Why bartering biodiversity fails

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Abstract

Regulatory biodiversity trading (or biodiversity "offsets") is increasingly promoted as a way to enable both conservation and development while achieving "no net loss" or even "net gain" in biodiversity, but to date has facilitated development while perpetuating biodiversity loss. Ecologists seeking improved biodiversity outcomes are developing better assessment tools and recommending more rigorous restrictions and enforcement. We explain why such recommendations overlook and cannot correct key causes of failure to protect biodiversity. Viable trading requires simple, measurable, and interchangeable commodities, but the currencies, restrictions, and oversight needed to protect complex, difficult-to-measure, and noninterchangeable resources like biodiversity are costly and intractable. These safeguards compromise trading viability and benefit neither traders nor regulatory officials. Political theory predicts that (1) biodiversity protection interests will fail to counter motivations for officials to resist and relax safeguards to facilitate exchanges and resource development at cost to biodiversity, and (2) trading is more vulnerable than pure administrative mechanisms to institutional dynamics that undermine environmental protection. Delivery of no net loss or net gain through biodiversity trading is thus administratively improbable and technically unrealistic. Their proliferation without credible solutions suggests biodiversity offset programs are successful "symbolic policies," potentially obscuring biodiversity loss and dissipating impetus for action.

Introduction

Biodiversity trading programs (which include biodiversity compensation, offsets, banking, and biobanking) have proliferated internationally, and are promoted by policy makers and developers as facilitating both conservation and development. Like programs developed for simpler environmental commodities such as air pollutants (Pedersen 1994), most biodiversity trading has a regulatory or statutory basis that prohibits an activity (e.g., indigenous vegetation clearance, species habitat destruction, filling of wetlands) and later permits it conditionally (Salzman & Ruhl 2000).

As a regulatory incentive mechanism (Figure 1), environmental trading relies on developers' self-interest and resources in addition to administrative enforcement (Gustafsson 1998:268). Compared with pure administrative mechanisms (e.g., rules, standards), such market mechanisms are often purported to (1) allocate natural resources more efficiently, (2) satisfy developers better (increase access to resources, reduce compliance costs, and/or enhance green credentials; ten Kate *et al.* 2004), and (3) provide improved environmental protection (see Gustafsson 1998; Kroeger & Casey 2007). In trading biodiversity, some programs aim to reduce rates of biodiversity loss (e.g., Lueck & Michael 2003; Chomitz 2004). Others, perhaps increasingly, propose to achieve no net loss or a net gain in biodiversity (e.g., WHOEP 1993; VDNRE 2002; WA EPA 2006).

So far, evaluations suggest that biodiversity trading has not produced its promised biodiversity outcomes. Typically, development proceeds while offsets fall short

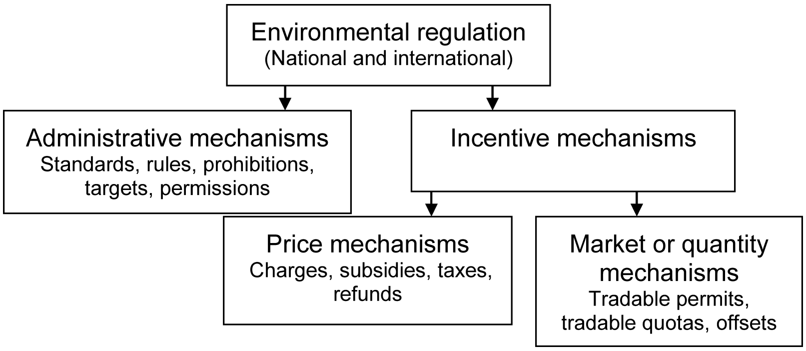

Figure 1 A taxonomy of environmental policy instruments (after Gustafsson 1998).

of goals or are never implemented (for some primary sources see Race 1985; Gardner 1996; Race & Fonseca 1996; NRC 2001; Brown & Veneman 2001; Quigley & Harper 2005a, b; Mack & Micacchion 2006; Gibbons & Lindenmayer 2007; Matthews & Endress 2008; Appendix S1). Such evaluations usually blame failure on inadequate assessment currencies, disregard for exchange restrictions, and poor enforcement. Their authors regularly recommend better currencies, more or different restrictions on exchanges, and better audit and compliance procedures.

