Check for updates

Received: 9 June 2020 | Revised: 7 June 2021 | Accepted: 19 June 2021

DOI: 10.1111/csp2.488

CONTRIBUTED PAPER

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

WILEY

The importance of future generations and conflict management in conservation

Emily Lewis-Brown[1] | **Hope Beatty**[1,2] | **Katrina Davis**[3] | **Ando Rabearisoa**[4,5] | **Jeannot Ramiaramanana**[6] | **Michael B. Mascia**[7] | **Morena Mills**[1]

[1]Science and Solutions for a Changing Planet DTP, Grantham Institute and the Department Life Sciences, Imperial College London Silwood Park, Berks, SL5 7PY, UK

[2]Blue Ventures, London, UK

[3]Department of Zoology, University of Oxford, Zoology Research and Administration Building, Oxford, UK

[4]Conservation International, Antananarivo, Madagascar & Conservation Action Lab, Arlington, Virginia, USA

[5]University of California Santa Cruz, Santa Cruz, California, USA

[6]University of Antananarivo, Antananarivo, Madagascar

[7]Moore Centre for Science, Conservation International, Arlington, Virginia, USA

Correspondence
Emily Lewis-Brown, Centre for Population Biology, Silwood Park, Buckhurst Rd, Berks SL5 7PY, UK.
Email: e.lewis-brown17@imperial.ac.uk

Funding information
Margaret A. Cargill Philanthropies; Natural Environment Research Council, Grant/Award Number: NE/L002515/1

Abstract

The need to scale-up conservation initiatives is widely accepted, but understanding how to catalyze the adoption of conservation initiatives remains elusive. To address this challenge, we used diffusion of innovation theory and Best-Worst Scaling experiments to rank the factors that influence the adoption of Locally Managed Marine Areas (LMMAs) by villages in north Madagascar. The most important driver for respondents to adopt LMMAs was the wellbeing of future generations, while the most important barrier was conflict within and between villages that could arise from the adoption of LMMAs. This emphasis on the benefits and costs of adoption is consistent with diffusion of innovation theory. However, our results indicate that people's intrinsic values (e.g., benevolence and peace) were more important to survey respondents in the adoption of LMMAs than is generally reported in the diffusion of innovation literature. Concerns about conflict from LMMAs and the distribution of livestock incentives warrant further consideration to support the adoption of this conservation initiative in the context of the Sustainable Development Goals. Our study can guide future conservation research and practice to identify the "best" and "worst" attributes of LMMAs and other initiatives to increase the adoption of conservation.

KEYWORDS

Best-Worst Scaling, community conservation, diffusion of innovation, LMMAs, marine conservation

1 | INTRODUCTION

Environmental degradation has led to detrimental impacts on people, ecosystems and wildlife (IPBES, 2019). Conservation initiatives can help mitigate these detrimental impacts by protecting ecosystems and supporting sustainable development (Field et al., 2012). However, despite over US $20 billion of investments annually in conservation (2001–2008) (Waldron et al., 2013), and international conservation targets (United Nations, 1992), conservation initiatives are not being adopted at the required rate (O'Brien, 2012). To address this misalignment, we need to better understand

This is an open access article under the terms of the Creative Commons Attribution License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited.
© 2021 The Authors. Conservation Science and Practice published by Wiley Periodicals LLC. on behalf of Society for Conservation Biology

what influences the adoption of effective conservation initiatives by governments, communities and individuals.

Research to date finds a variety of factors can influence people's conservation choices, such as their education (Tayouga & Gagné, 2016) and capacity to engage in conservation (Bennett et al., 2018), or their motivations, including a desire to provide public goods (Admiraal et al., 2017; Farmer, Knapp, Meretsky, Chancellor, & Fischer, 2011). Sustaining fisheries over the long-term has been an important motivation for adopting marine conservation initiatives (Govan, 2009; Jupiter, Cohen, Weeks, Tawake, & Govan, 2014; Ruiz-Mallén, Schunko, Corbera, Rös, & Reyes-García, 2015). The local policy environment can also help or hinder engagement in marine and terrestrial conservation initiatives (Gladkikh, Collazo, Torres-Abreu, Reyes, & Molina, 2020; Rocliffe, Peabody, Samoilys, & Hawkins, 2014). Despite this literature base, there remains insufficient information about what drives people to adopt conservation projects (Admiraal et al., 2017) and an integrated analytical framework for conservation is only just emerging (Bennett et al., 2018). However, a framework to understand the factors that influence decisions to adopt or reject innovations is provided by diffusion of innovation theory (Rogers, 2003). This can be usefully applied to conservation initiatives to improve our understanding of the pace and scale of their adoption by individuals, organizations or communities (Mascia & Mills, 2018; Pannell et al., 2006).

Diffusion of innovation theory (hereafter, diffusion theory) is based on seven decades of research to understand, predict and increase the adoption of a range of technological and policy innovations in different disciplines, from agriculture and health to education and sales marketing (Atkinson, 2007; Balas & Chapman, 2018; Dearing, 2009; Rogers, 2003). Diffusion theory proposes that the characteristics of innovations, and how these interact with the characteristics of adopters, and the wider context in which they exist, play an important role in adoption (Dearing & Cox, 2018; Pannell et al., 2006). Five key characteristics of innovations influence their adoption: relative advantage (e.g., status and income); compatibility (e.g., with values and needs); complexity of the innovation; trialability; and observability (Rogers, 2003; Wisdom, Chor, Hoagwood, & Horwitz, 2014). The importance of these characteristics can depend on their interactions with characteristics of the adopter and context (Pannell et al., 2006). For example, the relative advantage of adopting sustainable agricultural practices depends on the compatibility of the practice with adopters' beliefs and values (Pannell et al., 2006) and social norms (Wisdom et al., 2014).

Values drive people's motivations and influence behaviors (Schwartz, 1996). Most values fall within two basic axes; the first ranges from "self-enhancing" (extrinsic) (e.g., personal success, status and wealth) to "self-transcending" (intrinsic) values (e.g., equality, peace, and protecting the environment) and the second, bisecting axis, ranges from "resistant to change," to "open to change" (Schwartz, 1996). Environmental organizations often use extrinsic values (e.g., financial benefits or status) to increase adoption of conservation initiatives (Crompton & Kasser, 2010), although several authors conclude that intrinsic rather than extrinsic values are key in conservation (Admiraal et al., 2017; Crompton & Kasser, 2010; Farmer et al., 2011). Further, extrinsic values, such as payments for conservation, have been found to "crowd-out" intrinsic values (Agrawal, Chhatre, & Gerber, 2015; Crompton & Kasser, 2010) and can reduce support for pro-environmental behaviors (Rode, Gómez-Baggethun, & Krause, 2015). In contrast, others (Bennett et al., 2018; Nilsson et al., 2016) find that both intrinsic and extrinsic values play a role in conservation. Therefore, empirical research is required to understand the influence of values, alongside other factors, in the adoption of conservation initiatives.

