaps operate at multiple societal (e.g., jurisdictional) scales (e.g., Fig. 3). Moreover, because conservation is a negotiated outcome, some virtuous cycles may have quid pro quo dependencies with other cycles (e.g., Fig. 4). Multiple cycles, for example, may be required to secure a needed change in place: a theory of change to restore a forest might aim to influence an agency to reform its management policy; to achieve that influence, conservationists may need to mobilize two distinct groups of people, each valuing different aspects of the intended conservation outcome (e.g., those who would benefit from jobs in restoration forestry, and downstream water users that would benefit from improved water security). Alternatively, multiple cycles may be needed to secure different outcomes that are needed to advance the broader objective: a change in timber harvest practices may conserve some elements of forest biodiversity, but to conserve others a new protected area may be required; each strategy may require engaging different focal people.

The framework applies to designing theories of change at any scale, local to global — for specific places as well as for broad strategies that apply to multiple places or types of places. Moreover, the virtuous cycle established in one place may be a model that can be replicated elsewhere, which could amplify the impact of a given intervention (Morrison, 2015). For example, a planning team may engage a conservation issue in a particular place knowing that the issue also affects other places, and could build into their strategy a mechanism to transfer knowledge to others who might replicate a similar change in policy or practice. Indeed, the team may consider that broader context and opportunity from the onset, and select the place to engage the conservation issue based on the likelihood that a successful demonstration in that place would be influential in advancing a larger outcome. In this light, the places of engagement are not only important for delivering local conservation outcomes but also a component of a broader theory of change to drive systemic change.

4. Designing a theory of change

Below, I outline the core components of a conservation theory of change, introduced as framing questions (Fig. 2). In practice, the components need not be developed in the sequence presented here. Conservation planners will likely find it helpful to iterate through the different components as they draft and refine their theory of change. What is critical is that in the end, the three nodes and three links of the framework (Fig. 1) are articulated and as robust as possible. In using the

Fig. 2. Framing questions for planning a theory of change. Questions include: *Which* specific elements of biodiversity are the focus of the conservation engagement and what do they need?; *Where* are the places that need to be protected or enhanced to meet those needs?; *Who* are the people that need to be engaged to effect that change?; *Why* is the proposed conservation or the intervention relevant to them?; and, *What* are those people needed to do in order to change policy or practices to create a positive feedback, and that also would support the desired biodiversity *outcomes* through time? The planning team would then identify *how* conservationists should intervene in the socio-ecological system to activate the virtuous cycle(s) needed to produce the biodiversity outcome.

diagram, planners would be expressing their assumptions of relationships in the socio-ecological system that the conservation intervention will aim to affect. Being explicit about such assumptions, and the evidence they are based on, facilitates both the development and evaluation of strategy (Weiss, 1995). Given the complexity of socio-ecological systems, this conservation planning requires not just ecological sciences, but a variety of disciplines that may include economics, marketing, social and political sciences, as well as traditional knowledge. The *planning team* referred to henceforth should strive to comprise or involve the diversity of expertise needed to define the bounds and understand the attributes and dynamics of the socio-ecological system to be engaged.

4.1. Which biodiversity elements are the conservation focus and what do they need?

The framework calls on the planning team to decide which subset of biodiversity is the focus of the proposed conservation engagement. That subset will help to determine the boundaries of the socio-ecological system, which is represented by the whole of Fig. 1 (see Section 4.3). Protection of the full suite of biodiversity on Earth is the ultimate objective, and some conservation strategies (e.g., international trade policies) may seek to advance conservation at that scale, and therefore define the socio-ecological system as global. More often, however, a more local (e.g., a watershed) or system-specific subset of the whole (e.g., tropical forests, migratory birds) will be the conservation focus. Characterizing threats to that focal diversity and the drivers of those threats is necessary at this stage, because much of the theory of change will focus on influencing those drivers (Section 4.3). There are a variety of ways to define and map biodiversity, and assess its condition and threats to it, in order to prioritize conservation investments (Groves, 2003); users of the framework can select among those.

In a world dominated by human uses, it is important to consider not only current ranges of species, but also their potential ranges if restoration or other direct management could provide habitat features otherwise scarce. That consideration can lead to the identification of places that currently have diminished biodiversity but through restoration have potential to contribute better to overall conservation goals (Rosenzweig, 2003). In those degraded or more human-dominated places, the priority biodiversity elements may be those species reliant on having their habitat needs met in that particular place, in contrast perhaps to human commensal species or generalists that may be adequately protected by habitat elsewhere. For example, a priority conservation focus in intensively developed floodplain agricultural areas may be providing habitat for migratory birds (Stralberg et al., 2011).

