



---

*Contributed Paper*

---

# Geography of conservation spending, biodiversity, and culture

T.R. McClanahan\* and P.S. Rankin†¶

\*Wildlife Conservation Society, Marine Programs, Bronx, NY 10460, U.S.A.

†ARC Centre of Excellence for Environmental Decisions, School of Biological Sciences, and The Life Course Centre, Institute for Social Science Research, The University of Queensland, St. Lucia, 4072 Queensland, Australia

**Abstract:** We used linear and multivariate models to examine the associations between geography, biodiversity, per capita economic output, national spending on conservation, governance, and cultural traits in 55 countries. Cultural traits and social metrics of modernization correlated positively with national spending on conservation. The global distribution of this spending culture was poorly aligned with the distribution of biodiversity. Specifically, biodiversity was greater in the tropics where cultures tended to spend relatively less on conservation and tended to 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 Earth's biodiversity. This has significant implications for setting policies and priorities for resource management given that biological diversity is rapidly disappearing and cultural traits change slowly. Therefore, we suggest natural resource management adapt to and use characteristics of existing social organization rather than wait for or promote social values associated with conservation spending. Supporting biocultural 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 here conservation actions need to ensure that biodiversity is not being lost.

**Keywords:** cultural dimensions, economics, human development, governance, social-ecological, social traits, tropical-temperate

Geografía del Gasto de Conservación, la Biodiversidad y la Cultura

**Resumen:** Utilizamos modelos lineales y multivariados para examinar las relaciones entre la geografía, la biodiversidad, la producción per cápita y económica, el gasto nacional en conservación, la gobernanza y las características culturales en 55 países. Las características culturales y las medidas sociales de la modernización tuvieron una correlación positiva con el gasto nacional en conservación. La distribución global de esta cultura de gasto tuvo una alineación mínima con la distribución de la biodiversidad. En específico, la biodiversidad fue mayor en los trópicos en donde las culturas tuvieron la tendencia a gastar relativamente menos en la conservación y tuvieron la tendencia a tener un colectivismo mayor, liderazgo formalizado y jerárquico y gobiernos más débiles. En consecuencia, los países carentes de características sociales asociadas frecuentemente con la modernización, el ambientalismo y el gasto de conservación tienen el mayor componente de biodiversidad de la Tierra. Esto tiene implicaciones significativas para establecer políticas y prioridades para el manejo dado que la diversidad biológica está desapareciendo rápidamente y las características culturales cambian lentamente. Por esto, sugerimos que el manejo de recursos naturales se adapte y use las características de las organizaciones sociales existentes en lugar de esperar o promover valores sociales asociados con el gasto de conservación. Apoyar las tradiciones bioculturales, involucrar a los líderes para incrementar los compromisos de conservación, realizar esfuerzos internacionales que complementen los atributos de las culturas y evitar la interferencia con la naturaleza puede funcionar mejor para conservar la naturaleza en sociedades colectivas y jerárquicas. El gasto en los países modernizados puede ser una respuesta

¶Address correspondence to P.S. Rankin, email p.rankin@uqconnect.edu.au  
Paper submitted February 28, 2015; revised manuscript accepted March 8, 2016.

*simbólica al síntoma del desarrollo económico y la degradación ambiental, y es aquí donde la conservación tiene que asegurar que no se está perdiendo la biodiversidad.*

**Palabras Clave:** características sociales, desarrollo humano, dimensiones culturales, economía, gobierno, socio-ecológico, tropical-templado

## 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 toward 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 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 and protecting ecological services. If, how, and why conservation values and actions are acknowledged should differ with cultural history, human economic development, and personality (Inglehart & Welzel 2005; McCrae & Terracciano 2005). Development changes human psychology and culture, and frequently beliefs in intrinsic rights to survival and individualism or self-sufficiency and ideological support for species conservation increase with economic development (Inglehart & Welzel 2005; Greenfield 2009). Nevertheless, resource management responses are complicated because 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). In addition, 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 resource management, and resource management is not always undermined by 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 toward management options when natural resources decline.

## Cultural Traits, Modernization Theory, and Governance

Funding for biodiversity conservation can be explained by modernization theory. New modernization theory proponents argue that cultural values change from materialist to postmaterialistic as economies develop from rural to urban and societies adhere 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; that is, people value the intrinsic rights of nonhuman species to survive and be conserved (Singer 2011). Furthermore, economic development parallels psychological development and increases individual innovation, specialization, education, and self-expression. Consequently, people organize less 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 postmaterialist 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, and there is 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, postmaterialist 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).

Although modernization may lead to values that 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). In addition, 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 and 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.

## Aims

We evaluated the proportion of national domestic conservation spending worldwide (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 positively with conservation spending, whereas 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

We used 6 main national-level data sources (Table 1). The first 3 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 versus self-expression index and the autonomy index, arise from questions designed to elicit underlying cultural values. These indices help distinguish countries; autonomy and self-expression increase as common metrics of human development increase.

