Compromises and trade-offs in the selection of indicators for the EU sustainable development indicator set

Monitoring sustainable management and use of natural resources in the European Union

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June 2008

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PIHLAJAMÄKI, MIA: Compromises and trade-offs in the selection of indicators for the EU sustainable development indicator set. Monitoring sustainable management and use of natural resources in the European Union

Master's thesis: 100 pages, 2 appendices (11 pages)

Environmental policy

June 2008

Abstract

The aim of this study is to explore the process that has resulted in the selection of a set of indicators under the Natural Resources theme in the EU 2007 sustainable development indicator set.

Qualitative content analysis is used to identify, on one hand, dynamic features characterising the selection process and the role of different factors in the selection of indicators, and on the other hand, to explore the arguments used to justify the selection or removal of any given indicator. The material for this study comprises of documents relating to the meetings of the Sustainable Development Indicators Task Force and Working Group. The results are discussed with consideration for the predefined factors affecting the indicator selection (e.g. the framework and approach chosen, and data availability), while conclusions of the arguments used to justify the selection are studied in the light of the three characteristics of a good indicator; scientific validity, policy relevance and communicability.

The results show that the selection process is characterised by dynamic features such as the dynamics of sustainable development and the nature of policy processes, as well as the on-going indicator development process, resulting in constant need for revision of the set. The selection of the indicators is affected by the compromises and trade-offs made in the selection process between policy- and statistics-driven approach, a thematic-framework and causal-chain framework, participatory and expert-driven approach, stable and active indicator set, and data availability and the development of the most suitable indicators. The main argumentation for the selection of any given indicator was its policy relevance. Features relating to the scientific validity of an indicator were also discussed, especially in terms of suitability for the purpose and with respect to data availability and methodology, while there was no significant consideration given to the indicators ability to communicate to its target audience.

Keywords: sustainable development indicators, indicator selection process, natural resources, European Union

Abbreviations

BOD(5)	Biochemical Oxygen Demand (over five days)
CIRCA	Communication and Information Research Centre Administrator
COD	Chemical Oxygen Demand
DEFRA	Department for Food and Rural Affairs
DG	Directorate-General
EBCC	European Bird Census Council
EEA	European Environment agency
Eurostat	The Statistical Office of the European Communities
EU-27	The 27 Member States of the European Union
EU-25	The 25 Member States of the European Union until 31 December 2006
EU-15	The 15 Member States of the European Union until 30 April 2004
ICES	International Council for the Exploration of the Seas
IWRM	Integrated Water Resources Management
JCR	Joint Research Centre of the European Commission
MS	Member States of the European Union
MCPFE	Ministerial Conference on the Protection of Forests in Europe
NGO	Non-Governmental Organisation
OECD	Organisation for Economic Cooperation and Development
PECBM	Pan-European Common Bird Monitoring Scheme
PoI2002	Plan of Implementation 2002
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals
SDIs	Sustainable Development Indicators
SDI/TF	Sustainable Development Indicators Task Force
SDI/WG	Sustainable Development Indicators Working Group
SDS	Sustainable Development Strategy
SEBI 2010	Streamlining European 2010 Biodiversity Indicators
SFM	Sustainable Forest Management
SG	Secretariat-General
SIs	Structural Indicators
TERM	Transport Environment Reporting Mechanism
UNCSD	United Nations Commission on Sustainable Development
UNDSD	United Nations Division for Sustainable Development
UNECE	United Nations Economic Commission for Europe
6EAP	Sixth Environmental Action Programme

Countries

BE	Belgium
BG	Bulgaria
CZ	Czech Republic
DK	Denmark
DE	Germany
EE	Estonia
IE	Ireland
EL	Greece
ES	Spain
FR	France
IT	Italy
CY	Cyprus
LV	Latvia
LT	Lithuania
LU	Luxembourg
HU	Hungary
MT	Malta
NL	Netherlands
AT	Austria
PL	Poland
PT	Portugal
RO	Romania
SI	Slovenia
SK	Slovakia
FI	Finland
SE	Sweden
UK	United Kingdom
NO	Norway
CH	Switzerland

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Foreword

I began to work on a FP6-funded research project called “Development and Comparison of Sustainable Development Indicators” in November 2006. As part of my role, I attended the second meeting of the Sustainable Development Indicators Working Group in November 2006. During the meeting I learnt that in order to monitor biodiversity and the management of natural resources at the EU-level, an indicator on population trends of farmland birds was used. I became very curious as to the reason this particular indicator was used and what kind of information it can provide about sustainable development in relation to biodiversity and the management of natural resources. The concept for this study originates from that meeting.

Another reason for my initial interest on this topic originates from my first three years in university during which I studied marine sciences in the University of Southampton. While I was excited about doing field research at the sea, I always kept wondering what is actually done with the results I gathered. Since indicators are in the interface of science and policy, and can be aimed at inter-linking the two, they provide – to some extent – an answer to my wonderment.

I would like to thank all the people who have supported and encouraged me through this process.

1. Introduction

1.1 Background

In 1999, at the request of the European Council, the European Commission began to prepare "a proposal for a long-term strategy dovetailing policies for economically, socially and ecologically sustainable development". The strategy was to complete and build on the previously adopted Lisbon strategy, which sought to enable "the Union to become the most competitive and dynamic knowledge-based economy in the world capable of sustainable economic growth with more and better jobs and greater social cohesion", by including environmental dimension. In 2001, the Gothenburg European Council adopted the first EU sustainable development strategy (SDS). (European Commission 2001, 2.)

The strategy identifies six unsustainable trends in Europe, which relate to 1) climate change and clean energy, 2) public health, 3) poverty and social exclusion, 4) an ageing society, 5) management of natural resources, and 6) land use and transport. A set of headline objectives, targets and specific measures at EU level were proposed in order to tackle these threats. Prior to the formation of the EU SDS, the European Councils had agreed upon a strategy to tackle two of the fore-mentioned unsustainable trends – poverty and an ageing society, therefore the SDS concentrates only on proposing objectives and measures on the remaining four issues (limit climate change and increase the use of clear energy, address threats to public health, manage natural resources more responsibly, and improve transport system and land-use management). (European Commission 2001, 10.)

Following the adoption of the EU sustainable development strategy in 2001, a Task Force was established by the Statistical Programme Committee (SPC) to develop indicators for sustainable development. The Task Force worked on developing an indicator set between the years 2001 and 2005 through nine meetings. The Task Force consisted of volunteers from European countries, both EU and non-EU countries together with representatives from the

European Commission, international organisations (such as EEA, OECD), and external experts. (CPS 2005/57/20/EN, 1.)

The first EU sustainable development indicator (SDI) set was published in 2005 (European Commission 2005a). The indicators were organised into a thematic framework that corresponds to themes and sub-themes of sustainable development (SDI/TF/30/4 rev. 4 2003, 4). The 2005 SDI set includes 155 indicators, which are grouped under 10 themes with six corresponding priority areas of the 2001 EU sustainable development strategy (themes 2, 3, 4, 5, 7 and 8), one (theme 10) from the 2002 communication on global partnership, two (themes 6 and 9) from the WSSD plan of implementation and one (theme 1) from the Lisbon process. The ten themes are: (1) economic development, (2) poverty and social exclusion, (3) ageing society, (4) public health, (5) climate change and energy, (6) production and consumption patterns, (7) management of natural resources, (8) transport, (9) good governance, and (10) global partnership. (EUROSTAT 2005, x.)

Only a year after the publication of the EU sustainable development set, in 2006, a renewed EU sustainable development strategy was adopted. The renewed EU sustainable development strategy builds on the 2001 strategy, but also on the other EU commitments such as the external dimensions added in 2002 by the European Council in Barcelona, and the Plan of Implementation of the Johannesburg World Summit on sustainable development, which were integrated into the strategy. The strategy includes four key objectives, ten policy guiding principles and identifies seven key challenges with corresponding overall objectives, operational objectives, targets and actions. (European Commission 2006.)

Since the purpose of the SDI set is to monitor the EU sustainable development strategy, preceding the adoption of the renewed sustainable development strategy in 2006, the SDI set had to be revised. Following the expiration of the mandate of the Task Force in 2005, a Sustainable Development Indicators Working Group (WG) was formed. The main difference between the two working groups was that all the Member States and associated countries were invited to participate in work of the WG (SDI/WG/2 2006).

The revised SDI set was published in 2007 and uses a similar thematic framework for organising indicators as the 2005 SDI set. In the 2007 set, the ten themes have been revised to better correspond to policy priorities identified in the renewed sustainable development strategy. As in the 2005 set, the 2007 divides the themes into sub-themes, which reflect the

operational objectives and actions of the 2006 SDS. The EU 2007 SDI set includes 122 indicators organised into a three-level pyramid within each theme. Level 1 indicators or headline indicators correspond to lead objectives of the renewed SDS, while Level 2 and Level 3 indicators correspond to priority objectives of the renewed SDS and explanatory variables, respectfully. The revised SDI set also includes 10 contextual indicators for background information, thus being useful for the analysis. (Eurostat 2007a, 3-6.)

The ten themes and their respective headline indicators and sub-themes as shown in the 2007 Monitoring report (Eurostat 2007, 297-301) include:

1. Socio-Economic development
    - Headline indicator: Growth rate of GDP per inhabitant
    - Level 2 and 3 indicators are arranged in three sub-themes: economic development, competitiveness and eco-efficiency, and employment
2. Sustainable consumption and production
    - Headline indicator: Resource productivity
    - Level 2 and 3 indicators are arranged in three sub-themes: resource use and waste, consumption patterns, and production patterns, in addition, there are two contextual indicators
3. Social inclusion
    - Headline indicator: At-risk-of-poverty rate after social transfer
    - Level 2 and 3 indicators are arranged in three sub-themes: monetary poverty and living conditions, access to labour market, and education, in addition, there is one contextual indicator
4. Demographic changes
    - Headline indicator: Employment rate of older workers
    - Level 2 and 3 indicators are arranged in three sub-themes: demography, old-age income adequacy, and public finance sustainability, in addition, there are three contextual indicators
5. Public health
    - Headline indicator: Healthy life-years and life expectancy at birth, by gender
    - Level 2 and 3 indicators are arranged in two sub-themes: health and health inequalities, and determinants of health
6. Climate change and energy
    - Headline indicators: Total greenhouse gas emissions, and Consumption of renewables
    - Level 2 and 3 indicators are arranged in two sub-themes: climate change, and energy

7. Sustainable transport
    - Headline indicator: Energy consumption of transport
    - Level 2 and 3 indicators are arranged in three sub-themes: transport growth, transport prices, and social and environmental impact of transport
8. Natural Resources
    - Headline indicators: Common bird index, and Fish catches taken from stocks outside safe biological limits
    - Level 2 and 3 indicators are arranged in four sub-themes: biodiversity, Fresh Water Resources, Marine Ecosystems, and land use
9. Global partnership
    - Headline indicator: Official development assistance (ODA)
    - Level 2 and 3 indicators are arranged in three sub-themes: globalisation of trade, financing for sustainable development, and global resources management
    - In addition, there are three contextual indicators
10. Good governance
    - there is no headline indicator for this theme
    - Level 2 and 3 indicators are arranged in three sub-themes: policy coherence and effectiveness, openness and participation, and economic instruments
    - In addition, there is one contextual indicator

The complete list of the 2007 EU sustainable development indicators and their respective themes and sub-themes is presented in Appendix I. It should be noted that there are inconsistencies in the 2007 Monitoring report with regards to the numbering of the themes.

The purpose of my study is to explore the indicator selection process in order to determine why a particular set of indicators were selected under the Natural Resources theme. In order to provide a conclusive review, I will study the selection process between the first meeting of the Task Force in 2002 and the publication of the revised EU sustainable development indicator set in 2007.

1.2 Aim of the study

When I first examined the 2005 EU sustainable development indicator set, one indicator in particular stood out – population trends of farmland birds was used as a headline indicator

under the Management of Natural Resources theme and also for biodiversity. I was not able to understand how this particular indicator could provide information about the development of the management of natural resources and biodiversity. I instantly became very curious as to why this indicator had been chosen to the SDI set.

The aim of this study is to explore why a certain set of indicators have been chosen under the Natural Resources theme. In order to review the selection of certain indicators it is important in the scope of this study to show them in the context of all the indicators under the Natural Resources theme. As the 2007 SDI set builds on the 2005 SDI set, in order to answer my research problem, I am studying the indicator selection process from the beginning in 2002 until the publication of the revised set in 2007.

The objective of my study is to explore the process that has resulted in the selection of thirteen indicators under the Natural Resources theme (published in the EU sustainable development indicator set in 2007) by identifying factors that have affected the selection of these indicators. The selection of the indicators occurs in an on-going process over six years. Therefore it can be assumed that the process itself affects the end-result. The aim is thus to review the selection process between the years 2002 and 2007 in respect to the Natural Resources theme in order to identify the factors determining or affecting the final outcome.

I am also interested in what are the arguments used when any given indicator is proposed to be added to the list, selected for inclusion, or removed from the list. These arguments provide means for persuasion and when argumentation is effective, it is also convincing and prerequisites that the action of argumentation is done in a language which is comprehensible for the target audience (Perelman 1996, 8, 50). According to Moldan and Dahl (2007), sustainable development indicators should be scientifically valid, policy relevant and effectively communicate to their target audience. In this study I am exploring whether the arguments used to justify the selection fall under these characteristics. I will make no attempt to force the arguments to adhere to these characteristics; rather I am reflecting the results with reference to them. This is to say whether the selection of any given indicator was justified by its quality to communicate to the target audience, scientifically validity, or policy relevance, i.e. whether the indicators were selected because they correspond to either all of the three criterions or at minimum one of them. As a result of this study, I will make no attempt to say whether the indicators selected are good or bad, rather to identify the characteristics used as justifications for their selection.

My research questions can be presented in the following way:

> What kind of dynamic features have characterised the process of selecting indicators under the Natural Resources theme?
>
> What has been the role of various factors in different stages of the selection process?
>
> What are the main arguments used to justify the selection or removal of any given indicator?

The identification of the dynamic features characterising the selection process and well as the possible factors affecting the selection of any given indicator can be assisted with the following sub-questions, which can be considered as relatively obvious candidates, but which might have influenced the selection process in different stages of the process and with varying significance:

- Who participates in the SDI selection process for the Natural Resources theme?
- To what extend does previous experience and other indicator sets affect the selection process?
- How does data availability affect the selection of any given indicator?

The following sub-questions are used to structure the arguments used for justifying the selection or removal of the indicators:

- How does the argumentation used for justifying the selection or removal of any given indicator reflect the three characteristics identified (scientific validity, policy relevance, and communicability)?
- How are the different characteristics emphasised during the selection process?
- What is the role of different characteristics in the formation of the set?

1.3 Structure of the study

I have previously given a general outline of the development of the 2007 EU sustainable development indicator set, starting from the adoption of the first EU sustainable development strategy in 2001. I have also presented the aim and objective of this study with relevant

research questions in part 1.2. In the following chapter (Chapter 2), I describe the material and method used in this study.

In Chapter 3, I elaborate on the issue of sustainable development indicators. More specifically, I give a short presentation of the history of the formation of sustainable development indicators in the European Union in part 3.1. In part 3.2 I define the main concepts relative to sustainable development indicators and finally, in part 3.3 the factors affecting the development of sustainable development indicator sets are presented.

Chapter 4 aims at presenting the EU sustainable development strategies in respect to the Natural Resources theme, the fundamental differences between the Task Force and the Working Group, and the indicators selected under the Natural Resources theme in the 2005 and 2007 EU sustainable development indicator sets.

In Chapter 5, I categorise the results under five headings corresponding to the headline indicators and the four sub-themes. These headings are further divided into sub-headings corresponding to the main indicators discussed. I present the results in the form of evolutionary storylines under each of the sub-headings to portray the selection process. In the end of each of the heading, the main results are summarised under the sub-theme and the negative and positive comments on all the indicators discussed are presented in tables.

In Chapter 6, I discuss the dynamic features characterising the selection process as well as the role of the various factors in different stages of the process in reference to the background information provided in Chapters 3 and 4, and the arguments used to justify the selection of the indicators in reference to the three characteristics provided in Chapter 3. In Chapter 7, conclusions are drawn and recommendations made to improve the effectiveness of the selection process.

2. Material and method

2.1 Material

The material for this study comes from the documents used in and related to the meetings of the EU Sustainable Development Indicators Task Force (TF) and Working Group (WG) between 2002 and 2007. All the documents can be found on the EU's discussion forum for sustainable development indicators, the CIRCA (Communication & Information Research Centre Administrator) website[1]. The EU's official statistical office Eurostat, is in charge of maintaining the discussion forum. All documents relating to the work of the Sustainable Development Indicators Task Force and Working Group are routinely uploaded to the website.

The website contains a vast number of documents from the TF and WG meetings, reports from theme based discussion groups, background documents, and other complementary documents such as policy documents, and information about other related indicator work. The documents from the TF and WG meetings include meeting agendas and minutes, working papers – for instance, meeting objectives, proposals for the SDI set and framework, and Member State and expert contributions on the proposed indicators. PowerPoint documents presented at any meeting by the Eurostat, Member State representatives or outside experts, and also the e-mail contributions that were sent between the meetings are uploaded on the CIRCA site. Furthermore, the Eurostat publishes every other year a monitoring report (European Commission 2006, 26), which outlines the progress towards a more sustainable Europe (see Eurostat 2001, Eurostat 2005 and Eurostat 2007a). These monitoring reports are based on the EU sustainable development indicators and can be found from both the CIRCA website and the Eurostat's website on sustainable development indicators[2].

I have reviewed the documents uploaded to the CIRCA, between 2002 and 2007, which relate to nine meetings of the Task Force and four meetings of the Working Group. All the working papers, agendas, minutes, etc., relating to a specific meeting are organised into a meeting

[1] http://circa.europa.eu/Public/irc/dsis/susdevind/home (these are public pages, but by signing in more documents can be accessed to)
[2] http://epp.eurostat.ec.europa.eu/portal/page?_pageid=1998,66119021,1998_66292168&_dad=portal&_schema=PORTAL

specific file on the CIRCA site. However, the site is missing folders for the second and third meeting of the Task Force. I do not believe that this has a great influence on my research as the actual indicator selection started during the fourth meeting of the Task Force coinciding with the formation of theme based sub-groups. It should be also noted that the seventh meeting was a workshop organised in Stockholm, thus the material from this meeting is different from all the other meetings comprising mainly from the objectives of the workshop and the minutes. The work of the Working Group is on-going, but since the 2007 SDI set was published after the fourth meeting, I have precluded all material uploaded to the CIRCA after that particular meeting, with the exception of the minutes from the fourth WG meeting that were uploaded on CIRCA in April, 2008.

From the uploaded documents, I have selected the ones that address the indicators under the Natural Resources theme and the related policy documents. The information provided by the documents from 2002 to 2007 are used for identifying factors affecting the selection or removal of the proposed indicators as well as for extracting arguments used in the discussions relating to the indicator selection under the Natural Resources theme. The inclusion of all the indicators discussed under the theme into the investigation enables me to study the selection process and therefore the identification of dynamic features characterising the selection process can also be carried out.

Since all the documents used in the meetings and produced based on the meetings are uploaded to the CIRCA website, the documents can be considered to provide a good representation of the work carried out in the meetings. However, the use of these documents as research material may include some limitations in respect to the information provided by these documents. Due to the nature of the documents – they are merely meant to summarise the discussions – there is a lack of detail to some extent and very little or no elaboration on any subject matter. The implications proposed by this kind of limitation are two fold. Firstly, the possible lack of detail can make the interpretation of the contents of the documents for outsiders very difficult at parts. Secondly, any hidden knowledge – based on the past knowledge of the participants or collaboration between the participants – is not evident.

In order to gain confirmation for my interpretations of the documents due to their limited elaboration, I debated the option of interviewing a number of key experts who were present at the meetings to gain further insight. However, I discovered that doing such interviews would not be possible or reasonable within the scope of this study. This is because, after approaching

an Eurostat representative and the Finnish TF and WG representative about this, it was clear to me that in order to undertake such interviews I would have to embark on in-depth discussions with the people who participated in the sub-group meetings of Natural Resources theme, which would entail travelling to multiple European countries.

2.2 Method

I use content analysis in this study in order to identify what kind of dynamic features have characterised the selection process, what is the role of various factors in the selection of indicators under the Natural Resource theme, and what are the arguments used for justifying the selection or removal of any indicator proposed.

Content analysis can be applied to either for quantitative or qualitative analysis. The main difference is that quantitative content analysis aims at answering questions such as "how much of a given phenomenon there is in a chosen set of texts" (Stokes 2003, 57) whereas qualitative content analysis does not aim at giving numerical results, but with the help of quotes, aims to identify themes or give meanings within the studied text (Bewerton 2001, 151). In this study I use qualitative content analysis to describe the content of the investigated documents with words rather than numbers.

Tuomi and Sarajärvi identify three different approaches for analysing qualitative data and how these different approaches determine and affect the selection of framework, data collection, data analysis and reporting. One of the approaches for qualitative analysis – the one used in this study – is data-driven analysis for which a framework can be built from what is already known from the phenomenon under investigation. The collection of data for this type of analysis is not predetermined by any type of data collection method and the analysis and reporting are completely data-driven. (Tuomi & Sarajärvi 2002, 101.)

The qualitative data-driven content analysis is carried out by following three steps: 1) data reduction, i.e. the information on the documents to be analysed is reduced to include only the kind of information that is relevant for the research question and problem, 2) clustering or categorising the data, 3) formation of theoretical concepts (Miles and Huberman 1984, 21-23; Tuomi and Sarajärvi 2002, 110-115).

I have reviewed in detail all the documents uploaded to the CIRCA and collected texts relating to the Natural Resources theme. I selected only the parts of the documents that assist in understanding the selection process and provide arguments for or against the suggested indicators under the theme. I have then categorised the material under five headings corresponding to the headline indicators and the four sub-themes. I felt that the most reader friendly way of portraying the results, would be to write a historical excursion of the selection process between 2002 and 2007 under each of the indicators for the fore-mentioned five headings. Thus, the headings are further divided into sub-headings corresponding to the main indicators discussed.

The evolutionary storyline enables me to combine the comments on all the indicators, those on the current list, those suggested, and those now removed in their respective contexts. This kind of a storyline also helps to identify the factors affecting the selection in different stages of the process by showing when the indicator was first proposed, where it came from and what criteria defined the substantiality of the indicator on the 2007 SDI set. The purpose of the storyline is also to show the process of indicator selection in order to draw conclusions on what kind of dynamic features have characterised the selection process. After each of the historical storylines under the five headings I summarise the main results by collecting the negative and positive comments on all the indicators discussed into a single table. I also combine the factors which affected the selection process under each heading.

