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INDICATORS FOR ASSESSING PROGRESS TOWARDS THE 2010 TARGET: TRENDS IN ABUNDANCE AND DISTRIBUTION OF SELECTED SPECIES

Note by the Executive Secretary

I. SUMMARY

1. Species population trend indices are valuable ways for monitoring and communicating biodiversity change at global, regional and (sub-) national scales or within biogeographic units. They can also be applied to taxonomic groups (e.g. birds), habitat-dependent species (e.g. waterfowl) or species with certain characteristics (e.g. migratory species). Species population trend indices can be built using existing biological data to show clearly understandable trends in species abundance and, by implication, the condition of the ecosystems in which they occur.

2. Two of the most well-known species population trend indices are the Living Planet Index and the European Farmland Bird Index.

3. The Living Planet Index (LPI) is an indicator of trends in populations of vertebrate species living in terrestrial, freshwater, and marine ecosystems around the world. The LPI currently incorporates data on approximately 3,000 population trends for more than 1 100 species. It combines three separate indices measuring changes in abundance of 555 terrestrial species, 323 freshwater species, and 267 marine species around the world. While the LPI fell by some 40% between 1970 and 2000, the terrestrial index fell by about 30%, the freshwater index by about 50%, and the marine index by around 30% over the same period (Figure 1).

4. Population trends of common and widespread bird species can serve as useful indicators of sustainable development, and in Europe and North America they are increasingly being used to support information about biodiversity loss. A recent initiative to generate the first pan-European indicators for common wildlife populations — data for 23 abundant and widespread bird species breeding in, and characteristic of, farmland — shows that the European farmland bird index declined by 34% between 1966 and 2002, with decline rates greatest in the late 1970s and early 1980s (Figure 2). It is widely

* UNEP/CBD/SBSTTA/10/1.

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accepted that these declines have been driven by agricultural intensification and the resulting deterioration of farmland habitats, and it is likely that the trends observed are mirrored by other farmland taxa.

Figure 1. Living Planet Index (modified from WWF 2004 1/)

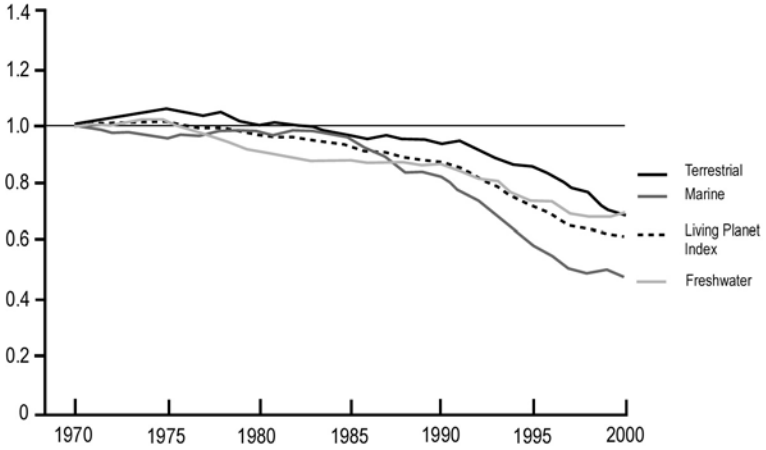
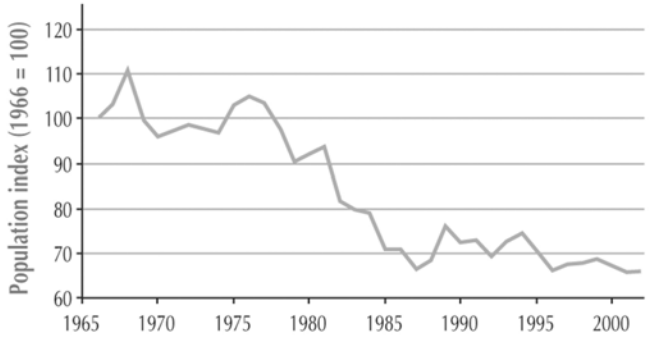


Figure 2. European farmland bird index (Birdlife International 2004 2/)



II. RELATION OF INDICATOR TO FOCAL AREA

5. Each species reacts differently to the various anthropogenic pressures that potentially impact the population size. By monitoring a large enough number of populations from different taxonomic groups, different biogeographic regions and areas subjected to different types and levels of pressures, this indicator has a potential to alert decision makers of the decline of populations in relation to environmental and geographic factors.