Schwartz cultural values are based on theoretical considerations of values and have 3 main axes: social equality or hierarchy (egalitarian), individual mastery or group cohesion (harmony), and individual autonomy or social conservatism (embeddedness). Hofstede et al.'s (2010) 6 cultural dimensions are based on a global survey of company managers: autonomy (individualism or collectivism); formality or strength of social hierarchies (small to large power distances); tolerance of risk and competition (masculinity or femininity); social response to stresses (low to high uncertainty avoidance); planning approaches (long- to short-term orientation), and attitude toward life (indulgence or restraint).

The Schwartz cultural values and cultural dimensions of Hofstede et al. (2010) have some similarities, and the

dimensions 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 are related concepts but have slightly different theoretical, historical, and methods usage by these values investigators. Here, individuals in society see themselves as separate and autonomous from each other, whereas the opposite, collectivism, and embeddedness refers to perceiving individuals as highly interconnected and defined by their relations and social context (Nisbett et al. 2001).

Our fourth source of data was the World Governance Indicators of the World Bank. These are regularly produced country-level governance indicators used to 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 variables included species richness from the Catalogue of Life and International Union for Conservation of Nature (IUCN) Red List and a country's average latitude. The environmental regulatory regime of pollutants in a country provided a proxy of environmental management (Esty & Porter 2005). The sixth and final data sources were 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 from 55 countries, Schwartz from 34, and World Values Survey from 27.

### Data Analyses

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 (Waldron et al. 2013), number of species listed on the IUCN Red List, and absolute latitude as a proxy for numbers of species and other cultural and economic factors (Maffi 2005; Burnside et al. 2012). We focused on proportion of GDP spent on biodiversity conservation, number of species listed on the IUCN Red List, and latitude for 2 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 IUCN Red List, and evaluation effort varies within each country, thereby influencing species estimates. The Catalogue of Life (CoL) data are species centered, which biases national-level species estimates. Consequently, using these 2 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). Because IUCN data are and the CoL is not significantly associated with latitude, we suspected IUCN data would be a better proxy for species richness in the countries we analyzed (Supporting Information). Second, we used the proportion

**Table 1.** Summary of types of data used in the analysis of the relationship of the various metrics with the percentage of gross domestic product (GDP) spent on biodiversity conservation (Waldron et al. 2013), number of species listed on the IUCN Red List, and absolute latitude.

Variable	n <sup>a</sup>	Description	Source
World Values Survey (WVS) self-expression vs. survival <sup>a, b</sup>	27	Values derived using factor scores in Inglehart and Welzel (2005). Survival values focus on economic and physical security 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 <sup>a</sup>	32	Values derived from the importance of the following qualities in children: religious faith and obedience (nonautonomous) and independence and determination or perseverance (autonomous).	World Values Survey 2009
Schwartz egalitarian <sup>a</sup>	34	High egalitarian scores indicate people consider everyone to be equal and concern should be shown for everyone.	Siegel et al. 2013
Schwartz harmony <sup>a</sup>	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 <sup>a</sup>	34	High embeddedness indicates a focus on tradition, avoiding change, and maintaining social structure.	Siegel et al. 2013
Hofstede individualism <sup>c</sup>	55	High individualism indicates a society where people are generally expected to look after only 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 to which societal members feel uncomfortable with uncertainty and ambiguity. High uncertainty avoidance is associated with strict codes of belief and behavior and intolerance to other codes. Low uncertainty-avoidance societies are more accepting, and outcomes are more important than principles.	Hofstede et al. 2010
Hofstede long-term orientation	50	High scores indicate a society prefers to maintain time-honored traditions and norms and is 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	Highly 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
World Governance Indicator (WGI) corruption control <sup>d</sup>	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
WGI voice accountability	55	Average 2002 to 2008; perceptions of the extent a country's citizens can participate in government selection and have freedom of expression, association, and the media.	World Bank 2014c
WGI government effectiveness <sup>d</sup>	55	Average 2002 to 2008; measures perceptions of the quality of public and civil services and their political independence; includes the quality of the policy process and government reliability to implement policies.	World Bank 2014c
WGI rule of law <sup>d</sup>	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

*continued*

**Table 1.** *continued.*

Variable	n <sup>a</sup>	Description	Source
WGI regulatory quality <sup>d</sup>	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.	Esty & Porter 2005
International Union for Conservation of Nature (IUCN) species <sup>c, e</sup>	55	Total species richness per country listed in the IUCN Red List 2014.3. (Only species with an extinction assessment are included in this list.)	IUCN 2014
Catalogue of Life species <sup>c, f</sup>	55	Total species richness in the country.	Catalogue of Life 2014
IUCN species by country size <sup>c</sup>	55	IUCN species divided by country size.	IUCN 2014; World Bank 2014b
Absolute latitude	55	Absolute latitude at center point of country.	CIA World Factbook 2014
Country size <sup>c</sup>	55	Square kilometers.	World Bank 2014b
Population size <sup>c, g</sup>	55	Average 2001 to 2008.	UNDP 2014
Country gross domestic product (GDP) <sup>c, g</sup>	55	Average 2001 to 2008 (2005 U.S. dollars).	World Bank 2014a
GDP per capita <sup>c</sup>	55	Country GDP divided by population size.	World Bank 2014a; UNPD 2014
Total spent on conservation <sup>c</sup>	55	Average national biodiversity conservation spending, excluding international assistance, 2001 to 2008 (2005 U.S. dollars).	Waldron et al. 2013
% GDP spent on conservation per capita <sup>c</sup>	55	Total spent on conservation divided by country GDP divided by population size.	Waldron et al. 2013; World Bank 2014a; UNPD 2014
% of GDP spent on conservation <sup>c</sup>	55	Total spent on conservation divided by country GDP.	Waldron et al. 2013; World Bank 2014a

<sup>a</sup>Includes countries with Hofstede individualism data.

