



# A Comparison of Global Conservation Prioritization Models with Spatial Spending Patterns of Conservation Nongovernmental Organizations

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**Abstract:** *In recent decades, various conservation organizations have developed models to prioritize locations for conservation. Through a survey of the spending patterns of 281 conservation nongovernmental organizations (NGOs), we examined the relation between 2 such models and spatial patterns of spending by conservation NGOs in 44 countries in sub-Saharan Africa. We tested whether, at the country level, the proportion of a country designated as a conservation priority was correlated with where NGOs spent money. For one model (the combination of Conservation International's hotspots and High Biodiversity Wilderness Areas, which are areas of high endemism with high or low levels of vegetation loss respectively), there was no relation between the proportion of a country designated as a priority and levels of NGO spending, including by the NGO associated with the model. In the second model (Global 200), the proportion of a country designated as a priority and the amount of money spent by NGOs were significantly and positively related. Less money was spent in countries in northern and western sub-Saharan Africa than countries in southern and eastern Africa, relative to the proportion of the country designated as a conservation priority. We suggest that on the basis of our results some NGOs consider increasing their spending on the areas designated as of conservation priority which are currently relatively underfunded, although there are economic, political, cultural, historical, biological, and practical reasons why current spending patterns may not align with priority sites.*

**Keywords:** Africa, conservation spending, high biodiversity wilderness areas, hotspots, NGOs, prioritization modeling

Una Comparación de Modelos de Priorización de Conservación Global con Patrones Espaciales de Gastos de Organizaciones de Conservación No Gubernamentales

**Resumen:** *En décadas recientes, varias organizaciones de conservación han desarrollado modelos para priorizar localidades para conservar. Mediante un muestreo de los patrones gastos de 281 organizaciones de conservación no gubernamentales (ONGs), examinamos la relación entre dos de esos modelos y los patrones espaciales de gastos de ONGs de conservación en 44 países en África sub-Sahara. Probamos si, a nivel de país, la proporción de un país designado como prioridad de conservación se correlacionaba con donde gastaban el dinero las ONGs. Para un modelo (la combinación de las áreas de importancia para la conservación de Conservación Internacional y las Áreas Silvestres de Alta Biodiversidad, que son áreas de alto endemismo con altos o bajos niveles de pérdida de vegetación respectivamente), no hubo relación entre la proporción de un país designada como una prioridad y los niveles de gastos de las ONGs, incluyendo la ONG asociada con el modelo. E el segundo modelo (Global 200), la proporción de un país designada como prioridad y la cantidad de dinero gastada por ONGs se correlacionaron significativa y positivamente. Se gastó menos*

*dinero en países del norte y occidente de África que países del sur y oriente, en relación con la proporción del país designada como prioridad para la conservación. Sugerimos que con base en nuestros resultados, algunas ONGs consideren incrementar su gasto en áreas designadas como prioridad para la conservación que actualmente están recibiendo relativamente pocos fondos, aunque hay razones económicas, políticas, culturales, históricas, biológicas y prácticas por las que los patrones de gastos actuales no están alineados con los sitios prioritarios.*

**Palabras Clave:** África, áreas de importancia para la conservación, áreas silvestres con alta biodiversidad, gasto en conservación, modelos de priorización, ONGs

## Introduction

In the last few decades, some nongovernmental conservation organizations (NGOs) have developed methods to prioritize locations for conservation. Often based on spatially extensive data, these methods aim to make conservation more strategic and effective by identifying locations of the highest priority for conservation on the basis of a given set of criteria (Olson & Dinerstein 1998; Myers et al. 2000; Halpern et al. 2006). Different methods apply different criteria to identify high-priority areas, and the methods have become increasingly complex, incorporating a broad range of biological and economic criteria across a variety of scales (Wilson et al. 2006, 2009). Despite calls for empirical assessment of the effectiveness of conservation spending (Ferraro & Pattanayak 2006), whether the designation of conservation priority areas is linked to spending on conservation has not been studied thoroughly. We explored the relation between the locations identified by prioritization models and locations of spending by NGOs in sub-Saharan Africa.

