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Towards a coherent and informative set of European Biodiversity indicators

SEBI 2010 Working Group on Interlinkages

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Acknowledgements

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Ben ten Brink
Sophie Condé
Frederik Schutyser

Summary

The European Community, as a contracting party of the CBD, adopted the EC Biodiversity Strategy (ECBS) in 1998 as a comprehensive response to the many requirements of the CBD. The objective 'Sustainable management of natural resources' was adopted by the EU in its Strategy for Sustainable Development at the European Summit in Gothenburg in 2001. In 2003 the 'Kyiv Resolution on Biodiversity' (UNECE, 2003) was adopted at the fifth Ministerial Conference Environment for Europe (Kiev, Ukraine) reinforcing the objective to halt the loss of biological diversity at all levels by the year 2010. It then became essential to examine and report on progress as a condition for effective policies.

The project Streamlining European 2010 Biodiversity Indicators (SEBI 2010) was therefore established in 2005 to elaborate on a limited set of indicators based on the 2010 indicators adopted by the Convention on Biological Diversity. The SEBI project has been delivered through an open, participatory process, with data holders, those who have developed indicators and users all involved in the review, development and documentation of candidate indicators. Over 120 experts participated, led by the European Environment Agency (EEA), with representatives from ECNC, UNEP-WCMC, DG Environment, PEBLDS Joint Secretariat and the Czech Republic plus the chairs and coordinators of various expert groups.

This work and joint activity resulted in the publication of: a technical report on 'A first set of indicators to monitor progress in Europe' (EEA, 2007); and an indicator-based assessment report 'Progress towards the European 2010 biodiversity target' (EEA, 2009). In June 2009 the Environment Council adopted conclusions on the mid-term assessment of implementing the EU Biodiversity Action Plan (the 2008 Report) and Towards an EU Strategy on Invasive Alien Species (Council of the European Union, 2009), highlighting the importance of strengthening the integration of biodiversity and ecosystem concerns into relevant sectoral policies and of effective implementation of existing EU policies and legislation to address the biodiversity challenge. Regarding SEBI2010, the Council welcomed the efforts to streamline European Biodiversity Indicators through the SEBI 2010 project, but stressed that they need to be complemented by other indicators, especially indicators designed to assess progress in sectoral policies. On the basis of the two reports resulting from the SEBI 2010 work, the mid-term assessment and other information, the European Commission announced that the 2010 target would not be met and that more action would be needed (EC, 2008 and 2010a).

The SEBI project has been highly successful; however, there remain a number of areas where further developments can still be made. For example, it was recognised that more work would be needed to make the set more coherent. With this in mind, at the end of 2008 the Coordination Team of the SEBI 2010 project enabled the establishment of (among others) a 'Working Group on Interlinkages' to explore how improved synergy could increase the political power of the information that the indicators provide as a set: in essence, how the set could deliver 'more than the sum of its parts'.

This report is a summary of the outcomes and outputs of the Working Group on Interlinkages and therefore provides recommendations on:

i) how to group indicators in informative subsets;
ii) how to improve their interlinkages and coherence (also including their monitoring, modelling, baselines, assessment principles, scales and critical levels); and
iii) how to fill in the gaps in their representation.

Overall, the Group concluded that considerable progress has been made towards establishing a functional set of biodiversity indicators which could enable policymakers to evaluate: whether biodiversity loss has been halted at European and national levels; levels of threat to biodiversity; the sustainable use of agriculture, forests and marine ecosystems; and the effectiveness of policy responses. It is also clear that the set's accuracy and informative value to policymakers for underpinning their subsequent actions could be significantly improved through further development.

The Working Group recommends the following:

1. The use of monitoring systems needs to be considerably extended to include more Member States (and beyond) and take more components of biodiversity to enable sound and representative assessment.

2. The current set draws on existing indicators, offering a variable and inconsistent picture in relation to temporal and spatial scales, baselines, assessment principles and critical levels. Improving its coherence would greatly enhance its informational power.

3. In order to evolve from an incidental information system to one that is systemic, similar to the socio-economic, climate and environmental quality indicators, the production of the indicators should be standardised, automated in reporting, well-founded, and financially and institutionally guaranteed,.

4. The implementation of these recommendations requires a concerted action between the European Commission, the EEA, EU Member States, and the institutions and NGOs that produce the indicators, data and models. A task force under the SEBI project could initiate and coordinate this process.

1 Conclusions and recommendations

Considerable progress has been made towards establishing a functional set of European biodiversity indicators. The indicator set has the potential to enable policymakers to evaluate whether biodiversity loss has been halted at European and national levels. However, the construction of this first set of indicators has been constrained by the quality and availability of the data, which has so far only allowed an incomplete picture to be drawn up. Further development is required and will significantly improve the accuracy and informative value of the information from which policymakers can draw conclusions as a basis for more detailed action. The same applies to the indicators of threats, the sustainable use of agriculture, forests and marine ecosystems, and effectiveness of policy responses.

The working group recommends that the following actions be pursued over the long-term:

In relation to the representativeness of the indicators, to:

1) Take more components into consideration within the set of indicators at the species and genetic levels. The aim is not to increase the number of indicators but to improve or extend those in the existing set to include additional species groups beyond birds and butterflies (e.g. other vertebrates and higher plants) and additional genetic resources.
2) Use existing data sources such as CORINE Land Cover and Article 17 reporting under the Habitats Directive at the ecosystems level. These should also be collected in a harmonised way.
3) Further develop the indicators of the focal areas: threats to biodiversity; ecosystem integrity, goods and services; sustainable use; and status and trends of components of biodiversity. 'Ecosystem integrity' requires further elaboration.
4) Improve the coverage and consistency of monitoring systems across Europe. These systems must respect harmonised standards and be quality controlled. It is highly recommended that practical solutions be investigated through the concerted and combined actions of the European Commission, the European Environment Agency, Member States, data producing institutions and Non-Governmental Organisations.

In relation to the interlinkages between indicators:

1) Make a concerted scientific effort to build models of the major cause–effect relationships (DPSIR[1]); using the few models that already exist as a starting point.
2) Increase the coherence between indicators in relation to (e.g.) temporal scales, spatial scales, baselines, assessment principles and critical levels. As proposed by the CBD, the current SEBI indicators draw to a great extent on existing data and indicators; however, as they have been variously derived from different institutions where they

[1] A common framework spearheaded by the European Environment Agency is the "DPSIR" or "drivers, pressures, state, impact, response" framework. Drivers and pressures are indicators of the human activities and resulting pressures on the environment in the form of pollution or land-use change, for example. State and impact indicators are the resulting conditions in the environment and the implications for the health of ecosystems and humans. The response indicators measure the reaction of human society to the environmental issue. See for example: http://en.wikipedia.org/wiki/Environmental_indicator

had been developed for different purposes, they therefore offer a less-than-coherent picture, potentially limiting policy conclusions.

3) Determine critical levels for assessing whether marine ecosystems, forests and agriculture are sustainably managed.
4) Connection must be made with the European Platform for Biodiversity Research Strategy and national biodiversity research strategies to support and reinforce existing, and increase the potential for future research on these issues.

The working group recommends the following short-term actions:

1. Reorder the focal areas as follows: i) state, ii) threats, iii) goods & services and sustainable use and, iv) response; in order to better match the four key policy questions[2].
2. Re-confirm and revise links with the European Union's Biodiversity Action Plan, particularly in the post 2010 era.
3. Ensure that each indicator is accompanied by a clear guide to its interpretation. For the lay reader in particular, the indicators may appear to show contradictory messages (with graphs showing trends that proceed in different directions) or may be difficult to interpret - not every decrease constitutes a loss and not every increase a win. Subsequent revisions of the SEBI technical report on indicators should reflect the progress in the use, presentation and interpretation of the enhanced indicator set.
4. Show underlying positive or negative exceptions in addition to average results.
5. Provide state and trend information (absolute and relative) and ranges.
6. In order to illustrate the diversity within Europe, use major ecosystem types (biomes) and/or groups of countries as intermediate spatial scales between (pan) European and country level,. The monitoring resolution/scale should be adjusted accordingly.
7. In order to strengthen the European biodiversity assessment; which is based on still incomplete monitoring data, apply biodiversity models used in global assessments; (a form of triangulation).
8. Seek to emulate common practice in the socio-economic, climate and environmental fields by producing the indicators in a standardised, automated, well-founded, and financially and institutionally guaranteed setting; in order to evolve from an incidental information system to one that is systemic and systematic.
9. Implement the above recommendations through the concerted and combined actions of the European Commission, the European Environment Agency, Member States, institutes and Non-Governmental Organisations that produce data and indicators. A task force under the SEBI project could initiate and coordinate this process.

The indicators inform policymakers about the actual change in biodiversity and its use in relation to time and space. In combination with models, indicators are an indispensable tool for determining the major causes of biodiversity loss and the cost-effectiveness of policy measures. It is important to evaluate progress in reaching targets, but using indicators as a continuous feedback to adjust and fine-tune policies is of much greater value.

The Working Group on Interlinkages is aware that establishing an indicator system according to the above recommendations will require considerable effort and cost. However, the Group is of the opinion that the societal cost of policy inaction or the development of wrong policies based on invalid information will be multi-fold and, ultimately, much greater.

[2] See page 10 for full context. According to the CBD (1997, 2003[2]), policymakers will ask the following key questions: 1) What is changing; 2 Why is it changing; 3. Why is it important; and What are we doing about it?

2 Introduction

2.1 The biodiversity 2010-target and indicators

In 2002, the Convention on Biological Diversity (CBD) and the Johannesburg Summit on Sustainable Development endorsed a 2010 target for biodiversity at global level by agreeing to achieve a significant reduction in the current rate of biodiversity loss by 2010. In 2003, pan-European environment ministers agreed to halt the loss of biodiversity by 2010, in the Kiev Resolution on Biodiversity[3]. The political agreement on the 2010 target was accompanied by a growing consensus on the need for long-term, structured, global and European coordination of biodiversity monitoring, indicators and reporting efforts and a sound funding basis.

Having set the target of halting the loss of biodiversity by 2010, it became essential to examine and report on progress, as a condition for targeted and cost-effective policies. To make this a meaningful process to a variety of audiences, a set of indicators was needed. This should provide a quick, easy-to-understand reference point in relation to progress for technical and non-technical audiences alike. The indicators would be underpinned by sound scientific knowledge and analysis. In June 2004, the EU Environment Council welcomed the set of biodiversity indicators that was referred to in the 'Message from Malahide', which was itself based on the global set that was accepted in 2004 at the CBD 7th Conference of the Parties in Kuala Lumpur. The Council urged the European Commission to develop, test and finalise the EU set. The same framework of 16 headline indicators was also adopted by the PEBLDS Council[4] in 2005.

As a response, the project Streamlining European 2010 Biodiversity Indicators (SEBI 2010) was set up to execute this request and to oversee implementation of the adopted CBD framework at both EU and pan-European levels. The SEBI project also aimed to achieve the maximum streamlining of indicators between national, regional and global levels. The resulting 26 indicators were launched in 2007[5] and draw as much as possible on the best available data and indicators in Europe (Figure 1). This pragmatic approach had a down side. After all, the indicators were made for different purposes, coming from different sources and institutions and therefore lacked coherence. The resulting picture would be kaleidoscopic. It could even puzzle rather than enlighten policymakers. This would be a waste of its information potential. Consequently, in 2008, the coordination team of the SEBI project established the Working Group on Interlinkages to explore how improved synergy could increase the political information-power of the indicators as a set: thereby creating something 'more than the sum of its parts'.

2.2 Aim of the report

The SEBI coordination team assigned the Working Group on Interlinkages to make recommendations in relation to[6]:

[3] When this report refers to 'the 2010 target', it refers to the EU and Pan-European target to halt the loss of biodiversity by 2010.
[4] Pan-European Biological and Landscape Diversity Strategy
[5] EEA Technical report No 11/2007, 'Halting the loss of biodiversity by 2010: proposal for a first set of indicators to monitor progress in Europe'. The indicators draw on the indicators agreed on, under the Convention on Biological Diversity (CBD, decision VII/30).
[6] See Terms of reference in Appendix 2

1. the creation of informative indicator subsets;
2. improving interlinkages and coherence between the indicators, monitoring, modelling, baselines, assessment principles, scales and critical levels;
3. lowering the burden of reporting at different geopolitical levels;
4. indicator handling and set up of the 1st EEA Biodiversity Assessment Report 2009;
5. identifying gaps in indicators, monitoring, modelling and dealing with uncertainty.

Recommendations are given in relation to both short and long term perspectives.

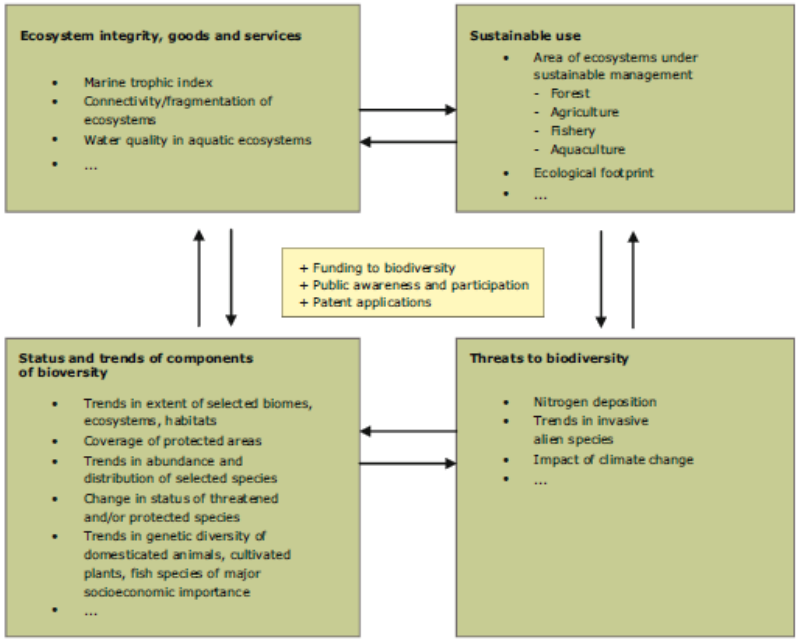


Figure 1: Major 2010 indicators selected under the SEBI process arranged according to four focal areas

2.3 Key policy questions as the starting point for the analysis

According to the CBD (UNEP 1997b, 2003a[7]), policymakers will ask the following key questions:

1. What is changing?
2. Why is it changing?
3. Why is it important?
4. What are we doing about it?

These four key questions provided the starting point of the analysis carried out in this report and have been the basis for deriving recommendations targeted at improving the coherence of the indicator set. No individual indicator can answer one of those questions sufficiently, but a subset of indicators could if well designed and mutually coherent. As stated in the SEBI indicator report (EEA, 2007), indicator-based information must be communicated quickly in a simple and intelligible way. Similarly, a set of instruments onboard an aeroplane is not just a random set, but is carefully designed and selected to provide the pilot with a range of interrelated information which allows the aircraft to be flown safely. Speed, altitude, distance to the target, fuel level, fuel consumption and direction may be relevant individually, but in

[7] UNEP/CBD/SBSTTA/3/INF/13 (pag 7); UNEP/CBD/SBSTTA/9/10 (page 28)

order to reach the destination safely they also need to be interpreted as a group of complementary elements,. This same logic applies to the indicators in a biodiversity set.

2.4 The process of biodiversity loss

The first question to answer is: 'What is the core process of biodiversity loss for which an indicator would be desirable?' Unfortunately, given the complexity of biodiversity there is no easy answer; however, a few generic changes can be observed:

- At ecosystem level, biodiversity loss is characterised by the conversion, reduction or degradation of habitats.
- At species level, many original species decrease in abundance while at the same time a few other – often opportunistic – species increase in abundance (as a result of human interventions). The original species are gradually replaced by those that are favoured by human influence; some of which may even reach plague proportions. Indeed, extinction is just the final step in an often long process of incremental retreat and eventual disappearance of species. Remarkably, local or national species richness often increases initially because of these new species. This is the so-called 'intermediate disturbance diversity peak' (Lockwood and McKinney, 2001). Just as in wild species, biodiversity loss has also taken place in crop varieties and livestock breeds; the initially large diversity of varieties and breeds from traditional agricultural landscapes, adapted to their local environments, has been replaced by an ever shrinking group of highly productive ones that have been bred and selected for modern agricultural conditions.

Because of these changes, ecosystems lose their regional specifics and become more and more alike: *homogenisation* (Lockwood and McKinney, 2001; MA, 2005). In essence, biological homogenisation is very similar to economic globalisation[8]. Figure shows a schematic view of human socio-economic development from a long-term perspective. Humans have relentlessly changed their environment; beginning with hunter-gatherers, followed by pastoralism and the increasingly intensive cultivation of land; finally acting to protect the areas they deem to be of sufficient 'natural'value.

[8] A similar process is the change in the number and types of shops. The number of shops in streets is not changing. It is merely the type of shops. Specific, local shops are gradually replaced by common global chains such as the Body Shop, McDonalds and IKEA. As a result, the 'shop-richness' in towns is not changing but towns are becoming more and more alike, having all the same shops. The same holds for biodiversity. We get the same set of species everywhere.

