How national context, project design, and local community characteristics influence success in community-based conservation projects

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Community-based conservation (CBC) promotes the idea that conservation success requires engaging with, and providing benefits for, local communities. However, CBC projects are neither consistently successful nor free of controversy. Innovative recent studies evaluating the factors associated with success and failure typically examine only a single resource domain, have limited geographic scope, consider only one outcome, or ignore the nested nature of socioecological systems. To remedy these issues, we use a global comparative database of CBC projects identified by systematic review to evaluate success in four outcome domains (attitudes, behaviors, ecological, economic) and explore synergies and trade-offs among these outcomes. We test hypotheses about how features of the national context, project design, and local community characteristics affect these measures of success. Using bivariate analyses and multivariate proportional odds logistic regressions within a multilevel analysis and model-fitting framework, we show that project design, particularly capacity-building in local communities, is associated with success across all outcomes. In addition, some characteristics of the local community in which projects are conducted, such as tenure regimes and supportive cultural beliefs and institutions, are important for project success. Surprisingly, there is little evidence that national context systematically influences project outcomes. We also find evidence of synergies between pairs of outcomes, particularly between ecological and economic success. We suggest that well-designed and implemented projects can overcome many of the obstacles imposed by local and national conditions to succeed in multiple domains.

evidence-based conservation | conservation evaluation | conservation and development | natural resource management

As conservation practitioners seek viable alternatives to strict protectionism, they increasingly recognize that projects must achieve ecological, economic, and social goals to be successful. One class of alternatives includes comanagement and community-based natural resource management and is most easily referred to as community-based conservation (CBC). Although diverse in their details (1), CBC projects typically aim to combine elements that link conservation with development, engage local communities as active stakeholders, and devolve control over natural resources. CBC often promotes the welfare and cooperation of people living in and around areas of conservation interest by providing development opportunities, guaranteeing rights to harvest, emphasizing community involvement and autonomy, and administering payments for ecosystem services. Such approaches have become prominent, especially in the developing world (2–4), as problems associated with protectionism, including human rights infractions (5), high financial costs of protected areas management (6), and difficulty achieving biodiversity conservation without exacerbating poverty (7), became apparent. The rationale is that engaging with communities and promoting socioeconomic benefits, either directly or by compensating for opportunity costs associated with conservation, can contribute to both poverty alleviation and biodiversity protection.

Although widespread, contemporary CBC faces criticism. Communities are often idealized as harmonious units (8), decentralization initiatives stall because centralized governments are unwilling to cede power (9, 10), and market-based approaches to CBC (3) are challenged for assuming that commercialization is compatible with conservation goals (11). Some conservationists anticipate sharp trade-offs between conservation and economic development and fear that delegitimizing conservation as a priority will water down already limited funds (12).

With such controversies unresolved, we need a better understanding of the factors associated with the success and failure of conservation projects, the scale at which these factors operate, and the extent of synergies and trade-offs among pairs of outcomes. Here, we tackle these questions by developing a large comparative database of CBC projects identified from a systematic literature review. We use a multilevel design and model-fitting approach to evaluate CBC success in four outcomes (attitudinal, behavioral, ecological, economic) by testing hypotheses about how features of the national context (H-NC), project design (H-PD), and community-level characteristics (H-CC) affect measures of success. We also explore evidence for synergies between pairs of outcomes.

Qualitative (4, 13, 14) and quantitative (15–21) studies suggest a number of factors can be associated with project success, including leadership, strong local institutions, local participation, capacity building, secure rights to land and resources, and provision and equitable distribution of economic benefits. Nevertheless most of these studies (*i*) examine only a single resource domain (e.g., forestry), (*ii*) have limited geographic scope, (*iii*) consider only one outcome (e.g., ecological success *or* economic success), or (*iv*) ignore the nested nature of socioecological systems (22). Nested analyses are particularly important because recent studies (19, 20, 23, 24) suggest that national governance institutions, corruption, and standards of living can influence project outcomes.

Our study is unique in assessing the effect of national socioeconomic and political conditions on the outcomes of a full range of CBC projects [although see Gutierrez et al. (20) on fisheries comanagement]. The 136 CBC projects in our sample focus on challenges in conserving forests, grasslands, wildlife, and fisheries, and are nested within national socioeconomic and political contexts of 40 countries (see Table S1 for included projects). Because many of the debates in conservation result from concerns with different goals inherent to CBC (25, 26), we evaluate attitudinal,

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behavioral, ecological, and economic outcomes, where success reflects positive changes in views of conservation goals, decreased off-take, improved outcomes for the habitat or species of interest, and a variety of livelihood benefits, respectively (15) (*SI Text*). Each outcome was coded as success (most indicators show improvement), limited success (some indicators show improvement), or failure (majority of indicators show no change or decline).

