Toward a global biodiversity observation network

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Understanding, monitoring and conserving biodiversity is one of the nine societal benefit areas of GEOSS because biodiversity, or the variety of life on earth, makes up and sustains all life processes of the biosphere. Therefore, biodiversity contributes both utilitarian values, such as ecosystem goods and services, as well as intrinsic values, such as aesthetic enjoyment and a sense of identity, to human well-being.

Current scientific evidence overwhelmingly demonstrates a continued decline in the status of biodiversity, because it is almost invariably impacted negatively by unsustainable human resource consumption. Such declining trends lead to reduced benefits for people and increasingly limited opportunities for development and livelihood options in the short and long term, as well as increasing occurrences of sudden negative changes in the world's ecosystems and life processes. Further understanding of biodiversity change is therefore critical if decision-makers at all scales, as well as the public, are to be informed about the global scale of biodiversity degradation, and the consequences of such degradation on ecosystem services and human well-being.

A wide range of user groups began a process to express their needs for biodiversity observation data at a GEOSS-DIVERSITAS workshop in 2006. Those present included users of natural resources (e.g. agriculture, forestry, fisheries), the health sector (e.g. infectious diseases, emerging pathogens, allergy forecasts), the genetics sector (e.g. bio safety aspects, genetically manipulated organisms, genetic diversity of cultivars), the conservation planning community (e.g. species and ecosystems change, conservation management) and several international treaties (e.g. CBD, CCD, CMS, Ramsar).

As a result of the workshop, the GEO Biodiversity Observation Network was established as a global partnership to collect, manage, analyse and report on the status and trends of the world's biodiversity. The network will provide a scientifically robust framework for global biodiversity monitoring and define a strategy to reach network goals and objectives. In broad strokes, these objectives are:

- Bring together biodiversity data and information from many different provider communities (e.g. museums, remote sensing, intensive plot-type monitoring systems) and existing networks of such communities
- Ascertain data requirements of user groups, develop new analytical tools, and facilitate interoperability among information system components and the interconnectivity of databases
- Establish a global biodiversity observation mechanism and data clearinghouse, supervized by an independent advisory board and supported by adequate long-term international funding.
- Review and prioritize research spatially and topically by identifying 1) gaps in methodological, taxonomic, regional or ecosystematic knowledge, and 2) those ecosystems particularly important for the supply of ecosystem services.
- Assess biodiversity at both the species and ecosystems level, and thereby identify priorities for global conservation, such as unique or highly diverse ecosystems, those supporting migratory, endemic or globally threatened species, and then use this information to guide global conservation priorities
- Generate regular reports of global biodiversity trends, including not only species and ecosystem trends, but also associated ecosystem goods and services vital to human well-being, as well as associated threats and drivers of biodiversity change, such as habitat conversion, climate change, pollution etc.
- Communicate the importance of 'biodiversity change' to human well-being so that the status of 'biodiversity change' in the public discourse is elevated to that currently held on climate change.
- Design decision support systems that integrate monitoring with ecological modelling and forecasting; these can then be used to generate future biodiversity scenarios which will provide essential information for the sustainable use and management of biodiversity, including analysis, prediction, early warning, conservation planning, policy making, and management effectiveness evaluation
- Make these data, tools, analytical products and reports available through the GEOSS web portal.

Another important strategic goal of the GEO Biodiversity Observation Network is to increase capacity to monitor biodiversity, especially in developing countries because these countries host most of global biodiversity (e.g. in the so-called biodiversity hotspots), but often lack the resources to adequate monitoring. Therefore, the

Network places great emphasis on the establishment of a shared but distributed architecture of data provision, processing and delivery of information open to everyone. For example, we envision that each partner institution will form a data node within the network, so that each node may share its individual databases with the network to the extent the partner wishes.

