Research

A biocultural approach to navigating conservation trade-offs through participatory methods

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ABSTRACT. The desire to simultaneously address the well-being of local people while also mitigating the destruction of ecosystems resulted in a variety of win-win approaches, including popular models such as community-based conservation and integrated conservation and development projects. More than 25 years of international conservation experience show that win-win outcomes are decidedly mixed; there is a need to shift to a trade-off narrative to make these approaches more effective and sustainable. In this article we consider how a biocultural approach could provide relevant information to better understand and navigate trade-offs in protected area planning and management processes. Using these central tenets, this research uses participatory mapping methods to identify and document communities' physical and cultural landscapes and how they are connected. We then utilize community visioning facilitation to create a shared vision of participatory forest management. The results indicate that this approach can identify geographic boundaries and spatial biocultural resource-use patterns, uncover those resources' cultural relevance, and cultivate a foundation for more meaningful participation for communities in the protected area planning and management processes.

Key Words: *biocultural approach; conservation; participatory forest management; participatory mapping; protected areas*

INTRODUCTION

Much of the world's biodiversity coexists with communities dependent on those natural resources for their livelihoods (Sunderlin et al. 2005, Raven et al. 2020). This reality clashes often with the early protectionist paradigm of biodiversity conservation, which promoted protected areas (PA) with minimal human presence as the ideal to safeguard biodiversity adequately (Brockington et al. 2008, Niedziałkowski et al. 2012). The paradigm endured sharp criticism for unethical practices after mounting literature was published deploring human rights violations, such as the relocation or forcible eviction of local peoples in the name of conservation (Mulder and Coppolillo 2005). This tension fueled a movement in the 1980s to decentralize PA management and shift international policy and practice to more participatory, human-centered approaches (Brockington et al. 2008). The most notable shift came with the 1987 Brundtland Report from the World Commission of Environment and Development, which suggested that new approaches to conservation were needed to replace the traditional park-centered approach (Miller et al. 2011). Popular models followed, such as community-based conservation (CBC), integrated conservation and development projects (ICDPs), and more recently, payments for ecosystem services (PES), which aim to address the well-being of local people while simultaneously mitigating the loss of biodiversity.

Christensen (2004, as cited in Muradian et al. 2013:275) points out that human-centered models rose in popularity primarily because they offered something for everyone: "They promised to defuse the major threats to biodiversity, create better opportunities for people to earn a decent living and gain access to basic services, and equitably address the rights and interests of everyone who uses land and resources in and around protected areas." Therefore, these approaches offered the promise of win-win solutions. Although that promise was appealing, decades of international conservation experience since indicate that positive win-win outcomes are often the exception, not the rule (Wells and

McShane 2004, Sunderland et al. 2007, Brooks 2017). Some conservationists advocate for stricter protections and argue that the integration of human well-being has compromised the rigor needed for biodiversity conservation (Terborgh 1999, Sanderson and Redford 2003). Conversely, human well-being initiatives have been criticized for not being extensive enough, arriving quickly enough, providing adequate income-generating activities, and failing to distribute benefits effectively (Ferraro 2001, Sayer and Campbell 2003). Even one of the more successful projects, the 1990s Ranomafana National Park Project in Madagascar, has been criticized for failing to provide sufficient tourism revenue and social services to reach local people (Miller et al. 2011).

These criticisms highlight one of the win-win premise's primary weaknesses, which is implying that everyone will win instead of acknowledging that people will be impacted unequally by conservation interventions over time (Biggs et al. 2015, Chaigneau and Brown 2016). The win-win discourse can fuel a cycle of optimism and disappointment for local communities when supposed panaceas fail repeatedly to deliver promised outcomes, such as increased employment or financial opportunities (Hirsch et al. 2011). The trust and support necessary to achieve conservation objectives can erode over time, affecting attitudes and compliance negatively, which can be difficult to reverse (Chuenpagdee et al. 2013). These pitfalls have prompted the need to incorporate a trade-off narrative to participatory approaches to enhance the efficiency and sustainability (McShane et al. 2011, Galafassi et al. 2017).

Foundationally, the trade-off narrative asserts that when some things are gained, others are lost (McShane et al. 2011). Hirsch et al. (2011) note that acknowledging losses and gains can invite dialog, creativity, and learning, allowing more comprehensive planning and reducing the likelihood of disappointment and disillusionment in the process. Furthermore, identifying trade-offs can highlight conflicting views and interests, facilitating useful deliberation and intentional negotiation (Hirsch et al.

2011). However, not all trade-offs are equal; they vary based on spatial and temporal scale, and what services, interests, or values are traded off (Daw et al. 2015). All communities have what they consider to be protected norms and values, e.g., tradition, honor, or justice, that they may or may not be willing to trade for more secular values, such as money (Tetlock 2003). For example, Bedelian and Ogutu (2017) explored the opportunities and conflicts that emerged for pastoral landowners who were part of wildlife conservancies in Mara, Kenya. Results show that community members recognized certain benefits of conservancy partnership, such as a year-round source of income through regular payments, mitigating stress for cash needs. However, conservancies did not adequately compensate landowners and reduced access to resources and their ability to remain mobile (Bedelian and Ogutu 2017). The restrictions created trade-offs for their livestock-based livelihoods. Furthermore, conservancy payments are limited to those owning land inside a conservancy, excluding women and other marginalized groups (Bedelian and Ogutu 2017).

Analytical approaches, like cost-benefit analyses or quantifying ecosystem services, are used widely and often to deal with trade-offs (Galafassi et al. 2017). Reducing trade-offs to the quantifiable costs and benefits of conservation initiatives can obscure the communities' values and interests, which are challenging to quantify and therefore difficult to compare in socially meaningful ways. Trade-offs analysis can fail to consider differing perspectives and detract from the decision processes' integrity by shifting the focus toward technical issues and away from the social contexts of conservation trade-offs (Hirsch et al. 2011). Knowledge of these social and cultural linkages could help clarify which resources may trigger conflicts, promote discussion, support deliberation, or potentially identify and reduce management compliance (Daw et al. 2015). Consequently, there is a need for tools, methods, and approaches that identify and communicate trade-offs effectively to local and outside stakeholders, instead of reverting to the popular win-win language (Carpenter et al. 2009, McShane et al. 2011). We propose utilizing a biocultural approach with participatory mapping and community visioning methods to identify and communicate trade-offs in the southern highlands of Tanzania. The study site is now recognized as Magombera Nature Reserve, but when data were collected, it was an unprotected forest recognized internationally for its rich biodiversity. Engaging with the four forest-adjacent communities prior to the forest's protected area designation, the proposed approach and methods were used. The paper will give the reader a detailed account of both biocultural approaches and participatory methods to provide the appropriate context.

