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SUBSIDIARY BODY ON SCIENTIFIC, TECHNICAL AND TECHNOLOGICAL ADVICE
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Items 5.1 and 6.5 of the provisional agenda*

INDICATORS FOR ASSESSING PROGRESS TOWARDS THE 2010 TARGET: ECOLOGICAL FOOTPRINT AND RELATED CONCEPTS

Note by the Executive Secretary

I. SUMMARY

1. Noting the absence of a suitable indicator for assessing progress towards target 4.2 ("unsustainable consumption, of biological resources, or that impacts upon biodiversity, reduced") of the framework of goals and targets adopted in decision VII/30, the Subsidiary Body on Scientific, Technical and Technological Advice, at its tenth meeting, recommended the addition of a possible indicator to be developed on the "ecological footprint and related concepts" (recommendation X/5).

2. The ecological footprint is a method to assess one aspect of human demand on the biosphere, the extent to which the regenerative capacity of the planet is being used by human activities. When this demand exceeds (overshoots) the available limits, consumption is clearly unsustainable, and fewer resources are available for wild species, negatively impacting biodiversity. The footprint assesses demand by measuring the land (and water) area that is required to support a defined human activity, given prevailing technology. The footprint therefore depends on the size of a population and their material standard of living, including the use of energy, food, water, building material and other consumables.

3. The ecological footprint is also a function of the efficiency with which these consumables are produced. The footprint can be compared globally or locally with available biocapacity, defined anthropomorphically as the ability of biologically productive ecosystems to provide the resources and services used by humanity. This comparison of demand and supply provides a rigorous accounting of the extent to which human pressure is approaching or exceeding the Earth's ecological limits. In addition, the footprint has been shown to be a powerful metaphor that is able to communicate complex scientific information in simple and intuitive terms to a wide variety of audiences, to explain the relationship between human consumption and the natural environment, and to convey the idea and importance of ecological limits.

* UNEP/CBD/SBSTTA/11/1.

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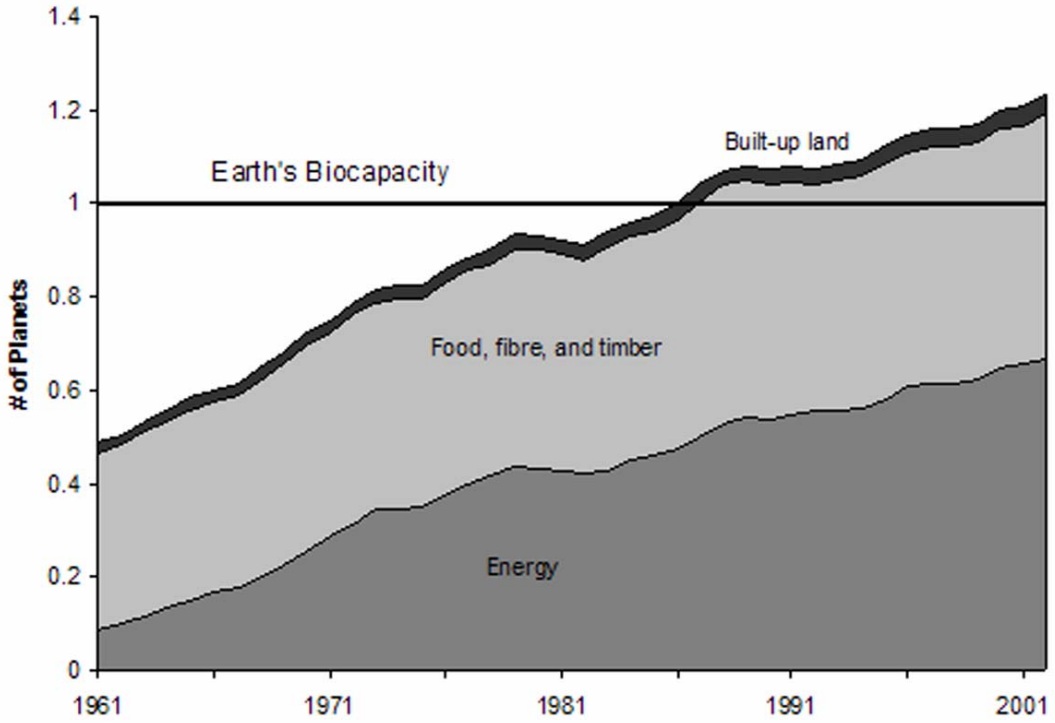
4. The Ecological Footprint has been calculated globally for each year since 1961, when complete United Nations statistics became available, by the Global Footprint Network. 1/ Ecological Footprint accounts assess, how many Earths are needed to meet the resource requirements of humanity. Resource demand (Ecological Footprint) for the world as a whole is the product of population times per capita consumption, and reflects the efficiency with which resources are turned into consumption products. Resource supply (biocapacity) varies each year with ecosystem management, agricultural practices (such as fertilizer use and irrigation), ecosystem degradation, and weather.

