ECOLOGICAL FOOTPRINT AND BIOCAPACITY
TECHNICAL NOTES: 2006 EDITION

1. THE ECOLOGICAL FOOTPRINT

The **Ecological Footprint** is a measure of how much biologically productive land and water area an individual, a city, a country, a region, or humanity uses to produce the resources it consumes and to absorb the waste it generates, using prevailing technology and resource management. This land and water area can be physically located anywhere in the world.

The Ecological Footprint is most commonly expressed in units of **global hectares**. A global hectare is a hectare that is normalized to have the world average productivity of all biologically productive land and water in a given year. In 2003 (the most recent year for which consistent data are available), the biosphere had 11.2 billion hectares of biologically productive area, corresponding to roughly one quarter of the planet's surface. These 11.2 billion hectares include 2.4 billion hectares of water (ocean shelves and inland water) and 8.8 billion hectares of land. The land area is composed of 1.5 billion hectares of cropland, 3.4 billion hectares of grazing land, 3.7 billion hectares of forest land, and 0.2 billion hectares of built-up land.

The Ecological Footprint can also be expressed in numbers of planets, with one planet representing the biological capacity of the Earth in a given year. Just as financial accounts can express the same amount of expenditure in different currencies, results could also be reported in country-specific hectares, such as Austrian or Danish hectares (hectares with average Austrian or Danish productivity).

In many Ecological Footprint reports and applications, including the Living Planet Report 2006, the Ecological Footprint of consumption is reported for each nation in global hectares per capita, the Footprint of the average resident of that country. These country-level calculations are drawn from the National Footprint Accounts, which are maintained and updated by Global Footprint Network with the support of its 70+ partner organizations. The Ecological Footprint of a country measures the biological capacity needed to produce the goods and services consumed by people in that country, as well as the capacity needed to assimilate the waste they generate. Resources used for the production of goods and services that are exported are counted in the Ecological Footprint of the country where the goods and services are consumed.

National Footprint Accounts calculations are based primarily on international data sets published by the Food and Agriculture Organization of the United Nations (FAO), the International Energy Agency (IEA), the UN Statistics Division (UN Commodity Trade Statistics Database – UN Comtrade), and the Intergovernmental Panel on Climate Change (IPCC). Other data sources include studies in peer-reviewed science journals and thematic collections. More information on these sources can be found in the References section and in the free Academic Edition of the National Footprint Accounts.

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2. BIOCAPACITY

Biocapacity (or biological capacity) is the capacity of ecosystems to produce useful biological materials and to absorb waste materials generated by humans using current management schemes and extraction technologies. "Useful biological materials" are defined for each year as those used by the human economy that year. What is considered "useful" can change over time (e.g. the use of corn stover to produce cellulosic ethanol would result in corn stover becoming a useful material, thereby increasing the biocapacity of maize cropland). Like the Ecological Footprint, biocapacity is usually expressed in units of global hectares, and is calculated for all biologically productive land and sea area on the planet.

Biologically productive area is land and water (both marine and inland) area that supports significant photosynthetic activity and biomass accumulation that can be used by humans. Non-productive and marginal areas such as arid regions, open oceans, the cryosphere, and other low-productive surfaces are not included. Areas producing biomass that is not of use to humans are also not included. In 2003, there were approximately 11.2 billion global hectares of biologically productive land and water area on the planet, covering less than one quarter of the planet's total surface. The **bioproductivity** of any given area is defined as its ability to produce useful biological materials and to absorb human-generated wastes per unit area.

The amount of biocapacity available per person globally is calculated by dividing the 11.2 billion global hectares of biologically productive area by the number of people on Earth (6.3 billion in 2003). This ratio gives the average amount of biocapacity available on the planet per person - 1.8 global hectares. This simple calculation of available biocapacity assumes that no capacity is set aside for the demands of wild species.

