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# Protecting Paradise: a Cross-National Analysis of Biome-Protection Policies

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ARTICLE

## Protecting paradise: a cross-national analysis of biome-protection policies

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Land protection policies such as creating and preserving national parks have been promoted to counter global threats to the environment and to conserve biodiversity. We know little, however, about the country characteristics that might be good predictors of whether states will choose to protect land or not. What factors within a state need to be the focus of global attention or need to be encouraged to promote land-protection policies? Using the global standard of 10% ecoregion protection, we test four categories of predictors—biodiversity, environmental threats, politics (such as treaty participation and NGO activity), and economics (such as GDP and trade measures)—as well as a multidimensional model in a multivariate analysis of 129 countries. Our findings suggest that the multidimensional model best predicts when it is likely that a country will protect land. While a number of key variables such as economic are not supported, the environmental threats model presents us with the strongest individual reason for land protection.

KEYWORDS: natural areas protection, biodiversity, geopolitics, economic factors, environmental impact sources, environmental management

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### Introduction

Land-protection policies have been promoted to counter global threats to the environment such as timber harvesting, land overuse, and population growth. In 1987, the United Nations Commission on Environment and Development (UNCED) recommended in the Brundtland Report, *Our Common Future*, that adequate conservation of the earth's ecosystems required at minimum a tripling of the total expanse of protected areas (Brundtland Commission, 1987). Building on this report goal, many governments and conservation organizations have interpreted this recommendation to mean protecting between 10 and 12% of a region's land area (O'Neill, 1996).<sup>1</sup> In 1992, the targeted goals were further specified at the Fourth World Conservation Union (IUCN) World Parks Congress. Refining the UNCED targets to ensure protection of varied ecosystems and landscapes, the IUCN called for at least 10% of each of the fifteen global biomes to be protected (IUCN, 2007).<sup>2</sup>

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<sup>1</sup> It should be noted that this 10–12% target has been criticized as inadequate, reflecting what was deemed politically viable at the time rather than what was optimal from an environmental protection standpoint (see, for example, Cox et al. 1994).

<sup>2</sup> Biomes are defined as "the world's major communities, classified according to the predominant vegetation and characterized by adaptations of organisms to that particular environment" (Campbell, 1996).

Together the UNCED and IUCN targets express the continuing development of a global norm to protect land through policy mechanisms such as national parks. The World Conservation Union estimates that there are 44,000 protected areas in the world that cover over 13.6 million square kilometers, reflecting a dramatic increase since the formation of the world's first national park at Yellowstone in the United States in 1872 (IUCN, 2007), yet still insufficient from an environmental policy perspective (Rodrigues et al. 2004; Parris, 2005; Deguise & Kerr, 2006)

While the extent of protected land has grown over the last century and the importance of protecting land has been widely cited as critical to sustainable development and environmental protection, there has been little scholarly work on why countries might choose to protect land (Gutman, 2002; Abuzinada, 2003; Parrish et al. 2003; Stoll-Kleemann, 2005). Specifically, do such countries share any characteristics? This presents an interesting scholarly puzzle, and from an applied policy perspective it is imperative to understand the factors that influence decisions to protect land. What country characteristics might be good predictors of whether states will choose to protect land or not and more explicitly attain the 10% biome protection goal? What factors within a state need to be the focus of global attention or need to be encouraged to promote land protection policies? Based on answers to these questions, can we predict what areas may or may not be protected in the future

and perhaps change the policy process to protect valuable land and meet related sustainable development goals?

Two issues merit further discussion. First, actual and effective land protection ultimately depends on several factors including state capacity (financial and administrative) to carry out the policies in place. Although many states appear on the list as meeting the 10% target, this designation might in actual practice be exaggerated because governments are unable to effectively enforce the stated policies. This important issue has drawn the attention of several scholars who argue that legally protecting land does not easily translate into actually protecting land. Moreover, it has been proven that lands with a “protected” designation differ widely in actual protection (see Zimmerer et al. 2004; Naughton-Treves et al. 2005; 2006). We acknowledge the lack of homogenization among lands under protective status and agree that the process is more complicated than simply legislating protection. In this article, however, we focus on understanding state similarities and differences that would predict when the 10% threshold is met or approached. Even if the actual protection applied to a particular piece of land that helps a state reach the threshold is less than ideal, we assert that carrying out or enforcing protection is ultimately dependent on the policies being constructed and land being designated for protection. While the 10% threshold might be an imperfect measure of what is actually occurring in terms of conservation on the ground, protected status is a necessary initial condition for committing state financial and administrative resources and for actual protection to begin. The difference between how land is actually protected from state to state and how state capacity influences the success of protection is beyond the scope of this paper, but clearly we need to better understand those issues as well.<sup>3</sup>

Second, specific state contexts and anecdotal accounts of specific pieces of land are compelling, but our goal is to assess the practice more systematically. Thus, the present study seeks to provide a better understanding of why countries might choose to implement policies to protect land. Using the global standard of 10% biome protection we test four categories of predictors—biodiversity, environmental threats, politics, and economics—which are discussed below.