To understand what characteristics of conservation initiatives influence adoption, we studied Locally Managed Marine Areas (LMMAs), a community-based marine management tool that has spread relatively rapidly in Madagascar (Rocliffe et al., 2014), with 178 LMMAs established since 1998 (MIHARI, 2020). We used a Best-Worst Scaling (BWS) choice experiment (Louviere, Flynn, & Marley, 2015) to rank the characteristics of LMMAs that were most influential in people's decision to establish LMMAs in four villages in north east Madagascar. Our results develop our understanding of what influences the adoption of these conservation initiatives and highlight how diffusion theory can be effectively applied to conservation. Conservation practitioners can use these results to inform the design of future conservation initiatives to improve the likelihood of adoption.

2 | METHODS

2.1 | Madagascar and locally managed marine areas (LMMAs)

Madagascar is one of the world's poorest nations, with declining wellbeing fuelled by political unrest and climate shocks (Osborne & Hassine, 2016). Half of all children under five are chronically malnourished, with high levels of stunting and disease susceptibility (Bagcchi, 2020). The population is increasing rapidly, particularly along the coast where many are reliant upon the sea for food security and incomes (Le Manach et al., 2012). Pressure on marine resources led to the establishment of Madagascar's first

25784854, 2021, 9, Downloaded from https://conbio.onlinelibrary.wiley.com/doi/10.1111/csp2.488 by Imperial College London, Wiley Online Library on [26/09/2025]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

LMMA in Velondriake, in the south-west, and LMMAs are now established nation-wide (Gardner et al., 2020). LMMAs in Madagascar are agreements within or between villages to sustainably manage shared traditional fishing grounds and include an associated management plan, management body, and defined marine area (MIHARI, 2015). LMMAs can be managed by villages, or government agencies can be involved with permits, legal recognition and enforcement. Most LMMAs in Madagascar have been developed with support from NGOs (MIHARI, 2015; Rocliffe et al., 2014).

In addition to restrictions on gear use and protection of habitats such as coral reefs and mangroves, LMMAs include periodic closures to all harvesting activities (Figure 1). These closures can be for periods of a few weeks to months (Oliver et al., 2015). Immediately after periodic closures are re-opened, harvests improve with increases in octopus sizes, fish abundance and incomes (Oliver et al., 2015). LMMA rules and periodic closures act in addition to national fisheries management rules and periods of no fishing during the windy season. For the purposes of this study, LMMAs are considered an innovation (something new within this context) that is adopted when an LMMA is established. We selected four villages with LMMAs along the north east coast of Madagascar's Diana Region to study between April and June 2018. An NGO had supported each village to establish an LMMA with training, livestock (hens and goats), and financial support. Each LMMA studied was managed by the villages' fisheries associations.

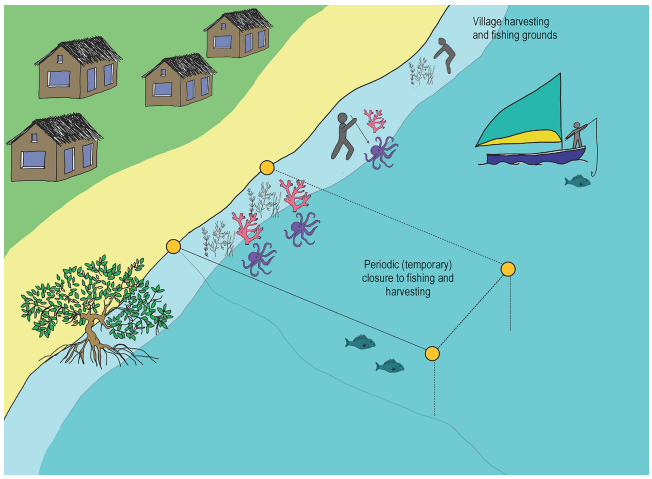

FIGURE 1 Locally Managed Marine Area (LMMA) with a periodic closure to harvesting and fishing (rectangle) marked with buoys (circles). LMMAs are a community-based agreement to establish a management body and plan to manage a defined marine area, such as a village's traditional fishing ground. This may include rules that protect selected species and habitats and ban the use of certain gears, such as small-holed nets and poisons. Typically, LMMAs include areas where all harvesting of any wildlife is prohibited for agreed periods (periodic closures) allowing wildlife to increase in size and number. Periodic closures may cover the whole LMMA and fishing ground, or a portion as depicted by the rectangle in this illustration

2.2 | Survey

The research and survey comprised four elements. First, we used a literature review, discussions with an NGO staff in the United Kingdom and the experience of the research team to generate a list of 33 attributes of innovations that were considered to influence adoption (Table S1). The literature review spanned diffusion theory, including papers from health (Balas & Chapman, 2018), agriculture (Pannell et al., 2006), education (Atkinson, 2007), animal welfare (Hansson & Lagerkvist, 2016), information technology (Moore, 1991) and conservation (Mascia & Mills, 2018). Literature on conservation outcomes, including socioecological impacts (Mascia et al., 2017) and conflict (Bennett et al., 2017), were also reviewed to inform the development of the survey questions and attributes to test.

Second, we designed focus groups to be undertaken in the field to test the list of 33 attributes generated above and identify the most important attributes to research further. We developed the focus group protocol in line with recommendations for low literacy settings (Jakobsen, 2012) and invited male and female community leaders (village representative, council member, vice president or president), and non-leaders, fisher-folk, and non-fisher-folk to attend. Four focus groups were held across two villages, with ten participants in each, with males and females grouped separately to encourage participants to speak freely. Research assistants presented the list of 33 attributes to participants one at a time and asked participants to say whether each attribute was important or not. A simple frequency count was used to identify the attributes considered most important to participants. Two attributes were adjusted based on participant feedback, for example: "The benefit other people or the environment may have from the LMMA" was reworded by focus group participants to: "The benefit to future generations" (Table S1).