Biocultural approaches
Biocultural approaches to conservation can identify and communicate trade-offs effectively, in part because of their conceptual grounding in biocultural diversity. Biocultural diversity was coined in 1988 during the First International Congress of Ethnobiology in Belem, Brazil. The 1988 Congress produced The Declaration of Belem, which stated for the first time that there is an "inextricable link" between cultural and biological diversity (Posey and Dutfield 1996). Two years later, at the International Society for Ethnobiology's 1990 World Congress, the Global Coalition for Bio-Cultural Diversity was

established to implement a strategy for the use of traditional knowledge, involvement of local peoples in conservation and development strategies, and implementation of alternative, people-centered conservation models (Posey and Dutfield 1996). Biocultural approaches are unique and based on a central premise that the complex system of cultural diversity not only parallels, but is interrelated profoundly with the natural world (Maffi and Woodley 2010). That system of cultural diversity has been articulated in many ways, but most often in the context of language, traditional knowledge, and values (Maffi 2005, Pretty et al. 2009, Sterling et al. 2017a). The loss of this diversity represents loss of different worldviews and knowledge systems that represent a wealth of conservation opportunities (Gavin et al. 2018).

Conceptual foundations for biocultural approaches embrace the values of these various ways of thinking, drawing lessons from previous models of conservation, such as CBC and ICDPs (Gavin et al. 2015, 2018). Biocultural approaches include conservation actions made "in the service of sustaining the biophysical and socio-cultural components of dynamic, interacting, and interdependent social-ecological systems" (Gavin et al. 2015:140). Gavin et al. (2015) clarify this definition further, emphasizing that the biophysical and socio-cultural components of social-ecological systems are linked and can be sustained through the process of biocultural conservation. Social-ecological systems (SES) are complex, integrated systems where humans are a part of nature (Berkes et al. 2000a). Whereas Gavin et al. (2015) say the conceptual model is embedded in a SES framework, others say that by acknowledging the inseparable link between nature and culture, the concept is ingrained profoundly in a systems perspective (Maffi 2005, Liu et al. 2007).

In their seminal work, Gavin et al. (2015) identify eight principles of biocultural approaches to conservation (Box 1) based on a synthesis of prior work, such as Maffi (2001). Although all the principles have value in trade-offs discourse, the first principle is particularly relevant. Gavin et al.'s (2015) first principle acknowledges that conservation almost always involves multiple stakeholders who promote diverse objectives, including variation within the same group of stakeholders, which speaks directly to the necessity of a trade-off narrative.

Sterling et al. (2017a:1800) make another important contribution by articulating biocultural approaches as those that "explicitly start with and build on place-based cultural perspectives — encompassing values, knowledge, and needs — and recognize feedbacks between ecological state and human well-being." This definition echoes Gavin et al.'s (2015) third principle, which recognizes that culture is dynamic, and this dynamism shapes resource use and conservation. A deeper understanding of how culture shapes resource use is central to identifying potentially taboo trade-offs and is thus essential in shifting away from the win-win narrative. Therefore, it is clear how important it is to conserve ever-shifting cultural systems in the context of conservation management (Pretty et al. 2009), as manifested in multiple worldviews, languages, and sources of knowledge (Gavin et al. 2015).

Sterling et al. (2017b) focus further on creating indicators that capture the interconnected ecological and social factors of

resources. Sterling et al. (2017a:1800) argue that these indicators can capture both the "ecological underpinnings of a cultural system and the cultural perspective of an ecological state," thereby revealing useful feedbacks between communities and the environment. For example, a social indicator could be how the percentage of elders or parents transmitting traditional harvesting knowledge to their children translates to healthy populations of plant species (Sterling et al. 2017c). Current indicators, such as the United Nations Sustainable Development Goals, include people-focused and ecological goals but often fail to integrate these domains (Caillon et al. 2017).

Box 1:

Principles of biocultural approaches to conservation (Gavin et al. 2015).

1. Acknowledge that conservation can have multiple objectives and stakeholders.

2. Recognize the importance of intergenerational planning and institutions for long-term adaptive governance.

3. Recognize that culture is dynamic, and this dynamism shapes resource use and conservation.

4. Tailor interventions to the social-ecological context.

5. Devise and draw upon novel, diverse, and nested institutional frameworks.

6. Prioritize the importance of partnership and relationship building for conservation outcomes.

7. Incorporate the distinct rights and responsibilities of all parties.

8. Respect and incorporate different worldviews and knowledge systems into conservation.

Whether in definition, principles, or implementation, the common thread in applying biocultural approaches is highlighting the interconnectedness between socio-cultural and ecological systems, while stressing the importance of a locally relevant cultural perspective amongst stakeholders. Using these central tenets, the research described herein used participatory mapping and community visioning methods to identify biocultural resources and uncover a culturally grounded understanding of what factors drive their use.

Participatory methods

It is well known in the field of environmental governance that the concept of participation has a wide range of typologies (Wesselink et al. 2011, Paavola and Hubacek 2013). For example, Arnstein's (1969) well-known eight-level ladder of participation focuses on categories from "manipulation" to "citizen control," each corresponding to the extent of citizens' power in determining the end product or decision. Despite criticism of the linear, hierarchal, and simplistic nature of the model (Collins and Ison

2009), Arnstein's (1969) gradient helped illustrate an important point about the quality, or authenticity, of participation and served as an important jumping-off point for later models. Davidson's (1998) "wheel of participation" is a popular variation of Arnstein's (1969) work that highlights four overarching approaches to community involvement: information, consultation, participation, and empowerment. Davidson's (1998) wheel promotes community involvement, but without suggesting that the aim is always to climb to the top of the ladder (Collins and Ison 2009). Other participation typologies concentrate on the theoretical basis, like the popular classification dichotomy that Cleaver (1999) describes as efficiency versus empowerment, also referred to as pragmatic vs. normative (Thomas 1993, Beierle 2002), or more simply, ends vs. means. Mannigel (2008) summarizes the two approaches succinctly:

- As a means, to improve the efficiency of management interventions, participation is used as a tool for achieving better project outcomes.

