Natural capital, ecosystem services, and conservation: Maps to sustain both nature and humanity

Contribution to Session: Multi-scale water-energy-land nexus planning to manage socio-economic, climatic, and technological change

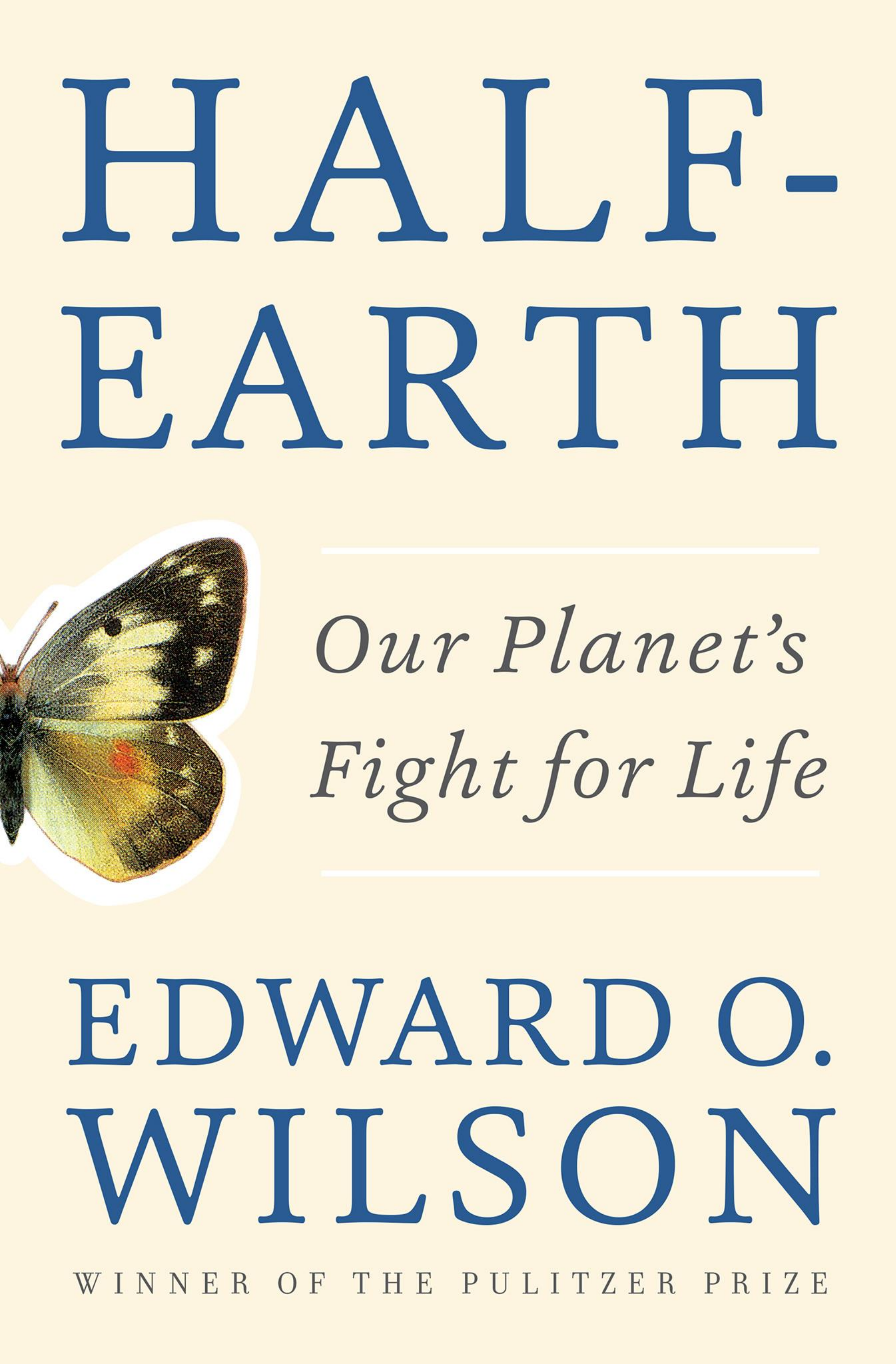
Display D2308 | EGU2020-20646, Session ITS1.1/ERE7.1
European Geophysical Union annual meeting 2020

Becky Chaplin Kramer, Rachel Neugarten, Pamela Collins, Dave Hole, Steve Polasky, Rich Sharp, Monica Noon, Mark Mulligan (and many others)

2020.05.07, 08:30-10:15 CEST

KEITH LAWRENCE


UN BIODIVERSITY
CONFERENCE
Investing in biodiversity for people and planet
COP 14 - CP/MOP9-NP/MOP3
Sharm El Sheikh, Egypt, 2018
H.E. Yasmine Fouad
Minister of Environment of Egypt
jolie ville



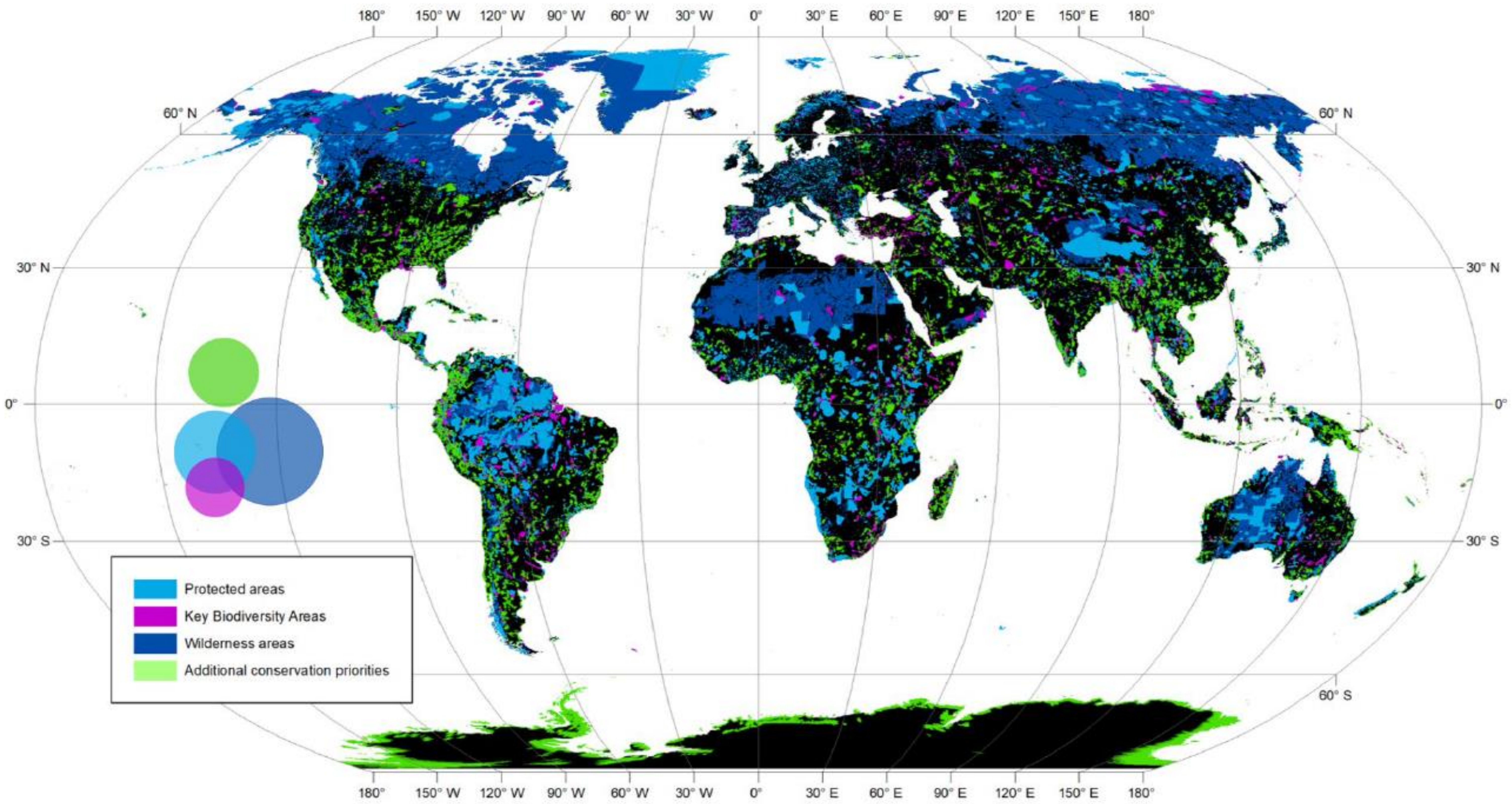
BIODIVERSITY TARGETS: 30-50%

New Results

Comment on this paper

Conservation attention necessary across at least 44% of Earth's terrestrial area to safeguard biodiversity

James R. Allan, Hugh P. Possingham, Scott C. Atkinson, Anthony Waldron, Moreno Di Marco, Vanessa M. Adams, Stuart H. M. Butchart, Oscar Venter, Martine Maron, Brooke A. Williams, Kendall R. Jones, Piero Visconti, Brendan A. Wintle, April E. Reside, James E.M. Watson



Allan JR et al. 2019. Conservation attention necessary across at least 44% of Earth's terrestrial area to safeguard biodiversity. bioRxiv:839977.