In the last step of the analysis, I use theory-bound content analysis, which is very similar to data-driven analysis, but instead of being inductive, it is deductive in the sense that a theory or concepts identified as “already known about the phenomenon” are used for intertwining with the empirical results (Miles and Huberman 1984, Tuomi and Sarajärvi 2002, 110-115). To summarise, the theoretical framework for the study is derived firstly, from the three qualities of a good indicator; scientific validity, policy relevance and communicability, as identified by Moldan and Dahl (2007) and secondly from what is already known about the process of developing sustainable development indicators.

The characteristics together with other factors known to affect the selection process are presented in more detail in Chapter 3. In addition, background information about sustainable development indicators in more general and the basis for the selection process are presented in Chapters 3 and 4, respectively. However, the use of these predefined factors and characteristics does not exclude the possibility that new factors or characteristics might stem

from the results. In Chapter 6, I bring together all the factors and arguments summarised in Chapter 5 and discuss them in the light of the theoretical framework provided in Chapter 3 and draw conclusions on the dynamic features characterising the selection process.

3. Sustainable development and indicators

3.1 Sustainable development indicators and the European Union

The notion of sustainable development was initially instigated by the Brundtland Commission with their bold global vision of desired development, which "meets the needs of the present without compromising the ability of future generations to meet their needs" (WCED 1987, 5). The initial definition provided by the Brundtland Commission is still widely used, but the concept itself leaves plenty of room for debate because, to mention an example, sustainable development means different things to different people and in different parts of the world (Karlsson *et al.* 2007, 27; Lawn 2006, 13). Nevertheless, during the past decade the idea of sustainable development has been absorbed into policy-making at local, national and international levels, and despite the conceptual problems, the implementation of the concept takes place at different levels (Lafferty and Meadowcroft 2000, 1).

When a framework for economically, socially and environmentally sustainable development was created after the Rio Earth Summit in 1992, the UN Commission for Sustainable Development (UNCSD) was established to support its implementation (Eurostat 2004a, 4). Sustainable development indicators form a core part of the implementation of sustainable development as tools for measuring and monitoring the implementation and for evaluating current efforts to achieve sustainable development (Lafferty and Meadowcroft 2000, 5). The European Union's official statistical office Eurostat, has been collaborating with the UNCSD since 1996 in the development of sustainable development indicators. Since the Earth Summit, the role of the EU in the promotion of sustainable development has become stronger (Baker 2000, 333) and according to Lafferty and Meadowcroft (2000, 1), sustainable development has reached almost a constitutional status in the EU.

There are various sustainable development indicator sets published at international, regional and national levels, although attempts have been made to create a "common indicator set" that could be used universally (Dhakal and Imura 2003, 117). However, there is no ideal indicator

set that could be used for any given purpose, since it is difficult to objectively assess sustainable development between different countries and regional levels, instead there are different approaches that can be recommended to be applied to for a specific use (Moldan and Dahl 2007, 5; Dhakal and Imura 2003, 117). Thus the development of sustainability indicators relies on already existing indicator sets. For example, due to the close cooperation between UNCSD and the Eurostat, the early publications on SDIs by the Eurostat rely on the UNCSD's indicator lists, especially in the 2001 report "Measuring Progress Towards a More Sustainable Europe" 66 percent of the indicators are from the UNCSD SDI list. (SDI/TF/003/3.1 2002, 3). On top of the UN core set of sustainable development indicators, published in 2001(United Nations 2001, 20), another important core set of indicators was published by the OECD (the Organization for Economic Co-operation and Development), which includes approximately 50 indicators covering environmental concerns (OECD 1998, 9). The list of OECD's key environmental indicators is regularly updated (OECD 2004, 8).

At EU-level, indicator sets include, for example, Eurostat's Environmental Pressure Indicators, which were published in 1999 (Eurostat 1999), the Structural Indicators (SI), the IRENA indicators (EEA 2005a), the EU sustainable development indicators, the indicators on transport and environmental integration in EU (TERM), and the European Common Indicators. The European Environment Agency (EEA) has published a core set of 37 indicators, which contribute to other EU indicator sets (EEA 2005b).

A set of structural indicators (SI) were identified and chosen in order to monitor the European Union's strategic target set at the Lisbon Special European Council in 2000. The indicators in the first set were arranged under five headlines: which were employment, innovation, economic reform and social cohesion. In addition, there were also some general economic background indicators. In 2001, The Gothenburg European Council asked for environmental dimension to be added into the set, and in the 2002 synthesis report, a chapter covering environment was included. The structural indicator set forms a basis for the EU sustainable development indicator set. (SDI/TF/003/3.1 2002, 2-3.) There are also more specifically targeted indicator sets such as the SEBI 2010 (Streamlining European 2010 Biodiversity Indicators), which was launched in 2005 and aims at developing a European biodiversity indicator set in order to assess and to provide information about the progress towards the European 2010 targets (EEA 2007a, 12).

3.2 Sustainable development indicators – defining the concept

The concept of indicators might seem unfamiliar at first, but we are dealing with indicators in our everyday life even though we might not call them such. An example of such an indicator is temperature. Before leaving our homes in the morning, we often check the outdoors thermometer to give us an indication how cold or warm it is so that we can dress up appropriately. Another example of a familiar indicator is gross domestic product (GDB), which is incorporated regularly into general news discussions on national and international economy. Of the so-called environmental indicators, CO_2 emissions is probably a well known example. Most people are common with these concepts, but do not necessarily recognise them as indicators.

The following is an outline of definitions for the indicator related concepts. I will then discuss the qualities of a good indicator. The basic concepts relating to indicators are defined in the Table 1.

Concept	Definition
Indicator	A parameter or a value derived from parameters, which points to, provides information about, describes the state of a phenomenon/environment/area, with a significance extending beyond that directly associated with a parameter value
Index	A set of aggregated or weighted parameters or indicators
Parameter	A property that is measured or observe Source: OECD 1998, 107

Table 1. Definitions for the basic indicator related concepts

In addition to the fore-mentioned concepts, the concept of a proxy indicator and its use should also be elaborated on. Proxy indicators are substitute indicators, which according to Moldan and Dahl, are often used for providing information about complex systems, such as biodiversity, climate change and economic welfare. Proxy indicators are used when it is not possible to measure the phenomenon directly due to lack of data, methodological problems and insufficient understanding of complex interactions within the phenomenon. For example, there is no parameter for measuring climate change directly by identifying the precise dynamics of change and possible intervention points, instead proxy indicators on greenhouse

gas emissions or CO_2 emissions are used to signal general trends related to the phenomenon. (Moldan and Dahl 2007, 11.)

The EEA divides environmental indicators into five categories depending on their typology in order to aid indicator selection, i.e. what do we want to measure with that particular indicator. The first category includes descriptive indicators that tell us what is happening. The second category includes performance indicators that aim to answer questions such as "does it matter?" and "are we reaching targets?". The third category includes efficiency indicators that answer the question "are we improving?", while the policy effectiveness indicators in the fourth category aim at determining whether the measures are working. Total welfare indicators form the fifth category to answer the question "are we on the whole better off?". (Stanners *et al*. 2007, 134-139.)

The purpose of sustainable development indicators is to measure and monitor sustainable development, in other words to measure sustainable development performance (Lawn 2006). Sustainable development indicators are mainly quantitative, although qualitative indicators have also been developed for example, to measure happiness (Moldan and Dahl 2007, 10). Indicators tend to reduce information into simplifications, which might produce a clear and attractive message. However, indicators that have aggregated information might produce a misleading picture due to inaccurate and incomplete data sets. (Bell and Morse 2001, 293.) Also the choice of selecting certain indicators to be aggregated into an index is problematic as it might result in arbitrary weightings or distortions (Moldan and Dahl 2007, 4). As Dhakal and Imura (2003) point out, even though the selection of certain indicators has been criticised, as has their relevance and use, the development of indicators is on-going.

3.3 Developing sustainable development indicator sets

The outcome of a sustainable development indicators selection process is affected, for example, by the people participating in the process, and the framework and criteria used to guide the selection process.

In the selection process of sustainable development indicators, either a top-down or bottom-up approach can be used (Bell and Morse 2005, 39). The debate concerning which approach should be used is on-going, however the top-down approach, which includes experts and

scientists from national governments, academia and research institutes is used more often than the bottom-up approach, possibly because it is considered more appealing for the decision-makers (Bell and Morse 2001, 293; Dhakal and Imura 2003, 116). The bottom-up approach includes non-governmental organisations, local authorities and international donor agencies, and produces indicators which are more simple and qualitative in nature, while the top-down approach produces indicators which are more complicated, quantitative, possibly difficult to understand (Dhakal and Imura 2003, 116), and scientifically valid, but which might be irrelevant to the end users (Rosenström and Kyllönen 2007, 282; Bell and Morse 2005, 39). Rosenström and Kyllönen (2007) studied the impacts of a participatory approach to developing sustainable development indicators. They found that large stakeholder participation clearly influenced the indicators produced, however, the absence of possible end-users caused the outcome to fail to provide a tool for decision-makers and public (Rosenström and Kyllönen 2007, 296). In order to make top-down indicators more relevant to the end-users, i.e. to ensure that the indicators are of practical use, the participation of the potential users (grass-root level) is crucial (Dhakal and Imura 2003, 116-117).

In the actual selection process a framework and criteria should be applied to in order to select the best possible indicators for the purpose of the set. Frameworks are used to aid the selection of indicators into a sustainable development indicator set (Becker 2007, 138) and to organise information on the indicator set in order to aid their communication to target audiences (Bosch 2002, 11). A framework that includes the three dimensions of sustainable development and their respective goals can be used to select the most relevant indicators out of all the indicators available. Using a framework this way can operationalise sustainable development (Becker 2007, 138). Frameworks can also assist the interpretation of the information provided by indicators and hence guide the decision-making (Stanners *et al.* 2007, 127). The frameworks used to guide indicator selection for sustainable development indicator sets has shifted from causal-chain frameworks to thematic frameworks, such as the one applied with the EU SDIs, which directs the focus on themes and sub-themes of sustainable development, thus enhancing the focus on policy relevant issues (SDI/TF/30/4 Rev. 4. 2003, 4).

Criteria can help the selection process and provides a benchmark against which the selected indicators can be validated (OECD 1998, 106). As an example of such criteria, the EEA has been using the following criteria to help the selection process of indicators to the EEA:

1) policy relevance, 2) progress towards targets, 3) availability and routinely collected data, 4 and 5) spatial and temporal coverage, 6) national scale and representativeness of data, 7) understandability of indicators, 8) methodologically well founded, and 9) EU priority policy issues (EEA 2005a, 10). OECD has used three criterions in their selection process, which are 1) policy relevance and utility for users, 2) analytical soundness, and 3) measurability (OECD 1998, 107).

The Task Force identified criteria to aid the selection of indicators on the set (SDI/TF/30/4 Rev. 4. 2003, 7). The criteria include six criterions, which provide a quality check for any proposed indicator. According to the criteria, an indicator should:

1. capture the essence of the problem and have a clear and accepted normative interpretation
2. be robust and statistically validated
3. be responsive to policy interventions
4. comparable across Member States and to the extent possible with the standards applied internationally by the UN and OECD
5. be timely and susceptible to revision
6. be based on existing data collections made by Eurostat, the EEA or other international sources, so that data collection does not impose unreasonable burden on the Member States.

The Commission participated in the review of 2005 SDI set and emphasised the importance of three main criterions for indicators, which are policy relevance, communicability, and statistical quality of indicators (Eurostat 2007a, 4).

At more general level, it can be said that sustainable development indicators should be scientifically valid, policy relevant and it should communicate to its target audience. According to Moldan and Dahl, the ultimate test of any indicators effort is “its suitability for a specific use and the impact the indicators have on policies and in raising public awareness”. The quality of an indicator can be assessed by its fitness for purpose, measurability, representativeness of the system, reliability and feasibility, and its communicability to target audiences. Data availability can affect indicator selection, since often indicators, for which data is readily available are selected instead of developing completely new indicators which can be time consuming. Since sustainable development indicators are usually developed to

monitor policies, policy relevance of an indicator can be improved by setting a reference value such as a target, which helps in the interpretation of the indicator. However, communicability is an essential quality for an indicator as it will become useless without it. (Moldan and Dahl 2007, 1-11.)

4. Selecting indicators for monitoring the management and use of natural resources

4.1 An objective in the EU sustainable development strategy

From the point of view of this study, it is necessary to look into the headline objectives and measures proposed in the EU sustainable development strategies relating to the Natural Resources theme more closely. The 2001 EU sustainable development strategy identifies four priorities for action: 1) to limit climate change and increase the use of clean energy, 2) to address threats to public health, 3) to manage natural resources more responsibly, and 4) to improve transport system and land-use management. Under each of these priorities, headline objectives are listed. The headline objectives under the transport and land-use priority were all related to transport and are not therefore relevant for this study. The priority on natural resources includes two headline objectives which had to be taken into account when the indicators for the Management of Natural Resources theme were discussed and decided upon. The two objectives were to "protect and restore habitats and natural systems and halt the loss of biodiversity by 2010" and to "improve fisheries management to reverse the decline in stocks and ensure sustainable fisheries and healthy Marine Ecosystems, both in the EU and globally". There is also a third objective under this priority, to "break the links between economic growth, the use of resources and the generation of waste". (European Commission 2001, 12.). This objective was addressed under a separate theme, production and consumption patterns (SDI/TF/44/04 Rev. 4, 2004).

The purpose of the EU SDI set is to monitor progress towards sustainable development in Europe. In the 2005 SDI set, the headline objectives of the EU sustainable development strategy as well as objectives and targets identified in the Sixth Environmental Action Programme (6EAP) and the Presidency conclusions of the European Council, were used to guide the Task Force members with what needed to be monitored (SDI/TF/44 Rev.7 2004). Since the EU has committed to the Plan of Implementation of the 2002 World Summit on

Sustainable Development (PoI2002), also the priority areas covered in the PoI are monitored with the indicators in the EU SDI set (SDI/TF/30/4 Rev.2 2003, 2; SDI/TF/44 Rev. 7 2004).

The revised 2006 EU sustainable development strategy (European Commission 2006) is more specific in terms of objectives and targets. The 2006 SDS includes seven key challenges with an overall objective for each key challenge, with operational objectives and targets with corresponding actions. The overall objective of the key challenge on conservation and management of natural resources is to "improve management and avoid overexploitation of natural resources, recognising the value of ecosystem services". Three operational objectives and targets relating to the Natural Resources theme are:

1) Improving management and avoiding overexploitation of renewable natural resources such as fisheries, biodiversity, water, air, soil and atmosphere, restoring degraded Marine Ecosystems by 2015 in line with the Johannesburg Plan (2002) including achievement of the Maximum Yield in Fisheries by 2015.
2) Halting the loss of biodiversity and contribution to a significant reduction in the worldwide rate of biodiversity loss by 2010
3) Contributing effectively to achieving the four United Nations global objectives on forests by 2015

The main difference between the 2001 strategy and 2006 strategy from the point of view of the theme on natural resources is that whilst the headline objective on fisheries in the 2001 SDS was removed from the 2006 SDS as its own objective, it has been integrated into the objective to improve management and avoid over-exploitation. The other difference comes from the addition of a separate objective on forests into the 2006 SDS.

4.2 The Sustainable Development Indicators Task Force and Working Group

The Task Force was established in 2001 by the Statistical Programme Committee[3] (SPC). The purpose of The Task Force was to develop indicators for sustainable development. The Task Force worked on selecting indicators for the set between year 2001 and 2005 through nine

[3] A Committee on the Statistical Programmes of the European Communities was established in 1989 by the European Council. The Committee is composed of representatives of the statistical institutes of the Member States and is chaired by a representative of the Commission (the Director-General of the Statistical Office of the European Communities). (European Communities 1998-2008)

meetings. The Task Force consisted of volunteers[4] representing the following EU-countries; Finland, France, Germany, Italy, the Netherlands, Sweden, the United Kingdom, Norway and the Czech Republic. Later also Austria, Belgium, Denmark, Estonia, Luxembourg, Spain and Switzerland joined the Task Force. Most of the volunteer countries had significant experience in the development of sustainable development indicators both at national and international levels. (CPS 2005/57/20/EN, 1.)

Back in 1996, the United Nations Commission on Sustainable Development (UNCSD) implemented a national testing programme, which aimed at improving the development of sustainable development indicators. Altogether the testing programme included 22 volunteer countries around the world. The EU Member States and the Task Force members participating in the testing programme were Austria, Belgium, Finland, France, Germany and the United Kingdom. (SDI/TF/006/04 2002, 7.)

On national scale, the adoption of national sustainable development strategies, followed by the development of sustainable development indicators, occurred in the 1990s in Belgium, Finland, France, Ireland, Luxembourg and the United Kingdom and after the adoption of the EU 2001 sustainable development strategy, also Austria, Denmark, Germany, Greece, Italy, the Netherlands, Portugal, Spain and Sweden have produced national strategies (Eurostat 2004a, 5-6).

In addition to aforementioned volunteers, representatives from the EEA, UNCSD, OECD, UNECE, and European Commission (including several representatives of the Eurostat, the DGs and the SG) participated in at least one of the nine meetings. A number of consultants were also present in most meetings.

The mandate of the Task Force expired in 2005. Only a year later, the European Council adopted the renewed EU sustainable development strategy, hence the sustainable development indicator set published in 2005, had to be revised. For this purpose, the Sustainable Development Indicators Working Group (SDI/WG) was established. The main difference between the sustainable development indicators Working Group and the Task Force is that all the Member States and associated countries were invited to participate in the work of the WG. (SDI/WG/2 2006.)

[4]The EU-country representatives were mainly from the respective statistical offices, environmental agencies or from the country's Ministry of the Environment (or equivalent organisation)

In addition to aforementioned Member States, representatives of different international organisations, the European Commission[5], consultants, research centres, an NGO and universities also participated in the meetings. The participant of the Task Force and Working Group meetings are presented in Table 2 on the following page; when more than one representative per country or organization was present, the number is indicated in brackets.

At the fourth Task Force meeting, sub-groups were formed (Eurostat, 2003). The purpose of the sub-groups was to propose possible indicators under each theme. After the initial formation of the sub-groups, parallel sub-group meetings were held during each TF and later WG meeting. Each of the sub-groups corresponded to one of the themes identified in the framework for the SDIs. The purpose of the subgroups was to discuss and suggest indicators under each theme. (SDI/TF/36 2003, 3.) The first sub-group meeting was held during the fourth TF meeting (SDI/TF/037/01, 2003). The sub-group meetings, during both TF and WG meetings, were held in parallel sessions and the results of the discussions were presented and further discussed in plenary sessions.

The task of sub-group 6 was to discuss and suggest indicators under the theme Natural Resources and Transport theme. The sub-group members included a representative from Austria, Belgium, Czech Republic, Estonia, Italy; two representatives from France, Norway, and Eurostat; three representatives from the United Kingdom and DG Environment; and a consultant (Eurostat 2003, 3). In the sub-group discussions it was noted that there are overlaps between three themes; Natural Resources and Transport, Production and Consumption, and Environmental Quality. The sub-group proposed to rename the title as "Management (protection and utilisation) of Natural Systems". (SG6 – natural resources and transport, 2003.)

[5] The different Directorates of the Eurostat participating in the meetings and their respective units: Directorate B: Statistical methods and tools, Directorate C: National and European accounts, Directorate D: Economic and regional statistics *(e.g. D1 Key indicators for European policies)*, Directorate E: Agriculture and environment statistics; statistical cooperation *(e.g. E1 Agriculture statistics – methodology, E2 Agriculture statistics – production, E3 Environment statistics)*, Directorate F: Social statistics and information society, Directorate G: Business statistics.

Other Directorates-General of the EC participating in the meetings: Agriculture and rural development, Development, Economic and financial affairs, Employment, social affairs and equal opportunities, Energy and transportation, Enterprise and energy, Environment, Fisheries, Health and consumer protection, Information society and media, Research, Secretariat-General. The Joint Research Centre of the EC also participated in the TF and WG meetings.

TF meetings	Countries	International Organisations	European Commission	Others
1. 11-12.4.2002	DK, DE (2), IT (2), LU, NL, AT, FI, SE, UK, NO, CZ	EEA, UNCSD	23 (Eurostat, DGs)	Consultants (9)
2. 3-4.2.2003	BE, DK, DE (2), ES (2), FR, IT (2), LU, NL (2), AT, FI, SE (2), UK (2), CH, NO, CZ, EE	EEA (2), OECD	25 (Eurostat, DGs, SG)	University representative
3. 10-11.6.2003	BE, DK, DE, ES, FR (2), IT (2), LU, NL, AT (2), FI, SE (2), UK, NO, CZ, EE		16 (Eurostat, DG)	
4. 16-17.10.2003	BE (3), DE, ES, FR, LU, AT (2), FI, SE, UK (2), EE (2)		23 (Eurostat, DG, SG)	Consultants (2)
5. 25-26.11.2003	BE, DK, DE (2), ES, FR (2), IT (2), LU, NL, AT (2), FI, SE (2), UK, CH, NO (2), CZ, EE (2)	EEA, UNECE	18 (Eurostat, DG, JRC)	Consultants (3)
6. 13-14.1.2004	BE, DK, DE (2), ES, FR, IT, LU, NL, AT, FI, SE (2), UK, CH, NO (2), CZ,		17 (Eurostat, DG, SG)	Consultants (2)
7. 9-12.2.2004	Sustainable development workshop in Stockholm			
8. 21-22.6.2004	BE, DK, DE, ES, FR, IT, LU, NL, AT, FI, SE (2), UK (2), CH, NO	EEA	13 (Eurostat, DG, JRC)	Consultants (3)
9. 25-26.4.2005	BE, CZ (2), DK, DE (2), ES, FR, IT, LU, NL, AT (2), FI, SE, UK, CH		11 (Eurostat, DG)	
WG meetings	**Country**	**International organisation**	**European Commission**	**Others**
1. 5-6.4.2006	AT, BE (2), CZ, DK (2), DE, EL (2), ES, EE, FR, HU, IE, IT, LV, LU, MT, NL, SI, SK, SE, UK (2), RO, TR, NO	UNECE, UNDSD	22 (Eurostat, DG and SG)	
2. 9-10.11.2006	BE, DK, DE (4), EL, ES (2), EE, FI, FR, LT, LU (2), MT, NL, PT, SI, SK, UK (2), BG, RO, TR, NO, CH, AL, ME, RS	EEA (2)	23 (Eurostat, DG and JRC)	Research Institute (6) NGO (1)
3. 8-9.2.2007	BE, BG (2), CZ, DK, DE (2), EE, IE, EL, ES (2), FR (2), IT, CY, LV, LT, LU (3), HU, NL, AT, PL (2), PT, RO, SI (2), SK, SE, UK, NO, CH	EEA (4), OECD	31(Eurostat, DG and SG)	Research Institute (3) NGO (1)
4. 10-11.5.2007	BE (2), BG, CZ, DK, DE (5), EE, IE, EL, ES, FR,, IT (2), CY, LV, LT, LU (2), HU, NL, AT, PL (2), RO, SK, SE, FI, UK, NO, CH (2)	EEA (2), UNECE	29 (Eurostat, DG and SG)	Research Institute (7)
Sources: for 1-6 TF meetings, separate participant lists uploaded on CIRCA, for 8-9 TF meetings and 1-4 WG meetings the participant lists are included in the minutes of the meeting.				