Hypotheses

Conservation typically requires individuals to limit or forego their use of a resource, suffering short-term costs for future benefits often enjoyed by a larger number of people. In this respect conservation creates collective action problems insofar as those who limit their current resource use must be confident of reaping future benefits (27). Both deductive theory (4, 28) and inductive observations (29) suggest that there are specific conditions that both favor and disfavor adopting conservation behaviors. Here, we test a range of hypotheses for how various national-, project-, and community-level features may affect conservation outcomes by identifying factors we predict to be associated with measures of success. Variable names are parenthesized after each hypothesis. Detailed definitions and coding information are provided for all variables in Table S2 with summary statistics in Table S3.

National Context (H-NC). Like other forms of cooperation, conservation attitudes and behaviors require conditions of trust (24, 30). The stability, transparency and accountability of national governance institutions might therefore influence project outcomes directly and indirectly by affecting confidence in local-level institutions and governance (23) and minimizing corruption (24).

H-NC1 National political context: Success when projects are implemented in countries where there is greater transparency and stability in governance (*Governance*) or where the populace has a voice in politics and enjoys common civil liberties (*Rights*).

Conservation projects typically restrict resource use or access. Where standards of living are low (or highly unequal), such restrictions may be unpopular, making conformity costly or impossible. Low access to education and healthcare may also hinder conservation by increasing the temporal discounting that can render conservation costly (31).

H-NC2 National socioeconomic context: Success when projects are implemented in countries with a higher level of development progress (*HDI*) or greater economic equality (*Gini*).

Project Design (H-PD). Project design structures the payoffs to foregoing resource use by determining who makes the rules associated with the project, how much of the resource is used as opposed to protected, and what benefits are provided and to whom. We characterize these aspects of project design along four dimensions: decentralization, utilization, effective benefit provision, and investment in human and social capital. Below, we derive hypotheses for each of these dimensions.

Many studies indicate the benefits of devolved decision-making and control to local communities (32). Local bodies may be more responsive to local conditions, better understand local resource dynamics, and have incentives to harvest resources sustainably because of lower discount rates than outsiders (32). Similarly, engagement with local leaders and cultural traditions can increase the likelihood of securing participation and decrease the likelihood of failure because of cultural insensitivity (33).

H-PD1 Grassroots: Success when there is more emphasis on local participation in the initiation, establishment, and daily management of a project (*Participation*), or when the project engages positively with traditional organizations and cultural beliefs, practices, and traditions (*Engagement*).

Evidence for utilization as an effective conservation tool is mixed. Protectionism can sometimes result in ecological success (34). Alternately, access to resources can provide economic and other benefits, encouraging communities to extract resources sustainably and potentially enhancing support for, and compliance with, conservation initiatives (35). Furthermore, lost access to resources, or insufficient compensation, may engender resentment (36) and, consequently, biodiversity loss (37). Our hypothesis is based on the latter logic.

H-PD2 Access to and utilization of resources: Success when projects avoid placing natural resources off limits (*Protectionism*) or emphasize greater levels of utilization (*Resource use*).

Economic benefits can reduce harvests by rewarding sustainable use through performance payments (38) or providing alternative livelihoods (31). With this logic, CBC success depends on the extent of benefits provided through income generation opportunities, development infrastructure, or direct compensation. Success may also depend on ensuring equitable distribution of benefits among community members and limiting elite capture.

H-PD3 Project benefits: Success when projects provide clear and well-directed economic benefits (*Provision benefits*); also where projects ensure benefits are shared equitably and prevent elite capture (*Equity*).

Investments in human and social capital can make positive outcomes more likely by lowering transaction costs and strengthening the potential for local coordination (39). For example, in a study of enterprise-based projects, training locals as managers and using community policing was a better predictor of project success than economic returns (40).

H-PD4 Human and social capital: Success when projects invest in human capital through capacity building (*PD-Capacity*) or environmental education (*PD-Environmental education*), or where they aim to enhance community pride, empowerment, and cohesion (*PD-Social capital*).

