

Equity trade-offs in conservation decision making

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applications of equity in decision making can lead to improved conservation.

Abstract

Conservation decisions increasingly involve multiple environmental and social objectives, which result in complex decision contexts with high potential for trade-offs. Improving social equity is one such objective that is often considered an enabler of successful outcomes and a virtuous ideal in itself. Despite its idealized importance in conservation policy, social equity is often highly simplified or ill-defined and is applied uncritically. What constitutes equitable outcomes and processes is highly normative and subject to ethical deliberation. Different ethical frameworks may lead to different conceptions of equity through alternative perspectives of what is good or right. This can lead to different and potentially conflicting equity objectives in practice. We promote a more transparent, nuanced, and pluralistic conceptualization of equity in conservation decision making that particularly recognizes where multidimensional equity objectives may conflict. To help identify and mitigate ethical conflicts and avoid cases of good intentions producing bad outcomes, we encourage a more analytical incorporation of equity into conservation decision making particularly during mechanistic integration of

equity objectives. We recommend that in conservation planning motivations and objectives for equity be made explicit within the problem context, methods used to incorporate equity objectives be applied with respect to stated objectives, and, should objectives dictate, evaluation of equity outcomes and adaptation of strategies be employed during policy implementation

Equity in Conservation

Conservation decisions involve multiple objectives and result in complex decision contexts with high potential for trade-offs and explicit conflict among stakeholders. Such trade-offs are common (Martin et al. 2008; Pfund 2010; Howe et al. 2014) and fraught with ethical dilemmas (Jax et al. 2013). Even when so-called win-win outcomes are socially and ecologically beneficial, they usually come at substantial opportunity costs for one or more stakeholders (McShane et al. 2011; Law et al. 2017). Conservation decision making, including the planning, prioritization, and implementation of conservation actions, needs to account for equity. Some stakeholders may receive or perceive they are receiving unfair treatment (Bennett 2016), and stakeholder responses to this may derail conservation interventions (Ferraro et al. 2007; Waylen et al. 2013).

Equity is seen as both a virtuous policy ideal in itself and instrumental to the success of conservation and has become embedded in national and international conservation mandates. However, these mandates often lack practical conceptual and methodological clarity. For instance, the Convention on Biological Diversity Aichi Target 11 specifies that networks of protected areas must be “equitably managed” (CBD 2011), yet no operational definition of *equity* is provided, despite ongoing efforts to do so (Zafra-Calvo

et al. 2017). This emphasizes equity is a highly normative and multifaceted concept and thus, as a policy goal, can be highly contested and problematic to implement.

Many normative guidelines exist related to stakeholder participation (Ives & Kendal 2014) and general equity considerations (Robinson 2011). However, equity is included quantitatively in conservation planning and prioritization relatively superficially, for instance in simplified metrics of stakeholder needs or desires (Klein et al. 2010; Law et al. 2017) or indices of distributional factors (Halpern et al. 2013). Multiple equity objectives are rarely considered, especially those derived from different moral philosophies. This is problematic because alternative ethical frameworks can dramatically influence trade-offs between equity objectives (Dietz & Atkinson 2010).

Given the idealized importance, prominence, and potential benefits of equity in conservation policy and decision making, there is a need for a more sophisticated operational understanding (Jax et al. 2013). We sought to provide an overview of equity in conservation decision making by identifying motivations for considering equity, illustrating how alternative ethical frameworks influence what is considered equitable, and demonstrating how alternative equity objectives may conflict. Last, we considered the objectives and challenges of alternative methods for incorporating equity in conservation decision making, emphasizing that appropriate methods may differ based on the context, equity motivations, and objectives.

Dimensions of Equity

Equity, in simple terms, refers to fair or just treatment of individuals or groups. Here we applied the definition of equity established for environmental management (McDermott

et al. 2013) that has 3 dimensions: *procedural*, equitable involvement and inclusion of all stakeholder groups in rule making and decisions; *distributional*, equitable distribution of costs, benefits, rights, responsibilities, and risk within and among groups from present and future generations; *recognitional*, equitable respect for knowledge systems, values, social norms, and rights of all stakeholders in policy or program design and implementation; and *contextual*, equitable consideration of the broad social, governance, economic, and cultural contexts, past and present (e.g., power dynamics, gender, education, ethnicity, age), that influence an actor's ability to gain recognition, participate in decision making, and lobby for fair distribution.

Procedural, distributional, and recognitional dimensions can be incorporated directly in conservation plans. Contextual equity often defines what is necessary and enables or constrains achievement of equity in conservation initiatives. Stakeholders may include individuals or groups that affect, are affected by or otherwise have an interest in the problem context and decision process. In conservation decisions, stakeholders typically include consideration of elements of nature, either directly or via the expressed interest of human stakeholders.

Motivations for Considering Equity

Motivations for social equity inclusion in conservation decision making can be fundamental (virtues or ego) or outcome based (social or environmental) (Fig. 1). Fundamental motivations are embodied by the perception that equity – in processes and outcomes – is inherently right or valuable, whether or not it leads to support for conservation (Chan & Satterfield 2013). Outcome-based motivations result from framing equity as instrumental to achieving desirable ends. For example, increasing the

equity of decision making processes or social outcomes may facilitate community acceptance of conservation decisions and result in a higher likelihood of success (Halpern et al. 2013; Bennett 2016). It is possible to be motivated by fundamental and outcome-based rationales simultaneously, maintaining both social and environmental values (Chan et al. 2016). We premised our argument on the idea that there are different motivations and objectives for including equity in environmental decision making (many of which are held simultaneously) and did not prejudging their relative merit or virtue.

