ESA DUE DIVERSITY II

Supporting the Convention on Biological Diversity

Requirements Baseline Document

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Acronyms and Abbreviations

AHTEG	Ad Hoc Technical Expert Group
AZE	Alliance for Zero Extinction
BIP	Biodiversity Indicators Partnership
CBD	Convention on Biological Diversity
CI	Conservation International
COP	Conference of Parties
CPD	Centers of Plant Diversity
CDR	Critical Design Review
Diversitas	An international programme of biodiversity science
DUB	Diversity User Bureau
DUG	Diversity User Group
EBA	Endemic Bird Areas
EO	Earth Observation
ESCAP	United Nations Economic and Social Commission for Asia and the Pacific
ESA	European Space Agency
EVI	Enhanced Vegetation Index
FAO	Food and Agricultural Organisation of the United Nations
fAPAR	Fraction of Absorbed Photosynthetically Active Radiation
FEOW	Freshwater Ecoregions of the World
GBO	Global Biodiversity Outlook
GEF	Global Environment Facility
GEO	Group on Earth Observations
GEO BON	Group on Earth Observations Biodiversity Observation Network
HR	High Resolution
IBA	Important Bird Area
ICESat/GLAS	Ice, Cloud and land Elevation Satellite/Geoscience Laser Altimeter System
IGO	International Governmental Organization
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
IPA	Important Plant Areas
IUCN	International Union for Conservation of Nature
KBA	Key Biodiversity Area

LADA	Global Land Degradation Assessment
LAI	Leaf Area Index
LIDAR	Light Detection And Ranging
LUCC	Land use/cover change
MA	Millennium Ecosystem Assessment
NDVI	Normalized Difference Vegetation Index
NGO	Non Governmental Organization
NPP	Net Primary Productivity
PMP	Project Management Plan
PoW	Programme of Work
RADAR	Radio Detection and Ranging
Ramsar	The Convention on Wetlands
SAVI	Soil Adjusted Vegetation Index
SBSTTA	Subsidiary Body on Scientific, Technical and Technological Advice
SCBD	Secretariat of the Convention on Biological Diversity
SoW	Statement of Work of the Diversity II project
SUNCCD	Secretariat of the United Nations Convention to Combat Desertification
SRR	System Requirements Review
TBPA	Transboundary Protected Areas
TEEB	The Economics of Ecosystems and Biodiversity
TSM	Total Suspended Matter
UNCCC	United Nations Framework Convention on Climate Change
UNCCD	United Nations Convention to Combat Desertification
UNEP-WCMC	United Nations Environment Programme – World Conservation Monitoring Centre
VHR	Very High Resolution
WRI	World Resources Institute
WWF	World Wildlife Fund

1 Introduction

The purpose of this document is to provide a detailed specification of the requirements on biodiversity products by the user communities. It is the primary input for all system engineering tasks of the Project.

The Project will give highest priority to the user side during the whole implementation period. A direct and active involvement of the wide user community during the execution of the Project is a precondition for success. This applies not only to the consolidation of the user requirements in the initial stages of the implementation but to all phases of the Project. Therefore, the users will be requested to actively participate in its execution.

The Diversity II Project will contribute to the work of the Convention on Biological Diversity (CBD), particularly by assessing biological diversity in two important ecosystems of the Earth, Inland Waters and Drylands, using satellite data. The ultimate goal of Project is to support the implementation of the 2011-2020 biodiversity Strategic Plan of the CBD and, more specifically, to contribute to the assessment and monitoring of the Aichi 2020 Biodiversity Targets of the Convention. The Project will, for selected key parameters, provide status maps, associated change maps, status indicators and trend indicators aggregated at different administrative and biome level. The work will be carried out in close collaboration with the User Communities.

2 The Diversity II Users

2.1 Analysis of Users

2.1.1 Determination of User types

User requirements constitute a starting point and a lodestar for the execution of the Diversity II Project. Greatest possible consideration will be given to user requirements within the framework of the technical limitations of EO data expressed in the SoW. High priority will be given to the user side during the whole implementation period. A direct and active involvement of the wide user community during the execution of the Project is required. This applies not only to the consolidation of the user requirements in the initial stages of the implementation but to all phases of the Project. Therefore, the users will be requested to actively participate in its execution.

In addition to the CBD and other organizations, conventions, projects etc. mentioned in the SoW, a limited number of international bodies involved in biodiversity conservation has been – or will be – contacted in order to include them in the user network of the Project. These include financiers of biodiversity conservation projects (e.g. GEF); scientific-oriented organizations or networks dealing with biodiversity (e.g. DIVERSITAS); regional economic-oriented organizations dealing with biodiversity (e.g. ESCAP); international biodiversity conventions (e.g. Ramsar); IGOs working with issues that affect biodiversity (e.g. FAO) and NGOs working with biodiversity conservation (e.g. WWF).

National governments also constitute an important group of users. They will not generally be involved directly in the Project but can benefit from and use its results, e.g. as a basis for national measures as well as for reporting to and negotiations within the CBD and other global or regional conventions dealing with biodiversity. As far as possible, the Project has been tailored to fulfill these national needs.

Indicators on the status and trends of biodiversity are essential to produce information required for policy and management decisions. Therefore, a basic issue for consultation with users, particularly in the initial stages of the Project, will be the development of such indicators. Users require simple and reliable indicators providing information that is needed for policy action to conserve biodiversity and can be utilized without a deeper scientific or technical knowledge of conservation biology or EO technology. The indicators will function in such a way so as to describe and highlight, in an easy understandable, abstracted (high level) manner, the overall status and trend of inland water and dryland biodiversity.

2.1.2 The role of CBD

The main task of Diversity II Project is to support the work of CBD as regards inland water and dryland biodiversity. Accordingly, the CBD is the main user of the results of the Project. In performing this assignment, the Project Team will cooperate closely with the SCBD. The CBD has close links to the whole global biodiversity community, both its Parties (193 countries) and the wide range of other user organizations (conventions, IGOs, NGOs etc.). It is anticipated that SCBD will play a leading and coordinating role in the user community. COP and SBSTTA will be dependent on the results of the Project for their work with inland water and dryland biodiversity but these results will primarily be channelled through the SCBD to a great number of other users. An important task for the SCBD – and the Project Team – will also be to inform the global user community about the Project and the potential of EO as a provider of data for monitoring and assessment of status and trends of inland water and dryland biodiversity.

2.2 User organisations and end-use of Diversity II products

2.2.1 User descriptions

A selection of Key Users has been made and is reproduced as the Key User List in Annex 12. The List contains about 40 organizations that represent the most prominent actors of the global biodiversity community. For each organization, one or in a few cases a couple of contact persons with a senior position and a specific responsibility for biodiversity monitoring are mentioned.

The List is topped by the CBD followed by two global conventions of great importance from the Diversity II perspective (UNCCD and Ramsar). Then a number of IGOs with various but important roles in the global or European work to conserve biodiversity, mainly dealing with policy and management issues, are listed. They are followed by a great number of NGOs, IGOs and national organizations mainly dealing with monitoring and/or research. Most Key Users play leading roles in global networks. Therefore, they in practise represent not only themselves but a wider group of Users. Some of them just consist of networks, e.g. DIVERSITAS and GEO BON.

2.2.2 User applications and reporting requirements

Users will be able to use the Diversity II products in several ways. Pending contacts with all Users – including review of the questionnaires – it is anticipated that the Project will provide data for:

- Reporting, policy development, policy evaluation, information etc.
- Planning, implementation and evaluation of monitoring programmes, conservation projects, development projects etc.
- Multilateral and bilateral international negotiations

The Diversity II Project aims at providing data that can be used at all levels (global, regional, national and subnational) and by both the biodiversity sector and other sectors of society that affect biodiversity.

2.2.3 User contacts

A prioritisation of the user list in Annex 12 was done and the following users/organisations were contacted by an introducing Email which included the questionnaire, and followed-up by phone calls. The list below presented the intermediate status of these contacts and inquires at the time of PDR. It will be updated for the final version of this document.

2.2.3.1 Generic

UNEP-WCMC

MP and PW visited its office in Cambridge on 15/3 to inform about the Diversity II Project and discuss potential areas of cooperation. WCMC was represented by Matt Walpole (Head of Science, Economics, Policy & Partnerships), Claire Brown, Val Kapos, Anna Chenery and Liz Farmer. The discussions were fruitful and encouraging. MW declared that WCMC would be an active partner of the Project with CB as the contact person. However, the WCMC has up to now not been able to contribute further to the Project.

CBD

Robert Höft was mailed 20/5 and 30/5. He replied 31/5 but showed a limited interest in the Project and will not participate in the UCM.

Geography Department, UZH (large Bio-diversity project)

Michael Schaepmann was mailed 15/5. He cannot participate in the UCM in June but would be interested to attend a UCM at a later time.

RAMSAR

Nick Davidson was mailed 20/5 and 30/5. No response to the mail was received but he is well aware of the Project and participated in its presentation at CBD COP XI in October 2012.

DIVERSITAS

Anne Larigauderie was mailed 20/5 and replied 21/5. She will not participate in the UCM.

2.2.3.2 Inland Water

GEO Inland – Quality RS Group

Arnold Decker was mailed 15/5. The Group will be represented by Erin Hester who will participate in the UCM remotely. The questionnaire has been filled in.

GloboLakes

Andrew Taylor was mailed 15/5. Peter Hunter has filled in the freshwater questionnaire (18/6) and will participate in the UCM.

ChloroGIN

Steward Bernard was mailed 15/5. He will be represented by Mark Matthews at the UCM. The questionnaire has been filled in.

JRC

Mark Dowell was mailed 15/5 and positive response received. A questionnaire will be filled, however, until now it was possible to agree on a phone date.

EAWAG

Florian Altermatt was mailed 5/6. No response to the mail was received. No contact managed to be established.

NOAA

George Leshkewich was mailed 15/5. No response to the mail was received. No contact managed to be established.

GLEON

Paul Hanson was mailed on 17/5 and phoned on 11/6. He seemed to be interested to promote Diversity II within GLEON and fill in the questionnaire, but no actions followed. A reminder sent on 17/6 remained unanswered.

GEOBON – Freshwater Group

Ian Harrison was mailed 20/5 and replied 25/5 and 29/5. He will not participate in the UCM but will fill in the questionnaire. He also proposed four additional names to contact (Robin Abell, Jorge Ahumada, Peter McIntyre and Eren Turak). They were mailed 31/5 but no responses have been received.

UN University – Water Programme

C. Mayfield was mailed 20/5 and 30/5. No response to the mail was received. No contact managed to be established.

UNESCO – WQ

Olcay Ünver was phoned 13/5 – positive reaction – and mailed 16/5. After a reminder by mail 9/6 and further contacts it was decided that Engin Koncagul would participate in the UCM (subsidized by the Project). The questionnaire will also be filled in.

IUCN – Freshwater Programme

James Dalton was mailed 20/5 and replied 21/5. He referred to Will Darwall who was mailed 22/5. No response to the mail was received. No contact managed to be established.

2.2.3.3 Drylands

Centre de Suivi Écologique (CSE), Senegal

Assize Toure was mailed 28/5. No response to the mail was received. No contact managed to be established.

UNCCD

Victor Castillo was mailed 20/5 and replied 28/5. He wants to broaden the scope of the Project. A discussion is ongoing.

UNEP – Division of Early Warning and Assessment

Peter Gilruth was phoned 13/5 – neutral reaction – and mailed 20/5. According to a response the same day he would come back after internal consultations. As no response was received a reminder was mailed to him 9/6 but no further contact managed to be established.

UNESCO – DL

Thomas Schaaf was phoned 13/5 – neutral reaction – and mailed 16/5 with a reply the same day. Due to his impending retirement the organization cannot be involved in the Project but he recommended us to come back in September – October when his successor is in place.

UN University – Dryland Programme

Richard Thomas was mailed 20/5 and 9/6. A response was received 10/6 saying that he was on leave and referring to his deputy Emmanuelle Quillerou. She was mailed 11/6. No response to the mail was received. No contact managed to be established.

FAO – Land and Water Division

Parviz Koohafkan was mailed 20/5 and 9/6. A response was received 10/6 saying that he had left his position. The acting Head of Division – Pasquale Steduto – was mailed 11/6. No response to the mail was received. No contact managed to be established.

EEA

Ronan Uhel was phoned 13/5 – positive reaction – and mailed 16/5 with a reminder 9/6. Then several unsuccessful attempts to reach him by phone were made.

IUCN – Dryland Programme

Jonathan Davies was phoned 14/5 – positive reaction – and mailed 16/5. In a response 20/5 he said that the questionnaire is not relevant to his organization and refrained from participation in the Project.

JRC

Alan Belward was mailed 16/5 and phoned 21/5. After further contacts it was decided that Eva Ivits would participate in the UCM. The questionnaire has been filled in.

GEOBON – Drylands

Bob Scholes was mailed 16/5 and phoned 20/5. He will not participate in the UCM. The questionnaire has been filled in.

NASA

Jorge Pinzon was mailed on 16/5 and phoned later. He will not participate in the UCM but provided additional contacts.

NASA

Compton Tucker was mailed on 16/5. No response to the mail was received. No contact managed to be established upon a reminder.

University of Adeleide

Kenneth Clarke was mailed on 16 – 21/5 and phoned 23/5. He will not participate in the UCM. The questionnaire has been filled in. He also provided contacts for data validation.

Desert Research Foundation of Namibia

Mary Seely was mailed on 16/5 and phoned 29/5. She will not participate in the UCM but will provide data.

Mälardalen University

Patrik Klintenberg was mailed on 29/5 followed by phone calls. He will participate in the UCM. The questionnaire has been filled in. He also represents the Desert Research Foundation of Namibia.

North-West University, South Africa

Klaus Kellner was mailed on 29/5. No response to the mail was received. No contact managed to be established.

Danish Ministry of Foreign Affairs

Flemming Poul Winther Olsen was mailed on 4/6. He responded on 17/6 that he has delegated the request to their technical division with Henning Nøhr. No further response yet.

Centre de Suivi Écologique (CSE), Senegal

Amadou M. Dieye was mailed on 6/6 and reminded 12/6. He replied 12/6 and several mails were then exchanged. He will participate in the UCM (subsidized by the Project).

3 Analyses of relevant CBD documents

3.1 Introduction

The SoW for the Diversity II Project states that "the Contractor shall thoroughly analyse the CBD strategic plan, the CBD programs of work on inland waters and on drylands, and in particular the proposed indicators and metrics, currently being defined by the CBD Ad-Hoc Technical Expert Group (AHTEG) on Indicators."

Furthermore, the Contractor shall ”conduct an in-depth analysis of the most relevant scientific papers, in particular for water quality retrievals and for drylands productivity and rain use efficiency retrievals.”

These tasks are specified in the Project Management Plan to include analyses of:

- Relevant documents prepared for COP, SBSTTA and IPBES meetings 2010 – 2012
- Relevant scientific papers
- CBD Strategic Plan and its implementation up to now
- Relevant AHTEG documents

This chapter presents the results of the analyses carried out, except those directly related to indicators which are presented in Chapter 4 . It consists of four main sections. First the results of the most recent global assessment of status and trends of biodiversity – the GBO-3 – are presented with a focus on freshwater and dryland biodiversity. Then the CBD work on freshwater and drylands, particularly the PoWs, is presented (including references to relevant meetings/documents) and discussed. Finally, the CBD Strategic Plan 2011 – 2020 and the IPBES are dealt with.

The text is mainly based on official CBD- and other UN-documents to which references are made. Altogether, more than 200 documents have been reviewed. Excerpts from some documents of specific interest to this chapter are found in Annexes 1 - 4.

3.2 Background

The CBD came into force in 1993. It has three objectives: the conservation of biological diversity; the sustainable use of its components; and the fair and equitable sharing of benefits arising out of the utilization of genetic resources. At present, the Convention has 193 Parties.

The first Strategic Plan of the Convention, for the period 2002 – 2010, was adopted by the COP in 2002 (Decision VI/26)[1]. In that Plan, the Parties committed themselves “to a more effective and coherent implementation of the three objectives of the Convention, 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.” In addition to this overall target, 21 subsidiary targets were set up.

The Strategic Plan 2002 – 2010 was evaluated by COP X 2010, based on GBO-3. COP X also adopted the new Strategic Plan for the period 2011 – 2020.

A decision to establish a new international body in the field of biodiversity – the IPBES – was taken 2012. The intention is to make IPBES operational during 2013.

3.3 GBO-3

The third edition of the Global Biodiversity Outlook (GBO-3, 2010), compiled by the SCBD, drawing upon national reports, indicators and research studies, assessed progress towards the 2010 target and provided scenarios for the future of biodiversity. According to the Outlook, the 2010 biodiversity target has inspired action at many levels to implement the CBD. However, such actions have not been on a scale sufficient to address the pressures on biodiversity in most places. The target agreed by the world’s Governments in 2002 has not been met. There has been insufficient integration of biodiversity issues into broader policies, strategies and programmes, and the underlying drivers of biodiversity loss have not been addressed significantly. The

[1] Document UNEP/CBD/COP/6/20

diversity of genes, species and ecosystems continues to decline, as the pressures on biodiversity remain constant or increase in intensity, mainly as a result of human actions.

Missing the 2010 target has serious implications for human societies. Biodiversity underpins a wide range of services that support economies, food production systems and secure living conditions. The loss of biodiversity (at the genetic, species and ecosystem levels) also affects human health in many ways. Scientific consensus projects a continuing loss of habitats and high rates of extinctions throughout this century if current trends persist, with the risk of drastic consequences to human societies as several thresholds or "tipping points" are crossed.

None of the 21 sub-targets accompanying the overall target of significantly reducing the rate of biodiversity loss by 2010 has been achieved globally, although some have been partially or locally achieved. This is clearly shown by a number of agreed indicators of progress towards the 2010 biodiversity target (see Chapter 4).

The main reasons for the failure to meet the 2010 biodiversity target is that actions have focused on measures that mainly respond to changes in the state of biodiversity, such as steps to save threatened species, or focus on direct pressures on biodiversity, such as pollution control. In many cases, the underlying causes of biodiversity loss have not been addressed in a meaningful manner. Moreover, actions have rarely matched the magnitude of the challenges they were attempting to address.

Among other reasons, lack of data and information on status and trends of biodiversity, particularly in developing countries, should be mentioned. This is of specific interest in the light of the Diversity II Project as it aims to derive such data in an efficient way that is particularly adapted for developing countries.

Inland water ecosystems have been dramatically altered in recent decades according to the GBO-3. The unsatisfactory situation is strongly underlined but few data aggregated at global or regional levels are presented. The main reason for this is lack of such data, especially those that have been peer reviewed. The following quotes from the GBO-3 show the general status and trends for data relating to freshwater biodiversity:

> "Rivers and their floodplains, lakes and wetlands have undergone more dramatic changes than any other type of ecosystem, due to a combination of human activities including drainage for agriculture, abstraction of water for irrigation, industrial and household use, the input of nutrients and other pollutants, introduction of alien species and the damming of rivers. Verifiable global data for loss of inland water habitats as a whole are not available, but it is known that shallow-water wetlands such as marshes, swamps and shallow lakes have declined significantly in many parts of the world. "
>
> "Water quality in freshwater ecosystems, an important biodiversity indicator, shows variable trends, and global data are very incomplete. Relevant information about pollution loads and changes in water quality is lacking precisely where water use is most intense – in densely populated developing countries. As a result, the serious impacts of polluting activities on the health of people and ecosystems remain largely unreported."
>
> "Pollution control through sewage treatment and regulation of industrial effluent has had significant success in improving water quality in many inland water ecosystems, although such progress has so far been very limited in developing countries. Pollution originating from diffuse or non-point sources (particularly from agriculture) remains a significant and growing problem in many parts of the world."
>
> "Rivers are becoming increasingly fragmented, often with severe disruption to their flows. The most fragmented rivers are in industrialized regions like much of the United States and Europe, and in heavily-populated countries such as China and India. Rivers in arid regions also tend to be highly fragmented, as scarce water supplies have often been managed through the use of dams and reservoirs. This fragmentation is important because so much of the variety of freshwater life is determined by the connections formed between different parts of a river basin. "

Dryland ecosystems are treated more briefly in the GBO-3 than inland water ecosystems, mainly because of an even more pronounced shortage of data.

A general estimation that nearly one quarter (24%) of the world's land area was undergoing degradation over the period 1980-2003, as measured by a decline in primary productivity, is presented. Specifically, savannahs and grasslands, while less well documented, have suffered severe declines.

The Sahel in Africa, under pressure from climate change and over-use of limited land resources, shifts to alternative, degraded states, further driving desertification. Severe impacts on biodiversity and agricultural productivity result. Continued degradation of the Sahel has caused and could continue to cause loss of biodiversity and shortages of food, fibre and water in Western Africa.

Also North American drylands suffer from degradation. For example, bird populations in those areas have declined by nearly 30 % since the late 1960s.

The thematic PoWs (e.g. on biodiversity of inland waters and biodiversity of drylands) together with the various cross-cutting PoWs (e.g. on protected areas) and issues (e.g. on indicators)[2] provide detailed guidance on implementation of strategic plans.

3.4 The CBD PoW on Biological Diversity of Inland Water Ecosystems

Inland water biodiversity provides important ecosystem services. These include water purification, flow regulation, fisheries, erosion and sedimentation control etc. Wetlands are particularly effective at removing bacteria, microbes, excess nutrients and sediments. Conversely, impaired water quality and quantity negatively affects biodiversity.

Eutrophication, habitat loss through land drainage, river flow regulation and sediment load from soil erosion can cause declines in freshwater biodiversity and changes in ecosystem structure and functioning. Freshwater is also a major link between different ecosystems and geographical areas (see Annex 2).

The importance of inland water biodiversity was recognized by the CBD at an early stage of its implementation. ***COP II*** (1995) decided that the status and trends of inland water biodiversity should be assessed (Decision II/18)[3].

COP III (1996) generally underlined the need for scientific advice on monitoring and assessment (Decision III/10)[4]. COP III also recognised the Ramsar Convention on Wetlands[5] as the lead implementing partner on wetlands for the CBD (Decision III/21)[6]. The definition of wetland used by the Ramsar Convention includes all categories of inland water ecosystems.

SBSTTA III (1997) responded to these decisions by laying the basis for the first PoW on biological diversity of inland water ecosystems (Recommendation III/1)[7].

COP IV (1998) adopted a PoW (Decision IV/4) which was based on SBSTTA Decision III/1. Thus, biological diversity of inland water ecosystems was established as a key issue for the CBD, even if monitoring and assessment still played a less prominent role in the programme.

COP VI (2002) emphasized the need for review and elaboration of the PoW on biological diversity of inland water ecosystems (Decision VI/2)[8]. As part of the preparatory process for such a review, a study of status and trends of freshwater biodiversity was undertaken, which indicated an ongoing negative trend (CBD Technical Series No. 11).

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[2] A full list of programmes and initiatives is available at: http://www.cbd.int/programmes/

[3] Document UNEP/CBD/COP/2/19

[4] Document UNEP/CBD/COP/3/38

[5] The Convention on Wetlands (Ramsar, Iran, 1971) -- the "Ramsar Convention" -- is an intergovernmental treaty that embodies the commitments of its member countries to maintain the ecological character of their Wetlands of International Importance and to plan for the sustainable use of all of the wetlands in their territories. Unlike the other global environmental conventions, Ramsar is not affiliated with the United Nations system of Multilateral Environmental Agreements, but it works very closely with the other MEA:s and is a full partner among the "biodiversity-related cluster" of treaties and agreements

[6] Document UNEP/CBD/COP/3/38

[7] Document UNEP/CBD/COP/4/2

[8] Document UNEP/CBD/COP/6/20

COP VII (2004) adopted a revised and elaborated PoW on biological diversity of inland water ecosystems (Decision VII/4)[9]. This programme still applies.

The PoW gives guidelines, recommendations and requests for the implementation of the CBD in the field of freshwater biodiversity. It encourages cross-referencing and coherence with other thematic CBD programmes. Particular attention is paid to ecosystem considerations (not to species). The need for continued coordination between CBD and other conventions, international bodies etc., particularly the Ramsar Convention, is strongly emphasized. The same applies to the need for reliable baseline data and subsequent regular assessments of the status and trends of freshwater biodiversity at national, regional and global levels. The programme consists of three parts of which the third deals with knowledge, monitoring and assessment. As shown in Annex 1, the programme underlines the importance of monitoring and assessment. However, its guidelines and recommendations are quite general and largely lack operational, specific guidance on techniques and methods. Indicators are only briefly treated.

COP VIII (2006) reviewed the implementation of the PoW and underlined the need to develop further ways and means to improve mechanisms for assessing the extent, distribution and characteristics of inland water ecosystems, in particular paying attention to ecosystem considerations (Decision VIII/20)[10]. Basic data on extent and distribution of freshwater ecosystems was still given high priority.

COP IX (2008) made a limited review of the PoW, focusing on the cooperation between the CBD and the Ramsar Convention. Issues concerning assessment and monitoring were not raised (Decision IX/19)[11].

SBSTTA XIV (2010) made a thorough, critical examination of the implementation of the PoW on biological diversity of inland water ecosystems as a basis for a review by the COP X (Recommendation XIV/2)[12].

COP X (2010) made an in-depth review of the PoW (Decision X/28)[13]. It was based on SBSTTA Recommendation XIV/2. Its general picture of status and trends of freshwater biodiversity was gloomy.

It was noted (§ 1) "with concern that the rapidly increasing pressures from the drivers of change in inland water ecosystems, the overall continuing and accelerating rate of loss of the biodiversity of these ecosystems and of associated critical ecosystem services are already resulting in significant economic, social and environmental costs, which are projected to rapidly escalate."

The conclusion was (§ 6) "that the programme of work on the biological diversity of inland water ecosystems remains a good framework for implementation of relevant activities but that implementation needs to be significantly enhanced". Therefore COP urged (§ 10) "Parties, other Governments and relevant organizations to reinforce their efforts for the implementation of the programme of work on the biological diversity of inland water ecosystems, taking into account the relevant goals and Aichi Biodiversity Targets of the Strategic Plan for Biodiversity 2011 – 2020".

Scientific aspects were highlighted stronger than in previous CBD-documents. The "need for enhanced science-policy coordination and integration between natural and socio-economic sciences and notably between the inter-related subjects, among others, of biodiversity, terrestrial and inland water ecosystem functioning and service provision," was recognized (§ 29).

The need for monitoring and assessment was also underlined. The "importance of robust data on inland water species in determining the status and trends of these ecosystems, including as key underlying data for other assessments and initiatives," was noted (§ 30). Parties and other Governments were urged "to support strengthened capacity for monitoring of the biodiversity of inland water ecosystems, including at the species level;" (§ 31). COP also recognized that there is a "need for improved guidance on the relationships between

[9] Document UNEP/CBD/COP/7/21

[10] Document UNEP/CBD/COP/8/31

[11] Document UNEP/CBD/COP/9/29

[12] Document UNEP/CBD/COP/10/3

[13] Document UNEP/CBD/COP/10/27

biodiversity and water" and called for "further policy-relevant scientific assessments of the relationships between biodiversity, hydrology, ecosystem services and sustainable development" (§ 32).

Parties and other Governments were urged to consider the implications of changes in the water cycle, and freshwater resources, in the implementation of all thematic and cross-cutting programmes of work. Special attention should be paid to the links between hydrology, biodiversity, ecosystem functioning and sustainable development (§ 38).

The establishment of an expert group to review available information, and provide key policy relevant messages, on maintaining the ability of biodiversity to continue to support the water cycle was also initiated (§ 39).

The COP Decision X/28 differed from earlier decisions by stronger emphasis on scientific aspects, monitoring and assessment. However, that emphasis was more pronounced in the SBSTTA-recommendations that preceded the COP-decision. The emphasis on species, as opposed to mainly ecosystems in previous decisions, is certainly a consequence of an improved general knowledge of inland water ecosystems.

SBSTTA XV (2011) concluded that the implications of the water cycle and freshwater resources in the implementation of all thematic and cross-cutting programmes of work and the Strategic Plan 2011-2020 are wide, diverse and far-reaching (Recommendation XV/5)[14]. SBSTTA also endorsed the ongoing work of the expert group on biodiversity and the water cycle.

SBSTTA XVI (2012) did not specifically address inland water biodiversity but underlined the need for monitoring and assessment in general terms as well as a close cooperation with the recently established IPBES (Recommendation XVI/1)[15].

COP XI (2012) endorsed the SBSTTA XV recommendations and welcomed the work of the expert group on maintaining the ability of biodiversity to support the water cycle (Decision XI/23)[16]. The report of the expert group[17] gives a comprehensive, scientifically well-founded (a great number of references are included) overview of the crucial role of biodiversity conservation in sustainable water management. See also the section on drylands.

3.4.1 Conclusions in summary

- Inland water biodiversity is of crucial importance to man all over the world by providing a number of necessary ecosystem services.
- There is a continuing and accelerating rate of loss of the inland water biodiversity all over the world.
- Among other reasons for the failure to meet the 2010 biodiversity target, lack of data and information on status and trends of biodiversity, particularly in developing countries, should be mentioned. This is of specific interest in the light of the Diversity II Project as it aims to derive such data in an efficient way that is particularly adapted for developing countries.
- The implementation of the PoW on inland water biodiversity has to a large extent been carried out by or in cooperation with the Secretariat of the Ramsar Convention.
- The implementation of the PoW on inland water biodiversity needs to be significantly enhanced if the current negative trend is to be reversed. Increased monitoring and assessment should be an important part of such an enhancement.
- Even though the PoW and recent COP Decisions underline their importance, monitoring and assessment are mainly dealt with in general terms. Few concrete directives or instructions for the execution of the task are given. No specific indicators are proposed. It is evident that there is an urgent need for significantly increased efforts to monitor and assess inland water biodiversity in many

[14] Document UNEP/CBD/COP/11/2

[15] Document UNEP/CBD/COP/11/3

[16] Document UNEP/CBD/COP/11/35

[17] Documents UNEP/CBD/COP/11/30 (an executive summary) and UNEP/CBD/COP/11/INF/2 (the full report)

parts of the world, particularly in developing countries. These efforts have to include development of methodologies and indicators for monitoring and assessment, not least to be able to follow the implementation of the Aichi Targets. EO based monitoring has a potential to become a core component of such methodologies. This is in particular due to its ability to provide extensive overviews of biodiversity status and trends that are obtained in a cost-effective, consistent and repeatable manner. Therefore, the Diversity II Project has a key role to play in the continuing work to implement the Aichi Targets.

3.5 The CBD PoW on Biological Diversity of Dry and Sub-Humid Lands

Dryland biodiversity differs from that in most other biomes. It is rich in highly specialized species and provides important ecosystem services of crucial importance to human livelihood, particularly of indigenous and local communities. Such ecosystem services include water, pastures, firewood, bushmeat etc. as well as protection against desertification and soil erosion, climate regulation etc. The causal linkages between loss of biodiversity and poverty are close in dry and sub-humid lands (or drylands). They host many endemic and/or endangered species and play an important role as centres of diversity for a number of our most valuable genetic resources. See Annex 3.

Despite its great value to man, it took some time before the issue of dryland biodiversity was fully addressed by the CBD. It also seems as if this issue has received less focus in the implementation of the convention than, for example, inland water biodiversity and marine and coastal biodiversity.

SBSTTA II (1996) took the first step by recommending cooperation between CBD and UNCCD[18] (Recommendation II/8)[19].

COP III (1996) requested the SCBD (Decision III/13)[20] ”to explore ways and means to cooperate with the United Nations Convention to Combat Desertification in those countries experiencing serious drought and/or desertification, particularly in Africa, on matters relating to biological diversity and drylands with a view to identifying common priorities.” The decision was based on the recommendation by SBSTTA II. More general or substantive issues, such as the state of dryland biodiversity or monitoring and assessment, were not addressed.

COP IV (1998) took a similar but strengthened and more specific decision (IV/15)[21]. The SCBD was requested to strengthen relationships with the SUNCCD ”with a view to making implementation activities and institutional arrangements mutually supportive.” The COP also considered dryland ecosystems as matters requiring in-depth consideration at its fifth meeting (Decision IV/16)[22].

SBSTTA IV (1999) emphasized the characteristics and importance of dryland biodiversity. The SCBD was requested to ”prepare a draft programme of work on biological diversity of dryland, Mediterranean, arid, semi-arid, grassland and savannah ecosystems” (Recommendation IV/3)[23]. The PoW should be drafted in consultation with the SUNCCD and should be presented to SBSTTA V.

SBSTTA V considered the draft PoW and sent a final proposal to COP for adoption (Recommendation V/8)[24].

COP V (2000) established the ”programme of work on the biological diversity of dryland, Mediterranean, arid, semi-arid, grassland, and savannah ecosystems” (Decision V/23)[25]. It should also be known as the programme

[18] United Nations Convention to Combat Desertification (UNCCD) was established in 1994. It is the only legally binding international agreement linking environment and development to sustainable land management. The Convention addresses specifically the arid, semi-arid and dry sub-humid areas, known as the drylands. Its goal is *to forge a global partnership to reverse and prevent desertification/land degradation and to mitigate the effects of drought in affected areas in order to support poverty reduction and environmental sustainability.*

[19] Document UNEP/CBD/COP/3/2

[20] Document UNEP/CBD/COP/3/38

[21] Document UNEP/CBD/COP/4/27

[22] Document UNEP/CBD/COP/4/27

[23] Document UNEP/CBD/COP/5/2

[24] Document UNEP/CBD/COP/5/3

[25] Document UNEP/CBD/COP/5/23

on ”dry and sub-humid lands” (in this document generally called drylands). Parties, other countries, international organizations etc. were urged to implement the programme. Its elaboration and implementation should aim at applying the ecosystem approach. The SCBD was requested to collaborate with the SUNCCD, including through a joint work programme. Of specific interest to the Diversity II Project is that it was also decided that an AHTEG should be established to, inter alia, consolidate and assess information on the status and trends of biodiversity, on the possible establishment of an international network of dryland areas of particular value for biodiversity and on indicators.

It was underlined that water constraint is a defining characteristic of dryland ecosystems. Water availability is therefore a key factor determining their biodiversity. It was also underlined that these ecosystems tend to be naturally highly dynamic. Assessment of their status and trends is therefore particularly challenging. There is an urgent need for a better understanding of dryland biodiversity, its dynamics, socio-economic value etc. and consequences of its loss and change.

The PoW consists of two parts, (1) assessment and (2) targeted actions in response to identified needs. This means that monitoring and assessment from the very beginning was highlighted in a completely different way than in the corresponding PoW on inland water biodiversity.

The operational objective of the assessment part of the programme is to ”assemble and analyse information on the state of the biological diversity of dry and sub-humid lands and the pressures on it, to disseminate existing knowledge and best practises, and to fill knowledge gaps in order to determine adequate activities.” A number of activities to achieve this are listed in the PoW:

1. Assessment of the status and trends of the dryland biodiversity and the effectiveness of conservation measures.
2. Identification of specific dryland areas of particular value for biodiversity and/or under specific threat, such as endemic species and low lying wetlands.
3. Development of indicators of the dryland biodiversity and its loss, for various ecosystem types, for use in the assessment of status and trends of this biodiversity.
4. Building knowledge on ecological, physical and social processes that affect the dryland biodiversity, especially ecosystem structure and functioning.
5. Identification of benefits, including soil and water conservation, derived from dryland biodiversity, assessment of the socio-economic impacts of its loss and studies on the interrelationship between biodiversity and poverty.
6. Identification and dissemination of best management practises for dryland areas.

The activities should be carried out through consolidation of information from various sources, targeted research, case studies on management practises, dissemination of information and capacity building. Activities 1-3 have direct relevance to the Diversity II Project.

However, the PoW deals with methodological and technical aspects on monitoring in a rather general way. For example, the potential role of EO is not developed closer.

SBSTTA VII (2001) examined a progress report on the implementation of the PoW on dryland biodiversity (Recommendation VII/3)[26]. The urgency and importance of dealing with threats to this biodiversity was recognized. The importance of synergy and cooperation between SCBD and other conventions, such as UNCCD, UNCCC and Ramsar, was emphasized. SBSTTA urged the convening of the AHTEG on dryland biodiversity and requested it to take into consideration, inter alia, the value of goods and services of drylands and indicators of biodiversity loss as well as preventive measures, monitoring and early warning systems.

COP VI (2002) took note of the ”Report of the first meeting of the Ad Hoc Technical Expert Group on Dry and Sub-Humid Lands”[27] (Decision VI/4)[28]. The most relevant section of the report appears in Annex 3. The COP also

[26] Document UNEP/CBD/COP/6/4

[27] Document UNEP/CBD/COP/6/INF/39

[28] Document UNEP/CBD/COP/6/20

requested the development of a mechanism to coordinate activities between CBD, UNCCD and UNCCC and to enhance synergies with other CBD programmes in the implementation of the PoW on drylands.

SBSTTA VIII (2003) proposed (Recommendation VIII/4)[29] the adoption of a process for the periodic assessment of status and trends of dryland biodiversity (Activity 1 in the PoW). A comprehensive global review and assessment report should be presented in 2012 and be followed by periodic 10-year reports based on continuous assessments. The wording was, however, quite general and lacked specifications for the work. The recommendation also included further refinement of the PoW and better coordination within the CBD and between CBD and other actors working with dryland management.

SBSTTA IX (2003) welcomed (Recommendation IX/1)[30] a report on "Progress in the implementation of the thematic programmes of work"[31]. Regarding Activity 1 (Assessment of status and trends of dryland biodiversity) it was reported that the Global Land Degradation Assessment (LADA) of FAO and the Millennium Ecosystem Assessment (MA) were examining how their respective methods could be used for biodiversity purposes.

COP VII (2004) adopted the proposals made by SBSTTA VIII (Decision VII/2)[32].

SBSTTA X (2005) recognized the importance of scientific assessments on status and trends of biodiversity and recommended that one working group during SBSTTA meetings should focus entirely on scientific assessments of biodiversity status and trends related to CBD´s thematic programmes of work (Recommendation X/2)[33]. A draft operational plan of SBSTTA was presented[34] but the position on it as a whole was postponed. The draft, however, emphasized the need for assessments of (1) status and trends, and threats to, dryland biodiversity and (2) status of implementation and effectiveness of the PoW. These assessments should be carried out prior to COP VIII in 2006.

SBSTTA XI (2005) reviewed the PoW and noted that its components had been implemented to varying degrees. The overall judgement was that only limited progress in the implementation had been made. Activity 1 was one of the most widely nationally implemented activities. Despite this, only four Parties reported comprehensive assessments addressing habitat extent, abundance and distribution of selected species, coverage of protected areas, and threats to biodiversity. Serious gaps remained when considering the assessment of status and trends. For example, the LADA project revealed that due to lack of data it was not possible to determine an accurate level of correlation between the rate of dryland degradation and the rate of species extinction. Likewise, the MA synthesis report on desertification expressed concern that current evaluations covered too short time periods and were executed at a scale that was either too large to include local phenomena or too small to be useful for scaling. Another shortcoming of the implementation of the PoW was the limited availability of recent information on each of the activities of the programme.

SBSTTA recognized the need for a more comprehensive assessment of status and trends of, and threats to, dryland biodiversity. The need for systematic collection of data at three levels (genetic, species and ecosystem) and across all biomes of the PoW was emphasized (Recommendation XI/1)[35].

COP VIII (2006) took note of the reports of the implementation of the PoW and adopted the main recommendations made by SBSTTA XI (Decision VIII/2)[36]. The programme was supplemented with, inter alia, provisional goal and targets. The need for cooperation with other conventions, international bodies etc. was further emphasized.

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[29] Document UNEP/CBD/COP/7/3

[30] Document UNEP/CBD/COP/7/4

[31] Document UNEP/CBD/SBSTTA/9/2

[32] Document UNEP/CBD/COP/7/22

[33] Document UNEP/CBD/COP/8/2

[34] Document UNEP/CBD/SBSTTA/10/5

[35] Document UNEP/CBD/COP/8/3

[36] Document UNEP/CBD/COP/8/31

SBSTTA XII (2007) further underlined the need for coordinated assessments of dryland biodiversity by CBD and other actors in cooperation. According to its proposals (Recommendation XII/6)[37], the SCBD should, inter alia:

- Work with relevant collaborators, in particular SUNCCD, in view of the lack of a common definition of dry and sub-humid lands, to clarify these areas to facilitate global status and trend assessments.
- Strengthen collaboration with SUNCCD, SUNCCC and FAO on assessment of status and trends of, and threats to, dryland biodiversity.
- Liaise with relevant partners on activities necessary to fill gaps in data related to establishing baselines prior to the assessment of the achievements towards the 2010 target.

COP IX (2008) took note of the reports of the implementation of the PoW and adopted the main recommendations made by SBSTTA XII (Decision IX/17)[38]. A deep concern regarding the major obstacles, needs and constraints that may prevent achievement of the 2010 biodiversity target in drylands was expressed. These concerns include: (i) capacity constraints, (ii) weak collaboration and coordination, (iii) gaps in scientific and technical knowledge, and (iv) gaps in public awareness.

COP adopted a definition of dry and sub-humid lands and stated their delineation based on a study by the UNEP-WCMC, subject to the addition of dry and sub-humid tropical forests. The delineation encompasses biological and ecological criteria as a basis to define dry and sub-humid lands. The SCBD was requested to update the map to better reflect dry and sub-humid tropical forests.

Regarding establishment of baselines, the COP referred to the ESA that under its Diversity project was supporting the efforts of the CBD to quantify changes in the rate of biodiversity loss as related to the extent of drylands. By reclassifying and harmonizing three datasets from 1992/93, 2000 and 2005, the project has developed indicators for the change in drylands.

SBSTTA XIV (2010) addressed dryland biodiversity in a similar way as before. Focus was on management and collaboration with other conventions and international bodies. No specific reference to monitoring and assessment was made (Recommendation XIV/11)[39]. However, in an official document[40] prepared for the SBSTTA deliberations, the need for further mapping programmes (including mapping the extent of desertification and land degradation) was underlined. Also the need for long term ecological monitoring within early warning systems, with particular regard to assessing baseline conditions and initial vulnerability, as part of drought management, was mentioned.[41]

COP X (2010) adopted the main recommendations made by SBSTTA XIV (Decision X/35)[42]. Key issues were a far-reaching coordination and cooperation between CBD and other conventions and international bodies, particularly UNCCD and UNCCC. However, an in depth evaluation of the PoW similar to that for inland water had not been carried out. Most of the activities, which were decided by COP V, were not even referred to. Only a general reference was made to the 2010 biodiversity target which had not been achieved (Decision X/4). The CBD map of drylands was updated to better reflect dry and sub-humid tropical forests (the revised map is shown below in Figure 1). Harmonized reporting between relevant conventions and strengthened collaboration on the assessment of status, trends and threats in dry and sub-humid lands were thereby facilitated.

[37] Document UNEP/CBD/COP/9/2

[38] Document UNEP/CBD/COP/9/29

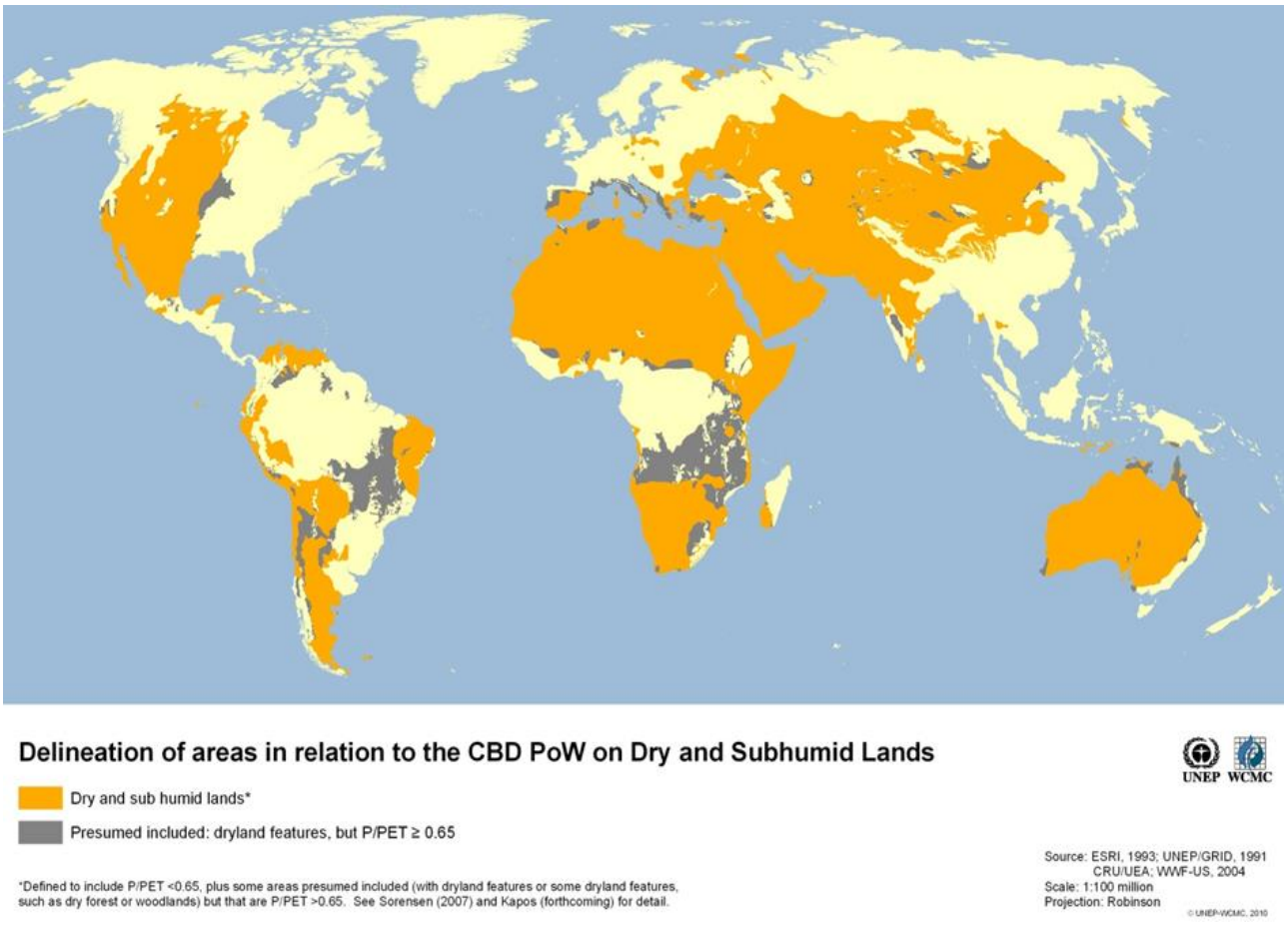
[39] Document UNEP/CBD/COP/10/3

[40] Document UNEP/CBD/SBSTTA/14/13

[41] For example, the Long Term Ecological Monitoring Observatories Network (ROSELT/OSS) has been established in the Sahara and Sahel regions in order to better assess and monitor desertification phenomena. Designed to support implementation of UNCCD, ROSELT/OSS assesses both trends in ecological systems and the links between ecological and socio-economic systems (http://www.enviroinfo2004.org/cdrom/Datas/Paper_OSS_EnviroInfo2004.htm).

[42] Document UNEP/CBD/COP/10/27

Figure 1 CBD Map of dryland areas, as revised by COP X. The revision implied addition of the areas shaded in gray.



SBSTTA XV (2011) did not specifically address dryland biodiversity. The need for SBSTTA to strengthen its scientific role was however underlined (Recommendation XV/8)[43].

SBSTTA XVI (2012) did not specifically address dryland biodiversity but underlined the need for monitoring and assessment in general terms as well as a close cooperation with the recently established IPBES (Recommendation XVI/1)[44].

COP XI (2012) adopted the main recommendations made by SBSTTA XV and XVI[45]. Dryland biodiversity was not specifically addressed but was to some extent touched upon indirectly in deliberations on "Cooperation with other conventions, international organizations, and initiatives" (Decision XI/6) and "Biodiversity for poverty eradication and development" (Decision XI/22). As regards dryland monitoring and assessment, no substantial progress was made but general scientific aspects were highlighted in Decision XI/13. The SCBD was requested to prepare information on (1) scientific and technical needs related to the implementation of the Strategic Plan 2011-2020 and its Aichi Targets and (2) the adequacy of observations, and of data systems, for monitoring the biodiversity attributes addressed in the Aichi Targets. The SBSTTA was requested to identify scientific and technical needs related to the implementation of the Strategic Plan.

[43] Document UNEP/CBD/COP/11/2

[44] Document UNEP/CBD/COP/11/3

[45] Document UNEP/CBD/COP/11/35

3.5.1 Conclusions in summary

- Dryland biodiversity is of crucial importance to man in large parts of the world by providing a number of necessary ecosystem services.
- Even if available data on status and trends of biodiversity are limited, there seems to be a continuing loss of dryland biodiversity all over the world.
- Among other reasons for the failure to meet the 2010 biodiversity target, lack of data and information on status and trends of biodiversity, particularly in developing countries, should be mentioned. This is of specific interest in the light of the Diversity II Project as it aims to derive such data in an efficient way that is particularly adapted for developing countries.
- The PoW is ambitious but has only partly been implemented, particularly in regard to monitoring and assessment. Encouraging statements by COP and SBSTTA have not been followed by corresponding action. Therefore, if the current negative trend of dryland biodiversity is to be reversed, the implementation of the PoW has to be significantly enhanced, especially as regards to monitoring and assessment of biodiversity status and trends.
- The implementation of the PoW on dryland biodiversity has been carried out far too much in isolation. Increased coordination and cooperation with primarily UNCCD is needed.
- Even though the PoW and recent COP Decisions underline their importance, monitoring and assessment are mainly dealt with in general terms. Few concrete directives or instructions for the execution of the tasks are given. No specific indicators are proposed. It is evident that there is an urgent need for increased efforts to monitor and assess dryland biodiversity in many parts of the world, particularly in developing countries. The need is probably even more pronounced than for inland water biodiversity. These efforts have to include development of methodologies and indicators for monitoring and assessment, not least to be able to follow the implementation of the Aichi Targets. EO based monitoring has a potential to become a core component of such methodologies. This is in particular due to its ability to provide extensive overviews of biodiversity status and trends that are obtained in a cost-effective, consistent and repeatable manner. EO is also particularly well suited for monitoring of drylands because they often are inaccessible and sparsely covered with vegetation. In addition, the vegetation is quite dynamic and shows clear differences between seasons and years. Therefore, the Diversity II Project has a key role to play in the continuing work to implement the Aichi Targets.

3.6 The CBD Strategic Plan for Biodiversity 2011 – 2020

The CBD COP X adopted in 2010 a new Strategic Plan for Biodiversity, including the Aichi Biodiversity Targets, for the 2011 – 2020 period (Decision X/2)[46]. In the Decision, Parties and other Governments are urged, with the support of intergovernmental and other organizations, to implement the Strategic Plan. It will be the overarching framework on biodiversity for the UN system, other international organizations and national governments. It consists, inter alia, of five Strategic Goals and the 20 Aichi Biodiversity Targets (see Annex 4) with the overall objective to save biodiversity.

The *purpose* of the Strategic Plan is to promote effective implementation of the CBD through a strategic approach. The Plan includes a shared vision, a mission, goals and targets which will inspire broad-based action by all Parties and stakeholders.

The *vision* of the Strategic Plan is a world "Living in harmony with nature" where "By 2050, biodiversity is valued, conserved, restored and wisely used, maintaining ecosystem services, sustaining a healthy planet and delivering benefits essential for all people."

The *mission* of the Strategic Plan is to "take effective and urgent action to halt the loss of biodiversity in order to ensure that by 2020 ecosystems are resilient and continue to provide essential services, thereby securing the

[46] Document UNEP/CBD/COP/10/27

planet's variety of life, and contributing to human well-being, and poverty eradication. To ensure this, pressures on biodiversity are reduced, ecosystems are restored, biological resources are sustainably used and benefits arising out of utilization of genetic resources are shared in a fair and equitable manner."

The goals and targets of the Strategic Plan consist of five strategic goals under which 20 headline targets for 2015 or 2020 (the Aichi Biodiversity Targets) are organized. These are contained in Section IV of the Plan which is reproduced in Annex 4.

The Diversity II Project can be seen as a direct response to § 3 g of the Plan which urges Parties, with the support of intergovernmental and other organizations, to:

> "Promote the generation and use of scientific information, develop methodologies and initiatives to monitor status and trends of biodiversity and ecosystem services, share data, develop indicators and measures, and undertake regular and timely assessments, to underpin the proposed new intergovernmental science-policy platform on biodiversity and ecosystem services (IPBES) and an effective Subsidiary Body on Scientific, Technical and Technological Advice in order to strengthen the science policy interface, thereby enhancing the implementation of the Strategic Plan for Biodiversity 2011-2020".

The previous sections of this chapter have clearly shown that the efforts to implement the assessment component of the CBD so far have been totally inadequate for the objectives of the Convention to be achieved.

The Aichi Biodiversity Targets provide guiding principles for the implementation of the CBD and seek to inspire broad-based action in support of biodiversity. The ultimate goal of the Diversity II Project is to contribute to the monitoring and assessment of how the Targets are met. They include, inter alia, a commitment to halve and, where feasible, bring close to zero the loss of habitats and also to protect 17 % of terrestrial areas – e.g. dry and sub-humid lands – as well as inland water areas. One of the Targets (No. 19) is of specific relevance to the Project:

> "By 2020, knowledge, the science base and technologies relating to biodiversity, its values, functioning, status and trends, and the consequences of loss, are improved, widely shared and transferred, and applied."

The potential role of Earth Observations (EO) to meet this Target, particularly as regards status and trends of biodiversity, was considered during the negotiations that led to the Strategic Plan.

3.6.1 Implementation of the Strategic Plan for Biodiversity 2011 – 2020

SBSTTA XV discussed updated technical rationales for the Goals and Targets of the Strategic Plan.[47] The GEO BON Report was also presented. Targets that can be monitored by EO methodologies are of specific relevance to the Diversity II Project.

COP XI (2012) presented an indicative list of indicators for the Strategic Plan (see Chapter 4) and recognized it as a starting point for assessing progress in the achievement of the Aichi Targets. However, COP did not address the implementation of the Plan as such (Decision XI/3)[48]. The importance of the on-going work with the preparation of the fourth edition of the GBO was underlined. According to the COP Decision X/2, GBO-4 shall provide a mid-term review of progress towards the Aichi Targets.

The SCBD was requested to explore, in cooperation with the Secretariat of IPBES, options for a global assessment on biodiversity and ecosystem services. It should focus on status and trends, their impacts on human wellbeing, effectiveness of responses to biodiversity loss and progress towards the achievement of the Aichi Targets.

[47] Documents UNEP/CBD/COP/10/27/Add.1 and UNEP/CBD/SBSTTA/15/3

[48] Document UNEP/CBD/COP/11/35

3.7 Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES)

One of the major challenges for the conservation and sustainable use of biodiversity and ecosystem services is to ensure that decisions and policies are made with the best available scientific information. This has long been lacking, especially as SBSTTA has become more and more politicized. At present, there is no ongoing global mechanism, recognized by both scientific and policy communities, to gather, synthesize and analyze information for decision making in a range of policy fora, such as the CBD, other environmental conventions and development dialogues.

After years of international negotiations, more than 90 governments in April 2012 agreed to officially establish the IPBES to this end. It will provide a mechanism recognized by both the scientific and the policy communities to synthesize, review, assess and critically evaluate relevant data, information and knowledge generated worldwide by governments, academia, scientific organizations, non-governmental organizations and indigenous communities. This task has to involve a credible group of experts in conducting assessments of such data, information and knowledge in a transparent way.[49]

IPBES will strengthen the interface between the scientific community and policy makers relating to biodiversity and ecosystem services. It will be a leading global body providing scientifically sound and relevant information to support more informed decisions on how biodiversity and ecosystem services are conserved and used around the world.

The main *raison d'être* for IPBES is to give biodiversity issues more weight at the global level, primarily by building capacity for and strengthening the use of science in policy making. Acknowledging that biodiversity-related data, information and knowledge is currently scattered over various organizations, IPBES will become the central place for generation and dissemination of knowledge on biodiversity, similar to the IPCC. However, IPBES will aim to go further than IPCC, playing a role not just in conducting assessments, but also in capacity building and bringing together different knowledge systems, such as the scientific community and holders of traditional knowledge.[50]

The four main areas of work of IPBES are to:

- identify and prioritise key scientific information needed for policymakers and to catalyse efforts to generate new knowledge;
- perform regular and timely assessments of knowledge on biodiversity and ecosystem services and their inter-linkages;
- support policy formulation and implementation by identifying policy-relevant tools and methodologies; and
- prioritise key capacity-building needs to improve the science-policy interface, and to provide and call for financial and other support for the highest-priority needs related directly to its activities. [51]

The first IPBES Plenary Meeting was arranged in January 2013 in Bonn where the secretariat will be located. The meeting mainly discussed procedural matters and the initial Work Programme of IPBES was an important item on its agenda. This Programme deals with, inter alia, assessments which is an issue of specific interest to the Diversity II Project. Assessments provide an important evidence base for decision-makers to make informed decisions based on science, and are one of the key tools available to support the science-policy interface, at all scales. However, the discussions focused on issues like organization, authority, responsibility, funding and nomination of experts. Technical and scientific issues, e.g. methods for the collection of data, were hardly discussed.

[49] http:/www.ipbes.net

[50] http://www.iisd.ca/ipbes/ipbes1/

[51] http:/www.ipbes.net

During the negotiation process leading up to the meeting in Bonn, it was stated that IPBES should perform regular and timely assessments of knowledge on biodiversity and ecosystem services and their inter-linkages at global, regional and sub-regional levels. The assessments should include thematic issues at appropriate scales and new topics identified by science. These assessments must be scientifically credible, independent and peer-reviewed, and must identify uncertainties. There should be a clear and transparent process for sharing and incorporating relevant data. IPBES´ assessments will of course be mainly based on existing data, information and knowledge. The Platform will not collect data on its own.[52]

In a document[53] prepared for the Plenary Meeting in Bonn a possible scenario for a work programme was presented. A number of possible key programme deliverables and potential activities were listed. The deliverables are as follows:

- A series of focused thematic assessments (for example on pollination, dryland ecosystem services, ocean acidification, ecosystem restoration, the Aichi biodiversity targets and GBO 4/5)
- Regional and sub-regional assessments of biodiversity and ecosystem services and their interlinkages
- An integrated global assessment of biodiversity and ecosystem services that builds on national and regional assessments
- Increased access to support (both technical support and funding) for addressing capacity building needs
- A conceptual framework for IPBES assessments, and guidance on its application
- An improved understanding of the assessment landscape
- A strategy for promoting and engaging with national and subregional assessment activities
- Increased access to policy support tools and methodologies
- Increased access to the people, data and information necessary for supporting assessments and the related decision making processes

A critical review of the global assessment landscape, that includes relevant thematic and comprehensive assessments at the national, regional, sub-regional and global levels, has also been carried out.[54] It lists 13 global assessment initiatives relating to biodiversity and ecosystem services and summarises some of their key characteristics, strengths and shortcomings. These assessments include the MA, TEEB, GBO and GEO. The critical review of assessments draws key lessons learned from these and other assessment processes. Excerpts from the review are presented in Annex 6.

A Catalogue of Assessments has also been set up on an interim basis.[55] It is a source of information on assessments of biodiversity and ecosystem services from the global to the sub-national scales. The primary intention is to learn lessons from existing and on-going assessment processes so as to provide information for the future development of IPBES. The Catalogue is available online.[56]

The Plenary Meeting in Bonn decided that a Work Programme for 2014-2018, based on the work carried out up to now, should be drafted and presented to IPBES-2 for adoption. That meeting will be arranged in late 2013 or early 2014.