The process of measuring both the Ecological Footprint and biocapacity of a business, nation, region, or the planet is often referred to as **Ecological Footprint accounting**. In 2003, global Ecological Footprint accounts showed that humanity's total Footprint exceeded the Earth's biocapacity by approximately 25 per cent.

3. ASSUMPTIONS UNDERLYING ECOLOGICAL FOOTPRINT AND BIOCAPACITY ACCOUNTS

Ecological Footprint accounting is based on six fundamental assumptions:

- The majority of the resources people consume and the wastes they generate can be tracked.
- Most of these resource and waste flows can be measured in terms of the biologically productive area necessary to maintain these flows. Resource and waste flows that cannot be measured are excluded from the assessment, leading to a systematic underestimate of the true Ecological Footprint.
- By weighting each area in proportion to its bioproductivity, different types of areas can be converted into the common unit of global hectares, hectares with world average bioproductivity.
- Because a single global hectare represents a single use, and all global hectares in any single year represent the same amount of bioproductivity, they can be added up to obtain an aggregate indicator of Ecological Footprint or biocapacity.
- Human demand, expressed as the Ecological Footprint, can be directly compared to nature's supply, biocapacity, when both are expressed in global hectares.
- Area demanded can exceed area supplied if demand on an ecosystem exceeds that ecosystems regenerative capacity (e.g., humans can temporarily demand more biocapacity from forests, or fisheries, than those ecosystems have available). This situation, where Ecological Footprint exceeds available biocapacity, is known as **overshoot**.

4. ACTIVITIES NOT INCLUDED IN FOOTPRINT ACCOUNTING

Although the goal of Ecological Footprint accounting is to measure human demand on the biosphere as accurately as possible, the methodology is designed to underestimate human demand on the biosphere where uncertainty exists. Because the Footprint is a historical account, many activities that systematically erode nature's future regenerative capacity are not included in current and past Ecological Footprint accounts. These activities include the release of materials for which the biosphere has no significant assimilation capacity (e.g.

plutonium, PCBs, dioxins, and other persistent pollutants) and processes that damage the biosphere's future capacity (e.g. species extinction, salination resulting from cropland irrigation, soil erosion from tilling). Although the consequences of these activities will be reflected in future Ecological Footprint accounts as a decrease in biocapacity, Ecological Footprint accounting does not currently include risk assessment models that would allow a present accounting of these future damages.

Similarly, Ecological Footprint accounts do not directly account for freshwater use and availability, since freshwater acts as a limit on the amount of biological capacity in an area but is not itself a biologically produced good or service. Although the loss of biocapacity associated with water appropriation is reflected as a decrease in overall biocapacity in that year, this use of biocapacity is not currently allocated to the consumer of the water resource.

Activities surrounding tourism are currently attributed to the country in which they occur rather than to the traveller's country of origin. This distorts the relative size of some countries' Footprints, overestimating those that host tourists and underestimating the home countries of travellers. Current data constraints also prevent the Footprint associated with the generation of internationally-traded electricity from being allocated to the final consumer of this energy. These two limitations affect the allocation of Ecological Footprint between nations but not the total global Footprint.

The demand on biocapacity resulting from emission of greenhouse gases other than carbon dioxide is not currently included in Ecological Footprint accounts. Incomplete scientific knowledge about the fate of greenhouse gases other than carbon dioxide makes it difficult to estimate the biocapacity required to neutralize their climate change potential.

5. METHODOLOGY

The methodology behind Ecological Footprint accounting continues to undergo significant development and regularly incorporates additional data and scientific understanding as they become available. Global Footprint Network has taken the lead in stewarding this process through the improvement of the National Footprint Accounts and the ongoing Footprint Standards process. The methodology behind the 2006 Edition of the National Footprint Accounts, the data set on which all Ecological Footprint calculations are based, builds on the method described in Monfreda et al. (2004). An updated version of this methodology paper, as well as a free Academic Edition of the National Footprint Accounts calculation template, can be downloaded from Global Footprint Network's website.