Similarly, conservation teams need to determine how best to set local management goals in the context of global change. The impacts of climate change, human population growth, invasive species and other anthropogenic factors on species' ranges and status (Hobbs et al., 2013) challenge conservationists to assess how their individual efforts will combine with those of others to advance the ultimate objective of protection of biodiversity on Earth. For example, it may be appropriate for some teams to manage for historical assemblages of species whereas others may be needed to manage for conditions still only anticipated. And when considering climate change, it is essential to consider its impacts not only on nature but on the broader socio-ecological system, as human responses also will directly and indirectly affect biodiversity (Watson and Segan, 2013). Because this framework is focused on guiding conservation strategy development, its focus on climate resiliency is as an ecological outcome, with societal resiliency being an important – indeed, necessary – means to that end. Fortunately, conservation can play an important role in enhancing resiliency of the overall system (Jones et al., 2012); specific elements of biodiversity that do so (e.g., wetlands that protect coastal communities from storm surge) would be accounted for in the link from places to people.

In sum, analyses for this component of the framework would specify which elements of biodiversity are the priority of the conservation

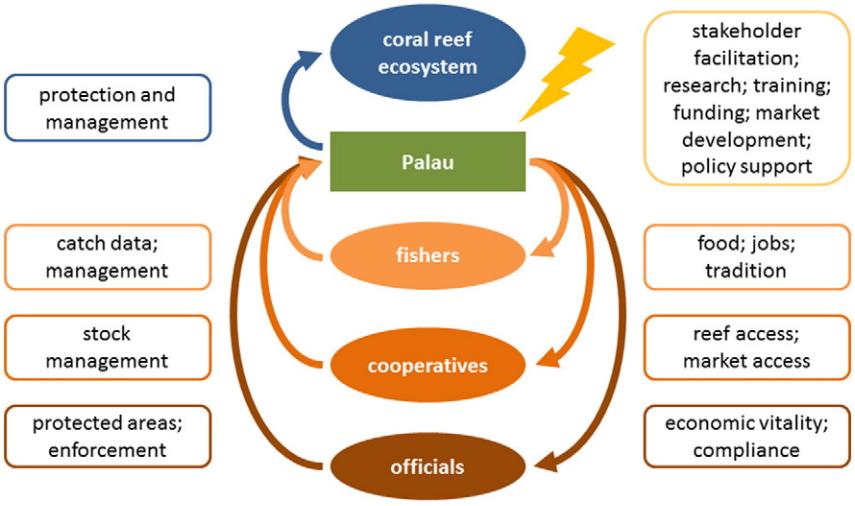

Fig. 3. A theory of change for restoring coral reef ecosystems in Palau using community-based fisheries management: a case study. Palau encompasses coral reef ecosystems of high biodiversity conservation value. Overfishing is among the major stressors threatening the reef. Declining fisheries also threaten food security, livelihoods, and culture. Sustainable management of fish stocks is hampered by open access, regulated at the national level; traditionally, fisheries management was instituted at village level through controlled rights-based access. Over recent years, conservation planners and scientists have engaged community leaders and fishers to collaboratively identify strategies to secure some desired socio-ecological outcomes (E. McCloud, The Nature Conservancy, pers. comm.). Their theory of change is that fisheries can recover and thereafter be managed sustainably by reinvigorating local, rights-based fishery principles, increasing knowledge on the status of fish stocks, providing incentives to improve management, and strengthening governance systems. Multiple virtuous cycles, operating at multiple societal scales, are required to secure the desired conservation outcome, and the framework can be used to capture the team's thinking and assumptions. The team assumed that fishers (*who*, in Fig. 2) who benefit economically and culturally from a healthy reef ecosystem (*why*) would in turn be willing to collect stock assessment data to inform management and – if suitable alternative livelihoods were available – temporarily reduce harvesting of stocks needing to recover (*what*). The team also assumed that fishers who participated in stock assessments would organize into fishing cooperatives (*who*), which could benefit from having greater control over fishing grounds/reef areas and the seafood supply (*why*), and could create incentives for sustainable management of the resource (*what*). Finally, local leaders and national officials would provide a supportive regulatory and policy environment (*what*) to help ensure economic vitality and the fulfillment of regional and international agreements (*why*), such as the Micronesia Challenge and the UN Convention on Biological Diversity. Potential interventions (*how*) by conservation organizations to actualize these virtuous cycles include facilitating the science and outreach related to stock assessments; providing training and subsidies for the development of alternative livelihoods; supporting the development of markets for sustainable seafood; and, supporting effective outreach, governance, and enforcement systems. Successful practices and policies in Palau could potentially serve as models elsewhere in the Pacific.