How Ethics Underpins What is Considered Equitable

Ethical frameworks are the cognitive basis on which the desire for equity is motivated and on which equity is defined, planned for, and judged relative to the 4 dimensions of equity described above. Ethics is the theory and practice of rational and reasoned deliberations when moral codes conflict. For example, Western philosophy distinguishes 3 broad schools of thought in normative ethics– consequentialism, deontology, and virtue. These respectively shift the focus of the ethical lens from the outcomes of actions, to the actions themselves, and to the inherent character of the actor (Table 1).

Approaching a dilemma from different ethical stances can yield different solutions. In conservation triage, for example, the sacrifice of the most threatened species may be rationalized and accepted under a consequentialist framework based on a principle of the greatest good for the greatest number but challenged from a deontological perspective of the fundamental wrongness of allowing (or arguably facilitating) species extinctions and from a virtue-based principle of respect for all species (Wilson & Law

2016). These simplistic examples illustrate how underlying ethics affect perceptions of appropriate conservation action and result in different emphases being placed on contextual, recognition, procedural, and distributional aspects of equity (Table 1). These examples are an incomplete representation of the diversity of ethics that may be present in conservation decisions (e.g., Callicott 1997; Rozzi et al. 2013).

Conflicting Equity Objectives

A diversity of ethical stances means that perspectives of what is equitable differ and can conflict (Robinson 2011). This potential for conflict can be illustrated using formalized cake-cutting games. Cake-cutting games exemplify three facets of equity: recognition, who should play the game; procedure, what protocols are involved; and distribution, how much cake is allocated to each player. In the simple form of the game (2 players, no negotiation, one divisible and homogeneous cake), one player cuts the cake and the other takes the piece she or he prefers. Theory predicts this will result in an equal distribution of cake and is a procedure where neither player envies the other's piece of cake or the role of the other player (Brams & Taylor 1996; Robertson & Webb 1998).

This I cut, you choose method is generally Pareto efficient and envy free; however, equal pieces of cake, while providing outcome equality, may not necessarily be equitable in terms of equal utility. Each player's subjective valuation of his or her piece is not necessarily equal to the others' subjective valuation of their respective pieces (Nicolò & Yu 2008). For instance, if one player has a large appetite for cake and the other is watching their weight, then an equal division is not necessarily optimal, efficient, or

equitable in terms of utility, even if it is derived from a proportional, envy-free process (Nicolò & Yu 2008).

This simple game shows the inevitability of an ethical dilemma in allocation decisions: conflict between procedural and distributional equity. Rarely do environmental problems involve only two players, however, and never do they concern only one, divisible, homogenous cake. Three or more players make the game more complex, and although strategies exist, they cannot be envy-free and result in equal proportions (Nicolò & Yu 2008). Thus, in practice, the notion of equity is intrinsically subjective and context dependent and involves trade-offs among equity objectives (Dietz & Atkinson 2010).

Matching Motivations with Methods in Conservation Practice

Given the potential for conflicting equity objectives, how can trade-offs be managed best within a conservation-decision process? Quantitatively, conservation decision making is typically framed with utilitarian ethics, such as maximizing the utility of an outcome exemplified by the many systematic decision tools used to determine the optimal areas to protect for maximum species representation or actions to undertake for maximum species persistence (Moilanen et al. 2009). However, these planning tools are typically applied within a wider and often more qualitative decision making process to which the majority of ethical deliberations are often passed. We considered how different methods at different stages of this process can be used to address a range of ethical motivations and equity objectives and highlight where inappropriate use may result in perverse outcomes.

Defining Equity Motivations and Objectives within the Problem Context

Motivations for considering equity within conservation need to be discerned as fundamental or outcome based, virtuous or self-serving, and focused on social or environmental outcomes (Fig. 1). These motivations form the guiding principles of the decision-making process: determining how the problem is conceptualized, the general objectives for equity within the process, and methods used to implement interventions and assess outcomes. For example, improving social acceptance of conservation implementation is an objective based on the community perception of the conservation project and requires extensive community participation (Martin et al. 2014), whereas determining how equality and cost-efficiency objectives trade off may not require public consultation (Halpern et al. 2013). Managing trade-offs effectively requires recognizing where important objectives (equity or otherwise) may conflict in the decision-making process or may not be achievable with available resources (e.g., if they are not tractable given the data and time available). Transparent communication of these motivations, objectives, and potential limitations is useful to manage expectations.

Considering Preexisting and Potential Conflicts when Including Stakeholders

Including stakeholders in decision making is commonly endorsed (Cowling et al. 2008; Pressey & Bottrill 2008; Knight et al. 2011). This ethic is sometimes motivated by a stakeholder's perceived right to be included within or in control of a decision process that concerns them (i.e., recognitional and procedural equity [Fontana & Grugel 2016; Martin et al. 2016]) but is often also motivated by desires to account for all stakeholder preferences in a consequentialist framework (i.e., distributional equity [Law et al. 2017]). Stakeholders can give voice to values that are more difficult to objectively quantify. Including stakeholders may also be motivated by the desire for outcome

effectiveness and efficiency, based on the assumption that including stakeholders leads to a better acceptance of the decision-making process and outcomes and thereafter to more successful implementation (Halpern et al. 2013).

These ethical ideals may not eventuate, however, because equitable participation can be difficult to ensure (Goodwin 1998; Fontana & Grugel 2016; Martin et al. 2016).