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Major updates since the 2004 Edition methodology include a simplification of the pasture calculation, a refined measure of carbon dioxide sequestration and forest productivity, the incorporation of International Energy Agency carbon dioxide emissions data, and the addition of the United Nations COMTRADE database to track the Ecological Footprint embodied in traded goods. Major changes since the 2005 Edition methodology include an additional refinement to the calculation of the embodied Footprint in traded goods.

Most Ecological Footprint studies report the Footprint of Consumption for nations and the world. Although globally, the Footprint of all goods and services produced must equal the Footprint of all goods and services consumed (minus changes in stocks), this does not hold true at the national level. A nation's Footprint of Consumption equals that nation's Footprint of Primary Production plus imports plus stock changes minus exports. This calculation represents the apparent consumption of biological capacity within a nation.

Comment [jk7]: Do you want this to be your formal definition of apparent?

The Footprint of Consumption is calculated for all countries that are represented in United Nations statistical data that have populations greater than one million people. Results are available for over 150 nations from 1961 through 2003.

More than 200 resource categories and are included in the National Footprint Accounts such as crop products, fibres, livestock, wild and farmed fish, timber, and fuelwood. , The accounts also explicitly track one major waste product – carbon dioxide. Demands for resource production and waste assimilation are translated into global hectares by dividing the total amount of resource consumed (or waste generated) by the global average yield of the land type that produces that resource (or absorbs that waste). Each of these area totals is multiplied by the appropriate equivalence factor to express the total demand in global hectares. Yields are calculated based on various international statistics, primarily those from the United Nations Food and Agriculture Organization. Equivalence factors are explained in more detail in Section 7. The biologically productive area occupied by built-up infrastructure is also included in Footprint accounts, as explained below.

Manufactured or derivative products (e.g., flour or wood pulp), are converted into primary product equivalents (e.g., wheat or roundwood) for the purposes of Ecological Footprint calculations. The quantities of primary product equivalents are then translated into global hectares.

6. LAND USE TYPES IN ECOLOGICAL FOOTPRINT ACCOUNTING

Ecological Footprint accounting tracks five biocapacity components and six Footprint components ("carbon land" is considered a distinct Footprint component for which there is currently no biocapacity explicitly set aside). These components of demand and supply are added together to obtain an aggregate Ecological Footprint or biocapacity estimate.

Cropland

Growing crops for food, animal feed, fibre, and oil requires cropland, the land type with the greatest average bioproductivity per hectare. The FAO estimates that there are roughly 1.5 billion hectares of cropland worldwide as of 2003. Using FAO harvest and area data for 74 major crops, the area of cropland needed to produce a given quantity of crop product is calculated. As described in Section 4, the accounts do not track activities that decrease the long-term productivity of cropland such as soil degradation, erosion, or salination. Although these processes will be reflected in future decreases in biocapacity, this decrease is not currently allocated to the activities producing this degradation today.

Grazing land

Raising animals for meat, hides, wool, and milk can entail the use of feed products grown on cropland, fishmeal from wild or farmed fish, and/or range land area for grazing. Worldwide, there are approximately 3.5 billion hectares of natural and semi-natural grassland and pasture. To calculate the grazing land Ecological Footprint of a livestock product, diet profiles are created to determine the mix of crop-based food, fishmeal, animal-based food, cropped grasses, and grazed grasses consumed by that type of livestock. The amount of grazing land demanded by a livestock product is calculated using the amount of pasture grass that is required to meet the total feed requirements of that product, after subtracting the other sources of feed used.

Fishing grounds

Harvesting fish and other marine products requires productive freshwater and marine fishing grounds. More than 95 per cent of marine fish catch is located on continental shelves, which, excluding inaccessible or unproductive waters, total 1.9 billion hectares. Marine areas outside continental shelves are currently excluded from Ecological Footprint accounts. Inland waters comprises an additional 0.4 billion hectares of available fishing grounds.

