Chapter 1

OVERARCHING FOREST GOALS

Theme 1 Assessment

ANNEX A: KEY TERMS

TREE COVER LOSS: stand replacement disturbance which is considered to be clearing of at least half of tree cover within a 30-meter pixel. The exact threshold is variable both through space and time, and is biome-dependent (updated from Hansen et al., 2013). Such a change that may or may not be permanent. Non-permanent tree cover loss routinely occurs in the context of logging, fire, or shifting agriculture. Tree cover loss data is often analyzed as a first step to measure deforestation.

DEFORESTATION: a tree cover loss event that is permanent in nature, e.g., when forest is converted to cropland or cleared for development; or when it occurs within humid tropical primary forest boundaries (Forest Declaration Assessment, 2022).

FOREST LANDSCAPE INTEGRITY INDEX (FLII): tracks the ecological integrity of forests through a combined use of data on the intensity and distribution of human pressures known to cause forest degradation, combined with observed losses in forest connectivity. The FLII ranges from 0 to 10 corresponding to the lowest and the highest level of forest integrity, respectively (Grantham *et al.*, 2020).

FOREST LANDSCAPE RESTORATION (FLR): The long-term process of regaining ecological functionality and enhancing human well-being across deforested or degraded forest landscapes.

FOREST PROTECTION: A suite of interventions aimed at halting and reversing deforestation by 2030, in line with the Paris Agreement and Glasgow Leaders' Declaration. Forest protection includes reducing deforestation and forest degradation, restoring degraded forestlands, and sustainable management of production forests, with involvement of governments, the private sector, IPs and LCs, and other actors.

AREA UNDER RESTORATION: Area shifting from a non-forest cover state to a forest cover one through afforestation, reforestation activities or assisted natural regeneration.

TROPICAL MOIST FOREST REGROWTH: Two-phase transition from moist forest to (i) deforested land and then (ii) vegetative regrowth. A minimum of 3-year duration of permanent moist forest cover presence is needed to classify a pixel as forest regrowth to avoid confusion with agriculture (Vancutsem *et al.*, 2021).

GROSS ZERO DEFORESTATION: The Glasgow Leaders' Declaration on Forests and Land Use calls to "... halt and reverse forest loss and land degradation by 2030" but does not specify whether the goal should be to reach gross or net zero by the end of the decade. The 2021-2030 benchmark presented in this year's report for the different indicators uses the "gross zero" interpretation. Indicators tracking a less ambitious "net zero" pathway will be developed in future assessments as data becomes available (e.g., by using the gross forest loss and gain of the upcoming 2025 FAO Forest Resource Assessment).

KEY BIODIVERSITY AREAS (KBAs): Sites of global significance for the conservation of biodiversity identified through globally standardized criteria and thresholds (IUCN, 2022a). There are 11 criteria organized into five categories: threatened biodiversity, geographically restricted biodiversity, ecological integrity, biological processes, and irreplaceability.

FORESTED KBAs: Key Biodiversity Areas contained in the tree cover layer for the year 2000 (Hansen *et al.*, 2013), for which the Forest Landscape Integrity Index (Grantham *et al.*, 2020) was available, and that supported at least one forest-dependent species that triggered KBA criteria at the site. Season was taken into account for migratory species that are not forest-dependent throughout their annual life cycle (Crowe *et al.*, In Review).

FOREST-DEPENDENT SPECIES: Refers to any species for which 'Forest' is identified as a suitable habitat in the IUCN Red List (IUCN, 2023). This definition implies that these species depend on forest habitats during at least one stage of their life cycle (e.g., reproduction).

FOREST SPECIALISTS: Refers to any species with 'Forest' listed as its only suitable habitat in the IUCN Red List (IUCN, 2023). This definition of specialist is narrow as the 'Forest' category from the IUCN Red List refers to natural habitat and does not include artificial habitats such as plantations. However, as the category applies to the major habitats a species occurs in, it is still possible that all or part of a population may be located in or adjacent to a plantation (Green *et al.*, 2020).