6. The indicator on trends in abundance and distribution of selected species provides a direct measure of changes of species status for well-monitored taxonomic groups. Biome- or ecosystem-specific data also provide an indicator of ecosystem quality, complementing the indicator on trends in ecosystem area. Species assemblage population indices are available for marine, freshwater and forest systems (aggregated as the Living Planet Index). Bird population indices also cover agricultural ecosystems. The Red List Index provides complementary information on trends in extinction risk. It can also be applied to different biomes and different taxonomic groups. The marine trophic index allows statements about

1/ WWF International. 2004. The Living Planet Report. J. Loh, M. Wackernagel (eds.), Gland, 40 pp.

2/ BirdLife International 2004. State of the world's birds 2004: indicators for our changing world. Cambridge, UK: BirdLife International.

changes in the population size and structure of marine fishes reflecting unsustainable fisheries. Invasive alien species compete with and reduce resident species populations.

7. Pollution and climate change are also recognized as drivers of biodiversity loss. Nitrogen deposition in nutrient-poor ecosystems favours a few populations while leading to the decrease and loss of a large proportion of other species. Eutrophication and other parameters assessed through the indicator on water quality have similar effects on inland and coastal waters. Along with efforts to reduce pollution and climate change, national, regional and global networks of protected areas represent one of the most effective measures to safeguard the populations of native species.

III. GENERAL DESCRIPTION

8. The Living Planet Index (LPI) is derived from trends over the past 30 years in approximately 3,000 populations of more than 1,100 species of species of birds, mammals, reptiles, amphibians and fish. The LPI combines three separate indices measuring changes in abundance of 555 terrestrial species, 323 freshwater species, and 267 marine species around the world. While the LPI fell by some 40% between 1970 and 2000, the terrestrial index fell by about 30%, the freshwater index by about 50%, and the marine index by around 30% over the same period (see Figure 1 above).

9. Similar trends have been observed for abundant and widespread bird species breeding on farmland throughout Europe (Figure 2 above). Through the Pan-European Common Bird Monitoring Scheme, initiated by the BirdLife Partnership in Europe and the European Bird Census Council regional indicators for common bird populations in Europe are being provided. Annual breeding bird survey data collated from 18 European countries are used to calculate regional indices for species, taking into account the proportion of the population occurring in each country. One such indicator has been produced by combining data for 23 abundant and widespread bird species breeding in, and characteristic of, farmland. The results show that the European farmland bird index declined by 34% between 1966 and 2002, with decline rates greatest in the late 1970s and early 1980s. 3/ It is widely accepted that these declines have been driven by agricultural intensification and the resulting deterioration of farmland habitats, and it is likely that the trends observed are mirrored by other farmland taxa.

10. In the United Kingdom, butterfly species have disappeared from 13% of their previously occupied 10-kilometre squares and over 70% have declined in population size in the last 20 years. Declines in birds and plants were less pronounced but insect populations typically respond more rapidly to adverse environmental change. 4/

11. Monitoring trends in population size of species from different taxonomic groups and with different ecological requirements (specialists, generalists, opportunists; different trophic levels; from different biomes and biogeographic regions) allows correlating, within certain confidence limits, species population trends with changes in anthropogenic pressures. The main drawback of this indicator is the limited number of species or populations for which time-series data exist and which have ongoing monitoring programmes. Relying to a large extent on charismatic species (elephants, rhinos, tigers etc.), for which such data exist, would insert an unhelpful bias as many of these species are subject of active conservation programmes.

3/ BirdLife International 2004. State of the world's birds 2004: indicators for our changing world. Cambridge, UK: BirdLife International.

4/ Thomas, J. A., M. G. Telfer, D. B. Roy, C. D. Preston, J. J. D. Greenwood, J. Asher, R. Fox, R. T. Clarke, and J. H. Lawton. 2004. Comparative Losses of British Butterflies, Birds, and Plants and the Global Extinction Crisis. Science 19 (303): 1879-1881.