The final list of 16 attributes used in the BWS choice experiment (Table 1) included the attributes identified by the focus groups as the most important, ensuring the five key characteristics described in diffusion literature were encompassed (compatibility, complexity, observability, relative advantage, and trialability) because we wanted to test the relevance of this theory (Dearing & Cox, 2018).

Thirdly, we developed a survey instrument to gain information about the villagers and their opinions about the adoption of LMMAs. We then piloted the survey with NGO staff in the field and researchers translated it to

25784854, 2021, 9, Downloaded from https://conbio.onlinelibrary.wiley.com/doi/10.1111/csp2.488 by Imperial College London, Wiley Online Library on [26/09/2025]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

TABLE 1 Attributes used in the Best-Worst Scaling choice experiment and abbreviation codes

Attribute used in the BWS choice experiment	Code
The amount of money we could earn	Money
The food we could catch to eat	Food
Connections to people beyond the village	Connections
The control we would have over our marine resources	Control
The level of conflict in or beyond the village	Conflict
The monitoring and enforcement of the rules	Monitoring
How complicated or simple it seemed to establish an LMMA	Complexity
Someone in the village had seen or heard of LMMAs and their impacts	Observability
Whether LMMAs can be tested or changed to meet our needs	Trialability
The restriction of certain activities in an LMMA	Restrictions
New habits that might be needed	Habits
The health of the environment (non-target species)	Conservation
The benefit to future generations	Future generations
The pressure on the resources due to more people fishing	Resource pressure
The incentives for villages to establish and run an LMMA	Incentives
The funding and training provided by an NGO	Funding

Malagasy. Ethics approval was secured from Imperial College London prior to the focus groups and piloting of the survey.

The core of the survey was a Case 1 BWS choice experiment (Louviere et al., 2015). In this experiment, we asked respondents: "When your village was deciding whether or not to have an LMMA, which one of these four statements was thought by your village to be the best thing about an LMMA? And which one was thought by your village to be the worst thing about an LMMA?" We provided four attributes in each choice set and asked respondents to select the best and worst attribute from each set (Figure S1). Each attribute was seen twice across eight choice sets in each survey, and there were eight survey versions, designed with Lighthouse Studio 9.5 (Sawtooth Software, 2017). We used multi-choice and open-box questions to assess respondents' characteristics, including their education, whether they were a village leader, and their views about the LMMA (Figure S1). For example, we used Likert-style questions to understand respondents' level of involvement in and agreement with the decision to establish the LMMA.

Finally, from April to June 2018, Malagasy researchers undertook key informant interviews with an NGO representative working within the region and village chiefs to understand the context around LMMA establishment and secured permission to undertake surveys from the village chiefs. The researchers used purposive quota sampling in each village with a priori criteria (males, females, leaders, non-leaders, fishers, and non-fishers) to ensure a heterogeneous sample (Robinson, 2013). Snowball sampling was used to identify 30 respondents per village including respondents within each criteria, after Davis et al. (2015) and Peay, Hollin, Fischer, and Bridges (2014). Consenting respondents were interviewed with the questionnaire survey and key informants and focus group participants were not included in the survey sample.

2.3 | Analysis

Initial cleaning of the data removed respondents who were not present during the adoption decision. We also undertook a sensitivity analysis to determine the effects of incomplete responses in the choice experiment (Table S2), and eliminated responses with ≤60% of best or worst responses completed.

Initially, we assessed the frequency with which each attribute was selected as best or worst to rank the attributes (Louviere et al., 2015). In contrast to Likert-scale questions, BWS experiments provide two sets of data, best and worst choices, indicating the drivers and barriers to adoption of LMMAs along the same perceptual preference scale (Louviere et al., 2015). The frequency with which an attribute is selected and the consistency with which respondents rate an attribute as either best or worst influences the attribute's ranking on the Best-Worst scale. To assess the significance of any differences in the rankings of attributes along the derived preference scale, we first analyzed best and worst responses separately and then combined, using conditional logit models (Hoffman & Duncan, 1988) in Stata 16. The results provide the statistical difference between each attribute and the attribute selected as the reference case. Across the sample, no respondent selected *conflict* as "best" in the choice experiment. To facilitate model estimation, we therefore included two best observations for this attribute to two randomly selected choices in the sample. We then assessed combined best and worst responses using a heteroscedastic conditional logit model (HOLE, 2006), which allows for variance between the best and worst choice types. We tested whether best and worst responses could be

25784854, 2021, 9, Downloaded from https://conbio.onlinelibrary.wiley.com/doi/10.1111/csp2.488 by Imperial College London, Wiley Online Library on [26/09/2025]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

combined through two log likelihood tests of the best and worst models compared to the combined conditional logit and heteroscedastic conditional logit models.

The attributes were mapped across values that motivate behaviors (Schwartz, 1996). For example, attributes relating to conservation and conflict were considered to reflect intrinsic values of "universalism"; while control over resources and financial attributes indicated more extrinsic values of "influence and wealth." Attributes relating to changing habits and connections to others within and beyond the village were considered to relate to respondents' values of "openness to change" as described by Schwartz (1996).

2.4 | Survey and sample

Local researchers undertook 25–30 surveys in each of four villages studied ($n = 110$), and each village had one LMMA. We report results for 88 respondents who met our criteria of being present during the decision-making process about establishing an LMMA and who completed >60% of both the best and worst responses in the BWS questions. Two-thirds of respondents were male (68.2%) and approximately half (52.27%) were leaders in the community (Table S4).

3 | RESULTS

3.1 | Best-worst scaling (BWS)

Attributes ranked frequently as best were not ranked frequently as worst, and vice-versa (Figure S2), permitting the use of BWS frequency analysis to derive a preference scale (Louviere et al., 2015). *Conflict* and *resource pressure* were selected most frequently (89.8% and 65.3%, respectively), and consistently ranked as worst when selected (100% and 93.9%, respectively), resulting in highly negative rankings for these attributes. *Future generations* and *conservation* were selected respectively 60.0% and 36.9% of the times they occurred, and consistently as best (93.4 and 92.3%, respectively) (Figure 2), resulting in strong positive rankings. Conversely, *trialability* and *complexity* were infrequently selected when they occurred in the choice experiment (31.8% and 32.4%, respectively), and were selected as best or worst in similar measure, resulting in rankings close to zero on the preference scale (Tables 2 and 3, and Figures 2 and 3).

