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Geography of Conservation Spending, Biodiversity, and Culture

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Abstract

We examined the associations between geography, biodiversity, national spending on conservation, governance and cultural traits. Cultural traits and social metrics of modernization correlate positively with national spending on conservation. Further, we show the global distribution of this spending culture is poorly aligned with the distribution of biodiversity. Specifically, biodiversity increases towards the tropics where cultures tend to spend less on conservation, and have higher collectivism, formalized and hierarchical leadership, and weaker governance. Consequently, nations lacking social traits frequently associated with modernization, environmentalism, and conservation spending have the largest component of the Earth's biodiversity. This has significant implications for setting policies and priorities for resource management given that biological diversity is rapidly disappearing

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and cultural traits change slowly. Therefore, we suggest that natural resource management adapt to and utilize characteristics of existing social organization rather than wait for or promote social values associated with conservation spending. Supporting bio-cultural traditions, engaging leaders to increase conservation commitments, cross-national efforts that complement attributes of cultures, and avoiding interference with nature may work best to conserve nature in collective and hierarchical societies. Spending in modernized nations may be a symbolic response to a symptom of economic development and environmental degradation, and must therefore, be accountable for conservation impact.

Introduction

The diversity of plant and animal species, human cultures, and institutional traits, and capacity to conserve them are unequally distributed (Maffi 2005; Gavin et al. 2013). For example, species and human cultures are more diverse towards the tropics, apparently due to similar drivers (Collard & Foley 2002; Burnside et al. 2012). However, social organization – potentially critical for providing a basis for human adaptation to future environmental change – has received less attention (Greenfield 2009; Hofstede et al. 2010). Conservation funding aimed at preventing losses of species and ecosystem service is also unequally distributed, both within and between countries, causing heterogeneous and targeted efforts with uncertain outcomes for broader-scale biodiversity conservation (Miller et al. 2013; Waldron et al. 2013).

Global heterogeneity in the adaptive capacity of cultures, state of resources, and stresses to the environment creates a diverse context to guide social-ecological adaptation (Boyd et al. 2011; McClanahan & Cinner 2012). As a normative science, conservation requires culture to acknowledge the importance of conserving species conservation and protecting ecological services. If, how, and why conservation values and actions are acknowledged is expected to

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differ with cultural history, human development, and associated personalities (Inglehart & Welzel 2005; McCrae & Terracciano 2005). Human development correlates with many psychological and cultural changes, and frequently emphasizes intrinsic rights to survival, individualism or self-sufficiency, and ideological support for species conservation (Inglehart & Welzel 2005; Greenfield 2009). Nevertheless, resource management responses are complicated as poor nations with strong materialistic or survival values may support conservation, and wealthy nations do not always effectively protect resources (Steinberg 2005; Dietz et al. 2012). Additionally, people's perceptions of their ability to adapt to their environment can differ substantially – often influenced by culture (Nisbett et al. 2001; McCright & Dunlap 2011). Consequently, problem framing and social institutions may influence resources management more than poverty or values that emphasize survival, economics and physical security (Wilshusen et al. 2002; Kahan 2012). These observations and studies indicate a complex interaction between cultural attitudes, personalities, and perceptions towards management options when natural resources decline.

Cultural Traits, Modernization Theory, and Governance

Funding for biodiversity conservation has been explained by modernization theory. "New modernization theory" proponents argue that cultural values change from materialist to post-materialistic as economies develop from rural to urban, with societies adhering more to principles of human rights, democracy, good governance, and individualism, and less to survival values along a "human development sequence" (Inglehart & Welzel 2005). According to this theory, expansion of intrinsic rights often extends from people to the larger community of species, associating them with conservation values (Singer 2011). Further, economic development parallels psychological development, and increases individual innovation, specialization, education, and self-expression. Consequently, people organize less

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on necessity and more on cognitive and behavioral affinities, such as conservation concerns (Greenfield 2009).

New modernization theory states that once development passes into a post-materialist economy, survival and economic growth concerns become less important than protecting the rights of people, other species, and the environment (Pinker 2011). When realizing that human and technological power can threaten life, respect for life increases, with less reliance on traditional religions and collectivist affinities in favor of personal, nature conservation, and humanistic values (Inglehart & Welzel 2005). Risks and caution become more common cultural considerations and, as they emerge, post-material priorities lead to increased spending on conservation. Individualistic and self-expression values, while increasing recently, can reverse when economic development reverses but generally change slowly across generations (Greenfield 2013).

Though modernization may change values to support increased expressions of environmentalism and conservation, only rarely does it relate to objective metrics of energy efficiency or conservation that might reflect these values – at least at national levels (Dietz et al. 2012; Rodrigues et al. 2014). Additionally, individualism, private property, and national laws that support them can undermine the informal social institutions and collective behaviors that protect common property. Further, modernization theory may focus on some dominant trends while potentially oversimplify the complexity of cultures (Smith et al. 2002; Hofstede et al. 2010). Finally, values and associated symbolism, including spending money, can be responses to the symptoms of environmental degradation and not necessarily measures of effective action (York et al. 2010). Consequently, factors that help conserve natural resources are not always evident from cultural traits and conservation spending, but their associations provide social-ecological context for developing conservation strategies.