Prioritization models variously emphasize endemism, ecosystem richness, presence of habitat for given species, level of human influence on the landscape, amount of loss of natural vegetation, and other factors. Different models prioritize different areas. Combined, 9 global models identified by Brooks et al. (2006) prioritize 79% of Earth's land surface area, although many of the models prioritize the same locations. We focused on 2 of those models, WWF-International's Global 200 priority areas and Conservation International's combined hotspots and high biodiversity wilderness areas (HWBAs). Hotspots are places with relatively high endemism and vegetation loss. More than 0.5% of the world's vascular plant species are endemic to each hotspot, and at least 70% of primary vegetation no longer remains within each hotspot (Myers et al. 2000). High biodiversity wilderness areas are defined as areas >10,000 km<sup>2</sup> that contain more than 70% of vegetation similar to that believed to be present 500 years ago; that have an average density of <1 person/km<sup>2</sup>, excluding urban areas; and that have relatively high species richness (Mittermeier et al. 2003). Unlike other prioritization models, these are spatially explicit, global in extent, and identify large areas. The creators of the models aim to provide guidance for coordinated action by the en-

tire conservation sector, not just the organizations with whom they are associated (Olson & Dinerstein 1998; Myers et al. 2000; Halpern et al. 2006). We compared the locations prioritized by those models with spatial patterns of spending by conservation NGOs. Data on NGO spending comes from a previous survey of expenditure by 281 conservation organizations across 44 countries in sub-Saharan Africa (Scholfield & Brockington 2008).

The WWF's Global 200 model (Olson & Dinerstein 1998) identifies 233 marine, freshwater, and terrestrial priority areas on the basis of species richness and taxonomic, evolutionary, and ecological distinctiveness. The set of priority areas was intended to represent as many global types of land cover as possible. Its creators see it as a guide for the whole conservation sector, not just WWF (Olson & Dinerstein 1998). In sub-Saharan Africa, 28 terrestrial priority areas cover 9,445,932 km<sup>2</sup> across 38 countries (range 4,574–1,924,886 km<sup>2</sup>, mean 337,354 km<sup>2</sup> [SD 425,743]) and 9 freshwater priority areas cover 5,788,379 km<sup>2</sup> across 24 countries (range 11,167–2,868,296 km<sup>2</sup>, mean 643,153 km<sup>2</sup> [SD 875,267]). Of the freshwater priority areas, 3,860,967 km<sup>2</sup> overlap terrestrial priority areas. Six marine priority areas cover 2,657,928 km<sup>2</sup> in the exclusive economic area of 13 countries (range 104,957–706,680 km<sup>2</sup>, mean 442,998 km<sup>2</sup> [SD 243,136]). Although 2 of the marine priority areas extend into other continents, we included in our study only the portions inside the 44 sub-Saharan African countries represented in the spending survey. Of the 44 countries, only Cape Verde and Burkina Faso contain no Global 200 sites. Terrestrial and freshwater Global 200 sites cover 49.1% of the surface area of the 44 sub-Saharan African countries represented in the survey, and marine Global 200 sites cover a total of 34.5% of the exclusive economic areas of the same group of countries.

The number of hotspots increased from 10 (Myers 1988), to 14 (Myers 1990), to 25 (Myers et al. 2000) as the data were reexamined or updated. As of 2003, there were 34 hotspots, 9 of which were in sub-Saharan Africa (Mittermeier et al. 2003). These 9 hotspots cover 4,160,410 km<sup>2</sup> across 31 countries (range 3,730 [Cape Verde's portion of the Mediterranean ecosystem] to 1,290,335 [Horn of Africa] km<sup>2</sup>, mean of 520,021 km<sup>2</sup> [SD 432,774]). Three sub-Saharan African hotspots extend into other continents, but we included only the portions of these

hotspots located inside the 44 countries included in the spending survey.

Conservation International, which was involved in the development and revision of the hotspot model, has used it to identify places where it should prioritize its work (Myers et al. 2000). Since 2003, it has used the high biodiversity wilderness area (HBWA) model along with delineations of hotspots to identify priority sites (Mittermeier et al. 2003). Of the 5 HBWAs, 2 are in sub-Saharan Africa: the Congo Basin (1,726,260 km<sup>2</sup> across 6 countries) and the Miombo-Mopane Woodlands and Savannas of Southern Africa (1,194,990 km<sup>2</sup> across 9 countries). Combined, hotspots and HBWAs cover 30.7% of the 44 countries in the spending sample, although of these, 8 countries contain neither HBWAs nor hotspots. The models' creators argue that the 2 models combined can inform a plan for coordinated global conservation action by the entire conservation sector, not just Conservation International (Mittermeier et al. 2003).

