Population pressure

Indicator name

Population Pressure Indicator (PPI) and Change in Population Pressure Indicator (CPPI).

Indicator unit

The PPI assesses human population density for a given area in year 2015, expressed as the average number of people per km^2. The CPPI assesses the percent change in human population density for the same area from 2000 to 2015.

Area of interest

PPI and CPPI have been calculated, in DOPA Explorer, for each terrestrial protected area of size ≥ 10 km^2 and for the terrestrial parts of each coastal protected areas of size ≥ 10 km^2. To assess pressures around protected areas, we further computed the indicators for the 10 km unprotected buffer zone around the protected area. We further show trends regarding the changes in rural and urban population at the country level.

Related targets

Sustainable Development Goal 14 on life below water

Sustainable Development Goal 15 on life on land

Aichi Biodiversity Target 11 on protected areas

Aichi Biodiversity Target 12 on species

Policy question

How much potential impact may humans living in a protected area have on that protected area and on the habitats, species and ecological processes therein? How much of this potential impact is due to recent (15-year) increases in human population density? By identifying protected areas with low population density, it is possible to highlight locations that are likely to better conserve the species and ecological processes that are associated to more pristine conditions and that are more sensitive to the direct and indirect impacts from human activities. On the other hand, by identifying protected areas with a relatively high or increasing population density, it is possible to suggest in which locations it is likely most necessary to ensure an effective management of the human-nature relationships and the sustainability of human activities. In these locations, a priority would be to orient human activities and livelihoods in ways that are compatible with the conservation targets, such as ecotourism and other regulated recreation activities, or supporting traditional modes of rural development that have been compatible with the persistence of the biodiversity values of the protected area.

Use and interpretation

PPI can be used to assess the relative potential impact that human population may have on the biodiversity and ecological integrity of a protected area, while

CPPI is useful as a proxy of the changes in the potential impacts of human population in a protected area over the last 15 years. Because about 40% of the world's population lives within 100 kilometers of the coast, a figure that is constantly increasing, this indicator is particularly useful to assess pressures on coastal protected areas. There are several reasons why a high or increasing human population density in a protected area may be of concern and lead to negative outcomes for the conservation of the habitats, species and ecological processes therein (see e.g. Mcdonald *et al.*, 2009; Güneralp & Seto, 2013). First, human activities may increase pollution, noise and light disturbance in marine and terrestrial protected areas. Second, human settlements and built-up areas may cause, by themselves, some habitat loss and degradation, as well as trigger additional unregulated land cover and land use changes or extractive activities within the protected area. Third, human presence in the protected area may in some cases, if not properly regulated, directly reduce wildlife populations through poaching and overfishing. Fourth, some species may avoid or be found at lower abundances near human settlements, as related to the impacts just mentioned. Fifth, a higher human population density may increase the number and the spread rates of invasive species, including new diseases to which native species may have no or may only have a weak immunity response, as well as of disturbances like forest fires. Even if no invasions of alien species occur, humans may also indirectly favor the abundance of more generalist, cosmopolitan species in detriment of the specialist species that are associated to largely undisturbed habitats, which are usually those species of higher conservation concern. Although the PPI and CPPI do not separately evaluate each of these pressures or potential effects, they provide a general assessment of the potential combined magnitude of all these impacts that may be associated to human populations living in a protected area. These impacts are exacerbated in protected areas with poor management, enforcement or institutional support, and are likely to be significantly lower in effectively managed protected areas in which the impacts of humans on biodiversity and ecosystems are minimized through appropriate regulation and support to the activities, such as traditional ones, that are compatible with the conservation objectives. Protected areas can in many cases, if they are well managed, supported and funded, provide opportunities for enhancing the livelihoods of local communities, promoting job creation and reducing poverty, as well as help to maintain the ecosystem services on which many communities depend, thereby contributing both to biodiversity conservation and to the long-term sustainability of human activities in and around protected areas (Scherl *et al.*, 2004; EU 2015). For further discussions on population growth near protected areas, we also refer to Wittemyer *et al.* (2008) and Joppa, Loarie & Pimm (2009) who obtain contradicting conclusions.

In DOPA Explorer, we provide the population map as well as the population and population change statistics for each terrestrial protected area of size ≥ 10 km^2 and its 10 km unprotected buffer statistics s (Figure 1). Trends on urban and rural population provided by the United Nations Population Division are also displayed (Figure 2) in the country section.

