Road pressure

Indicator name	**Road Pressure Indicator (RPI)**
Indicator unit	The RPI assesses road density in an area of interest, expressed as the percentage of cells with presence of roads (with a 250 m buffer).
Area of interest	RPI has been calculated, in DOPA Explorer, for each terrestrial protected area of size ≥ 25 km^2 and for the terrestrial parts of each coastal protected areas of size ≥ 25 km^2. To assess pressures around protected areas, we further computed the RPI for the 10 km unprotected buffer zone around the protected area.

Related targets

Sustainable Development Goal 15 on life on land

Aichi Biodiversity Target 5 on natural habitats

Aichi Biodiversity Target 11 on protected areas

Aichi Biodiversity Target 12 on species

Policy question
How much potential impact may roads have on a protected area and on the habitats, species and ecological processes therein? By identifying protected areas with low pressure from roads, it is possible to highlight locations that are likely to better conserve species and ecosystems, given that transport infrastructure has been identified as a major driving factor of biodiversity loss.

Use and interpretation
RPI can be used to assess the relative potential impact that roads may have on the biodiversity and ecological integrity of a protected area. There are several reasons why an increased number and density of roads in a protected area, as assessed by RPI, may lead to negative outcomes for the conservation of the habitats, species and ecological processes in the protected area (see e.g. Laurance, Goosem & Laurance 2009; Laurance *et al.*, 2014; Haddad *et al.*, 2015). First, there is the direct effect of habitat loss by road construction. Second, many species avoid or are found at reduced population densities in the proximity of roads, in some cases up to several kilometers of distance from the infrastructure. Third, and related to the just mentioned population responses, roads increase chemical pollution, noise and light disturbance, and wildlife mortality due to collisions with vehicles. Fourth, roads can fragment habitats and act as barriers that reduce functional connectivity in and around the protected areas. Fifth, roads provide an intrusion of edge effects in natural areas, which tends to favor more generalist, cosmopolitan species in detriment of the specialist species that are associated to large core areas of intact habitats, which are usually those species of higher conservation concern. Sixth, roads facilitate human access to natural areas, which may be accompanied by an increase in poaching, deforestation, mining or other activities that are potentially harmful for wildlife and ecosystem functioning. Finally, roads can act

as an entry point and expansion gateway for invasive species, which are frequently aided by human transportation. Although the RPI does not separately evaluate each of these pressures, it provides a general assessment of the potential combined magnitude of all these road-related effects in a given protected area.

In DOPA Explorer, for each terrestrial protected area of size ≥ 25 km^2 and its 10 km unprotected buffer zone we provide the map and coverage statistics by roads (Figure 1).
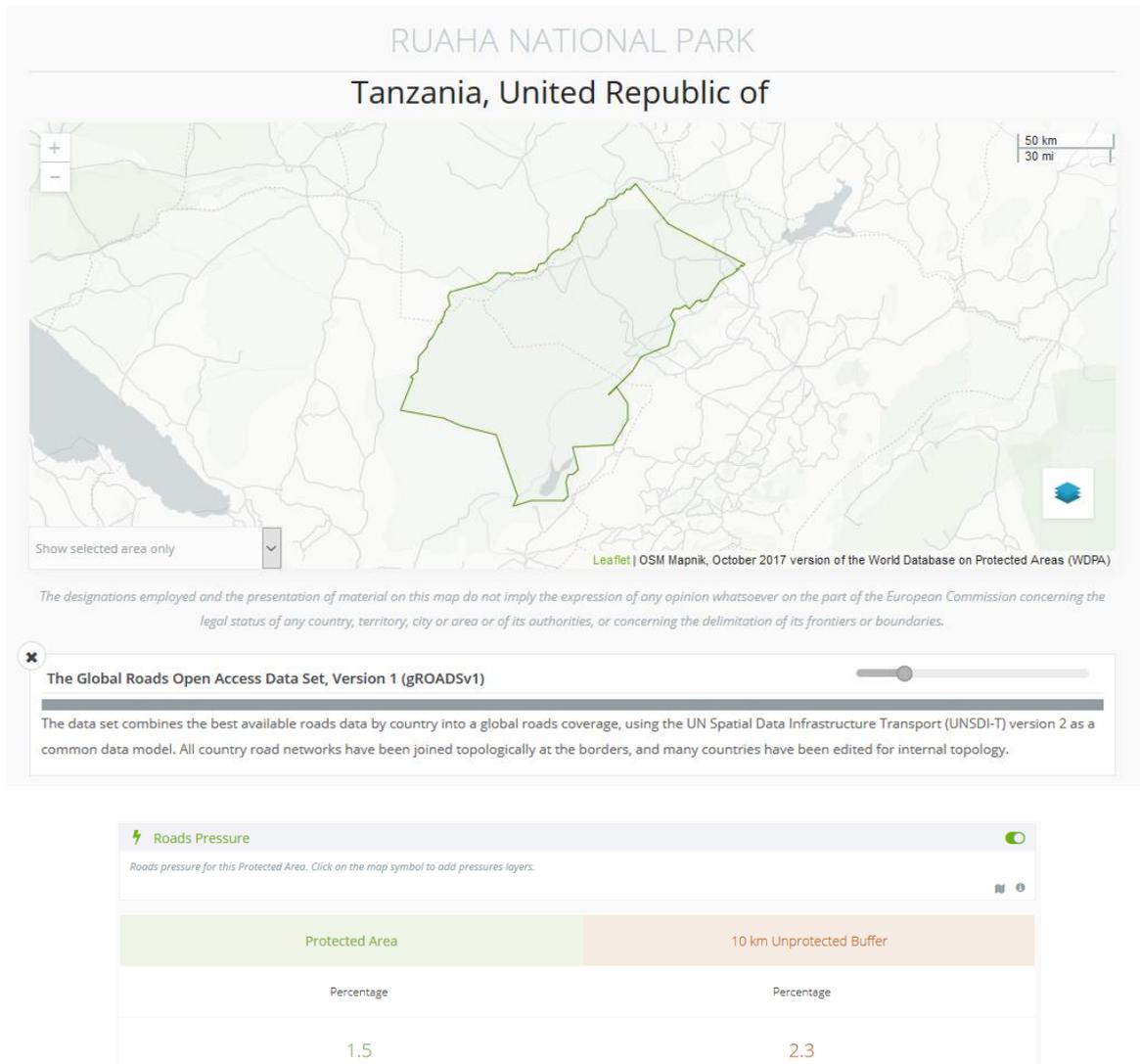