We posit that weak technical design and lax enforcement are predictable features of regulatory biodiversity trading, and that sound and well-intentioned ecological advice is unlikely to correct this. We use three insights of Salzman & Ruhl (2000), who (1) provided a three-part analytical framework—currency, exchange restrictions, and review—to predict whether a trading program is likely to protect the environmental goods concerned; (2) recognized that simplicity, measurability, and interchangeability (also called *fungibility* or *substitutability*) determine whether environmental goods can be traded and protected simultaneously; and (3) predicted that in trading a complex, noninterchangeable and poorly measurable resource such as biodiversity, ecological realities, and political factors would combine to ensure inadequate currency, exchange restrictions, and review, to the detriment of that resource.

Our review examines ecological and political science theories that suggest protecting biodiversity in trading is neither technically realistic nor administratively probable. We first consider ecological aspects of recent biodiversity trading practice, using Salzman & Ruhl's framework. We assess the adequacy of currencies, exchange restrictions, and oversight to protect biodiversity, and identify issues ecologists have yet to consider. Next, we use public choice theory to extend Salzman & Ruhl's insights into problems of biodiversity trading administration. While biodiversity trading programs proliferate and advance optimistic promises to protect biodiversity, core impediments to improved biodiversity outcomes remain largely unrecognized and unaddressed. We consider whether this trend is explained by the effectiveness of "symbolic policies," (Edelman 1964), and suggest both ecological and political science are relevant for the assessment of biodiversity trading programs and potential alternative policy tools.

Inadequate biodiversity currencies

The test of a currency's adequacy is "... can [it] capture the significant values exchanged or do some important features remain external to the trades?" (Salzman & Ruhl 2000:614, Table 1). Simple environmental goods are easiest to commodify in currency: for example, a kilogram of sulfur dioxide provides a simple, relatively measurable, and adequate exchange currency for a unit of air pollution. But for biodiversity, there is no simple currency that adequately "... capture[s] what we care about" (Salzman & Ruhl 2000:623) (see also Robertson 2000). Biodiversity—the variety of living organisms—is hierarchical, with levels of organization from genes to ecosystems, an extraordinary number of elements at each level that vary in time and space, and diverse interactions within and between levels (e.g., Gaston 2000). Such complexity makes it exceptionally difficult to measure biodiversity, and to estimate an element's contribution to the whole.

Furthermore, if "what we care about" is persistence of the full variety of life, contributions of different biodiversity elements are noninterchangeable. This noninterchangeability can be conceived of in three different dimensions (Salzman & Ruhl 2000): *type* (e.g., endangered frog habitat is neither equivalent to nor exchangeable for endangered tree habitat; captive-bred subpopulations do not replicate a diverse population gene pool); *space* (e.g., isolated and contiguous habitat patches are not equivalent); and *time* (e.g., genetic bottlenecks alter population characteristics irreversibly; early and late seral stages of an ecosystem type support different species suites).

Table 1 Assessment framework adapted from Salzman & Ruhl (2000) for biodiversity trading, and examples of pertinent questions

Component 1. Currency adequacy		
"Does the chosen metric fully capture the valued characteristics of the biodiversity exchanged, or do some important features remain external to the trades?" or, "Does the currency 'capture what we care about'?"		
Component 2. Exchange adequacy		
"Are market rules (exchange restrictions) adequate to ensure trades do not enable biodiversity loss?"		
a. Type restrictions	b. Space restrictions	c. Time restrictions
"Are like communities, species or processes replaced with like?" and if not *"Is this a trade-up (and what IS a trade-up)?"*	*"Is the offset situated so ecological interactions and processes are maintained?" "Are existing biological communities and ecosystems displaced by the location of the offset?"*	*"Will there be a temporal gap? And will it compromise biodiversity persistence?" "What is the risk and cost of offset failure and permanent loss, and who bears that risk?"*
"Are biodiversity platforms in place and is biodiversity information sufficient to inform exchange restrictions (and if not, who should pay for their development)?"		
"What is the logic behind offset ratios? Do ratios ensure replacement of like ecosystems with like, restoration of spatially dependent processes, and/or that risks and costs of biodiversity loss are fairly apportioned?"		
"What will be the cumulative effects on biodiversity of multiple exchanges and/or offset program(s)?"		
Component 3. Review adequacy		
"Do review provisions: a) Ensure robust valuation of the goods exchanged? b) Ensure fair apportioning of costs and risks (given who stands to gain from the exchange)? c) Effectively counteract agencies' and trading parties' incentives to transact trades that compromise biodiversity?"		