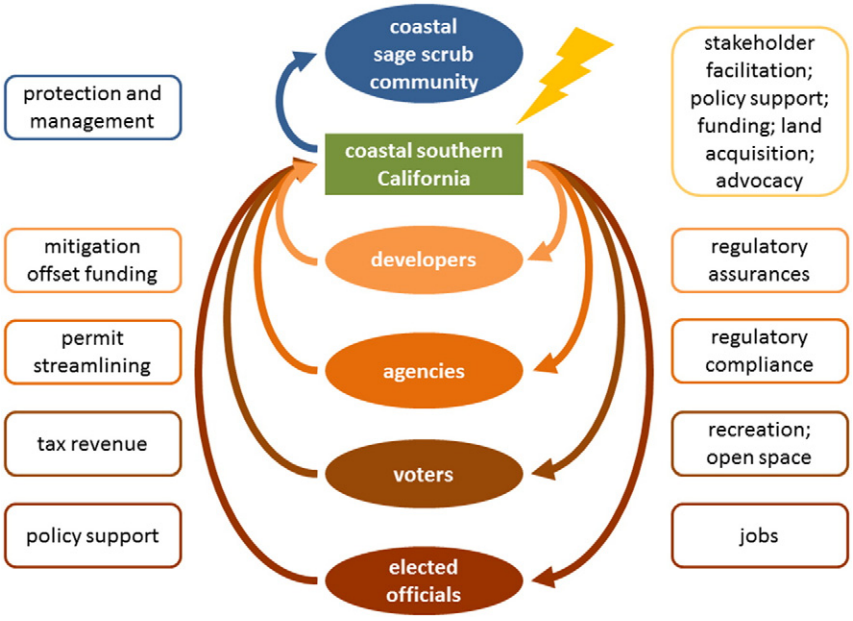

Fig. 4. A theory of change for establishing a protected area network in southern California, U.S.A. using regional conservation planning: a case study. Socio-ecological problems can create enabling conditions for developing innovative conservation solutions, such as policy that helps transform threats to biodiversity into drivers of conservation. For example, in the 1990s conflict between conservation and development in coastal southern California created an imminent socio-ecological "train wreck" (Atwood and Noss, 1994). High levels of species diversity and endemism were threatened by habitat loss and fragmentation due to residential housing development. An obstacle to establishing the needed network of protected areas was the high cost of undeveloped real estate. Meanwhile, the conflict between development and conservation resulted in potentially costly uncertainty in the development permitting process and potentially untenable political pressure on important environmental laws (e.g., the U.S. Endangered Species Act). An integrative, negotiated, "win–win" solution followed from the recognition that a science-based map of areas in the region most important for meeting biodiversity protection goals, coupled to regulatory, market-based and other implementing mechanisms that could steer development projects away from those places, and direct public, private, and mitigation offset conservation funding to them, would provide myriad benefits to key stakeholders. Multiple constituencies needed to be engaged and virtuous cycles established to execute this theory of change. Planners assumed that developers (*who*, in Fig. 2) would embrace a plan that facilitated their compliance with environmental laws and reduced regulatory uncertainty in the permitting process (*why*), and in exchange, they would contribute to an offset scheme to mitigate environmental impacts by protecting priority habitats (*what*). For land use permitting agencies (*who*), such a plan would improve attainment of mandates of environmental protections (*why*); in exchange they could offer a more streamlined, 'no surprises' permitting process and co-investment in habitat protection (*what*). (Note the quid pro quo, dependent complementarity of the two previous virtuous cycles.) For area residents and business leaders (*who*), it was assumed the resulting protected areas would provide co-benefits (e.g., outdoor recreation, watershed protection) that enhance quality of life in the region (*why*), so they in turn would support tax measures (*what*) to fund implementation of the reserve network. Finally, elected officials (*who*) would see economic and other measures of success (*why*), and so prioritize public funding for the program and support enabling policy (*what*). Conservation organizations could intervene to advance this theory of change (*how*) by: supporting the development of needed local, state, and federal policy; quantifying and promoting co-benefits of conservation to focal people; sponsoring public funding campaigns to support implementation of the plan; and, acquiring key parcels. Indicators of a successful *outcome* would be protection of important habitats areas, viability of focal species, and reliable funding to support conservation management. A local success could serve as a model of improved performance of endangered species regulations, which through replication could increase the conservation return on investment beyond just southern California.

engagement and what that biodiversity needs in order to persist. In other words, in this step the planning team defines the problem for nature that needs to be solved.