FOREST SPECIALISTS INDEX: A tool developed to measure trends in the size of populations of threatened and non-threatened forest specialist vertebrate species (Green *et al.*, 2020). It was created by applying the Living Planet

Index (LPI) methodology specifically to forest specialists, which are species that live only in forest habitats. The FSI is used to monitor the impacts of drivers other than habitat degradation, such as wildlife harvesting and disease, on forest vertebrate populations. The index provides a direct measure of forest biodiversity and is recommended to fill the gap in monitoring forest biodiversity. The FSI was first published in 2019 and was updated in 2022 after concerted data collection from under-represented regions of the world.

ANNEX B: METHODOLOGY

Regional aggregation

The regional classification adopted in this Assessment is based on the United Nations geoscheme designations (also referred to as M49 Standard1). The geographic regions of the UN geoscheme have been disaggregated into “tropical” and “non-tropical” regions, where applicable. The regional aggregation used in this Assessment are detailed in Table 1. Country boundaries are based on the Database of Global Administrate Areas (GADM) version 3.6.

Table 1. Regional Aggregation

Tropical Latin America and the Caribbean (LAC)	Aruba; Anguilla; Antigua and Barbuda; Bonaire; Bahamas; Saint Barthélemy; Belize; Bermuda; Bolivia; Brazil; Barbados; Colombia; Costa Rica; Cuba; Curaçao; Cayman Islands; Dominica; Dominican Republic; Ecuador; Guadeloupe; Grenada; Guatemala; French Guiana; Guyana; Honduras; Haiti; Jamaica; Saint Kitts and Nevis; Saint Lucia; Saint Martin (French part); Mexico; Montserrat; Martinique; Nicaragua; Panama; Peru; Puerto Rico; Paraguay; El Salvador; Suriname; Sint Maarten; Turks and Caicos Islands; Trinidad and Tobago; Saint Vincent and the Grenadines; Venezuela; British Virgin Islands; Virgin Islands, U.S.
Tropical Asia	Bangladesh; Brunei; Bhutan; Fiji; Micronesia (Federated States of); Indonesia; India; Cambodia; Kiribati; Laos; Sri Lanka; Macao; Myanmar; Malaysia; New Caledonia; Nepal; Philippines; Palau; Papua New Guinea; Singapore; Solomon Islands; Thailand; East Timor; Tuvalu; United States Minor Outlying Islands; Vietnam; Vanuatu.
Tropical Africa	Angola; Burundi; Benin; Burkina Faso; Botswana; Central African Republic; Côte d'Ivoire; Cameroon; Democratic Republic of the Congo; Republic of Congo; Comoros; Cape Verde; Djibouti; Eritrea; Ethiopia; Gabon; Ghana; Guinea; Gambia; Guinea-Bissau; Equatorial Guinea; Kenya; Liberia; Madagascar; Maldives; Mali; Mozambique; Mauritania; Mauritius; Malawi; Mayotte; Namibia; Niger; Nigeria; Réunion; Rwanda; Sudan; Senegal; Sierra Leone; Somalia; South Sudan; Swaziland; Seychelles; Chad; Togo; Tanzania; Uganda; Zambia; Zimbabwe.
North America	Canada; Saint Pierre and Miquelon; United States of America (the).
Non-tropical LAC	Argentina; Chile; Falkland Islands; Uruguay.
Non-tropical Asia	Afghanistan; United Arab Emirates; Armenia; Australia; Azerbaijan; Bahrain; China; Georgia; Hong Kong; Iran; Iraq; Israel; Jordan; Japan; Kazakhstan; Kyrgyzstan; Korea; Kuwait; Lebanon; Mongolia; Norfolk Island; Nauru; New Zealand; Oman; Pakistan; Korea (the Democratic People's Republic of); Palestine; State of; Qatar; Russian Federation; Saudi Arabia; Syria; Tajikistan; Turkmenistan; Turkey; Taiwan; Uzbekistan; Yemen.
Non-tropical Africa	French Southern Territories; Algeria; Egypt; Western Sahara; Libya; Lesotho; Morocco; Sao Tome and Principe; Tunisia; South Africa.
Europe	Åland Islands; Albania; Andorra; Austria; Belgium; Bulgaria; Bosnia and Herzegovina; Belarus; Switzerland; Cyprus; Czechia; Germany; Denmark; Spain; Estonia; Finland; France; Faroe Islands; United Kingdom of Great Britain and Northern Ireland; Guernsey; Gibraltar; Greece; Greenland; Croatia; Hungary; Isle of Man; Ireland; Iceland; Italy; Jersey; Liechtenstein; Lithuania; Luxembourg; Latvia; Monaco; Moldova; North Macedonia; Malta; Montenegro; Netherlands; Norway; Poland; Portugal; Romania; Svalbard and Jan Mayen; San Marino; Serbia; Slovakia; Slovenia; Sweden; Ukraine; Holy See.