Incomplete measurement, imprecise valuation, and noninterchangeability mean biodiversity exchange is strictly not commodity trading, but barter: "individuals haggling over goods and services with unique attributes" (Salzman & Ruhl 2000:614). But unlike barter in private goods, exchanges in environmental goods affect interests beyond direct participants; trading can erode the public's interest in public resources (Gustafsson 1998; Salzman & Ruhl 2000; Kroeger & Casey 2007). Unavoidably, simple biodiversity currencies are inadequate; they facilitate nominal biodiversity accounting, but omit, obscure, or conceal biodiversity features and noninterchangeabilities (Robertson 2000; Salzman & Ruhl 2000; e.g., see Stein *et al*. 2000; McCarthy *et al*. 2004; Fox & Nino-Murcia 2005). And in any exchange, a characteristic not counted is protected only by chance, which facilitates its loss. Simple currencies simultaneously enable poor accountability for biodiversity outcomes and provide opportunity for damage to biodiversity, bringing a need for restrictions on exchanges if public interests are to be protected (Salzman & Ruhl 2000).

Exchange restrictions to compensate for currency inadequacy

The literature describes many restrictions on biodiversity exchange intended to compensate for currency inadequacies in the three noninterchangeability dimensions. In each case, a test of adequacy asks: "is this restriction adequate to ensure against biodiversity loss?" (Table 1).

(1) *Type*. Exchanges of dissimilar biodiversity risk loss of biodiversity components and functions (Salzman & Ruhl 2000; ten Kate *et al*. 2004). To counter this problem, some trading programs propose no-go areas to prohibit trading of critical assets (e.g., WA EPA 2006) but permit exchanges of noncritical biodiversity. Others limit exchanges to the same species, communities, or ecosystem type (e.g., VDNRE 2002; Brownlie *et al*. 2007), relying on simplified biodiversity classification tools. Some suggest out-of-kind exchanges ("like for like or better" or "trading up"; ten Kate *et al*. 2004:61; WA EPA 2006:10; Brownlie *et al*. 2007:6) might offer greater value if affected biodiversity is secure and more imperilled biodiversity is protected, although credible guidelines based on measures of complementarity (Justus & Sarkar 2002) have been slow to emerge.

(2) *Space*. The location of individuals, populations, and communities profoundly influences ecological interactions and biodiversity persistence (Hanski 1998); and ecosystems in different locations serve dissimilar functions (e.g., Mitsch 1998). To maintain biodiversity, exchanges must replace ecological interactions and functions lost in development, and restoration projects must not displace other natural ecosystems. Yet quantifying spatial dependency is data demanding, even for single species (e.g., Ovaskainen & Hanski 2004), and adverse effects of spatial displacement are poorly recognized and

rarely remedied in biodiversity trading. Some programs use a rule-of-thumb preference for nearby replacements over distant ones (ten Kate *et al*. 2004). Others restrict trades to within geographic zones (e.g., wetland service areas; Salzman & Ruhl 2000), or concentrate replacements in aggregated sites, intending to overcome fragmentation (e.g., Fox & Nino-Murcia 2005). Still others apparently ignore the problem (see Burgin 2008).