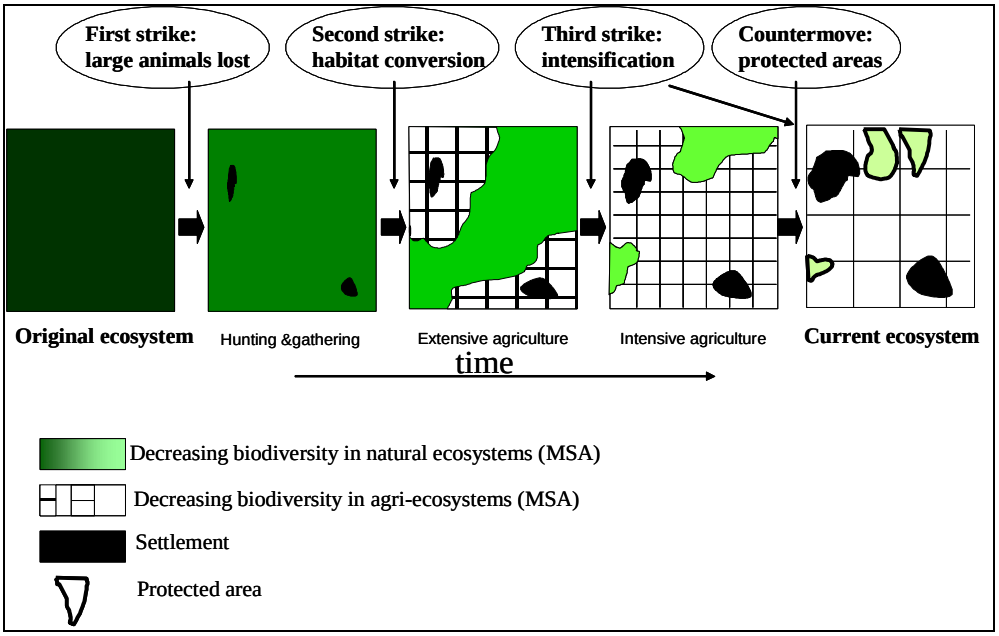
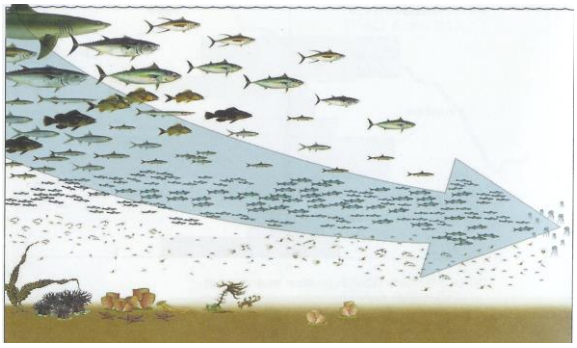


Figure 2: *Schematic picture of the different stages of human interventions in natural ecosystems and the corresponding loss of biodiversity due to homogenisation. From left to right human appropriation of solar energy is increasing. Humans 'parcel' multi-functional natural systems into highly productive mono-functional production systems of wheat, rice, cattle, houses, water basins, roads and nature. The remaining nature is still suffering from increasing pressure (pollution, climate change, invasive species)*

Daniel Pauly provided a striking representation of this process with the 'fishing down the food web' illustration (Figure 3). Irrespective of whether we deal with agricultural, forest, marine, or aquacultural ecosystems, the underlying homogenisation process is similar.

Figure 3: *Fishing down the food web according to Pauly (Pauly et. al, 1998). Large, long-lived and slow reproductive species are replaced by small, short-lived, highly reproductive species due to fishing, pollution, eutrophication and other pressures. A similar process can be seen in terrestrial ecosystems: "logging, burning, hunting, polluting and ploughing down the food web".*



The indicator set should also indicate the major causes of biodiversity loss such as habitat change, invasive species, pollution, overexploitation and climate change (MA, 2005; Wilson, 2002). This also includes the relative contribution of each cause in order to identify the most cost-effective measures in relation to potential policy responses. Lastly, the indicator set should provide clear indications of the benefits biodiversity provides to humankind and of the policy actions to be taken to achieve the targets.

2.5 Criteria for suitable indicators as a set

The CBD developed criteria for suitable policy-oriented indicators. These criteria also apply to the indicators as a set (UNEP, 2003a; EEA, 2007). In brief, indicators should: i) be policy relevant and meaningful; ii) be biodiversity relevant; iii) show progress; iv) be methodologically well founded; v) be broadly accepted; vi) allow affordable monitoring; vii) allow affordable modelling; viii) cover the pan-European territory; ix) show trends over time; x) allow comparison between countries; and xi) be sensitive to human-induced changes. The set as a whole should: a) provide a representative picture of the DPSIR chain; b) have as small a number of indicators as possible in order to better communicate to policymakers and the public; and c) enable aggregation and multiple use on a range of scales (Appendix 3). These criteria were also taken into account in our analysis.

3 Which indicator interlinkages could be improved?

The working group found 7 major types of interlinkages to be further analysed (Figure 4). These can be framed in the form of 7 questions:

i) Which indicator subsets could answer the four key policy questions (listed in Section 2.3, page 10)?
ii) How do indicators, models and monitoring interlink?
iii) Can we distinguish indicator families which are nested?
iv) How could indicator subsets provide a representative picture of the focal areas of Status and trends of components of biodiversity; Threats to biodiversity; Sustainable use; and Ecosystem integrity, goods and services (Figure 1)?
v) How could indicator subsets provide a representative picture of an entire ecosystem?
vi) Do the indicators cover the causal chain and do we know their causal relationship according to the pressure-state-response framework (P-S-R)?
vii) Is the indicator set coherent in terms of temporal and spatial scales, assessment principles, baselines and critical levels?

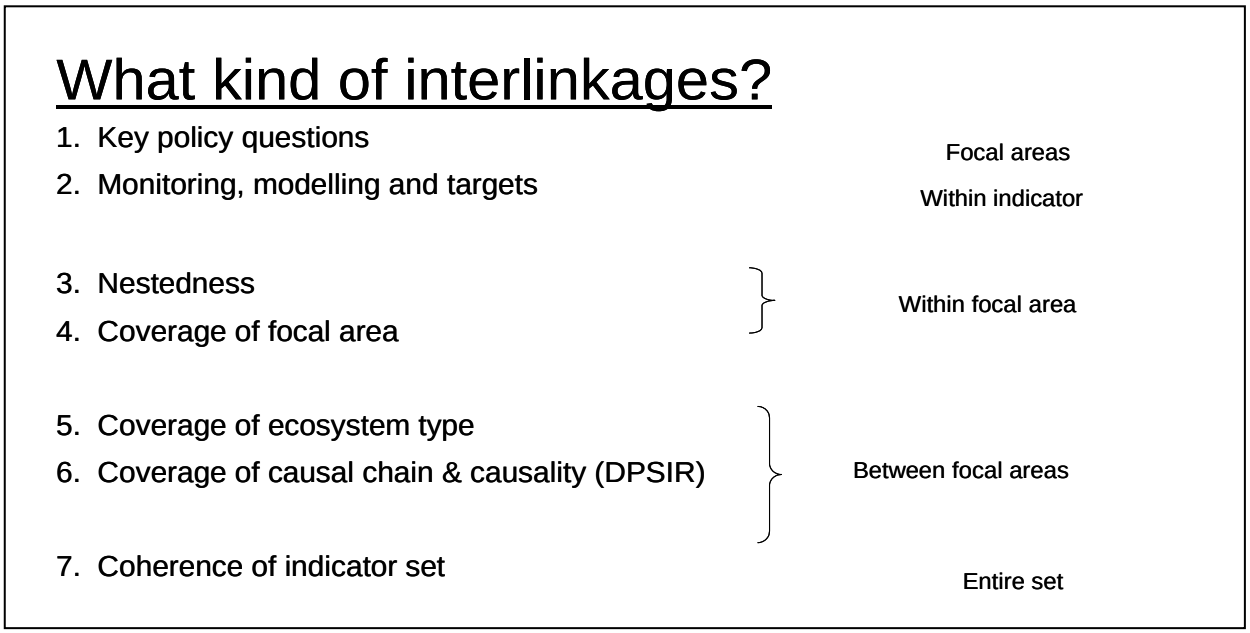


Figure 4: Major interlinkages between indicators identified and analysed

The multiple application of indicators (so that they are used to provide information in more than one focal area) means a more efficient and effective use of information and therefore a better return in relation to the amount of effort expected. The working group concluded that most individual indicators are useful in more than one focal area (Table 1). For instance, 'ecosystem extent' is a useful state indicator but at the same time shows 'habitat loss' which is a pressure indicator. The 'amount of deadwood' is an indicator of sustainable use of forest, but it is also of critical importance for many forest invertebrate species and might also be used as a substitute indicator of the abundance of invertebrate species. It also provides information about timber and biofuel collection, which are pressures.

The sections below briefly describe the working group's findings on the interlinkages, opportunities for multiple use and recommendations. The entire set, if functioning optimally, has features similar to a watch with all its parts fitting together precisely, each part influencing all the others.

3.1 Which indicator subsets answer the four key policy questions?

Which four subsets of indicators will help in answering the four policy questions? Currently, the indicators are grouped according to focal areas: Status and trends of components of biodiversity, Threats to biodiversity, Sustainable use, and Ecosystem integrity, goods & services, as shown in Figure 1 and 5. The focal areas *State* and *Threats* correspond with the first two key questions: 'What is changing?'; and 'Why is it changing?'. The focal areas 'Sustainable use' and 'Ecosystem integrity, Goods & Services' do not directly correspond with the last two key questions: 'Why is it important?' and 'What are we doing about it?'.

The working group concluded that a slight reordering of the original CBD focal areas would improve the match with the key policy questions (Figure 5,
Table *1*).

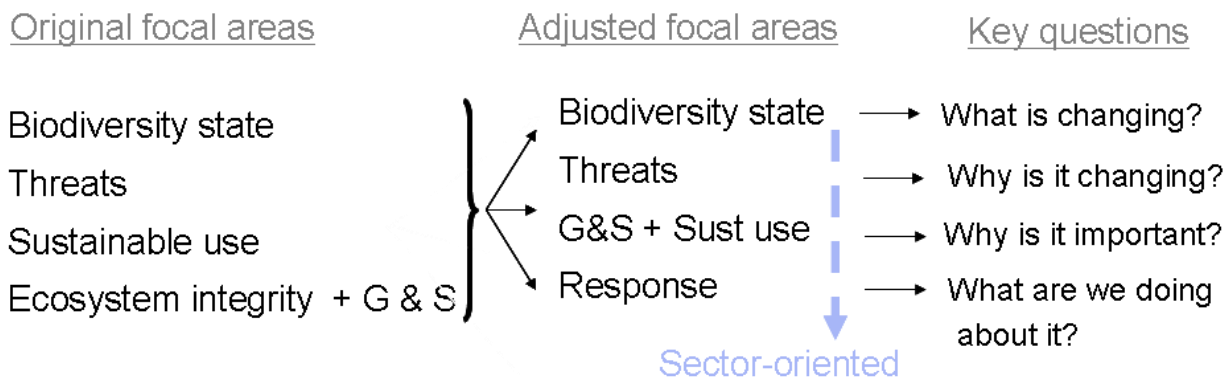


Figure 5: *Reordering of the original focal areas of the CBD (2004) in order to better cope with the four key policy questions. 'Response' and 'Sector-oriented' have been added as focal areas.*

Table 1: Contribution from each indicator to the focal areas of Biodiversity state, Threats, Goods & services and sustainable use, Response, and Sector-oriented. The picture presented is not clear-cut, but provides an indication. For example, ecosystem extent contributes to the state and to threats (conversion); forest stock, increment and felling contributes to state (stock and increment), threats (felling) and use (fibres and biofuel yield).

Indicator	Biodiversity state	Threats	G&S and Sustainable use	Response	Sector-oriented
01 Birds	Birds only				Agriculture, forestry
01 Butterflies	Butterflies only				Agriculture
02 Red List Index	Birds only				
03 Species FFH	FFH species				
04 Ecosystems	Major ecosystem types	Land use, habitat loss	Land use		Agriculture, urban, plantation forestry, infra
05 Habitat FFH	FFH habitats				
06 Livestock genetic	Sheep and cattle				Agriculture
07 National sites				Protected areas	
08 SCIs & SPAs				Natura2000	
09 Critical load		Eutrophication	Absorption capacity		Agriculture, households, industry, transport
10 Alien invasive species	Invasive species	Invasive species			Agriculture, households, transport,
11 Temperature-sensitive species	Temperature-sensitive species	Climate change			Agriculture, households, transport, industry etc
12 Marine Trophic Index	Marine fish and ecosystem	Fisheries catch	Fish		Fisheries
13 Fragmentation (semi-) natural,		Habitat fragmentation			Agriculture, urban, infrastructure
14 Fragmentation Rivers		River fragmentation			Energy, agriculture
15 Nutrients coastal and marine waters		Eutrophication			Agriculture, households, industry, etc
16 Fresh water		Eutrophication			Agriculture, households, industry, etc
17 Forest	Stock, increment	Forestry fellings	Fibres, biofuels		Forestry
18 Dead wood	Invertebrates in forest	Forestry, biofuels			Forestry
19 Nitrogen		Eutrophication			Agriculture
20 Agricultural Management	High Nature Value farmland	Intensive/extensive agriculture		Agri-env scheme organic farming	Agriculture
21 Fisheries	Commercial fish stocks	Fisheries catch	Fish		Fisheries
22 Aquaculture		Eutrophication marine waters			Aquaculture
23 Footprint		Habitat loss outside Europe	Food, fish, fibres, fuel		Agriculture, forestry, fisheries, energy
24 Patents			Patents		Agriculture, industry, fisheries
25 Financing				Nature policy	
26 Public awareness				Nature policy	

The working group merged the two CBD focal areas *Goods & services* and *Sustainable use*, into one focal area answering the key question 'why is it important?' It became clear that '*sustainable* use' is not in reality an independent indicator deserving separation from state and threat indicators; rather it provides critical levels for these indicators beyond which the use of goods and services becomes unsustainable[9].

[9] See the final report of the SEBI Expert Group on Sustainable Management Indicators, background report of the EEA Technical report nr. 11, 2007.

'Response' was added to the focal areas, according to the pressure-state-response framework, which relates to the fourth key question. A fifth focal area of *'Sector-oriented'* could group indicators concerning threat, use or response per sector.

Indicators of *Integrity* have not been worked out well in the CBD indicator set, or in the SEBI set; probably because integrity is a relatively blurred concept. In the literature it is generally defined as:

1. *naturalness of the ecosystem ('untouched'); or*
2. *an ecosystem's capability to produce goods and services for humankind.*

In the first, 'integrity' is covered by the focal area 'State', where a natural or pre-industrial state is chosen as baseline (e.g. 'distance to the natural ecosystem'). In the second, integrity is covered by the new focal area 'Goods & services and sustainable use', where critical levels are defined for the capability to produce such goods and services. Within the limits of this study, integrity was not further elaborated.

3.2 Linking monitoring, models and target *per* individual indicator

Monitoring, models, targets, baselines and critical levels (if applicable) can be included as elements of any single indicator; as is shown in Figure 6. In practice they are treated as separate entities (and are therefore not combined as elements of a given indicator) because they have been developed by different people working in different fields and for different purposes. Thus

- monitoring programs are developed by monitoring experts (often NGOs);
- models by scientists in incidental research projects;
- indicators by policymakers or governmental institutions;
- baselines[10] and critical levels by scientists; and
- targets by policy-makers and politicians.

The working group concluded that many indicators are hampered by the lack of one or more basic elements:

- **Monitoring**: is a major concern. For several indicators, this is because of incidental, non-standardised or incomplete data, or a serious lack of geographical coverage. The monitoring of state indicators is slowly improving. Threats, goods (such as fish and timber) and responses are reasonably well-monitored as part of the well-developed socio-economic and environmental monitoring. Services are hardly monitored, partly because they are still ill-defined. See Appendix 6 to Appendix 9.
- **Models**: Apart from a few exceptions, such as the GTAP-IMAGE-GLOBIO models and the BioScore model[11], models which link indicators of threats, state, use and response have

[10] The word 'baselines' is applied in various ways: i) a target baseline is a reference year to a target, ii) an indicator baseline is a maximum (100%), minimum (0 %) or particular point for an indicator to make it meaningful (assessment principle) and iii) a baseline scenario is a development over time without new policies, which can be used to assess the effectiveness of new policies. In this document, baselines are applied as indicator baselines. More on baselines, see Section 3.7 and Appendix 5

[11] The IMAGE-GLOBIO model was built by PBL, UNEP-WCMC and UNEP-GRID (Alkemade et al., 2009), in conjunction with the global marine EcoOcean model of the University of British Colombia (Alder et al., 2007). They have been implemented in regional and global assessments of the CBD (sCBD, 2006, 2010; sCBD/MNP, 2007), OECD (2008), UNEP (2008) and the MA (2005). The BioScore model was built by a consortium of European institutes under the EU 6st framework led by ECNC (Delbaere et al., 2009; http://www.ecnc.org/publications/technicalreports/bioscore). GTAP originates from the Global Trade Analysis Project and links land use to the final assembling of goods and services for consumption (Hertel, 1997; Van Meijl et al., 2005). JRC builds a fragmentation model, UN/ECE built a nitrogen-deposition

received little attention are have been hardly developed, IEEP et al. (2009) reviewed the suitability of current biodiversity models commissioned by the European Commission.