Log likelihood ratio tests of: (1) the conditional logit models of best, worst, and combined choices; and (2) the heteroscedastic conditional logit models of combined best and worst choices rejected the combined models.

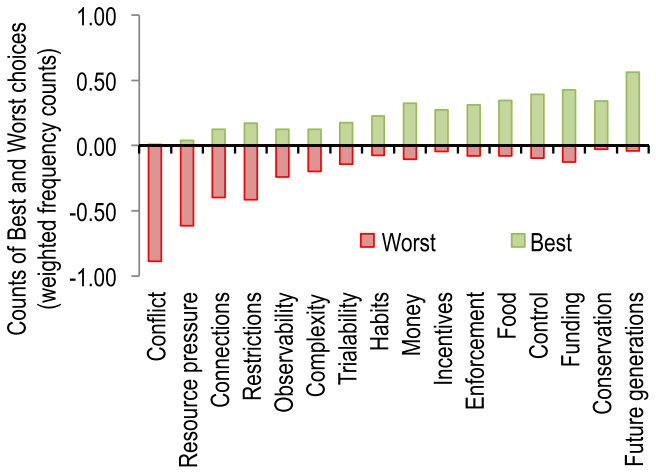

FIGURE 2 Best and Worst frequency count data for each attribute of LMMAs included in the Best-Worst Scaling choice experiment. Data are weighted for the occurrence of each attribute (n = 176), where 1.0 would indicate 100% selection as Best (green) and −1.0 would indicate 100% selection as Worst (red). Surveys completed to >60% only are included (n = 88)

Therefore, we report the results of the conditional logit model for best choices here with the most centrally ranked attribute, trialability, as the reference case (Table 3) as this provides a clear scale of preference of LMMA attributes.

The conditional logit model of best responses ranks the *benefits to future generations* as the best attribute of LMMAs, followed by *funding*, then *resource control*, *conservation*, *food*, *money* and *enforcement*, with significant positive rankings in relation to the reference case, *trialability* ($p < .01$). *Conflict* was ranked significantly worse than any other attribute ($p < .01$), followed by the *pressure on the resource* ($p < .01$). The remaining six attributes were ranked with no significant difference to the central reference attribute. Figure 3 illustrates the positions of the attributes on the preference scale relative to *trialability*, and the rankings are provided in detail in Table S2. Consistent with previous research (Davis, Burton, & Kragt, 2016), the ranking between the simple frequency count analysis and conditional logit model is similar.

3.2 | Adoption-decision

As indicated by their response to Likert-style questions, most respondents felt very involved or somewhat involved in the adoption-decision (71.76%). However, leaders felt more involved in the adoption decision than non-leaders, on a scale of one (I was unaware of the decision) to five (I was very involved in the decision). Males

25784854, 2021, 9, Downloaded from https://conbio.onlinelibrary.wiley.com/doi/10.1111/csp2.488 by Imperial College London, Wiley Online Library on [26/09/2025]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

TABLE 2 Preference scale of attributes; derived from frequency data, weighted by the occurrence of each attribute across all surveys, such that 1.00 would indicate an attribute was chosen on every occurrence (completion rate > 60%, $n = 88$)

Attribute	Best	Attribute	Worst	Attribute	Best-worst
Future generations	0.56	Conservation	0.03	Future generations	0.523
Funding	0.43	Future generations	0.04	Conservation	0.313
Control	0.39	Incentives	0.05	Funding	0.301
Food	0.35	Habits	0.07	Control	0.295
Conservation	0.34	Enforcement	0.08	Food	0.267
Money	0.32	Food	0.08	Enforcement	0.233
Enforcement	0.31	Control	0.10	Incentives	0.227
Incentives	0.27	Money	0.10	Money	0.222
Habits	0.23	Funding	0.13	Habits	0.153
Trialability	0.18	Trialability	0.14	Trialability	0.034
Restrictions	0.17	Complexity	0.20	Complexity	−0.074
Connections	0.13	Observability	0.24	Observability	−0.114
Complexity	0.13	Connections	0.40	Restrictions	−0.244
Observability	0.13	Restrictions	0.41	Connections	−0.273
Resource pressure	0.04	Resource pressure	0.61	Resource pressure	−0.574
Conflict	0.01	Conflict	0.89	Conflict	−0.875

Note: Two best selections were randomly included for the attribute "conflict" to facilitate model estimation, as this attribute was never selected as the best attribute in the choice experiment.

TABLE 3 Conditional logit model results for attributes selected as best with trialability as the reference case (completion rate > 60%, $n = 88$)

	Trialability as reference (completion rate > 60%, $n = 88$)			
BEST attribute	**Coefficient**	***p* value**	**95% confidence interval**	
Future generations	*1.878*	*0.000*	*1.391*	*2.366*
Funding	*1.305*	*0.000*	*0.814*	*1.796*
Control	*1.078*	*0.000*	*0.583*	*1.573*
Conservation	*0.967*	*0.000*	*0.464*	*1.470*
Food	*0.913*	*0.000*	*0.428*	*1.397*
Money	*0.908*	*0.000*	*0.403*	*1.413*
Enforcement	*0.711*	*0.006*	*0.199*	*1.222*
Incentives	0.559	0.028	0.059	1.059
Habits	0.299	0.249	−0.209	0.807
Restrictions	0.047	0.864	−0.493	0.588
Trialability	**0.000**			
Complexity	−0.376	0.217	−0.971	0.220
Observability	−0.376	0.205	−0.957	0.205
Connections	−0.448	0.135	−1.036	0.140
Resource pressure	*−1.557*	*0.000*	*−2.403*	*−0.712*
Conflict	*−2.861*	*0.000*	*−4.309*	*−1.413*

Note: Italicization indicates attributes with a significant difference ($p < .01$) to trialability (in bold). Two best selections were randomly included for the attribute "conflict" to facilitate model estimation, as this attribute was never selected as the best attribute in the choice experiment.