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Aims

Our multidisciplinary study evaluated the proportion of national domestic conservation spending (excluding international assistance) associated with the global distributions of species richness, social traits, and governance. The social traits associated with individualism, modernization, and good governance were expected to correlate with conservation spending while species diversity was not. The suspected mismatch in the distribution of conservation spending and diversity provides a basis for reconsidering conservation strategies.

Methods

Data Sources

Our study uses six main national level data sources (Table 1). The first three are indices of cultural values and organization traits: the World Values Surveys (WVS; Inglehart & Welzel 2005), Schwartz's theory-based cultural values (Siegel et al. 2013), and Hofstede's cultural dimensions, which are based on manager's responses to organizational questions compiled and analyzed at the national level (Hofstede et al. 2010). The WVS is the simplest and largest summary of cultural values. Two national-level cultural indices, the survival vs. self-expression index and the autonomy index, arise from questions designed to elicit underlying cultural values. These indices help distinguish countries, with autonomy and self-expression increasing with common metrics of human development.

Schwartz cultural values, alternatives to the WVS, are based on theoretical considerations of values and has three main axes; social equality/hierarchy (egalitarian), individual mastery/group cohesion (harmony), and individual autonomy/social conservatism (embeddedness). Another more nuanced alternative to the WVS, Hofstede et al. (2010) proposes six cultural dimensions: individualism–collectivism (autonomy), small–large power

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distances (formality or strength of social hierarchies), masculinity–femininity (tolerance of risk and competition), low–high uncertainty avoidance (social response to stresses), long–short-term orientation (planning approaches), and indulgence–restraint (attitude towards life) based on a global survey of company managers.

The Schwartz cultural values and cultural dimensions of Hofstede et al. (2010) have some similarities and the dimensions can reliably influence a wide variety of human values, emotions, motivations, and behaviors (McCrae & Terracciano 2005; Talhelm et al. 2015). For example, the individualism, autonomy, and egalitarian dimensions refer to related concepts where individuals in society see themselves as separate and autonomous from each other, whereas the opposite, collectivism and emeddedness, refers to perceiving individuals as highly interconnected and defined by their relations and social context (Nisbett et al. 2001).

The fourth source of data is the World Governance Indictors of the World Bank. These are regularly produced country-level governance indicators that evaluate and scale accountability, political stability, effectiveness, regulations, citizen respect, rule of law, and graft. A range of environmental variables constitutes the fifth source of data. These include species richness from the Catalogue of Life and IUCN red list and the countries average latitude. Additionally, the environmental regulatory regime of pollutants in a country provides a proxy of environmental management (Etsy & Porter 2005). The sixth and final data source is a range of demographic and economic indicators including country and population size, economic productivity and domestic spending on biodiversity conservation. Hofstede et al. (2010) has values data from 55 countries, Schwartz for 34 nations, and World Values Survey for 27 nations.

Data analysis

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We used general linear models to analyze the relationship of the various metrics with the proportion of gross domestic product (GDP) spent on biodiversity conservation (Waldon et al. 2013), IUCN species, and absolute latitude as a proxy for numbers of species and other cultural and economic factors (Maffi 2005; Burnisde et al. 2012). We focused on proportion of GDP spent on biodiversity conservation, IUCN species and latitude for two reasons. First, species richness is poorly compiled at national and global levels and existing data may have various biases. Specifically, the IUCN data include species evaluated for the Red List, with evaluation effort varying within each country, thereby influencing species estimates. Additionally, the Catalogue of Life (CoL) data are species-centered, which biases national level species estimates. Consequently, using these two sources of data and recognizing their limits and biases while using latitude as a proxy for biodiversity, should strengthen conclusions about observed patterns (Burnside et al. 2012). Further, because IUCN data are, and the CoL is not significantly associated with latitude, we suspect IUCN data were a better proxy for species richness in the countries we analyzed (Fig. S1). Second, we use the proportion of GDP spent on conservation as countries vary substantially in GDP, the relative allocation of funds to biodiversity conservation should be more informative.

We did not use models including multiple predictors, first because data are insufficient to include all cultural dimensions in a model without losing substantial samples. Second, substantial cross correlations between variables complicate subsequent interpretations (Fig. S1). Specifically, spurious correlation (that could nonetheless be rationalized as important) might hide a casual determinant of spending on conservation. Third, we aimed to assess correlations and overlap of cultural traits with metrics of conservation interest, but not to predict spending on biodiversity conservation. Understanding what causes governments to spend money on biodiversity conservation would be valuable, but is outside the scope of our analysis. We deliberately used disparate sources of data to increase redundancy and the

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potential strength of the inference and conclusions. We centered and scaled the variables as per Gelman (2008) to report coefficients as standardized effect sizes, and transformed some variables before centering and scaling to improve linearity (Table 1). Reported statistical significance are adjusted for multiple comparisons.