The NGOs that developed each model argue that the models should be used to guide the global distribution of conservation resources, but each NGO acknowledges the following caveats and makes the following observations. First, although they believe the models should be used to direct the global distribution of conservation resources (financial and political), local expertise and circumstances should shape how these resources are used. Second, the creators of each model recognize the existence of other models, the ideological values shared among the NGOs, and the spatial overlaps in the high-priority sites identified. Third, each NGO acknowledges that resources for conservation need to be directed to places outside priority areas. Fourth, given the NGOs' desire to guide expenditure, each model assumes conservation resources can be easily moved from one location or issue to another, which excludes the political and economic factors that affect where conservation NGOs spend their money. In addition, these models serve purposes other than guiding conservation activity. The NGOs involved in the models' creation have used them successfully for fundraising, marketing, and lobbying (Myers 2003; Adams 2004; Sachedina 2010).

More effort has been put into creating global prioritization models than into measuring whether spending is concentrated in high-priority areas, even by NGOs associated with the models (Cleary 2006; Halpern et al. 2006). The scarce evidence indicates a limited correlation between spending and conservation priorities. Halpern et al. (2006) provide the sole peer-reviewed study of links between prioritization models and spending. They analyzed spending by major donors and conservation NGOs with the 2 prioritization models we analyzed and with a third model (BirdLife International's Important Bird Areas). They found that global priority models explain 37% of the variation in country-level spending. Results of other studies show that 15 of 57 WWF priority ecoregions in

Latin America and the Caribbean received no international funding from NGOs, government agencies, foundations, major research institutions, environmental trust funds, or bilateral or multilateral institutions between 1990 and 1997 (Castro & Locker 2000) and that of the 16 countries that receive the most international environmental aid, only 6 have >3 WWF Global 200 sites and 7 have >1 hotspot (Mansourian & Dudley 2008). Brockington and Scholfield (2010a) found that spending by conservation NGOs is greater in sub-Saharan African countries with higher species richness and a higher number of species on the International Union for Conservation of Nature Red List of threatened species.

We focused on NGO expenditure for 3 reasons. First, compared with governments, NGOs are relatively free to work where they wish and so should be more able to respond to changing priorities. Second, activities of NGOs are a more accurate measure of how much is being spent on conservation in each place than more distant grant making by international donors. Third, NGOs devised the prioritization models we analyzed here and other prioritization models (Brooks et al. 2006). In sub-Saharan Africa conservation NGOs have relatively high economic and political influence, given the region's limited financial resources for conservation.

## Methods

Data on NGO expenditures came from a previous survey of the activities of 281 conservation NGOs operating in 44 countries in sub-Saharan Africa before the secession of South Sudan from Sudan (Scholfield & Brockington 2008; Brockington & Scholfield 2009, 2010a, 2010b). The NGOs in the survey were identified from the literature, internet searches, and lists of grantees reported by funding organizations. We circulated the list among academics, practitioners with local expertise, and the NGOs listed, and asked them to provide names of any unlisted NGOs of which they were aware. Although we may have missed some of the smaller NGOs working in the region, we are confident the survey included the majority of organizations. We used a parsimonious definition of *conservation NGO* that excluded organizations working on animal welfare, soil or water conservation, and human development, but included organizations working on community-based wildlife issues whose spending on these issues could be identified. For full details of the survey methods, see Scholfield and Brockington (2008).

Expenditure data were for the years 2004, 2005, and 2006 and are expressed in 2006 U.S. dollars. The amounts presented are an average of spending across these 3 years for each country and include direct spending and costs of raising and administering funds. Values are not adjusted for the varying costs of conservation in different countries

and biomes or of different species; for the presence of regional headquarters in certain countries; or for the different costs of different activities. We ranked countries by the proportion of their territory that was contained within Conservation International's combined hotspots (Conservation International 2004) and HBWAs (Conservation International 2005) and WWF's Global 200 (Olson & Dinerstein 2002) per square kilometer of national terrestrial territory and per square kilometer of national territory including marine economic exclusive area (data from VLIZ 2009). We used Spearman's rank correlation to compare the latter rankings with those we based on spending.