Negotiations are inherently argumentative processes that involve information asymmetries and incentives to lie, posture, and exaggerate. Procedures can encourage stakeholders to act reasonably and honestly in their self-interest (e.g., by including third-party audiences, both legal and peer), but even these can be gamed (e.g., by initiating escrow bargaining mechanisms) or convergence can be forced to focal points rather than truthfully fair distributions (Brams & Taylor 1996). Focal points may be an equal distribution, which, as discussed above, may not be equitable. Alternatively, as is commonly seen in international forums, focal points may be vague or weak solutions (Maxwell et al. 2015) that may be inequitable if they do not lead to substantive action.

Given that many of the world's most pressing environmental problems occur in socially and politically unstable contexts (Hammill et al. 2016), practicing conflict-sensitive identification and engagement of stakeholders should be of a higher priority than merely including stakeholders (Gaynor et al. 2016; Martin et al. 2016). Conflict-sensitive conservation (Hammill et al. 2000) considers and accounts for the preexisting equity context – the causes, actors, and impacts of conflict – to minimize the negative impacts of conflict on social and environmental outcomes and maximize peace-building opportunities. The challenge presented by focal points emphasizes the need to revisit equity objectives regularly through the decision process and that no one approach to

equity is likely to be sufficient to deliver processes and outcomes that are equitable across all dimensions.

Defining Metrics and Targets that Include Process and Outcome

Metrics measure the concerns or values of stakeholders, whereas targets are a way of integrating stakeholder demand, entitlement, utility, and aspirations. Metrics and targets for multiple stakeholders are used in social-equity planning (Klein et al. 2010), where *equity* is defined as satisfying stakeholder objectives or minimizing trade-offs (Law et al. 2017). Metrics differentially reflect the values expressed by stakeholders, incentivize positive action, and minimize negative action (Law et al. 2015). Yet decision making is often based pragmatically on available data, which biases against values and concerns that are difficult to quantify, such as existence or cultural heritage (Martinez-Harms et al. 2015). Defining threshold-based targets is complex and involves balancing the needs of sociopolitical feasibility and biophysical adequacy, avoiding perverse incentives, and ensuring adequate interpretations of underlying ethical principles (Carwardine et al. 2009; Hill et al. 2016). Underoptimistic targets could be inequitable or represent lost opportunity. However, overoptimistic targets can carry a high risk of failure (Blom et al. 2010; McShane et al. 2011), and some stakeholders may be burdened if risk levels exceed their risk preferences (Greiner et al. 2009; Estevez et al. 2015).

Different methods to elicit individual and group stakeholder values and targets can profoundly influence conservation outcomes (Martin et al. 2012; Burgman et al. 2014; Burton-Chellew et al. 2015) due to bounded rationality (Burton-Chellew et al. 2015), varying levels of risk aversion (Greiner et al. 2009; Hintze et al. 2015), framing effects (Krupenye et al. 2015), group partiality (Hildreth et al. 2016), and other cognitive

limitations or biases (Iftekhhar & Pannell 2015; Levine et al. 2015). Underlying values, which reflect the moral basis of ethical frameworks, are distinct from attitudes, which are explicit realizations of preferences in particular contextualized dilemmas (Ives & Kendal 2014). Equity implications of metrics and targets should consider the procedure (the metrics and targets applied and how they are measured or elicited) and the outcome (the resulting distribution of costs, benefits, and risk).

Critically Assessing Equality Metrics for Measuring Equity

Equity objectives may be specified explicitly as performance metrics during planning and prioritization, for example as a counterpoint to efficiency metrics in otherwise utilitarian-focused analyses (e.g. Halpern et al. 2013). The most commonly used metric of equity is the Gini coefficient (Maguire & Sheriff 2011; Halpern et al. 2013), a measure of equality (i.e., how evenly a resource is distributed among stakeholders) (Bellù & Liberati 2006; Maguire & Sheriff 2011). Other metrics include the Thiel index (a weighted average of inequality within subgroups plus inequality among subgroups) and the 20:20 ratio (income from the top 20% of the population versus the bottom 20%).

Equity metrics typically measure inequality, not inequity. Inequality metrics fail to consider, for instance, fairness or distributive justice and may fail to deliver an allocation that is efficient, socially optimal, or envy free. Equity metrics differ in sensitivity to sample size and ability to detect and interpret changes in the metric as good or bad (Mackebach & Kunst 1997; De Maio 2007; Maguire & Sheriff 2011).

Correlations drawn between measures of social welfare and income inequality are not always consistent over time (Hiilamo & Kangas 2014) or theme (Fisher & Naidoo 2016).

Halpern et al. (2013) use a Gini coefficient to account for equity concerns in a prioritization of marine protected areas across multiple fishing communities. Although large gains in equality can be realized for little additional cost (i.e., reduction in efficiency), they note that their equality considerations may fail to generate “accepted” plans when “the needs or desires of particularly vocal or powerful minorities are not met” (Halpern et al. 2013). Equal allocations are fair when a resource is homogenous and all stakeholders can gain the same utility from their allocation (i.e., have the same needs, preferences, and capabilities). In the Halpern et al. (2013) example, unequal utility may arise from communities differing in the amount of fish needed to sustain the village (e.g., if villages have different populations or access to alternative resources that either increase their capacity to fish despite the restrictions or reduce their dependency on fishing) or if the original allocation was uneven. For example, a community with a small custodial area may need to exploit proportionately more of that area to sustain the community than another community with access to a larger resource. Further ethical complications arise within communities because stakeholder groups are not homogenous entities (Waylen et al. 2013).