3.7.1 Linkages between the IPBES and the Diversity II Project

There are a number of close linkages between the IPBES and the Diversity II Project. Both deal ultimately with assessment of biodiversity. Both have a technical-scientific, global approach. Therefore, they have much in common. At the same time, they are fundamentally different. IPBES is a permanent IGO which synthesizes and analyses data on the whole field of biodiversity. The Diversity II is a temporary project focusing on the provision

[52] http://www.iisd.ca/ipbes/ipbes1/

[53] Document IPBES/1/INF/14/Rev 1

[54] Document IPBES/1/INF/8

[55] http://www.ipbes.unepwcmc-004.vm.brightbox.net/

[56] http://catalogue.ipbes.net

of EO-based data on freshwater and dryland biodiversity. Even if there are some overlaps, they do not compete with each other. On the contrary, they complement and strengthen each other. This applies particularly to the provision of data by Diversity II.

The Diversity II Project will provide a lot of data that will be very useful for the assessments made by IPBES. These data will be more or less relevant for a majority of the deliverables of IPBES. Also the Project´s development of EO-based methodologies for monitoring and assessment of biodiversity will be of great use for the IPBES.

Also the opposite is true. IPBES will produce data that could be used by the Diversity II Project. However, only limited data will be available during the duration of the Project. As far as can be judged at present, the most important contribution will be the Catalogue of Assessments, which is intended to be continuously updated, and the critical review of the global assessment landscape which was presented to the Bonn meeting. The Catalogue will give current pictures of other on-going assessments to which the Diversity II Project has to relate itself. The critical review gives information about other assessments which will be particularly useful for the reporting of the Project (see Annex 6).

4 Biodiversity Indicators – a tool to monitor the implementation of the CBD Strategic Plan 2011 – 2020

This chapter presents the results of analyses carried out as regards requirements for, and development of, biodiversity indicators that can be used to monitor the implementation of the CBD Strategic Plan 2011 – 2020. The text is mainly based on official CBD documents and scientific/technical literature to which references are made. Altogether, more than 50 documents and articles have been reviewed. Excerpts from some documents of specific interest to this chapter are found in Annexes 7-10.

4.1 Background

Biodiversity indicators play an important role in the implementation of the CBD.[57] [58] In the CBD context, an indicator can be defined as a measure or metric based on verifiable data that conveys information about more than itself. The measure (a standard unit used to express size, amount or degree) and the metric (a system or standard of measurement) should relate to biodiversity. Biodiversity indicators can be simple measurements or more complex indices.

The term biodiversity indicator, as used by the CBD, covers more than direct measures of biodiversity itself, inter alia actions to ensure its protection. Biodiversity indicators are measures of something biodiversity-related. Therefore, they usually can be presented in a numerical or quantitative form. As the measure or metric conveys information about more than itself, indicators are purpose-dependent. The interpretation depends on the purpose.

Biodiversity indicators can provide measures of the progress and success of policies or form part of an early warning system to detect the emergence of problems. They can also be used to raise awareness about an issue and put responses to it into context. However, indicators provide little understanding of an issue by themselves. They usually need some analysis and interpretation of what they are indicating.

Indicators constitute a central part of effective biodiversity management. They provide an interface between policy and biodiversity-related science by simplifying complex issues. An efficient indicator should be:

- Scientifically valid
- Based on available data
- Responsive to changes in the issue of focus
- Easily understandable
- Relevant to user´s needs
- Used for the relevant purposes

One of the common uses of biodiversity indicators is to monitor progress towards biodiversity targets at all levels. The use of biodiversity indicators, particularly at the international level, has increased considerably since the first Strategic Plan of the CBD, for the period 2002 – 2010, was adopted by the COP VI in 2002[59]. In that Plan, the Parties committed themselves "to a more effective and coherent implementation of the three objectives of the Convention, 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." In addition to this overall target, 21 subsidiary targets were set up. The requirement to report on progress in meeting these targets has been a major force in promoting the development of biodiversity indicators, both within the framework of the CBD and at national and regional levels. The work to further develop indicators has continued, and become intensified, as part of the implementation of the Strategic Plan 2011 – 2020.

[57] BIODIVERSITY INDICATORS & THE 2010 BIODIVERSITY TARGET: Outputs, experiences and lessons learnt from the *2010 Biodiversity Indicators Partnership.* CBD Technical Series No. 53

[58] Biodiversity Indicators Partnership (BIP) 2011: Guidance for National Biodiversity Indicator Development and Use. www.bipnational.net

[59] Document UNEP/CBD/COP/6/20

4.2 Development of biodiversity indicators within the context of CBD

Development of biodiversity indicators has been part of CBD´s agenda from the very beginning and became an issue of high priority following the adoption by ***COP VI*** (2002) of the Strategic Plan 2002 – 2010 (Decision VI/26)[60].

An expert meeting on indicators was convened in 2003 whose report[61] was welcomed by ***SBSTTA IX*** the same year (Recommendation IX/10).[62] SBSTTA recommended COP to urge all parties that had not done so to develop a set of indicators as part of their national strategies and action plans, taking into account the 2010 target. Parties, organizations etc. were recommended to make use of indicators in their assessment of biodiversity, in particular regarding progress towards the achievement of globally agreed targets like the Strategic Plan.

COP VII (2004) decided in line with the recommendations of SBSTTA IX (Decision VII/8)[63]. COP also agreed that a limited number of trial indicators, for which data were available from existing sources, be developed and used in reporting, in order to effectively assess progress at the global level towards the 2010 target and communicate trends in biodiversity related to the objectives of the CBD. Indicators ready for immediate testing and use and possible indicators for further development were listed (Decision VII/30).

An ***AHTEG*** on indicators for assessing the progress towards the 2010 biodiversity target met in 2005 to assist SBSTTA in the fulfilment of the tasks given by COP VII. The report[64] provides a detailed review of the indicators in question.

SBSTTA X (2005) welcomed the report of the AHTEG, confirmed the suitability of those indicators considered by the COP VII as ready for immediate use and proposed additional indicators ready for immediate testing (Recommendation X/7)[65]. The recommendation implied some amendments of the COP Decision VII/30.

COP VIII (2006) adopted a framework for monitoring the implementation of the achievement of the 2010 target and integration of targets into the thematic programmes of work (Decision VIII/15)[66]. The recommendations of SBSTTA X were endorsed. The decision implied a further step forward in the development of various types of indicators, inter alia global headline indicators. A comprehensive suite of indicators that should be used to follow up the implementation of the Strategic Plan was agreed. Global outcome-oriented targets were included in the PoW on inland water and on drylands.

COP VIII also noted the progress made in establishing the 2010 Biodiversity Indicators Partnership (2010 BIP), coordinated by the UNEP-WCMC, and emphasized the need for a continuing process to implement, and where necessary further develop and test, the global outcome-oriented indicators. BIP became operative in 2007 and has since then been a key actor in the work to develop and implement biodiversity indicators. The 2010 BIP has greatly contributed to a better understanding of relationships between policy actions, human threats, biodiversity status and services that nature provides by linking sets of indicators within a logical framework. Such analyses have enabled the compelling conclusions in the GBO-3 (see Section 3.3).

COP IX (2008) provided guidelines for a revised and updated Strategic Plan, including a revised biodiversity target, to be decided by the COP X (Decision IX/9)[67]. However, indicators were only dealt with in general and brief terms.

An important contribution to the upcoming SBSTTA meeting was an international workshop on indicators convened by the UNEP-WCMC and SCBD in 2009.[68]

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[60] Document UNEP/CBD/COP/6/20

[61] Document UNEP/CBD/SBSTTA/9/INF/7

[62] Document UNEP/CBD/COP/7/4

[63] Document UNEP/CBD/COP/7/21

[64] Document UNEP/CBD/SBSTTA/10/INF/7

[65] Document UNEP/CBD/COP/8/2

[66] Document UNEP/CBD/COP/8/31

[67] Document UNEP/CBD/COP/9/29

SBSTTA XIV (2010) made an examination of the outcome-oriented goals and targets and associated indicators of the Strategic Plan and considered their possible adjustment for the period beyond 2010 (Recommendation XIV/9)[69]. The need to continue the work of the 2010 BIP on global indicators for the post-2010 period was identified. SBSTTA also recommended continued use of the global headlines indicators and supplementing them with additional indicators suitable for targets which lack indicators at present as well as the further development of measures (or specific indicators) to monitor progress towards selected targets. The SCBD was urged to convene an AHTEG on Indicators for the Strategic Plan 2011 – 2020.

COP X (2010) endorsed the SBSTTA recommendations (Decision X/7)[70] and adopted the Strategic Plan for Biodiversity 2011 – 2020, including the Aichi Biodiversity Targets (Decision X/2). COP agreed to:

- Pursue the use of the global headlines indicators contained in COP Decision VIII/15 and the further development of measures (or specific indicators) to monitor progress towards selected targets.
- Complement these global headline indicators with additional ones that are suitable for monitoring progress towards those targets for which suitable indicators have not yet been identified, in particular in relation to the economics of biodiversity and ecosystem services and the benefits to people derived from these services;
- Develop measures (or specific indicators), in cooperation with the scientific community, that could complement or substitute the existing indicators, taking into account indicators developed under other multilateral environmental agreements and international organizations and sector-based processes.

An overview of the targets and associated indicators pointed out by the COP X is given in Annex 7**.**

The relevance of the different Aichi Targets, from the perspective of the Diversity II Project, is discussed in Section 4.3.

The COP X decisions were followed by an extensive effort to further develop indicators for monitoring the Aichi Biodiversity Targets. The work was to a large extent based on the report of the AHTEG on Indicators for the Strategic Plan for Biodiversity 2011 – 2020[71]. Its executive summary is contained in Annex 8 and its observations and recommendations in Annex 9.

Two reports were also presented in support of the AHTEG on Indicators for the Strategic Plan for Biodiversity 2011 – 2020. A report[72] entitled "Adequacy of Biodiversity Observation Systems to support the CBD 2020 Targets", submitted by the GEO BON, IUCN and UNEP-WCMC, is of specific interest to the Diversity II Project. The second report[73] submitted by UNEP-WCMC, presents a review of national indicators, monitoring and reporting for global biodiversity targets.

SBSTTA XV (2011) welcomed the reports of the AHTEG on Indicators for the Strategic Plan for Biodiversity 2011 – 2020 and other activities on indicators since COP X, took note of the indicative list of indicators identified by the Group (see Annex 10) and recognized that it provides a starting point to assess progress in the achievement of the Strategic Plan at various scales (Recommendation XV/1)[74].

SBSTTA XV also requested the SCBD to further develop global indicators identified in Annex 10, with a view to ensuring that each Aichi Biodiversity Target can be monitored by at least one global indicator by 2014, and to propose a limited number of simple, easily applicable and cost-effective indicators that can potentially be implemented by all Parties. During the SBSTTA discussions, the need for biodiversity monitoring and indicators

[68] Document UNEP/CBD/SBSTTA/14/INF/14

[69] Document UNEP/CBD/COP/10/3

[70] Document UNEP/CBD/COP/10/27

[71] Document UNEP/CBD/SBSTTA/15/INF/6

[72] Document UNEP/CBD/SBSTTA/15/INF/8

[73] Document UNEP/CBD/SBSTTA/15/INF/9

[74] Document UNEP/CBD/COP/11/2

adapted to remote sensing techniques was underlined by representatives from developing countries, international organizations and the scientific community.

COP XI (2012) fully endorsed the SBSTTA XV recommendations on indicators (including the list in Annex 10) and underlined the crucial role of indicators in the monitoring of progress towards the implementation of the Aichi Targets (Decision XI/3)[75].

Neither the COP XI nor earlier decisions/recommendations dealt with more specific technical or scientific aspects of monitoring and indicators. However, COP XI took a number of more general decisions of interest to the Diversity II Project. The COP XI:

- Decided that the indicator framework for the Strategic Plan should be kept under review with a view to enabling the future incorporation and/or revision of relevant indicators.
- Recognized the need to strengthen technical and institutional capacities for the development and application of indicators and monitoring systems.
- Requested the SCBD, in collaboration with the BIP and other relevant organizations, to provide support to parties for the further development of indicators and monitoring and reporting systems.
- Invited GEO BON to continue its work on the identification of essential biodiversity variables and the development of associated data sets.
- Invited relevant organizations, including funding bodies, to encourage and support long-term monitoring and the further development of indicators and report progress in the implementation of the Strategic Plan as well as the development of baselines for indicators where they do not yet exist.

The Diversity II Project should be tailored to promote the implementation of the Strategic Plan. Therefore relevant indicators in the preliminary list (Annex 10) constitute the basis for the development of status and trend indicators which are adapted to satellite data as the main source of information.

4.2.1 Conclusions in summary

- The importance of monitoring and further development of indicators for both inland water and dryland biodiversity is strongly underlined.
- Many indicators developed so far are without further development not suitable for such direct use that is based on EO data.
- There is an urgent need for indicators that can be used together with EO data. Such indicators can be the result of both adaptation of existing and development of new ones.
- There is awareness within the biodiversity community of the need for such indicators.

4.3 The potential of EO to provide data for indicators that can be used to monitor the implementation of the Aichi Targets

Remote sensing can provide consistent long-term EO data at scales from the local to the global domain.Two categories of approaches (direct and indirect EO approaches) are applicable for monitoring ecology, biodiversity and conservation.

Direct approaches refer to the direct observation of individual organisms, species or ecological communities from airborne or satellite sensors, such as the application of very high spatial resolution and hyper-spectral sensors to monitor penguin colonies in Antarctica.

Indirect approaches rely on environmental parameters derived from remotely sensed data as proxies. Habitat parameters, such as land degradation, vegetation phenology, land cover, phytoplankton chlorophyll concentration and species composition, can be considered as a proxy for accurate estimates of potential species ranges and patterns of species richness.

In the DIVERSITY-II Project it is primarily the indirect approaches that will be used for inferring metrics of biodiversity. Within the context of this Project, EO based approaches will be indicated as well as the potential use of EO data for diversity monitoring beyond the scope of methods/data applied in the Project.

[75] Document UNEP/CBD/COP/11/35

A number of the Aichi Targets are more or less relevant to the Diversity II Project. The relevance has been assessed based on the extent to which EO can be used to monitor progress towards the achievement of the Targets with respect to inland water and/or dryland biodiversity. This assessment is based, inter alia, on the SoW, the PMP and a report[76] by the GEO BON (in collaboration with the IUCN and the UNEP-WCMC) entitled "Adequacy of Biodiversity Observation Systems to support the CBD 2020 Targets" (see Annex 5). An important source of information was also the general knowledge and experience of the Project Team. A general overview of the Aichi Targets is given in Section 4.3.1 and a more specific, operational one in Section 4.3.2.

4.3.1 Aichi Targets of relevance to the Diversity II Project

Targets 1-4 address the underlying causes of biodiversity loss, i.e. societal issues which cannot be directly monitored by EO. Therefore, these Targets are not of direct relevance for the Diversity II Project. However, they might indirectly contribute to the monitoring of trends by detection of changes that are the result of modification of underlying causes.

Target 5 adresses loss of all natural habitats (i.e. including inland water and dryland biodiversity). It plays a key role in this context and is very relevant for the Diversity II Project, both as regards inland water and dryland biodiversity. A lot of data for the monitoring of progress towards this Target can be obtained by EO. The GEO BON Report highlights the following:

> "Trends in habitat loss and fragmentation of terrestrial habitats are typically measured using remotely-sensed data, which have the potential to deliver indicators [----] with very high spatial and temporal resolution. Field validation of remotely-sensed products is essential. Although data quality (spatial and spectral resolution) has improved over time there has been a lack of consistency. It is difficult to find products comparable with older datasets due to changes in spatial, spectral and radiometric scale, as well as in attribute naming conventions and definitions, making it difficult for trends to be accurately determined."
>
> "Going forward, between 2011-2019 high resolution maps that accurately provide information on changes in habitat extent and fragmentation rates are technically feasible to obtain for many terrestrial habitats, although careful consideration of the temporal scale will be essential for some habitats such as inland wetlands. Remote sensing has proved more effective in determining trends in extent of forest than in monitoring other habitats. In particular, accurate identification and separation of wetland habitats and of treeless habitats such as grasslands, savannah and agriculture is challenging. "
>
> "Measuring degradation *within* habitats is challenging: it can often go unnoticed until it leads to fragmentation. While hyperspatial and hyperspectral remote sensing data and LIDAR (Light Detection And Ranging) can provide relevant data for assessing habitat degradation, these are available only at local or in some cases national level."
>
> "As new remote sensing datasets become available, it is imperative that they can be calibrated to existing data to allow comparison of trends over time. The expertise and technical know-how on remote sensing and GIS is limited in many developing countries, and capacity building will be essential. A lot more might be needed to support the training process. Further analysis is required to derive fragmentation and degradation trends from remote sensing data for all habitat types. Expanded population trend and species extinction risk monitoring is needed to improve these measures of habitat degradation. Hyperspectral data are not widely available but would help greatly with discrimination of habitats and species on the ground. More hyperspectral instruments are required to provide repeated and global coverage."

Target 6 addresses unsustainable fisheries and is relevant for the Diversity II Project, mainly as regards inland water biodiversity. The most important issue is the impact of environmental degradation in inland water habitats (e.g. river fragmentation by dams, siltation, eutrophication) on freshwater fish species and species that during their life cycle migrate between marine and freshwater areas. EO can in many cases be used for

[76] Document UNEP/CBD/SBSTTA/15/INF/8 (September 2011)

monitoring of such degradation. To a certain extent, the statements by GEO BON under Target 5 also apply to this Target.

Target 7 addresses unsustainable agriculture, aquaculture and forestry. It deals with issues of great importance to both inland water and dryland biodiversity and is relevant for the Diversity II Project. EO can be used for the monitoring of progress towards this target, e.g. by documenting large-scale changes of agricultural and forest landscapes (including impact of grazing in drylands), exploitation of mangroves for aquaculture purposes and changes of the eutrophication level of inland water habitats. To a certain extent, the statements by GEO BON under Target 5 also apply to this Target.

Target 8 addresses pollution in a broad sense. It plays a key role for inland water biodiversity and is very relevant for the Diversity II Project but of limited importance to dryland biodiversity. EO can be useful for monitoring of water pollution, e.g. eutrophication and siltation. For some other pollution components, for example ozone, the use of satellite data for monitoring looks promising.

Target 9 addresses invasive alien species, a serious threat to both inland water and dryland biodiversity, and measures to combat them. The focus on measures makes the Target less relevant for the Diversity II Project. However, some relevance comes out of the fact that the Target includes reducing impacts on biodiversity of such species invasion, e.g. overgrowth of inland waters and bush encroachment in drylands, which can be monitored by EO. Therefore, the Target has some relevance for the Project.

Target 10 addresses multiple anthropogenic pressures on coral reefs and other vulnerable ecosystems impacted by climate change or ocean acidification. The Target seems to focus on human pressure and marine environments. However, ”other vulnerable ecosystems” could include inland waters and drylands. Furthermore, human-induced ecosystem failure can be expressed in ways that can be monitored by EO, e.g. reduced water flow of rivers and soil erosion. Therefore, the Target has some relevance for the Diversity II Project.

Target 11 addresses protected areas which is a key issue of great importance for both inland water and dryland biodiversity. The Target is relevant to the Diversity II Project, even if only a part of the data needed for the monitoring of progress towards the Target can be obtained from EO. Of specific interest is data at the landscape level related to ecological representativeness, integration in the broader landscape, fragmentation, connectivity etc. Several satellite based land cover products offer outstanding potential for assessing forest fragmentation and similar phenomena. However, according to the GEO BON, their utility in monitoring such characteristics of other habitats requires further testing.

Target 12 addresses the prevention of extinction of threatened species, an issue which cannot be monitored by EO. Therefore, this Target is not relevant for the Diversity II Project.

Target 13 addresses the maintenance of genetic diversity of cultivated plants, domesticated animals and other socio-economically valuable species. It is an issue which cannot be monitored by EO. Therefore, this Target is not relevant for the Diversity II Project.

Target 14 addresses the conservation of ecosystems that provide essential services to man. This is the core of the Diversity II Project: global assessments of (1) the availability of freshwater and its quality as well as (2) status and trends of dryland biodiversity, including land conditions and productivity. These EO-based assessments constitute a limited but very important part of the wide task to monitor progress towards the Target and are very relevant for the Project. Compare also Target 15.

Target 15 addresses enhancement of ecosystem resilience and the contribution of biodiversity to carbon stocks through conservation and restoration of ecosystems. The Target deals with important issues and shows similarities with Target 14. Important parts of it, especially dryland biodiversity, are well suited for monitoring by EO. Therefore, it is very relevant for the Diversity II Project. The GEO BON Report addresses the dryland component in the following way:

”Desertification”. Decline in vegetated green cover as detected by satellites, summed over the seasonal cycle, is the most widely used indicator of desertification. Many indices have been used (Normalized Difference Vegetation Index (NDVI), Enhanced Vegetation Index (EVI), Soil Adjusted Vegetation Index (SAVI) etc.). The

index most directly related to loss of plant productive capacity is the Fraction of Absorbed Photosynthetically Active Radiation (fAPAR). It is the core variable used in models of primary production in terrestrial ecosystems."

Target 16 addresses the Nagoya Protocol on Genetic resources, an issue which cannot be monitored by EO. Therefore, this Target is not relevant for the Diversity II Project.

Targets 17-18 address policy issues which cannot be monitored by EO. Therefore, these Targets are not relevant for the Diversity II Project.

Target 19 addresses the urgent need for improved knowledge about biodiversity and transfer of this knowledge to society as a whole. To achieve this is a precondition for the achievement of all other Aichi Targets. The Diversity II Project will provide an important contribution to the achievement of this Target and therefore it is indirectly very relevant.

Target 20 addresses the mobilization of financial resources for effectively implementing the Strategic Plan. This is a policy issue which cannot be monitored by EO. Therefore, this Target is not relevant for the Diversity II Project.

4.3.2 Contribution of EO data to the monitoring of how the Aichi Targets are met

An Indicative List of Indicators for the Strategic Plan for Biodiversity 2011–2020 (from CBD COP Decision XI/3) is presented as a table in Annex 10. The table is also reproduced here, supplemented with a third column that presents the potential of EO to provide data for indicators that can be used to monitor the implementation of the Aichi Targets. What can be done by EO is specified in words for each Target. Those Targets that are considered highly relevant or relevant are shaded green and orange respectively.

Table 1. The potential of EO to provide data for indicators that can be used to monitor the implementation of the Aichi Targets.

Strategic Goal A: Address the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society		
Aichi Target	**Headline indicators (in bold) and most relevant operational indicators**	**What can be done by EO**
Target 1 - By 2020, at the latest, people are aware of the values of biodiversity and the steps they can take to conserve and use it sustainably.	**Trends in awareness, attitudes and public engagement in support of biological diversity and ecosystem services** • *Trends in awareness and attitudes to biodiversity (C)* • *Trends in public engagement with biodiversity (C)* • *Trends in communication programmes and actions promoting social corporate responsibility (C)*	The Project will not contribute to the monitoring and assessment of how the Target is met. However, it might contribute to the visualization of ecosystem health parameters at a synoptic scale.
Target 2 - By 2020, at the latest, biodiversity values have been integrated into national and local development and poverty reduction strategies and planning processes and are being incorporated into national accounting, as appropriate, and reporting systems.	**Trends in integration of biodiversity, ecosystem services and benefits sharing into planning, policy formulation and implementation and incentives** • Trends in number of countries incorporating natural resource, biodiversity, and ecosystem service values into national accounting systems (B) • *Trends in number of countries that have assessed values of biodiversity, in accordance with the Convention (C)* • *Trends in guidelines and applications of economic appraisal tools (C)* • *Trends in integration of biodiversity and ecosystem service values into sectoral and development policies (C)* • *Trends in policies considering biodiversity and ecosystem service in environmental impact assessment and strategic environmental assessment (C)*	
Target 3 - By 2020, at the latest, incentives, including subsidies, harmful to biodiversity are eliminated, phased out or reformed in order to minimize or avoid negative impacts, and positive incentives for the conservation and sustainable use of biodiversity are developed and applied, consistent and in harmony with the Convention and other relevant international obligations, taking into account national socio economic conditions.	**Trends in integration of biodiversity, ecosystem services and benefits sharing into planning, policy formulation and implementation and incentives** • Trends in the number and value of incentives, including subsidies, harmful to biodiversity, removed, reformed or phased out (B) • *Trends in identification, assessment and establishment and strengthening of incentives that reward positive contribution to biodiversity and ecosystem services and penalize adverse impacts (C)*	The Project will not contribute directly to the monitoring and assessment of how the Target is met. However, it might indirectly contribute to the monitoring of trends by detection of land use changes (e.g. deforestation, mining) or changes of water quality (e.g. caused by aquaculture).

Strategic Goal A: Address the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society		
Aichi Target	**Headline indicators (in bold) and most relevant operational indicators**	**What can be done by EO**
Target 4 - By 2020, at the latest, Governments, business and stakeholders at all levels have taken steps to achieve or have implemented plans for sustainable production and consumption and have kept the impacts of use of natural resources well within safe ecological limits.	**Trends in pressures from unsustainable agriculture, forestry, fisheries and aquaculture** • Trends in Ecological Footprint and/or related concepts (A) (decisions VII/30 and VIII/15) • Trends in population and extinction risk of utilized species, including species in trade (A) (also used by CITES) • *Ecological limits assessed in terms of sustainable production and consumption (C)*	Time series of remote sensing products (e.g. Land Cover Classification) might show trends in pressure from forestry, e.g. by showing the reduction of forest area, logging and burning. EO data (time series) can be used for assessment of changes in land surface variables, associated with LUCC. These could be changes in forest cover, including (1) deforestation, e.g. for agricultural expansion, (2) forest recovery, e.g. due to farmland abandonment, (3) forest degradation, e.g. due to logging and (4) the replacement of natural forest by plantations. It might be difficult to use remote sensing to identify unsustainable agriculture. For global dryland areas unsustainable agricultural practices could potentially be monitored by using EO data of vegetation productivity and precipitation combined into the RUE that relates vegetation growth to the amount of rainfall.
	Trends in pressures from habitat conversion, pollution, invasive species, climate change, overexploitation and underlying drivers • *Trends in biodiversity of cities (C) (decision X/22)*	Direct land cover change might be observable using remote sensing data. From EO based land cover classification, the physiographical characteristics can be used to identify specific habitats and predict the distribution of both habitats and individual species at a large spatial extent. Pressure on habitats and invasive species etc. can be identified by land cover classification change detection analyses based on VHR and HR EO data. Change detection analysis provides continuous and long-term measurements of key ecological parameters to monitor ecosystems through time and over large areas, such as the application of climate change and habitat loss. Invasive species and biodiversity can be monitored from the combined use of high spatial resolution and hyperspectral sensors.

Strategic Goal A: Address the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society		
Aichi Target	**Headline indicators (in bold) and most relevant operational indicators**	**What can be done by EO**
	Trends in integration of biodiversity, ecosystem services and benefits sharing into planning, policy formulation and implementation and incentives • Trends in extent to which biodiversity and ecosystem service values are incorporated into organizational accounting and reporting (B)	

Strategic Goal B: Reduce the direct pressures on biodiversity and promote sustainable use		
Aichi Target	**Headline indicators (in bold) and most relevant operational indicators**	**What can be done by EO**
Target 5 - By 2020, the rate of loss of all natural habitats, including forests, is at least halved and where feasible brought close to zero, and degradation and fragmentation is significantly reduced.	**Trends in extent, condition and vulnerability of ecosystems, biomes and habitats** • Extinction risk trends of habitat dependent species in each major habitat type (A) • Trends in extent of selected biomes, ecosystems and habitats (A) (decision VII/30 and VIII/15) • Trends in proportion of degraded/threatened habitats (B) • Trends in fragmentation of natural habitats (B) (decision VII/30 and VIII/15) • *Trends in condition and vulnerability of ecosystems (C)* • *Trends in the proportion of natural habitats converted (C)*	Land use changes, e.g. loss of forests, and trends of areal extent of habitats in inland waters can be detected using remote sensing. Trends in proportion of degraded/threatened habitats might become visible using vegetation indices, fAPAR or LAI, for dryland habitats and CHL-a, turbidity, water availability, water temperature, NPP etc. for freshwater habitats. Trends in fragmentation of natural habitats might become visible using high resolution remote sensing data. Time series of HR (e.g. the upcoming Sentinel Satellites) EO data can be used to evaluate impact of landscape patterns, heterogeneity (patchiness and fragmentation of e.g. forest landscapes) on habitats and biodiversity.
	Trends in pressures from unsustainable agriculture, forestry, fisheries and aquaculture • *Trends in primary productivity (C)* • *Trends in proportion of land affected by desertification (C) (also used by UNCCD)*	EO-based integrated ecosystem measurements offer data on functions at different spatial scales, including whole ecosystems, using time series of moderate resolution sensors, such as ENVISAT. Variable derivation of fAPAR, LAI and NPP, either based on the NDVI or from EO-based modeling inversion, can be used for change detection analyses or long term trend analyses. These high temporal resolution time series of EO data sources can be used for studies of changes and trends in vegetation phenology, a key variable in biodiversity and land degradation and desertification assessment. Also, modeling NPP using remote sensing data might be a tool to identify trend in primary productivity

Strategic Goal B: Reduce the direct pressures on biodiversity and promote sustainable use		
Aichi Target	**Headline indicators (in bold) and most relevant operational indicators**	**What can be done by EO**
	Trends in pressures from habitat conversion, pollution, invasive species, climate change, overexploitation and underlying drivers • Population trends of habitat dependent species in each major habitat type (A)	Changes in natural habitats can be visualised using high resolution remote sensing data. Time series of HR (e.g. the upcoming Sentinel Satellites) EO data can be used to evaluate impact of landscape patterns, heterogeneity (patchiness and fragmentation of e.g. forest landscapes) on habitats and biodiversity. Land use changes, e.g. loss of vegetation cover, and changes in areal extent of habitats in for example drylands can be detected using remote sensing.
Target 6 - By 2020 all fish and invertebrate stocks and aquatic plants are managed and harvested sustainably, legally and applying ecosystem based approaches, so that overfishing is avoided, recovery plans and measures are in place for all depleted species, fisheries have no significant adverse impacts on threatened species and vulnerable ecosystems and the impacts of fisheries on stocks, species and ecosystems are within safe ecological limits.	**Trends in pressures from unsustainable agriculture, forestry, fisheries and aquaculture** • Trends in extinction risk of target and bycatch aquatic species (A) • Trends in population of target and bycatch aquatic species (A) • Trends in proportion of utilized stocks outside safe biological limits (A) (MDG indicator 7.4) • *Trends in catch per unit effort (C)* • *Trends in fishing effort capacity (C)* • *Trends in area, frequency, and/or intensity of destructive fishing practices (C)*	The Project might indirectly contribute to the monitoring of trends by detection of water quality (CHL-a) and water temperature. Also deterioration of key fish habitats may be detected. See also Section 0.
	Trends in integration of biodiversity, ecosystem services and benefits sharing into planning, policy formulation and implementation and incentives • Trends in proportion of depleted target and bycatch species with recovery plans (B)	

Strategic Goal B: Reduce the direct pressures on biodiversity and promote sustainable use		
Aichi Target	**Headline indicators (in bold) and most relevant operational indicators**	**What can be done by EO**
Target 7 - By 2020 areas under agriculture, aquaculture and forestry are managed sustainably, ensuring conservation of biodiversity.	**Trends in pressures from unsustainable agriculture, forestry, fisheries and aquaculture** • Trends in population of forest and agriculture dependent species in production systems (B) • Trends in production per input (B) • *Trends in proportion of products derived from sustainable sources (C) (decision VII/30 and VIII/15)*	The project might contribute to the monitoring of trends through LIDAR focusing on the forest vertical structure, especially forest canopy height and aboveground biomass estimation. EO based LIDAR has come through with the ICESat/GLAS operating 2003-2010. LIDAR data can be used for forest biodiversity monitoring and conservation and species distribution models. EO data can also be used for spatial heterogeneity assessment (e.g. monocultures and habitat aerial extent in lakes). See also Section 0.
	Trends in integration of biodiversity, ecosystem services and benefits sharing into planning, policy formulation and implementation and incentives • Trends in area of forest, agricultural and aquaculture ecosystems under sustainable management (B) (decision VII/30 and VIII/15)	

Strategic Goal B: Reduce the direct pressures on biodiversity and promote sustainable use		
Aichi Target	**Headline indicators (in bold) and most relevant operational indicators**	**What can be done by EO**
Target 8 - By 2020, pollution, including from excess nutrients, has been brought to levels that are not detrimental to ecosystem function and biodiversity.	**Trends in pressures from habitat conversion, pollution, invasive species, climate change, overexploitation and underlying drivers** • Trends in incidence of hypoxic zones and algal blooms (A) • Trends in water quality in aquatic ecosystems (A) (decision VII/30 and VIII/15) • Impact of pollution on extinction risk trends (B) • Trends in pollution deposition rate (B) (decision VII/30 and VIII/15) • Trends in sediment transfer rates (B) • *Trend in emission to the environment of pollutants relevant for biodiversity (C)* • *Trend in levels of contaminants in wildlife (C)* • *Trends in nitrogen footprint of consumption activities (C)* • *Trends in ozone levels in natural ecosystems (C)* • *Trends in proportion of wastewater discharged after treatment (C)* • *Trends in UV-radiation levels (C)*	Trends in ozone and UV-radiation can be detected using remote sensing data (http://wdc.dlr.de/data_products/TRACEGASES/) EO data can also be used for monitoring of water quality (CHL-a, TSM, turbidity etc.) and water temperature.

Strategic Goal B: Reduce the direct pressures on biodiversity and promote sustainable use		
Aichi Target	**Headline indicators (in bold) and most relevant operational indicators**	**What can be done by EO**
Target 9 - By 2020, invasive alien species and pathways are identified and prioritized, priority species are controlled or eradicated, and measures are in place to manage pathways to prevent their introduction and establishment.	**Trends in pressures from habitat conversion, pollution, invasive species, climate change, overexploitation and underlying drivers** • Trends in the impact of invasive alien species on extinction risk trends (A) • Trends in the economic impacts of selected invasive alien species (B) • Trends in number of invasive alien species (B) (decision VII/30 and VIII/15) • *Trends in incidence of wildlife diseases caused by invasive alien species (C)*	See Section 0.
	Trends in integration of biodiversity, ecosystem services and benefits sharing into planning, policy formulation and implementation and incentives • Trends in policy responses, legislation and management plans to control and prevent spread of invasive alien species (B) • *Trends in invasive alien species pathways management (C)*	
Target 10 - By 2015, the multiple anthro-pogenic pressures on coral reefs, and other vulnerable ecosystems impacted by climate change or ocean acidification are minimized, so as to maintain their integrity and functioning.	**Trends in pressures from habitat conversion, pollution, invasive species, climate change, overexploitation and underlying drivers** • Extinction risk trends of coral and reef fish (A) • Trends in climate change impacts on extinction risk (B) • Trends in coral reef condition (B) • Trends in extent, and rate of shifts of boundaries, of vulnerable ecosystems (B) • *Trends in climatic impacts on community composition (C)* • *Trends in climatic impacts on population trends (C)*	EO data can be used for benthos mapping and monitoring of water quality (CHL-a, TSM, turbidity etc.) and water temperature. See also Section 0.

Strategic Goal C: To improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity		
Aichi Target	**Headline indicators (in bold) and most relevant operational indicators**	**What can be done by EO**
Target 11 - By 2020, at least 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes.	**Trends in coverage, condition, representativeness and effectiveness of protected areas and other area-based approaches** • Trends in extent of marine protected areas, coverage of key biodiversity areas and management effectiveness (A) • Trends in protected area condition and/or management effectiveness including more equitable management (A) (decision X/31) • Trends in representative coverage of protected areas and other area based approaches, including sites of particular importance for biodiversity, and of terrestrial, marine and inland water systems (A) (decision VII/30 and VIII/15) • Trends in the connectivity of protected areas and other area based approaches integrated into landscapes and seascapes (B) (decision VII/30 and VIII/15) • *Trends in the delivery of ecosystem services and equitable benefits from protected areas (C)*	EO data can be used for monitoring of water quality (CHL-a, TSM, turbidity etc.), trend estimation of terrestrial habitat degradation, mapping of ecoregions, mapping of aerial extent of habitats in inland waters (individual lakes and connected water bodies). See also Section 0.
Target 12 - By 2020 the extinction of known threatened species has been prevented and their conservation status, particularly of those most in decline, has been improved and sustained.	**Trends in abundance, distribution and extinction risk of species** • Trends in abundance of selected species (A) (decision VII/30 and VIII/15) (UNCCD indicator) • Trends in extinction risk of species (A) (decision VII/30 and VIII/15) (MDG indicator 7.7) (also used by CMS) • Trends in distribution of selected species (B) (decision VII/30 and VIII/15) (also used by UNCCD)	
Target 13 - By 2020, the genetic diversity of cultivated plants and farmed and domesticated animals and of wild relatives, including other socio-economically as well as culturally valuable species, is maintained, and strategies have been developed and implemented for minimizing genetic erosion and safeguarding their genetic diversity.	**Trends in genetic diversity of species** • Trends in genetic diversity of cultivated plants, and farmed and domesticated animals and their wild relatives (B) (decision VII/30 and VIII/15) • *Trends in genetic diversity of selected species (C)*	
	Trends in integration of biodiversity, ecosystem services and benefits sharing into planning, policy formulation and implementation and incentives • Trends in number of effective policy mechanisms implemented to reduce genetic erosion and safeguard genetic diversity related to plant and animal genetic resources (B)	

Strategic Goal D: Enhance the benefits to all from biodiversity and ecosystem services		
Aichi Target	**Headline indicators (in bold) and most relevant operational indicators**	**What can be done by EO**
Target 14 - By 2020, ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being, are restored and safeguarded, taking into account the needs of women, indigenous and local communities, and the poor and vulnerable.	**Trends in distribution, condition and sustainability of ecosystem services for equitable human well-being** • Trends in proportion of total freshwater resources used (A) (MDG indicator 7.5) • Trends in proportion of the population using improved water services (A) (MDG indicator 7.8 and 7.9) • Trends in benefits that humans derive from selected ecosystem services (A) • Population trends and extinction risk trends of species that provide ecosystem services (A) • Trends in delivery of multiple ecosystem services (B) • Trends in economic and non-economic values of selected ecosystem services (B) • Trends in health and wellbeing of communities who depend directly on local ecosystem goods and services (B) (decision VII/30 and VIII/15) • Trends in human and economic losses due to water or natural resource related disasters (B) • Trends in nutritional contribution of biodiversity: Food composition (B) (decision VII/30 and VIII/15) • *Trends in incidence of emerging zoonotic diseases (C)* • *Trends in inclusive wealth (C)* • *Trends in nutritional contribution of biodiversity: Food consumption (C) (decision VII/30 and VIII/15)* • *Trends in prevalence of underweight children under-five years of age (C) (MDG indicator 1.8)* • *Trends in natural resource conflicts (C)* • *Trends in the condition of selected ecosystem services (C)* • *Trends in biocapacity (C)*	EO data can be used for monitoring of water availability and habitat extent and quality. EO also enables trend observations in remote areas. See also Section 0.
	Trends in coverage, condition, representativeness and effectiveness of protected areas and other area-based approaches • Trends in area of degraded ecosystems restored or being restored (B)	Trends in area of degraded ecosystems restored or being restored might be observed by using land cover change maps for a longer period.

Strategic Goal D: Enhance the benefits to all from biodiversity and ecosystem services		
Aichi Target	**Headline indicators (in bold) and most relevant operational indicators**	**What can be done by EO**
Target 15 - By 2020, ecosystem resilience and the contribution of biodiversity to carbon stocks has been enhanced, through conservation and restoration, including restoration of at least 15 per cent of degraded ecosystems, thereby contributing to climate change mitigation and adaptation and to combating desertification.	**Trends in distribution, condition and sustainability of ecosystem services for equitable human well-being** • Status and trends in extent and condition of habitats that provide carbon storage (A)	Time series of NPP maps might help to identify the trend in extent of habitats that provide carbon storage (biomass). Standing biomass maps might be derived from radar missions. The combined use of LIDAR, active/passive RADAR and optical EO data can be used for generating forest cover maps as a baseline for subsequent change monitoring. See also Section 0.
	Trends in coverage, condition, representativeness and effectiveness of protected areas and other area-based approaches • *Population trends of forest-dependent species in forests under restoration (C)*	High resolution land cover maps differentiating forest species might be used to observe trends.
Target 16 - By 2015, the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization is in force and operational, consistent with national legislation.	**Trends in access and equity of benefit-sharing of genetic resources** • ABS indicator to be specified through the ABS process (B)	

Strategic Goal E: Enhance implementation through participatory planning, knowledge management and capacity building		
Aichi Target	**Headline indicators (in bold) and most relevant operational indicators**	**What can be done by EO**
Target 17 - By 2015 each Party has developed, adopted as a policy instrument, and has commenced implementing an effective, participatory and updated national biodiversity strategy and action plan.	**Trends in integration of biodiversity, ecosystem services and benefit-sharing into planning, policy formulation and implementation and incentives** • Trends in implementation of national biodiversity strategies and action plans, including development, comprehensiveness, adoption and implementation (B)	
Target 18 - By 2020, the traditional knowledge, innovations and practices of indigenous and local communities relevant for the conservation and sustainable use of biodiversity, and their customary use of biological resources, are respected, subject to national legislation and relevant international obligations, and fully integrated and reflected in the implementation of the Convention with the full and effective participation of indigenous and local communities, at all relevant levels.	**Trends in integration of biodiversity, ecosystem services and benefit-sharing into planning, policy formulation and implementation and incentives** • Trends in land-use change and land tenure in the traditional territories of indigenous and local communities (B) (decision X/43) • Trends in the practice of traditional occupations (B) (decision X/43)	
	Trends in accessibility of scientific/technical/traditional knowledge and its application • Trends in which traditional knowledge and practices are respected through their full integration, safeguards and the full and effective participation of indigenous and local communities in the national implementation of the Strategic Plan (B)	
	Trends in accessibility of scientific/technical/traditional knowledge and its application • Trends of linguistic diversity and numbers of speakers of indigenous languages (B) (decision VII/30 and VIII/15)	

Strategic Goal E: Enhance implementation through participatory planning, knowledge management and capacity building		
Aichi Target	**Headline indicators (in bold) and most relevant operational indicators**	**What can be done by EO**
Target 19 - By 2020, knowledge, the science base and technologies relating to biodiversity, its values, functioning, status and trends, and the consequences of its loss, are improved, widely shared and transferred, and applied.	**Trends in accessibility of scientific/technical/traditional knowledge and its application** • Trends in coverage of comprehensive policy-relevant sub-global assessments including related capacity-building and knowledge transfer, plus trends in uptake into policy (B) • *Number of maintained species inventories being used to implement the Convention (C)*	This is the inherent purpose of the Diversity II Project. See also Section 0.
Target 20 - By 2020, at the latest, the mobilization of financial resources for effectively implementing the Strategic Plan for Biodiversity 2011-2020 from all sources, and in accordance with the consolidated and agreed process in the Strategy for Resource Mobilization, should increase substantially from the current levels. This target will be subject to changes contingent to resource needs assessments to be developed and reported by Parties.	**Trends in mobilization of financial resources** • Indicators agreed in decision X/3 (B)	

5 User Requirements

The chapter includes information on user requirements collected through user questionnaires and three dedicated user consultation meetings.

5.1 Analysis of the Questionnaires

This section presents a synthesis of the responses to the questionnaires up to the CDR. About 35 questionnaires were distributed to a wide range of users. Four filled in questionnaires could be collected for inland waters, and five for drylands. This limited number does not allow the drawing of far-reaching conclusions. However, some indications seem to emerge which will be discussed here.

The following persons/organisations responded and provided filled-in questionnaires:

Inland waters

Stewart Bernard and Mark Matthews, University of Cape Town and ChloroGin

Ian Harrison, Conservation International (CI) Biodiversity Assessment Unit and IUCN Global Species Programme

Erin Hester, CSIRO, Australia and GEO Inland – Quality RS Group

Peter Hunter, University of Stirling and GloboLakes

Drylands

Alan Belward, JRC, European Commission

Ken Clarke, University of Adelaide

Amadou Diege, Centre de Suivi Ecologique, Dakar

Patrik Klintenberg, Mälardalen University and Desert Research Foundation of Namibia

Bob Scholes, CSIR South Africa and GEOBON – Drylands

5.1.1 Inland Waters

Existing activities/projects

All respondents are involved in numerous activities of different scope and scale, from national to global, that are relevant for the Diversity II Project. However, not all of these activities focus on biodiversity issues.

Requirements overview

The need for Diversity II products and cooperation with the project is generally underlined, both in a developing country perspective (South Africa) and in a developed country perspective (Australia). A limiting challenge to the application of EO data for biodiversity assessment is the lack of bio-optical information for algorithm parameterization and of in situ observations for validation of EO products. Additional challenges are the boundary conditions of sensor specifications. An integrative approach is desirable under which the most suitable satellite data is acquired and processed to allow multiple information products to be delivered.

Parameters, Indicators and Product Requirements

The basic parameters that are proposed to be produced (turbidity, Secchi Disk depth, TSM, YS) meet very well the requirements. All four respondents gave highest marks (3-4 on a scale from 0-4; average 3.8) for the importance of these parameters. The concept of a “quality indicator” was not understood by all respondents and somewhat lower marks were given. Suggestions for additional parameters were made (cyanobacteria, PFTs), which should be discussed.

Water quantity parameters received slightly lower marks (2-4; average 3.5) and it was commented that the algorithms and accuracies should be explained. Three of the respondents gave the “horizontal extent” lower marks than they gave to the volume and water level.

The temporal aggregation was answered quite heterogeneously, i.e. the same aggregation time (e.g. monthly) was considered very relevant by two respondents (mark 4) and unimportant by one (mark 1).

The proposed types of first level indicators (change and trend maps) were considered to be very important by one respondent but of less interest by the others (marks 1 or 0 or no mark at all). One respondent pointed out the importance of time series in order to pick-up events. Here, more questionnaires are required before firm conclusions can be drawn.

The proposed second level indicators ("Area of the pelagic photic zone and the area of the aphotic zone", "Pressure on the photic zone due to changes in water level", "Habitat variety index") got less diverse and overall medium to high marks (average 3.4), indicating that they seem to go into the right direction.

The validation requirements and proposed measures were consistently considered very important (average 3.8). Meta data were ranked 4 by everyone. Comparison of water reflectance with in-situ data got mark 4 from three respondents. Quantitative accuracy requirements were expressed by only one user, basically requesting 30% error for turbidity and TSM, better than 10 cm for Secchi Depth and 1°C for LWST.

Respondents seem to be a bit hesitant to require spatially integrated products. Multiple answers were possible, and all included in their replies "no spatial integration". If integrated, this should preferably be on water bodies within a lake, or of whole lakes, but not beyond. Administratively defined areas were requested by one respondent. Another one requested "lake basin" which needs to be further understood.

As update frequency of the products, monthly, seasonal and yearly deliveries were considered appropriate even if the answers were quite heterogeneous.

Inland water sites

All lakes and reservoirs that are intended to be studied in the Diversity II Project could be of interest. One respondent specifically mentioned lakes in China, Indonesia and the Mekong area. Three large reservoirs in South Africa –Vaal, Loskop and Hartbeesport from which significant amounts of data are available were also specifically mentioned.

Other

Specific comments were given by two respondents.

There are two primary temporal considerations for inland water quality monitoring. The first is sampling designed to represent the dynamics of water quality and the range of conditions that can occur over diurnal, seasonal and annual cycles. The second is sampling designed to develop time series which are essential for assessing the condition and trends of inland water quality as they relate to the effect of water quality management and climate change.

There is much to be gained by an approach that focuses more on eutrophication, e.g. eutrophic indices, bloom indices and phenological approaches. Applications related to risk analyses, warning systems, harmful bloom occurrences etc. with a view to L3/4 Sentinel 2 and 3 data would also be valuable.

Some selected statements provided by respondents should be highlighted:

E. Hester on the basic products:

"Epochs as defined are not reflective of hydrologic epochs of Australia. Binning data by these epochs would result in high loss of information."

In order to develop accurate understanding of inland aquatic processes, it is critical to understand not only the trend of the data, but the stationarity of the time series as well. For example, sensu Hestir et al. (2013), a linear trend describing a sediment transport time series may lead to an incorrect conclusion about the sediment transport processes of a watershed. By analyzing the entire time series, and looking for changes in the trend (stationarity) and breaks, a different conclusion about sediment transport regimes is reached. I strongly encourage careful consideration of the handling of time series data for biodiversity and inland water assessment."

P. Hunter on first level indicators:

"In many lakes, Chla and TSM will be correlated – so the ratio Chla:TSM might say more re influence of eutrophication versus physical disturbance (e.g., resuspension, catchment runoff)."

S. Bernard and M. Matthews on spatial scales:

"South Africa offers chance to move to small water bodies & address very much larger user base!"

S. Bernard and M. Matthews on the first level indicators:

"Is there scope for more sophisticated time series analyses e.g. seasonal vs high frequency variability? " and later: "There is much to be gained by an approach that focuses more on eutrophication e.g. eutrophic indices, bloom indices and phenological approaches e.g. bloom occurrence."

These comments are in line with the overall low marks which the first level indicators got. If this trend is confirmed, the definition of the first level indicators should be accordingly revised.

Recommended additional contacts

A few names were proposed. They have been contacted in case they were not already included in the user list.

5.1.2 Drylands

Existing activities/projects

All respondents are involved in activities of different scope and scale that are relevant for the Diversity II Project. The global projects of JRC show similarities with the Diversity II Project which will be considered during its execution.

Requirements overview

The need for and/or interest in Diversity II data vary among the respondents depending on their own activities. It is most pronounced for the global work of JRC.

Parameters and Indicators

Status of vegetation productivity and water use efficiency

NPP indices, in particular based on MERIS fAPAR, were generally considered to be interesting and relevant for the work of the respondents and were given high priority. The assessments were somewhat more mixed as regards the importance of temporal aggregation of vegetation productivity, particularly maps of vegetation productivity for vegetation seasons, but were on average given medium priority. Approximately the same applies to type of water information used for efficiency indices. Spatial aggregation of vegetation productivity maps was given lower priority and the assessments were highly mixed.

Changes and trends of vegetation productivity

Change maps of vegetation productivity status and water use efficiency between 3-year periods 2002-2012 and corresponding trend maps were on average given medium priority, even if the assessments were quite mixed. Approximately the same applies to trend maps of water availability. The assessments on spatial aggregation of change and trend maps were highly mixed and the priority was low to medium. Finally, classification of the status, change and trend maps according to selected combinations of the delivered products and information (second level indicators) were on average given medium priority. The assessments were highly mixed.

The most appropriate temporal aggregation for the vegetation productivity was yearly and the vegetation season. The response of the respondents on the spatial aggregation was less clear. All options got both low and high marks. Within this diverse picture, the aggregation by land cover class got overall highest marks.

All proposed change and trend maps got consistently marks 3 and 4 (with the exception of JRC who prefers doing this type of processing in-house). However, when it comes to the spatial aggregation units for these maps, the same diverse and inconclusive picture as for the status maps is repeated.

The second level indicators were described in the questionnaire at a very generic level. All respondents gave mark 3, which seems to indicate that such indicators could be of value but need more clarification and specification. Unfortunately, no constructive proposal was made on how to construct such combined indicators.

Meta data were considered to be very important. The importance of accuracy and validation is generally acknowledged. The different ways to validate data and results that are presented are generally given high priority. At the same time the methodological problems associated with validation are underlined. (Bob Scholes: "You are comparing one poor guess with another.")

Product requirements

Spatial coverage

The interest extends from global down to specific areas where own work is carried out.

Spatial resolution

The general view seems to be that 100-250 m would be desirable, 500 m acceptable and 1000 m less usable but still satisfactory for some needs.

Spatial integration

Most options have been marked and no trend can be discerned.

Frequency of updates

Requirements vary between once a week and once a year.

Temporal integration

Only two respondents have indicated a preference: every year.

Accuracy requirements

Only two specific preferences have been expressed: CI=95% and the GCOS accuracy requirements.

Aggregation requirements

Only two respondents have indicated preferences which together cover most of the indicated options. Only aggregation with land cover data was marked by both of them.

Dryland sites

No change of sites is proposed. Only two respondents mention the existence of data.

Validation requirements and reference data availability

Three respondents have indicated a preference. There is a need for statistically valid comparison of EO data with trusted independent data, including field data. Extensive data are available from different parts of the world. However, making them available requires some effort.

Other

Only one comment was received: “The connection to biodiversity seems very tenuous.” (Bob Scholes)

Recommended additional contacts

A few names were proposed. They have been contacted in case they were not already included in the user list.

5.2 User Consultation Meetings

Three User Consultation Meetings (UCMs) have been held in the course of the project. The first one was held in June 2013, in Sigtuna, Sweden, and two more in 2014. The first UCM covered both inland waters and drylands during the two days with all participants attending most presentations and discussions. The second User Consultation Meeting, with focus on inland waters, was held in May 2014 in Frascati, Italy. The third User Consultation Meeting, with focus on land productivity indicators for drylands, was held in Bonn in Germany in July 2014.

The summary of the presentations are based on the meeting notes and include summaries of the discussions held. The workshop presentations are documented below in order of presentation for each speaker followed by notes of ensuing discussions. Summaries and conclusions are described at the end of each section.

5.2.1 User Consultation Meeting I

The first User Consultation Meeting was held on June 26-27, 2013, in Sigtuna, Sweden. The List of participants and the Agenda are shown Annex 16.

Day 1 eight presentations were made by representatives of ESA, Diversity II project, UNESCO, JRC, Mälardalen University, CSE and UNCCD. Day 2 included presentations from GloboLakes, CSIRO, Marc Matthews, and by Kai Sörensen, followed by concluding discussions covering both themes.

Marc Paganini: *ESA Data User Element Programme*

M. Paganini gave an introductory overview of the Diversity II Project from ESA´s perspective. Focus was on the Project´s ***raison d'être, in particular background*** and objectives. He also introduced the European Space Agency (ESA) and the objectives of the Data User Element (DUE). DUE is an ESA programme aiming at developing applications supporting user activities. ESA is very active in working with international conventions, participating in the COPs and supporting their projects.

ESA has launched the DIVERSITY II project in 2012 in order to support the Convention on Biodiversity (CBD). He explained the relationship between CBD and UNCCD and how ESA in general, and the Diversity II project specifically, could also support the UNCCD targets.

Data continuity has been understood as key for sustainable use of Earth Observation data by the user community. ESA and the EC have therefore established the Copernicus programme. ESA is providing the Copernicus space segment with a series of operational, long term ensured satellites called the Sentinels and planned for more than 20 years.

Carsten Brockmann: *Diversity overview, objectives of meeting*

Introductory overviews of the objectives of the meeting and the implementation of the Project, in particular its organization and work done up to now, were given. The project objectives and elements, as well as a summary of the products to be generated, were presented.

Per Wramner: *Diversity User Bureau (DUB), questionnaires and literature evaluation*

The presentation included the general outreach activities that until then had been implemented as well as the Diversity User Bureau (DUB), Diversity User Group (DUG), questionnaires and literature evaluation. User requirements constitute the starting point and lodestar for the execution of the Project and will be given greatest possible consideration. The outreach activities include a side event at CBD COP XI (on inland waters), a meeting with UNEP-WCMC in Cambridge, informal presentations at biodiversity meetings in Brussels, distribution of an Executive Summary, distribution of a Newsletter and establishment of a Homepage. They resulted in a general rise in awareness about the Project within the biodiversity communities, initiated links to BIP and to WCMC (which is now conducting a review of the use of EO data for monitoring biodiversity changes and progress towards the Aichi Targets), dissemination of written information on the Project and obtained information on user requirements.

A User Work Plan was adopted at SRR1 (December 2012) according to which a fixed organization with DUB and DUG would be established. DUB was a kind of steering committee which included external members who had committed themselves to play an active role in the implementation of the Project. DUG was a wider advisory body of users with a less active role in the Project. This organization proved difficult to establish and was made more informal and flexible at SRR2 (April 2013). DUB became an internal group and DUG an open network.

Identification of key users started at an early stage of the Project. About 40 organizations/persons were selected. They include CBD, global conventions (UNCCD, Ramsar etc.), IGOs (UNEP, FAO, UNESCO, EU etc.), research bodies, networks etc. and NGOs. Information on the Project was sent to the selected users by e-mail with an invitation to the UCM and a request to fill in a questionnaire. The e-mails were in most cases supplemented by phone calls. The number of participants in the meeting was somewhat less than anticipated. See the List of participants. Reasons for this include ignorance and/or doubt about the potential of EO for biodiversity monitoring, lack of funds for travel (even though travel costs for a few participants were paid by

the Project) and competing activities at this time of the year. However, most key users except for CBD and UNEP/WCMC were present. Regarding questionnaires see the previous section (5.1).

The literature review included relevant CBD documents (the Strategic Plan, PoWs on inland waters and drylands, AHTEG on indicators and its follow up etc.), IPBES documents and scientific literature (e.g. on biodiversity hotspots). The results are summarized in a table showing how EO data can contribute to monitoring of how the Aichi Targets are met. See Section 4.3.2.

Engin Koncagul: *UNESCO biodiversity related activities & requirements*

The biodiversity related work of UNESCO was presented together with the UN World Water Assessment Programme (WWAP). UNESCO is the UN body on education, science and culture which directly or indirectly deals with many biodiversity related issues, e.g. in the Man and Biosphere Programme (MAB) and the Small Island Developing States Initiative.

The UNESCO Biodiversity Initiative was initiated a few years ago. It is an inter-disciplinary initiative which cuts across all sector programmes and brings together UNESCO experts from all biodiversity relevant sectors. Main objectives are to strengthen the the biodiversity science-policy interface and help member states to implement CBD and other biodiversity conventions/agreements, e.g. IPBES. The Initiative has two main themes. Theme 1 is Biodiversity Research, monitoring and assessment. It includes, inter alia, DIVERSITAS (UNESCO is a funding member), GCOS and GEO-BON. Theme 2 is about setting the Biodiversity Policy Framework. UNESCO operates at both national and intergovernmental levels. Key tasks are to inform decision making processes, to fill gaps in existing datasets, to set standards, promote calibration efforts etc. and to develop new, innovative and cost-effective methods to collect/analyse/disseminate biodiversity data.

The WWAP is established, hosted and led by UNESCO. It is an umbrella programme for monitoring freshwater issues bringing together 30 UN agencies and 30 international organizations. The secretariat is small and cooperates closely with its partners (UNEP, FAO, WMO etc.). A main task is to collect data from the partners in order to inform decision making processes and provide recommendations on freshwater issues.

The primary product is the World Water Development Report (WWDR). It is a comprehensive review of the state of the world's freshwater resources and represents a unique effort within the UN system which has got status of UN-wide official report on freshwater. Four issues have been published since 2003. From 2014 onwards it will be published yearly and focus on a specific theme each year. The WWDR is a scientific report (but not a science report, even if it is based on science). It shows trends by using approximately 50 indicators which are precisely defined and graphically presented. WWAP relies entirely on its partners for the provision of data.

The Diversity II Project was strongly recommended to apply the same approach and provide the same type of information. Its products, in particular data on water quantity and quality, could probably be directly used by the WWDR. An interesting option could also be common publications. Finally, the Diversity II Project was invited to link to the UN networks dealing with freshwater issues, e.g. the International Lake Environment Committee (ILEC) and the International Institute for Applied Systems Analysis (IIASA).