(3) *Time*. Development is usually permanent, life cycles of companies are finite, and ecosystem reconstruction seldom, if ever, succeeds in structure, composition, or function (e.g., Zedler & Callaway 1999; Hilderbrand *et al*. 2005; Quigley & Harper 2005a, b; Morris *et al*. 2006; Gibbons & Lindenmayer 2007; Matthews & Endress 2008). Even temporary losses may permanently damage populations and engender or aggravate cumulative effects. To provide certainty that development will not cause biodiversity loss, new, equivalent habitat must be created before existing habitat is destroyed or modified (Veltman 1995; Crooks & Ledoux 2002). This would restrict exchanges to a few, simple, predictable, quickly maturing ecosystem types (Morris *et al*. 2006). In biodiversity trading practice, time noninterchangeability is dealt with in three ways. First, *permanent drawdown* trading overlooks it, and exchanges destruction of existing ecosystems or species habitats for improved protection of other, existing ecosystems or habitats (as in USA's conservation banking) (Fox & Nino-Murcia 2005; Carroll *et al*. 2008) and Brazil's forest set-aside trading (Chomitz 2004)). Second, *interim drawdown* programs permit ecosystem or species habitat destruction before reconstruction (e.g., Australian states; VDNRE 2002; Gibbons & Lindenmayer 2007). Such programs generate immediate ecosystem or habitat loss, interrupt ecological processes (see Fig. 4 of Gibbons & Lindenmayer 2007:30), and risk permanent loss through restoration failure (Moilanen *et al*. 2008). Third, *true banking* programs nominally address time noninterchangeability by requiring biodiversity replacement before development occurs. This eliminates interim biodiversity loss and risk of restoration failure (though such requirements appear to be seldom enforced; see Salzman & Ruhl 2000; Mack & Micacchion 2006).

Further ecological problems

The above scan reveals persistent deficiencies in information and practice that facilitate net biodiversity loss through nonequivalent exchanges. Further problems span all three noninterchangeability dimensions. For example, the biodiversity data needed to inform exchange restrictions usually exceed those that governments, developers, or habitat bankers have been willing to fund. Less comprehensive data bring greater uncertainty about biodiversity characteristics and hence increase potential for biodiversity loss. Also, researchers developing exchange restrictions at project scales often overlook cumulative (often nonlinear, synergistic, and indirect) negative effects of multiple nonequivalent exchanges in type, space, or time (Bedford & Preston 1988; Quigley & Harper 2005a; Mack & Micacchion 2006; but see Brownlie *et al*. 2007; Vesk *et al.* 2008). Another problem concerns ratios (or multipliers) applied to compensate for noninterchangeability in type, space, or time. Some have a statistical or ecological basis. For example, high offset ratios are needed to avoid risk of unfavorable biodiversity outcomes when restoration effectiveness is uncertain, failure is correlated among sites, or restoration is delayed (Moilanen *et al*. 2008). Brownlie *et al*. (2007) recommend multipliers to protect specified minimum areas, addressing the question "what ratio will achieve the biodiversity outcome sought?". Elsewhere, the basis for multipliers seems unsound: providing several times something different cannot replace a lost species or unique ecosystem; restoring something to higher abundance later may not compensate for consequences of a loss now. Similarly, financial insurance can neither restore the unrestorable nor remedy permanent loss.

Oversight of biodiversity barter

The currency and exchange inadequacies that beset biodiversity barter place a heavy burden on precautionary oversight (a review mechanism) to control exchanges sufficiently to protect biodiversity. Salzman & Ruhl (2000) suggest adequate oversight should ensure meaningful valuation of the public goods exchanged and fair apportioning of costs and risks, and counteract the agencies' and trading parties' incentives to transact bad deals (Table 1). Time and again, researchers report procedural and enforcement failures in biodiversity trading programs, and urge improvement, through more or better frameworks, resourcing, or insurance (e.g., Gibbons & Lindenmayer 2007; Matthews & Endress 2008; Norton 2008). But these suggestions do not address the political and administrative causes of inadequate review.