Community Characteristics (H-CC). Finally, characteristics of communities (as opposed to the project itself) could affect the success of the conservation initiative, particularly as a result of market integration, the nature of community institutions, and the size and heterogeneity of the population (29).

Neoliberal economic logic proposes that market integration enables communities to benefit from sustainably using and conserving their resources (3) by providing substitutes for locally harvested resources or adding value to local products (31). Conversely, market integration can increase pressure on resources and habitats as opportunities for market sales and rising prices incentivize extraction (41) and new roads attract immigrants (42). Our hypothesis, in line with at least some CBC logic (3), is based on the view that success is more likely in communities that are market integrated.

H-CC1 Market integration: Success when projects are in communities that are more integrated into local and global markets (*Market access*), or whose species/habitats of interest face fewer preexisting threats (*Threat*).

Strong community institutions can both incentivize and constrain behavior (32), and effective local governance can inspire trust (20) because well-organized communities are better positioned to provide the collective action that can, in theory, produce social goods [although it can also fuel opposition (43)]. Clearly defined rights for managing resources and excluding outsiders are also important because communities feel secure in their rights over future harvests (44). Secure tenure gives communities more buy-in, allows resource users to coordinate better, enables greater flexibility in rules, and can result in a lower discount rates, all of which can contribute to good outcomes (4, 13, 44). Finally, preexisting compatible

institutions to which individuals are accustomed to conforming and policing (45) can positively affect outcomes.

H-CC2 Supportive local context: Success when projects are in communities with effective governance institutions and cultural traditions that align with project goals (*CC-Local institutions*), locally held land tenure (*Tenure*), or strong leadership (*Charisma*).

Finally, community size and heterogeneity can affect project success (29). Collective action theory predicts an inverted U-shaped relationship between population size and successful community resource management, with small populations unable to absorb the transaction costs associated with management and large populations suffering prohibitively high transaction costs (46). Outcomes may also depend on whether community heterogeneity is economic, sociocultural, or political (47). Here we make the simplest and most general prediction that sociocultural heterogeneity negatively effects success (47, 48).

H-CC3 Local context: Success when projects are in communities with moderate sized human populations (*Population size*), or that are socioculturally homogenous (*Population heterogeneity*).

In addition, we controlled for the length of time a project had been running (*Years project running*), the first author's disciplinary background (*Auth discipline*), and the status of the ecoregion in which the project was located (*Ecoregion status*), and coded the data-collection method used for information on the dependent variables (see Table S2 and *SI Text* for additional details on dependent variables).

Results

Projects per country ranged from 1 to 19 (see Table S4), with the majority located in Africa (n = 63), followed by Asia/Oceania/Pacific Islands (n = 43) and the Americas (n = 30). Projects reported more successes than failures across all four domains, with ecological outcomes having, proportionally, the highest frequency of success (see Fig. 1 and *SI Results* for additional summary results).

National Context. In the bivariate analysis, high-quality governance, favorable human development index (HDI) and more equitable wealth distribution (as measured by the Gini inequality coefficient) are positively associated with attitudinal (*Governance*, *HDI*) and behavioral (*HDI, Gini*) success (Table S5). However, the full multivariate model with controls indicates that national context does not play an important role in any domain of project success as the 95% confidence intervals cross zero in all cases (Fig. 2). See Table S6 for complete multivariate model results and *SI Results* for interpretation of results.

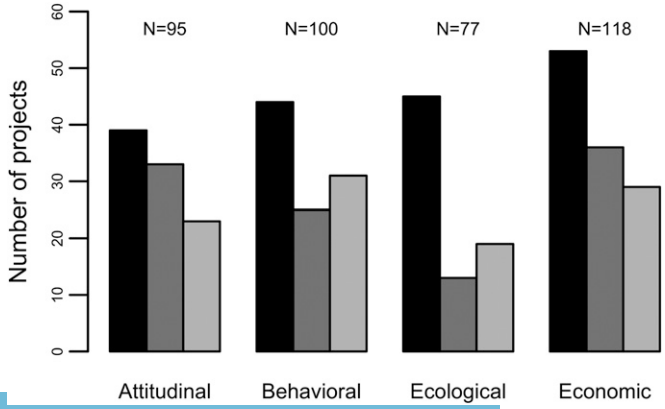

Fig. 1. Outcomes (success: black; limited success: dark gray; failure: light gray).