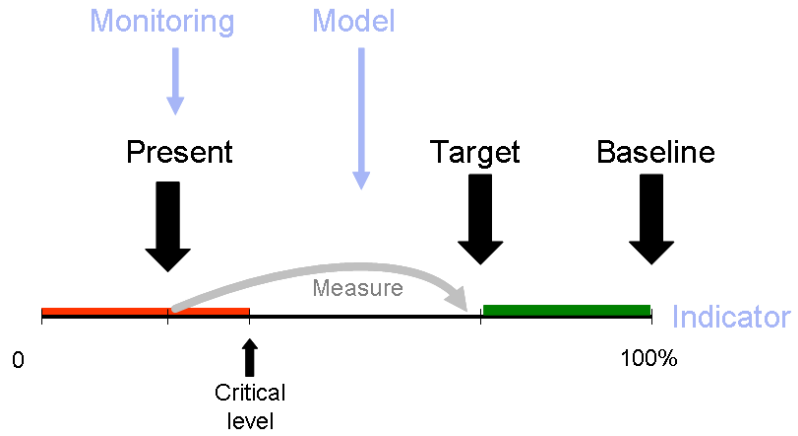


Figure 6: Monitoring, baselines and critical levels, models and targets can be included as elements of any single indicator. These components enable the user to: compare the current state with two meaningful reference value, to calculate the future state resulting from current or new policies; and to determine the distance to the target. Note: it is not imperative for every indicator to have a target, critical level or model.

- **Targets**: The general 2010 target of halting biodiversity loss applies to the SEBI indicators of the state of biodiversity; these are: Ecosystem extent; Species abundance; Red list; Livestock genetic diversity; and Species and habitats of EU interest. The specific target, nested within the 2010 target, of 'favourable conservation status' applies to the indicator: Species and habitats of EU interest, but leaves room for interpretation (not least in relation to what is actually meant by 'favourable conservation status').

  Targets for the SEBI indicators of pressure, goods and services and their sustainable use are lacking; but they could be derived from the 2010 target of halting biodiversity loss (and may well be derived in the post-2010 target setting process). The European Biodiversity Action Plan (BAP)[12] contains targets for various policy responses, but few are SMART (Specific, Measurable, Attainable, Relevant, Time-bound). A number of SEBI indicators can be used for monitoring progress in BAP (because, among other things, they are both fundamentally linked to the focal areas within the Convention on Biological Biodiversity).

  There are no verifiable targets for the response indicators of: Financing biodiversity management; Managed areas potentially supporting biodiversity; and Public awareness. However, they do exist for: Protected areas, which in the SEBI set refer to sites designated under the EU Birds and Habitats Directives.

- **Baselines**: There are various approaches to indicator baselines. The current state (of the attribute addressed by the SEBI indicator) can be assessed by comparing it with: i) a particular reference year; or (ii) a particular reference state that is, for example, a critical

model (UN-ECE, 2003; UNEP, 2005); and a nitrogen-deposition butterfly model was built by the University of Bristol (Feest, 2006).

[12] EC, 2006. Halting the loss of biodiversity by 2010 and beyond. Sustaining ecosystem services for human well-being. Communication 216

value or an intact or natural state (from an ecological perspective). Most SEBI indicators, such as Ecosystem extent and Species abundance, use a reference year for the first measurement. Several indicators use a reference state. Freshwater quality uses natural background levels; the Marine Trophic Index and Livestock genetic diversity use pre-industrial levels, and fish stocks; the Red List, and Nitrogen deposition use critical levels. However, critical levels for Goods & services and Sustainable use are not set.

[Note: The critical levels for Fish stocks and the Red List are long established and could serve as guidance for setting critical levels for indicators such as those for Species abundance, Ecosystem extent, Marine Trophic Index, Sustainable use of forests, Dead wood, and Nitrogen balance.]

3.3 Are indicators well-nested? Zooming in and out

We speak of "nestedness" in the context of an indicator family which forms a spatially hierarchical, nested structure, enabling zooming in and out from pan-European to lower scales (e.g. national, regional, etc). A key question in this respect is: "do the ecosystem extent indicators cover all of Europe, without any overlap or double counting?" For example, 'forest extent' is a subdivision of pan-Europe's total area. In turn, the indicator for pan-European forest extent can be split into one for forests in the EU and one for forests in France (Figure 7). Ideally, all other SEBI indicators could be divided over the 9 major habitat types and 3 geo-political levels, making possible a full assessment of each spatial unit. This enables scalable assessment within the same indicator set.

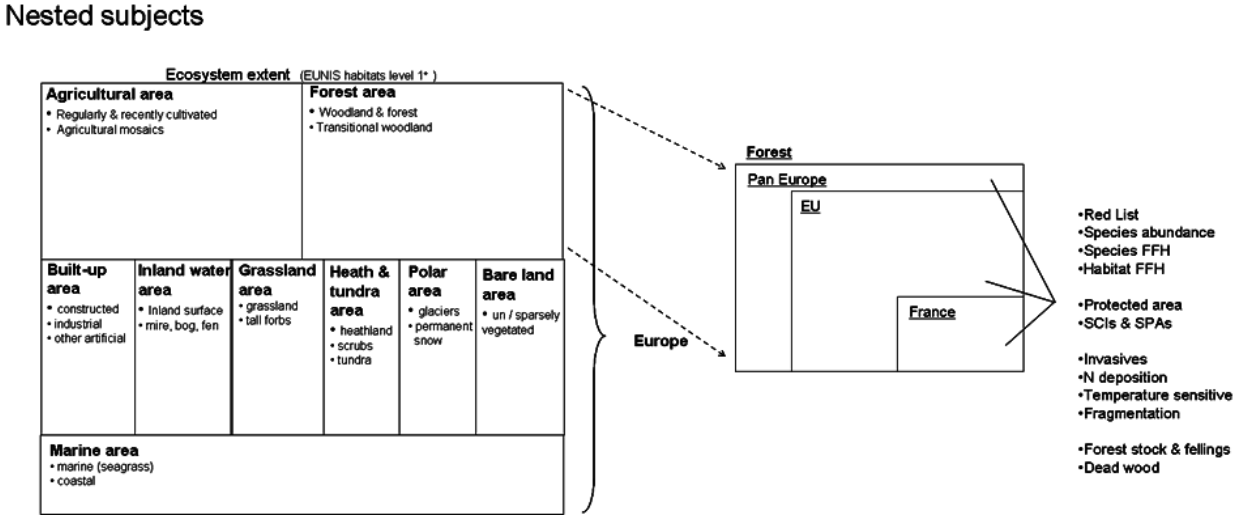


Figure 7: Schematic illustration of indicator families of nested subjects. It enables a full assessment using the state, threats, uses and response indicators in each of the spatial units.

Most indicators have been worked out for pan-Europe. This can also be done for Europe and individual countries (Appendix 9). A subdivision of these indicators into major habitat types is highly desirable and would require additional effort.

3.4 Is the focal area well-covered?

Focal area coverage concerns the extent to which the indicators provide a representative picture of a focal area (e.g., state, threats, etc) (Table 1). The main question therefore relates

to whether the indicators cover the main aspects of the focal area, are complementary and without overlap. In this context it is important to know if robust and valid conclusions about a focal area can be drawn on the basis of the indicator subset; for example: i) do Ecosystem extent, the species trend indices, the Red List and Livestock genetic diversity sufficiently cover the status of biodiversity on its different organisational levels and with all its components; or: ii) do the two species abundance indices (STI) and Red Lists represent the characteristic species of Europe's ecosystems; or iii) etc…? (Figures 8 and 9)

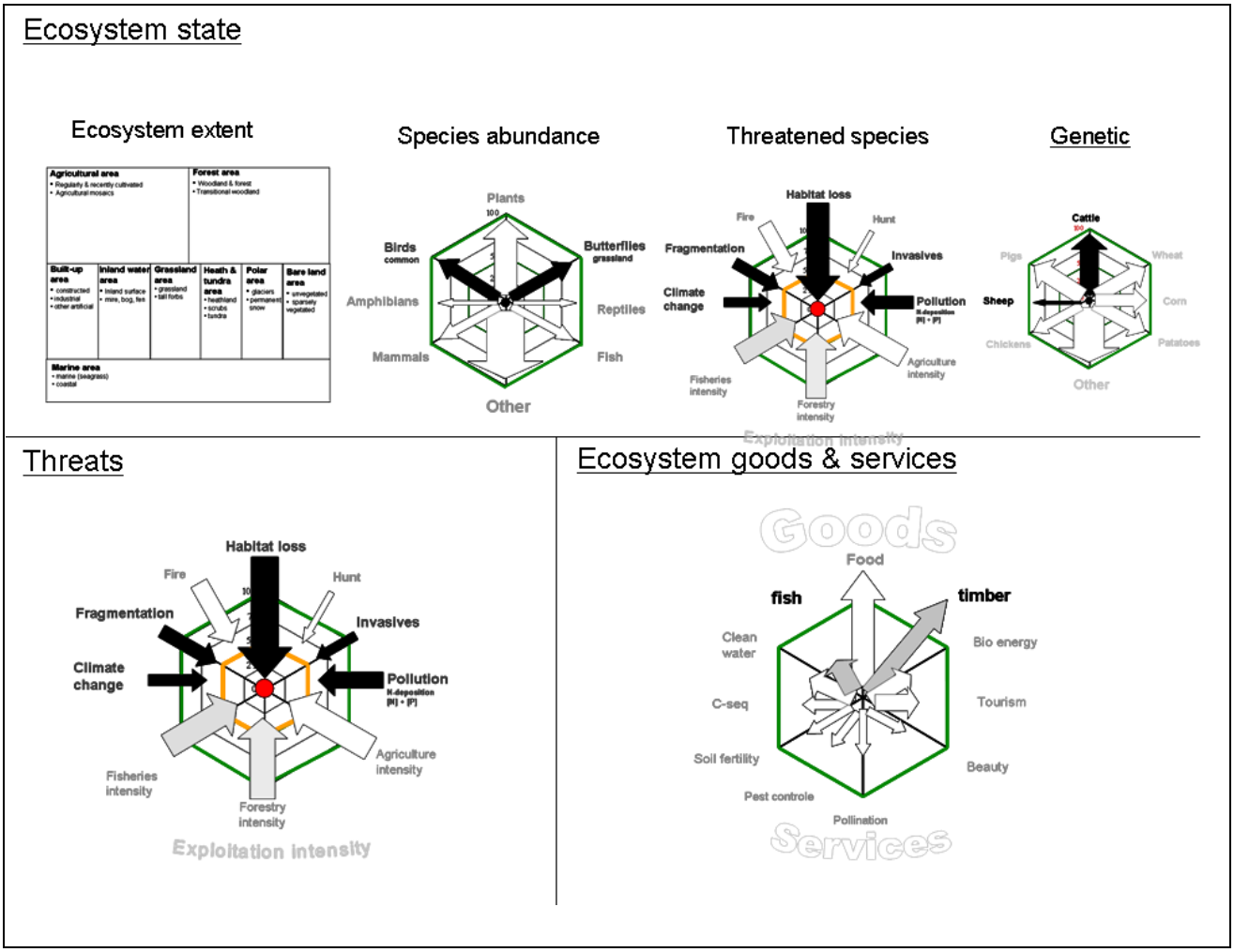


Figure 8: Coverage of the indicators per focal area. Black arrows: included in the SEBI set. White arrows: not included in the SEBI set. Gray arrows: information available in the SEBI set, but has not been made explicit. Width of the arrows is relative to their importance (commercial importance in relation to Ecosystem goods and services). Length of the arrows for goods & services indicates by how much they differ from the natural level (higher/lower). Ecosystem extent fully covers all major ecosystem types.

When worked through for the different focal areas, the following conclusions emerged:

State

- As a group, the indicators of *ecosystem extent*, *species abundance* and *Red List* provide complementary information on the overall state. *Species and habitats of EU interest* provide additional and more detailed (nested) information on particular sub-ecosystems and species.

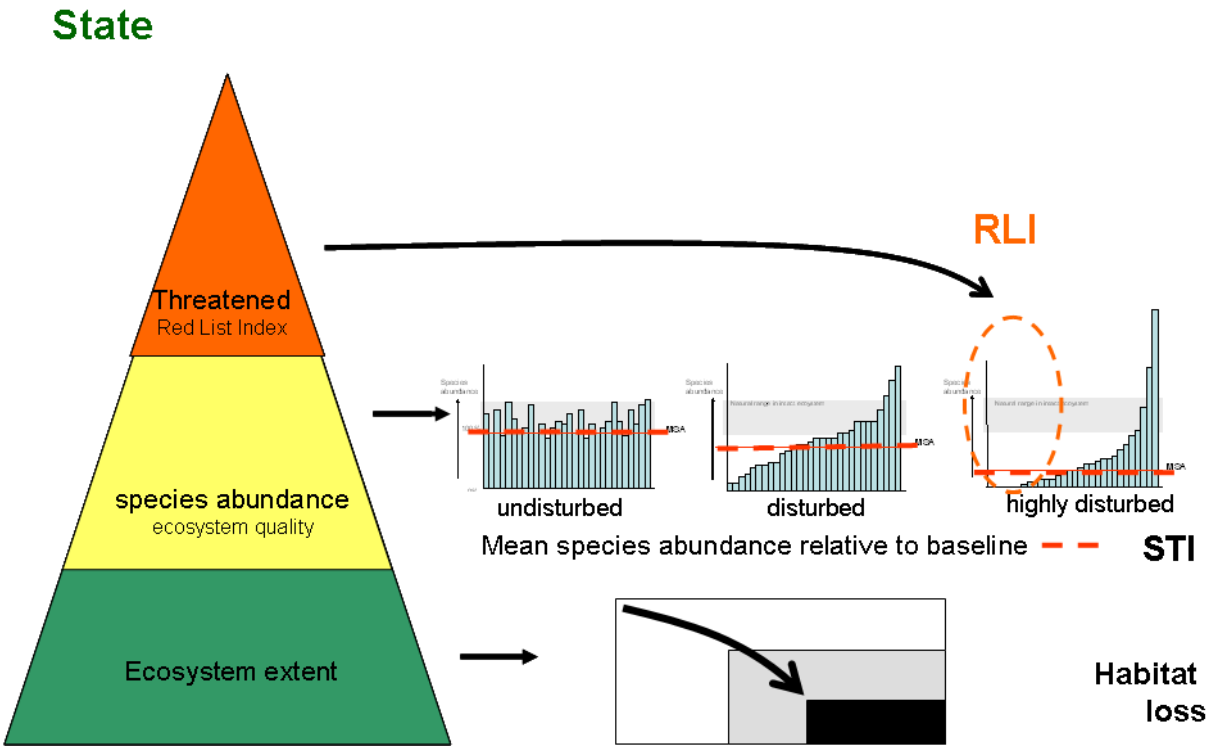


Figure 9: Ecosystem extent, species abundance (STI) and threatened species (RLI) are complementary indicators. The first informs about, for example, the remaining forests (in size) and grassland, the second indicates their average quality (mean abundance of species characteristic for these ecosystems as compared to the reference state), and the third shows the unevenness within the mean species abundance, focusing on those species that are threatened (RLI).

- *Ecosystem extent* is a key indicator. The nine major ecosystem types[13] are exclusive, complementary, and cover all of Europe (Figure 7). Many other indicators relate to these ecosystem types, for example the red list, species trend index, or fragmentation index of forests or grasslands.
- *Species trend indices of birds and butterflies* neither cover all of Europe, nor all of the nine major ecosystem types (Table *2)*. They cover a small set of common birds and grassland butterflies, which is hardly representative of all the species of birds and butterflies. Moreover, a more representative picture should also include species from other invertebrates (e.g. dragonflies), and could be extended to include vertebrate groups (e.g. fish, amphibians, reptiles, and mammals) and vascular plants.
- Indicators for species from freshwater and marine ecosystems are lacking almost entirely, except for some *Commercial fish stock within safe biological limits*.
- Species on the *Red List* will be complete by 2010 for birds and (possibly) mammals and amphibians. For a more representative picture, other vertebrate groups and vascular plants should be included, as well as invertebrate groups, such as butterflies or dragonflies for which enough measurement data are available.

[13] These are the 9 EUNIS habitat level 1^{+} categories, being a further aggregation of the 13 EUNIS habitats level 1: 1) [marine, coastal], 2) [inland water, mire-bog-fen], 3) [grassland, tall forb], 4) [heathland-scrub-tundra], 5) [forest, woodland, transitional woodland], 6) [un- sparsely vegetated], 7) [glaciers-permanent snow], 8) [regularly cultivated agriculture, agricultural mosaics], 9) built up.

- *Genetic diversity* is covered for only two livestock breeds: cattle and sheep. This is far from being representative of genetic diversity in Europe, which also includes other key livestock species, crops and selected wild animals, plants and fungi.
- Given the poor representativeness of the current state indicators, models can provide additional information to strengthen the evidence ('while the monitoring systems are under construction.