Table 2. The participants of the Sustainable Development Indicators Task Force and Working Group meetings

4.3 Indicators under the Natural Resources theme

The indicators selected into the Natural Resources theme in both the 2005 SDI set and the 2007 SDI set are presented in Table 3 on the following page. The indicators are grouped under four sub-themes: Biodiversity, Marine Ecosystems, Fresh Water Resources and Land-use. These sub-themes remained unchanged in the 2007 set. The indicators appearing in italics were not available when the SDI sets were published and are referred as the "best-needed" indicators, while the rest of the indicators are referred as the "best-available" indicators (Eurostat 2005, xi).

The main differences between the two sets include the name of the theme, the number of indicators, the amount of available indicators, and slight modifications on the indicators. In the 2005 SDI set the Natural Resources theme was called "management of natural resources". The number of indicators was decreased from 20 indicators in the 2005 SDI set to 13 indicators in the revised set, although three completely new indicators were added to the 2007 set, which are "red list index for European species", "concentration of mercury in fish and shellfish", and "forest increments and fellings".

The headline indicator on bird populations was changed to include also common species, hence the modified name. Also the sufficiency index was modified to include the Birds Directive in addition to the Habitats Directive. Similarly a measure of surface water abstraction was added on the water abstraction indicator and the indicator on wastewater was specified to focus on secondary treatment systems. While the indicator on "Fragmentation of habitats due to transport" was moved under the Transport theme as a indicator to be developed and the indicator on soil contamination was removed from the set, the rest of the indicators were not published in the 2007, but were mentioned in the 2007 Monitoring report as indicators to be developed (Eurostat 2007a, 305). Short definitions for the indicators in the 2007 set are given in Appendix II.

2005 SDI set	2007 SDI set
Headline indicators	
Biodiversity index (L1)	
Population trends of farmland birds (L1)	Common Bird Index (L1)
Fish catches taken from stocks outside safe biological limits (fish catches) (L1)	Fish catches taken from stocks outside safe biological limits (L1)
Sub-theme: Biodiversity	
Sufficiency of Member States' proposals for protected sites under the habitats directive (L2)	Sufficiency of sites designated under the EU Habitats and *Birds* directives (L2)
Change in status of threatened and/or protected species (L3)	*Red List Index for European species (L3)*
Sub-theme: Marine Ecosystems	
Trends of spawning biomass of selected fish stocks (L2)	*Concentration of mercury in fish and shellfish (L2)*
Effective fishing capacity and quotas, by specific fisheries (L3)	
Size of fishing fleet (fishing fleet) (L3)	Size of fishing fleet (L3)
Structural support to fisheries and percentage allocated to promote environmentally friendly fishing practices (L3)	
Sub-theme: Fresh Water Resources	
Groundwater abstraction as percentage of available groundwater resources (groundwater abstraction) (L2)	Surface and groundwater abstraction (L2)
Population connected to wastewater treatment systems (wastewater treatment systems) (L3)	Population connected to wastewater secondary treatment systems (L3)
Emissions of organic matter as biochemical oxygen demand to rivers (L3)	Biochemical oxygen demand in rivers (L3)
Index of toxic chemical risk to aquatic environment (L3)	
Sub-theme: Land use	
Land use change, by category (L2)	*Land use change, by category* (proxy: built-up areas) (L2)
Built-up areas as a percentage of total land area (built-up area) (L2)	Forest increment and fellings (L2)
Excess of critical loads of acidifying substances and nitrogen in sensitive natural areas (L2)	Forest trees damaged by defoliation (L3)
Percentage of total land area at risk of soil erosion (L3)	*Critical load exceedance for nitrogen (L3)*
Percentage of total land area at risk of soil contamination (L3)	
Percentage of forest trees damaged by defoliation (Defoliation) (L3)	
Fragmentation of habitats due to transport (L3)	

Table 3. The indicators selected for the 2005 and the 2007 sustainable development indicator set under the Natural Resources theme

5. Evolution of indicators under the Natural Resources theme

The work of the Task Force built on already existing indicator set initiatives in the EU, such as the 2001 proposal for the EU sustainable development indicator set published in 2001 (Eurostat 2001), and the environmental dimension added in the Structural Indicators (SDI/TF/004/3.2 2002, 2).

The proposed EU SDI list published in 2001 was based on the core set of sustainable development indicators of the UN Commission on Sustainable Development (UNCSD). The publication was produced by the Eurostat with contributions from Member States and the Commission. The Member States contributing to the selection of the proposed set were Austria, Belgium, France, Finland and Germany. (Eurostat 2001.)

The proposed SDI list includes 16 environmental indicators divided into five themes identified by the UNCSD: 1) Atmosphere, 2) Land, 3) Ocean, sea and coasts, 4) Fresh water, and 5) Biodiversity. The indicators coinciding with sub-themes of Natural Resources theme included: i) Agricultural area and organic farming, ii) Nitrogen balance, iii) Total forest area, iv) Wood harvesting ratio, and v) Growth of built-up area, vi) Eutrophication of coasts and marine waters and vii) Fish catches by selected over exploited species, viii) Intensity of water use, ix) BOD concentration in selected rivers, and x) Quality of bathing water, xi) Protected area as a % of total area, and xii) Number of threatened species. Indicators i, v, vi, vii and xii are different form the UN core set, whereas the remaining indicators have been adopted to the list either unchanged or modified. (Eurostat 2001, 1-6.)

When the environmental dimension was added as part of Structural Indicator set in 2001, the dimension included seven indicators. However, ffter the adoption of the seven indicators for the environmental dimension, the Council concluded that they were inadequate and requested an analysis of the environment-related indicators. An ‘open list’ of 34 environment-related indicators were gathered and the Commission together with the Eurostat, the EEA and the Member States produced an analysis where these indicators were classified as 1) currently feasible, 2) feasible, but incomplete, 3) inadequate data availability and unlikely to be feasible in the near future, and 4) unclear indicators, which might need further work. (European Commission 2002, 4.) The more precise comments provided by the Commission will be included in the following chapters for each of the indicators.

5.1 Headline indicators

5.1.1. Common bird index

The desired indicator under the Management of Natural Resources theme was “biodiversity index”, which would include over 400000 species. The “biodiversity index” was included in the ‘open list’ of indicators, and classified in the analysis as “an immature indicator, needing further work before accepted concept is developed”. However, it will, “due to its nature, suffer from slow responsiveness to policy actions”. (European Commission 2002.)

The indicator on birds was not intended to be included on the SDI set as a perfect indicator on biodiversity. It was suggested during the first meeting of sub-group on indicators for the Natural Resources and Transport theme, as a proxy indicator for the desired indicator on biodiversity, which was initially suggested as a headline indicator but was not available at the time. The sub-group noted that the Pan-European Common Breeding Birds project or the Wetland Bird Populations project could provide more information on the proposed indicator on birds. (SG6 – natural resources and transport, 2003.) Based on the sub-group discussion, the indicator on biodiversity and its proxy indicator, the population trends of wild birds, were listed as Level 1 indicators (i.e. headline indicators) in the preliminary list of sustainable development indicators (SDI/TF/44/04, 2003).

During the sixth meeting of the TF, the proposal of the sub-group was accepted and it was decided that the indicator on wild bird populations would be given “according to woodland, farmland and wetland populations” (SDI/TF/44/04 Rev. 2 2004; SDI/TF/46 2004, 15). It soon became evident that only data on farmland bird species would be available (SDI/TF/44/04 Rev. 4, 2004). Thus the preliminary list of SDIs was changed to include indicator on “population trends of farmland birds” as the best indicator available, while the “biodiversity index” remained as the “best-needed” indicator (SDI/TF/44/04 Rev. 6, 2004). The indicators were presented as corresponding to one of the objectives of the EU 2001 SDS “to protect and restore habitats and natural systems and halt the loss of biodiversity by 2010” and also the objectives of 6EAP and PoI, which are “conservation of species and habitats with a special concern of preventing habitat fragmentation” and to “achieve by 2010 a significant reduction in the current state of loss of biological diversity”, respectively. (SDI/TF/44 Rev.7 2004.)

In the eighth TF meeting, it was pointed out that the amount of Level 2 and Level 3 indicators should be decreased and that the TF should reconsider the justification for each of the indicators, because for example “there were methodological problems with the indicator on bird populations”. However, the TF decided that since the indicator benefits from “relatively solid base from 1995 onwards”, it should remain on the set until the “best-needed” indicator (biodiversity index) becomes available. Further on the EEA pointed out that “concerning the preparation of the biodiversity index, out of the species included in the index, the bird species were the most developed. It was decided that the biodiversity index was kept as “best-needed” indicator, even though there were some doubts concerning its eventual development”. (SDI/TF/52 2004, 10.)

In the final report of the TF a recommendation to further develop the indicator on birds to include other species, which were being developed by BirdLife International, and to expand the geographical coverage to include the EU-25 countries, were given. In the same report, regarding the “biodiversity index”, it was noted that the EEA keeps working on the indicator, but that “there were still disagreements about the methodology”. (CPS 2005/57/20/EN, 25.) When the first SDI set was published, the “biodiversity index” was identified as the “best-needed” indicator, while indicator on “farmland bird populations” was used as “best-available” (European Commission 2005a, 16).

According to the 2005 Monitoring report, it is acknowledged that the “farmland bird indicator does not cover the whole biodiversity across the EU, but monitors the objectives relating to reduction of biodiversity loss identified in the 2001 EU sustainable development strategy, the sixth environmental action programme (6EAP), the EU biodiversity strategy, and in the Plan of Implementation by providing a measure of the state of a number of species within one broad category of ecosystem, farmland” (Eurostat 2005, 138).

When the sustainable development indicator Working Group met the first time, a Eurostat representative gave a short presentation on the latest developments regarding the indicators in the 2005 SDI set. It was noted that the “methodology for the indicator on farmland bird populations is continuously evolving, while the so-called “best-needed” indicator, biodiversity index, is still under development, but results from the SEBI2010 -project should become available soon”. (SDI/WG/10 2006, 7.)

One difference between the meetings of the TF and WG was that Member State experiences on SDIs were exchanged during the WG meetings. During the first meeting, presentations on SDI experiences on national level were given by the representatives of Belgium, France, Slovenia and the UK (SDI/WG Belgium 2006; SDI/WG France 2006; SDI/WG Slovenia 2006; SDI/WG UK 2006). In the presentations of France and the UK, an "index on bird populations" was mentioned as part of national SDI sets (SDI/WG 2006 France; SDI/WG 2006 UK). In addition to the PowerPoint presentations, background papers relating to the presentations were given to the WG members. In the "background paper on the evolution of sustainable development indicators and their communication in the UK", the role of the bird indicator was brought up several times. For example, in the UK "the bird indicator on bird population had drawn people's minds on the issue, which had then led to the inclusion of the issue on the strategy. Had it not drawn the attention of the public, it might have been left out". (DEFRA 2006, 3-4.)

The background paper further points out that:

> "It is unlikely that many of the indicators have influenced policy owing to them being part of a sustainable development set. In most cases the indicators selected were already well-established measures of progress for their policy areas. One of the exceptions to this was the headline indicator on population of wild birds. The media initially made much of the novelty of the government measuring people's quality of life by counting birds, but the messages conveyed by the indicator demanded action. Whilst overall the population of birds had not changed significantly from what it was in 1970, the population of farmland species had fallen dramatically, almost halving in number compared with a peak in 1977. Woodland birds had fallen by almost 30% since a peak in 1974. In the case of farmland birds there was speculation that the loss was caused by the intensification of farming, the increased use of pesticides and the loss of hedgerows. As a direct result of the message conveyed by the headline indicator DEFRA was given a performance target to halt the decline and stabilise populations." (DEFRA 2006, 12-13.)

Furthermore, the media in the UK seemed interested in regional comparisons. In 2003, DEFRA produced a publication that included indicators on local and/or regional scale. This publication reached the headlines of several newspapers, for example in the Guardian the following headline was printed: "Poverty and crime make it tough up north – but more birds are singing". (DEFRA 2006, 16-17.)

In the second WG meeting, the 2005 SDI set was revised in the light of the renewed sustainable development strategy. It was pointed out that there were no major changes to the objectives for this theme from the 2001 strategy to the 2006 strategy, and that 'halting the loss

of biodiversity by 2010' remained one of the key issues, which meant that a headline indicator on biodiversity was still needed and the current the proxy headline indicator on farmland bird populations had to be reviewed. (SDI/WG/14 2006, 6.)

The selection of "farmland bird population trends" as a headline index had been criticised in the Council discussions, mainly due to its "narrow focus on one type of bird species". The discussion group (former sub-group) on Natural resources suggested that the indicator could be improved by "adding other bird species, such as forest birds and other common birds" into the indicator. The sub-group also decided to check from the SEBI 2010 indicator whether it would be possible to include other species such as butterflies and the indicator on land-use chance in the headline index. (SDI/WG/20 2006, 6.)

During the discussion group meeting, in the second meeting of the WG, a representative of pan-European Common Monitoring Project gave a presentation on the "Latest developments in European Biodiversity Indicators: wild bird indicator". The presentation included different ways of measuring the loss of biodiversity in EU and European levels, and the weaknesses and strengths of birds as indicators. (Gregory 2006.) The presentation together with the critique from the Council encouraged further discussion on the biodiversity indicator. It was concluded that "indicators based on birds were still recognised as the "best-available" for biodiversity, but since the farmland bird index had been criticised during Council discussions, it was proposed to consider enlarging the index to a common bird index (including forest birds and other common birds)". (SDI/WG/20 Rev. 1 2006, 6.)

The representative of BirdLife International gave several reasons to why birds can be considered as good indicators of biodiversity, however, he further pointed out that "while, with due care and attention, birds can be considered good indicators, it does not mean that they are necessarily the best indicator". He also listed the weaknesses and the strengths of bird indicators. (Gregory 2006.) The arguments provided by the representative of BirdLife International as well as the strengths and weaknesses are presented in Table 4 on the following page.

Arguments for the suitability of birds as indicators for biodiversity	Strengths of birds as indicators for biodiversity	Weaknesses of birds as indicators for biodiversity
widespread, diverse, mobile (live in most habitats)	simplicity/transparency	birds are much less specialised in micro-habitat use than other taxa – operating at large scale
relatively easy to identify, survey & census	temporal sensitivity	birds are highly mobile compared to other taxa & many migratory integrating effects from very different areas
high in food chains, thus sensitive to change e.g. land use and climate change	scientifically credible	species show a variety of responses to environmental change some benefit from anthropogenic damage and change
long-time series – masses of information available	policy relevant	may not work in certain types of habitats/biomes
data realistic and inexpensive to collect, analyse and report	clarity of message – they communicate	bird trend may not correlate with those of other taxa
methods of survey and analysis proven		populations likely to respond to an integrated set of factors rather than single simple factors
better known than other taxa		wild bird indicators may in some circumstances be relatively insensitive to environmental change – only reflecting large-scale pervasive effects
popular – have resonance with the public and decision makers alike		
very useful to raise awareness of biodiversity issues		
can, in some circumstances at least, faithfully reflect trends in other biodiversity		

Table 4. Arguments provided by BirdLife International for the use of birds as indicators for biodiversity

Bird indicators have been used in other indicator sets as well. For example, out of the EU related indicator sets, the indicator is included in the Structural Indicator (SI) set and the IRENA set (Eurostat 2005, 217). According to the representative of BirdLife International, "the European wild bird indicators have had a very high impact, as they have been used in a wide range of environmental reporting processes in Europe and globally". He also informed the WG that bird indicators for other habitats such as forests are ready for use and others are currently being developed. He further pointed out that "bird indicators received highest rating

from SEBI 2010 project, provide official data source for WWFs Living Planet Report 2006, are part of the 2010 Biodiversity Indicator Partnership Report 2006 and the 2010 Biodiversity Indicator Partnership via global Wild Bird Indicator project". (Gregory 2006.)

Before the third meeting of the WG, Eurostat sent the WG members a proposal for the revised SDI set, in which the Eurostat proposed that the "population trends of farmland bird" would be replaced by a "common bird index", if the results of a "quality assessment are satisfactory". (Eurostat 2006, 1.) The proposal was accepted in the following meeting in February 2007 (SDI/WG/33 2007, 12). In the fourth WG meeting, the EEA and DE suggested that an indicator on butterflies could eventually be incorporated into the index in order to support the bird indicator (SDI/WG/37 2007).

As the 2006 strategy retained the objective of halting the loss of biodiversity, the 2007 Monitoring report included similar rationale for the selection of the bird indicator. On policy relevance, if was further noted that "birds are recognised as good proxies for biodiversity as they are high on the food chain, the range of their habitats are wide and they can migrate, all of which can reflect changes in biodiversity of ecosystem rapidly". (Eurostat 2007a, 142.)

5.1.2 Fish catches taken from stocks outside safe biological limits

Although the indicator on fish catches was considered feasible in the analysis of open list indicators in 2001, the Commission complained that this indicator on one hand "does not show significant change in short term due to slow response of fish stocks to management action, which makes timely assessment of management actions difficult", and on the other hand "if only the number of stocks is considered, the outcome may not be representative". (European Commission 2002, 11-12.)

This second headline indicator however, sparked very little discussion throughout the meetings of the Sustainable Development Indicators Task Force and Working Group. The indicator was already listed in the 2001 Monitoring report as "fish catches by selected over exploited species" (Eurostat 2001, 6) and with the support of the Natural resources and transport sub-group (SG6 – natural resources and transport, 2003) it was added into the preliminary list of SDIs as "percentage of fish catches" (SDI/TF/44/04 2003) to measure one of the headline objectives of the EU SDS (to improve fisheries management to reverse the decline in stocks and ensure sustainable fisheries and healthy Marine Ecosystems, both in the

EU and globally) and the objectives of the 6EAP, PoI2002 and the Presidency conclusions of the Gothenburg Council 2001(SDI/TF/44 Rev. 7 2004).

During the fifth meeting of the Task Force, a Eurostat representative commented that "the indicator can be considered feasible, although there might be some problems with the data availability and classification". It was decided that the indicator would be presented by "species and water, and the assessment would take place from the point of view of resource stock" and the data would be obtained from the ICES (the International Council for the Exploration of the Sea). (SDI/TF/42/2 2003.) The indicator on "fish catches outside safe biological limits" was concurrently used in the Structural Indicator, the EEA and the CSD sets, although in the two latter sets the indicator is slightly different (Eurostat 2005, 217). The indicator on "fish catches outside safe biological limits" was published in the 2005 EU SDI set (European Commission 2005b, 16). The indicator was kept unchanged in the 2007 SDI set (Eurostat 2007a, 300).

In the 2001 SDS sustainable fisheries were identified as one of the key objectives of the strategy. The 2005 Monitoring report justifies the use of the indicator on "fish catches" by provision of "a direct measure of the level of pressure on fish populations, which have been assessed to be at-risk". The report further continues that fish catches show, on one hand, "the status of fish stocks" and, on the other hand, "the effectiveness of management action, since reducing catches by appropriate management of stocks outside safe biological limits would be reflected in the indicators". (Eurostat 2005, 135 and 147.)

Even though sustainable fisheries was not a separate objective in the 2006 strategy, fisheries was included in one of the operational objectives, in which the aim was to improve management and avoid overexploitation of renewable natural resources such as fisheries. The indicator can be considered policy relevant since in addition to the aforementioned SDS objective, the indicator monitors the objectives of the renewed Common Fisheries Policy, which aims at "maintaining or restoring stocks to levels that can produce the maximum sustainable yield in fisheries and especially to achieve these goals for depleted stocks on an urgent basis and where possible not later than 2015". (Eurostat 2007a, 144.)

5.1.3 Summary

The two headline indicators had very different evolutions in the EU SDI set. While the bird indicator was discussed throughout the TF and the WG meetings, the indicator on fish catches was accepted as such into the set at early stages of the process. Two issues affected the early acceptance of the second headline indicator, fish catches taken from stocks outside safe biological limits. Firstly, the indicator was considered feasible in the assessment carried out by the Commission in collaboration with Member States and the Eurostat, and the feasibility status was reconfirmed by the Eurostat during the Task Force meetings. Secondly, the indicator was also present in other the indicator sets, which, together with comments on its feasibility, indicate that the indicator has been widely accepted. Both of the headline indicators were selected to monitor the headline objectives of the 2001 strategy and although the objective of sustainable fisheries was not included in the revised strategy as a separate objective, it was considered policy relevant as it monitors one of the operational objectives.

The aim of the Task Force was not to have an indicator on farmland birds, but the TF ended up with such an indicator in the absence of better available alternative. Their initial intention was to include more bird species on the index, which would have provided larger coverage over different habitats and ecosystems. However, in 2005 the indicator in respect to other bird species (representing different habitats) suffered from methodological problems, thus only farmland bird species were included in the 2005 set.

When the first EU sustainable development indicator set was published in 2005 with a headline indicator on “population trends of farmland bird species”, the European Council criticised the choice due to its narrow coverage. Consequently, during the first two meetings of the Working Group, after the criticism from the Council, presentations concerning the benefits of birds as an indicator on biodiversity were given by the representatives of the UK and the BirdLife International. While the former embraced the indicator due to its ability to influence policy and its communicability to target audiences, the representative of the BirdLife International presented the strengths and weaknesses of birds as an indicator on biodiversity together with the latest developments concerning other bird species. The participation of BirdLife International in the WG meetings makes the bird indicator rather special, because measuring biodiversity was the only issue in the EU SDI set on behalf of which an NGO representative participated in the meetings. After the presentations, the Working Group concluded that birds are still recognised as the “best-available” option for

measuring biodiversity, but for the revised set possibilities to include other bird species should be explored and as a result the 2007 SDI set includes an indicator on common bird populations.