<sup>b</sup>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 are respondents unsure of their answer.

<sup>c</sup>Log transformed.

<sup>d</sup>To make numbers on the scale positive, 4 points were added and then that value was log transformed.

<sup>e</sup>Species in the IUCN (2014) database may have several records due to their occurrence in multiple environments (terrestrial, freshwater, marine). Thus, we only counted a species record once.

<sup>f</sup>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 we use the recorded number of species on Nature Serve 2014 (<http://explorer.natureserve.org/>, accessed October 2014).

<sup>g</sup>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\\_1.pdf](http://eng.stat.gov.tw/public/data/dgbas03/bs2/yearbook_eng/y011_1.pdf) and [www.tradingeconomics.com/taiwan/gdpm](http://www.tradingeconomics.com/taiwan/gdpm) [accessed May 2014] respectively.)

of GDP spent on conservation because countries vary substantially in GDP; thus, the relative allocation of funds to biodiversity conservation should be more informative.

We did not use models including multiple predictors, first, because data were insufficient to include all cultural dimensions in a model without losing substantial samples. Second, substantial cross correlations between variables complicate subsequent interpretations (Supporting Information). Specifically, spurious correlation (that could nonetheless be rationalized as important) may hide a causal determinant of spending on conservation. Third, we aimed to assess correlations and overlap of cultural traits with metrics of conservation interest, not to predict spending on biodiversity conservation. Understanding what causes governments to spend money on biodiver-

sity conservation would be valuable, but it was outside the scope of our analyses. We deliberately used disparate sources of data to increase redundancy and the 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). We adjusted statistical significance for multiple comparisons.

Inspecting residuals for homogeneity of variance (residuals vs. fitted plot) and normality (normal Q-Q plot) revealed no major departures from assumptions of general linear models, except that relationships for some variables appeared nonlinear even after transformation. Therefore, we ran nonparametric regression models,

which generated higher  $R^2$  values. However, the nonparametric 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 nonparametric 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. We retained the linear model because it clearly demonstrated the underlying positive or negative associations. Euclidean Kruskal's nonmetric multidimensional 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. Supporting Information contains cross-correlations for all variables.

### Analysis Software

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

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). Based on the IUCN Red List metric, species richness declined with distance from the equator (Fig. 2).

Our new finding was that social traits and qualitative aspects of culture and not just cultural diversity correlate with latitude and thus species diversity. Relationship strength depended on the source of cultural trait data, but WVS autonomy ( $n = 27$ ), Schwartz embeddedness ( $n = 34$ ), and Hofstede's individualism ( $n = 55$ ) were all significantly associated with latitude, whereas the other dimensions were not. Consequently, individualism increased with latitude and collectivism was common in the tropics. In some regions, however, collectivism was more common than predicted by latitude, such as in parts of Asia and Latin America. Hofstede's power distance was also strongly associated with latitude; tropical countries had larger power distances than temperate nations. Also, Hofstede's long-term orientation dimension was more common in temperate latitudes.

All World Bank governance indicators and the per capita GDP increased as latitude increased, suggesting national wealth and good governance increases with individualism, small power distance, and long-term orientation (Fig. 3a). The multidimensional scaling analysis similarly separated countries by social, conservation spending, and governance traits (Fig. 3b). High species diversity in the tropics was, therefore, associated with high per capita poverty, weak national governance, and low percent per capita GDP spending on conservation. Hofstede's individualism and Schwartz's embeddedness metrics both suggested that high biodiversity was located in areas with relatively more collectivism but relatively lower social harmony, larger power distance, and less per capita spending on conservation.

When considering what seemed to be the most important variables (Fig. 3a), links between cultural dimensions, governance, and proportion of GDP spending on conservation were strong, but there were 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 showed 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 were not always associated with high conservation spending.

### Discussion

#### Support for Modernization Theory

Diversity declined as distance from the equator increased, which confirms previously established patterns for many different taxa and also cultural and language diversity (Collard & Foley 2002). Overall, we found that some key social and modernization traits were significantly associated with geography, biodiversity, and spending on conservation. Although conservation spending and good governance are considered necessary for conserving biodiversity, many high biodiversity nations lacked these social traits. Although this may be problematic for conserving species, 2 distinct and gross human and conservation development models can contextualize conservation strategies and policy needs. One is the new modernization theory, where wealth and development drive increased autonomy and self-expression toward postmaterialist 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 actions and socially fair distributions of common resources when