To better assess the role of these indicators, we present a multivariate analysis of 129 countries.<sup>4</sup> We develop five models to test the relevance of sets of indicators, and include a multidimensional model

incorporating all categories. Our dependent variable is *protected ecoregions*, as calculated by the Center for International Earth Science Information Network (CIESIN) and derived from the World Database of Protected Areas and the World Wildlife Federation’s mapping of ecoregions. Our environmental testing is two pronged; we test the effects of both biodiversity and environmental threats on the likelihood that land will be protected. In our political model we test treaty participation, IUCN membership organizations per million of population (a measure of nongovernmental organization (NGO) activity), and regime type. The economic model looks at gross domestic product (GDP) per capita, external debt, trade, and gross national income and posits that country wealth and global economic interactions will affect biome protection. Finally, to understand the interaction of these models, we create a multidimensional model that combines the variables from the environmental, political, and economic models. We expect that protection will increase in response to high levels of biodiversity, the presence of environmental threats, political connectedness, and economic development.

Our findings suggest that the multidimensional model best predicts when it is likely that a country will protect biomes. The environmental threats model presents us with the strongest individual reasons for land protection. Surprisingly, the political variables are poor predictors of protected land and economic factors have mixed but interesting results. However, our multidimensional model provides better results than all four independent models. This leads us to conclude that predictors of land-protection policies are quite complex and must be understood as being an interaction among political, economic, and environmental factors.

The argument proceeds in four parts. First, we discuss land protection and the biome-protection standard. Second, we examine the theoretical literature that discusses why countries might protect land. From this, we identify the political, environmental, and economic variables suggested in the literature as reasons that states may choose to protect land. This variable can be used to construct hypotheses of why states might choose to place land in protective status. Third, we present our hypotheses about how our variables should affect the level of protected land and our statistical findings that support these hypotheses. Finally, we then interpret and discuss our results, show how our findings can inform policy, and suggest further areas for research.

### Measuring Protected Land: A Global Overview

As a key component of sustainable development, protected land is an umbrella term used to identify

<sup>3</sup> See for example O’Neill, 1996; Bates & Rudel, 2000; Hayes, 2006.

<sup>4</sup> Due to missing data, the N ranges from 109–129 across the five models.

areas that are managed by government for the benefit of the larger society. There are several ways to measure the amount of land under protection. The first method considers land based on management objectives for which IUCN has developed six standardized categories of protected land:

- I. *Strict Nature Reserve/Wilderness Area*: Managed primarily for scientific research and/or environmental monitoring with extremely limited public access.
- II. *National Park*: Managed for both ecosystem protection and public recreation.
- III. *Natural Monument*: Managed for conservation of specific natural or cultural features.
- IV. *Habitat/Species Management Area*: Managed mainly for conservation of a habitat and/or to provide for a particular species.
- V. *Protected Landscape/Seascape*: Managed primarily for landscape/seascape protection, sustainable use, and recreation.
- VI. *Managed Resource Protected Area*: Managed to support the sustainable use of natural ecosystems (IUCN, 1994).

In terms of individual parcels of protected land in the IUCN categories, Europe has the largest number of protected areas with over 43,000 sites, followed by North Eurasia with nearly 18,000 sites, North America with over 13,000 sites, and Australia and New Zealand with close to 9,000 protected areas. The Pacific, with around 320 sites, has the fewest number of protected areas. There are nearly 4,390 protected areas in Eastern and Southern Africa with a further 2,600 sites in Western and Central Africa. In terms of protected land mass, Central America and South America have the largest expanse of protected areas, covering almost 25% of each of these regions. North America is also well represented, with 4.5 million square kilometers (km<sup>2</sup>), or just over 18% of the region's land surface, although much of that is in the sparsely populated northern regions. Protected areas cover 1.6 million km<sup>2</sup> (over 14.5%) of Eastern and Southern Africa and over 1.1 million km<sup>2</sup> (over 10.5%) in Western and Central Africa. The Pacific has over 20,000 km<sup>2</sup> of protected areas (approximately 1.5%) (IUCN, 2007).

While the IUCN categories are an important way to assess the amount of protected land globally, they are not consistent with the norms suggested by the Brundtland Report, the United Nations Conference on Environment and Development (UNCED), and the 1992 Fourth IUCN World Parks Congress regarding environmental sustainability that are being tested here. International conferences have moved toward privileging land protection based on specific biomes

or types of ecosystem. A state could gain a high score on the IUCN categorical calculation and a low score on ecosystem protection by protecting one biome at the expense of another. For example, a large state could protect its entire desert (typically low biodiversity) and none of its rain forest (high biodiversity) and have a very high score according to the IUCN calculation, but a much lower score for ecoregion protection. Conversely, the CIESIN measure of ecoregion protection, which is derived from the World Database of Protected Areas and the World Wildlife Fund's ecoregion mapping, is consistent with the emerging global norms of interest to this research. This is the primary reason that the CIESIN measure is the dependent variable in this study. Of course, the disadvantage of this measure is that countries with fewer ecoregions may attain an unwarranted higher score; however this is reflective of larger problems with the international norm.

### Theories of Protected Land Creation

It is important to explain the wide variation in land protection across states. Theoretical discussions regarding the differing tendencies of states to protect land can be grouped into three categories: environmental (threats and diversity), political, and economic. Because little has been written about the specific reasons countries would choose to protect land, an interesting area of future study, this research relies on theoretical literature that addresses more general environmental protection to provide a basis for testable hypotheses.

#### *Protection for Environmental Reasons*

Environmental arguments for land protection are rooted in the idea that protected lands are created as a means to preserve species and endangered ecosystems. These contentions are based on two subtly nuanced claims: that parks protect biodiversity and/or that they protect against environmental threats such as urban sprawl and industrial development.