Even though the common bird index was chosen for the 2007 sustainable development indicator set as a headline indicator, there was still a clear need for a better indicator to monitor biodiversity, which is a core objective in the EU sustainable development strategies as well as in other sustainable development related initiatives to which EU has committed to. The methodological problems relating to the development of a “biodiversity index” indicates that even if agreement on methodology is eventually reached, the indicator might not become available anytime soon. Furthermore, the proposed “biodiversity index” suffers from slow responsiveness to policy actions, which might make it useless in duly monitoring the policy actions. Nevertheless, the indicator was kept on the list as the “best-needed” indicator, which indicates that there is genuine need for the development of such an indicator.

The strengths and weaknesses of the headline indicators are presented in Table 5 on the following page. These qualities will be further discussed in Chapter 6 in the light of the three qualities identified for a good indicator; policy relevance, scientific validity, and communicability.

Indicator	Strengths	Weaknesses	Status
Common bird index	data and information available from various bird-projects present in other EU sets (SI, IRENA, SEBI 2010) policy relevance data availability for farmland and common species "best-available" and a good proxy time series available from 1995 communicates to target audiences methodology developed UK experience: • communicability • policy effectiveness • policy relevance NGO: • policy relevance • communicability • scientific validity • simplicity • temporal sensitivity	methodology in respect to other habitats data availability for wetland and forest species narrow coverage NGO: • operates at large scale • mobility • different responses • not for all habitats • correlation with others • responsiveness to single factors • insensitiveness to environmental change	in the 2007 SDI set
Biodiversity index	"best-needed" for measuring biodiversity under development for other indicator sets as well	methodological disagreements and problems in defining the concept slow responsiveness to	to be developed
Fish catches	feasibility policy relevance responsiveness to management actions present in the 2001 Monitoring report data from ICES present in SI, EEA and CSD sets	timeliness (slow response to management actions) representativeness (if only the number of stocks is considered)	in the 2007 SDI set

Table 5. The strengths and weaknesses of the headline indicators

5.2 Sub-theme: Biodiversity

5.2.1 Indicators for protected sites

Initially instead of an indicator on “sufficiency of sites”, an indicator on “protected sites” was proposed for the list.

“Protected areas as a percentage of total area” was listed as an indicator of biodiversity in the 2001 Monitoring report and in the UN indicator set (Eurostat 2001, 6). The indicator on “protected areas” was also included in the open list of environment-related indicators. The report from the Commission to the Council classified the indicator as “feasible in 2002, but incomplete”. The report pointed out that on one hand “the problem with this indicator is the origin of designation as an area might be designated for several purposes and belong to several designation types, but not necessarily with the same spatial extension” and on the other hand the indicator “measures Member States response to the loss of biodiversity by showing ‘some protection effort’”, which therefore only tells part of the story. Furthermore, the usefulness of the indicator was questioned as “there is not going to be significant variation from one year to another after the initial designation phase”. (European Commission 2002, 18)

After the first meeting of the sub-group, an indicator on “protection of habitats and natural ecosystems”, i.e. percentage of protected area, was suggested to be included as a Level 3 indicator (SG6 – natural resources and transport, 2003). The indicator was soon upgraded from Level 3 to Level 2 and the proposed, “best-needed” indicator, on “sufficiency of protected areas” was placed at Level 3 (SDI/TF/44/04 2003; SDI/TF/44/04 Rev.2 2004). During the eighth meeting of the TF, it was decided to replace the indicator on “percentage of protected area”, to which data was available, with the “sufficiency indicator” (SDI/TF/52 2004). The “sufficiency indicator” was on the SDI list published in 2005, although there was no data available at the time (European Commission 2005b, 16). The indicator remained under development, because the aim was to have an indicator that measures the effectiveness of the EU response to threats to biodiversity (Eurostat 2005, 136).

The data for the sufficiency indicator became available in 2007 (SDI/WG/31 2006), however, at the first meeting of the WG, the usefulness of this indicator was questioned, because the indicator will become useless once the objective of the Directive is reached, which means that

the index reaches 100 % (i.e. the target) for all countries. This means that this indicator will not stay on the EU SDI set permanently, but will have to eventually be replaced with another indicator. (SDI/WG/10 2006.) The final decision on the faith of this particular indicator was to be made at the fourth WG meeting. Prior to the meeting, contributions from the EEA and the Birdlife International (EEA 2007b; BirdLife International/EBCC, 2007) on the indicator were circulated to the WG members and the data was uploaded on CIRCA (SDI/WG/33 2007). EEA pointed out that data for the indicator was "now available for EU-15 up to 2005 and for EU-25 based on data and information available up to 2006" (EEA 2007b).

In the contribution paper from the BirdLife International and European Bird Census Council (EBCC), concerns relating to the "sufficiency indicator" were expressed. The BirdLife/EBCC argued that the proposed index is not "fit for purpose and contains serious weaknesses, and would not deliver what is really required for biodiversity in Europe nor does it meet the scientific standards and qualities required for such high level index, the standard desired qualities of effective indicators". BirdLife/EBCC proposed that "given that the EU's Natura 2000 network includes sites designated under both the Habitats and the Birds Directives, this indicator should be extended to Special Protection Areas (SPAs) as well, which can be objectively and scientifically measured by using Important Bird Areas (IBAs) as a benchmark. The use of IBAs as a benchmark has been supported by the European Court of Justice and the Commission's Biodiversity Communications include it as an indicator (Coverage of Important Bird Areas by protected areas)". However, BirdLife International acknowledged that the IBA is "politically sensitive in some of the Member States, but points out that there are no credible alternatives", and criticised further on the proposed and selected sufficiency indicator on "lacking a clear defined target or reference point". The BirdLife/EBCC suggested that the indicator could be improved by elaborating it more clearly. However, the BirdLife/EBCC further criticised the use of this kinds of indicators, because it includes the assumption that the selected designations actually benefit nature. (BirdLife International/EBCC 2007.)

The data uploaded on CIRCA and the comments provided by the EEA and BirdLife International sparked conversation on the indicator during the fourth meeting of the WG, where France asked the WG members "why the coverage of the indicator (in terms of the Habitats Directive) was not as good as the coverage of Bird Directive?". A representative of the Eurostat replied that "this was in agreement with the SEBI 2010 set, because the definition

of a reference for the assessment of sufficiency is currently politically sensitive", but added that the situation might change in the future. Norway pointed out that this particular indicator is not applicable for non-EU countries. (SDI/WG/37 2007.) Despite some limitations relating to the coverage of the proposed indicator (SDI/WG/37 2007) and the abovementioned expected short lifespan, the indicator was published as such in the 2007 SDI set, however data was only available for sites under the Habitats Directive (Eurostat 2007a).

The 2007 Monitoring report commented on the indicator relevance that in addition to the EU SDS objective concerning biodiversity, implementation of Natura 2000 network, which aims at protecting biodiversity, should be monitored. Therefore the "sufficiency index of protected areas and species under the Habitats Directive" is used to measure the achievements of EU-bio-geographical regions and the Member States in reaching the target (i.e. 100 percent sufficiency) as it monitors one of the EU policy instruments for biodiversity. (Eurostat 2007a, 139 and 146.)

5.2.2 Monitoring the population trends of threatened species

Biodiversity indicator on "number of threatened species" was included in the 2001 Monitoring report (Eurostat 2001, 6). The indicator was included in the 2005 SDI set at Level 3 as "best-needed", i.e. it was not available at time when the set was published. The title was rephrased to "change in status of threatened and/or protected species". (European Commission 2005b, 16.) In the beginning of the revision of the SDI set, Eurostat proposed to the WG that the indicator would still be kept as a "best-needed" indicator, since the data could be eventually compiled as part of SEBI 2010 -project (Eurostat 2006). Meanwhile, the EEA proposed to include an indicator on "change in status of species of European interest", which would become available in 2008 from the 2007 reporting of Habitats Directive, but would probably have only one data point before 2010. EEA also suggested another indicator titled "Red list index for European species", which was available for threatened birds and could serve as a proxy indicator for the "best-needed" indicator on "change in status of species of European interest". (EEA 2007b; SDI/WG/33 2007.)

In the list of SDIs proposed prior to the fourth meeting of the WG, it was proposed to use the "red list index", for which two years of data was available, as a proxy for the indicator on "change is status of species of European interest" until the indicator under development

becomes available (SDI/WG/36, 2007). In the Spanish position paper on the proposed indicators, “more clarity in the method of calculation and identification of species to be included in the ‘red list indicator’” were requested (Spain 2007).

Prior to the fourth meeting of the WG, the BirdLife International provided the WG a contribution paper commenting on the proposed indicator on “change in status of species of European interest”. The proposed indicator was criticised for not being “useful for measuring the European progress towards the 2010 target as the first data point is from 2007 and the second from 2013”. The BirdLife International argued that “with a single time point, it is not in strict terms an indicator”. Furthermore, the indicator includes only species listed in the Habitats Directive, which leaves out species included in the Birds Directive. The inclusion of species listed in the “Birds Directive would make the indicator reflect the species of Community interest better” in BirdLife International’s opinion. The BirdLife International continued to argue that the assessment for this kind of indicator could be done relatively easily, since “most species of Community interest are better monitored in most MS than any other taxa and the MS are already obligated to report to the EC every three years”. (BirdLife International/EBCC 2007.)

The proposal to remove the “red list index” once the “best-needed” indicator becomes available was also criticised by the BirdLife/EBCC, because the indicator on “change in status of species of European interest” and the ‘red list index’ are “complementary to each other and the inclusion of one should not mean exclusion of the other”. The “red list index” should be kept in the set as “it is used widely to monitor biodiversity trends at global, regional and national scales (e.g. UN Millennium Development Goals)”. Further on, the indicator has been “backed up with a number of high impact scientific papers”. (BirdLife International/EBCC 2007.)

During the fourth meeting of the WG, the Finnish representative also pointed that if names such as ‘red list index’ were used, it might be difficult for the public or anyone outside a group of experts to understand what it is, and therefore recommended that the WG would consider easier titles (SDI/WG/37 2007).

In the 2007 SDI set the “red list index” is included in the list, as indicator under development, while the “change in status of species of European interest” indicator was not included in the list, but was mentioned separately as an indicator to be developed. It was also reported that

the latter should come from the reporting of the Habitats Directive. (Eurostat 2007a, 300 and 305.)

The 2007 Monitoring report concludes that the "red list index" is a complementary indicator under the Biodiversity sub-theme, which measures the rate of extinction of selected species. The "red list index" was said to be under development, but will be based initially on bird species. The indicator on "change of status of species of European interest" could be added under this sub-theme, when it becomes available as the indicator would provide information on policy responses. (Eurostat 2007a, 139.)

5.2.3. Summary

Biodiversity was initially monitored, in Levels 2 and 3, with an indicator on "protected sites", which was also used in the 2001 Monitoring Report and the UN indicator set. Data was readily available for this indicator and it had been considered feasible, but incomplete by the Commission, and furthermore its appropriateness was questioned. The indicator was changed to a more specifically defined indicator, which measured the effectiveness of the responses taken in the EU to reverse the loss of biodiversity, the 'sufficiency index'. The "sufficiency index" was selected although there was no data available at the time, but data became available during the revision of the SDI set, which was expected when the index was selected for the 2005 SDI set. The problem with this particular indicator is that it becomes useless once the target it measures has been reached, therefore the indicator will have to be eventually replaced with another indicator. Despite of its expected short lifespan, the indicator is able to currently monitor the implementation of Habitats and Birds Directives. This, of course, does not implicate that the indicator would or could monitor the loss of biodiversity by 2010, as pointed out by BirdLife International, which argued that the use of such an indicator includes the assumption that the protected areas would actually benefit biodiversity. The indicator is therefore measuring only the implementation of EU policy instrument, not the loss of biodiversity.

The aim of the TF and WG was to have another indicator under this sub-theme that would monitor biodiversity loss by looking at the trends related to the threatened species. The "change in status of threatened and/or protected species" indicator was selected for this purpose for the 2005 SDI set, although there was no data available. During the revision of the

set the indicator was slightly modified to an indicator for which data was expected to become available from the SEBI 2010 -project, in the near future. Another indicator, the 'red list index', was chosen as a proxy indicator for the selected indicator on "change in status of species in European interest" until the "best-needed" indicator would become available. However, there was no data available for the "red list index" either when the 2007 SDI set published.

The strengths and weaknesses of the indicators discussed under the Biodiversity sub-theme are presented in Table 6 on the following page. These qualities will be further discussed in Chapter 6 in the light of the three qualities identified for a good indicator; policy relevance, scientific validity, and communicability.

Indicator	Strengths	Weaknesses	Status
Percentage of protected areas	data availability present in the 2001 Monitoring report and UN indicator set	fitness for purpose responsiveness (little variation from one year to another)	replaced by the one below
Sufficiency of sites designated under the EU Habitats and Birds Directive	fitness for purpose defines a clear target data availability (from 2007) present in SEBI 2010	fitness of purpose data availability short lifespan scientific validity lack of reference point coverage (only available for EU-countries) assumes the protected areas benefit biodiversity	in the 2007 SDI set
Change in status of threatened and/or protected species	data eventually from the SEBI 2010	not available	modified to the one below
Change in status of species in European interest	available in 2008 monitors policy responses policy relevant	only one data point before 2010 scientific validity	to be developed
Red list index	provides complementary information on biodiversity loss proxy fitness for purpose available for bird species widely used (e.g. UN Millennium Development Goals) proxy for change in status of species in European interest scientifically valid (backed up with scientific papers) policy relevant	unclear methodology communicability: difficult to understand under development	in the 2007 SDI set, but under development

Table 6. The strengths and weaknesses of the indicators for biodiversity

5.3 Sub-theme: Fresh Water Resources

5.3.1 The issue of water abstraction

Initially an indicator on "intensity of water use" (SG6 – natural resources and transport, 2003), which corresponded to the indicator listed in the 2001 Monitoring report by the Eurostat (Eurostat 2001, 6) was proposed for monitoring water quantity. In the second preliminary SDI list, an indicator on "water abstraction from available resources" was added on the list as well (SDI/TF/44 rev. 2 2004). During the eighth meeting of the TF, it was decided that these two indicators are overlapping and the TF deleted the indicator on "intensity of water use" (SDI/TF/52 2004).

Before publishing the 2005 SDI set, a revision version was sent to the Commission services for comments (SDI/TF/54/5 2005). In the revision version, an indicator on "fresh water abstraction as a % of available resource" was proposed under the Fresh Water Resources sub-theme (SDI/TF/44 Rev. 7 2004). The Commission services commented that the indicator is problematic due to "variability in resource availability from country to country", which results from the "differences in annual precipitation and fresh water inflow in rivers". The Commission services recommended that as an alternative, indicator on the "stress on fresh groundwater resources" (abstraction in relation to total resources) could be used, because this way the problematic effect of river flow through would be avoided, but "an equal benchmark for countries with very different natural conditions" would be provided. The Commission services further pointed out that since the aim is not to compare the European countries, but to look at the EU as a whole, an indicator on "groundwater abstraction" would fit the purpose better. (SDI/TF/54/5 2005.)

Even though fresh water resources are not mentioned in the 2001 sustainable development strategy, the indicator on "groundwater abstraction as a percentage of available groundwater resources" was published in the 2005 SDI set, because the issue was seen crucial for achieving sustainable development. The policy relevance of all the indicators under the Fresh Water Resources sub-theme was further justified with the existence of the issue in the 6EAP and the Plan of Implementation. (Eurostat 2005, 217, 136, 143.)

During the revision of the SDI set, Eurostat D1 proposed to change the indicator from "groundwater abstraction" to "total water abstraction", if data quality meets satisfactory

standards (Eurostat 2006). The EEA supported the abovementioned change and argued that "indicator on total water abstraction would allow the evaluation of overexploitation as a whole". Eurostat E3 disagreed with the proposal and argued that "the issues were different and should be kept separate". The Member State representatives from Spain and France questioned the calculation and usefulness of an indicator on "total water abstraction". (SDI/WG/33 2007.) The Spanish comment was based on the fact that at the time the calculation of such indicator was not possible in Spain, and therefore suggested that indicators such as "available water per total run-off water" or "water consumption per available water", should be used instead, as these would "solve the problem of showing 'the real situation' in the dry parts of countries (e.g. S.E. Spain)" (Spain 2007). In response to abovementioned arguments, Eurostat D1 proposed to upload data on both, groundwater and surface water, indicators on the discussion forum (CIRCA), so that the WG members could make an informed decision at the next meeting (SDI/WG/33 2007).

The EEA commented on the proposal and further proposed to include an additional indicator to measure water quality. The arguments expressed by the EEA were that "in relation to freshwater resources the objective is 'improving management and avoiding overexploitation of renewable natural resources such as fisheries, biodiversity, water, air, soil, and atmosphere, restoring degraded Marine Ecosystems by 2015 (…)'" and therefore the "best-needed" indicator might be the "total water abstraction in relation to available resources". However, if the Water Framework Directive is considered, then the most suitable indicator might be the "percentage of water bodies with high or good ecological quality", which would make the indicator similar to the EEA's indicator on "water exploitation index". (EEA 2007b and EEA 2007c.)

Prior to the fourth WG meeting in May, the Eurostat sent a proposal for the final revised SDI set, including comments from the WG members. The proposal was to use indicator on "total water abstraction as % of total available resources", which was supported by the EEA's comment that this indicator "measures the overall degree of overexploitation". Eurostat E3, France and Spain argued against the proposal, because the "issues of defining the availability of surface water and availability of groundwater are separate". (SDI/WG/36 2007.)

The EEA sent the WG members a position paper, in which it commented the proposal. The EEA pointed out two issues relating to the proposed indicator on water abstraction. First, to the best of the EEA's knowledge, there was no data available for groundwater resources at

European national level and it seemed unlikely that data for all aquifiers in a country would become available, while at the same time there was data available for total freshwater resource. Second, the indicator on "water use intensity/ water exploitation index", which is calculated as total abstraction as percentage of available resource, has been used widely, for example by the Eurostat and the EEA. (EEA 2007c.)

Based on the abovementioned points, in the fourth meeting of the WG, the EEA proposed that the indicator would be changed to "total freshwater abstraction as % of available resources" due to lack of information on groundwater abstraction. The proposal was rejected by Eurostat E3, Spain and Finland, which argued that there is data available for groundwater abstraction from 19 Member States and in addition, looking only at total freshwater abstraction might hide part of the story, since specific stress on either surface or groundwater is not highlighted. Thus the recommendation was to go ahead with using both surface and groundwater abstraction. (SDI/WG/37 2007, 7.)

In the 2007 Monitoring report an indicator on "total gross water abstraction from fresh surface- and groundwater" was published. The report points out that the indicator is policy relevant as it corresponds to one of the actions identified in the renewed SDS, which is to "improve integrated water resource management and avoiding overexploitation". It also supports the objective of the Water Framework Directive to "achieve coherent and sustainable water management". (Eurostat 2007a, 139,148.)

5.3.2 Indicator for wastewater treatment

Indicator on "percentage of households connected to wastewater treatment systems" was first proposed in the third revision of the SDI list in 2004 as a Level 3 indicator (SDI/TF/44 Rev. 3 2004). The data for the indicator was readily available and the indicator was published in the final 2005 SDI set as "population connected to wastewater treatment systems". In the 2005 Monitoring report, the justification given for this indicator was that the indicator "monitors the degree of treatment of wastewater", because the Urban WWT Directive requires wastewater treatment before discharge. (Eurostat 2005, 136, 145.)

When the WG was revising the SDI set, the EEA sent a contribution paper to the WG, in which it noted that this particular indicator was outdated, because there will be only minor changes in the future for many countries in respect to this indicator, however, some changes

can still be achieved by improving the wastewater treatment plants. Therefore, the EEA recommended that this indicator should be changed to focus more on trends in wastewater treatment technology. (EEA 2007b.) Concurrently, Spain sent their comments on the review. In their view, the indicator on "population connected to wastewater treatment systems" was not appropriate. They suggested that "by taking into account all the obligations derived from ED Directive 91/271 it must be renamed as 'percentage of wastewater treated in urban populations with a population greater or equal than 2.000 (in case of estuaries or inland waters) or greater or equal than 10.000 (in case of coastal waters) equivalent inhabitants'". (Spain 2007.) Germany suggested that an indicator on "drinking water supply" should also be added under this sub-theme to complement the indicator on "population connected to wastewater treatment systems", because "in some of the new Member States it is not just the wastewater systems that will be inadequate in the next few years, but also the supply of drinking water". Germany further added that the progress made by the EU in implementing IWRM (Integrated Water Resource Management), to which the EU is committed to, should become more visible. (Germany 2007.)

During the third meeting of the WG, it was agreed to change this indicator to focus more on wastewater treatment technology, for example secondary treatment (SDI/WG/33 2007). Thus, in the 2007 Monitoring report, an indicator on the "population connected to urban wastewater treatment with at least secondary treatment" was used to monitor water quality (Eurostat 2007a, 139).

5.3.3 Debate over BOD versus COD

Both, the Eurostat 2001 indicator set and the UN indicator set included an indicator on "BOD concentration in rivers" to monitor water quality (Eurostat 2001, 6). In the 3rd revision version of the SDI set indicator on "BOD loading of rivers", or alternatively an indicator on "oxygen content in rivers", were listed as "best-needed" indicators on Level 3 (SDI/TF/44 Rev. 2 2004), however the latter was soon removed from the proposed list (SDI/TF/44 Rev. 5 2004). In the 2005 monitoring report, an indicator on "emissions of organic matter as biochemical oxygen demand to rivers" was listed as an indicator under development (Eurostat 2005, 136 and 217).

After the second meeting of the WG, Eurostat proposed to replace the indicator with an indicator on "concentration of organic matter as biochemical oxygen demand", for which the

data was to be obtained from the EEA (SDI/WG/31 2007). The change was further supported by the WG at the third meeting, however, it was suggested that an indicator on COD (chemical oxygen demand) would be listed as a "best-needed" indicator (SDI/WG/33 2007). Spain supported the selection of an indicator on "concentration of organic matter as biochemical oxygen demand", because "all the information needed for this indicator is already available and therefore its calculation is feasible" (Spain 2007). EEA noted that the change concerning the BOD indicator was inline with their suggestions, but expressed their concerns that Eurostat might change it back to an indicator on "emissions of organic matter", which in the EEA's opinion "cannot replace a concentration or water quality indicator" (EEA 2007b). The EEA further disagreed with the suggestion to keep the COD as "best-needed" indicator, since the COD was not available for all of Europe and the dataset was more complete for the BOD than for the COD. Thus the EEA suggested that the indicator should remain as "concentration of BOD", with perhaps an addition of ammonium, since both are indicators of "pollution with untreated sewage water". The EEA had previously forwarded diagrams of the BOD indicator to the Eurostat, which had then questioned the country coverage of the indicator. According to the EEA, the diagram "illustrates the overall trends from 1992 to 2004, based on a limited number of EU countries due to strict requirements that for the stations all years from 1992 to 2004 have to be available". However, the EEA has information from almost all of the EU-27 countries, with the exception of Malta, Portugal and Sweden. (EEA 2007c.)