Forest loss indicators

The Assessment's reporting framework analyses forest loss and degradation indicators in two different ways. First, the 2022 data are compared to a 2018-20 baseline, in order to assess whether there has been a short-term improvement or worsening of any given indicator. A multi-year baseline was chosen to smooth out any single-year anomalies and 2018-2020 were selected as the baseline period to represent the years before the Glasgow Leaders' Declaration. Second, the latest available data for each indicator are benchmarked against a future pathway that delivers the 2030 objectives (e.g., reaching zero deforestation by 2030). While multiple reduction pathways are in principle possible, for all deforestation, tropical primary forest loss, and forest degradation indicators, a linear reduction pathway between the baseline value (i.e., the 2018-2020 average) and the 2030 target (i.e., no gross loss) is established. This is consistent with previous NYDF and Forest Declaration Assessments, which also tracked progress against a linear reduction pathway. Each year of the decade – going from 2021 to 2030 – requires a 10 percent reduction in loss relative to the baseline to reach no gross loss by 2030. When the 10 percent reduction is not achieved in 2021, a higher percent reduction is required in following years to meet the linear reduction pathway.

The tree cover loss underlying deforestation and tropical primary forest loss was calculated using a >30 percent tree cover density threshold (Hansen et al., 2013). Improvements in the detection of tree cover loss due to the incorporation of new satellite data and methodology changes between 2011 and 2015 may result in higher estimates of loss in recent years compared to earlier years (Weisse & Potapov, 2021) but does not affect the comparison of 2022 data to the 2018-20 baseline.

Deforestation

Deforestation (ha/yr) is estimated as the part of global tree cover loss (Hansen et al. 2013, updated throughout 2022) that leads to a permanent conversion of forest to a new land use according to a map of the drivers of tree cover loss (Curtis et al. 2018, updated throughout 2022). Deforestation includes all tree cover losses that are likely attributed to the production of agricultural commodities and urbanization Curtis et al., 2018) as well as tree cover loss due to shifting agriculture in humid tropical primary forests (Turubanova et al., 2018). Deforestation estimates are based on an annually updated model of the drivers of tree cover loss, which revises and improves all previous year's deforestation estimates. Thus, previous years' deforestation estimates change as new patterns of tree cover loss emerge with ongoing data collection.

Global spatial data on forest change (Hansen et al. 2013, updated through 2022) differs in its definitions and methods from official national forest statistics. Moreover, the deforestation statistics used in this Assessment are derived from a map of drivers of tree cover loss (Curtis et al., 2018, updated through 2022) that attributes all tree cover loss to the same driver over the entire assessment period, even if changes in drivers do occur over time in regions or countries. In places where commodity-driven deforestation has declined significantly in recent years, current deforestation rates may be overestimated due to the large amounts of commodity-driven deforestation earlier in the period.

Humid tropical primary forest loss

Humid tropical primary forest loss (ha/yr) measures the tree cover loss occurring as of 2001 within humid tropical primary forests, which are defined as mature natural humid tropical forest cover that has not been completely cleared and regrown in recent history (Turubanova et al., 2018). No corresponding map of primary forest is available globally; hence, this indicator is limited to the humid tropics.