Eva Ivits: *JRC activities & requirements*

The presentation focused on mapping of land degradation – what is possible. The main task of the JRC drylands team is to produce the World Atlas of Desertification (WAD). It is a joint initiative of JRC and UNEP, which started in 2009. Two earlier versions of the WAD have been released under the leadership of UNEP (the most recent one in 1997). The third version will be published next year. The work is carried out in close cooperation with the UNCCD secretariat. A new Atlas of this type is urgently needed. No agreement on methodology exists currently and recent methodological improvements need to be taken into account in an authoritative presentation. The WAD will provide a holistic and global approach to Land Degradation and Desertification (LDD) based on a common view – something that is currently lacking. Such degradation is not a problem limited to deserts or arid areas. It is a global problem. Therefore the Atlas has global coverage. It shows land vegetation

loss, not soil degradation. As such, also loss of biodiversity will be presented in the Atlas. This means that there is a close link to the Diversity II Project.

The WAD will build on recent scientific advancements. Its objective is not only to delineate the LDD affected areas but also to inventory all contributive causal issues. The atlas is very important for a large variety of users. It will be the first global map of land productivity based on remote sensing and it should help the development of indicators, in particular the UNCCD impact indicators.

The Atlas is structured by themes. Climate change and biodiversity are included in each theme as a chapter. The Diversity II Project could provide input to these chapters. The Atlas will treat biodiversity under the aspect of ecosystem services.

The process of land degradation is rather slow, so the longest possible time series needs to be used. This is currently the AVHRR based GIMS dataset. Trends are being analysed at the level where they appear (a drop at a high level is different from a drop at a low level). E. Ivits made a strong statement that standardisation of methods (e.g. definition of integration periods) is of critical importance. Otherwise the data will be interpreted differently by different groups. This will mean that policy makers could be confused and usage of EO discredited.

The question of NPP and whether fAPAR or NDVI can be used as proxies for NPP was discussed. There is a diverse discussion of this question in the scientific domain, with no conclusion. The Project was recommended to be careful with the use of NPP and its proxies. In any case, definitions and standardisation are very important. U. Gangkofner will follow up the contact with E. Ivits to exchange data, e.g. in-situ data, for validation.

Patrik Klintenberg: *Mälaren University activities & requirements*

A study on impact of different land use and land cover changes for climate change adaptation in SE Namibia and NW South Africa was presented. Its objective was to improve decision making processes in land management by using EO data (AATSR and others, including aerial photography). Land degradation patterns were due to poor grazing management and to climate variability,

It was confirmed that the spectral characteristics of AATSR is not optimal for land cover classification. It was also shown that green biomass does not automatically mean good land conditions (for example, it could be the result of bush and shrub encroachment).

A new similar study is going to start right now. The Diversity II Project can provide valuable input to it. LC-CCI data can be used as well. U. Gangkofner will follow up the contact with P. Klintenberg to provide proper data for the study.

Amadou Dieye: *CSE activities & requirements*

The presentation focused on how EO can be an answer to environmental information needs and gave also an overview of activities of the CSE. The Centre was started as a pilot project by FAO and UNSO in 1983 to assess the sub-Saharan droughts (in Senegal) using EO data. It is operational since late 1980's and evolved into a national centre which is broadening its scope. CSE is not a research institute but an organization focussing on applications. For this purpose, it has a close cooperation with research institutes.

The current work focuses on monitoring biomass cover and greenness. Data sources include various satellite data and aerial surveys supplemented by field work. AVHRR 87-04 and SPOT-V from 05 are the main data sources. One core product is a vegetation growth map derived from a regression between NDVI and in-situ biomass data. Other products of CSE directly address food security. These include vegetation growth monitoring during the rainy season, yield forecast for millet and peanuts and monitoring of agricultural hazards using ICN, VCI indexes with VITO. Another focus area is bush fire monitoring which includes detection of active fires, mapping of burnt areas and analysis of causes and impacts. Rapid products (SEVIRI) are generated every 15 minutes to map hot spots and raise a warning. However, their usefulness is reduced because the resolution is too coarse and too many misclassifications happen.

Through participation to the LADA project, Senegal has been one of the pilot countries to test the 11 impact indicators of the UNCCD.

The expectations on the Diversity II Project include improved methods to derive NPP (from NDVI or otherwise) to reduce the amount of in-situ data required, data on land cover and land use on national level and data on water quantity in natural and artificial ponds and lakes.

Elysabeth David: *UNCCD activities & requirements*

UNCCD is a global convention with 195 Parties which addresses specifically the arid, semi-arid and dry sub-humid areas, known as the drylands (according to the UNCCD ratio of annual precipitation to potential evapotranspiration). In its 10-Year Strategy, Parties (countries) further specified their goals using the wording *"desertification/land degradation"*. Its implementation is based on long term integrated strategies focusing on improving productivity of land, rehabilitation, conservation and sustainable management of land and water resources. Parties declare themselves if they are affected even if they are not located in drylands. There are five UNCCD regional implementation Annexes. Parties are the end-users of the work done by the Convention through the activities of the Committee on Science and Technology. They are represented by their National Focal Points (NFPs). Parties also have Science and Technology Correspondents (STCs). The UNCCD implementation relies principally on National, Regional and Sub-regional Action Programmes (NAPs, RAPs and SRAPs).

The Strategy aims at improving the living conditions of affected populations and ecosystems and generating general global benefits through its work. Before the Strategy, the reporting has been only on the implementation of the UNCCD and not on the impact of the implementation (as no impact indicator was adopted by the COP). Now Parties have to report on *performance indicators* every two years and on *impact indicators* every four years (first in 2012, next in 2016). Only affected countries have to report on impact indicators. Out of eleven impact indicators accepted by the COP, two are mandatory for reporting, e.g. “land cover status” and “proportion of population living below the poverty line”. Reporting on the remaining nine impact indicators is on a voluntary basis.

A pilot exercise on tracking impact indicators was undertaken in 2011 with support of UNEP/WCMC. There is some overlap with the test sites selected by the Diversity II Project. The ad hoc Advisory Group of Technical Experts for Impact Refinement (AGTE) of the UNCCD will report on the results of its work (2012-2013) on the refinement of impact indicators at COP11 in September 2013. AGTE underlines the need for the scientifically best approach to the delineation of affected areas, proposes criteria for the demarcation of such areas to be done every five years, underlines the need for classification of such areas, reflecting different stages of desertification, proposes a further refined set of the provisionally adopted impact indicators, proposes a scientifically based approach for integrating, analyzing and interpreting impact information, proposes that impact indicators be renamed to *progress indicators* and proposes a set of common, global progress indicators complemented by formal and narrative indicators at national/local scale.

Water quantity as well as land use and trends were highlighted as Diversity II indicators of specific relevance for UNCCD. The importance of validation was also highlighted. Experts from UNCCD may support the Diversity II Project in this work.

Discussion round drylands and conclusions of day 1

The following conclusions of the presentations and discussions were made:

- Precise definitions are very important for projects like the Diversity II. The Project should therefore define all relevant terms and show the definitions on its Website.
- Most of the presentations indicated a need for Diversity II products and an interest in cooperation with the Project. The cooperation should in several cases (e.g. JRC, Mälardalen University, CSE and UNCCD) include also methodological issues.

- Several participants expressed an interest in biodiversity stories and underlined the need for a strong local and national involvement in their preparation.

Peter Hunter: *Globolakes activities & requirements*

GloboLakes was established in the light of the fact that only a very small proportion of the world´s 304 million lakes (3% of the total land area) was routinely monitored. It is a multi-disciplinary scientific project run by six UK partners and funded by the UK. The Project Team consists of EO specialists, freshwater ecologists, bio-optical oceanographers, environmental statisticians and ecosystem modellers. The aim is to determine spatial and temporal trends and attribute causes of change for at least 1,000 lakes worldwide and to forecast their sensitivity to environmental changes. The approach is to establish a satellite-based observatory system with near real time processing of the selected lakes: SeaWIFS (1997-2010), MERIS (2002-2012) and OLCI (2014-).

The selected lakes can be divided into three categories: (1) 15 case study lakes where the algorithms will be tested, (2) about 50 international lakes which will be studied in greater detail and (3) the rest of the lakes which will be studied in more general terms.

This year, GloboLakes is conducting field campaigns for collecting data, including optical and biological lake data as well as catchment area data. Core products are LSWT, TSM, CDOM, Chla and CPC (C-phycocyanin). A Web-based GIS portal will be developed to show and distribute the GloboLakes products.

A current achievement is the definition and setting-up of the Limnades database, primarily for in-situ data, to be used for algorithm development and match-up analysis.

GloboLakes data will mainly be used for internal project studies of lake ecology. External users are, inter alia, the environmental agencies of UK and Ireland. Their main requirements are biomass abundance and transparency as well as bloom frequency and intensity (in particular for cyanobacterial abundance).

Collaboration with the Diversity II Project is deemed appropriate concerning collection of in-situ data (Limnades), algorithm selection and validation and engagement with end-users.

The discussion addressed

- how to do the spatial integration, an issue not really addressed by GloboLakes,
- which temporal sampling interval should be used,
- the need for a user requirements survey and
- the need for observations for 14 days temporal binning.

Erin Hester: *CSIRO activities & requirements*

The presentation addressed inland waters, EO and biodiversity in Australia. The state of inland water ecosystems is declining, at an already negative index level. In-situ data sampling is a challenge given the size of the country and limited accessibility to vast areas. Data coverage and temporal continuity are very poor. Sampling strategies are not harmonised and data accessibility varies. Remote sensing of aquatic ecosystems may contribute strongly to an improvement of the situation but could only be a part of a larger observation network.

End user needs are defined in the National Water Quality Management Strategy. However, it is a strategy and not legally binding, i.e. it contains just recommendations. A monitoring framework is recommended which is open to new methodologies, making it ideal for EO. There is also a national Adaptation Framework, the objective of which is to reduce vulnerability of water resources to climate change. Key adaption options are to improve the state of inland water ecosystems to alleviate existing pressure. CSIRO has expertise in model-based integration of in-situ and remotely-sensed biodiversity data (contact: Simon.Ferrier@csiro.au).

The recent and future fleet of satellites (LDCM, S2, S3, HySpiri) is well suited to provide WQ data. Such data are of great importance. A spatial resolution of 60 m or better will significantly increase the number of lakes that can be monitored. Working on catchment areas is a promising approach.

The value of time series in order to understand ecosystem function and change was strongly underlined. A main challenge in Australia is to capture the dynamics of inland water systems.

Technical and methodological developments are aiming at blending spatial and temporal high resolution data. Work is also undertaken to compile AOP – (S)IOP datasets.

Marc Matthews: *Activities & requirements from South African users*

The presentation addressed the link between water quality and biodiversity in South African lakes. The overwhelming majority of the lakes are small, i.e. less than 20 km². The country also has a large number of man-made water reservoirs (capacity larger than 1 Mkm³). There is severe impact of sewage on eutrophication status in lakes and water reservoirs. Monitoring of freshwater status is insufficient all over South Africa. Remote sensing could be an efficient way to increase the monitoring efforts.

Case studies on Loskop Dam/Olifant river catchment and Lake Krugersdrift were presented. Both address the issue of occurrence of toxic cyanobacterial blooms, surface scums and negative impact on freshwater species. They were proposed to be included in the Diversity II Project.

The main concerns for lakes and reservoirs leading to a reduction in aquatic biodiversity are: turbidity, cyanobacterial blooms, cyanobacterial toxins, eutrophication and changed PFTs[77]. EO based indicators targeting these main issues will be most useful for monitoring lakes and reservoirs. Phytoplankton species composition can be used as indications for the evaluation of pollution and loss of biodiversity.

Kai Sörensen: *User requirement for Lake Victoria*

A general overview of Lake Victoria was presented. It is the second largest lake in the world and located at a rather high altitude of 1134 m. Its catchment area is huge – 194 000 km² and maximum depth 80 m. Eutrophication (e.g. causing cyanobacterial blooms), invasion of water hyacinths, introduction of Nile Perch and overfishing constitute serious biodiversity problems in the lake. International efforts to improve the environmental situation in Lake Victoria are underway but are hampered by lack of reliable data on the status of the lake. Available in-situ data have to be handled with caution. Therefore, there is an urgent need for EO data which can be used to monitor status and trends of the lake´s biodiversity.

Remote sensing in Lake Victoria has to face a number of specific challenges. These include particles, cyanobacteria and floating hyacinths in the water. The lake is characterized by high scattering and high absorption as well as lack of reliable validation data.

Discussion round inland waters

The issue of water use efficiencies was raised specifically. The general view was that further discussions were needed and that a specific Skype or WebEx meeting to this end should be arranged.

Temporal aggregation proved to be a major issue. A general view was that both time series (required for statistical analysis) and temporal aggregation (required by end-users) are needed. End-users will in many cases also need time series because averaging may remove useful information, particularly in arid or semi-arid areas. It was also underlined that different users have different needs.

Concluding discussion round

A number of specific issues to be considered during the continuous implementation of the Project were identified. In particular, it was underlined that there are urgent needs for:

- Continuous following up of contacts with users. In particular, key users who up to now have not shown any interest, e.g. CBD, IUCN and UNEP/WCMC, should be approached again. Among other things, their work on impact indicators will be of great interest to the Project.
- Additional efforts to establish a close collaboration with the new initiative, coordinated by

[77] Phytoplankton Functional Types (PFTs) are conceptual groupings of phytoplankton species, which have an ecological functionality in common.

UNEP/WCMC, to review the use of remotely-sensed data for monitoring biodiversity change and tracking progress towards the CBD Aichi Biodiversity Target.

- Additional efforts to get filled in questionnaires from all users who have received the forms.
- Identification of additional users to be asked to fill in the questionnaires. A number of potential users have been suggested during the project. However, several of them have been contacted without any response.
- Additional efforts to inform about the Project (e.g. NGOs, academia and national focal points for CBD, UNCCD etc.).
- Continued presence at relevant international meetings to inform about the Project. The next relevant meeting after CBD SBSTTA 17 (14-18 October 2013) will be the second plenary meeting of IPBES which will be held in Antalya, Turkey, from 9 to 14 December 2013.
- Identification of issues that require increased attention, e.g. cyanobacterial blooms.
- Consistent use of a common terminology/nomenclature in the Project. It should be based on clear definitions which are presented on the Website.
- Increased attention to phenological analysis, both for drylands and lakes.

We have to make better use of the fact that the issues addressed by the Diversity II Project are in focus on the international environmental agenda!

5.2.2 User Consultation Meeting II – Inland Waters

The second User Consultation Meeting, with focus on inland waters, was held on the 19th May 2014 in Frascati, Italy. The user consultation meeting was jointly organised by Diversity II and the GloboLakes projects. The List of participants and the Agenda are shown Annex 17. The meeting was arranged in connection to the "Sentinel 2 for Science workshop" hosted by ESA, and a training sessions with hands-on experience with Diversity II lake products and tools was held on the 20th of May at ESA premises.

At the Workshop, 15 presentations were made by representatives of ESA, Diversity II project, University of Stirling, Norwegian Institute for Water Research (NIVA), Environment Agency/The Freshwater Biological Association, Finnish Environment Institute (SYKE), University of Dundee, IOCCG/GEO, and Plymouth Marine Laboratory.

Presentations and discussions

***Marc Paganini**: ESA Data User Element Programme*

M. Paganini opened the meeting and introduced the European Space Agency (ESA) and the objectives of the Data User Element (DUE). DUE is an ESA programme aiming at developing applications supporting user activities. ESA is very active in working with international conventions, participating in the COPs and supporting their projects. He specifically mentioned the call for Innovators III, with focus on R&D activities for Sentinel-1 and Sentinel-2. He also introduced the Copernicus Sentinel missions, its long term data access and free and open data policy.

ESA launched the DIVERSITY II project in 2012 in order to support the Convention on Biodiversity (CBD) and Marc briefly presented the report CBD Technical Series No 72: Earth Observation for Biodiversity Monitoring.

***Carsten Brockmann**: Diversity overview, objectives of meeting*

Introductory overviews of the objectives of the meeting and the implementation of the Project, in particular its organization and work done up to now (Water quality and water quantity products, as well as, 1st and 2nd order indicators), were given. The currently selected 300 lakes were shown and an explanation why different processing branches are required for absorbing, turbid and eutrophic lakes was given. Attendees are invited to propose further lakes of their interest. The final production system will be handed to GloboLakes for further development.

***Andrew Tyler**: GloboLakes overview, objectives of meeting*

- Introduces the LIMNADES database, for which data from 110 lakes in 20 countries is available, in particular many reflectance measurements. The reflectance ratio of 708 and 665 nm bands is well related to CHL concentrations for a wide range of different lake types. SCAPE-M validation for Lake Balaton is very promising, but results for other lakes are not yet available.
- GloboLakes WP 1 and 2 link directly to Diversity II.
- Driver/effect relationships will be investigated by the UK Centre for Ecology and Hydrology (CEH)
- The LSWT ARC Lakes database was extended to 1600 lakes (v.3)
- The project aims to classify all invested lakes according to temperature and water constituents, including the time series extreme amplitude, frequency and shape.
- Aside archive processing, NRT services will be provided using S-3 OLCI
- Other relevant projects with involvement of the GloboLakes team: GLaSS, INFORM, DNCERS, CYANOCOST

***Carsten Brockmann**: Earth observation of inland water*

An introductory overview of methods and applications for non-EO expert attendees is provided.

***Anna Birgitta Ledang**: Water quality monitoring by NIVA*

NIVA is a private R&D institute with about 200 employees that runs monitoring sensors, systems and platforms. EO is currently used for coastal monitoring and water quality reporting, but not yet for lakes. The largest lake in Norway is only 369 km2, inland waters get therefore much less attention than the coasts.

The separation of Norway in 6 ecoregions was explained, and case studies of the Inner Oslo fjord and other catchments are shown.

The monitoring data is collected in the online WAMPIR database. However, the integration of EO data is behind the in situ measurements. It is not yet sure if the data will be publicly and free available in the future.

***Bill Brierley**: Lakes monitoring in the UK – challenges now and in the future*

The UK consists of about 44000 lakes, but most are very small (about 1 ha). Nitrate is considered the most relevant pollutant. Phycocyanin is also of high interest. The UK lakes are generally quite eutrophicated. National incidents caused by cyanobacteria between 2006 and 2010, 11 category 1 incidents and 60 category 2 incidents.

The lakes are currently classified using phytoplankton samples from 4 samples collected between June and September, including species abundances and biovolumina. The monitoring programme is predominantly reactive, i.e. intensive actions are initiated when blooms are reported, but little is undertaken to detect such blooms. EO, webcams and volunteer work are considered to be the best options to complement the existing monitoring scheme. A redesign of monitoring practice (2015-2030) is currently in progress, driven mainly by budget reductions. A pilot study shall assess the integration of EO, but the project start coincided with the demise of MERIS. The WFD reporting is very demanding, requires the use of new methods. Currently 743 UK water bodies are covered. Main challenges are expected in the integration of data from different monitoring technologies, including e.g. intercalibration. It is also questionable how flexible the reporting protocols are, e.g. using a_pig rather than chl-a.

***Sampsa Koponen**: Use of remote sensing for lake (and coastal) ecosystem monitoring at the Finnish Environment Institute (SYKE)*

The largest EO potential is expected in Secchi depth retrieval using hi-res instruments, demonstrated e.g. by Kallio (2008), even for strongly absorbing waters of 3-10 m Secchi depth and Chlorophyll monitoring using S-2

and S-3 will hopefully allow the investigation of smaller lakes, and in addition help to reduce the errors caused by high CDOM concentrations in Finnish lakes.

The widening of reed belts is mentioned as another indicator for eutrophication.

Although available from SYKE, EO lake water quality products are not yet considered for official monitoring and reporting practise and since additional parameters are required, EO can never replace field campaigns. This complicates the establishment of EO "on top" of the existing data sources. It is expected that an enhanced integration of in situ and EO data will allow best estimates of water quality and also help to convince the end-users. At the same time, different product formats must be derived, as users often can't handle maps and spatial data.

Discussion points:

- Data from the Baltic Sea are publicly available, but not the lakes data. However, the latter will be provided in LIMNADES.
- Jörg asks for reed belt mapping by EO, with is experimentally possible.
- The experience with users in Finland and Sweden coincides regarding their focus on WFD implementation, for which the EO products in CDOM dominated lakes are considered insufficient.
- Two main approaches how to better address end-users are discussed, [1] by producing and providing data for their exploratory use, [2] by introducing time series as final products, e.g. as established in the climate change community.

***Jörg Freyhof**: A summary of iDIV activities*

Nature2000 is the biodiversity framework, which should be considered aside WFD. The loss of freshwater species is tremendous and well documented by red lists of endangered species. However, it is not well understood what lake parameters are changing, what are the drivers and the results. He agrees that the time series consist of the best information content. Eutrophication is the preferred parameter.EO

Products addressing the change in lake water quality are needed especially for lakes outside the Western world, e.g. China should be contacted for collaboration.

***Steven Greb** (presented by Carsten Brockmann): GEO Global Inland and Near-Coastal Water Quality Information System*

A GEO water quality website is under construction, an IOCCG working group report is in work and GEO webinars are organized once a month.

The GEO water quality community is joining efforts to enhance EO products quality and use. Consulting was offered to World Bank projects. A GEO Water Quality Summit meeting will be April 2015 in Geneva. A side event at the World Lakes Conference in Perugia (1.-5. Sep.) will unite most of the GEO water quality community. The goal is to provide a strategic plan for incorporation of current and future EO information into national and international near-coastal and inland water quality monitoring efforts.

***Eirini Politi**: Lake selection and the determination of global scale metrics for interpreting change (GloboLakes)*

The criteria for lake selection are explained:

- GLWD as a basis (3721 water bodies)
- Size, 5x5 FR pixels at least, other water bodies excluded
- Area to shoreline ratio was considered, lakes were less than 20% of the area is detected are excluded
- Number of daytime observations per year, less than 10 excluded
- Exclude targets that are coastal bays, fjords, estuaries, leaky/restricted lagoons or circles
- 960 lakes, lagoons and reservoirs remain

Lake catchment datasets prepared for GloboLakes are:

- Using SRTM 90m DEM and GLWD lake shapefiles
- Merging several global bio-geophysical datasets, e.g. NDVI, climate, run-off, sols etc.
- Estimating decadal changes by comparing the 1990-2000 and 2000-2010 datasets
- Using the HydroBASINS global hydrographic information, which is derived from HydroSHEDS and the GLWD, using SRTM.

***Steve Groom**: Operationalising the global observatory for lakes*

BEAM will be used for processing, using the MERIS archive at BC or ESA and a live stream for S-2 and S-3 data. The lakes will be grouped by LSWT, using maximum August temperatures and annual LSWT range.

As dissemination options, the ChloroGIN and OC-CCI web pages are shown, as well as CoastColour processing on demand.

The GloboLakes v.1 processing chain based on Diversity II will be implemented in 2014. A first upgrade to GloboLakes algorithms (v.2) is expected for 2015. GloboLakes will follow-up the alternative to offer processing on demand instead of web archived data.

***Daniel Odermatt**: From EO products to higher level products and biodiversity indicators*

Among the currently selected lakes, it is expected that about 30 are expected to be ephemeral lakes, for which the specific, reduced water extent processing scheme will be applied.

Starting with the monthly and yearly products, several derivatives are possible:

- Trophic state classification
- Identification of sub-basins
- Time series extraction for whole or sub-basins
- WQP variability indicators
- Simplified arithmetic proxies for phenology (e.g. monthly mean difference)
- Mean phenology
- Phenology trends

The design of higher order products faces a challenging trade-off between desired simplification and inevitable information loss.

***Petra Philipson**: Diversity II data and products supporting estimation of ecological status*

A new questionnaire for user requirements inquiries was designed. CHL is widely accepted as key factor for ecosystem dynamics.

CHL is considered to improve diversity up to a lake-specific critical level, at which the species compositions tend to become dominated. The corresponding level for Lake Vanern is around 35-40 mg/m3.

One of the main challenges is to define a good reference quantity to indicate biodiversity. Pure species counts can be misleading. Process proxies such as the consumption of phytoplankton after algae blooms might help, but are difficult to define universally.

***Stephanie Palmer** (presented by Peter Hunter): Determining trends in lake phenology from the MERIS archive*

Timesat phenology analyses provide a very interesting set of indicators. However, it must be assessed if the available temporal resolution in more humid regions allow for reasonably consistent time series. Diversity II provided the investigated Lake Balaton 10 days FLH timeseries.

The spatial variability of phonological parameters corresponds on the whole to the known basins of separate water types, but a lot of small-scale variability is visible in addition. A key question is how to move from phenoloygy metrics to the identification of the drivers for changes in the ecological status? The next steps

include: The assessment of thresholds for bloom identification, sensibility to errors, effect of temporal binning (daily, 8-day, 16 day), data gaps, assessment of climate and catchment drivers on phenology variance.

***João Campos**: Contrasting EO indicators with biodiversity data*

Matchups are shown for several different diversity reference datasets and EO products. Ambiguity persists regarding the expected and actual regressions.

J. Freyhof recommends not using GBIP data. Instead, a database on fish data in lakes worldwide is hosted in Paris. Additional data should be collected through contact with national stakeholders.

Concluding discussion

Several people express concerns regarding the further aggregation of the 1st order products, due to the presented trade-off between simplification and information loss, and the uncertainty regarding relevant habitat conditions. Alternatively, user uptake could be fostered by:

- Doing as much validation as possible
- Presenting time series and overview figures that indicate trends and variability for the complete MERIS decade
- Providing links to coupled hydrologic-biological models
- Assessing uncertainties
- Investigate historical regime shifts for detail investigations (i.e. biodiversity stories).

E. Politi proposes to use LC CCI database information to predict water quality variability.

5.2.3 User Consultation Meeting III - Drylands

The second User Consultation Meeting on the drylands theme was held on July 7-9, 2013, in Bonn, Germany. It was hosted by the UNCCD secretariat with an audience of approximately 20 people representing the project and the user/expert community. The list of participants and the agenda are shown in Annex 18.

At the Workshop on Land Productivity Indicators for Drylands 18 presentations were made by representatives of ESA, Diversity II project, UNCCD secreteriat, CBD, University of Wurzburg, University of Copenhagen, DLR, JRC, CSIR, Mälardalen University, UNCCD Portugal, and INSA.

In summary, experiences and knowhow from quite different perspectives gathered in the event, including field experts, remote sensing specialists all along the science and value adding chain of Earth Observation and space industry, representatives from the large Conventions and their national focal points, as well as university scientists. Consequently, a large range of different aspects of dryland observation and its usage were addressed, as well as the capabilities but also the limitations of Earth Observation for dryland monitoring.

***Marc Paganini, ESA:** Introduction, welcome, objectives of the meeting*

Marc gave an introduction to the workshop and highlighted that it is a great opportunity to have both the CBD and UNCCD attending together as Diversity II project is responding to the needs of both conventions. M. also introduced ESA and gave a short summary on Copernicus, objectives and future of ESA Data User Element (DUE). He also presented the foundations of the project and described first order indicators and related these to different user perspectives. A description of the main outcomes of Diversity II project half way, including the development of indicators and the basis for their derivation were then outlined and the presentation concluded with the objectives of the workshop.

Carsten Brockmann, Brockmann Consult: *DIVERSITY II project overview*

Carsten gave a presentation of the main findings and issues encountered in the project. As change of land use is one of the main drivers for loss of biodiversity the relationship to phenology is important because it is potentially resolvable in EO data. There is a need for multi-scale analysis because ecological processes are scale dependent. He also covered aspects of NPP and NPP proxies in relation to precipitation fAPAR and discussed the relationship between 1st and 2nd order indicators and that we need to determine the user needs of each. Carsten concluded with status and plan for the project and showed two examples of status and trend maps.

João Carlos Campos, Cibio: *Contrasting EO indicators with biodiversity data: drylands*

João gave a summary of his work on EO indicators for drylands and showed described the results from analyses on the continental level using in situ global scale environmental input variables. Validation was performed by modelling species distribution and resulting output values represent the probability of occurrence of (faunal) species. Common patterns of species richness were confirmed by Diversity products both for the European site and the Australian and Brazilian sites. Also trends were largely verified and positive correlations for ponds were seen where number of amphibians found in different years correlated with NPP proxies.

Discussions followed with participants questioned using the relationship between species richness and primary productivity the validation data source (GBIF) as other factors such as land cover change play important roles. Other recommendations were for more refined statistical analysis, multi-scale analysis and use of land use change data especially with species distributions models to establish what the benefits of remote sensing are.

Victor Castillo, UNCCD Secretariat: *The use of Land productivity as an indicator for the UNCCD reporting process and to monitor Land Degradation Neutrality*

Links: *http://www.unccd.int/Lists/OfficialDocuments/cric11/14eng.pdf*

Victor presented a summary of the processes in the UNCCD that have developed and refined indicators of land degradation since 2007. Strategic decisions underpin these developments and consultations including the establishment of an Advisory Group of Technical Experts (AGTE) have resulted in lists of indicators. An iterative refinement of indicators have ensued including development of a conceptual framework that allows for integration of indicators, a name change from impact to progress indicators, delineation of affected areas (including degrees and risks) and dealing with very sensitive political issues. In 2009 a provisional list of 11 indicators was followed by a division into two levels, national and international resulting in a proposal for a reduction to 6 indicators in 2013, including land productivity dynamics and land cover. Scale issues have been central to modifications as degradation is a global problem that manifests locally. Other issues relate to comparisons, combinations, aggregations and harmonization at different levels. All mean challenges for reporting at UNCCD who desire an approach with positive feedback. A concept called Land Degradation Neutrality (LDN) comes from Rio+20 Summit and recognises the need for action to revert land degradation with a move to a land degradation neutral world. In addition the following seed questions were put to ESA and Diversity II:

- On the UNCCD Reporting process
    - How can land Productivity be reported across scales? From subnational to national to global?
    - How should the temporal dimension of estimates of land productivity be considered for monitoring purposes?
    - Which EO methodologies are applicable to monitor land productivity of agricultural systems?
    - Should land productivity be considered a “common indicator” to be used in UNCCD and CBD reporting?
- About LDN
    - Could land productivity indicators be used to identify target areas?
    - To evaluate the success / failure of management strategies?

Other thoughts included the following points:

- It is not possible to meet all three UNCCD strategic objectives in a single place
- Each single indicator means nothing
- Global harmonisation is a big problem (e.g. differences in land cover classes)
- Need for long term data and indicators on ecosystem resilience

Discussions covered issues of relationships and differences between global and local approaches and the implications for the establishment of useful indicators and evaluation or validation. Different flexible approaches and interpretation seem necessary because of variation in processes of degradation, definitions and land cover classes especially at national levels

Sakhile Koketso, CBD: *CBD information needs with a focus on dry and sub-humid lands*

Links: *http://www.cbd.int/doc/meetings/sbstta/sbstta-17/information/sbstta-17-inf-07-en.pdf*

Sakhile presented the CBD information needs with focus on dry and sub-humid lands. These cover identification of the extent of degraded land including its definition especially in relation to agricultural lands that often have high productivity and low biodiversity. Other multifaceted issues include for example bush encroachment associated with optimized ecosystem service of CO2 sequestration while biodiversity and rangeland productivities are low. The indicator needs of the CBD are quite similar to those of UNCCD and are based on COP decisions from different years. Products could help mapping vulnerable regions to climate change, setting base lines and model impacts of climate change on biodiversity. More accessible, reliable, consistent and comparable data could be facilitated by EO data with in situ monitoring combined with EO monitoring. Land productivity indicators could be valuable for countries without capacities of monitoring the impact of climate change on biodiversity and for target 14 and 15. Other needs include spatially explicit biodiversity data, collection of new data, capacity of calculating carbon storage capacity of soils and wetlands as well as long term data, near real time data and data related to ecosystem services.

Products need to be in the form of information to suit decision makers.

Martin Wegmann,University of Würzburg: *Overview about the role and work of GEO BON and CEOS Biodiversity*

Links: *http://www.remote-sensing-biodiversity.org/ceos*,

Pettorelli et al. 2014: http://rstb.royalsocietypublishing.org/content/369/1643/20130190.full.pdf

Martin presented an overview of the role and work of GEO BON and CEOS Biodiversity. GEO BON aims at coordinating biodiversity observations, develop EBVs, fill data gaps, providing frameworks ("BON in a BOX").

It is a network of people, structured in different working groups with a large range of topics. CEOS is a Committee on Earth Observation Satellites. Members are basically all space agencies and CEOS is trying to coordinate their activities.

One of the goals of GEO BON is to homogenize data for global use, e.g. GlobCover. Identified problems include:

- still missing some data
- problems of data adequacy
- problems of links of EO and people on the ground

Martin pointed out that **Essential Biodiversity Variables (EBV)** are quite challenging to determine but should provide any kind of information related to biodiversity.

Within CEOS Biodiversity there is a group on Remote Sensing for Biodiversity and Conservation which coordinates activities, defines relevant products, and through networking tries to communicate what is feasible with EO data from conservation perspectives. Problems of globally addressing conservation communities are

that some regions are hardly responsive; interests have mainly been expressed from Europe and North America. The key is free data availability, e.g. Landsat.

Conclusions are that further development of EO indicators is important as the interest in the topic is increasing and it is challenging to implement integrative approaches. It should be feasible but the actual implementation is hard.

Rasmus Fensholt, University of Copenhagen: *Desertification; what can we learn from time series of Earth Observation data?*

Links:*Fensholt et al. 2012, http://www.sciencedirect.com/science/article/pii/S0034425712000545*

Geist and Lambin 2004, http://www.bioone.org/doi/abs/10.1641/0006-3568%282004%29054%5B0817%3ADCPOD%5D2.0.CO%3B2?journalCode=bisi

Prince et al. 2009: http://www.sciencedirect.com/science/article/pii/S0034425709000273

Wessels et al. 2007: http://www.sciencedirect.com/science/article/pii/S014019630600190X

Verbesselt et al. 2010: http://bfast.r-forge.r-project.org/Verbesselt+Hyndman+Zeileis-2010.pdf

Rasmus provided definitions and outlined aspects of desertification and what we can learn from EO data time series. He pointed out that included in the UNCCD definition of land degradation is that it leads to a reduction of either the biological, economical productivity or biodiversity. Better understanding of the drivers and exacerbation by climate variation is needed including the importance of scale and dynamic causal patterns. There are several productivity indicators, e.g. NDVI, fAPAR, NPP, that are derived from EO data and long term time series on NDVI (GIMMS) show that globally, drylands are predominantly greening (Fensholt et al. 2012). However, there may be a contradiction between global dryland greening and actual status of drylands. Hence, it is important to separate climatic drivers into several abiotic variables: radiation, rainfall, temperature and to refine the indicators to extract phenology (e.g. TIMESAT). Important indicators such as CFR (Cyclic Fraction), SOS (Start of Season), LOS (Length of Season) and new approaches to their use can improve the understanding of seasonality and hence changes in land degradation.

Rasmus also discussed causes of global scale trends and pointed out the strong coupling between rainfall and vegetation. Several different temporal and spatial approaches to the use of RUE (Rain Use Efficiency) were covered including the classic method where the climate signal is removed from a time series. Rasmus listed the following issues as important for future analysis:

- Parameterization of long term time series is needed.
  Verbesselt et al. 2010 (see link) suggest BFAST (Breaks For Additive Seasonal and Trend), split up time series into single segments, look into breaks
  BFAST can also be useful to see breaks related to different sensors
- Ground truthing is very important but data is very scarce
- We need to know what is behind the greening seen in the long term GIMMS trends
- Spatial scale, we need to use EO data at different scales; HR (High Resolution) observations are important to understand the drivers of observed changes. Spatial pattern are important in this respect and for understanding change in land use
- MODIS 250 and MERIS 300 can tell much more than what we can get from GIMMS
- We need to use the Landsat archive in a clever way in time series analysis

Conclusions from the work to date were that:

- Trend/epoch based analysis of NPP indicators works well but they don't give signs of widespread global on-going land degradation
- We must be careful with approaches to normalise for rainfall variability (spatio/temporal RUE, RESTREND)
- We need to start thinking beyond linearity in trend analysis and use explicit reference to which part of UNCCD definition (biological, economical productivity or biodiversity) that is applied. This will reduce contradicting empirical evidence of land degradation.

Kurt Günther, DLR: *Modelling NPP and NPP Proxies*

Kurt talked about his experience in modelling NPP and NPP proxies. Precipitation, temperature, vegetation period length, Vegetation Indices etc. are all related to NPP and may be proxies of NPP and potentially also LAI or non-irrigated land and certain other types of land cover. DLR has developed a sophisticated model for NPP modelling: BETHY (Biosphere Energy Transfer Hydrology). It uses inputs of land cover, LAI, soils, relief data, cloud cover soil water content, rainfall, temperature, and wind speed. BETHY models full water budgets and does an energy/water/CO2 budget. Modelling of NPP is done a daily time scale and BETHY results are compared with NPP proxies derived in Diversity II in Southern Africa, such as vegetation year greenness, CFR and dry season average. The results show good agreement between the two methods.

Gregor Ratzmann, Geoville: *Non-linearities between rainfall and vegetation in dryla*nds

Gregor presented information about the non-linear relationships between rainfall and vegetation in drylands. Study results include sensitivity of vegetation dynamics to rainfall, using GIMMS NDVI and TRMM rainfall data from investigating the correlation using sliding temporal windows of different lengths on the entire time series data. The results are comprised of a series of model coefficients (vegetation sensitivity to rainfall) at different states of the entire temporal evolution of rainfall and vegetation. From these results can be concluded that temporally consistent linearity between rainfall and vegetation is hardly achievable over extended time series.

The reasons are that several variables determine the rainfall/vegetation relationship of which rainfall pattern and land use are the most important. Different reaction of vegetation depends on PFTs (Plant functional types) but another driver to change of sensitivity (vegetation response to rainfall changes) can be land cover and land cover change. Also changes in rainfall can an increase of sensitivity. A suitable approach could include a combination with the with the BFAST approach of Verbesselt at all (2010), see contribution of Rasmus Fensholt.

Ute Gangkofner, GeoVille: *Methods and products of Diversity II*

Ute gave a comprehensive presentation on the methods used and the output products from the project for drylands including information on the test and validation sites and their variability. The input data consist of MERIS derived fAPAR data, Gimms NDVI data and TRMM rainfall data. The project has developed a set of detailed vegetation phenology and productivity parameters and introduced the term “vegetation year”, composed of the green vegetation season and the (or cold) season, and covering the period between two corresponding and consecutive SOS. The reasons for the need of phenological and productivity parameters was outlined, e.g. between year variations of SOS, assurance of appropriate integration and yearly estimates, growing season fraction of vegetation is needed to derive direct response of vegetation to rainfall, classic not adequate measures of degraded land is based on RUE, indirect information on land cover can be derived when vegetation greenness of different seasons are related to each other.

Phenology and productivity parameters were also explained using a phenology diagram which clearly shows different aspects of between year variations and how to integrate them to ensure comparability. Relationships between different parameters such as fAPAR and CFR were explained. The Diversity II (first three) and other important parameters (last two) covered were:

- Average of the vegetation year
- Cyclic fraction (excluding short and small peaks)
- Average of the dry season
- Start of the vegetation
- Length of the growing season (can vary a lot)

Rainfall trends have been compared using different data sources and care needs to be taken when generating efficiency indicators based on rainfall data due to the inconsistency between the different precipitation data sets.

Variability of indicators can be a good indication of bio diversity. This should be further investigated and needs a co-analysis of the various indicators.

In addition, two other issues were covered (noted by Marc); pertinence of the RUE indicators (validity of RUE), and of the trend indicators (given the short period) including floor discussions about the relationship between RUE as an NPP proxy and rainfall as well as layout and map design issues.

Michael Cherlet, JRC: *The World Atlas of Desertification (WAD)*

Links: *for reference* *http://www.eoearth.org/view/article/150964/*

Michael presented information about the World Atlas of Desertification. It is an initiative based on voluntary basis with the involvement of UNEP. The reasons for a new Atlas include a long gap since previous atlas, a need to establish a holistic and global approach to LDD and advance indicator reporting in response to policy. It will be a baseline for assessment of LDD and a foundation for economic validations. The definitions for LDD are persistent reduction or loss of biological and economic productivity. Drivers and causes of land degradation are considered key. The concept of the Atlas is about convergence of evidence; the variables like land use are global and the issues are global but we have to treat them locally. Lists of LDDS issues are to be considered (drought, population pressure, grazing, vegetation cover, population movement, pollution, etc…).

The implementation of the concept is based on a desire to address more than just NPP and just as Diversity II phenology and productivity variables have been computed per pixel base on Reed approach. A number of long-term change maps have been defined. They use "Ecosystem Functional Types" to stratify the long term time series and for local scaling. Classified maps of steadiness are used instead of trends. The maps are not of land degradation but rather of land system productive capacity estimations and are called Land Productivity Dynamics Maps with the classes decreasing productivity, early signs of decline, stable but stressed, stable and not stressed. These maps are to be compared with the causal maps. Currently missing are maps on global land use / land use change at adequate scales.

Graham von Maltitz, CSIR, South Africa*: Experience from South Africa in mapping land degradation*

Graham talked about how the CSIR has been "chasing the holy grail of land condition mapping". The requirements are for spatially explicit maps that track change and are cost effective. No product so far can track change over time on a large scale as there is a problem in using districts to aggregate information when entire districts are rated one degradation category. In SA the biggest land degradation concerns involve land use change and alien vegetation invasion. Bush encroachment is also seen as problematic, i.e. increasing carbons stocks but decreasing grass and biodiversity with worse water storing capacity. There is a potential to use LAI instead of NDVI and to map N content in leaf and grass biomass as well as LIDAR based mapping of tree cover, all are current R&D topics in CSIR. EO data for the mapping of bush encroachment is based on HR data and phenology based variables.

Patrik Klintenberg, Mälardalen University, Sweden**:** *Indicators of land degradation and desertification: a Southern African perspective*

Patrik covered a range of Southern African perspectives in his presentation. The reasons to monitor land degradation are to:

- Determine current and past states of the environment that influence our livelihood
- Evaluate effects of our actions
- Inform decision-makers
- Guide policy development
- Regulate resource utilization
- Scientific curiosity

The requirements for land degradation indicators include:

- Preferred indicators should be defined by the UNCCD
- Should provide relevant information (should answer the question)

- Be based on accepted scientific theories
- Have well defined thresholds / benchmarks
- Be relevant for immediate action, that is, near real time
- DATA: Easy to collect data, data can be collected regularly, available in all countries, for as long as possible, data collected consistently
- ANALYSIS: be quick, real time delivery, results should be understandable

Assessment of UNCCD indicators in SADC has been made in the AID-CCD project which is a EU funded project that analysed the country reports. SA had 54 biophysical and 42 socio-economic indicators (52 local and 44 national)**.** The review identified 225 UNIQUE indicators in the whole SADC countries. Only 34 had some kind of thresholds or benchmarks to compare to. Seldom was a specific indicator used in more than one country and most of the indicators were not monitored regularly. This means that it is very difficult to develop a universal core set of land degradation indicators.

Patrik also described two case studies, one in Namibia and one in a semi-arid area south of Windhoek. The objective of the first case study was to produce a map with the extent of desertification in Namibia. Indicators were identified using different criteria such as scientific relevance and data availability. The indicators included land cover change, soil erosion or NDVI but also population pressure, etc. Five indicators were selected: population pressure, total grazing pressure, soil erosion and rainfall index, excluding NDVI due to issues on bush encroachment. The indicators were mixed to produce unique land degradation risks. The conclusions were that there are no universal causes or effects of land degradation and that a participatory approach creates stakeholder ownership.

The objective of the second case study was to understand environmental change and its impact on livelihoods. It was performed by interviewing farmers and the findings included increased grazing pressure by introduction of sheep herds, the rainy season starts later, more seasonal rainfall, higher frequency of bush fires since 2000, range land productivity has decreased, less grass production and more soil erosion. The aspects of most importance to farmers and stakeholders are economy followed by social aspects; environmental aspects were considered rather unimportant. Global data sets not too far processed should be provided and combined with local stories of e.g. farmers, which make up the local experts.

Patrik also discussed issues related to how to make the best use of RS techniques to support monitoring and evaluation of land degradation:

- We must provide global datasets well standardized with sound methodologies to facilitate local and national decision making
- Guidance is needed!
- Levels of complexity needs to considered. Presenting a final product such a global picture of land degradation is too high.
- Question is how to operational this scheme (from Global to Local)?

Lúcio Pires do Rosário, National Focal Point for UNCCD, Portugal: *UNCCD Indicators. Application on the Portuguese NAPCD*

Lucio talked about the UNCCD indicators from a Portuguese perspective and outlined the DISMED project which involves assessing climatic sensitivity to desertification using 6 progress indicators plus 2 other (aridity index + population abundance in affected areas). They showed a large aridity increase in Portugal since 1960. The Desert Watch project in cooperation with ESA identified that there is need for less expensive up to date data.

UNCCD monitoring is part of the local rural monitoring program and the delineation of affected areas is an important map requested by the UNCCD. The LDI developed by Gabriel del Barrio for mapping land degradation in Portugal has been adopted.

Indicators should be evaluated and not validated in the field!!

Parties will report on the indicators not only on the affected areas but also outside the affected areas to account for the variability of the affected areas.

Indicators that can be derived from EO are land productivity and biodiversity where the latter is on the way by means of field work. Some of Diversity II products might be of use already.

Aldrin Perez-Marin, INSA, Brazil: *Experiencia Proyecto ASA-INSA: Monitoramiento de sistemas agricolas familiares en el semiárido del Brazil*

Aldrin presented information on the Caatinga ecoregion, one of the test sites in Brazil. It is 1,000,000 km2 with 22 Mio inhabitants. It is semi-arid with very high rainfall variability and high variability in soil types (6 different types). Typical vegetation is Caatinga (white in native language), which is green only during the rainy season. There is high environmental variability and agriculture, livestock and wood extraction are the main land uses. Approaches to determine land degradation include data mining and an observation system using permanent sampling plots for monitoring. The affected area has been delineated with about 58% of the area is actually affected by desertification, in total 1,3 million hectares.

Desertification is a dynamic process and Aldrin pointed out that they need a baseline in order to define trend!

Indicators are very much dependent on the stakeholder and there is a need to analyse the vulnerability of small farms and analyse vulnerability towards climatic variability.

Ute Gangkofner, GeoVille: *Proposed "second order" indicators of Diversity II*

Ute described the currently proposed "second order" indicators by the Diversity II project and how they can turn descriptive information ("first order" indicators) into assessments and evaluation of status and trends of degradation and land improvement. An important point (from Lucio) is that indicators should be evaluated not validated in the field. The proposal is to deliver both levels of information to the users together with interpretations keys and alternatives. Diversity II will hence deliver 2nd order indicators containing diagnoses of potential status and trends, example of interpretation keys (generic) and some short narrative to link some of the results to developments on the ground. Structure for the continued work around 5 lines was proposed:

- biodiversity
- degradation (persisting or progressing trends of vegetation productivity)
- degradation through bush encroachment
- Land Use / Cover Change
- sallinisation (not addressed)
- other manifestations or potential hints to land status change (meteorological and soil moisture data, other EO data)

Michael Cherlet, JRC: *Presentation on Copernicus*

Michael gave an update on the activities of Copernicus. This includes the implementation of a hot-spot monitoring component as part of the global service (a request from EU institutions). It is based on HR/VHR products. Copernicus aims for integrated EO with an in-situ service system. Included in the EO constellation is now Proba-V, a continuation of SPOT-VGT, which is operational since April 2014. Currently a preparation is under way for an ITT on on-demand land cover mapping at HR-VHR, including hot spot mapping. Michael also mentioned DOPA (Digital Observatory for Protected Areas) which is a JRC conducted project aiming to integrate biodiversity data by bringing together a large variety of sensors, databases and systems as a possible contribution to GEOBON.

Marc Paganini, ESA: *Near Future: EO sensors, other developments and their impacts on dryland monitoring*

Marc finished the presentation sessions by talking about the near future in regards to developments including the EO sensors Sentinel 2 and 3 for which funding now has been secured for until 2020, big data issues as well as access via data hubs and likely impacts on dryland monitoring.

The following points are extracts from the final discussion:

- Rasmus: agree specifically with the way RUE is used, it is a practical way to address the problem of normalization of NPP with rainfall
- Graham: good approach; will be a lot of material to digest. Indicators must be usable by the parties
- Sakhile: we tend to solve the technical issues but forget to solve the soft issues. The project needs feedback from the local people, e.g. government of Southern African countries. My advice: identify users in the government and allow them to play around with the information. They will provide a richer feedback. From CBD perspective: the global approach is really useful for CBD. To move beyond the global scale go to the countries. There is not that many in Southern Africa. Another point: the time frame is important. Between 1999 and 20xx the political and economic situation in Zimbabwe changed and that had an impact on the environment which should be visible and of very valuable information for the local government.
- Ute: yes, that's why we do not want to label the results. The interpretation shall be done by the local experts.
- Sakhile: Who do you want to use your assessment? If this is the CBD that is fine. If the target is decision makers in Africa or South America you want them to be involved in the preparation of the results (definition, data, review). This kind of information as produced by the project is needed because these countries do not have the means to do it. But they need to be involved closely in the process. Do not give them ready products without having them involved before.
- Tiejun: Agree, the products need to be further evaluated by the local experts. These should be done by experts (researchers, not government). Tiejun can make contact to Zimbabwe.
- Victor: agreed that the final end users should be involved in the process of definition and generating the products.
- Patrick: it is complicated to use EO information. Experts should use these data. When it comes to the interpretation this is the responsibility of the countries. Not every country should do this work of generating the maps. The countries should do the interpretation.
- Michel: still do not know where this project will go. Is it research on content or methods? The project should really go up to the end.
- Marc: example of Desert Watch: countries were closely involved; specifically Portugal. At the end Portugal (Lucio) adopted the method at national level. Coming to DIVERSITY: the UNCCD has changes from land degradation to land productivity. Requirements were also on higher resolution. DIVERSITY is more a R&D project preparing the future, going to even higher spatial resolution. During the progress of the project we also look at the evolution of CBD and UNCCD. EBD is still a question mark, everything is moving. Next projects will be on Land Cover as well as (another one) on EBVs
- Kurt: the project is in a very scientific stage. We are talking about first and second order indicators, and we discussed 10s of them. When we go to government, we can come with only 1 or 2 indicators, otherwise they will not listen. Missing: I have not yet seen how NPP is linked to biodiversity (linear, exponential, ...?) Where do we want to go? More scientific? Or stop and focus on first order indicators and make them read to use for government.

The following list summarizes the main issues and questions that were raised at the workshop:

- **CBD and UNCCD common indicators**
    - Can/should land productivity indicator(s) be considered as a “common indicator” to be used in UNCCD and CBD reporting?
- **Change of land use** is one of the main drivers for loss of biodiversity and land productivity in drylands.
    - How can we associate the detection of change in land use with phenological analysis of land productivity?
    - How can we stratify land productivity indicators by LC/LU?
    - Many Land Cover maps will start to be available globally at different spatial resolution (see 300m LC CCI, soon Global Land Cover maps from 30m Landsat
- Desertification is a dynamic process. We need a **baseline in order to define trend**!
- **Level of complexity**
    - To present a final and unique product (such as a global map of land degradation) is too high level.
    - Land degradation means a persistent/long term reduction of loss of the biological and economical productivity.
    - Desertification is the results from poor land management which can be exacerbated by climate variations
    - There are no universal causes or effects of land degradation

  - Why discrepancy between global EO and field based assessment?
  - Increase of land productivity does not necessarily mean better land conditions! E.g. bush encroachments.
  - Understanding drivers is key when assessing land degradation
  - Each single indicator means nothing (we need to look at all factors for land degradation)
  - Need for storylines
  - Convergence of evidence is the approach
- **Trend estimates**
  - How should the temporal dimension of estimates of land productivity be considered for monitoring purposes?
  - Long term linear regressions are not taking into account trend breaks
  - Some parameterization of long term time series is needed.
  - See BFAST paper that identify breaks in the time series
  - See Gregor's presentation
- **RUE-type of indicators**
  - We want to normalize for rain fall variability but we need to be careful how to do it!
  - RUE (if strictly applied according to the definition) has strong limitation
  - Rainfall-vegetation relationships cannot be assumed to be linear
  - vegetation sensitivity to rainfall can change over time and inter-annually
  - Long term regressions should NOT be used to analyse the impact of rainfall on vegetation
- Building indicators on **different data sources / different spatial/temporal resolutions**
  - NPP proxies are available at a much more detailed level that what is available for precipitation and soil moisture
  - How to deal with different spatial and temporal resolutions in the input data sets
- Parties have to appropriate the indicators. They must be **standardized**, **validated** and **understood** by Parties.
  - We must provide these global datasets well standardized with sound methodologies
  - Combining / comparing different indicators from different countries must be harmonized
- **Need for multi-scale approaches**
  - ecological models are very sensitive to scaling factors
  - Long time series at coarse resolution (e.g. 30y of 8km GIMMS NDVI, 15y SPOT VEGETATION) recent 300m time series or similar (MERIS, MODIS, PROBA-V and soon S3 OLCI)
  - MODIS 250 and MERIS 300 can tell much more that what we can get from GIMSS
  - We need to use the time series of Landsat in a clever way in time series analysis
  - And soon will come the dense time series of Sentinel 2
  - How to deal with different scaling of observations?
- **Global datasets vs local and national decision making**
  - Land degradation is a global problem but it manifests locally
  - UNCCD requires national estimates for the 6 indicators to be based on global indicators
  - How can land Productivity be reported across scales? From subnational to national to global?
  - Could global land productivity indicators be used to identify target areas?
  - Scaling up from local to national and global cannot always be done by aggregation
  - Guidance to Parties is needed
  - Participatory approach creates stakeholder ownership
  - How to operational this scheme (from Global to Local)?
  - Which EO methodologies are applicable to monitor land productivity of agricultural systems?
  - And to evaluate the success / failure of management strategies?

5.3 Synthesis of User Requirements

5.3.1 Second order indicators - Inland waters

Major international, national and regional agreements, directives and management plans aim to protect and monitor freshwater habitats in order to assure a sustainable management of freshwater ecosystems. A fundamental part of this work is to monitor ***temporal*** variation in order to assure a satisfactory status of water bodies and to assess the ***spatial*** distribution of the most sensitive and essential habitats requiring long-term protection. Recognizing the importance of protecting and restoring habitats to sustain biodiversity is reflected

in many initiatives worldwide and for EU members the Birds- and Habitats Directives, Water Framework Directive and Nature 2000 were mentioned. These directives are demanding and constitute a heavy financial burden when using traditional monitoring tools. Mainly driven by budget reductions, it was stated that the use of new methods are required and that a redesign of monitoring practice is on the agenda in several countries.

Increased levels of nutrients, leading to enhanced production of phytoplankton, increased abundance of cyanobacteria and eutrophication was brought forward as a significant process for assessment of fresh water biodiversity, both at the meeting and in submitted questionnaires. Eutrophication primarily enhances the production of phytoplankton and thus leads to increased levels of chlorophyll and reduced transparency, but also secondarily by negatively affecting the depth distribution of macrophytes and leading to a more pronounced re-suspension of sediments by wave action, thus also leading to increased levels of total suspended matter. Chlorophyll concentration is commonly used as a proxy for phytoplankton biomass and is consequently the primary indicator for eutrophication. Cyanobacteria occurrence is a secondary indicator for the assessment of this process. Lake level and water surface temperature can on one hand provide additional information on the course of eutrophication, e.g. in terms of inflow and terrestrial nutrient input, or vertical mixing. On the other hand, they may represent physical stress in non-eutrophicated waters. In this scope it was also mentioned in the questionnaires that the correlation or ratio between chlorophyll and TSM could be used to estimate whether eutrophication or physical disturbance is the prevailing pressure variable for diversity.

All mentioned ecological indicators can be measured by remote sensing and the user consultation supported the statement that first order status maps, and trends represented by time series, act as relevant indicators of biodiversity. The fact that these indicators are of different significance for different water bodies complicates however the development of further aggregation into second order indicators, which as derivatives imply information loss in contrast to the full set of first order indicators. Several users recommended that maximum information content is of primary interest, and further spatial or temporal aggregation, or combination with other information sources, should be done by users on a case-by-case basis. It was therefore agreed that software tools to assess status and trends of first order indicators and to customize derivatives according to individual user requirements are the most effective means to support product usage.

5.3.2 Second order indicators - Drylands

Generating second order dryland indicators means to turn descriptive information or characterisations provided with the first order indicators into assessments and evaluations of the status and trends of degradation or land improvement. Our suggestion is to deliver both first order (descriptive) and second order information to the users including interpretation keys (alternatives).

Diversity II can contribute elaborated first order indicators (both maps and underlying data) and a set of second order indicators containing diagnoses of potential status and trends as well as short narratives to link some of the outcomes to developments on the ground or provide overviews of what may have happened according to EO results.

Second order indicators are based on first order indicators, which on their own are highly aggregated products based on phenologically adapted yearly and seasonal Vegetation Index and hydrometeorological data. The first order indicators basically include vegetation greenness and RUE indicators, supplemented with satellite based soil moisture indicators. They reflect the vegetation productivity, vegetation decline and potential degradation and show the high variability and trends of vegetation greenness during the observed years. By differentiating between the green and the dry periods, they also highlight the relation and potential shifts of the seasonal vegetation growth. The latter may give hints to land cover changes and bush encroachment, a widespread dryland degradation process. The second order indicators combine various first order indicators, and aim at further enhancing the information content of the former. One type of derived second order products relate vegetation greenness developments directly to rainfall and provide a synopsis of rainfall and vegetation development, which is not given by RUE indicators alone. Another group of these products integrates the relation and trends of overall vegetation greenness and seasonal development, resulting in a sort of functional vegetation classification and related change and trend products. They aim at differentiating the type of vegetation and the kind of ongoing trends, which are manifested in different phenological behaviour. In order

to characterise the timing of vegetation growth in the various dryland sites, the start of the vegetation year, of the green season and the length of the vegetation period are supplementing the first and second order products.

The Diversity II project with its large number of proposed indicators on different levels was acknowledged to offer useful contributions to degradation studies. Many further items and details were brought forward by the different speakers, highlighting scientific and methodological aspects of the indicator development (e.g. what is the baseline of land degradation? Can we assume a linear relation between rainfall and vegetation growth?). Important issues raised by several speakers related to the question as to how the local stakeholders of the drylands should be approached with the EO products and what their active part in using the products might be.

Defining land productivity as common indicators to land degradation **AND** biodiversity in drylands was both the basis and also part of the agreed common findings of the workshop. At the same time the relationship between productivity and biodiversity remained a rather open issue, and was stated to be highly scale-dependent. In situ data and local expert knowledge for assessments and evaluations of the results would be needed to make sure they are useful and practically usable.

To assess the complete range of different land degradation issues more comprehensively, multi-scale approaches are required with a strong involvement and ownership of the countries, parties, and local stakeholders.

5.3.3 User Requirements Derived from Additional Discussions and Current Developments

With a few of the listed dryland product users, additional discussions and meetings have taken place in the course of the Diversity II project. In addition, an extensive study of the literature especially with regard to prominent current developments in drylands on the one hand, and to state of the art remote sensing approaches to monitor these developments on the other. These led to up to date requirements for the dryland indicators, which are not necessarily taken into account in many EO based dryland studies up to now. These shall be shortly summarized below.