5. Figure 1 shows the ratio between the world's footprint and the world's biocapacity in each year, and how humanity has moved from using, in net terms, about half the planet's biocapacity in 1961 to 1.2 times the biocapacity of the Earth in 2001. The global "ecological deficit" of 0.2 Earths is an estimate of a lower boundary of the globe's ecological overshoot.

Figure 1. Global ecological footprint: ratio of footprint to biocapacity. Biocapcity is standardized to 1 for each year (Source: Global Footprint Network). 2/



6. This graph shows how humanity has moved from using, in net terms, about half the planet's biocapacity in 1961 to 1.2 times the biocapacity of the Earth in 2001. The global "ecological deficit" of 0.2 Earths is equal to the globe's ecological overshoot.

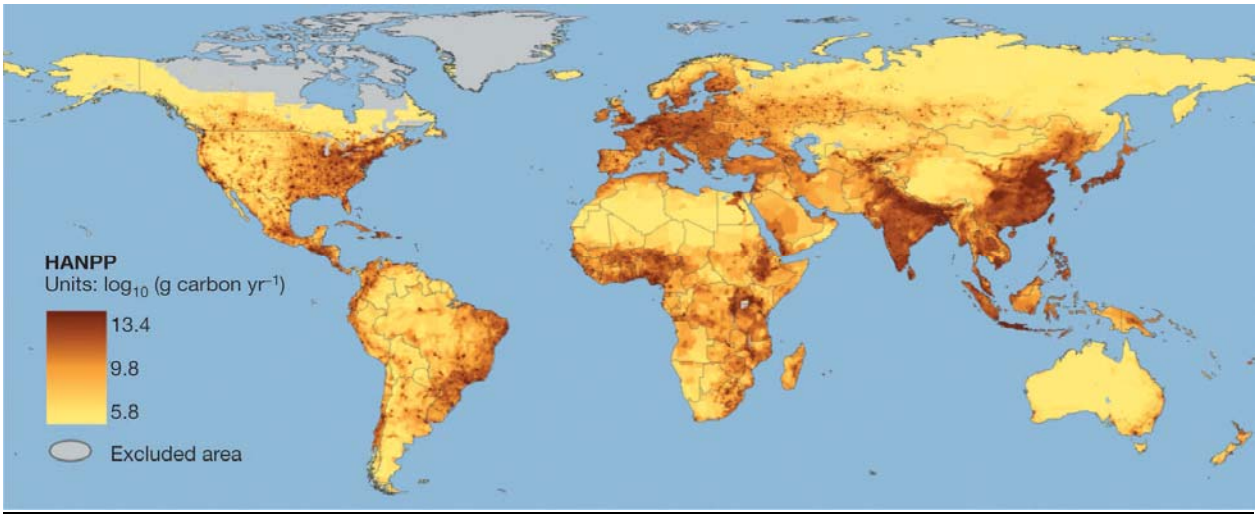
7. A number of concepts related to the ecological footprint calculate human consumption. For example, the human appropriation of net primary productivity (HANPP) calculates human pressure on

1/ http://www.footprintnetwork.org/. In this document 'Ecological Footprint' (with capital letters) refers to the accounts prepared by the Global Footprint Network and reported in the WWF Living Planet Reports. The more generic terms 'ecological footprint' or 'human footprint' (with small letters) refer to the various methods and underlying data used at individual, local, municipality, national level and/or global levels to quantify and/or map certain components of resource use in relation to resource availability.