Project Design. Grassroots participation and engagement, equity in benefits, and enhancement of human and social capital are particularly important in the bivariate results, as variables from these clusters are significantly associated with each of the four outcomes (Table S5). The results of the multivariate analysis (Fig. 2) support the bivariate results, in that several distinct aspects of project design are associated with success across all four outcomes (95% confidence intervals do not cross zero; see *SI Results* for the technical interpretation of model outputs). Attitudinal success is most likely when the project creates or enhances social capital (*Social capital*), when communities participate in project initiation, establishment, and daily management (*Participation*), and when benefits are equitably distributed without elite capture (*Equity*). Behavioral success is most likely when the project invests in building capacity of local individuals and institutions (*Capacity*). Ecological success is most likely when the project engages positively with cultural traditions and governance institutions (*Engagement*), builds capacity in communities (*Capacity*), and when communities participate in project initiation, establishment, and daily management (*Participation*). Finally, economic success is most likely when the project invests in capacity building (*Capacity*).

Community Characteristics. In the bivariate analysis, outcomes are markedly less often associated with community characteristics than with project design variables (Table S5). Tenure shows the strongest effect and is positively associated with attitudinal, ecological, and economic outcomes. There is a similar pattern in the multivariate analysis as only three variables are significant predictors and in only the behavioral and economic domains (Fig. 2). Supportive local traditions and beliefs and effective local government (*Local institutions*) and smaller populations (*Population size*) are associated with behavioral success, and local tenure rights (*Tenure*) are associated with economic success. Interestingly, charismatic leadership is negatively associated with the likelihood of economic success, although the apparent underreporting of charismatic individuals may explain this result [charisma was only reported in 15% of our sample whereas 69% of authors responding to our questionnaire reported the involvement of a charismatic individual (*SI Text*)].

The length of time the project has been running (*Years project running*) is significantly and positively associated with economic success. There are no effects of author discipline or ecoregion status.

Synergies and Trade-Offs. Between 29% and 47% of outcomes for all pairings are full synergies (both outcomes were reported as successes), and between 54% and 79% of all pairings are either full or partial synergies (a combination of success and limited success) (Fig. 3). Behavioral and ecological outcomes have the greatest proportion of synergies, and ecological and economic outcomes have the greatest proportion of full and partial synergies and the lowest proportion of tradeoffs (see *SI Text* and Fig. S1 for synergies and trade-offs among combinations of three variables).

Discussion

This study was inspired by Ostrom's (22) call for researchers to recognize the complex, multivariate, and multilevel nature of socioecological systems. That we found more successes than failures across all outcomes and more evidence for synergies than trade-offs between pairs of outcomes supports our case that CBC is generally an effective approach. Our results support findings of prior studies and provide new insights into the role of project design, national context, community characteristics, the impact of markets, and outcome synergies. We turn to these before examining the consistency of our results with previous work.

Most significant is the support our study provides for how and why well-designed CBC projects work. Our findings show the importance of design features that include emphasis on community participation, capacity building, and equitable distribution of