Many dryland studies conducted during recent years have revealed a widespread greening of semi-arid regions, and have concluded that the formerly often claimed steady and irreversible degradation of drylands cannot be stated in EO data and that on the contrary rather a greening process can globally be observed. Recent research in this context (e.g. Herrmann and Tappan 2013[78]) have tried to relate observed greening trends to developments on the ground and could establish relations of the greening with the phenomenon of bush encroachment. The latter, also referred to as “woody encroachment” or “woody thickening” is a worldwide observed development during the last decades, with many possible causes including overutilization (especially overgrazing) of the land, but also increasing rainfalls, natural succession and the growing CO^2 feeding by the atmosphere. Bush encroachment in drylands is mainly perceived as negative development, where the bushes lead to range land degradation by reducing grass cover and impeding the access of cattle to the remaining grass. Also impoverishment of biodiversity was frequently found as an effect of bush encroachment (Ratajczak et al. 2011[79]).

The phenomenon of bush encroachment and thus the negative impact of the actual greening trend is a development that needs to be monitored and studied in the Diversity II project, in addition to the “classical” degradation measures such as the decrease of vegetation productivity. For this reason, a very differentiated approach of the study is required, leading to indicators that reveal both degradation processes related to negative vegetation productivity trends and those triggering positive developments of the EO indicators, but actually have negative impacts (i.e. the observable bush encroachment).

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[78] Herrmann, S.M. and Tappan, G.G. (2013), Vegetation impoverishment despite greening: A case study from central Senegal, Journal of Arid Environments 90 (2013) 55-66.

[79] Ratajczak, Z., Nippert, J.B. and Scott, L. (2011), The effects of woody encroachment on plant diversity in global grasslands and savannas: a meta-analysis. http://media.wix.com/ugd/d270f9_013ee3e8ed68377da3047468fb523488.pdf

6 Biodiversity Hotspots and Global Bioregionalization – Requirements on Site Selection

According to the SoW, great attention should be paid to biodiversity hotspots and other areas of specific value for the conservation of biodiversity during the implementation of the Diversity II Project, particularly in its introductory site selection phase. This chapter addresses that issue, with focus on the biodiversity value of and the selection and delineation of such areas. Its main purpose is to constitute a basis for the selection of those specific areas from which the Project should provide key observations, based on satellite remotely sensed data, to assess status and trends of biodiversity.

These areas should include 300 large perennial inland waters globally distributed around the world (i.e. most natural lakes and water reservoirs with a size over 500 km^2 and some natural lakes of biodiversity importance over 100 km^2) and at least 20 dryland areas with a total surface of 10 million km^2.

The SoW points out that, during the final selection of the sites, particular attention shall be given to include a number of biodiversity hotspots, i.e. areas which are home for the world's biologically richest and most threatened ecosystems. At least 50 lakes and 10 dryland areas of primary biodiversity importance shall be selected.

The dryland geographical areas selected for the demonstration sites shall include large and representative areas of dryland-related biomes from the terrestrial ecoregions defined by the WWF. Some biodiversity indicators (multi-annual status and trends) in drylands shall be derived by relating the status/change maps to existing biodiversity databases such as Protected Areas databases, including the Transboundary Protected Areas (TBPA), Endemic Bird Areas (EBAs), Centers of Plant Diversity (CPDs), and major watersheds (as defined by WRI). The drylands retrieval algorithms shall be validated on five test sites, selected for their representativeness of dryland biodiversity, principally but not exclusively among the WWF ecoregions.

Biodiversity stories constitute an important component of the Diversity II Project. Such stories shall be written for 50 lakes and 20+ drylands located in biodiversity hot spots. The biodiversity stories shall include both hotspots that are “bright” (lakes and drylands in good condition) and “critical” (lakes and drylands in bad condition).

A great number of different terms are used to capture different kinds of areas of value for biodiversity conservation. This has created a confusing conservation landscape to navigate. Therefore, there is a need for clear, concise and relevant information about all kinds of important areas for biodiversity conservation that can be used by all sectors of society. Such information is provided by UNEP-WCMC in the guide A to Z.[80] This guide provides a lot of data and information which will be of direct use in the selection process of the Diversity II Project.

This chapter is mainly based on scientific and technical literature to which references are made. Altogether, more than 60 books and articles have been reviewed.

6.1 The concept of Biodiversity Hotspots

As shown in the previous section, biodiversity hotspots should play an important role in the implementation of the Diversity II Project. The term biodiversity hotspot is used with two different meanings which sometimes lead to confusion. Biodiversity hotspots *sensu lato* refer to any area or region with exceptionally high biodiversity. This wider, more general meaning differs from biodiversity hotspot *sensu stricto* which is a technical/scientific term with a specific meaning. Both these meanings are referred to in the SoW.

[80] A to Z is an online guide (http://www.biodiversitya-z.org/) which provides data on areas of biodiversity importance. These include internationally recognized protected areas (e.g. World Heritage Sites and Ramsar Sites), nationally protected areas as well as approaches used to prioritize areas for conservation, such as biodiversity hotspots. The guide also covers criteria behind the management practices for protected areas as well as other relevant information, including legal and compliance aspects, and the biodiversity and socio-cultural values that need to be upheld in each location.

In its strict sense, a biodiversity hotspot is a biogeographic region with a significant reservoir of biodiversity that is under threat from humans. The definition of biodiversity hotspot *sensu stricto* is based on a combination of quantified species endemism (at least 1,500 endemic vascular plant species, i.e. > 0.5 % of all known species) and habitat loss (70% or more of an area's natural vegetation has been lost). To qualify as a hotspot, a region has to meet these two criteria. The biodiversity hotspot sensu stricto approach – or paradigm – addresses a major conservation challenge: what areas are the most immediately important for conserving biodiversity. It combines biodiversity value with threats to that value. More than 50 % of the world´s plant species and 42 % of all terrestrial vertebrates species are endemic to these biodiversity hotspots that together cover only 2,3 % of the Earth´s land surface. Each hotspot faces serious threats and has already lost a considerable part of its original biodiversity. 86 % of the hotspot habitats have been destroyed.[81]

In addition to biodiversity hotspots, a number of related concepts have been developed and are used in parallel; so also in the SoW. No authoritative international recommendation on the use of different concepts or terms, e.g. by the CBD COP, exists at present. However, this is not a serious problem if the different concepts are used in defined ways and kept separate, because they complement each other in important respects.

Spatial patterns of biodiversity form the basis for the biodiversity hotspot approach. It is used as a way to effectively target conservation measures in areas of the greatest diversity, and the highest levels of endemism and threat. However, there are also temporal dimensions of biodiversity that could be of interest in this context. Paleoecology and other techniques to understand vegetation changes over time may complement traditional hotspot analyses and give us a better picture of the current situation. In particular, understanding how the distribution of biodiversity has changed over time can help us predict what might happen in the future.[82]

6.2 Biodiversity Hotspots sensu stricto

The concept of biodiversity hotspots *sensu stricto* was initiated and further developed by the British ecologist Norman Myers.[83] [84] It was from the beginning successfully promoted by the US-based NGO *Conservation International (CI)* that adopted the concept as its institutional blueprint.[85] [86]

The number of acknowledged biodiversity hotspots sensu stricto has, over the years, increased from 18 in the late 1980s and 25 in 2000 [87] [88] [89] to 34 today. The last nine areas were added in 2005 as a result of a global reanalysis of the whole concept. The reanalysis implied not only new areas but also a revised delineation and inclusion of additional groups of organisms as criteria for the selection of hotspots.[90] [91] Since then additional hotspots have been proposed, e.g. forests in Eastern Australia.[92]

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[81] Zachos, F.E. & Habel, J.C. (eds) 2011: Biodiversity Hotspots Distribution and Protection of Conservation Priority Areas. Springer-Verlag Berlin Heidelberg.

[82] Willis, K.J., Gillson, L. & Knapp, S. 2007: Biodiversity hotspots through time: an introduction. Phil. Trans. R. Soc. B. 362: 169–174.

[83] Myers, N. 1988: Threatened biotas: `hotspots' in tropical forests. Environmentalist 8: 187-208.

[84] Myers, N. 1990: The biodiversity challenge: expanded hotspots analysis. Environmentalist 10: 243-256.

[85] Myers, N. 1996: Two key challenges for biodiversity: discontinuities and synergisms. Biodiversity Conservation 5: 1025-1034.

[86] http://www.conservation.org/where/priority_areas/hotspots/Pages/hotspots_main.aspx

[87] Mittermeier, R. A., Myers, N., Thomsen, J. B., da Fonseca, G.A.B. & Olivieri, S. 1998: Biodiversity hotspots and major tropical wilderness areas: approaches to setting conservation priorities. Conservation Biology 12: 516-520.

[88] Mittermeier, R. A., Myers, N., Gil, P. R. & Mittermeier, C. G. 1999: Hotspots: Earth's Biologically Richest and Most Endangered Terrestrial Ecoregions (Cemex, Conservation International and Agrupacion SierraMadre, Monterrey, Mexico).

[89] Myers, N., Russell, A., Mittermeier, C.G., da Fonseca, G.A.B. & Kent, J. 2000: Biodiversity hotspots for conservation priorities. NATURE VOL. 403.

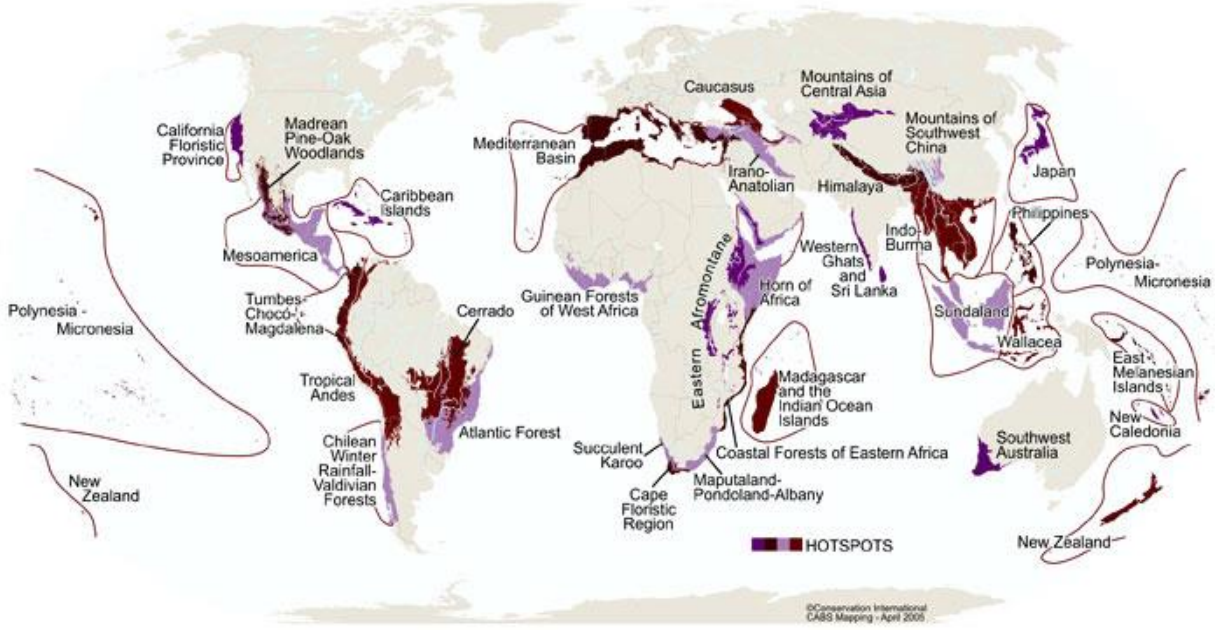
[90] Mittermeier, R. A., Gil, P.R., Hoffman, M., Pilgrim, J., Brooks, T., Mittermeier, C.G., Lamoreux, J. & da Fonseca, G.A.B. 2005: *Hotspots* Revisited: Earth´s Biologically Richest and Most Endangered Terrestrial Ecoregions. Conservation International, Washington, DC.

[91] The National Geographic Society has prepared a world map of the Biodiversity Hotspots sensu stricto as well as an ArcView shapefile and metadata for each spot including details of the individual endangered fauna, which is available from Conservation International.

[92] Zachos, F.E. & Habel, J.C. (eds) 2011: Biodiversity Hotspots Distribution and Protection of Conservation Priority Areas. Springer-Verlag Berlin Heidelberg.

The 34 biodiversity hotspots acknowledged at present are shown in the map in Figure 2.

Figure 2 Map of Biodiversity Hotspots sensu stricto (from Conservation International)



Even if the biodiversity hotspot approach to conservation has gained much support, it has also been criticized, not least because of its high profile in the debate on biodiversity conservation. Critics (e.g. the US-based NGO *The Nature Conservancy)* argue that the approach is narrow, e.g. by not considering

- all relevant components of biodiversity;
- ecosystem services;
- smaller scale richness hotspots; and
- ongoing changes of land use (e.g. in the Amazon Basin).[93] [94] [95]

The critics have shown that it is difficult to apply a ”One size fits all”-approach to the issue of assessing biodiversity and prioritizing measures to conserve it. Often, the best strategy seems to be a combination of different approaches, as is the case in the SoW.

6.3 Global Ecoregions[96] [97]

According to the SoW, the WWF ecoregions (now usually called Global Ecoregions) should be considered by the Diversity II Project, in particular when areas for the demonstration sites in drylands are selected. These regions are outstanding examples of the world’s diverse ecosystems and should be priority targets for biodiversity conservation actions.

The WWF has identified 238 ecoregions worldwide. They are chosen for their species richness, endemism, taxonomic uniqueness, extraordinary ecological or evolutionary phenomena (e.g. adaptive radiations, intact

[93] Kareiva, P. & M. Marvier, M. 2003: Conserving Biodiversity Coldspots. Scientific American 91: 344-351.

[94] Possingham, H. & Wilson, K. 2005: Turning up the heat on hotspots. Nature 436: 919-920.

[95] http://www.nature.org/

[96] http://worldwildlife.org/biomes

[97] http://wwf.panda.org/about_our_earth/ecoregions/about/

large vertebrate assemblages or migrations) and global rarity of the major habitat type. All biodiversity hotspots sensu stricto contain at least one Global Ecoregion. Almost two thirds of the terrestrial Global Ecoregions overlap with hotspots.

The Global Ecoregions concept is a science-based global ranking of the Earth's most biologically outstanding terrestrial, freshwater and marine habitats. It provides a critical blueprint for biodiversity conservation at a global scale. The Global Ecoregions is the first comparative analysis of biodiversity to cover every major habitat type, spanning five continents and all the world's oceans.

The aim of the Global Ecoregions analysis is to ensure that the full range of ecosystems is represented within regional conservation and development strategies, so that conservation efforts around the world contribute to a global biodiversity strategy.

Biodiversity is not spread evenly across the Earth but follows complex patterns determined by climate, geology and the evolutionary history of the planet. These patterns are reflected in the Global Ecoregions concept. WWF defines an ecoregion as a "large unit of land or water containing a geographically distinct assemblage of species, natural communities, and environmental conditions". Each ecoregion is characterized by a relatively uniform climate and a specific set of species and ecological communities.

Whilst tropical forests and coral reefs harbour the highest biodiversity values and are the traditional targets of conservation organizations, unique manifestations of nature are found also in temperate and boreal regions, in deserts and mountain chains etc. all over the world.

The Global Ecoregions concept is *comprehensive* in its scope. It encompasses all major habitat types on Earth, freshwater and marine systems as well as land-based habitats. The concept is *representative* in its final selection. The most outstanding examples of each major habitat type are included from every continent and ocean basin. It uses *ecoregions* as the unit of scale for comparison and analysis. By focusing on large, biologically distinct areas of land and water, the Global Ecoregions set the stage for conserving biodiversity.

The 238 ecoregions identified worldwide are distributed among 14 terrestrial, seven freshwater and five marine habitat types. Of the 138 terrestrial ecoregions, 24 can be characterized as drylands (> 40 % of their area is dryland).

The ecoregions were chosen from outstanding examples of each terrestrial, freshwater, and marine major habitat type. The 26 major habitat types describe different areas of the world that share similar environmental conditions, habitat structure, and patterns of biological complexity, and that contain similar communities and species adaptations.

In order to represent the unique fauna and flora of the world's continents and ocean basins, each major habitat type was further subdivided by seven biogeographic realms (Afrotropical, Australasia, Indo-Malayan, Nearctic, Neotropical, Oceania, Palearctic). Finally, ecoregions that represented the most distinctive examples of biodiversity for a given major habitat type were identified within each biogeographic realm.

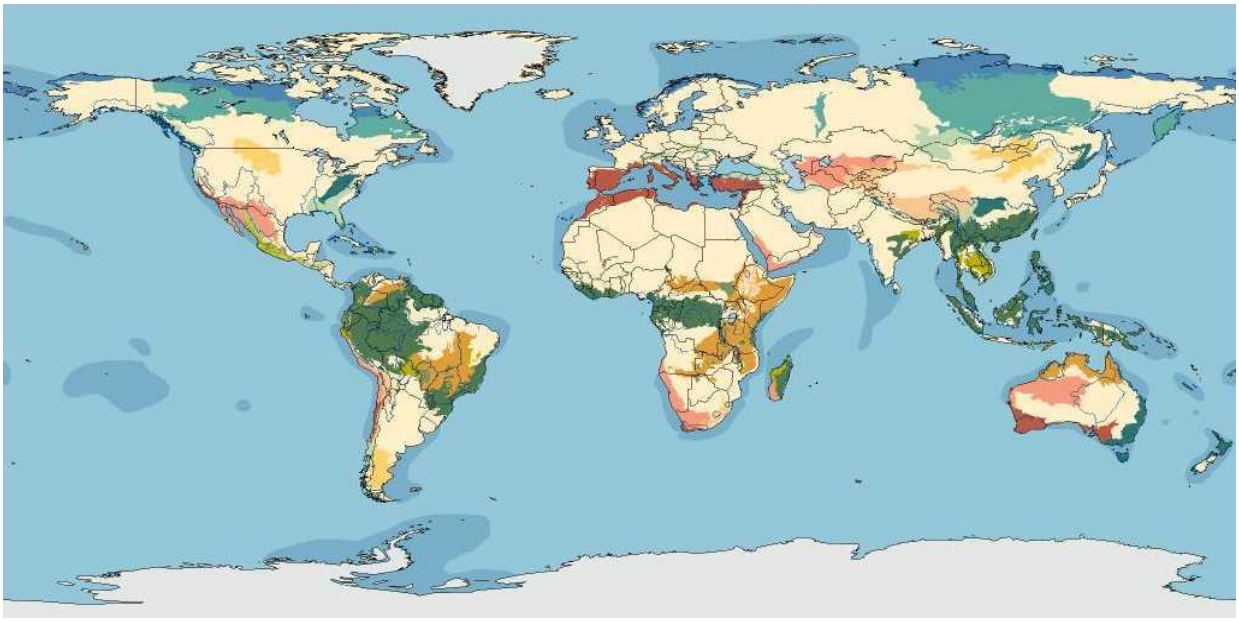
Only the biodiversity value of ecoregions sharing the same major habitat type were compared because the relative magnitude of parameters such as richness and endemism varies widely among them.

The boundaries of an ecoregion are not fixed and sharp. They rather encompass an area within which important ecological and evolutionary processes most strongly interact.

The 238 Global Ecoregions are shown in Figure 3 which was produced by WWF.[98] The map also shows the major terrestrial habitat types. Annex 11 contains data on each of the Global Ecoregions.

[98] http://awsassets.panda.org/downloads/ecoregions_map.jpg

Figure 3 Map of Global Ecoregions



6.4 Key Biodiversity Areas

Site conservation is among the most effective means to reduce global biodiversity loss. Therefore, it is critical to identify those sites where unique biodiversity must be conserved. Key Biodiversity Areas (KBAs) are places of international importance for the conservation of biodiversity through protected areas and other governance mechanisms (Figure 4). They are identified nationally, using standardized, globally applicable, simple and threshold-based criteria, driven by the distribution and population of species that require site-level conservation. The criteria address the two key issues for setting site conservation priorities: vulnerability and irreplaceability. As the building blocks for designing the ecosystem approach and maintaining effective ecological networks, KBAs are the starting point for conservation planning at the landscape level. A KBA can be

a protected area or can lie wholly outside such areas. The KBA identification is focused on land, freshwater and marine environments under national jurisdiction.[99] [100]

The identification of KBAs is an important approach to address biodiversity conservation at the site scale, i.e. at the level of individual protected areas and land management units. There is no maximum or minimum size of sites, because appropriate size varies according to the ecological and socio-economic criteria. Governments, IGOs, NGOs, the private sector and other stakeholders can use KBAs as a tool to identify and augment national systems of globally important sites for conservation.

KBAs extend the previously established Important Bird Area (IBA) concept to other taxonomic groups and are now being identified in many parts of the world, by a range of organizations. KBAs have been – and are being – identified for a range of animal and plant groups, on land, in freshwater and at sea by using the IBA methodology in a somewhat modified form. It has proved to be of particular importance to consider a broader range of threatened species and to increase the involvement of local stakeholders in the work.[101]

The aim of the KBA approach is to identify, document and protect sites that are critical for the conservation of the global biodiversity. A site is an area that can be delimited and, potentially, managed for conservation. As with IBAs, KBAs are identified based on populations of species that are threatened or geographically concentrated. All IBAs are KBAs, but some KBAs are not IBAs (i.e. they are significant for the conservation of other taxa than birds). Nevertheless, the IBA network has proved a good approximation to the overall network of KBAs, as it includes the bulk of other target species and the most significant sites. IBAs are thus an excellent starting point for immediate conservation planning and action. Other sites can be added to complete the network as data become available.

KBAs comprise an 'umbrella' which encompasses globally important sites for different taxa and realms. These include, inter alia:

- Important Bird Areas (IBAs)
- Important Plant Areas (IPAs)
- Important Sites for Freshwater Biodiversity
- Alliance for Zero Extinction (AZE) sites

Many organizations are involved in the identification of KBAs. These include WWF, BirdLife International, Plantlife International, Conservation International, Critical Ecosystem Partnership Fund, and over 100 national/regional civil society and governmental conservation bodies. A key role is played by the IUCN – the International Union for Conservation of Nature. IUCN is an international organization dedicated to ensuring sustainable use of biodiversity. One of its best-known products is the IUCN Red List of Threatened Species which is internationally recognized as the most authoritative measure of the threatened status of species. The Red List Index has been adopted by CBD as one of the key indicators of change for biodiversity.[102]

KBAs have been identified in over 200 countries. The identification and delineation of KBAs is an ongoing process but terrestrial KBA identification is expected to plateau at around 20,000 sites worldwide. Identification of an area as a KBA does not necessarily lead to legal protection or recognition by the national government. However, over 60 % of the KBA sites identified so far, are located within existing protected areas and hence are legally protected. The identification of KBA can also lead to the designation of additional protected areas.

[99] Eken, G. et al. 2004: Key biodiversity areas as site conservation targets. BioScience Vol. 54, No. 12.

[100] Langhammer, P. F. et al. 2007: Identification and gap analysis of key biodiversity areas: targets for comprehensive protected area systems. IUCN, Best Practice Protected Area Guidelines Series 15, Gland, Switzerland.

[101] Knight, A.T. et al. 2007: Improving the Key Biodiversity Areas Approach for Effective Conservation Planning. BioScience, Vol. 57, No. 3.

[102] http://www.iucn.org/about/union/secretariat/

The *Important Bird Areas Programme* of BirdLife International[103] seeks to identify, document and conserve sites that are critical for the long-term viability of bird populations. The programme began in the 1980s and the process of site inventory is very well advanced in the terrestrial environment, with more than 11,000 IBA sites already identified around the world. Birdlife International has also identified 218 Endemic Bird Areas (EBAs)[104] each of which hold two or more bird species found nowhere else and is working with the identification of Marine Important Bird Areas.

Important Plant Areas are identified by several projects around the world, in most cases coordinated by Plantlife International.[105] [106] This work is an important part of the implementation of the consolidated update of the Global Strategy for Plant Conservation for the period 2011-2020 which was adopted by the CBD COP X (2010).[107]

Important Sites for Freshwater Biodiversity are being identified in a couple of ongoing global or regional processes. IUCN plays an important coordinating role.[108] [109] [110] WWF and The Nature Conservancy synthesize biodiversity and threat data.[111] BioFresh, an EU-funded international project, is building a global freshwater biodiversity information platform to bring together, and complement, the vast amount of information on freshwater biodiversity currently scattered among a wide range of databases.[112]

The sites of the *Alliance for Zero Extinction (AZE)* hold the last remaining populations of critically endangered or endangered species. Within the broader set of KBAs, there exists a particularly sensitive subset of sites which represent the most urgent site-scale priorities where immediate action to conserve threatened and irreplaceable biodiversity is required. The Alliance for Zero Extinction, an international partnership of NGOs, works for the identification and conservation of these sites. AZE has identified more than 600 sites globally for birds, amphibians, mammals and conifers.[113]

Other taxa and realms are addressed in the global work on KBAs but have been considered to be of less specific interest to the Diversity II Project due to irrelevant habitat type, lack of data etc. These include marine biodiversity,[114] Important Mammal Areas[115] and Prime Butterfly Areas.[116]

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[103] BirdLife International 2008: What are Key Biodiversity Areas? http://www.birdlife.org/datazone/sowb/casestudy/88

[104] Stattersfield, A.J. et al. 1998: Endemic Bird Areas of the World. Priorities for Biodiversity Conservation. BirdLife International, Cambridge, UK.

[105] Anderson, S. 2002: Identifying Important Plant Areas. Plantlife International, London, UK.

[106] Plantlife International 2004: Identifying and Protecting the World's Most Important Plant Areas: A Guide to Implementing Target 5 of the Global Strategy for Plant Conservation. Salisbury, UK.

[107] https://cbd.int/gspc/

[108] Darwall, W. & Vié, J. C. 2005: Identifying important sites for conservation of freshwater biodiversity: extending the species-based approach. IUCN, Gland, Switzerland & Cambridge, UK.

[109] http://freshwaterbiodiversity.eu/index.php/iucn.html

[110] Darwall, W. et al. 2008: Freshwater biodiversity – a hidden resource under threat. In: J.-C. Vié, J.-C., Hilton-Taylor, C. & Stuart, S.N. (eds.) The 2008 Review of The IUCN Red List of Threatened Species. IUCN, Gland, Switzerland.

[111] http://www.feow.org/

[112] http://freshwaterbiodiversity.eu/

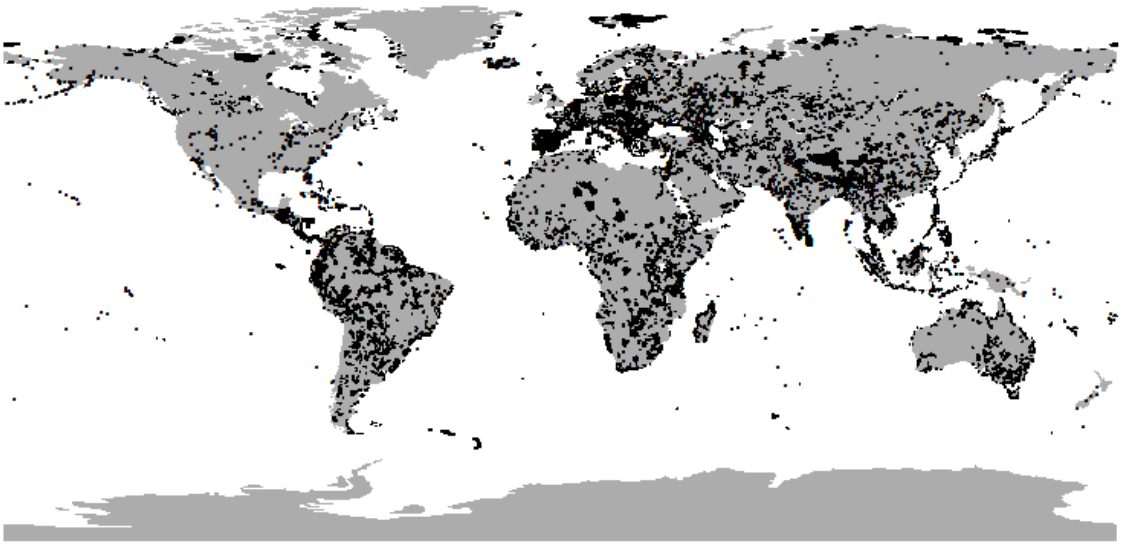
[113] www.zeroextinction.org

[114] Edgar G. J. et al. 2008: Key Biodiversity Areas as globally significant target sites for the conservation of marine biological diversity. Aquatic Conservation 18: 969–983.

[115] Linzey, A. V. 2002: Important Mammal Areas: A US pilot project. Society for Conservation Biology, 16th Annual Meeting. Durrell Institute of Conservation and Ecology, Canterbury, UK.

[116] van Swaay, C. A. M. & Warren, M. S. 2003: Prime Butterfly Areas in Europe: Priority Sites for Conservation. National Reference Center for Agriculture, Nature and Fisheries, Ministry of Agriculture, Nature Management and Fisheries, Wageningen, Netherlands.

Figure 4 Map of Key Biodiversity Areas



6.5 Global bioregionalization

Global bioregionalization of all freshwater areas, marine areas and terrestrial areas has been carried out by WWF in cooperation with other NGOs, scientific bodies etc. Important data is provided but no areas of specific interest to biodiversity conservation (hotspots) are pointed out.

6.5.1 Freshwater Ecoregions of the World

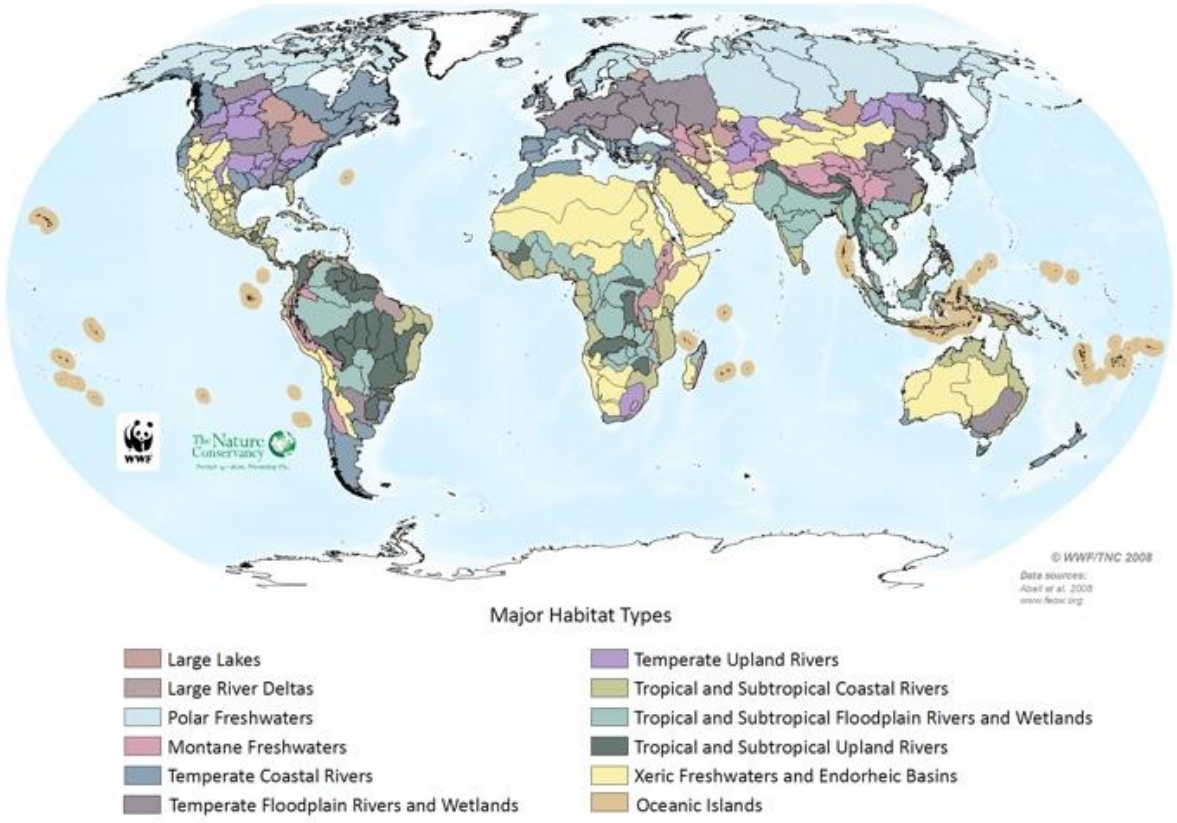
Freshwater Ecoregions of the World is a collaborative project coordinated by WWF and The Nature Conservancy. It provides the first global biogeographic regionalization of the Earth's freshwater biodiversity, and synthesizes biodiversity and threat data for the resulting ecoregions. A freshwater ecoregion is defined as a large area encompassing one or more freshwater systems that contains a distinct assemblage of natural freshwater communities and species. The freshwater species, dynamics and environmental conditions within a given ecoregion are more similar to each other than to those of surrounding ecoregions and form together a conservation unit. It should be underlined that the freshwater ecoregions cover virtually all freshwater habitats on Earth, not only regions of specific interest from a biodiversity conservation perspective which is the case for the Global Ecoregions concept, as seen in the preceding section (Figure 4).

Figure 5 shows the freshwater ecoregions of the world. Together with associated species data, the map will be a useful tool for underpinning global and regional conservation planning efforts. Particularly it will facilitate the identification of outstanding and imperilled freshwater systems and serve as a logical framework for large-scale conservation strategies.[117] [118]

[117] Abell, R. et al. 2008: Freshwater Ecoregions of the World: A New Map of Biogeographic Units for Freshwater Biodiversity Conservation. BioScience Vol 58 No. 5.

[118] www.feow.org

Figure 5 Map of Freshwater Ecoregions of the World



6.5.2 Marine Ecoregions of the World

A similar bioregionalization of coastal and shelf areas – Marine Ecoregions of the World – has also been carried out.[119] However, it is of limited relevance to the Diversity II Project and will not be further addressed in this report.

6.5.3 Terrestrial Ecoregions of the World

Various maps of terrestrial ecoregions have been produced during the last decade. Primarily, the "Terrestrial Major Habitat Types" should be mentioned.[120] However, it is of limited relevance to the Diversity II Project and will not be further addressed in this report.

6.6 Conclusions

This overview makes it clear that a great number of areas all over the world have been identified as having rich and valuable biodiversity. They constitute biodiversity hotspots sensu latu and fulfill the criteria for the selection of test or study areas established by the SoW. They also fulfill the criteria for area protection according to the CBD (see the report "Analyses of relevant CBD documents"). These areas represent various

[119] Spalding, M.D. et al. 2007: Marine Ecoregions of the World: A Bioregionalization of Coastal and Shelf Areas. BioScience Vol. 57 No. 7.

[120] http://wwf.panda.org/about_our_earth/ecoregions/about/habitat_types/selecting_terrestrial_ecoregions/

freshwater and dryland biomes and habitats, sizes, levels of documentation, status and trends of biodiversity, reasons for the selection, levels of protection etc. However, important habitat types show similarity of physical geography, vegetation structure etc. between different parts of the world, even if the species to a large extent are different. In the context of the selection of sites for the Diversity II Project, many areas singled out in the various hotspot identification processes therefore seem to be more or less interchangeable with each other.

A general conclusion is thus that in many cases more than one option exists for the selection of test or study areas as regards conditions on the ground. This means that sites with the most suitable EO-data can normally be selected as test or study areas for the Diversity II Project.

These conclusions are based on the purely scientific review and are complemented by the outcome of the User Consultation meeting in Sigtuna (26-28 June). In the discussion with the users it turned out that their focus is on ecological issues in the context of field validation of remotely-sensed data, but – for example – not on the selection of study sites for the Project. However, it should be noted that the site selection, both for dryland and inland water areas, up to now has been entirely in line with the conclusions. In this respect it was not possible to reach one main objective of the UCM, namely to understand requirements for biodiversity indicators, and develop concepts together with the users how to construct them. We should conclude that more discussions with users are necessary, in order to prepare them to understand the possibilities of remote sensing, and also to better understand their concerns.

Annex 1 Excerpt from Biodiversity Work Programme

Main features in Programme Element 3 of the REVISED PROGRAMME OF WORK ON INLAND WATER BIOLOGICAL DIVERSITY

Adopted by COP VII (2004)

PROGRAMME ELEMENT 3: KNOWLEDGE, ASSESSMENT AND MONITORING

Goal 3.1: To develop an improved understanding of the biodiversity found in inland water ecosystems, how these systems function, their ecosystem goods and services and the values they can provide

Objectives

(a) Develop an improved picture of the status and trends of the biological diversity of inland waters, its uses, taxonomy and threats and ensure adequate dissemination of this information.

(b) Establish, maintain and further develop expertise in inland water biological diversity and ecosystems.

Activities of the Parties

3.1.1. Encourage, and where possible support, applied research to gain an improved understanding of the status, trends, taxonomy and uses of biological diversity in inland water ecosystems, including transboundary systems where applicable.

3.1.2. Promote research to improve the understanding of the social, economic, political and cultural drivers within civil society that are directly impacting on the conservation and sustainable use of the biological diversity of inland waters.

3.1.3. In line with the Global Taxonomy Initiative (GTI) encourage studies aimed at improving the understanding of the taxonomy of the biological diversity of inland water ecosystems.

3.1.4. Support efforts to achieve international consistency and interoperability of taxonomic nomenclature, databases and metadata standards, as well as data-sharing policies.

3.1.5. As part of national communication, education and public awareness activities/programme (see goal 2.4), provide mechanisms for disseminating research findings to all relevant stakeholders, in a form which will be most useful to them. Make this same information available to the Executive Secretary for sharing with other Parties.

Supporting activities of the Executive Secretary

3.1.6. Strengthen working partnerships with appropriate organizations and institutions which undertake, or can assist in mobilizing, research efforts leading to an improved understanding of the biodiversity and functioning of inland water ecosystems, and the practical application of the ecosystem approach.

3.1.7. As part of the agreed PoW for the GTI, support and assist, in collaboration with suitable partners, the development of the series of regional guides to the taxonomy of freshwater fish and invertebrates (including adult terrestrial forms where appropriate) as an input to ecosystem monitoring for river and lake health.

3.1.8. Further develop methods and techniques for the valuation of goods and services of inland water ecosystems, incentives and policy reform, and the understanding of ecosystem function.

Main partners

IUCN, UNEP, WCMC, WRI, FAO, World Fisheries Trust.

Collaborators

WWAP, MA, FAO, GEO, GBIF, WRI, Conservation International, and other relevant international, regional and national organizations and stakeholders.

Goal 3.2: To develop, based on inventories, rapid and other assessments applied at the regional, national and local levels, an improved understanding of threats to inland water ecosystems and responses of different types of inland water ecosystems to these threats

Objectives

(a) Assessments and inventories of inland water biodiversity undertaken, including the urgent identification of stressed inland water ecosystems and those mentioned in Annex I of the Convention.

(b) Rapid assessments, using suitable indicators, being undertaken for inland water biodiversity, in particular in States where inland water ecosystems suffer from ecological disasters and urgent provision of support to develop and implement national strategies for the prevention and mitigation of ecological disasters in inland water ecosystem types.

(c) Build national capacity for undertaking the above-mentioned assessments through appropriate mechanisms.

See also goal 3.3 in relation to environmental, cultural and social impact assessments.

Activities of the Parties

3.2.1. In accordance with the priorities set down in national biodiversity strategies and action plans, undertake comprehensive national inventories and assessments of inland water biological diversity, which may be regarded as important. Furthermore, undertake assessments of threatened habitats and species, and conduct inventories and impact assessments of alien species in inland water ecosystems. The transboundary nature of many inland water ecosystems should be fully taken into account in assessments, and it may be appropriate for relevant regional and international bodies to contribute to such assessments.

3.2.2. Identify the most cost-effective approaches and methods to describe the status, trends and threats of inland waters and indicate their condition in functional as well as species terms.

3.2.3. Adopt an integrated approach in the assessment, management and, where possible, remedial actions of inland water ecosystems, including associated terrestrial and in-shore marine ecosystems. It should be noted that:

(a) Assessments should involve all stakeholders, including indigenous and local communities, should be cross-sectoral and should make full use of indigenous knowledge based on prior informed consent;

(b) Suitable organisms should be identified as being particularly important in the assessment of inland water ecosystems. Ideally, such groups (taxa) should meet the following criteria:

(i) The group should contain a reasonable number of species with varied ecological requirements;

(ii) The taxonomy of the group should be reasonably well understood;

(iii) The species should be easy to identify;

(iv) The group should be easy to sample or observe so that density - absolute or as indices - can be assessed, used objectively and treated statistically;

(v) The group should serve as indicators of overall ecosystem health or indicators of the development of a key threat to ecosystem health;

(c) In view of the great economic importance of some groups (e.g. inland water fish species and aquatic macro-invertebrates), and of the large gaps in taxonomic knowledge for many species, capacity-building in taxonomy should focus on inland water biodiversity of economic as well as ecological importance.

3.2.4. Apply the rapid assessment guidelines for national circumstances and adapt these as necessary to suit current and emerging priorities. Assessments should be simple, inexpensive, rapid and easy to use. Such rapid assessment programmes will never replace thorough inventories.

3.2.5. Seek the resources, opportunities and mechanisms to build national capacity for undertaking assessments and inventories.

3.2.6. Promote the development of criteria and indicators for the evaluation of the impacts on inland water ecosystems from both physical infrastructure projects and watershed activities,

including, *inter alia*, agriculture, forestry, mining and physical alteration, taking into consideration the natural variability of water conditions.

3.2.7. Promote, in close cooperation with indigenous and local communities, the development of global social indicators in accordance with decision VII/30 relevant to the implementation of the PoW on inland water biological diversity.

3.2.8. Develop means of identifying and protecting groundwater recharge areas, groundwater aquifers, and surface waters fed by groundwater discharges.

3.2.9. Assessments should be carried out with a view to implementing other articles of the Convention and, in particular, to addressing the threats to inland water ecosystems. Of particular importance is the undertaking of environmental impact assessments on biological diversity of development projects involving inland water ecosystems**.**

Supporting activities

3.2.10. Make available to Parties guidelines for rapid, simple, inexpensive, and easy-to-use assessments of inland water biological diversity, taking into account the different types of such ecosystems and regional considerations, and giving special consideration to the priority needs of States in which inland water ecosystems are suffering from ecological disasters.

3.2.11. In collaboration with the Ramsar Convention and other partners, make available to Parties guidance for:

(a) Undertaking national inventories and assessments of inland water biological diversity;

(b) The identification of stressed inland water ecosystems;

(c) The national elaboration of Annex I of the Convention on Biological Diversity in relation to biological diversity of inland waters;

(d) A list of indicators grouped as driver, state, impact, and response to pressures on biological diversity of inland water ecosystems.

3.2.12. Through continued collaboration with global and regional assessments including, but not restricted to, the WWAP, the MA, the FAO Fisheries Assessment, the GEO, the GBIF, the report on State of the World's Plant and Animal Resources and the IUCN Freshwater Biodiversity Assessment and Red List of Threatened Species, seek to advance the generation of information on status and trends of inland water biodiversity.

3.2.13. Make available to Parties information on the various global and regional assessments referred to in activity 3.2.10, and how these may offer information to support the implementation of national biodiversity strategies and action plans in relation to inland waters.

Main partners

Ramsar Secretariat and STRP of the Ramsar Convention, Conservation International.

Other collaborators

UNESCO (SIDS programme), WWAP, the MA and other relevant international, regional and national organizations.

Goal 3.3. To ensure projects and actions with the potential to impact negatively on the biological diversity of inland water ecosystems are subjected, in accordance with national legislation and where appropriate, to suitably rigorous impact assessments, including consideration of their potential impact on sacred sites and on lands and waters traditionally occupied or used by indigenous and local communities

Objectives

(a) Undertake environmental impact assessments, in accordance with national legislation and where appropriate, for all projects with the potential to impact on the biological diversity of inland water ecosystems, ensuring that these take into account the "inter-related socio-economic, cultural and human-health impacts, both beneficial and adverse".

(b) Conduct cultural, environmental, and socio-economic impact assessments, in accordance with national legislation and where appropriate, regarding developments proposed to take place on, or which are likely to impact on, sacred sites and on lands and waters traditionally occupied or used by indigenous and local communities.

Activities of the Parties:

3.3.1. Taking into account COP decision VI/7 A on guidelines for incorporating biodiversity-related issues into environmental impact assessment legislation and/or processes and in strategic environmental assessment, and decision COP VII/16, on Article 8(j) and related provisions:

(a) Apply environmental impact assessments on water-development projects, aquaculture and watershed activities, including agriculture, forestry and mining, and best predictions with well designed sampling schemes that can adequately distinguish the effects of anthropogenic activities from natural processes;

(b) Strengthen efforts to apply environmental impact assessments, not only of individual proposed projects, but also taking into account effects of existing and proposed developments on the watershed, catchment or river basin; and

(c) Incorporate, where appropriate, environmental flow assessments into impact assessment processes for any projects with the potential to have negative effects on inland water ecosystems, and also undertake baseline ecosystem assessments in the planning phase to ensure that the necessary basic data will be available to support the environmental impact assessment process and the development of effective mitigation measures if necessary.

3.3.2. Apply the recommendations for the conduct of cultural, environmental, and social impact assessments regarding developments proposed to take place on, or which are likely to impact on, sacred sites and on lands and waters traditionally occupied or used by indigenous and local communities.

3.3.3. For transboundary inland water ecosystems, undertake, where feasible and appropriate and by agreement between the Parties concerned, collaborative impact and environmental flow assessments when applying the Convention's guidelines for incorporating biodiversity-related issues into environmental impact assessment legislation and/or processes and in strategic environmental assessment.

Supporting activities of the Executive Secretary

3.3.4. Collaborate with the IAIA and other relevant organizations to contribute to the implementation of COP decision VI/7 A on further development and refinement of the guidelines, particularly to incorporate all stages of the environmental impact assessment processes taking into account the ecosystem approach.

3.3.5. Compile:

(a) Information on impact assessment and other methodologies that address inland water biological diversity issues in an adaptive management framework;

(b) Examples of the impacts of invasive alien species and of programmes used to control their introduction and mitigate negative consequences on inland water ecosystems especially at the watershed, catchment and river-basin level.

Main partners

IAIA, Ramsar Convention Secretariat and STRP, IUCN, Conservation International.

The Ramsar Secretariat is expected to share with the SCBD the resolutions of the eighth meeting of the Conference of the Contracting Parties to the Ramsar Convention concerning the guidelines for integrating biodiversity considerations into environmental impact assessment legislation and/or processes and in strategic impact assessment, annexed to decision COP VI/7 A.

Other collaborators

Other relevant international, regional and national organizations, interested Parties and stakeholders.

Goal 3.4. To introduce and maintain appropriate monitoring arrangements to detect changes in the status and trends of inland water biodiversity

Objective

Establish and maintain national monitoring programmes for the components of inland water biodiversity, paying particular attention to those requiring urgent conservation measures and those which offer the greatest potential for sustainable use.

Activities of the Parties

3.4.1. Introduce appropriate monitoring regimes based on the CBD and other guidance for priority inland water biodiversity and ecosystems in the first instance, taking into account the implementation of decisions COP VI/7 A-C on identification, monitoring, indicators and assessments and possible adoption by the COP VII of principles for developing and implementing national-level monitoring and indicators.

Supporting activities of the Executive Secretary

3.4.2. Develop a proposal on the establishment of monitoring programmes for inland water ecosystems taking into account existing guidance, including the Ramsar Convention guidance, relating to the establishment of monitoring programmes for wetland sites.

Lead partners

Ramsar Convention Secretariat and STRP

Other collaborators

Relevant international, regional and national organizations and stakeholders.

Annex 2 Relationships between biodiversity and the water cycle

Relationships between biodiversity and the water cycle

Extract from Document UNEP/CBD/COP/10/20 (compiled by the SCBD 2010)

The following should be observed in the implementation of the PoW on inland water:

- The relationship between biodiversity and the water cycle is indeed an important and neglected area. Whereas the role of ecosystems (primarily terrestrial vegetation and wetlands) and land use in sustaining water quality is relatively well known, the role of ecosystems and land use in regulating water availability (quantity) is a key area in terms of science needs and awareness. Reviews of the impacts of deforestation on flood risk are available but the role of forests in regulating longer-term water availability in particular requires further review;

- A growing body of evidence suggests that significant interactions are occurring between terrestrial vegetation (land-use changes) and water availability, examples include: projected tipping points in the South American water cycle through deforestation in the Amazon basin; a growing number of countries are reporting shifts in surface water availability due to vegetation loss (Nicaragua is one, and reported impacts there include reduced river flows sufficient to undermine hydropower generation and conversion of lowland forests to agriculture impacting montane cloud forest ecosystems); and, for example, land-cover change in the Mekong River basin, including deforestation, is now thought to be a major driver of change in Mekong River flows;

- A growing body of evidence indicates that human-induced changes in water availability are affecting terrestrial ecosystems – in particular forests. Some evidence and case-studies are available especially for forest-groundwater interactions;

- Studies might focus on land-cover in general, not just forests. For example, natural grasslands probably perform a similar function to forests in these regards. The important issue is land-cover change, including the role of natural vegetation *versus* agricultural crops in regulating green and blue water flows;

- Changes to local and regional water cycles have significant implications for ecosystem-service delivery from both terrestrial and wetland ecosystems, including carbon storage. But the relationship is a reciprocal one: for example, improved forest carbon stores might (but not necessarily) help sustain water availability (for both people and forests) but water loss from forest ecosystems (either through land-use changes or direct water use by humans) almost certainly can pose significant threats to carbon stores;

- In the short-term, vegetation changes may have more significant impacts than climate change on the water cycle and hence on services provided by ecosystems, although climate change could certainly be an additional stressor which drives ecosystems beyond tipping points.

Annex 3 Status and Trends of Biodiversity of Dry and Sub-Humid Lands

STATUS AND TRENDS OF BIODIVERSITY OF DRY AND SUB-HUMID LANDS

Extract from the "Report of the first meeting of the Ad Hoc Technical Expert Group on Dry and Sub-Humid Lands" (2002)

Summary of Dryland Characteristics

Drylands comprise a very wide range of natural habitats, ranging from barren deserts and semi-desert with xerophytic plants, to grasslands and savannah, and many different kinds of scrubland, woodlands and forests. Dryland biodiversity is unique in its adaptation to survive and thrive in a highly variable climate of low rainfall and prolonged dry periods. Two billion people (20% of the human population) rely on the resilience of dryland biodiversity to provide their daily needs.

The PoW agreed by the CBD COP in Decision V/23 covers the biological diversity of dryland, Mediterranean, arid, semi-arid, grassland and savannah ecosystems. When assessing and monitoring biodiversity the following characteristics of drylands need to be taken into account:

Biological diversity: Biological diversity assessed in terms of species number tends to be moderate in semi-arid areas and to decline to low or very low levels as aridity increases. In contrast to this general rule, diversity in some groups such as scorpions and other predatory arthropods, tereprionid beetles, ants, termites, snakes and lizards, and annual plants, tends at first to increase as aridity increases but to decrease at extreme desert conditions. Diversity at the genetic level in dryland species has been sampled very unevenly, but is well marked in some groups, particularly so in some desert plants where different forms of the same species may vary in karyotype or carbon metabolism.

Mediterranean ecosystems: Species richness and endemism in Mediterranean ecosystems is generally high, with countries around the Mediterranean basin holding some 25,000 vascular plants (10 % of the known vascular plants) of which around 60% are endemic.

Grassland and savannah ecosystems: Around 20 per cent of the Earth`s land surface supports grasslands of varying degree of naturalness from those that are in pristine state to those that are influenced to a greater extent by human activity. Natural grasslands and savannahs host very distinctive plant and animal communities where diversity tends to increase towards tropics. All these systems hold an array of native herbivores and these in turn support a number of high profile mammals and avian predators. The savannah communities of East Africa, for example, are typified by large herds of ungulate herbivores including more than 70 species of antelope and other medium to large sized bovids. At very fine spatial scales, natural grasslands can be among the most species-rich habitats on Earth. Up to 80 plant species have been identified in a square metre in the Central Asian steppe, and 42 plant species in a quarter of a square metre in pine savannah on the United States Atlantic Coastal Plain.

Desert species adaptations: True desert species show a wide range of adaptation to the extreme environment. Strategies for survival amongst both plants and animals often include long periods of dormancy punctuated with brief periods of high activity. Much interest is currently focused on identifying the genetic basis for drought tolerance, salt tolerance and other traits associated with stress conditions that could eventually be utilized to improve productivity in dryland agriculture.

Species associated with humans: Dry and sub-humid ecosystems are the centres of origin of many major crops including wheat, barley, sorghum, millet, many pulses, and cotton. They are also ecosystems in which are naturally found animals that have become closely linked to the development of human civilizations, including

the horse, sheep, goats, cattle, camel and lama. Our human past has therefore relied significantly on the biodiversity of dry lands.

Threatened species: At present data is insufficient to determine whether species in drylands are relatively more or less prone to extinction than elsewhere. However, in general dryland mammals tend to be relatively wide ranging but to occur at low population densities. Summary analysis of the habitat distribution of globally threatened mammals and birds shows that drylands, scrublands and grasslands make up the second most important group of threatened species of mammals, and a high percentage of continental species believed or known to have become extinct since 1600 occurred in dry land ecosystems. Some critically endangered dryland species are listed in the *Global Biodiversity Outlook*.

Surveys of species biodiversity: Most surveys in the drylands have been concentrated on species composition and abundance within habitats (alpha diversity), between habitats (beta diversity) and between regions, each of which is made of many habitats (gamma diversity). The ability of the flora and fauna of drylands to bounce back after dry spells calls for long-term series of habitat monitoring to ascertain degradation of gamma, beta and alpha diversity in the context of permanent desertification.

Threats: Humans have an enormous impact on dryland, grassland and Mediterranean ecosystems, often with major negative impacts on biodiversity. These impacts are often complex and interrelated, and may lead to land degradation and desertification. This tends to promote poverty, resulting in even greater stress on natural resources.

Proposed Action/Recommendations

The following includes:

- Actions that need to be undertaken by the AHTEG members and the CBD Secretariat over the next few months in order to better focus future development and implementation of the PoW on dry and sub-humid lands (Decision V/23); and
- Preliminary recommendations on how the PoW might be further elaborated and/or implemented.

1. Review of existing assessments

Carry out a review of existing assessments and assessment processes to assess the extent to which they adequately and systematically cover all biodiversity levels and components, all conservation actions and threats, and all geographical areas relevant to the PoW on dry and subhumid lands.

Those studies which would be reviewed include: MA; GEO; CGIAR system and SINGER; FAO Domestic Animals Information Network; UNESCO MAB programme; Asia-Pacific Network of IGBP; LADA; UNCCD TPNs; UNEP-GRID activities.

Outputs of this review would include:

- Summary of coverage as identified above
- Identification of the extent to which dryland-relevant information can be extracted
- Preliminary recommendations on adaptation of existing surveys to meet needs
- Identification of gaps
- Identification of examples/case studies where adequate information is not available

2. Periodic drylands assessment

Once the review of assessments is complete, consideration should be given as to whether a period drylands assessment needs to be carried out in similar manner to the Forest Resources Assessment carried out by FAO and UNECE. This should also take into account the current work on harmonization of assessments initiated by UNEP.

3. Simple presentation of assessment results

In order to increase accessibility of the results of assessments, consideration also needs to be given to presentation of some of the results of such assessments in simpler forms in order to guide decisions and to promote understanding of dryland issues. For example in a series of posters or maps concerning key issues.

4. Completion of gap relating to human use issues

There is a concern that existing assessments of status and trends of dryland biodiversity do not take adequate account of biodiversity linked to human development. This includes the biodiversity of crop plants and animal feeds, *ex-situ* collections, and the manner in which human conversion of dryland habitats impacts on these resources directly relevant to human development. It is noted that much of this information already exists, and can be readily compiled.

5. Areas of particular value to biodiversity

Also with assessments, particular attention might need to be paid to the areas of particular value for biodiversity identified by the liaison/contact group established by the secretariats of CBD and UNCCD. These are: rangelands; desert margins; species "hot spots"; protected areas; parklands/croplands; dryland forests; and wetlands and oases.

6. Voluntary national report

It is recommended that consideration be given to asking Contracting Parties to submit voluntary national reports on dryland issues.

7. Assessment at regional and national levels

It was agreed that while that international community could direct and carry out assessments of status and trends at the global level, at regional, sub-regional and national levels it was more appropriate to provide guidance where necessary, and to strongly promote the sharing of information and collaboration in information management and assessment.

8. Use of indicators at the national level

It was noted that indicators were likely to be most effective when focused on specific planning and management needs in key thematic areas. It was also noted that indicators needed to address a wide range of issues also beyond status and trends of biodiversity, including *inter alia* threats and pressures, use and sustainability, economic values and imperatives, etc. A range of existing SBSTTA and COP papers are relevant to this work.

It was agreed that it was important to promote the development and testing of indicators at the national level, and to promote the sharing of experience. This might include the compilation of case studies from Contracting Parties, or the extension of existing work in this area (such as the GEF funded project working with national level indicators relevant to other CBD programmes of work).

9. Use of indicators at the global level

There are clear concerns about the use of global level indicators because of the potential political problems of defining and using them. Such indicators are of no use unless they are practicable, feasible and applicable both technically and politically, and there is no point taking time and effort to develop and test them unless it is clear

what the resulting indicators will be used to achieve. It was noted, however, that there are examples of areas where indicators or early warning at an international level are acceptable and used, for example in early warning of locusts.

The group recognized that there was already work in this area under way under the auspices of the UNCCD, and proposed that consideration be given to working with the UNCCD *ad hoc* panels on benchmarks and indicators and on monitoring and early warning systems to investigate how work with them might incorporate issues relevant to biodiversity concerns including habitat loss and water availability.

10. Public awareness and education

The group emphasized the importance of recognizing both good and bad messages coming out of assessment and indicator programmes, and using these in public awareness programmes. It was noted that this was particularly the case for good messages.

11. Capacity development

It was agreed that capacity development in information management and use was often needed, but that often the necessary skills and information were already available in country but not focused on the needs. Capacity development in this area needs to take the form of facilitation and guidance.

Annex 4 Section IV of Strategic Plan

Section IV in The Strategic Plan for Biodiversity 2011-2020 and the Aichi Biodiversity Targets

IV. STRATEGIC GOALS AND THE AICHI BIODIVERSITY TARGETS

The Strategic Plan includes 20 headline targets for 2015 or 2020 (the "Aichi Biodiversity Targets"), organized under five strategic goals. The goals and targets comprise both: (i) aspirations for achievement at the global level; and (ii) a flexible framework for the establishment of national or regional targets. Parties are invited to set their own targets within this flexible framework, taking into account national needs and priorities, while also bearing in mind national contributions to the achievement of the global targets. Not all countries necessarily need to develop a national target for each and every global target. For some countries, the global threshold set through certain targets may already have been achieved. Others targets may not be relevant in the country context.

Strategic goal A. Address the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society

***Target 1*:** By 2020, at the latest, people are aware of the values of biodiversity and the steps they can take to conserve and use it sustainably.

***Target 2*:** By 2020, at the latest, biodiversity values have been integrated into national and local development and poverty reduction strategies and planning processes and are being incorporated into national accounting, as appropriate, and reporting systems.

***Target 3*:** By 2020, at the latest, incentives, including subsidies, harmful to biodiversity are eliminated, phased out or reformed in order to minimize or avoid negative impacts, and positive incentives for the conservation and sustainable use of biodiversity are developed and applied, consistent and in harmony with the Convention and other relevant international obligations, taking into account national socio-economic conditions.