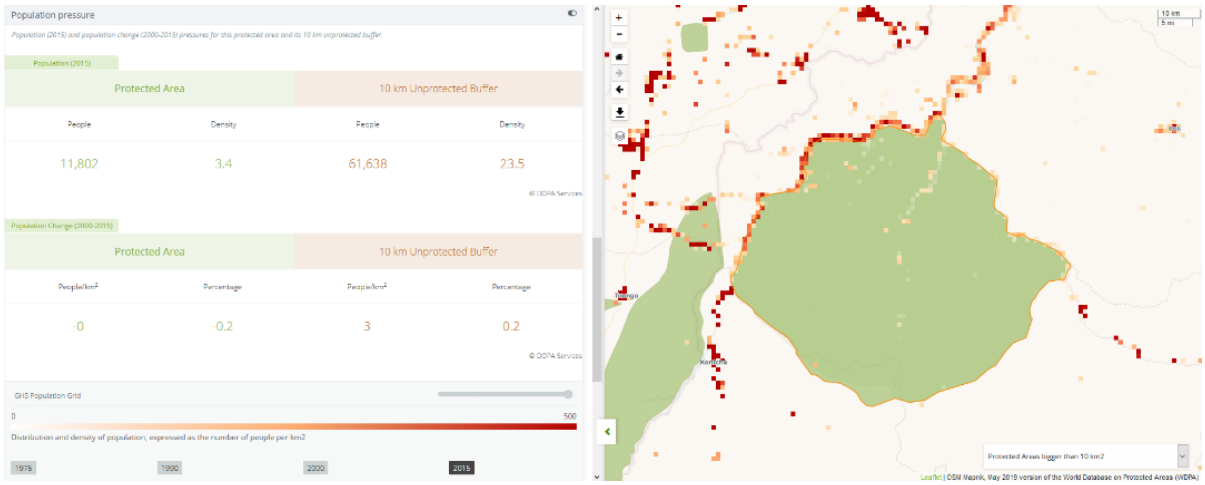

Figure 1. Population map for 2015 (right), population and population change statistics (left) inside and outside (10 km unprotected buffer zone) of a protected area in Cameroon (Faro) as displayed in DOPA Explorer.