- As an end, participation is necessary for equity and empowerment, used as a process that enhances individuals' capacity to improve their own lives, and facilitates social change to the advantage of marginalized groups.

As an "ends," some research has continually emphasized the importance of equity and empowerment, claiming that empowering and engaging a wider variety of actors could deliver a more just system of protected areas, as well as a broader and deeper acceptance and mainstream support of the approach (Roughley and Williams 2007, Lockwood 2010). Also, a more equitable focus allows PA management to benefit from the skills and knowledge of local actors (Berkes et al. 2000b, Roughley and Williams 2007), promotes a sense of ownership for the communities (Pretty and Smith 2004, Andrade and Rhodes 2012), and can motivate stakeholders to contribute voluntarily to concrete projects and initiatives (Weixlbaumer et al. 2015). As a "means" to improve the efficiency of management interventions, there is ample consensus that successful long-term protection is unlikely in PAs without the inclusive and authentic participation of local stakeholders (Pimbert and Pretty 1997, Beierle 2002, Brody 2003, Wells and McShane 2004, Koontz 2005, Sultana and Abeyasekera 2008, Newig and Fritsch 2009).

Recent studies have reached similar conclusions. Leverington et al. (2010) researched over 8000 assessments of protected area management effectiveness worldwide. The authors concluded that in all regions, communication, community involvement, and programs of community benefit were generally inadequate and correlated strongly with both overall effectiveness and good management outcomes (Leverington et al. 2010). A recent meta-analysis conducted by Andrade and Rhodes (2012) found that local community participation in protected area decision making was the only variable related significantly to the level of community compliance with policies. The study reviewed 55 published case studies from developing countries, measuring six variables to determine whether a local community's compliance level was related to protected area regulations. The authors identified a general trend that higher levels of participation result in higher levels of compliance (Andrade and Rhodes 2012). These studies have important implications for protected area

effectiveness, suggesting that greater inclusion of local communities in management should be a key strategy for ensuring the reliability and sustainability of protected areas.

These typologies highlight importantly the danger in generalizing participation (Cooke and Kothari 2001, Kesby 2005) and emphasize the variation in motivation and degree to which participants are involved in the decision-making process. Outlining eight key features of best practice participation that have emerged from a grounded theory analysis of the literature, Reed (2008) emphasizes that the quality of a decision depends strongly on the quality of the process leading to it. In Reed et al.'s (2017) most recent work on participation theory, they underscore context, process design, management of power dynamics, and scalar fit as key factors in what makes stakeholder and public engagement in environmental management work. Shifting from theory, the authors offer the following recommendations for practice (see Box 2):

Box 2:

Recommendations for implementing stakeholder and public engagement (Reed et al. 2017).

1. Take time to understand the local context fully to determine the appropriate type of engagement approach and adapt its design to the context.

2. Engage all stakeholders in a dialogue as soon as possible to develop shared goals and co-produce outcomes based on the most relevant sources of knowledge.

3. Manage power dynamics, so every participant's contribution is valued and all have an equal opportunity to contribute.

4. Match the length and frequency of engagement to the goals of the process, recognizing that changes in deeply held values (that may be at the root of a conflict) are likely to take longer than changes in preferences.

5. Match the representation of stakeholder interests and decision-making power to the spatial scale of the issues being considered.

Like biocultural approaches, sound and successful participatory practices highlight local context, the co-production of outcomes, and the value of stakeholder input (Reed 2008, Brooks 2017, Reed et al. 2017). A broad spectrum of participatory methods could be used to achieve these standards; the research described herein focused specifically on participatory mapping and community visioning. According to Herlihy and Knapp (2003:303), the participatory mapping method "recognizes the cognitive spatial and environmental knowledge of local peoples and transforms this into more conventional forms." For decades, researchers have utilized participatory mapping methods to incorporate the value of local knowledge and empower communities through their direct involvement. More broadly, participatory mapping reveals

spatial patterns and generates information for better planning and management (Gilmore and Young 2012, Smith et al. 2017). Our research used the participatory mapping process to identify and document the connectedness of communities' physical and cultural landscapes. This information was vital to the next step, which was developing a community vision that articulated what participatory forest management (PFM) looked like in the eyes of our participants. Grounded in the ideals of good governance (Graham et al. 2003) and the best practice participation principles (Reed et al. 2017), the community visioning process built a shared vision through a consensus-building process (Kretzmann and McKnight 1993). That foundation was then attached to strategies toward making the vision a reality.

METHODS

Context of site location

Located in the southern highlands of Tanzania, Magombera forest was declared a Forest Reserve under the custodianship of the Forest and Beekeeping Division in 1955 (Harrison and Laizer 2007). Contiguous originally with the Udzungwa Mountains forest, which is part of the Eastern Arc Mountains, the area is recognized internationally for its rich biodiversity and as a hotspot for unique endemic species (Newmark et al. 1993). Following various events, including the construction of the TAZARA railroad, establishment of two villages, and expansion of Kilombero Sugar Company, the Forest Reserve status was deemed inadequate for long-term conservation (Marshall 2008). Government management authorities agreed that the southern forest should be degazetted and annexed into the adjacent Selous Game Reserve (Marshall 2008). The Forest Reserve status was degazetted in 1981; however, it was never annexed formally, leaving it without a protected status. Until recently, the forest was threatened because of its unclear protection status and lack of proper management (Harrison and Laizer 2007), which is a point that management authorities and conservation advocates have re-emphasized in recent years. Our data were collected at a time when the protection status of the forest was looming. Shortly following our research, the forest was established as the Magombera Nature Reserve, a 26-square kilometer protected area (Fig. 1).

Data collection and analysis

Data were collected in the four forest-adjacent villages in the Kilombero district: Magombera, Katurukila, Kanyenja, and Msolwa Station (Fig. 2). These villages were identified because they collectively surround the forest, meaning the impending protection status and governance structure deliberations play an essential role in their access to and usage of the forest, and subsequently, the conservation of Magombera forest's biocultural resources. In total, 94 participants contributed through the end of the data collection process, 40 females and 54 males (Table 1). The average age of participants was 40 years old. On average, participants lived in their respective villages for 24 years and had attained an average seven years of formal education. Just under 70% of the participants owned 1.2 ha of land on average. In total, 21 languages were spoken amongst the 94 participants; however, all participants used Swahili as their primary means of communication, which is the official and most used language in Tanzania.