4.2. Where does biodiversity need to be protected or the conditions for it enhanced?

Based on maps of where biodiversity is or could be (assuming restoration or climate adaptation), the planning team selects the place or types of places to address the problem facing nature. Depending on the likely intervention – which may be determined, for example, by the preferred strategies of the conservation organization – the focus may be a particular place, or a type of place (e.g., a community-based strategy may prioritize a specific landscape whereas a policy strategy might be aimed at a particular type of land use.)

When identifying places to advance conservation, planners may prioritize places that offer the greatest potential direct conservation return on investment (e.g., Myers et al., 2000). However, biological considerations are only some of the inputs needed to make a strategic decision; factors such as partners, funding, and opportunity are also important (Knight et al., 2010). An additional consideration in the selection of places may be whether action in a particular place could help advance a broader theory of change. There may be places to engage an issue that may not be the highest priority places for biodiversity in their own right, but could be strategic priorities if they provide an opportunity to influence key actors, such as an agency or a transnational corporation. Perhaps by working in those places, and by creating models of policy or practice that can be replicated elsewhere, the conservation impact could extend well beyond those places (Morrison, 2015). In this scenario, the selection of place may best be informed by *who* (Section 4.3) is needed to be engaged in order to have the broader impact on conservation. For example, if the strategy is to change the policy or practices of a governmental agency's flood management practices, it might be most strategic to work in a watershed where there is an opportunity to engage the agency on one of its current projects, even if that is not the most important watershed from a biodiversity perspective. In such cases, however, it is incumbent on the planning team to design a credible theory of change articulating how engagement in the place with less direct biodiversity conservation value will ultimately advance broader conservation goals. In sum, analyses for this component of the framework would elucidate where conservation needs to occur and what needs to happen there to achieve the biodiversity outcome, and that may include leveraged as well as local outcomes.

4.3. Who needs to be engaged?

Conservation is fundamentally an effort to change the way humans interact with nature (Schultz, 2011), so the framework focuses on identifying people whose behavior is needed to change or whose action is required to drive needed change, as well as people who may be affected – positively and negatively – by the proposed conservation. These are not people in the abstract, but specific individuals, groups,

or entities that directly or indirectly drive socio-economic dynamics that affect the ability of places to sustain the focal biodiversity. They, in concert with the biodiversity, comprise the socio-ecological system that will be engaged through the intervention (i.e., Fig. 1). People may range from those who benefit from the provisioning of ecosystem services from a place, to those who will not be supportive of the proposed conservation. People that would be disadvantaged by conservation may become a focal population in the overall strategy, in part because it might be necessary to address their needs in order to create the virtuous cycle and conservation outcome. A key role for conservationists may be to illuminate the connections of conservation issues to people who may not even be aware they are stakeholders in the issue. For example, an explicit consideration of potential climate change impacts may reveal populations that could or should be engaged, e.g., people or livelihoods that may be displaced by climate impacts, or people who may benefit from nature-based solutions to problems related to climate change.

Generally, the more people that are engaged and supportive, the more durable the conservation outcome. To hone a more precise intervention, however, it is important to identify people who *must* be engaged versus those who would be nice to have engaged, lest limited conservation resources be diffused. Although it may be desirable to have broad community support for conservation, the entities that control the prospects for conservation may be a much smaller group. A variety of methods (e.g., situation analysis; Margoluis and Salafsky, 1998) can help teams conduct the analysis for this component of the framework, aimed at identifying interested and affected people in the system, and the problems for people for which nature conservation could offer a solution, or which need to be solved in order to address the problem facing nature.

4.4. Why should they engage?

Planning a theory of change requires identifying benefits from conservation that could flow to the people needed to create a conservation outcome and that could motivate them to act. Depicted as the linkage between place and people, this component of the framework seeks to identify what interests of the focal people align with conservation. Why should members of a local community or an industry or a politician support a conservation effort? What is the value proposition, or the business case for conservation? “What's in it for them?” Perhaps they could benefit from an ecosystem service, or a branding opportunity to distinguish their products as wildlife friendly. Perhaps they, as consumers, want to know their purchases are conservation compatible. Note that the benefit or interest may not be nature per se: for example, a transportation agency may support building wildlife crossing structures not because they reduce habitat fragmentation but because they reduce wildlife–vehicle collisions and so improve driver safety. The outcome of this component of the framework is a clear understanding of why the conservation action or outcome should be relevant to the people needed to act. Methods for elucidating this linkage include mapping of ecosystem services and beneficiaries (Bagstad et al., 2014), value chain analysis (Scherr and McNeely, 2008), and engaging affected people in problem solving (Scarlett, 2013).