WHERE IS THE NATURE WE NEED TO SUSTAIN HUMANITY?

CRITICAL NATURAL CAPITAL

Natural capital is the stock [of biodiversity and ecosystems] that yields a flow of valuable goods and services [*ecosystem services]* (Costanza and Daly 1992)

***Critical* natural capital** consists of those resources of nature essential for sustaining human welfare and for which substitution is difficult or impossible. (Farley 2008)

- Irreplaceable **biodiversity**
- Sources of **fresh water** that provide the sole supply in water-scarce regions
- Wild sources of **food** that provide a safety net in times of crisis
- Natural places that are part of a **culture**'s identity

Costanza R, Daly HE. 1992. Natural Capital and Sustainable Development. Conservation Biology 6:37–46.
Farley, J. (2008). The Role of Prices in Conserving Critical Natural Capital. Conservation Biology, 22(6), 1399–1408.

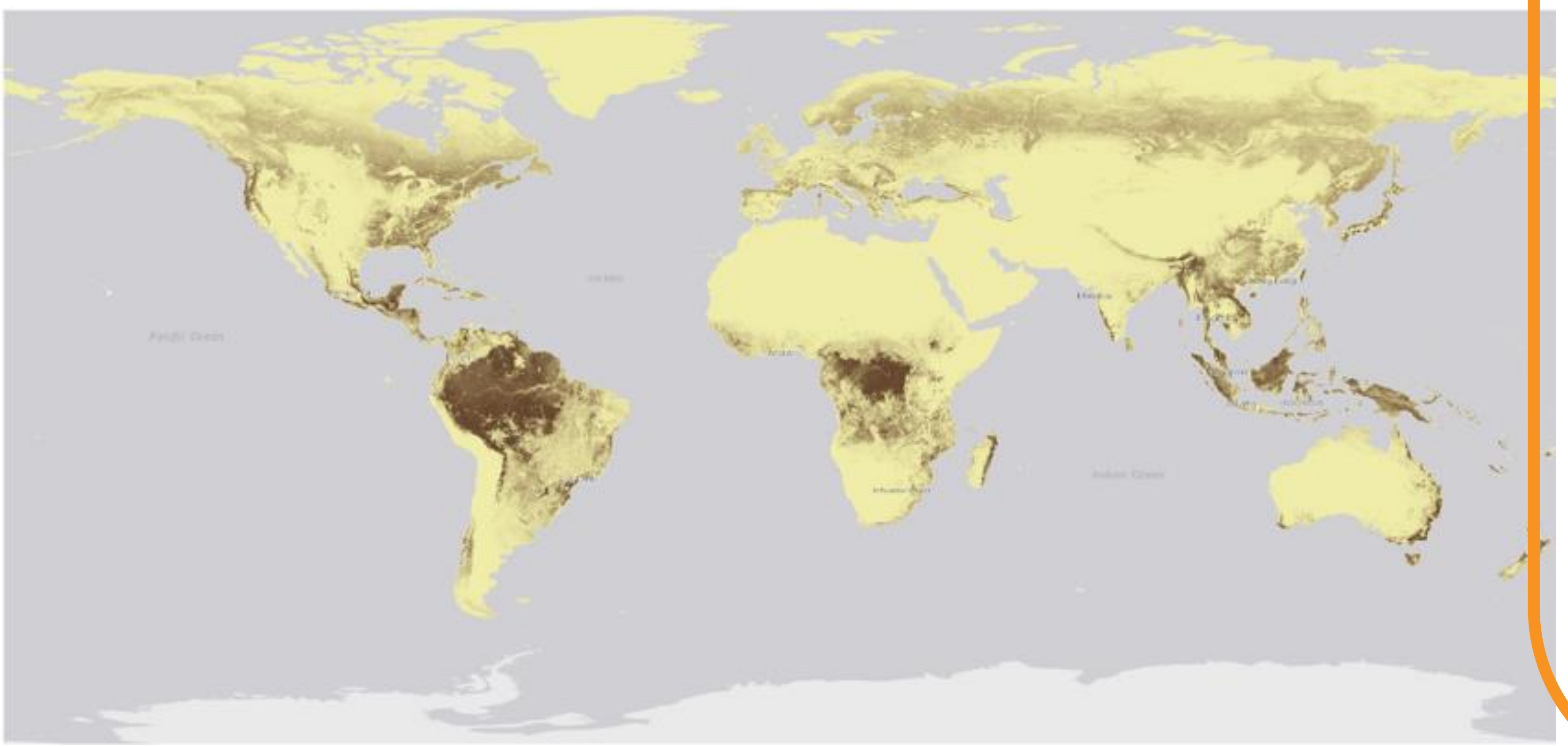
15 ECOSYSTEM SERVICES

	Ecosystem Service	Data source / provider(s)
1	Nitrogen retention (water quality)	Chaplin-Kramer et al. 2019 (InVEST)
2	Sediment retention (water quality)	Becky Chaplin-Kramer, Natural Capital Project (InVEST)
3	Atmospheric moisture recycling	Pat Keyes, Colorado State University
4	Pollination	Chaplin-Kramer et al. 2019 (InVEST)
5	Grazing	Mark Mulligan, King's College London (Co$ting Nature)
6	Timber	Mark Mulligan, King's College London (Co$ting Nature)
7	Fuelwood	Mark Mulligan, King's College London (Co$ting Nature)
8	Wild food and non-wood products	Natural Capital Project / Conservation International
9	Flood regulation	Mark Mulligan, King's College London (Co$ting Nature)
10	Access to nature (recreation)	Natural Capital Project / Conservation International
11	Linguistic diversity	Larry Gorenflo, Pennsylvania State University
12	Riverine fisheries	Pete McIntyre, Cornell University (et al.)
13	Marine fisheries	Watson and Tidd 2018
14	Coastal protection	Chaplin-Kramer et al. 2019 (InVEST)
15	Coral reef tourism	Spalding et al. 2017