Administrative problems

Salzman & Ruhl (2000) observed an administrative playing field of biodiversity barter tilted toward development. We propose that classic theories of politics predict this tilt, and that biodiversity's poor measurability and noninterchangeability exacerbate it. Together, political, and ecological factors create two fundamental problems for public administration of biodiversity barter:

(1) *Thin markets*. For a viable trading program to operate in practice, currencies must be simple, review cannot be onerous, and restrictions must be straightforward and few (Pedersen 1994; Salzman & Ruhl 2000). But to protect biodiversity, high-quality data must inform precautionary exchange restrictions. Such restrictions create transaction costs and allow few exchanges, constraining an otherwise well-supplied trading market (Salzman & Ruhl 2000; see e.g., Chomitz 2004).

(2) *Inequality, divergence, and coincidence of interests*. Precautionary exchange is also unlikely because of the unequal power and different goals of participants. This is foreseen by the public choice theory of politics, which predicts that rational actors act in their own self-interest, and that some actors are more powerful than others (e.g., see McCubbins *et al*. 1987; Eskridge 1988). Specifically, the motivated few will be more powerful than the disorganized many (Olson 1965); so public choice theory predicts private interests—such as developers—will often defeat public interests—such as biodiversity protection—and reap most policy benefits. As Eskridge (1988:294) observed, "[t]he legislative market is one that works badly. The public goods that government ought to be providing . . . are seldom passed by the legislature, because demand for them is usually not strong and legislators gain too little from sponsoring them . . . Conversely, rent-seeking statutes – primarily, concentrated benefit, distributed cost measures – seem inevitable."

Three interests compete in biodiversity barter:

(a) *Traders* (developers and restoration/offset providers) have a financial, or vested, interest in obtaining permits to conduct business. Such traders in environmental goods need not be conscious of the quality of environmental outcomes if a permit is forthcoming (Gustafsson 1998; Floumoy 2000; Salzman & Ruhl 2000; Kroeger & Casey 2007). This encourages developers seeking permits to underestimate (perhaps unintentionally) environmental impacts, and restoration providers to exaggerate (maybe unwittingly) the value of biodiversity goods offered in exchange. Neither trader profits from investment in data to support independent assessment, robust exchange restrictions, and meaningful review. Instead, they benefit from simple currencies that are inexpensive to measure, plentiful trading options with few exchange restrictions, and limited review to minimize risk that a permit will be overturned.

(b) *Biodiversity protection interests* usually have no vested interest in biodiversity barter. They benefit from exchanges that are fully measured, exchange restrictions that are robust and upheld, and review mechanisms that are meaningful and effective in protecting biodiversity.

(c) *Regulatory officials* are those appointed to enforce trading conditions, and are both referee and representative of the public's interest in biodiversity. Because traders have little incentive to control quality, officials shoulder the full burden of enforcement. But officials are not disinterested "billiard balls," faithfully implementing democratically determined rules (Wilson 1989:88). Without inferring corruption or malfeasance, public choice theory predicts that officials often have motivations that are different from their statutory mandates, and that, given freedom to choose, officials will often pursue their own self interest (e.g., Niskanen 1971; McCubbins *et al*. 1987; O'Toole 1988). In environmental regulation, incentives on officials often coincide more strongly with development than environmental interests: Winter (1985) even suggests that governments rarely fund full enforcement, and sometimes directly discourage officials from frustrating powerful vested interests. Therefore, officials can and sometimes do reduce their financial or political costs by offering development interests more palatable and less environmentally demanding options (Winter 1985; Salzman & Ruhl 2000:648–665; Brower 2008:20–22; 84–108). Simple inexpensive biodiversity currencies, weak or ambiguous exchange restrictions, and limited review benefit both officials and traders because they are cheap and offer flexibility, or utility (see Pedersen 1994; Parkes *et al*. 2004). Coincidentally, they also facilitate development at the expense of biodiversity.

The playing field on which these interests compete is far from level; the "default setting" (Brower 2008:14) predicted by Olson (1965) is that development will defeat biodiversity. To address biodiversity decline, policy instruments must level this playing field. But theory predicts biodiversity barter will reinforce, rather than correct, this default setting.