Catch data from the UN's Food and Agriculture Organization are used to estimate demand on fishing grounds, which is compared to an aggregate potential supply estimate of 93 million tonnes per year. Current accounts track both fish catch for direct human consumption and for fishmeal. An adjustment for bycatch is added to each country's reported catch.

Forest area

Harvesting timber products and fuelwood requires natural or plantation forests. Approximately 3.9 billion hectares of forests are available worldwide. The productivity of these forests is estimated using a variety of sources, primarily the Temperate and Boreal Forest Resource Assessment (TBFRA) and the Global Fibre Supply Model (GFSM). Consumption of roundwood and wood fuel are tracked along with four processed products – sawnwood, wood-based panels, paper and paperboard, and wood pulp.

Built-up land

Infrastructure for housing, transportation, and industrial production occupies built-up land. This space is the most poorly documented of all land use types, since the low-resolution satellite images available for most areas are not able to capture dispersed infrastructure and roads. Best estimates indicate a global total of 0.2 billion hectares of built-up land. Built-up land is assumed to have replaced cropland, as human settlements are predominantly located in the most fertile areas of a country.

Areas occupied by hydroelectric dams and reservoirs, used for the production of hydropower, are also counted within built-up land. The hydropower Footprint is calculated for each country using the average ratio of power output to inundated reservoir area for the world's 28 largest dams (Table 1).

Table 1: THE WORLD'S LARGEST HYDRO DAMS

Aguamilpa, Mexico	Guri, Venezuela	Sayanskaya, Russian Federation
Akosombo, Ghana	Ilha Solteira, Brazil	Sobradinho, Brazil
Aswan High Dam, Egypt	Itaipu, Brazil and Paraguay	Three Gorges, China
Balbina, Brazil	Jupia, Brazil	Três Marias, Brazil
Brokopondo, Suriname	Kariba, Zimbabwe and Zambia	Tucurui, Brazil
Carbora Bassa, Mozambique	Paredao, Brazil	Urra I and II, Colombia
Churchill Falls, Canada	Paulo Alfonso, Brazil	
Curua-una, Brazil	Pehuenche, Chile	
Furnas, Brazil	Rio Grande II, Colombia	
Grand Coulee, USA	Samuel, Brazil	
Guavio, Colombia	Sao Simao, Brazil	

Source: Goodland 1990 and WWF International 2000.

"Carbon land"

Humans add carbon dioxide to the atmosphere in a number of ways, including by burning fossil fuels. Several natural cycles remove carbon dioxide from the atmosphere, including ocean absorption and uptake of carbon dioxide by plants during photosynthesis. The Ecological Footprint of fossil fuel consumption is calculated by estimating the biologically productive area needed to assimilate this waste product of the human economy. In this calculation, the accounts first subtract an estimated 1.8 Giga tonnes of carbon that are sequestered by the oceans every year (IPCC 2001). Potential negative impacts of this absorption on marine biocapacity are not included in current accounts.

The biologically productive area required to absorb the carbon dioxide not sequestered by the oceans is then calculated using the carbon absorption potential of world average forest. Sequestration capacity changes with both the maturity and composition of forests and with possible shifts in bioproductivity due to higher atmospheric carbon dioxide levels. An alternate method, not employed in current accounts, would be to calculate sequestration based on the carbon absorption potential of world average bioproductive land, rather than just forests. As forests are understood to be the most efficient of all land types at long term sequestration of carbon, a method using world average land would result in a larger total carbon Footprint.

Estimates of the land required to produce biomass energy equivalent to fossil fuels yield similar, but larger, Carbon Footprints than the waste assimilation approach. Other possible methods for accounting for fossil fuel use include calculating the past biocapacity embodied in fossil fuels, which would result in significantly larger Footprint estimates.