The hotspot-HBWA model is exclusively terrestrial, whereas the Global 200 model includes terrestrial, freshwater, and marine areas. In the survey, respondents were not asked to distinguish between spending on marine and land-based projects, so we could not remove spending on marine conservation from the data set. We think it is unlikely that marine spending is substantial. In 2003 marine conservation was a relatively low priority (IUCN 2003), and it is doubtful that spending changed considerably by the time the survey was conducted. To test whether including or excluding marine data affected our results, we used Spearman's rank correlation to compare spending per unit land area and spending per unit land and sea area.

To compare locations identified by prioritization models with locations of conservation spending, we used ArcGIS Desktop (version 9.3.1) and ArcGIS Desktop (version 10 SP3) (ESRI, Redlands, California) to overlay global vector maps of hotspots, high biodiversity wilderness areas, and Global 200 sites with maps of national borders (both including and excluding marine exclusive economic area). We calculated the percentage of land in each country in sub-Saharan Africa that lies within one of these sites. For the Global 200 sites (Olson & Dinerstein 2002), we avoided double counting areas within overlapping terrestrial and freshwater sites by classifying the overlapping areas as terrestrial. We combined hotspots (Conservation International 2004) and HBWAs (Conservation International 2005) because they did not overlap in space. We compiled data at the national level so we could compare it with the data on NGO spending.

We ranked countries by NGO spending (U.S. dollars per square kilometer national land surface area and marine exclusive economic area) and by the percentage of each country's land surface area and sea surface area designated as a conservation priority under each of the models (Table 1). We compared the terrestrial and marine rankings with Spearman's rank correlation, and tested whether rankings were significantly different at  $\alpha = 0.05$  with a 2-tailed  $t$  test.

We also tested whether the relation between spending patterns and locations of conservation priority areas varied between NGOs with different annual expendi-

ture. First, we excluded spending by WWF-International and WWF-South Africa because the WWF partnership accounts for 29% of spending by NGOs in sub-Saharan Africa. Second, we classified the NGOs on the basis of annual expenditure. The first category included the 4 NGOs that spent over \$10 million/year, or 61% of total conservation spending (WWF, Conservation International, Wildlife Conservation Society, and African Wildlife Foundation). The second category included the 6 NGOs that spent between \$2 and 10 million annually, or 21% of total funding (Peace Parks Foundation, Jane Goodall Institute, Fauna and Flora International, Frankfurt Zoological Society, African Parks Foundation, and Dian Fossey Gorilla Fund International). The third category included the remaining 271 NGOs that spent <\$2 million annually, or 17% of total spending. We ranked countries by spending by NGOs (in dollars per square kilometer national land surface area and marine exclusive economic area) in each class and used Spearman's rank correlation and a 2-tailed  $t$  test to compare each of the 3 rankings with percentage of the country's land surface area and sea area designated as a priority area under each of the prioritization models. To test the relation between each model and its associated NGO, we used Spearman's rank correlation and a 2-tailed  $t$  test to compare the percentage of each country's land surface area and sea area designated as a Global 200 site with spending per square kilometer land and sea surface area by WWF. We repeated the process with hotspot-HBWA sites and Conservation International spending per square kilometer land area.

To assess which countries tended to receive most and least NGO spending relative to the percentage of their land surface area designated as a conservation priority, we ranked countries by the total amount of NGO spending they received divided by the total area of Global 200 sites contained within their borders. We repeated this process for combined hotspot-HBWA sites.

## Results

The relation between percentage of a country's land and a country's land and marine exclusive economic area included within hotspot-HBWA sites and the total amount spent by NGOs within that country was not statistically significant (land area:  $r_s = 0.25$ ,  $p = 0.35$ ; land and marine area:  $r_s = 0.39$ ,  $p = 0.008$ ). There was a positive relation between the percentage of a country's land surface area contained within Global 200 terrestrial and freshwater areas and spending by NGOs overall ( $r_s = 0.49$ ,  $p < 0.001$ ), NGOs excluding WWF ( $r_s = 0.59$ ,  $p < 0.001$ ), and NGOs with total annual expenditure exceeding \$10 million ( $r_s = 0.43$ ,  $p < 0.001$ ). There was a significant positive correlation between percentage of a country's marine exclusive economic area and land surface area

**Table 1.** Total annual spending (2006 U.S. dollars) in countries in sub-Saharan Africa by conservation nongovernmental organizations (2004 through 2006), per square kilometer of a nation's land area only, and a nation's land area and marine exclusive economic area (MEEA).