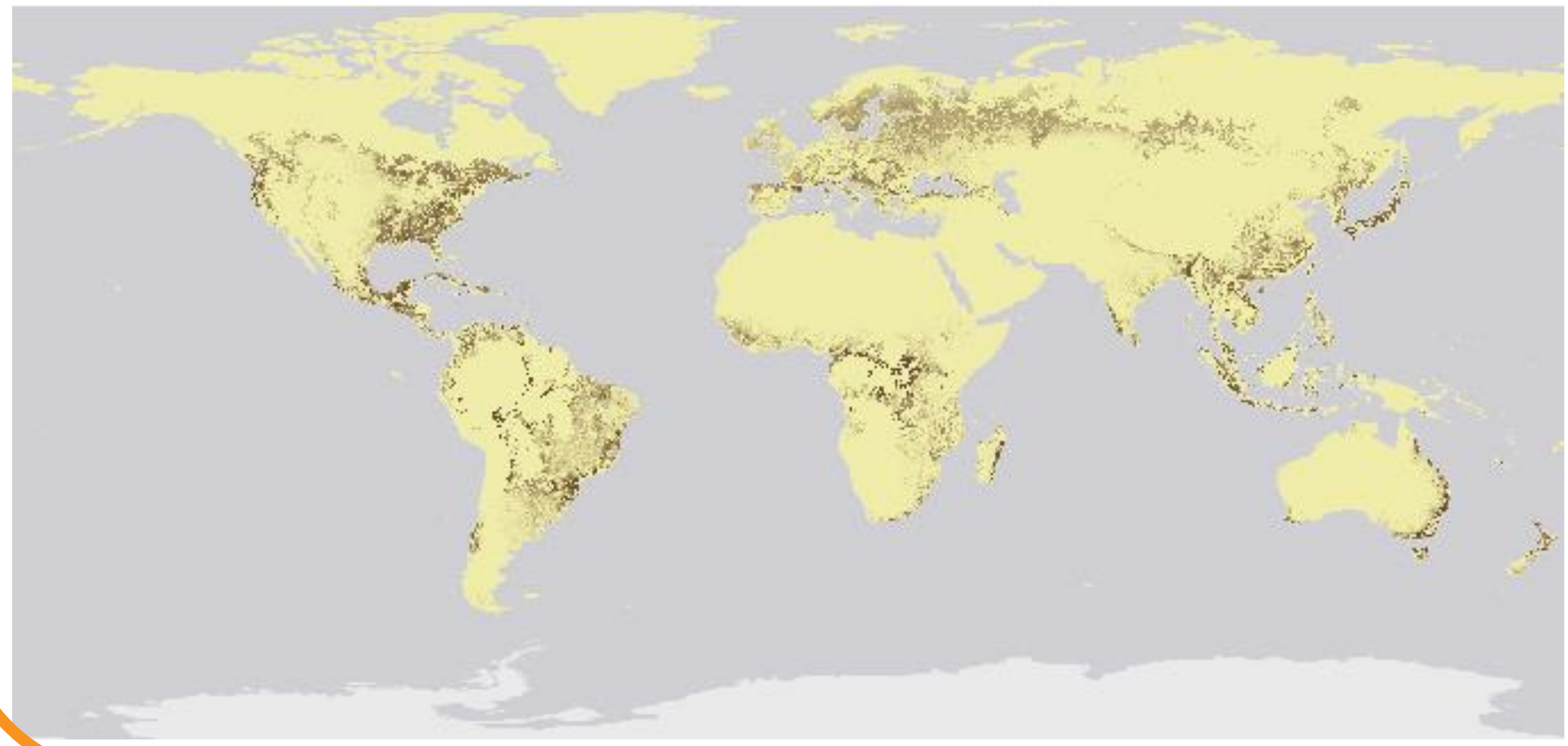
FRAMEWORK EXAMPLE: TIMBER AND FUELWOOD

- **Potential** ecosystem services: benefits provided by nature even if they are not currently used (may become critical in the future)
- **Realized** ecosystem services: benefits provided by nature that are being used by anyone
- **Critical** ecosystem services: benefits provided by nature that cannot easily be substituted or replaced, for example, benefits accruing to the world's most poor or vulnerable