Comment [jk8]: You mean like how much algae it took to make the fuel way back in the day?

Pending further research, each unit of energy produced by nuclear power is currently counted as equal in Footprint to a unit of energy produce by burning fossil fuels.

The carbon dioxide added to the atmosphere by human-induced land disturbances, such as slash-and-burn agricultural practices, is not currently accounted for in the Ecological Footprint, nor are the emissions of greenhouse gases other than carbon dioxide.

Comment [jk9]: You mention this above, but it is pretty important…

Embodied energy is the energy used during a product's entire life cycle in order to manufacture, transport, use and dispose of the product. The embodied energy in more than 600 categories of products is used with trade flows from the UN's COMTRADE database to generate estimates of the embodied carbon Footprint in traded goods.

7. NORMALIZING BIOPRODUCTIVE AREAS

In order to express Ecological Footprint results in a single measurement unit, global hectares, Ecological Footprint accounting normalizes different types of areas to account for differences in land and sea productivity. Equivalence factors and yield factors are used to convert actual areas in hectares of different land types into their equivalents numbers of global hectares. Equivalence and yield factors are applied to both Footprint and biocapacity calculations.

Equivalence factors translate a specific land type (i.e. cropland, pasture, forest, fishing ground) into a universal unit of biologically productive area, a global hectare. In 2003, for example, primary cropland had an equivalence factor of 2.21 (Table 4), indicating that primary cropland was more than twice as productive as a hectare of land with world average productivity. This same year, pasture had an equivalence factor of 0.49, showing that pasture was approximately half as productive as the average bioproductive hectare. The equivalence factor for built land is equal to that for cropland (see Section 5). Equivalence factors are calculated on a yearly basis.

Table 4: Equivalence Factors, 2003

Area Type	Equivalence Factor [gha/ha]
Primary Cropland	2.21
Forest	1.34
Grazing Land	0.49
Marine	0.36
Inland Water	0.36
Built	2.21

Yield factors account for the difference in production of a given land type across different nations. A hectare of pasture in New Zealand, for example, produces more meat on average than a hectare of pasture in Jordan. These differences may be due to natural factors, such as precipitation or soil quality, or management practices. To account for these differences, the yield factor compares the production of a specific land type in a nation to a world average hectare of the same land type. Each country and each year has its own set of yield factors. For example, Table 7 shows that, hectare by hectare, New Zealand's pastures are 2.5 times as productive as world average pastures. The yield factor for built land is assumed to be the same as that for cropland (see Section 5).

Table 7: Sample Yield Factors for Selected Countries, 2003

	Primary cropland	Forest	Grazing Land	Ocean Fisheries
World average yield	1.0	1.0	1.0	1.0
Algeria	0.6	0.0	0.7	0.8
Guatemala	1.0	1.4	2.9	0.2
Hungary	1.1	2.9	2.0	1.9
Japan	1.5	2.6	2.2	1.4
Jordan	1.0	0.0	0.4	0.8
Laos	0.8	0.2	2.7	1.0
New Zealand	2.2	2.5	2.5	0.2
Zambia	0.5	0.3	1.5	1.1

8. CONSTANT GLOBAL HECTARES

In Living Planet Report 2006, all time trends in Ecological Footprint and biocapacity are expressed in a modified unit, a "constant 2003 global hectare." These hectares are closely related to the standard year-specific "global hectare" that has been used in the past when showing time trends. The constant global hectare allows for a more detailed discussion of the factors that determine overshoot: it shows year-by-year changes in the *absolute* levels of both biological productivity and human demand. On average, productivity has increased over time. A 1961 global hectare, a hectare with world average productivity in 1961, produced fewer useful goods and services for humanity than a 2003 global hectare. As such, a "1961 global hectare" equals less than one "2003 global hectare". By taking into account annual changes in yield, constant global hectares more meaningfully depict future overshoot scenarios. 2003 was selected as the reference year, as this is the most recent data year in the current 2006 Edition of the National Footprint Accounts.