***Target 4*:** By 2020, at the latest, Governments, business and stakeholders at all levels have taken steps to achieve or have implemented plans for sustainable production and consumption and have kept the impacts of use of natural resources well within safe ecological limits.

Strategic goal B. Reduce the direct pressures on biodiversity and promote sustainable use

***Target 5*:** By 2020, the rate of loss of all natural habitats, including forests, is at least halved and where feasible brought close to zero, and degradation and fragmentation is significantly reduced.

***Target 6*:** By 2020 all fish and invertebrate stocks and aquatic plants are managed and harvested sustainably, legally and applying ecosystem based approaches, so that overfishing is avoided, recovery plans and measures are in place for all depleted species, fisheries have no significant adverse impacts on threatened species and vulnerable ecosystems and the impacts of fisheries on stocks, species and ecosystems are within safe ecological limits.

***Target 7*:** By 2020 areas under agriculture, aquaculture and forestry are managed sustainably, ensuring conservation of biodiversity.

***Target 8*:** By 2020, pollution, including from excess nutrients, has been brought to levels that are not detrimental to ecosystem function and biodiversity.

Target 9**:** By 2020, invasive alien species and pathways are identified and prioritized, priority species are controlled or eradicated, and measures are in place to manage pathways to prevent their introduction and establishment.

Target 10**:** By 2015, the multiple anthropogenic pressures on coral reefs, and other vulnerable ecosystems impacted by climate change or ocean acidification are minimized, so as to maintain their integrity and functioning.

Strategic goal C: Improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity

Target 11**:** By 2020, at least 17 per cent of terrestrial and inland water areas, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes.

Target 12**:** By 2020 the extinction of known threatened species has been prevented and their conservation status, particularly of those most in decline, has been improved and sustained.

Target 13**:** By 2020, the genetic diversity of cultivated plants and farmed and domesticated animals and of wild relatives, including other socio-economically as well as culturally valuable species, is maintained, and strategies have been developed and implemented for minimizing genetic erosion and safeguarding their genetic diversity.

Strategic goal D: Enhance the benefits to all from biodiversity and ecosystem services

Target 14**:** By 2020, ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being, are restored and safeguarded, taking into account the needs of women, indigenous and local communities, and the poor and vulnerable.

Target 15**:** By 2020, ecosystem resilience and the contribution of biodiversity to carbon stocks has been enhanced, through conservation and restoration, including restoration of at least 15 per cent of degraded ecosystems, thereby contributing to climate change mitigation and adaptation and to combating desertification.

Target 16**:** By 2015, the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization is in force and operational, consistent with national legislation.

Strategic goal E. Enhance implementation through participatory planning, knowledge management and capacity building

Target 17**:** By 2015 each Party has developed, adopted as a policy instrument, and has commenced implementing an effective, participatory and updated national biodiversity strategy and action plan.

Target 18**:** By 2020, the traditional knowledge, innovations and practices of indigenous and local communities relevant for the conservation and sustainable use of biodiversity, and their customary use of biological resources, are respected, subject to national legislation and relevant international obligations, and fully integrated and reflected in the implementation of the Convention with the full and effective participation of indigenous and local communities, at all relevant levels.

Target 19**:** By 2020, knowledge, the science base and technologies relating to biodiversity, its values, functioning, status and trends, and the consequences of its loss, are improved, widely shared and transferred, and applied.

Target 20**:** By 2020, at the latest, the mobilization of financial resources for effectively implementing the Strategic Plan for Biodiversity 2011-2020 from all sources, and in accordance with the consolidated and agreed

process in the Strategy for Resource Mobilization, should increase substantially from the current levels. This target will be subject to changes contingent to resource needs assessments to be developed and reported by Parties.

Annex 5 Exec Summary of Adequacy of Biodiversity

Executive Summary of the ”ADEQUACY OF BIODIVERSITY OBSERVATION SYSTEMS TO SUPPORT THE CBD 2020 TARGETS”

This report constitutes the first attempt to assess the adequacy of global observation systems for the monitoring of biodiversity, specifically in relation to the information needs of the twenty ‘Aichi targets’ defined by the Convention on Biological Diversity (CBD) for the period 2011–2020. The report was prepared, at the request of the CBD, by the Group on Earth Observations Biodiversity Observation Network (GEO BON) in collaboration with a range of biodiversity-related organisations, and is based on inputs from over 120 specialists.

Strategic goal A of the CBD addresses the drivers of biodiversity change. The global adequacy of existing systems for quantifying Targets 1, 2 and 3 under this goal, relating to public awareness, the valuation of biodiversity and the presence of biodiversity-damaging policies respectively, is low. The presence of some national or regional observation system and databases, and work in nonbiodiversity fields suggest that an adequate observation system could be achieved for these targets within five years. The fourth target on sustainable consumption already has some global observation systems, with potential for improvement.

Goal B contains five targets related to the state of biodiversity. All have significant global-scale observation systems, typically with national or better resolution, already in place. There are deficiencies in the evenness of global coverage and data quality, and some of the observations are too narrow in scope, but in the opinion of the experts, fit-for-purpose adequacy is technically achievable in all cases if sufficient resources are made available.

Goal C contains three targets that look at the effectiveness of actions taken to protect biodiversity. Global observation systems with national resolution exist for all three. Ongoing, but relatively minor and well-understood improvements to the observations are needed to bring them to full adequacy, especially with respect to accompanying data in Target 11 (on protected areas) and taxonomic coverage in Targets 12 (threatened species) and 13 (genetic diversity of valuable species).

Goal D contains seven somewhat diverse targets relating to the benefits derived from biodiversity. Target 14 (ecosystem services) does not yet have a globally adequate observation system, but is rapidly working towards one for key services. Target 15 seeks to relate biodiversity and climate change in both directions. Observation systems are technically feasible and some global-scale databases exist that could serve as pilots.

Goal E contains Targets 16 to 20 which largely relate to the CBD mechanisms. No observation systems currently exist, but achieving adequacy should in principle be relatively straightforward. In some cases (e.g. Target 16 on access and benefit-sharing) the basis for an information-gathering system are planned to emerge from the coming into force of a protocol. In others, the information should be part of national submissions to the CBD, but an information extraction process and database mechanism is yet to be developed.

There is fair alignment between the biodiversity observation needs determined from the Aichi targets, those derived from the GEO BON implementation plan, and those identified by the biodiversity observation community as essential biodiversity variables, with some exceptions. The GEO BON and essential variables approaches underemphasise social, economic and policy observations, while the Aichi targets call for less detail and sustained accuracy of biological observations than is required by the research community.

Annex 6 Excerpts from the ”Critical review …”

Excerpts from the ”Critical review of the assessment landscape for biodiversity and ecosystem services” (Document IPBES/1/INF/8)

The message of the review is summarized in the following so called key lessons:

1. While many assessments exist or are under way, there remain substantial gaps in coverage both geographically and thematically, and in the extent to which assessments address the interests and needs of different sectors.
2. Ensuring that assessments from different scales can be effectively aggregated together in meaningful ways requires further consideration, in particular with respect to development of the conceptual framework.
3. All the main assessments to date have used conceptual frameworks to guide and facilitate their work, supporting a common approach and language amongst the assessment practitioners and contributors and across scales, and underpinning both the work programmes of assessments, and also their communications.
4. Conceptual frameworks also provide a valuable means of comparing one assessment process with another, allowing for both comparison, increased understanding of environmental issues, and sharing of findings.
5. When capacity-building is integrated into the assessment process it can broaden and enhance participation, as well as leading to development of capacity to perform assessments on an ongoing basis. Specific approaches include ensuring ability to participate, sharing experience and guidance, facilitating national level assessments that contribute to global and regional assessments as well as national needs, and effective involvement of regional centres of excellence.
6. Integrating input from diverse knowledge systems is essential to understanding complex social-ecological issues, and knowledge holders from a diversity of knowledge systems should be included at all levels of the assessment process.
7. Development of a ‘dual or multiple evidence base’ which has been validated in an appropriate way will help achieve integration of input from diverse knowledge systems in an effective manner.
8. Use of scenarios in assessments can be very effective in understanding and helping to communicate assessment outcomes, but there may be opportunities for greater dialogue between individuals and institutions involved in assessments and other processes developing and using scenarios to allow for consistency and lesson learning.
9. Application of a combination of explorative and policy-orientated scenario approaches might be considered in assessments, together with full engagement of user groups and effective communication, as a means of strengthening scenarios exercises.
10. Indicators and metrics are widely used as a means for illustrating trends, and can be a powerful means for communication.
11. Given that indicators and metrics are already widely used, and that the CBD is actively reviewing indicators for assessing achievement of the Aichi Biodiversity Targets, it seems appropriate to collaborate rather than risk duplication and the potential for delivering mixed messages.
12. While assessments have obtained their authorising environments from a range of different bodies, those mandated by governments and/or intergovernmental processes are generally more closely aligned with the needs of decision makers, and thus have a ‘receiving environment’ for the findings.
13. The full and effective engagement of stakeholders at all stages in an assessment process helps to ensure the credibility, relevance and legitimacy of an assessment, and increases the extent to which assessment findings are reflected in decision making.
14. The stakeholder group on which the heaviest onus tends to fall is the experts from the scientific and other knowledge communities who provide the major input, contribute to and edit chapters, and review

the resulting outputs. It is important to have the necessary incentives in place to ensure that they are able to engage.

15. While many assessments appear to have significant policy impact, this is not usually assessed in a systematic or critical manner. In developing IPBES assessments consideration needs to be given to how policy impacts will be assessed.
16. Identifying knowledge gaps and capacity needs are important elements of the assessment process, providing these gaps and needs are clearly communicated so that they can be addressed either as part of the assessment process or as a result of it.

The report also contains an overview of a number of global scenario studies[121] summarized in the following table:

	Key reference + website	**Focus**	**Key issues focused at**	**Policy process in focus**	**Approach**
Global Scenario Group	http://www.gsg.org/ (Raskin etal.,2002)	Sustainable develop-ment	Multiple	Not explicit	Strong focus on storyline, supported by quantitative accounting system
IPCC–SRES	www.ipcc.ch/ipccreports/sres/ emission (Nakicenovic et al.,2000)	Greenhouse gas emissions	Energy, land use, emissions	UNFCCC and climate policies of national governments	Modeling supported by simple storylines. Multiple models elaborate the same storyline to map out uncertainties
IPCC-TAR AR4	www.ipcc.ch (IPCC, 2001, 2007)	Climate change, causes and impacts	Climate, energy, land use, emissions	UNFCCC and climate policies of national governments	Summary of scenario literature
UNEP GEO3/4	www.unep.org/geo (UNEP, 2002,2007)	Global environmen-tal change	All international environment -tal issues	Environmental policies of national governments and UNEP	Storylines and modeling on the basis of linked models
MA	www.millenniumassessment.org (MA, 2005)	Ecosystem services	Ecosystems and drivers	Various international conventions, and national governments	Storylines and modeling; modeling on the basis of linked models
FAO AT 2030/2050	ftp.fao.org/docrep/fao/009/a0607e/a0607e00.pdf (FAO, 2006)	Agriculture	Agriculture trends and policies	Agricultural policies of national governments	Single projection, mostly based on expert judgment
CA	www.iwmi.cgiar.org/assessment (CA, 2007)	Water and agriculture	Water use, agriculture	Agricultural policies of national governments	Storylines and modeling; modeling on the basis of linked models
IAASTD	www.agassessment.org (Watson, 2008)	Agriculture	Develop-ment, R&D, agriculture	Agricultural policies of national governments	Baseline and alternative scenarios; modeling on the basis of linked models
IEA-WEO	www.worldenergyoutlook.org (IEA, 2008)	Energy	Energy, energy security, climate	Energy and climate policy of national governments	Baseline and alternative scenarios

121 Extracted with permission from van Vuuren et al. (in press)

World Water Develop-ment Report	www.unesco.org/water/wwap	Water, environmen-tal problems and develop-ment	Drivers of change, use of resources, state of resources, options to respond to a changing world	All levels including non-governmental bodies	24 UN agencies; coordination by WWAP (UNESCO); input in writing teams from universities, individual experts, professional organisations, NGOs

Annex 7 Possible Indicators for the Aichi Biodiversity Targets

Possible Indicators for the Aichi Biodiversity Targets[122]

Strategic Goal A. Address the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society

Aichi Target	**Possible Indicators (Parenthesis = new indicator)**
1. By 2020, at the latest, people are aware of the values of biodiversity and the steps they can take to conserve and use it sustainably.	(Number of opinion and awareness surveys) (Number of education programmes or materials) (Number of visits to museums, parks) (Number of programmes for citizen led actions)
2. By 2020, at the latest, biodiversity values have been integrated into national and local development and poverty reduction strategies and planning processes and are being incorporated into nation accounting, as appropriate, and reporting systems.	(Number of countries with PRSP/NDP incorporating biodiversity) (Number of countries with biodiversity reflected in national statistics) (Number of companies/market share with biodiversity friendly practices) (Stocks and flows of natural capital)
3. By 2020, at the latest, incentives, including subsidies, harmful to biodiversity are eliminated, phased out or reformed in order to minimize or avoid negative impacts and positive incentives for the conservation and sustainable use of biodiversity are developed and applied, consistent and in harmony with the Convention and other relevant international obligations, taking into account national socio-economic conditions.	(Value of subsidies harmful to biodiversity) (Successful conclusion of WTO negotiations on fishery subsidies and on agricultural domestic support)
4. By 2020, at the latest, Governments, business and stakeholders at all levels have taken steps to achieve or have implemented plans for sustainable production and consumption and have kept the impacts of use of natural resources well within safe ecological limits.	Ecological footprint and related concepts (Number of sectors, by country and company, with management plans incorporating biodiversity) (Number of plans with clear and measurable targets) (Number of countries with SEA tools including biodiversity, and their application at multiple levels of government)

[122] Excerpts from Document UNEP/CBD/COP/10/27/Add.1

Strategic Goal B. Reduce the direct pressures on biodiversity and promote sustainable use

Aichi Target	**Possible Indicators (Parenthesis = new indicator)**
5. By 2020, the rate of loss of all natural habitats, including forests, is at least halved and where feasible brought close to zero, and degradation and fragmentation is significantly reduced.	Trends in extent of selected biomes, ecosystems and habitats Trends in abundance and distribution of species Connectivity/ fragmentation of ecosystems Proportion of products from sustainable sources The incidence of human-induced ecosystem failure
6. By 2020, all fish and invertebrate stocks and aquatic plants are managed and harvested sustainably, legally and applying eco-system based approaches, so that overfishing is avoided, recovery plans and measures are in place for all depleted species, fisheries have no significant adverse impacts on threatened species and vulnerable ecosystems and the impacts of fisheries on stocks, species and ecosystems are within safe ecological limits.	Marine trophic index Distribution and abundance of fish species Proportion of products derived from sustainable sources (Proportion of collapsed species) (Fisheries catch) (Catch per unit effort) (Proportion of stocks overexploited)
7. By 2020, areas under agriculture, aquaculture and forestry are managed sustainably, ensuring conservation of biodiversity.	Area of forest, agricultural and aquaculture ecosystems under sustainable management Proportion of products derived from sustainable sources Trends in genetic diversity of domesticated animals, cultivated plants and fish species of major socioeconomic importance The ecological footprint and related concepts (Use of good agricultural practices)
8. By 2020, pollution, including from excess nutrients, has been brought to levels that are not detrimental to ecosystem function and biodiversity.	Nitrogen deposition Water quality in aquatic ecosystems Ecological footprint and related concepts, Human-induced ecosystem failure (Total nutrient use, nutrient loading in fresh-water and marine areas) (Incidence of hypoxic zones and algal blooms)
9. By 2020, invasive alien species and pathways are identified and prioritized, priority species are controlled or eradicated and measures are in place to manage pathways to prevent their introduction and establishment.	Trends in invasive alien species The Red List Index for impacts of invasive alien species (Number of countries with national invasive species strategies and action plans) (Number of countries which have ratified relevant international agreements and standards)
10. By 2015 the multiple anthropogenic pressures on coral reefs, and other vulnerable ecosystems impacted by climate change or ocean acidification are minimized, so as to maintain their integrity and functioning	Trends in extent of selected biomes, ecosystems and habitats (% live coral, bleaching) The marine trophic index The incidence of human-induced ecosystem failure Health and well-being of communities who depend directly on local ecosystem services

Strategic Goal C. Improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity

Aichi Target	**Possible Indicators (Parenthesis = new indicator)**
11. By 2020, at least 17 per cent of terrestrial and inland water areas and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well-connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscape and seascape.	Coverage of protected areas Management effectiveness of protected areas Trends in extent of selected biomes, ecosystems and habitats Water quality in aquatic ecosystems Connectivity/ fragmentation of ecosystems The marine trophic index The overlay of protected areas with ecoregions
12. By 2020 the extinction of known threatened species has been prevented and their conservation status, particularly of those most in decline, has been improved and sustained.	Change in status of threatened species Protected area coverage (Proportion of known threatened species protected)
13. By 2020, the genetic diversity of cultivated plants and farmed and domesticated animals and of wild relatives, including other socio-economically as well as culturally valuable species is maintained and strategies have been developed and implemented for minimizing genetic erosion and safeguarding their genetic diversity.	Trends in genetic diversity of domesticated animals, cultivated plants, and fish species of major socio-economic importance (Number of genebank accessions) (*Ex-situ* crop collections)

Strategic Goal D. Enhance the benefits to all from biodiversity and ecosystem services

Aichi Target	**Possible Indicators (Parenthesis = new indicator)**
14. By 2020, ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being, are restored and safeguarded, taking into account the needs of women, indigenous and local communities and the poor and vulnerable.	Connectivity/fragmentation of ecosystems Health and well-being of communities who depend directly on local ecosystem services Biodiversity used in food and medicine Incidence of human-induced ecosystem failure (Status and trends of land use in indigenous peoples' territories) (Status and trends in the practice of traditional occupations)
15. By 2020, ecosystem resilience and the contribution of biodiversity to carbon stocks has been enhanced, through conservation and restoration, including restoration of at least 15% of degraded ecosystems, thereby contributing to climate change mitigation and adaptation and to combating desertification.	Trends in extent of selected biomes, ecosystems, and habitats Trophic integrity of other systems (Storage of carbon and other GHG (using UNFCCC inventories supplemented by scientific assessments)) (Assessment of vulnerability and adaptive capacity)
16. By 2015, the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization is in force and operational, consistent with national legislation.	Access and benefit-sharing (Number of countries Party to international regime, ITPGRFA) (Number of national ABS frameworks, legislation) (Number of ABS agreements) (Number of technical assistance programmes) (Value of benefits shared)

Strategic Goal E. Enhance implementation through participatory planning, knowledge management and capacity-building

Aichi Target	**Possible Indicators (Parenthesis = new indicator)**
17. By 2015, each Party has developed, adopted as a policy instrument, and has commenced implementing, an effective, participatory and updated national biodiversity strategy and action plan.	(Number of countries with revised NBSAPs) (Number of stakeholders participating in the revision progress) (Assessment of NBSAP implementation)
18. By 2020, the traditional knowledge, innovations and practices of indigenous and local communities relevant for the conservation and sustainable use of biodiversity, and their customary use of biological resources, are respected, subject to national legislation and relevant international obligations, and fully integrated and reflected in the implementation of the Convention with the full and effective participation of indigenous and local communities, at all relevant levels.	(Number of countries using biodiversity indicators and the extent of their data coverage) (Number of cases technical assistance to developing countries) (Number of countries with national CHM websites) (Visitors/per year at each national CHM websites) (Quality of web content and on-line services) (Use of biodiversity information in the fifth and sixth national reports)
19. By 2020, knowledge, the science base and technologies relating to biodiversity, its values, functioning, status and trends, and the consequences of its loss, are improved, widely shared and transferred, and applied.	(Number of countries using biodiversity indicators and the extent of their data coverage) (Number of cases technical assistance to developing countries) (Number of countries with national CHM websites) (Visitors/per year at each national CHM websites) (Quality of web content and on-line services) (Use of biodiversity information in the fifth and sixth national reports)
20. By 2020, at the latest, the mobilization of financial resources for effectively implementing the Strategic Plan for Biodiversity 2011-2020 from all sources and in accordance with the consolidated and agreed process in the Strategy for Resource Mobilization should increase substantially from the current levels. This target will be subject to changes contingent to resources needs assessments to be developed and reported by Parties	Official Development Assistance provided in support of the Convention (Number of officials and experts qualified on biodiversity related matters)

Annex 8 INDICATORS FOR THE STRATEGIC PLAN FOR BIODIVERSITY 2011-2020

INDICATORS FOR THE STRATEGIC PLAN FOR BIODIVERSITY 2011-2020

(Executive Summary of the Report of the AHTEG on Indicators for the Strategic Plan for Biodiversity 2011 – 2020)

"Pursuant to the request in decision X/7 (paragraph 5) the Executive Secretary convened an Ad hoc Technical Expert Group (AHTEG) meeting to provide guidance for monitoring the implementation of the Strategic Plan for Biodiversity 2011-2020. The meeting was held at Uplands Conference Centre in High Wycombe, Bucks, United Kingdom from 20 to 24 June 2011. From 20 to 22 June the Ad Hoc Technical Expert Group was supported by an International Expert Meeting.

The Group agreed that a framework for communicating biodiversity information should respond to the following questions: How is the status of biodiversity changing? (*state* – broadly relating to Strategic Goal C); Why are we losing biodiversity? (*pressures and underlying causes* – broadly relating to Strategic Goal B); What are the implications? (*benefits* – broadly relating to Strategic Goal D); and What do we do about it? (*responses* – broadly relating to Strategic Goals A and E). The group also noted that the Aichi Biodiversity Targets of the Strategic Plan for Biodiversity 2011-2020 imply responses at multiple levels.

The Group developed a set of 12 headline indicators around these questions, under which operational indicators could be organized (e.g. for communication to decision-makers), noting that each headline indicator covers several sub-topics for which distinct metrics are required. The Group listed a number of operational indicators and categorized them as: A - global priority and ready for use (22 indicators); B - priority for development at global level (36 indicators); C - for consideration at sub-global level (39 indicators). The list of indicators that is not considered to be a priority globally could be expanded, taking into account ongoing processes of partner organizations and the experience of Parties at regional, national and sub-national levels. The global priority lists A and B could be further refined and could also be reviewed periodically to allow for adjustments in line with other processes. A table providing further details about the operational indicators is accessible from http://www.cbd.int/doc/meetings/ind/ahteg-sp-ind-01/official/ahteg-sp-ind-01-03-add1-en.xls.

The indicators previously agreed for assessing progress towards the 2010 target of a significant reduction in the rate of biodiversity loss (decisions VII/30 and VIII/15) should continue to be developed and used with minor modifications.

It will be essential that countries with limited capacities for developing and applying indicators based on national data and monitoring are enabled to carry out the monitoring activities that are considered a priority at national level. This will imply the need for financial resources and technical support. The organizations involved in the Biodiversity Indicators Partnership and in the Group on Earth Observations Biodiversity Observation Network (GEO BON) could have a key role in assisting countries to develop appropriate monitoring programmes and indicators, subject to the availability of financial resources.

In accordance with decision X/2, Parties to the Convention have committed to reporting information on progress made towards targets adopted at the national level in their fifth national report which is due in March 2014. The strategic goals, Aichi Biodiversity Targets and proposed indicator framework provide a flexible framework for Parties to be adapted taking into account national priorities and circumstances. For most headline indicators it would be expected that countries will use different metrics and methodologies for their indicators depending on national targets and available data and methods. Where quantitative trend information relating to themes and headline indicators is reported by Parties it could be aggregated globally in the form of qualitative change (e.g. number of indicators showing improving trends). Where a significant number of countries use comparable data and methods a quantitative analysis of trends may be possible.

The Group concluded that there is a reasonably good basis for monitoring biodiversity globally but that significant investments will be necessary to enable countries with limited capacities to establish adequate biodiversity monitoring systems and indicators."

Annex 9 Excerpt from the Report of the AHTEG on Indicators for the Strategic Plan for Biodiversity

Excerpt from the Report of the AHTEG on Indicators for the Strategic Plan for Biodiversity 2011-2020

OBSERVATIONS AND RECOMMENDATIONS FROM THE GROUP

Use of indicators for the Strategic Plan, including framework and proposed global indicators

1. The Conference of the Parties requested the Ad Hoc Technical Expert Group on Indicators for the Strategic Plan for Biodiversity 2011-2020 to suggest indicators that have been, or could be, developed, where necessary, to constitute a coherent framework designed to assess progress towards targets of the Strategic Plan for Biodiversity 2011-2020 (decision X/7, paragraph 5 (b)).

2. In considering this issue the Group noted that the suite of indicators for the Strategic Plan for Biodiversity fulfils multiple purposes:

(a) They help to change the way in which decisions are made: a small number of easily understood indicators that have a high impact would be particularly suitable for this purpose;

(b) They serve to assess progress in the achievement of the Strategic Plan for Biodiversity 2011-2020 at the global level;

(c) They assist Parties to monitor and review the implementation of their national biodiversity strategies and action plans in accordance with the Strategic Plan and their national targets, including at sub-national level as appropriate; and

(d) They may serve as a tool for promoting synergies and mainstreaming between biodiversity-related multilateral agreements, with other sectors and with the emerging Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES).

3. For each of these purposes a different sub-set of the indicators would be particularly well suited.

4. The meeting agreed that the framework to monitor progress towards the implementation of the Strategic Plan for Biodiversity 2011-2020 and the Aichi Biodiversity Targets should be scientifically sound, that is provide logical linkages between its elements that enable coherent analyses, but also easy to communicate. In addition the meeting observed that the framework should be flexible enough to facilitate its use at the sub-global level and by different stakeholders.

5. To ensure its work was policy relevant the Group focused on four overarching policy questions which link to the goals of the Strategic Plan and which are loosely based on the DPSIR (driver-pressure-state-impact-response) model (see conceptual model in Appendix I). The questions are:

(a) How is the status of biodiversity changing? (*state*);

(b) Why are we losing biodiversity? (*pressures and underlying causes*);

(c) What are the implications of biodiversity loss? (*benefits*);

(d) What do we do about biodiversity loss? (*responses*).

6. For each of the policy questions a series of headline indicators were developed in order to structure the information required to provide the answers to policymakers, linking to the goals of the Strategic Plan. In total 12 headline indicators where developed around these questions, under which operational indicators could be organized (e.g. for communication to decision-makers), noting that each headline indicator covers several sub-topics for which distinct metrics are required. The sub-topics cover key issues which it will be important to monitor and communicate in order to assess and report on the state of progress towards the 2020 Mission of the Strategic Plan (see the relationship between the headline indicators and indicator sub-topics in Appendices II and IV). Each of the 12 headline indicators has at least one, but in most cases several operational indicators associated with it. The operational indicators are the metrics, methods and analytical frameworks through which progress will actually be measured (See Appendix III). The meeting determined that some operational indicators may be relevant and capable of application at all scales (global – regional – national - sub-national), whereas others are relevant or limited by data to particular scales. The meeting developed a list of 97 operational indicators. The meeting than divided these indicators into three categories:

(A) Priority and ready for use globally (22 indicators);

(B) Priority to be developed at global and sub-global level (36 indicators);

(C) For consideration at sub-global level (39 indicators).

7. The first group (A) of indicators represent those which have data, a methodology and have been peer reviewed and/or published. While some of these indicators could benefit from more robust data to fill information gaps, they can currently be used to assess progress towards the Strategic Plan at the global level. The second group (B) of indicators represent those which could be developed in time to assess progress towards the Strategic Plan at the global level and are urgently required to fill gaps in the assessment framework. While many of these indicators require further development to be applicable globally and across multiple ecosystems, several can currently be used to assess progress in the implementation of the Strategic Plan for certain components of biodiversity. Many of the indicators in these first two groups could be disaggregated or re-calculated for use at the sub-global level as well, depending on available data. The third group (C) of indicators represent those which could be useful at the sub-global level, depending on particular needs and circumstances, but which would be difficult to use to assess progress globally given limited data availability and comparability issues (The relationship between the headline indicators, operational indicators and Aichi Biodiversity Targets is presented in Appendix V).

8. All targets, except Target 1 (awareness about values of biodiversity) have at least one proposed operational indicator associated with them at the global level, though for Target 16 (access and benefit-sharing) the operational indicator is as yet undefined. Each indicator in Appendix VI is listed against the targets it is related to. Many indicators are relevant to several targets, including frequently to targets under different Strategic Goals. Furthermore several of the indicators identified are currently being used by other conventions or processes including UNCCD, CITES, CMS and the Millennium Development Goals (MDGs).

9. Generally, the indicators under Strategic Goals A, D and E require the most attention with regard to the further development of the indicators framework. Given the different elements (policy questions, headline indicators, indicator sub-topics and operational indicators) developed by the meeting, the framework can be presented in a number of ways depending on specific needs. In addition in Appendix VII the AHTEG identified global indicators which could be particularly useful from a communications perspective. A table listing the different information sources for each of the indicators, as well as their status of development and other relevant information is accessible from http://www.cbd.int/doc/meetings/ind/ahteg-sp-ind-01/official/ahteg-sp-ind-01-03-add1-en.xls.

10. Indicators, particularly those on trends to establish performance, require that initial baselines be established to provide a reference point against which gains or losses can be assessed.

11. The Group made the following recommendation:

Recommendation 1:

The indicator framework (consisting of a conceptual model, policy questions, headline indicators, indicator sub-topics and prioritised operational indicators) provides a sufficient basis to assess progress in the achievement of the Strategic Plan for Biodiversity 2011-2020 at various scales, from global to regional, national, sub-national and local. It should be applied flexibly for specific purposes and be considered as guidance for Parties and other Governments in the development or refinement of their monitoring and assessment systems to support the development and implementation of National Biodiversity Strategies and Action Plans (NBSAPs) as well as implementation of the Strategic Plan for Biodiversity 2011-2020.

Rationale:

The conceptual model, policy questions and 12 headline indicators are likely to be of wide relevance and may be used as guidance for Parties in developing their own monitoring and assessment frameworks. The use of a common framework by different Parties will improve the scope for regional and global assessments.

The proposed conceptual model has already been tested by the Biodiversity Indicators Partnership to link indicators so as to create a more informative set that can better guide policy. Equally many of the global indicators have already been previously agreed and used, including in the third edition of Global Biodiversity Outlook and/or are being used by other Conventions and processes.

The indicator framework could be further refined depending on how it will be used. Indicators can serve multiple purposes at all scales. Some indicators are more useful for communicating with external audiences, others are more useful for internal reviews of implementation and others can facilitate linkage across scales and mainstreaming with other sectors, international agreements and processes. There is no limit to the number of indicators that could be listed.

For the list of operational indicators prioritized for use at the global level (categories A and B), the intention was to identify a limited number of indicators that together would provide information on all targets, noting that many indicators are relevant to multiple targets and that many targets have multiple elements which need to be assessed and also noting that several indicators are based on the same underlying data. In addition many of the indicators rely on the same essential variables and could be further refined if desired. The list in category C should be considered open with additional guidance on indicators in use at regional and national level contained, for example, in the report on National Indicators, Monitoring and Reporting for Global Biodiversity Targets (UNEP/CBD/AHTEG-SP-Ind/1/INF/2).

The indicators can also be applied flexibly as guidance for monitoring biodiversity at the sub-national level. In this context it is noted that decision X/22 endorses the Plan of Action on Subnational Governments, Cities and Other Local Authorities for Biodiversity and invites Parties to involve them when revising their NBSAPs.

Adjustments to global indicators agreed in decision VII/30

12. The Conference of the Parties requested the Ad Hoc Technical Expert Group on Indicators for the Strategic Plan for Biodiversity 2011-2020 to provide advice on the further development of indicators agreed through decisions VII/30 and VIII/15 (decision X/7, paragraph 5 (a)).

13. The meeting, recognizing the large amount of resources and efforts that have been invested in the indicators agreed through decisions VII/30 and VIII/15, decided to retain most of the indicators already agreed. However in some cases changes to the wording of the indicators were required to bring them in line with the language of the Strategic Plan for Biodiversity 2011-2020 and the Aichi Biodiversity Targets. In addition in a few cases the meeting also decided to subsume some indicators under broader headings or to disaggregate indicators into several in order to facilitate reporting at a global level. Appendix VIII illustrates the relationship between the indicators agreed through decisions VII/30 and VIII/15 and those discussed by the AHTEG.

Support for national biodiversity monitoring and reporting

14. The Conference of the Parties requested the Ad Hoc Technical Expert Group on Indicators for the Strategic Plan for Biodiversity 2011-2020 to develop further guidance and propose options for the establishment of mechanisms to support Parties in their efforts to develop national indicators and associated biodiversity monitoring and reporting systems, in support of setting of targets, according to national priorities and capacities, and in the monitoring of progress towards them (decision X/7, paragraph 5 (c)).

15. The Group considered that the adoption of the Strategic Plan for Biodiversity and the commitment by Parties both to: (a) develop national and/or regional targets, using the Strategic Plan and its Aichi Biodiversity Targets as a flexible framework; and (b) report on progress and achievements in 2012 and early 2014, present significant opportunities for the provision of coherent guidance and the establishment of comparable systems (data sets, indicator methodologies and reporting) across a range of countries. It would be important to demonstrate to countries that there are benefits in applying the same indicators including better technical support on their development, additional data available from disaggregating global or regional data sets, greater interest from stakeholders to contribute data, comparability of data and trends, and better ability to interpret observed trends in light of trends in other countries/regions.

16. The Group made the following specific recommendations:

Recommendation 2:

Parties to the CBD should use the Strategic Goals and the Aichi Biodiversity Targets of the Strategic Plan for Biodiversity 2011-2020 and the proposed indicator framework **as a flexible framework to help develop**

indicators to monitor and review the implementation of their updated NBSAPs, according to national needs and priorities, and taking into account the potential use of indicators at sub-national, regional and global scales.

Rationale:

The Strategic Plan for Biodiversity 2011-2020 (decision X/2) urges Parties and other Governments to update their NBSAPs, including the adaptation of the Aichi Biodiversity Targets at the national or regional level and monitoring and review of implementation using the set of indicators developed for the Strategic Plan as a flexible framework. Parties agreed to report on progress including the use of indicators in their fifth and sixth national reports. Seeking consistency and aggregation of indicators across scales has been recommended by many regional and national indicator workshops and initiatives. This can be facilitated by emphasizing the development of scalable indicators.

Recommendation 3:

Countries, especially those with limited resources (and not yet using systematically produced indicators in their official reports) are encouraged **initially** to **establish a few simple indicators for priority issues** identified within their national biodiversity strategies and action plans and in line with the Aichi Biodiversity Targets, to demonstrate the benefits of indicators and build support for their use for other issues. Ideally this should be done with a view to **progressively identify and adopt a few commonly used indicators that are based on consistent/standardized methodologies and data sets**, including those that are commonly used based on existing international data collection.

Rationale:

The adoption and reporting of the Aichi Biodiversity Targets or of the corresponding national targets requires a step-change in the mode of implementation of the Convention on Biological Diversity, in terms of defining for the first time measurable targets and reporting on progress. Where the use of indicators is not an established part of decision-making and reporting it may be beneficial to demonstrate their value for issues of high national priority. A stepwise approach could involve:

• Step 1. Parties start to do what can be done immediately (including process-type indicators and indicators based on expert judgment or those available from global or regional data sources – Recommendation 2) to assess priority issues;

• Step 2. Parties gradually develop additional indicators with a view to reporting on these in line with the schedule laid out in decision X/2.

The desire to develop or enhance national/regional monitoring programmes in line with the Strategic Plan for Biodiversity 2011-2020 provides an opportunity to make a significant step towards a common set of indicators. By using the same indicators across a large number of countries significant advantages could be achieved:

(i) capacity support could focus on a limited number of indicators;

(ii) guidance for these indicators could be prioritized;

(iii) indicators could be aggregated up from national to global scale, thereby maximizing their utility and policy impact;

(iv) data collection efforts would focus on informing the indicators leading to increasingly comprehensive data sets;

(v) existing international data gathering and collation efforts (such as remotely sensed information or agreed processes like the FAO Global Forest Resources Assessment) would complement and support national data collection efforts and global data sources could thus serve to inform national processes; (vi) mainstreaming indicator development, including the involvement of national statistical offices, would be facilitated thereby mobilizing national data sources for the global process.

It should be noted that the United Nations Statistics Division and national statistics offices are increasingly seeking to include environmental and biodiversity information in their work.

Recommendation 4:

Countries not yet using systematically-produced indicators for biodiversity should be encouraged to **establish or identify a facilitator** (individual, committee, agency or mechanism) **to promote and co-ordinate the collection and production of national biodiversity information** and to make it publicly available.

Rationale:

The existence of a body, or even an individual, with the role of promoting and co-ordinating the collection, analysis and communication of national biodiversity information results in a fundamental improvement in the information available to support implementation of the Strategic Plan for Biodiversity 2011-2020 as well as the implementation of other biodiversity-related conventions and agreements.

Recommendation 5:

Relevant organizations, including funding bodies, should encourage and support the long-term monitoring and reporting of priority information, including by promoting the development or strengthening of 'communities of practice' on biodiversity monitoring and by ensuring that available data at all scales are made publicly available. It will be critical to gradually **increase the capacity for producing and communicating information**, including indicators. Resources should be mobilized to **share the expertise with and amongst countries** that have less capacity. **Public involvement in recording observations ('citizen science') should also be strengthened and recognized**, keeping in mind the need for quality control.

Rationale:

National adaptation of, and reporting of progress towards, the twenty Aichi Biodiversity Targets require a range of expertise and information, and sometimes new ways of working (e.g. integrating biodiversity values into national accounts), which few countries are likely to have in place in the short term. However, by sharing experiences amongst the countries and involving, as appropriate, representatives of the scientific and development community, it will be possible to cover the wide range of issues in the Strategic Plan for Biodiversity 2011-2020. 'Communities of Practice' for individual Aichi Biodiversity Targets and cross-cutting issues, operating within countries, regions and globally can provide necessary practical advice and encouragement, including the dissemination of lessons learned and solutions to problems. Capacity-building activities could for example:

(i) develop capacities for the gathering and making publicly accessibility of data at **all scales**, using internet resources as appropriate;

(ii) involve stakeholders at all levels including governments, NGOs, academic bodies and business;

(iii) be linked to the process of revising/updating national biodiversity strategies and action plans;

(iv) include a range of approaches such as peer-to-peer learning, technical training, expert exchanges, technical expert visits, and on-line support;

(v) offer services from international organizations such as IUCN, UNEP-WCMC, UNDP and members of the Biodiversity Indicators Partnership and GEO BON.

Recommendation 6:

Technical guidance materials for capacity building and support to Parties for the further development of indicators and monitoring and reporting systems **should be compiled and provided in an accessible manner**. Guidance, reference materials, examples of indicator methods and use could be compiled in a **toolkit** which should be used for, and further developed through, technical support activities.

Rationale:

Given the breadth of subjects covered by the Aichi Biodiversity Targets, and the current lack of relevant national indicators in many countries, guidance is needed for Parties to help them assess the relevance and practicality of using the framework of indicators in a flexible way for possible application at national and regional scales.

Co-ordinated initiatives, such as the Biodiversity Indicators Partnership and the GEO BON, have generated a wealth of experience and learning resources and facilitated links between the competent national authorities to the scientific and data-provider communities as well development agencies. Indicator developers, reporting organizations and scientific bodies, from national to global scales, should collaborate to jointly contribute to a toolkit on resources for biodiversity indicators, building on existing materials accessible from the Biodiversity Indicators Partnership websites5 as well as case studies6. The toolkit should include examples demonstrating the

utility of indicators for decision-making and how they facilitate reporting. It should also include guidance on a minimum set of key data that could be collected or mobilized in support of producing indicators for national targets and their integration in national biodiversity strategies and action plans. Guidance is also needed to show that high utility and policy impact can be achieved with a small number of indicators and at limited additional cost, particularly by drawing on available data. Furthermore, the toolkit should include guidance to Parties on the relevance and practicality at national and regional scales of the global indicators recommended by the AHTEG for the Strategic Plan for Biodiversity 2011-2020.

Recommendation 7:

There is a need for **guidance on each of the Aichi Biodiversity Targets and their connections** to explain the scientific concepts and information needs that underpins the setting of national targets, strategy development, and reporting.

Rationale:

Since many of the Aichi Biodiversity Targets address complex issues, and some of the targets address new areas for implementation of the CBD, guidance to help understand the scientific and technical aspects of the targets and their measurement is an important requirement as countries update their NBSAPs. A consolidation of guidance and explanatory notes, based on documentation on the technical rationales for the Aichi Biodiversity Targets, should be led by the CBD Secretariat and involve relevant scientific and technical partners. A pragmatic approach should be taken, focusing on the key elements of the targets, and should include examples of operational indicators that could be produced in a cost-effective way. The guidance could be made available through the Convention's Clearing-House Mechanism and could be used in capacity-building workshops.

Strengthening linkage between global, regional and national

17. The Conference of the Parties requested the Ad Hoc Technical Expert Group on Indicators for the Strategic Plan for Biodiversity 2011-2020 to provide advice on the strengthening of linkages between global and national indicator development and reporting (decision X/7, paragraph 5 (d)).

18. The Group made the following specific recommendations, which are also linked to recommendations 2, 3 and 6:

Recommendation 8:

The **5th national report to the CBD** should make a significant step towards **indicator-based reporting**.

Rationale:

Indicator-based reporting would reduce the reporting burden, promote coherent reporting to different processes and improve the quality and utility of reports by presenting available data. The guidance manual for the 5th National Report to the CBD should be developed accordingly, focusing on the assessment of national progress in the implementation/achievement of the Strategic Plan. The information obtained through the 5th National Report will be a key input to the fourth edition of Global Biodiversity Outlook and contribute to the evaluation of the Millennium Development Goals in 2015. Indicator-based reports should contribute to streamlined reporting by enabling information to be easily re-used for different purposes at national, regional and global levels.

Recommendation 9:

Parties should be encouraged to **contribute to, update, verify and maintain relevant national data in regional and global data sets** as a contribution to optimize and coordinate the production of indicators for monitoring and reporting at various scales.

Rationale:

There are a small number of global datasets which are of particular importance for monitoring the Strategic Plan as they are used for a variety of analyses and purposes at various scales. There are therefore multiple advantages in ensuring that these data sets are as up-to-date and complete as possible.

Synergies with other MEAs and other sectoral and intergovernmental processes

19. The Ad Hoc Technical Expert Group on Indicators for the Strategic Plan for Biodiversity 2011-2020 recognized that the Strategic Plan is relevant to a range of stakeholders and sectors and that their involvement both in the implementation on monitoring will be essential for the achievement of the Strategic Plan.

20. The Group noted that a number of collaborative processes are already underway that aim to ensure coherence and collaboration in the delivery of the biodiversity agenda. They include *inter alia* the efforts of the Liaison Group of Biodiversity-related Conventions (BLG); the meetings of the Chairs of Scientific Advisory Bodies of Biodiversity-related Conventions (CSAB), the Issue Management Group on Biodiversity of the Environment Management Group (EMG), and collaborative action in support of Parties as they update their national biodiversity strategies and action plans in the light of the Strategic Plan for Biodiversity 2011-2020.

21. The Group made the following specific recommendations:

Recommendation 10:

The **report of the Ad Hoc Technical Expert Group on Indicators for the Strategic Plan for Biodiversity 2011-2020 should be circulated widely to partner organizations** to solicit their comments and inputs.

Rationale:

Efforts have been made to have representation from a wide variety of stakeholder groups in the meeting of the AHTEG, including by organizing the parallel International Expert Meeting. Nevertheless, in a number of areas key stakeholders were not represented. Offering the opportunity to comment on the report would enable those stakeholders to engage in a collaborative process to support countries in their efforts to monitor biodiversity.

Recommendation 11:

The CBD should **explore opportunities to collaborate** with other multi-lateral environmental agreements and relevant international organizations and agencies in **working towards coherent and prioritized monitoring programmes for biodiversity**.

Rationale:

The Strategic Plan for Biodiversity 2011-2020 is relevant to all stakeholders who contribute to the achievement of its mission and goals. This provides an opening for the collaborative implementation by relevant partners for each of the Aichi Biodiversity Targets. It also underpins the need for partner agencies to promote synergies and offer support to countries in a coordinated and mutually supportive manner. The request by the Chairs of Scientific Advisory Bodies of Biodiversity-related Conventions (CSAB) to IUCN to map the respective strategic plans of the biodiversity-related conventions against the Strategic Plan could help to identify obvious areas of collaboration. The Environment Management Group could complete a similar analysis for UN agencies and organizations. Considerations for coherent biodiversity monitoring could build on background work conducted by UNEP-WCMC and the Biodiversity Indicators Partnership in which indicators used by different multi-lateral environmental agreements where mapped against each other. Such a collaborative approach towards implementation and monitoring of the Strategic Plan would have significant advantages such as to:

(i) provide context and purpose for national synergies;

(ii) enable multi-lateral environmental agreements to identify other indicators that can contribute to their implementation;

(iii) inform the review and updating of national biodiversity strategies and action plans;

(iv) enable streamlining and help to put national reporting into context;

(v) help to inform other sectors and parts of government about biodiversity issues;

(vi) help to inform the intergovernmental platform on biodiversity and ecosystem services and ensure that its contributions are relevant to multiple users;

(vii) support the planning for the Rio 2012 United Nations Conference on Sustainable Development.

Recommendation 12:

The proposed indicator framework for the Strategic Plan should be kept under review with a view to enabling the future incorporation of relevant indicators developed by other Conventions and processes that are relevant to monitoring biodiversity.

Rationale:

A number of indicator processes relevant to the Strategic Plan are currently underway, such as the work on methodologies and data needs for an effective use of the sub-set of impact indicators for the 10-year strategic plan and framework (2008-2018) to enhance the implementation of the United Nations Conference on Desertification, or the discussions about monitoring for REDD plus. Providing guidance on the use of indicators from other processes once these are completed would be in line with and facilitate the progressive identification and adoption of a set of commonly used key indicators referred to in recommendation 3 above. It also is a signal of the desire to seize opportunities to collaborate with other multi-lateral environmental agreements and relevant international organizations and agencies in working towards coherent and prioritized monitoring programmes for biodiversity referred to in recommendation 11 above.

Production of global indicators

22. In decision X/2 (paragraph 13) the Conference of the Parties decided that the fourth edition of the Global Biodiversity Outlook (GBO-4) shall be prepared to provide a mid-term review of progress towards the Aichi Biodiversity Targets, including an analysis of how the implementation of the Convention and its Strategic Plan has contributed to the 2015 targets of the Millennium Development Goals. GBO-4 should be indicator-based. It should use global level indicators and also synthesize indicators presented in the fifth national reports to the Convention on Biological Diversity. Of the global priority indicators 22 are ready for use globally, while another 36 could be developed as a priority for use at the global level. Particular gaps exist with regard to indicators relevant to Strategic Goals A (mainstreaming), D (benefits) and E (implementation) and significant efforts are required to fill these gaps.

23. The further development of indicators will require the involvement of the key stakeholders working in this field in order to enhance synergies between various ongoing processes. Coordination for the development process could be provided by the Biodiversity Indicators Partnership, which, resources permitting, would be expected to engage with those stakeholders who are active in indicator development related to Goals A, D and E.

24. In developing the indicators framework and list of indicators for the Strategic Plan for Biodiversity 2011-2020 the Group identified several issues relevant to monitoring and data. It was observed that many of the indicators rely on the same key data sets. For example the data used to calculate the Red List Index as well as the Living Planet Index, can be analysed in different ways to produce a number of other indicators. Emphasizing these data sets, improving their coverage and temporal and spatial resolution should therefore be considered a priority. The report on the Adequacy of Biodiversity Observation Systems to Support the CBD 2020 Targets (UNEP/CBD/AHTEG-SP-Ind/1/INF/1) contains a section on essential biodiversity variables (starting on page 74) which identifies key data sets that inform several of the indicators discussed by the AHTEG. An in-depth analysis would allow the identification of where investment in data collection and collation and promotion of common methodologies, would provide greatest benefit.

Recommendation 13:

The mid term evaluation of the Strategic Plan and application of the indicators framework in the fifth National Reports and in the fourth edition of the Global Biodiversity Outlook, to be published in 2015, provides an opportunity to **review progress in developing indicators and the adequacy and effectiveness of the set of indicators and in assessing the achievement of the Strategic Plan for Biodiversity at all levels**.

Rationale:

The preparation of the fourth edition of Global Biodiversity Outlook and analysis of fifth national reports provides an opportunity to test the set of indicators and the framework proposed in this document and to review their effectiveness in assessing and communicating progress in the achievement of the Strategic Plan for Biodiversity 2011-2020 and the Aichi Biodiversity Targets. It will allow for a better understanding of how Parties have adopted and adapted the Aichi Biodiversity Targets at the national and regional levels. Adjustments to the set of indicators and/or the framework could be made in the light of this experience.

Conclusions

25. The Ad Hoc Technical Expert Group on Indicators for the Strategic Plan for Biodiversity 2011-2020 concluded that there is a good basis for assessing progress towards the Aichi Biodiversity Targets globally and that any future work should build on the investments made in the period up to 2010. It is also noteworthy that many countries have undertaken detailed analyses and assessments with regard to the achievement of the 2010 target of a significant reduction in the rate of biodiversity loss at the national level. Where indicators have been used successfully at national level there is good reason to continue their use in the future, taking into account guidance provided by this report.

26. In its deliberations the Group noted that the suite of indicators for the Strategic Plan for Biodiversity can be used to fulfil multiple purposes. They help to change the way in which decisions are made; they can serve to assess progress in the achievement of the Strategic Plan for Biodiversity 2011-2020 at the global level; they can serve to enable Parties to monitor and review the implementation of their national biodiversity strategies and action plans; and, they can serve as a tool for promoting synergies and mainstreaming between biodiversity-related multilateral agreements and with other sectors. Further the group noted that the list of global and sub-national indicators could be further refined depending on their intended use.

27. There is no limit to the number of indicators that might be applied at the sub-global level, as demonstrated in the analysis of indicators in use at national level (UNEP/CBD/AHTEG-SP-Ind/1/INF/2), and the absence of an indicator in the list prepared by the Group does not imply that it would be less suitable for a given purpose than one that might be in the list. In that sense, the list of indicators for consideration at sub-global level should be considered flexibly. Nevertheless, the list should provide useful guidance and examples for Parties seeking to monitor each of the elements and themes in the overall framework.

28. For countries which undertake efforts to establish monitoring and assessment programmes in accordance with decision X/2 it is recommended to consider an iterative process starting with a few easy to implement indicators and emphasize scalable indicators that draw on global data sets and tested methodologies.

Annex 10 Indicative List of Indicators for the Strategic Plan for Biodiversity 2011–2020

Indicative List of Indicators for the Strategic Plan for Biodiversity 2011–2020 (from CBD COP Decision XI/3)

The Ad Hoc Technical Expert Group on Indicators for the Strategic Plan for Biodiversity 2011-2020 identified three categories of operational indicators. Indicators which are ready for use at the global level are denoted by the letter (A). Indicators which could be used at the global level but which require further development to be ready for use are denoted by the letter (B). Additional indicators for consideration for use at the national or other sub-global level are denoted by the letter (C) and given in italics. The set of (A) and (B) indicators are those which should be used to assess progress at the global level, while the (C) indicators are illustrative of some of the additional indicators available to Parties to use at the national level, according to their national priorities and circumstances.