Prior to the fourth meeting, Eurostat sent a proposal in which it was suggested that concentration of BOD would be changed to COD as soon as data for the latter becomes available (SDI/WG/36 2007). During the fourth meeting of the WG, EEA stressed its disagreement to move from BOC to COD as data for BOD is readily available, but not for the COD. Eurostat E3 replied that BOD excludes important organic substance and that the same move from BOD to COD is planned in other international fora as well. Hence it was decided to keep COD as an indicator to be developed. (SDI/WG/37 2007.) In the 2007 Monitoring report the COD indicator was listed as indicator under development, which would be eventually included in the SDI set as a complementary indicator to the indicator on BOD. The selection of the BOD indicator was justified by its ability to monitor water quality, which is contributes for the monitoring of the Integrated Water Resources Management. (Eurostat 2007a, 151, 305.)

5.3.4 Fresh water quality indicators to be developed

For another indicator on fresh water quality, the Task Force proposed to include an indicator on "pesticide risk to aquatic environment" as a Level 3 indicator for the Fresh Water Resources sub-theme (SDI/TF/44 Rev. 2 2004), but this was considered to be too specific by the Commission services, which suggested that the indicator should also include non-agricultural chemicals and to rename the indicator "index of toxic chemical risk to aquatic environment" (SDI/TF/54/5 2005). The indicator proposed by the Commission services was listed in the 2005 Monitoring report as an indicator under development (Eurostat 2005, 136).

In the third meeting of the WG, it was noted that there were two options for an indicator on water quality. Either the pressure indicator published in the 2005 SDI set, the index of toxic chemical risk to aquatic environment, for which data would be obtained from the REACH project could be used, or alternatively a state indicator on "good ecological status" for which data was foreseen to be obtained from the Water Framework Directive. However, their selection should be based on the timetable of their expected development. (SDI/WG/33 2007.) The proposal was to keep both indicators as indicators to be developed. The Eurostat noted that the state indicator is preferred, but once the data becomes available, the indicator should be checked. (SDI/WG/36 2007, 16.) The EEA commented on this that neither of the proposed indicators were currently available and that while the latter might be produced in 3-5 years time, the former would not be produced in the near future, at least not by the EEA (EEA 2007b and c). Spain also commented on the likeliness of data availability by stating that neither is the "toxic chemical risk to aquatic environment index" available or is the calculation of an alternative index for measuring ecotoxicity foreseen in Spain at the present (Spain 2007). In the fourth meeting of the WG, Finland requested to keep both indicators on list as indicators to be developed, until data becomes available and the WG can make the decision based on it (SDI/WG/37 2007). Both of these indicators were published in the 2007 Monitoring report as indicators to be developed (Eurostat 2007a, 305).

5.3.5 Summary

Although fresh water resources were not mentioned in the 2001 strategy, the sub-theme was included in the 2005 SDI set, because of other sustainable development related commitments made by the EU. In the 2005 strategy the issue of fresh water resources was included in the

operational objectives as well as in the actions needed to be taken. In order to monitor fresh water resources, indicators monitoring both, the quantity and quality of fresh water resources were needed.

Initially an indicator on “water use intensity” was used to monitor the quantity of fresh water resources. The indicator was already part of the 2001 Monitoring report and even though its selection to the EU sustainable development indicator set was further supported by its use in many other indicator sets, the indicator was dropped from the list, because it overlapped with the indicator on “water abstraction”. The replacement, indicator on water abstraction, caused substantial amount of discussion and disagreements on whether the use of total, surface, or groundwater resources would be the most appropriate for the purpose. There were disagreements concerning data availability and whether the two could be united into one indicator. Neither groundwater abstraction nor surface water abstraction was seen adequate as such, but combining the two was also problematic as the issues covered by each indicator were different. A compromise in which the indicator was called “total water abstraction”, but the two indicators were kept separate, was made.

For water quality, a number of indicators were selected. The indicator on wastewater treatment selected for the 2005 SDI set had to be modified for the 2007 set, since the initial version of the indicator had become useless. The initial “wastewater treatment” indicator monitored the implementation of such treatment to wastewater before discharge and as the implementation had been more or less completed in the EU, it was more feasible to monitor the technical changes in the wastewater treatment plants. Thus the indicator on “population connected to wastewater secondary treatment systems” was selected for the 2007 SDI set.

Other water quality indicators were also selected, although data was not yet available for them. As a general remark of the evolution of indicators under this sub-theme, it should be noted that the discussion evolved around the definition of what kind of indicator would be the most appropriate for the purpose. For example, there was on-going debate concerning whether biochemical or chemical oxygen demand to rivers should be used. Data became available for the BOD indicator before the 2007 SDI set was published, hence it was selected for the set as “best-available”, while the indicator on COD remained under development and would eventually complement the BOD indicator.

Two additional indicators on fresh water quality were listed in the 2007 SDI set as indicators to be developed. One of them, “index of toxic chemical risk to aquatic environment” is a

pressure indicator, while the other "percentage of water bodies with high or good ecological status" is a state indicator. There is no data foreseen for the pressure indicator, while the state indicator might be produced in 3-5 years by the EEA.

The strengths and weaknesses of the indicators discussed under the Fresh Water Resources sub-theme are presented in Table 7. These qualities will be further discussed in Chapter 6 in the light of the three qualities identified for a good indicator; policy relevance, scientific validity, and communicability.

Indicator	**Strengths**	**Weaknesses**	**Status**
Water use intensity	widely used	overlapping with water abstraction	removed
Fresh water abstraction	data availability	unfair fitness for purpose	part of the total water abstraction
Groundwater abstraction	fair data availability fitness to purpose	data availability	in the 2005 SDI set part of the total water abstraction
Total Water abstraction (= fresh water and groundwater abstraction)	fitness to purpose policy relevance	separate issues usefulness	in the 2007 SDI set
Wastewater treatment	data availability (2005 version)	useless (2005 version)	updated for the 2007 set
Biochemical oxygen demand to river	feasible data availability fitness to purpose	coverage methodology	in the 2007 SDI set
Chemical oxygen demand	to be widely used	data availability	to be developed
Index of toxic chemicals	data from the REACH - framework	data availability	to be developed
High or good ecological quality	similar to EEA's indicator	data availability	to be developed

Table 7. The strengths and weaknesses of fresh water resources indicators

5.4 Sub-theme: Marine Ecosystems

5.4.1 Trends of spawning biomass

In the sixth meeting of the TF, the sub-group for the Management of Natural Resources theme considered possible indicators for Marine Ecosystems sub-theme. The use of an indicator based on both fishing capacity and fishing quota was discussed, but there were uncertainties relating to data availability. DG FISH and Norway confirmed that there are problems with data availability as well as with methodological approach to this indicator. Norway also proposed that an indicator on "trends of spawning biomass" in order to support the indicator on fishing capacity would be included. Hence, the sub-group concluded that at Level 2, possibilities to use the indicator on "fishing capacity and quota" will be explored and if it proves unfeasible it is going to be dropped. (SDI/TF/46/3 2004.) Both of the proposed indicators were included in the preliminary lists of the SDI set, however their hierarchical places were exchanged so that in the final revision version indicator on "trends of spawning stocks of selected species" was at Level 2 and the indicator on "effective fishing capacity and quotas, by specific fisheries" at Level 3 (SDI/TF/44 Rev. 2 and Rev. 7 2004). The Commission services recommended renaming the indicator as "trends of spawning biomass of selected fish stocks", because the indicator measures fish stocks, not species (SDI/TF/54/5 2005). Both of these indicators were listed in the 2005 SDI, although neither one of them was available at the time (Eurostat 2005, 217).

During the review, Eurostat suggested that the indicator on spawning biomass would be kept in the set as "best-needed" indicator and the possibility to use data from the ICES would be investigated. DG FISH replied that "ICES reports have data on the evolution and trends for many stocks". (SDI/WG/31 2007.) Concurrently, the EEA suggested the removal of the indicator since it was overlapping with the headline indicator. Eurostat replied that "there was a longer time series available, thus it could be seen as complementing the headline indicator, which provides more of a snapshot of the situation". (SDI/WG/33 2007.)

Before the final meeting of the WG, the EEA sent a contribution paper to the WG in which it recommended to keep 'trends in spawning biomass' on the set, because of the long time series produced by the Eurostat and since the indicator supports the "core indicators" on fish catches and fishing capacity. The EEA further noted that the "effective fishing capacity and quotas" indicator can be used to support the information provided by the EEA core set indicators (i.e.

the abovementioned), but claimed the data source and status of this indicator to be unclear. (EEA 2007c.)

In the Eurostat's proposal for the SDI review prior to the fourth meeting, is was further confirmed by the DG FISH that data for this indicator can be obtained from the ICES reports, but the Eurostat proposal was to remove the indicator, because it was overlapping with the headline indicator on fish catches, as was pointed out by the EEA. (SDI/WG/36 2007.) Thus, the indicator was not listed in the 2007 SDI set (Eurostat 2007a, 300).

5.4.2 Proxy indicator on "size of fishing fleet"

The proposal in the preliminary SDI set was to have an indicator on "effective fishing capacity vs. quotas, by specific fisheries" as a "best-needed" indicator at Level 2 for the Marine Ecosystems sub-theme. Since the indicator was under development, a proxy indicator on "size of fishing fleet" was assigned for it. (SDI/TF/44 Rev. 2 2004.) At the eighth meeting of the TF, the indicator and its proxy were moved from Level 2 to Level 3 (SDI/TF/52 2004) and they were listed as such in the 2005 SDI set, but neither of the pressure indicators was available at the time (Eurostat 2005, 136 and 217). In the 2005 Monitoring report the policy relevance of these indicators were stressed since "the Gothenburg Council underlined the need to address the overall fishing pressure by adapting the EU fishing effort to the level of available resources, taking into account the social impact and the need to avoid over-fishing" (Eurostat 2005, 142).

At the third meeting of the WG, it was noted that "previous exchange with DG FISH indicates that the best proxy for 'fishing capacity' would be fishing fleet in tonnages, complemented by the power of the fleet and number of vessels" (SDI/WG/33 2007, 12). In the list of the SDIs, proposed by the Eurostat prior to the third meeting of the WG, DG FISH pointed out that "tonnage is better for the measurement of the size of fisheries than the size of fishing fleet, but there is a break in the time series in 2003". Furthermore, DG FISH mentioned that "capacity does not seem to be a good proxy for the fishing effort, let alone mortality". As a response, the Eurostat proposed to remove this indicator from the set completely. (SDI/WG/36 2007.) The EEA objected the removal of the indicator on fishing fleet and confirmed that they have the data available for fishing fleet capacity (EEA 2007c).

In the fourth meeting of the WG, the EEA suggested to keep the indicator on the "size of fishing fleet", for which there is data available and added that effective fishing capacity should remain as an indicator to be developed. The Eurostat proposed on behalf of the DG FISH to keep the "size of fishing fleet" indicator on the set until there is a better indicator available. Eurostat D1 explained the interpretation problems linked to the "size of fishing fleet" indicator and preferred that the effective fishing capacity is kept as an indicator to be developed. (SDI/WG/37 2007.) The 2007 Monitoring report recognises that the only indicator available for measuring pressure on fish stocks is the indicator on the "size of fishing fleet", which suffers from some methodological problems. Therefore indicator on "fishing capacity and quota" was kept as the "best-needed" indicator. (Eurostat 2007a, 139.)

While the improvement of fisheries management was no longer a separate objective in the renewed strategy (European Commission 2006, 13), the 2007 Monitoring report highlights the policy relevance of this indicator: "while 2001 Gothenburg Council had specifically stressed the need to address the overall fishing pressure by adapting the EU fishing effort to the level of available resources, the renewed SDS focuses on the need of avoiding overexploitation of renewable natural resources such as fisheries. It also specifies that the Member States and the Commission should make further efforts in the field of fisheries through the reformed common fisheries policy, which requires that Member States match fishing capacity with fishing possibilities". (Eurostat 2007a, 152.)

5.4.3 Selecting a policy-related response indicator

The 2005 Monitoring report lists another indicator that should be developed for the Marine Ecosystems sub-theme, which is a "policy-related response indicator on 'structural support to fisheries and percentage allocated to promoting environmentally friendly fishing practices'" (Eurostat 2005, 136). However, during the revision of the SDI set, the Eurostat proposed to remove this indicator completely from the 2007 set, as there were no prospects to obtain data before at least 2010 and there were uncertainties even after that (SDI/WG/31 2007, 2). The EEA and DG ENV objected the removal of the indicator due to its policy relevance (SDI/WG/33 2007 and SDI/WG/36 2007). The EEA further stressed that this indicator would be used even after 2010 as it will provide "a useful figure for judging future efforts on improving management and avoiding overexploitation of fisheries" (EEA 2007c). The 2007 Monitoring report concludes that the indicator is kept on list as an indicator to be developed,

because of its policy relevance and despites of the fact that the development of such an indicator is not likely before 2010 (Eurostat 2007a, 305).

5.4.4 From the removal of the sub-theme to an indicator on "concentration of mercury in fish and shellfish"

The tasks given to the discussion groups of the WG (former sub-group) were to 1) review the list of indicators of indicators, focusing on progress on "best-needed" indicators; 2) review the need for new indicators in the light or the renewed SDS; and 3) to suggest candidates for removal in order to reduce the total amount of indicators in the SDI set (SDI/WG/20 Rev.1 2006, 3). In the 2005 SDI set there were 155 indicators, of which 20 were under the 'management of natural resources' theme (Eurostat 2005, 214-218). The aim was to reduce the number of indicators in this theme closer to 10 (SDI/WG/31 2007). The Eurostat requested the WG to suggest candidates for removal from the Natural Resources theme. Austria responded that "since the factual number of indicators where data are available is much lower than 16, it is difficult to improve the quality of indicators from "best-needed" to available ones in this theme". DG ENV suggested that "all agricultural indicators could be moved to land-use sub-theme". (SDI/WG/31 2007, 2-3.) The EEA noticed that in the Eurostat's proposal the Marine Ecosystems sub-theme had been deleted and the relevant indicators had been either removed completely or moved under the Biodiversity sub-theme, which was "not in agreement with the EEA view". The EEA recommended maintaining the sub-theme, because the large fishing pressure exerted on European seas and the occurrence of fishing outside safe biological limits in all regions. Therefore, the EEA proposed to keep the indicators on "fish catches outside safe biological limits", "trends of spawning biomass" and "size of fishing fleet" on the revised SDI set under the Marine Ecosystems sub-theme. (EEA 2007c.)

The appropriateness of the Marine Ecosystems sub-theme was also discussed in the light of the renewed strategy, which no longer highlighted "improvement of fisheries management" as a separate objective, however the issue was included in the operational objectives and targets ("improving management and avoiding overexploitation of renewable natural resources such as fisheries, biodiversity, water, air, soil, and atmosphere…") (European Commission 2006, 13). The Eurostat proposed that the Marine Ecosystems sub-theme could be merged with the sub-theme on Fresh Water Resources (SDI/WG/13 2006, 5). The issue was discussed in the

discussion group meeting during the second WG meeting, where it was decided to keep the two sub-themes separate and investigate possible new indicators under the Marine Ecosystems sub-theme (SDI/WG/20 Rev.1 2006, 6).

In the last meeting of the WG in May 2007, the discussion of the possible removal of the Marine Ecosystems sub-theme was again opened, because of the latest proposals to remove indicators on “size of fishing fleet” and “trends of spawning biomass” from the set, left only one currently unavailable indicator under this sub-theme (SDI/WG/35 2007, 15). The EEA supported by Eurostat E2, DG ENV, Germany, Finland and Norway requested that the sub-theme on Marine Ecosystems would be kept under the Natural Resources theme. Thus it was decided to keep the sub-theme on the framework, which meant that further work on this sub-theme was needed as commented by Norway. Germany and the EEA proposed to add an impact indicator on “mercury in fish” under the Marine Ecosystems sub-theme. (SDI/WG/37 2007, 6.) The indicator was listed in the 2007 SDI set as an indicator to under development (Eurostat 2007a, 200).

5.4.5 Summary

The ideal or “best-needed” indicator identified by the TF and WG for this sub-group was the indicator on “fishing capacity and quotas”, but there was no data available for it and it suffered from methodological problems. An indicator on “trends of spawning biomass” was suggested to support the indicator on fishing capacity. Both of these indicators were published in the 2005 SDI set, even though neither of them was available at time. Soon after the revision of the SDI set had begun, long time series of data for the “spawning biomass” became available from the ICES reports, but the indicator was eventually dropped from the 2007 SDI set as it was seen overlapping with the headline indicator on “fish catches”.

Since the indicator on “fishing capacity and quotas" was not available, it was decided to assign a proxy indicator for it. An indicator on the “size of fishing fleet” was suggested and selected already for the 2005 SDI set, despite of data unavailability. Data became available for this indicator during the revision of the SDI set, but the usefulness of the indicator was questioned as it suffered from methodological and some interpretation problems, and also it was criticised as unsuitable for the purpose. Nevertheless, the decision was to keep this

indicator in the SDI set until the indicator on “fishing capacity and quotas” would become available.

Also an indicator measuring policy response was added under this theme. The indicator on “structural support and environmental fishing” was listed as an indicator under development in both SDI sets, although there it seemed unlikely to have data for it before 2010. The indicator was kept as an indicator under development, because of its policy relevance and its usefulness even after 2010.

Thus so far for the 2007 SDI set, the heavily criticised indicator on the “size of fishing fleet” was the only available indicator for the Marine Ecosystems sub-theme. In addition to the lack of indicators for this sub-theme, there was pressure to reduce the total amount of indicators in the SDI set. Since the separate objective on fisheries had been deleted from the renewed SDS, possibility to remove the sub-theme or combine it with the sub-theme on the Fresh Water Resources sub-theme was debated on. During the fourth meeting it was agreed that the sub-theme would stay on set as it had before and that new possible indicators for this sub-theme would be explored. The proposal to add an indicator on “concentration of mercury in fish and shellfish” was accepted without further comments and was hence listed in the 2007 SDI set as an indicator under development.

The strengths and weaknesses of the indicators discussed under the Marine Ecosystems sub-theme are presented in Table 8 on the following page. These qualities will be further discussed in Chapter 6 in the light of the three qualities identified for a good indicator; policy relevance, scientific validity, and communicability.

Indicator	Strengths	Weaknesses	Status
Trends of spawning biomass	complementary to fishing capacity data availability (long time series) complementary to fish catches data from the ICES	overlapping with fish catches	removed
Fishing capacity and quotas	"best-needed" policy relevant	data availability methodology data source and status fitness of purpose	to be developed
Size of fishing fleet	proxy for fishing fleet data availability policy relevant	fitness for purpose under development difficult to interpret methodological problems	in the 2007 SDI set
Structural support to fisheries and environmentally friendly fishing practices	policy relevant fitness for purpose usefulness for a long time	data availability development uncertain	to be developed
Mercury in fish and shellfish			in the 2007 SDI set, but under development

Table 8. The strengths and weaknesses of marine ecosystems indicators

5.5 Sub-theme: Land-use

5.5.1 Soil erosion and contamination

In the first meeting of Management of natural resources sub-group in 2003, the objective relating to soil loss, degradation and sealing was recognised, but the issue of soil erosion was considered too localised to be included in the EU SDI set (SG6 – natural resources and transport, 2003). During the sixth meeting of the Task Force, a state indicator on soil was proposed. During the discussions, DG ENV pointed out that geographical focus was essential and suggested that the indicator on soil degradation could be broken down to categories. (SDI/TF/46/3 2004.) In the preliminary SDI list, indicator on "total area at risk from soil

degradation, by category of degradation (erosion, heavy metal contamination, etc.)" was listed as the "best-needed" indicator, which corresponds to an objective of the 6EAP to "promote sustainable use of the soil, with particular attention to preventing erosion, deterioration, contamination and desertification" (SDI/TF/44 Rev. 2 2004). In the following revision version of the preliminary SDI list, an indicator on "total area affected by erosion or local contamination" was listed as a proxy indicator for the "best-needed" indicator on soil degradation (SDI/TF/44 Rev. 4 2007). The proxy indicator was later divided into two separate indicators, which were "percentage of total land area at risk of soil erosion" and "percentage of total land area at risk of soil contamination" (SDI/TF/44 Rev. 7 2004). The future of these indicators were questioned in the eighth meeting of the TF by the EEA, which mentioned that "there is no longer specific EU funding for soils and data are therefore not disseminated easily and while finding a way to improve the use of these data sets could be worthwhile, it doesn't really fall under the tasks of the TF". (SDI/TF/52 2004.) Even though there was no data available for the two indicators on soils in 2005 and the prospects of obtaining data later was uncertain, the two indicators were listed as indicators under development in the 2005 SDI set (Eurostat 2005, 217).

During the revision of the SDI set, Eurostat suggested keeping the indicator on soil erosion, because it was part of the agri-environmental indicator set, and even though it was unlikely that data would become available in the near future. The Eurostat suggested that the indicator on soil contamination would be removed, since there was only modelled data available with no prospect of regular data stream. (SDI/WG/31 2007.) Austria suggested that the data for the indicator on soil erosion could be obtained from the agri-environmental programmes, which was the case in Austria, as long as the programmes are comparable (Austria, 2007). Calculations on soil erosion had been also carried out in Spain (Spain 2007).

At the third meeting of the WG, it was agreed to keep for the time being the "best-needed" indicator on soil erosion, although there problems with data presentation were identified (SDI/WG/33 2007). The indicator on soil contamination was removed from the in the fourth meeting of the WG due to lack of data. Concurrently, it was noted by Eurostat the indicator on soil erosion also suffers from lack of data, but the since the indicator was also an agri-environmental indicator, the suggestion was to keep it as an indicator to be developed. (SDI/WG/36 2007.) The indicator was listed in the 2007 Monitoring report as such (Eurostat 2007a, 305).