Although equality is a rational choice when preferences are unknown, engagement of stakeholders usually aims to reveal preferences (Cowling et al. 2008; Pressey & Bottrill 2008; Knight et al. 2011). Further, strict equality is typically not preferred within societies, regardless of ethical stance (Dietz & Atkinson 2010; Martin et al. 2014). Thus, although incorporating equity metrics in conservation decision making can be useful, careful consideration of how they align with overall equity objectives is needed.

Pursuing Efficiency or Equity

Environmental prioritization problems typically involve the (utilitarian) objective of efficiency – maximizing the benefit-to-cost ratio. The simplicity of this formulation belies the complexity of equity considerations: different types of benefits and costs, time frames, and how different stakeholder values are aggregated or disaggregated (Nyborg 2012; Andrews & Entwistle 2014). Conservation decision making has typically focused on technical efficiency, a short-run approach assuming fixed resources, costs, and benefits (Moilanen et al. 2009). Other efficiency concepts include dynamic efficiency, which balances short-run management objectives with long-run monitoring objectives (Grantham et al. 2008; Grantham et al. 2009), and allocative efficiency, which equates supply with demand (Ando & Shah 2010). With Pareto or Kaldor-Hicks efficiency additional benefits for some stakeholders should only be made without cost to another, a criterion often applied to policy decisions (Stavins 2007). Pareto frontiers are particularly useful in environmental management for analyzing the nature of trade-offs between objectives, clarifying possible and impossible solutions, and evaluating efficiency of current or planned allocations against this frontier (Law et al. 2017). Distributive efficiency aims to maximize social utility and is a focus of the sustainability and welfare literature (Andrews 2014; Herrera & Rosellón 2014).

The different types of efficiency emphasize the trade-offs and links between efficiency and equity. Focusing on one definition of *efficiency* compromises the achievement of other formulations of efficiency, which will likely be detrimental to equity objectives. Although some types of efficiency may seem more focused on equity than others, equity and efficiency are fundamentally codependent. If one stakeholder can be made better off without detriment to another, then this is likely a more ethical approach to pursue (Martin et al. 2008; Dietz & Atkinson 2010; Halpern et al. 2013). Rarely are

environments managed optimally, however, and management may be so suboptimal that it may be more pragmatic in some cases to focus initially on allocations satisfying basic needs (i.e. adequacy) rather than efficiency.

Facilitating, Monitoring, and Evaluating Equity in Implementation

If equity is incorporated in conservation decisions to ensure an equitable or accepted outcome, then it follows that conservation interventions should be evaluated during and after implementation with respect to the equity objectives and modified, expanded, or terminated accordingly. Rarely are planned policies implemented optimally.

Unintended outcomes may occur, particularly when interventions rely on the behavior of stakeholders. For example, land-clearing legislation may incite panic clearing (Whelan & Lyons 2005) and endangered species policy may encourage preemptive destruction (Ferraro et al. 2007). Furthermore, what is considered equitable may change over time, particularly during periods of negotiation and reflection, and with changes in social and economic systems. Causal-inference approaches offer ways to robustly estimate policy impacts (Pfaff & Robalino 2012; Ferraro & Hanauer 2014; Baylis et al. 2016). Eliciting stakeholder perceptions of intervention outcomes offers a direct metric of stakeholder perceptions of equity (Bennett 2016), including of values less amenable to quantification, and, depending on equity objectives, can provide a useful adjunct or replacement of biodiversity metrics that may be more difficult, time consuming, or costly.

Interventions relying on voluntary participation are perhaps most sensitive to variation because effort is not guaranteed and the motivational landscape may change during implementation. For example in private-land conservation, participants are often financially motivated ; however, personal circumstances, social and conservation

attitudes, place attachment, bequest values, nonmonetary costs, and networking, recreational, and educational opportunities are often equally if not more important (Moon & Cocklin 2011; Ma et al. 2012; Selinske et al. 2015). There may be trade-offs in regard to promoting broad participation, volunteer retention, and additionality (Armsworth et al. 2012). Moreover, crowding out may occur, wherein intrinsic moral obligations for conservation action are replaced by extrinsic finance or regulation (Moon & Cocklin 2011; Brown et al. 2015; Rode et al. 2015): an inefficient and likely inequitable outcome (Cooke et al. 2012).

The right of self-determination (e.g., land tenure and customary rights) is a strong and recurring theme in discussions of environmental ethics. How then can a regional planner have any certainty of the outcomes? Arguably, regional level plans will always evolve during implementation (Pressey et al. 2013); however, allowing local governance institutions to have autonomy may exacerbate this. A novel approach to this problem treats the outcomes as uncertain. With this approach, planners could use decision-theoretic techniques that account for this uncertainty (Tulloch et al. 2013). Parcels could be allocated to community groups with the expectation that not all will be restored and that this outcome may be stochastic. This may allow planning at regional scales to occur with an accepted (and specified) level of certainty but preserve self-determination at local scales.

Discussion and Recommendations

The importance of equity as an enabler for successful conservation and as a virtuous goal gives credence to the increasing prominence of equity in policy. This is challenged by the reality of diverse individual values, attitudes, and preferences, and, at least in

practice, that what is considered good or right is subjective and relative to social, cultural, historical, or personal circumstances. The conservation decision-making literature has focused on many equity dimensions: distributional, recognitional, procedural, and contextual. Although these are useful starting points for understanding equity, a nuanced understanding of how these can be incorporated at different stages of a decision-making process is critical, particularly how objectives may trade-off and how equity can be better integrated into quantitative planning and prioritization. Different concepts of equity can be drawn from a variety of ethical frameworks and further different equity objectives, although often not entirely independent, can conflict and are likely not commensurable. This potential pluralism of equity means that different concepts of equity are likely to be held by different stakeholders and that these varied equity objectives may not be mutually achievable.