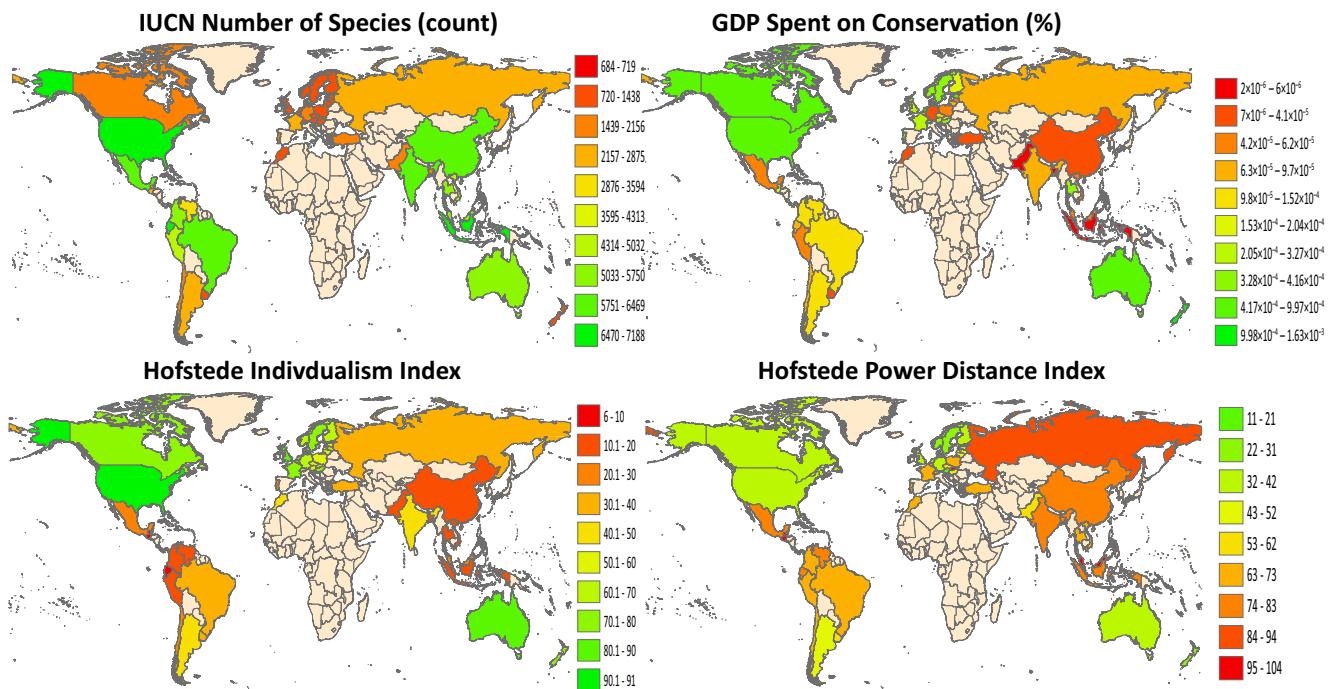


Figure 1. Map of the national distribution of the number of species evaluated by the International Union for Conservation of Nature (IUCN), proportion of gross domestic product spent within country on conservation of biodiversity, and Hofstede's individualism index and power distance scores (described in Table 1). Map data comes from the Global Administrative Areas project ([www.gadm.org](http://www.gadm.org), Version 2.0, accessed November 2014).

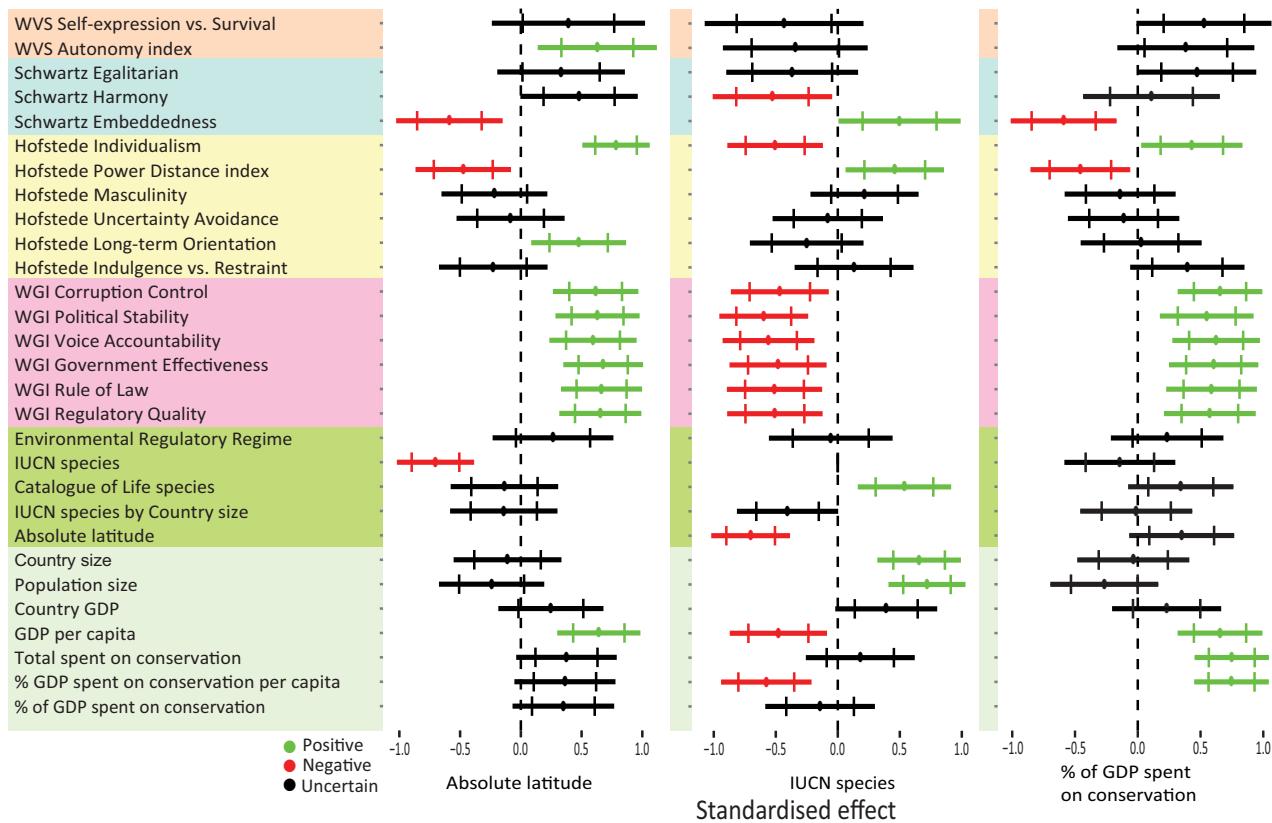
private property is lacking or weak (Ostrom et al. 2007). Social institutions determine the effectiveness of collective action and subsequent adaptations to social-ecological environments (Wilson et al. 2013). Common-property theory is based less on economic development but more on the qualities of institutions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