4.5. What are they needed to do?

It is not enough to deliver benefits of conservation to people and for people to understand the relevance of conservation to their well-being: they are needed to act. This component of the theory of change – the feedback from people to places – is focused on identifying ways the focal people are needed to help change practices or policy in order to ensure that places sustain both what is relevant to them and the connected biodiversity outcomes. The aim is to create a virtuous cycle that will be the engine for continued accrual of the benefits to both people and nature, by mainstreaming conservation so it becomes a part of and product of business as usual. The means by which this feedback is created include policy reform, improved corporate practices, creation of market-based incentives such as product certification programs, and adaptation of cultural norms. The focus on the need for creating or reinforcing this linkage is perhaps the most important component of this framework. Underinvesting in it can make conservation gains more difficult to attain, and render any gains attained vulnerable over the longer term. With it, conservationists can advance systemic change. Policy and market analyses are tools that can help planners identify mechanisms for institutionalizing this feedback to place (Miteva et al., 2012; Bryan, 2013).

4.6. What outcomes for nature are expected?

Places must contribute to meeting the ultimate objective of biodiversity conservation for the theory of change to be complete. In the framework, *outcome* is depicted as a process – a linkage from place to nature – rather than an end state (Fig. 2), because conservation is never “done”. The aim is to establish socio-ecological conditions that enable biodiversity to persist. It would be insufficient, for example, to develop a theory of change that resulted in the creation of a protected area, but did not include mechanisms to sustain its conservation value over time (such as a virtuous cycle that would generate funding for ongoing management). Analyses for this component of the framework include identification of indicators for assessing effectiveness of the strategy in delivering the desired outcomes (e.g., Margoluis et al., 2009).

4.7. How should conservationists engage the system?

Having identified the focal people and what they are needed to do, the planning team needs to identify what interventions will motivate them to do it. Interventions will likely consist of multiple strategies and phases. Although probably most interventions will focus on engaging people (e.g., organizing coalitions, supporting legislation) the framework illustrates the intervention as a lightning bolt touching down in place (Fig. 1) because conservation strategies ultimately need to affect places to benefit wild nature.

In planning an intervention, it may be helpful for teams to identify obstacles to the functioning of the virtuous cycle needing to be established or fortified, and to develop plans to overcome those obstacles. Some barriers may be material, e.g., a lack of funding, effective regulation, or knowledge about how to manage an ecosystem to meet socio-ecological goals. Other obstacles will be more social, posed by the actions or inactions of focal people. For example, a potentially influential group of people might benefit from the proposed conservation but they are generally unaware of the extent they are stakeholders; the intervention may therefore aim to develop evidence of that benefit, and to communicate it to the group so they become part of a coalition empowered with information to advance needed change. Other focal people may have interests opposed to the proposed conservation, so the planning team may need to develop specific strategies to address their concerns or provide alternate pathways for conservation to proceed. For example, if there was political pressure on an elected official to repeal important environmental regulation, conservationists may need to mobilize a separate constituency – one that also would be influential with that official – in support of the regulation; in this case, both the needed constituency and the official would likely be included as focal people in the theory of change, and the planning team would focus on how to establish the corresponding affirmative feedbacks.

Critical for mobilizing focal people to change policy or practice is an understanding of their motivations and constraints, and what would be persuasive to them. Motivations run the gamut: a desire, perhaps, to preserve traditional livelihoods, or enhance social license to operate, or avoid lawsuits, or protect a sacred landscape, or stay elected. Based on an understanding of interests of focal people, strategic communications

plans and (formal or informal) advocacy campaigns can be designed to build momentum toward the needed social change (e.g., Figs. 3 and 4). A variety of tools and disciplines can help planning teams develop the strategy and tactics of an intervention, e.g., results chains (Margoluis et al., 2009), behavioral economics (e.g., Martín-López et al., 2007) and social marketing (e.g., Jenks et al., 2010).

In their planning, teams also should identify barriers to scaling up the impact of their engagement, because some interventions can be designed to advance conservation at multiple scales. For example, a conservation engagement may be focused on improving farming practices in order to restore a degraded watershed; by concurrently engaging agencies or organizations that have broader interests and influence, conservationists may be able to bridge the local strategy and outcome to broader efforts and impacts. One model of designing interventions for leverage is to consider the place-based engagement to be a demonstration of a solution to a problem that likely affects people and nature elsewhere. In such cases, knowledge transfer and strategic partnerships can foster the replication of that solution by other actors, amplifying the conservation impact (Morrison, 2015). Alternatively, a strategy may be to create – e.g., through policy or market-based approaches – broad-scale enabling conditions, with a connected strategy to facilitate uptake by local actors. The framework encourages the planning team to be deliberate in ensuring such leverage is developed and exercised.