Such potential for trade-offs and conflict highlights the need for a more transparent and nuanced understanding of equity in conservation decision making. Starting with the premise of ethical pluralism, we identified 10 recommendations for a more nuanced integration of equity into conservation decisions (Fig. 2), organized into 3 guiding principles: defining motivations and objectives for equity within the problem context; planning for diverse stakeholders and equity objectives; and ensuring equity is achieved during implementation.

We suggest that conservation decision-making be guided by the concept of ethical pluralism. We see opportunity for a greater application of applied ethics in environmental decisions in terms of understanding the ethical stances of stakeholders (and incorporating these into conservation decision making [e.g. Martin et al. 2014]) and examining how different institutional and policy approaches address different

ethical dilemmas. We also see the potential for ethical pluralism to be incorporated into the design of more holistic measures and methods for assessing equity, given the increasing prominence of social equity in conservation actions. Such assessment frameworks may, for example, be differentiated by theme (e.g., social or environmental) and dominant motivations for incorporating equity. Performance metrics that factor in potential conflict among equity objectives may be required. Although incorporating equity into conservation decision making adds a layer of complexity to already challenging social and environmental decision contexts, we hope this complexity will be embraced and better conservation decisions will result.

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Literature Cited

Ando AW, Shah P. 2010. Demand-side factors in optimal land conservation choice. *Resource and Energy Economics* **32**:203-221.

- Andrews R. 2014. Distributive efficiency. Pages 47-64 in Andrews R, and Entwistle T, editors. Public service efficiency. Routledge, London.
- Andrews R, Entwistle T. 2014. Public service efficiency. New York: Routledge.
- Armsworth PR, Acs S, Dallimer M, Gaston KJ, Hanley N, Wilson P. 2012. The cost of policy simplification in conservation incentive programs. *Ecology Letters* **15**:406-414.
- Baylis K, Honey-Rosés J, Börner J, Corbera E, Ezzine-de-Blas D, Ferraro PJ, Lapeyre R, Persson UM, Pfaff A, Wunder S. 2016. Mainstreaming impact evaluation in nature conservation. *Conservation Letters* **9**:58-64.
- Bellù LG, Liberati P. 2006. Inequality analysis: the gini index. EASYPol Module 40. UN Food and Agriculture Organization, Rome.
- Bennett NJ. 2016. Using perceptions as evidence to improve conservation and environmental management. *Conservation Biology* **30**:582-592.
- Blom B, Sunderland T, Murdiyarso D. 2010. Getting REDD to work locally: lessons learned from integrated conservation and development projects. *Environmental Science & Policy* **13**:164-172.
- Brams SJ, Taylor AD 1996. Fair division: from cake-cutting to dispute resolution. Cambridge University Press, Cambridge.
- Brown Z, Alvarez B, Johnstone N. 2015. Tender instruments: programme participation and impact in australian conservation tenders, grants and volunteer organisations. Environment working papers number 85. Organisation for Economic Co-Operation and Development Publishing, Paris.
- Burgman MA, Regan HM, Maguire LA, Colyvan M, Justus J, Martin TG, Rothley K. 2014. Voting systems for environmental decisions. *Conservation Biology* **28**:322-332.

- Burton-Chellew MN, Nax HH, West SA. 2015. Payoff-based learning explains the decline in cooperation in public goods games. *Proceedings of the Royal Society B* **282**:20142678.
- Callicott BJ 1997. *Earth's insights: a multicultural survey of ecological ethics from the Mediterranean Basin to the Australian Outback*. University of California Press, Berkeley.
- Carwardine J, Klein CJ, Wilson KA, Pressey RL, Possingham HP. 2009. Hitting the target and missing the point: target-based conservation planning in context. *Conservation Letters* **2**:4-11.
- CBD (Convention on Biological Diversity). 2011. TARGET 11 - technical rationale extended (provided in document COP/10/INF/12/Rev.1). CBD Secretariate, Montreal. Available from <https://www.cbd.int/sp/targets/rationale/target-11/> (accessed September 2016).
- Chan KM, et al. 2016. Why protect nature? Rethinking values and the environment. *Proceedings of the National Academy of Sciences USA* **113**:1462-1465.
- Chan KMA, Satterfield T. 2013. Justice, equity and biodiversity. Pages 434-441 in Levin SA, editor. *Encyclopaedia of biodiversity*. Academic Press, Waltham.
- Cooke B, Langford WT, Gordon A, Bekessy S. 2012. Social context and the role of collaborative policy making for private land conservation. *Journal of Environmental Planning and Management* **55**:469-485.
- Cowling RM, Egoh B, Knight AT, O'Farrell PJ, Reyers B, Rouget M, Roux DJ, Welz A, Wilhelm-Rechman A. 2008. An operational model for mainstreaming ecosystem services for implementation. *Proceedings of the National Academy of Sciences USA* **105**:9483-9488.