For 2003, the Ecological Footprint and biocapacity of the world, and of nations, is the same whether expressed in global hectares or in constant 2003 global hectares. In addition, the ratio between Footprint and biocapacity in any given year is unchanged regardless of whether the data is expressed in year-specific global hectares or in constant 2003 global hectares.

The ratio between the productivity of a 1961 global hectare and a constant 2003 global hectare is calculated by first taking the ratio of the biocapacity in 1961, expressed in standard 1961 global hectares, to the biocapacity in 1961 expressed in 2003 global hectares (this is done by using equivalence factors and yields from 2003). This ratio is then divided by the ratio of total bioproductive area in 1961 to total bioproductive area in 2003 to isolate the change in productivity between these two years. A draft memo documenting the calculation method behind the 2003 global hectare can be downloaded here.

Comment [JK10]: Link to 2003 gha memo.

This table gives the ratios that relate the production of a global hectare in any year to a 2003 global hectare. To convert from a "global hectare" in 1961 to a "2003 global hectare" in 1961, the "global hectare" value is multiplied by the ratio below.

Year	AreaTotGHA	BiocapTotGHA	Ratio
1961	10,566,772,462	9,074,133,049	86%
1962	10,588,530,488	9,141,593,869	86%
1963	10,598,624,791	9,136,295,059	86%
1964	10,609,717,416	9,198,714,701	86%
1965	10,616,609,178	9,213,236,239	86%
1966	10,628,201,742	9,327,572,123	87%
1967	10,642,577,457	9,378,805,992	88%
1968	10,654,838,968	9,446,243,168	88%
1969	10,679,210,071	9,495,323,096	89%
1970	10,691,230,044	9,566,154,349	89%
1971	10,705,666,300	9,662,634,334	90%
1972	10,723,133,546	9,620,987,264	89%
1973	10,741,059,289	9,782,362,705	91%
1974	10,757,836,864	9,724,653,190	90%
1975	10,767,983,437	9,724,376,413	90%
1976	10,770,426,600	9,849,300,492	91%
1977	10,777,610,491	9,883,336,378	91%
1978	10,783,921,297	9,976,530,235	92%
1979	10,801,143,734	10,003,985,731	92%
1980	10,816,980,774	9,978,191,719	92%
1981	10,826,751,413	10,086,290,165	93%
1982	10,842,907,078	10,231,275,005	94%
1983	10,864,443,571	10,238,414,530	94%
1984	10,887,791,909	10,409,462,304	95%
1985	10,923,550,603	10,470,415,489	95%
1986	10,953,680,781	10,504,866,451	96%
1987	10,975,013,706	10,542,823,100	96%
1988	11,004,207,358	10,496,052,070	95%
1989	11,022,172,157	10,624,428,859	96%
1990	11,036,144,689	10,766,514,373	97%
1991	11,040,036,676	10,677,430,205	96%
1992	11,112,435,716	10,776,965,466	97%
1993	11,143,262,184	10,793,605,061	96%
1994	11,157,958,021	10,866,713,472	97%
1995	11,157,667,830	10,811,782,885	97%
1996	11,160,302,556	10,987,183,486	98%
1997	11,161,039,147	11,036,297,903	98%
1998	11,167,982,398	11,083,540,773	99%
1999	11,177,166,645	11,127,465,019	99%
2000	11,188,005,400	11,147,985,069	99%
2001	11,203,176,815	11,227,899,513	100%
2002	11,197,216,912	11,198,348,487	100%
2003	11,193,231,992	11,237,141,310	100%

These conversion ratios are applied to adjust global and national *total* Footprint and biocapacity calculations. This adjustment, however, cannot be equally applied to all *components* of global or national Footprints, as the relative productivity of different land types has changed differently over time (while cropland yields have increased dramatically, the average increment on global forests has increased minimally, if at all). A fully robust method has not yet been developed to calculate a time trend for Footprint and biocapacity components (e.g., cropland, pasture, fishing grounds, etc.) in constant global hectares.