25784854, 2021, 9, Downloaded from https://conbio.onlinelibrary.wiley.com/doi/10.1111/csp2.488 by Imperial College London, Wiley Online Library on [26/09/2025]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

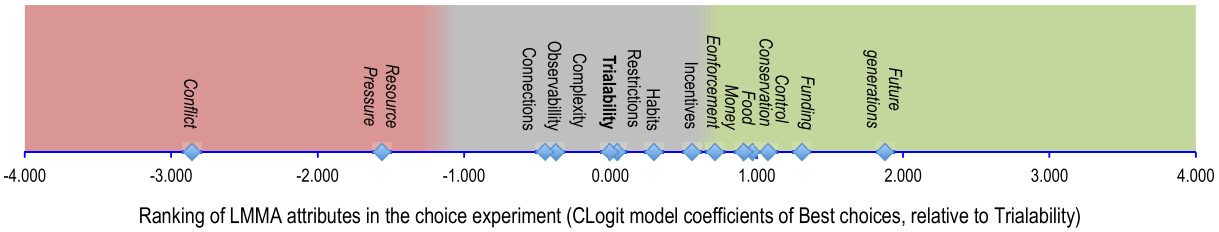

FIGURE 3 The preference scale of LMMA attributes, derived from the rankings (coefficients) of each attribute relative to the most centrally ranked attribute, Trialability (in bold), using a conditional logit (CLogit) model of attributes selected as Best. Italics and red shading indicates attributes with a significantly more negative coefficient relative to Trialability. Grey shading indicates attributes with no significant difference in their ranking in relation to Trialability. Green shading indicates attributes with a significantly more positive coefficient relative to Trialability ($p < 0.01$). Two Best selections were randomly included for the attribute "conflict" to facilitate model estimation, as this attribute was never selected as the Best attribute in the choice experiment. Conflict was the strongest barrier to adoption of LMMAs and Future generations was the strongest driver of adoption of LMMAs in this study

and females in leadership roles scored their involvement level as four or five out of five more often (males, 85.71% and females, 90.91%) than did male or female non-leaders (males 47.83% and females 68.75%) (Figure S6). Overall agreement with the decision to adopt an LMMA was high (91.95%) and most respondents (91.43%) reported that a particular individual or NGO influenced this decision.

3.3 | Personal perspectives

When asked in open-ended questions about the decision to establish an LMMA, many respondents said that livestock incentives (chickens and goats) were important in the decision and mentioned that they would like more goats to be provided in the future. Livestock were provided by the NGO to villages establishing LMMAs. However, several people, including fishers, reported disquiet about the way the livestock were distributed and asked that everyone in the village receive livestock incentives, not just fishers. The distribution of livestock incentives was reported as one source of conflict in villages. Participants also reported issues associated with villagers agreeing with and respecting the fishing rules, and negative impacts on village traditions caused by LMMA adoption. Pressure on the resource, which ranked as the second worst aspect of LMMAs in the conditional logit model (Table 3), may have reflected concerns expressed during interviews that the fishing resources had been deteriorating before the LMMA was established, which motivated them to protect the resource.

4 | DISCUSSION

We found the strongest positive driver for establishing Locally Managed Marine Areas (LMMAs) in our sample was the belief that LMMAs would bring benefits to future generations. Other positive influences included, financial factors, control over resources, conservation and food availability. The strongest opinions overall however consistently related to a negative attribute associated with the adoption of LMMAs: the level of conflict within or between the villages.

4.1 | Motivations for adoption of LMMAs

Our findings are broadly consistent with previous research into the motivations of individuals and communities to engage in conservation, and the importance of relative advantages and disadvantages in the decision to adopt within diffusion theory (Dearing & Cox, 2018; Pannell et al., 2006; Rogers, 2003; Wisdom et al., 2014). However, our results emphasize the importance of intrinsic in influencing the decision to adopt LMMAs.

The importance to adopters of avoiding conflict, of future generations, and conservation in our study indicates that self-transcendent (intrinsic) values of benevolence (i.e., preservation and enhancement of family, friends and community) and universalism (i.e., tolerance and protection of all people and for nature) (Schwartz, 1996) were of primary importance to respondents. Adopting temporary closures, primarily for the benefit of future generations seems particularly benevolent as fisheries and other harvests for food and income can be constrained during periodic closures (Hall, 2002). Keller (2009) reports that increasing future generations (the offspring of oneself and others) and providing natural resources for them is the essence of a meaningful and moral life in rural Madagascar. Bequeathing benefits to future generations was also a key motivation for establishing LMMAs in Pacific islands (Govan, 2009; Jupiter et al., 2014). Intrinsic values,

25784854, 2021, 9, Downloaded from https://conbio.onlinelibrary.wiley.com/doi/10.1111/csp2.488 by Imperial College London, Wiley Online Library on [26/09/2025]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

including place attachment and providing a public good (Farmer et al., 2011) and having a meaningful life and moral attitudes towards others (Admiraal et al., 2017; Bennett et al., 2018), are key drivers in influencing adoption of conservation initiatives more broadly.

In contrast, the motivations for adoption discussed within diffusion theory, for example, financial rewards, risk reduction, and status (Kuehne et al., 2017; Pannell et al., 2006; Rogers, 2003), are underpinned by self-enhancing (extrinsic) values (Bennett et al., 2018; Crompton & Kasser, 2010; Schwartz, 1996). Self-enhancing values are also found to be significant in this study, through the importance attributed to financial factors, resource control, and food, but of significantly less importance than two of the factors reflecting self-transcending (intrinsic) values of "benevolence" (Tables 2 and 3) (Bennett et al., 2018; Crompton & Kasser, 2010; Schwartz, 1996). Motivations for autonomy and control over local resources were also found to be important in the adoption of LMMAs in the Pacific (Jupiter et al., 2014) and in community-based conservation in Latin America (Ruiz-Mallén et al., 2015). There is less consistency, however, amongst the literature about the relative importance of financial benefits and incentives in the adoption of conservation initiatives. These have been found to be important in Payments for Ecosystem Services (Ruiz-Mallén et al., 2015) and conservation agriculture (Pannell et al., 2006), but were shown to be the least important factor influencing the adoption of conservation easements (Farmer et al., 2011). Therefore, we find that motivations that are consistent with intrinsic values played a greater role in the adoption of this conservation initiative than is typically described in diffusion theory (Kuehne et al., 2017; Pannell et al., 2006; Rogers, 2003; Wisdom et al., 2014).

4.2 | Removing barriers to adoption of LMMAs

Our study highlights the need to address the conflict that can be generated by conservation, not only because it was perceived as the most negative characteristic of LMMAs and could therefore reduce adoption of conservation initiatives, but also for ethical reasons (Bennett et al., 2017). The cause of conflict in the villages studied was not always clear, but the distribution of livestock incentives was cited as one cause of conflict during LMMA establishment. Accounting for local perceptions of "fairness" and local power dynamics that may lead to elite capture when distributing incentives are known to be important in influencing attitudes towards conservation initiatives (Randrianarison, Ramiaramanana, & Wätzold, 2017).