- De Maio FG. 2007. Income inequality measures. *Journal of Epidemiology and Community Health* **61**:849-852.
- Dietz S, Atkinson G. 2010. The equity-efficiency trade-off in environmental policy: Evidence from stated preferences. *Land Economics* **86**:423-443.
- Estevez RA, Anderson CB, Pizarro JC, Burgman MA. 2015. Clarifying values, risk perceptions, and attitudes to resolve or avoid social conflicts in invasive species management. *Conservation Biology* **29**:19-30.
- Ferraro PJ, Hanauer MM. 2014. Advances in measuring the environmental and social impacts of environmental programs. *Annual Review of Environment and Resources* **39**:495-517.
- Ferraro PJ, McIntosh C, Ospina M. 2007. The effectiveness of the US endangered species act: an econometric analysis using matching methods. *Journal of Environmental Economics and Management* **54**:245-261.
- Fisher B, Naidoo R. 2016. The geography of gender inequality. *PLoS One* **11** (e0145778) DOI: 10.1371/journal.pone.0145778.
- Fontana LB, Grugel J. 2016. The politics of indigenous participation through “free prior informed consent”: Reflections from the Bolivian case. *World Development* **77**:249-261.
- Gaynor KM, Fiorella KJ, Gregory GH, Kurz DJ, Seto KL, Withey LS, Brashares JS. 2016. War and wildlife: linking armed conflict to conservation. *Frontiers in Ecology and the Environment* **14**:533-542.
- Goodwin P. 1998. 'Hired hands' or 'local voice': Understandings and experience of local participation in conservation. *Transactions of the Institute of British Geographers* **23**:481-499.

- Grantham HS, Moilanen A, Wilson KA, Pressey RL, Rebelo TG, Possingham HP. 2008. Diminishing return on investment for biodiversity data in conservation planning. *Conservation Letters* **1**:190-198.
- Grantham HS, Wilson KA, Moilanen A, Rebelo T, Possingham HP. 2009. Delaying conservation actions for improved knowledge: how long should we wait? *Ecology Letters* **12**:293-301.
- Greiner R, Patterson L, Miller O. 2009. Motivations, risk perceptions and adoption of conservation practices by farmers. *Agricultural Systems* **99**:86-104.
- Halpern BS, et al. 2013. Achieving the triple bottom line in the face of inherent trade-offs among social equity, economic return, and conservation. *Proceedings of the National Academy of Sciences USA* **110**:6229-6234.
- Hammill A, Crawford A, Craig R 2000. Conflict-sensitive conservation: practitioners' manual. International Institute for Sustainable Development, . Available from <http://www.iisd.org/library/conflict-sensitive-conservation-practitioners-manual> (accessed September 2016).
- Hammill E, Tulloch AI, Possingham HP, Strange N, Wilson KA. 2016. Factoring attitudes towards armed conflict risk into selection of protected areas for conservation. *Nature Communications* **7**:11042.
- Herrera LÁ, Rosellón J. 2014. On distributive effects of optimal regulation for power grid expansion. *Energy Policy* **69**:189-204.
- Hiilamo H, Kangas O. 2014. Cherry picking. *The International Journal of Sociology and Social Policy* **34**:771-771.
- Hildreth JAD, Gino F, Bazerman M. 2016. Blind loyalty? When group loyalty makes us see evil or engage in it. *Organizational Behavior and Human Decision Processes* **132**:16-36.

- Hill SLL, Harfoot M, Purvis A, Purves DW, Collen B, Newbold T, Burgess ND, Mace GM. 2016. Reconciling biodiversity indicators to guide understanding and action. *Conservation Letters* **9**:405-412.
- Hintze A, Olson RS, Adami C, Hertwig R. 2015. Risk sensitivity as an evolutionary adaptation. *Scientific Reports* **5**:8242.
- Howe C, Suich H, Vira B, Mace GM. 2014. Creating win-wins from trade-offs? Ecosystem services for human well-being: A meta-analysis of ecosystem service trade-offs and synergies in the real world. *Global Environmental Change* **28**:263-275.
- Iftexhar MS, Pannell DJ. 2015. "Biases" in adaptive natural resource management. *Conservation Letters* **8**:388-396.
- Ives CD, Kendal D. 2014. The role of social values in the management of ecological systems. *Journal of Environmental Management* **144**:67-72.
- Jax K, et al. 2013. Ecosystem services and ethics. *Ecological Economics* **93**:260-268.
- Klein CJ, Steinback C, Watts M, Scholz AJ, Possingham HP. 2010. Spatial marine zoning for fisheries and conservation. *Frontiers in Ecology and the Environment* **8**:349-353.
- Knight AT, Cowling RM, Boshoff AF, Wilson SL, Pierce SM. 2011. Walking in STEP: Lessons for linking spatial prioritisations to implementation strategies. *Biological Conservation* **144**:202-211.
- Krupenye C, Rosati AG, Hare B. 2015. Bonobos and chimpanzees exhibit human-like framing effects. *Biology Letters* **11**:20140527.
- Law EA, Bryan BA, Meijaard E, Mallawaarachchi T, Struebig MJ, Watts ME, Wilson KA, Mori A. 2017. Mixed policies give more options in multifunctional tropical forest landscapes. *Journal of Applied Ecology* **54**:51-60

- Law EA, Bryan BA, Torabi N, Bekessy SA, McAlpine CA, Wilson KA. 2015. Measurement matters in managing landscape carbon. *Ecosystem Services* **13**:6-15.
- Levine J, Chan KMA, Satterfield T. 2015. From rational actor to efficient complexity manager: Exorcising the ghost of Homo economicus with a unified synthesis of cognition research. *Ecological Economics* **114**:22-32.
- Ma Z, Butler BJ, Kittredge DB, Catanzaro P. 2012. Factors associated with landowner involvement in forest conservation programs in the U.S.: Implications for policy design and outreach. *Land Use Policy* **29**:53-61.
- Mackenbach JP, Kunst AE. 1997. Measuring the magnitude of socio-economic inequalities in health: an overview of available measures illustrated with two examples from Europe. *Social Science and Medicine* **44**:757-771.
- Maguire K, Sheriff G. 2011. Comparing distributions of environmental outcomes for regulatory environmental justice analysis. *International Journal of Environmental Research and Public Health* **8**:1707-1726.
- Martin A, Blowers A, Boersema J. 2008. Paying for environmental services: can we afford to lose a cultural basis for conservation? *Environmental Sciences* **5**:1-5.
- Martin A, Coolsaet B, Corbera E, Dawson NM, Fraser JA, Lehmann I, Rodriguez I. 2016. Justice and conservation: The need to incorporate recognition. *Biological Conservation* **197**:254-261.
- Martin A, Gross-Camp N, Kebede B, McGuire S. 2014. Measuring effectiveness, efficiency and equity in an experimental Payments for Ecosystem Services trial. *Global Environmental Change* **28**:216-226.