Aichi Target	Headline indicators (in bold) and most relevant operational indicators
Strategic Goal A: Address the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society	
Target 1 - By 2020, at the latest, people are aware of the values of biodiversity and the steps they can take to conserve and use it sustainably.	**Trends in awareness, attitudes and public engagement in support of biological diversity and ecosystem services** • *Trends in awareness and attitudes to biodiversity (C)* • *Trends in public engagement with biodiversity (C)* • *Trends in communication programmes and actions promoting social corporate responsibility (C)*
Target 2 - By 2020, at the latest, biodiversity values have been integrated into national and local development and poverty reduction strategies and planning processes and are being incorporated into national accounting, as appropriate, and reporting systems.	**Trends in integration of biodiversity, ecosystem services and benefits sharing into planning, policy formulation and implementation and incentives** • Trends in number of countries incorporating natural resource, biodiversity, and ecosystem service values into national accounting systems (B) • *Trends in number of countries that have assessed values of biodiversity, in accordance with the Convention (C)* • *Trends in guidelines and applications of economic appraisal tools (C)* • *Trends in integration of biodiversity and ecosystem service values into sectoral and development policies (C)* • *Trends in policies considering biodiversity and ecosystem service in environmental impact assessment and strategic environmental assessment (C)*
Target 3 - By 2020, at the latest, incentives, including subsidies, harmful to biodiversity are eliminated, phased out or reformed in order to minimize or avoid negative impacts, and positive incentives for the conservation and sustainable use of biodiversity are developed and applied, consistent and in harmony with the Convention and other relevant international obligations, taking into account national socio economic conditions.	**Trends in integration of biodiversity, ecosystem services and benefits sharing into planning, policy formulation and implementation and incentives** • Trends in the number and value of incentives, including subsidies, harmful to biodiversity, removed, reformed or phased out (B) • *Trends in identification, assessment and establishment and strengthening of incentives that reward positive contribution to biodiversity and ecosystem services penalize adverse impacts (C)*
Target 4 - By 2020, at the latest, Governments, business and stakeholders at all levels have taken steps to achieve or have implemented plans for sustainable production and consumption and have kept	**Trends in pressures from unsustainable agriculture, forestry, fisheries and aquaculture** • Trends in Ecological Footprint and/or related concepts (A) (decisions VII/30 and VIII/15) • Trends in population and extinction risk of utilized species,

the impacts of use of natural resources well within safe ecological limits.	including species in trade (A) (also used by CITES) • *Ecological limits assessed in terms of sustainable production and consumption (C)*
	Trends in pressures from habitat conversion, pollution, invasive species, climate change, overexploitation and underlying drivers • *Trends in biodiversity of cities (C) (decision X/22)*
	Trends in integration of biodiversity, ecosystem services and benefits sharing into planning, policy formulation and implementation and incentives • Trends in extent to which biodiversity and ecosystem service values are incorporated into organizational accounting and reporting (B)

Strategic Goal B: Reduce the direct pressures on biodiversity and promote sustainable use	
Target 5 - By 2020, the rate of loss of all natural habitats, including forests, is at least halved and where feasible brought close to zero, and degradation and fragmentation is significantly reduced.	**Trends in extent, condition and vulnerability of ecosystems, biomes and habitats** • Extinction risk trends of habitat dependent species in each major habitat type (A) • Trends in extent of selected biomes, ecosystems and habitats (A) (decision VII/30 and VIII/15) • Trends in proportion of degraded/threatened habitats (B) • Trends in fragmentation of natural habitats (B) (decision VII/30 and VIII/15) • *Trends in condition and vulnerability of ecosystems (C)* • *Trends in the proportion of natural habitats converted (C)*
	Trends in pressures from unsustainable agriculture, forestry, fisheries and aquaculture • *Trends in primary productivity (C)* • *Trends in proportion of land affected by desertification (C) (also used by UNCCD)*
	Trends in pressures from habitat conversion, pollution, invasive species, climate change, overexploitation and underlying drivers • Population trends of habitat dependent species in each major habitat type (A)
Target 6 - By 2020 all fish and invertebrate stocks and aquatic plants are managed and harvested sustainably, legally and applying ecosystem based approaches, so that overfishing is avoided, recovery plans and measures are in place for all depleted species, fisheries have no significant adverse impacts on threatened species and vulnerable ecosystems and the impacts of fisheries on stocks, species and ecosystems are within safe ecological limits.	**Trends in pressures from unsustainable agriculture, forestry, fisheries and aquaculture** • Trends in extinction risk of target and bycatch aquatic species (A) • Trends in population of target and bycatch aquatic species (A) • Trends in proportion of utilized stocks outside safe biological limits (A) (MDG indicator 7.4) • *Trends in catch per unit effort (C)* • *Trends in fishing effort capacity (C)* • *Trends in area, frequency, and/or intensity of destructive fishing practices (C)*
	Trends in integration of biodiversity, ecosystem services and benefits sharing into planning, policy formulation and implementation and incentives • Trends in proportion of depleted target and bycatch species with recovery plans (B)
Target 7 - By 2020 areas under agriculture, aquaculture and forestry are managed sustainably, ensuring conservation of biodiversity.	**Trends in pressures from unsustainable agriculture, forestry, fisheries and aquaculture** • Trends in population of forest and agriculture dependent species in production systems (B)

	• Trends in production per input (B) • *Trends in proportion of products derived from sustainable sources (C) (decision VII/30 and VIII/15)*
	Trends in integration of biodiversity, ecosystem services and benefits sharing into planning, policy formulation and implementation and incentives • Trends in area of forest, agricultural and aquaculture ecosystems under sustainable management (B) (decision VII/30 and VIII/15)
Target 8 - By 2020, pollution, including from excess nutrients, has been brought to levels that are not detrimental to ecosystem function and biodiversity.	**Trends in pressures from habitat conversion, pollution, invasive species, climate change, overexploitation and underlying drivers** • Trends in incidence of hypoxic zones and algal blooms (A) • Trends in water quality in aquatic ecosystems (A) (decision VII/30 and VIII/15) • Impact of pollution on extinction risk trends (B) • Trends in pollution deposition rate (B) (decision VII/30 and VIII/15) • Trends in sediment transfer rates (B) • *Trend in emission to the environment of pollutants relevant for biodiversity (C)* • *Trend in levels of contaminants in wildlife (C)* • *Trends in nitrogen footprint of consumption activities (C)* • *Trends in ozone levels in natural ecosystems (C)* • *Trends in proportion of wastewater discharged after treatment (C)* • *Trends in UV-radiation levels (C)*
Target 9 - By 2020, invasive alien species and pathways are identified and prioritized, priority species are controlled or eradicated, and measures are in place to manage pathways to prevent their introduction and establishment.	**Trends in pressures from habitat conversion, pollution, invasive species, climate change, overexploitation and underlying drivers** • Trends in the impact of invasive alien species on extinction risk trends (A) • Trends in the economic impacts of selected invasive alien species (B) • Trends in number of invasive alien species (B) (decision VII/30 and VIII/15) • *Trends in incidence of wildlife diseases caused by invasive alien species (C)*
	Trends in integration of biodiversity, ecosystem services and benefits sharing into planning, policy formulation and implementation and incentives • Trends in policy responses, legislation and management plans to control and prevent spread of invasive alien species (B) • *Trends in invasive alien species pathways management (C)*
Target 10 - By 2015, the multiple anthropogenic pressures on coral reefs, and other vulnerable ecosystems impacted by climate change or ocean acidification are minimized, so as to maintain their integrity and functioning.	**Trends in pressures from habitat conversion, pollution, invasive species, climate change, overexploitation and underlying drivers** • Extinction risk trends of coral and reef fish (A) • Trends in climate change impacts on extinction risk (B) • Trends in coral reef condition (B) • Trends in extent, and rate of shifts of boundaries, of vulnerable ecosystems (B) • *Trends in climatic impacts on community composition (C)* • *Trends in climatic impacts on population trends (C)*

Strategic Goal C: To improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity	
Target 11 - By 2020, at least 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes.	**Trends in coverage, condition, representativeness and effectiveness of protected areas and other area-based approaches** • Trends in extent of marine protected areas, coverage of key biodiversity areas and management effectiveness (A) • Trends in protected area condition and/or management effectiveness including more equitable management (A) (decision X/31) • Trends in representative coverage of protected areas and other area based approaches, including sites of particular importance for biodiversity, and of terrestrial, marine and inland water systems (A) (decision VII/30 and VIII/15) • Trends in the connectivity of protected areas and other area based approaches integrated into landscapes and seascapes (B) (decision VII/30 and VIII/15) • *Trends in the delivery of ecosystem services and equitable benefits from protected areas (C)*
Target 12 - By 2020 the extinction of known threatened species has been prevented and their conservation status, particularly of those most in decline, has been improved and sustained.	**Trends in abundance, distribution and extinction risk of species** • Trends in abundance of selected species (A) (decision VII/30 and VIII/15) (UNCCD indicator) • Trends in extinction risk of species (A) (decision VII/30 and VIII/15) (MDG indicator 7.7) (also used by CMS) • Trends in distribution of selected species (B) (decision VII/30 and VIII/15) (also used by UNCCD)
Target 13 - By 2020, the genetic diversity of cultivated plants and farmed and domesticated animals and of wild relatives, including other socio-economically as well as culturally valuable species, is maintained, and strategies have been developed and implemented for minimizing genetic erosion and safeguarding their genetic diversity.	**Trends in genetic diversity of species** • Trends in genetic diversity of cultivated plants, and farmed and domesticated animals and their wild relatives (B) (decision VII/30 and VIII/15) • *Trends in genetic diversity of selected species (C)*
	Trends in integration of biodiversity, ecosystem services and benefits sharing into planning, policy formulation and implementation and incentives • Trends in number of effective policy mechanisms implemented to reduce genetic erosion and safeguard genetic diversity related to plant and animal genetic resources (B)

Strategic Goal D: Enhance the benefits to all from biodiversity and ecosystem services	
Target 14 - By 2020, ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being, are restored and safeguarded, taking into account the needs of women, indigenous and local communities, and the poor and vulnerable.	**Trends in distribution, condition and sustainability of ecosystem services for equitable human well-being** • Trends in proportion of total freshwater resources used (A) (MDG indicator 7.5) • Trends in proportion of the population using improved water services (A) (MDG indicator 7.8 and 7.9) • Trends in benefits that humans derive from selected ecosystem services (A) • Population trends and extinction risk trends of species that provide ecosystem services (A) • Trends in delivery of multiple ecosystem services (B) • Trends in economic and non-economic values of selected ecosystem services (B) • Trends in health and wellbeing of communities who depend directly on local ecosystem goods and services (B) (decision VII/30 and VIII/15)

	• Trends in human and economic losses due to water or natural resource related disasters (B) • Trends in nutritional contribution of biodiversity: Food composition (B) (decision VII/30 and VIII/15) • *Trends in incidence of emerging zoonotic diseases (C)* • *Trends in inclusive wealth (C)* • *Trends in nutritional contribution of biodiversity: Food consumption (C) (decision VII/30 and VIII/15)* • *Trends in prevalence of underweight children under-five years of age (C) (MDG indicator 1.8)* • *Trends in natural resource conflicts (C)* • *Trends in the condition of selected ecosystem services (C)* • *Trends in biocapacity (C)*
	Trends in coverage, condition, representativeness and effectiveness of protected areas and other area-based approaches • Trends in area of degraded ecosystems restored or being restored (B)
Target 15 - By 2020, ecosystem resilience and the contribution of biodiversity to carbon stocks has been enhanced, through conservation and restoration, including restoration of at least 15 per cent of degraded ecosystems, thereby contributing to climate change mitigation and adaptation and to combating desertification.	**Trends in distribution, condition and sustainability of ecosystem services for equitable human well-being** • Status and trends in extent and condition of habitats that provide carbon storage (A)
	Trends in coverage, condition, representativeness and effectiveness of protected areas and other area-based approaches • *Population trends of forest-dependent species in forests under restoration (C)*
Target 16 - By 2015, the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization is in force and operational, consistent with national legislation.	**Trends in access and equity of benefit-sharing of genetic resources** • ABS indicator to be specified through the ABS process (B)

Strategic Goal E: Enhance implementation through participatory planning, knowledge management and capacity building	
Target 17 - By 2015 each Party has developed, adopted as a policy instrument, and has commenced implementing an effective, participatory and updated national biodiversity strategy and action plan.	**Trends in integration of biodiversity, ecosystem services and benefit-sharing into planning, policy formulation and implementation and incentives** • Trends in implementation of national biodiversity strategies and action plans, including development, comprehensiveness, adoption and implementation (B)
Target 18 - By 2020, the traditional knowledge, innovations and practices of indigenous and local communities relevant for the conservation and sustainable use of biodiversity, and their customary use of biological resources, are respected, subject to national legislation and relevant international obligations, and fully integrated and reflected in the implementation of the Convention with the full and effective participation of indigenous and local communities, at all relevant levels.	**Trends in integration of biodiversity, ecosystem services and benefit-sharing into planning, policy formulation and implementation and incentives** • Trends in land-use change and land tenure in the traditional territories of indigenous and local communities (B) (decision X/43) • Trends in the practice of traditional occupations (B) (decision X/43)
	Trends in accessibility of scientific/technical/traditional knowledge and its application • Trends in which traditional knowledge and practices are respected through their full integration, safeguards and the full and effective participation of indigenous and local communities in the national implementation of the Strategic Plan (B)
	Trends in accessibility of scientific/technical/traditional knowledge

	and its application • Trends of linguistic diversity and numbers of speakers of indigenous languages (B) (decision VII/30 and VIII/15)
Target 19 - By 2020, knowledge, the science base and technologies relating to biodiversity, its values, functioning, status and trends, and the consequences of its loss, are improved, widely shared and transferred, and applied.	**Trends in accessibility of scientific/technical/traditional knowledge and its application** • Trends in coverage of comprehensive policy-relevant sub-global assessments including related capacity-building and knowledge transfer, plus trends in uptake into policy (B) • *Number of maintained species inventories being used to implement the Convention (C)*
Target 20 - By 2020, at the latest, the mobilization of financial resources for effectively implementing the Strategic Plan for Biodiversity 2011-2020 from all sources, and in accordance with the consolidated and agreed process in the Strategy for Resource Mobilization, should increase substantially from the current levels. This target will be subject to changes contingent to resource needs assessments to be developed and reported by Parties.	**Trends in mobilization of financial resources** • Indicators agreed in decision X/3 (B)

Annex 11 List of Global Ecoregions

List of Global Ecoregions (from WWF)[123]

TERRESTRIAL ECOREGIONS

Tropical and Subtropical Moist Broadleaf Forests

Afrotropical

(1) Guinean Moist Forests - Benin, Côte d'Ivoire, Ghana, Guinea, Liberia, Sierra Leone, Togo

(2) Congolian Coastal Forests- Angola, Cameroon, Democratic Republic of Congo, Equatorial Guinea, Gabon, Nigeria, São Tomé & Príncipe, Republic of Congo

(3) Cameroon Highlands Forests- Cameroon, Equatorial Guinea, Nigeria

(4) Northeastern Congo Basin Moist Forests - Central African Republic, Democratic Republic of Congo

(5) Central Congo Basin Moist Forests - Democratic Republic of Congo

(6) Western Congo Basin Moist Forests - Cameroon, Central African Republic, Democratic Republic of Congo, Gabon, Republic of Congo

(7) Albertine Rift Montane Forests - Burundi, Democratic Republic of Congo, Rwanda, Tanzania, Uganda

(8) East African Coastal Forests- Kenya, Somalia, Tanzania

(9) Eastern Arc Montane Forests - Kenya, Tanzania

(10) Madagascar Forests and Shrublands – Madagascar

(11) Seychelles and Mascarenes Moist Forests - Mauritius, Reunion (France), Seychelles,

Australasia

(12) Sulawesi Moist Forests – Indonesia

(13) Moluccas Moist Forests – Indonesia

(14) Southern New Guinea Lowland Forests - Indonesia, Papua New Guinea

(15) New Guinea Montane Forests - Indonesia, Papua New Guinea

(16) Solomons-Vanuatu-Bismarck Moist Forests - Papua New Guinea, Solomon Islands, Vanuatu

(17) Queensland Tropical Forests – Australia

(18) New Caledonia Moist Forests - New Caledonia (France)

(19) Lord Howe-Norfolk Islands Forests – Australia

Indo-Malayan

(20) Southwestern Ghats Moist Forests – India

(21) Sri Lankan Moist Forests - Sri Lanka

(22) Northern Indochina Subtropical Moist Forests - China, Laos, Myanmar, Thailand, Vietnam

(23) Southeast China-Hainan Moist Forests - China, Vietnam

(24) Taiwan Montane Forests – China

(25) Annamite Range Moist Forests - Cambodia, Laos, Vietnam

(26) Sumatran Islands Lowland and Montane Forests – Indonesia

(27) Philippines Moist Forests – Philippines

[123] http://wwf.panda.org/about_our_earth/ecoregions/ecoregion_list/

(28) Palawan Moist Forests – Philippines

(29) Kayah-Karen / Tenasserim Moist Forests - Malaysia, Myanmar, Thailand

(30) Peninsular Malaysian Lowland and Mountain Forests - Indonesia, Malaysia, Singapore, Thailand

(31) Borneo Lowland and Montane Forests - Brunei, Indonesia, Malaysia

(32) Nansei Shoto Archipelago Forests – Japan

(33) Eastern Deccan Plateau Moist Forests – India

(34) Naga-Manipuri-Chin Hills Moist Forests - Bangladesh, India, Myanmar

(35) Cardamom Mountains Moist Forests - Cambodia, Thailand

(36) Western Java Mountain Forests – Indonesia,

Neotropical

(37) Greater Antillean Moist Forests - Cuba, Dominican Republic, Haiti, Jamaica, Puerto Rico (United States)

(38) Talamancan and Isthmian Pacific Forests - Costa Rica, Panama

(39) Chocó-Darién Moist Forests - Colombia, Ecuador, Panama

(40) Northern Andean Montane Forests - Colombia, Ecuador, Venezuela, Peru

(41) Coastal Venezuela Montane Forests – Venezuela

(42) Guianan Moist Forests - Brazil, French Guiana (France), Guyana, Suriname, Venezuela

(43) Napo Moist Forests - Colombia, Ecuador, Peru

(44) Río Negro-Juruá Moist Forests - Brazil, Colombia, Peru, Venezuela

(45) Guayanan Highlands Forests - Brazil, Colombia, Guayana, Suriname, Venezuela

(46) Central Andean Yungas - Argentina, Bolivia, Peru

(47) Southwestern Amazonian Moist Forests - Bolivia, Brazil, Peru

(48) Atlantic Forests - Argentina, Brazil, Paraguay

Oceania

(49) South Pacific Islands Forests - American Samoa (United States), Cook Islands (New Zealand), Fiji, French Polynesia (France), Niue (New Zealand), Samoa, Tonga, Wallis and Futuna Islands (France)

(50) Hawaii Moist Forests - Hawaii (United States)

Tropical and Subtropical Dry Broadleaf Forests

Afrotropical

(51) Madagascar Dry Forests – Madagascar

Australasia

(52) Nusu Tenggara Dry Forests – Indonesia

(53) New Caledonia Dry Forests - New Caledonia (France)

Indo-Malayan

(54) Indochina Dry Forests - Cambodia, Laos, Thailand, Vietnam

(55) Chhota-Nagpur Dry Forests – India

Neotropical

(56) Mexican Dry Forests - Guatemala, Mexico

(57) Tumbesian-Andean Valleys Dry Forests - Colombia, Ecuador, Peru

(58) Chiquitano Dry Forests - Bolivia, Brazil

(59) Atlantic Dry Forests – Brazil

Oceania

(60) Hawaii's Dry Forests - Hawaii (United States)

Tropical and Subtropical Coniferous Forests

Nearctic

(61) Sierra Madre Oriental and Occidental Pine-Oak Forests - Mexico, United States

Neotropical

(62) Greater Antillean Pine Forests - Cuba, Dominican Republic, Haiti

(63) Mesoamerican Pine-Oak Forests - El Salvador, Guatemala, Honduras, Mexico, Nicaragua

Temperate Broadleaf and Mixed Forests

Australasia

(64) Eastern Australia Temperate Forests - Australia

(65) Tasmanian Temperate Rain Forests - Australia

(66) New Zealand Temperate Forests - New Zealand

Indo-Malayan

(67) Eastern Himalayan Broadleaf and Conifer Forests - Bhutan, China, India, Myanmar, Nepal

(68) Western Himalayan Temperate Forests - Afghanistan, India, Nepal, Pakistan

Nearctic

(69) Appalachian and Mixed Mesophytic Forests - United States

Palearctic

(70) Southwest China Temperate Forests - China

(71) Russian Far East Temperate Forests - Russia

Temperate Coniferous Forests

Nearctic

(72) Pacific Temperate Rainforests - Canada, United States

(73) Klamath-Siskiyou Coniferous Forests - United States

(74) Sierra Nevada Coniferous Forests - United States

(75) Southeastern Coniferous and Broadleaf Forests - United States

Neotropical

(76) Valdivian Temperate Rainforests / Juan Fernandez Islands - Argentina, Chile

Palearctic

(77) European-Mediterranean Montane Mixed Forests - Albania, Algeria, Andorra, Austria, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, France, Germany, Greece, Italy, Liechtenstein, Macedonia, Morocco, Poland, Romania, Russia, Slovakia, Slovenia

(78) Caucasus-Anatolian-Hyrcanian Temperate Forests - Armenia, Azerbaijan, Bulgaria, Georgia, Iran, Russia, Turkey, Turkmenistan

(79) Altai-Sayan Montane Forests - China, Kazakstan, Mongolia, Russia

(80) Hengduan Shan Coniferous Forests - China

Boreal Forests / Taiga

Nearctic

(81) Muskwa / Slave Lake Boreal Forests - Canada

(82) Canadian Boreal Forests - Canada

Palearctic

(83) Ural Mountains Taiga - Russia

(84) Eastern Siberian Taiga - Russia

(85) Kamchatka Taiga and Grasslands- Russia

Tropical and Subtropical Grasslands, Savannas and Shrublands

Afrotropical

(86) Horn of Africa Acacia Savannas - Eritrea, Ethiopia, Kenya, Somalia, Sudan

(87) East African Acacia Savannas - Ethiopia, Kenya, Sudan, Tanzania, Uganda

(88) Central and Eastern Miombo Woodlands - Angola, Botswana, Burundi, Democratic Republic of Congo, Malawi, Mozambique, Namibia, Tanzania, Zambia, Zimbabwe

(89) Sudanian Savannas - Cameroon, Central African Republic, Chad, Nigeria, Democratic Republic of Congo, Eritrea, Ethiopia, Kenya, Sudan, Uganda

Australasia

(90) Northern Australia and Trans-Fly Savannas - Australia, Indonesia, Papua New Guinea

Indo-Malayan

(91) Terai-Duar Savannas and Grasslands - Bangladesh, Bhutan, India, Nepal

Neotropical

(92) Llanos Savannas - Colombia, Venezuela

(93) Cerrado Woodlands and Savannas - Bolivia, Brazil, Paraguay

Temperate Grasslands, Savannas and Shrublands

Nearctic

(94) Northern Prairie - Canada, United States

Neotropical

(95) Patagonian Steppe - Argentina, Chile

Palearctic

(96) Daurian Steppe - China, Mongolia, Russia

Flooded Grasslands and Savannas

Afrotropical

(97) Sudd-Sahelian Flooded Grasslands and Savannas - Cameroon, Chad, Ethiopia, Mali, Niger, Nigeria, Sudan, Uganda

(98) Zambezian Flooded Savannas - Angola, Botswana, Democratic Republic of Congo, Malawi, Mozambique, Namibia, Tanzania, Zambia

Indo-Malayan

(99) Rann of Kutch Flooded Grasslands - India, Pakistan

Neotropical

(100) Everglades Flooded Grasslands - United States

(101) Pantanal Flooded Savannas - Bolivia, Brazil, Paraguay

Montane Grasslands and Shrublands

Afrotropical

(102) Ethiopian Highlands - Eritrea, Ethiopia, Sudan

(103) Southern Rift Montane Woodlands - Malawi, Mozambique, Tanzania, Zambia

(104) East African Moorlands - Democratic Republic of Congo, Kenya, Rwanda, Tanzania, Uganda

(105) Drakensberg Montane Shrublands and Woodlands - Lesotho, South Africa, Swaziland

Australasia

(106) Central Range Subalpine Grasslands - Indonesia, Papua New Guinea

Indo-Malayan

(107) Kinabalu Montane Scrub - Malaysia

Neotropical

(108) Northern Andean Paramo - Colombia, Ecuador, Peru, Venezuela

(109) Central Andean Dry Puna - Argentina, Bolivia, Chile, Peru

Palearctic

(110) Tibetan Plateau Steppe - Afghanistan, China, India, Pakistan, Tajikistan

(111) Middle Asian Montane Steppe and Woodlands - Afghanistan, China, Kazakstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan

(112) Eastern Himalayan Alpine Meadows - Bhutan, China, India, Myanmar, Nepal

Tundra

Nearctic

(113) Alaskan North Slope Coastal Tundra - Canada, United States

(114) Canadian Low Arctic Tundra - Canada

Palearctic

(115) Fenno-Scandia Alpine Tundra and Taiga - Finland, Norway, Russia, Sweden

(116) Taimyr and Siberian Coastal Tundra - Russia

(117) Chukote Coastal Tundra - Russia

Mediterranean Forests, Woodlands and Scrub

Afrotropical

(118) Fynbos - South Africa

Australasia

(119) Southwestern Australia Forests and Scrub - Australia

(120) Southern Australia Mallee and Woodlands - Australia

Nearctic

(121) California Chaparral and Woodlands - Mexico, United States

Neotropical

(122) Chilean Matorral - Chile

Palearctic

(123) Mediterranean Forests, Woodlands and Scrub - Albania, Algeria, Bosnia and Herzegovina, Bulgaria, Canary Islands (Spain), Croatia, Cyprus, Egypt, France, Gibraltar (United Kingdom), Greece, Iraq, Israel, Italy, Jordan, Lebanon, Libya, Macedonia, Madeira Islands (Portugal), Malta, Monaco, Morocco, Portugal, San Marino, Slovenia, Spain, Syria, Tunisia, Turkey, Western Sahara (Morocco), Yugoslavia

Deserts and Xeric Shrublands

Afrotropical

(124) Namib-Karoo-Kaokeveld Deserts - Angola, Namibia, South Africa

(125) Madagascar Spiny Thicket - Madagascar

(126) Socotra Island Desert - Yemen

(127) Arabian Highland Woodlands and Shrublands - Oman, Saudi Arabia, United Arab Emirates, Yemen

Australasia

(128) Carnavon Xeric Scrub - Australia

(129) Great Sandy-Tanami Deserts - Australia

Nearctic

(130) Sonoran-Baja Deserts - Mexico, United States

(131) Chihuahuan-Tehuacán Deserts - Mexico, United States

Neotropical

(132) Galápagos Islands Scrub - Ecuador

(133) Atacama-Sechura Deserts - Chile, Peru

Palearctic

(134) Central Asian Deserts - Kazakstan, Kyrgyzstan, Uzbekistan, Turkmenistan

Mangroves

Afrotropical

(135) Gulf of Guinea Mangroves - Angola, Cameroon, Democratic Republic of Congo, Equatorial Guinea, Gabon, Ghana, Nigeria

(136) East African Mangroves - Kenya, Mozambique, Somalia, Tanzania

(137) Madagascar Mangroves - Madagascar

Australasia

(138) New Guinea Mangroves - Indonesia, Papua New Guinea

Indo-Malayan

(139) Sundarbans Mangroves - Bangladesh, India

(140) Greater Sundas Mangroves - Brunei, Indonesia, Malaysia

Neotropical

(141) Guianan-Amazon Mangroves - Brazil, French Guiana (France), Suriname, Trinidad and Tobago, Venezuela

(142) Panama Bight Mangroves - Colombia, Ecuador, Panama, Peru

FRESHWATER ECOREGIONS

Large Rivers

Afrotropical

(143) Congo River and Flooded Forests - Angola, Democratic Republic of Congo, Republic of Congo

Indo-Malayan

(144) Mekong River - Cambodia, China, Laos, Myanmar, Thailand, Vietnam

Nearctic

(145) Colorado River - Mexico, United States

(146) Lower Mississippi River- United States

Neotropical

(147) Amazon River and Flooded Forests - Brazil, Colombia, Peru

(148) Orinoco River and Flooded Forests - Brazil, Colombia, Venezuela

Palearctic

(149) Yangtze River and Lakes - China

Large River Headwaters

Afrotropical

(150) Congo Basin Piedmont Rivers and Streams - Angola, Cameroon, Central African Republic, Democratic Republic of Congo, Gabon, Republic of Congo, Sudan

Nearctic

(151) Mississippi Piedmont Rivers and Streams - United States

Neotropical

(152) Upper Amazon Rivers and Streams - Bolivia, Brazil, Colombia, Ecuador, French Guiana (France), Guyana, Peru, Suriname, Venezuela

(153) Upper Paraná Rivers and Streams - Argentina, Brazil, Paraguay

(154) Brazilian Shield Amazonian Rivers and Streams - Bolivia, Brazil, Paraguay

Large River Deltas

Afrotropical

(155) Niger River Delta - Nigeria

Indo-Malayan

(156) Indus River Delta - India, Pakistan

Palearctic

(157) Volga River Delta - Kazakstan, Russia

(158) Mesopotamian Delta and Marshes - Iran, Iraq, Kuwait

(159) Danube River Delta - Bulgaria, Moldova, Romania, Ukraine, Yugoslavia

(160) Lena River Delta - Russia

Small Rivers

Afrotropical

(161) Upper Guinea Rivers and Streams - Côte D'Ivoire, Guinea, Liberia, Sierra Leone

(162) Madagascar Freshwater - Madagascar

(163) Gulf of Guinea Rivers and Streams - Angola, Cameroon, Democratic Republic of Congo, Equatorial Guinea, Gabon, Nigeria, Republic of Congo

(164) Cape Rivers and Streams - South Africa

Australasia

(165) New Guinea Rivers and Streams - Indonesia, Papua New Guinea

(166) New Caledonia Rivers and Streams - New Caledonia (France)

(167) Kimberley Rivers and Streams - Australia

(168) Southwest Australia Rivers and Streams - Australia

(169) Eastern Australia Rivers and Streams - Australia

Indo-Malayan

(170) Xi Jiang Rivers and Streams - China, Vietnam

(171) Western Ghats Rivers and Streams - India

(172) Southwestern Sri Lanka Rivers and Streams - Sri Lanka

(173) Salween River - China, Myanmar, Thailand

(174) Sundaland Rivers and Swamps - Brunei, Malaysia, Indonesia, Singapore

Nearctic

(175) Southeastern Rivers and Streams - United States

(176) Pacific Northwest Coastal Rivers and Streams - United States

(177) Gulf of Alaska Coastal Rivers and Streams - Canada, United States

Neotropical

(178) Guianan Freshwater - Brazil, French Guiana (France), Guyana, Suriname, Venezuela

(179) Greater Antillean Freshwater - Cuba, Dominican Republic, Haiti, Puerto Rico (United States)

Palearctic

(180) Balkan Rivers and Streams - Albania, Bosnia and Herzogovina, Bulgaria, Croatia, Greece, Macedonia, Turkey, Yugoslavia

(181) Russian Far East Rivers and Wetlands - China, Mongolia, Russia

Large Lakes

Afrotropical

(182) Rift Valley Lakes - Burundi, Democratic Republic of Congo, Ethiopia, Kenya, Malawi, Mozambique, Rwanda, Tanzania, Uganda, Zambia

Neotropical

(183) High Andean Lakes - Argentina, Bolivia, Chile, Peru

Palearctic

(184) Lake Baikal- Russia

(185) Lake Biwa - Japan

Small Lakes

Afrotropical

(186) Cameroon Crater Lakes - Cameroon

Australasia

(187) Lakes Kutubu and Sentani - Indonesia, Papua New Guinea

(188) Central Sulawesi Lakes - Indonesia

Indo-Malayan

(189) Philippines Freshwater - Philippines

(190) Lake Inle - Myanmar

(191) Yunnan Lakes and Streams - China

Neotropical

(192) Mexican Highland Lakes - Mexico

Xeric Basins

Australasia

(193) Central Australian Freshwater - Australia

Nearctic

(194) Chihuahuan Freshwater - Mexico, United States

Palearctic

(195) Anatolian Freshwater - Syria, Turkey

MARINE ECOREGIONS

Polar Seas

Antarctic

(196) Antarctic Peninsula & Weddell Sea - Antarctic Peninsula & Weddell Sea

Arctic

(197) Bering Sea - Canada, Russia, United States

(198) Barents-Kara Sea - Norway, Russia

Temperate Shelfs and Seas

Mediterranean

(199) Mediterranean Sea - Albania, Algeria, Bosnia and Herzegovina, Croatia, Cyprus, Egypt, France, Gibraltar (United Kingdom), Greece, Israel, Italy, Lebanon, Libya, Malta, Monaco, Morocco, Slovenia, Spain, Syria, Tunisia, Turkey, Yugoslavia

North Temperate Atlantic

(200) Northeast Atlantic Shelf Marine - Belgium, Denmark, Estonia, Finland, France, Germany, Ireland, Latvia, Lithuania, Netherlands, Norway, Poland, Russia, Sweden, United Kingdom

(201) Grand Banks - Canada, St. Pierre and Miquelon (France), United States

(202) Chesapeake Bay - United States

North Temperate Indo-Pacific

(203) Yellow Sea - China, North Korea, South Korea

(204) Okhotsk Sea - Japan, Russia

Southern Ocean

(205) Patagonian Southwest Atlantic - Argentina, Brazil, Chile, Uruguay

(206) Southern Australian Marine - Australia

(207) New Zealand Marine - New Zealand

Temperate Upwelling

North Temperate Indo-Pacific

(208) Californian Current - Canada, Mexico, United States

South Temperate Atlantic

(209) Benguela Current - Namibia, South Africa

South Temperate Indo-Pacific

(210) Humboldt Current - Chile, Ecuador, Peru

(211) Agulhas Current - Mozambique, South Africa

Tropical Upwelling

Central Indo-Pacific

(212) Western Australian Marine - Australia

Eastern Indo-Pacific

(213) Panama Bight - Colombia, Ecuador, Panama

(214) Gulf of California - Mexico

(215) Galápagos Marine - Ecuador

Eastern Tropical Atlantic

(216) Canary Current - Canary Islands (Spain), Gambia, Guinea-Bissau, Mauritania, Morocco, Senegal, Western Sahara (Morocco)

Tropical Coral

Central Indo-Pacific

(217) Nansei Shoto - Japan

(218) Sulu-Sulawesi Seas - Indonesia, Malaysia, Philippines

(219) Bismarck-Solomon Seas - Indonesia, Papua New Guinea, Solomon Islands

(220) Banda-Flores Sea - Indonesia

(221) New Caledonia Barrier Reef - New Caledonia (France)

(222) Great Barrier Reef - Australia

(223) Lord Howe-Norfolk Islands Marine - Australia

(224) Palau Marine - Palau

(225) Andaman Sea - Andaman and Nicobar Islands (India), Indonesia, Malaysia, Myanmar, Thailand

Eastern Indo-Pacific

(226) Tahitian Marine - Cook Islands (New Zealand), French Polynesia (France)

(227) Hawaiian Marine - Hawaii (United States)

(228) Rapa Nui - Chile

(229) Fiji Barrier Reef - Fiji

Western Indo-Pacific

(230) Maldives, Chagos, Lakshadweep Atolls - Chagos Archipelago (United Kingdom), India, Maldives, Sri Lanka

(231) Red Sea - Djibouti, Egypt, Eritrea, Israel, Jordan, Saudi Arabia, Sudan, Yemen

(232) Arabian Sea - Djibouti, Iran, Oman, Pakistan, Qatar, Saudi Arabia, Somalia, United Arab Emirates, Yemen

(233) East African Marine - Kenya, Mozambique, Somalia, Tanzania

(234) West Madagascar Marine - Comoros, Madagascar, Mayotte and Iles Glorieuses (France), Seychelles

Western Tropical Atlantic

(235) Mesoamerican Reef - Belize, Guatemala, Honduras, Mexico

(236) Greater Antillean Marine - Bahamas, Cayman Islands (United Kingdom), Cuba, Dominican Republic, Haiti, Jamaica, Puerto Rico (United States), Turks and Caicos Islands (United Kingdom), United States

(237) Southern Caribbean Sea - Aruba (Netherlands), Columbia, Netherlands Antilles (Netherlands), Panama, Trinidad and Tobago, Venezuela

(238) Northeast Brazil Shelf Marine – Brazil

Annex 12 List of key users

List of Key Users

CBD Secretariat

Mr Robert Höft, Environmental Affairs Officer, Scientific Assessment robert.hoft@cbd.int

Mr David Coates, Environmental Affairs Officer, Inland Waters david.coates@cbd.int

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UNEP-WCMC

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European Environment Agency (EEA)

Mr Ronan Uhel, Head of Programme, Natural systems and vulnerability ronan.uhel@eea.europa.eu

International Union for Conservation of Nature (IUCN)

Dr James Dalton, Coordinator of the Global Water Initiative james.dalton@iucn.org

Dr Jonathan Davies, Coordinator of the Global Drylands Initiative jonathan.davies@iucn.org

GEO-BON

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Ms Michele Walters, Executive Officer mwalters@csir.co.za

GEO Inland and Near-coastal Coastal Water Quality Remote Sensing Working Group

Prof Arnold Decker, Co-Chair, CSIRO (see below) arnold.decker@csiro.au

DIVERSITAS

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GloboLakes Project

Dr Andrew Tyler, Coordinator, Stirling University, UK a.n.tyler@stir.ac.uk

ChloroGIN (Chlorophyll Globally Integrated Network) – Lakes

Dr Stewart Bernard, Contact person, CSIR (see below) sbernard@csir.co.za

Global Lake Ecological Observatory Network (GLEON)

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International Lake Environment Committee (ILEC)

Prof Masahisa Nakamura, Chairman of the Scientific Body, Japan m-nakamu@biwako.shiga-u.ac.jp

University of Zurich, Department of Geography

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United States Naval Research Laboratory (NRL)

Dr Wesley Moses, Coastal Section, Remote Sensing Division wesley.moses.ctr.in@nrl.navy.mil

Commonwealth Scientific and Industrial Research Organisation (CSIRO)

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National Oceanic and Atmospheric Administration, Great Lakes Environmental Research Laboratory

Mr George Leshkewich, Remote sensing specialist george.leshkevich@noaa.gov

Council for Scientific and Industrial Research (CSIR), Natural Resources and the Environment (NRE)

Inland waters: see ChloroGIN

Drylands: see GEO-BON

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Desert Research Foundation of Namibia

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Centre de Suivi Ecologique pour la gestion des resources naturelles (CSE

Dr Assize Toure, Directeur Général dt@cse.sn

Annex 13 Diversity II Product Requirements Questionnaire for Inland Waters

DIVERSITY II

diversity
inland waters

"Inland Waters"
Products Requirements
User Questionnaire

Get free access to 10 years of geophysical remote sensing products of your study site
Provide us with your expertise about biodiversity indicators
Benefit from future product enhancements based on your suggestions

Purpose of collecting Product Requirements

The Earth Observation (EO) and Biodiversity organisations that would like to participate in the *Diversity II* project are cordially invited to provide user products requirements to the European Space Agency (ESA) and the project consortium. This provides an excellent opportunity for interested organisations to influence the project outputs to ensure their usefulness for the user communities.

All participants who provide requirements and support will be given access to all data, project information and outputs produced by the project. This will be facilitated through a Web Portal and Web GIS interface.

The technical requirements for the products are derived from the Earth Observation data and expert knowledge of state of the algorithms for retrieval of several bio-geo-physical parameters. These parameters will be used to finally derive biodiversity indicators. The definition of these indicators as well as the tailoring of the project products will be based on the response from participating and supporting organisations.

The requirements that you specify in this questionnaire will be used as input to tailor the Diversity products, including status and change maps, trend analysis and biodiversity indicators. To generate higher level status and trend indicators we also need information on requirements for aggregations of data.

The completeness of this information and the level of detail received will directly impact the products produced and their ability to meet the user needs of the Inland Water biodiversity communities. You are therefore kindly requested to fill-in all sections of the Diversity II user requirement questionnaire as accurately and thoroughly as possible.

All participating organisations will have unrestricted access to the project documentation and will receive at no cost all products (maps, indicators and documentations).

The following pages constitute the Questionnaire for the product requirements for inland waters, to be filled in by organisations interested in participating in the *Diversity II* project and/or who would like to contribute support in the form of advice and feedback.

Could you please fill-in the provided Questionnaire as accurately and thoroughly as possible, and return the completed Questionnaire at the indicated address within the next 3 weeks.

We look forward to your response and hope you will enjoy filling in the Questionnaire. Should you need any clarification on how to answer, you can contact Per Wramner either by email at per.wramner@brockmann-geomatics.se or by phone at +46 702604708.

If you fill in this questionnaire please return to:

Per Wramner
Diversity II User Bureau
Brockmann Geomatics AB
Torshamnsgatan 39
164 40 KISTA Sweden
Tel: +46 702604708
Email: per.wramner@brockmann-geomatics.se

Subject/objet ***Diversity II* User Product Requirements Inland Waters**

1. Organisation details	
Organisation	
Contact Name	
Position of the Contact within the organisation	
Postal address	
Email	
Telephone	
Type of organisation e.g. IGO, NGO, Scientific Body, Biodiversity or Earth Observation focus	
Brief description of the organisation's activities and its role in relation to the CBD and to the conservation and wise use of Inland Waters.	

2. Region / Country	
Region / Country (geographical area of interest)	

3. Existing Activities / Projects
Please provide details of existing activities / projects which could, even partly, complement the work planned in Diversity II. To achieve the best synergy with existing projects, existing activities should be taken into account when defining the work plan of the Diversity II project.

4. Requirements Overview

Please provide a general description of your applications including your requirements for Diversity II products. Highlight the major limitations of your current practices and the activity areas (e.g. biodiversity indicators for Inland Water assessment and/or management, reporting to the CBD) where you think the Diversity II project could help you.

5. Products and Indicators for Inland Water: Status, Change and Trends

In this table, please share your preferences and ideas about Inland Water products and indicators that you would like to be developed and demonstrated during the Diversity II project (please refer also to the product overview given in the Diversity II Executive Summary).

Please indicate on a scale of 0 to 4 as shown below, how do you judge the importance of the proposed products for your work:

0: Cannot tell
1: Not important, not interesting for your work
2: Might be interesting, lower priority
3: Interesting, medium priority
4: Interesting and relevant for your work, high priority

Description	Water Quality and Temperature					
Water Quality of large perennial inland water will be assessed through a set of parameters derived from ENVISAT MERIS and AATSR instruments.	***5.1. Parameters on water quality and temperature:***	0	1	2	3	4
	5.1.1 Turbidity:	.	.	.	.	.
	5.1.2 Secchi Disk depth	.	.	.	.	.
	5.1.3 Chlorophyll-a concentration	.	.	.	.	.
	5.1.4 Suspended sediment conc.	.	.	.	.	.
	5.1.5 Yellow substance absorption	.	.	.	.	.
	5.1.6 Quality indicator	.	.	.	.	.
	5.1.7 Variance of parameter during averaging interval	.	.	.	.	.
	5.1.8 Lake Surface Water Temperature	.	.	.	.	.
	5.1.9 Uncertainty estimate for lake surface temperature	.	.	.	.	.
	5.1.10 Chi-squared (goodness of fit measure for OE retrieval	.	.	.	.	.
	5.1.11 Variance of LSWT over averaging period/area over averaging period/area	.	.	.	.	.

	Further suggestions and/or comments?
	5.2. Temporal Aggregation of water quality and temperature parameters 0 1 2 3 4 5.2.1 None . . . . . 5.2.2 Daily . . . . . 5.2.3 Monthly . . . . . 5.2.4 Yearly . . . . . 5.2.5 Climatology . . . . . 5.2.4 Time series . . . . .
	Further suggestions and/or comments?
	5.3. Water Quantity parameters 0 1 2 3 4 5.3.1 Water height difference to reference level . . . . . 5.3.2 Water volume difference . . . . . 5.3.3 Horizontal extent of the lake water surface . . . . .
	Further suggestions and/or comments?

<table>
<tr><th>Description</th><th colspan="6">First level indicators:
Changes and Trends of Water Quality and Quantity products</th></tr>
<tr><td rowspan="2">Changes and trends of water quality and quantity potentially point to developments with impacts on biodiversity.
Differences between single years or epochs are to a large degree part of the “normal” variability of inland water conditions.
Abrupt and big changes as well as longer term trends, however, may be hints of changed conditions for biodiversity.
The parameters are:
<table><tr><th>Parameter</th><th>Indicator for</th></tr><tr><td>Chla</td><td>Eutrophication</td></tr><tr><td>TSM</td><td>Physical disturbance</td></tr><tr><td>Yellow Substance</td><td>Contamination</td></tr><tr><td>Turbidity</td><td>Physical disturbance and/or contamination</td></tr><tr><td>Secchi Depth</td><td>Physical disturbance and/or contamination</td></tr><tr><td>Temperature</td><td>Eutrophication</td></tr><tr><td>Volume and extend</td><td>Physical disturbance, rain fall</td></tr></table>
The epochs are:
Epoch 1 = 2004 – 2006
Epoch 2 = 2007 – 2009
Epoch 3 = 2010 – 2012</td><td colspan="6">5.4. Change Maps of water quality and water quantity status between “epochs”</td></tr>
<tr><td>5.4.1 Averages of <parameter*> for the three <epochs*>
* see left side</td><td>0
.</td><td>1
.</td><td>2
.</td><td>3
.</td><td>4
.</td></tr>
<tr><td>5.4.2 Trend <parameter> between <epoch i**> and <epoch j**>
** i and j are any combination of the three epochs; e.g. the trend from epoch 1 to epoch 2</td><td>.</td><td>.</td><td>.</td><td>.</td><td>.</td></tr>
<tr><td>5.4.3 Lake status = Mean(epoch1)/Mean(epoch2)</td><td>.</td><td>.</td><td>.</td><td>.</td><td>.</td></tr>
<tr><td>5.4.4 Lake trend = Trend(epoch 1/2) and Trend(epoch2/3) are positive, negative, stable, uncertain</td><td>.</td><td>.</td><td>.</td><td>.</td><td>.</td></tr>
<tr><td colspan="6">Further suggestions and/or comments?</td></tr>
</table>

Description	Second level indicators					
Second level indicators combine several of the above listed contents and complement them with additional information such as land use or biodiversity data, thus aiming at establishing links to biodiversity and its drivers. Compared to the descriptive level of the status, change and trend maps of vegetation productivity, the second level indicator maps will provide more abstract information on the dynamics of biological productivity, drivers, and potential biodiversity trends.	***5.5. Second Level Indicators***	0	1	2	3	4
	5.5.1 Area of the pelagic photic zone and the area of the aphotic zone	·	·	·	·	·
	5.5.2 Pressure on the photic zone due to changes in water level	·	·	·	·	·
	5.5.3 Habitat variety index (structure of the shoreline combined with water quality)	·	·	·	·	·
	Further suggestions and/or comments?					

Description	Accuracy and Validation of Inland Water Products					
Accuracy assessments and validation efforts will be made at various levels of the products, and will relate to the following questions: • Quality and scope of the retrieval algorithms • Accuracy of the water quality parameters • Relation of the results to biodiversity	**5.6. Accuracy checks and validation**	0	1	2	3	4
	5.6.1 Metadata describing characteristics and quality of input data, e.g. processing parameters, or number of MERIS observations within integration etc	·	·	·	·	·
	5.6.2 Plausibility checks (e.g. transects across a lake, time series to check the occurrence of blooms etc	·	·	·	·	·
	5.6.3 Accuracy of water leaving reflectances by comparison with in-situ reflectance measurements	·	·	·	·	·
	5.6.4 Accuracy of the water quality and temperature parameters by comparison with in situ measurements	·	·	·	·	·
	5.6.5 Comparison of the higher level indicators (status, trends, second level indicators) with in situ data on biodiversity	·	·	·	·	·

	Further suggestions and/or comments?

6. Product Requirements	
In this table, please specify the requirements of the Inland Water Products that you would like to be developed and demonstrated during the Diversity II project and for which sites. Please motivate your answers. ***For further explanation please refer to the list of products given in the Diversity II Executive Summary.***	
Spatial Coverage *Please indicate your area of interest. You can specify e.g. the name of a lake, or a larger area with several lakes (lake system). If possible please provide the coordinates of a bounding box.*	
Spatial integration *Please indicate the spatial integration required.*	☐ no spatial integration (i.e. keep original satellite pixels) ☐ water body within a lake (i.e. average all pixels within a water body) ☐ whole lake (i.e. one value for the whole lake) ☐ lake system ☐ administrative local ☐ administrative regional ☐ administrative national ☐ protected area ☐ hot spot ☐ bio-geographic region ☐ other ….

Temporal integration *Please provide a description of the temporal integration required, e.g. yearly, bi-annually, monthly, seasonally, other.* *Please refer to the indicators listed under question 5 if there are different requirements per indicator.*	Water Quality and Water Quantity parameters	☐ daily ☐ weekly ☐ monthly ☐ seasonal	☐ yearly ☐ epoch ☐ other …
	First level indicators: changes and trends of Water Quality and Quantity products	☐ monthly ☐ seasonal ☐ yearly	☐ epoch ☐ other …
	Second level indicators	☐ daily ☐ weekly ☐ monthly ☐ seasonal	☐ yearly ☐ epoch ☐ other …
Frequency of updates *Please provide a description of the temporal frequency required, i.e. how often you require information.*	Water Quality and Water Quantity parameters	☐ daily ☐ weekly ☐ monthly ☐ seasonal	☐ yearly ☐ epoch ☐ other …
	First level indicators: changes and trends of Water Quality and Quantity products	☐ monthly ☐ seasonal ☐ yearly	☐ epoch ☐ other …
	Second level indicators	☐ daily ☐ weekly ☐ monthly ☐ seasonal	☐ yearly ☐ epoch ☐ other …
Accuracy requirements for Water Quality Parameters *Please specify accuracy requirements for the parameters listed under question 5.1.*	Turbidity:		
	Secchi Disk depth:		
	Chlorophyll-a concentration:		
	Suspended sediment conc.:		
	Yellow substance absorption:		
	Lake Surface Water Temperature:		

<table>
<tr><th colspan="2">7. Inland Water sites</th></tr>
<tr><td colspan="2">Results will be produced for 300 large perennial Inland Water sites for the time period 2002-2012. In question 6 we asked for the inland water sites of your direct interest. Here we would like to get your opinion which other inland waters should be in included in the final list of 300 lakes. A justification of your choice would be appreciated.</td></tr>
<tr><td>Sites
List Inland Water sites of your interest by order of priority, preferably with coordinates, for the area for which products are required.</td><td></td></tr>
<tr><td rowspan="2">Available data
Please list any data that would be available as additional information for the proposed Inland Water supporting the product generation (including the sites you specified under question 6)
Please indicate also if there are any restrictions on the use and disclosure of these data.</td><td></td></tr>
<tr><td>Terms of use:
☐ can be made publicly available
☐ publication on request
☐ restricted to use within the project</td></tr>
</table>

9. Other
Is there anything else you think should be taken into account in tailoring the products, but which doesn't seem to fit into any of the other boxes?

10. Recommended additional contacts
We are intending to involve as completely as possible those organisations that could benefit from the Diversity II Products. Please list any other organisations (including contact names) that you think would be interested.

Annex 14 Diversity II Product Requirements Questionnaire for Drylands

"Drylands" Products Requirements User Questionnaire

Get free access to 10 years of geophysical remote sensing products of your study site

Provide us with your expertise about biodiversity indicators

Benefit from future product enhancements based on your suggestions

Purpose of collecting Product Requirements

The Earth Observation (EO) and Biodiversity organisations that would like to participate in the *Diversity II* project are cordially invited to provide user products requirements to the European Space Agency (ESA) and the project consortium. This provides an excellent opportunity for interested organisations to influence the project outputs to ensure their usefulness for the user communities.

All participants who provide requirements and support will be given access to all data, project information and outputs produced by the project. This will be facilitated through a Web Portal and Web GIS interface.

The technical requirements for the products are derived from the Earth Observation data and expert knowledge of state of the algorithms for retrieval of several bio-geo-physical parameters. These parameters will be used to finally derive biodiversity indicators. The definition of these indicators as well as the tailoring of the project products will be based on the response from participating and supporting organisations.

The requirements that you specify in this questionnaire will be used as input to tailor the Diversity products, including status and change maps, trend analysis and biodiversity indicators. To generate higher level status and trend indicators we also need information on requirements for aggregations of data.

The completeness of this information and the level of detail received will directly impact the products produced and their ability to meet the user needs of the Dryland biodiversity communities. You are therefore kindly requested to fill-in all sections of the Diversity II user requirement questionnaire as accurately and thoroughly as possible.

All participating organisations will have unrestricted access to the project documentation and will receive at no cost all products (maps, indicators and documentations).

The following pages constitute the Questionnaire for the product requirements for drylands to be filled in by organisations interested in participating in the *Diversity II* project and/or who would like to contribute support in the form of advice and feedback.

Could you please fill-in the provided Questionnaire as accurately and thoroughly as possible, and return the completed Questionnaire at the indicated address within the next 3 weeks.

We look forward to your response and hope you will enjoy filling in the Questionnaire. Should you need any clarification on how to answer, you can contact Per Wramner either by email at per.wramner@brockmann-geomatics.se or by phone at +46 702604708.

If you fill in this questionnaire please return to:

Per Wramner
Diversity II User Bureau
Brockmann Geomatics AB
Torshamnsgatan 39
164 40 KISTA Sweden
Tel: +46 702604708
Email: per.wramner@brockmann-geomatics.se

Subject/objet ***Diversity II* User Product Requirements Drylands**

1. Organisation details	
Organisation	
Contact Name	
Position of the Contact within the organisation	
Postal address	
Email	
Telephone	
Type of organisation e.g. IGO, NGO, Scientific Body, Biodiversity or Earth Observation focus	
Brief description of the organisation's activities and its role in relation to the CBD and to the conservation and wise use of Drylands.	

2. Region / Country	
Region / Country (geographical area of interest)	

3. Existing Activities / Projects
Please provide details of any existing activities / projects which could, even partly, complement the work planned in Diversity II. To achieve the best synergy with existing projects, any existing activities should be taken into account when defining the work plan of the Diversity II project.

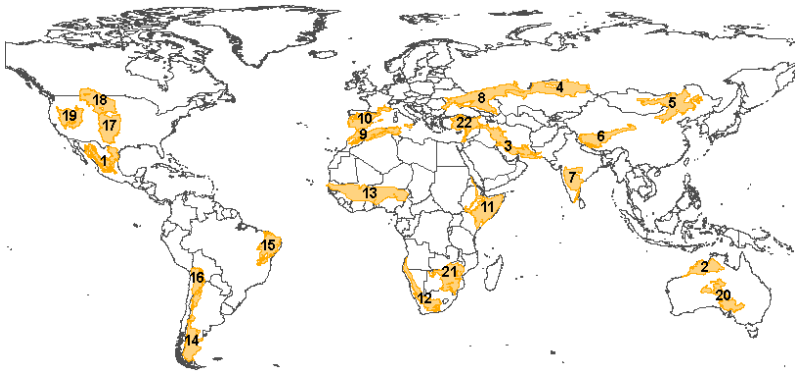
4. Requirements Overview
Please provide a general description of your applications including your requirements for Diversity II products. Highlight the major limitations of your current practices and the activity areas (e.g. biodiversity indicators for Dryland assessment and/or management, reporting to the CBD) where you think the Diversity II project could help you. Please make reference to the Diversity II products and initial indicators listed in the Diversity II Executive Summary.

5. Maps and Indicators for Dryland: Status, Change and Trends	
In this table, please share your preferences and ideas about Dryland maps and indicators that you would like to be developed and demonstrated during the Diversity II project (please refer also to the product overview given in the Diversity II Executive Summary). ***Please indicate on a scale of 0 to 4 as shown below, how do you judge the importance of the proposed products for your work:*** **0: Cannot tell** **1: Not important, not interesting for your work** **2: Might be interesting, lower priority** **3: Interesting, medium priority** **4: Interesting and relevant for your work, high priority**	
Description	**Status of Vegetation Productivity and Water Use Efficiency in Drylands**
The status of vegetation productivity is mapped by ENVISAT MERIS based spectral indices of Net Primary Productivity (NPP) and by indices that relate NPP to the available water (e.g. Rain Use Efficienc). The DIVERSITY II product portfolio has variations with regard to • the type of NPP index, • temporal aggregation, • the type of water information used (rainfall, soil moisture, evapotrans-piration)	***1. Type of NPP Index:*** 1.1 Indices based on MERIS fAPAR - fraction of photosynthetically active radiation absorbed by the vegetation: 0 1 2 3 4 1.2 Indices based on MERIS NDVI (Normalised Difference Vegetation Index, spectrally adapted to NOAA AVHRR NDVI) 0 1 2 3 4 1.3 All together for comparison 0 1 2 3 4 ***Further suggestions and/or comments?***

• spatial aggregation	***2. Temporal Aggregation of vegetation productivity*** 2.1 Maps of vegetation productivity for entire vegetation years (wet and dry season) 0 1 2 3 4 2.2 Maps of vegetation productivity for Vegetation seasons 0 1 2 3 4 2.3 Maps of vegetation productivity for "Epochs" (3 vegetation years) 0 1 2 3 4 2.4 All together for comparison 0 1 2 3 4 ***Further suggestions and/or comments?***
	3. Type of Water Information Used for Efficiency Indices 3. 1 Rain Use Efficiency 0 1 2 3 4 3.2 Soil Moisture Use Efficiency 0 1 2 3 4 3.3 Water Use Efficiency 0 1 2 3 4 3.4 All together for comparison 0 1 2 3 4 ***Further suggestions and/or comments?***
	4. Spatial Aggregation of vegetation productivity maps 4.1 Administrative areas 0 1 2 3 4 4.2 Protected areas 0 1 2 3 4 4.3 Land cover classes / types 0 1 2 3 4 4.4 Degree of aridity 0 1 2 3 4 4.5 Continent 0 1 2 3 4 ***Further suggestions and/or comments?***

Description	Changes and Trends of Vegetation Productivity
Changes and trends of vegetation productivity potentially point to developments with impacts on biodiversity. Differences between single years or epochs are to a large degree part of the "normal" variability of dryland conditions. Abrupt and big changes as well as longer term trends, however, may be hints of changed conditions for biodiversity.	***5. Change Maps of vegetation productivity status and water use efficiency indices between "epochs" (3-year periods 2002 – 2012)*** 5.1 Change maps of NPP status maps (MERIS fAPAR, NDVI) 0 1 2 3 4 5.2 Change maps of rain/soil moisture/water use efficiency 0 1 2 3 4 ***Further suggestions and/or comments?***
	6.Trend maps of vegetation productivity status and water use efficiency indices (based on vegetation years and seasons 2002 to 2012) 6.1 Vegetation productivity (MERIS fAPAR, NDVI) 0 1 2 3 4 6.2 Rain use efficiency 0 1 2 3 4 6.3 Soil moisture use efficiency 0 1 2 3 4 6.4 Water use efficiency 0 1 2 3 4 6.5 All together for comparison 0 1 2 3 4 ***Further suggestions and/or comments?***
	7. Trend maps of water availability 7.1 Rainfall 0 1 2 3 4 7.2 Soil moisture 0 1 2 3 4 7.3 Evapotranspiration 0 1 2 3 4 ***Further suggestions and/or comments?***
	8. Spatial Aggregation of change and trend maps 4.1 Administrative areas 0 1 2 3 4 4.2 Protected areas 0 1 2 3 4 4.3 Land cover classes / types 0 1 2 3 4 4.4 Degree of aridity 0 1 2 3 4 4.5 Continent 0 1 2 3 4 ***Further suggestions and/or comments?***

Description	**Second level indicators**
Second level indicators combine several of the above listed contents and complement them with additional information such as land use or biodiversity data, thus aiming at establishing links to biodiversity and its drivers. Compared to the descriptive level of the status, change and trend maps of vegetation productivity, the second level indicator maps will provide more abstract information on the dynamics of vegetation productivity, drivers, and potential biodiversity trends. .	***9. Classification of the status, change and trend maps according to selected combinations of the above listed products and information*** 9.1 Classified size and direction of changes and trends combined with the status information 0 1 2 3 4 9.2 Classified size and direction of changes and trends of water use efficiency combined with selected parameters and indices (e.g. leading to classes potentially pointing to biodiversity changes such as: - regions with a low general level of NPP with a strong positive trend of water use efficiency and increasing rainfall - regions with high initial vegetation productivity and a strong negative trend of water use efficiency - regions with significant positive NPP trends during dry seasons with or without rainfall trends 0 1 2 3 4 ***Further suggestions and/or comments?***
Description	**Accuracy and Validation of Dryland Products**
Accuracy assessments and validation efforts will be made at various levels of the products, and will relate to the following questions: • Validity of the input data • Accuracy of the NPP indices • Relation of the results to biodiversity	10. Accuracy checks and validation 10.1 Metadata referring to number of MERIS observations within integration period (half months), to contaminated data, to no data 0 1 2 3 4 10.2 Qualitative comparisons of the input data, plausibility checks (e.g. time series diagrams of NPP indices vs. rainfall, soil moisture and evapotranspiration 0 1 2 3 4 10.3 Accuracy of the NPP indices Comparison with in situ fAPAR, Comparison with modelled NPP 0 1 2 3 4 10.4 Comparison of the results with in situ data on biodiversity 0 1 2 3 4 ***Further suggestions and/or comments?***

Description	**Dryland Testsites**
The 22 proposed global dryland sites have been selected according to the following criteria: • Aridity Index • WWF ecoregions • Biodiversity • Size *If you are interested in certain additional sites and/or can make contributions in these sites with data provided to the project, please indicate at the right.*	 ***Further suggestions and/or comments?***

6. Product Requirements	
In this table, please specify the requirements of the Dryland Products that you would like to be developed and demonstrated during the Diversity II project and for which sites. Please motivate your answers. ***For further explanation please refer to the list of products given in the Diversity II Executive Summary.***	
Spatial Coverage *Please provide a description of the required spatial coverage, i.e. area of interest.* *Please refer to the indicators listed under question 5 if there are different requirements per indicator.*	
Spatial resolution *Please provide a description of the spatial resolution required, i.e. the minimum mapping unit that you require.* *Please refer to the indicators listed under question 5 if there are different requirements per indicator.*	
Spatial integration *Please provide a description of*	☐ continent

the spatial integration required, e.g. lake site, lake systems, continent, global, administrative (local, regional, national), protected area, hot spot, bio-geographic region, biome, land cover, other zones or combinations. *Please refer to the indicators listed under question 5 if there are different requirements per indicator.*	☐ global ☐ administrative local ☐ administrative regional ☐ administrative national ☐ protected area ☐ hot spot ☐ bio-geographic region ☐ land cover ☐ other …. ☐ other ….
Frequency of updates *Please provide a description of the temporal frequency required, i.e. how often you require information.* *Please refer to the indicators listed under question 5 if there are different requirements per indicator.*	1. Parameter status and change maps a. … b. … 2. Trends a. … b. … 3. Indicators a. … b. …
Temporal integration *Please provide a description of the temporal integration required, e.g. yearly, bi-annually, monthly, seasonally, other.* *Please refer to the indicators listed under question 5 if there are different requirements per indicator.*	1. Parameter status and change maps a. … b. … 2. Trends a. … b. … 3. Indicators a. … b. …
Accuracy requirements *Please provide a description of the accuracy requirements* *Please refer to the indicators listed under question 5 if there are different requirements per indicator.*	1. Parameter status and change maps a. … b. … 2. Trends a. … b. … 3. Indicators a. … b. …
Aggregation requirements *Please provide a description of*	☐ aggregation of indicators

the aggregation requirements. Examples are provided on the right, but please specify other, more appropriate if you need.	☐ aggregation over time ☐ aggregation with other data ☐ with land cover data ☐ land productivity data ☐ soil moisture data ☐ other (please specify)

7. Dryland Sites	
Results will be produced for for 22 Dryland regions for the time period 2002-2012. For a tentative list of sites please refer to the Diversity II Executive Summary. To determine a final list we would appreciate your input.	
Sites *List the Dryland sites of interest by order of priority, preferably with coordinates, for the area for which products are required.* *Please refer to the indicators listed under question 5 if there are different requirements per indicator.*	
Available data *Please list any data that would be available as additional information for the proposed Dryland sites, supporting the product generation.* *Please indicate also if there are any restrictions on the use and disclosure of these data.*	Terms of use: ☐ can be made publicly available ☐ publication on request ☐ restricted to use within the project

8. Validation requirements and reference data availability	
Validation of the products is critical for acceptance of the products by users. Please indicate here what kind of validation you would require / accept. If you have reference data (in-situ data) available that could support the validation activities please indicate here.	
Validation Requirements *Please specify the type of validation you would expect/accept that you need as a proof of product quality*	
Available data *Please list any data that would be available for the validation of Dryland products.* *Please indicate also if there are any restrictions on the use and disclosure of these data.*	Terms of use: ☐ can be made publicly available ☐ publication on request ☐ restricted to use within the project

9. Other
Is there anything else you think should be taken into account in tailoring the products, but which doesn't seem to fit into any of the other boxes?

10. Recommended additional contacts
We are intending to involve as completely as possible those organisations that could benefit from the Diversity II Products. Please list any other organisations (including contact names) that you think would be interested.

Annex 15 Returned User Questionnaires

15.1 JRC Land Resource Management Unit

1. Organisation details	
Organisation	European Commission
Contact Name	Alan Belward
Position of the Contact within the organisation	head of Land Resource Management Unit
Postal address	Via E. Fermi, Ispra, Varese Italy
Email	alan.belward@jrc.ec.europa.eu
Telephone	+39 0332 789298
Type of organisation e.g. IGO, NGO, Scientific Body, Biodiversity or Earth Observation focus	Govenment
Brief description of the organisation's activities and its role in relation to the CBD and to the conservation and wise use of Inland Waters.	The Joint Research Centre's mission is to provide EU policies with independent, evidence-based scientific and technical support throughout the whole policy cycle.
2. Region / Country	
Region / Country (geographical area of interest)	Global

3. Existing Activities / Projects
Please provide details of any existing activities / projects which could, even partly, complement the work planned in Diversity II. To achieve the best synergy with existing projects, any existing activities should be taken into account when defining the work plan of the Diversity II project.
EU strategic and policy priorities including the Commission's Rio +20 Action Plan and Resource Efficient Europe 2020 emphasize the need to protect, conserve and enhance the land's natural capital. We currently run a project to help realise EU commitments to the Rio +20 goal of achieving a land degradation neutral world. the prject develops methods and protocols for integrated assessment of land degradation and will contribute to the economic valuations of land degradation. Major milestones include the World Atlas on Desertification, to be released in 2014 and a status report on European Land degradation just published. See http://wad.jrc.ec.europa.eu for more detail.

Other relevant exercise is the Global Land Service run on behalf of Copernicus (our Unit manages the project on behalf of ENTR) http://land.copernicus.eu/global. This produces data across a wide range of biophysical variables at a global scale, which describe the state of vegetation (e.g. leaf area index), the energy budget (e.g. albedo) and the water cycle (e.g. soil moisture index)… which looks awfully like Diversity drylands product list.

Third relevant area is Digital Observatory for Protected Areas (DOPA) http://dopa.jrc.ec.europa.eu . This provides a large variety of endusers including park managers, decision-makers and researchers with means to assess, monitor and possibly forecast the state and pressure of protected areas at the global scale.