Fig. 1. Map of the Udzungwa Mountains showing the location of Magombera forest, prior to its current designation (Source: Cavada et al. 2019).
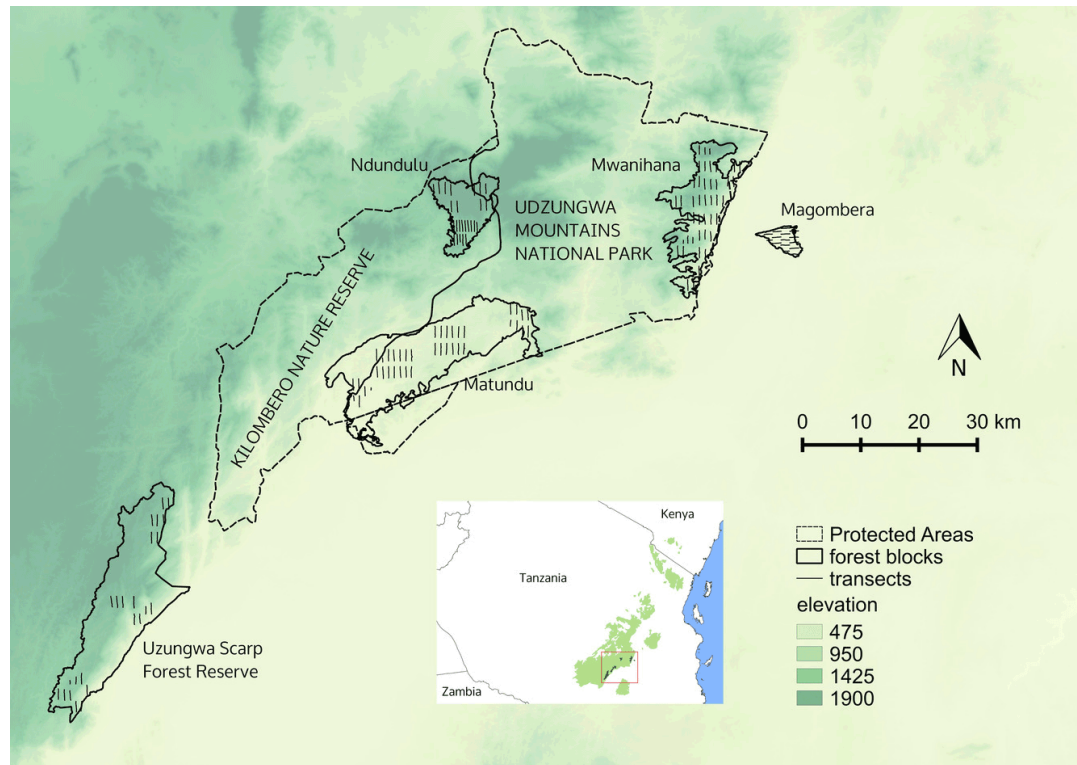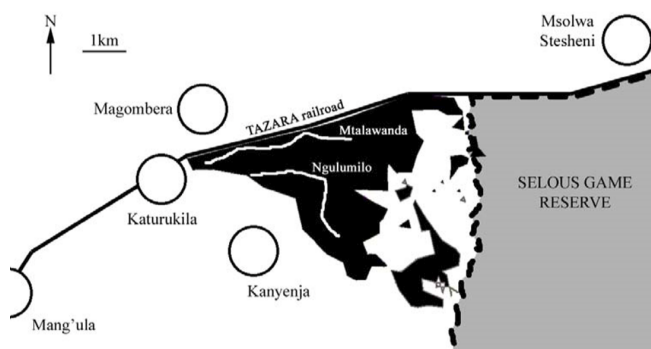

Fig. 2. Map of the four Magombera forest-adjacent villages, prior to its current designation (Marshall, 2008)

Table 1. Summary of participant demographic information from the survey, organized by village.

	Msolwa Station	Magom-bera	Katurukila	Kanyenja	Total
Number of participants	24	25	20	25	94
Female	11	10	8	11	40
Male	13	15	12	14	54
Average age	42	37	42	38	40
Average years of schooling	7	7	7	5	7
Average years living in village	28	20	31	20	24
Number of languages spoken	11	11	8	8	21
Number of residents that own land	16	16	16	15	63
Average hectares owned	1.2	1.2	1.6	0.8	1.2

Data were collected with the help of two Tanzanian field assistants selected based on their previous research experience, English language abilities, and familiarity with the study site area. Both field assistants participated in a three-day training session, during which we reviewed theoretical underpinnings of the research as well as a detailed account of the proposed methods. Following the training, time was spent revising the methods based on field assistants' knowledge of the communities, e.g., community meeting procedures. Assistants reviewed, edited, and translated the surveys into Swahili. The field assistants facilitated data collection, alternating between leading the sessions and recording responses. Following each day of data collection, we would debrief with our lead assistant and prepare for the following day, making any necessary adjustments.

Before the data collection process, prior and informed consent was acquired from the appropriate local governments' representatives, including the village chairmen, village executives,

and sometimes members of the village councils. Following their consent, the village governments used local communication methods to inform residents of a community meeting. All community members were invited, including the local officials. The purpose of the meeting was to review the study's objectives and logistics and recruit voluntary participants. The meetings were held outside in a central location in each village and facilitated in Swahili primarily by the field assistants. However, there was a short introduction at the beginning and we were available for questions throughout. Attendance varied from village-to-village, but we estimate that 50–100 community members were at each of the meetings, depending on village size.

Participatory biocultural resource mapping
The day following the community meeting, participants were separated into two groups: men and women. This division was made to ensure the women's voices were heard throughout the mapping process, which was a decision based on the participatory mapping literature (Chapin and Threlkeld 2001, Herlihy and Knapp 2003, Smith et al. 2017) and informed by previous research experience of the research assistants. Each group was given a blank, high-resolution Google Earth map of the Magombera forest and the surrounding area. Participants were asked to identify their village and any major geographic and hydrological features, such as rivers, ponds, or mountains. Next, each group was asked to identify what resources (or *maliasili*, which means natural resource) are used from the forest and indicate the approximate location of those resources on the map using a unique symbol. Participants were also asked to identify resources that held cultural significance, either by norm or value.