Inspecting residuals for homogeneity of variance (residuals versus fitted plot) and normality (normal Q-Q plot) revealed no major departures from assumptions of general linear models, except relationships for some variables appeared non-linear even after transformation. Therefore, we ran non-parametric regression models, which generated higher R^2 values. However, the non-parametric relationships were variable and specific countries (i.e. Costa Rica, Slovak Republic, and Austria) disproportionately affected the general trends. Nonetheless, the underlying positive or negative associations of the non-parametric models mirrored those of the linear models. Inferences are, thus, not prescriptive or predictive due to many unaccounted sources of variation in national traits, conservation spending practices, and the distribution of species richness. Therefore, we retained the linear model as it clearly demonstrates the underlying positive or negative associations. Euclidean Kruskal's non-metric multi-dimensional scaling for the Hofstede Individualism and Power Distance indices, the WGI and proportion of GDP spent on conservation was undertaken to supplement the scatterplot results. The Supplementary Material contains cross-correlations for all variables.

Analysis software

General linear models were run in R 3.0.2 (R Core Team 2014), as were non-parametric regressions using the npregbw function in the np package (Hayfield & Racine 2008) and the isoMDS function in the MASS package for non-metric multi-dimensional scaling (Venables & Ripley 2002). Data were transformed in Microsoft Excel 2010. Country maps were created

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with ArcMap 10.1. Forest plots were created in R 3.0.2 using ggplot2 (Wickham 2009) and figures were improved using Adobe Illustrator (CS3).

Results and Discussion

Geography and Interrelationships

The world's regions were well represented in the 55 studied nations, except for Africa, portions of the Middle East, northern Asia and Eastern Europe (Fig. 1). The IUCN Red List metric indicates that species richness declines with distance from the equator (Fig. 2), confirming previously-established patterns for many different taxa and also cultural and language diversity (Collard & Foley 2002). Our new finding is that social traits and qualitative aspects of culture and not just cultural diversity correlate with latitude and thus species diversity. Relationship strength depends on the source of cultural trait data, but WVS autonomy (n = 27), Schwartz embeddeness (n = 34), and Hofstede's individualism (n = 55) were all significantly associated with latitude while the other dimensions were not. Consequently, individualism increases with latitude and collectivism is common in the tropics. In some regions, however, collectivism is more common than predicted by latitude, such as in parts of Asia and Latin America. Hofstede's power distance also strongly associates with latitude, with tropical countries having larger power distances than temperate nations. Also, Hofstede's long-term orientation dimension is more common in temperate latitudes.

All World Bank governance indicators and the per capita GDP increase with latitude, suggesting national wealth and good governance increases with individualism, small power distance, and long-term orientation (Fig. 3A). The multi-dimensional scaling analysis similarly separates countries by social, conservation spending, and governance traits (Fig. 3B). Higher species diversity in the tropics is, therefore, associated with more per capita

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poverty and weak national governance, as well as low % per capita GDP spending on conservation. Hofstede's individualism and Schwartz's embeddedness metrics both suggest high biodiversity is located in areas with more collectivism, but lower social harmony, larger power distance, and less per capita spending on conservation.

When considering what seem to be the most important variables (Fig. 3A), links between cultural dimensions, governance, and proportion of GDP spending on conservation are strong but there are notable outliers to the general pattern, such as high conservation spending in Costa Rica, Croatia, and Thailand – countries with a collective and moderate to high power distance culture and governance. In contrast, Luxembourg, Israel, Latvia, and Germany have strong individualism, low power distance and strong national governance but small proportion of GDP spending on conservation. Consequently, individualism, wealth, associated rules of law and good governance are not always associated with high conservation spending.

Support for Modernization Theory?

Overall, the results indicate that some key social and modernization traits are significantly associated with geography, biodiversity, and spending on conservation. While conservation spending and good governance are considered necessary for conserving biodiversity, many high biodiversity nations did not have these social traits. While this may be problematic for conserving species, two distinct and gross human and conservation development models can contextualize the conservation strategy and policy needs. One is the new modernization theory where wealth and development drive increased autonomy and self-expression towards post-materialist values, such as conservation (Inglehart & Welzel 2005). The second, and possibly more inclusive, is an institutional design theory that focuses on institutions created by human organization and governance. Here, institutions promote effective collective

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actions and socially fair distributions of common resources when private property is lacking or weak (Ostrom et. al. 2007). Social institutions determine the effectiveness of collective action and subsequent adaptations to social-ecological environments (Wilson et al. 2013). Common-property theory is based less on human development but more on the qualities of institutions and their potential to protect collective resources.

Despite evidence to support modernization theory, many societies change slowly or maintain key social and organizational traits when they do change, despite increasing wealth (Norris & Inglehart 2002; Hamamura 2012). Modern and wealthy societies may correspond poorly with actions to conserve resources if either the money or institutions implementing values are more symbolic than effective. Symbolic spending can be a symptom of rather than a solution to environmental problems (York et al. 2010). So, while modernization axes have simplicity of two often positively correlated axes, context-specific models imply that these axes can miss cultural nuances. The value dimensions developed by Schwartz and Hofstede consider a greater diversity of core values and cultural histories.

The different metrics and traits used here largely supported each other but modernization theory may be oversimplified by having only two axes. For example, the WVS self-expression is strongly correlated ($r = 0.62$) with conservation spending, even more than Schwartz egalitarian ($r = 0.43$) and Hofstede's individualism ($r = 0.51$). Power distance is, however, weakly expressed in the WVS autonomy metric by a moderate but statistically insignificant correlation with % conservation spending ($r = -0.31$), possibly due to smaller overlap between data sets and lower samples size. In contrast, Schwartz embeddedness is strong ($r = -0.63$) and Hofstede's power distance is statistically significant ($r = -0.35$) (Fig. S1), which indicates that this aspect of social organization may influence decisions on conservation spending.