- Martin TG, Burgman MA, Fidler F, Kuhnert PM, Low-Choy S, McBride M, Mengersen K. 2012. Eliciting expert knowledge in conservation science. *Conservation Biology* **26**:29-38.
- Martinez-Harms MJ, Bryan BA, Balvanera P, Law EA, Rhodes JR, Possingham HP, Wilson KA. 2015. Making decisions for managing ecosystem services. *Biological Conservation* **184**:229-238.
- Maxwell SL, Milner-Gulland EJ, Jones JP, Knight AT, Bunnefeld N, Nuno A, Bal P, Earle S, Watson JE, Rhodes JR. 2015. Environmental science. Being smart about SMART environmental targets. *Science* **347**:1075-1076.
- McDermott M, Mahanty S, Schreckenberg K. 2013. Examining equity: a multidimensional framework for assessing equity in payments for ecosystem services. *Environmental Science & Policy* **33**:416-427.
- McShane TO, et al. 2011. Hard choices: Making trade-offs between biodiversity conservation and human well-being. *Biological Conservation* **144**:966-972.
- Moilanen A, Wilson K, Possingham H. 2009. *Spatial Conservation Prioritization: Quantitative Methods and Computational Tools*. Oxford University Press, Oxford.
- Moon K, Cocklin C. 2011. Participation in biodiversity conservation: Motivations and barriers of Australian landholders. *Journal of Rural Studies* **27**:331-342.
- Nicolò A, Yu Y. 2008. Strategic divide and choose. *Games and Economic Behavior* **64**:268-289.
- Nyborg K 2012. *The Ethics and Politics of Environmental Cost-Benefit Analysis*. Routledge, Abingdon, Oxon, United Kingdom.

- Pfaff A, Robalino J. 2012. Protecting forests, biodiversity, and the climate: predicting policy impact to improve policy choice. *Oxford Review of Economic Policy* **28**:164-179.
- Pfund J-L. 2010. Landscape-scale research for conservation and development in the tropics: fighting persisting challenges. *Current Opinion in Environmental Sustainability* **2**:117-126.
- Pressey RL, Bottrill MC. 2008. Opportunism, threats, and the evolution of systematic conservation planning. *Conservation Biology* **22**:1340-1345.
- Pressey RL, Mills M, Weeks R, Day JC. 2013. The plan of the day: Managing the dynamic transition from regional conservation designs to local conservation actions. *Biological Conservation* **166**:155-169.
- Robertson J, Webb W 1998. *Cake-cutting algorithms: be fair if you can*. AK Peters, Massachusetts.
- Robinson J.G. 2011. Ethical pluralism, pragmatism, and sustainability in conservation practice. *Biological Conservation* **144**:958–965.
- 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.
- Rozzi R, Pickett STA, Palmer C, Armesto JJ, Callicott BJ, editors. 2013. *Linking Ecology and Ethics for a Changing World*. Springer, New York.
- Selinske MJ, Coetzee J, Purnell K, Knight AT. 2015. Understanding the motivations, satisfaction, and retention of landowners in private land conservation programs. *Conservation Letters* **8**:282-289.

Stavins RN. 2007. Environmental economics. Working paper 13574. National Bureau of Economic Research, New York. Available from

<http://www.nber.org/papers/w13574> (accessed September 2016).

Tulloch VJ, Possingham HP, Jupiter SD, Roelfsema C, Tulloch AIT, Klein CJ. 2013.

Incorporating uncertainty associated with habitat data in marine reserve design.

Biological Conservation **162**:41-51.

Waylen KA, Fischer A, McGowan PJ, Milner-Gulland EJ. 2013. Deconstructing community

for conservation: Why simple assumptions are not sufficient. *Human Ecology*

41:575-585.

Whelan J, Lyons K. 2005. Community engagement or community action: Choosing not to

play the game. *Environmental Politics* **14**:596-610.

Wilson KA, Law EA. 2016. Ethics of conservation triage. *Frontiers in Ecology and*

Evolution **4**:112.