Threats

- The indicators of ecosystem extent (such as habitat loss), invasive alien species, pollution (N deposition, N balance, N input, eutrophication), overexploitation (fish, timber) and climate change provide information on the major pressures and threats, although improvements are possible. It should be noted that these pressures are often collectively abbreviated as 'HIPOC' (H-Habitat loss; I - Invasive species; P – Pollution; O - Over-consumption; C - Cumulative impacts and Climate Change), these being the top five of the main direct drivers of change in biodiversity and ecosystems as presented by the Millenium Ecosystem Assessment report (MA, 2005).
- Many threats are context-specific and thus difficult to interpret on an aggregated European scale. For instance, an increase in forest area may be positive for biodiversity in one part of Europe, but negative in another; (see also Section 3.7 on this complex issue).

Goods & services and sustainable use

- With the exception of commercial marine fish and timber yields, indicators of ecosystem goods and services are hardly included in the list. The indicator *forest stock, increment and felling* shows the production of timber, but provides no information on whether or not forestry is ecologically sustainable. To do so would require additional information on the state indicators such as *ecosystem extent, species abundance* and *Red List* specific to forests. The *Marine Trophic Index* provides a picture of decreasing fish sizes in European catches as a result of both intensive exploitation and catch regulations. However, information on yields (in tonnes) is also available, being a major good provided by ecosystems.
- The extent to which fisheries, forestry and agricultural ecosystems are sustainably managed cannot be assessed merely from the few indicators under the focal area 'Sustainable use'. The SEBI Expert Group on sustainable use of forests, marine and agricultural ecosystems concluded in their report that sustainability requires the broad set of SEBI indicators of state, threat, use and response[14]. In addition, they recommend indicators of discards and bottom trawling (both in relation to fisheries) and forest naturalness (as proposed by the MCPFE advisory group)[15] to further complete the picture.
- In actual practice, assessing *sustainable use* of forests, marine ecosystems and agriculture also requires socio-economic indicators. We support the conclusions by the SEBI Expert Group to add *employment* and *gross value added per sector* to *sustainable use*, in order to complete the picture, where appropriate. Results from the Millennium Ecosystem Assessment (MA, 2005), the Economics of Ecosystems and Biodiversity project (TEEB, 2010), and research projects such as RUBICODE[16], could further help to complete the full picture.

[14] See: Introduction to sustainable management indicators (SEBI EG6)

[15] MCPFE Advisory Group Recommendations for improved pan-european indicators for sustainable forest management, 2002: http://www.foresteurope.org/filestore/foresteurope/Meetings/2002/MCPFE_EXPERT_LEVEL_MEETING_October_Vienna_Austria/AGrecomeddation_indicators.pdf

[16] http://www.rubicode.net/rubicode/index.html

- As stated earlier, critical levels are an indispensable element in operationalising sustainable use. Experience with critical levels on N deposition and marine fish stocks can be a guidance in establishing those for other indicators.

Response

- The indicators of *protected areas, sites designated under the EU Habitats and Birds Directives*, *financing biodiversity management*, *management practices potentially supporting biodiversity* and *public awareness* provide a limited picture of responses.
- Many other responses are conceivable, such as environmental abatement measures and sectoral measures. They are not in the list, but can be easily derived if so desired.

Sectors

- Various indicators have a sector-orientation, especially for forestry, fisheries and agriculture (
- Table *1*). For other sectors, such as traffic, industry and households indicators are lacking.

3.5 The extent to which the main aspects are covered for each ecosystem type

The key question under consideration here is whether the SEBI indicators provide an overall picture of *state*, *threats*, goods and services, *sustainable use* and *response* per major ecosystem type; in an ideal situation a full set of indicators would be capable of doing this (Figure 10 and 12).

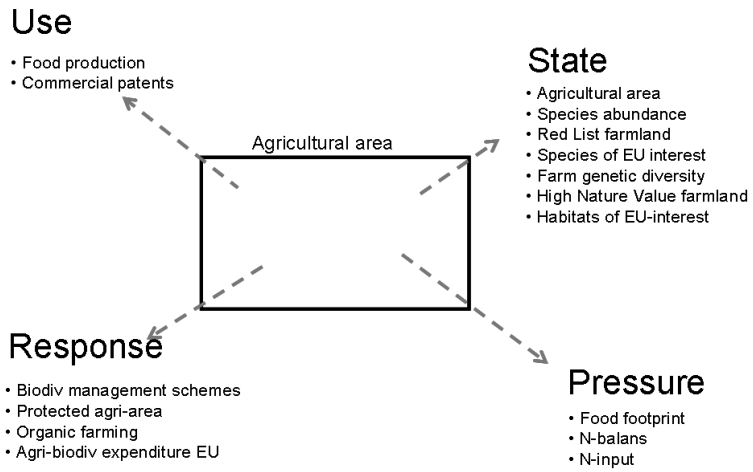


Figure 10: *Schematic illustration of ecosystem-oriented indicators. All indicators apply to the same ecosystem type and provide complementary aspects of it.*

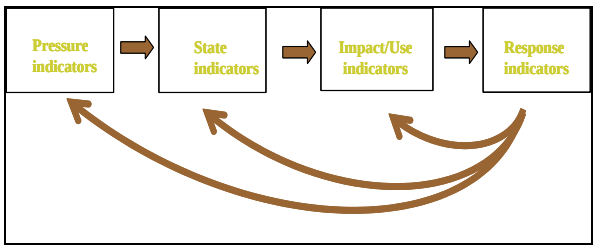
The group concluded that most ecosystems are covered by the indicators except for urban areas; however, species abundance (within the state indicators) is limited to agriculture and forests. Table *2* provides an overview.

Table 2: Relevant indicators per ecosystem type

Indicator/ Major ecosystem type	agriculture	Forests	urban	inland waters	grassland	heath / tundra	polar	bare	marine
01 Birds	1	1							
01 Butterflies	1								
02 RLI	1	1		1	1	1	1	1	1
03 Species FFH	1	1		1	1	1	1	1	1
04 Ecosystems	1	1	1	1	1	1	1	1	1
05 Habitat FFH	1	1		1	1	1	1	1	1
06 Livestock genetic	1								
07 National sites		1		1	1	1	1	1	1
08 SCIs & SPAs	1	1		1	1	1	1	1	1
09 Critical load	1	1			1	1	1	1	
10 IAS	1	1		1	1	1	1	1	1
11 Temperature-sensitive species	1	1		1	1	1	1	1	1
12 Marine Trophic Index									1
13 Frag natural & semi,	1	1			1	1	1	1	
14 Frag rivers				1					
15 Nutrients coastal and marine waters									1
16 Fresh waters				1					
17 Forests		1							
18 Dead wood		1							
19 Nitrogen	1			1					
20 Agricultural Management	1								
21 Fisheries									1
22 Aquaculture									1
23 Footprint	1	1							1
24 Patents									
25 Financing									
26 Public awareness									
Total	15	14	1	11	10		10	10	13

3.6 Is the causal chain being covered and do we know the causality?

Major questions regarding the causal chain and causality are: i) are all elements of the causal chain (Pressures-State-Sustainable use-Response) being covered; ii) are causal relationships between indicators known; iii) are these relationships formalised in sound models; and iv) for example, can N-input measures be related to N input and with STI farmland birds, butterflies and the farmland species on the Red List? Figure 11 shows the major causal relationships between threat and state indicators. Figure 11 shows a manner of presenting those related indicators in an overall picture.



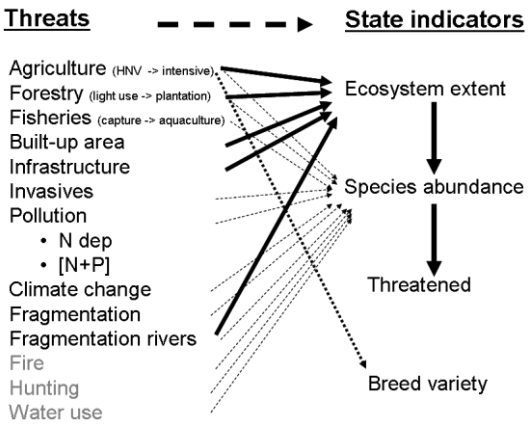


Figure 11: *The causal chain according to the Pressure-State-Impact/Use-Response framework (left), and elaboration of causal relationships between pressure and state indicators (right).*

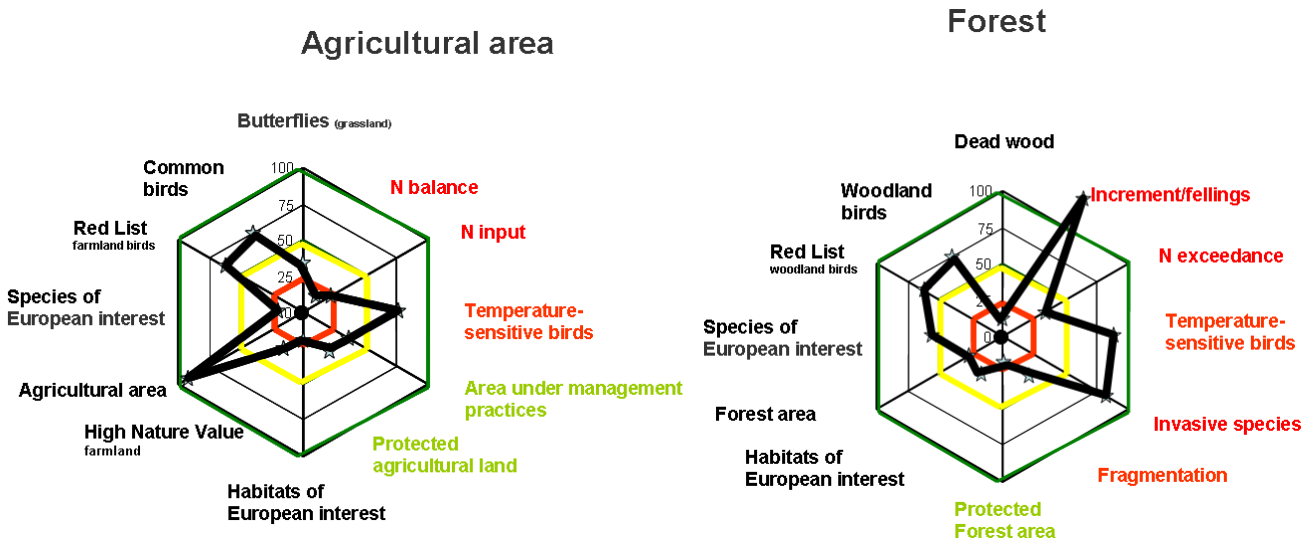


Figure 12: *Radar diagram of, in principle, causally related indicators for forests (left) and agriculture (right). Black: state, red: pressure; green: response*

The outcomes of this consideration were that:

- The set includes indicators for each focal area. Driving forces, such as population growth, economic growth, consumption, technology, and production efficiency are not included. However, they are available and could be included or at least taken into consideration in the analyses if relevant or appropriate.
- The representativeness of indicators needs improvement (see above).
- A small number of models have been developed in relation to certain of the relationships between threats, state, goods and services, sustainable use and response indicators. Examples are the IMAGE/GLOBIO model (Alkemade et al., 2009) and the marine EcoOcean model (Alder et al., 2007)**Erreur ! Signet non défini.** which have been applied in regional and global assessments. The report 'Scenarios and models for exploring future trends of biodiversity and ecosystem services changes' (IEEP et al., 2009) provides information on existing models and their suitability for policy support.

3.7 Coherence of the entire set

An indicator is defined by specific spatial and temporal scales, a baseline and an assessment principle. However, these are often not mentioned explicitly. A key question is whether or not the various SEBI indicators have been defined using similar approaches. If they are not, there is a danger that the separate indicators are like (metaphorical) pieces from different puzzles providing a kaleidoscopic picture that is difficult to understand (Figure 13).

State of the Environment report	Assessment principles/baseline
Forest area halved in 20 years	reference year
Crane population became viable	viability
Starling population twice the target	policy target
Defoliation decreased since 1900	naturalness
Lynx from vulnerable to nearly extinct	no extinction
Salmon stocks increased 10% in the last 10 years	the more the better

State of the country:

Figure 13: Indicators with different assessment principles do not provide a coherent overall picture.

Many disputes stem from different implicitly applied assessment principles. Examples of disputes could include, for example: 'whether an increase in forest-edge animals due to human-induced fragmentation is perceived as positive or negative'; or 'whether an increase in the amount of dead wood in forests is awarded a positive or negative value'. Figure 14 shows how commonly used assessment principles attach entirely different values to biodiversity change. Making assessment principles explicit and mutually coherent is a prerequisite for them to become informative to policymakers.

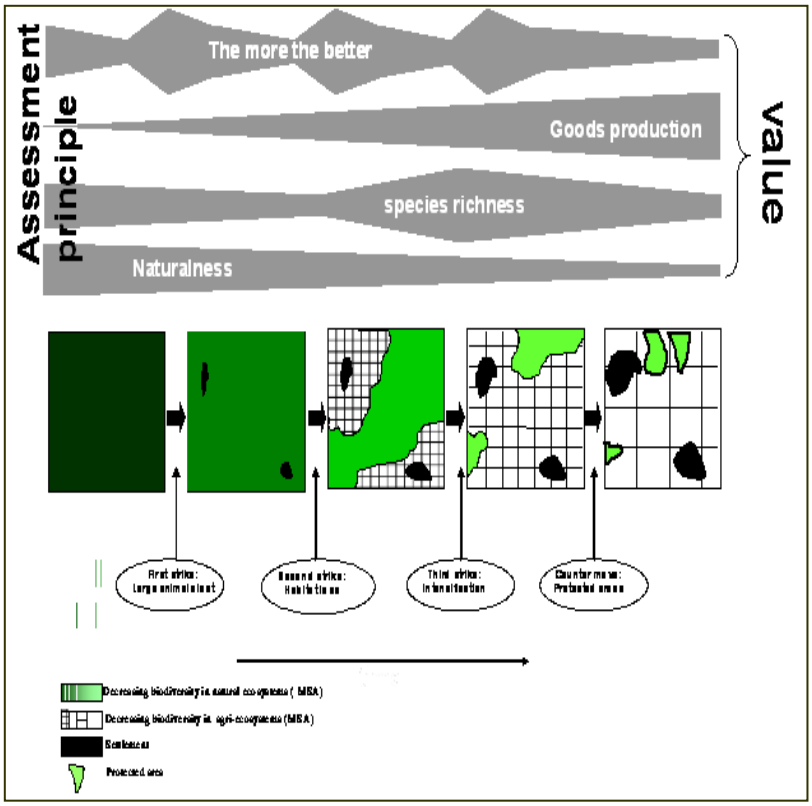


Figure 14: *The change in natural areas, from supporting hunting and gathering, into extensive agriculture, followed by intensification is valued differently depending on the assessment principle ('stand point'). From the perspective of naturalness biodiversity is deterioratin;, from the perspective of local species richness it is first deteriorating, then improving and again deteriorating (see the 'intermediate disturbance diversity peak', Lockwood et al, 2001). From the perspective of*

goods production it is improving all the way until the ecosystem degrades and loses its production capability. From a 'the more the better' perspective the biodiversity value flips, depending on which biodiversity components are considered; some species are decreasing while other, human-favoured species, are increasing in numbers or even reach plague proportions.

Appendix 9, Appendix 10 and Appendix 11 show spatial scales, temporal scales, baselines, critical levels and assessment principles of the set of SEBI indicators.

In summary:

- A clear distinction must be made between assessment principles, baselines, critical levels and targets.
- An assessment principle is the basic view on which change is judged.
- A baseline is the operationalisation of an assessment principle. It defines the end point of the indicator and helps to interpret it. Unfortunately this is often driven by data availability.
- A critical level is a value, the exceedance of which may provoke (for example) a population or ecosystem collapse or cause irremediable pollution. Estimation of these values requires additional research.
- A target is a political choice, balancing socio-economic and ecological interests, and is set somewhere between zero and the baseline. Scientific knowledge can help to define feasible and realistic targets.
- An indicator can be read according to different assessment principles.
- The current set contains many different spatial scales, assessment principles, baselines and time ranges. Only a few critical levels are available. This seriously impedes clear policy interpretation of the indicators (Figure3).

The working group discussed various **alternative assessment principles**, but could not agree on a single assessment principle for the full set:

- The following assessment principles were distinguished: naturalness ('the more natural the better'), species richness ('the more species the better'), number of individuals (etc.), extinction risk, viability, productivity, absence of human pressure, profitability, pre-industrial, and critical level. In addition, a mix of all the principles was proposed – 'a best balance between principles'.
- The suitability of these assessment principles was judged according to different criteria: policy relevance; ecosystem relevance; meaningfulness; as few as possible; feasibility; sensibility; and fairness.
- Initially 'best balance between principles' and 'critical level' were judged as the most important. However, it was acknowledged that the former was contrary to two of the basic criteria for selecting suitable indicators: meaningfulness; and being simple to understand. More importantly, indicators are not supposed to (implicitly) balance socio-economic and ecological interests; this should be the role of policymakers. To be able to do that, policymakers need clear-cut, undiluted information. Using the 'best balance of principles' would lead to a two-step acceptance of biodiversity loss; one step would be to define the 'best balance of principles' as a socioeconomic – ecological compromise; and another one to balance the resulting biodiversity indicator (state) against the socioeconomic state.
- 'Naturalness' would be the most logical and undiluted assessment principle; showing human impact on biodiversity, despite a country's socioeconomic stage of development. However, naturalness is not easy to determine in Europe (in contrast to most other continents). It requires a new field of research: that of historical ecology, next to comparative ecology. In South Africa, national parks were used as a reference for the Biodiversity Intactness Index. A similar choice was made in the Water Framework Directive (WFD). A natural baseline was

applied to natural water bodies, and an artificial/potential baseline was applied to man-made water bodies. It would make sense to assess water and terrestrial ecosystems in a similar manner. A 'Nature Framework Directive' could be the terrestrial equivalent of the WFD. Both historical and geographical references are data sources by which to approach and set baselines.