2/ The ecological footprint calculation assumes that current agricultural yields are sustainable which may not be the case. The ecological footprint may therefore be larger than shown.

ecosystems. Although there is some uncertainty in key parameters, it is estimated that between 20 and 40 per cent of the net primary productivity (biomass produced each year by green plants through photosynthesis) produced on the Earth's continents (i.e. excluding marine primary productivity) is consumed by humans each year. 3/ 4/ 5/ 6/ The current level of appropriation of net primary productivity constitutes a significant intervention into the natural energy flow of ecosystems and there is theoretical as well as evidence empirical evidence showing that HANPP is directly responsible for biodiversity loss. 7/

Figure 2. Spatial distribution of the annual NPP resources required by the human population as measured by HANPP (Source: Imhoff et al. in Nature). 3/



8. To visualize the human influence on the biosphere, the human footprint has been illustrated by mapping population density, land transformation, accessibility, and electrical power infrastructure. 8/

II. RELATION OF INDICATOR TO FOCAL AREA

9. Sustainable use of biodiversity is difficult to quantify. Efforts to assess trends in sustainable use tend to capture only a portion of the area that is sustainably used or of the products that come from sustainable sources. Unsustainable use, on the other hand, is more easily measurable. The ecological footprint and related concepts provide an indication of human consumption in relation to the earth's capacity to renew the respective resources. The indicator is also relevant to the focal areas on *threats to biodiversity* and on *ecosystem integrity and ecosystem goods and services*. The indicator on *incidence of human-induced ecosystem failure* quantifies the occurrence of catastrophic events resulting from unsustainable use.

3/ Imhoff, M. L., Bounoua, L., Ricketts, T., Loucks, C., Harriss, R., Lawrence, W. T., 2004. Global patterns in human consumption of net primary production. Nature 429, 870-873.

4/ Vitousek, P. M., Ehrlich, P. R., Ehrlich, A. H., Matson, P. A., 1986. Human Appropriation of the Products of Photosynthesis. BioScience 36(6), 363-373.

5/ Wright, D. H., 1990. Human Impacts on the Energy Flow Through Natural Ecosystems, and Implications for Species Endangerment. Ambio 19(4), 189-194.

6/ Haberl, H., Schulz, N.B., Plutzar, C., Erb, K.H., Krausmann, F., Loibl, W., Moser, D., Sauberer, N., Weisz, H., Zechmeister, H.G., Zulka, P. 2004. Human appropriation of net primary production and species diversity in agricultural landscapes. Agriculture, Ecosystems and Environment Vol. 102 (2), pp. 213-218.

7/ Haberl, H. 1997. Human appropriation of net primary production as an environmental indicator: implications for sustainable development. Ambio 26 (3): 143-146.

8/ Sanderson, E.W., Jaiteh, M., Levy, M.A., Redford, K.H., Wannebo, A.V., Woolmer, G. 2002. The Human Footprint and the Last of the Wild. Bioscience 52 (10): 891-904.

10. To the extent that humans and their domesticated animals are using available biocapacity, they are in competition with the wild species that would otherwise make use of these resources. By comparing the ecological footprint with biocapacity, it is possible to determine how much productive area is being occupied by human activities, and how much is being left for the use of wild species.