In line with a "do no harm" approach, the United Nations (UN) encourages the use of social protection measures to protect food security during initiatives that affect food availability (CFS, 2012), and providing livestock for villages with fisheries closures in LMMAs can be considered as fulfilling this responsibility. While social protection measures (such as providing livestock) are important in conservation, the risk of causing conflict in each sociocultural context needs to be considered (HLPE, 2012). The potential for conservation to cause conflict can often be predicted a priori (Ban et al., 2019; Matulis & Moyer, 2017), and the onus is on practitioners to minimize and manage conflict, with particular attention to protecting vulnerable small-scale fishers (UNFAO, 2015). This can be achieved, for example, by providing stakeholders with access to conflict management (Ostrom, 2009). UN Food and Agricultural Organisation recommend that in support of the Sustainable Development Goals (SDGs), community-based conservation "pay particular attention to issues of gender equality, participation, transparency and accountability in decision-making and the progressive realization of the right to adequate food for all" (UNFAO, 2017).

In addition to livestock incentives being cited as a cause of conflict in our study, incentives can also prime extrinsic values and crowd-out intrinsic motivations for undertaking conservation (Agrawal et al., 2015; Crompton & Kasser, 2010; Randrianarison et al., 2017; Rode et al., 2015). Given that intrinsic values were important to the adoption of LMMAs in our study, it is worth considering whether livestock can be provided in ways that prime intrinsic values and are perceived more positively by adopters, for example as a social protection measure that is implemented equitably with emphasis on protecting vulnerable community members (UNFAO, 2015; UNFAO, 2017).

4.3 | Limitations and recommendations for future research

Our study was limited to a relatively small sample size of 88 respondents across four villages in Madagascar; however, an advantage of BWS is that preference estimation is robust to small sample sizes (Lancsar, Louviere, Donaldson, Currie, & Burgess, 2013). As with Davis et al. (2015) and Peay et al. (2014), we used quota and snowball sampling (Robinson, 2013) due to field constraints. This limited our interpretation of results to the sample group rather than permitting generalization to the whole population. Additionally, data collection was undertaken by Malagasy research assistants to minimize the influence of the presence of foreign researchers on respondents, however respondents may have associated

25784854, 2021, 9, Downloaded from https://conbio.onlinelibrary.wiley.com/doi/10.1111/csp2.488 by Imperial College London, Wiley Online Library on [26/09/2025]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

the researchers with environmental NGOs and responded accordingly. Fortunately, BWS has been shown to reduce biases such as acquiescence bias, and errors due to cultural or language obstacles commonly found in other survey methods (Lee, Soutar, & Louviere, 2008).

Future research should investigate whether the patterns found here are relevant for LMMAs across Madagascar and other cultural settings internationally, and delve deeper into understanding responses associated with future generations and conflict. Although we identified that "benefits to future generations" influences adoption decisions, our study does not differentiate which benefits for future generations were most important. The causes of conflict in the adoption of conservation initiatives, mechanisms to mitigate conflict, and the most effective management of livestock or other social protection measures, warrant further research. It would also be interesting to investigate whether people considering conservation initiatives linked to their livelihoods, such as in farming and fisheries, respond differently to financial motivations and incentives compared to those considering conservation initiatives that are unrelated to their livelihoods.

4.4 | Implications for conservation science and practice

In conclusion, our research found that the most important driver for respondents when adopting LMMAs was the wellbeing of future generations, which relates to intrinsic values. Direct benefits to adopters that relate to extrinsic values, such as food and financial security were of less importance in the decision to adopt. The strongest barrier was conflict that arose within and between villages, at least in part relating to elite capture of livestock provided to support villages adopting LMMAs. This might be addressed through the delivery of UNFAO and High Level Panel of Experts recommendations for conservation to avoid conflict, support food security, and protect vulnerable communities.

We found that while diffusion theory can be applied to conservation initiatives it should be refined to better fit conservation initiatives as people's intrinsic values and motivations may be particularly important in applying diffusion theory to this context.

Methodologically, a benefit of our approach is that a simple BWS count analysis can effectively approximate preference scales without reliance on more computationally complex estimation methods. Conservation practitioners can use BWS to easily identify the factors that are most important to potential adopters and design conservation initiatives accordingly to increase adoption.

ACKNOWLEDGMENTS

This work was supported by the Natural Environment Research Council (grant number NE/L002515/1), and Margaret A. Cargill Philanthropies via the Alliance for Conservation Evidence and Sustainability. It forms paper #5 in the Catalysing Conservation series. The authors extend our thanks to: Michael Burton for the BIBD design and comments on the manuscript; Jean Noel Andrianjaka, Rodial Makampa, Arsene Jaona Ramahalefitra for fieldwork; Noel Smits Van Waesberghe for data entry; Jordan Louviere for advice on Best-Worst Scaling; and everyone who permitted and participated in focus groups and interviews. Gratitude and credit for the LMMA Illustration: Bryony Good

CONFLICT OF INTEREST

Two authors worked for the conservation organization involved in the LMMAs studied, but they were not involved in the establishment of the LMMAs, field research or data analysis.

AUTHOR CONTRIBUTIONS

Concept to study LMMAs using diffusion theory: Michael Mascia, Morena Mills; literature review and development of attributes: Emily Lewis-Brown; survey instrument design, field trials and refinements: Emily Lewis-Brown, Morena Mills, Katrina Davis, Hope Beatty; fieldwork: arrangement, hosting, permits and management: Hope Beatty, Mike Mascia, Ando Rabearisoa, Professor Jeannot Ramiaramanana; data entry: Hope Beatty, Emily Lewis-Brown; data cleaning and analysis: Emily Lewis-Brown, Katrina Davis; code for excel and Stata: Katrina Davis, Emily Lewis-Brown; figures and tables: Emily Lewis-Brown; writing: Emily Lewis-Brown, Morena Mills; reviewing and editing: all authors.

ETHICS STATEMENT

Ethics approval was granted by Imperial College London: 2018-01438539-BEATTY-HB.

DATA AVAILABILITY STATEMENT

Data and code can be accessed online (https://doi.org/10.5281/zenodo.4462622) and can be used under the Creative Commons Attribution License CC BY-NC.