5.5.2 Fragmentation due to transport

The sub-group on Management of Natural Resources considered adding an indicator on "fragmentation due to transport" (SG6 – natural resources and transport, 2003), but the indicator was not present in the preliminary SDI lists (SDI/TF/44 Rev. 2-7 2004). In the fifth meeting of the TF, DG Research observed that the preliminary SDI lists for this sub-theme considered only land, while fragmentation, rural areas and regional disparities were excluded (SDI/TF/42/2 2003). EEA had previously produced fragmentation maps (SG6 – natural resources and transport, 2003), and the EEA mentioned at the fifth meeting of the TF that "fragmentation can still be considered as an experimental indicator" and should be therefore placed at Level 3. The Task Force further noted that there are some overlaps between the issues of land-use and transport, because the same indicator is used to describe both of them. (SDI/TF/42/2 2003.) In the following meeting it was suggested that the "best-needed" indicator on fragmentation would be allocated under the Transport theme (SDI/TF/46/3 2004, 15). However, in the 2005 SDI set the indicator was listed under the Land-use sub-theme as an indicator under development (Eurostat 2005, 136 and 217).

During the revision of the SDI set, Eurostat recommended to remove the indicator, because the TERM -indicator had no further data update foreseen, but suggested to replace the indicator with another fragmentation indicator from the SEBI 2010 -project, and to move it under the Biodiversity sub-theme (SDI/WG/31 2007, 2). The EEA responded that "the SEBI 2010 Coordination Team proposes an indicator on 'changes in patch size of major ecosystem types' as its main indicator on fragmentation, which shows the change in patch size of major ecosystem types based on Corine Land Cover (CLC) data, (e.g. traditional woodland, forest and tall woodland, heathland etc.)" (EEA 2007a). Germany commented that the indicator on fragmentation should be further pursued, even though there are problems related to data and methodology, because of the consequence of the pressure exerted on biodiversity by the fragmentation of habitats (Germany 2007). For the final set, the indicator on fragmentation of habitats due to transport was moved under the transport theme as an indicator to be developed (SDI/WG/36 2007; Eurostat 2007a, 305).

5.5.3 Built-up areas

The UN indicator set included an environmental indicator on “area of urban formal and informal settlements”, which was changed in the Eurostat’s 2001 indicator set to “growth of built-up area” (Eurostat 2001, 6). In the first sub-group meeting, the proposal was to use the “land use changes by main categories” indicator, however it was pointed out that “in order to get information on built-up area, data needs to be harmonised” (SG6 – natural resources and transport, 2003). However, the relevance of assessing loss of biodiversity on the basis of land use changes was questioned by France (SDI/TF/42/2, 2003).

In the preliminary SDI list land-use change was given in respect to “natural, agricultural and built-up land” at Level 2, while at Level 3 an indicator on “growth of built-up land” was listed (SDI/TF/44 Rev. 2 2004). At the sixth meeting of the TF, it was proposed to “use the shift from natural to agricultural and to build up as well as from agricultural to built-up area” at Level 2 (SDI/TF/46/3 2004). Hence in the final SDI set, “land-use change” was identified as “best-needed” indicator, while “growth of built-up area as a percentage of total area” was the “best-available” indicator, both at Level 2 (SDI/TF/44 Rev. 7 2004; Eurostat 2005, 217). The 2005 Monitoring report further explains that the indicator on “land-use change by category” could not be used due to inadequate data. The report also highlights the importance of measuring “the pressures caused by development on land resources, which responds to the 2001 strategy’s call for improvements in the transport systems and land-use management and the 6EAP’s call for the importance of sustainable use and management of land and sea”. (Eurostat 2005, 136 and 147.)

During the revision of the SDI set in 2006 and 2007, Eurostat proposed to keep the indicator on “land-use change” as “best-needed” and to investigate the EEA’s data for it from 1990-2000 (SDI/WG/31 2007). Spain criticised the proposal to keep the proxy indicator on “built-up areas” in the reviewed set, because of the periodicity of the data available for this indicator (Spain 2007).

The use of Corine Land Cover (CLC) data was discussed already during the meetings of Task Force. In the fifth TF meeting, however, it was concluded that the use of CLC is not yet possible (SDI/TF/42/2 2003), but only a year later the situation seemed to have changed. The EEA informed the TF during the eighth meeting that “the CLC database will become available over the next nine months and the information could be the basis for an indicator in

the future, but probably not this year" (SDI/TF/52 2004). The indicator was not listed in the 2005 SDI set (Eurostat 2005).

The Corine-based data on land cover was not on the revision list provided by Eurostat in 2007 (SDI/WG/31 2007), however, the question of its possible use was again raised by the EEA in their contribution on the review of the SDI set in February 2007, in which it was mentioned that "the SEBI 2010 Coordination Team proposes to include in the first headline set an indicator that is of relevance to the indicator set on land use, trends in extent and composition of selected ecosystems in Europe, which is a CLC based indicator that measures changes in land cover, classified into 13 types of ecosystems". (EEA a 2007.) Eurostat E1 expressed some doubts concerning the CLC based indicator on land use change, because "the resolution of the data is not high enough". The EEA and DG ENV supported the indicator because it could provide more relevant information than "built-up area". (SDI/WG/31 2007.) The EEA further insisted that "the use of Corine-based data on land cover could be useful as the change provides a better picture than 'built-up area'". However, Eurostat neglected EEA's remaks, because the indicator suffers from low resolution and there is data available only for two years (1990 and 2000). (SDI/WG/37 2007.) In the fourth meeting of the WG, UK questioned the usefulness of the indicator on "built-up area", to which Eurostat D1 replied that "it is only a proxy indicator, and it will be removed from the list as soon as the "best-needed" indicator becomes available" (SDI/WG/37 2007). The indicator on built-up areas was listed on the 2007 SDI set as a proxy indicator for land-use change, and aims to measure progress towards the one of the overall objective of the renewed strategy to "improve management and avoid overexploitation of natural resources, recognising the value of ecosystem services" (Eurostat 2007a, 153).

5.5.4 Forest trees damaged by defoliation

At the sixth meeting of the TF, UK pointed out that the proposed list of indicators was missing an indicator on forestry, to which the EEA replied that one possibility would be to use forest defoliation data. The TF agreed that an indicator addressing forestry will also be included in the list, since "forestry is part of the natural resources management -story". (SDI/TF/46 2004.) The seventh meeting of the Task Force was a workshop on EU Sustainable Development Indicators held in Stockholm. The purpose of the meeting was to bring together wider audience (i.e. NGOs, regional councils, associating countries etc.) to get consultation

on the SDI list put together by the Task Force, and to get input for the "best-needed" indicators (i.e. which should be developed in the future). (Eurostat 2004b.) During the meeting, the TF requested input from the representative of Austrian Federal Environment Agency (Department of Forests), Dr. Linser (Linser, 2004).

The only forest related indicator in the preliminary SDI list was an indicator on percentage of forest showing severe forest defoliation (SDI/TF/44 Rev. 2 2004). Dr. Linser explained that "the use of the word 'severe' might give a wrong picture of the forest ecosystem health in Europe, since also moderate defoliation of trees has been observed in Europe, which also influences forest health by predestining the trees for further damaging agents". The recommendation given by Dr. Linser was to adjust the wording and the context to the one used in the pan-European indicator for Sustainable Forest Management (SFM), which is "defoliation of one or more main tree species on forest and other wooded land in each of the defoliation classes 'moderate, sever, and dead'". This way the indicator would give a more appropriate picture of the situation in Europe.

During the 8th meeting of the TF, BE referred to the Stockholm discussions, in which it had been mentioned that the indicator should cover both "severe defoliation and medium defoliation, as severe defoliation is less of an actual concern". It was then explained to the TF that the data for the different classes was already presented in the chart and relevant labels will be added shortly on the chart. (SDI/TF/46/3 2004.) In the 2005 SDI set the indicator on forest trees damaged by defoliation was published as a complementary indicator for land-use change and the classification recommended by Dr. Linser (i.e. moderate, severe, dead) was applied (Eurostat 2005,136 and 149). The inclusion of an forestry indicator was justified by explaining that forests are "biodiverse habitats and are relevant for water catchments, carbon storage, soil conservation and water management", for which it corresponds to "the need to protect and restore habitats and natural systems", as identified in the 2001 SDS. In addition, the issue of sustainable forestry is included in the 6EAP targets as well as in the Plan of Implementation. (Eurostat 2005, 149.)

During the review of the SDI set, it was noted that the new objective on "contributing effectively to achieving the UN global objectives on forests by 2015" had been added in the renewed strategy, which meant that new indicators covering forest health should be considered. The global objectives on forests set by the UN were pointed out:

- Reverse the loss of forest cover worldwide through sustainable forest management (SFM), including protection, restoration, afforestation and reforestation, and increase efforts to prevent forest degradation;

- Enhance forest-based economic, social and environmental benefits, including by improving the livelihoods of forest-dependent people;

- Increase significantly the area of protected forests and other sustainably managed forests, and increase the proportion of forest products derived from sustainably managed forests; and

- Reverse the decline in official development assistance for sustainable forest management and mobilize significantly- increased new and additional financial resources from all sources for the implementation of SFM. (SDI/WG/14, 2006.)

It was further noted that the new objective on forests calls also for new forest management indicators and that there are several initiatives reviewing forest indicators, such as MCPFE and SEBI 2010. In order to select the most suitable indicators to the set, a target to strengthen the dialogue between the WG and relevant experts was set. (SDI/WG/20 2006.) During the third meeting of the WG, there was debate on whether "defoliation", which is more focused on forest health, should be replaced by "deadwood", which is more focused management and biodiversity. It was decided that the final decision should be based on the UN goals on forests. (SDI/WG/33 2007.) There was also information available on this matter (Spain 2007).

Eurostat pointed out during the fourth WG meeting that the indicator on deadwood, which would come from SEBI 2010, was proposed as a second forestry indicator, but while this indicator addresses forest management, there is also need for a forest health indicator, which would cover the global objectives on forests: "reverse the loss of forest cover worldwide through sustainable forest management (SFM) […] and increase efforts to prevent forest degradations". (SDI/WG/36 2007.) The 2007 Monitoring report mentions that the indicator on "defoliation", which corresponds to the UN global objectives on forests, is a management and a health indicator for forests, while the indicator to be developed, "deadwood", is going to be used as a proxy for biodiversity in forests, and will eventually replace the indicator on defoliation (Eurostat 2007a, 139 and 156).

5.5.5 Additional forest and forestry indicators

During the sustainable development indicators workshop in Stockholm, the UK representative had pointed out that "a second indicator on forests and forestry would make the set more balanced as a number of indicators are used to asses Marine Ecosystems and fresh water resources". The TF consulted again Dr. Linser from the Austrian Federal Environment Agency on additional forest indicators. During the workshop, a Latvian participant had suggested an indicator on "illegal logging", but this suggestion was rejected by Dr. Linser since "the indicator and the topic are on the one hand politically very sensitive and on the other hand reliable data is hardly available in European countries". (Linser 2004.)

Linser recommended the TF to choose the second indicator from the Improved Pan-European Indicators for Sustainable Forest Management (SFM) or the Ministerial Conference on the Protection of Forests in Europe (MCPFE) as selecting indicators from already existing indicator sets would not increase the reporting burden for the European countries, which are already providing data for these existing sets, such as the abovementioned. One of the indicators suggested by Linser was an indicator on "balance between net annual increment and annual fellings of wood on forest availability for wood supply", which corresponds to the Plan of Implementation, in which the following target is identified: "take immediate action at the national and international levels to promote and facilitate the means to achieve sustainable timber harvesting,…, and thereby address unsustainable timber-harvesting practices". (Linser 2004.)

During the revision of the SDI set in 2006 and 2007, and taking into account the suggestions sent by Linser (2004), Eurostat proposed to add an indicator on forestry management. The preliminary proposal was to use an indicator from the SEBI 2010 set on 'protected forests' and/or 'fellings and increments' (SDI/WG/31 2007). Austria complained that indicator on protected forests cannot be the only solution to achieve the UN global objectives on forests and both, the EEA and Eurostat added that there is a problem with definition of protected forests. The EEA further pointed out that increments and fellings are more relevant. (SDI/WG/36 2007.)

Spain pointed out that while "the fellings are documented, but there is no data on the matter. Exploiting the existing information so as to obtain precise data would take a long time since it would involve to gather information province by province at the least. The data for the

National Total obtained by summing up all the areas taken into account would have a high estimation error." (Spain 2007.) The EEA send the TF comments on the Eurostat's proposal for a forest management indicator to monitor the UN Global objectives on forests and wrote that "the SEBI 2010 Coordination Team proposes to include the indicator 'Growing stock, increment and fellings', from the set of MCPFE indicators, and not to include 'protected forests'". (EEA 2007b.)

In the third meeting of the WG it was agreed that the indicator on "growing stock, increment and fellings" would be added in the EU SDI set, since the MCPFE indicator is also adopted in the SEBI 2010 (SDI/WG/33 2007). In the fourth meeting, Estat E2 informed the TF that there are three possible sources of data for this indicator (SDI/WG/37 2007).

The 2007 Monitoring report points out in respect to policy relevance that the indicator reflects to management and health of forests, which are part of the renewed strategy in which the need for achieving UN global objectives on forests are also identified as well as the objectives of the EU forest action plan (Eurostat 2007a, 139 and 154).

5.5.6 Indicators for depositions

In the 2001 monitoring report, Eurostat published an indicator on "nitrogen balance" (Eurostat 2001, 6). An indicator on "nitrogen surpluses" was also suggested in the first sub-group meeting (SG6 – natural resource and transport, 2003). In the minutes of the sixth TF meeting, an indicator on deposition, which would merge acidifying and nitrogen depositions, was considered reasonable (SDI/TF/46/3 2004). In the preliminary SDI lists an indicator on "exceedance of critical loads of acidifying substances and nitrogen in sensitive natural areas" was listed as the "best-needed" Level 2 indicator (SDI/TF/44 Rev. 2-7 2004). The indicator was dropped from the list as a similar indicator was included at Level 2 under the Production and Consumption Patterns theme (SDI/TF/52 2004). But it was, however, re-inserted in the 2005 SDI set as "best-needed" indicator under the Land-use sub-theme at Level 2 (Eurostat 2005, 217).

In 2006, Eurostat proposed to remove the indicator on "exceedance of critical loads" unless suitable and regular data stream can be identified, and to add an indicator on "nitrogen surplus" from the Production and Consumption Patterns theme and rename it with an agri-environmental title: "gross nitrogen balance" (Eurostat 2006). Spain commented that it

seemed that “there was no available uniform data regarding land polluted by nitrogen (excessive use of nitrogen fertilizers)” (Spain 2007).

In the following proposal for the SDI list, Eurostat recommended to “keep the “best-needed” indicator for the moment and explore annual data in the form of maps from EEA” (SDI/WG/31 2007). Germany expressed its position on “retaining the indicator on the list as the data for the ‘critical loads’ indicator is available in the form of maps over long time series collated under the UNECE Convention on Long-range Transboundary Air Pollution and will continue to be collected. It is indeed possible to represent this indicator, which would highlight one of the most significant impacts on biodiversity reduction”. (Germany 2007.)

The EEA informed the TF that “the indicator is presented in the form of a map, which is updated annually and there is a long time series available” (SDI/WG/31 2007). The EEA informed the WG that there is “an equivalent indicator on ecosystem exceedances within the EEA core set of indicators and the data flows for this indicator are regularly updated by the EEA” (EEA 2007b). Austria also pointed out that “nitrogen surplus is a threat to water quality and is already covered by a separate sub-theme” (SDI/WG/31 2007).

Germany signalled that “exceedance of critical loads” is not under development as the data has been available for some years. Eurostat D1 said that the issue was not the raw data, but the calculation and presentation of the indicator. (SDI/WG/37 2007.) The indicator on “critical exceedance of nitrogen”, which reflects pressure exerted on soils, was listed in the 2007 as an indicator under development (Eurostat 2007a, 139).

5.5.7 Summary

The indicators for soil contamination and erosion were initially added on the SDI set as proxies for soil degradation, although there was no data available for either of them. The indicator on “soil contamination” was removed from the set due to lack of data, but even though the indicator on “soil erosion” suffered from the same problem, it was kept on the revised SDI set as it corresponded to the agri-environmental indicator set.

The indicator on “fragmentation of habitats” was selected for the 2005 SDI set as an indicator under development. In the revised SDI set, the indicator was moved under the Transport theme. The TF and WG both expressed a clear need for an indicator for fragmentation, the

only issue for which consensus had to be reached was the location of the indicator in the whole SDI set as it monitored on one hand land-use and on the other hand the environmental impacts of transportation.

The “land-use change” indicator was identified as the “best-needed” indicator for the Land-use sub-theme, however the data for the indicator was inadequate and the indicator remained in both SDI sets as indicator under development. Since the “best-needed” indicator was not available a proxy indicator was selected for it. The debate over whether an indicator on “built-up area” was the most appropriate for this purpose was on-going. The WG did not agree on a better alternative for the proxy indicator, thus this indicator remained as such in the revised set, although its removal would be inevitable ones the “best-needed” indicator on “land-use change” becomes available.

Forestry was not included as such in the 2001 strategy and therefore an indicator for the issue was missing form the preliminary SDI set. However, the TF felt that sustainable forestry is part of the management of natural resources issue and therefore, it was decided to add a forest indicator on the list. The TF consulted an outside expert on this issue and modified the indicator to be published in the 2005 SDI set accordingly. Since the renewed strategy included a separate objective relating to forests, additional forest indicators had to be selected for the revised set. In the 2007 SDI set an indicator on “deadwood” was listed as an indicator under development, which would eventually replace the indicator on “defoliation” published already in the 2005 SDI set.

After the separate objective on forests had been included in the 2006 SDS, the WG consulted an outside expert on additional indicators for forests and forestry. The recommendation provided by the expert was to use an indicator from already existing indicator set, because that would ensure that the report burden of the EU Member States would not increase as they were already committed to report on forest related issues for these other sets. The WG then contemplated between indicators on “protected area” and “increment and felling”. The latter was chosen as data for it was readily available from other indicator sets and because it was also included in the SEBI 2010 -project.

For this sub-theme, the TF and WG selected also an indicator for depositions. The issue of depositions was mainly problematic, because it was already covered by another theme. The indicator was however published in both SDI set as an indicator under development.

The strengths and weaknesses of the indicators discussed under the land-use sub-theme are presented in Table 9. These qualities will be further discussed in Chapter 6.2 in the light of the three qualities identified for a good indicator; policy relevance, scientific validity, and communicability.

Indicator	Strengths	Weaknesses	Status
Land-use change	"best-needed"	inadequate data	in the 2007 SDI set, but under development
Built-up areas	"best-available" proxy	relevance proxy usefulness	in the 2007 SDI set
Corine land based data	fit for purpose	data quality data availability	not selected
Soil erosion	proxy for degradation part of agri-environmental set calculations	localised data availability	to be developed
Soil contamination	proxy for degradation	data availability	removed
Defoliation	appropriateness	definition suitability	in the 2007 SDI set
Illegal logging		unreliable data politically sensitive	not selected
Protected forests		definition fitness for purpose	removed
Increment and fellings	relevant from the MCPFE set part of SEBI 2010		in the 2007 SDI set
Exceedance for nitrogen	reasonable data available in form of maps	overlapping data availability	in the 2007 SDI set, but under development
Fragmentation of habitats	fitness for purpose	experimental overlapping data availability methodology	moved under the Transport theme

Table 9. The strengths and weaknesses of land-use indicators

6. Compromises that had to be made

6.1 Dynamic features characterising the selection process and the role of various factors in different stages of the selection process

The thirteen indicators selected under the Natural Resources theme were not chosen on the basis of a single reason, but rather they are a result of dynamic process during which a variety of different kind of factors have affected the final selection. As a starting point, it should be noted that the concept of sustainable development is a dynamic process, which by definition constantly changes. Any given phenomenon identified as unsustainable might change as our understanding of the complexities relating to the phenomenon increases and at the same time, new issues might be raised on the agenda of sustainable development. The selection of indicators to any given sustainable development indicator set has to respond to this dynamic feature through an on-going revision process. Within the selection process, this brings a "cyclical" element to the process as the participants of the working groups have to regularly revisit the possibility of selecting new indicators, which might be more appropriate for the desired purpose, as well as covering new issues. In practise this means that the proposals relating to the inclusion of any given indicator into the set are discussed several times within the process.

The sustainable development indicator selection process is characterised by two separate selection processes within the scope of this study. These are the initial selection process carried out by the Sustainable Development Indicators Task Force and the revision process carried out by the Sustainable Development Indicators Working Group. The main difference between the two working groups is the number of participants invited to the selection process, the duration of the selection process, and the content of the meetings as well as the communication between the meetings.

The Task Force consisted of volunteer EU-countries experienced in the development of sustainable development indicators at national level. In addition, many of the countries represented in the Task Force had previously participated in the UNCSD national testing

programme on the development of sustainable development indicators and/or had contributed for selecting indicators into the 2001 proposal for EU sustainable development indicator set. Thus the Task Force members obtained up-to-date information on the state-of-the-art in respect to sustainable development indicators.

The use of already established indicators or indicators that were being developed in parallel indicator projects was evident in the early work of the Task Force. The selection process during the period of the Task Force built on the previous sustainable development indicator related work done in the EU and in the Member States, without neglecting the contributions of the UN to the subject matter. The initial selection of indicators produced by the Eurostat and the UNCSD was characterised with general acceptance within the Task Force, which further indicates that the participants were relatively familiar with the indicators. The issue of familiarity is further supported by the fact that many of the Task Force members had participated in the early work on sustainable development indicators, both at national and international levels.

The Task Force also sought for contributions from external experts. This was done by two means. First, the Commission Services was given a draft of the SDI set for comments prior to the publication of the set. The set was then modified accordingly. Second, the seventh meeting of the Task Force was a workshop held in Stockholm. The purpose of the workshop was to introduce the preliminary SDI set to a wider audience and further develop the set according to the feedback and input received. During the workshop, external experts were consulted concerning selection of most appropriate forestry indicators. The selection of the forest indicators in the 2007 SDI set is based on the suggestions from such external expert.

The selection process during the period of the Working Group was slightly different, since the aim was to revise the set in respect to the new strategy. The new strategy included some of the objectives of the first strategy, which meant that the indicators corresponding to those objectives had to be reviewed for better alternatives, and new objectives, for which also new indicators had to be selected. However, the Working Group meetings were characterised by the involvement of all the EU Member States and other EU-countries. The communication between the Working Group members was enhanced by adding Member State presentations on national SDI experiences on the agenda. During the Working Group period, a representative of an NGO also participated in the meetings. The contributions from the NGO concentrated on the indicators for biodiversity and were given by means of a presentation and

a contribution paper. While it was on the agenda of the NGO to lobby for the subject matter of their interest, which in this case is the use of birds as indicators for biodiversity, it should be noted that the NGO was the only participant who actually questioned the selection of certain indicators produced by the EEA, based on the indicator's scientific validity.

