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Reckoning perverse outcomes of resource conservation policies using the Ecological Footprint

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ABSTRACT

Spatially expanding economies threaten the status of basic natural resources. In particular, wildlife habitats rarely benefit. Apart from protected areas, political-economic decision-making is ill-prepared to accommodate wildlife habitats with standard valuation methods. In some cases habitat loss is an inadvertent outcome of resource conservation policies intended to lower resource consumption.

We recognize the term *resource conservation* as multifaceted, with a range of meanings from protecting wildlife habitats to efficiently allocating and using materials and energy. Resource conservation policies that spur economic benefits may produce unwanted outcomes. This is partly because linkages between economic and conservation goals seem tangential. Moreover, relevant information is imperfect and predictive tools are limited. This is particularly true for land converting impacts, which are often addressed after the fact, not during policy formulation, and can lead to successive resource degradation.

We argue for the need to calculate the positive and negative land converting impacts from resource conservation policies that may expand the economy. Using the Ecological Footprint (EF) approach, we tested for potentially perverse outcomes of an existing resource conservation policy. In doing so, we conceptually mapped linkages among economic sectors to their cumulative effects of converting land. We assume an inverse relationship between economic expansion and land conservation.

A New York State energy efficiency incentive program was tested using recent data from all tracked economic sectors. The economic data were converted in a series of steps from dollar values to energy units, to carbon dioxide emissions, and ultimately expressed in hectares of net land conversion. A policy scenario was compared to a reference scenario (no resource conservation policy), and the results anticipate a net gain in conserving land (0.6% reduced conversion). We interpret this as a potentially proportional offset favoring wildlife habitat retention. Two sensitivity analyses demonstrated that the policy's impact on conserving land depended on both the affected economy's scale (tripling reduces the estimated benefit to 0.2%), and the level of economic expansion that followed (doubling leads to a net loss of wildlands).

This novel use of the EF approach may serve as a model for a more general approach to assessing a broader class of policies. It may also hold promise toward developing tools that can better examine well-intentioned resource conservation policies with uncertain outcomes. Our hope is that work like this can lead to better sets of tools for examining critical ecological–economic linkages for improved policy design.

1. Introduction

1.1. Conservation policy: intents versus outcomes

Spatially expanding economies threaten the status of basic natural resources (Ehrlich and Ehrlich, 2008; Stedman-Edwards, 2000; Tilman, 2000). In particular, terrestrial wildlife habitats usually decline in proportion to an expanding economy (Haines-Young, 2009; Czech, 2008; Czech and Krausman, 1999). High rates of land conversion represent the greatest global threat to wildlife (Czech, 2000; Dietz and Adger, 2003; Hockstra et al., 2005; Fischer and Lindenmayer, 2007; Moran et al., 2008). But the evidence has limited impact on political-economic decision-making (Robertson and Hull, 2001). Even well-intentioned resource conservation policies can lead to more pressure on wildlands, if new or changing markets result in further expansion.

We view the term *resource conservation* as multifaceted, with a range of meanings from protecting wildlife habitats to efficiently allocating and using materials and energy. Resource

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conservation policies designed to produce economic benefits can lead to unwanted outcomes. For example, eco-tourism aims to raise income levels while protecting wildlife, but associated activities may spatially expand a local economy and degrade habitats (Mbaiwa, 2003). Perverse outcomes from well-intentioned plans are often difficult to anticipate, in part because linkages between the goals of conserving resources and economic growth appear tangential. This is partly because relevant information is imperfect and predictive tools are limited.

Economic growth is closely tied to intensity of resource use and the capture of additional resources via spatial expansion. We use the Ecological Footprint (EF) concept (Wackernagel and Rees, 1996) to deal with potentially perverse outcomes of resource conservation. We view those outcomes in terms of conserving land (i.e., preventing wildlands from being converted and the loss of the wildlife it harbors). In this paper, we follow a stepwise process to conceptually map linkages among economic sectors that ultimately appropriate wildlands. These linkages are rarely drawn in the context of resource conservation policies. Specific impacts on geographic locations or species are not addressed, only the change in the amount of converted land over the region the policy encompasses. Nonetheless, this may be the first test of its kind, and could lead to developing more sophisticated tools to deal with an economically driven global conservation crisis (Stedman-Edwards, 2000; Balmford et al., 2003; Wallington et al., 2005; Reich et al., 2012).

As an example the EF is used to test whether potential economic growth associated with a New York State resource conservation policy aimed at energy efficiency is likely to lead to more or less converted land. On the one hand, energy efficiency reduces resource use intensity, but on the other hand, additional economic activity from the policy can spatially expand the economy and thereby increase land conversion. We compare a new-policy scenario with a business-as-usual or no-policy scenario. We also carried-out two sensitivity analyses that varied the affected economy's scale and the amount of economic expansion that follows policy implementation. All results are expressed in hectares of the net amount of land converted.