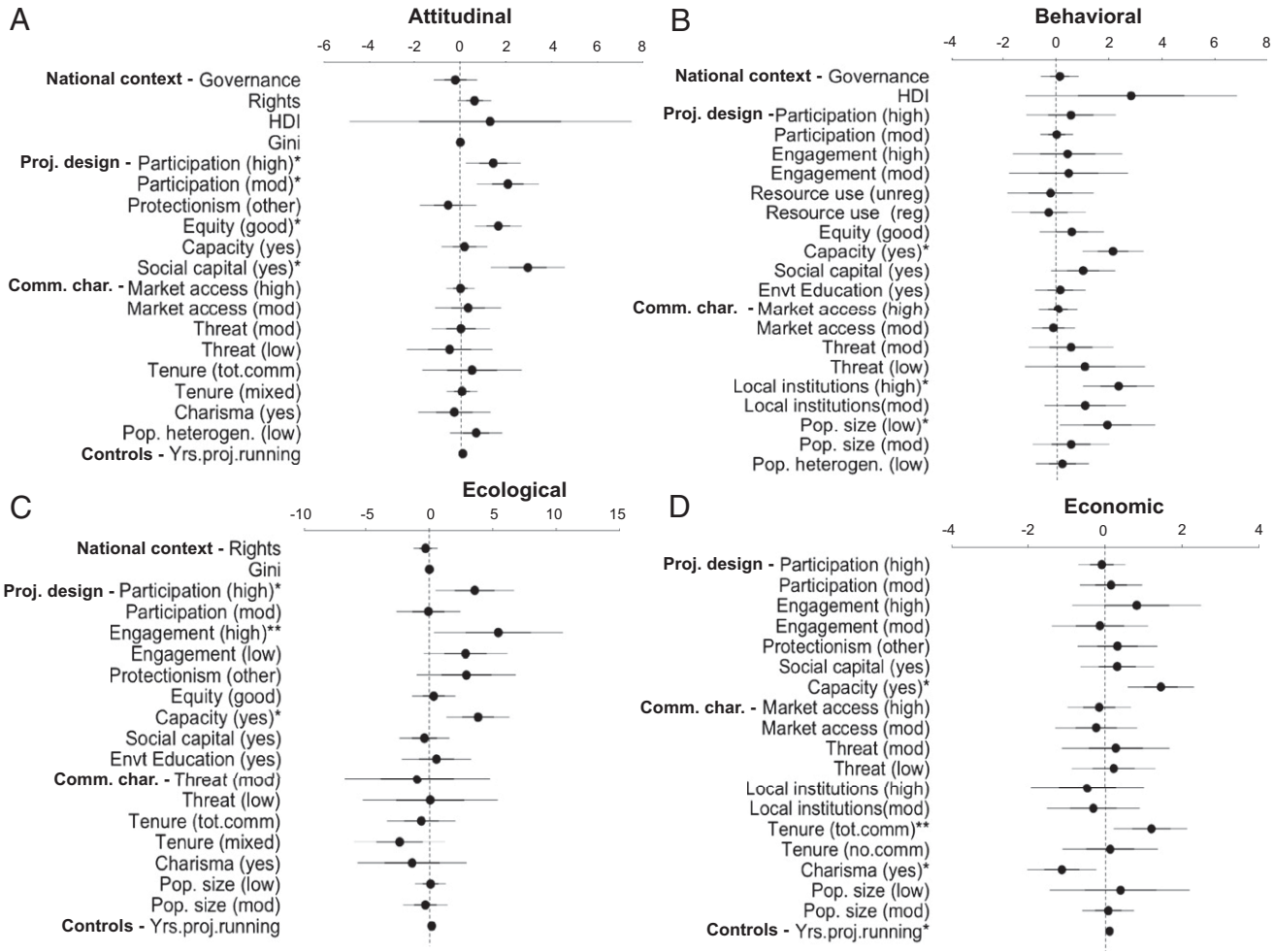

Fig. 2. (*A–D*) Plots of the pooled coefficients and 50% and 95% confidence intervals (*x* axis) for variables in the reduced-fit model for each outcome variable as selected by forward, stepwise AIC. *Indicates a significant association with an outcome. **For display purposes only, the reference categories (unseen level of the variable) were chosen so as to show the significant differences between categories. Had we visibly displayed the model outputs based on the reference categories reported in Table S6, the empirical source of the statistical relationship would have been hidden. See Table S6 for model outputs. See *SI Text* for treatment of separation problems for Attitudinal and Ecological analyses.

economic benefits, and support, to some degree, conclusions from previous reviews and empirical studies on fisheries comanagement (20, 43), integrated conservation and development projects (13, 19), and community forest management (14, 16, 18, 49). Taken together, these studies suggest that projects that balance economic incentives, community empowerment, and secure rights can succeed. This is the case despite the fact that community harmony is often a myth (8), decentralization depends on a commitment from the center to devolve rights and responsibilities (9, 10), and effective community-level institutions must exist that minimize the likelihood of elite capture (4, 50).

Indeed three of the four project design hypotheses (H-PD1, -PD-3, and -PD4) were supported to some degree, consistent with previous reviews emphasizing the importance of: (*i*) building local institutional capacity (14) and training and skills development (13, 19), (*ii*) equitable benefit distribution including avoidance of elite capture (14, 51), (*iii*) engagement with local institutions and cultural beliefs and traditions (17, 52), (*iv*) the provision of social capital and other intangible social benefits (13, 14, 20), and (*v*) participation in rule making and daily management (14, 16, 49) [although greater say in project design can lead to elite capture (43)]. As an example, in Yunnan, China, community-led monitoring resulted in community-drafted rules for sustainable harvesting of forest products (53). Similarly, participatory monitoring in Tanzania led to reductions in wildlife traps and improvements in forest quality (54).