Species extinction has been tied to the greater "biome crisis" in which biodiversity loss and ecological problems are intrinsically related to the larger issue of ecosystem degradation (Parrish et al. 2003; Dilsaver & Wyckoff, 2005; Hoekstra et al. 2005). While most policy initiatives to protect endangered species are tied to small "hot spots," such as Penang National Park in Malaysia, the world's smallest national park (25.62 km<sup>2</sup>), a broader conservation policy focused on entire ecosystem protection is required to make a significant difference (Hoekstra et al. 2005). Larger expanses of protected land such as Denmark's Greenland National Park (972,000 km<sup>2</sup>) and the Amazon Rain Forest (over 1 million km<sup>2</sup> un-

der varying levels of protection) are examples of this approach.

Notwithstanding a general consensus that biodiversity must be conserved, it is still largely unclear how best to do so. Despite the emergence of the global norm of land protection, the debate continues over the value of protected land status versus sustainable use. Sustainable use arguments suggest that conservation occurs through people's use of resources (Robinson, 1993), while protected area arguments suggest that use must be strictly limited to reduce biodiversity stress. While sustainable use arguments may have political and economic appeal, they have been deemed largely insufficient from an ecological perspective (Parrish et al. 2003; Hoekstra et al. 2005; Gorenflo & Brandon, 2006). The analysis presented in this article provides a preliminary test of these competing claims to determine if measures of biodiversity in fact are related to protection in the international arena.

Forests are critical to environmental health for a number of reasons: preventing erosion, providing habitat for flora and fauna, absorbing carbon dioxide and replenishing oxygen (which is critical to preventing climate change), reducing pollution, and conserving groundwater, to name a few (Taylor, 1973; Bates & Rudel, 2000; United Nations Forum on Forests, 2007). As such, forestry issues have been a global priority since the 1992 United Nations Forum on Forests (United Nations Forum on Forests, 2007). Because forests of all types (temperate, boreal, and tropical) provide homes to a wide array of flora and fauna, and because they are less likely to face competing land uses, it seems that forested areas would be more likely to be protected (Bates & Rudel, 2000).

Perhaps the most obvious theoretical argument for protecting land is to prevent the degradation of the natural environment (Sprinz & Vaahtoranta, 1994). The motivation for protecting land in this case stems from a response to threats such as human use, deforestation, and population growth (Ridenour, 1994; Hopkins, 1995; Lowry, 1999; Macleod, 2001; The Coalition of Concerned National Park Service Retirees, 2004; Stoll-Kleemann, 2005; Hayes, 2006). The likelihood that states facing environmental threats may protect land to a greater degree is a relationship worth investigating.

One of the most significant concerns in terms of protected land is the need to safeguard ecosystems from human use. High anthropogenic impacts are problematic because they degrade the natural environment and disrupt ecosystems (Hoekstra et al. 2005). According to recent estimates, 21.8% of global land area is under human dominated use, extensively in tropical dry forests (for example, 69% of southeast Asia has been converted to human use),

temperate broadleaf and mixed forests, temperate grasslands and savannas (with more than 50% lost in North America), and Mediterranean forests, woodlands, and scrub. In contrast, tundra and boreal forests remain almost entirely intact (Hoekstra et al. 2005). This posits a relationship between the amount of human impact on a state and its likelihood to protect land.

Similarly, it has been argued that deforestation is a particularly compelling threat, leading to conservation policies (broadly construed) because of visual evidence that can spur citizens and policymakers to action (Bates & Rudel, 2000). It would be expected that timber harvest rates should be positively correlated with ecoregion protection.

The rate of population growth has been linked with a number of associated environmental threats, including pollution, waste, habitat loss, water scarcity, soil erosion, development, deforestation, and increased resource demands. Many questions remain, however, about the relationship between population growth and biodiversity (Cincotta & Engleman, 2000). For instance, does population growth spur protection policies or are protection policies less likely in high growth areas because of competing demands for land?

### *Protection for Political Reasons*

Protecting land is an inherently contentious process. Since the establishment of protection removes land from private and public development, it typically involves imposing restrictions on contact and use. This can affect a population's access to profitable natural resources (e.g., minerals) or needed subsistence resources (e.g., food or firewood). Protected land creation is most often a political decision,<sup>5</sup> and by and large stems from the policy process, political actors, and governmental decision making. The development of protected lands is usually the direct result of government policy and it is governments who implement that policy. In contrast, other environmental policies, such as air pollution and alternative energy, may originate with and/or be implemented by private corporations.

Due to its political nature, one theory about land protection suggests that governments are most likely to confer protective status when there is a critical mass of public support. One way to study public support on an international scale is through the activities of organized interests. Interest groups, particularly global NGOs, have been active in environmental is-

<sup>5</sup> There are a few exceptions of NGOs purchasing private land and putting it into a public trust or quasitrust to protect it from development. The Nature Conservancy is one example of an NGO involved in various land acquisition arrangements such as debt-for-nature swaps and conservation easements.

sues and specifically in promoting national parks and protected land. These organizations may encourage the protection of land and resources through direct political pressure or indirectly through international intergovernmental organizations (IGOs) like the World Bank or regional lenders (Bates & Rudel, 2000; Frank et al. 2000). NGOs have been instrumental in lobbying governments, purchasing land, facilitating debt-for-nature swaps, training conservation personnel, and identifying suitable land for protection (Frank et al. 2000).