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Over-reliance on modernization theory or some specific aspects of it could result in "blue prints", development panaceas, and ideologically driven conservation approaches when evaluating conservation needs (Ostrom & Cox 2010). For example, one potentially overly simplified conservation and development model that could arise from over reliance on weak correlations as strong support for theory is the assumption that until wealth, post-materialist values, the rule of law, and governance supporting individual rights are established, the case for valuing and supporting nature conservation will largely fail. The alternative is to examine the environment-resource-social organization matrix and use this information to diagnose and consider institutional designs and associated policy options likely to succeed in these contexts (McClanahan & Cinner 2012).

Collectivism and Power Distance Influences

The modern theory of conservation has typically been developed in nations with modern post-materialist social traits (Brechin et al. 2002). These societies may, therefore, implicitly assume core individualism and autonomy values are universal and applications arising from them are both prerequisites for change and inevitable as wealth develops. If so, the theory will apply to materialist societies once education, wealth, and the government support the rights of individuals and nature are established. Even if this theory were true, this is a large theoretical and implicit gamble when one considers most biodiversity exists in countries with collective, large power distance relationships, and weak national governments, and that rates of extinction and climate change are rapid and accelerating (Barnosky et al. 2011; Quintero & Wiens 2013). Inverse relationships between spending and diversity and collectivism/power distance suggest a need to reconsider policies and mechanisms required for conserving biodiversity given immediate threats to species, the slow pace of cultural change, and the potentially symbolic nature of conservation spending in modernized economies.

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Sufficient variation in observed correlations suggests rapid accumulation of wealth will produce hybrid social organizations rather than the core hoped-for responses of development-minded conservationists. For example, resource rich countries of Africa are often the most politically corrupt and environmentally damaging (Collier 2007), probably because individualism and autonomy do not rapidly replace collective and power distance social organization during wealth accumulation – at least initially or in cultures with strongly traditional or religious foundations (Saroglou et al. 2004). Parent-child relationships form the basis for core social values and appear to change generationally and often slowly (Greenfield 2013). So, while universal equality concepts in low power distance societies should extend to nature, and are very likely to create a willingness to pay for nature conservation, large power distance societies are typified by acceptance and adapting to the overall environment, moderation, social resignation and codependent emotional relationships between social strata. Change and environmental protection in these cultural contexts, might require superiors to see the value of including conservation in their patronage. Additionally, because collective and high power distance cultures typically perceive the natural environment as beyond their control, conservation may occur indirectly through an unwillingness to interfere with nature rather than direct conservation efforts (McCright & Dunlap 2011; Talhelm et al. 2015). This form of benign neglect can indirectly explain the coexistence of people and nature in many collective-high power distance societies, particularly when population numbers are low relative to resources.

Power distance reflects stratification of individuals within society and the formality of their interactions. Small power distance societies have greater and more mutual or equal social interactions. Here, internal emotion and shame can control actions better than authority and legal sanctions. This change works most on the young, secure, and the more educated once traditional and religious give way to secular rational values (Hofstede et al. 2010).

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Consequently, conservation movements are largely composed of post materialist people driven by a desire to reduce harm and expand the circle of ethics. Large power distance societies are more stratified, with hierarchical social relationships more focused on the rules established by leaders. Nations with large power distances tend to be autocratic and politically polarized; the long tenure of their political parties is likely to influence spending decisions over generations.

Politicians in large power distance societies typically spend money on status symbols and furthering their power; environmental protection may be seen as the role of donors (Sims et al. 2012; Zheng et al. 2013). In collective cultures, involvement in property, business, or management arrangement can require gift giving to superiors, which is viewed as corruption in the west (Husted 1999). While corruption poses challenges to conservation, acknowledging the poor autonomy and the potential of subordinate individuals to undermine implementation and compliance can increase chances of success, particularly when the leaders' consent is lacking (Sims et al. 2012). When people who promote conservation fall outside the collective and social hierarchy they are often ignored, at best. Therefore, support from social superiors is important for integrating conservation projects within the political order. It does not, however, ensure that lower social strata will enforce rules unless their leaders are visibly committed and integrated into resource management initiatives.

Missing Social Dimensions

While this study identified key social dimensions associated with conservation, it failed to find some expected relationships. These include Hofstede's masculine–feminine, uncertainty avoidance, temporal orientation and indulgence–restraint, which have the potential to either contract or expand core values and influence societies' willingness to support conservation. For example, the masculine–feminine dimension is often associated with the trade-offs

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between economic growth and the state of the environment. Masculine societies are expected to promote economic competition and risk taking, and associated fluctuations between wealth and poverty. A feminine focus, in contrast, would promote other non-growth factors, lower risk taking, and favoring stability and environmental protection. Masculine societies might ignore environmental issues, treat them as "externalities", and exercise veto powers when economic growth is challenged (McCright & Dunlap 2010; Kahan 2012).