Eventually, this method will need to incorporate dynamic changes over time in the equivalence factors.

Where component time trends for the world were presented in LPR 2006, an estimated method was used. To estimate the component breakdowns, the total Footprint and biocapacity was first calculated in constant 2003 global hectares (using the conversion factors above). The constant 2003 global hectare value for each component in a given year was then calculated as the same percentage of the "2003 global hectare" total as it was of the "global hectare" total in that year (i.e., if cropland was 10% of total Footprint in 1980 expressed in global hectares, it was similarly calculated as 10% of total Footprint in 1980 expressed in constant 2003 global hectares).

9. CALCULATING ECOLOGICAL DEFICITS AND RESERVES

An **ecological deficit** represents the amount by which the Ecological Footprint of a population exceeds the available biocapacity of that population's territory in a given year. A national ecological deficit measures the amount by which a country's Footprint exceeds its biocapacity. A nation can operate its economy with an ecological deficit by importing biocapacity from other nations, by placing demands on the global commons (e.g., carbon stocks in the atmosphere, fishing in international waters), or by depleting its own domestic ecological assets. A global ecological deficit, however, cannot be offset through trade and inevitably leads to the depletion of ecological assets and/or the accumulation of wastes. The global ecological deficit is thus equivalent to the annual global overshoot.

Populations with an Ecological Footprint smaller than their available biocapacity run an **ecological reserve**, the opposite of an ecological deficit. This reserve is not necessarily unused, however, but may be occupied by the Footprints of other countries if that area is used for export production.

Ecological debt is the sum of annual ecological deficits that have accumulated over a period of time. The current global ecological debt can be expressed as the number of "planet-years" of ecological deficit the planet accrued since humanity entered into overshoot in the 1980s. One planet-year equals the total productivity of useful biological materials by the Earth in a given year.

10. SHRINK & SHARE

The current state of global overshoot highlights the need for reducing humanity's Ecological Footprint in order to avoid persistent depletion and, potentially, collapse of global ecosystems. Paths for reducing overshoot will need to be agreed upon, and reductions will need to be shared amongst all individuals and nations, since all share the use of the global biosphere. One approach to meeting these goals is "Shrink and Share." Shrink means reducing Ecological Footprints so that consumption of renewable resources does not exceed the regenerative capacity of Earth's productive ecosystems. This targeted reduction will need to consider whether a portion of the Earth's biocapacity should be allocated for the use of wild species and the preservation of biodiversity. Share refers to the way the Earth's biologically productive capacity is to be divided amongst individuals, nations, or regions.

The need for shrinking is evidenced by the current state of global overshoot. Sharing implies that some regions or nations will need to reduce their Footprints, but allows the potential for others to increase their Footprints in order to meet basic standards of living. To remain within the global ecological budget on a limited planet and avoid the long-term depletion of ecological capital, increases in demand in some regions will need to be offset by corresponding reductions elsewhere. Neither the 'Shrink' nor the 'Share' paths suggested by Ecological Footprint analysis make claims about what should be, what is ethical, or what is appropriate. They simply provide information on possible paths that global society could choose to take in the future.

Increases in biocapacity could help reduce the gap between demand and supply. These increases could be brought about by adding to the Earth's total bioproductive area—irrigating deserts, for example, or by increasing the yields of existing bioproductive areas. These increases must be carefully managed since the resources required can cause an increase in Footprint and negative impacts on biodiversity.

Further discussion on Shrink and Share scenarios and analysis, including the framework, data, and methods, can be found in Lovink et al. 2004, the *Living Planet Report 2006*, and Kitzes et al. 2007 (see references).

Comment [JK11]: Link to reference page