- From a biodiversity conservation point of view, 'the more individuals the better' (as in the Species Assemblage Trend Index; STI) makes no sense. At a certain point a species can achieve plague-like numbers.
- As for ecosystem extent, the total area of Europe or a county could be a simple and pragmatic baseline against which to make comparisons (e.g. 10% of Europe). Another possibility could be the 'potential biome'.
- For genetic diversity, traditional agriculture might be a logical baseline for the loss accelerated since the commencement of agricultural industrialisation.
- Looking to other fields, the UN Framework Convention on Climate Change applies a 'pre-industrial baseline' of 1890. For natural chemicals, natural background values are applied next to no observed effect concentrations (NOEC) levels.
- The working group also briefly took note of the discussions by the Ad Hoc Technical Expert Groups of the CBD, who also recommend a natural baseline but, for pragmatic reasons, prefer a postulated baseline set in pre-industrial times, for the longer term (UNEP, 1997a; 2003b). It was suggested that current data could be starting point for 'picking low hanging fruit' (e.g. dead wood volumes per forest type), and to gradually reconstruct better baselines.
- The working group considered naturalness[17] and critical levels, also including extinction, as the most ambitious and clear assessment principles. However, the working group was not in a position to oversee the political and scientific consequences of such a choice.
- Baselines and assessment principles for a set of indicators should be selected in advance and in a coherent way. Each indicator should be accompanied by a clear indication of how the absolute level and change, respectively, should be interpreted.

The working group concluded on **scales**:

- The state of biodiversity varies greatly in different parts of Europe. For indicators that have diverging trends in certain parts of Europe it would therefore be essential to show these trends. As it is not possible to describe all European countries in one graph, countries would need to be grouped. Different groupings were envisaged:
    1. Bio geographical regions ('Article 17 perspective')
    2. Eco regions based on EUNIS level 1^{+} classification (9 major ecosystem types)
    3. Country groupings (e.g. 'Scandinavian' or Mediterranean')
    4. European sub-regions (e.g. EU27, pan-Europe, EU17, EU10).
    5. NUTS level
    6. According to the quality of data.

- The working group considered that each additional spatial scale would mean significant additional effort and cost with respect to, for example: monitoring; modelling; baselines; and analyses. In addition, each additional scale would provide not only extra information, but would also confuse the overall picture. The working group considered that a maximum of two additional scales between Europe and the country level might provide the required information for policymakers without confusing the big picture; and would be feasible from the perspective of financial resources and data collection.

[17] It was stated that even if we could quantify such a baseline we could never reach it. It should be noted, however, that a baseline is not a target. A target is a value somewhere between zero and the baseline, resulting from a political balance of socioeconomic and ecological interests.

- Criteria for the selection of spatial scales should be that they be: policy relevant; ecosystem relevant; affordable; and achievable, all in the near future.
- The group recommended for the purpose of SEBI to break down indicators[18]:
  - according to country grouping;
  - according to major ecosystem type (EUNIS level 1^{+}), in the knowledge that some problems have yet to be solved.
- The smallest spatial 'building block' would be the major ecosystem type per country. It should be noted that the scale of presentation can differ from the scale of analysis.

[18] There are no intrinsic 'good or bad' scales, merely less or more suitable scales given the target audience.

4 Towards a European design

In order to provide a more tangible and appealing picture to illustrate the SEBI indicators, the working group sketched a **fictitious** 'blue print' including fictitious possible policy messages. This indicator 'cockpit' is scalable: it can be used at the level of pan Europe, the EU, country groups, major ecosystem types, and country as presented in figure 15 and with details in Appendix 12.

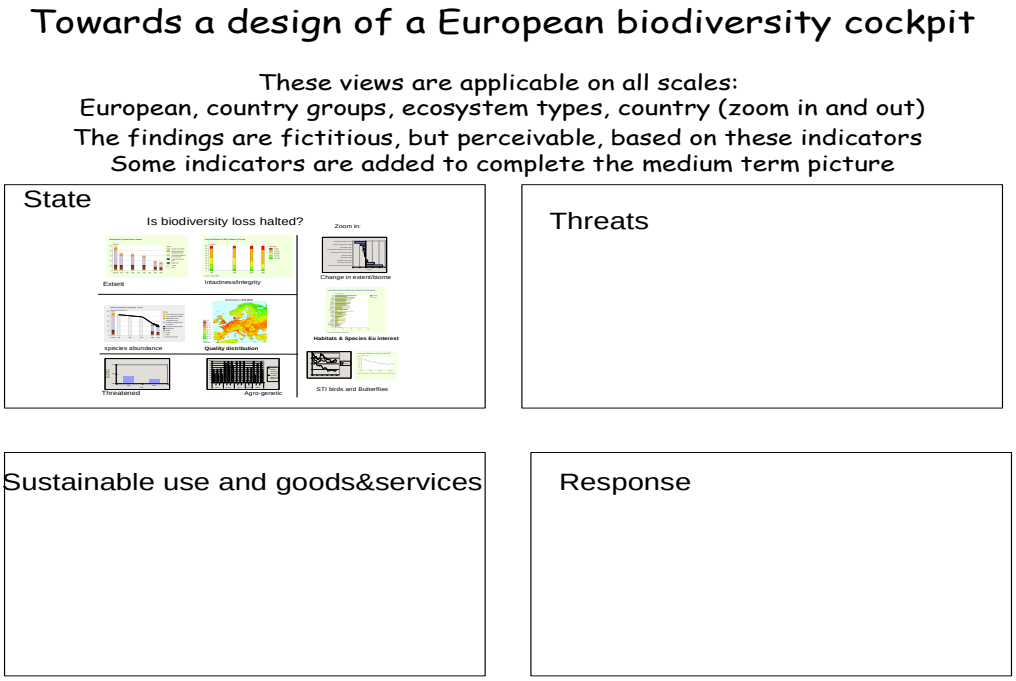


Figure 15: *Possible illustration of the SEBI indicators*

5 Conclusions and recommendations

Considerable progress has been made towards establishing a functional European set of European biodiversity indicators. The indicator set has the potential to enable policymakers to evaluate whether biodiversity loss has been halted at European and national levels. However, the construction of this first set of indicators has been constrained by the quality and availability of the data, which has so far only allowed an incomplete picture to be drawn up. Further development is required and will significantly improve the accuracy and informative value of the information from which policymakers can draw conclusions as a basis for more detailed action. The same applies to the indicators of threats, the sustainable use of agriculture, forests and marine ecosystems, and effectiveness of policy responses.

The working group recommends that the **following actions be pursued over the long-term:**

In relation to the representativeness of the indicators, to:

1) Take more components into consideration within the set of indicators at the species and genetic levels. The aim is not to increase the number of indicators but to improve or extend those in the existing set to include additional species groups beyond birds and butterflies (e.g. other vertebrates and higher plants) and additional genetic resources.
2) Use existing data sources such as Corine Land Cover and Article 17 reporting under the Habitats Directive at the ecosystems level. These should also be collected in a harmonised way.
3) Further develop the indicators of the focal areas: threats to biodiversity; ecosystem integrity, goods and services; sustainable use; and status and trends of components of biodiversity. 'Ecosystem integrity' requires further elaboration.
4) Improve the coverage and consistency of monitoring systems across Europe. These systems must respect harmonised standards and be quality controlled. It is highly recommended that practical solutions be investigated through the concerted and combined actions of the European Commission, the European Environment Agency, Member States, data producing institutions and Non-Governmental Organisations.

In relation to the interlinkages between indicators:

1) Make a concerted scientific effort to build models of the major cause–effect relationships (DPSIR [19]); using the few models that already exist as a starting point.
2) Increase the coherence between indicators in relation to (e.g.) temporal scales, spatial scales, baselines, assessment principles and critical levels. As proposed by the CBD, the current SEBI indicators draw to a great extent on existing data and indicators; however, as they have been, variously derived from different institutions where they had been developed for different purposes, they therefore offer a less-than-coherent picture, potentially limiting policy conclusions.
3) Determine critical levels for assessing whether marine ecosystems, forests and agriculture are sustainably managed.

[19] A common framework spearheaded by the European Environment Agency is the "DPSIR" or "drivers, pressures, state, impact, response" framework. Drivers and pressures are indicators of the human activities and resulting pressures on the environment in the form of pollution or land-use change, for example. State and impact indicators are the resulting conditions in the environment and the implications for the health of ecosystems and humans. The response indicators measure the reaction of human society to the environmental issue. See for example: http://en.wikipedia.org/wiki/Environmental_indicator

4) Connection must be made with the European Platform for Biodiversity Research Strategy and national biodiversity research strategies to support and reinforce existing and increase the potential for future research on these issues.

The working group recommends the **following short-term actions:**

1. Reorder the focal areas as follows: i) state, ii) threats, iii) goods & services and sustainable use and, iv) response; in order to better match the four key policy questions.
2. Re-confirm and revise links with the European Union's Biodiversity Action Plan, particularly in the post 2010 era.
3. Ensure that each indicator is accompanied by a clear guide to its interpretation. For the lay reader in particular, the indicators may appear to show contradictory messages (with graphs showing trends that proceed in different directions) or may be difficult to interpret. Not every decrease constitutes a loss and not every increase a win. Subsequent revisions of the SEBI technical report on indicators should reflect the progress in the use, presentation and interpretation of the enhanced indicator set.
4. Show underlying positive or negative exceptions in addition to average results.
5. Provide state and trend information (absolute and relative) and ranges.
6. In order to illustrate the diversity within Europe, use major ecosystem types (biomes) and/or groups of countries as intermediate spatial scales between (pan) European and country level. The monitoring resolution/scale should be adjusted accordingly.
7. In order to strengthen the European biodiversity assessment; which is based on still incomplete monitoring data, apply biodiversity models used in global assessments; (a form of triangulation).
8. Seek to emulate common practice in the socio-economic, climate and environmental fields by producing the indicators in a standardised, automated, well-founded, and financially and institutionally guaranteed setting;, in order to evolve from an incidental information system to one that is systemic and systematic.
9. Implement the above recommendations through the concerted and combined actions of the European Commission, the European Environment Agency, Member States, institutes and Non-Governmental Organisations that produce data and indicators. A task force under the SEBI project could initiate and coordinate this process.

The indicators inform policymakers about the actual change in biodiversity and its use in relation to time and space. In combination with models, indicators are an indispensable tool for determining the major causes of biodiversity loss, and the cost-effectiveness of policy measures. It is important to evaluate progress in reaching targets, but using indicators as a continuous feedback to adjust and fine-tune policies is of much greater value.

The Working Group on Interlinkages is aware that establishing an indicator system according to the above recommendations will require considerable effort and cost. However, the Group is of the opinion that the societal cost of policy inaction or the development of wrong policies based on invalid information will be multi-fold and, ultimately, much greater.

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Appendix 2: Terms of Reference

The Interlinkages Group advises and reports to the coordination team (CT) on the linkages and flexible use of the set of SEBI-2010 indicators in indicator-based biodiversity state reporting, taking stock of global and national experiences.

Three main products will be prepared in 2008:
1) Presentation of linkages according to different perspectives based on a discussion held during the first meeting (first version for the CT meeting on 4-5 March)
2) Assessment of links and cross-cutting analysis (end of May)
3) Advice on indicator-set improvements and handling (November).

The work will be driven along the details below:

Scientific links between the indicators and on the links with policies to empower the policy significance/meaning of the indicators

- Assessment of the links between indicators and the four key policy questions[20]
    - Do sub-sets of indicators answer the 4 questions
    - How can the indicators enable the evaluation of the targets (2010, EU policies/Communication ...*)?*
    - How can the indicators enable evaluation of the EC Communication on 150 actions (evaluation of the progress, link between measures and biodiversity change)?
    - How can complementary indicator sub-sets be presented as a whole?
- Cross-cutting analysis of the indicators
    - How do the indicators relate in the DPSIR chain (modeling)?
    - What are the main messages?
    - Do they offer a complete and coherent picture? Gaps?
    - What existing indicators could be added to complete the picture?

Expertise on how indicators can be improved & structuring the indicators in the future

- Improving the understanding by consistency, reference values and information-reduction by aggregation
    - Common scales (time and space) and baselines to make the set consistent
    - Do common scales and baselines enable scaling up and down the indicator sub-sets and comparability? If not, what else is needed?
    - Needs for composite indicators (Technics to transform single to composite indicators (EBI?)
    - How to establish critical levels of the sustainable use indicators?
    - Zooming in/out on topics, insensitivity by averaging, baseline setting and uncertainties
    - To do list to make the indicators scale (time and space) and baseline coherent and fill the gaps in the European coverage
- Towards streamlined reporting (national, EU, CBD), lowest work burden, maximum use of existing indicators, complementarity. What can we learn from national experiences?
- Any up-coming questions from the CT
- Advice on the way the indicators can be structured and presented from different perspectives, amongst which an ecosystem approach and the CBD focal areas..

****

[20] What is happening, what are the causes, why is it important and what can we do about it?

Appendix 3: Criteria relevant for the set as a whole

Criteria for selecting the SEBI indicators (EEA, 2007), derived from the CBD (CBD, 2003). The criteria 1, 2, 4, 8, 10 and the last 3 bullets, have been applied in the analysis of this report.

Box 2.2 Criteria for selection of the proposed indicators

1. Policy relevant and meaningful: indicators should send a clear message and provide information at a level appropriate for policy and management decision-making by assessing changes in the status of biodiversity (or pressures, responses, use or capacity), related to baselines and agreed policy targets if possible.
2. Biodiversity relevant: indicators should address key properties of biodiversity or related issues as pressures, state, impacts and responses.
3. Progress towards 2010: indicators should show clear progress towards the 2010 target.
4. Well founded methodology: the methodology should be clear, well defined and relatively simple. Indicators should be measurable in an accurate and affordable way, and constitute part of a sustainable monitoring system. data should be collected using standard methods with known accuracy and precision, using determinable baselines and targets for the assessment of improvements and declines.
5. Acceptance and intelligibility: the power of an indicator depends on its broad acceptance. Involvement of policy-makers as well as major stakeholders and experts in the development of an indicator is crucial.
6. Routinely collected data: indicators must be based on routinely collected, clearly defined, verifiable and scientifically acceptable data.
7. Cause-effect relationship: information on cause-effect relationships should be achievable and quantifiable in order to link pressures, state and response indicators. These relationship models allow scenario analysis and represent the basis of the ecosystem approach.
8. Spatial coverage: indicators should ideally be pan-European and include adjacent marine areas, if and where appropriate.
9. Temporal trend: indicators should show temporal trends.
10. Country comparison: as far as possible, it should be possible to make valid comparisons between countries using the indicators selected.
11. Sensitivity towards change: indicators should show trends and, where possible, permit distinction between human-induced and natural changes. Indicators should thus be able to detect changes in systems in timeframes and on scales that are relevant to the decisions, but also be robust enough to measure errors that do not affect interpretation.

In addition, the following criteria were used to evaluate the set as a whole:

- Representative: the set of indicators provides a representative picture of the DPSIR chain.
- Small in number: the smaller the total number of indicators, the easier it is to communicate cost-effectively to policy-makers and the public.
- Aggregation and flexibility: aggregation should be facilitated on a range of scales.