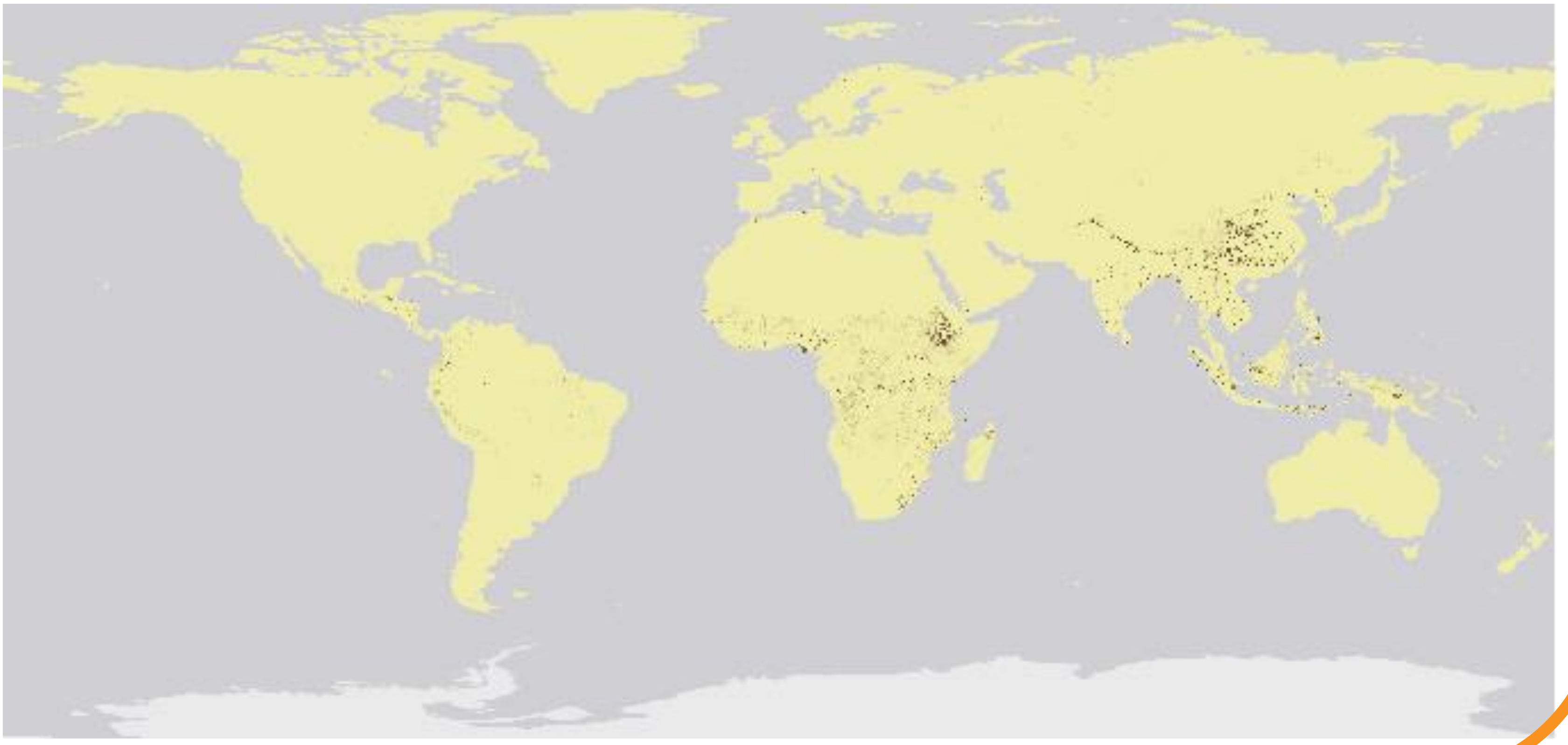
Potential: Woody biomass



Realized: Woody biomass accessible to all people



Critical: Woody biomass accessible to the world's poorest people

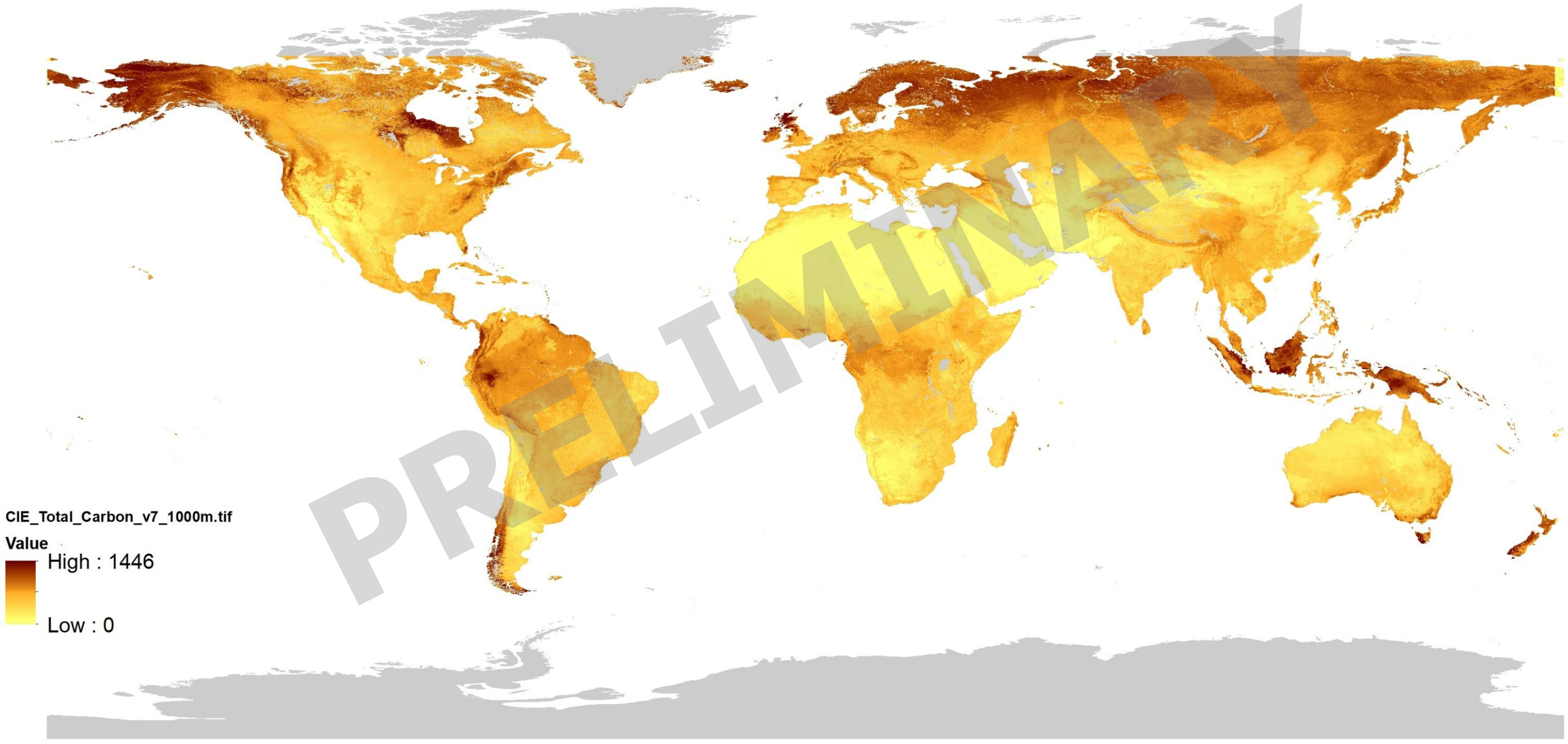


MAPS: MARK MULLIGAN

PRELIMINARY MAPS

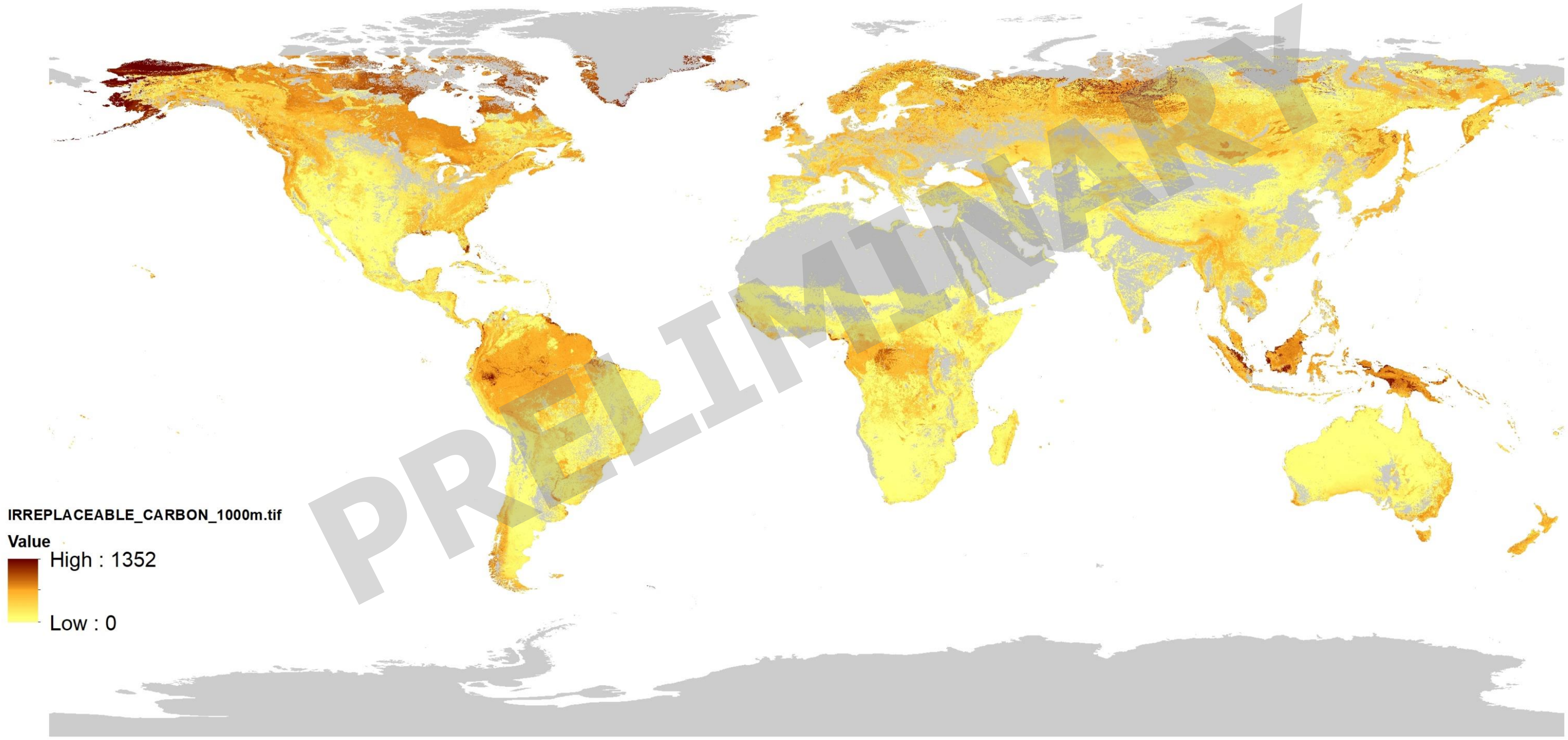
Darker colors = more important areas for providing realized ecosystem services (for all people)

CLIMATE REGULATION: TOTAL CARBON



Map: Monica Noon, Conservation International (publication in prep).

CLIMATE REGULATION: "IRREPLACEABLE" CARBON



Map: Monica Noon, Conservation International (publication in prep).

POPULATION (FOR CONTEXT)

Rose AN, McKee JJ, Urban ML, Bright EA. 2018. LandScan 2017. Oak Ridge National Laboratory. Available from https://landscan.ornl.gov/.

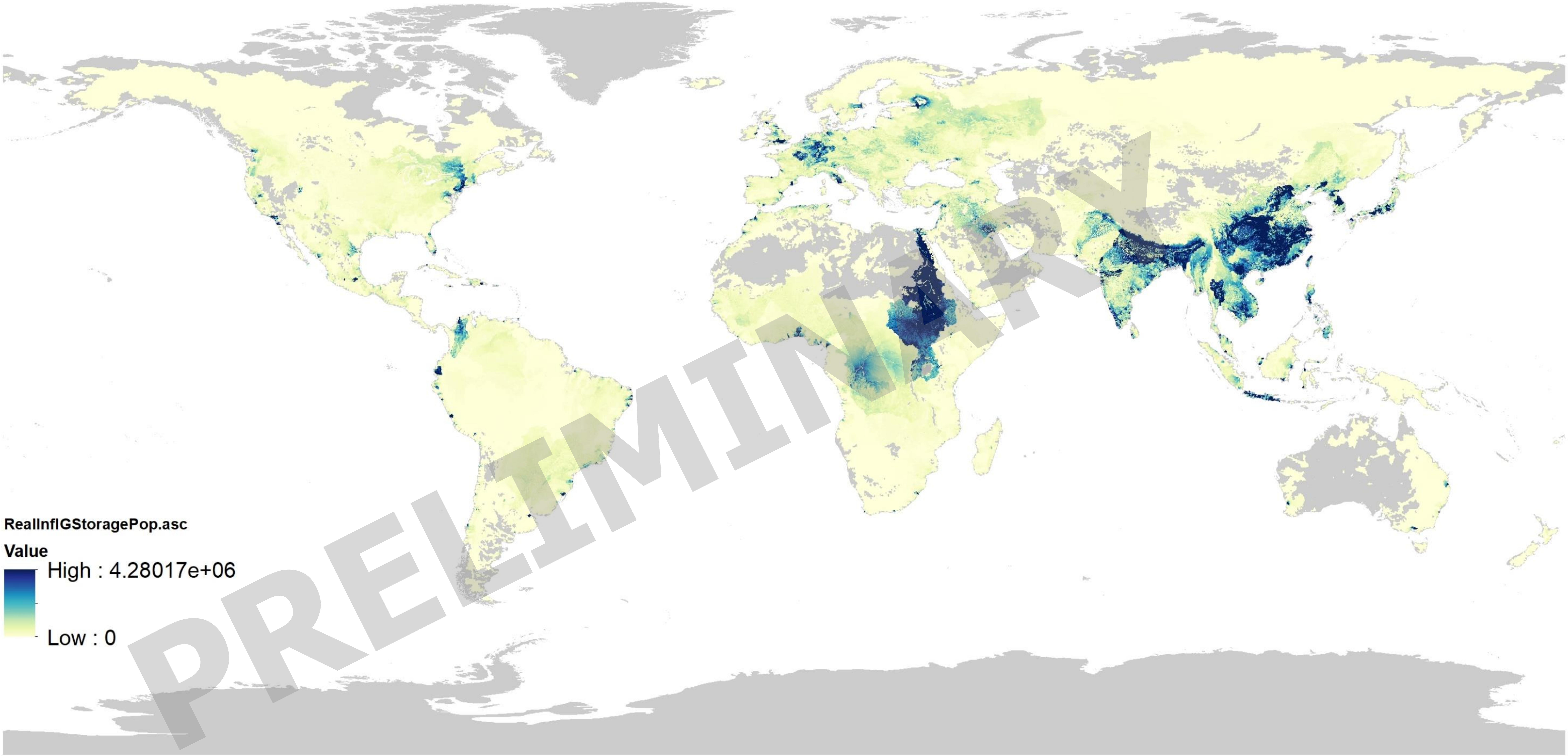
POVERTY (FOR CONTEXT)

Map: Monica Noon, Conservation International
Based on: Elvidge CD, Sutton PC, Ghosh T, Tuttle BT, Baugh KE, Bhaduri B, Bright E. 2009. A global poverty map derived from satellite data. Computers & Geosciences **35**:1652–1660.