Once each group was finished with their map, the men's and women's maps were synthesized and condensed onto one map by the field assistants. Once the draft map was completed, it was shared with the participants for review and validation. During these meetings, we reviewed all the steps involved in the mapping process, and then participants made corrections and provided additional information for the final map. All participants then had the chance to discuss and debate final locations, names, and symbols of mapped features to ensure that the final map was as accurate as possible and agreed upon through negotiated consensus. The biocultural resource mapping process took one full day per village, including focus group discussions with all participants to understand and record how, when, and why each resource is used. During the discussions, the field assistants listed the Swahili and English names of each mapped resource, while the participants described their uses, their cultural significance, and what time of year they are used. All of this information was documented on large sheets of paper and later compiled in a database. This information was coded by resource area and resource use; then, using a deductive approach, the data were coded into broader resource categories. After this process was completed in all four villages, the field assistants took each of the finalized maps from the communities. They combined them into one map to visually represent the collective biocultural resource usage. In combining the maps, the field assistants had to negotiate resource location duplication, meaning that if all villages marked the same resource in the same spot, it was only recorded once instead of four times. It could be helpful to record that information in the future.

Community visioning
A community visioning process was also facilitated in each village, with all the men and women together. The process began by reviewing the biocultural resources list. In a focus group setting, participants used this information to outline a joint forest management community vision. Four questions (listed below) were used to guide the discussion and focus on future community participation, highlighting the connection with resources, accountability, partnerships, and transparency. The questions are grounded heavily in the early good governance principles outlined by Borrini-Feyerabend et al. (2014):

- How does your village want to use each of the biocultural resources listed in the future?

- How will you, meaning the individual village, manage those resources and who will hold the community accountable?

- In the case of a shared governance structure, which outside stakeholder would you want to partner with and why?

- What measures do you think would improve communication and transparency with an outside stakeholder/partner?

After creating their community visions, two representatives from each of the four villages gathered for a two-day session to create one joint community vision. In most cases, the representatives were elected by fellow participants, and we tried to foster both male and female representation. The format and facilitation were the same for the joint community vision meetings as in each of the individual villages; however, in this instance participants also had to compromise and negotiate the needs and realities of all the villages. Ideally, the joint community vision would serve as one unified voice to outside stakeholders for all four communities. Still, it is important to note that assuming the needs and use of biocultural resources for all four communities were uniform would be inaccurate and short-sighted. The joint community vision was presented orally to regional and national stakeholders by two elected representatives from the two-day session in two separate meetings. Paper copies of the community vision were provided in Swahili to all who attended, including the two representatives from each village, local government officials, and the outside stakeholders.

RESULTS
The central focus of data analysis was determining what information the biocultural approach identified could be useful in promoting a trade-off narrative. The results indicate that utilizing this approach with participatory mapping and community visioning methods can identify a locally relevant and culturally grounded perspective on resource use and identify areas of potential hard choices or sustainable outcomes.

**Participatory biocultural resource mapping**

Spatial resource use patterns
Following the identification of local roads, rivers, and ponds on the Google Earth base map, each community then identified areas where biocultural resources are collected or used. Figures 3 and 4 are examples of maps created during this exercise, although the legend has been removed to protect the location of specific resources and rights of the participants. Resource use tended to radiate out from the villages, as exemplified in Figures 3 and 4.

Fig. 3. Biocultural resource use mapped by the northwestern village, Magombera.

Fig. 4. Biocultural resource use mapped by the southeastern village, Kanyenja.
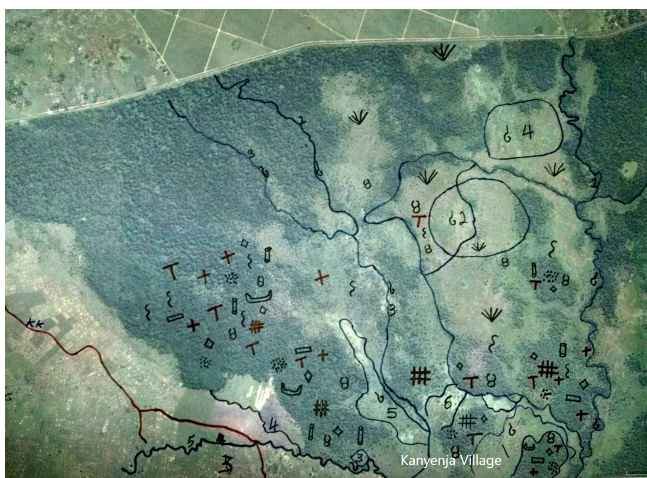
Combining the four individual village maps revealed that between the four communities, the entire forested area is utilized for resources. The maps also allowed us to uncover areas of high impact, such as areas of overlap in resource use among the four communities. Figure 5 shows a portion of the final combined map, where resource use was particularly high, including the collection of traditional medicine, hunting, harvesting of timber and poles, and the collection of honey and various understory plants.

Biocultural resource use
Each of the villages mapped 89 biocultural sites on average (Table 2). A "site" is defined as any location mapped by participants where a resource would be used or collected.

Fig. 5. Example of a high impact biocultural resource area in Magombera Nature Reserve, Tanzania.

Table 2. Summary of biocultural sites identified, organized by village.

Village	Number of biocultural sites identified
Msolwa Station	75
Magombera	104
Katurukila	86
Kanyenja	92
Average	89.25

From the four individual community maps, 357 resource sites were identified in total. However, after negotiating overlapping resource sites, a combined map recorded 213 biocultural resource sites. For those 213 sites, "resource uses" were identified based on participant activities. On average, communities identified 16 different types of resource uses. The uses included fishing, irrigation, building, drinking, bathing, washing, crafts, traditional medicine, ritual/ceremony, sacrifice, foraging, roofing, hunting, income, energy, and tool handles.

Breakdown between utilitarian use versus culturally important
Once the resource uses were identified, the focus group discussion with participants added context to how, why, and when different resources are used. Information from these discussions revealed that some resources were viewed distinctly by participants as necessities for everyday living or serving a practical purpose (classified as utilitarian), whereas others held a higher degree of cultural importance (classified as culturally important) to the communities.