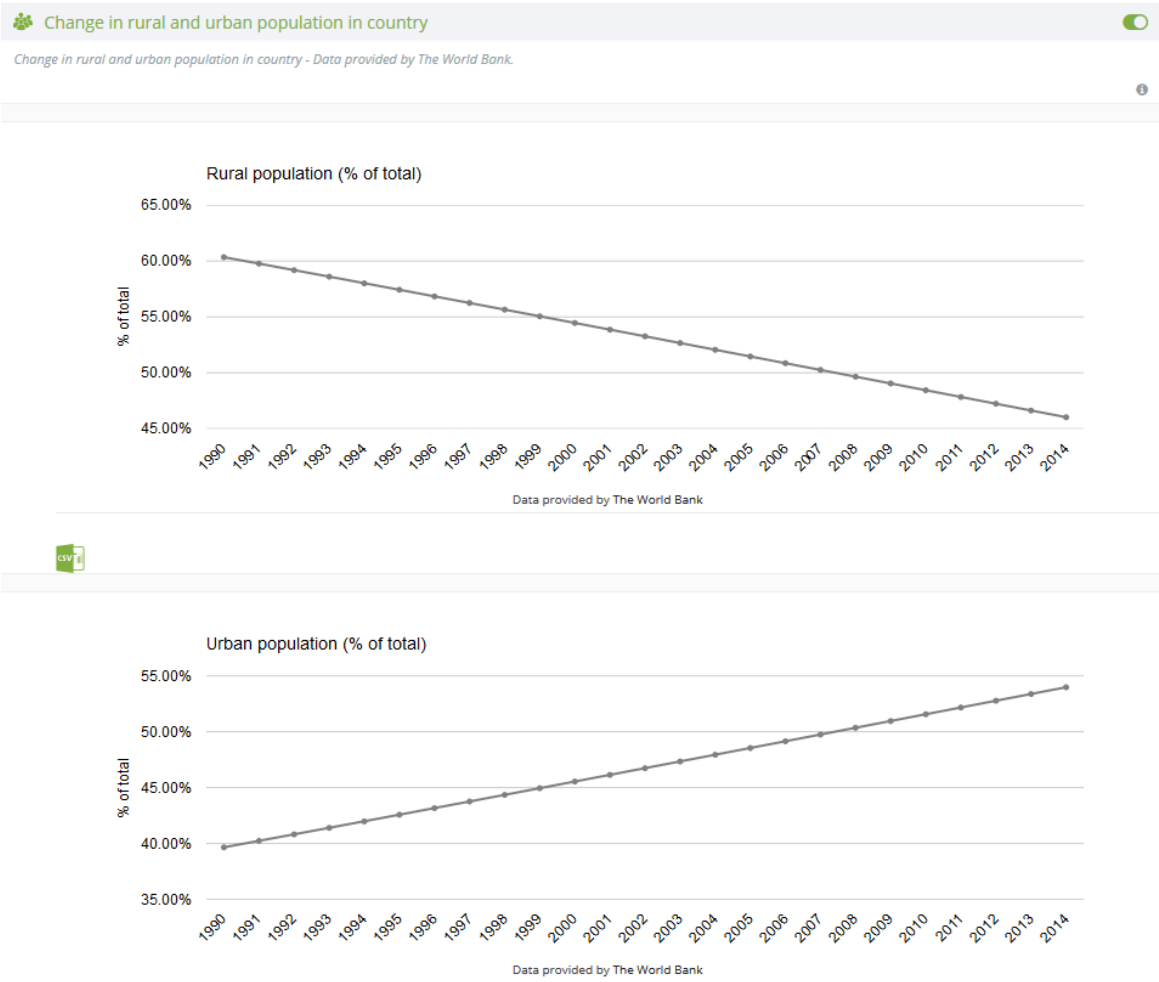

Figure 2. Temporal changes in urban and rural population in the Cameroon as displayed in DOPA Explorer.

Key caveats

- Not all human activities are detrimental, or not all are equally detrimental, for biodiversity conservation. In particular, traditional use of the resources by local communities may be compatible in some cases with the conservation values for which protected areas are declared. In addition, some level of permanent human presence in the protected areas may be beneficial for conservation if, for instance, it allows detecting activities such as poaching or illegal timber extraction that might otherwise remained unnoticed. On the other hand, the magnitude of the effects of human presence is variable across species, although in general these effects will 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. The different types of human activity in the protected areas, and their different impacts for conservation in general or for certain species in particular, are not separately disclosed by the PPI and CPPI. There is however clear evidence that a high or increased human population density is correlated with significantly negative impacts on most of the habitats, species and ecosystem processes. The PPI and CPPI provide therefore a general assessment of the potential combined magnitude of these aggregated effects of human population in protected areas.
- A significant pressure on protected areas may be due to human population outside a protected area (even if near it), at a magnitude that may exceed in some cases the pressure from people living inside the protected area. The current PPI and CPPI only consider population density in the protected areas, although these indicators are planned to be assessed also in the surroundings of the protected areas as part of DOPA in the next updates.
- The PPI and CPPI only refer to the population density in protected areas, and not to other human-driven changes in protected areas that may happen independently of the number of people permanently living in or around a protected area, such as deforestation, which is assessed in a different indicator in DOPA.
- The population data used (see the section below on methodology) assumes that population density is distributed, within an administrative unit, proportionally to the area covered by built up areas in the unit. Although this is a reasonable and sufficiently accurate assumption, not all built up areas are used by the same number of persons, for the same periods or for the same activities. In addition, the population density for the administrative units is provided with 2015 as the reference year, but the year of the actual population data varies in the different countries and administrative units and is in general earlier than 2015, with the estimates for 2015 being obtained through population projections up to 2015.

Indicator status

Operational indicator based on standard GIS analysis. Published in Wittemyer *et al.* (2008), Joppa, Loarie & Pimm (2009), Dubois *et al.,* (2016) with different input data regarding the population density.

Available data and resources

Data available

PPI and CPPI values are available for each protected area of size ≥ 10 km^2 as well as for the unprotected 10 km buffer zone around the PA. The values computed

inside the protected areas can be further compared at country and ecoregion levels, on the DOPA Explorer website: http://dopa-explorer.jrc.ec.europa.eu/

Data updates Planned with each update of DOPA.

Codes Standard GIS operations applied to vector and raster data.

Methodology

Methodology The PPI and CPPI are based on population data at the administrative unit level from the 2010 global round of censuses, as given by the Gridded Population of the World (GPW4). Population projections based on the raw census counts were used in GPW4 to provide estimates for years 2000 and 2015. These population data were disaggregated from the administrative units to 1 km^2 grid cells using the distribution and density of built-up as mapped in the Global Human Settlement Layer (GHSL) global layer (Freire *et al.*, 2016). The 1-km^2 population grid was overlaid with the boundaries of each protected area of size ≥ 10 km^2 and a 10 km unprotected buffer to produce the PPI and CPPI values for the DOPA. UNESCO Biosphere Reserves were discarded as well as protected areas with known areas but undefined boundaries. Trends regarding urban and rural population are provided directly by a web service from the World Bank.

Input datasets The indicator uses the following input datasets:

Protected Areas

- WDPA of May 2019 (UNEP-WCMC & IUCN, 2019).
    - Latest version available from: www.protectedplanet.net

Global Human Settlements

- GHS population grid for the years 1975, 1990, 2000, 2015.
    - Available from : http://ghsl.jrc.ec.europa.eu/datasets.php

Urban and rural population trends

- Country urban population trends by the United Nations Population Division are provided by the World Bank
    - Available from : http://databank.worldbank.org/data/reports.aspx?source=2&type=metadata&series=SP.URB.TOTL.IN.ZS
- Country rural population trends by the United Nations Population Division are provided by the World Bank
    - Available from : http://databank.worldbank.org/data/reports.aspx?source=2&type=metadata&series=SP.RUR.TOTL

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