

**Eco-Region Protection Indicator  
for the 2011 release of the Natural Resource Management Index of the  
Millennium Challenge Corporation**

**Data and Methodology**

CIESIN, Columbia University

***Summary of major changes and future developments***

*For the 2010 release of the NRMI, 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. In the 2011 release, the 2010 results were recalculated so that the correct areas were used, and points without areas were not included.*

*Note that in the future, from the 2012 release onwards, the target will be moved to a weighted average of 17% of biome area protected, which is based on a revised target established at the Convention on Biological Diversity Conference of Parties 10 in Nagoya, Japan, October 2010. We also plan to use data provided by the UNEP-World Conservation Monitoring Centre which is based on a slightly different methodology in which the time series is developed by the date of establishment of the protected area rather than on the basis of the latest release of the World Database on Protected Areas (WDPA). This will ensure that any changes in percent of biomes protected will be due to actual changes in protected status and not due to improvements to the database (such as improved protected area boundary information). Each annual release will use the most up to date WDPA for calculating the time series.*

**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 2011 World Database of Protected Areas (WDPA) maintained by UNEP’s World Conservation Monitoring Centre (WDPA 2010). As with prior versions of the WDPA, the 2011 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.<sup>1</sup> 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

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<sup>1</sup> 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](mailto:protectedareas@unep-wcmc.org).

biome data to match ISciences coastline data to ensure that all areas particularly along the coast or small islands are assigned biome type.

We do not 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 changes in total area under protection.

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.

## References

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World Conservation Monitoring Center of the United Nations Environment Programme (UNEP-WCMC). 2011. *World Database on Protected Areas (WDPA) Annual Release 2011* [Downloaded: May 2011]. 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](mailto:protectedareas@unep-wcmc.org) or <http://www.wdpa.org>.