The existence of public support, and the influence of NGOs domestically, are probably directly affected by the political system within a state. In a democracy, it is more likely that interest groups and public opinion affect policies than in a nondemocracy. Several authors argue that the common characteristics of democracy (e.g., freedom of speech, freedom of association, voting) allow citizens to mobilize more effectively to influence government and, in turn, act in the interests of environmental protection (Payne, 1995; Midlarsky, 1998). In a larger study, Neumayer (2002) concluded that democracies exhibit a stronger commitment to many environmental issues than nondemocracies. He specifically includes land under protected status and finds that democracies are likely to protect a larger percentage of their land. Although the connection between democracy and environmental protection continues to be questioned (Desai, 1998), evidence suggests that democracy may be a determinate of which countries choose to protect their land.<sup>6</sup>

The development of an international norm to protect land also seems important politically. Using event-history analysis, Frank et al. (2000) finds that parks (along with four other dependent variables) increase over time as national environmental protection becomes normalized both domestically and internationally. Country ties to world society are positively related to land protection, as is the presence of "domestic receptor sites" that can transfer information from the world to local actors, such as state organizations. These effects are present even when

<sup>6</sup> There is an ongoing debate in the literature about the relationship between democracy and environmental protection. Democracies seem to be more likely to sign and ratify environmental agreements, participate in environmental intergovernmental organizations, and comply with reporting requirements. Democratic processes also tend to facilitate information sharing about environmental problems. Furthermore, the interest group tradition in most democracies enables victims of pollution or other environmental threats to organize and make demands on government. At the crux of the debate, however, is the fact that many of the democracies in the world also tend to have the highest levels of greenhouse gas emissions and pollution. The interactions between democracy, economic development, and the environment are extensive and complicated and are a rich area for further research.

population and industrial development are controlled, although parks are somewhat more likely to be founded in countries with large populations. Frank et al. (2000) argue that park development may more accurately reflect organizational capacity or population pressures. While these variables are different than those we are examining, this prior study does suggest that politics plays a role in the increase in the number of parks over time.

O'Neill (1996) explores whether states create protected areas in response to pressure from international organizations and other states. She operationalizes international pressure as participation in international treaties (e.g., trade, arms control, and the environment) and uses this measure as a proxy to estimate exposure of state officials to norms of international relations, and more precisely, to conservation. We build on this work with the creation of a different measure of norms and treaty participation by creating a variable measuring participation specifically in protected land treaties.

Regime type and international norms emerge from the literature as political factors encouraging states to choose to protect land. We use Freedom House scores to test regime type. To indicate a commitment to international environmental norms, we use IGO membership and the level to which a state is party to protected land treaties.

### *Protection for Economic Reasons*

Tradeoffs between protecting the environment and encouraging economic growth are cited in both the economics and international political economics literature. This connection between the environment and economics can be traced back to the 1960s when global environmental movements began (Meier & Rauch, 2005). Both developed and developing countries have to find ways to balance environmental concerns with promoting economic growth. For developed countries, the issues coalesce around how industrialization and economic expansion have generated pollutants such as greenhouse gases or landfill waste. In developing countries, the issues are usually couched in terms of the relationship between poverty and the environment, and how attempts to escape poor economic conditions can lead to environmental degradation. Even though the connection between countries protecting land and their economic status has not been significantly explored, we can use studies dealing with other environmental concerns to posit relationships between economics and land protection.

The advent of sustainable development paradigms facilitated the expansion of the field of environmental economics to study the interactions between economics and the environment. But the evi-

dence about how the two affect each other is complicated. In some cases, economic growth improves environmental quality, and in others, it does not. Most studies on this topic are relatively recent and suggest at least three discernable relationships between economic growth and the environment; that economic growth (1) improves environmental quality, (2) at first damages, but later helps a society protect the environment or (3) hurts the environment (World Bank, 1992).

The optimistic position is that economic growth, or an increase in a population's affluence, will positively affect environmental protection. The argument is that states with greater wealth are more likely to protect land and the environment overall. Some work has been done to examine the relationship between wealth and park creation. Bates & Rudel (2000) argue, "nations that create parks are probably more prosperous than other nations" and, given the expense of park management, this correlation seems likely. Frank et al. (2000) have also found that industrial development has a positive and significant effect on the formation of parks.

The case that wealth affects environmental protection also derives from the argument that more affluent societies are more attuned to postmaterialistic needs. Inglehart (1990; 1997) argues that industrial societies have different cultures or values that derive from their affluence and the satisfaction of their more immediate needs. In his view, postmaterialist societies are more prone to value the environment and therefore are more likely to protect it. Supporting Inglehart's position are studies suggesting that attitudes about protecting the environment are more prevalent in countries with higher per capita GNP (Diekmann & Franzen, 1999; Franzen, 2003).<sup>7</sup>

This reasoning leads one to believe that perhaps affluence and economic growth is the savior for the environment, and conversely global poverty is the problem (Beckerman, 1992; Hollander, 2004). Such ideas are supported by the experiences of many developed countries that have fewer incidences of specific environmental problems such as contaminated drinking water or adequate sanitation (World Bank, 1992).

A corollary to this argument, and a second way that economic growth affects the environment, is the

suggestion that while environmental problems may increase at early developmental stages, they will taper off as personal incomes and national wealth rise. This position has been termed the "environmental Kuznets curve." Named after a similar curve hypothesized by Simon Kuznets (1955) to explain the relationship between economic growth and income inequality, the environmental Kuznets curve literature suggests that economic growth might initially give rise to environmental damage, but environmental quality improves once incomes surpass about US\$12,000 (Grossman & Krueger, 1995). The strongest support for this relationship has been found in air-quality measures and in certain pollutants across various countries (Selden & Song, 1994; Grossman & Krueger, 1995; Cole et al. 1997). However, there is significant debate about whether the environmental Kuznets curve is specific to only some pollutants and thus not generalizable across a wider range of environmental issues (Shafik, 1994; Ekins, 1997).