Global maps of primary forest differ in their definitions from national primary forest maps. The statistics presented here are therefore different from official country statistics on loss of primary forests.

Gross GHG emissions from forest loss

GHG emissions from global deforestation (measured in metric tons of carbon dioxide equivalent per year) are estimated by combining data on carbon stocks, tree cover loss, and additional contextual geospatial data (Harris *et al.*, 2021, updated through 2022). Our estimates of gross GHG emissions include aboveground carbon, belowground carbon, deadwood and litter carbon, as well as soil organic carbon. CO_2, CH_4, and N_2O emissions from peat drainage and forest fires are also included. Emissions are attributed to deforestation using Curtis et al. (2018, updated through 2022) following the same categories used for the global deforestation indicator. Gross GHG emissions from humid tropical primary forest loss (tCO_2e/yr) are estimated by overlaying gross emissions from Harris *et al.* 2021 with humid tropical primary forest extent in 2001 (Turubanova *et al.*, 2018).

Degradation

The Forest Landscape Integrity Index (FLII) provides an index of the overall level of degradation (i.e., human modification) for all forests across a continuous scale from the lowest (FLII = 0) to the highest (FLII = 10) level of integrity (Grantham *et al.*, 2020). It has been updated annually from 2017 until 2021, and further updates (i.e., 2022 and 2023) are currently being produced. The Glasgow Leaders' Declaration calls for a halt to land degradation (including forest degradation) by 2030. Therefore, the 2030 target is set at zero further degradation (i.e., no further loss in FLII). Analogous to other indicators, the pathway to reach this 2030 target reflects a ten percent decline each year from the baseline rate, which is the average annual loss of FLII units across 2018-2020. The FLII uses proxies for degradation, combining observable pressures within pixels (agriculture, forest cover loss and infrastructure), inferred pressures (e.g., edge effects, overharvest), and losses in forest connectivity in the surrounding landscape to give an aggregate score. However, the FLII is not designed to detect certain categories of human impact such as those related to climate change or distortion of natural fire regimes.

Carbon stocks

Average density of carbon stocks at the national level are calculated from the Global Forest Aboveground Carbon Stocks and Fluxes from GEDI and ICESat-2, 2018-2021 (Ma *et al.*, 2023). The dataset provides global gridded estimates of forest aboveground carbon stocks and potential fluxes at a 0.01-degree resolution (approximately 1.11 kilometers at the equator).

The density of above ground biomass is averaged at country level, as displayed in Figure 1.11.

For further details on the dataset and for download, please visit the data portal of the Oak Ridge National Laboratory.

Restoration indicators

In absence of up-to-date data (i.e., as of 2022) on forest cover gain at global scale and a global dataset of the area under restoration, this Assessment assesses forest landscape restoration through two separate parameters: tropical moist forest regrowth (Vancutsem *et al.*, 2021), and area under restoration.

Tropical moist forest regrowth

Country data on tropical moist forest (TMF) regrowth is retrieved by the TMF Data Portal to calculate regional aggregates.

Area under restoration

The area under restoration is estimated from two separate sources: country-level data and project-level data stored.

Country data are sourced from the Restoration Barometer Report (IUCN, 2022b) and reported as is, without conducting any further analysis.

Project-level data are retrieved from the Restor database (Crowther *et al.*, 2022). The data supplied by Restor have not been validated – either directly by Restor or otherwise. The sites included in this analysis are those which have been made publicly viewable on the Restor platform – and this subset of sites is generally of higher quality than the full suite of locations in the full database (which includes sites uploaded for private use). However, Restor makes no guarantee that the summaries provided are accurate or complete.

Restor uses the RESOLVE biome classification, and each site is only assigned to a single biome type. Large sites and those at biome boundaries have been assigned to the biome which occupies the largest percentage of their total area.

The query used to retrieve estimates of area under forest restoration is outlined below.