Appendix 4: The 26 indicators grouped according to CBD focal area and EU/PEBLDS headlines

Source: EEA, 2007

Focal area	EU and PEBLDS headline (*italics indicate changes from CBD headlines*)	Proposed indicators	SEBI 2010 contributions/main strengths of the indicator	Suggested improvements
Status and trends of the components of biological diversity	Trends in the abundance and distribution of selected species	1 Abundance and distribution of selected species	Birds: indicator produced by NGO established in SDI, SI and SEBI 2010 sets. Butterflies: methodology agreed.	Expand geographical coverage. Add additional taxonomic groups and ecosystems.
	Change in status of threatened *and/or protected* species	2 Red List Index for European species	Production of an RLI based on European risk.	Expand taxonomic coverage.
		3 Species of European interest	New indicator based on Habitats Directive reporting.	Improve guidance on monitoring and data collection.
	Trends in extent of selected biomes, ecosystems and habitats	4 Ecosystem coverage	Comprehensive indicator of trends in European ecosystems.	Increase geographical coverage. Use Global Land Cover data set?
		5 Habitats of European interest	New indicator based on Habitats Directive reporting.	Improve guidance on monitoring and data collection.
		6 Livestock genetic diversity	First step in the development of indicators for genetic diversity.	Improve definitions of and data on native breeds, and endangerment.
	Coverage of protected areas	7 Nationally designated protected areas	Key response indicator.	Improve accuracy and quality of national reporting.
		8 Sites designated under the EU Habitats and Birds Directives	Combined indicator (designated area and sufficiency) of relevance to the key EU policy instruments for biodiversity.	Add spatial layers and improve data flow. Explore similar indicator for non EU countries based on the Emerald network ([6]).
Threats to biodiversity	Nitrogen deposition	9 Critical load exceedance for nitrogen	Reinforced links between atmospheric and biodiversity expert communities.	Strengthen the link between critical load exceedance and loss of biodiversity, and quantify CLE impacts in protected areas in Europe.
	Trends in invasive alien species	10 Invasive alien species in Europe	Combined indicator on alien species, and development of a new list of worst invasives in Europe.	Add distinction between invasive species and alien species. Increase geographical coverage.
	Impact of climate change on biodiversity	11 Occurrence of temperature-sensitive species	Inventory of existing indicators and specific proposal for development.	Develop specific indicator.
Ecosystem integrity and ecosystem goods and services	Marine Trophic Index	12 Marine Trophic Index of European seas	Adaptation of MTI for Europe and agreement on methodology.	Using data on the size of landings or of the survey samples.
	Connectivity/ fragmentation of ecosystems	13 Fragmentation of natural and semi-natural areas	New indicator based on use of CLC inventory.	Add additional CLC data point. Increase geographical coverage.
		14 Fragmentation of river systems	New indicator.	Improving data quality.
	Water quality in *aquatic* ecosystems	15 Nutrients in transitional, coastal and marine waters	EEA Core Set Indicator adapted to a biodiversity perspective.	Improve spatial coverage and time series. Develop methods for comparing data from the same region over different years.
		16 Freshwater quality	Two EEA Core Set Indicators combined and adapted to a biodiversity perspective.	Improve data quality. Fill gaps related to catchment pressures.

Continued Appendix 4:

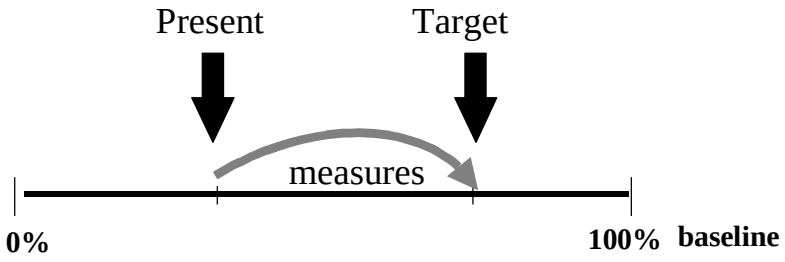
Focal area	EU and PEBLDS headline (*italics indicate changes from CBD headlines*)	Proposed indicators	SEBI 2010 contributions/ main strengths of the indicator	Suggested improvements
Sustainable use	Area of forest, agricultural, fishery and aquaculture ecosystems under sustainable management	17 Forest: growing stock, increment and fellings	Adoption of MCPFE indicator with specific biodiversity relevance.	Use new proposed EEA forest types.
		18 Forest: deadwood	Adoption of MCPFE indicator with specific biodiversity relevance.	Use new proposed EEA forest types. Document relation between biodiversity and deadwood.
		19 Agriculture: nitrogen balance	Adoption of IRENA indicator with specific biodiversity relevance.	Calculate regional nitrogen balances
		20 Agriculture: area under management practices potentially supporting biodiversity	Combination of indicators relevant to biodiversity (HNV, area under organic farming and with agri-environment measures that support biodiversity).	Stratified sampling of HNV farmland. Better data on biodiversity supportive agri-environment measures.
		21 Fisheries: European commercial fish stocks	EEA Core Set Indicator with biodiversity perspective adopted.	Improve data quality.
		22 Aquaculture: effluent water quality from finfish farms	First proposal for biodiversity related aquaculture indicator.	Refine methodology.
	Ecological Footprint of European countries	23 Ecological Footprint of European countries	Ecological footprint adapted to Europe.	Refine methodology.
Status of access and benefits sharing	*Percentage of European patent applications for inventions based on genetic resources*	24 Patent applications based on genetic resources	New indicator.	Refine methodology.
Status of resource transfers and use	*Funding to biodiversity* (Note: PEBLDS also added 'PEBLDS public and private sources')	25 Financing biodiversity management	New indicator.	Include national and private spending. Refine accounting categories. Expand beyond EU.
Public opinion	*Public awareness and participation*	26 Public awareness	Inventory of potential indicators and specific proposal for development.	Develop specific indicator.

Appendix 5: Role and function of biodiversity baselines

Source: UNEP/CBD/SBSTTA/9/INF/7

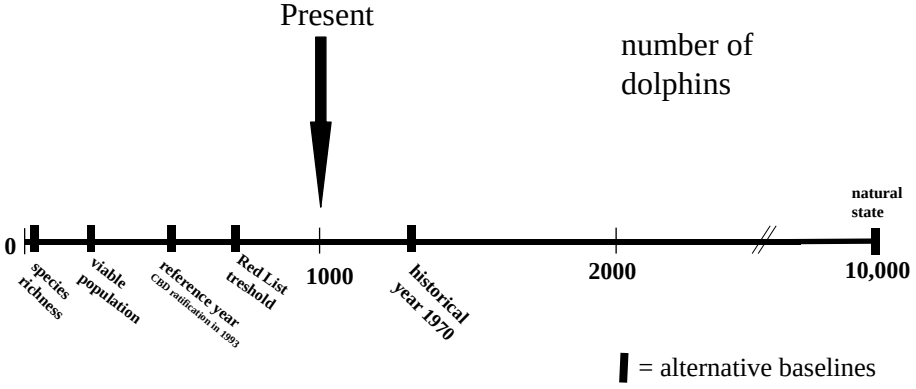
1. A *baseline* is one of the elements of an indicator. Baselines are 'starting points' for measuring change from a certain date or state (see Figure A). Although they give rise to much discussion and confusion in biodiversity indicator development, they are common practice and broadly accepted in such fields as medical care, economics, abiotic environmental quality, climate change and education. A patient's health is assessed by comparing its actual values, for example, on blood pressure or blood sugar level, to baseline values corresponding to his/her gender, height, weight and age. In the quality assessment of soil, water, air, and climate change, natural background values play a prominent role. Baselines are involved in all quality assessments, implicitly or explicitly.

Figure A:. A baseline is one of the elements of an indicator, next to actual state (present, past or future) and the targeted state. It is an endpoint of an indicator (maximum or minimum) and determines its meaning.



2. Baselines are involved in assessing the status of biodiversity, in a similar way. Data on the number of species or its population size are meaningless without a baseline to compare them to. As shown in Box 1, from one piece of information several indicators can be constructed using different baselines (see Figure B).

Figure B: Six different indicators constructed from a particular piece of information (1000 dolphins present). A 'current population of 1000 dolphins' has a different meaning when different baselines are used. Both the assessment principle (e.g. viability, naturalness, threat status) and the value statement (four times the viable population or one tenth of the natural population) differ.



Box 1. Baselines and their function in policy-making

Biodiversity data, as such, have no meaning. For example: "the **1,000 dolphins currently** in a particular sea" only have significance in relation to baseline values. Baselines turn such statistics into meaningful indicators. The type of baseline determines the policy message. Some examples:

Baseline type	*Baseline value*[21]	*Meaning of current value of 1,000 dolphins vis-à-vis the baseline*	*Policy signal*
1. Natural state	> 10,000	Currently 10% of original population is left. 90% was destroyed by anthropogenic factors, such as pollution, depletion of major fish stocks and drowning in fishnets.	The population is still heavily impacted. Let's work out further measures and policies to ensure that the populations increase.
2. Specific year 1993: CBD entered into force	500	The current population has been doubled	Policy makers did a very good job. Fishermen speak about a plague. They propose that the population limit be 500. Limitation measures?
3. Genetically Minimum population size	250	The current population is 4 times above the critical level	No need to worry about dolphins.
4. Red list	750	The current population is 33% above red list criterion	Great job done in last years. Dolphins can be removed from the red list. "Let's go back to business".
5. Species richness	2 indivi-duals	Much of the population can still be lost without losing a species. Even if extirpated it would not affect the species- richness. An alien seal species compensates the loss.	1000 dolphins are fine but not interesting. The species richness is only affected when the population is zero. No measures are needed, even if the dolphins were to disappear.
6. None	---	1000 dolphins seems a lot, and the population appears to be growing.	Fishermen say dolphins are becoming a plague and must be limited. Conservationists state that 1000 is not much at all. To restore a healthy marine ecosystem it should increase to several 1000s. A political discussion is needed.

3. The role of a baseline is that it limits the indicator, setting a maximum or minimum. The function of a baseline is to:

- Give **meaning** to raw data and statistics (see Box 1);
- Allow **aggregation** of different indicators to a coherent composite indicator[22];
- Make biodiversity indicators **comparable** within and between countries[23];

[21] In number of dolphins
[22] e.g. resulting in an index on ecosystem quality
[23] e.g. nature types, such as forests, marine ecosystems and grasslands, are assessed in a similar way

- **Simplify communication** with politicians and the general public[24];
- Provide a **fair** and common denominator for all countries, even when in different stages of economic development.

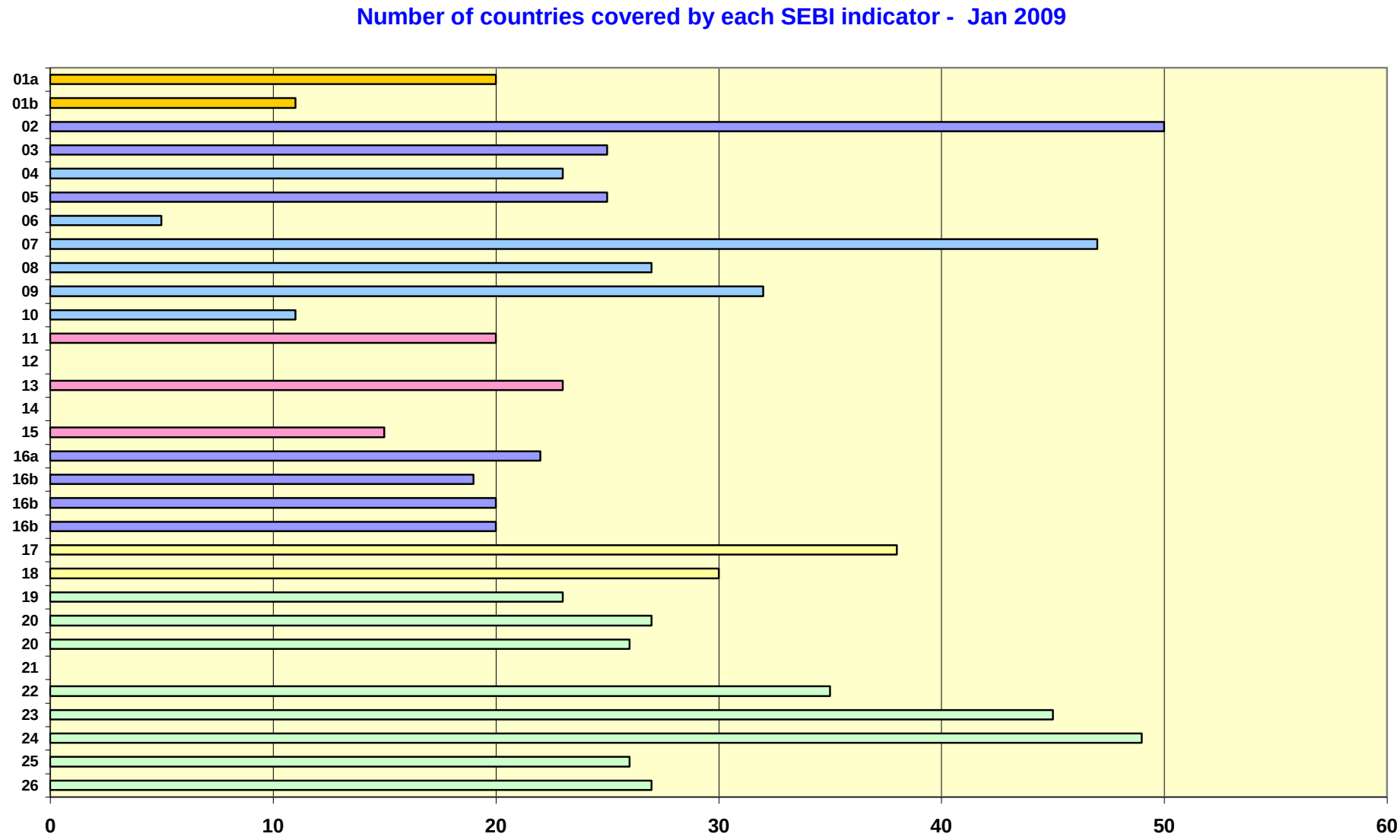
4. It has to be stressed that the baseline is **not** the targeted state. Policymakers choose their ecological targets somewhere on the axis between zero and 100%, depending on the political balance between social, economic and ecological interests.

5. Although some indicators are used simply for comparison over time (for example, the Dow Jones Index and the Retail Price Index), biological indicators are far more powerful if they are measured against a specific meaningful baseline. Setting such a baseline is a complex and rather arbitrary process. As shown in Box 1 there are many alternative baselines possible. Each alternative generates a different result and different policy information.

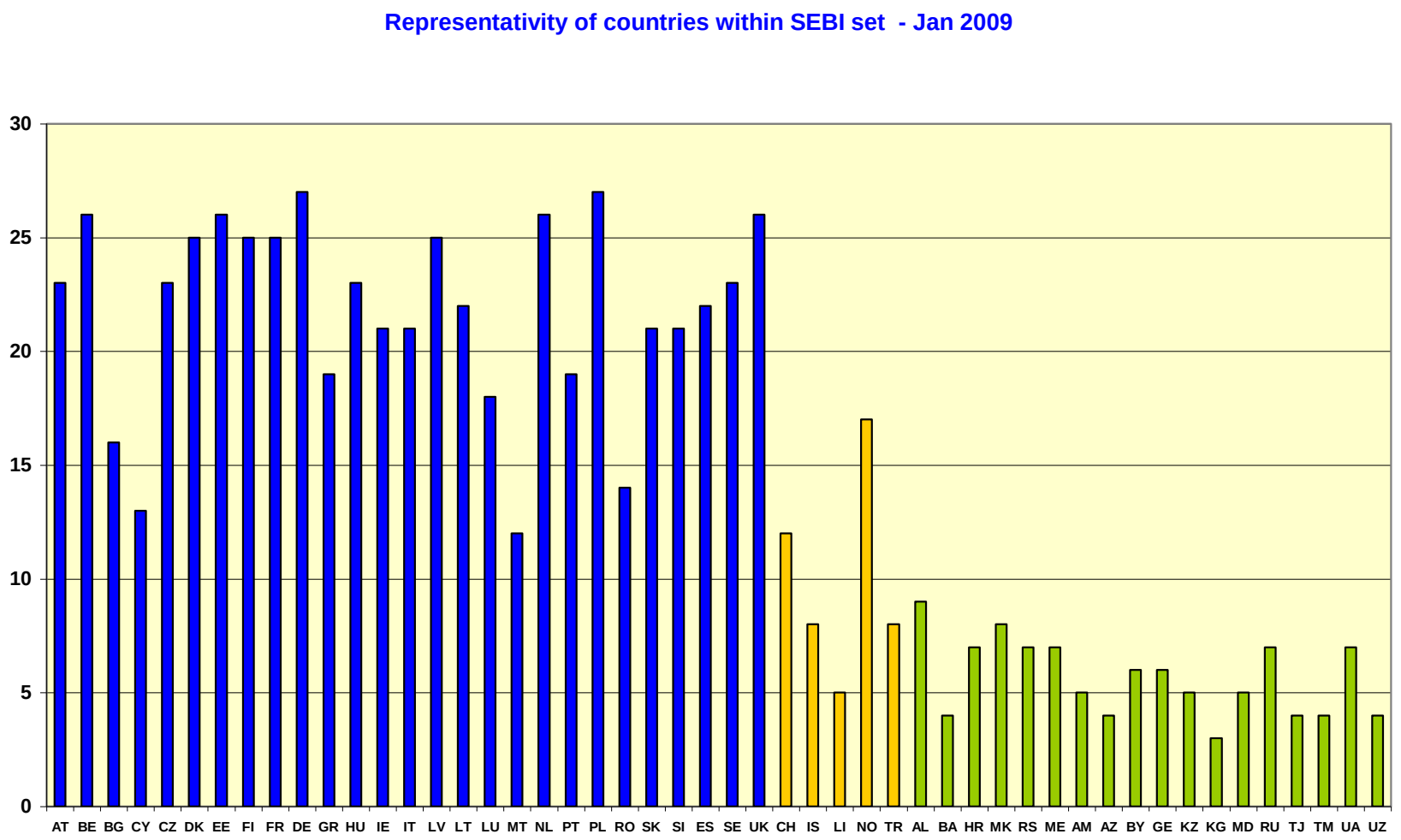
Considerations and recommendations by the CBD expert group on the practical choice of a baseline can be found in the CBD document (UNEP, 2003b).

[24] if different baselines and consequently different indicators would be used for the various nature types, this would seriously hamper communication as their meaning differs.

Appendix 6: Number of countries covered by each indicator



Appendix 7: Representativity of countries within SEBI set



How to read the graph: 23 SEBI indicators include data on Austria. However, this does not necessary mean that Austria has developed 23 SEBI indicators at national level.