The final posited relationship between economic growth and the environment is that rising incomes and national wealth harm the environment. Several strands of economic and sociological literature support this contention, including those that represent an anticapitalist agenda and argue that capitalist production systems are more concerned with short-term growth than with issues like environmental protection (Redclift, 1987). Thus, industrial production systems and expanding economic growth, while possibly raising a state's economic profile, do so at the expense and exploitation of the environment (Dauvergne, 2001; 2005; Rees, 2003). Even studies that suggest some positive relationships between economic growth and the environment often also point out that rich countries are more likely than low-income countries to deal with certain environmental problems, including resource depletion and excessive waste (World Bank, 1992; Dauvergne, 2005).

One economic factor that has received significant criticism regarding its effect on the environment is trade. Scholars have argued that liberal trade causes developing countries to specialize in dirty industries, subsequently harming local environments to exploit their comparative advantage. Liberal trade policies are seen from this perspective to lead to an environmental "race to the bottom" and contribute to declining environmental quality (Rock, 1996; Grether & deMelo, 2003). But many empirical studies have had a difficult time proving that increased trade as a result of liberalization has led to environmental problems within less developed countries (Birdsall & Wheeler, 1993; Mani & Wheeler, 1998; Eskeland & Harrison, 2003) and Antweiler et al. (2001) argue that free trade appears to benefit the environment, for

<sup>7</sup> The environmental and affluence arguments have been countered by Frank et al. (2000), who argue that the affluence and environmental degradation arguments do not hold up to historical scrutiny. They argue that the international exponential rise in environmental activities, including park creation, is evidence that countries pursue environmental protection regardless of affluence. Indeed, affluence seems to have little effect on degree of protection, as evidenced by the oil wealth of the Middle East. Others who contradict Inglehart's thesis include Brechin & Kempton (1994) and Dunlap & Mertig (1995).

**Table 1** Descriptive statistics of variables.

Variables	N	Minimum	Maximum	Mean	Standard Deviation	VIF in Multi-dimensional Model	Original data source and notes
Ecoregion Protection	132	0.0	100	62.72	31.53	n/a	Center for International Earth Science Information Network at Columbia University (CIESIN) – in conjunction with IUCN, World Database on Protected Areas and UNEP World Conservation Monitoring Centre
National Biodiversity Index	157	0.11	1.00	.55	.159	1.50	Convention on Biological Diversity (United Nations)
Forest Area	186	.00	95.00	30.12	22.56	1.55	World Development Indicators (WDI)
High Anthropogenic Impact	217	.00	100.00	8.13	16.54	1.95	CIESIN
Timber Harvest rates	132	.00	100.00	89.76	25.70	1.37	Food and Agriculture Organization (FAO) forestry database
Population Growth	199	-1.00	5.00	1.39	1.17	1.66	WDI
Trade 2004	150	31	372	93.19	47.7	1.32	WDI
GDP Per Capita (US \$) (log)	169	2.02	4.70	3.30	.68	3.241	WDI (log transformation by authors)
Party to Protected Land Treaties	191	0	22	5.7	1.84	2.40	Compiled from <a href="http://sedac.ciesin.org/entri/">http://sedac.ciesin.org/entri/</a> Environmental Treaties and Resource Indicators of the CIESIN
Freedom House Standardized scale (2000) 100 points	188	14.28	99.96	64.63	28.59	1.93	Freedom House
IUCN membership	199	.00	62.5	1.694	7.09234	1.29	IUCN

example by promoting production in areas where it is most environmentally appropriate, or by enhancing global economic development sufficiently to fund environmental programs. The relationship between trade and negative environmental effects is more strongly demonstrated in the area of land use and deforestation. For instance, López (1997) asserts that deforestation increases with expanded trade liberalization and Chichilnisky (1994) argues that many studies have confirmed that deforested areas are caused by agricultural production for the international market. Thus, a relationship might exist between a state's desire to protect land and its level of international trade, assuming higher volumes of trade would be more indicative of a more liberal trade policy.

Although the literature on economic growth and the environment comes to sometimes divergent conclusions, evidence suggests a relationship between the environment and certain economic variables. Building on this work, we are interested in under-

standing how, if at all, economic variables might predict whether states protect land. The economic variables we use are country affluence or wealth as expressed through gross domestic product (GDP) per capita and international trade. With regard to protected land, our general assumptions are that wealthier countries will protect land better.

### Variables and Model Specifications

The theoretical literature provides adequate support for investigating the roles of environmental, political, and economic variables in predicting the amount of land that a state protects. To test these relationships, we develop five models based on these theoretical insights. A discussion of the dependent variable and our independent variables in each of our models follows. Descriptive statistics for all variables are shown in Table 1.



### ***Dependent Variable: Protected Ecoregions***

The protected ecoregions variable was calculated by CIESIN from the 2004 World Database of Protected Areas and the World Wildlife Federations map Terrestrial Ecoregions of the World.<sup>8</sup> The dependent variable is based on the global target of protecting 10% of the land area of each biome (i.e., desert, forest, grassland) in each country. CIESIN developed this variable by calculating the land area of 10% of each biome in a country and then comparing the values to the actual land area under protected status for each biome as a ratio. If the protected area is equal to or greater than 10%, then the country receives a score of 1 for that biome; if, for example, only 5% of the biome is protected (half the global target) then it receives a score of 0.5. These ratios are then averaged for all of the biomes in a country, and converted to percentages in the regression analysis. A score of 100% means that all biomes in a country are at least 10% protected.