IV. POLICY RELEVANCE

12. *Trends in abundance and distribution of selected species* are indicators to assess the achievement of target 2.1 (Restore, maintain, or reduce the decline of populations of species of selected taxonomic groups) set out in the framework of goals and sub-targets adopted in decision VII/30. Since data on population trends are the basis of monitoring the status of threatened species this indicator also links to target 2.2 (Status of threatened species improved) and target 4.3 (No species of wild flora or fauna endangered by international trade). Habitat degradation and loss being the main causes of changes in population sizes of species and of shifts in species composition, this indicator is also relevant to targets 1.1 (At least 10 per cent of each of the world's ecological regions effectively conserved) and 1.2 (Areas of particular importance to biodiversity protected).

13. The 2002 World Summit on Sustainable Development acknowledged the loss of biodiversity as one of the major problems facing humanity at the start of the 21st century. Its Plan of Implementation called on action at all levels so that by 2010 measures would have been put in place to halt biodiversity loss and a significant reduction in the rate of biodiversity loss would have been achieved.

14. The following factors underline the relevance of the indicator for decision making and communication:

(a) Strong public support for saving threatened species or groups of species;

(b) Concept easily understood;

(c) Understanding species habitat requirements allows us to determine potential reasons for population declines and to formulate management recommendations that enable us to maintain viable populations;

(d) Allows the general public to participate, e.g. in bird counts, which each year unites thousands of volunteers in different countries;

(e) Transnational effort where migratory species are concerned;

(f) Draws attention to less charismatic animal and plant species;

(g) Important to design efficient monitoring programmes from which policy relevant statistics can be produced;

(h) Monitoring population trends in order to grasp dynamic and seasonal component of biodiversity;

(i) Assembly indicators to make best use of what is available;

(j) Use of common standards.

15. A representative set of species or a group of sensitive habitat-specific (indicator) species with narrow ecological amplitude can also provide a measure of ecosystem quality.

16. Even the best-case scenario indicates that at least 11.5 per cent (31,195 out of an estimated 270,000 species) of the world's vascular flora is under threat. However it must be recognized that irrespective of the figures used, the situation in reality is much worse due to the major gaps of knowledge about plants, from different regions or taxonomic groups, as well as a conservation point of view. This is particularly accentuated in the tropics. 5/

17. No international targets have been established for this specific indicator. Targets exist for selected taxa.

5/ http://www.unep-wcmc.org/index.html?http://www.unep-wcmc.org/species/plants/species_counts.htm~main.

18. Where migratory and/or threatened species are used to calculate the index, the indicator relates to the Convention on the Conservation of Migratory Species of which animals (CMS) and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

V. TECHNICAL INFORMATION 6/

19. The Living Planet Index (LPI) is derived from trends over the past 30 years. It uses data on 555 terrestrial species, 323 freshwater species, and 267 marine species of birds, mammals, reptiles, amphibians and fish. The LPI was first developed in 1997 by the World Wide Fund for Nature (WWF) and the World Conservation Monitoring Centre of the United Nation Environment Programme (UNEP-WCMC) and published in 1998 in the Living Planet Report 7/, as a contribution to the WWF Living Planet Campaign. It was originally conceived as an attempt to answer the question, "how fast is nature disappearing?" The aim was not to design in the abstract the best possible indicator of biodiversity change, but to implement a system that makes effective and quantitative use of the imperfect data that are available. After several attempts to design an index that could shed some light on this question, the LPI was formulated. The LPI is an index based on an underlying dataset of population trends in a large number of animal species from all around the world. The LPI has gradually evolved since 1998, and the number of species in the underlying dataset has increased considerably.

20. While in previous years the basic methodology for calculating the index had not changed very much, it was modified for the 2004 report. This allows a higher temporal resolution with population changes calculated an annual rather than a five-yearly basis. As there are relatively few data points from recent years, the index does not extend beyond the year 2000. The index is now more robust than its earlier versions but the results presented remain consistent.

A. Data collection

21. The species population data used to calculate the index were gathered from a variety of sources published in scientific journals, NGO literature, or on the worldwide web. Any data used in constructing the index had to be a time series of either population size or a proxy of population size. Some data are total population estimates such as counts of an entire species, others are density measures, for example the number of birds per km of transect, some are biomass or stock estimates, particularly for commercial fish species, and others are proxies of population size, such as the number of nests of marine turtle species on various nesting beaches.