Appendix 8: Spatial coverage per SEBI indicator

Appendix 9: Overall view of the features of the SEBI indicators

Indicator	Initial year	Most recent Year	Period Points	No. of points (1)	Scale of geographical unit	Monitoring or survey (3)	Spatial Monitoring/Survey unit	Nestedness (spatial/temperal)	Complementarity within the indicator
01 Birds	1980	2006	1	27	Pan Europe	x per country	random sites	country/EU/Pan Europe	Low
01 Butterflies	1990	2004	1	15	Pan Europe	from 10 to 750 per country	random/selected sites	EU/Pan Europe	Low
02 RLI	1994	2004	10	2	EU/Pan Europe	expert	not relevant	EU/Pan Europe	Low
03 Species FFH	2008	-	6	1	EU	reporting	?	country/EU	Good
04 Ecosystems	1990	2000	10	2	Pan Europe	grid	25 ha	country/EU/Pan Europe	Good
05 Habitat FFH	2008	-	6	1	EU	reporting	?	country/EU	Good
06 Livestock genetic	1995-1997	2005	5	3	country	survey	country	country	Low
07 National sites	1912	2007	1	96	Pan Europe	survey	country	country/EU/Pan Europe	good
08 SCIs & SPAs	1995	2007	1	13	EU	survey	country	country/EU	good
09 Critical load	1990	2004	1	15	Pan Europe	grid 50km x 50km	grid 50km x 50km	country/EU/Pan Europe	good
10 IAS	1900	2006	10	12	country/EU/Pan Europe	survey	country	country/EU/Pan Europe	medium
11 Temperature-sensitive species	1980	2005	1	26	Pan Europe	x per country & modelling	random sites	EU	
12 Marine Trophic Index	1950	2004	1	55	regional sea	survey	n/a	regional sea	medium
13 Frag natural & semi-natural	1990	2000	10	2	Pan Europe	grid & modelling	25 ha	country/EU	
14 Fragmentation Rivers	Not available								
15 Nutrients coastal & marine waters	1985	2005	1 (2)	21	Country/regional sea	745 & 756 stations	station	country/regional sea	good
16 Fresh water	1992	2006	1	13	Pan Europe	around 2000 stations 1473 st rivers 369 lakes	station	country/EU/Pan Europe	good
17 Forest	1990	2005	5	3	country	survey	country	country/EU/Pan Europe	good
18 Dead wood	1990	2005	5	3	country	Survey ?	country	country/EU/Pan Europe	good
19 Nitrogen	1985	2005	1	11	Pan Europe	?	country	country/EU/Pan Europe	good
20 Agricultural Management	2000	2005	3	3	Country/Pan Europe	survey	country	country/EU/Pan Europe	medium
21 Fisheries	2006	-		1	regional sea	survey	?	regional sea	Low
22 Aquaculture	1990	2006	1	17	Country/Pan Europe	survey	country	country/EU/Pan Europe	Low
23 Footprint	1961	2005	1	45	Pan Europe	survey	country	country/EU/Pan Europe	
24 Patents	1990	2006	Var.	Var.	Pan Europe	survey	country	country/EU/Pan Europe	
25 Financing	2000	2006	1	5	country/EU	survey	country	country/EU	medium
26 Public awareness	2007	-	-	1	country/EU	survey	country	country/EU	good

Var. = variable Not rel. = not relevant

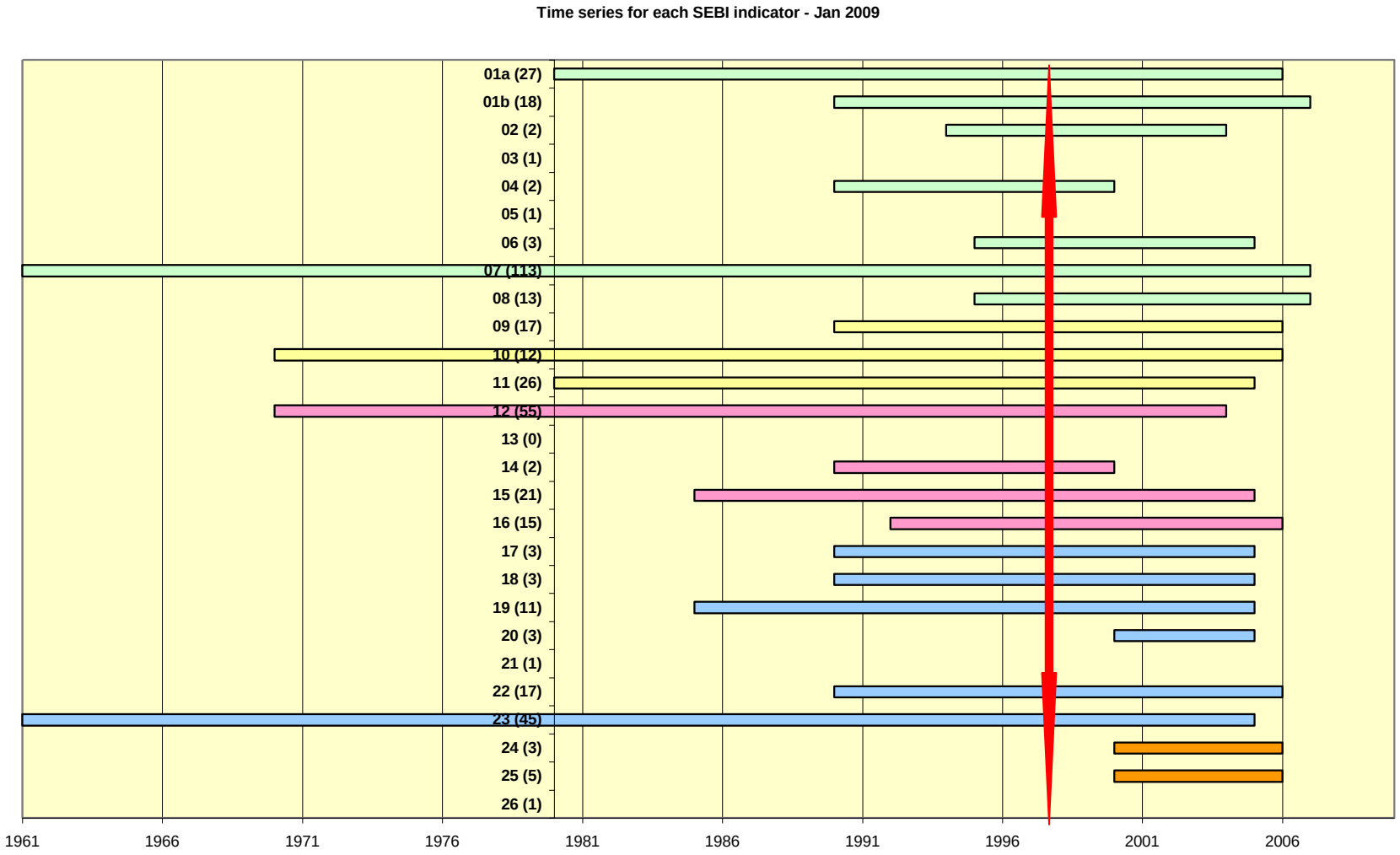
(1) in the graph; (2) aggregated from monthly data; (3) survey means data collected through survey not from monitoring sites

Appendix 10: Coherence of the set of indicators: assessment principles

No of Indicator	species/ ecosystem	Assessment Principle	Meaning
01 Birds	Species	The more individuals the better	Change in mean species abundance of group
01 Butterflies	Species	The more individuals the better	Change in mean species abundance of group
02 RLI	Species	No extinction	Change in extinction risk of group
03 Species FFH	Species	Good status of conservation for all species, viability?	Good conservation status of species
04 Ecosystems – Natural ecosystems	Ecosystem	The more the better, or area needed to achieve a good status of conservation for all species and habitats?	What is the status of Europe's ecosystems and habitats – in terms of remaining area - and how can land-use policy be used to preserve natural and semi-natural areas? How much of the natural areas has been converted?
04 Ecosystems – Agricultural ecosystems	Ecosystem	The more the better, or not threatening a good status of conservation for all species and habitats?	Ditto; More agriculture means less space for natural ecosystems, but more potential for farmlands of High Nature Value.
04 Ecosystems – Built up	Ecosystem	The less the better, or not threatening a good status of conservation for all species and habitats?	Ditto; More built-up areas means less space for natural ecosystems
05 Habitat FFH	Ecosystem	Good status of conservation for all habitats; viability?	What is the conservation status of key habitats and how successful has the Habitats Directive been in influencing this status in the EU?
06 Livestock genetic	Genetic	The more the better; or abundance in pre-industrial state?	What is the status of genetic diversity in European livestock breeds, and how can countries ensure conservation of breeds for which they have a special responsibility?
07 National sites	Ecosystem	The more the better; or area needed to achieve a good status of conservation for all species and habitats, viability?	How effective has the designation of protected areas been as a tool to protect biodiversity and as a response to biodiversity loss?
08 SCIs and SPAs	Ecosystem/species	Sufficiently for the Habitat Directive, or for the area needed to achieve a good status of conservation for all species and habitats?	Have countries proposed sufficient sites under the Habitat and Birds Directives?
09 Critical load	Ecosystem	No exceedance of CL, natural levels of deposition	The higher the exceedance, the higher the impact.
10 IAS	Species	Natural state, pragmatically determined as pre-1900	The higher the number of alien species, the greater the threat
11 Temperature-sensitive species	Species	Pre-climate change (pre-industrial)	A measure of the share of climate impact on biodiversity in terms of change in mean species abundance of birds.
12 Marine Trophic Index	Species	Natural state	Decrease in fish size and economic value of yield
13 Frag Natural & semi,	Ecosystem	Natural fragmentation or degree of connection needed to achieve a good status of conservation?	Disruption of ecosystems, loss of integrity = natural functioning?
14 Frag Rivers	Ecosystem	Natural fragmentation or degree of connection needed to	Disruption of ecosystems,

No of Indicator	species/ ecosystem	Assessment Principle	Meaning
		achieve a good status of conservation?	loss of integrity = natural functioning?
15 Nutrients coastal & marine waters	Ecosystem	Natural background level	Unclear; no informative baseline, NOEC, or target available
16 Fresh water	Ecosystem	Natural background level	Unclear; no informative baseline, NOEC or target available
17 Forest	Ecosystem	Harvest may not exceed growth	Is the stock growing or over-harvested?
18 Dead wood	Species/ Substitute for invertebrates	Natural state or amount needed to achieve a good status of conservation of deadwood species?	The more natural the volume of dead wood, the better the chance of naturally present invertebrate species. Substitute for 'unmeasurable' invertebrate species
19 Nitrogen	Ecosystem	Natural background leakage	Less leakage means less pressure on surrounding natural ecosystems. Less input means a better chance of greater species abundance of wild species
20 Agriculture management	Ecosystem	The more High Nature Value farmland, organic agriculture and biodiversity management schemes, the better	Measure of intensity of agriculture and corresponding room for wild species, and public effort on safeguarding wild biodiversity
21 Fisheries	Species	Safe biological limit or no commercial extinction?	Risk of commercial or total extinction and optimisation of use
22 Aquaculture	Ecosystem	Natural background concentrations	Informs about the leakage to the natural environment of nutrients, pesticides, and parasites
23 Footprint	Ecosystem	Average capacity of the planet per person	Europeans not only cause the deterioration of their own biodiversity but also of a considerable amount outside Europe
24 Patents	Genetic	The more patents the better	The more economic the use, the more direct is the value for society

Appendix 11: Baseline (first measurement) and time period per indicator

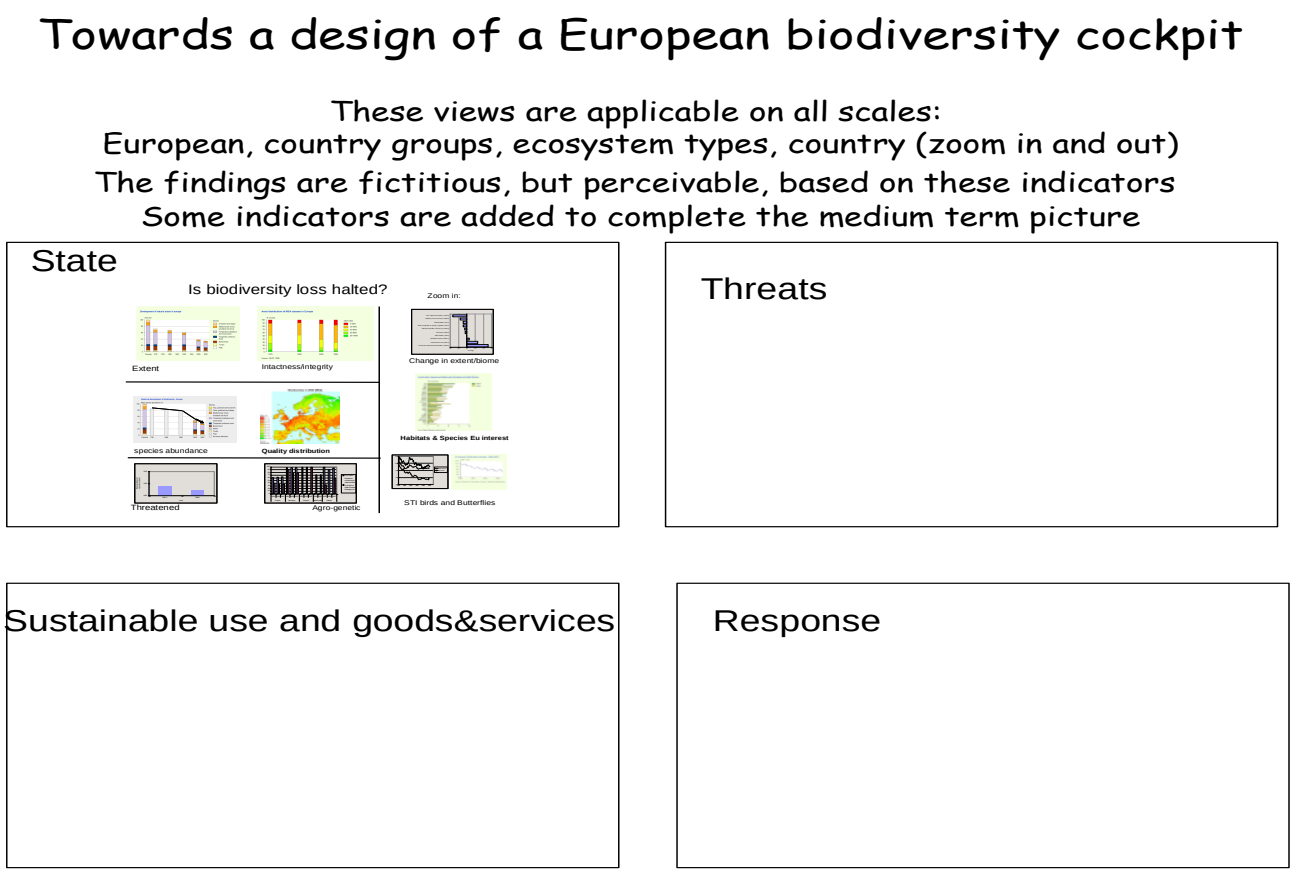


Appendix 12: A *fictitious*, medium-term blueprint of the SEBI indicators and policy messages

This appendix is an (amateur-) 'artist' illustration of how a coherent set of indicators could look like and of what kind of policy messages could be drawn from it. The structure is according to the four key policy questions, related to the four new focal areas.

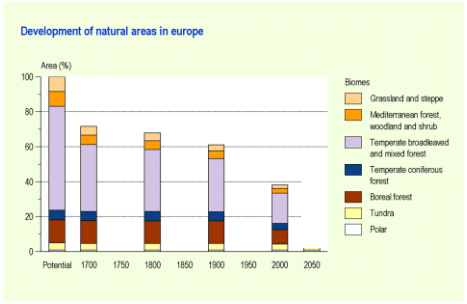
These views are applicable to all scales, from pan-Europe to sub-national.

The figures and findings are fictitious. The illustrations are taken from existing reports as examples, and can be highly improved.

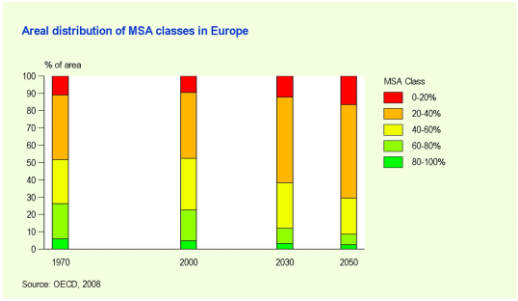


Has biodiversity loss been halted?