Protecting land for the sake of protecting land fails to advance the sustainable development agenda. A commitment to protecting the diverse biomes of the world goes much farther in ensuring that environmental goals are being met. The correlation between the variables *ecoregion protection* and *percentage of protected land* is only 0.293, suggesting that policies to protect land do not necessarily take into account the international standard of biome protection, thereby giving reliability and confidence to the dependent variable.

### ***Independent Variables***

A number of different independent variables are employed to test five different models for protecting ecoregions. For the sake of clarity, the independent variables are introduced according to the model in which they are tested. The theoretical discussions above regarding the environmental, political, and economic explanations associated with protection policies have driven our choice of independent variables and we have grouped these variables based on their association with the model being tested.

## **Environmental Models**

### ***The Biodiversity Model***

The theoretical literature suggests that biodiversity is a key reason for protecting land. To test this hypothesis, this model includes two independent variables that are reflective of biodiversity. First, *forest*

*area* is derived from the World Development Indicators (published by the World Bank) and identifies the percentage of standing forest in each country. Second, we use the *National Biodiversity Index*, which is based on estimates of the richness of four terrestrial vertebrate classes and vascular plants, with each considered equally. Only countries with a land area greater than 5,000 k<sup>2</sup> are included in this measure. Index values range from a maximum of 1.00 (i.e., Indonesia) to a minimum of 0.00 (Greenland, excluded from study).

*H<sub>1</sub>: As the Forest Area and National Biodiversity Index increase, ecoregion protection increases.*

### ***The Environmental Threats Model***

Our second environmental model is based on assumptions in the literature that a perceived environmental threat will spur countries to protect land. We use three independent variables in this model that represent threats. First, *Timber Harvest Rates* are used to understand threats to biodiversity. The data on timber harvest are sourced from the Food and Agriculture Organization (FAO) forestry database and represent all roundwood that has been felled/harvested and removed.<sup>9</sup> Second, *Population Growth (annual percentage)* represents the encroachment of human activity on land as this intrusion could lead to environmental problems. Population growth is calculated as an annual percentage of growth from the 2005 World Development Indicators. Third, *High Anthropogenic Impact* is used. As discussed above, human use is one of the major environmental threats contributing to the biodiversity crisis. This variable is measured as the percentage of total land area (including inland waters) with a very high anthropogenic impact. The original source of the data is the CIESIN at Columbia University (Esty et al. 2005).

*H<sub>2</sub>: As anthropogenic impacts, timber harvest rates, and population growth increase, ecoregion protection decreases.*

### ***Political Model***

In the political model we are interested in testing if international norms and regime type, specifically democratic or authoritarian, affect whether a state chooses to protect land. Three independent variables are used. First, *IUCN Membership* is measured as the number of IUCN membership organizations per mil-

<sup>8</sup> 2004 World Database of Protected Areas is available at [http://maps.geog.umd.edu/WDP/WDP\\_info/English/WDP2005.html](http://maps.geog.umd.edu/WDP/WDP_info/English/WDP2005.html) and the World Wildlife Federations map of Terrestrial Ecoregions of the World is available at <http://worldwildlife.org/worldworld/>.

<sup>9</sup> The original data are available at: <http://faostat.fao.org/faostat/collections?version=ext&hasbulk=0&subset=forestry>.

lion people.<sup>10</sup> IUCN members include national/international NGOs, state agencies, and state members. This variable is used to suggest how connected to international organizations a state is, assuming that organizations carry international norms with them. The original information source is the IUCN; however, the data were obtained from the Millennium Development Goals. Second, *Independent Party to Protected Land Treaties* is used to understand the environmental commitment of a state. It is assumed that a more highly committed state will be party to a larger number of treaties. This variable is measured as a count of protected land treaties to which a country is a party.<sup>11</sup> The variable was constructed by the authors and is used as a proxy for political commitment to the international norm of protected land. Third, *Freedom House Standardized Scores* are used as a proxy measure of regime type, or the degree of democratic freedom in a country. The variable is a standardized scale from 0–100 measuring civil liberties and political rights.

*H<sub>3</sub>: As IUCN membership, Freedom House scores, and treaty participation increase, ecoregion protection increases.*

### **The Economic Model**

The economic model tests the relationship between affluence and trade on the designation of protected public lands. We use two independent variables in the economic model. Per capita GDP is a standard measure of national income. A number of analysts have argued that the variable should be logged based on the assumption that differences of a few hundred dollars are more significant for poorer nations than wealthier nations (Brechin & Kempton, 1994; Dunlap & Mertig 1995). In working with a large data set, we concurred with this assumption and logged *GDP per capita (2004)*. The data source is the World Development Indicators produced by the World Bank. Second, *Trade* is used to measure connectedness to international markets and also to measure economic success. The relationship between trade and the environment is heavily studied. The literature concludes that trade will both impair and improve environmental quality, but makes stronger claims

about the negative effects of trade on land degradation; therefore, we hypothesize that increased trade will weaken land protection. Higher levels of trade will suggest a greater commitment to liberal trading policies. This variable was derived from the World Development indicators and is measured in US\$ for 2004, the most recent complete year of data.