22. All population time series have at least two data points, and most have more than two, collected by methods that are comparable across years, so that it is possible to determine a trend. A population estimate taken at one point in time would not be used with a second estimate from another survey of the same population at another point in time, unless it was clear that the second was meant to be comparable with the first. Plants and invertebrates were excluded, as few population time series data were available. It is assumed, therefore, that trends in vertebrate populations are indicative of overall trends in global biodiversity.

B. Calculation of the indices

23. For each species, the ratio between its population in each pair of consecutive years was calculated. To calculate the index in a given year, the geometric mean of the all the ratios of species populations in that year and the previous year was multiplied by the index value of the previous year. The

6/ Based on: Jenkins, M, Kapos, V. and Loh, J. 2004. Rising to the Biodiversity Challenge. The role of Species Population Trend Indices such as the Living Planet Index in tracking progress towards global and national biodiversity targets. Draft discussion paper prepared for the seventh meeting of the Conference of the Parties, February 2004.

7/ Loh, J., et.al. 1998. Living Planet Report, WWF International, Gland.

index value was set equal to 1 in 1970. Therefore the index starts at 1 then changes from year to year in line with the geometric mean of all the changes in population of each species with population data in both years.

24. In cases where data were collected for more than one population of a single species, or where more than one time series was collected for the same population, the geometric mean of all ratios for that species was used in the calculations instead of multiple series of ratios.

25. More species population data are available from temperate than tropical regions of the world, whereas species richness is higher in the tropics. If the LPI were calculated simply as described above, then it would be unrepresentative of global biodiversity. Therefore, before carrying out any calculations, the data were divided up by biome – terrestrial, freshwater or marine – depending on the principle habitat of the species. Where a species commonly occurs in more than one biome, its breeding habitat was used to determine its biome. Then, within each biome, species were divided up according to the biogeographic realm or ocean they inhabit: Afrotropical, Australasian, Indo-Malayan, Nearctic, Neotropical or Palearctic realms for terrestrial and freshwater species; Atlantic/Arctic, Pacific, Indian or Southern Oceans for marine species. For some species, different populations would occur within different realms or oceans, in which case the populations would be divided accordingly. The total numbers of species contributing to each realm/ocean and biome are given in Table 1.

Table 1. Numbers of species included in the LPI by realm/ocean and biome

Realm or Ocean	**Terrestrial**	**Freshwater**	**Marine**
Australasian	15	11	
Afrotropical	72	12	
Indo-Malayan	28	19	
Nearctic	269	168	
Neotropical	19	12	
Palearctic	159	101	
Atlantic/Arctic Ocean			117
Indian Ocean/Southeast Asia			15
Pacific Ocean			105
Southern Ocean			30
Total	**562**	**323**	**267**

26. Separate indices were first calculated for each biogeographic realm (one each for terrestrial and freshwater) and ocean. The terrestrial and freshwater species indices were then calculated as the geometric mean of the six biogeographic realm indices within each biome, and the marine species index was calculated as the geometric mean of the four ocean indices. Thus the terrestrial species index includes 562 species of mammals, birds and reptiles found in forest, grassland, savanna, desert or tundra ecosystems worldwide. The freshwater species index comprises 323 species of mammals, birds, reptiles,

amphibians and fish living in rivers, lakes or wetland ecosystems. The marine species index includes 267 species of mammals, birds, reptiles and fish from the world's oceans, seas and coastal ecosystems. The LPI is the geometric mean of the terrestrial, freshwater, and marine species indices.

27. The advantages of species population trend indices such as the LPI are as follows:

(a) Population trend indices are easy to understand, easy to communicate and transparent. They simply show the average change in the abundance of a large number of species over time. They are easy to communicate to a non-scientific audience without a lengthy prior explanation of what they measure, and are analogous to well-known stock market indices like the FTSE or Dow Jones. It is also easy to make the indices transparent by listing the species populations included in them;

(b) Importantly, data exist going back to the 1970s for many species, and even earlier for some species. The dataset collected by WWF/WCMC now includes some 3,000 population time-series, and it is certainly not exhaustive. The existence of reasonably long time-series is crucial for monitoring progress towards the 2010 target;

(c) Species population trend indices can be indicators of more than just the state of the species in the index: they can also serve as proxies for the healthy functioning of the ecosystems the species live in. Therefore they can be used as biodiversity indices in a broader sense than a measure of the state of species only;

(d) Species population trend indices can be constructed as indicators of biodiversity at any level: national, regional or global; by biome or biogeographic realm; for any ecosystem large or small. The only constraint on the application of such indices is the availability of time-series population data;

(e) It is very easy to aggregate and disaggregate species population trend indices up into big-picture "headline" indicators or down into their component parts.