WATER QUALITY: SEDIMENT RETENTION*

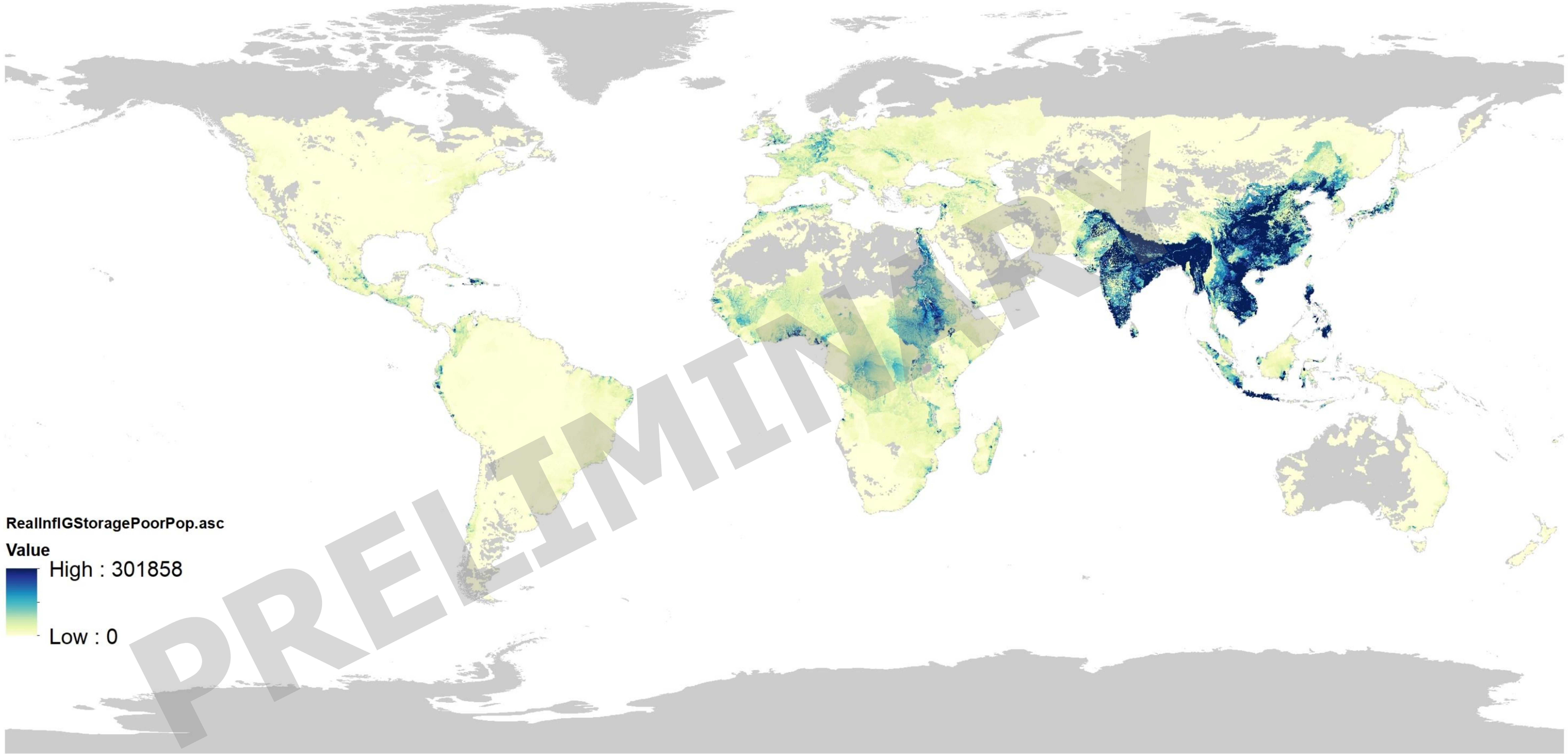
MAP: BECKY CHAPLIN-KRAMER

FLOOD REGULATION: TOTAL POPULATION IN FLOODPLAINS



MAP: MARK MULLIGAN

FLOOD REGULATION: POOR POPULATION IN FLOODPLAINS



MAP: MARK MULLIGAN

WATER QUALITY: SEDIMENT RETENTION*

MAP: BECKY CHAPLIN-KRAMER

FOOD SECURITY: POLLINATION

Chaplin-Kramer R et al. 2019. Global modeling of nature's contributions to people. Science 366:255–258.

FOOD SECURITY: GRAZING / FORAGE FOR LIVESTOCK

FOOD SECURITY: RIVERINE FISHERIES*

McIntyre PB, Liermann CAR, Revenga C. 2016. Linking freshwater fishery management to global food security and biodiversity conservation. Proceedings of the National Academy of Sciences 113:12880–12885.

FOOD SECURITY: MARINE FISHERIES

Watson RA, Tidd A. 2018. Mapping nearly a century and a half of global marine fishing: 1869–2015. Marine Policy **93**:171–177.

ENERGY: FUELWOOD

MAP: MARK MULLIGAN

WATER QUALITY: NITROGEN RETENTION*

Chaplin-Kramer R et al. 2019. Global modeling of nature's contributions to people. Science 366:255–258.