Feminine societies typically vote more to the "left" and masculine to the "right", and greater voting along these lines might lead to greater expenditures for nature conservation. So, while the lack of association is surprising for this and other dimensions that influence values, they may indicate a poor connection between national level cultural values and actual public expenditures. They may be an important part of the social dynamics of people, subcultures, and institutions (Verweij et al. 2006) but, given weak final impact on national expenditures, these social traits are latent or subordinate to individualism and power distance.

A More Inclusive Theory to Inform Conservation Action

Modernization theory can explain patterns in economically developing countries, but it might be a special case most relevant to our age of non-renewable resource dependence. A more inclusive theory should include a larger contextual and a diagnostic approach where social traits are contextualized as a mixture of historical contingency and adaptation to specific social-ecological environments (Ostrom et al. 2007; Wilson et al. 2013). Here, the elements of core values, social traits, and institutions interact around common-pool resources to produce local solutions around the complexities of natural resource management. From this perspective, cultural dimensions have a parallel metaphor to biological traits, where traits are key to adaptation and ecological functions are expected to arise as responses to environment and commons problems, including competition within and between communities. They can

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also be neutral and maladaptive, driven by cultural change and choices that are independent of the environment or overall societal needs. The extent to which adaptations have an historical trend is by their coupling with historical social precedents, such as the emergences of individual rights, and specific environmental-resource drivers. Modernization appears to be a specialized response to innovations around increasing resources – especially non-renewable energies. Access to new forms of energy drive social innovations and expand diversity – many potentially being maladaptive when non-renewable resources diminish.

From this context-diagnostic perspective, one would predict social-ecological adaptive and maladaptive connections between social traits, institutions, their functions and environmental conditions. Functional factors associated with these cultural traits include differences in climate conditions, work rates and types of production, stability of families and roles in production, and the creation of new products (Oishi & Graham 2010; Talhelm et al. 2014). While social traits have emerged in historical environments where the conservation of natural species was not critical to human survival, these social traits can change over time with the conditions for human survival and adaptation (Hamamura 2012; Greenfield 2013). For those sharing this vision, promoting the accumulation of rapid wealth and quickly changing cultural inertia are inadvisable. Rather, policies that promote local adaptations to emerging threats should use historical social-ecological precedents as a means to manage responses.

Given that wealth and good governance are located in temperate latitudes, and wealthy people typically have strategies to invest and expand, individualism is strongly linked to capitalism and beliefs that investments in people and money are required to solve problems. Consequently, people having concepts of the intrinsic right to survive and individual autonomy are expected to contribute or agree to be taxed for conservation. The rights of the individual underpin formal legal institutions such as antitrust policies and laws, and business

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transparency (Siegel et al. 2011). International businesses can shun countries with weak formal institutions, but if the conservation and prevention of extinction is desired, the luxury of this specific formal social affinity could undermine efforts to engage globally in conservation.

Collectivism, in contrast, is predicted to focus on group cohesion and loyalty, with non-group foci and expenditures likely being lower priorities – hence the possibility for 'management' by neglecting nature, or leaving it alone because it is viewed as beyond human concern. Nevertheless, species important for group identity and traditions may resonate with collectivists, and these links can promote conservation more broadly. One would expect concepts like total biodiversity conservation based on the intrinsic right-to-life to work in individualistic cultures, whereas traditional forms of behavior and iconic and traditionally-important species might influence collective cultures. One would expect social-ecological management to be typified by autocratic or paternal interactions between leaders and subordinates in large power distance societies, whereas a consultative approach should be more common in low power distance societies (Hofstede et al. 2010).

Society's core values and management styles should influence the ways that nature is managed and protected. Each system may prove effective at different tasks; small power distance societies are likely to succeed where individual and subordinate initiatives are helpful, whereas discipline and acceptance of routine tasks are likely to succeed in high power distance societies. Nature conservation requires both of these approaches, but raising funds for conservation appears to be more difficult in high power distance societies and may require cross-society efforts to achieve immediate conservation goals. Developing cross society relationships that are informed about core values and complement the strengths of social organization may have the greatest chance to stem the loss of biodiversity (Sodhi et al.

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2011). Regardless of the cultural organization, the future of nature conservation requires that spending is effective and not just symbolic.

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Table 1. Types of data used in the analysis, their description and source. Note sample sizes (n) only include countries with Hofstede Individualism data.

Variable	n	Description	Source
WVS Self-expression vs. Survival [a]	27	Via factor scores in Inglehart & Welzel (2005). Survival values focus on economic and physical security, along with low tolerance and trust levels. Self-expression values are associated with tolerance of others and supporting participation in economic and political decision-making.	World Values Survey (2009)
WVS Autonomy	32	Derived from the importance of the four following qualities in children; religious faith and obedience (non-autonomous), independence and determination/ perseverance (autonomous).	World Values Survey (2009)
Schwartz Egalitarian	34	High egalitarian scores indicate people consider everyone to be equal and concern should be shown for everyone.	Siegel et al. (2013)
Schwartz Harmony	34	High harmony scores indicate people accept their place in the world as opposed to seeking self-improvement. There is a greater emphasis on the group over the individual.	Siegel et al. (2013)
Schwartz Embeddedness	34	High embeddedness indicates a focus on	Siegel et al. (2013)