Figure 1. Road map and percentage of coverage by roads with a 250 m buffer inside and outside (10 km unprotected buffer zone) of a protected area as displayed in DOPA Explorer.

Key caveats	• RPI does not differentiate road types based on their traffic intensity, width, number of lanes, perimeter fences, availability of wildlife passages, or other characteristics. All considered roads are assumed to similarly impact on the protected areas.
	• There are differences between countries in the density, date and detail of the road data supplied in the global dataset used. Therefore, the RPI values can be compared only for protected areas falling within the same country and not at the ecoregion level.
	• RPI assesses the potential pressures of the road network on a protected area, but not the realized, actual impacts that transport infrastructure may have on the conservation targets, ecosystems or species therein. For instance, the magnitude, and even the direction, of the road effects is variable across species, although in general road effects tend to be larger and more detrimental for those species specialized in relatively pristine and undisturbed habitats, which are also usually those most endangered and in need of more conservation efforts.
Indicator status	Operational indicator based on standard GIS analysis. Published in peer reviewed papers (Dubois *et al.*, 2015) and technical reports (Dubois *et al.*, 2016).

Available data and resources

Data available	RPI values are available for each protected area of size ≥ 25 km^2 and its 10 km unprotected buffer zone. The values can also be compared at country level, on the DOPA Explorer website: http://dopa-explorer.jrc.ec.europa.eu/
Data updates	Planned with each update of DOPA.
Codes	The python codes used to generate the RPI can be found in the Documentation section of the DOPA web site, see http://dopa.jrc.ec.europa.eu/

Methodology

Methodology	A 250 m buffer was applied to the global road vector dataset, meaning that roads where enlarged to a size of 2 x 250 = 500 m, before being rasterized into a grid of 250 m resolution. RPI was calculated as the percentage of cells with presence of roads inside protected areas, for each protected area of size ≥ 25 km^2. UNESCO Biosphere Reserves were discarded as well as protected areas with known areas but undefined boundaries.
Input datasets	The indicator uses the following two input datasets:
	Protected Areas
	• WDPA of July 2018 (UNEP-WCMC & IUCN, 2018)
	○ Latest version available from: www.protectedplanet.net

Road maps
- gROADS version 1. 1980-2010. (CIESIN-ITOS, 2013)
  - Latest version available from: http://sedac.ciesin.columbia.edu/data/set/groads-global-roads-open-access-v1

References

CIESIN-ITOS (2013). Center for International Earth Science Information Network - CIESIN - Columbia University, and Information Technology Outreach Services - ITOS - University of Georgia. 2013. Global Roads Open Access Data Set, Version 1 (gROADSv1). Palisades, NY: NASA Socioeconomic Data and Applications Center (SEDAC). http://dx.doi.org/10.7927/H4VD6WCT

Dubois, G., *et al.* (2015). *The Digital Observatory for Protected Areas (DOPA) Explorer 1.0.* EUR 27162 EN. Publications Office of the European Union, Luxembourg, 53 p. https://dx.doi.org/10.2788/436594

Dubois, G., *et al.* (2016). Integrating multiple spatial datasets to assess protected areas: Lessons learnt from the Digital Observatory for Protected Area (DOPA). *International Journal of Geo-Information*, 5(12): 242. http://dx.doi.org/10.3390/ijgi5120242

Haddad, N. M., *et al.* (2015). Habitat fragmentation and its lasting impact on Earth's ecosystems. *Science*, 1(2): e1500052. http://dx.doi.org/10.1126/sciadv.1500052

Laurance, W. F., *et al.* (2014). A global strategy for road building. *Nature*, 513: 229–232. https://dx.doi.org/10.1038/nature13717

Laurance, W. F., Goosem, M. & Laurance, S. W. G. (2009). Impacts of roads and linear clearings on tropical forests. *Trends in Ecology & Evolution,* 24(12): 659-669. https://doi.org/10.1016/j.tree.2009.06.009

UNEP-WCMC & IUCN (2018). Protected Planet: The World Database on Protected Areas (WDPA) [On-line], [July], Cambridge, UK: UNEP-WCMC and IUCN. www.protectedplanet.net

Contact

Please contact us at: JRC-DOPA@ec.europa.eu

Factsheet last updated

March 27, 2019

@EU_DOPA