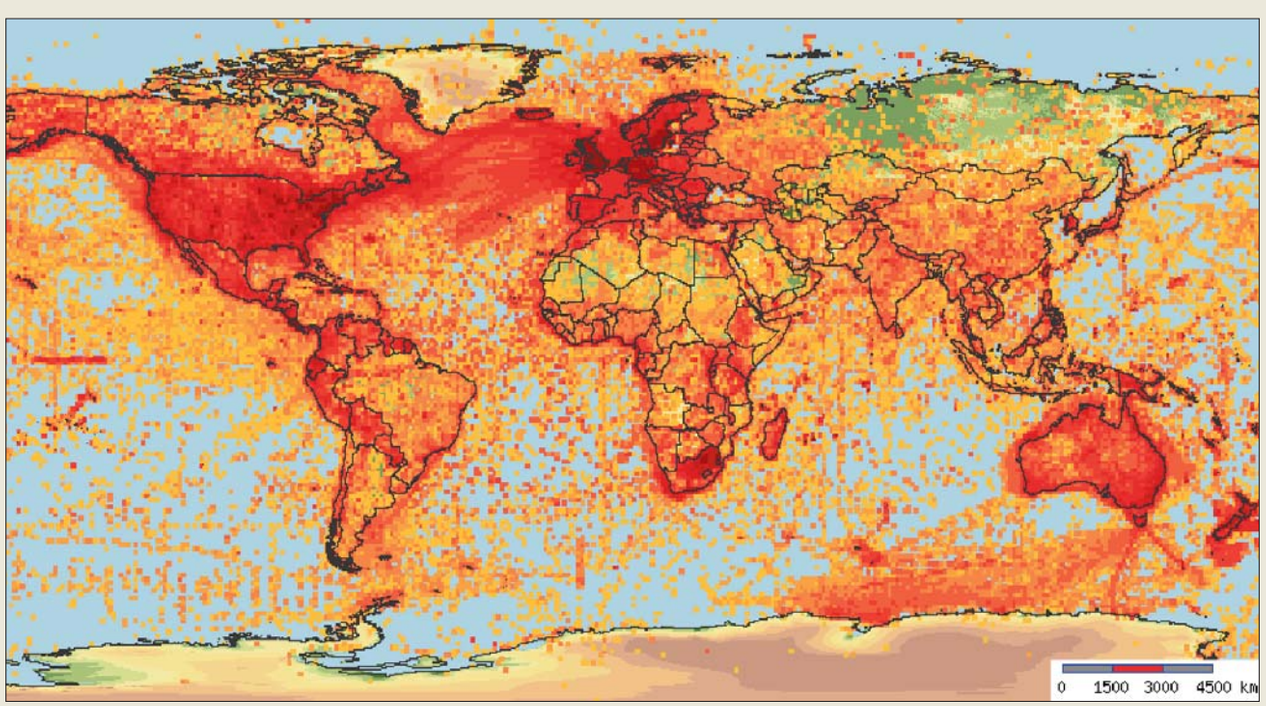
Toward these goals, several demonstration projects are currently being developed on biodiversity and climate change, protected areas characterization and monitoring, the use of geospatial data to improve threatened and endangered species assessments, and a monitoring system for invasive species. For example, one of the network partners, the Ecological Forecasting Program at NASA, is developing the Ecological Model Web, which is an open-ended system to improve ecological forecasting abilities. The Model Web brings together various computer models and databases dealing with a broad scope of physical, chemical, biological and ecological processes and making them interoperable via a distributed network of web services. Model interoperability is often limited by both technical and non-technical barriers, thus severely limiting their potential uses and users. Following the GEOSS architecture, the Model Web will try to remove such barriers so that global access to sophisticated ecological modelling and forecasting becomes a reality. A demonstration system is currently being developed that will test the viability of the concept as well as provide a core onto which further components can be added.

In a similar vein, the World Data Center for Biodiversity and Ecology (WDCBE)[1] is supporting the data and information requirements for some of the world's global biodiversity and ecological issues. It is building the framework and partnerships for housing integrated, updated and accessible global biodiversity, ecology and geophysical data for use by the scientific and conservation community. Its work toward the GEO Biodiversity Observation Network includes, for example, the distribution of data and results from the Millennium Ecosystem Assessment. Likewise, the USGS, NBII, and other governmental and non-governmental institutions are pursuing: (1) development of web-enabled capabilities (tools) to improve the efficiency of digital data input and resulting accuracies; (2) Integration and improved accessibility of key global data sets; (3) Creation of long-term data sharing and analysis partnerships with leading international biodiversity and ecological informatics and conservation organizations.

For this purpose, various global biodiversity and associated geophysical datasets are being created. Combined datasets allow for the creation and analysis of valued-added products and analyses. The following tools are being developed, tested, and deployed:

- The Global Integrated Trends Analysis Network (GITAN) is developing a Global Data Toolset (GDT)[2] which is an operational and easy-to-use online polygon data entry tool to facilitate an organization's ability to engage its network in the entry and/or validation of digital data (e.g. protected areas, species distributions, Important Bird Areas).

Geographic distribution of density of species occurrence records



The Global Biodiversity Information Facility (GBIF) currently mediates approximately 135 million records of species occurrences through its data portal (http://data.gbif.org). Such historical biodiversity data is needed in many fields of biodiversity research, for example, in establishing baselines for measurement and monitoring of biodiversity change

- Rapid Land Cover/Ecosystem Mapping Tool: an online tool to manually interpret satellite imagery for mapping land cover.
- Integrated Taxonomic Information System (ITIS): a taxonomic crosswalk to operationally compare, integrate and apply global biodiversity data sets.
- TerraLook[3] expands and broadens the remote sensing user community by providing a user-selectable collection of satellite images from three epochs (circa 1975, 1990 and 2000).