Another difference between the Task Force and the Working Group is the discussion effort within the working groups on the proposed indicators. The Task Force met nine times between 2002 and 2005, while the Working Group only met four times between 2005 and 2007. However, based on the information uploaded on the CIRCA forum, during the selection process of the Task Force the discussions were strictly restricted to the meetings, while the Working Group's revision process was completely different in this sense. During the revision process by the Working Group, discussions on the proposed indicators were continued even between the meetings through emails and contribution papers, which were circulated to the Working Group members prior to the meetings. Although this might have been due to tighter schedule as the Working group had only two years to revise the set, the adoption of inter-meeting communication resulted in deepened discussions.

One of the differences between the Task Force and the Working Group is the number of participants in the selection process. Rosenström and Kyllönen (2007, 296) had previously found that a larger number of stakeholders participating in the selection process influences the final outcome. However, based on the results from this study, such correlation between the two was not evident, i.e. it was not evident that the larger participation in the selection process would have affected the indicator selection. Having said this, if the larger number of stakeholders is considered to refer to the number of different stakeholders participating in the meeting, i.e. not only larger participation of the representatives of the European Commission, the Member States and international research organisations, but also larger participation of, for example representatives of local authorities and different NGOs. In this case, the results from this study can support the conclusion that larger participation affects the final outcome. This is due to the participation of the NGO in the meetings of the Working Group, which appeared to enhance the discussions, since the NGO questioned the scientific validity of the proposed indicators and made suggestions to improve them.

If the whole selection process is considered, the indicator selection was characterised by two distinctive phases defined by their purpose. The first phase corresponds to the initial indicator selection and the second phase to the reviewing of the set (during both TF and WG meetings).

As discussed above, the preliminary selection of indicators was mainly done based on previously established indicator sets. Having said this, it should be noted that the indicator on "population trends of farmland birds", was not present in the previous SDI sets produced by the Eurostat or the UN, but was suggested during the first meeting, most likely supported by the UK's previous experience. During the second phase, the SDI set was reviewed by the Task Force and the Working Group. This means that better alternatives were actively sought, suggested and their selection or removal were discussed. The need for better alternatives was on-going and therefore the working groups consulted parallel indicator development processes in order to find out whether better alternatives could be expected in the near future. This resulted in re-opening the discussions on certain indicators several times during the selection process.

Throughout the selection process the role of existing indicators was significant. However, the existence of an indicator in another indicator set did not automatically mean that it would be the best possible indicator for the EU sustainable development indicator set. Indicators that were being developed were considered equally good candidates for the selection as the indicators already developed. Since the aim of the working groups was not to developed indicators themselves, the selection relied completely on the development of sustainability indicators by other stakeholders. While the Eurostat and the European Environment Agency provided the Working Group up-to-date information about the latest developments in respect to relevant indicators in the EU-level, the development of indicators was also the responsibility of relative NGOs, as is the case with bird indicators. The preference to select indicators produced by the EEA, the Eurostat or by other international indicator developers was due to the aim of minimising the effects of data collection on the Member States, as highlighted by the criteria identified for assisting the indicator selection (SDI/TF/30/4 Rev. 4 2003, 7).

One distinctive feature of the working groups is that their aim was to select indicators, not to develop them. The selection process was therefore affected by, and dependent on the indicator development and production processes carried out by the other stakeholders. This to some extent explains the active participation of the EEA and different units of the Eurostat, both of which are developing sustainable development (and other) indicators for the EU. The communication between the indicator developers and the selectors was not obvious. Rather, after the initial selection, it was the developers who proposed additional or substitute

indicators and between whom most of the discussions on any proposed indicator were held. The proposals for new indicators by any Member State representative related to indicators developed for their national SDI sets and included the question on whether they could be used at EU-level as well. This is not to say that the Member States did not contribute to the selection process, because they did, but since the aim was to select indicators whose geographical coverage would be appropriate, the role of those developing such indicators was more obvious.

In respect to end-user participation, the presence of different Directorates General (DGs) as well as the participation of a representative from the Secretariat-General (SG) can, at least to some extent, be considered as end-user participation. While the SG representative did not comment on the indicators proposed for the Natural Resources theme, the DGs participation was rather active in terms of contributing to the latest developments concerning data availability, the modification of indicators to better fit the purpose, and in terms of policy relevance in a few occasions. The participation of possible end-users is considered to enhance the relevance of the outcome to these end-users (Rosenström and Kyllönen 2007, 296). Therefore, the participation of the Commission representatives enhanced the selection an indicator set that would be relevant to the Commission.

The discussion so far supports the view on the use of expert-driven approach in the selection process, which has been observed to be affect the indicators selected (Bell and Morse 2001, 293; Bell and Morse 2005, 39; Dhakal and Imura 2003, 166; Rosenström and Kyllönen 2007; 282). In addition, the framework used for assisting the selection of EU sustainable development indicators affected the outcome (). But more interestingly, there was a clear effort to make a stable indicator set that would benefit from the existing indicators to the extent possible, without compromising the development of the most appropriate indicator for any given purpose.

The aim of the sustainable development indicator set is to monitor the objectives and targets identified in the EU sustainable development strategies as well as the objectives of other commitments made by the EU relating to sustainable development, such as the sixth Environmental Action Plan and the Johannesburg Plan of Implementation. For this purpose the Task Force and the Working Group used a thematic framework, which assisted the selection of the most relevant indicators for measuring the objectives and targets.

One of the most discussed issues during both the Task Force and the Working Group meetings was data availability. Although data availability was used as a reason to remove the indicator on “soil contamination” from the set, this was more of an exception than a rule. For many of the indicators the lack of data was not used as a reason to exclude the indicator from the set. This is evident since many of the indicators selected especially for the 2005 SDI set, but also for the 2007 SDI set were still under development when the sets were published. On one hand this was because the data was expected to become available in the near future, but on the other hand the presence of an unavailable indicator on the set sends the developers the message that there is a need for such indicator and sufficient efforts should be undertaken to develop that particular indicator.

The presence of indicators under development and indicators to be developed in the sustainable development indicator set indicates that the working groups aimed to pursue the development of indicators that would be the most suitable for the set. As Moldan and Dalh (2007) pointed out, often indicators for which there is data readily available are chosen for any given indicator set, which results in the use of indicators that are not the most suitable for the purpose and at the same time better ones are not being developed because there is no apparent market for them. The Task Force and the Working Group clearly aimed for selecting indicators that would be the most suitable for monitoring the targets, rather than selecting indicators for which data was available.

There are downsides in having indicators which are not currently available or have only one data point before 2010, as was the case with the “red list index” and the “changes in status of species in European interest”, respectively. These two selected indicators aim at monitoring the objective to halt the loss of biodiversity by 2010, which neither of them will do due to the fore-mentioned reasons. The third indicator under the Biodiversity sub-theme suffered from the opposite; it is able to monitor the implementation of the Habitats Directive at present, but it will become useless, once the designation phase has been completed. The opposition to such a temporary indicator indicates that one of the targets of the working groups was to have a stable indicator set, in which any given indicator could be expected to be relevant for long time.

There was an apparent effort in developing a sustainable development indicator set, which would on one hand be the most suitable for monitoring the sustainable development strategy and on the other hand, be relevant and useful also in long-term. Since a monitoring report

based on the indicator set is published every other year, having a stable set would be beneficial. In other words, if the indicators are changed frequently, they are not going to be adopted by a wider audience and then there is always the risk that people loose interest, if following sustainable development with the aid of indicators is too difficult and confusing. However, due to the nature of policy processes, which are cyclical, some of the indicators in the set have to be revised for the set to remain policy relevant but concurrently, continuous changes in an indicator set affect the familiarity and continuity of the set, which are essential factors for the achievement of wider adoption and use of sustainable development indicators (Moldan and Dahl 2007, 4).

The division of indicators into "best-needed" and "best-available" affected at least the numerical outcome of the selection process. One of the reasons for the large number of indicators in the 2005 SDI set is that the list includes a number of indicators, which were identified as "best-available", but which are supposed to be removed once the "best-needed" indicator becomes available. In the 2007 set the number of indicators has been successfully decreased because, out of the "best-needed" indicators, only the ones which were recognised as under development (i.e. which are supposed to become available in the near future) were listed in the 2007 set. Indicators that were considered "best-needed", but whose actual development might not happen in the near future, if at all, (i.e. the indicators to be developed) were not included in the 2007 set but mentioned separately in the appendices of the 2007 Monitoring report. In addition, in the 2007 set the "red list index" provides an example of an indicator considered to be removed once the "best-needed" becomes available, but which itself was not yet available. The use of the "best-needed" and "best-available" indicators contradicts with the aim of having a stable set as the division between the two is based on the presumption that once the former becomes available, the latter is removed. However, it should be noted that it is not reasonable to select an indicator set for which none of the selected indicators are available. In addition, if the "best-needed" indicators are also present in the set, the end-users can start becoming familiar with them prior to their eventual development.

One of the targets given to the Task Force and the Working Group was to keep the overall number of indicators in the set to a minimum. The number of indicators in the preliminary indicator set was recommended to be reduced before the publication of the 2005 SDI set and the Task Force was requested to revise the proposed set in terms of justifications for the indicators. Similarly, during the revision of the set, the number of indicators was

recommended to be decreased. As a result, one indicator was removed completely (the indicator on soil contamination), while the indicator on fragmentation was moved under the Transport theme. The most significant reduction in the number of indicators came from removing unavailable indicators from the SDI set, while keeping them in a separate list of indicators to be developed, as explained above.

While some of the indicators present in the set during the selection process were removed because they were considered to overlap with another indicator, some of the selected indicators were due to be removed once the "best-needed" indicator becomes available. The problem derives from the nature of the issues under the Natural Resources theme. For example, the issue of biodiversity is way too complicated to be measured or monitored with a single indicator or even a set of indicators. Thus proxy indicators are used and the situation is the same with the other issues covered by the theme. Hence, while the target was to keep the number of indicators low and some of the indicators were argued to overlap with another indicator, their removal was opposed because the indicators were considered to actually support and compliment each other rather than measure or monitor the same thing. Therefore, it was further argued that the removal of indicators due to the issue of overlapping might result in the loss of information.

The removal of the indicators during the revision process also resulted in short-comings in respect to the Marine Ecosystems sub-theme. During the last meeting of the Working Group, it was apparent that new indicators were needed under this sub-theme. The lack of indicators was mainly due to the fact that, when the overlapping indicator on "trends of spawning biomass" had been removed, new indicators had not been discussed as the Working Group had been debating on the validity of the sub-theme in the set. Therefore, following all the changes done during the revision of the set, the sub-theme was in desperate need for new indicators and subsequently, when the indicator on "mercury in fish and shellfish" was suggested, it was accepted as such without any further comments, even tough the indicator was not yet available.

The dynamic features charactering the indicator selection process affected the discussions during the meeting. For example, the affects of the use of expert-driven approach to the content of the discussions was evident, because most of the participants were familiar with the latest indicator developments. Therefore there was no need to "sell" any given indicator for

the Task Force or the Working Group; instead the working groups appeared familiar with the indicators and their possible feasibility.

6.2 Arguments used in the selection process

During the selection process of indicators under the Natural Resources theme, arguments were given to justify the proposals to select or remove any given indicator. The strengths and weaknesses mentioned in relation to the indicators discussed are presented in Tables 5-9, in Chapter 5. In order to review the arguments used in the selection process in respect to scientific validity, policy relevance and communicability, I have organised the arguments corresponding to these characteristics in Tables 10-14 below. The five tables correspond to the headline indicators and the four sub-themes of the Natural Resources theme.

The selection of the indicators was mainly supported by arguments relating to scientific validity and policy relevance. Whilst the determining argument for the removal of indicators such as “trends of spawning biomass” and “water use intensity” was that they were considered to be overlapping with another indicator; the removal of indicators was also suggested based on problems relating to scientific validity in terms of data availability, methodology and the suitability for monitoring the phenomena in question. None of the indicators were proposed to be removed due to problems relating to policy relevance, such as slow responsiveness to policy actions, but such problems were acknowledged. It appears that indicators ability to communicate to target audiences was not considered as a reason to include or to remove any indicator, as the characteristic was hardly discussed upon. The differences in the amount of discussion in respect to the three characteristics are shown clearly in the Tables below; especially obvious is the lack of discussion on the communicability of the indicators.

The arguments for the proposed headline indicators in respect to scientific validity, policy relevance and communicability are presented in Table 10 on the following page. The selection of headline indicators on “common bird index” and “fish catches taken from stocks outside safe biological limits” was justified by their policy relevance and scientific validity, although neither of the indicators were perfect in this sense. While the bird indicator suffered from narrow focus on certain habitats, it was the best proxy indicator available for monitoring

biodiversity. The indicator on fish catches suffers from slow responsiveness to policy actions, which can be argued to affect the usefulness of such an indicator. However, the indicator is widely accepted to be feasible and since it is tailored to measure the effectiveness of management actions, the indicator was selected as a headline indicator into the SDI set.

When the "population trends of farmland birds" indicator had been criticised by the European Council, the arguments for keeping the indicator on the sustainable development indicators set were partly based on its communicability strength to the public and the decision-makers. Needless to say that it is easy for non-experts to, on one hand, observe some of the changes in bird populations themselves, and on the other hand, relate to and understand the message provided by the indicator. The communicability of this indicator was stressed by the representative of the BirdLife International, but also was further supported by past experiences related to the use of this indicator in the UK. The bird indicator was an exception in respect to discussions relating to the communicability as can be seen from the Tables 10-14.

In respect of the biodiversity index, the problems relating to the scientific validity, especially in terms of methodology, and the uncertainties relating to the possibility of resolving these problems, resulted in the removal of the indicator from the actual set. However, the indicator was kept on the list of indicators to be developed, since it was considered to be the most useful indicator for measuring biodiversity, even though it suffers from slow responsiveness to policy actions.

Indicator	**Scientific validity**	**Policy Relevance**	**Communicability**
Common bird index	- methodological problems + data availability + long time series - narrow focus + scientific validity	+ "best-available" for measuring biodiversity + influenced policy in UK + policy relevance	+ reaches target audiences + easy to understand + communicates
Biodiversity index	- methodological disagreements - data availability	+ fitness for purpose - responsiveness	
Fish catches taken from stocks outside safe biological limits	+ feasibility - timely assessment - representativeness + shows the status of fish stocks	+ measures effectiveness of management - responsiveness	

Table 10. The arguments used for the headline indicators in respect to scientific validity, policy relevance and communicability

The justification for the selection of indicators under the Biodiversity sub-theme, as presented in Table 11 below, were similar for all of the indicators selected. The main argument was that the indicators were policy relevant as they monitored EU's policy responses to the issue of halting the loss of biodiversity by 2010. The reason why these particular indicators were selected is the same as why they were proposed to be removed. The participants disagreeing with the selection of these indicators argued that the indicators were not suitable for measuring the progress towards halting the loss of biodiversity by 2010. The "red list index" was the only indicator under this sub-theme, whose communicability was questioned due to the unclear title chosen for the indicator.

Biodiversity	**Scientific validity**	**Policy relevance**	**Communicability**
Changes in status of species in European interest	+ data availability - unsuitable - only one data point before 2010	+ measures policy responses	
Sufficiency of sites	- /+data availability - no reference point - coverage (politically sensitive) - suitability to assess biodiveristy	- will become useless + suitability + measures implementation of Natura 2000 + monitors SDS	
Protected areas	+ data availability - feasible, but incomplete - suitability	- responsiveness	
Red list index		+ suitable	- title difficult to understand

Table 11. The arguments used for biodiversity indicators in respect to scientific validity, policy relevance and communicability

The arguments used in relation to indicators for fresh water resources are presented in Table 12 on the following page. Out of the indicators under the Fresh Water Resources sub-theme, the selection of the indicator on "wastewater secondary treatment systems" was justified by the policy relevance of measuring the degree of wastewater treatment systems in terms of technological developments. The other indicators were also selected, because they were seen suitable for monitoring the objectives of the EU sustainable development strategy. The scientific validity of these indicators was also discussed in terms of data availability and methodology. Any possible problems relating to scientific validity were not considered, as a

reason to remove the indicators as the problems were expected to be solved in the future. The communicability of the indicators was not considered during the discussions.

Fresh Water Resources	Scientific validity	Policy relevance	Communicability
Water use intensity	+ widely used in other sets	- overlapping with water abstraction	
Fresh water abstraction	+ data availability - unfair	- does not fit the purpose	
Groundwater abstraction	+fair +/- data availability	+ fitness for purpose	
Total water abstraction	- usefulness - fresh water and groundwater separate issues	+ fitness for purpose + policy relevance	
Wastewater treatment		+ monitors the degree of treatment as set by the Urban WWT Directive	
Biochemical oxygen demand	+ feasible + data availability - coverage - methodology	+ fitness for purpose	
Chemical oxygen demand	+ plans to use it widely - data availability		
Index of toxic chemicals	+ data from the REACH - data availability		
High or good ecological quality	+ similar to EEA's indicator - data availability		

Table 12. The arguments used for fresh water resources indicators in respect to scientific validity, policy relevance and communicability

The arguments relating to discussions on indicators for the Marine Resources theme are presented in Table 13 on the following page. The selection of the indicator on "trends of spawning biomass" was supported by its scientific validity in terms of data availability and source, and it was also considered to complement the indicators on "fishing capacity and quotas" and the headline indicator on "fish catches". However, the indicator was removed from the final set as it was considered to overlap with the headline indicator. The selection of indicators on "fishing capacity and quotas" and "size of fishing fleet" was justified by their

policy relevance, although both indicators were criticised for not being fit for the purpose they were selected for. Their scientific validity was also criticised due to methodological problems. While the "size of fishing fleet" indicator benefited from data availability, there was an issue with the indicator on "fishing capacity and quotas" as well as was the uncertainty related to the data source (i.e. who would actually produce the indicator). The indicator on "structural support to fisheries and environmentally friendly fishing practices" was considered both policy relevant and fit for the purpose. However, there were some doubts concerning its eventual development. The selection of the indicator on "mercury in fish and shellfish" occurred during the last meeting of the Working Group prior to the publication of the revised set and the indicator was selected without any justification after it had been proposed. This is because there was a need to have more indicators under the sub-theme.

Marine Ecosystems	**Scientific validity**	**Policy relevance**	**Communicability**
Trends of spawning biomass	+ data availability + complementary to fish catches and fishing capacity + data from ICES - overlaps with fishing capacity		
Fishing capacity and quotas	- no data available - unclear data source and status - methodology	+ policy relevant - does not fit the purpose	
Size of fishing fleet	+ data availability - methodological problems	+ policy relevant - does not fit the purpose	- difficult to interpret
Structural support to fisheries and environmentally friendly fishing practices	- no data available - uncertainties in the eventual development	+ policy relevant + fitness for purpose	
Mercury in fish and shellfish			

Table 13. The arguments used for marine ecosystems indicators in respect to scientific validity, policy relevance and communicability

Land-use	Scientific validity	Policy relevance	Communicability
Land-use change	- inadequate data	- relevance for biodiversity + policy relevant	
Built-up areas	- usefulness + proxy for land-use change + "best-available" - data periodicity	- relevance	
Corine land based data	- data quality - data availability	+ fit for purpose	
Soil erosion	+ proxy for degradation + part of agri-environmental set + calculations - localised - data availability		
Soil contamination	+ proxy for degradation - data availability		
Defoliation	+ appropriateness - definition	- suitability + policy relevant	
Illegal logging	- unreliable data	- politically sensitive	
Protected forests	- definition	- fitness for purpose	
Increment and felling	+ from the MCPFE set + part of SEBI 2010	+ policy relevant	
Exceedance for nitrogen	+ reasonable - data availability + data available in the form of maps	- overlapping	
Fragmentation of habitats	- experimental - data availability - methodology	+ fitness for purpose - overlapping	

Table 14. The arguments used for land-use indicators in respect to scientific validity, policy relevance and communicability

The arguments used for land-use indicators in respect to scientific validity, policy relevance and communicability are presented in Table 14. The indicator on "land-use change" was considered to be policy relevant, although its relevance to the issue of monitoring biodiversity was questioned. However, the indicator was not yet available due to inadequate data, thus it was listed as "best-needed" in the 2007 SDI set. The indicator on "built-up areas" was

selected, because it was the “best-available” proxy indicator for the “best-needed” indicator. Even though its usefulness and relevance were questioned and problems relating to data periodicity were highlighted, these comments were neglected as the indicator would be removed once the “best-needed” indicator became available. Another proxy indicator, which was considered to fit the purpose better (the indicator on “corine land based data”) for the “best-needed” indicator was also suggested. The suggestion was overruled due to data availability and quality. The indicators on “soil erosion” and “soil contamination” were selected as proxy indicators for the policy relevant issue of degradation. Both indicators suffered from lack of data, but the former was kept on the 2007 SDI set, because the same indicator was used in other indicator sets, thus keeping the indicator promotes the use of “common indicators”. The forestry indicators were of special interest during the revision of the set as the issue was emphasised in the renewed strategy. The arguments for the selection of the forestry indicators evolved around their policy relevance and suitability for this purpose. The reasonability and eventual data availability in the form of maps for the indicator on “exceedance of nitrogen” were the main justifications for the selection of the indicator. This indicator appears to be an exception to the rule, since its selection was justified by scientific validity rather than policy relevance. The indicator on “fragmentation of habitats” lacked scientific validity as it was still experimental and there were problems with methodology and data availability, but it was considered to be fit for the purpose. The indicator was selected on the SDI set, but placed under the Transport theme.

If all the arguments are considered, it is obvious that the emphasis during the discussions was on the scientific validity and policy relevance of any given indicator, while communicability was not a common argument in the selection process. The exception for this was the indicator on bird populations, whose ability to communicate to the target audiences was stressed. For headline indicators, by their definition, the capability to communicate to the public and decision-makers is crucial. This characteristic of an indicator was only mentioned in two other occasions in respect to the difficulties in interpreting and understanding the indicator by target audiences. This did not however affect the final outcome.

The scientific validity of the indicators was most widely discussed out of the three characteristics. However, the characteristics relating to scientific validity were mostly mentioned matter-of-factly in order to inform the other participants about the state of the development of the indicator in question. Lack of data and/or problems relating to the

methodology resulted in placing the indicators in question on the list of indicators to be developed, if these problems were not expected to be solved in the near future. The lack of in-depth methodological discussions originates from the nature of the selection process, which leaves the development related issues as tasks for others. The selection occurred out of a pool of indicators being developed or already developed by a parallel development processes, therefore there was no need to justify the selection of the indicator by its scientific validity, as this can be assumed to be covered in the development process.