After synthesizing similar use categories, the data were organized into 13 broad resource use categories to summarize the data. Tables 3 and 4 organize those resource categories by utilitarian (Table 3) and culturally important (Table 4) uses, including information on the resource use categories, examples of specific resources identified, and how those resources are used. Most of the resource use categories (10) were identified as fulfilling utilitarian needs. For example, sand and stones are collected from the rivers as raw materials for making bricks that are used for building. The remaining resource use categories (3) were identified

Table 3. Summary of biocultural resource uses identified as utilitarian.

Resource use category	Specific resources listed	Identified utilitarian use
Fishing	Fish, worms	The fishing methods used in both the rivers and ponds are line fishing (hooks), fishing nets (special nets and mosquito nets), fishing traps, and spears. The most common fish species mentioned include tilapia, "mudfish," sardine, *ningu*, *mkunga*, and *ngogo*. Worms are also collected by the river, which are used for fishing.
Irrigation	Water	River water is used for rice paddy irrigation outside the forest year-round.
Building Material	Sand, stones, vines	Sand and stones are collected from the rivers as raw material for brick making. Timber is harvested within dense forests for building, especially roofing and furniture. Poles are harvested for building. Vines are used in building, instead of nails.
Domestic Use	Water and vines	During dry seasons the rivers are used for domestic uses such as drinking, washing dishes, and bathing. Ponds are used for bathing throughout the year. Some rope species such as *mkulumu* are crushed and used as soap.
Hunting	Animals	Hunting is common in the grasslands because there are a variety of animal species there. Hunting in the forest is also very common, and one village noted hunting hippos at the river. Hunting is done with dogs and spears. The most commonly hunted animal is *ndezi,* a type of rat. Other hunted animals are hare, antelopes, buffalo, hippos, wild pig, elephant, and hyena.
Craft	Grasses and trees	Grasses are harvested primarily in the grasslands, as well as along riverbanks, for handicrafts such as grass mats, baskets, brooms, and beds. Ropes are also made and used in making chairs, mats, beds, and baskets.
Foraging	Honey, mushrooms, vegetables	Honey is used as an alternative to sugar in many households. Mushrooms are harvested as a food source. One village mentioned a wild vegetable called *mlenda*, which is harvested around ponds.
Income	Trees	Some people depend on timber for building as a source of income. Firewood is also harvested for selling. Charcoal is not often used by the communities; instead they sell it in nearby towns.
Energy	Trees	Firewood and charcoal are used for cooking.
Miscellaneous		Bark is used to make canoes which are mostly used in the rainy season. Grinding mortars are made from *myegea*, a tree species.

as having some higher degree of perceived cultural importance. For example, traditional medicines are harvested in densely forested areas to treat a variety of ailments.

Joint community visioning

Resources listed in community visioning
In total, the joint community vision identified a combination of 17 specific resources, e.g., timber, and resource uses, e.g., medicinal bathing. The vision details the resources' negotiated future uses between the four villages, including whether permission for access should be granted, proposed alternatives, as well as a documented need for access to certain resources. Most resources (10) listed "no permission," and sometimes offered alternative solutions. For example, Table 5 identifies resources, such as timber and poles used for building materials, which communities advised they should not have access to because of the damaging effects on the forest.

Identifying future resource uses and taboo trade-offs
Participants insisted that future access to seven resource uses would be critical for either utilitarian or cultural reasons. However, perceived threats and the desire to conserve these resources for the long term led to a variety of management guidelines. Like the biocultural mapping, the future use data were organized into two groups: utilitarian and culturally important. Tables 6 and 7 indicate the resource uses, with representative quotes from the joint community vision, as well as the proposed resource use guidelines presented by participants.

Table 6 indicates that fishing, mushroom foraging, and firewood collection are three activities that participants felt either do not have a detrimental impact on the forest or are inextricably linked to sustaining their well-being and/or livelihood. Interestingly, mushroom foraging was the only resource use that was consistently identified by women but not by men, which aligns with the traditional gendered division of labor and tasks. Table 7 outlines traditional medicine, sacrifices, and the collection of certain grass species to make ceremonial mats as important for maintaining their cultural norms and traditions. It is important to note that "medicinal bathing" was listed as a separate use but was combined with traditional medicine based on the recommended regulations.

DISCUSSION
After decades of decidedly mixed conservation results, there is a need for approaches and methods that can communicate trade-offs more effectively versus reverting to the popular win-win language (Carpenter et al. 2009, McShane et al. 2011). Our research illustrates how utilizing a biocultural approach with participatory mapping and community visioning methods is one way to facilitate this, which can be seen in both the process and products of this research.

Process
Although the Forest Act of 2002 provides a clear legal basis for the implementation of participatory forest management (PFM) in Tanzania (Harrison and Laizer 2007), like most legislation, the

Table 4. Summary of biocultural resource uses identified as culturally important.

Resource Use Category	Specific Resources Listed	Identified Cultural Use
Traditional Medicine	Water, stones, honey, roots, barks, shoots, leaves, grasses, insects	There are some traditional medicines harvested along the riverbanks and within the rivers. Medicinal bathing in the rivers is done both outside and in the interior of the forest. Some grass species are used in traditional medicine (e.g., roots of a specific grass species are boiled and the liquid consumed three times/day to treat a patient with evil or spiritual attacks). Other species used in traditional medicine are also harvested in the dense forest for a variety of reasons (e.g., *Miwanga* is used as firewood to boil other medicines. It is believed that miwanga firewood makes medicines stronger and more targeted because this tree species is a very hard wood.)
Ceremony/ Ritual	Water, snails, grasses	Ceremonies (e.g., adult preparation, baptism, circumcision, purification) are done near the river in the forest where they can easily access water. Resources are also collected from the rivers for rituals outside the forest (e.g., snails are processed and mixed with crop seeds before planting, protecting them from being stolen). Certain grass species are used as mattresses for the youth ceremony.
Sacrifice	Trees, ponds, animals	Sacrifices are practiced differently depending on the tribe, but the general purposes of sacrifices include treating diseases, enhancing marriage or employment/promotion opportunities, purification, and summoning rainfall.

