1. **INDICATOR**

(a) **Name:** Abundance of Selected Key Species.

(b) **Brief Definition:** This indicator uses estimates of population trends in selected species to represent changes in biodiversity, and the relative effectiveness of measures to maintain biodiversity. The indicator can be applied to individual species groups (e.g. birds, butterflies), or can be aggregated to incorporate a number of taxa (e.g. in a fashion similar to the Living Planet Index), according to data availability and indicator applicability.

(c) **Unit of Measurement:** Number of mature individuals or other relevant indicator of abundance within a given area or population.

(d) **Placement in the CSD Indicator Set:** Biodiversity/Species.

2. **POLICY RELEVANCE**

(a) **Purpose:** The indicator has the potential to illustrate the effectiveness of national measures designed to conserve biological diversity and ensure its use is sustainable, including the measures implemented in fulfilment of obligations accepted under the Convention on Biological Diversity (CBD).

(b) **Relevance to Sustainable/Unsustainable Development (theme/sub-theme):** The CBD recognises that biodiversity has its own intrinsic value and that biodiversity maintenance is essential for human life and sustainable development. Many biological resources, at gene, species and ecosystem level, are currently at risk of modification, damage or loss.

(c) **International Conventions and Agreements:** The conservation of biological diversity and the sustainable use of its components are among the primary objectives of the Convention on Biological Diversity. This indicator is of particular relevance to several articles of the CBD, e.g., Article 6 - General measures for conservation and sustainable use; Article 7 - Identification and monitoring; and Article 10 - Sustainable use of components of biological diversity.

This indicator is relevant to many other global agreements for which the maintenance of biological diversity is important, including: Convention on the Conservation of Migratory Species of Wild Animals (Bonn); [Convention on International Trade in Endangered Species (CITES)]; United Nations Convention on the Law of the Sea (UNCLOS); Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar); International Convention for the Regulation of Whaling.
Related regional conventions and agreements include: Convention on the conservation of European wildlife and natural habitats (Berne); Program for the Conservation of Arctic Flora and Fauna (CAFF); Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR); Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA).

(d) **International Targets/Recommended Standards:** The international community has committed “to achieve a significant reduction of the current rate of biodiversity loss at the global, regional, and national level as a contribution to poverty alleviation and to the benefit of all life on earth by 2010”. This “2010 Target” was formally adopted by governments at the 6th Conference of the Parties of the Convention on Biological Diversity in 2002, and endorsed later that year at the World Summit on Sustainable Development. The 2010 target, and the targets relating to the general objectives of the CBD, relate specifically to Parties to the Convention on Biological Diversity, but could also be used as a guide for non-Party states.

(e) **Linkages to Other Indicators:** This indicator can be linked to the majority of the CSD Environmental Core Indicators, eg. annual fisheries catch by major species. There may also be indirect links to social indicators, such as changes in human population. This indicator is also directly related to the suite of indicators measuring progress towards the CBD’s target to reduce the rate of biodiversity loss by 2010, which are being implemented by the members of the 2010 Biodiversity Indicators Partnership (2010BIP; www.twentyten.net). It particularly relates to the indicator on “Trends in abundance and distribution of selected species”, which includes the Living Planet Index (LPI) and associated population indices, and the Global Wild Bird Index.

3. **METHODOLOGICAL DESCRIPTION**

(a) **Underlying Definitions and Concepts:** Few of the concepts and definitions are as yet clearly and consistently applied. Some important points are noted below.

‘Abundance’ - This may be defined as the number of mature individuals within the population or area under study. Where it is difficult or inappropriate to survey individuals, comparable surrogate units of measurement, such as number of nests (marine turtles) or spawning stock biomass (fishes), may be acceptable.

‘Key species’ - It is possible to suggest general criteria for selecting key species, but it will be the responsibility of nations to undertake this selection. This should be done in a consultative way that ensures that regional and global interests are evaluated in addition to national priorities. No single organism or related group of organisms can be expected to reflect comprehensively the patterns of distribution and abundance of all other taxa, and effective biodiversity indicators are likely in most cases to be based on an indicator group composed of several appropriate species. The following categories of species might be considered as ‘key species’ when developing a biodiversity monitoring programme:

**Keystone species:** A taxon whose impact on the ecosystem or community studied is disproportionately large relative to its abundance (Caro and O’Doherty, 1998). The loss
of these species will significantly impact upon the population sizes of other species in
the ecosystem, potentially leading to further species loss ('cascade effect').

**Rare or locally endemic species**: Any area contributes to global biodiversity by the
overall number of different species within it (and the different higher taxa that are
represented), and by the proportion of those that do not occur anywhere else (species
endemic to the area). Conservation of endemic species, particularly those sharing a
discrete geographic area, can be a cost-effective way to maintain global biodiversity
levels.

