Livestock pressures

Indicator name **Livestock density (LD)**

Indicator unit Average livestock density (n/km2) for three different livestock species: cattle, sheep and goats.

Area of interest The LD has been calculated in DOPA for each terrestrial and coastal protected area of size ≥ 10 km^2 and its 10-km unprotected buffer, as well as for terrestrial ecoregions.

Related targets

Sustainable Development Goal 13 on climate action

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 livestock have on a protected area and what are the associated environmental and health issues?

Habitat degradation and land use change are among the major factors causing biodiversity loss. Livestock play a key role not only in global food systems as the main source of animal protein, but also in global environment, as a major source of greenhouse gas (GHG) emissions from enteric fermentation and manure, disruption of nitrogen and phosphorous cycles. Overgrazing and land use change (in particular, deforestation) have also a great impact on biodiversity and other ecosystem services. In addition, livestock creates competition with wild animals for food and water (Gilbert, M *et al.*, 2018).

Furthermore, together with population pressure, livestock density represents an important indicator of the human impact on protected areas, not only for assessing competition for natural resources and the risks of conflicts with wildlife but also for the assessing potential health risks (contagion between wildlife and livestock and potential emergence of human diseases). See e.g. Daszak, Cunningham and Hyatt (2000) for discussions.

On the other hand, livestock can also have beneficial effects on the environment, playing an active role in distributing seeds and improving vegetation cover (Ba Diao, 2006).

Hence, information on livestock pressure in the context of biodiversity conservation and protected area management is critical for decision-making.

Use and interpretation

Information on livestock pressure in the context of biodiversity conservation and protected area management is critical for decision-making. Hence, livestock density (LD) in and around protected areas can used to assess competition for resources and health risks.

DOPA Explorer provides maps of LD and summary statistics of the LD distribution for main ruminant species (cattle, sheep and goats) at ecoregion level and for all protected areas with size over 10 km^2, as illustrated in Figure 1.

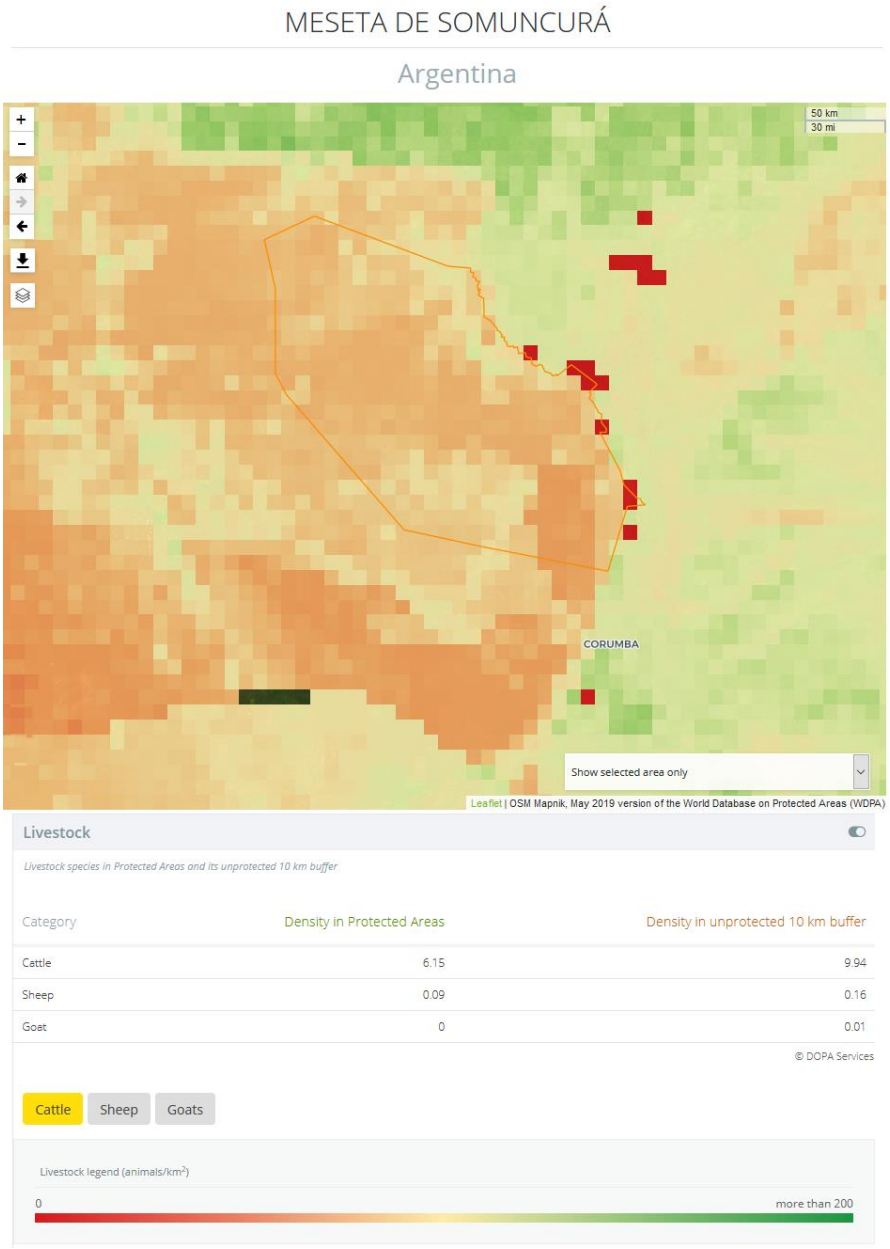

Figure 1: Example of Livestock data computed for a protected area in Argentina

Key caveats

GLW3 datasets provide the number of animals per each grid cell and has a spatial resolution of approximately 10 x 10 km at the equator. Therefore, computing values for protected areas much smaller than the GLW3 resolution would give unreliable figures or no results at all. For that reason, original GLW3 layers have been converted into animal density values. Assuming an even distribution of livestock within the considered area, we can get more realistic estimates.