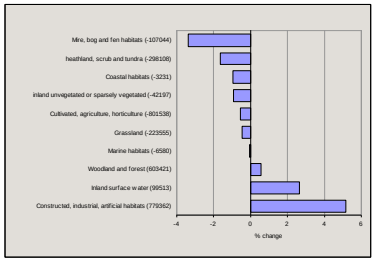
Zoom in:



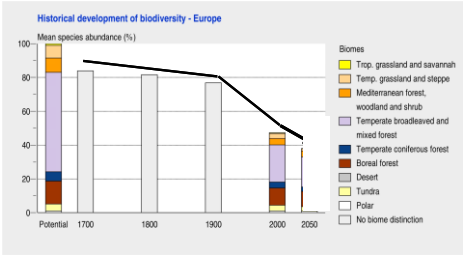
Extent



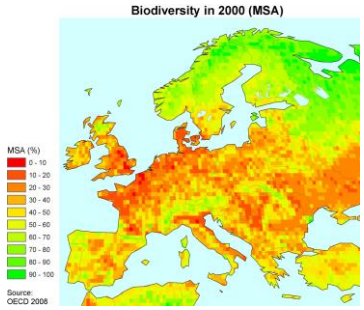
Intactness/integrity?



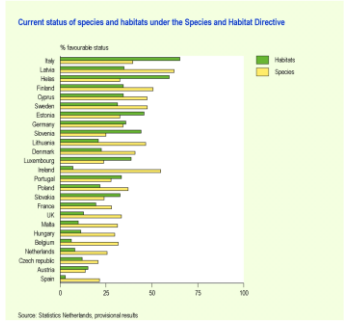
Change in extent/biome



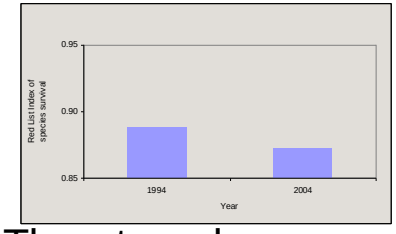
species abundance



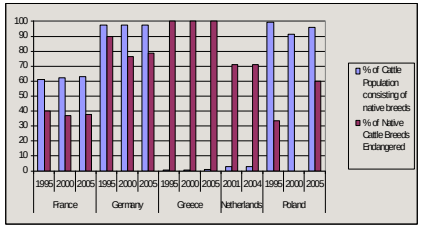
Quality distribution



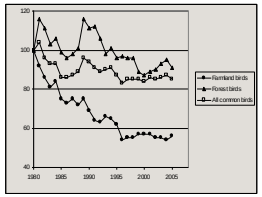
Habitats & Species Eu interest

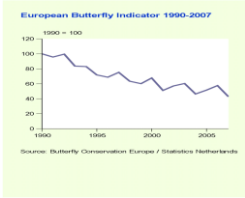


Threatened



Agro-genetic





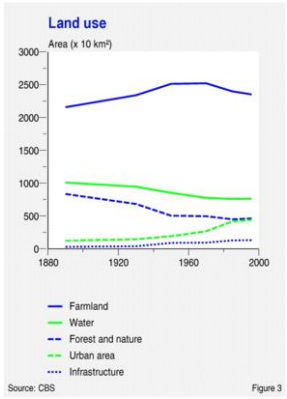
STI birds and Butterflies

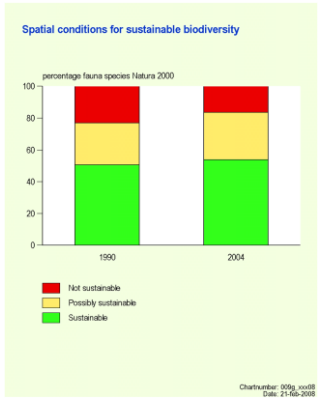
Findings on state (fictitious):

Overall, biodiversity loss has not been halted. Homogenisation continues.

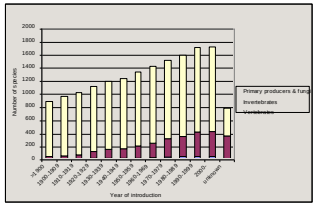
1. Areas of all ecosystem types are shrinking except for forests.
2. At the species level, less vulnerable species show slight improvements, while more vulnerable species show further decline. Consequently, the Red List is growing. The number of invasive alien species is growing rapidly.
3. Less then 10% of ecosystems have kept their original integrity. About x% of ecosystems have lost their capability to produce goods and services.
4. Agro-genetic diversity is low and probably will continue to decline.
5. Zooming in, most species and habitats of European interest are in an unfavourable conservation status.

Do threats decrease?

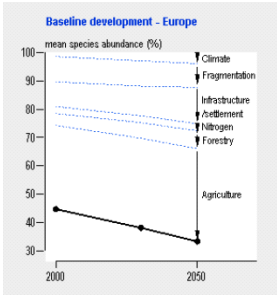




Habitat loss & fragmentation



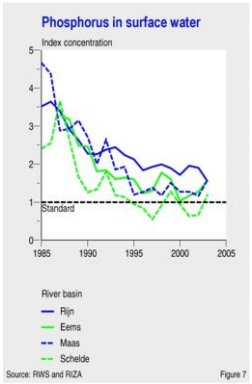
Invasive aliens



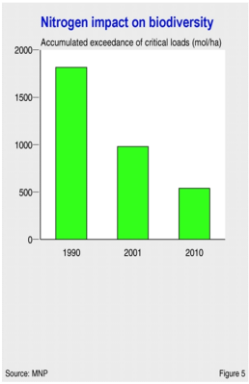
Share per pressure

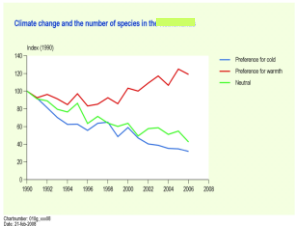
Pollution (N + P) & Climate

Water conc

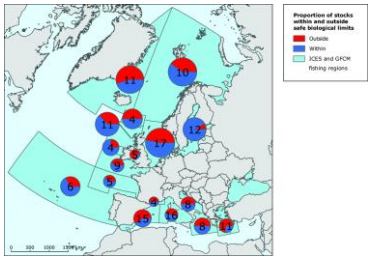


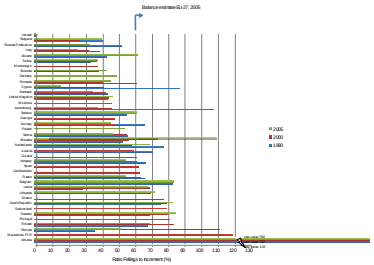
N-dep





Exploitation





% Fellings/increment

Findings on Threats (fictitious)

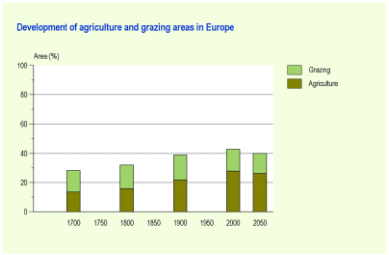
Some pressures have decreased, but not sufficiently:

1. Urbanisation and infrastructure continue to expand, leading to habitat loss and fragmentation.
2. Number of alien invasive species are rapidly increasing
3. Eutrophication declines in aquatic systems and from N deposition, but absolute levels are still too high
4. Agriculture intensifies, especially in the east. At the expense of High Nature Value farmland.
5. Marine fish are over-exploited
6. Climate change will worsen

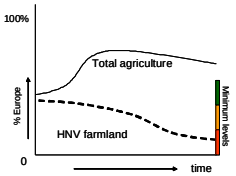
Is agriculture sustainably managed?

State

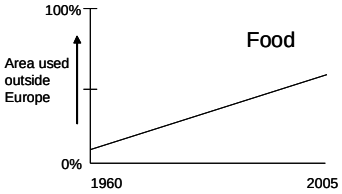
Footprint

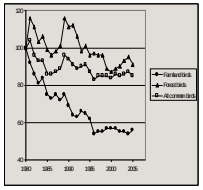


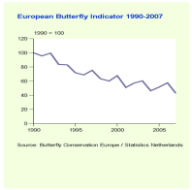
Agricultural area



HNV area



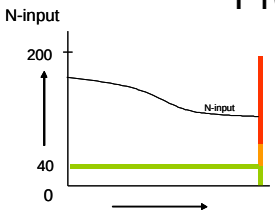




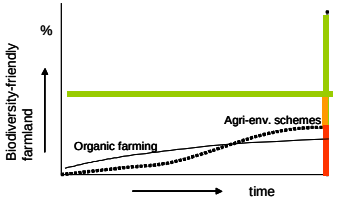
STI farmland birds & butterflies

Pressure

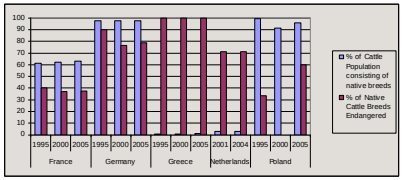
Response



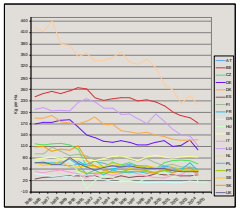
N-input



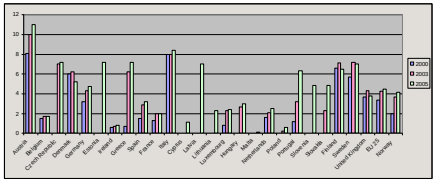
Potentially supporting practices



Agro-genetic



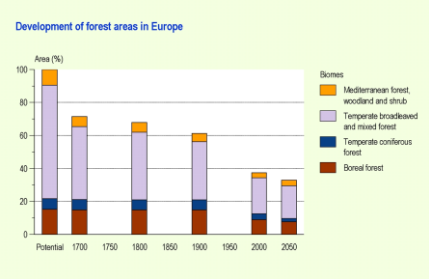
N-balance



% organic farming

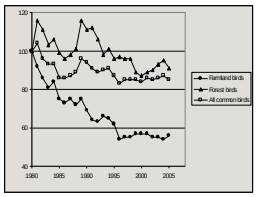
Are forests sustainably managed?

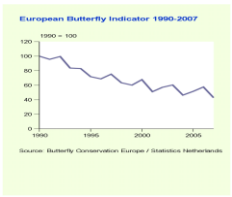
State



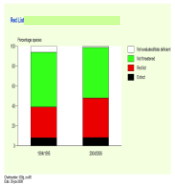
Forest area

Quality distribution

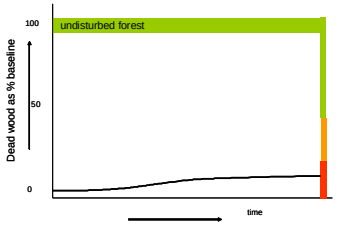




STI forest & butterflies

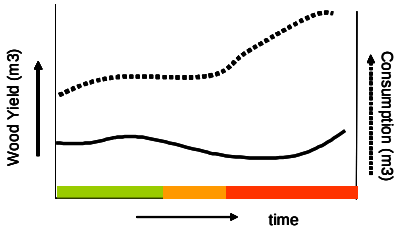


RLI forest



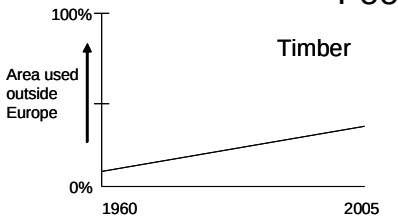
Dead wood

Yield



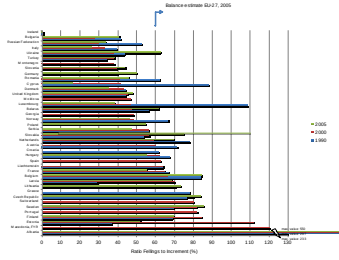
Yield & consumption

Footprint



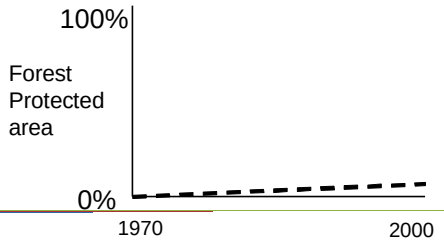
Area used outside Europe

Pressure



% Fellings/increment

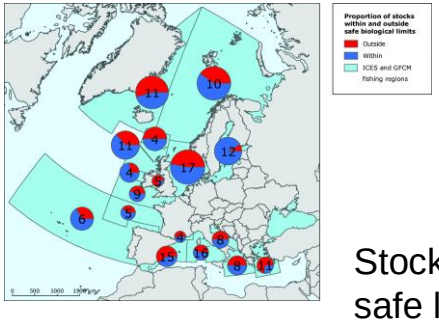
Response



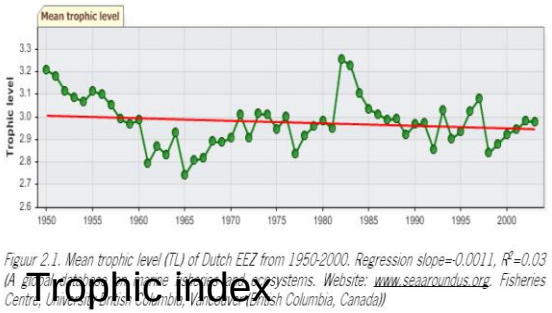
Protected area

Are fisheries sustainably managed?

State

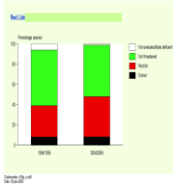


Stocks within safe limits



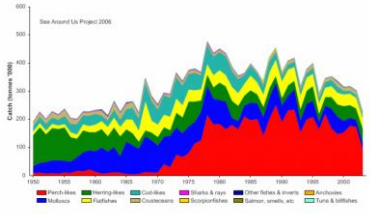
Figuur 2.1. Mean trophic level (TL) of Dutch EEZ from 1950-2000. Regression slope=-0.0011, R^2=0.03 (A global database on marine fisheries and ecosystems. Website: www.seaaroundus.org. Fisheries Centre, University of British Columbia, Vancouver, British Columbia, Canada))

Trophic index



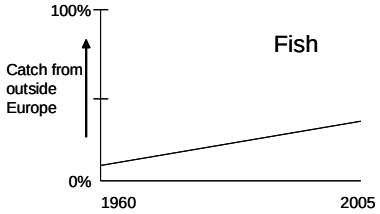
RLI marine

Catch

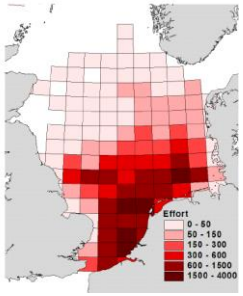


Catches (in tonnes) in Dutch EEZ (Sea Around Us, 2006. A global database on marine fisheries and

Footprint

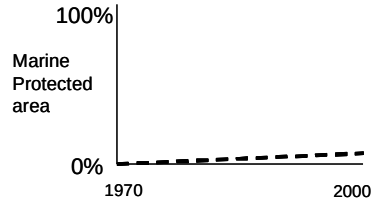


Pressure

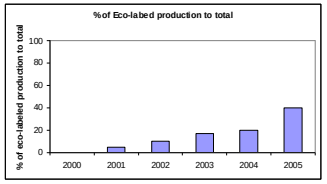


Bottom disturbance & discards

Response



Protected area



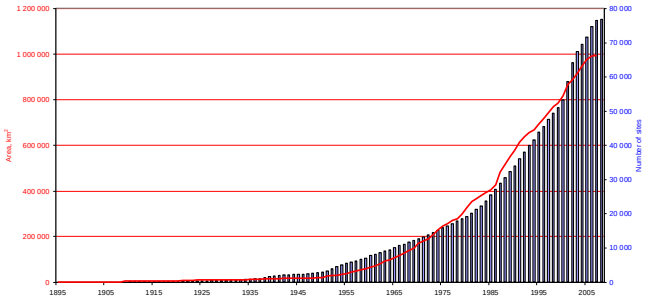
Eco-label

Findings on Sustainable use (fictitious):

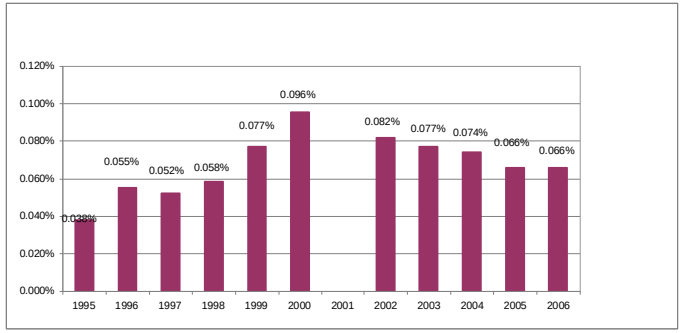
Sustainable use in fishery, forestry and agriculture is not yet on track.

1. Fisheries are managed unsustainably. Most stocks are overexploited. Yielding technique is unselective, resulting in high ecosystem losses due to discards (x% biomass) and bottom trawling
2. Forests are managed unsustainably from an ecological perspective. Biodiversity is low and Europe has a large timber footprint outside its borders.
3. Agriculture is highly efficient, but wild and agro-biodiversity are low and severely in decline. High Nature Value farmland is decreasing. The food and fodder footprint outside Europe is large. High N input leads to major leakages into the environment. Biodiversity-supportive policies are not effective in halting the loss.
4. The European footprint outside Europe, for all of its consumption, corresponds with an area the size of Europe.

What can we do about it? (to be further developed)



Proteced area in 39 EEA countries (16%)
Nationally designated



% total EU expenditure on Life project 1995 - 2006

Findings on Response (fictitious):

Measures are taken but are insufficient to halt the loss.

1. Protected areas are increasing, currently covering 16% of the European territory
2. Europe's budget for biodiversity conservation is 0.066% of its total budget, and is decreasing
3. Public awareness is growing