The world's natural history museums are a rich, and by far the main source of historical biodiversity data that are needed in many fields of biodiversity research. These data can provide a snapshot of biodiversity prior to the time when modern biodiversity monitoring systems were put in place.

The Global Biodiversity Information Facility (GBIF) is promoting the digitization and availability of such data, as well as datasets created by citizen scientists. GBIF has developed an information architecture that enables interoperability among datasets of this type, which is extensible to observational data and other datasets that contain scientific names. GBIF currently manages approximately 135 million records of species occurrences. These primary biodiversity data records can serve both science and society in many ways because they can be utilized in many different analyses. GBIF's information infrastructure can also serve as a basis and example for the development of the information infrastructure that will be needed for the GEO Biodiversity Observation Network. The GBIF Data Portal is already interoperable with the GEO Web Portal, and the WDCBE is providing tools that help to validate such historical data, and incorporate it into analyses conducted using its other tools.

The GEO Biodiversity Observation Network will also build on the work and outputs of the 2010 Biodiversity Indicators Partnership (2010 BIP), which was established in direct response to the need for global biodiversity indicators to track progress toward the 2010 biodiversity target[4] in order 'to achieve by 2010 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.' The 2010 BIP brings together the numerous organizations and agencies working on developing and communicating biodiversity indicators in support of the 2010 target, and will facilitate the regular delivery of global biodiversity indicators into the CBD and other relevant fora in order to help track progress toward the 2010 target. The 2010 BIP will thus play a crucial role in advancing the data and processes for monitoring global biodiversity change within the context of the GEO Biodiversity Observation Network.

DIVERSITAS and NASA are leading the early planning stages for the GEO Biodiversity Observation Network. For this purpose, DIVERSITAS has assembled an expert group of monitoring and modelling scientists under its bioDISCOVERY Core Project, which will develop a scientific framework to improve global biodiversity monitoring. This expert group of leading scientists will develop the underpinning scientific research and advice on strategic goals for the Network. Furthermore, since not everything can be monitored, an increased interaction with field experiments and ecological model development will be sought that will help fill the knowledge gaps left by incomplete monitoring. Finally, the expert group will work on how results from long-term monitoring need to be analysed and presented so as to be useful to data users; e.g. value judgments going into summary and interpretation need to be clarified and explicitly stated. This is especially important for the development of global biodiversity indicators, as they will be one of the main means by which information is delivered to decision-makers and the public. Monitoring results will be interpreted in an ecosystem context — that is to say that efforts will be made to compare the current state of an ecosystem to its potential capacity. For example, an ecological assessment might not just report the measured state of a depleted fishery over the last five years, but also use ecological modelling to estimate the possible population levels of the fishery if sustainable fishing regimes had been adopted, so that monitoring results are embedded in the context of management options of the respective ecosystem. Combined with economic calculations, not just the *actual*, but also the *potential* productivity of an ecosystem's services could be estimated, and thus give stakeholders and decision-makers robust and rational arguments for weighing alternative policy options.

The ongoing activities generated by the GEO Biodiversity Observation Network have already helped to improve data access, sharing, and use, and to establish fora for crosscutting development and interdisciplinary collaboration within the biodiversity community, thus advancing biodiversity science and its applications. In the near future, the biodiversity science community, through the GEO framework, will increase capacity building, especially in developing nations, to fill monitoring gaps; develop more tools for policy making to be used in decision-making, especially in the light of improved resource management of marine, freshwater and terrestrial biodiversity resources and ecosystem services; and develop crosslinks with other GEOSS societal benefit areas, e.g. land use change, coastal zones, water management and health; and further integrate monitoring activities and modelling exercises.

The GEO Biodiversity Observation Network

The GEO Biodiversity Observation Network (www.bioobservation.net) is made up of many relevant programmes and networks, for example:BIOTA-AFRICA, Birdlife International, CBD, Census of Marine Life, CEOS, CI, DIVERSITAS, GBIF, GTOS, ILTER, IUCN, NASA, NBII, The Nature Conservancy, UNESCO-MAB, US Geological Survey, WMO and 2010 BIP, to name just a few, plus a host of other of governmental, non-governmental, private and academic institutions, organizations and programmes.

For further information:
2010 BIP (www.twentyten.net)
CBD (www.cbd.int)
DIVERSITAS (www.diversitas-international.org)
GBIF (www.gbif.org)

The Network is open to any other relevant entity or institution that wishes to contribute to and benefit from the consortium of the whole.