Country	\$/km <sup>2</sup> land area	\$/km <sup>2</sup> land area and MEEA	Country	\$/km <sup>2</sup> land surface area	\$/km <sup>2</sup> land area and MEEA
Rwanda	100.65	100.65	Namibia	4.95	2.95
Cape Verde	37.66	0.10	Congo, DRC	4.46	4.46
Swaziland	34.19	34.19	Sao Tome & Principe	4.16	0.02
Gabon	27.49	15.86	Guinea	2.71	1.87
Kenya	23.76	19.94	Central African Republic	2.65	2.65
Malawi	18.73	18.73	Botswana	2.29	2.29
Lesotho	18.68	18.68	Ghana	2.21	1.14
Madagascar	17.94	5.91	Senegal	1.89	1.05
Uganda	17.04	17.04	Ethiopia	1.39	1.39
Tanzania	15.37	12.23	Cote d'Ivoire	1.23	0.80
The Gambia	14.32	4.37	Nigeria	0.85	0.71
Congo	13.28	11.88	Burkina Faso	0.67	0.67
Burundi	12.47	12.47	Angola	0.46	0.33
Sierra Leone	11.39	3.57	Togo	0.28	0.22
Liberia	11.34	3.16	Djibouti	0.16	0.12
South Africa	11.20	5.97	Niger	0.12	0.12
Guinea-Bissau	9.84	2.25	Eritrea	0.10	0.06
Zimbabwe	9.30	9.30	Sudan	0.05	0.05
Cameroon	8.80	8.53	Mali	< 0.01	< 0.01
Zambia	7.29	7.29	Benin	0	0
Equatorial Guinea	7.05	0.56	Chad	0	0
Mozambique	5.29	3.07	Somalia	0	0

Note: Data from Scholfield and Brockington (2008).

within a WWF Global 200 site and spending by NGOs overall ( $r_s = 0.71, p < 0.001$ ), spending by NGOs excluding WWF ( $r_s = 0.64, p < 0.001$ ), and spending by NGOs with total annual expenditures  $> \$10$  million ( $r_s = 0.65, p < 0.001$ ),  $\$2$ - $10$  million ( $r_s = 0.53, p < 0.001$ ), and  $< \$2$  million ( $r_s = 0.50, p < 0.001$ ).

Whether marine exclusive economic area was included did not substantially alter the results. Total NGO spending per unit land area was significantly and positively correlated with spending per unit land and marine exclusive economic area ( $r_s = 0.85, p < 0.001$ ).

The relation between the country-level expenditure of Conservation International and the proportion of national surface area included in hotspots and HBWAs was not statistically significant ( $r_s = 0.24, p = 0.118$ ). We found a significant positive relation between percentage of a country's land and marine exclusive economic area designated as WWF Global 200 priority sites and spending by WWF ( $r_s = 0.63, p < 0.001$ ).

Large ( $> \$10$  million/year) and small ( $< \$2$  million/year) NGOs tended to spend similar proportions of money in the same countries ( $r_s = 0.60, p < 0.001$  for land area;  $r_s = 0.72, p < 0.001$  for combined land and marine area). The relation between spending by small and medium ( $\$2$ - $10$  million/year) NGOs was statistically significant ( $r_s = 0.34, p = 0.003$  for land area;  $r_s = 0.46, p < 0.001$  for combined land and marine area). The relation between location of spending by medium and large NGOs was not statistically significant. There was a significant positive correlation between the percentage of a country's land

and marine exclusive economic area within a Global 200 site and within hotspot-HBWA sites.

Of the 10 countries that ranked highest for NGO spending per square kilometer of hotspot-HBWA sites within their borders, 6 were also among the 10 most highly ranked for NGO spending per square kilometer of Global 200 sites within their borders (Table 2). This ranking excludes countries in which money was spent but none of its territory was designated as a priority under either model. Of the 14 countries in Table 2, 10 are in southern or eastern Africa and 10 are former British colonies that gained independence after 1956 (of the 44 countries in our sample, 14 are former British colonies that gained independence after 1956). Of the 10 countries that ranked lowest for NGO spending per square kilometer of hotspot-HBWA sites within their borders, 7 were also among the 10 lowest ranked countries for NGO spending per square kilometer of Global 200 sites within their borders (Table 3). Of the 13 countries in Table 3, all except Angola are located in West Africa and the arid and semiarid regions of northern sub-Saharan Africa.