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		tradition, avoiding change and maintaining social structure.	
Hofstede Individualism [b]	55	High individualism indicates a society where people are generally expected to only look after themselves and their family. Low individualism indicates people can be expected to be cared for by everyone within a group provided unquestioning loyalty is maintained.	(Hofstede et al. 2010)
Hofstede Power Distance	55	A high power distance score indicates people accept a hierarchical order, where inequalities between people do not need justification. People in low power distance societies work to equalize the distribution of power and inequalities of power need to be justified.	(Hofstede et al. 2010)
Hofstede Masculinity	55	High masculinity indicates a preference for achievement, heroism, assertiveness and material rewards for success and society is more competitive. Femininity represents a preference for cooperation, modesty, caring for the weak and quality of life.	(Hofstede et al. 2010)
Hofstede Uncertainty Avoidance	55	Expresses the extent societal members feel uncomfortable with uncertainty and ambiguity. High uncertainty avoidance is	(Hofstede et al. 2010)

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		associated with strict codes of belief and behavior and intolerance to other codes. Lower uncertainty avoidance societies are more accepting and outcomes are more important than principles.	
Hofstede Long-Term Orientation	50	Societies scoring high on this dimension prefer to maintain time-honored traditions and norms and are suspicious of societal change. Those in a society with low scores prefer to encourage modern education, quick results and examining profit or loss from decisions.	(Hofstede et al. 2010)
Hofstede Indulgence vs. Restraint	49	High indulgent societies allow relatively free pursuit of human drives for fun and amusement. Restraint focused societies suppress and regulate these needs with strict social codes.	(Hofstede et al. 2010)
WGI Corruption Control[d]	55	Average 2002 to 2008. Perceptions of the extent to which public power is used to further private interests.	World Bank (2014c)
WGI Political Stability	55	Average 2002 to 2008. Perceptions of the likelihood for political uncertainty and politically-driven violence, including terrorism.	World Bank (2014c)

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WGI Voice Accountability	55	Average 2002 to 2008. Perceptions of the extent a country's citizens can participate in government selection, alongside freedom of expression, association and the media.	World Bank (2014c)
WGI Government Effectiveness [d]	55	Average 2002 to 2008. Measures perceptions of the quality of public and civil services and their political independence. Also includes the quality of the policy process and government reliability to implement policies.	World Bank (2014c)
WGI Rule of Law [d]	55	Average 2002 to 2008. Perceptions of the confidence people have in society's rules. Includes quality of contract enforcement, property rights, the police and courts and likelihood of crime and violence.	World Bank (2014c)
WGI Regulatory Quality [d]	55	Average 2002 to 2008. Perceptions of government ability to create and apply policies and regulations to authorize and advance private sector development.	World Bank (2014c)
Environmental Regulatory Regime	47	Measure of government laws regulating pollutants	Etsy & Porter (2005)
IUCN species [b, e]	55	Total species richness per country listed in the Red List 2014.3. Only species with an extinction assessment are included in this	IUCN 2014)

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		list.	
Catalogue of Life species [b, f]	55	Total species richness found in the country	Catalogue of Life (2014)
IUCN species by Country size [b]	55	IUCN species divided by country size	IUCN (2014); World Bank (2014b)
Absolute latitude	55	Absolute latitude at centre point of country	CIA World Factbook (2014)
Country size [b]	55	Square kilometers	World Bank (2014b)
Population size [b, g]	55	Average 2001 to 2008	UNDP (2014)
Country GDP [b, g]	55	Average 2001 to 2008 (2005 US dollars)	World Bank (2014 a)
GDP per capita [b]	55	Country GDP divided by population size	World Bank (2014 a); UNPD (2014)
Total spent on conservation [b]	55	Average national biodiversity conservation spending, excluding international assistance, 2001 to 2008 (2005 US dollars).	Waldron et al. (2013)
% GDP spent on conservation per capita [b]	55	Total spent on conservation divided by country GDP divided by population size	Waldron et al. (2013); World Bank (2014 a); UNPD (2014)
Proportion (%) of GDP spent on conservation [b]	55	Total spent on conservation divided by country GDP	Waldron et al. (2013); World Bank (2014 a)

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a) Calculated as the sum of responses multiplied by factor scores. The country score is then the average of this sum for respondents of that country. Missing values are excluded from this calculation, as well as respondents unsure of their answer.

b) Log transformed

c) +4 (to make positive numbers on the scale) then log transformed

d) Species in the IUCN (2014) database may have several records due to occurring in multiple environments (terrestrial, freshwater, marine). Thus, we only counted a species record once.

e) Catalogue of Life (2014) does not yet have full availability of species distributions. Thus, we searched for all species within each country, and took the number of records as the number of species. Due to confounding terms, for the United States of America we use the recorded number of species on Nature Serve 2014 (http://explorer.natureserve.org/, accessed 31/10/2014).

f) Taiwan is not included in UNDP (2014) and World Bank (2014a) data; therefore Taiwan's population size and GDP for 2001 to 2008 are from government sources (http://eng.stat.gov.tw/public/data/dgbas03/bs2/yearbook_eng/y011_I.pdf, accessed 5/28/2014; and www.tradingeconomics.com/taiwan/gdpm, accessed 5/28/2014, respectively.)