4. Requirements Overview

Please provide a general description of your applications including your requirements for Diversity II products. Highlight the major limitations of your current practices and the activity areas (e.g. biodiversity indicators for Dryland assessment and/or management, reporting to the CBD) where you think the Diversity II project could help you. Please make reference to the Diversity II products and initial indicators listed in the Diversity II Executive Summary.

see above for applications: All the products in your exec summary have potential value for DOPA and for WAD. There may be overlap with Copernicus global land service though, which currently feeds these two major projects. The WAD analysis currently uses 1982 to 2012 AVHRR time series - the data sets you propose should be better given the performance of MERIS with respect to AVHR, but our analysis uses the 30 year time frame to compute land degradation / land productivity measures. We wouldn't need aggregation by land cover class or by protected area as we have our own access to these data, but the MERIS derived time series for all variables would be welcome. The change maps and trend maps are less important for us as again we have in house methods for calculating these factors. Validation is critical. Where will you get the in situ biodiversity data from (10.4)? We rely on IUCN, GBIF, Birdlife international and WCMC.

5. Maps and Indicators for Dryland: Status, Change and Trends

In this table, please share your preferences and ideas about Dryland maps and indicators that you would like to be developed and demonstrated during the Diversity II project (please refer also to the product overview given in the Diversity II Executive Summary).

Please indicate on a scale of 0 to 4 as shown below, how do you judge the importance of the proposed products for your work:

0: Cannot tell

1: Not important, not interesting for your work

2: Might be interesting, lower priority

3: Interesting, medium priority

4: Interesting and relevant for your work, high priority

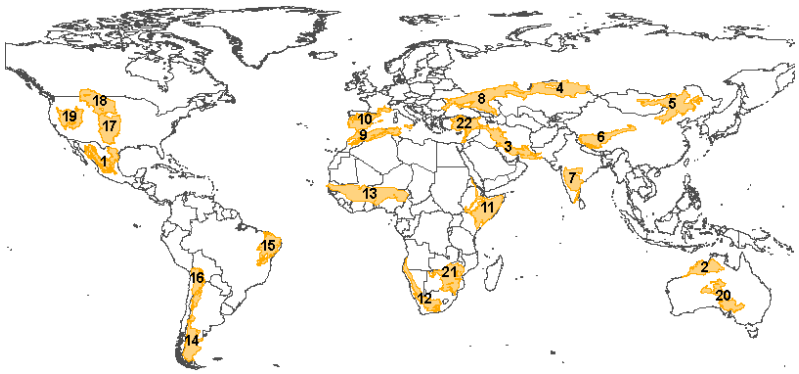
Description	Status of Vegetation Productivity and Water Use Efficiency in Drylands
The status of vegetation productivity is mapped by ENVISAT MERIS based spectral indices of Net Primary Productivity (NPP) and by indices that relate NPP to the available water (e.g. Rain Use Efficienc). The DIVERSITY II product portfolio has variations with regard to • the type of NPP index, • temporal aggregation, • the type of water information used (rainfall, soil moisture, evapotrans-piration) • spatial aggregation	***1. Type of NPP Index:*** 1.1 Indices based on MERIS fAPAR - fraction of photosynthetically active radiation absorbed by the vegetation: 0 1 2 3 4 ☐ ☐ ☐ ☐ ☒ 1.2 Indices based on MERIS NDVI (Normalised Difference Vegetation Index, spectrally adapted to NOAA AVHRR NDVI) 0 1 2 3 4 ☐ ☐ ☒ ☐ ☐ 1.3 All together for comparison 0 1 2 3 4 ☐ ☐ ☒ ☐ ☐ ***Further suggestions and/or comments?*** What do you do now that communication with ENVISAT has been lost?
	2. Temporal Aggregation of vegetation productivity 2.1 Maps of vegetation productivity for entire vegetation years (wet and dry season) 0 1 2 3 4 ☐ ☐ ☐ ☐ ☒ 2.2 Maps of vegetation productivity for Vegetation seasons 0 1 2 3 4 ☒ ☐ ☐ ☐ ☐ 2.3 Maps of vegetation productivity for “Epochs” (3 vegetation years) 0 1 2 3 4 ☐ ☐ ☐ ☐ ☒ 2.4 All together for comparison 0 1 2 3 4 ☒ ☒ ☐ ☐ ☐ ***Further suggestions and/or comments?***
	3. Type of Water Information Used for Efficiency Indices 3. 1 Rain Use Efficiency 0 1 2 3 4 ☐ ☐ ☐ ☐ ☒ 3.2 Soil Moisture Use Efficiency 0 1 2 3 4

	☐ ☐ ☐ ☐ ☒ 3.3 Water Use Efficiency 0 1 2 3 4 ☐ ☐ ☐ ☐ ☒ 3.4 All together for comparison 0 1 2 3 4 ☐ ☐ ☐ ☐ ☒ ***Further suggestions and/or comments?***
	4. Spatial Aggregation of vegetation productivity maps 4.1 Administrative areas 0 1 2 3 4 ☒ ☐ ☐ ☐ ☐ 4.2 Protected areas 0 1 2 3 4 ☒ ☐ ☐ ☐ ☐ 4.3 Land cover classes / types 0 1 2 3 4 ☒ ☐ ☐ ☐ ☐ 4.4 Degree of aridity 0 1 2 3 4 ☒ ☐ ☐ ☐ ☐ 4.5 Continent 0 1 2 3 4 ☒ ☐ ☐ ☐ ☐ ***Further suggestions and/or comments?***

Description	Changes and Trends of Vegetation Productivity
Changes and trends of vegetation productivity potentially point to developments with impacts on biodiversity. Differences between single years or epochs are to a large degree part of the "normal" variability of dryland conditions. Abrupt and big changes as well as longer term trends, however, may be hints of changed conditions for biodiversity.	***5. Change Maps of vegetation productivity status and water use efficiency indices between "epochs" (3-year periods 2002 – 2012)*** 5.1 Change maps of NPP status maps (MERIS fAPAR, NDVI) 0 1 2 3 4 ☒ ☐ ☐ ☐ ☐ 5.2 Change maps of rain/soil moisture/water use efficiency 0 1 2 3 4 ☒ ☐ ☐ ☐ ☐ ***Further suggestions and/or comments?***
	6.Trend maps of vegetation productivity status and water use efficiency indices (based on vegetation years and seasons 2002 to 2012) 6.1 Vegetation productivity (MERIS fAPAR, NDVI) 0 1 2 3 4 ☒ ☐ ☐ ☐ ☐ 6.2 Rain use efficiency 0 1 2 3 4 ☒ ☐ ☐ ☐ ☐ 6.3 Soil moisture use efficiency 0 1 2 3 4 ☒ ☐ ☐ ☐ ☐ 6.4 Water use efficiency 0 1 2 3 4 ☒ ☐ ☐ ☐ ☐ 6.5 All together for comparison 0 1 2 3 4 ☒ ☐ ☐ ☐ ☐ ***Further suggestions and/or comments?***
	7. Trend maps of water availability 7.1 Rainfall 0 1 2 3 4 ☒ ☐ ☐ ☐ ☐

	7.2 Soil moisture 0 1 2 3 4 ☒ ☐ ☐ ☐ ☐ 7.3 Evapotranspiration 0 1 2 3 4 ☒ ☐ ☐ ☐ ☐ ***Further suggestions and/or comments?***
	8. Spatial Aggregation of change and trend maps 4.1 Administrative areas 0 1 2 3 4 ☒ ☐ ☐ ☐ ☐ 4.2 Protected areas 0 1 2 3 4 ☒ ☐ ☐ ☐ ☐ 4.3 Land cover classes / types 0 1 2 3 4 ☒ ☐ ☐ ☐ ☐ 4.4 Degree of aridity 0 1 2 3 4 ☒ ☐ ☐ ☐ ☐ 4.5 Continent 0 1 2 3 4 ☒ ☐ ☐ ☐ ☐ ***Further suggestions and/or comments?***
Description	**Second level indicators**

Second level indicators combine several of the above listed contents and complement them with additional information such as land use or biodiversity data, thus aiming at establishing links to biodiversity and its drivers. Compared to the descriptive level of the status, change and trend maps of vegetation productivity, the second level indicator maps will provide more abstract information on the dynamics of vegetation productivity, drivers, and potential biodiversity trends. .	***9. Classification of the status, change and trend maps according to selected combinations of the above listed products and information*** 9.1 Classified size and direction of changes and trends combined with the status information 0 1 2 3 4 ☒ ☐ ☐ ☐ ☐ 9.2 Classified size and direction of changes and trends of water use efficiency combined with selected parameters and indices (e.g. leading to classes potentially pointing to biodiversity changes such as: - regions with a low general level of NPP with a strong positive trend of water use efficiency and increasing rainfall - regions with high initial vegetation productivity and a strong negative trend of water use efficiency - regions with significant positive NPP trends during dry seasons with or without rainfall trends 0 1 2 3 4 ☒ ☐ ☐ ☐ ☐ ***Further suggestions and/or comments?***
Description	**Accuracy and Validation of Dryland Products**
Accuracy assessments and validation efforts will be made at various levels of the products, and will relate to the following questions: • Validity of the input data • Accuracy of the NPP indices • Relation of the results to biodiversity	10. Accuracy checks and validation 10.1 Metadata referring to number of MERIS observations within integration period (half months), to contaminated data, to no data 0 1 2 3 4 ☐ ☐ ☐ ☐ ☒ 10.2 Qualitative comparisons of the input data, plausibility checks (e.g. time series diagrams of NPP indices vs. rainfall, soil moisture and evapotranspiration 0 1 2 3 4 ☐ ☐ ☐ ☐ ☒ 10.3 Accuracy of the NPP indices Comparison with in situ fAPAR, Comparison with modelled NPP 0 1 2 3 4 ☐ ☐ ☐ ☐ ☒ 10.4 Comparison of the results with in situ data on biodiversity 0 1 2 3 4 ☐ ☐ ☐ ☐ ☒ ***Further suggestions and/or comments?***

Description	Dryland Testsites
The 22 proposed global dryland sites have been selected according to the following criteria: • Aridity Index • WWF ecoregions • Biodiversity • Size *If you are interested in certain additional sites and/or can make contributions in these sites with data provided to the project, please indicate at the right.*	 ***Further suggestions and/or comments?*** We have intensive field data collection in Tanzania

6. Product Requirements	
In this table, please specify the requirements of the Dryland Products that you would like to be developed and demonstrated during the Diversity II project and for which sites. Please motivate your answers. ***For further explanation please refer to the list of products given in the Diversity II Executive Summary.***	
Spatial Coverage *Please provide a description of the required spatial coverage, i.e. area of interest.* *Please refer to the indicators listed under question 5 if there are different requirements per indicator.*	global
Spatial resolution *Please provide a description of the spatial resolution required, i.e. the minimum mapping unit that you require.* *Please refer to the indicators listed under question 5 if there are different requirements per indicator.*	Global 100 metre would be ideal, but right now we would be happy with PROBA V resolution.
Spatial integration *Please provide a description of the spatial integration required, e.g. lake site, lake systems, continent, global, administrative (local, regional, national),*	☐ continent ☒ global ☐ administrative local ☐ administrative regional ☐ administrative national ☐ protected area ☐ hot spot

protected area, hot spot, bio-geographic region, biome, land cover, other zones or combinations. *Please refer to the indicators listed under question 5 if there are different requirements per indicator.*	☐ bio-geographic region ☐ land cover ☐ other …. ☐ other ….
Frequency of updates *Please provide a description of the temporal frequency required, i.e. how often you require information.* *Please refer to the indicators listed under question 5 if there are different requirements per indicator.*	4. Parameter status and change maps a. once a year b. 5. Trends c. d. 6. Indicators c. d.
Temporal integration *Please provide a description of the temporal integration required, e.g. yearly, bi-annually, monthly, seasonally, other.* *Please refer to the indicators listed under question 5 if there are different requirements per indicator.*	4. Parameter status and change maps a. yearly b. 5. Trends a. b. 6. Indicators a. b.
Accuracy requirements *Please provide a description of the accuracy requirements* *Please refer to the indicators listed under question 5 if there are different requirements per indicator.*	4. Parameter status and change maps a. If you can hit the GCOS accuracy requirements that's good enough. b. 5. Trends a. b. 6. Indicators a. b.
Aggregation requirements *Please provide a description of the aggregation requirements. Examples are provided on the right, but please specify other, more appropriate if you need.*	☐ aggregation of indicators ☐ aggregation over time ☐ aggregation with other data ☐ with land cover data ☐ land productivity data ☐ soil moisture data ☐ other (please specify)

7. Dryland Sites	
Results will be produced for for 22 Dryland regions for the time period 2002-2012. For a tentative list of sites please refer to the Diversity II Executive Summary. To determine a final list we would appreciate your input.	
Sites *List the Dryland sites of interest by order of priority, preferably with coordinates, for the area for which products are required.* *Please refer to the indicators listed under question 5 if there are different requirements per indicator.*	
Available data *Please list any data that would be available as additional information for the proposed Dryland sites, supporting the product generation.* *Please indicate also if there are any restrictions on the use and disclosure of these data.*	Terms of use: ☐ can be made publicly available ☐ publication on request ☐ restricted to use within the project

8. Validation requirements and reference data availability	
Validation of the products is critical for acceptance of the products by users. Please indicate here what kind of validation you would require / accept. If you have reference data (in-situ data) available that could support the validation activities please indicate here.	
Validation Requirements *Please specify the type of validation you would expect/accept that you need as a proof of product quality*	
Available data *Please list any data that would be available for the validation of Dryland products.* *Please indicate also if there are any restrictions on the use and disclosure of these data.*	Terms of use: ☐ can be made publicly available ☐ publication on request ☐ restricted to use within the project

9. Other
Is there anything else you think should be taken into account in tailoring the products, but which doesn't seem to fit into any of the other boxes?

10. Recommended additional contacts
We are intending to involve as completely as possible those organisations that could benefit from the Diversity II Products. Please list any other organisations (including contact names) that you think would be interested.
World Conservation Monitoring Centre, Cambridge UK

CSIR Bob Scholes

1. Organisation details	
Organisation	CSIR
Contact Name	RJ (Bob) Scholes
Position of the Contact within the organisation	Research group Leader
Postal address	PO Box 395 Pretoria 0001 South Africa
Email	bscholes@csir.co.za
Telephone	+27128412045
Type of organisation e.g. IGO, NGO, Scientific Body, Biodiversity or Earth Observation focus	Large national R&D organisation
Brief description of the organisation's activities and its role in relation to the CBD and to the conservation and wise use of Drylands.	Covers many fields. Have ~300 staff in the environment field, working on among other things, carbon cycle, biodiversity, ecosystem services, water

2. Region / Country	
Region / Country (geographical area of interest)	Southern Africa

3. Existing Activities / Projects
Please provide details of any existing activities / projects which could, even partly, complement the work planned in Diversity II. To achieve the best synergy with existing projects, any existing activities should be taken into account when defining the work plan of the Diversity II project.
Vital Signs Africa: Integrated observations of human wellbeing, agriculture and ecosystem services in 3 large regions of Africa South Africa Carbon stocks and fluxes: measurement of GPP over all of South Africa at fine resolution, including the dryland areas

4. Requirements Overview
Please provide a general description of your applications including your requirements for Diversity II products. Highlight the major limitations of your current practices and the activity areas (e.g. biodiversity indicators for Dryland assessment and/or management, reporting to the CBD) where you think the Diversity II project could help you. Please make reference to the Diversity II products and initial indicators listed in the Diversity II Executive Summary.
We have an interest in NPP products, including trend analyses

5. Maps and Indicators for Dryland: Status, Change and Trends	
In this table, please share your preferences and ideas about Dryland maps and indicators that you would like to be developed and demonstrated during the Diversity II project (please refer also to the product overview given in the Diversity II Executive Summary). ***Please indicate on a scale of 0 to 4 as shown below, how do you judge the importance of the proposed products for your work:*** **0: Cannot tell** **1: Not important, not interesting for your work** **2: Might be interesting, lower priority** **3: Interesting, medium priority** **4: Interesting and relevant for your work, high priority**	
Description	**Status of Vegetation Productivity and Water Use Efficiency in Drylands**
The status of vegetation productivity is mapped by ENVISAT MERIS based spectral indices of Net Primary Productivity (NPP) and by indices that relate NPP to the available water (e.g. Rain Use Efficienc). The DIVERSITY II product portfolio has variations with regard to • the type of NPP index, • temporal aggregation, • the type of water information used (rainfall, soil moisture, evapotrans-piration)	***1. Type of NPP Index:*** 1.1 Indices based on MERIS fAPAR - fraction of photosynthetically active radiation absorbed by the vegetation: 0 1 2 3 4 ☐ ☐ ☐ ☐ ☒ 1.2 Indices based on MERIS NDVI (Normalised Difference Vegetation Index, spectrally adapted to NOAA AVHRR NDVI) 0 1 2 3 4 ☐ ☐ ☒ ☐ ☐ 1.3 All together for comparison 0 1 2 3 4 ☐ ☐ ☒ ☐ ☐ ***Further suggestions and/or comments?*** The devil is in the detail. FAPAR by itself is not that useful. FAPAR

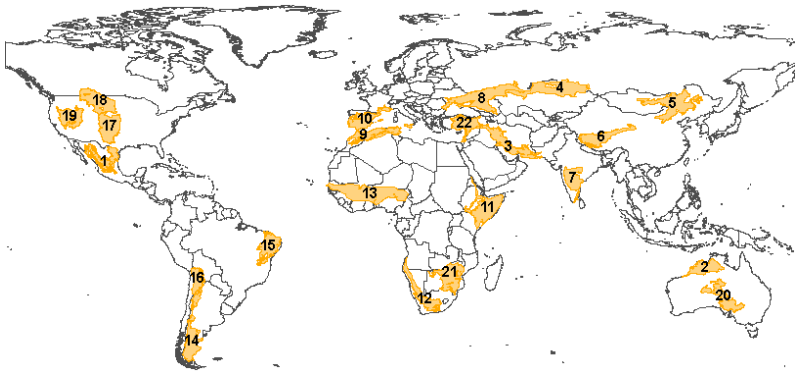
• spatial aggregation	processed through an intelligent model to get NPP is.
	2. Temporal Aggregation of vegetation productivity 2.1 Maps of vegetation productivity for entire vegetation years (wet and dry season) 0 1 2 3 4 ☐ ☐ ☐ ☒ ☐ 2.2 Maps of vegetation productivity for Vegetation seasons 0 1 2 3 4 ☐ ☐ ☐ ☐ ☒ 2.3 Maps of vegetation productivity for "Epochs" (3 vegetation years) 0 1 2 3 4 ☐ ☐ ☒ ☐ ☐ 2.4 All together for comparison 0 1 2 3 4 ☐ ☐ ☒ ☐ ☐ ***Further suggestions and/or comments?***
	3. Type of Water Information Used for Efficiency Indices 3. 1 Rain Use Efficiency 0 1 2 3 4 ☐ ☐ ☒ ☐ ☐ 3.2 Soil Moisture Use Efficiency 0 1 2 3 4 ☐ ☐ ☒ ☐ ☐ 3.3 Water Use Efficiency

	0 1 2 3 4 ☐ ☐ ☐ ☒ ☐ 3.4 All together for comparison 0 1 2 3 4 ☐ ☐ ☒ ☐ ☐ ***Further suggestions and/or comments?*** Again, it depends on definitions. The standare RUE (=NPP/rain) is almost useless
	4. Spatial Aggregation of vegetation productivity maps 4.1 Administrative areas 0 1 2 3 4 ☐ ☐ ☐ ☒ ☐ 4.2 Protected areas 0 1 2 3 4 ☐ ☐ ☒ ☐ ☐ 4.3 Land cover classes / types 0 1 2 3 4 ☐ ☐ ☐ ☐ ☒ 4.4 Degree of aridity 0 1 2 3 4 ☐ ☐ ☒ ☐ ☐ 4.5 Continent 0 1 2 3 4 ☐ ☐ ☒ ☐ ☐ ***Further suggestions and/or comments?***

Description	Changes and Trends of Vegetation Productivity
Changes and trends of vegetation productivity potentially point to developments with impacts on biodiversity. Differences between single years or epochs are to a large degree part of the "normal" variability of dryland conditions. Abrupt and big changes as well as longer term trends, however, may be hints of changed conditions for biodiversity.	***5. Change Maps of vegetation productivity status and water use efficiency indices between "epochs" (3-year periods 2002 – 2012)*** 5.1 Change maps of NPP status maps (MERIS fAPAR, NDVI) 0 1 2 3 4 ☐ ☐ ☐ ☒ ☐ 5.2 Change maps of rain/soil moisture/water use efficiency 0 1 2 3 4 ☐ ☐ ☐ ☒ ☐ ***Further suggestions and/or comments?*** Only as good as their underlying indices
	6.Trend maps of vegetation productivity status and water use efficiency indices (based on vegetation years and seasons 2002 to 2012) 6.1 Vegetation productivity (MERIS fAPAR, NDVI) 0 1 2 3 4 ☐ ☐ ☐ ☐ ☒ 6.2 Rain use efficiency 0 1 2 3 4 ☐ ☐ ☐ ☒ ☐ 6.3 Soil moisture use efficiency 0 1 2 3 4 ☐ ☐ ☐ ☒ ☐ 6.4 Water use efficiency 0 1 2 3 4 ☐ ☐ ☐ ☐ ☒ 6.5 All together for comparison 0 1 2 3 4 ☐ ☐ ☒ ☒ ☐ ***Further suggestions and/or comments?*** Linear trend is of limited use
	7. Trend maps of water availability 7.1 Rainfall 0 1 2 3 4 ☐ ☐ ☐ ☐ ☒

	7.2 Soil moisture 0 1 2 3 4 ☐ ☐ ☐ ☒ ☐ 7.3 Evapotranspiration 0 1 2 3 4 ☐ ☐ ☐ ☐ ☒ ***Further suggestions and/or comments?*** if they are only at TRMM resolution, we have those already. What value did you add?
	8. Spatial Aggregation of change and trend maps 4.1 Administrative areas 0 1 2 3 4 ☐ ☐ ☐ ☐ ☒ 4.2 Protected areas 0 1 2 3 4 ☐ ☐ ☒ ☐ ☐ 4.3 Land cover classes / types 0 1 2 3 4 ☐ ☐ ☐ ☐ ☒ 4.4 Degree of aridity 0 1 2 3 4 ☐ ☐ ☒ ☐ ☐ 4.5 Continent 0 1 2 3 4 ☐ ☐ ☒ ☐ ☐ ***Further suggestions and/or comments?***
Description	**Second level indicators**

Second level indicators combine several of the above listed contents and complement them with additional information such as land use or biodiversity data, thus aiming at establishing links to biodiversity and its drivers. Compared to the descriptive level of the status, change and trend maps of vegetation productivity, the second level indicator maps will provide more abstract information on the dynamics of vegetation productivity, drivers, and potential biodiversity trends. .	***9. Classification of the status, change and trend maps according to selected combinations of the above listed products and information*** 9.1 Classified size and direction of changes and trends combined with the status information 0 1 2 3 4 ☐ ☐ ☐ ☒ ☐ 9.2 Classified size and direction of changes and trends of water use efficiency combined with selected parameters and indices (e.g. leading to classes potentially pointing to biodiversity changes such as: - regions with a low general level of NPP with a strong positive trend of water use efficiency and increasing rainfall - regions with high initial vegetation productivity and a strong negative trend of water use efficiency - regions with significant positive NPP trends during dry seasons with or without rainfall trends 0 1 2 3 4 ☐ ☐ ☐ ☒ ☐ ***Further suggestions and/or comments?***
Description	**Accuracy and Validation of Dryland Products**
Accuracy assessments and validation efforts will be made at various levels of the products, and will relate to the following questions: • Validity of the input data • Accuracy of the NPP indices • Relation of the results to biodiversity	10. Accuracy checks and validation 10.1 Metadata referring to number of MERIS observations within integration period (half months), to contaminated data, to no data 0 1 2 3 4 ☐ ☐ ☐ ☐ ☒ 10.2 Qualitative comparisons of the input data, plausibility checks (e.g. time series diagrams of NPP indices vs. rainfall, soil moisture and evapotranspiration 0 1 2 3 4 ☐ ☐ ☐ ☐ ☒ 10.3 Accuracy of the NPP indices Comparison with in situ fAPAR, Comparison with modelled NPP 0 1 2 3 4 ☐ ☐ ☐ ☐ ☒ 10.4 Comparison of the results with in situ data on biodiversity 0 1 2 3 4 ☐ ☐ ☒ ☐ ☐ ***Further suggestions and/or comments?*** The problem with all of these is that they do not constitute validation. You are comparing one poor guess with another.

Description	**Dryland Testsites**
The 22 proposed global dryland sites have been selected according to the following criteria: • Aridity Index • WWF ecoregions • Biodiversity • Size *If you are interested in certain additional sites and/or can make contributions in these sites with data provided to the project, please indicate at the right.*	 ***Further suggestions and/or comments?*** 21, 12

6. Product Requirements	
In this table, please specify the requirements of the Dryland Products that you would like to be developed and demonstrated during the Diversity II project and for which sites. Please motivate your answers. ***For further explanation please refer to the list of products given in the Diversity II Executive Summary.***	
Spatial Coverage *Please provide a description of the required spatial coverage, i.e. area of interest.* *Please refer to the indicators listed under question 5 if there are different requirements per indicator.*	Southern Africa (ie Africa south of 15 deg S) All indicators needed for the whole area: FAPAR, Rain, ET
Spatial resolution *Please provide a description of the spatial resolution required, i.e. the minimum mapping unit that you require.* *Please refer to the indicators listed under question 5 if there are different requirements per indicator.*	We work at 1 km (sometimes at 300 m)
Spatial integration *Please provide a description of the spatial integration required, e.g. lake site, lake systems,*	☐ continent ☐ global ☒ administrative local ☒ administrative regional ☒ administrative national

continent, global, administrative (local, regional, national), protected area, hot spot, bio-geographic region, biome, land cover, other zones or combinations. *Please refer to the indicators listed under question 5 if there are different requirements per indicator.*	☐ protected area ☐ hot spot ☐ bio-geographic region ☒ land cover ☐ other …. ☐ other ….
Frequency of updates *Please provide a description of the temporal frequency required, i.e. how often you require information.* *Please refer to the indicators listed under question 5 if there are different requirements per indicator.*	7. Parameter status and change maps a. 5 b. 8. Trends e. 5 f. 9. Indicators e. 5 f.
Temporal integration *Please provide a description of the temporal integration required, e.g. yearly, bi-annually, monthly, seasonally, other.* *Please refer to the indicators listed under question 5 if there are different requirements per indicator.*	7. Parameter status and change maps a. 5 b. 8. Trends a. 5 b. 9. Indicators a. 5 b.
Accuracy requirements *Please provide a description of the accuracy requirements* *Please refer to the indicators listed under question 5 if there are different requirements per indicator.*	7. Parameter status and change maps a. CI=95% b. 8. Trends a. CI=95% b. 9. Indicators a. CI=95% b.
Aggregation requirements *Please provide a description of the aggregation requirements. Examples are provided on the right, but please specify other, more appropriate if you need.*	☐ aggregation of indicators ☐ aggregation over time ☐ aggregation with other data ☐ with land cover data ☐ land productivity data ☐ soil moisture data ☐ other (please specify) I don't understand the question

7. Dryland Sites	
Results will be produced for for 22 Dryland regions for the time period 2002-2012. For a tentative list of sites please refer to the Diversity II Executive Summary. To determine a final list we would appreciate your input.	
Sites *List the Dryland sites of interest by order of priority, preferably with coordinates, for the area for which products are required.* *Please refer to the indicators listed under question 5 if there are different requirements per indicator.*	12 (NE south Africa) and 21 (SW South Africa) For 12, the Skukuza (25.02S 31.50E) and Malopeni sites are good reference points in 21, you should chose the ~ 30 BIOTA sites
Available data *Please list any data that would be available as additional information for the proposed Dryland sites, supporting the product generation.* *Please indicate also if there are any restrictions on the use and disclosure of these data.*	12 years of flux tower data for Skukuza and 6 years from Malopeni
	Terms of use: ☐ can be made publicly available ☒ publication on request ☐ restricted to use within the project

8. Validation requirements and reference data availability	
Validation of the products is critical for acceptance of the products by users. Please indicate here what kind of validation you would require / accept. If you have reference data (in-situ data) available that could support the validation activities please indicate here.	
Validation Requirements *Please specify the type of validation you would expect/accept that you need as a proof of product quality*	There needs to be statistically-valid comparison to trusted sources of independent data, in enough places to give condidence in the product. Furthermore, the trend and change detection products need to agree with on-the-ground experience of where the issues are.
Available data *Please list any data that would be available for the validation of Dryland products.* *Please indicate also if there are any restrictions on the use and disclosure of these data.*	Extensive data are collected; making them available requires some effort.
	Terms of use: ☐ can be made publicly available ☒ publication on request ☐ restricted to use within the project

9. Other
Is there anything else you think should be taken into account in tailoring the products, but which doesn't seem to fit into any of the other boxes?
The connection to biodiversity seems very tenuous.

10. Recommended additional contacts
We are intending to involve as completely as possible those organisations that could benefit from the Diversity II Products. Please list any other organisations (including contact names) that you think would be interested.

University Adelaide Ken Clarke

1. Organisation details	
Organisation	University of Adelaide
Contact Name	Ken Clarke
Position of the Contact within the organisation	Postdoctoral Research Associate
Postal address	Room 121, Davies Building DX 650 614, Waite Campus, PMB 1, Glen Osmond Rd., S.A. 5064 Australia
Email	kenneth.clarke@adelaide.edu.au
Telephone	+61 (0)8 8313 8112
Type of organisation e.g. IGO, NGO, Scientific Body, Biodiversity or Earth Observation focus	Research group within a University
Brief description of the organisation's activities and its role in relation to the CBD and to the conservation and wise use of Drylands.	One focal area of the research group I'm part of is the monitoring of rangeland condition. In that context we are interested in measuring and monitoring rangeland biodiverstiy.

2. Region / Country	
Region / Country (geographical area of interest)	Australian arid and semi-arid lands (~70 % of the continent).

3. Existing Activities / Projects
Please provide details of any existing activities / projects which could, even partly, complement the work planned in Diversity II. To achieve the best synergy with existing projects, any existing activities should be taken into account when defining the work plan of the Diversity II project.
The Australian "Ground Cover Monitoring for Australia" project, which seeks to develop a nationally consistent remote sensing method for measuring and monitoring changes in fractional green, dead and soil cover at a national scale with a high temporal frequency.

4. Requirements Overview
Please provide a general description of your applications including your requirements for Diversity II products. Highlight the major limitations of your current practices and the activity areas (e.g. biodiversity indicators for Dryland assessment and/or management, reporting to the CBD) where you think the Diversity II project could help you. Please make reference to the Diversity II products and initial indicators listed in the Diversity II Executive Summary.
Need remote sensing enabling the measurement of depth of the cellulose absorption feature in the mid infrared. Need remote sensing of vegetation net primary productivity (NPP) with high temporal frequency. Already get both of these from MODIS with very degrees of satisfaction. Derivation of depth of cellulose absorption feature is currently impossible with certainty, due to lack of spectral resolution on MODIS. Measures of vegetation stress would be desirable, but is difficult with current spectral resolution.

5. Maps and Indicators for Dryland: Status, Change and Trends	
In this table, please share your preferences and ideas about Dryland maps and indicators that you would like to be developed and demonstrated during the Diversity II project (please refer also to the product overview given in the Diversity II Executive Summary). ***Please indicate on a scale of 0 to 4 as shown below, how do you judge the importance of the proposed products for your work:*** **0: Cannot tell** **1: Not important, not interesting for your work** **2: Might be interesting, lower priority** **3: Interesting, medium priority** **4: Interesting and relevant for your work, high priority**	
Description	**Status of Vegetation Productivity and Water Use Efficiency in Drylands**

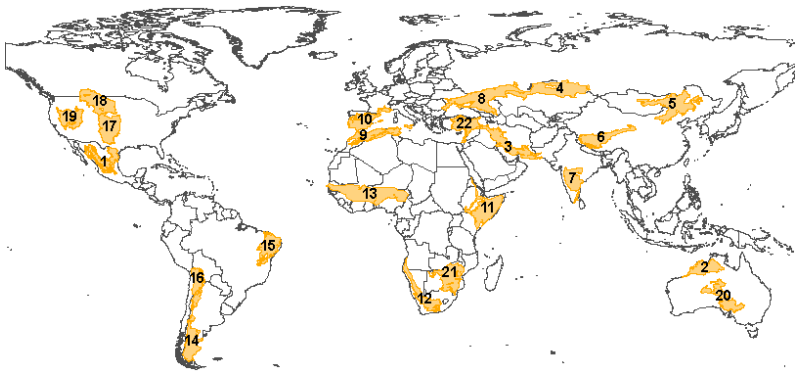
The status of vegetation productivity is mapped by ENVISAT MERIS based spectral indices of Net Primary Productivity (NPP) and by indices that relate NPP to the available water (e.g. Rain Use Efficienc). The DIVERSITY II product portfolio has variations with regard to • the type of NPP index, • temporal aggregation, • the type of water information used (rainfall, soil moisture, evapotrans-piration) • spatial aggregation	***1. Type of NPP Index:*** 1.1 Indices based on MERIS fAPAR - fraction of photosynthetically active radiation absorbed by the vegetation: 0 1 2 3 4 ☐ ☐ ☒ ☐ ☐ 1.2 Indices based on MERIS NDVI (Normalised Difference Vegetation Index, spectrally adapted to NOAA AVHRR NDVI) 0 1 2 3 4 ☐ ☐ ☐ ☒ ☐ 1.3 All together for comparison 0 1 2 3 4 ☐ ☐ ☒ ☐ ☐ ***Further suggestions and/or comments?***
	2. Temporal Aggregation of vegetation productivity 2.1 Maps of vegetation productivity for entire vegetation years (wet and dry season) 0 1 2 3 4 ☐ ☐ ☐ ☒ ☐ 2.2 Maps of vegetation productivity for Vegetation seasons 0 1 2 3 4 ☐ ☐ ☐ ☒ ☐ 2.3 Maps of vegetation productivity for “Epochs” (3 vegetation years) 0 1 2 3 4 ☐ ☐ ☒ ☐ ☐ 2.4 All together for comparison 0 1 2 3 4 ☐ ☐ ☒ ☐ ☐ ***Further suggestions and/or comments?***
	3. Type of Water Information Used for Efficiency Indices 3. 1 Rain Use Efficiency 0 1 2 3 4 ☐ ☐ ☐ ☒ ☐ 3.2 Soil Moisture Use Efficiency 0 1 2 3 4 ☐ ☐ ☐ ☒ ☐

	3.3 Water Use Efficiency 0 1 2 3 4 ☐ ☐ ☐ ☒ ☐ 3.4 All together for comparison 0 1 2 3 4 ☐ ☐ ☐ ☒ ☐ ***Further suggestions and/or comments?***
	4. Spatial Aggregation of vegetation productivity maps 4.1 Administrative areas 0 1 2 3 4 ☐ ☐ ☒ ☐ ☐ 4.2 Protected areas 0 1 2 3 4 ☒ ☐ ☐ ☐ ☐ 4.3 Land cover classes / types 0 1 2 3 4 ☐ ☐ ☐ ☒ ☐ 4.4 Degree of aridity 0 1 2 3 4 ☐ ☐ ☐ ☒ ☐ 4.5 Continent 0 1 2 3 4 ☐ ☐ ☐ ☒ ☐ ***Further suggestions and/or comments?***

Description	Changes and Trends of Vegetation Productivity
Changes and trends of vegetation productivity potentially point to developments with impacts on biodiversity. Differences between single years or epochs are to a large degree part of the "normal" variability of dryland conditions. Abrupt and big changes as well as longer term trends, however, may be hints of changed conditions for biodiversity.	***5. Change Maps of vegetation productivity status and water use efficiency indices between "epochs" (3-year periods 2002 – 2012)*** 5.1 Change maps of NPP status maps (MERIS fAPAR, NDVI) 0 1 2 3 4 ☐ ☐ ☐ ☒ ☐ 5.2 Change maps of rain/soil moisture/water use efficiency 0 1 2 3 4 ☐ ☐ ☐ ☒ ☐ ***Further suggestions and/or comments?***
	6.Trend maps of vegetation productivity status and water use efficiency indices (based on vegetation years and seasons 2002 to 2012) 6.1 Vegetation productivity (MERIS fAPAR, NDVI) 0 1 2 3 4 ☐ ☐ ☐ ☒ ☐ 6.2 Rain use efficiency 0 1 2 3 4 ☐ ☐ ☐ ☒ ☐ 6.3 Soil moisture use efficiency 0 1 2 3 4 ☐ ☐ ☐ ☒ ☐ 6.4 Water use efficiency 0 1 2 3 4 ☐ ☐ ☐ ☒ ☐ 6.5 All together for comparison 0 1 2 3 4 ☐ ☐ ☐ ☒ ☐ ***Further suggestions and/or comments?*** Emissivity contrast could also enable better measurement of the amout of exposed soil, and therefore enable better separation of green vegetation, dead vegetation and soil fractional cover.
	7. Trend maps of water availability 7.1 Rainfall 0 1 2 3 4

	☐ ☐ ☐ ☒ ☐ 7.2 Soil moisture 0 1 2 3 4 ☐ ☐ ☐ ☒ ☐ 7.3 Evapotranspiration 0 1 2 3 4 ☐ ☐ ☐ ☒ ☐ ***Further suggestions and/or comments?***
	8. Spatial Aggregation of change and trend maps 4.1 Administrative areas 0 1 2 3 4 ☐ ☐ ☒ ☐ ☐ 4.2 Protected areas 0 1 2 3 4 ☒ ☐ ☐ ☐ ☐ 4.3 Land cover classes / types 0 1 2 3 4 ☐ ☐ ☐ ☒ ☐ 4.4 Degree of aridity 0 1 2 3 4 ☐ ☐ ☐ ☒ ☐ 4.5 Continent 0 1 2 3 4 ☐ ☐ ☐ ☒ ☐ ***Further suggestions and/or comments?***
Description	**Second level indicators**

Second level indicators combine several of the above listed contents and complement them with additional information such as land use or biodiversity data, thus aiming at establishing links to biodiversity and its drivers. Compared to the descriptive level of the status, change and trend maps of vegetation productivity, the second level indicator maps will provide more abstract information on the dynamics of vegetation productivity, drivers, and potential biodiversity trends. .	***9. Classification of the status, change and trend maps according to selected combinations of the above listed products and information*** 9.1 Classified size and direction of changes and trends combined with the status information 0 1 2 3 4 ☐ ☐ ☐ ☒ ☐ 9.2 Classified size and direction of changes and trends of water use efficiency combined with selected parameters and indices (e.g. leading to classes potentially pointing to biodiversity changes such as: - regions with a low general level of NPP with a strong positive trend of water use efficiency and increasing rainfall - regions with high initial vegetation productivity and a strong negative trend of water use efficiency - regions with significant positive NPP trends during dry seasons with or without rainfall trends 0 1 2 3 4 ☐ ☐ ☐ ☒ ☐ ***Further suggestions and/or comments?***
Description	**Accuracy and Validation of Dryland Products**
Accuracy assessments and validation efforts will be made at various levels of the products, and will relate to the following questions: • Validity of the input data • Accuracy of the NPP indices • Relation of the results to biodiversity	10. Accuracy checks and validation 10.1 Metadata referring to number of MERIS observations within integration period (half months), to contaminated data, to no data 0 1 2 3 4 ☐ ☐ ☒ ☐ ☐ 10.2 Qualitative comparisons of the input data, plausibility checks (e.g. time series diagrams of NPP indices vs. rainfall, soil moisture and evapotranspiration 0 1 2 3 4 ☐ ☐ ☒ ☐ ☐ 10.3 Accuracy of the NPP indices Comparison with in situ fAPAR, Comparison with modelled NPP 0 1 2 3 4 ☐ ☐ ☒ ☐ ☐ 10.4 Comparison of the results with in situ data on biodiversity 0 1 2 3 4 ☐ ☐ ☐ ☒ ☐ ***Further suggestions and/or comments?***

Description	Dryland Testsites
The 22 proposed global dryland sites have been selected according to the following criteria: • Aridity Index • WWF ecoregions • Biodiversity • Size *If you are interested in certain additional sites and/or can make contributions in these sites with data provided to the project, please indicate at the right.*	 ***Further suggestions and/or comments?*** I'm quite interested in area 20, in South Australia, Northern Territory, and Western Australia.

6. Product Requirements	
In this table, please specify the requirements of the Dryland Products that you would like to be developed and demonstrated during the Diversity II project and for which sites. Please motivate your answers. ***For further explanation please refer to the list of products given in the Diversity II Executive Summary.***	
Spatial Coverage *Please provide a description of the required spatial coverage, i.e. area of interest.* *Please refer to the indicators listed under question 5 if there are different requirements per indicator.*	NPP, RUE, soil moisture use efficiency, and water use efficiency could all be useful.
Spatial resolution *Please provide a description of the spatial resolution required, i.e. the minimum mapping unit that you require.* *Please refer to the indicators listed under question 5 if there are different requirements per indicator.*	250 m or finer would be desirable. 500 m would be acceptable. 1000 m or coarser would be less usable, but still satisfy some needs.
Spatial integration *Please provide a description of the spatial integration required, e.g. lake site, lake systems, continent, global, administrative*	☐ continent ☐ global ☐ administrative local ☐ administrative regional ☐ administrative national ☐ protected area

(local, regional, national), protected area, hot spot, bio-geographic region, biome, land cover, other zones or combinations. *Please refer to the indicators listed under question 5 if there are different requirements per indicator.*	☐ hot spot ☐ bio-geographic region ☐ land cover ☐ other …. ☐ other ….
Frequency of updates *Please provide a description of the temporal frequency required, i.e. how often you require information.* *Please refer to the indicators listed under question 5 if there are different requirements per indicator.*	10. Parameter status and change maps a. Weekly/fortnightly b. 11. Trends g. Annually h. 12. Indicators g. Annually h.
Temporal integration *Please provide a description of the temporal integration required, e.g. yearly, bi-annually, monthly, seasonally, other.* *Please refer to the indicators listed under question 5 if there are different requirements per indicator.*	10. Parameter status and change maps a. b. 11. Trends a. b. 12. Indicators a. b.
Accuracy requirements *Please provide a description of the accuracy requirements* *Please refer to the indicators listed under question 5 if there are different requirements per indicator.*	10. Parameter status and change maps a. quantified accuracy b. 11. Trends a. quantified accuracy b. 12. Indicators a. quantified accuracy b.
Aggregation requirements *Please provide a description of the aggregation requirements. Examples are provided on the right, but please specify other, more appropriate if you need.*	☐ aggregation of indicators ☐ aggregation over time ☐ aggregation with other data ☐ with land cover data ☐ land productivity data ☐ soil moisture data ☐ other (please specify)

7. Dryland Sites	
Results will be produced for for 22 Dryland regions for the time period 2002-2012. For a tentative list of sites please refer to the Diversity II Executive Summary. To determine a final list we would appreciate your input.	
Sites *List the Dryland sites of interest by order of priority, preferably with coordinates, for the area for which products are required.* *Please refer to the indicators listed under question 5 if there are different requirements per indicator.*	22, 2.
Available data *Please list any data that would be available as additional information for the proposed Dryland sites, supporting the product generation.* *Please indicate also if there are any restrictions on the use and disclosure of these data.*	 Terms of use: ☐ can be made publicly available ☐ publication on request ☐ restricted to use within the project

8. Validation requirements and reference data availability	
Validation of the products is critical for acceptance of the products by users. Please indicate here what kind of validation you would require / accept. If you have reference data (in-situ data) available that could support the validation activities please indicate here.	
Validation Requirements *Please specify the type of validation you would expect/accept that you need as a proof of product quality*	Comparison of new RS product values with appropriate field measured values; comparison of new RS product values with existing RS produt values.
Available data *Please list any data that would be available for the validation of Dryland products.* *Please indicate also if there are any restrictions on the use and disclosure of these data.*	I would imagine that data collected for, or made available through the AusCover facility of TERN would be available for ESA to use in calibration/validation. This includes SLATS star transect field measurements, AusPlots field quadrat measurements, AusCover calibration/validation site airborne hyperspectral and LiDAR, as well as concurrent ground based hyperspectral reference target and sun photomoter measurements. Geoscience Australia (GA), or other parts of AusCover may be able to provide more information. Suggest you contact Leo Lymburner (leo.lymburner@ga.gov.au) in GA, and Kasper Johansen (k.johansen@uq.edu.au) in AusCover/University Queensland as potential leads.

	Terms of use: ☒ can be made publicly available ☐ publication on request ☐ restricted to use within the project

9. Other
Is there anything else you think should be taken into account in tailoring the products, but which doesn't seem to fit into any of the other boxes?

10. Recommended additional contacts
We are intending to involve as completely as possible those organisations that could benefit from the Diversity II Products. Please list any other organisations (including contact names) that you think would be interested.
Already mentioned sioGeoscience Australia and AusCover (part of TERN) should be included. In addition to Kapser Johansen, suggest you contact the director of AusCover, Alex Held (alex.held@csiro.au), and Tim Malthus (tim.malthus@csiro.au).

Desert Research Foundation of Namibia and Mälardalen University Patrik Klintenberg (Drylands)

1. Organisation details	
Organisation	Desert Research Foundation of Namibia and Mälardalen Univeristy
Contact Name	Dr. Patrik Klintenberg
Position of the Contact within the organisation	Researcher
Postal address	
Email	patrik.klintenberg@mdh.se
Telephone	?46736620925
Type of organisation e.g. IGO, NGO, Scientific Body, Biodiversity or Earth Observation focus	DRFN=NGO, MDH=University
Brief description of the organisation's activities and its role in relation to the CBD and to the conservation and wise use of Drylands.	DRFN: Environmental NGO in the fields of water, land and energy. Was leading the implementation of Namibia's program to combat desertification (NAPCOD) under UNCCDEnvironmental NGO in the fields of water, land and energy. Was leading the implementation of Namibia's program to combat desertification (NAPCOD) under UNCCD

2. Region / Country	
Region / Country (geographical area of interest)	Southern Africa, Namibia, South Africa, see illustration below.

3. Existing Activities / Projects
Please provide details of any existing activities / projects which could, even partly, complement the work planned in Diversity II. To achieve the best synergy with existing projects, any existing activities should be taken into account when defining the work plan of the Diversity II project.
Small project carried out together with School of Environmental Sciences and Development North West University (Potchefstroom campus) looking at changes in ecosystem function and ecosystem services due to different land uses in rural Kalahari (RSA, Botswana and Namibia), using remote sensing, GIS and field based observations and interviews with key informants in study areas

4. Requirements Overview
Please provide a general description of your applications including your requirements for Diversity II products. Highlight the major limitations of your current practices and the activity areas (e.g. biodiversity indicators for Dryland assessment and/or management, reporting to the CBD) where you think the Diversity II project could help you. Please make reference to the Diversity II products and initial indicators listed in the Diversity II Executive Summary.
The only data that could be of any use for this project would be the MERIS data, but it might be too coarse for the purposes of the project as we are looking at rather small areas and detailed changes in the ground cover and its composition.

5. Maps and Indicators for Dryland: Status, Change and Trends	
In this table, please share your preferences and ideas about Dryland maps and indicators that you would like to be developed and demonstrated during the Diversity II project (please refer also to the product overview given in the Diversity II Executive Summary). ***Please indicate on a scale of 0 to 4 as shown below, how do you judge the importance of the proposed products for your work:*** **0: Cannot tell** **1: Not important, not interesting for your work** **2: Might be interesting, lower priority** **3: Interesting, medium priority** **4: Interesting and relevant for your work, high priority**	
Description	**Status of Vegetation Productivity and Water Use Efficiency in Drylands**

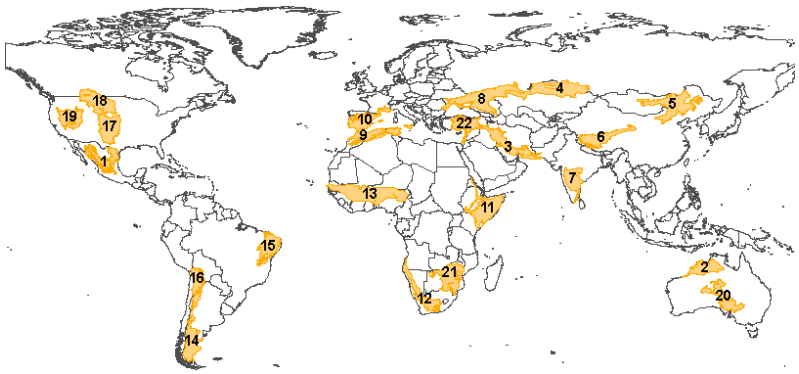
The status of vegetation productivity is mapped by ENVISAT MERIS based spectral indices of Net Primary Productivity (NPP) and by indices that relate NPP to the available water (e.g. Rain Use Efficienc). The DIVERSITY II product portfolio has variations with regard to • the type of NPP index, • temporal aggregation, • the type of water information used (rainfall, soil moisture, evapotrans-piration) • spatial aggregation	***1. Type of NPP Index:*** 1.1 Indices based on MERIS fAPAR - fraction of photosynthetically active radiation absorbed by the vegetation: 0 1 2 3 4 ☐ ☐ ☐ ☐ ☒ 1.2 Indices based on MERIS NDVI (Normalised Difference Vegetation Index, spectrally adapted to NOAA AVHRR NDVI) 0 1 2 3 4 ☐ ☐ ☐ ☐ ☒ 1.3 All together for comparison 0 1 2 3 4 ☐ ☐ ☐ ☐ ☒ ***Further suggestions and/or comments?***
	2. Temporal Aggregation of vegetation productivity 2.1 Maps of vegetation productivity for entire vegetation years (wet and dry season) 0 1 2 3 4 ☐ ☐ ☐ ☐ ☒ 2.2 Maps of vegetation productivity for Vegetation seasons 0 1 2 3 4 ☐ ☐ ☐ ☐ ☒ 2.3 Maps of vegetation productivity for “Epochs” (3 vegetation years) 0 1 2 3 4 ☐ ☐ ☐ ☐ ☒ 2.4 All together for comparison 0 1 2 3 4 ☐ ☐ ☐ ☐ ☒ ***Further suggestions and/or comments?***
	3. Type of Water Information Used for Efficiency Indices 3. 1 Rain Use Efficiency 0 1 2 3 4 ☐ ☐ ☐ ☐ ☒ 3.2 Soil Moisture Use Efficiency 0 1 2 3 4 ☐ ☐ ☐ ☐ ☒

	3.3 Water Use Efficiency 0 1 2 3 4 ☐ ☐ ☐ ☐ ☒ 3.4 All together for comparison 0 1 2 3 4 ☐ ☐ ☐ ☐ ☒ ***Further suggestions and/or comments?***
	4. Spatial Aggregation of vegetation productivity maps 4.1 Administrative areas 0 1 2 3 4 ☐ ☒ ☐ ☐ ☐ 4.2 Protected areas 0 1 2 3 4 ☐ ☒ ☐ ☐ ☐ 4.3 Land cover classes / types 0 1 2 3 4 ☐ ☐ ☐ ☐ ☒ 4.4 Degree of aridity 0 1 2 3 4 ☐ ☐ ☐ ☐ ☒ 4.5 Continent 0 1 2 3 4 ☐ ☒ ☐ ☐ ☐ ***Further suggestions and/or comments?***

Description	Changes and Trends of Vegetation Productivity
Changes and trends of vegetation productivity potentially point to developments with impacts on biodiversity. Differences between single years or epochs are to a large degree part of the "normal" variability of dryland conditions. Abrupt and big changes as well as longer term trends, however, may be hints of changed conditions for biodiversity.	***5. Change Maps of vegetation productivity status and water use efficiency indices between "epochs" (3-year periods 2002 – 2012)*** 5.1 Change maps of NPP status maps (MERIS fAPAR, NDVI) 0 1 2 3 4 ☐ ☐ ☐ ☐ ☒ 5.2 Change maps of rain/soil moisture/water use efficiency 0 1 2 3 4 ☐ ☐ ☐ ☐ ☒ ***Further suggestions and/or comments?***
	6.Trend maps of vegetation productivity status and water use efficiency indices (based on vegetation years and seasons 2002 to 2012) 6.1 Vegetation productivity (MERIS fAPAR, NDVI) 0 1 2 3 4 ☐ ☐ ☐ ☐ ☒ 6.2 Rain use efficiency 0 1 2 3 4 ☐ ☐ ☐ ☐ ☒ 6.3 Soil moisture use efficiency 0 1 2 3 4 ☐ ☐ ☐ ☐ ☒ 6.4 Water use efficiency 0 1 2 3 4 ☐ ☐ ☐ ☐ ☒ 6.5 All together for comparison 0 1 2 3 4 ☐ ☐ ☐ ☐ ☒ ***Further suggestions and/or comments?***
	7. Trend maps of water availability 7.1 Rainfall 0 1 2 3 4 ☐ ☐ ☐ ☐ ☒

	7.2 Soil moisture 0 1 2 3 4 ☐ ☐ ☐ ☐ ☒ 7.3 Evapotranspiration 0 1 2 3 4 ☐ ☐ ☐ ☐ ☒ ***Further suggestions and/or comments?***
	8. Spatial Aggregation of change and trend maps 4.1 Administrative areas 0 1 2 3 4 ☐ ☒ ☐ ☐ ☐ 4.2 Protected areas 0 1 2 3 4 ☐ ☐ ☐ ☐ ☒ 4.3 Land cover classes / types 0 1 2 3 4 ☐ ☐ ☐ ☐ ☒ 4.4 Degree of aridity 0 1 2 3 4 ☐ ☐ ☐ ☐ ☒ 4.5 Continent 0 1 2 3 4 ☐ ☒ ☐ ☐ ☐ ***Further suggestions and/or comments?***
Description	**Second level indicators**

Second level indicators combine several of the above listed contents and complement them with additional information such as land use or biodiversity data, thus aiming at establishing links to biodiversity and its drivers. Compared to the descriptive level of the status, change and trend maps of vegetation productivity, the second level indicator maps will provide more abstract information on the dynamics of vegetation productivity, drivers, and potential biodiversity trends. .	***9. Classification of the status, change and trend maps according to selected combinations of the above listed products and information*** 9.1 Classified size and direction of changes and trends combined with the status information 0 1 2 3 4 ☐ ☐ ☐ ☐ ☒ 9.2 Classified size and direction of changes and trends of water use efficiency combined with selected parameters and indices (e.g. leading to classes potentially pointing to biodiversity changes such as: - regions with a low general level of NPP with a strong positive trend of water use efficiency and increasing rainfall - regions with high initial vegetation productivity and a strong negative trend of water use efficiency - regions with significant positive NPP trends during dry seasons with or without rainfall trends 0 1 2 3 4 ☐ ☐ ☐ ☐ ☒ ***Further suggestions and/or comments?***
Description	**Accuracy and Validation of Dryland Products**
Accuracy assessments and validation efforts will be made at various levels of the products, and will relate to the following questions: • Validity of the input data • Accuracy of the NPP indices • Relation of the results to biodiversity	10. Accuracy checks and validation 10.1 Metadata referring to number of MERIS observations within integration period (half months), to contaminated data, to no data 0 1 2 3 4 ☐ ☐ ☐ ☐ ☒ 10.2 Qualitative comparisons of the input data, plausibility checks (e.g. time series diagrams of NPP indices vs. rainfall, soil moisture and evapotranspiration 0 1 2 3 4 ☐ ☐ ☐ ☐ ☒ 10.3 Accuracy of the NPP indices Comparison with in situ fAPAR, Comparison with modelled NPP 0 1 2 3 4 ☐ ☐ ☐ ☐ ☒ 10.4 Comparison of the results with in situ data on biodiversity 0 1 2 3 4 ☐ ☐ ☐ ☐ ☒ ***Further suggestions and/or comments?***

Description	Dryland Testsites
The 22 proposed global dryland sites have been selected according to the following criteria: • Aridity Index • WWF ecoregions • Biodiversity • Size *If you are interested in certain additional sites and/or can make contributions in these sites with data provided to the project, please indicate at the right.*	 ***Further suggestions and/or comments?***

6. Product Requirements	
In this table, please specify the requirements of the Dryland Products that you would like to be developed and demonstrated during the Diversity II project and for which sites. Please motivate your answers. ***For further explanation please refer to the list of products given in the Diversity II Executive Summary.***	
Spatial Coverage *Please provide a description of the required spatial coverage, i.e. area of interest.* *Please refer to the indicators listed under question 5 if there are different requirements per indicator.*	Southern Namibia, North-western South Afric (See attached file).
Spatial resolution *Please provide a description of the spatial resolution required, i.e. the minimum mapping unit that you require.* *Please refer to the indicators listed under question 5 if there are different requirements per indicator.*	MERIS, however, we would most likely require data of higher resolution, e.g. TM or SPOT to be able to detect environmental changes in the study areas.
Spatial integration *Please provide a description of the spatial integration required, e.g. lake site, lake systems, continent, global, administrative (local, regional, national),*	☐ continent ☐ global ☐ administrative local ☐ administrative regional ☐ administrative national ☐ protected area ☒ hot spot

protected area, hot spot, bio-geographic region, biome, land cover, other zones or combinations. *Please refer to the indicators listed under question 5 if there are different requirements per indicator.*	☒ bio-geographic region ☒ land cover ☐ other …. ☐ other ….
Frequency of updates *Please provide a description of the temporal frequency required, i.e. how often you require information.* *Please refer to the indicators listed under question 5 if there are different requirements per indicator.*	13. Parameter status and change maps a. annual b. annual 14. Trends i. annual j. annual 15. Indicators i. annual j. annual
Temporal integration *Please provide a description of the temporal integration required, e.g. yearly, bi-annually, monthly, seasonally, other.* *Please refer to the indicators listed under question 5 if there are different requirements per indicator.*	13. Parameter status and change maps a. yearly b. yearly 14. Trends a. yearly b. yearly 15. Indicators a. yearly b. yearly
Accuracy requirements *Please provide a description of the accuracy requirements* *Please refer to the indicators listed under question 5 if there are different requirements per indicator.*	13. Parameter status and change maps a. ? b. ? 14. Trends a. ? b. ? 15. Indicators a. ? b. ?
Aggregation requirements *Please provide a description of the aggregation requirements. Examples are provided on the right, but please specify other, more appropriate if you need.*	☐ aggregation of indicators ☐ aggregation over time ☒ aggregation with other data ☒ with land cover data ☒ land productivity data ☒ soil moisture data ☐ other (please specify)

7. Dryland Sites	
Results will be produced for for 22 Dryland regions for the time period 2002-2012. For a tentative list of sites please refer to the Diversity II Executive Summary. To determine a final list we would appreciate your input.	
Sites *List the Dryland sites of interest by order of priority, preferably with coordinates, for the area for which products are required.* *Please refer to the indicators listed under question 5 if there are different requirements per indicator.*	see attached illustration.
Available data *Please list any data that would be available as additional information for the proposed Dryland sites, supporting the product generation.* *Please indicate also if there are any restrictions on the use and disclosure of these data.*	 Terms of use: ☐ can be made publicly available ☐ publication on request ☐ restricted to use within the project

8. Validation requirements and reference data availability	
Validation of the products is critical for acceptance of the products by users. Please indicate here what kind of validation you would require / accept. If you have reference data (in-situ data) available that could support the validation activities please indicate here.	
Validation Requirements *Please specify the type of validation you would expect/accept that you need as a proof of product quality*	
Available data *Please list any data that would be available for the validation of Dryland products.* *Please indicate also if there are any restrictions on the use and disclosure of these data.*	 Terms of use: ☐ can be made publicly available ☐ publication on request ☐ restricted to use within the project

9. Other
Is there anything else you think should be taken into account in tailoring the products, but which doesn't seem to fit into any of the other boxes?