Finally, although not classed as a feature of project design, we found [unlike previous reviews (20)] that projects running for a longer period are more likely to have economic success than more recent projects. This finding suggests that CBC requires time for development opportunities and income generation to emerge before measureable economic success is achieved.

The lack of evidence for significant effects of national-level indicators on project success is surprising, and fails to support our hypotheses (H-NC1 and H-NC2), which represent the intuitively appealing view that transparent and effective national governance influences project success through enhanced trust and lower time discounting among its citizens. This lack also runs counter to the finding from the only other quantitative study of national indicators that HDI is important for successful fisheries comanagement (20). Given the fact that countries were not equally represented by projects, we do not conclude that higher-level institutions do not matter, but rather that well-designed projects can be successful even in national contexts often viewed as nonconducive to success (such as rampant corruption). This finding is encouraging because conservation practitioners generally cannot change national development progress, governance, or political rights and freedoms.

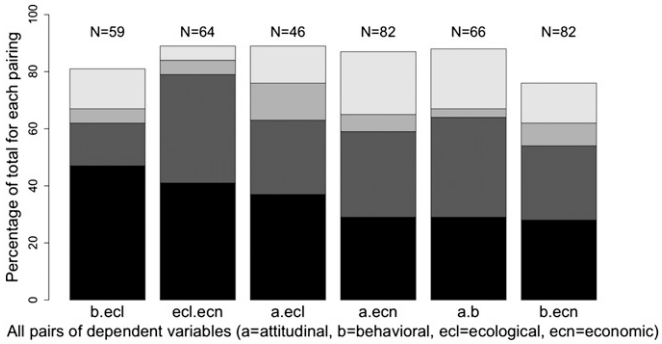

Fig. 3. Percentage of projects reporting synergies and trade-offs for all pairs of outcome variables. The values are for all pairings of each outcome variable including when those variables were measured along with other outcomes. Thus, studies with four outcomes monitored produce six possible pairings, with three outcomes three pairings, and with two outcomes one pairing. Data are plotted by pairing and ordered according to the greatest prevalence of synergy. Synergies are defined as when both outcomes were "successful" (black); partial synergies when one outcome was "successful" and one was "limited success, or both were "limited success" (dark gray); partial trade-offs when one outcome was "failure" and one was "limited success" (midgray): trade-offs when one outcome was "failure" and one was "success" (light gray). Reports of dual failures are not shown.

There is less evidence than we expected for consistent associations between community characteristics and project outcomes. In fact, only H-CC2 and H-CC3 were supported in that strong tenure rights related to economic success and local culture and institutions and population size were associated with behavioral success. We also found no evidence that market integration was associated with any measure of success, underscoring how generalizations should not be made about the effects of market access on project outcomes without considering the nature of the resources, the size and makeup of the community, and the type of market activity in question.

Again, this result does not mean that community characteristics are unimportant. Many studies point to features of the local context that are key to securing successful outcomes, such as supportive local belief systems (13, 17) and (as we find here) well-defined property rights and local tenure regimes (13, 16, 19). Among our cases reviewed, Bajracharya et al. (55) note that strong traditional management institutions (*Ban Samiti*) and a culture of cooperation were critical for behavioral and ecological success in the Annapurna Conservation Area in Nepal. In addition, Aswani et al. (56) noted that secure tenure and governance provided the context for successful marine protected area management in the Solomon Islands. These anecdotes illustrate some of the pathways through which local contexts can affect project success, such as lower discount rates, internalization of externalities, increased accountability, and the salience of trust, reciprocity, and social norms (32, 39). Our findings nonetheless suggest that well-designed projects can in many instances trump unfavorable features of the local cultural and institutional context.

More generally, incorporating multiple dimensions of project outcomes has gained traction in recent years (19, 49, 57, 58). The positive and significant association we found between all pairs of outcomes (*SI Text*) indicates strong synergies, particularly among ecological and economic outcomes that are most critical to local communities and conservation practitioners. These synergies were more prominent than in other studies (19, 49), although our use of additional outcome measures and an additional outcome level (limited success) make results difficult to compare. More importantly, our study shows that synergies are possible between all pairings of outcomes, challenging concerns about CBC (57). It is important to note, however, that trade-offs and synergies can vary over time (e.g., synergies between ecological and economic success may not persist if harvest rates become unsustainable or market fluctuations reduce the value of a resource) and may be spatially heterogeneous (59).