Zafra-Calvo N, Pascual U, Brockington D, Coolsaet B, Cortes-Vazquez JA, Gross-Camp N,

Palomo I, Burgess ND. 2017. Towards an indicator system to assess equitable

management in protected areas. *Biological Conservation* **211**:134-141

Table 1: Three examples of normative ethical frameworks prominent in western philosophy that can be interpreted as emphasizing different definitions, approaches, and objectives in conservation decision making.*

	Consequential ism	Deontology	Virtue
Broad definition and examples of	Morality is contingent on the outcome.	Morality is contingent on the actions	Morality is based on inherent

<p>potential principles</p>	<p>Objectives aim to maximize good or minimize bad. examples include utilitarianism (the greatest good for the greatest number), hedonism (maximizing own pleasure), egoism (maximizing benefit for self), and altruism (maximizing benefit for others)</p>	<p>themselves rather than the outcomes. Emphasis is on one's duties and others' rights. examples include the concepts of natural (universal) rights, divine command (the word of god), contractualism, and contractarianism (rights and duties mutually agreed on, focus on interpersonal and social relationships, respectively);</p>	<p>character, not individual actions. examples include eudiamonism (practicing everyday activities that benefit personal well-being), agent based (character traits that are admirable), and the ethics of care (compassion, patience, nurture, and self-sacrifice)</p>
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		can be conceptualized as pluralistic, including 7 prima facie duties of benevolence, nonmaleficence, justice, self-improvement, reparation, gratitude, and promise keeping	
Example equity objective in environmental decision making	Increase acceptance and success of the decision	Stakeholders should have a right to be in the decision-making process.	As a decision maker, I want to be a good person.
contextual equity	considered in terms of perceptions of equity relative to past experience	considered in terms of stakeholder capacity to participate fairly	considered in terms of potential to right past wrongs

	because costs and benefits are perceived relative to preexisting socioeconomic conditions		
recognition al equity	consideration of all major stakeholders that can influence success of implementation	include all stakeholders who believe they have a stake.	consider all stakeholders who believe they have a stake
procedural equity	emphasized to reduce conflict and improve ownership of final decisions	emphasized to fairly allocate participation (voice) in decision-making process.	emphasized to reduce conflict, and allow full participation, minimizing own voice
distributio nal equity	emphasized to maximize acceptance by stakeholders and success of the	less emphasized – allowed to be stakeholder driven	emphasized in recognition of the inherent

	policy		worth and dignity of all stakeholders
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* In reality conservation decisions will include a much greater diversity of ethical concepts.

Figure 1: Motivations for considering equity in environmental decision making. These different motivations influence which methods and actions are seen as right, appropriate, and useful to include in a conservation decision-making process.

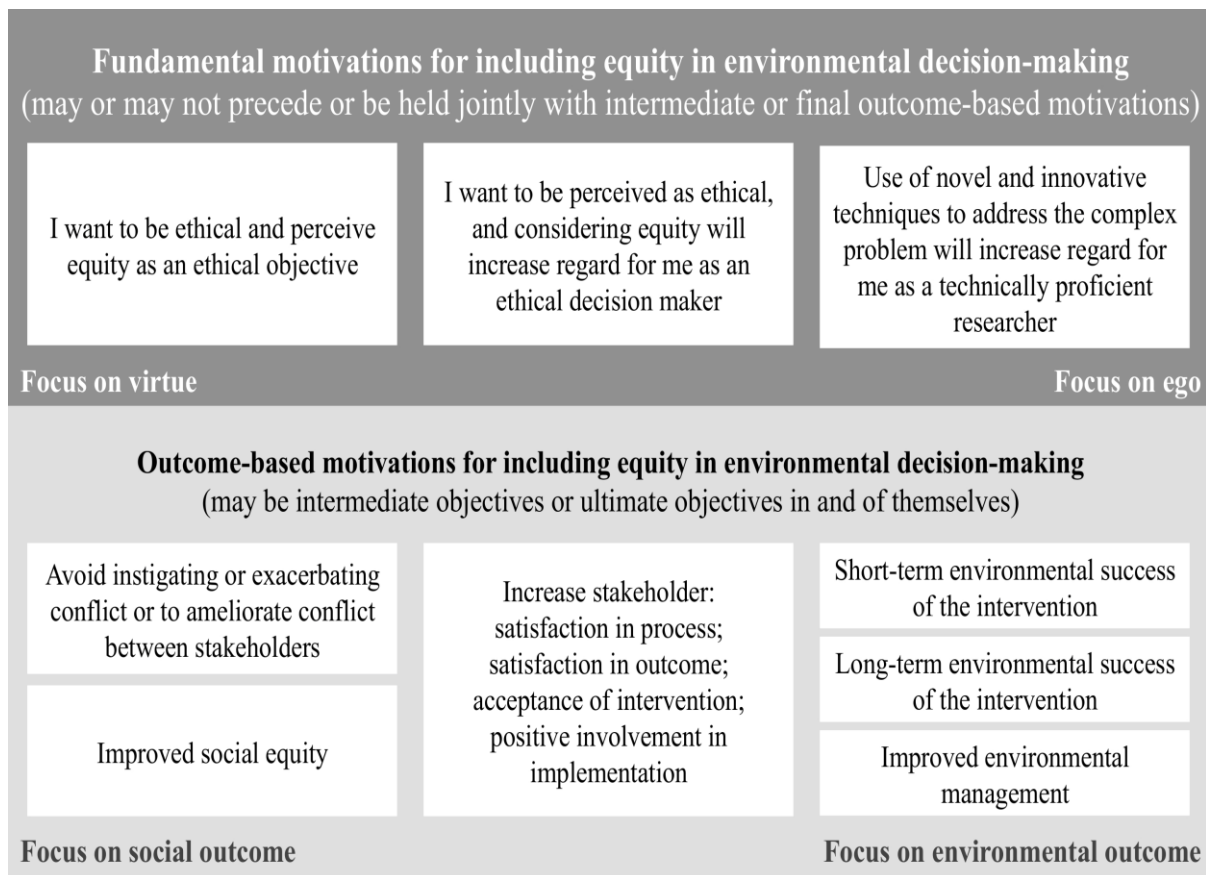


Figure 2: Ten recommendations for a more nuanced integration of ethics into conservation decisions that considers trade-offs between equity objectives.