28. The main limitation of the Living Planet Index is the limited amount of reliable time-series data available to calculate trends and the limited taxonomic coverage. In addition to the calculation of trends by ecosystem type one could also analyse trends to taxonomic group and by species ecology. This has been addressed in part in the 2004 LPI report by presenting trends of selected individual species from different geographic areas and trends for some ecosystem types (e.g. a grassland, savanna, desert, and tundra species population index).

29. Until now the Living Planet Index has been updated on an ad hoc basis, whereby with each iteration of the Living Planet Report any additional species population time-series data that were collected have been included in the underlying dataset. Any biases in the underlying dataset were then compensated for by weighting regions and biomes on an equal basis. However, for species population trend indices to be used as a tool for tracking progress towards the 2010 target, regular monitoring of a sufficiently large number of species must be undertaken or otherwise guaranteed in order to ensure the necessary data will be available in future years.

30. Birds are valuable indicator species for biodiversity conservation for a number of reasons. Birds have widespread popular appeal and therefore make good flagship species for mobilizing volunteer-based monitoring networks, as well as for education and advocacy within civil society. They occupy a very broad range of ecosystems, have varied natural histories and are widely dispersed in all regions and countries of the world. They are high in the food chain, thus integrating changes at lower levels. Moreover, birds are the best known and documented major taxonomic group, especially in terms of the sizes and trends of populations and distributions, and the number of species (c.10,000) is manageable, thereby permitting comprehensive and rigorous analyses.

31. Trend information for the Pan-European Common Bird Monitoring Scheme was derived from annually operated national breeding bird surveys spanning different periods from 18 European countries. A software package named TRIM (which allows for missing counts in the time series and thus yields unbiased yearly indices and standard errors using Poisson regression) was used to calculate national species' indices and then to combine these into supranational indices for species, weighted by estimates of national population sizes. Weighting recognized the fact that different countries hold different proportions of each species' European population. Supranational indices for species were then combined (on a geometric scale) to create multi-species indicators, fixed (for the purpose of presentation) to a value of 100 in 1980. Although national schemes differ in count methods in the field, these differences do not influence the supranational results, because the indices are standardized before being combined.

32. The Pan-European Common Bird Monitoring Scheme collates national data in a harmonized way from a European network of ornithologists. It aims to increase both the number of countries collecting and submitting data on trends, and the number of bird species covered, to help develop and promote biodiversity indicators in Europe. More widely, the project aims to improve the scientific standard of bird monitoring across Europe by fostering co-operation and the sharing of best practice and expertise.

33. While data for birds are generally more available than those for any other taxonomic group, no global farmland bird index can as yet be calculated. Several other indicators are available for birds alone but few of these can be applied to other taxonomic groups.

34. Data on changes in geographic distribution (presence/absence data mapped over time) are available for plants only in a few countries.

35. There are a number of constraints on the ability to generate species population trend indices owing to uneven coverage of the available data. The biases are geographical, taxonomic and ecological.

36. More population data are available for developed countries than developing countries. Some countries in Europe and North America have datasets of species populations going back many years based on annual censuses and surveys, but these are exceptional. For most of rest of the world, data availability is patchy.

37. Among terrestrial ecosystems, more population data are available for grassland species than forest species (largely because they are easier to count), and among aquatic ecosystems more data are available for marine than freshwater species, with the exception of water birds. Species which have good time-series population data are those which have been subject to long-standing monitoring efforts, whether because they are commercially important, of conservation interest, or simply easier to count.

38. These data constraints have important implications for the application of species population trend indices in some of the most biodiverse regions of the world, particularly tropical moist forests, where high levels of diversity mean that almost every species is rare, and animals are hard to count.

39. Because of the lag between collection and publication of census data, there are always relatively few data available for the most recent time interval.

