Eco-Region Protection Indicator for the 2010 release of the Natural Resource Management Index of the Millennium Challenge Corporation

Data and Methodology

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Note: *An error was detected in the protected area points layer for the 2010 version of the World Database of Protected Areas (WDPA) after processing the eco-region protection indicator, but too late to be addressed in the 2010 NRMI results. Many points without area estimates in past versions were arbitrarily assigned areas of 200 sq. km. After contacting the UNEP World Conservation Monitoring Center (WCMC) it was discovered that this was a database error and that the problem had been corrected in versions made available after May 2010, when we downloaded the WDPA. No notification was given to users who had downloaded earlier versions. For more details see page 5 of this document.*

What it measures

This indicator measures the degree to which a country achieves the target of protecting at least 10% of each terrestrial biome within its borders. We adopted a target of 10% of each biome protected because that is the target most faithful to the existing international consensus. The Convention on Biological Diversity (CBD), at its 7th Conference of the Parties, set the following target: "At least 10% of each of the world's ecological regions effectively conserved." (http://www.biodiv.org/doc/decisions/COP-07-dec-en.doc, page 385). We treat protected status as a necessary but not sufficient condition for an ecological region to be "effectively conserved." How well protected areas are managed, the strength of the legal protections extended to them, and the actual outcomes on the ground, are all vital elements of a comprehensive assessment of effective conservation. Such measures are not available on a widespread basis, though there are efforts underway to fill critical gaps (Chape et al, 2005, 452).

There are some nuances that need to be made clear about this target.

First, the target as expressed by the CBD and the conservation community more generally refers to "ecological regions." In the 2006 Environmental Performance Index (EPI) we abbreviated this as "ecoregion" (Esty et al 2006). To make this metric concrete we had to choose a specific data set accepted in both scientific and policy-making circles. We used the Olson et al (2001) delineation of "biomes" for this purpose. Biomes are broad terrestrial ecological regions. Nested within the biomes are what the authors call "ecoregions," which are finer-scale areas sensitive to more specific ecological patterns. These "ecoregions" are probably more appropriate as policy targets, because they identify areas based on factors that affect biodiversity on the ground more precisely than biomes. However, given the scale of the present analysis (global 1-km grids) and the processing

time requirements, it was determined that using ecoregions as the unit of analysis would not be possible (see Caveats section below).

Second, the target of 10% is clearly the result of many political considerations. Based purely on the scientific merits, some ecological regions should probably be protected to a greater extent. One systematic review of the literature concluded that most ecological regions probably require more than 10% protection (Svancara et al 2005). We feel it is incumbent on us to point out that the 10% target probably represents more of a floor than a ceiling, and that over time it is likely that either a) the scientific community will come to a more precise consensus on more ambitious targets, perhaps differentiated by ecoregion, or b) the policy-community will endorse a more ambitious target, also possibly differentiated, or both. Certainly, it would not be prudent to make any assumption about the 10% target being fixed into the future.

Data Set Preparation

We utilized the 2010 World Database of Protected Areas (WDPA) maintained by UNEP's World Conservation Monitoring Centre (WDPA 2010). As with prior versions of the WDPA, the 2010 release includes both points and polygon layers. The protected areas represented by polygons, which provide the actual boundaries, are a subset of the protected areas represented by points.

We excluded protected areas that were listed as historical, archaeological, or cultural sites, or that were listed as proposed but not yet designated. For protected areas that had point and area information but not an explicit polygon identified, we created a circular buffer around the point with a total area equivalent to the area listed in the database. However, where PAs are near a country's border, the buffered point is arbitrarily clipped to the border (so as not to spill over into neighboring countries), thereby losing a certain percentage of the total area.[1] Marine Protected Areas whose points were located offshore were excluded from this step. To avoid over-counting overlapping protected areas, the dissolve command in ArcMap was used to create a consolidated set of polygons that distinguished areas that were under protected status from those that were not.

We used a high resolution and spatially accurate coastline dataset developed by ISciences L.L.C (ISciences 2009). The ISciences coastline data has higher resolution (3 arc-second, or approximately 90m).

The biome data were obtained from WWF's Terrestrial Ecoregions of the World (Olson *et al.* 2001). Rather than utilize the 200 ecoregions, many of which are quite small, we utilized 14 terrestrial biomes identified in the data set. Because we are measuring the extent of terrestrial protected areas, biome 98 (water) was excluded. We manually extended the WWF Terrestrial biome data to match ISciences coastline data to ensure that all areas particularly along the coast or small islands are assigned biome type.

[1] This is a case in which it would be important for the country to provide accurate boundary files to the WCMC for incorporation in the next iteration of the WDPA. For more information visit http://www.wdpa.org or contact protectedareas@unep-wcmc.org.