## Discussion

The relation between the percentage of a country's area designated as a conservation priority and spending by conservation NGOs is inconsistent. Neither overall NGO spending nor spending by Conservation International was significantly correlated with proportion of area

**Table 2.** Countries in sub-Saharan Africa in which total annual spending by conservation nongovernmental organizations (2004 through 2006 in 2006 U.S. dollars) was greatest per square kilometer of area in combined hotspots and high biodiversity wilderness areas (HS and HBWA) and combined terrestrial, freshwater, and marine Global 200 areas (G200).

HS and HBWA		G200	
country	\$/km <sup>2</sup> priority area <sup>a</sup>	country	\$/km <sup>2</sup> priority area <sup>b</sup>
Rwanda	299.21	Zimbabwe	107.35
Malawi	172.80	Guinea-Bissau	106.69
Uganda	95.96	Rwanda	100.65
Namibia	93.40	Swaziland	81.52
Botswana	88.45	Niger	48.07
Kenya	76.04	Lesotho	34.30
Zimbabwe	63.63	Botswana	29.84
Swaziland	51.24	Gabon	27.55
Tanzania	49.70	Kenya	25.59
Cape Verde	40.70	Malawi	22.04

<sup>a</sup>Excludes 8 countries that do not contain hotspots or HBWAs (Burkina Faso, Chad, Guinea-Bissau, Lesotho, Mali, Niger, Senegal, The Gambia).

<sup>b</sup>Excludes 2 countries that do not contain Global 200 areas (Burkina Faso, Cape Verde).

designated as hotspots and HBWAs. There was a statistically significant relation between percentage of a country included within Global 200 sites and NGO spending for all NGOs, for NGOs of different sizes, and for spending by WWF. Results did not differ on the basis of land area only or on the basis of land and marine area because 16 of the 44 countries in the sample are landlocked and many others have small marine economic exclusive areas. Our results suggest that some NGOs could increase the align-

**Table 3.** Countries in sub-Saharan Africa in which total annual spending by conservation nongovernmental organizations (2004 through 2006 in 2006 U.S. dollars) was least per square kilometer of area in combined hotspots and high biodiversity wilderness areas (HS and HBWA) and in combined terrestrial, freshwater, and marine Global 200 areas (G200).

HS and HBWA		G200	
country	\$/km <sup>2</sup> priority area	country	\$/km <sup>2</sup> priority area
Nigeria	6.11	Togo	2.57
Sao Tome & Principe	4.97	Ethiopia	1.90
Cote d'Ivoire	2.67	Angola	1.15
Togo	2.57	Djibouti	0.46
Angola	1.63	Sudan	0.24
Ethiopia	1.55	Eritrea	0.13
Eritrea	0.18	Mali	< 0.01
Djibouti	0.16	Benin	0
Benin	0	Chad	0
Somalia	0	Somalia	0

Note: Conservation nongovernmental organizations spent no money in Benin, Chad, or Somalia.

ment of their spending with the locations of areas designated as a conservation priority by the hotspot-HBWA and Global 200 models. However, factors other than prioritization affect where conservation NGOs spend money. First, about one-third of NGOs working in sub-Saharan Africa have missions that emphasize one species, taxonomic group, or place, whereas the prioritization models are based on assemblages (Scholfield & Brockington 2008). However, the missions of 7 of the 10 NGOs that spend the most money in sub-Saharan Africa are not specific to species, taxonomic groups, or places. The 2 clear exceptions are the Jane Goodall Institute, which focuses on chimpanzees (*Pan* spp.), and the Dian Fossey Gorilla Fund International. The Wildlife Conservation Society focuses on areas with high degrees of ecological integrity and "global priority species."

Second, current conservation spending may be influenced by the inertia of past spending and by culturally powerful notions about biological diversity. Certain species, particularly charismatic megafauna, attract more funding than others, which particularly affects spending patterns if the range of the species is restricted. For example, overall NGO spending was by far the greatest in Rwanda (\$100.65/km<sup>2</sup>; mean \$5.09/km<sup>2</sup> for all countries), most likely because this is where mountain gorillas (*Gorilla gorilla beringei*) occur. Rwanda also received the highest amount of spending per square kilometer of its territory designated as hotspots and HBWAs and the third highest for Global 200 sites (Table 2). Countries in southern and eastern Africa may have received higher levels of NGO spending per square kilometer of conservation priority area within their borders compared with countries in western and northern sub-Saharan Africa because they contained a greater number of charismatic animals traditionally associated with African conservation, such as lions (*Panthera Leo*), elephants (*Loxodonta* spp.), and rhinoceros (*Diceros bicornis* and *Ceratotherium simum*) (Tables 2 & 3). The historical legacy of British colonialism in eastern and southern Africa may also have affected spending. The conservation programs and wildlife departments of former British colonies in this area were well organized, relatively well funded and received considerable support from politicians and NGOs before independence, and these programs, departments, and NGO interests persisted after independence (MacKenzie 1988; Neumann 1998; Adams 2004).