Table 5. Example of resources participants selected to restrict access to, resulting from the joint community vision exercise carried out in communities adjacent to Magombera Nature Reserve, Tanzania.

Resource Use Category	Participant quotes representing the preferred or negotiated future use	Proposed alternatives presented by participants
Building Material: Timber	"It is strictly no timber harvest since it has strong negative impact to the forest as it changes the habitat type from dense forest to grassland and can lead to desertification. The forest is very important as it gives good habitat to the animals."	Plant timber species outside the forest to harvest.
Building Material: Pole	"No permission to cut poles as it is explained in timber. It kills immature small trees which are good for the ecological system of animals living in the forest."	Use bricks and bamboo as alternative building materials.

Act does not offer context to the gradation of participation. The quality of participation ultimately plays an important role in the quality of the dialogue. According to the Forest Act (Lovett 2003), details on the involvement of local communities in the use and management of forest resources are left to the creation of forest management plans. A forest management plan is required for each forest reserve (Lovett 2003) and is where the application of this process is most relevant. Guided by best practice participatory methods (Reed 2008, Reed et al. 2017), this study culminated with the creation of a PFM community vision. This process facilitated a trade-off narrative.

Early engagement with local stakeholders
Engaging local stakeholders in decision making as early as possible has been cited frequently as an essential component of participatory processes that lead to sustainable solutions (Reed 2008). Typically, local stakeholders are brought into the decision-making process late, when it is time to implement a plan. This field site in this study was chosen specifically because of impending government engagement with the communities on participatory forest management. Including the communities in the process early ensured that they would go into a dialogue with outside stakeholders having reflected on their local needs and priorities.

Focus on local context
Context is important, especially in matters of resource use. After mapping the resources, our process focused deliberately on why resources are used, which provides a window into the history of the people, place, and cultural values associated with resource use practices. Understanding these linkages with resource usage could help to better understand how trade-offs could prompt conflicts, which could also promote discussions, support negotiations, and potentially reduce barriers to sustainable management compliance in the face of hard choices (Daw et al. 2015).

Manage power dynamics
It is necessary to implement a process that dissuades power dynamics so that the value of every participant's contribution is recognized, and everyone is given an equal opportunity to contribute (Reed et al. 2017). At the community level, great care was taken to ensure every participant's contribution was valued, and all had an equal opportunity to contribute. The best example of this was separating the men and women during the mapping processes. This provided an opportunity to understand how resource use varies for different segments of the population, which is critical for effective resource management.

Emphasis on empowerment, equity, and dialogue
An important principle of the community visioning process is that it starts with strengths and capacities, rather than problems and constraints (Sanginga et al. 2004). After months of work, the communities walked away with a PFM community vision, translated into the local language, and printed. The document serves as an example of the communities' commitment to being involved in forest management and their ability to articulate their contribution. The PFM community vision was presented to both regional and national stakeholders and provided the communities an opportunity to start the conversation on their terms. At the regional level especially, valuable dialogue was exchanged on next

Table 6. Resources identified as "utilitarian" and their proposed use from the joint community vision exercise carried out in communities adjacent to Magombera Nature Reserve, Tanzania.

Resource Use Category	Quotes representing the preferred or negotiated future use from the Joint Community Vision	Proposed use guidelines presented by participants
Fishing	"We need fishes from our forest but with certain regulations in a specified season particularly from June to December."	January to May is a breeding season and fishing should be allowed. Permits will be issued by a committee and will be provided to groups and not to individuals. Sustainable fishing methods will be required. Illegal harvest using mosquito nets, poison, spears, and the like will not be tolerated.
Foraging: Mushrooms	"No specific day should be set for mushroom collection."	Anybody can collect while participating in other allowed activities in the forest.
Energy: Firewood	"Generally, firewood is the main source of cooking energy in all four villages. Therefore, we need firewood with a set of regulations."	The Village government will be responsible of announcing special days for firewood collection while a different committee will be responsible for administering the firewood collection process. During firewood collection, it will be illegal to carry any destructive tool like axes or machetes. No one will be allowed to take vines from the forest; instead, people should bring rope from their homes. Failure to comply with these regulations should result in strong measures taken upon them. Firewood collection will be once per week to avoid the destruction of animal habitats.

steps and how to integrate knowledge of the outside stakeholders, e.g., resource use laws and regulations unfamiliar to the communities.

Institutionalization of knowledge
The sustainability of participatory processes can depend often on institutionally embedding stakeholder participation, which can facilitate future negotiated outcomes that were left uncertain previously (Reed et al. 2017). In this case, formalizing participation happened in two ways. The first was through the creation of the PFM community vision, which the communities kept as a future guide and reference. The second was through partnership with a local conservation project called the Udzungwa Forest Project (UFP). The organization already has strong relationships with the communities and will continue to work with them throughout the management planning process.

Products
Aside from the process, the data collected can also be used to support a trade-off narrative in several ways.

Spatial resource use patterns
Aside from understanding where resources are being used or collected spatially across the landscape, the maps also identified overlap between the communities resulting in high-impact areas, which can often be an important point of contention in resource use negotiations.

Resource use: breakdown between utilitarian versus cultural
The data revealed that some resources were distinctly viewed by participants as utilitarian, or necessary for everyday living, while others held a higher degree of perceived cultural importance to the communities. This information is useful in promoting a trade-off narrative because it gives specific information on how and why a resource is used. For example, our data identified the animals hunted most, hunting methods used, and the most common hunting areas. From a resource management perspective, this information could facilitate discussion about the scale of use, the potential impacts on the forest, and the logistics and justifications for how to manage future access.

Identifying future resource use and taboo trade-offs
The biocultural mapping data documented resource uses, offering important insights to understand how and why trade-offs might be considered taboo or trigger conflicts. The participatory forest management community visioning clearly identified negotiable resources, those that are utilitarianly important (e.g., fishing, mushroom foraging, and firewood collection), and those with some higher degree of perceived cultural importance (e.g., traditional medicine, sacrifice, and the collection of certain grasses). This information is valuable to both communities and management stakeholders when entering a dialogue or negotiation.