*H<sub>4</sub>: As GDP per capita increases, ecoregion protection increases.*

*H<sub>4.1</sub>: As trade increases, ecoregion protection decreases.*

### **The Multidimensional Model**

Finally, our multidimensional model recognizes that perhaps the decision to protect land is not solely expressed through environmental, political, or economic lenses, but is actually a representation of the interactions of these three sets of variables. To test this conjecture, we combine all of the variables discussed above into a single model.

One general problem with multidimensional models is issues of collinearity whereby a misspecified model includes mutually dependent, and thus redundant, predictors. To test for issues of multicollinearity we ran diagnostic tests, specifically the variance inflation factor (VIF), which is a more sophisticated test than reporting correlations of the independent variables. Although there is some dispute over the appropriate cut-off point, a generally accepted rule is that the VIF should not exceed ten (Belsley et al. 1980). The debate in this case is somewhat moot as only two variables had VIFs higher than 2.0 (*Party to Protected Land Treaties* = 2.40 and *Log GDP per capita* = 4.725) and neither of them were close to a value of concern. VIF values are included in Table 1.

### **Findings**

Table 2 presents multiple regression results. Model 1 (Biodiversity) supports the biodiversity variable, however, forest area is not supported. Model 2 (Environmental threats) is fully supported in the regression analysis with all variables significant. However, the variable *High Anthropogenic Impact* shows a negative relationship which is counter to our hypothesis. One explanation for this outcome is that land-protection policies are lagging behind human development. This observation suggests that once an area is subject to a high anthropogenic impact, protection policies fall off the agenda, even if the area could be rehabilitated. This possibility is particularly worrisome from a protection standpoint as human development is infringing on more and more of the world. Of course, conversely it may be that these areas are

<sup>10</sup> While other measures of civil society would be ideal, for instance international NGO (e.g., the Nature Conservancy) activity in a country, such data are not available on the scale of this data set. Clearly there is a need for data collection on this issue.

<sup>11</sup> Some of these treaties are broad umbrella agreements such as *The Convention on Biological Diversity* and the *International Convention for the Protection of Birds*, while others are more specific such as the *Convention on the Conservation of Migratory Species of Wild Animals* and the *Convention on Wetlands of International Importance especially as Waterfowl Habitat*.

**Table 2** Dependent variable: ecoregion protection

Variables	(1) Biodiversity		(2) Environmental Threats		(3) Political		(4) Economic		(5) Multidimensional	
	<i>B</i>	Beta	<i>B</i>	Beta	<i>B</i>	Beta	<i>B</i>	Beta	<i>B</i>	Beta
National Biodiversity Index	47.268* (18.313)	.239							50.645* (20.498)	.259
Forest Area	-184 (.140)	-.121							-.024 (.173)	-.015
High Anthropogenic Impact			-1.075* (.303)	-.223					-1.741* (.579)	-.359
Timber Harvest rates			.303** (.105)	.248					-.144 (.127)	-.114
Population Growth			6.861** (2.771)	.233					6.598* (3.265)	.222
IUCN Membership					2.645 (3.132)	.075			3.174 (3.126)	.099
Freedom House					.087 (.132)	.075			.127 (.147)	.103
Party to Protected Land Treaties					-1.595 (.901)	-.190			.470 (1.101)	.057
GDP Per Capita (US \$) (log)							-9.419* (4.390)	-.203	1.903 (7.135)	.041
Trade 2004							-.081 (.083)	-.091	-.010 (.087)	-.011
R	.309		.403		.177		.236		.527	
r <sup>2</sup> (adj.)	.081		.142		.008		.038		.204	
N	129		128		127		111		109	

Numbers in parentheses are standard errors

\* $p < .05$  \*\* $p < .01$  (one-tailed tests)

Note: *B* refers to the independent contribution of each independent variable to the prediction of the dependent variable. Beta refers to standardized variables thereby allowing comparisons of the relative contribution of each independent variable to the prediction of the dependent variable.

no longer worth protecting because the extent of damage is so great. Additional research on this topic is needed.

Somewhat surprisingly, none of the variables were significant in Model 3 (Political). Additional correlational data on IUCN membership suggest that IGOs are not usually active in countries with strong measures of the National Biodiversity Index (-0.077) or forests (0.149), but are slightly more likely to be present in areas with high anthropogenic impacts (0.383). Political participation on the part of environmental organizations thus may be more associated with areas under environmental stress than with high levels of biodiversity. This perhaps represents a reactive rather than a proactive policy presence. Taken into context with the regression results, IGOs may have less of a need to work in high biodiversity countries, as their sensitive areas may be more likely to have some protected status. Further analysis of non-IUCN member organizations may answer some of these questions.

Model 4 (Economic) indicates that trade is not a significant variable in predicting levels of ecoregion protection; however per capita GDP (logged) is significant, with a negative relationship. Alternative

specifications of economic variables, such as per capita Gross National Income (GNI), produced results that were not significant when analyzed in a bivariate regression. An external debt management variable derived from the 2004 World Development Indicators was dropped from the analysis due to multicollinearity problems, but in a bivariate regression with ecoregion protection it has a *B* of 5.527 (significant at the 0.05 level) and an adjusted  $R^2$  of 0.028.

The economic model did not perform as we had expected. Both trade and per capita GDP relationships proved counter to our hypotheses. First, we anticipated that trade would have some effect on protected land and we advanced the conjecture that more trade would be correlated with less protection. This relationship was suggested by the literature on trade and the environment, but does not apply for protected land. Regarding trade, we found no significant relationship between trade levels and protection. The more interesting relationship is that per capita GDP was negatively correlated, a finding that suggests richer countries are less likely to protect land. Our attempts to better understand this relationship by using GNI did not yield any definitive results.