Despite evidence to support modernization theory, many societies change slowly or maintain key historical social and organizational traits when they do change, despite increasing wealth (Norris & Inglehart 2002; Hamamura 2012). Traits of 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, although modernization axes have the simplicity of 2 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 were largely consistent with each other, but modernization theory may be oversimplified by having only 2 axes. For example, the WVS self-expression was strongly correlated ( $r = 0.62$ ) with conservation spending, even more than Schwartz's

egalitarian ( $r = 0.43$ ) and Hofstede's individualism ( $r = 0.51$ ). Power distance was, however, weakly expressed in the WVS autonomy metric by a moderate but statistically insignificant correlation with percent conservation spending ( $r = -0.31$ ), possibly due to smaller overlap between data sets and lower samples size. In contrast, Schwartz embeddedness was strong ( $r = -0.63$ ) and Hofstede's power distance was statistically significant ( $r = -0.35$ ) (Supporting Information), which indicates this aspect of social organization may influence decisions on conservation spending.

Overreliance on modernization theory or some specific aspects of it for guiding conservation action 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, postmaterialist 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).



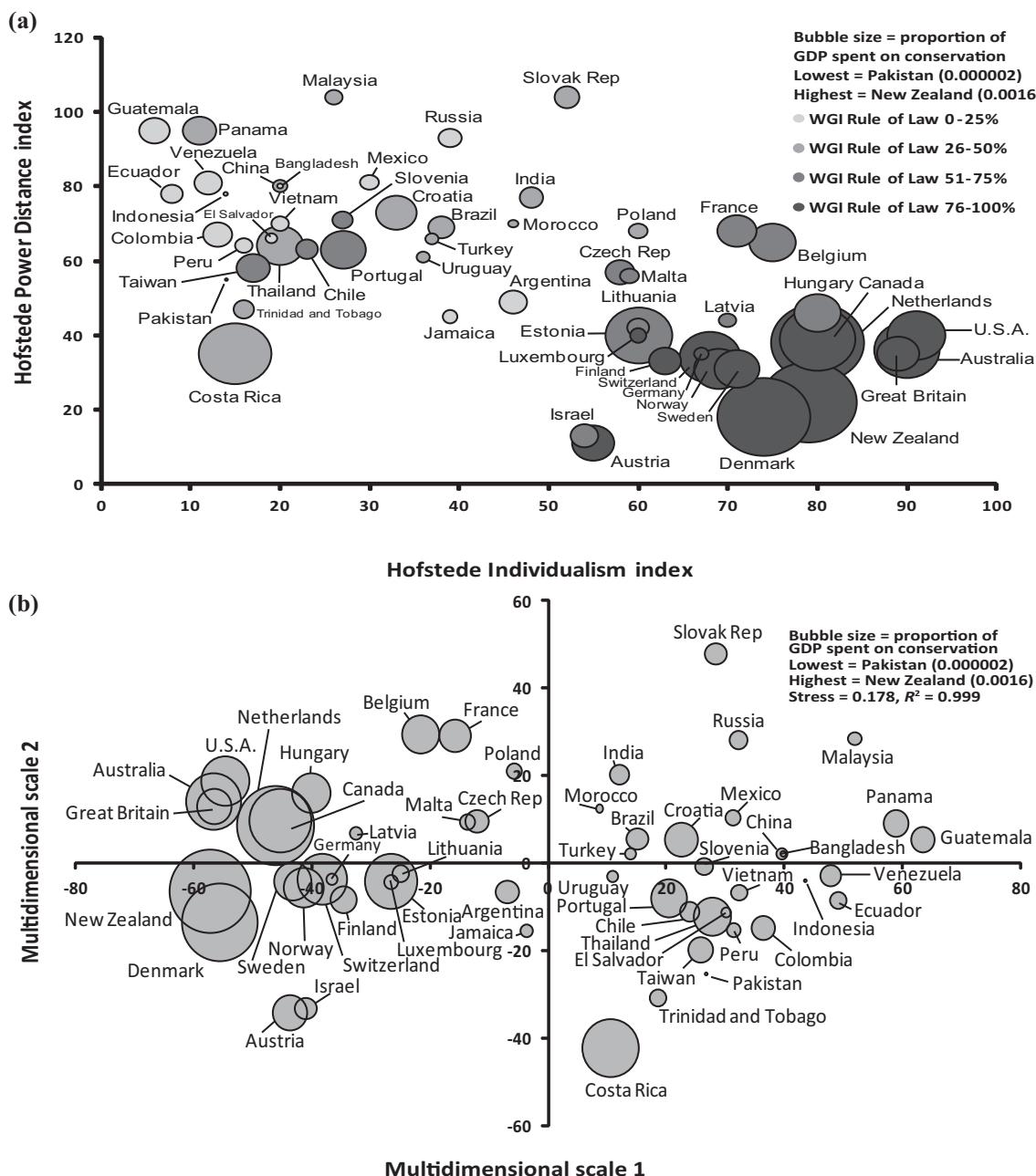
**Figure 2.** Social dimensions (from 3 sources: WVS, World Values Survey, Schwartz theory of values, and Hofstede's management values); governance indicators (World Bank); environmental regulations and species diversity; and national-level country geographic and economic predictive variable associations with absolute latitude, IUCN estimates of numbers of species, and the percentage of national money spent on conservation. Color or shading gradient reflects coefficient significance and direction at the 99.8% level (positive, negative, or uncertain); horizontal bars, 99.8% confidence intervals; vertical notches, 95% confidence intervals; and circles, coefficient midpoint. To interpret coefficients, a standardized effect size of 0.5 indicates the response (dependent) variable moves 1 SD with a 2 SD movement in the predictor variable. The response variable moves 2 SDs if the standardized effect size is 1. Elements on the y-axis are described in Table 1.