Field	Selected Values
Type of site	'Restoration'
Project stage	'Ongoing' or 'Complete'
Intervention type	'Active restoration' or 'Assisted natural regeneration'
Target land cover following restoration	'Natural forests'
Biomes	'Tropical and subtropical moist broadleaf forests' or 'Tropical and subtropical dry broadleaf forests' or 'Tropical and subtropical coniferous forests' or 'Temperate broadleaf and mixed forests' or 'Temperate conifer forests' or 'Boreal forests or taiga' or 'Mediterranean forests, woodlands, and scrub'

Biodiversity indicators

Forested Key Biodiversity Areas (fKBAs)

Based on the Key Biodiversity Areas database, we retrieve a subset of 6,822 sites identified as forested KBAs (Crowe *et al.*, In Review) to evaluate the impact of tree cover loss on forest-dependent species.

Two indicators are calculated:

- Tree cover loss (Hansen *et al.*, 2013) in fKBA is calculated by summing the area of tree cover loss occurring within fKBAs in a given year. The resulting values are aggregated to obtain regional estimates.
- Degradation in fKBAs is calculated as the mean annual variation in FLII score (Grantham *et al.*, 2020) within fKBAs.

Forest Specialists Index (FSI)

Data for the FSI and on the threats to forest specialists are provided by the Zoological Society of London and presented as is, without conducting any further analysis.

For details on data and methods, please visit the Living Planet Index portal.

ANNEX C: SUPPLEMENTARY MATERIAL

Figure 1. Area under restoration by region, disaggregated by restoration type.

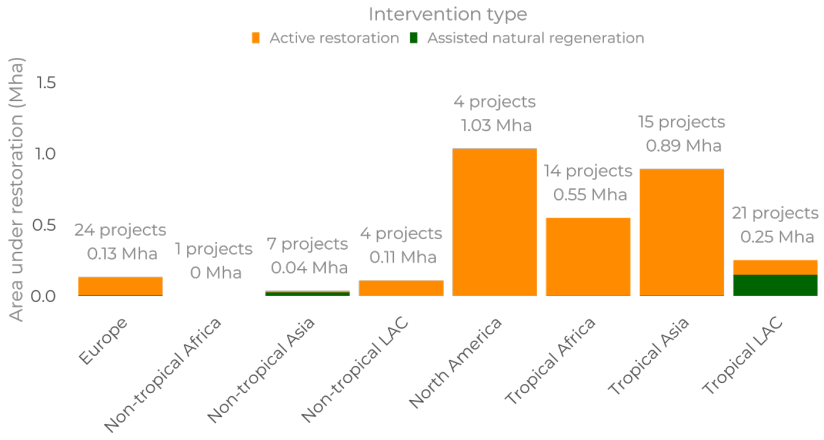

Table 2. The 30 countries with the highest absolute levels of deforestation (in million hectares, Mha) and the relative change from 2018-2020 baseline to 2022 level.

	Deforestation baseline 2018-2020 (Mha)	Interim target for 2022 (Mha)	Deforestation in 2022 (Mha)	Percent change from baseline	Percent deviation from interim target
Brazil	1.93	1.55	2.34	21%	51%
Indonesia	1.05	0.84	0.83	-21%	-2%
Bolivia	0.47	0.38	0.53	12%	40%
Democratic Republic of the Congo	0.48	0.39	0.51	6%	32%
Laos	0.28	0.22	0.26	-6%	18%
Malaysia	0.35	0.28	0.24	-32%	-15%
Myanmar	0.22	0.18	0.19	-15%	7%
Peru	0.17	0.14	0.17	-2%	23%
Paraguay	0.23	0.19	0.16	-29%	-12%
Colombia	0.17	0.13	0.14	-17%	4%
Argentina	0.09	0.07	0.12	33%	66%
United States of America (the)	0.16	0.13	0.12	-26%	-8%
Vietnam	0.16	0.13	0.10	-35%	-19%
Cambodia	0.12	0.10	0.09	-24%	-5%
Cameroon	0.07	0.06	0.08	7%	33%
Papua New Guinea	0.06	0.05	0.07	31%	63%
Philippines	0.06	0.05	0.07	24%	55%
Thailand	0.06	0.05	0.05	-13%	8%
Mexico	0.07	0.06	0.05	-28%	-9%
Madagascar	0.08	0.06	0.05	-31%	-14%
Honduras	0.04	0.03	0.03	-17%	4%
Liberia	0.03	0.02	0.03	6%	33%
Republic of Congo	0.03	0.02	0.03	-8%	15%
Nigeria	0.02	0.02	0.02	-1%	24%
Nicaragua	0.04	0.03	0.02	-43%	-29%
Venezuela	0.06	0.04	0.02	-61%	-52%
Ghana	0.01	0.01	0.02	42%	77%
Ecuador	0.01	0.01	0.02	39%	73%
Angola	0.01	0.01	0.02	47%	84%
Gabon	0.01	0.01	0.01	18%	47%