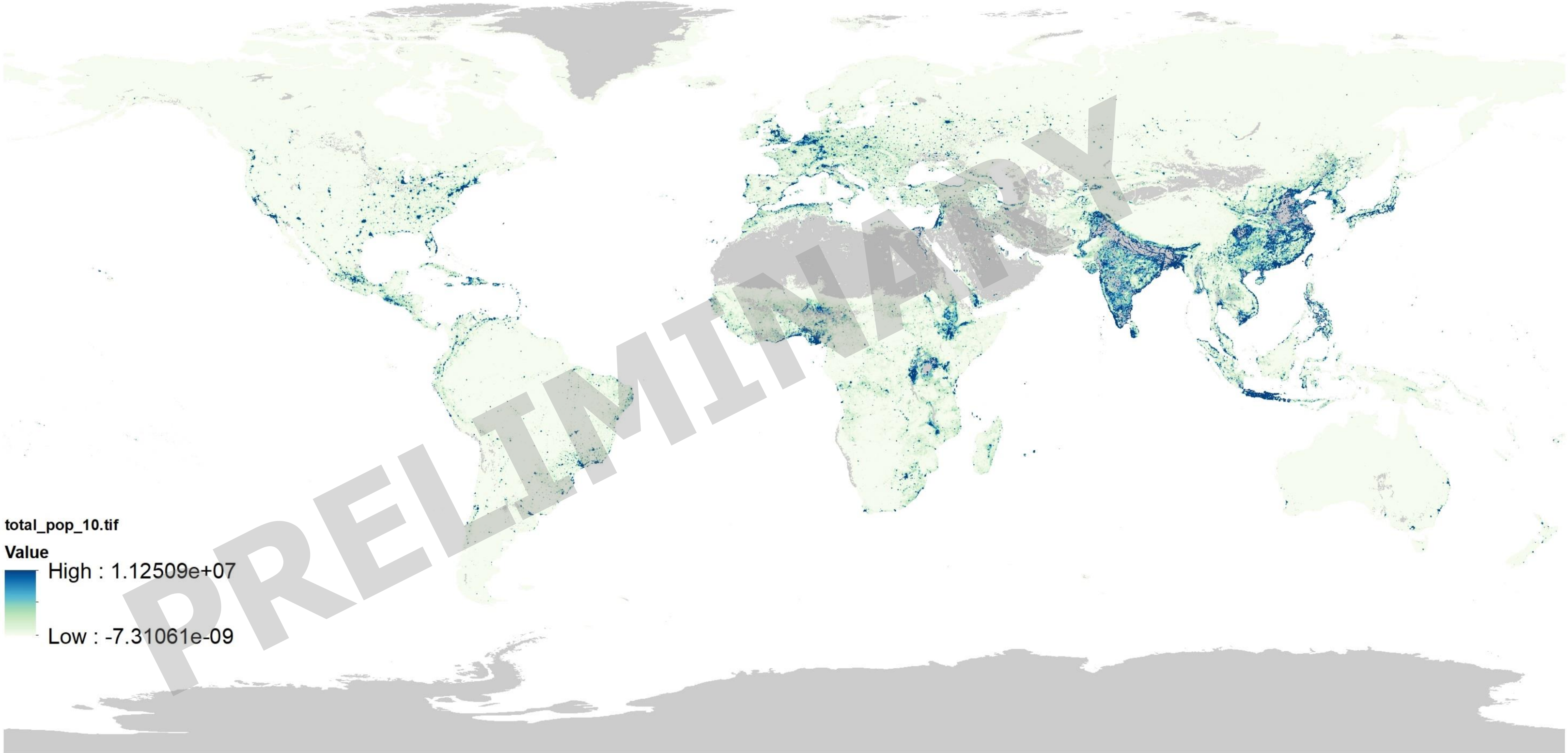
RAW MATERIALS: TIMBER

MAP: MARK MULLIGAN

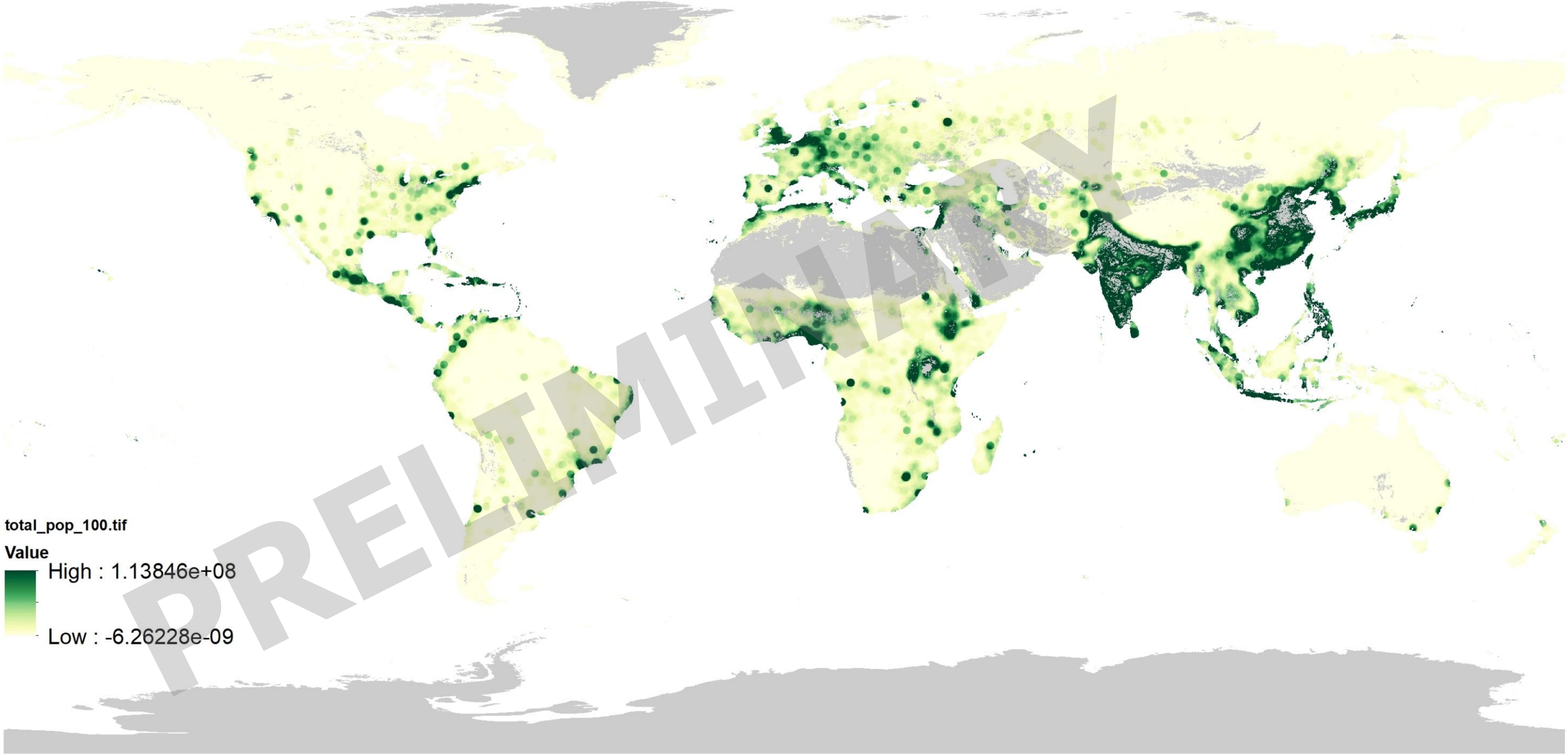
CULTURE: CORAL REEF TOURISM

Spalding M, Burke L, Wood SA, Ashpole J, Hutchison J, zu Ermgassen P. 2017. Mapping the global value and distribution of coral reef tourism. Marine Policy **82**:104–113.

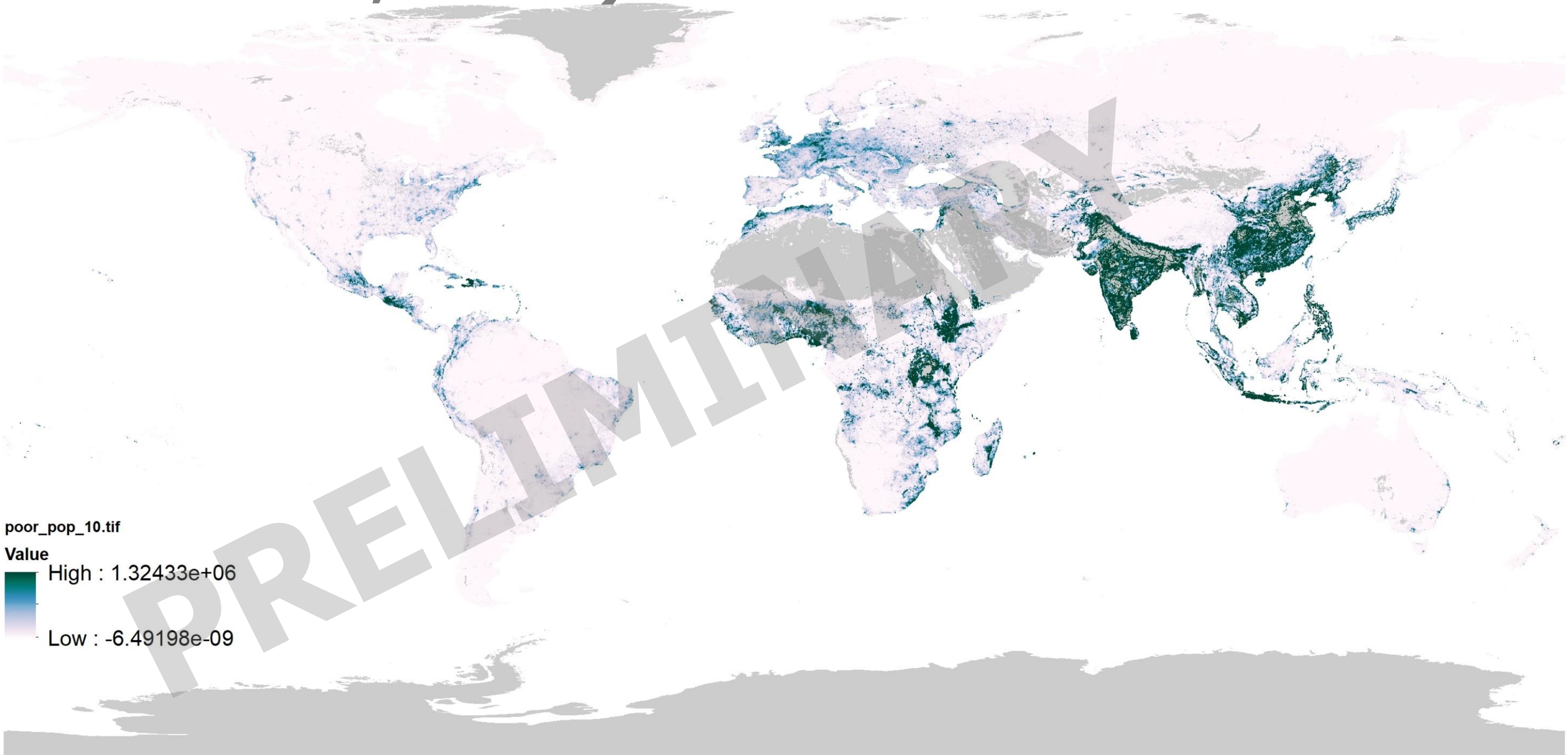
CULTURE: ACCESS TO NATURE (TOTAL POPULATION, 10 KM)