ORCID

Emily Lewis-Brown https://orcid.org/0000-0002-2504-5411
Katrina Davis https://orcid.org/0000-0002-6982-9381
Michael B. Mascia https://orcid.org/0000-0002-9874-9778

25784854, 2021, 9, Downloaded from https://conbio.onlinelibrary.wiley.com/doi/10.1111/csp2.488 by Imperial College London, Wiley Online Library on [26/09/2025]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

REFERENCES

Admiraal, J. F., Van Den Born, R. J. G., Beringer, A., Bonaiuto, F., Cicero, L., Hiedanpää, J., ... De Groot, W. T. (2017). Motivations for committed nature conservation action in Europe. *Environmental Conservation*, *44*, 148–157.

Agrawal, A., Chhatre, A., & Gerber, E. (2015). Motivational crowding in sustainable development interventions. *American Political Science Review*, *109*, 470–487.

Atkinson, N. L. (2007). Developing a questionnaire to measure perceived attributes of eHealth innovations. *American Journal of Health Behavior*, *31*, 612–621.

Bagcchi, S. (2020). Madagascar's vulnerable children. *The Lancet Infectious Diseases*, *20*(4), e416.

Balas, E. A., & Chapman, W. W. (2018). Road map for diffusion of innovation in health care. *Health Affairs (Millwood)*, *37*, 198–204.

Ban, N. C., Gurney, G. G., Marshall, N. A., Whitney, C. K., Mills, M., Gelcich, S., ... Breslow, S. J. (2019). Well-being outcomes of marine protected areas. *Nature Sustainability*, *2*, 524–532.

Bennett, N., Teh, L., Ota, Y., Christie, P., Ayers, A., Day, J. C., ... Satterfield, T. (2017). An appeal for a code of conduct for marine conservation. *Marine Policy*, *81*, 411–418.

Bennett, N. J., Whitty, T. S., Finkbeiner, E., Pittman, J., Bassett, H., Gelcich, S., & Allison, E. H. (2018). Environmental stewardship: A conceptual review and analytical framework. *Environmental Management*, *61*, 597–614.

CFS. (2012). *Policy roundtable on social protection for food security and nutrition*. Rome: Committee on World Food Security.

Crompton, T., & Kasser, T. (2010). Human identity: A missing link in environmental campaigning. *Environment: Science and Policy for Sustainable Development*, *52*, 23–33.

Davis, K., Burton, M., & Kragt, E. (2016). Discrete choice models: Scale heterogeneity and why it matters. *Working Paper 1602*.

Davis, K. J. K., Marit, E., Gelcich, S., Burton, M., Schilizzi, S., & Pannell, D. J. (2015). Why are fishers not enforcing their marine user rights? *Environmental and Resource Economics*, *67*, 661–681.

Dearing, J. W. (2009). Applying diffusion of innovation theory to intervention development. *Research on Social Work Practice*, *19*, 503–518.

Dearing, J. W., & Cox, J. G. (2018). Diffusion of innovations theory, principles, and practice. *Health Affairs (Millwood)*, *37*, 183–190.

Farmer, J. R., Knapp, D., Meretsky, V. J., Chancellor, C., & Fischer, B. C. (2011). Motivations influencing the adoption of conservation easements. *Conservation Biology*, *25*, 827–834.

Field, C. B., Barros, V., Stocker, T. F., Qin, D., Dokken, D. J., Ebi, K. L., ... Midgley, P. M. (2012). *Managing the risks of extreme events and disasters to advance climate change adaptation. A special report of working groups I and II of the intergovernmental panel on climate change* (pp. 1–582). Cambridge, England: Cambridge University Press.

Gardner, C. J., Cripps, G., Day, L. P., Dewar, K., Gough, C., Peabody, S., ... Harris, A. (2020). A decade and a half of learning from Madagascar's first locally managed marine area. *Conservation Science and Practice*, *2*(12), e298.

Gladkikh, T. M., Collazo, J. A., Torres-Abreu, A., Reyes, A. M., & Molina, M. (2020). Factors that influence participation of Puerto Rican coffee farmers in conservation programs. *Conservation Science and Practice*, *2*, e172.

Govan, H. (2009). *Status and potential of locally-managed marine areas in the Pacific Island Region: Meeting nature conservation and sustainable livelihood targets through wide-spread implementation of LMMAs*. Germany: University Library of Munich.

Hall, S. (2002). The Use of Technical Measures in Responsible Fisheries: Area and time restrictions. *A fishery manager's guidebook-management measures and their application*. Fisheries technical paper, 424, Rome, Italy: UNFAO.

Hansson, H., & Lagerkvist, C. J. (2016). Dairy farmers' use and non-use values in animal welfare: Determining the empirical content and structure with anchored best-worst scaling. *Journal of Dairy Science*, *99*, 579–592.

HLPE. (2012). *Social protection for food security*. Rome: High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security.

Hoffman, S. D., & Duncan, G. J. (1988). Multinomial and conditional logit discrete-choice models in demography. *Demography*, *25*, 415–427.

HOLE. (2006). Small-sample properties of tests for heteroscedasticity in the conditional logit model. *Economics Bulletin*, *3*(18), 1–14.

IPBES (2019). In S. Díaz, J. Settele, E. S. Brondizio, H. T. Ngo, M. Guèze, J. Agard, et al. (Eds.), *Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services*, Chapter 2.2. Bonn, Germany: IPBES Secretariat.

Jakobsen, H. (2012). Focus groups and methodological rigour outside the minority world: Making the method work to its strengths in Tanzania. *Qualitative Research*, *12*, 111–130.

Jupiter, S. D., Cohen, P. J., Weeks, R., Tawake, A., & Govan, H. (2014). Locally-managed marine areas: Multiple objectives and diverse strategies. *Pacific Conservation Biology*, *20*, 165–179.

Keller, E. (2009). The danger of misunderstanding 'culture'. *Madagascar Conservation and Development*, *4*, 82–85.

Kuehne, G. L., Llewellyn, R., Pannell, D. J., Wilkinson, R., Dolling, P., Ouzman, J., & Ewing, M. (2017). Predicting farmer uptake of new agricultural practices: A tool for research, extension and policy. *Agricultural Systems*, *156*, 115–125.

Lancsar, E., Louviere, J., Donaldson, C., Currie, G., & Burgess, L. (2013). Best worst discrete choice experiments in health: Methods and an application. *Social Science & Medicine*, *76*, 74–82.