III. GENERAL DESCRIPTION OF INDICATOR

11. The ecological footprint is an estimate of how much land and water area is required to sustain a human population. It incorporates requirements of both producing the resources a population consumes, and absorbing its wastes. The measure takes into account available technologies, conversion efficiencies, or agricultural technologies, and provides a quantitative indication of human demand on the biosphere. Ecological footprints can be calculated at different scales, and a range of methodologies are available and used to calculate footprints for the global population, for regions, countries, cities, and individuals. Global Footprint Network, with its 40 partner organizations, is now in the process of standardizing the methodologies to increase the robustness, reliability and comparability of the results.

12. At a global scale, the ecological footprint compares the total requirements of the human population with the biological capacity of the planet, expressed in terms of its capacity to renew resources. It represents the ratio between the global demand for goods and services from a growing human population, and the changing capacity of the planet to supply these goods and services. This ratio represents the "number of Earths" required to support the global population - the "biocapacity" of the Earth always being one Earth, although a different Earth each year. The growing human population, which has doubled since the early 1960's, has moved from using, in net terms, half the planet's biocapacity in the early 1960s to approximately 1.2 times the Earth's biocapacity in 2001. Although methodologies vary and are not yet standardized, it is widely accepted that the global ecological footprint surpassed the biocapacity of the planet at some time between the late 1970s and the mid 1980s. Moreover, the method is conservative in assuming prevailing agricultural practices (and the yields attainable through them) to be sustainable.

13. Another concept, which relates the productive capacity of ecosystems to human consumption, is the human appropriation of net primary production (HANPP). Whereas the ecological footprint is based on the calculation of material flows including energy resources, HANPP measures the volume of net primary production (biomass) used by humans from ecosystems. HANPP is an indicator for the changes in the production ecology that are induced by land use. It takes changes in ecosystem productivity and harvest into account. HANPP is a more explicit measure of the intensity of human pressure on ecosystem use than the ecological footprint, which focuses more explicitly on demand. 9/ There is also evidence for the direct link between HANPP and biodiversity loss, in particular at species level. 10/ On a global level, HANPP amounts to 20-40 per cent of the potential vegetation's net primary production 11/ 12/ 13/ and is probably higher than 40 per cent in many industrialized countries.

9/ Haberl, H., Wackernagel, M., Krausmann, F., Erb, K.-H. and Monfreda, C. (2004a) Ecological footprints and human appropriation of net primary production: A comparison. Land Use Policy 21, 279-288.

10/ Haberl, H., Erb, K.H., Plutzar, C., Fischer-Kowalski, M., Krausmann, F. in press. Human appropriation of net primary production (HANPP) as indicator for pressures on biodiversity. In: Moldan, B. et al. Assessment of Sustainability Indicators. SCOPE. Island Press, Washington, D.C.

11/ Vitousek, P.M., Ehrlich, P.R., Ehrlich, A.H. and Matson, P.A., 1986. Human Appropriation of the Products of Photosynthesis. BioScience 36, 368-373.

12/ Wright, D.H., 1990. Human Impacts on the Energy Flow Through Natural Ecosystems, and Implications for Species Endangerment. Ambio 19, 189-194.

13/ Imhoff, M., Laheuari, B., Ricketts, T., Loucks, C., Harriss, R., Lawrence, W.T. 2004. Global patterns in human consumption of net primary production [Letter]. Nature 429: 870-873.

14. Analysis of the human footprint map, which presents the degree of and proximity to human disturbance, indicates that 83 per cent of the land's surface is influenced by one or more of the following factors: human population density greater than 1 person per square kilometre, within 15 km of a road or major river, occupied by urban or agricultural land uses, within 2 km of a settlement or a railway, and/or producing enough light to be visible regularly to a satellite at night. 98 per cent of the areas where it is possible to grow rice, wheat or maize are similarly influenced. 14/

IV. POLICY RELEVANCE

15. Ecological footprint analysis provides a metric of environmental performance and is therefore a useful tool for visualizing and comparing consumption levels and comparing them to biological capacities available. It provides a valuable form of ecological accounting that can be used to assess current ecological demand and supply, set policy targets, and monitor success in achieving them. Using the footprint as an aggregate measure of demand on ecosystem resources provides a system perspective that allows researchers to calculate global overshoot, and show the extent to which a policy solution is actually reducing rather than shifting humanity's footprint to ecosystems elsewhere. Disaggregated into its components, the footprint that can be used to set specific policy targets (for example, reducing the footprint of transport, energy, or other categories of consumption).