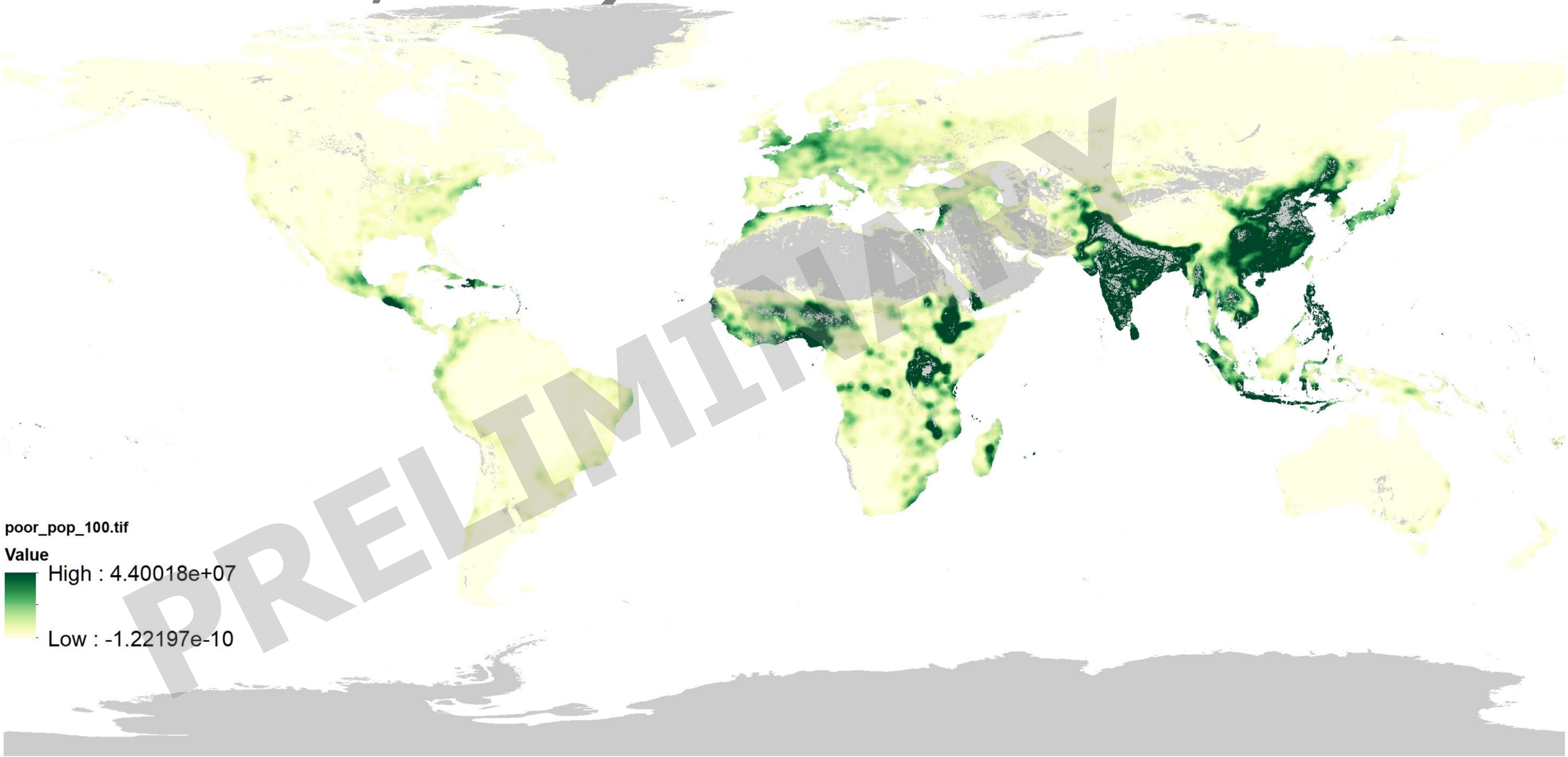
CULTURE: ACCESS TO NATURE (TOTAL POPULATION, 100 KM)



FOOD SECURITY: ACCESS TO NATURE (URBAN POOR / TOTAL RURAL POPULATION, 10 KM)



FOOD SECURITY: ACCESS TO NATURE (URBAN POOR / TOTAL RURAL POPULATION, 10 KM)



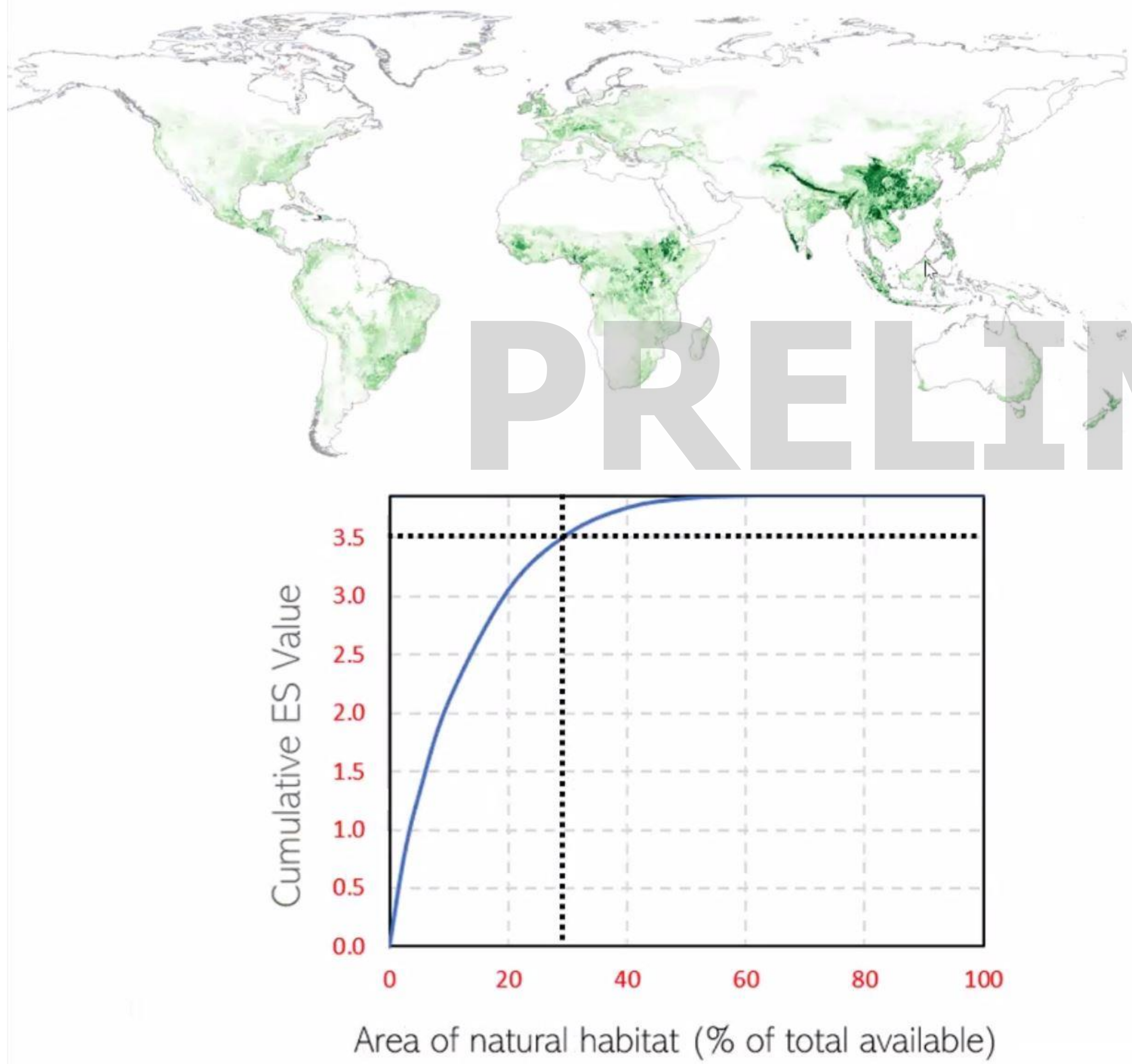
CULTURE: LINGUISTIC DIVERSITY*

SIX TERRESTRIAL ECOSYSTEM SERVICES* (NORMALIZED GLOBALLY)