First, mandates to barter biodiversity weaken existing statutory constraints on biodiversity harm by allowing officials discretion to circumvent them; for example, the Habitat Conservation Plan provision of the USA's Endangered Species Act erodes its absolute prohibition on species take (Ruhl 1999). Even in situations of routine noncompliance, legitimizing barter may produce worse environmental outcomes than policy regimes in which officials barter with developers "outside the shadow of the law" (Ellickson 1991:52), but the existence of a clear statute constrains their bartering leeway (see Winter 1985:240). More generally, in giving officials discretion to work toward unspecified outcomes, barter increases opportunity for officials already motivated to "skip rather lightly past avoidance and minimization and proceed instead directly to compensation" (Bean & Dwyer 2000:10537), while reducing public power to specify rules and goals through democratic processes (see Salzman & Ruhl 2000:683).

Second, the case-by-case decision making inherent in biodiversity barter reinforces dominance of vested development interests by constraining the effectiveness of biodiversity protection interests. Case-by-case decision making keeps biodiversity loss off the national radar and limits its importance, hence weakening the environmental voice (see Schattschneider 1960; Pralle 2006). It is more costly and less feasible for environmental interests to marshal the resources to challenge proposals case-by-case than through high-level orchestrated campaigns (Brower 2008:57).

Third, problematic measurement and case-by-case barter each render biodiversity trading especially vulnerable to *information asymmetry*—the situation in which insiders (traders and officials) know more than outsiders (biodiversity protection interests and the public), who are unable to measure the quality of biodiversity deals. Information asymmetry creates slack, or "a zone of freedom of action for regulators. . .in which they can operate with lessened fear of punishment by the polity for decisions that deviate from those the polity would adopt on its own" (Levine 1998:269). When officials' and developers' interests coincide in negotiating permits, a pattern of informal and less-than-transparent deals can result (Winter 1985; Freeman 2000; Brower 2008) with norms of behavior and standards of fairness that benefit insiders, but deviate from statutes and ideas of fairness held to protect outsiders—the public (Ellickson 1991). Thus, information asymmetry will systematically favor development over protection.

No net loss as symbolic policy

Absence of opportunity for public input in case-by-case decisions often renders ecological scientists the most vocal critics of biodiversity trading. But scientists appear reluctant to abandon hope that biodiversity offsets might yet deliver no net loss (see Gibbons & Lindenmayer 2007; Burgin 2008; Norton 2008). We see compelling reasons for skepticism.

Some ecologists insist biodiversity barter could achieve no net loss—if only there were better currencies, informed exchange restrictions, and attention to review (e.g., ten Kate *et al*. 2004; Gibbons & Lindenmayer 2007). They assume that if improved information and measures were available, and rules were clear and transparently defensible on ecological grounds, officials would use and implement them. Empirical evidence shows that officials have repeatedly failed to do so (e.g., Salzman & Ruhl 2000; Fox & Nino-Murcia 2005; Burgin 2008); and public choice theory predicts this failure. Others might see opportunities to leverage funds for improved biodiversity data and measurement; developers, agencies, and governments are likely to resist this. Those recognizing the primacy of administrative problems posit carefully designed review might counter motivations of traders and officials (Salzman & Ruhl 2000:693). But this would constrain exchanges to the detriment of developers and officials, and no such review institution has emerged. In the absence of credible solutions to these problems, biodiversity trading is likely to continue to facilitate development at the expense of biodiversity.

In addition, biodiversity exchange has potential to postpone social and legislative changes needed to address the basic problem of biodiversity loss (see Pedersen 1994; Gustafsson 1998:271). We see two reasons. First, bartering focuses parties' attention on immediate steps, rather than stimulating them to proceed "according to some larger progressive principle" (Winter 1985:246). This resembles displacement behavior in which "organizational means become transformed into ends-in-themselves and displace the principal goals of the organization" (Merton 1957). Conservation programs with a preference for near-term, achievable, procedural goals can deflect attention from long-term, more difficult goals for ecological outcomes (Brower *et al*. 2001).