**Threatened species**: By definition, a threatened species represents actual or
potential decline in biodiversity, and recovery of threatened species following
management intervention is strongly indicative of successful conservation measures.
Any candidate ‘key species’ selected from the above categories, or whatever other
categories may be deemed appropriate, can be further selected on the basis of other
more general biological and logistic criteria. The following are among the characteristics
that effective indicator species are likely to possess (e.g., Noss, 1990; Pearson, 1994):

- taxonomically well known, so that populations can be reliably identified, usually
  in the field,
- biologically well understood,
- easy to survey (e.g., abundant, non-cryptic),
- widely distributed at higher taxonomic levels (e.g., order, family, tribe, genus)
  across a large geographic and habitat range,
- diverse and include many specialist taxa at lower taxonomic levels (e.g., species
  or species populations) which would be sensitive to habitat change,
- representative to some extent of distribution and abundance patterns in other
  related and unrelated taxa,
- actually or potentially of economic importance.

(b) **Measurement Methods**: Information on species abundance should be collected
through the consistent, long-term, application of an appropriate survey technique that is
widely accepted by the scientific community. Examples of publications with details of
field study methodologies for certain groups are given below. Retrospective population
information may be obtained through review of published literature, including previous
field study reports, seeking material that is appropriate for comparison with the ongoing
methodologies adopted.

While it is in most cases impossible to count every individual within a population or
area, a knowledge of habitat requirements and species population density in sample
areas, coupled with data on climate, altitude, soil type or vegetation cover may be used
to estimate population size in the area of interest. A geographic information system
(GIS) is commonly used to analyse the spatial data. It is important that population size
predictions are verified by fieldwork.

This indicator will be better capable of international integration if, after recording,
abundance values are processed in a way that minimises or avoids the effects of
different scales of change in species that are biologically very different. For example,
raw abundance values derived from a large terrestrial predator and from Antarctic krill would need to be measured on scales possibly several orders of magnitude apart, making any comparison between them meaningless. This also bears on national selection of key species, whenever the goal is to derive a single integrated national indicator value for biodiversity change over time.

By definition, monitoring of indicator species will be a continuing process, but for studies within a set timeframe, species should have a life history that complements this period, i.e., there may be little benefit from attempting to monitor very long-lived species over a five-year period only. For studies within a set area it is preferable to avoid selecting taxa that are directly influenced by external events, for example species that annually migrate outside of the study area. For many purposes, it will be preferable to avoid species that show high amplitude annual or irregular variation in population number.

(c) Limitations of the Indicator: Application of this indicator is constrained by several factors, but these can mostly be overcome if resources and personnel are available. The main factor preventing the immediate and widespread application of this indicator is the scarcity of suitable time-series of population data. In practice, change in biodiversity at species and habitat level has to date very often been identified retrospectively, on an ad hoc basis, by means of largely anecdotal evidence, and using terms and units of measurement that are highly case-specific. A structured monitoring framework is preferred, with a secure project lifetime of many years. For comparative purposes, perhaps seeking to build a comprehensive continental or global picture from national data, it is important that similar parameters are measured in similar terms. Care should be taken in interpreting the results of studies based on indicator groups, since the empirical relationship between biodiversity in different groups of organisms has been little investigated.

It is important to note that more species population data are available from temperate than tropical regions of the world, whereas species richness is higher in the tropics. Aside from the issue of data availability this does not have the same implications for national-scale indicators as it does for regional or global aggregate indices. The LPI overcomes this problem by dividing data by biome (terrestrial/freshwater/marine) depending on the principle habitat of the species, and then according to the biogeographic realm or ocean they inhabit.

(d) Status of the Methodology: No single practicable and universally accepted methodology for national-level indicators of abundance of selected key species currently exists. However, through the Living Planet Index, UNEP-WCMC and WWF (Loh et al. 1998, 1999, 2000, 2005) have designed and implemented a system to generate indicators of biodiversity change over time, principally at global or continental level. Output from this system was first used in the WWF Living Planet Report 1998 and has been regularly updated since then (in 2000, 2002 and 2004). This method is designed to make use of the very imperfect data that are available. The index value for each period is derived by normalising the geometric mean change over the period in the sample of populations. A line graph of these index values provides an indicator of biodiversity change. In
principle, range area could be used where population counts are not available. This system is limited ultimately by the number of populations for which quantitative size (or area) estimates are available.

BirdLife International’s Wild Bird Index (WBI) (Gregory et al, 2003, 2004, 2005; Roberts et al 2005; van Strien 2001) measures average population trends of a suite of representative wild birds, as an indicator of the general health of the wider environment. The WBI can be disaggregated geographically and by habitat for analysis, interpretation and communication. The methodology is already well developed and has been peer-reviewed. The WBI is currently used in Europe to measure aspects of sustainable human development, and is in the process of being expanded to the global scale.