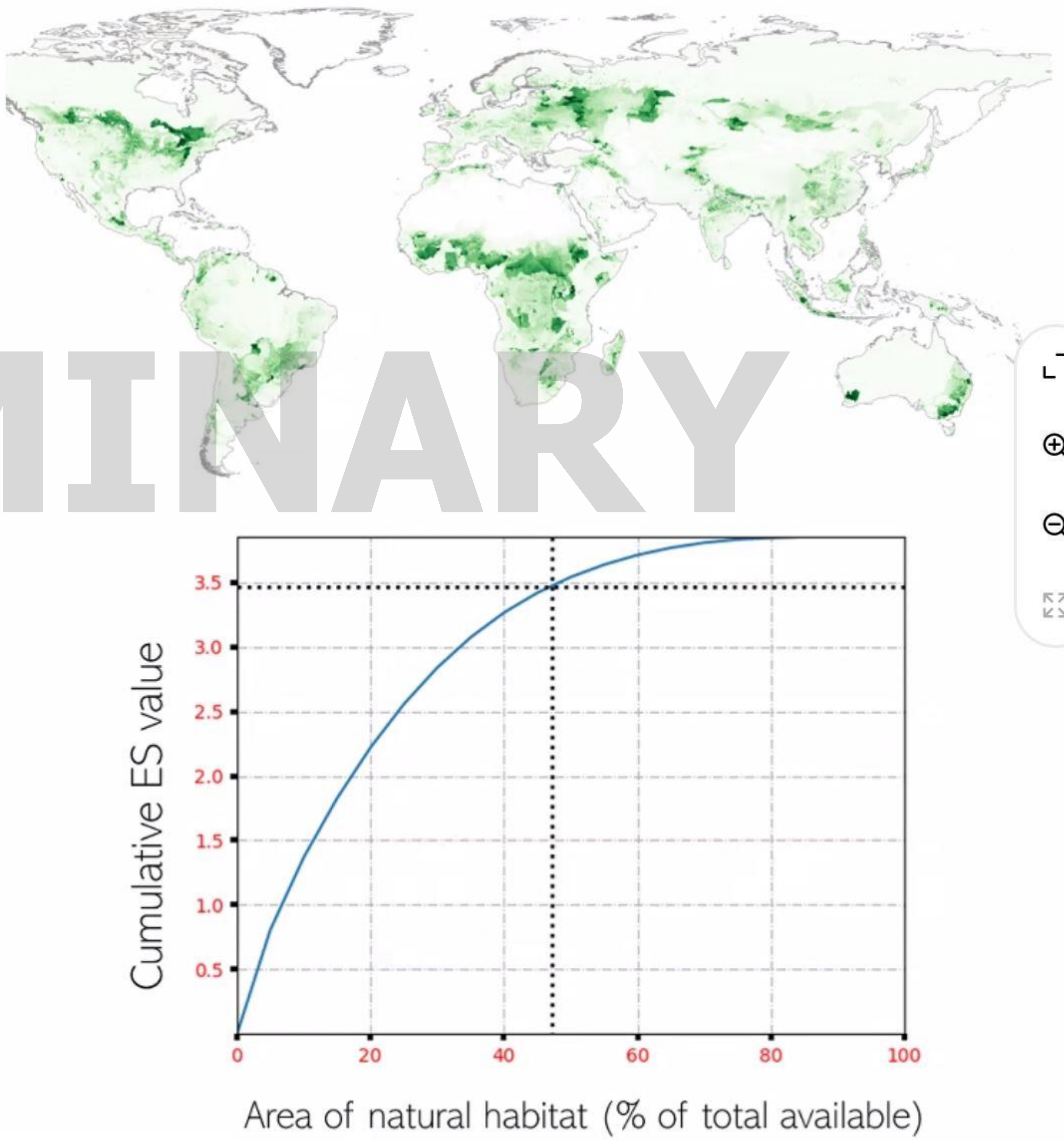
*Data unavailable above 60 degrees N latitude

SIX TERRESTRIAL ECOSYSTEM SERVICES* (NORMALIZED BY COUNTRY)

Aggregate ES Value - Normalized globally



Aggregate ES Value - Normalized by country



SIX ECOSYSTEM SERVICES* + BIODIVERSITY

LIMITATIONS

- Only 15 ecosystem services out of ~68
- Data limitations
- Models based on assumptions
- Influenced by high population areas
- Do not account for global trade
- Do not account for critical natural capital which is already converted / degraded
- Do not account for basic life support functions / ecological thresholds
- Do not account for future needs

PRODUCTS

- Scientific publication
- Open access* maps & GIS data
- Policy recommendations for the Post-2020 Biodiversity Framework

*whenever data providers grant us permission

THANK YOU

Pam Collins, Dave Hole, Rachel Neugarten, Becky Chaplin Kramer, Steve Polasky
Not pictured: Justin Johnson, Rich Sharp, Monica Noon, Will Turner
Mark Mulligan, Arnout Van Soesbergen and many others
Funding for this work was provided by Conservation International & the Natural Capital Project

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Cornell University · Conservation International · natural capital PROJECT · King's College London

EXTRA SLIDES

REVIEW SUMMARY

GLOBAL CONSERVATION

Pervasive human-driven decline of life on Earth points to the need for transformative change

Sandra Díaz*, Josef Settele, Eduardo S. Brondízio, Hien T. Ngo, John Agard, Almut Arneth, Patricia Balvanera, Kate A. Brauman, Stuart H. M. Butchart, Kai M. A. Chan, Lucas A. Garibaldi, Kazuhito Ichii, Jianguo Liu, Suneetha M. Subramanian, Guy F. Midgley, Patricia Miloslavich, Zsolt Molnár, David Obura, Alexander Pfaff, Stephen Polasky, Andy Purvis, Jona Razzaque, Belinda Reyers, Rinku Roy Chowdhury, Yunne-Jai Shin, Ingrid Visseren-Hamakers, Katherine J. Willis, Cynthia N. Zayas

BACKGROUND: Human actions have long been known to drive declines in nature, and there is growing awareness of how globalization means that these drivers increasingly act at a distance (telecoupling). However, evidence from different disciplines has largely accumulated in parallel, and the global effects of telecouplings have never been addressed comprehensively. Now, the first integrated global-scale intergovernmental assessment of the status, trends, and future of the links between people and nature provides an unprecedented picture of the extent of our mutual dependence, the breadth and depth of the ongoing and impending crisis, and the interconnectedness among sectors and regions.

ADVANCES: Human impacts on life on Earth have increased sharply since the 1970s. The world is increasingly managed to maximize the flow of material contributions from nature to keep up with rising demands for food, energy, timber, and more, with global trade increasing the geographic separation between supply and demand. This unparalleled appropriation of nature is causing the fabric of life on which humanity depends to fray and unravel: Most indicators of the state of nature, whether monitored by natural and social scientists or by Indigenous Peoples and local communities, are declining. These include the number and population size of wild species, the number of local varieties of domesticated species, the distinctness of ecological communities, and the extent and integrity of many terrestrial and aquatic ecosystems. As a consequence, nature's capacity to provide crucial benefits has also declined, including environmental processes underpinning human health and nonmaterial contributions to human quality of life. The costs are distributed unequally, as are the benefits of an expanding global economy.

These trends in nature and its contributions to people are projected to worsen in the coming decades—unevenly so among different regions—unless rapid and integrated action is taken to reduce the direct drivers responsible for most change over the past 50 years: land and sea use change, direct harvesting of many plants and animals, climate change (whose impacts are set to accelerate), pollution, and the spread of invasive alien species. Exploratory scenarios suggest that a world with increased regional barriers—resonating with recent geopolitical trends—will yield more negative global trends in nature, as well as the greatest disparity in trends across regions, greater than a world with liberal financial markets, and much greater than one that prioritizes and integrates actions toward sustainable development. Evidence from target-seeking scenarios and pathways indicates that a world that achieves many of the global biodiversity targets and sustainability goals related to food, energy, climate, and water is not—yet—beyond reach, but that no single action can get us there.

OUTLOOK: Our comprehensive assessment of status, trends, and possible futures for nature and people suggests that action at the level of direct drivers of nature decline, although necessary, is not sufficient to prevent further deterioration of the fabric of life on Earth. Reversal of recent declines—and a sustainable global future—are only possible with urgent transformative change that tackles the root causes: the interconnected economic, sociocultural, demographic, political, institutional, and technological indirect drivers behind the direct drivers. As well as a pan-sectoral approach to conserving and restoring the nature that underpins many goals, this transformation will need innovative governance approaches that are adaptive; inclusive; informed by existing and new evidence; and integrative across systems, jurisdictions, and tools. Although the challenge is formidable, every delay will make the task even harder. Crucially, our analysis pinpoints five priority interventions ("levers") and eight leverage points for intervention in the indirect drivers of global social and economic systems where they can make the biggest difference. ■

ON OUR WEBSITE

Read the full article at http://dx.doi.org/10.1126/science.aax3100

PHOTO CREDIT: WWW.ESTEBANTAPELLA.COM

Traditional diversity-rich human landscapes, and the livelihoods and identities that depend on them, face global threats. Mosaics of crops, forest, and pasture have been maintained for millennia around the world. Now, they are under increasing threat from climate change and large-scale land use change to accommodate global demands for commodities. So are the livelihoods and cultural identity of the peoples that live in them, such as this woman collecting fodder for her flock in the Checacupe district, Perú.

The list of author affiliations is available in the full article online.
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Cite this article as S. Díaz *et al.*, *Science* 366, eaax3100 (2019). DOI: 10.1126/science.aaw3100

Díaz S et al. 2019. Pervasive human-driven decline of life on Earth points to the need for transformative change. Science **366**.

WHY MAP CRITICAL NATURAL CAPITAL?

Maps of critical natural capital are needed to:

- Identify where nature is supporting the UN Sustainable Development Goals (SDGs)
- Inform the Convention on Biological Diversity (CBD) Post-2020 Biodiversity Framework
- **Guide scarce resources to the places where they can be most effective**

FORTHCOMING

- Coastal protection
- Flood regulation
- Atmospheric moisture recycling
- Access to nature (recreation, wild food and forest products)
- All maps: areas important for world's poorest people