### Collectivism and Power Distance Influences

The modern theory of conservation has typically been developed in nations with modern postmaterialist 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.

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, although universal equality concepts in low



**Figure 3.** (a) Summary of the nations for which 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) Nonmetric multidimensional 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.

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 adaptation to the overall environment, moderation, social resignation, and codependent emotional relationships between social strata. Change and

environmental protection in these cultural contexts, may require superiors to see the value of including conservation in their patronage. 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, the secure, and the more educated when traditional and religious values give way to secular rational values (Hofstede et al. 2010). Consequently, conservation movements are largely composed of postmaterialist people driven by a desire to reduce harm and expand the circle of ethics. Large power-distance societies are more stratified; hierarchical social relationships focus on the rules established by leaders. Governance within 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). Although 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**

Although we identified key social dimensions associated with conservation, we failed to find some expected relationships. Hofstede's masculine-feminine dimension, uncertainty avoidance, temporal orientation, and indulgence or restraint were not related to conservation, although they have the potential to either contract or expand the inclusion of valued objects and influence societies' willingness to support conservation. For example, the masculine-feminine dimension is often associated with the trade-offs between economic growth and

the state of the environment. Masculine societies are expected to promote economic competition, value market forces and risk taking and to be tolerant of associated fluctuations between wealth and poverty. A feminine focus, in contrast, would promote nongrowth factors and less risk taking and favor stability and environmental protection. Masculine societies may ignore environmental issues, treat them as externalities, and exercise veto powers when economic growth is challenged (McCright & Dunlap 2011; Kahan 2012).

Feminine societies typically vote more to the left and masculine to the right, and greater voting along these lines may lead to greater expenditures for nature conservation. So, although 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 the weak final impact on national expenditures, these social traits appear to be latent or subordinate to individualism and power distance.

### **An Inclusive Theory to Inform Conservation Action**

Modernization theory explains patterns in economically developing countries, but it may be a special case most relevant to our age of dependence on nonrenewable resources. A more inclusive theory should include a larger contextual and 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. If so, social-ecological functions are expected to arise as responses to environment and commons problems, including competition within and between communities. They can also be neutral and maladaptive, driven by cultural change and choices that are independent of the environment or overall, as opposed to elite, societal needs (Fukuyama 2011). The extent to which adaptations have a historical trend is in 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 nonrenewable energies. Access to new forms of energy drive social innovations and expand diversity—many of which may be maladaptive when nonrenewable 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). Although 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 as the conditions for human survival and adaptation change (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 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 nongroup foci and expenditures likely being lower priorities—which suggests the possibility for management by neglecting nature or leaving it alone because it is viewed as beyond human and elite's concerns. 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. In contrast, in collective cultures one would expect traditional forms of behavior and iconic and traditionally important species to have more influence. 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 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. 2011). Regardless of the cultural organization, the future of nature conservation requires that spending be effective—not just symbolic.

## Acknowledgments

T.R.M. received support from the John D. and Catherine T. MacArthur Foundation when this article was conceived and written.