ENDNOTES

Crowther, T. W., Thomas, S. M., van den Hoogen, J., Robmann, N., Chavarría, A., Cottam, A., et al. (2022). Restor: Transparency and connectivity for the global environmental movement. One Earth, 5(5), 476–481.

Curtis, P. G., Slay, C. M., Harris, N. L., Tyukavina, A., & Hansen, M. C. (2018). Classifying drivers of global forest loss. Science, 361(6407), 1108–1111.

Forest Declaration Assessment. (2022). Overarching forest goals: Theme 1 assessment. Retrieved from https://forestdeclaration.org/

Grantham, H. S., Duncan, A., Evans, T. D., Jones, K. R., Beyer, H. L., Schuster, R., et al. (2020). Anthropogenic modification of forests means only 40% of remaining forests have high ecosystem integrity. Nature Communications, 11(1), 5978.

Green, E. J., McRae, L., Freeman, R., Harfoot, M. B. J., Hill, S. L. L., Baldwin-Cantello, W., & Simonson, W. D. (2020). Below the canopy: global trends in forest vertebrate populations and their drivers. Proceedings of the Royal Society B: Biological Sciences, 287(1928), 20200533.

Hansen, M. C., Potapov, P. V., Moore, R., Hancher, M., Turubanova, S. A., Tyukavina, A., et al. (2013). High-Resolution Global Maps of 21st-Century Forest Cover Change. Science, 342(6160), 850–853.

Harris, N. L., Gibbs, D. A., Baccini, A., Birdsey, R. A., de Bruin, S., Farina, M., et al. (2021). Global maps of twenty-first century forest carbon fluxes. Nature Climate Change, 11(3), 234–240.

IUCN. (2022a). Guidelines for using A global standard for the identification of Key Biodiversity Areas : version 1.2. Retrieved April 25, 2023, from https://portals.iucn.org/library/node/49979

IUCN. (2022b). Restoration Barometer 2022 Report [Resource]. Retrieved August 15, 2023, from https://www.iucn.org/resources/annual-reports/restoration-barometer-2022-report

Ma, L., Hurtt, G., Tang, H., Lamb, R., Lister, A., Chini, L., et al. (2023). Spatial heterogeneity of global forest aboveground carbon stocks and fluxes constrained by spaceborne lidar data and mechanistic modeling. Global Change Biology, 29(12), 3378–3394.

Turubanova, S., Potapov, P. V., Tyukavina, A., & Hansen, M. C. (2018). Ongoing primary forest loss in Brazil, Democratic Republic of the Congo, and Indonesia. Environmental Research Letters, 13(7), 074028.

Vancutsem, C., Achard, F., Pekel, J.-F., Vieilledent, G., Carboni, S., Simonetti, D., et al. (2021). Long-term (1990–2019) monitoring of forest cover changes in the humid tropics. Science Advances, 7(10), eabe1603.

Weisse, M. J., & Potapov, P. V. (2021, April 28). How Tree Cover Loss Data Has Changed Over Time | GFW Blog. Global Forest Watch Content. Retrieved November 10, 2023, from https://www.globalforestwatch.org/blog/data-and-research/tree-cover-loss-satellite-data-trend-analysis