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Figure legends

Fig. 1. Map of the national distribution of the number of species evaluated by IUCN Red List, proportion of gross domestic product spent within country on conservation of biodiversity and Hofstede's two key cultural dimensions had the greatest overlap with the other data sources at the national level and Individualism and Power Distance were statistically significantly associated with conservation spending and IUCN Red List Species. Map data comes from the Global Administrative Areas project (www.gadm.org, Version 2.0, accessed 11/12/2014).

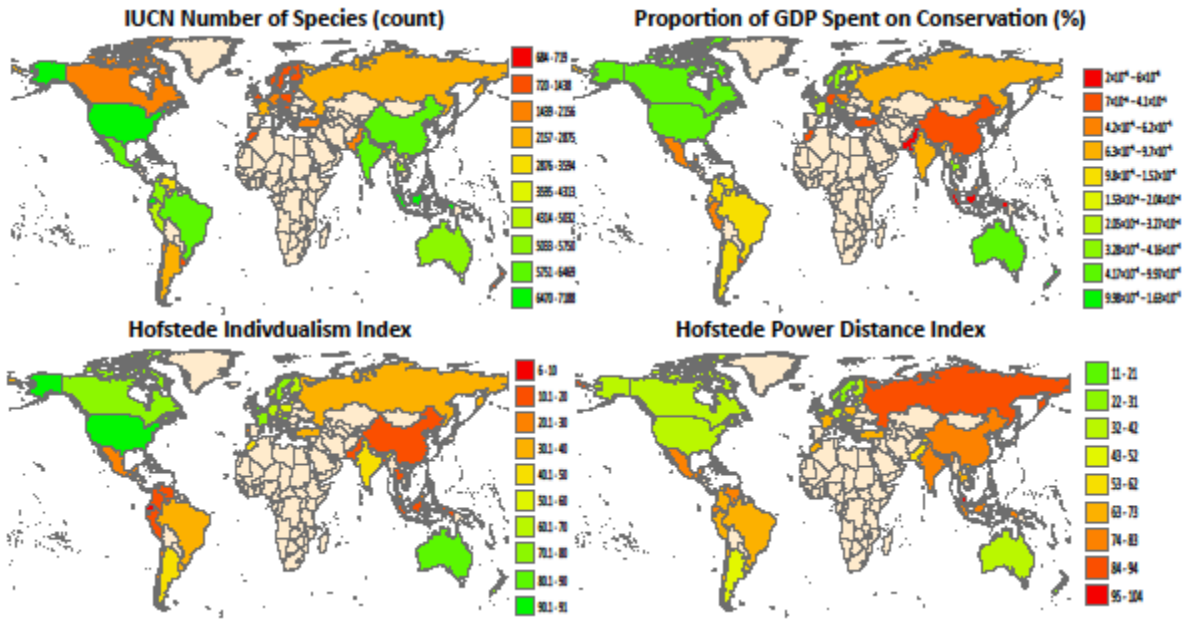

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Fig. 2. Forest plot of social dimensions by three separate studies (WVS = World Values Survey, Schwartz theory of values, and Hofstede's management values), governance indicators (World Bank), environmental regulations and species diversity, and national level country geographic and economic predictive variables associations with the percent of national money spent on conservation (left panel), IUCN estimates of numbers of species (middle panel), and absolute latitude (right panel). Legend: colors reflect coefficient significance and direction at the 99.8% level – green = positive, red = negative, black = uncertain. Horizontal bars are 99.8% confidence intervals, vertical notches are the 95% confidence intervals and circles are the coefficient mid-point. To interpret coefficients, a standardized effect size of 0.5 indicates the response (dependent) variable moves one standard deviation with a two standard deviation movement in the predictor variable. The response variable moves two standard deviations if the standardized effect size is 1.