## Supporting Information

Pearson's *r* cross-correlations for all variables used in the analysis of the relationship of the various metrics with the percentage of gross domestic product (GDP) spent on biodiversity conservation, number of species on the IUCN Red List, and absolute latitude (Appendix S1) are available online. The authors are solely responsible for the content and functionality of these materials. Queries (other than absence of the material) should be directed to the corresponding author.

## Literature Cited

- Barnosky AD, et al. 2011. Has the earth's sixth mass extinction already arrived? *Nature* **471**:51–57.
- Boyd R, Richerson PJ, Henrich J. 2011. The cultural niche: why social learning is essential for human adaptation. *Proceedings of the National Academy of Sciences* **108**:10918–10925.
- Brechin SR, Wilshusen PR, Fortwangler CL, West PC. 2002. Beyond the square wheel: toward a more comprehensive understanding of biodiversity conservation as social and political process. *Society & Natural Resources* **15**:41–64.
- Burnside WR, Brown JH, Burger O, Hamilton MJ, Moses M, Bettencourt L. 2012. Human macroecology: linking pattern and process in big-picture human ecology. *Biological Reviews* **87**:194–208.
- Catalogue of Life. 2014. Annual checklist 2014. Available from <https://www.catalogueoflife.org/annual-checklist/2014> (accessed June 2014).
- CIA. 2014. CIA world factbook. Available from <https://www.cia.gov/library/publications/the-world-factbook/> (accessed June 2014).
- Collard IF, Foley RA. 2002. Latitudinal patterns and environmental determinants of recent human cultural diversity: Do humans follow biogeographical rules? *Evolutionary Ecology Research* **4**:371–383.
- Collier P. 2007. *The bottom billion: why the poorest countries are failing and what can be done about it*. Oxford University Press, New York.