Knowing the importance of various resources allowed participants to articulate what is important and why. For example, when talking about activities that participants were unwilling to give up, e.g., sacrifice activities, one participant said, "The community members need to keep their belief in sacrifices. Sacrifices existed even before the coming of foreign religions. They help to solve several problems in the communities." Equipping stakeholders with this context enhances the overall effectiveness of conservation initiatives and ensures the sustainability of PFM compliance. A key example of this is traditional medicine, for which strong cultural norms were continually emphasized; this resource use was non-negotiable but open to management. Participants communicated continuously that traditional medicine collected from the forest was used long before the introduction of Western medical practices, e.g., clinics, and they expressed their strong desire to continue these traditions.

Limitations
Although the utility of this approach has been observed, no research is without limitations, and there are two important compromises inherent in the results of this work that should be mentioned. The first is the risk of too much emphasis on a unified voice or consensus. Susskind et al. (1999:9) define consensus as, "a process of seeking unanimous agreement. It involves a good-faith effort to meet the interests of all stakeholders. Consensus has been reached when everyone agrees they can live with whatever

Table 7. Resources identified as "culturally important" and their proposed uses from the joint community vision exercise carried out in communities adjacent to Magombera Nature Reserve, Tanzania.

Resource Use Category	Quotes representing the preferred or negotiated future use from the Joint Community Vision	Proposed use guidelines presented by participants
Traditional medicine	"The medicine collection system should not have specific times but should have some procedures. This is because diseases can happen any time and the patients will need to be treated immediately. For instance, a person bitten by a snake needs fast rescue."	There should be a committee established by members of the government and traditional healers. These are the ones who will administer all traditional medicine guidelines. The traditional healer should report to the committee before and after medicine collection. The Village Game Scout (VGS) should accompany the traditional healers during medicine collection to reduce destruction.
	"Medicinal bathing should be allowed with a certain regulation, as stipulated in traditional medicines."	The tools allowed during medicine collection are machetes and hoes only. The committee should meet several times/year to discuss the condition of the forest from medicine harvesting. Medicines should be harvested or collected rotationally to avoid destruction of the area. Medicinal trees from the forest should be planted outside the forest to reduce the frequency of forest entry.
Sacrifices	"The community members need to keep their belief in sacrifices. Sacrifices existed even before the coming of foreign religions. They help to solve several problems in the communities."	A committee through the village government will administer permits. Elders should be involved in administering the sacrifices as they know the traditions and customs best. The VGS will enforce rules by assessing environmental destruction. The sacrifices will be done anytime and anywhere in the forest depending on the beliefs of different tribes.
Craft: Grasses	"No grass cutting should be allowed as some grass are food and shelter to animals. But the grass mat should be allowed to sustain our culture for future generations."	A committee will regulate the grass harvest. People should have permits and pay taxes for grass mats. The VGS should accompany the grass mat harvesters. Grass mat cutting should be once per week.

is proposed after every effort has been made to meet the interests of all stakeholder parties." A closer look at the joint and individual community visions demonstrates this point and the potential conflict. In the example of bush meat/hunting, when deciding on the future use of resources, the joint community vision states the following:

> We don't need hunting because we want photographic tourism, so if we allow hunting, we will finish the animals keeping in mind that our forest is very small and animals are few. The revenues from photographic tourism will be split equally with all four villages.

This decision was reached through a process of negotiated consensus of chosen community representatives. However, only one of the four villages mentioned explicitly that access to bushmeat or hunting should be eliminated in their individual community vision. The remaining villages cite their interest in maintaining hunting for community members or allowing a higher authority to hunt and sell to the communities. Although it is often assumed that the objective of stakeholder dialogue should be to build consensus (Susskind et al. 1999), too much emphasis on finding consensus can hide or distort differences in opinions and values, ultimately affecting sustainability. In the context of this research, a unified plan was an essential function of the approach. Regional and national stakeholders will view the collective use of forest resources; however, Coglianese (2001, https://doi.org/10.2139/ssrn.270488) would criticize this approach because the goal shifts away from reaching a quality decision toward reaching an agreeable one in the push for consensus. The problem is not unique to this approach. Still, in any context where consensus-building is the focus, careful consideration should be taken to strike a balance to ensure the decision's sustainability.

From a broader lens, conservation and decision-making processes do not occur in a vacuum, but are rather embedded within a pre-established power structure and social-political context (Brechin et al. 2002, Young et al. 2013). The intra-community and inter-community power differentials were expected and immediately evident at our research site. The most substantial intra-community challenges surrounded the established gender role hierarchy. Tanzanian women are generally less vocal in mixed company; we did our best to mitigate this by separating the men and women for as much data collection as possible, and by having both a female and a male field assistant available to lead. Inter-community dynamics were less visible but present, especially when negotiating resource access needs in the joint community vision. Some of the effects of these embedded power differentials can be eased through thoughtful processes and effective facilitation; however, it is important to acknowledge the reality of these structures.

Despite these limitations, the approach has utility in gaining a locally relevant cultural perspective on resource use; how that perspective is applied, however, is primarily dependent on the meaningful sharing of power with outside stakeholders. The presentations to the regional and national stakeholders highlighted this complexity as the local stakeholders' voices intersected with regional and national systems and structures. Gavin et al. (2015) emphasized that one of the key challenges in power sharing comes when local priorities, goals, and institutions conflict with those at other spatial and institutional levels. Although Tanzania has taken action to create more collaborative conservation management, the legacy of a people-free, top-down approach will take time and effort to move past. The success of biocultural approaches, as with any approach, will depend on

relationship building based on trust, accountability, open communication, and processes that promote empowerment and local stakeholder capacity (Gavin et al. 2015).

CONCLUSION
Although challenges exist, this should not discount the value of the biocultural resource mapping approach and the information gained from this process. The participatory mapping process is an inclusive method that creates a powerful visual of resource use in a locally relevant context. Creating a list of resources used based on the mapping and focus group discussions could provide a better understanding of the cultural context of those resources, which is powerful information to have when navigating the path toward conservation trade-offs. Linking this methodology with a biocultural approach makes a distinct effort to sustain conservation of an ecological system, while also preserving the values, knowledge, and needs of communities. Recognizing this feedback could contribute to the start of a critical and meaningful dialogue between multi-institutional stakeholders necessary for the success and sustainability of any conservation effort.

Responses to this article can be read online at:
https://www.ecologyandsociety.org/issues/responses.
php/13273

Data Availability:

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available because they contain information that could compromise the privacy of research participants.

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