We appreciate that conservationists work in a more complicated world than portrayed here, and that some hypotheses may only hold in combinatorial conditions. For example, our results indicate the importance of participation and capacity building, but do not tell us how precisely to implement such features. Furthermore, although our multilevel design permits exploration of how features of project design might function in different contexts, it does not fully solve the problem that multiple variables may interact to affect project success. In addition, given the likely complexity of causal processes in producing conservation outcomes, detailed qualitative research may sometimes better illuminate key dynamics, and we note that in quantitative correlative studies like ours, correlation is not causation. We nevertheless view quantitative approaches as critical for testing hypotheses derived from qualitative work (5, 7, 23) and conducting systematic comparisons that are indispensable for guiding a broader understanding of the challenges and opportunities of CBC.

This comparative quantitative analysis strengthens the case for CBC as an effective conservation strategy and reveals unique findings with regard to the relative importance of project design vis à vis national context or community characteristics. We stress that multilevel analyses are critical to understanding the dynamics at the different scales that can affect project outcomes, especially because many of the effects shown in the bivariate analysis disappeared in the larger multivariate and multilevel analysis. We also emphasize that the amount and rigor of outcome monitoring across the domains remains low (see Fig. S2) (15, 17), despite persistent calls for more systematic evaluation of important outcomes. See efforts to standardize monitoring (http://www.conservationmeasures.org/). With more thorough data collection, future research can address important questions about mechanisms underlying key relationships, causal relationships, interactions among key variables that affect CBC outcomes, and emerging questions about synergies and tradeoffs (58).

Materials and Methods

Our data were collected through a systematic review of the CBC literature using online databases for the primary search and the Advancing Conservation in a Social Context (ACSC) digital library (www.tradeoffs.org/app/Public/Catalog) for the secondary search (see *SI Text* for search details). The searches resulted in 74 projects added to a sample of 62 projects identified in previous systematic reviews (15, 17). Studies were included if they: (*i*) were published in the primary or gray literature and were the most recent of multiple sources that address the same project, (*ii*) addressed a CBC intervention in which conservation was the primary aim, (*iii*) measured at least two of the four outcomes, and (*iv*) had missing information for no more than one-third of independent variables.

The coding protocol was modified from previous reviews (15, 17) to collect 65 pieces of information for each project, although only those relevant to the hypotheses are presented here. J.S.B. and K.A.W. coded each of the 46 projects from the primary search and discussed disagreements to choose the appropriate coding. J.S.B. then recoded all projects from the prior reviews and from the secondary (ACSC) search. K.A.W coded 47 (52%) of these remaining projects that required a second opinion. Coders based their decisions only on the information presented. Intercoder reliability for the 47 papers that K.A.W. and J.S.B coded separately was calculated (average $\kappa = 0.78$) using Cohen's κ with the *irr* function in R statistical computing (60). To reduce the amount of missing information, corresponding authors for whom a viable e-mail address was located were contacted (for use of these data see *SI Text*).

Data were analyzed using R statistical computing (60) (see *SI Results* for details of analysis and Table S7 for the correlation matrix of Spearman's *r* values for predictors used in the multivariate analysis for all five imputed datasets). Bivariate analyses were conducted using 2D contingency tables for categorical predictors and proportional odds logistic regression for continuous predictors. The Goodman–Kruskal γ-statistic was used to summarize the association between predictors and outcomes and as a test statistic for Monte Carlo significance tests. Models for the five continuous predictor variables and each outcome variable were fit using the *polr* function in R. Multiple testing

was controlled for by adjusting significance levels using *q* values (61) to obtain approximate control of the false-discovery rate. The *P* values obtained from the contingency tables and the regression models were supplied to the *q* value software (available at http://www.bioconductor.org/packages/release/bioc/html/qvalue.html).

The first step in the multivariate analysis was to impute missing values (62). Five unique datasets were created using the *MICE* package in R. All predictor and outcome variables were used to impute missing values, although these were not imputed for outcomes. After imputing missing values, conceptually similar variables were combined to reduce the number of predictors. Best-fit proportional odds models for each outcome variable were selected using a forward, stepwise Akaike Information Criterion (AIC) procedure (63). Finally, after the stepAIC algorithm identified the best-fit model, this model was fit in *lrm*, which allowed for the use of the *robcov* function to calculate robust SEs for the coefficients. Robust SEs were calculated to account for clustering of projects at the country level. We then averaged the estimates for the five imputed datasets and calculated pooled SEs (64).

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