As of 2009 we no longer include protected areas that are listed as “International” in the World Database on Protected Area (WDPA). The vast majority of such internationally designated protected areas, which include World Heritage, Ramsar, and Biosphere Reserve sites, are contained in either the IUCN I-VI or the “no category” national protected area databases of the WDPA, meaning that they have some national legal status. Where they have no national legal status, such protected areas cannot be considered to be adequately protected. This decision is supported by the common practice of many studies that utilize the WDPA to assess the protected status of a nation’s territory.

Methods

In order to compute what proportion of each biome in a country is protected, we first created a composite layer consisting of country boundaries (ISciences 2009), WWF’s terrestrial biomes layer and the consolidated global protected area polygon layer. The combined country boundary-biome-protected area map was projected using Molleweide equal area projection and the area for each unique polygon was computed. The attribute table of the projected layer was exported into tabular data for import into statistical packages.

The tabular data set quantifies, for each country, the total area of each biome and the total protected area of each biome. The percentage of each biome that is protected was calculated. The percentage was capped at 10%, so that additional “credit” does not accrue where protection exceeds 10%. The countries overall score is a weighted average of the protection score for each biome. The weights are derived by calculating the biome area as a fraction of a country’s overall land area. Greater weights are applied to larger biomes.

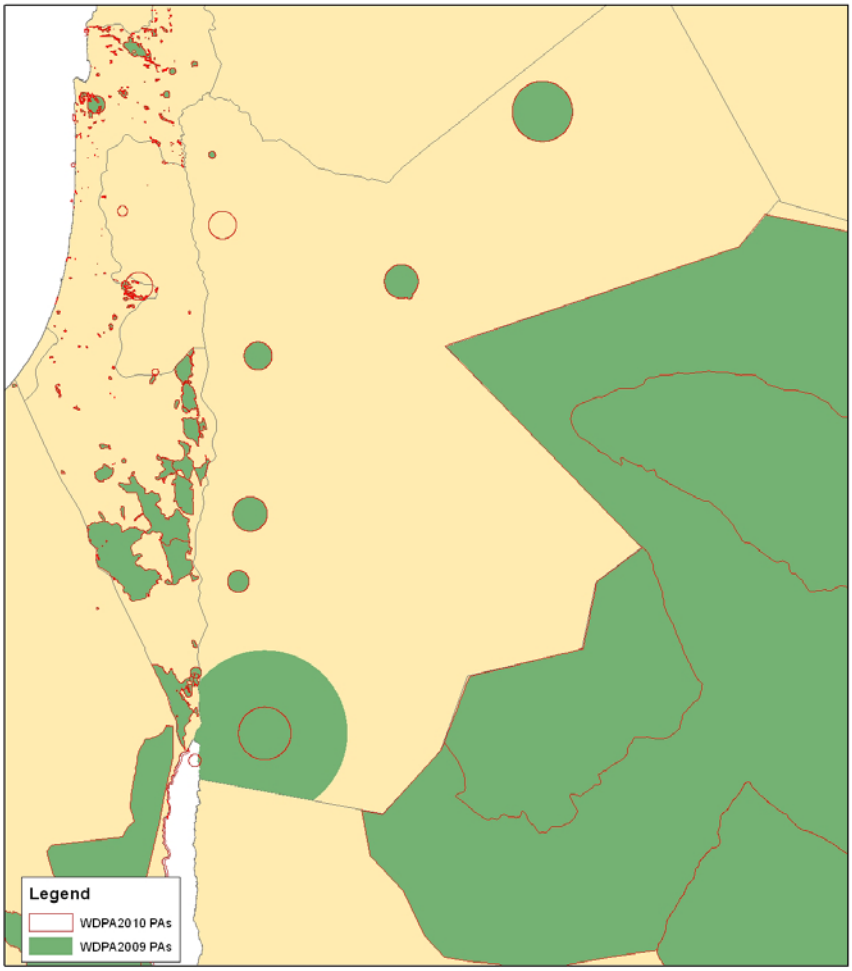
Caveats

Spatial errors are always a possibility when combining multiple global, 1:1m scale data sets for analytical purposes. Uncertainty about the exact location of boundaries of some protected areas, especially those represented by creating circles around points, and the potential spatial mismatch between the protected areas layer and the biome-country layer represent potential sources of error. Also worth mentioning is that the WDPA database has been a work in progress since 2006. Over the years, as relatively accurate boundary data becomes available, point protected areas are replaced with boundary delineations that often result in a decrease in total area under protection. The 2010 WDPA saw the largest such replacement of the versions used to date to calculate the ecoregion protection indicator. There were a number of decreases in total protected area extent from 2009 to 2010, which are described in more detail in Table 1. A map depicting the change for Jordan is found in Figure 1.