Second, no net loss and net gain slogans themselves may be effective political diversions. We have argued that achieving no net biodiversity loss through barter is an illusion that crumbles under scrutiny from ecological and political science. But Edelman (1960, 1964) suggests that some policies are never intended by politicians to be more than hollow promises. Such symbolic policies promise much but guarantee little, and allow the motivated few to reap most of a policy's benefits while leaving the disorganized many unaware, or lulled into "political quiescence" (Edelman 1964). No environmentalist will disagree with the goal of no net biodiversity loss. In attaching the slogan "no net loss" to biodiversity barter, politicians can appear to take action while continuing to serve development interests, and ignoring or perhaps exacerbating biodiversity loss. In engaging ecologists' collaboration in a symbolic but illusory goal, biodiversity barter may succeed by "keeping friends close and enemies closer" (Brower 2008:58) thus defusing potential opposition (Robertson 2000). Developers, politicians, and officials embrace biodiversity barter under "no net loss" or "net gain" flags (Robertson 2000; Salzman & Ruhl 2000; Burgin 2008) because it benefits them to do so. Support from ecological scientists, whether tacit or active, sustains and authenticates the illusion.

Conclusions

Viable biodiversity barter and meaningful biodiversity protection seem mutually exclusive. We can achieve one or the other, but not both. Although compensation and no net loss are laudable ideals, ecological and political problems appear intractable, and mean that bartering is likely to accomplish more harm than good for biodiversity.

Ecological and political factors combine in bartering biodiversity to produce currencies, exchange restrictions, and oversight that are inadequate to protect biodiversity. Because biodiversity is complex and its elements noninterchangeable, there is no simple currency to measure fairness of exchange, and restrictive exchange rules and robust review institutions are needed to protect it. But a functioning exchange program requires simple currencies, few restrictions, and undemanding review. This gulf between market and ecological viability seems to render biodiversity trading doomed to fail—more specifically, to fail biodiversity. Indeed, the simplistic currencies, lax exchange restrictions and inadequate review that benefit both traders and officials are predicted by political theory and observed in practice. All come at a cost to biodiversity.

We further conclude that inequalities, divergence, and coincidence among interests in biodiversity barter mean that improved biodiversity measures and exchange restrictions recommended by ecologists will rarely be adopted. Few academics and practitioners have understood and tried to address these nonecological causes of failure (Salzman & Ruhl 2000:693).

The administrative playing field described in this article shapes the outcomes of not only biodiversity trading, but also all environmental policy. However, political theory predicts that biodiversity exchange policies—because of biodiversity's complexity, poor measurability, and noninterchangeability—will be more vulnerable to the institutional failings that undermine environmental protection than simple (albeit imperfectly enforced) prohibitions. Public choice theory suggests officials and traders have more incentive to facilitate barter than to ensure biodiversity protection. Thus, given the option of saying to developers "yes, with conditions" rather than "no," officials will prefer "yes, with conditions"—particularly when compliance with conditions cannot be credibly measured and officials can avoid accountability for outcomes. Legitimized bartering can thus create a policy situation "obscure enough to please all parties . . . and so ill-defined that failures . . . will be difficult to detect and impossible to litigate" (Walker *et al.* 2008:226; see also Winter 1985).

Furthermore, recent proliferation of offset programs, with the promise of no net loss or net gain, is consistent with effective use of symbolic policy to "give the rhetoric to one side and the decision to the other" (Edelman 1960:703). Symbolic policy may cost conservation by obscuring biodiversity loss and dissipating impetus for social activism and forthright conservation planning.

In sum, while compensation and no net loss are worthy goals, and bartering biodiversity might appear more promising than simple and weakly enforced prohibitions, this article suggests policies that enable biodiversity trading may perversely yield worse biodiversity outcomes. All theoretical predictions point to further biodiversity loss paving the way for development in any biodiversity trading program, while a no net loss tag-line defuses potential opposition and impetus for change.

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Supporting Information

Additional Supporting Information may be found in the online version of this article:

Appendix S1: Major regulatory biodiversity trading programs and references given in the manuscript.

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