The Intact Forest Landscapes 2000/2013/2016

The IFL Mapping Team, May 2018

www.intactforests.org

Product description

An Intact Forest Landscape (IFL) is an unbroken expanse of natural ecosystems within the current forest extent, with no remotely detected signs of human activity, and large enough that all native biodiversity, including viable populations of wide-ranging species, could be maintained. For the purposes of our global assessment, an IFL is defined as a territory which contains forest and non-forest ecosystems minimally influenced by human activity, with (i) an area of at least 500 km^2 (50,000 ha), (ii) a minimum width of 10 km (measured as the diameter of a circle that could be entirely inscribed within the boundaries of the territory), and (iii) a minimum corridor/appendage width of 2 km. Areas with the evidence of certain types of human influence are considered disturbed or fragmented and consequently not eligible for inclusion in the IFL. Specifically, we excluded from the IFL areas which in the last 30-70 years were affected by industrial activities (e.g. logging, mining, oil and gas exploration and extraction) or by stand-replacement fires in the vicinity of transport infrastructure or resource extraction sites, or which were cleared for agriculture or transformed into tree plantations. Settlements and infrastructure (including roads, navigable rivers, power lines, and pipelines) are excluded with a buffer zone of 1 km. Low-intensity and old (> 70 years) disturbances are treated as a "background" influence, and don't lead to exclusion of the area from the IFL. Sources of background influence include historic (abandoned) shifting cultivation activities, diffuse grazing by domestic animals, low-intensity selective logging (without road infrastructure), and hunting. Although all IFLs are located within the forest zone (area with tree canopy over above 20%), some may contain extensive naturally tree-less areas, including grasslands, wetlands, lakes, alpine areas, and ice, if they are surrounded by forests.

IFL mapping and monitoring relies on freely available medium spatial resolution satellite imagery (primarily Landsat), high spatial resolution imagery available through Google Earth(TM) platform, and road and settlement data from open access sources. The IFL concept and mapping method were developed by a group of research and environmental organizations (Greenpeace, University of Maryland, World Resources Institute, and Transparent World) and have been used both in regional and global forest monitoring and research projects. For detailed methodology overview please refer to *Potapov et al., 2008*; *Potapov et al., 2017,* and the IFL project website www.intactforests.org

Product history

The first global IFL map (IFL 2000 v1.0) was prepared in 2005-2006 under the leadership of Greenpeace, with contributions from Biodiversity Conservation Center, International Socio-Ecological Union, and Transparent World (Russia), Luonto Liitto (Finnish Nature League), Forest Watch Indonesia, and Global Forest Watch, a network initiated by the World Resources Institute. The map (***ifl_ 2000.shp***) was updated to v.2.0 by Greenpeace Russia and the University of Maryland in 2012 using the year 2000 global cloud-free Landsat data composites that were produced following the methodology developed by *Hansen et al. (2013)*. The outdated v1.0 and v2.0 datasets are available on the project website www.intactforests.org

The global IFL map update was performed in 2014-2015 by Greenpeace, The University of Maryland and Transparent World, with support from the World Resources Institute and WWF Russia. The new analysis shows the extent of the IFL by the end of the year 2013 (***ifl_ 2013.shp***), and their degradation since the year 2000. The year 2000 dataset was corrected in a few instances if the available high-resolution satellite data from Google Earth (TM) revealed pre-2000 infrastructure or disturbances that were not clearly visible on the year 2000 Landsat data. The boundaries of the forest zone (area with 20% tree canopy density) were corrected using the year 2000 Landsat-based tree canopy cover dataset *(Hansen et al., 2013)*, and a few IFL areas were excluded as located outside of the forest zone. The IFL map update for the year 2013 was based on the same data sources and methodology as the year 2000 mapping to ensure consistency. In our work we leveraged annual cloud-free Landsat composites and the 2001-2013 gross tree cover loss map produced by the University of Maryland and available on-line (http://earthenginepartners.appspot.com/science-2013-global-forest). During the IFL update, all human-induced forest clearing, new infrastructure, and burned areas adjacent to actively used infrastructure (permanent roads, rivers, pipelines and power lines) were excluded from the year 2000 IFL, and the remaining areas were attributed as the year 2013 IFL if they passed our size and shape criteria.

In the end of 2017 – early 2018, the University of Maryland, Wildlife Conservation Society, Greenpeace, and Transparent World completed the update of the global IFL map for the year 2016 (***ifl_ 2016.shp***). The project was funded by Wildlife Conservation Society and Greenpeace. The update employed Landsat data and annual forest cover change products produced by the Global Land Analysis and Discover lab (https://glad.umd.edu/). We used the latest available cloud-free Landsat observation composites for visual IFL change assessment using the same methodology as was used for the year 2013 update. The update IFL layer represent situation as close as possible to the end for the year 2016 and beginning of the year 2017. The map can be used in the framework of Forest Stewardship Council responsible forest management certification that require the IFL extent for January 1, 2017. To simplify the analysis of global IFL change we provide the joined layer that shows IFL extent changes from the year 2000 to 2016 (***ifl_2000_2013_2016.shp***).

New data availability that includes cloud-free consistently processed Landsat time series, Sentinel-2 imagery and high resolution image time-series available from Google Earth (TM) allowed us to detect roads and other forms of anthropogenic fragmentation that were not evident during the early IFL mapping process. However, new information rarely allows us to date the fragmentation infrastructure in order to apply corrections for a specific historic IFL layer. We also considered that if historic layers are

periodically updated, this may complicate the data analysis. For the 2016 update all newly detected fragmentation infrastructure were mapped together and used for the IFL map update. However, the change of the IFL boundary from 2013 to 2016 does not always represent new degradation, and may correspond to pre-2013 disturbances. A separate layer that specify reasons for the IFL boundary update (pre-2013 or post-2013 disturbance) will be released later.