Third, the prioritization models are based on different criteria and consequently identify different places that do not overlap much. Spending patterns cannot closely follow the outputs of all models. The WWF's Global 200 model uses a much broader range of criteria to identify priority areas than hotspots and HBWAs, which are based on high vascular plant diversity and large extents of either very high or very low levels of landscape alteration. The Global 200 model aims for representativeness by

covering as broad a range of biomes as possible. Such an approach may be more likely to identify places of interest to diverse NGOs, and therefore those places may receive relatively high levels of spending.

Fourth, conservation NGOs may be reallocating their spending to priority areas, but because the spending data are a snapshot, we could not assess whether spending is shifting toward priority areas. The spending data covered financial years 2004–2006, whereas the prioritization models were developed in 2003 (hotspots and HBWAs) and 2001 (Global 200 areas) (there are earlier versions of each model). The fact that there are so few empirical assessments of where conservation money is spent will make it difficult to assess progress in this respect.

Fifth, comparing spending by country with the proportion of a national territory designated as a conservation priority assumes that in a perfect correlation, funds are allocated proportionally to the total land surface area within a given priority polygon. There are reasons why funding is not distributed this way. The cost of conservation across different places and biomes varies. Much of the biological diversity within a priority area may already be altered (by definition, hotspots have lost a minimum of 70% of their primary land cover), so conservation NGOs may choose to concentrate spending on remaining intact areas rather than parts of the polygon that have been altered. The polygons may include many urban or agricultural areas or other places of little interest to conservation NGOs.

Finally, and perhaps most importantly, a variety of political and economic factors influence where money is spent. Political circumstances may limit action. For example, although parts of Somalia are designated as priorities under both models (99.6% of its land surface area is designated as hotspot), we did not document any conservation NGOs spending money there, probably due to long-term political instability in this country. Histories of conflict may also account for low NGO spending in Ethiopia and Angola, although some countries with long histories of conflict or conflict in the period immediately before that for which NGO spending data were collected, such as the Democratic Republic of Congo, Sierra Leone, and Liberia, receive average or greater than average levels of spending. An NGO may be unable or unwilling to base its strategies solely on prioritization models, even if it created the model. The vagaries of funding opportunities may make it much more worthwhile for an organization to spend money in a place that is not a priority than one that is. Funding received by NGOs may come with strict conditions on where and how an NGO can spend it, which challenges the idea that spending can be easily reallocated and optimized on the basis of model results (Wilson et al. 2009). Some funders also may not be interested in following the prioritization models and may restrict funding in ways that limit NGOs' abilities to adhere to their own priorities. Detailed analyses of

conservation NGOs in sub-Saharan Africa show that they adjust their strategies so that they better fit the priorities of funding agencies (Sachedina 2010). The large NGOs that create the models are diverse organizations; thus, although one part of the organization may be creating a prioritization model to guide strategy, influences and strategies emerging from other parts of the organization may alter the organization's overall direction.

Although our results suggest that conservation NGOs may be spending money in places identified as a Global 200 priority, it appears they do not disproportionately spend money in hotspots and HBWAs. This includes Conservation International, the NGO associated with this model. Some researchers have used places identified by prioritization models as a proxy for places where NGOs are likely to work, albeit with caveats (Redford et al. 2008). Our results show that this assumption is problematic. Furthermore, our results demonstrate that countries in eastern and southern Africa received higher levels of conservation NGO spending, and countries in western and northern sub-Saharan Africa received lower levels of conservation NGO spending, relative to the proportion of the country designated as a conservation priority area. Given our findings and the difficulties of directing resources to conservation priority areas, we suggest that NGOs, either individually or collectively, pay more attention to where they are spending their money. If conservation NGOs wish their spending to reflect conservation priorities as identified on the basis of hotspot-HBWAs and Global 200 models, we suggest they consider increasing activities in northern and western African biomes rather than focusing effort on the traditional conservation areas of southern and eastern Africa.

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