5. Operationalizing the framework

As planning teams develop their theory of change, they will likely find it helpful to iterate through the different components of the heuristic, rather than proceed through them in linear order. For example, while planning (or, adaptively implementing) an intervention, a planning team may refine their idea for how to influence a desired change in policy, and that may spur a reassessment of who to include among their focal people. Indeed, the framework has multiple entry points. Some planning teams might look first at potential institutional mechanisms – market-based tools like product certification, or an opportunity to advance a policy initiative – which would be represented in the feedback from people to place; teams would then explore how to use that approach to create or augment the other linkages in the framework. Likewise, they may look first at potential ecosystems services and the beneficiaries of them (i.e., the link from place to people) and then evaluate how strategies aimed at bolstering the provisioning of those services could also improve habitat for priority species. The framework also can be useful for planning projects that have human well-being, versus biodiversity conservation, as their primary objective. Projects by entities ranging from development agencies to corporations to agricultural extension programs that are aimed at advancing development goals, promoting green economies, or implementing sustainability plans could serve as a basis for a virtuous cycle; such efforts should be examined for their potential to also deliver biodiversity conservation co-benefits. Regardless of where in the framework the planning team initiates the analysis, however, the complete theory of change requires a clearly articulated biodiversity return, and a durable virtuous cycle that maintains that return.

Many tools now standard in systematic conservation planning (see *Open Standards*; http://cmp-openstandards.org/) can provide the analytical and science inputs needed for the different components of the framework (Fig. 2). The framework, in turn, provides context for their application that teams may find helpful for focusing their planning effort. Most general conservation planning heuristics are oriented to project management, offering variations of the adaptive management process (e.g., set goals, develop strategies, take action, measure results) or tactical diagrams of pathways to achieve a desired future condition (e.g., logic models linking inputs and actions to outputs and outcomes). If the core components of a theory of change as described herein are developed when implementing those frameworks, that information is not consolidated let alone prominent. In contrast, this framework aims to help teams characterize socio-ecological systems in a succinct, intuitive, and integrative construct, so they can efficiently isolate the essential components of their strategy to effect systemic change.

The framework's clear focus on biodiversity conservation as the ultimate objective is especially important considering that most, if not all, conservation outcomes involve tradeoffs between other societal values (McShane et al., 2011). Clarity about means and ends, between objectives and strategies, is essential as conservationists navigate such negotiations. The allocation of scarce conservation resources must be based on the relative conservation return on investment of different strategies (Wilson et al., 2007). Especially as conservationists necessarily experiment with nontraditional approaches to conservation (Kareiva et al., 2012), and focus on places with less current and potential biodiversity conservation value (e.g., urban areas; Parker, 2015), they must defend the logic of and supporting evidence for those investments vis-à-vis how they will contribute to broader biodiversity conservation goals. It may well be that focusing on such strategies and places – even those with relatively marginal direct biodiversity benefit – is an imperative for conservation success over the long term. The framework can help teams articulate that theory of change, and facilitate critical review as to whether it does indeed represent the highest and best use of today's limited funds. To that end, the framework would benefit from systematic methods to quantify the strength and sufficiency of its feedbacks, as that would improve estimation of the durability of the outcomes from a proposed intervention, and support objective comparison of the tradeoffs and opportunity costs inherent in conservation.

How one plans a strategy need not be how one markets it. Indeed, the framework – being foremost a planning tool – may not be the most effective communications tool to engage general audiences about the importance of biodiversity or conservation. However, the framework probably would facilitate communication with one key population perhaps most conservation theories of change rely on: the conservation donor. Potential investors would likely appreciate a clearly diagrammed theory of change. By applying the framework, planning teams would be developing and illustrating a hypothesis for engaging the socio-ecological system that – hopefully – will be seen as credible, compelling, and relevant to those seeking to have conservation impact through their giving. Especially appealing might be the assumption of virtuous cycles that over time may reduce the dependence of biodiversity on ongoing direct investment by conservation philanthropists. In this application, the conservation donor would effectively fuel the lightning bolt of Fig. 1.

6. Concluding remarks

As conservationists have come to a fuller understanding of the scale and complexity of the socio-ecological system they need to engage (Liu et al., 2007), conservation planning has become ever more sophisticated and rigorous (Groves and Game, 2015). Amid that complexity, it is often difficult to elucidate the key constituents and relationships in the system that must be engaged to advance a conservation outcome. This framework transcribes the socio-ecological system into a simple depiction of the core components of a conservation theory of change, one based on the need to mobilize people to change policies and practices that affect the ability of places to sustain biodiversity. Those core components are the same whether the aim is to restore an artisanal fishery or to launch a global protected area campaign (e.g., Locke, 2014).