Le Manach, F., Gough, C., Harris, A., Humber, F., Harper, S., & Zeller, D. (2012). Unreported fishing, hungry people and political turmoil: The recipe for a food security crisis in Madagascar? *Marine Policy*, *36*, 218–225.

Lee, J. A., Soutar, G., & Louviere, J. (2008). The best-worst scaling approach: An alternative to Schwartz's values survey. *Journal of Personality Assessment*, *90*, 335–347.

Louviere, J. J., Flynn, T. N., & Marley, A. A. J. (2015). *Best-worst scaling: Theory, methods and applications*. Cambridge: Cambridge University Press.

Mascia, M. B., Fox, H. E., Glew, L., Ahmadia, G. N., Agrawal, A., Barnes, M., ... White, A. T. (2017). A novel framework for analyzing conservation impacts: Evaluation, theory, and marine protected areas. *Annals of the New York Academy of Sciences*, *1399*, 93–115.

25784854, 2021, 9, Downloaded from https://conbio.onlinelibrary.wiley.com/doi/10.1111/csp2.488 by Imperial College London, Wiley Online Library on [26/09/2025]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

Mascia, M. B., & Mills, M. (2018). When conservation goes viral: The diffusion of innovative biodiversity conservation policies and practices. *Conservation Letters*, *11*(3), e12442.

Matulis, B. S., & Moyer, J. R. (2017). Beyond inclusive conservation: The value of pluralism, the need for agonism, and the case for social instrumentalism. *Conservation Letters*, *10*, 279–287.

MIHARI. (2015). *Madagascar's locally managed marine area network*. Madagascar: MIHARI Network.

MIHARI. (2020). *Madagascar LMMA database*. Retrieved from https://mihari-network.org/fr/base-de-donnees/public-dashboard/.

Moore, G. C. A. I. B. (1991). Development of an instrument to measure the perceptions of adopting an information technology innovation. *Information Systems Research*, *2*, 192–222.

Nilsson, D., Gramotnev, G., Baxter, G., Butler, J. R. A., Wich, S. A., & Mcalpine, C. A. (2016). Community motivations to engage in conservation behavior to conserve the Sumatran orangutan. *Conservation Biology*, *30*, 816–826.

O'Brien, K. (2012). Closing the gap between knowledge and action. *Progress in Human Geography*, *37*, 587–596.

Oliver, T. A., Oleson, K. L., Ratsimbazafy, H., Raberinary, D., Benbow, S., & Harris, A. (2015). Positive catch & economic benefits of periodic octopus fishery closures: Do effective, narrowly targeted actions 'catalyze' broader management? *PLoS One*, *10*, e0129075.

Osborne, T., & Hassine, N. B. (2016). *Poverty and employment in Madagascar 2001–2012: A synthesis of recent findings*. Washington, DC: The World Bank.

Ostrom, E. (2009). A generalised framework for analysis socio-ecological systems. *Science*, *325*, 419–422.

Pannell, D., Marshall, G., Barr, N., Curtis, A., Vanclay, F., & Wilkinson, R. (2006). Understanding and promoting adoption of conservation practices by rural landholders. *Australian Journal of Experimental Agriculture*, *46*, 1407.

Peay, H. L., Hollin, I., Fischer, R., & Bridges, J. F. (2014). A community-engaged approach to quantifying caregiver preferences for the benefits and risks of emerging therapies for Duchenne muscular dystrophy. *Clinical Therapeutics*, *36*, 624–637.

Randrianarison, H., Ramiaramanana, J., & Wätzold, F. (2017). When to pay? Adjusting the timing of payments in PES design to the needs of poor land-users. *Ecological Economics*, *138*, 168–177.

Robinson, O. C. (2013). Sampling in interview-based qualitative research: A theoretical and practical guide. *Qualitative Research in Psychology*, *11*, 25–41.

Rocliffe, S., Peabody, S., Samoilys, M., & Hawkins, J. P. (2014). Towards a network of locally managed marine areas (LMMAs) in the Western Indian Ocean. *PLoS One*, *9*, e103000.

Rode, J., Gómez-Baggethun, E., & Krause, T. (2015). Motivation crowding by economic incentives in conservation policy: A review of the empirical evidence. *Ecological Economics*, *117*, 270–282.

Rogers, E. M. (2003). *Diffusion of innovations*. New York: Free Press.

Ruiz-Mallén, I., Schunko, C., Corbera, E., Rös, M., & Reyes-García, V. (2015). Meanings, drivers, and motivations for community-based conservation in Latin America. *Ecology and Society*, *20*, 215–233.

Schwartz, S. H. (1996). Value priorities and behavior: Applying a theory of integrated value systems. In C. Seligman, J. M. Olson, & M. P. Zanna (Eds.), *The psychology of values: The Ontario Symposium*. Ontario, Canada: Psychology Press.

Tayouga, S. J., & Gagné, S. A. (2016). The socio-ecological factors that influence the adoption of green infrastructure. *Sustainability*, *8* (12), 1277–1294.

UNFAO. (2015). *Voluntary guidelines for securing sustainable small-scale fisheries in the context of food security and poverty eradication*. Rome: UNFAO.

UNFAO. (2017). *The relationship between the governance of small-scale fisheries and the realization of the right to adequate food in the context of the sustainable development goals*. Rome: UNFAO and OHCHR.

United Nations. (1992). *Convention on biological diversity*. Rio de Janeiro, Brazil: United Nations.

Waldron, A., Mooers, A. O., Miller, D. C., Nibbelink, N., Redding, D., Kuhn, T. S., ... Gittleman, J. L. (2013). Targeting global conservation funding to limit immediate biodiversity declines. *Proceedings of the National Academy of Sciences of the United States of America*, *110*, 12144–12148.

Wisdom, J. P., Chor, K. H., Hoagwood, K. E., & Horwitz, S. M. (2014). Innovation adoption: A review of theories and constructs. *Administration and Policy in Mental Health*, *41*, 480–502.

SUPPORTING INFORMATION

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

How to cite this article: Lewis-Brown, E., Beatty, H., Davis, K., Rabearisoa, A., Ramiaramanana, J., Mascia, M. B., & Mills, M. (2021). The importance of future generations and conflict management in conservation. *Conservation Science and Practice*, *3* (9), e488. https://doi.org/10.1111/csp2.488

25784854, 2021, 9, Downloaded from https://conbio.onlinelibrary.wiley.com/doi/10.1111/csp2.488 by Imperial College London, Wiley Online Library on [26/09/2025]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License