A similar method has been used in the UK Government’s indicators programme (see http://www.environment.detr.gov.uk/sustainable/) to show population change in bird groups. Other related approaches have been used, and several other proposed biodiversity indicators remain at the design stage.

(e) Alternative Definitions/Indicators: The percentage of a country’s flora or fauna that is categorised as threatened with extinction provides a static view of the status of national biodiversity, and change over time in this proportion, or the changing membership of particular status categories (e.g., ‘Extinct in the Wild’ or ‘Critically Endangered’), could illustrate the effectiveness of measures for maintaining particular elements of biological diversity. This approach requires a stable species-level taxonomy, and a standard system for assessing conservation status. The IUCN Red List Categories and Criteria offer such a system (see indicator Assessment of Threatened Species). This indicator is only of value if changes in Red List Categories can be attributed to actual change in the conservation status of species, rather than changes in taxonomy or in the availability of information, for example.

Permanent reduction in habitat area or quality will tend to lead to loss of some species originally present. Therefore, indicators of change in habitat area and quality (assessment of the latter is problematic) also have the potential to indicate change in overall biodiversity.

4. ASSESSMENT OF DATA

(a) Data Needed to Compile the Indicator: The preferred input would be sets of quantitative data on the population size (or proxy of population size) of selected species within a given area, assessed at suitable time intervals using a standardised method. Data can include total population estimates (e.g. counts of an entire species), direct measures (e.g. the number of birds per km of transect), biomass or stock estimates (e.g. for commercial fish species), and proxies of population size (e.g. number of nests of marine turtle species on various nesting beaches).

(b) National and International Data Availability and Sources: In the absence of any comprehensive global programme for species monitoring, and of universal standards for national monitoring, suitable data are in relatively short supply. Several developed countries hold data that would be suitable as a basis for this indicator. These data have
variously been collected by amateur field biologists or as part of official monitoring programmes. It is in some cases probable that much more information exists with individuals, groups and organisations than is generally known, and the problem is thus one of gaining access to suitable data. However, although the number of field surveys and biodiversity assessments has increased greatly in recent years, very little true monitoring has taken place in developing countries or biodiversity-rich countries in the tropics. These are the nations most likely to face difficulties in developing monitoring programmes, but also to be much in need of them. By far the greatest volume of readily available time-series data relate to stock estimates and catch levels (the latter not usually suitable for abundance estimation) in the marine fish populations targeted by industrialised fisheries of developed countries. The various management bodies are often sources of these data. The bird species that are surveyed regularly by networks of mainly amateur ornithologists in developed countries are by far the best-known large terrestrial group. Suggestions for taxa that can be focused upon therefore include farmland and woodland birds, as well as butterflies which are also well-surveyed in a number of countries.

(c) **Data References:** Selected references only are mentioned as a general guide to the kinds of work that exist in this field. Population data and analytic tools for birds and other groups can be accessed at the website of the United States Geological Survey Patuxent Wildlife Research Centre ([http://www.pwrc.usgs.gov](http://www.pwrc.usgs.gov)), and see, for example, Sauer et al., 2000. Bird populations are the focus of one headline indicator in the UK Government’s strategy for sustainable development: DETR Government Statistical Service, 1999, *Indicators for a Strategy of Sustainable Development for the UK: a baseline assessment*. Extensive documentation on fish populations in the North Atlantic region is available at the website of the International Council for the Exploration of the Sea (ICES) ([http://www.ices.dk](http://www.ices.dk)). Results of the Living Planet Index methodology are presented in Loh et al. (1998, 1999, 2000). The methodology and results have been published and peer-reviewed (Loh et al 2005).

5. **AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR**

(a) **Lead Agency:** The lead agencies are the UNEP World Conservation Monitoring Centre (UNEP-WCMC), and the World Wide Fund for Nature (WWF International) and Zoological Society of London (ZSL) who are jointly responsible for the Living Planet Index.

(b) **Other Contributing Organisations:** The number of other organisations and individuals with the potential to contribute data or advice, or otherwise interested in further development of this indicator is very large. At global level, they would include *inter alia:* the Secretariat of the Convention on Biological Diversity (CBD), BirdLife International, and IUCN – The World Conservation Union. Other concerned organisations include the Organisation for Economic Cooperation and Development (OECD), the National Institute of Public Health and the Environment (RIVM) in The Netherlands.

6. **REFERENCES**
(a) Readings:


Field study guidelines:


(b) Internet sites:

http://www.biodiv.org/
http://www.ices.dk
http://www.iucn.org/themes/ssc/guidelines.htm
http://www.redlist.org/
http://www.unep-wcmc.org/species/reports/
http://www.wri.org/wri/biodiv/cascade.html