People protect what they value. But, as this framework highlights, people valuing biodiversity need not be a prerequisite to achieving needed conservation outcomes. Conservation can be an important means to address pressing challenges for people (WHO, 2005). And many efforts to improve human well-being offer tremendous potential synergies with biodiversity protection. Conservationists need to be driven to find such opportunities, and bridge the real and perceived disconnects between people and nature in the socio-ecological system.

Closing those loops requires demonstrating and translating the relevance of conservation into terms that matter to the people needing to act, and being as creative in negotiation as one is focused on objective.

It is imperative that those whom society assumes and relies on to be most vigilant and vocal for the needs of biodiversity – conservation organizations – retain that as their overarching purpose. If they are not effective in that role, we risk protecting only the biodiversity that is the arbitrary bycatch of resource management designed to provide direct benefit to people. The more effective they are, the more likely future generations will accrue the incalculable benefits of a diverse world. Using this framework, conservationists can better perform their indispensable role of challenging society to ensure the plants and animals that represent the diversity of life on Earth persist – and demonstrating to society how together we can rise to that challenge.

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References

Atwood, J.L., Noss, R.F., 1994. Gnatcatchers and development: a “train wreck” avoided? Illahee 10 (2), 123–130.
Bagstad, K.J., Villa, F., Batker, D., Harrison-Cox, J., Voigt, B., Johnson, G.W., 2014. From theoretical to actual ecosystem services: mapping beneficiaries and spatial flows in ecosystem service assessments. Ecol. Soc. 19 (2), 64.
Bryan, B.A., 2013. Incentives, land use, and ecosystem services: synthesizing complex linkages. Environ. Sci. Pol. 27, 124–134.
Bullock, J.M., Aronson, J., Newton, A.C., Pywell, R.F., Rey-Benayas, J.M., 2011. Restoration of ecosystem services and biodiversity: conflicts and opportunities. Trends Ecol. Evol. 26 (10), 541–549.
Chan, K.M.A., Pringle, R.M., Ranganathan, J., Boggs, C.L., Chan, Y.L., et al., 2007. When agendas collide: human welfare and biological conservation. Conserv. Biol. 21 (1), 59–68.
Chan, K.M.A., Shaw, M.R., Cameron, D.R., Underwood, E.C., Daily, G.C., 2006. Conservation planning for ecosystem services. PLoS Biol. 4. http://dx.doi.org/10.1371/journal.pbio.0040379.
Cowling, R.M., Egoh, B., Knight, A.T., O'Farrell, P.J., Reyers, B., et al., 2008. An operational model for mainstreaming ecosystem services for implementation. Proc. Natl. Acad. Sci. 105 (28), 9483–9488.
Díaz, S., Fargione, J., Chapin III, F.S., Tilman, D., 2006. Biodiversity loss threatens human well-being. PLoS Biol. 4 (8), e277. http://dx.doi.org/10.1371/journal.pbio.0040277.
Gleason, M., Fox, E., Ashcraft, S., Vasques, J., Whiteman, E., et al., 2013. Designing a network of marine protected areas in California: achievements, costs, lessons learned, and challenges ahead. Ocean Coast. Manag. 74, 90–101.
Groves, C.R., Game, E.T., 2015. Conservation Planning: Informed Decisions for a Healthier Planet. Roberts and Company Publishers, Greenwood Village, Colorado.
Groves, C.R., 2003. Drafting a Conservation Blueprint: A Practitioner's Guide to Planning for Biodiversity. Island Press, Washington, DC.
Hobbs, R.J., Higgs, E.S., Hall, C.M. (Eds.), 2013. Novel Ecosystems: Intervening in the New Ecological World Order. John Wiley & Sons, Chichester, UK.
Hunter, M.L., Redford, K.H., Lindenmayer, D.B., 2014. The complementary niches of anthropocentric and biocentric conservationists. Conserv. Biol. 28 (3), 641–645.
Jenks, B., Vaughan, P.W., Butler, P.J., 2010. The evolution of Rare Pride: using evaluation to drive adaptive management in a biodiversity conservation organization. Eval. Program Plan. 33 (2), 186–190.
Jones, H.P., Hole, D.G., Zavaleta, E.S., 2012. Harnessing nature to help people adapt to climate change. Nat. Clim. Chang. 2 (7), 504–509.
Kareiva, P., Marvier, M., Lalasz, R., 2012. Conservation in the Anthropocene: beyond solitude and fragility. Breakthrough J. 2 (http://thebreakthrough.org/index.php/journal/past-issue/issue-2/conservation-in-the-anthropocene).