Although the literature on postmaterialism suggests industrial countries are more concerned with values that privilege the environment, our findings suggest that this is not the case. Such a contention with respect to land protection may not be counter-intuitive for several reasons. Since land sells at a premium in developed countries, and land protection means removing land from use (and probably from private hands), it would be a much more expensive endeavor to protect land in a developed country than in a poorer one. Due to the increased cost, it is also probably a more contentious policy decision. Although these results were not what we expected, they are supported by literature that suggests economic development can impair portions of the environment. In addition, our results seem to contradict the post-materialist thesis and thus contribute to a larger theoretical debate on whether affluence and environmentalism are connected. GDP is not a good predictor of land protection.

The fifth stage of the regression analysis is the multidimensional model which integrates the previous four models into a single multiple regression equation. This model notes a number of changes, in particular that both per capita GDP and timber-harvest rates drop out once the other variables are introduced. This model provides a better explanation of variance than the others, suggesting that the reasons for protecting land are quite complex and draw from many different policies and preferences.

What is a plausible explanation for the multidimensional model findings? What these analyses suggest is that biodiversity is the primary driving forces of protected land policies. Countries with high biodiversity are more likely to protect land. As such a goal is consistent with the land-protection norm, this outcome is one small indicator of success. The second driver is population growth which suggests either a reactionary policy approach as a rationale for protecting land or people's preference for beautiful areas. Case-study research would likely help to clarify this point. The only significant negative factor was high anthropogenic impact. While case studies would also shed greater light on this variable, it is likely that areas with high anthropogenic impacts have less that is still worth protecting due to the degradation caused by use. This observation suggests that while protected land policies are targeted to areas worth protecting, and in need of protecting from a biodiversity perspective, there is an urgency to protect land at risk of human-caused degradation. Politics and economics, at least based on these measures, are not as influential. This may reflect the fact that protection policies are not necessarily *meaningful* protection policies, which would require both political and economic resources.

One limitation of this statistical analysis is the small  $R^2$  terms for each of the models. While perhaps endemic to the research question at hand, these outcomes nonetheless highlight the complexity of protection policies and suggest room for further study. To try to improve the predictive nature of our models, we did a secondary analysis that included regional variables to see if this lower level of aggregation would increase the  $R^2$  values or change the resultant analysis. We ran regressions on just Latin America, just Africa, just tropical countries, and also included these as regional dummy variables. We also added a developing countries variable into the full data set. None of these analyses generated significant results, suggesting that regional variation does not affect land-protection policies. In fact, in the case of Latin America, the only significant variable was *High Anthropogenic Impact* (negative relationship) and for Africa none of the variables was significant. The four models were also run with standardized variables to see if the considerable variation in magnitude in the independent variables biased the results. There was no change when the variables were standardized. We also tested a variable based on the number of ecoregions per state, but this was not significant.

## Conclusion

According to IUCN, by the year 2000 there were 30,000 protected areas covering more than 13 million  $\text{km}^2$  of the world's land surface (roughly the size of India and China combined). Protected areas not only conserve biodiversity and natural features, but also protect watersheds and soils. They serve important research and education needs and contribute to local economies through sustainable activities. Other areas protect and promote cultural values and, of course, can provide emotional or spiritual escapes from modern life.

Failure to protect the land from human activity results in biodiversity loss, decreases landscape variety, and diminishes ecological interactions and the evolutionary processes that sustain and promote biodiversity (Hoekstra et al. 2005). Although there are costs, and protecting land can be a difficult policy decision, the social and environmental benefits can be enormous. Moreover, as environmental issues rise on national and international policy agendas, the role of protected land will remain important.

Despite the many benefits of land protection, most countries have fallen far short of the international target of protecting 10% of each national biome. Based on the multiple regression findings in this article, land protection can be predicted based upon biodiversity factors, environmental threats (high anthropogenic impact and timber harvest rates), and

economic development. Some these findings are reassuring, in particular that environmental factors are leading to more protection. As the concern for the environment continues to grow, and as states add these issues to their policy agendas, it is likely that we will continue to see more biomes come under protection. From an international policy perspective, these findings suggest that making connections with environmental issues is probably the best choice for getting land protection onto national agendas.

The political and economic results provide less hope for the future of land protection and are in need of more research. Politically, international environmental norms and treaties to address environmental issues are more prevalent than ever before, as are states with political systems and policy processes that allow public interests to be expressed. But these factors are not leading to greater land protection. Further research needs to focus on how linkages can be made between these positive political developments and land protection.

Further study also needs to be conducted regarding economic issues. The relationship between environmental and economic objectives is complicated and our results contribute to these debates, particularly whether wealthier countries are more committed to environmental issues. Our findings contradict the belief that richer countries are better at protecting the environment and therefore challenge the postmaterialist thesis. More research is needed to isolate economic variables and to test their significance for land protection. In addition, we need to better understand the policy issues surrounding land protection in developed countries. Do property values affect protection and why might it be more difficult to protect land in more economically advanced countries?

Our results confirm that the decision to protect land is a complex one that appears to be influenced by many factors. While we have begun to explore this issue and offer some much needed research, questions still remain. In particular, uncertainty still surrounds whether land protection policies are actually meaningful and which policy mechanisms can encourage more than just token protection. Since land protection is vital for so many social benefits and for continued environmental preservation, we must continue to work to understand these relationships to devise better strategies.

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