The remainder of Section 1 reviews general relationships between economic expansion and resource conservation, with emphasis on land conversion and concludes with a description of the advantages of the EF approach. Section 2 describes our use of the EF to examine those relationships, with an application to the specific state-government resource conservation policy that serves as a test case. Section 3 provides the test case results including, sensitivity analyses, and Section 4 concludes with theoretical and practical implications.

1.2. Two realms of resource conservation

Resource conservation is a common goal in planning sustainable economies (Goodstein, 2010). The term "conservation" is applied in the sense of preventing waste and overuse of valuable resources. Success can be measured in both resource units (fish stocks, mineral reserves, etc.) and in monetary units, but only for resources brought into the market. This excludes the vast majority of biological resources (most non-human species and their habitats). These largely unaccounted-for resources can be measured, although most measurements are made in terms of rarity or fractional losses leading to scarcity (e.g., Robinson, 2012).

Conservation planning accounts for human consumption patterns. But, standard measures need to include the amount and intensity of land conversion leading to wildlife habitat degradation and loss (Ehrlich and Wilson, 1991; Meyers and Turner, 1992; Daly, 1991; Luck et al., 2003; Radeloff et al., 2012). Resource conservation requires protecting habitats from imposing economies (Vitousek et al., 1997; Cruzen, 2002; Arrow et al., 2004; Haberl et al., 2004a; Vince, 2011).

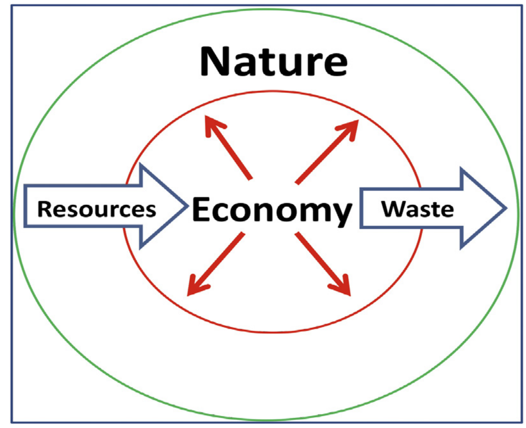

Fig. 1. Diagram of the linkages between nature and an economy (Daly, 1996). Natural habitats shrink as economies expand (indicated by the small arrows pushing the economic boundary outward), due to resource extraction and resource degradation.

Policies aimed at conserving resources brought into the market are not necessarily conserving wildlife habitats. This is because the savings incurred from conserving resources may lead to economic expansion and converting wildlands (Rammel et al., 2007; see Fig. 1). For example, technological advancements in reducing pollution may expand markets or create new ones that draw down additional natural resources or produce more waste. Basically, the new or expanded markets put more pressure on natural systems (Moran et al., 2008). But those outcomes are much more difficult to monetize (Fishburn et al., 2009), particularly when global commerce obscures relationships between economic scale and land conversion (Czech et al., 2000).

Direct exploitation probably affects less than 1% of global wildlife (Perrings et al., 1992). But, converting land for commercial purposes is producing a conservation crisis (Hanski, 2005; Walz and Sybre, 2013), with natural habitats drawn on faster than recovery or replenishment rates (Constanza and Daly, 1992; Monfreda et al., 2004; Czech, 2008). Whereas some natural resource stocks can be rebuilt or replaced, wildlife loss tends to be permanent, in the form of irreversible extinctions or unaffordable recovery costs (Wilson, 2002; Christensen, 2005; Walz and Sybre, 2013). Survivor populations carry an "extinction debt", which accumulates when species persist in fewer, smaller, more vulnerable populations (Hughes et al., 1997; Reich et al., 2012).

1.3. Applying the Ecological Footprint approach

As a resource appropriation metric, land conversion is a pivotal link between an expanding economy and impacts on wildlife habitat (Fig. 2; Dietz and Adger, 2003). Wackernagel and Rees (1996) introduced the Ecological Footprint (EF), a well-recognized approach for linking economic activity to appropriating wildlands (Hubacek and Giljum, 2003; Kissinger and Gottlieb, 2012). Using integrated resource accounting and translating all consumption in a society into land use per capita (Fiala, 2008), it measures the human demands on terrestrial ecosystems (Schwarzlmuller, 2009). It recognizes that an economy is an expanding, dependent subsystem in a non-expanding natural environment (Rees, 2000, 2006; see Fig. 1).

The EF builds on the assessments of Vitousek et al. (1986), which estimated human appropriation of net primary productivity (Wackernagel and Silverstein, 2000; Niccolucci et al., 2008). The EF does not estimate human appropriation of net primary productivity. But the EF does track the amount of biologically productive