10. Recommended additional contacts
We are intending to involve as completely as possible those organisations that could benefit from the Diversity II Products. Please list any other organisations (including contact names) that you think would be interested.

CSIRO Erin Hestir

1. Organisation details	
Organisation	Commonwealth Scientific and Industrial Research Organization (CSIRO)
Contact Name	Erin Lee Hestir
Position of the Contact within the organisation	Postdoctoral Fellow
Postal address	GPO Box 1666 Acton, ACT 2601 Australia
Email	Erin.hestir@csiro.au
Telephone	+61 024265723
Type of organisation e.g. IGO, NGO, Scientific Body, Biodiversity or Earth Observation focus	Scientific Enterprise
Brief description of the organisation's activities and its role in relation to the CBD and to the conservation and wise use of Inland Waters.	CSIRO's National Research Flagships are tasked with delivering scienitific solutions to advance Australia's most pressing national objectives with a clear focus on the delivery and adoption of research outputs to maximize impact for Australia. As a signee to the CBD, the Australian government supports research into biological diversity conservation. Through its National Research Flagships, CSIRO conducts research critical to addressing biodiversity and conservation of inland waters through the following activities: **Water for a Healthy Country Flagship:** this flagship focuses on the development of science and technologies that will improve the social, economic and environmental outcomes from water. Research activities are organized around the following activities: 1. *Water Resource Assessment* to help Australia better manage its river basins and groundwater resources 2. *Ecosystems and Contaminants* to help Australia better manage water ecosystems 3. *Urban Water* to enable the adoption of innovative, integrated and sustainable water management for Australia's cities 4. *Integrated Water Resource Management* to improve social, economic and environmental benefits from river and groundwater management. Many of Australia's aquatic ecosystems are either degraded or under threat. These problems result from interacting stresses such as consumptive water use, land and habitat degradation, invasive species, and poor surface or ground water quality from excess loadings of nutrients, organic carbons, contaminants or sediment. Degradation of ecosystems is of widespread concern in Australia because of their role in maintaining a healthy environment, and the accepted intrinsic value and international significance of Australia's biodiversity, ecosystems and natural heritage. There is strong community expectation that these systems will be protected or restored. **Climate Adaptation Flagship:** This flagship focuses on research that can be used to equip policy makers, industries and communities with practical and effective adaptation options to climate change and variability. Research focused on *Managing species and natural ecosystems in a changing climate* focuses on anticipating and measuring changes in species and ecosystems

	and designing effective adaptation responses to minimize the losses of species and capture opportunities for positive change. Australia's natural species and ecosystems are highly vulnerable to climate change and will have difficulty adapting to the rate and extent of projected changes. Many species are at risk because they are restricted in geographical and climatic range. Alpine regions, south-western Australia, coral reefs and freshwater wetlands are likely to be particularly vulnerable. **Wealth from Oceans Flagship:** designed specifically to align with the Convention on Biodiversity, Australia's the World Heritage Convention, the Convention for the Prevention and the Ramsar Convention on Wetlands, research in this flagship addresses the challenges facing coastal zone. This includes quantifying the links between catchment influences and impacts on coastal environments.

2. Region / Country	
Region / Country (geographical area of interest)	All of Australia, its territories and coastal zones

3. Existing Activities / Projects
Please provide details of existing activities / projects which could, even partly, complement the work planned in Diversity II. To achieve the best synergy with existing projects, existing activities should be taken into account when defining the work plan of the Diversity II project.
Remote sensing of Australia's inland waters: Toward a continental-scale product (CSIRO Division of Land and Water, CSIRO Water for a Healthy Country). The objective of this research is to develop continental scale earth observation products of inland water quality from the MERIS and Landsat archive of imagery over Australia. The anticipated output is a time series of remote-sensing derived estimates of chlorophyll-a concentration, total suspended solids, and colored dissolved organic matter in Australia's large lakes and reservoirs from 2005-2012. These products will be validated using independent water quality monitoring data provided by a number of different water quality monitoring programs and authorities. These initial water quality products can be used to understand trends in inland surface water quality and responses of inland water systems to climatic extremes (drought and flood). The findings from this research can be used to inform water quality product development for future missions, improved algorithm design, and informed *in situ* monitoring and modeling activities. **Remote sensing of inland water quality: near surface sensing (CSIRO Water for a Healthy Country).** Although the National Water Quality Management Strategy (1994, 1998) provide a national framework for improving water quality in the country's waterways, there is no national system for monitoring such improvements. The aim is for development of a tool that can be used to sustainably monitor water quality at appropriate spatio-temporal scales across Australia. The water quality indicators assessed can be used to inform trajectories of ecosystem recovery or deterioration. This can then be linked to land-based management and pollution sources, downstream responses to fluxes of sediment N and P and assist in the design of adaptive management programs. The goal of the work is to develop a generalizable approach to measure inland water quality from remote sensing observations to meet NRM monitoring needs. A generalized approach will allow rapid

targeted regional water quality assessments, algal bloom detection and tracking, with a focussed development of near surface proximal sensing methods.

Bio-optical transformations in the catchment-to-reef continuum (CSIRO Division of Land and Water).

Increasingly, the scientific community is recognizing the importance of the connectivities that determine the global water system's response to change. Understanding these connectivities will be fundamental to our core science mission to understand and predict natural and engineered water systems and how they respond to change. The objective of this project is to analyze bio-optical datasets collected in an upstream reservoir and downstream estuary in the Great Barrier Reef Lagoon to describe the transformation of the bio-optical properties of particulate and dissolved matter from the reservoir through the estuary and in the adjacent coastal waters in the GBR Lagoon.

eReefs (CSIRO Wealth from Oceans, Australian Bureau of Meteorology, Great Barrier Reef Foundation, Australian Institute of Marine Sciences and Queensland Government).

eReefs is a collaborative project to develop an environmental information system for current and future health monitoring of the Great Barrier Reef. The environmental information system will include catchments, estuaries, the lagoon and open ocean, providing information on physical processes, sediment transport, biogeochemistry and ocean colour.

Understanding floodplain ecosystems (CSIRO Water for a Healthy Country, Murray-Darling Freshwater Research Centre, NSW Government).

Floodplain ecosystems have high levels of production and biodiversity, provide habitat for many species, redistribute nutrients sediments and organic matter, and maintain water quality. In Australia, they are among the most threatened ecosystems due to environmental change. The objective of this research is to develop knowledge base and modelling tools to develop management strategies to ensure floodplains maintain biodiversity and ecosystem function in the future of changing drought and flood cycles.

4. Requirements Overview

Please provide a general description of your applications including your requirements for Diversity II products. Highlight the major limitations of your current practices and the activity areas (e.g. biodiversity indicators for Inland Water assessment and/or management, reporting to the CBD) where you think the Diversity II project could help you.

Existing water quality information in Australia is sparse, difficult to obtain, and variable in content and accuracy. Earth observation for water quality monitoring is well suited for Australia's large areas with sparse population and limited access. The state of the science is sufficiently advanced to produce earth observation-based water quality information at multiple spatial scales and temporal frequencies for both current and historic conditions. However, a limiting challenge to the application of earth observation data for biodiversity and inland water assessment is the lack of bio-optical information for algorithm parameterization, and the lack of *in situ* observations for validation of EO products.

Additional challenges to the application of EO data to biodiversity and inland water assessment are the boundary conditions of sensor specifications. The end-user requirements (policy, legislative, environmental change drivers) should determine the data used for application to biodiversity and water assessment. However, the ideal satellite sensor system for inland water quality does not exist; there are tradeoffs between spatial, temporal, spectral and radiometric resolution.

The current practice of project-based research or applications that focus on mapping catchment vegetation and soil cover, riparian vegetation or water quality are problematic. An integrative approach is desirable under which the most suitable satellite data is acquired and processed to allow multiple information products to be delivered across the terrestrial and aquatic domains. Significant effort is already spent using optical earth observation data for detecting inundation, flood extent and drying. However, there is potential to also assess water quality from the same datasets. The potential for

integrated use of optical earth observation data for both water quantity and water quality applications should be investigated. Integration would provide economy of scale for the required earth observation processing infrastructure, making as much use as possible of existing investments this research and applications area. This approach also provides a framework for priority setting for earth observation-related *in situ* infrastructure investments at state, basin, local, regional and local levels offering a large return on investment and ensuring ease of implementation.

5. Products and Indicators for Inland Water: Status, Change and Trends

In this table, please share your preferences and ideas about Inland Water products and indicators that you would like to be developed and demonstrated during the Diversity II project (please refer also to the product overview given in the Diversity II Executive Summary).

Please indicate on a scale of 0 to 4 as shown below, how do you judge the importance of the proposed products for your work:

0: Cannot tell

1: Not important, not interesting for your work

2: Might be interesting, lower priority

3: Interesting, medium priority

4: Interesting and relevant for your work, high priority

Description	Water Quality and Temperature					
Water Quality of large perennial inland water will be assessed through a set of parameters derived from ENVISAT MERIS and AATSR instruments.	***5.1. Parameters on water quality and temperature:***	0	1	2	3	4
	5.1.1 Turbidity:					X
	5.1.2 Secchi Disk depth				X	
	5.1.3 Chlorophyll-a concentration					X
	5.1.4 Suspended sediment conc.					X
	5.1.5 Yellow substance absorption			X		
	5.1.6 Quality indicator			X		
	5.1.7 Variance of parameter during averaging interval					X
	5.1.8 Lake Surface Water Temperature					X
	5.1.9 Uncertainty estimate for lake surface temperature					X
	5.1.10 Chi-squared (goodness of fit measure for OE retrieval					X
	5.1.11 Variance of LSWT over averaging period/area over averaging period/area					X
	Further suggestions and/or comments?					
	5.2. Temporal Aggregation of water quality and temperature parameters	0	1	2	3	4
	5.2.1 None					X

	5.2.2 Daily	.	.	.	X	.
	5.2.3 Monthly	.	X	.	.	.
	5.2.4 Yearly	.	X	.	.	.
	5.2.5 Climatology	.	.	X	.	.
	5.2.4 Time series	.	.	.	.	X
	Further suggestions and/or comments?					
	5.3. Water Quantity parameters	0	1	2	3	4
	5.3.1 Water height difference to reference level	.	.	.	.	X
	5.3.2 Water volume difference	.	.	.	.	X
	5.3.3 Horizontal extent of the lake water surface	.	.	.	X	.
	Further suggestions and/or comments?					

<table>
<tr><th>Description</th><th colspan="6">First level indicators:
Changes and Trends of Water Quality and Quantity products</th></tr>
<tr><td rowspan="2">Changes and trends of water quality and quantity potentially point to developments with impacts on biodiversity.
Differences between single years or epochs are to a large degree part of the “normal” variability of inland water conditions.
Abrupt and big changes as well as longer term trends, however, may be hints of changed conditions for biodiversity.
The parameters are:
<table><tr><th>Parameter</th><th>Indicator for</th></tr><tr><td>Chla</td><td>Eutrophication</td></tr><tr><td>TSM</td><td>Physical disturbance</td></tr><tr><td>Yellow Substance</td><td>Contamination</td></tr><tr><td>Turbidity</td><td>Physical disturbance and/or contamination</td></tr><tr><td>Secchi Depth</td><td>Physical disturbance and/or contamination</td></tr><tr><td>Temperature</td><td>Eutrophication</td></tr><tr><td>Volume and extend</td><td>Physical disturbance, rain fall</td></tr></table>
The epochs are:
Epoch 1 = 2004 – 2006
Epoch 2 = 2007 – 2009
Epoch 3 = 2010 – 2012</td><td colspan="6"><table><tr><td>5.4. Change Maps of water quality and water quantity status between “epochs”</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td>5.4.1 Averages of <parameter*> for the three <epochs*>
* see left side</td><td>X</td><td>.</td><td>.</td><td>.</td><td>.</td></tr><tr><td>5.4.2 Trend <parameter> between <epoch i**> and <epoch j**>
** i and j are any combination of the three epochs; e.g. the trend from epoch 1 to epoch 2</td><td>X</td><td>.</td><td>.</td><td>.</td><td>.</td></tr><tr><td>5.4.3 Lake status = Mean(epoch1)/Mean(epoch2)</td><td>X</td><td>.</td><td>.</td><td>.</td><td>.</td></tr><tr><td>5.4.4 Lake trend = Trend(epoch 1/2) and Trend(epoch2/3) are positive, negative, stable, uncertain</td><td>X</td><td>.</td><td>.</td><td>.</td><td>.</td></tr></table>
<u>Further suggestions and/or comments?</u>
CDOM as contamination problematic for Australia
Temperature for Eutrophication problematic for Australia
Volume and extent and turbidity indicators for eutrophication in Australia
Epochs as defined not reflective of hydrologic epochs of Australia. Binning data by these epochs would result in high loss of information.
In order to develop accurate understanding of inland aquatic processes, it is critical to understand not only the trend of the data, but the stationarityy of the time series as well. For example, sensu Hestir et al. (2013), a linear trend describing a sediment transport time series may lead to an incorrect conclusion about the sediment transport processes of a watershed. By analyzing the entire time series, and looking for changes in the trend (stationarity) and breaks, a different conclusion about sediment transport regimes is reached. I strongly encourage careful consideration of the handling of time series data for biodiversity and inland water assessment.</td></tr>
</table>

Description	Second level indicators					
Second level indicators combine several of the above listed contents and complement them with additional information such as land use or biodiversity data, thus aiming at establishing links to biodiversity and its drivers. Compared to the descriptive level of the status, change and trend maps of vegetation productivity, the second level indicator maps will provide more abstract information on the dynamics of biological productivity, drivers, and potential biodiversity trends.	***5.5. Second Level Indicators***	0	1	2	3	4
	5.5.1 Area of the pelagic photic zone and the area of the aphotic zone				X	
	5.5.2 Pressure on the photic zone due to changes in water level				X	
	5.5.3 Habitat variety index (structure of the shoreline combined with water quality)				X	
	Further suggestions and/or comments?					

Description	Accuracy and Validation of Inland Water Products					
Accuracy assessments and validation efforts will be made at various levels of the products, and will relate to the following questions: • Quality and scope of the retrieval algorithms • Accuracy of the water quality parameters • Relation of the results to biodiversity	**5.6. Accuracy checks and validation**	0	1	2	3	4
	5.6.1 Metadata describing characteristics and quality of input data, e.g. processing parameters, or number of MERIS observations within integration etc					X
	5.6.2 Plausibility checks (e.g. transects across a lake, time series to check the occurrence of blooms etc					X
	5.6.3 Accuracy of water leaving reflectances by comparison with in-situ reflectance measurements					X
	5.6.4 Accuracy of the water quality and temperature parameters by comparison with in situ measurements					X
	5.6.5 Comparison of the higher level indicators (status, trends, second level indicators) with in situ data on biodiversity					X

	Further suggestions and/or comments?

6. Product Requirements	
In this table, please specify the requirements of the Inland Water Products that you would like to be developed and demonstrated during the Diversity II project and for which sites. Please motivate your answers. ***For further explanation please refer to the list of products given in the Diversity II Executive Summary.***	
Spatial Coverage *Please indicate your area of interest. You can specify e.g. the name of a lake, or a larger area with several lakes (lake system). If possible please provide the coordinates of a bounding box.*	All inland water bodies of Australia. (See attached info)
Spatial integration *Please indicate the spatial integration required.*	X☐ no spatial integration (i.e. keep original satellite pixels) X☐ water body within a lake (i.e. average all pixels within a water body) ☐ whole lake (i.e. one value for the whole lake) ☐ lake system ☐ administrative local ☐ administrative regional ☐ administrative national ☐ protected area ☐ hot spot ☐ bio-geographic region ☐ other ….

Temporal integration *Please provide a description of the temporal integration required, e.g. yearly, bi-annually, monthly, seasonally, other.* *Please refer to the indicators listed under question 5 if there are different requirements per indicator.*	Water Quality and Water Quantity parameters	X☐ daily X☐ weekly ☐ monthly ☐ seasonal	☐ yearly ☐ epoch X☐ other … *raw time series- important for event-based occurrences and extreme events that drive many ecological processes in Australia*
	First level indicators: changes and trends of Water Quality and Quantity products	☐ monthly ☐ seasonal ☐ yearly	☐ epoch X☐ other … *Raw (see above and below)*
	Second level indicators	☐ daily ☐ weekly ☐ monthly ☐ seasonal	☐ yearly ☐ epoch X☐ other … *Raw (see above and below)*
Frequency of updates *Please provide a description of the temporal frequency required, i.e. how often you require information.*	Water Quality and Water Quantity parameters	☐ daily X☐ weekly ☐ monthly X☐ seasonal	☐ yearly ☐ epoch ☐ other …
	First level indicators: changes and trends of Water Quality and Quantity products	☐ monthly ☐ seasonal ☐ yearly	☐ epoch X☐ other …
	Second level indicators	☐ daily ☐ weekly ☐ monthly ☐ seasonal	X☐ yearly ☐ epoch X☐ other …
Accuracy requirements for Water Quality Parameters *Please specify accuracy requirements for the parameters listed under question 5.1.*	Turbidity:		
	Secchi Disk depth:		
	Chlorophyll-a concentration:		
	Suspended sediment conc.:		
	Yellow substance absorption:		
	Lake Surface Water Temperature:		

<table>
<tr><th colspan="2">7. Inland Water sites</th></tr>
<tr><td colspan="2">Results will be produced for 300 large perennial Inland Water sites for the time period 2002-2012. In question 6 we asked for the inland water sites of your direct interest. Here we would like to get your opinion which other inland waters should be in included in the final list of 300 lakes. A justification of your choice would be appreciated.</td></tr>
<tr><td>Sites
List Inland Water sites of your interest by order of priority, preferably with coordinates, for the area for which products are required.</td><td>To be discussed</td></tr>
<tr><td rowspan="2">Available data
Please list any data that would be available as additional information for the proposed Inland Water supporting the product generation (including the sites you specified under question 6)
Please indicate also if there are any restrictions on the use and disclosure of these data.</td><td></td></tr>
<tr><td>Terms of use:
☐ can be made publicly available
☐ publication on request
☐ restricted to use within the project</td></tr>
</table>

9. Other
Is there anything else you think should be taken into account in tailoring the products, but which doesn't seem to fit into any of the other boxes?
There are two primary temporal considerations for inland water quality monitoring. The first is sampling designed to represent the dynamics of water quality and the range of conditions that can occur over diurnal, seasonal and annual cycles. The second temporal consideration is sampling designed to develop a time series. Time series are essential for assessing the condition and trends of inland water quality as they relate to the effect of water quality management and climate change. Many Australian inland waters are exposed to cycles of long periods of relative low flow or drought conditions, interspersed with intense periods of rainfall leading to flash floods in high relief terrain or extended and extensive floods in flat terrain. Floods cause large fluxes of suspended sediment, dissolved organic material, salt, nutrients and contaminants which can lead to changes in environmental state in aquatic ecosystems. In the wet tropics higher flows occur throughout the year. Under stable or drought conditions seasonal algal species composition and growth, and salinity are considered important variables to monitor. More frequent sampling is required when algal blooms are likely to affect water quality. During intense rainfall and resulting stream-flow events the focus changes to estimating fluxes of material such as suspended sediment and organic matter. Algal-related measurements are less relevant as water turbulence and the re-suspension and dissolution of soil materials may prevent algal growth. Monitoring rapid changes in water quality during extreme events poses challenges to any monitoring method. Nevertheless this challenge must be met if increased understanding of the effects of extreme flow events on the aquatic ecosystems is to be better understood.

10. Recommended additional contacts
We are intending to involve as completely as possible those organisations that could benefit from the Diversity II Products. Please list any other organisations (including contact names) that you think would be interested.

Globolakes University of Stirling Peter Hunter

1. Organisation details	
Organisation	University of Stirling
Contact Name	Dr Peter D. Hunter
Position of the Contact within the organisation	Lecturer in Earth Observation
Postal address	Biological and Environmental Sciences University of Stirling Stirling FK9 4LA
Email	p.d.hunter@stir.ac.uk
Telephone	44 1786 466538
Type of organisation e.g. IGO, NGO, Scientific Body, Biodiversity or Earth Observation focus	University (Higher Education)
Brief description of the organisation's activities and its role in relation to the CBD and to the conservation and wise use of Inland Waters.	The University of Stirling is an institution of higher education established by Royal Charter in 1967. In Biological and Environmental Sciences we undertake research at the interface between the environment and society. We led several international projects in the field of biological conservation and undertake research pertaining to the sustainable management of inland waters. We are the lead institution on the NERC-funded GloboLakes project and a partner in the EU FP7 INFORM project.

2. Region / Country	
Region / Country (geographical area of interest)	United Kingdom; Europe; Global

3. Existing Activities / Projects
Please provide details of existing activities / projects which could, even partly, complement the work planned in Diversity II. To achieve the best synergy with existing projects, existing activities should be taken into account when defining the work plan of the Diversity II project.
GloboLakes (Global Observatory of Lake Responses to Environmental Change; Funding: UK NERC). *GloboLakes is a five year research programme investigating the state of lakes and their response to climatic and other environmental drivers of change at a global scale through the realisation of a near-real time satellite based observatory with archive data processing to produce a 20-year time series, of observed*

ecological parameters and lake temperature supported by linked auxiliary data on catchment land-use and meteorological forcing.

LIMNADES (Lake Bio-optical Measurements and Matchup Data for Remote Sensing; Funding: UK NERC via GloboLakes). *LIMNADES is an initiative to centralise data of ground bio-optical measurements of worldwide lakes through voluntary cooperation across the international scientific community.*

INFORM (Improved monitoring and forecasting of ecological status of European INland waters by combining Future earth ObseRvation data and Models; Funding: EU FP7 Space). *INFORM is aiming to develop new or improved methods for extracting information on water quality from satellite data; this will include parameters such as coloured dissolved organic matter, phytoplankton functional types and size classes, primary productivity and macrophyte functional types. The project will also look at how the data can be integrated into lake ecosystem models.*

DANCERS (DANube macroregion: Capacity building and Excellence in River Systems; Funding: EU FP7). The DANCERS project will identify the knowledge and technological requirements to develop a strategy to deliver on science, economic development and sustainable management goals in the Danube Delta area.

KTAMOP (Historical and current trends in the ecological status of Lake Balaton; Funding: Hungarian Academy of Sciences). *This project is focusing on improving our knowledge and understanding of the ecological status of Lake Balaton, Hungary and our monitoring capability. It involves work on bio-optical properties and satellite remote sensing.*

Algal Blooms Pilot Project (Funding: UK Environment Agency). *This project is undertaking a validation of MERIS algorithms for water quality parameters over UK lakes. It also included the use of citizen science for high frequency shoreline monitoring of blooms and also for satellite validation.*

TIDES (Toxins in Desert Environments; Funding: Qatari Research Foundation). *This is a newly established research initiative that is partly looking at the occurrence of cyanobacterial-dominated soil crusts in desert environments. There is interest with the consortium in the use of remote sensing for monitoring the distribution and growth of biological soil crusts.*

4. Requirements Overview

Please provide a general description of your applications including your requirements for Diversity II products. Highlight the major limitations of your current practices and the activity areas (e.g. biodiversity indicators for Inland Water assessment and/or management, reporting to the CBD) where you think the Diversity II project could help you.

Through the GloboLakes and INFORM projects, we are interested in working alongside the Diversity II project on the development and validation of algorithms for inland waters. To this end, we would like to share data and knowledge between our consortia.

5. Products and Indicators for Inland Water: Status, Change and Trends						
In this table, please share your preferences and ideas about Inland Water products and indicators that you would like to be developed and demonstrated during the Diversity II project (please refer also to the product overview given in the Diversity II Executive Summary). ***Please indicate on a scale of 0 to 4 as shown below, how do you judge the importance of the proposed products for your work:*** **0: Cannot tell** **1: Not important, not interesting for your work** **2: Might be interesting, lower priority** **3: Interesting, medium priority** **4: Interesting and relevant for your work, high priority**						
Description	**Water Quality and Temperature**					
Water Quality of large perennial inland water will be assessed through a set of parameters derived from ENVISAT MERIS and AATSR instruments.	***5.1. Parameters on water quality and temperature:***	0	1	2	3	4
	5.1.1 Turbidity:				X	
	5.1.2 Secchi Disk depth					X
	5.1.3 Chlorophyll-a concentration					X
	5.1.4 Suspended sediment conc.					X
	5.1.5 Yellow substance absorption					X
	5.1.6 Quality indicator			X		
	5.1.7 Variance of parameter during averaging interval					X
	5.1.8 Lake Surface Water Temperature					X
	5.1.9 Uncertainty estimate for lake surface temperature					X
	5.1.10 Chi-squared (goodness of fit measure for OE retrieval					x
	5.1.11 Variance of LSWT over averaging period/area over averaging period/area					X
	Further suggestions and/or comments? How would "turbidty" be expressed – as *K*d or as something like NTU? We would prefer *K*d because it is a bulk optical parameter and can be retrieved through physical inversion; if so, we'd also rate this as "high priority". I'm not sure what is meant specifically by "Quality Indicator"?					
	5.2. Temporal Aggregation of water quality and temperature parameters	0	1	2	3	4
	5.2.1 None					
	5.2.2 Daily					X
	5.2.3 Monthly				X	

	5.2.4 Yearly					
	5.2.5 Climatology			X		
	5.2.4 Time series				X	
	Further suggestions and/or comments?					
	5.3. Water Quantity parameters	0	1	2	3	4
	5.3.1 Water height difference to reference level				X	
	5.3.2 Water volume difference				X	
	5.3.3 Horizontal extent of the lake water surface				X	
	Further suggestions and/or comments?					

<table>
<tr><th>Description</th><th colspan="6">First level indicators:
Changes and Trends of Water Quality and Quantity products</th></tr>
<tr><td rowspan="2">Changes and trends of water quality and quantity potentially point to developments with impacts on biodiversity.
Differences between single years or epochs are to a large degree part of the “normal” variability of inland water conditions.
Abrupt and big changes as well as longer term trends, however, may be hints of changed conditions for biodiversity.
The parameters are:
<table><tr><th>Parameter</th><th>Indicator for</th></tr><tr><td>Chla</td><td>Eutrophication</td></tr><tr><td>TSM</td><td>Physical disturbance</td></tr><tr><td>Yellow Substance</td><td>Contamination</td></tr><tr><td>Turbidity</td><td>Physical disturbance and/or contamination</td></tr><tr><td>Secchi Depth</td><td>Physical disturbance and/or contamination</td></tr><tr><td>Temperature</td><td>Eutrophication</td></tr><tr><td>Volume and extend</td><td>Physical disturbance, rain fall</td></tr></table>
The epochs are:
Epoch 1 = 2004 – 2006
Epoch 2 = 2007 – 2009
Epoch 3 = 2010 – 2012</td><td colspan="6">5.4. Change Maps of water quality and water quantity status between “epochs”</td></tr>
<tr><td></td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td></tr>
<tr><td></td><td colspan="5">5.4.1 Averages of <parameter*> for the three <epochs*>
* see left side</td><td>X</td></tr>
<tr><td></td><td colspan="5">5.4.2 Trend <parameter> between <epoch i**> and <epoch j**>
** i and j are any combination of the three epochs; e.g. the trend from epoch 1 to epoch 2</td><td>X</td></tr>
<tr><td></td><td colspan="5">5.4.3 Lake status = Mean(epoch1)/Mean(epoch2)</td><td>X</td></tr>
<tr><td></td><td colspan="5">5.4.4 Lake trend = Trend(epoch 1/2) and Trend(epoch2/3) are positive, negative, stable, uncertain</td><td>X</td></tr>
<tr><td></td><td colspan="6">Further suggestions and/or comments?
In many lakes, Chla and TSM will be correlated – so the ratio Chla:TSM might say more re influence of eutrophication versus physical disturbance (e.g., resuspension, catchment runoff).</td></tr>
</table>

Description	Second level indicators					
Second level indicators combine several of the above listed contents and complement them with additional information such as land use or biodiversity data, thus aiming at establishing links to biodiversity and its drivers. Compared to the descriptive level of the status, change and trend maps of vegetation productivity, the second level indicator maps will provide more abstract information on the dynamics of biological productivity, drivers, and potential biodiversity trends.	***5.5. Second Level Indicators***	0	1	2	3	4
	5.5.1 Area of the pelagic photic zone and the area of the aphotic zone					
	5.5.2 Pressure on the photic zone due to changes in water level					
	5.5.3 Habitat variety index (structure of the shoreline combined with water quality)					
	Further suggestions and/or comments?					

Description	Accuracy and Validation of Inland Water Products					
Accuracy assessments and validation efforts will be made at various levels of the products, and will relate to the following questions: • Quality and scope of the retrieval algorithms • Accuracy of the water quality parameters • Relation of the results to biodiversity	**5.6. Accuracy checks and validation**	0	1	2	3	4
	5.6.1 Metadata describing characteristics and quality of input data, e.g. processing parameters, or number of MERIS observations within integration etc					X
	5.6.2 Plausibility checks (e.g. transects across a lake, time series to check the occurrence of blooms etc				X	
	5.6.3 Accuracy of water leaving reflectances by comparison with in-situ reflectance measurements					X
	5.6.4 Accuracy of the water quality and temperature parameters by comparison with in situ measurements					X
	5.6.5 Comparison of the higher level indicators (status, trends, second level indicators) with in situ data on biodiversity			X		

	Further suggestions and/or comments?

6. Product Requirements	
In this table, please specify the requirements of the Inland Water Products that you would like to be developed and demonstrated during the Diversity II project and for which sites. Please motivate your answers. ***For further explanation please refer to the list of products given in the Diversity II Executive Summary.***	
Spatial Coverage *Please indicate your area of interest. You can specify e.g. the name of a lake, or a larger area with several lakes (lake system). If possible please provide the coordinates of a bounding box.*	
Spatial integration *Please indicate the spatial integration required.*	X no spatial integration (i.e. keep original satellite pixels) ☐ water body within a lake (i.e. average all pixels within a water body) X whole lake (i.e. one value for the whole lake) ☐ lake system ☐ administrative local ☐ administrative regional ☐ administrative national ☐ protected area ☐ hot spot ☐ bio-geographic region X other …. Spatial averaging by lake basin (where these are known).

<table>
<tr><td rowspan="3">Temporal integration
Please provide a description of the temporal integration required, e.g. yearly, bi-annually, monthly, seasonally, other.
Please refer to the indicators listed under question 5 if there are different requirements per indicator.</td><td>Water Quality and Water Quantity parameters</td><td>X daily
☐ weekly
☐ monthly
☐ seasonal</td><td>☐ yearly
☐ epoch
☐ other …</td></tr>
<tr><td>First level indicators: changes and trends of Water Quality and Quantity products</td><td>☐ monthly
☐ seasonal
☐ yearly</td><td>☐ epoch
☐ other …</td></tr>
<tr><td>Second level indicators</td><td>☐ daily
☐ weekly
☐ monthly
☐ seasonal</td><td>☐ yearly
☐ epoch
☐ other …</td></tr>
<tr><td rowspan="3">Frequency of updates
Please provide a description of the temporal frequency required, i.e. how often you require information.</td><td>Water Quality and Water Quantity parameters</td><td>☐ daily
☐ weekly
X monthly
☐ seasonal</td><td>☐ yearly
☐ epoch
☐ other …</td></tr>
<tr><td>First level indicators: changes and trends of Water Quality and Quantity products</td><td>☐ monthly
☐ seasonal
X yearly</td><td>☐ epoch
☐ other …</td></tr>
<tr><td>Second level indicators</td><td>☐ daily
☐ weekly
☐ monthly
☐ seasonal</td><td>X yearly
☐ epoch
☐ other …</td></tr>
<tr><td rowspan="6">Accuracy requirements for Water Quality Parameters
Please specify accuracy requirements for the parameters listed under question 5.1.</td><td colspan="3">Turbidity:</td></tr>
<tr><td colspan="3">Secchi Disk depth:</td></tr>
<tr><td colspan="3">Chlorophyll-a concentration:</td></tr>
<tr><td colspan="3">Suspended sediment conc.:</td></tr>
<tr><td colspan="3">Yellow substance absorption:</td></tr>
<tr><td colspan="3">Lake Surface Water Temperature:</td></tr>
</table>

7. Inland Water sites	
Results will be produced for 300 large perennial Inland Water sites for the time period 2002-2012. In question 6 we asked for the inland water sites of your direct interest. Here we would like to get your opinion which other inland waters should be in included in the final list of 300 lakes. A justification of your choice would be appreciated.	
Sites *List Inland Water sites of your interest by order of priority, preferably with coordinates, for the area for which products are required.*	We imagine all 300 of the Diversity II lakes will be included in the global population of lakes considered by GloboLakes.
Available data *Please list any data that would be available as additional information for the proposed Inland Water supporting the product generation (including the sites you specified under question 6)* *Please indicate also if there are any restrictions on the use and disclosure of these data.*	We would be able to provide information on catchment variables for some of the 300 lakes covered by the Diversity II project.
	Terms of use: ☐ can be made publicly available ☐ publication on request ☐ restricted to use within the project

9. Other
Is there anything else you think should be taken into account in tailoring the products, but which doesn't seem to fit into any of the other boxes?

10. Recommended additional contacts
We are intending to involve as completely as possible those organisations that could benefit from the Diversity II Products. Please list any other organisations (including contact names) that you think would be interested.

CSIR Stewart Bernard & Mark Matthews

1. Organisation details	
Organisation	University of Cape Town (UCT), Council for Scientific and Industrial Research (CSIR), Department of Water Affairs of South Africa (DWA)
Contact Name	Dr. Stewart Bernard, Mark Matthews
Position of the Contact within the organisation	Senior Research Scientist, PhD Student
Postal address	Centre for High Performance Computing 15 Lower Hope Street, Rosebank Cape Town 7700 South Africa
Email	MTTMAR017@myuct.ac.za; sbernard@csir.co.za
Telephone	+27216505775
Type of organisation e.g. IGO, NGO, Scientific Body, Biodiversity or Earth Observation focus	*Collaboration between academic (UCT), scientific research organisation (CSIR), government department (DWA) focussing on earth observation for water resources management and assessment*
Brief description of the organisation's activities and its role in relation to the CBD and to the conservation and wise use of Inland Waters.	UCT and CSIR conduct primary research and play an advisory role. CSIR aims to provide information for water resources management through various portals. DWA is primarily tasked with all activities related to the monitoring, management, and conservation of South Africa's scare and valuable freshwater resources.

2. Region / Country	
Region / Country (geographical area of interest)	Republic of South Africa

3. Existing Activities / Projects
Please provide details of existing activities / projects which could, even partly, complement the work planned in Diversity II. To achieve the best synergy with existing projects, existing activities should be taken into account when defining the work plan of the Diversity II project.
Safe Waters Earth Observation Systems (SWEOS) was a collaborative project between DWA, CSIR, UCT SANSA (South African National Space Agency), and DST (Department of Science and Technology) providing pilot demonstration freely available EO based water monitoring data though an online portal as well as development of low-cost autonomous in situ water quality and radiometric buoys. There are ongoing CSIR/DST funded EO water quality projects aimed toward achieving operational EO based water quality/quantity monitoring system for South African reservoirs, for example, iWater. The upcoming Monitoring for Environment and Security - Marine and Aquatic Ecosystems in South Africa

(MES – MAESA) forms part of the Sential 3 cal./val. team project.

4. Requirements Overview

Please provide a general description of your applications including your requirements for Diversity II products. Highlight the major limitations of your current practices and the activity areas (e.g. biodiversity indicators for Inland Water assessment and/or management, reporting to the CBD) where you think the Diversity II project could help you.

The primary need for South African is information on eutrophication in small water-scarce inland waters and phenological characterisation of phytoblooms. Further efforts are needed to integrate these products into applications for water resources and catchment management, and input to hydrological models. The main limitations are lack of satellite data (primarily coverage) as well as data accessibility, portability and dissemination – hopefully Diversity can help overcome some of these challenges. Uptake by a broad-base of water management authorities and users has been challenging. A pilot demonstration through Diversity II would have very strong political interest in SA, both for direct applications and with regard to EO strategy and development of sensors in SA e.g. forthcoming ARMC satellite.

5. Products and Indicators for Inland Water: Status, Change and Trends

In this table, please share your preferences and ideas about Inland Water products and indicators that you would like to be developed and demonstrated during the Diversity II project (please refer also to the product overview given in the Diversity II Executive Summary).

Please indicate on a scale of 0 to 4 as shown below, how do you judge the importance of the proposed products for your work:

0: Cannot tell
1: Not important, not interesting for your work
2: Might be interesting, lower priority
3: Interesting, medium priority
4: Interesting and relevant for your work, high priority

Description	Water Quality and Temperature					
Water Quality of large perennial inland water will be assessed through a set of parameters derived from ENVISAT MERIS and AATSR instruments. SA offers chance to move to small water bodies & address very much larger user base!	***5.1. Parameters on water quality and temperature:***	0	1	2	3	4
	5.1.1 Turbidity:					
	5.1.2 Secchi Disk depth					
	5.1.3 Chlorophyll-a concentration					
	5.1.4 Suspended sediment conc.					
	5.1.5 Yellow substance absorption					
	5.1.6 Quality indicator					
	5.1.7 Variance of parameter during averaging interval					
	5.1.8 Lake Surface Water Temperature					
	5.1.9 Uncertainty estimate for lake surface temperature					

	5.1.10 Chi-squared (goodness of fit measure for OE retrieval					
	5.1.11 Variance of LSWT over averaging period/area over averaging period/area					
	Further suggestions and/or comments?					
	Cyanobacteria, PFT and macrophytes flags e.g. MPH algorithm.					
	5.2. Temporal Aggregation of water quality and temperature parameters	0	1	2	3	4
	5.2.1 None					
	5.2.2 Daily					
	5.2.3 Monthly					
	5.2.4 Yearly					
	5.2.5 Climatology					
	5.2.4 Time series					
	Further suggestions and/or comments?					
	5.3. Water Quantity parameters	0	1	2	3	4
	5.3.1 Water height difference to reference level					
	5.3.2 Water volume difference					
	5.3.3 Horizontal extent of the lake water surface					
	Further suggestions and/or comments? Data availability & algo performance unknown? –Water level issues certainly more important in more infrastructure poor areas of Africa					

<table>
<tr><th>Description</th><th colspan="6">First level indicators:
Changes and Trends of Water Quality and Quantity products</th></tr>
<tr><td rowspan="2">Changes and trends of water quality and quantity potentially point to developments with impacts on biodiversity.
Differences between single years or epochs are to a large degree part of the “normal” variability of inland water conditions.
Abrupt and big changes as well as longer term trends, however, may be hints of changed conditions for biodiversity.
The parameters are:
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The epochs are:
Epoch 1 = 2004 – 2006
Epoch 2 = 2007 – 2009
Epoch 3 = 2010 – 2012</td><td colspan="6">5.4. Change Maps of water quality and water quantity status between “epochs”</td></tr>
<tr><td></td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td></tr>
<tr><td></td><td>5.4.1 Averages of <parameter*> for the three <epochs*>
* see left side</td><td>.</td><td>.</td><td>.</td><td>.</td><td>..</td></tr>
<tr><td></td><td>5.4.2 Trend <parameter> between <epoch i**> and <epoch j**>
** i and j are any combination of the three epochs; e.g. the trend from epoch 1 to epoch 2</td><td>.</td><td>.</td><td>.</td><td>.</td><td>..</td></tr>
<tr><td></td><td>5.4.3 Lake status = Mean(epoch1)/Mean(epoch2)</td><td>.</td><td>.</td><td>.</td><td>.</td><td>..</td></tr>
<tr><td></td><td>5.4.4 Lake trend = Trend(epoch 1/2) and Trend(epoch2/3) are positive, negative, stable, uncertain</td><td>.</td><td>.</td><td>.</td><td>.</td><td>..</td></tr>
<tr><td></td><td colspan="6">Further suggestions and/or comments?
Is there scope for more sophisticated time series analyses e.g. seasonal vs high frequency variability?</td></tr>
</table>

Description	Second level indicators					
Second level indicators combine several of the above listed contents and complement them with additional information such as land use or biodiversity data, thus aiming at establishing links to biodiversity and its drivers. Compared to the descriptive level of the status, change and trend maps of vegetation productivity, the second level indicator maps will provide more abstract information on the dynamics of biological productivity, drivers, and potential biodiversity trends.	***5.5. Second Level Indicators***	0	1	2	3	4
	5.5.1 Area of the pelagic photic zone and the area of the aphotic zone	·	·	··	·	·
	5.5.2 Pressure on the photic zone due to changes in water level	·	·	·	·	··
	5.5.3 Habitat variety index (structure of the shoreline combined with water quality)	·	·	·	·	··
	Further suggestions and/or comments?					

Description	Accuracy and Validation of Inland Water Products					
Accuracy assessments and validation efforts will be made at various levels of the products, and will relate to the following questions: • Quality and scope of the retrieval algorithms • Accuracy of the water quality parameters • Relation of the results to biodiversity	**5.6. Accuracy checks and validation**	0	1	2	3	4
	5.6.1 Metadata describing characteristics and quality of input data, e.g. processing parameters, or number of MERIS observations within integration etc	·	·	·	·	··
	5.6.2 Plausibility checks (e.g. transects across a lake, time series to check the occurrence of blooms etc	·	·	·	·	··
	5.6.3 Accuracy of water leaving reflectances by comparison with in-situ reflectance measurements	·	·	·	·	··
	5.6.4 Accuracy of the water quality and temperature parameters by comparison with in situ measurements	·	·	·	·	··
	5.6.5 Comparison of the higher level indicators (status, trends, second level indicators) with in situ data on biodiversity	·	·	·	·	··

	Further suggestions and/or comments?

6. Product Requirements	
In this table, please specify the requirements of the Inland Water Products that you would like to be developed and demonstrated during the Diversity II project and for which sites. Please motivate your answers. ***For further explanation please refer to the list of products given in the Diversity II Executive Summary.***	
Spatial Coverage *Please indicate your area of interest. You can specify e.g. the name of a lake, or a larger area with several lakes (lake system). If possible please provide the coordinates of a bounding box.*	Ideally regional system incorporating several water bodies including the Vaal, Hartbeespoort and Loskop reservoirs. These reservoirs offer a good comparative approach with validation data being available at both Hartbeespoort and Loskop reservoirs. The Vaal is the 2nd largest reservoir in SA providing potable water supply to large population with extremely high pressures from development and agriculture on water quality. Bounding box: Top left: -25.3N, 27.7W Bottom right:-27.3S, 28.9E
Spatial integration *Please indicate the spatial integration required.*	☐ X no spatial integration (i.e. keep original satellite pixels) ☐ Xwater body within a lake (i.e. average all pixels within a water body) ☐ X whole lake (i.e. one value for the whole lake) ☐ lake system ☐ administrative local ☐ administrative regional ☐ administrative national ☐ protected area ☐ X hot spot ☐ X bio-geographic region ☐ other ….

<table>
<tr><td rowspan="3">Temporal integration
Please provide a description of the temporal integration required, e.g. yearly, bi-annually, monthly, seasonally, other.
Please refer to the indicators listed under question 5 if there are different requirements per indicator.</td><td>Water Quality and Water Quantity parameters all</td><td>☐ daily
☐ weekly
☐ monthly
☐ seasonal</td><td>☐ yearly
☐ epoch
☐ other …</td></tr>
<tr><td>First level indicators: changes and trends of Water Quality and Quantity products all</td><td>☐ monthly
☐ seasonal
☐ yearly</td><td>☐ epoch
☐ other …</td></tr>
<tr><td>Second level indicators</td><td>☐ daily
☐ weekly
☐ X monthly
☐ Xseasonal</td><td>☐ yearly
☐ epoch
☐ other …</td></tr>
<tr><td rowspan="3">Frequency of updates
Please provide a description of the temporal frequency required, i.e. how often you require information.</td><td>Water Quality and Water Quantity parameters</td><td>☐ X daily
☐ weekly
☐ monthly
☐ seasonal</td><td>☐ yearly
☐ epoch
☐ other …</td></tr>
<tr><td>First level indicators: changes and trends of Water Quality and Quantity products</td><td>☐ Xmonthly
☐ Xseasonal
☐ Xyearly</td><td>☐ epoch
☐ other …</td></tr>
<tr><td>Second level indicators</td><td>☐ daily
☐ weekly
☐ Xmonthly
☐ Xseasonal</td><td>☐ yearly
☐ epoch
☐ other …</td></tr>
<tr><td rowspan="5">Accuracy requirements for Water Quality Parameters
Please specify accuracy requirements for the parameters listed under question 5.1.</td><td colspan="3">Turbidity: ±30%</td></tr>
<tr><td colspan="3">Secchi Disk depth: < 10cm</td></tr>
<tr><td colspan="3">Chlorophyll-a concentration: ± 30%</td></tr>
<tr><td colspan="3">Suspended sediment conc.: ±30%</td></tr>
<tr><td colspan="3">Yellow substance absorption:
unlikely anyway</td></tr>
<tr><td></td><td colspan="3">Lake Surface Water Temperature:
± 1 C</td></tr>
</table>

7. Inland Water sites	
Results will be produced for 300 large perennial Inland Water sites for the time period 2002-2012. In question 6 we asked for the inland water sites of your direct interest. Here we would like to get your opinion which other inland waters should be in included in the final list of 300 lakes. A justification of your choice would be appreciated.	
Sites *List Inland Water sites of your interest by order of priority, preferably with coordinates, for the area for which products are required.*	Vaal: -26.88S, 28.96E Loskop: -25.45S, 28.96E Hartbeespoort: -25.74S, 27.85E The Vaal is the 2nd largest reservoir in SA providing potable water supply to large population with extremely high pressures from development and agriculture on water quality. Hartbeespoort and Loskop reservoirs have been characterised extensively from a bio-optical perspective and are ideal sites for validation. They are also extremely important as conservation, agricultural, potable and recreational water uses.
Available data *Please list any data that would be available as additional information for the proposed Inland Water supporting the product generation (including the sites you specified under question 6)* *Please indicate also if there are any restrictions on the use and disclosure of these data.*	UCT/CSIR (Hartbeespoort and Loskop reservoirs): Rrs, chl-a, Zsd, TSM, aCDOM, phytoplankton, pigments, - restricted to within project, publish with acknowledgement DWA: Water level, chl-a, TSM, chemical, biological, turbidity (in some instances), - publicly available, publication with acknowledgement
	Terms of use: (see above) ☐ can be made publicly available ☐ publication on request ☐ restricted to use within the project

9. Other
Is there anything else you think should be taken into account in tailoring the products, but which doesn't seem to fit into any of the other boxes?
There is much to be gained by an approach that focuses more on eutrophication e.g. eutrophic indices, bloom indices and phenological approaches e.g. bloom occurrence. Applications related to risk analyses/warning systems/harmful bloom occurrence with view to L3/4 Sentinel 3 (and 2) data would also be valuable.

10. Recommended additional contacts
We are intending to involve as completely as possible those organisations that could benefit from the Diversity II Products. Please list any other organisations (including contact names) that you think would be interested.
DWA - Carey Rajah, RajahC@dwa.gov; Nadine Slabbert, SlabbertN@dwa.gov University of Makarere, Uganda, Anthony Gidudu – Anthony.gidudu@gmail.com

Annex 16 User Consultation Meeting Sigtuna, June 2013

Wednesday 26.06.2013

10:00	12:00	02:00	Coffee & Preparations - Project group	all
12:00	13:00	01:00	**Lunch at Sigtuna Stadshotell**	
			User consultation meeting	
13:00	13:10	00:10	Welcome & logistics	Per Wramner/Kjell Wester
13:10	13:20	00:10	Tour de Table	all
13:20	13:30	00:10	ESA Data User Element Programme	Marc Paganini
13:30	13:40	00:10	Diversity overview, objective of meeting	Carsten Brockmann
13:40	14:10	00:30	Diversity User Bureau (DUB), questionnaires and literature evaluation	Per Wramner
14:10	14:30	00:20	UNESCO biodiversity related activities & requirements	Engin Koncagul
14:30	15:00	00:30	**Coffee break**	
			Drylands users	
15:00	15:20	00:20	JRC activities & requirements	Eva Ivits
15:20	15:40	00:20	Mälaren Univ. activities & requirements	Patrik Klintenberg
15:40	16:00	00:20	CSE activities & requirements	Amadou Dieye
16:00	16:20	00:20	UNCCD activities & requirements	Elysabeth David
16:20	16:50	00:30	Discussion round drylands	all
16:50	17:00	00:10	Conclusions of Day 1	Carsten Brockmann
17:30	18:30	01:00	**Historical guided tour in Sigtuna, Appr. 1 hours**	
19:00			**Dinner at "Båthuset"**	

Thursday 27.06.2013

			Inland Water Users	
09:00	09:20	00:20	Globolakes activities & requirements	Peter Hunter
09:20	09:40	00:20	CSIRO activities & requirements	Erin Hestir
09:40	10:00	00:20	Activities & requirements from South African users	Mark Matthews
10:00	10:20	00:20	User requirement for Lake Victoria	Kai Sörensen
10:20	10:50	00:30	Discussion round inland waters	all
10:20	10:50	00:30	**Coffee break**	
			User Consultation Wrap-up	
10:50	11:00	00:10	Summary of presented concerns	Wramner/Brockmann
11:00	12:30	01:30	Concluding dicussion round	all

List of participants

J. Brito, CIBIO

C. Brockmann, Brockmann Consult

J. Campos, CIBIO

O. Danne, Brockmann Consult

E. David, UNCCD

A. Dieye, Centre de Suivi Ecologique (CSE)

U. Gangkofner, Geoville

N. Hahn, Brockmann Geomatics

E. Hestir, CSIRO (via Skype from Australia)

P. Hunter, University of Stirling

E. Ivits, JRC

P. Klintenberg, Mälardalen University & Desert Research Foundation of Namibia

E. Koncagul, UNESCO & UN World Water Assessment Programme

A.B. Ledang, NIVA

M. Matthews, University of Cape Town & ChloroGin

D. Odermatt, Brockmann Consult

M. Paganini, ESA

P. Philipson, Brockmann Geomatics

G. Ratzmann, Geoville

K. Sörensen, NIVA

S. Thulin, Brockmann Geomatics

K. Wester, Brockmann Geomatics

P. Wramner, Brockmann Geomatics

Annex 17 User Consultation Meeting Frascati, May 2014

Lake User Consultation Meeting

Monday 19.05.2014

Villa Grazioli, Via Umberto Pavoni 19, 00046 Grottaferrata Roma

ESA ESRIN, Via Galileo Galilei 64, 00044 Frascati Roma

Shuttle Bus from Centre Frascati, Piazza Marconi, to Villa Graziolo 08:15

09:00	09:20	Introduction, welcome, objectives of the meeting	Marc Paganini, ESA
09:20	09:50	DIVERSITY II project overview	Carsten Brockmann, BC
09:50	10:20	GloboLakes project overview	Andrew Tyler, Univ. Stirling
10:20	10:40	Earth Observation of Inland Waters	Carsten Brockmann
10:40	11:10	**Break**	
11:10	12:40	Application topics (WFD, catchment scale processes, biodiversity), avoiding methodological discussions	
		Water Quality Monitoring by NIVA	Anna-Birgitta Ledang, NIVA
		Lakes monitoring in the UK - challenges now and in the future	Bill Brierley, FBA & EA
		Use of remote sensing for lake (and coastal) ecosystem monitoring at the Finnish Environment Institute (SYKE)	Sampsa Koponen, SYKE
		iDIV presentation	Jörg Freyhoff, iDIV (tbc)
		Feedback from user questionnaires	Carsten Brockmann
12:40	13:00	Discussion triggered by key questions. Goal: clarifications and feedback	Discussion lead CB
13:00	14:00	**Lunch**	
14:00	15:00	From EO products to Higher Level products and indicators: Short introductory presentations on Diversity II 1st order indicators, GloboLakes higher level products and 2 EO users	
		Lake selection and the determination of global scale metrics for interpreting change	Eirini Politi, Univ. Dundee
		Operationalising the Global Observatory for Lakes	Steve Groom, PML
		From EO products to Higher Level products and biodiversity indicators	Daniel Odermatt, BC
15:00	15:15	Discussion; goal is to come up with suggestions for temporal and spatial aggregation in view of first and second order indicators	Discussion lead DO
15:15	15:45	**Break**	
15:45	16:35	Continuation of discussion, triggered by a 2nd order biodiversity indicator concept presentation	
		Diversity II data and products supporting estimation of ecological status	Petra Philipson, BG
		Determining trends in lake phenology from the MERIS archive	Peter Hunter, Univ. Stirling
		Contrasting EO indicators with biodiversity data	Joao Campos, CIBIO
		Discussion; goal is to come up with suggestions for temporal and spatial aggregation in view of first and second order indicators	Discussion lead DO
16:35	16:55	Preparing the future: what do the new satellites offer us? Introduction by a presentation on S2, 3, L8 and impact on inland water remote sensing. 1 user presentation	Carsten Brockmann
16:55	17:15	Discussion triggered by some key questions. Goal: requirements on EO data, in view of Sentinel 2+3	Discussion lead CB
17:45	19:00	**Apperitivo**	

Tuesday 20.05.2014

Hands-on experience with Lakes products and tools

ESRIN

Training Room

MORNING		Sentinel 2 Workshop	
14:40	16:20	**ESRIN TRAINING ROOM** Introduction to DIVERSITY II Lake Products Unpacking First Level Indicators: How a phenological time series is constructed (Demonstration) Put your hands on MERIS products (guided tutorial, PC and data are available in the room)	
16:20	16:50	Break	
16:50	18:30	**ESRIN TRAINING ROOM** Interactive training: - introduce the DIVERSITY L2 products and processing - the new BEAM 5 Binning tool - managing Time series - pixel extraction	
18:30		Sentinel 2 Workshop, Poster Session	

List of participants

Firstname	Name	Organisation	Country
Stewart	**Bernard**	CSIR	South Africa
Seve	**Groom**	PML	UK
Sampsa	**Koponen**	SYKE	Finland
Joerg	**Freyhof**	GEO-BON, iDIV	Germany
Andrew	**Tyler**	Univ. Stirling	UK
Peter	**Hunter**	Univ. Stirling	UK
Bill	**Brierly**	Freshwater Biological Association & Environment Agency	UK
Anna-Birgitta	**Ledang**	NIVA	Norway
Erin	**Hestir**	CSIRO	Australia
Marc	**Paganini**	ESA	Italy
Ils	**Reusen**	VITO	Belgium
Petra	**Philipson**	BG	Sweden
Daniel	**Odermatt**	BC	Germany
Joao	**Campos**	CIBIO	Portugal
Eirini	**Politi**	Univ. Dundee	UK
Ana	**Ruescas**	BC	Germany
Kerstin	**Stelzer**	BC	Germany
Carsten	**Brockmann**	BC	Germany

Annex 18 User Consultation Meeting Bonn, July 2014

Monday, July 7, afternoon (part 1) **Welcome, Workshop Objectives, Diversity II project overview**		
14:00 – 14:20	Introduction, welcome, objectives of the meeting	Marc Paganini, *European Space Agency*
14:20 – 14:35	Short tour through the agenda and logistics	Carsten Brockmann, *Brockmann Consult* Ute Gangkofner, *Geoville*
14:35 – 14:45	Tour de table	all
14:45 – 15:45	DIVERSITY II project overview	Carsten Brockmann, *Brockmann Consult*
15:45 - 16:00	Coffee Break	
Monday, July 7, afternoon (part 2) **EO information needs related to Land Productivity Indicators of UNCCD and CBD**		
16:00 - 16:20	The use of Land productivity as an indicator for the UNCCD reporting process and to monitor Land Degradation Neutrality	Victor Castillo, *UNCCD secretariat*
16:20 - 16:40	CBD title tbd	Ms. Sakhile KOKETSO, *CBD secretariat*
16:40 - 17:00	Relation between land condition and biological diversity in drylands	Keynote Speaker tbd
17:00 - 17:30	Discussion, wrap up of common UNCCD and CBD information needs	all
Tuesday, July 8, morning **Existing EO approaches for drylands, Diversity II methods/indicators**		
08:45 - 09:00	Warm up	Whoever is there
09:00 - 09:30	Modelling NPP and NPP Proxies	Kurt Günther, *DLR*
09:30 - 10:00	Desertification; what can we learn from time series of Earth Observation data?	Rasmus Fensholt, *University of Copenhagen*
10:00 - 10:30	Non-linearities between rainfall and vegetation in drylands	Gregor Ratzmann, *Geoville*
10:30 - 10:45	Coffee Break	
11:00 - 12:30	Methods and products of Diversity II	Ute Gangkofner, *Geoville*
12:30 - 14:00	Lunch Break	
Tuesday, July 8, afternoon **Dryland productivity indicators and their potential**		

User/expert presentations (~20mins each) & Discussions		
14:00 - 16:00	The World Atlas of Desertification (WAD)	Michael Cherlet, *JRC, European Commission*
	Experience from South Africa in mapping land degradation	Graham von Maltitz, *CSIR, South Africa*
	Title tbd	Patrik Klintenberg, *Mälardalen University*
	tbd	tbd
16:00 - 16:15	Coffee Break	
16:15 - 17:30	UNCCD Indicators. Application on the Portuguese NAPCD	Lúcio Pires do Rosário, *National Focal Point for UNCCD, Portugal*
	Experiencia Proyecto ASA-INSA: Monitoramiento de sistemas agricolas familiares en el semiárido del Brazil	Aldrin Perez-Marin, *INSA, Brazil*
Wednesday, July 9, morning **Towards EO indicators serving UNCCD and CBD needs**		
08:45 - 09:00	Logistics, departure, lunch	Carsten Brockmann
09:00 - 10:00	Proposed "second order" indicators of Diversity II Discussions	Ute Gangkofner all
10:00 - 10:15	Coffee Break	
10:15 - 10:30	Near Future: EO sensors, other developments and their impacts on dryland monitoring	Marc Paganini
10:30 - 11:45	Final Discussions, suggestions continued	all
11:45 - 12:00	Concluding remarks	Marc, Ute, Carsten, whoever wants to say something
12:00	Official end of meeting, social lunch at convenience	Marc Paganini to conclude

List of participants

Name	Surname	Institution
Tim	**Wacher**	Zoological Society of London (ZSL)
Thomas	**Rabeil**	Sahara Conservation Fund (SCF)
Bert	**Toxopeus**	Geo-Information Science and Earth Observation (ITC)
Bob	**Scholes**	Council for Scientific and Industrial Research (CSIR), SA
Graham	**v. Maltitz**	Council for Scientific and Industrial Research (CSIR), SA
Konrad	**Wessels**	Council for Scientific and Industrial Research (CSIR), SA
Mary	**Seely**	Desert Research Foundation, Namibia
Patrik	**Klintenberg**	Mälardalen University, Sweden
David	**Mouat**	Desert Research Institute
Kenneth	**Clarke**	University of Adelaide

Victor	**Castillo**	UNCCD
Elysabeth	**David**	UNCCD
Alan	**Belward**	Joint Research Center (JRC)
Rasmus	**Fensholt**	University of Copenhagen
Kurt	**Günther**	DLR
Lúcio	**Pires do Rosário**	ICNF - Institute for Nature Conservation and Forests Planning and International Affairs Department National Focal Point for UNCCD
Aldrin	**Perez-Marin**	
Ignacio	**Salcedo**	President of the Brazilian Institute for Semi-arid regions
Leopoldo	**Rojo Serrano**	
Juan	**Puigdefábregas Tomás**	
Gabriel	**del Barrio**	