The discussion during the selection process evolved around the suitability of the proposed indicator in respect to the objectives and targets. In relation to policy relevance, the policy responsiveness of the proposed indicators was discussed. Since these indicators measure the effectiveness of the policies to achieve the targets outlined by sustainable development strategy, the indicators can be considered useless if they fail to be policy responsive. Examples of such indicators are "fish catches taken from stocks outside safe biological limits", "built-up areas" and "sufficiency of sites designated under the EU Habitats and Birds Directives". These indicators suffer from slow responsiveness, and are therefore not able to provide information for the decision-makers in due time.

However, despite of this apparent problem in respect to the indicator on "fish catches", justifications for its selection were hardly discussed upon, and neither were the justifications for the indicator on "mercury in fish and shell fish". While the latter was proposed and selected during the last meeting of the Working Group prior to the publication of the revised set, mainly because more indicators were needed under the Marine Ecosystems sub-theme, the former benefited from widely accepted feasibility. This means that the indicator has been used for a long time and it is recognised as a good indicator for the purpose.

Many of the indicators are so-called target indicators, which were selected to measure the implementation of policy actions taken in the EU. Examples of such indicators are "sufficiency of sites designated under the EU Habitats and Birds Directives" and "population connected to wastewater secondary treatment systems". While these indicators were selected due to their policy relevance, by their nature they will only provide indirect information about progress towards the objectives identified in the EU sustainable development strategy. This is to say that while the indicator on water quality measures the implementation of secondary treatment systems, it will not provide information about the state of the fresh water resources directly, only about the degree of implementation. Of course, the underlying assumption is

that by improving the wastewater treatment plants, water quality will also improve. The same applies to the sufficiency indicator in respect to what it can tell us about halting the loss of biodiversity by 2010.

While most of the arguments for the selection or removal of any given indicator related to its scientific validity, the emphasis was towards policy relevance. Therefore, it can be said that the justification of the selection of the set of indicators was policy-driven rather than statistic-driven.

7. Conclusion

The dynamic features charactering the selection process originated from the dynamics relating to the concept of sustainable development and the nature of policy processes. In order to respond to changes in sustainable development and the related policy processes, the selection of indicators had to be an on-going process during which more suitable indicators were continuously and repeatedly sought for. Within the selection process choices were made in respect to the approaches chosen and the framework used for organising the indicators. In addition, the aims and objectives of the selection process had to be identified to guide the selection process. The choices made resulted in compromises and trade-offs between policy-driven and statistics-driven (scientific validity driven) approach, expert-driven and participatory approach, a thematic-framework and a causal-chain framework, stable set and active set, data availability and the development of most suitable indicators. The selection of one results at least to some extent in the exclusion of the other.

The selection process of the EU sustainable development indicators was without a question, expert-driven. Whilst some of the problems relating to the use of such an approach were acknowledged during the selection process, no actions were taken to solve them. The expert-driven approach has been criticised for example, for producing indicators that are difficult to interpret (Dhakal and Imura 2003, 116). During the selection process, the use of titles that were considered difficult to interpret was considered a problem. However, the titles of such indicators were not rephrased despite of the recommendation to do so. Expert-driven approach is also considered to produce indicators that are often irrelevant for the possible end-users (Bell and Morse 2005, 39; Rosenström and Kyllönen 2007, 282). The inclusion of representatives of the European Commission enhanced the relevance of the indicator set produced to the end-user, the Commission. However, the relevance of the indicator set to wider public still remains as an issue.

Furthermore, the participation of stakeholders responsible for the development of sustainable development indicators influenced the outcome of the selection process. The input from participants such as Member State representatives and local authorities is often based on

indicators developed in national level and therefore such indicators might be irrelevant for monitoring sustainable development at EU-level. The participation of those stakeholders that were developing indicators for the EU, i.e. they were producing indicators with appropriate geographical coverage was essential for the selection process. However, while the participation of such stakeholders as the EEA and the Eurostat is crucial in the context of the selection process, from the point of view of the outcome, participation of stakeholders who are producing more specialised EU-level indicators, such as the bird indicators, could bring additional value to the selection process. This is because the wider participation of indicator developers and producers could bring more indicators into the pool of indicators to choose from. In addition, communication between the different developers might results in improvements of the indicators developed or to be developed.

While the selection process was expert-driven the selection of indicators was policy-driven. Although scientific validity was widely discussed for example in terms of data availability and methodology, the short comings of either of the issues was not enough to overrule the policy relevance of the indicators. The communicative value of the indicators was hardly discussed, with the exception of the headline indicator on bird populations and few cases in respect to interpretation. This is not a surprise as the aim of the EU sustainability indicator set is to monitor the EU sustainable development strategy, but this implies that the current set might suffer from the biggest problem identified with the sustainable development indicator sets worldwide, fail to communicate. This is a very interesting observation, because it is a widely acknowledged fact that the sustainable development indicators lack the ability to communicate to the target audiences and while proposals have been made to overcome this problem, yet there was no apparent effort during the selection process of the EU sustainable development indicators to take this issue into account.

The importance of the development of a policy relevant sustainable development indicator set was further supported by the arguments used in the discussions. However, while a thematic-framework assists the selection of indicators most suitable for monitoring the three dimensions of sustainable development and the related objectives and target (Becker 2007, 138), the selection is limited to the pool of indicators developed. The use of a thematic-framework instead of a causal-chain framework enables the indicator set to become as policy relevant as possible. The actual relevance in terms of whether the indicators are capable of

monitoring the targets and objectives of the EU sustainable development strategy is however, completely dependent on what kind of indicators are available or being developed.

The development of indicators was not one of the tasks of the working groups, thus the selection process depend completely on parallel indicator development processes in terms of what could have been selected. Through the selection process however, the working groups were able to send a message to those developing indicators by selecting those indicators that were still under development or identified as “to be developed” as their selection shows that there was a genuine need for their eventual development.

The selection process was further characterised by a clear effort to make a stable indicator set that would benefit from the existing indicators to the extent possible, without compromising the development of the most appropriate indicators for any given purpose. Despite of the effort, the indicators selected cannot be considered to represent a stable indicator set. The problem derives from the fundamental inconsistencies relating to the characteristics of a good sustainable development indicator set; the need for developing the most suitable indicators without losing familiarity and continuity (Moldan and Dahl 2007, 4, 10). Whilst the aim is to enhance the development of the most appropriate indicators, problems relating to data availability and methodology resulted in the selection of indicators that are going to be removed from the list once the more appropriate once become available.

The thirteen indicators under the Natural Resources theme, in the 2007 EU sustainable development indicator set, were selected because they were considered to be the most appropriate options out of the pool of indicators developed or being developed for monitoring the objectives and target identified in the renewed EU sustainable development strategy. They were not selected because they were perfect indicators for monitoring natural resources, but rather the least imperfect options.

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Appendix I: EU sustainable development indicators 2007

THEME 1: SOCIO-ECONOMIC DEVELOPMENT

Headline indicator

1. Growth rate of GDP per inhabitant

Sub-theme: ECONOMIC DEVELOPMENT

2. Total investment
3. Public investment
4. Business investment
5. Dispersion of regional GDP per inhabitant
6. Net national income
7. Gross household saving

Sub-theme: INNOVATION, COMPETITIVENESS AND ECO-EFFICIENCY

8. Labour productivity per hour worked
9. Total R&D expenditure
10. Real effective exchange rate
11. Turnover from innovation
12. Effects of innovation on material and energy efficiency
13. Energy intensity

Sub-theme: EMPLOYMENT

14. Total employment rate
15. Employment rate, by gender
16. Employment rate, by highest level of education attained
17. Dispersion of regional employment rates
18. Unemployment rate, by gender
19. Unemployment rate, by age group

THEME 2: SUSTAINABLE CONSUMPTION AND PRODUCTION

Headline indicator

1. Resource Productivity

Sub-theme: RESOURCE USE AND WASTE

2. Municipal waste generated
3. Components of domestic material consumption
4. Domestic material consumption by material
5. Municipal waste treatment, by type of treatment method
6. Generation of hazardous waste, by economic activity (not yet available)
7. Emissions of acidifying substances by source sector
8. Emissions of ozone precursors by source sector
9. Emissions of particulate matter by source sector

Sub-theme: CONSUMPTION PATTERNS

10. Electricity consumption by households
11. Final energy consumption by sector
12. Consumption of certain foodstuffs per inhabitant (not yet available)
13. Motorisation rate

Sub-theme: PRODUCTION PATTERNS

14. Enterprises with an environmental management system
15. Eco-label awards by products
16. Area under agri-environmental commitment
17. Area under organic farming
18. Livestock density index

Contextual indicators

- Number of households
- Household expenditure per inhabitant, by category

THEME 3: SOCIAL INCLUSION

Headline indicator

1. At-risk-of-poverty rate after social transfers, by gender

Sub-theme: MONETARY POVERTY AND LIVING CONDITIONS

2. At-persistent-risk-of-poverty rate
3. At-risk-of-poverty rate after social transfers, by age group
4. At-risk-of-poverty rate after social transfers, by household type
5. Relative at-risk-of-poverty gap
6. Inequality of income distribution

Sub-theme: ACCESS TO LABOUR MARKET

7. People living in jobless households, by age group
8. In-work poverty
9. Total long-term unemployment rate
10. Gender pay gap in unadjusted form

Sub-theme: EDUCATION

11. Early school leavers
12. At-risk-of-poverty rate, by highest level of education attained
13. Persons with low educational attainment, by age group
14. Life-long learning
15. Low reading literacy performance of pupils
16. Individuals' level of computer skills
17. Individuals' level of internet skills

Contextual indicator

- Public expenditure on education (for sub-theme Education)

THEME 4: DEMOGRAPHIC CHANGES

Headline indicator

1. Employment rate of older workers

Sub-theme: DEMOGRAPHY

2. Life expectancy at age 65, by gender
3. Total fertility rate
4. Net migration, by age group

Sub-theme: OLD-AGE INCOME ADEQUACY

5. Aggregated replacement ratio
6. At-risk-of-poverty rate for persons aged 65 years and over

Sub-theme: PUBLIC FINANCE SUSTAINABILITY

7. General government consolidated gross debt
8. Average exit age from the labour market

Contextual indicators

- Old age dependency ratio (for sub-theme Demographic changes)
- Projected old age dependency ratio (for sub-theme Demographic changes)
- Public expenditure on care for the elderly (for sub-theme Public finance sustainability)

THEME 5: PUBLIC HEALTH

Headline indicators

1. Healthy life years at birth, by gender
2. Life expectancy at birth, by gender

Sub-theme: HEALTH AND HEALTH INEQUALITIES

3. Death rate due to chronic diseases, by age group
4. Healthy life years at age 65, by gender
5. Life expectancy at age 65, by gender
6. Suicide death rate, total by age group
7. Suicide death rate, males by age group
8. Suicide death rate, females by age group

Sub-theme: DETERMINANTS OF HEALTH

9. Salmonellosis incident rate in human beings
10. Index of production of toxic chemicals, by toxicity class
11. Overweight people, by gender and age group
12. Percentage of present smokers, by gender
13. Percentage of present smokers among population, aged 15-24
14. Population exposure to air pollution by particular matter
15. Population exposure to air pollution by ozone
16. Population living in households considering that they suffer from noise
17. Serious accidents at work

THEME 6: CLIMATE CHANGE AND ENERGY

Headline indicators

1. Total greenhouse gas emissions
2. Renewables in gross inland energy consumption

Sub-theme: CLIMATE CHANGE

3. Greenhouse gas emissions by sector (including sinks)
4. Greenhouse gas emissions intensity of energy consumption
5. Projections of greenhouse gas emissions (not yet available)
6. Global surface average temperature (external link)

Sub-theme: ENERGY

7. Energy dependency
8. Gross inland energy consumption by fuel
9. Electricity generated from renewable sources
10. Consumption of biofuels by transport
11. Combined heat and power generation
12. Implicit tax rate on energy

THEME 7: SUSTAINABLE TRANSPORT

Headline indicator

1. Energy consumption by transport mode

Sub-theme: TRANSPORT GROWTH

2. Modal split of passenger transport
3. Modal split of freight transport
4. Volume of freight transport
5. Volume of passenger transport (data not yet availabe)

Sub-theme: TRANSPORT PRICES

6. Road fuel prices

Sub-theme: SOCIAL AND ENVIRONMENTAL IMPACT OF TRANSPORT

7. Greenhouse gas emissions by transport, by mode
8. People killed in road accidents
9. Emissions of ozone precursors from transport
10. Emissions of particulate matter from transport
11. Average CO2 emissions per km from new passenger cars

THEME 8: NATURAL RESOURCES

Headline indicators

1. Common Bird Index
2. Fish catches taken from stocks outside safe biological limits

Sub-theme: BIODIVERSITY

3. Sufficiency of sites designated under the EU Habitats directive
4. Red List Index for European species (not yet available)

Sub-theme: FRESH WATER RESOURCES

13. Surface and groundwater abstraction
14. Population connected to wastewater secondary treatment systems
15. Biochemical oxygen demand in rivers (not yet available)

Sub-theme: MARINE ECOSYSTEMS

16. Concentration of mercury in fish and shellfish (not yet available)
17. Size of fishing fleet

Sub-theme: LAND USE

10. Built-up areas
11. Forest increment and fellings
12. Forest trees damaged by defoliation
13. Critical load exceedance for nitrogen (not yet available)

THEME 9: GLOBAL PARTNERSHIP

Headline indicator

1. Official Development Assistance

Sub-theme: GLOBALISATION OF TRADE

2. EU imports from developing countries, by income group
3. EU imports from developing countries by group of products
4. EU imports from least-developed countries by group of products
5. Aggregated measurement of support (not yet available)

Sub-theme: FINANCING FOR SUSTAINABLE DEVELOPMENT

6. Total EU financing for developing countries, by type
7. Foreign direct investment in developing countries, by income group
8. Official development assistance, by income group

9. Untied official development assistance
10. Bilateral official development assistance by category

Sub-theme: GLOBAL RESOURCE MANAGEMENT

11. CO_2 emissions per inhabitant in the EU and in developing countries

Contextual indicators

- Population living on less than 1USD a day (for sub-theme Financing for SD) (not yet available)
- Official development assistance per inhabitant (for sub-theme Financing for SD)
- Population with sustainable access to an improved water source (for sub-theme Global Resource Management) (not yet available)

THEME 10: GOOD GOVERNANCE

Sub-theme: POLICY COHERENCE AND EFFECTIVENESS

1. New infringement cases, by policy area
2. Transposition of Community law, by policy area

Sub-theme: OPENNESS AND PARTICIPATION

3. Voter turnout in national and EU parliamentary elections
4. E-government on-line availability
5. E-government usage by individuals

Sub-theme: ECONOMIC INSTRUMENTS

6. Shares of environmental and labour taxes in total tax revenues

Contextual indicator

- Level of citizens´confidence in EU institutions (for sub-theme Policy coherence and effectiveness)

Appendix II: Definitions of the indicators under the Natural Resources theme in the 2007 SDI set

Headline indicators

'Natural Resources' theme includes two headline (Level 1) indicators, which are 'Common Bird Index' and 'Fish Catches outside safe biological limits'.

The Common Bird Index is calculated by integrating the population abundance and evenness or diversity of bird species selected to represent their respective habitats. Altogether, 123 different bird species are aggregated into one index of which 33 represent farmland species and 90 generalists or other common species (Eurostat 2007a, 142). The data is collected during national breeding bird surveys, which are done annually and then delivered to the Eurostat by the Pan-European Common Bird Monitoring (PECBM) (Eurostat 2007a, 157). The data for all the indicators on the EU SDI set has been uploaded on the Eurostat webpage[6] and is available to the public. For all common bird species there is data available from 1994 to 2005, but only for EU25, where as there is data for individual countries available as well for farmland bird species. (Eurostat 2008.)

The second headline indicator is based on fish catches taken from stocks in European seas, excluding stocks managed by Norway and Russia, considered to be outside of safe biological limits. A stock is classified to be 'outside safe biological limit' when the size of a stock has decreased below a level after which there is no guarantee it could increase by reproduction. The International Council for the Exploration of the Sea (ICES) is responsible for provided Eurostat the estimates for this indicator. (Eurostat 2004c, 1) Data is available for this indicator from 1994 to 2005 and the percentages are presented separately for demersal (close to seabed), pelagic (open sea), benthic (seabed) and industrial (fish used for reduction into fish meal and oil) fish.

6 http://epp.eurostat.ec.europa.eu/portal/page?_pageid=1998,66119021,1998_66391726&_dad=portal&_schema=PORTAL

Biodiversity

The Level 2 indicator under the Biodiversity sub-theme changed from "Sufficiency of Member States' proposals for protected sites under the Habitats directive" to "Sufficiency of sites designated under the EU Habitats and Birds directives". In the 2005 set, the abovementioned indicator was still under development, whereas in the 2007 data from the Habitats directive is available, but data for Bird directives is still under development.

The index of sufficiency of sites designated under the EU Habitats directive presents progress towards implementation of the Habitats Directive, i.e. it measures the coverage of the species and habitats listed in the habitats directive (Appendices I and II). The aim is to reach 100% sufficiency, which would mean that the implementation of Natura 2000 network has been completed in respect to habitats directive. (Eurostat 2007a, 146) Eurostat webpage has data available from 2006 to 2007 for EU 25 countries and from 2003 to 2007 for EU 15 countries. Also sufficiency indices have also been uploaded for individual countries.

The Level 3 indicator for changed from "Change in status of threatened and/or protected species" to "Red List Index for European species". Neither one of the Level 3 indicators for Biodiversity are currently available.

The Red List Index combines European species with threat status into a trend. The index also shows the development in short-term futures if further conservation actions are not taken. The data for generating the Red List Index Extinction is a key measure of biodiversity loss that has resonance with the public and decision makers, and which has clear relevance to ecological processes and ecosystem function. The main pressures affecting the trend in the RLI and biodiversity in general are: habitat loss, unsustainable exploitation, alien invasive species, pollution and climate change. The precise drivers can be determined from the data used to generate the RLI. (Eurostat 2007b)

Marine Ecosystems

For 'Marine Ecosystems' sub-theme only one Level 3 indicator, 'Size of fishing fleet' was kept the same in the 2007 SDI set. This indicator provides a measure of the EU fishing effort by calculating the total engine power and tonnage of the fishing fleet as well as the number of vessels (Eurostat 2007a, 152). The data is available from 1995 to 2006 for EU-15 Member

States, and from 2004 to 2006 for EU-25. In addition data from Iceland and Norway are available. The data includes only the registered fishing vessels. (Eurostat 2008.)

In the 2005 set, the only Level 2 indicator, "Trends of spawning biomass of selected fish stocks" as well as the two other Level 3 indicators "Effective fishing capacity and quotas, by specific fisheries" and "Structural support to fisheries and percentage allocated to promote environmentally friendly fishing practices", were all under development and were not kept in the 2007 SDI set. A new Level 2 indicator was added on the 2007 set, "Concentration of mercury in fish and shellfish". This indicator is, however, still under development.

Fresh Water Resources

In the 'Fresh Water Resources' sub-theme, the Level 2 indicator was changed from 'Groundwater abstraction as percentage of available groundwater resources' to 'Surface and groundwater abstraction". This indicator measures the removal of water from fresh surface water resources (i.e. rivers, streams, brooks, lakes etc) and from groundwater resources (i.e. the difference between input and output of water into and from aquifers) (Eurostat 2007a, 160). Data is available for 1994 to 2005, depending on the country and the results are presented as a percentage of MS' renewable groundwater and surface water resources available for abstraction (Eurostat 2008).

Two of the Level 3 indicators, 'Population connected to wastewater treatment systems' and 'Emissions of organic matter as biochemical oxygen demand to rivers' were changed to 'Population connected to wastewater (with at least) secondary treatment systems' and 'Biochemical oxygen demand in rivers', respectively . Urban secondary wastewater treatment means that the wastewater is treated with a process, which removes at least 70% of BOD and 75% of COD from the wastewater (Eurostat 2007a, 160). Data is available from 1994 to 2005, but the data availability varies greatly from country to country (Eurostat 2008). Biochemical oxygen demand (BOD) in rivers is an indicator of water quality. Aerobic microorganisms require oxygen to decompose organic matter and BOD is the amount required (Eurostat 2007a, 151).

The last Level 3 indicator in the 2005 SDI set, 'Index of toxic chemical risk to aquatic environment' was unavailable during the publishing of the first set and further on removed from the revised set.

Land use

In the 2005 SDI set, ‘Land use’ sub-theme included three Level 2 indicators, which were ‘Land use change, by category’, ‘Built-up areas as a percentage of total land area’, ‘ Excess of critical loads of acidifying substances and nitrogen in sensitive natural areas’ out of which only ‘Built-up areas’ was available in 2005. There were also four Level 3 indicators; ‘Percentage of total land area at risk of soil erosion’, ‘Percentage of total land area at risk of soil contamination’, ‘Percentage of forest trees damaged by defoliation’, and ‘Fragmentation of habitats due to transport’. Out of the Level 3 indicators only “Defoliation” was available at 2005 and this particular indicator was kept unchanged in the 2007 set. Although still unavailable, the indicator on ‘Land use change’ was kept in the 2007 SDI set as a Level 2 indicator, but for which indicator on “Built-up areas” was kept as a proxy indicator. Another Level 2 indicator was added on the 2007 set, which is ‘Forest increment and fellings’. Indicator on ‘Critical load exceedance for nitrogen’ was also kept in the 2007 set, although the indicator is not yet available.

Built-up area refers to the percentage of the total land area. Built-up are includes residential land, industrial land, quarries, pits and mines; commercial land, land used by public services; land of mixed use; land used for transportation and communications; for technical infrastructure; recreational and other open land. (Eurostat 2007a, 153) Data is available for countries for 1990, 1995 and 2000 (Eurostat 2008).

The indicator on forest increment (increase) and fellings is ratio between the two. Data is available for 1990, 1995 and 2005 for selected countries. Fellings is defined by the volume of all trees felled during a given period. ‘Removals’ is a proxy for fellings in 2005, and is equal to the difference between fellings and unrecovered fellings. The net annual increment is defined as gross increment in cubic metres overbark of all trees over a given period. (Eurostat 2008.)

The percentage of trees on forest and other wooded land damaged by defoliation. Defoliation is classed as moderate, severe and dead, which refer to the degree/percentage of needle/leaf loss. (Eurostat 2007a, 162). Data is available for most EU countries, EU-25 countries and EU -27 countries from 1995 to 2006 (Eurostat 2008).