VI. EXAMPLES OF USE OF INDICATOR AT NATIONAL/REGIONAL LEVEL *8*/

40. Full-scale species population trend indices have already been applied to monitor changes in biodiversity and progress towards biodiversity targets at national level. For Uganda, the Makerere University Institute of Environment and Natural Resources has calculated indices based on the methodology of the Living Planet Index. According to these calculations, the overall " Living Uganda Index" has declined by 35 per cent between 1970 and 2000. In the same period the Savanna species populations index, which shows the most severe decline of all biomes, has declines by over 80 per cent.

41. Both the United Kingdom and the Netherlands have embraced these approaches for generating national level indicators. In the UK, the Department for Environment, Farming and Rural Affairs, which has responsibility for biodiversity issues at both national and international levels, has adopted an index of trends in bird populations as one of 15 headline indicators of sustainable development. This index, which is based on data from the Common Bird Census and other sources, applies essentially the same approach used in the Living Planet Index to population trends in 105 UK bird species since 1970. The resulting "headline indicator" is considered to reflect trends in UK biodiversity more generally. Although the overall trend appears to be reasonably stable, disaggregation to explore trends in particular groups of species shows marked long-term declines in both woodland and farmland species. Addressing these declines is now the basis for Government targets in countryside management.

42. The Netherlands has also applied similar approaches to data on bird, butterfly and reptile species to explore trends in biodiversity in a number of ecosystem types. A number of developed countries such as Finland use trends in individual bird species to highlight biodiversity trends without generating indices.

VII. SUGGESTIONS FOR IMPROVEMENT OF THE INDICATOR

43. While indices can be calculated on the basis of any number of populations it is evident that the results will be more reliable if one (i) can draw from a greater number of population trend data; (ii) have a more representative sample, and (iii) ensure that species-based indices increasingly use the same data sets and sources, to reduce duplication and ensure the full use of available information. There are a number of ways in which this can be obtained. The most important are:

(a) Improving access to existing data, including those in academic and in grey literature and data held in site and project records;

(b) Promoting collaboration between partner organizations in collecting and sharing information relevant to the indicator;

(c) Making use of small data sets and employing expert-based approaches;

(d) Increasing monitoring activity by encouraging, and providing guidance for amateur networks, resource managers and project implementers to provide data, and by ensuring that adequate financial resources are available to support monitoring;

8/ Jenkins, M, Kapos, V. and Loh, J. 2004. Rising to the biodiversity challenge. The role of species population trend indices such as the Living Planet Index in tracking progress towards global and national biodiversity targets. Draft discussion paper prepared for the seventh meeting of the Conference of the Parties to the Convention on Biological Diversity, February 2004.

(e) Clearly defining criteria for the selection of species or populations included in the calculation of an index;

(f) There should be consistency between the LPI and the Red List index regarding the calculation and some overlap in the species considered.

44. Secondly, mechanisms need to be established to ensure that the data are collected, maintained and analysed appropriately so that reliable and relevant indicators can be produced at regular intervals to monitor progress towards policy targets. This is as much an institutional problem as a technical one: it requires data-holders to be willing to share their data, and one or more institutions at whatever level (national, regional, global) to be prepared to manage these data with the agreement of all data-providers. However, the successful production and dissemination of indicators should in itself provide a powerful incentive to existing data owners to generate and share their data for these purposes. Production of indicators should also serve to boost existing and planned monitoring efforts, by giving them a clear application. If the data are largely based on voluntary monitoring efforts (as is already sometimes the case), then this should also help to build constituencies for conservation at grass-roots level.

45. While establishing a worldwide monitoring network for biodiversity that comprehensively samples all biomes and ecosystems is clearly a daunting undertaking, experience with the global LPI and in a small number of individual countries has shown that basic but nevertheless useful indicators can be developed quite quickly and easily. If all countries, and indeed individual institutions involved in the conservation and management of natural resources, were to bring together their existing information to produce local or national indices and contribute to international efforts, a major start would have been achieved in monitoring progress towards the 2010 target. 9/ Evidence suggests, that a more systematic process of data searching which involves appropriate agencies in many countries could lead to far more information becoming available than is currently being utilized.

9/ See also: Balmford, A., R.E. Green, M. Jenkins. 2003. Measuring the changing state of nature. Trends in Ecology and Evolution 18: 326-330.