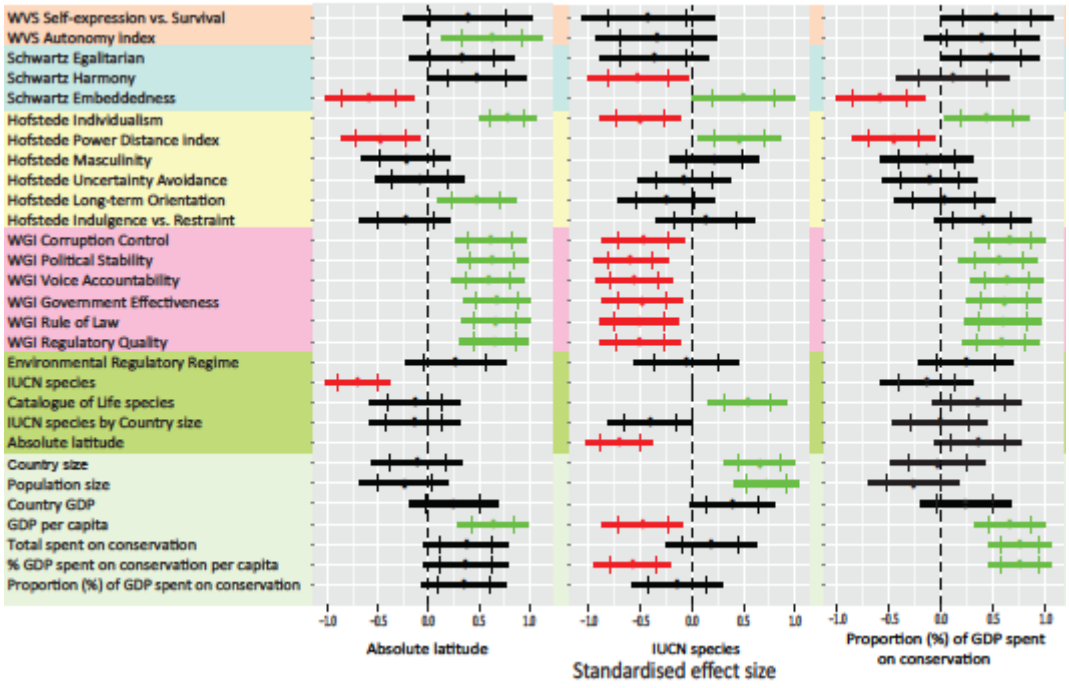

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Fig. 3. A) Scatterplot summarizing the nations where data were available for all key variables showing the relationships between the two key social dimensions of Individualism and Power Distance and the Waldron et al. (2013) national local spending on conservation and World Bank governance indicators (WGI). B) Scatterplot of non-metric multi-dimensional scale (NMDS) created using Hofstede individualism and Power Distance Indices, the WGI and proportion of GDP spent on conservation plus bubble size based on the proportion of GDP spent on conservation. Two dimensions were used for NMDS, with stress = 0.178 and R^2 = 0.999.

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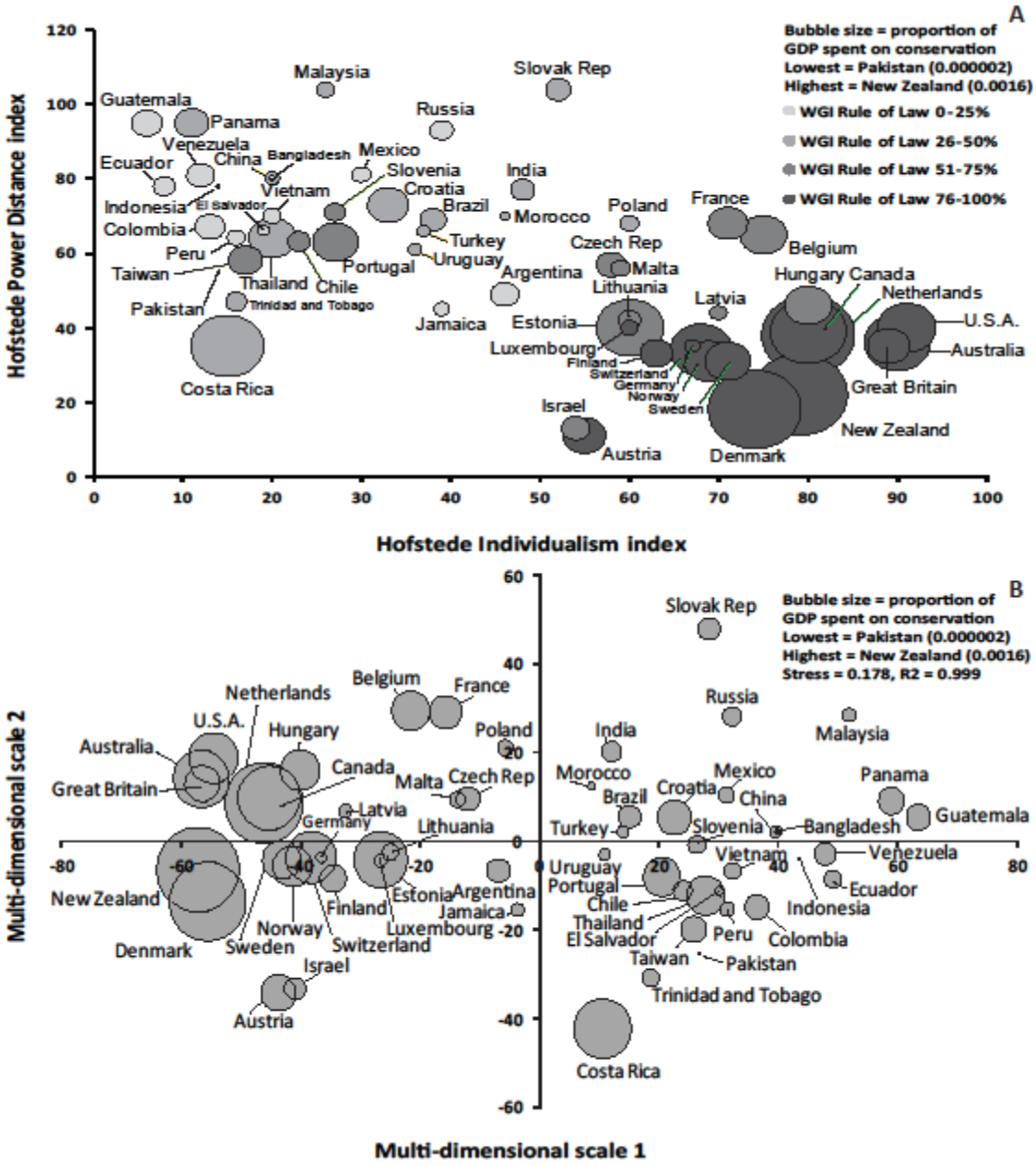

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