Knight, A.T., Cowling, R.M., Difford, M., Campbell, B.M., 2010. Mapping human and social dimensions of conservation opportunity for the scheduling of conservation action on private land. Conserv. Biol. 24 (5), 1348–1358.
Liu, J., Dietz, T., Carpenter, S.R., Alberti, M., Folke, C., et al., 2007. Complexity of coupled human and natural systems. Science 317 (5844), 1513–1516.
Locke, H., 2014. Nature needs half: a necessary and hopeful new agenda for protected areas in North America and around the world. George Wright Forum 31 (3), 359–371.
Margoluis, R., Salafsky, N., 1998. Measures of Success: Designing, Managing, and Monitoring Conservation and Development Projects. Island Press, Washington DC.
Margoluis, R., Stem, C., Salafsky, N., Brown, M., 2009. Using conceptual models as a planning and evaluation tool in conservation. Eval. Program Plan. 32 (2), 138–147.
Martín-López, B., Montes, C., Benayas, J., 2007. The non-economic motives behind the willingness to pay for biodiversity conservation. Biol. Conserv. 139 (1), 67–82.
McShane, T.O., Hirsch, P.D., Trung, T.C., Songorwa, A.N., Kinzig, A., et al., 2011. Hard choices: making trade-offs between biodiversity conservation and human well-being. Biol. Conserv. 144 (3), 966–972.
Miteva, D.A., Pattanayak, S.K., Ferraro, P.J., 2012. Evaluation of biodiversity policy instruments: what works and what doesn't? Oxf. Rev. Econ. Policy 28 (1), 69–92.
Morrison, S.A., 2015. A framework for conservation in a human-dominated world. Conserv. Biol. 29 (3), 960–964.
Myers, N., Mittermeier, R.A., Mittermeier, C.G., da Fonseca, G.A.B., Kent, J., 2000. Biodiversity hotspots for conservation priorities. Nature 403 (6772), 853–858.
Novacek, M.J., 2008. Engaging the public in biodiversity issues. Proceedings of the National Academy of Sciences. 105 (S1), 11571–11578.
Parker, S.S., 2015. Incorporating critical elements of city distinctiveness into urban biodiversity conservation. Biodivers. Conserv. 24 (3), 683–700.
Reyers, B., Polasky, S., Tallis, H., Mooney, H.A., Larigauderie, A., 2012. Finding common ground for biodiversity and ecosystem services. Bioscience 62 (5), 503–507.
Rosenzweig, M.L., 2003. Win–win Ecology: How the Earth's Species Can Survive in the Midst of Human Enterprise. Oxford University Press.
Scarlett, L., 2013. Collaborative adaptive management: challenges and opportunities. Ecol. Soc. 18 (3), 26.
Scherr, S.J., McNeely, J.A., 2008. Biodiversity conservation and agricultural sustainability: towards a new paradigm of ‘ecoagriculture’ landscapes. Philos. Trans. R. Soc. B Biol. Sci. 363 (1491), 477–494.
Schultz, P.W., 2011. Conservation means behavior. Conserv. Biol. 25 (6), 1080–1083.
Stralberg, D., Cameron, D.R., Reynolds, M.D., Hickey, C.M., Klausmeyer, K., et al., 2011. Identifying habitat conservation priorities and gaps for migratory shorebirds and waterfowl in California. Biodivers. Conserv. 20 (1), 19–40.
Trötschel, R., Hüffmeier, J., Loschelder, D.D., Schwartz, K., Gollwitzer, P.M., 2011. Perspective taking as a means to overcome motivational barriers in negotiations: when putting oneself into the opponent's shoes helps to walk toward agreements. J. Pers. Soc. Psychol. 101 (4), 771–790.
Urban, M.C., 2015. Accelerating extinction risk from climate change. Science 348 (6234), 571–573.
Vucetich, J.A., Bruskotter, J.T., Nelson, M.P., 2015. Evaluating whether nature's intrinsic value is an axiom of or anathema to conservation. Conserv. Biol. 29 (2), 321–332.
Watson, J.E.M., Segan, D.B., 2013. Accommodating the human response for realistic adaptation planning: response to Gillson et al. Trends Ecol. Evol. 28 (10), 573–574.
Weiss, C., 1995. Nothing as practical as good theory: exploring theory-based evaluation for comprehensive community initiatives for children and families. In: Connell, J.P., et al. (Eds.), New Approaches to Evaluating Community Initiatives. The Aspen Institute, Washington, D.C., pp. 65–92.
WHO [World Health Organization], 2005. Ecosystems and Human Well-Being vol. 5. Island Press, Washington, DC.
Wilson, K.A., Underwood, E.C., Morrison, S.A., Klausmeyer, K.R., Murdoch, W.W., et al., 2007. Conserving biodiversity efficiently: what to do, where, and when. PLoS Biol. 5 (9), e223.

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