- Dietz T, Rosa EA, York R. 2012. Environmentally efficient well-being: Is there a Kuznets curve? *Applied Geography* **32**:21–28.
- Esty DC, Porter ME. 2005. National environmental performance: an empirical analysis of policy results and determinants. *Environment and Development Economics* **10**:391–434.
- Fukuyama F. 2011. The origins of political order: from prehuman times to the French Revolution. Farrar, Straus, and Giroux, New York.
- Gavin MC, et al. 2013. Toward a mechanistic understanding of linguistic diversity. *BioScience* **63**:524–535.
- Gelman A. 2008. Scaling regression inputs by dividing by two standard deviations. *Statistics in Medicine* **27**:2865–2873.
- Greenfield PM. 2009. Linking social change and development change: shifting pathways of human development. *Developmental Psychology* **45**:401–418.
- Greenfield PM. 2013. The changing psychology of culture from 1800 through 2000. *Psychological Science* **24**:1722–1731.
- Hamamura T. 2012. Are cultures becoming individualistic? A cross-temporal comparison of individualism-collectivism in the United States and Japan. *Personality and Social Psychology Review* **16**:3–24.
- Hayfield T, Racine JS. 2008. Nonparametric econometrics: the np package. *Journal of Statistical Software* **27**(5):1–32.
- Hofstede G, Hofstede GJ, Minkov M. 2010. Cultures and organization: software of the mind: intercultural cooperation and its importance for survival. McGraw Hill, New York.
- Husted BW. 1999. Wealth, culture, and corruption. *Journal of International Business Studies* **30**:339–359.
- Inglehart R, Welzel C. 2005. Modernization, cultural change, and democracy: the human development sequence. Cambridge University Press, Cambridge, United Kingdom.
- IUCN (International Union for Conservation of Nature). 2014. Red list of threatened species. Version 2014.2. Available from <http://www.iucnredlist.org> (accessed June 2014).
- Kahan DM. 2012. Ideology, motivated reasoning, and cognitive reflection: an experimental study. *Judgment and Decision Making* **8**:407–424.
- Maffi L. 2005. Linguistic, cultural, and biological diversity. *Annual Review of Anthropology* **34**:599–617.
- McClanahan TR, Cinner JE. 2012. Adapting to a changing environment: confronting the consequences of climate change. Oxford University Press, New York.
- McCrae RR, Terracciano A. 2005. Personality profiles of cultures: aggregate personality traits. *Journal of Personality and Social Psychology* **89**:407–425.
- McCright AM, Dunlap RE. 2011. Cool dudes: the denial of climate change among conservative white males in the United States. *Global Environmental Change* **21**:1163–1172.
- Miller DC, Agrawal A, Roberts JT. 2013. Biodiversity, governance, and the allocation of international aid for conservation. *Conservation Letters* **6**:12–20.
- Nisbett RE, Peng K, Choi I, Norenzayan A. 2001. Culture and systems of thought: holistic versus analytic cognition. *Psychological Review* **108**:291–310.
- Norris P, Inglehart R. 2002. Islamic culture and democracy: testing the ‘clash of civilizations’ thesis. *Comparative Sociology* **1**:235–263.
- Oishi S, Graham J. 2010. Social ecology: lost and found in psychological science. *Perspectives on Psychological Science* **5**:356–377.
- Ostrom E, Cox M. 2010. Moving beyond panaceas: a multi-tiered diagnostic approach for social-ecological analysis. *Environmental Conservation* **37**:1–13.
- Ostrom E, Janssen MA, Anderies JM. 2007. Going beyond panaceas. *Proceedings of the National Academy of Sciences* **104**:15176–15178.
- Pinker S. 2011. The better angels of our nature: the decline of violence in history and its causes. Viking/Penguin, New York.
- Quintero I, Wiens JJ. 2013. Rates of projected climate change dramatically exceed past rates of climatic niche evolution among vertebrate species. *Ecology Letters* **16**:1095–1103.
- R Core Team. 2014. R: A language and environment for statistical computing. The R Project for Statistical Computing, Vienna. Available from <http://www.R-project.Org/>.
- Rodrigues ASL, Brooks TM, Butchart SHM, Chanson J, Cox N, Hoffmann M, Stuart SN. 2014. Spatially explicit trends in the global conservation status of vertebrates. *PLOS ONE* **9** (e113934) DOI: 10.1371/journal.pone.0121040.
- Saroglou V, Delpierre V, Dernelle R. 2004. Values and religiosity: a meta-analysis of studies using Schwartz’s model. *Personality and Individual Differences* **37**:721–734.
- Siegel JI, Licht AN, Schwartz SH. 2011. Egalitarianism and international investment. *Journal of Financial Economics* **102**:621–642.
- Siegel JI, Licht AN, Schwartz SH. 2013. Egalitarianism, cultural distance, and foreign direct investment: a new approach. *Organization Science* **24**:1174–1194.
- Sims RL, Gong B, Ruppel CP. 2012. A contingency theory of corruption: the effect of human development and national culture. *The Social Science Journal* **49**:90–97.
- Singer P. 2011. The expanding circle: ethics, evolution, and moral progress. Princeton University Press, Princeton, New Jersey.
- Smith PB, Peterson MF, Schwartz SH. 2002. Cultural values, sources of guidance, and their relevance to managerial behavior a 47-nation study. *Journal of Cross-cultural Psychology* **33**:188–208.
- Sodhi NS, Butler R, Laurance WF, Gibson L. 2011. Conservation successes at micro-, meso- and macroscales. *Trends in Ecology & Evolution* **26**:585–594.
- Steinberg DF. 2005. From public concern to policy effectiveness: civic conservation in developing countries. *Journal of International Wildlife Law & Policy* **8**:341–365.
- Talhelm T, Haidt J, Oishi S, Zhang X, Miao FF, Chen S. 2015. Liberals think more analytically (more “weird”) than conservatives. *Personality and Social Psychology Bulletin* **41**:250–267.
- Talhelm T, Zhang X, Oishi S, Shimin C, Duan D, Lan X, Kitayama S. 2014. Large-scale psychological differences within China explained by rice versus wheat agriculture. *Science* **344**:603–608.
- UNPD (United Nations Population Division). 2014. Total population - both sexes, 2012 revision. UNPD, New York. Available from <http://esa.un.org/wpp/Excel-Data/population.htm> (accessed June 2014).
- Venables WN, Ripley BD. 2002. Modern applied statistics with S. 4th edition. Springer, New York.
- Verweij M, Douglas M, Ellis R, Engel C, Hendriks F, Lohmann S, Ney S, Rayner S, Thompson M. 2006. Clumsy solutions for a complex world: the case of climate change. *Public Administration* **84**:817–843.
- Waldron A, Mooers AO, Miller DC, Nibbelink N, Redding D, Kuhn TS, Roberts JT, Gittleman JL. 2013. Targeting global conservation funding to limit immediate biodiversity declines. *Proceedings of the National Academy of Sciences* **110**:12144–12148.
- Wickham H. 2009. ggplot2: elegant graphics for data analysis. Springer, New York.
- Wilshusen PR, Brechin SR, Fortwangler CL, West PC. 2002. Reinventing a square wheel: critique of a resurgent “protection paradigm” in international biodiversity conservation. *Society & Natural Resources* **15**:17–40.
- Wilson DS, Ostrom E, Cox ME. 2013. Generalizing the core design principles for the efficacy of groups. *Journal of Economic Behavior & Organization* **90**:S21–S32.
- World Bank. 2014a. GDP (constant 2005 US\$). World Bank, Washington, D.C. Available from <http://data.worldbank.org/indicator/NY.GDP.MKTP.KD> (accessed June 2014).
- World Bank. 2014b. Land area (Km<sup>2</sup>). World Bank, Washington, D.C. Available from <http://data.worldbank.org/indicator/AG.LND.TOTL.K2> (accessed June 2014).

- World Bank. 2014c. World Bank Governance Indicators. World Bank, Washington, D.C. Available from <http://data.worldbank.org/data-catalog/worldwide-governance-indicators> (accessed June 2014).
- World Values Survey. 2009. Wave 5 2005-2008 official aggregate v.20140429. Available from <http://www.worldvaluessurvey.org/WVSDocumentationWV5.jsp> (accessed June 2014).
- York R, Rosa EA, Dietz T. 2010. Ecological modernization theory: theoretical and empirical challenges. Pages 77-90 in Redclift MR, Woodgate G, editors. *The international handbook of environmental sociology*. Edward Elgar Publishing, Massachusetts.
- Zheng X, El Ghoul S, Guedhami O, Kwok CCY. 2013. Collectivism and corruption in bank lending. *Journal of International Business Studies* 44:363-390.