Table 1. Countries with decrease in Protected Area from 2009 to 2010 due to changes in the underlying data from the WDPA

Country	ISO3	Total Area Protected in 2009 (km^2)	Total Area Protected in 2010 (km^2)	Remarks
El Salvador	SLV	510.18	166.04	Status change for a couple of PAs
Jordan	JOR	7,993.69	2,828.35	One PA changed from 7200 sq km to 720 sq km, another was deleted
Belgium	BEL	811.82	412.04	Point PAs removed in 2010
Panama	PAN	18,473.48	14,146.21	A number of polygon PAs were removed in 2010 in addition to removal of all point Pas
Congo, DR.	COD	290,210.00	232,877.13	Several PAs were removed in 2010
Costa Rica	CRI	12,767.06	10,749.55	A number of polygon PAs were removed in 2010 in addition to removal of all point Pas
Tanzania	TZA	307,896.12	277,287.37	Point PAs removed in 2010
Portugal	PRT	5,960.96	5712.07	Two Pas in 2009 were removed in 2010

Figure 1. Change in Protected Area Extent for Jordan from 2009 to 2010 versions of WDPA



Twenty-nine countries saw a 50 percent of more increase in area protected from 2009 to 2010. This is attributed to assignment of area information to more than 11,200 point PAs primarily in eastern Europe and some Island States that previously had no area assigned. Most of these PAs were assigned areas of 200 sq. km. It was learned subsequently that this area assignment was the result of a database error.

Table 2. Countries with more than 50 percent increase in Protected Areas since 2009

Country	ISO3	Area Protected in 2010 (km^2)	Percent increase since 2009	Remarks
Mexico	MEX	230118.94	53.93	Additional Pas in central Mexico
Croatia	HRV	7362.47	54.34	Area values available for point PAs
Turkey	TUR	24591.12	67.75	Area values available for point PAs
Latvia	LVA	17313.25	86.21	Area values available for point PAs
Nicaragua	NIC	41346.80	89.04	Addition of a biosphere to national pas
Slovenia	SVN	2414.07	90.57	New boundary data
Swaziland	SWZ	1032.49	96.81	Area values available for two point PAs
East Timor	TLS	888.76	102.47	Area values available for two point PAs
Liechtenstein	LIE	78.71	143.84	New boundary data
Vanuatu	VUT	1493.04	188.68	Addition of PAs
British Virgin Islands	VGB	28.22	215.04	Addition of Pas
Norway	NOR	66578.58	235.35	Area values available for point PAs
Sweden	SWE	151902.35	237.56	Area values available for point PAs
FYR of Macedonia	MKD	4175.43	254.06	Area values available for point PAs
Yugoslavia	SCG	5999.92	286.04	Additions of Pas
Belarus	BLR	60023.11	312.21	Area information added in 2010
St. Vincent and Gren.	VCT	223.94	406.65	Area information added in 2010
Greece	GRC	25480.43	406.72	Addition of Pas
Ukraine	UKR	106589.46	420.54	Area values available for point PAs
Antigua and Barbuda	ATG	174.36	438.41	Area information added in 2010
Qatar	QAT	244.30	445.21	Area information added in 2010
Estonia	EST	53361.04	492.54	Area information added in 2010
Bahrain	BHR	74.33	775.39	Area information added in 2010
Falkland Islands (Malvinas)	FLK	481.63	1,036.09	Area information added in 2010
Palau	PLW	134.61	1,127.72	Area information added in 2010
Fed States of Micronesia	FSM	332.69	1,513.19	Several PAs were added in 2010
Denmark	DNK	40573.98	1,767.78	Area information added in 2010
Lebanon	LBN	1066.30	22,45.46	Area information added in 2010
Barbados	BRB	175.58	43,690.81	Area information added in 2010

To streamline the processing steps we performed geospatial processing such as point PA buffering and country-biome-PA separately for each country before importing areas into the ecoregion protection indicator calculator. A major benefit of this change is eliminating over-estimation of PAs as a result of point buffers in adjacent countries from spilling over into neighboring countries thereby inflating the overall ecoregion protection score. For the 2008 and prior NRMIs there was "spillage" of buffered points across international borders that led to over estimation of protection in neighboring countries and underestimation in the target country. As mentioned earlier, as of the 2009 release, we clipped the buffered points at the border.

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World Conservation Monitoring Center of the United Nations Environment Programme (UNEP-WCMC). 2010. *World Database on Protected Areas (WDPA) Annual Release 2010* [Downloaded: May 2010]. The WDPA is a joint product of UNEP and IUCN, prepared by UNEP-WCMC, supported by IUCN WCPA and working with Governments, the Secretariats of MEAs and collaborating NGOs. For further information: protectedareas@unep-wcmc.org or http://www.wdpa.org.