In our global IFL assessment, burned areas in the vicinity of transportation infrastructure, agricultural areas, and logging sites were assumed to be caused by humans and thus treated as an IFL reduction factor. Regional conservation specialists have challenged the utility of applying globally consistent criteria at regional scales, specifically in interpreting the causes of fires in boreal Canada. In response to these concerns, our global analysis differentiates IFL reduction due to fire from other causes. A separate layer for the 2000-2013 interval (***ifl_change_2000-2013.shp***) specifies the proximate cause of IFL area loss: fire-related and non-fire-related alteration and fragmentation. A similar layer for the 2013-2016 interval will be released later.

References

P. Potapov, A. Yaroshenko, S. Turubanova, M. Dubinin, L. Laestadius, C. Thies, D. Aksenov, A. Egorov, Y. Yesipova, I. Glushkov, M. Karpachevskiy, A. Kostikova, A. Manisha, E. Tsybikova, I. Zhuravleva. Mapping the world's intact forest landscapes by remote sensing, *Ecology and Society, 2008*; 13

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Product availability and licensing

All up-to-date IFL maps and IFL monitoring results are available from the project website **www.intactforests.org** in formats suitable for use in professional GIS and freeware GIS browsers. The IFL Mapping Team is continuing to improve the IFL base map and to provide periodical updates as new data, technologies, and more sophisticated sources of information become available. Please check News & Updates for the information about the latest map releases.

We suggest referencing the IFL maps as:

Potapov, P., Hansen, M. C., Laestadius L., Turubanova S., Yaroshenko A., Thies C., Smith W., Zhuravleva I., Komarova A., Minnemeyer S., Esipova E. 2016. "The last frontiers of wilderness: Tracking loss of intact forest landscapes from 2000 to 2013" *Science Advances, 2017*; 3:e1600821

For the web-based applications the suggested reference is:

Greenpeace, University of Maryland, World Resources Institute and Transparent World. "Intact Forest Landscapes 2000/2013/2016" Available at www.intactforests.org

Technical description

The global IFL data provided in the ArcGIS shapefile format in geographic coordinates using the WGS84 coordinate system. The recommended scale for data visualization is 1:1,000,000. The dataset includes four layers: the IFL extent for the years 2000, 2013, and 2016 (**ifl_2000.shp, ifl_2013.shp,** and **ifl_2016.shp**) and the aggregate IFL change layer (**ifl_2000_2013_2016.shp**). The year 2000 dataset contains the unique IFL patch ID combined from the IFL region code (see table below) and unique ID within the region, e.g. "AFR_25". The same ID was retained for the year 2013 and 2016 datasets; however, in case IFL patch was fragmented into separate patches, an additional unique index was added to the IFL ID, e.g. "AFR_25_1", "AFR_25_2", etc. The area of IFL patches estimated in the equal-area Hammer-Aitoff projection and provided in thousands of hectares. Due to the limitations and possible uncertainties in exact area estimation, the actual area threshold for the IFL patch inclusion was 49,000 (instead of 50,000) hectares.

Regional abbreviations

Africa	*AFR*
Australia and New Zealand	*AUS*
North and Central America	*NAM*
Northern Eurasia	*NEA*
South America	*SAM*
South-East Asia	*SEA*

The **ifl_2000_2013_2016.shp** layer has [CLASS] database filed used as the IFL date identifier:
IFL2000 – IFL areas that were fragmented or degraded by the year 2013
IFL2013 – IFL areas that were fragmented or degraded by the year 2016
IFL2016 – IFL areas for the year 2016

The **ifl_change_2000-2013.shp** layer provides information on the proximate cause of IFL area loss for the 2000-2013 interval. A similar dataset for the 2013-2016 interval will be released later. Each polygon in this layer has the following information (DB fields):

[CLASS_NAME] A proximate cause of IFL area loss, with the following values:

IFL loss 2000-2013	- non-fire related fragmentation/alteration.
IFL fire-related loss 2000-2013	- fire related fragmentation/alteration.
IFL2013	- polygon remains as IFL.

[IFL13_ID] An IFL ID in the year 2013 (if the area considered as remaining IFL).
[IFL00_ID] An IFL ID in the year 2000.

The **forest_zone.shp** layer delineates the forest zone boundary. The extent of the forest zone was mapped using the global year 2000 tree canopy cover dataset with a 20% tree canopy cover threshold. Inland water bodies and naturally treeless ecosystems were included in the forest zone. Fragments of land in the forest zone with a contiguous area smaller than 500 km^2 were excluded from consideration. The database (DB field [Region]) specifies geographic regions used for the IFL analysis. Geographic regions within the forest zone were delineated using natural boundaries between forested areas. The boundary between northern boreal and southern boreal/temperate regions in North America and Northern Eurasia was based on Landsat data analysis and represents the de-facto dividing line between lands that have, and have not, been subject to industrial logging as of the year 2013. To delineate this boundary, we used Landsat images for year 2013 to map the northernmost extent of industrial logging, applied 5-km buffer around detected logging, and connected resulting polygons.

List of geographic regions and corresponding DB codes

Code	Region
1	Africa
2	Australia and New Zealand
3	Temperate South America
4	Tropical and subtropical South America and Mesoamerica
5	Temperate and southern boreal North America
6	Northern boreal North America
7	Temperate and southern boreal Eurasia
8	Northern boreal Eurasia
9	West Hemisphere Pacific Islands
10	Southeast Asia and Oceania