V. TECHNICAL INFORMATION

16. A scientific paper is available documenting the methodology used to calculate the ecological footprint in the 2005 Edition of the National Footprint and Biocapacity Accounts. 15/ 16/ This paper also documents the evolution of the methodology from a bottom-up, component-based approach towards an increasingly comprehensive and robust top-down compound footprinting approach. Complementary information is available from a number of organizations, including the World Wide Fund for Nature, Stockholm Environment Institute, Best Foot Forward, and Redefining Progress. 17/

17. Ecological footprint methodology continues to advance, and work is underway towards developing standards to guide use of the method and reporting of results. Along with this continual improvement there have been a number of ongoing challenges. Critics argue that many factors of the calculations are based on crude estimates. Moreover, in avoiding double-counting of productive area, the model generally does not count multiple uses of land: if unharvested forest is counted as a carbon sink, it is not also counted as a source of food (e.g., nuts and berries) that it may provide. In addition, few ecological footprint analyses include demand on fresh water (other than the energy used to provide or treat it).

18. Both ecological footprint and human appropriation of net primary production have limitations. Ecological footprint analysis is mostly considered to be a guide, rather than an exact measure, of ecological unsustainability. The focus of the ecological footprint is to alert people to the occurrence of ecological overshoot and its externalized costs. The challenge for NPP analyses is accurate measures of

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14/ http://www.wcs.org/humanfootprint.

15/ Wackernagel, M., Monfreda, C., Moran, D., Wermer, P., Goldfinger, S., Deumling, D., Murray, M. 2005. National Footprint and Biocapacity Accounts 2005: The underlying calculation method. Global Footprint Network. http://www.footprintnetwork.org/gfn_sub.php?content=download.

16/ The electronic calculation sheets for this edition will be presented by the European Environment Agency and will be available from the Global Footprint Network in October 2005.

17/ http://www.panda.org/news_facts/publications/general/livingplanet/index.cfm; http://www.sei.se/; http://www.bestfootforward.com/footprintlife.htm; http://redefiningprogress.org/programs/sustainabilityindicators/ef/methods/calculating.html

both the removal side (how much is being compromised) as well as specifying upper limits (how high a exploitation percentage is sustainable).

VI. APPLICATION OF THE INDICATOR AT NATIONAL/REGIONAL LEVEL

19. The ecological footprint metric is widely applied from individuals and households through community and municipalities, to the national, regional and global scale. It can also be used to determine the ecological demand associated with human activities such as constructing and operating a building or manufacturing a product. All analyses start from the common National Accounts data, although the particular methodologies and additional data sources used for the various types of assessments will obviously differ.

VII. SUGGESTIONS FOR THE IMPROVEMENT OF THE INDICATOR

20. The suite of approaches and indicators, which assess the environmental and social consequences of human economic activities, should be considered as a guide. Due to the complexities of consumption patterns and its direct and indirect consequences on the natural capital, ecological footprint analysis is unlikely to provide an accurate measure of ecological unsustainability. However, efforts are underway to improve its coverage, including the accurate representation of water consumption and waste water treatment.

21. Moreover, refinements of methodologies and efforts to standardize methodologies are underway. In addition, there is room for a number of complementary approaches each of which may focus on certain features and accordingly draw criticism with respect to particular details.

22. With a view to assessing progress in the sustainability of human use of biodiversity, it would be desirable if existing concepts could focus directly on the impacts of economic activities on biodiversity.