A number of terrestrial and coastal protected areas could not be documented initially in terms of LD pressure, because of their size and/or shape which needs to be of at least half the area of one pixel. In such cases, no average animal density could be computed for the corresponding polygon. For those protected areas, the indicator was computed assigning to the centroid of the protected area the value of the overlaying pixel.

Indicator status

The Gridded Livestock of the World, developed by FAO, is publicly available for download at https://dataverse.harvard.edu/dataverse/glw, and is described in detail in https://www.nature.com/articles/sdata2018227

Available data and resources

Data available

LD values are available on the DOPA Explorer website for each terrestrial ecoregion and each protected area of size ≥ 10 km^2 and its 10-km unprotected buffer. See http://dopa-explorer.jrc.ec.europa.eu/dopa_explorer/.

Data updates

Planned with each update of DOPA.

Codes

Standard GIS operations applied to vector and raster data.

Methodology

Methodology

The Gridded Livestock of the World was generated starting from detailed livestock census statistics, mined from agricultural yearbooks or through direct contacts with ministries or statistical bureau. In compiling GIS data from subnational census counts priority is given to censuses that most closely match the reference year (2010 for GLW 3) and those with the highest level of spatial detail. This results in a global mosaic of data from different spatial resolutions and different years. From the global database, two versions of each species distribution are produced: 1) Dasymetric Weighting, where livestock numbers are disaggregated within census polygons according to weights established by statistical models using high-resolution spatial covariates. 2) Areal Weighting, where animal numbers are distributed homogeneously with equal densities within their census polygons (areal weighting) to provide spatial data layers free of any assumptions linking them to other spatial variables.

For both modelling algorithms, a global mask of protected areas belonging to IUCN categories Ia and Ib (generated from the May 2019 version of WDPA) was applied to mask such areas as unsuitable as these are characterised by stringent conservation measures and tight regulation of human activity.

The GLW3 map data generated with Dasymetric Weighting, with a spatial resolution of 0.083333 decimal degrees (approximately 10 km at the equator), were first converted into animal density values by dividing, for each species, the relevant raster layer for the Land and Water Area layer (surface area of land and water in square kilometres per pixel). Animal density layers were then overlaid with the boundaries of each terrestrial ecoregion, each terrestrial or coastal protected area of size ≥ 10 km^2 and its associated 10 km unprotected buffer zone to calculate, for each species, average animal density within the polygon. UNESCO Biosphere Reserves were discarded as well as protected areas with known areas but undefined boundaries. Only the part of the buffer around each protected area that does not overlap with other protected areas is considered; therefore, there might be cases of protected areas with no information in their buffer area, when such buffer area fully overlaps with other surrounding protected areas.

Average animal density for each species has been computed, with the same methodology, for each protected area and for each terrestrial ecoregion.

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

Terrestrial Ecoregions of the World

- TEOW (2001). Terrestrial ecoregions of the world (Olson *et al.*, 2001)
    - Latest version available from: https://www.worldwildlife.org/publications/terrestrial-ecoregions-of-the-world

Livestock

- Gridded Livestock of the World (GLW3) (FAO, 2019)
    - Latest version available from: https://dataverse.harvard.edu/dataverse/glw_3

References

Ba Diao, M. (2006). Livestock production and conservation in and around protected areas: the Project for Integrated Ecosystem Management in Senegal Unasylva, 223, vol.57. http://www.fao.org/3/A0532e/A0532e04.pdf

Daszak, P., Cunningham. A.A. and A.D. Hyatt (2000). Emerging infectious diseases of wildlife–threats to biodiversity and human health. *Science*. 2000; 287:443–449. https://doi.org/10.1126/science.287.5452.443

Gilbert, M., Nicolas, G., Cinardi, G., Van Boeckel, T., Vanwambeke, S., Wint, G. R. W., Robinson, T. P. (2018). Global distribution data for cattle, buffaloes, horses, sheep, goats, pigs, chickens and ducks in 2010. Scientific Data volume 5, Artide number: 180227 (2018). https://doi.org/10.1038/sdata.2018.227

Olson, D. M., *et al.* (2001). Terrestrial ecoregions of the world: A new map of life on Earth. *Bioscience*, 51: 933–938. https://doi.org/10.1641/0006-3568(2001)051[0933:TEOTWA]2.0.CO;2

Robinson TP, Wint GRW, Conchedda G, Van Boeckel TP, Ercoli V, Palamara E, et al. (2014) Mapping the global distribution of livestock. PLoS ONE 9(5): e96084. https://doi.org/10.1371/journal.pone.0096084

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